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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

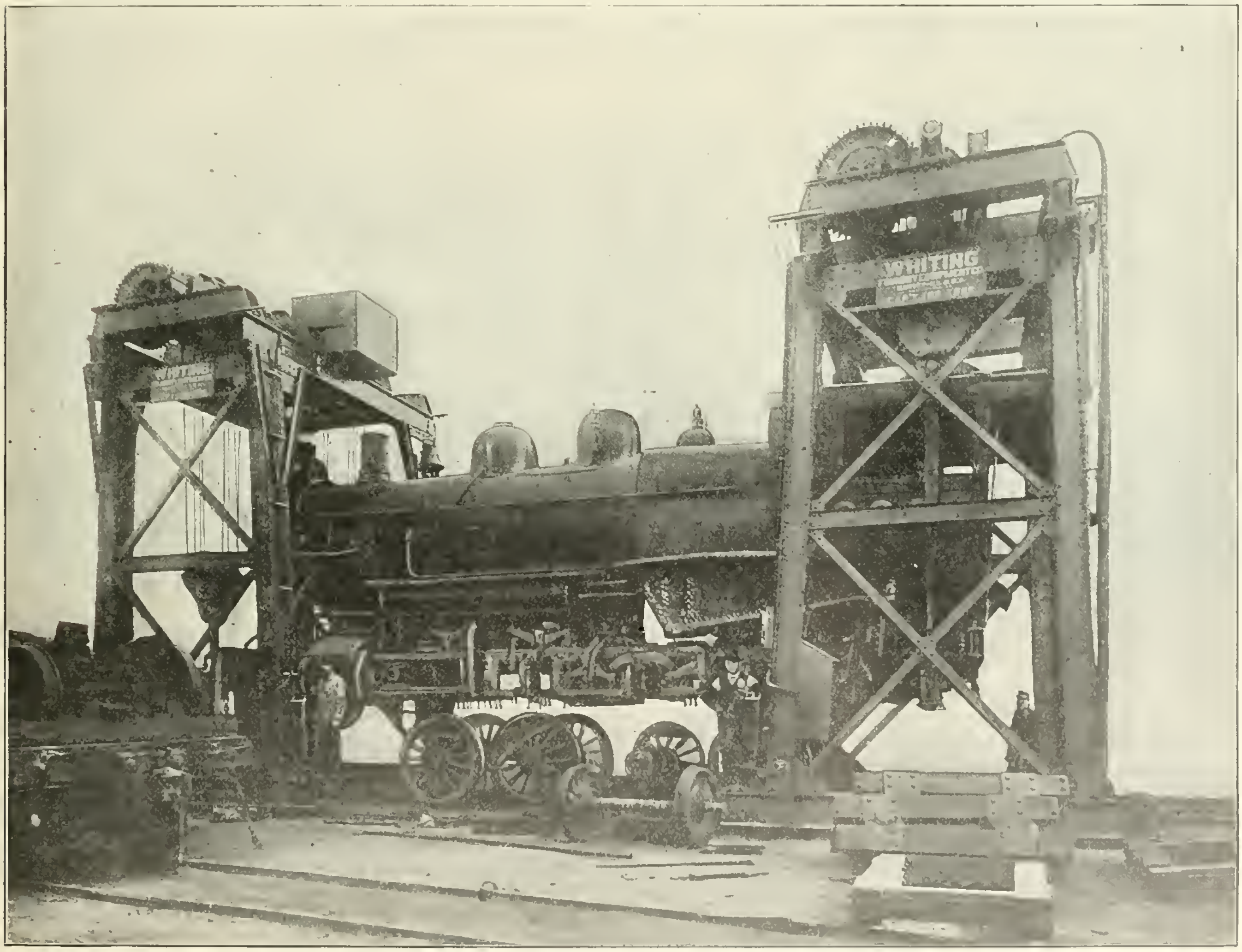
Vol. XXII. 114 Liberty Street, New York, January, 1909 No. 1

An Electric Traveling Gantry Crane.

The St. Paul shops of the Great Northern Railway have recently received six electric traveling gantry cranes of 100 tons capacity each. Mr. G. H. Emerson is the superintendent of motive power of the road, and Mr. W. R. Wood is the superintendent of the shops where these cranes have been sent. In one sense of the word, the installation may be said to have been inexpensive, as there are no permanent heavy girders and pillars required to carry the traveling mechanism. The railway company supplied the rails for the crane to run on and the builder did the rest.

These electric gantry cranes are specially adapted for lifting locomotives of all sizes for the purpose of wheeling or unwheeling them. In this way they may obviate the necessity for a drop pit. The cranes can be applied to a variety of uses in and about the shops, and are well worth their room, as the saying goes. The load is lifted by steel wire hoisting ropes winding on drums. These drums are driven by a system of spur and worm wheels run by an electric motor, and the whole is conveniently under control of one operator.

At St. Paul, where the cranes are in service, two were installed in the roundhouse and the other four over the tracks going into the roundhouse. Two similar cranes have been placed at the Great Northern shops at Havre, Mont. Another two have been set up at the Delta, Wash., shops, and two at Hillyard, Wash. This style of traveling crane is well fitted for use at divisional points where heavy, constant and rapid work is required. The Whiting Foundry & Equipment Company of Harvey, Ill., are the builders of these cranes.



ELECTRIC TRAVELING GANTRY CRANE, GREAT NORTHERN RAILWAY.

Each crane is capable of lifting 200,000 lbs., and the power is either hand or electric. The electric power can be conveniently supplied from the shop or at a point where electricity is not generated in the plant, city or town electric power is available. There is only one motor used to operate the lifting drums. The span of the crane, measured from center to center of the runway rails on which it stands or travels, is 14 ft. 6 in., and the clearance inside the legs is 13 ft. The clear

CLEARING THE LINE TO EDZELL—CALEDONIAN RAILWAY.

height from the top of the rail to the under side of the girder is 20 ft., thus giving ample space to raise a passenger engine clear of its wheels. The vertical distance through which the hooks may be raised or lowered is 11 ft., and the spread of the hooks or the distance they are apart is 14 ft. 6 in.

The trucks on top of the crane are made of structural steel members. To these members suitable bearings for the main axles are attached, and the trucks are carried on double-flanged cast iron wheels. The hoisting drums and gearing are supported on bridge girders by means of structural framing, and the design of the drums is such as to secure an equal distribution of the load upon the girders. The whole arrangement has been designed with a factor of safety of 5. The hoisting motor is comparatively small, as only a low speed is required. It has been fitted with a carefully worked-out automatic electric brake, which is so arranged that the brake acts automatically to hold the load the instant the current driving the motor is cut off. This action is secured by the use of a solenoid placed in circuit with the hoisting motor, and when the electric current is off the hoisting motor circuit the brake acts powerfully. The automatic feature of the brake renders it a safety appliance of the highest value. All the parts of the crane mechanism are easily accessible for oiling and repair, and the electrical work is in conformity with the underwriters' standards.

The use of these electric traveling gantry cranes forms a unique feature at each of the Great Northern shops where they have been installed. When one looks at these "giant lifters," as they may be called, capable of easily holding a modern consolidation engine in midair, the useful possibilities of the machine are apparent. Our frontispiece illustration this month shows one of these cranes at St. Paul holding up a heavy 2-8-0 locomotive, as if exhibiting its power. The word gantry, used as the correct technical description of this style of crane, is of curious origin. "Gaun" is an old English word used locally to mean a small tub or cask, and to this was added the word "tree," meaning the wooden frame or structure used in hoisting small barrels or casks. So that "gauntree," the original form, stood for the crude hoisting apparatus once used for hoisting barrels. The word "gaun," in time turned into "gan," and "tree" was transformed into "try," making our word gantry. The hoisting or lifting idea contained in the word remained, and not only has the original spelling of the word been altered, but the very form of the wooden cask lifter has given place to the modern electrically-driven movable steel frame structure, which can lift the iron horse itself off its feet.

Welfare Work.

An interesting article in a recent issue of the *American Review of Reviews*, by William Wenkel, deals with what he calls "welfare work" on American railroads. In explaining the meaning of the title he says:

"Welfare work may be defined as consisting of those efforts of the employer in behalf of the employee over and above the mere payment of wages, toward the betterment of the conditions under which the employee lives and works, making him more comfortable and contented, and raising his standard of living generally. This work takes expression in many forms. It makes the surroundings of the worker healthful and pleasant, provides wholesome recreation for his spare hours, affords him opportunity for mental improvement, supplies medical attendance when he is sick or disabled, helps him save his money and invest it wisely, aids him in acquiring a home of his own, secures for him cheap and safe insurance, and robs disability and old age of their terrors by means of relief and pension funds.

"While the railroads have undoubtedly entered into this work with humanitarian spirit, recognizing a duty in taking proper care of the thousands of men that they draw from the cities, the villages and the farms, who are deprived for extended periods of their home influences, the companies do not pretend that their motive in this work is purely philanthropic. They frankly confess that the considerate treatment of their employees is good business. The generous sums annually spent in this way have proved an investment bringing large returns; the expense is rightly charged to betterment and safety appliances.

"With the steady improvement in equipment, the enormous increase of traffic and the constant demand from the public for a highly efficient service, railroading has become much more exacting in its requirements from those who engage in it. The business more than ever demands a clear head, steady nerves and strong muscles.

Speaking of clubs and reading rooms he goes on to say:

"Distinct from the Y. M. C. A. establishments, yet resembling them in general purpose and equipment, are the club-houses and similar institutions erected and operated entirely by the railroads. Notable among these is the chain of club-houses built by the Southern Pacific along its lines in Nevada, California, Arizona, New Mexico and Texas. No expense is spared to make them beautiful as well as comfortable. Usually the style of architecture is determined by the surroundings. The bedrooms, arranged so that they may be darkened in the day for men who have night runs, are spread with immaculate linen. The bathrooms, toilets and washrooms are models of inviting cleanliness. There are cardrooms, writing and reading tables, billiard, pool and lounging-rooms, all artistically furnished, and they are supplied with books, as well as with magazines and daily papers. Opportunities for study are offered, and every inducement is made to the men to take advantage of them.

"In these clubs no iron-clad rules are made. The men meet on an equal footing. There are no membership fees and no deductions from the pay-roll for club maintenance. Trifling sums are charged for beds, baths, and billiard-

DIGGING OUT THE ENGINES—CALEDONIAN RAILWAY.

rooms—about enough to cover wear and tear. The only requirement for membership in these clubs is the following pledge:

> I hereby certify that I am a *bona fide* employee of the Southern Pacific Company, and I hereby agree to conduct myself as a gentleman while enjoying any of the privileges of the club."

Similar clubs are in operation on the Union Pacific and the Oregon Short Line, and there are "rest houses" and reading rooms now on all our leading railways. Not only is the regular railroad Y. M. C. A. everywhere a most important feature of the welfare work, but as an example of still further advance in the direction of affording employees educational advantages Mr. Wenkel gives as an interesting example the "Railroad High-School" at Altoona, Pa., where 15,000 employees of the Pennsylvania lines are at work in the shops, offices and yards. "The Pennsylvania Company equipped this school with the most modern appliances, placing it on a par with the foremost technical institutions in the United States, the aim of the company being to co-operate with the public school system in graduating men competent to earn a living. The four years' course begins with mechanical drawing and ends with machine design. A draughting-room, a carpenter's shop, a forging-room, and departments of wood-working and metal-working, all equipped with the most up-to-date tools, are at the service of the students. Graduates of the school are fitted to go into the Pennsylvania's shops on a footing between the untrained regular apprentices and the special apprentices. Interest on the company's investment will come in the form of well-trained employees, although none of the graduates of the school is obliged to enter the Pennsylvania's service."

These few and necessarily brief and fragmentary extracts from the account of the many phases of welfare work given in the article may be useful in pointing out the growth of the idea that railroading is not merely a temporary occupation, but a life work in which careful and patient training is necessary, and in which any man who hopes to succeed must take advantage of all the opportunities which may come in his way.

Baldwin Balanced Compounds.

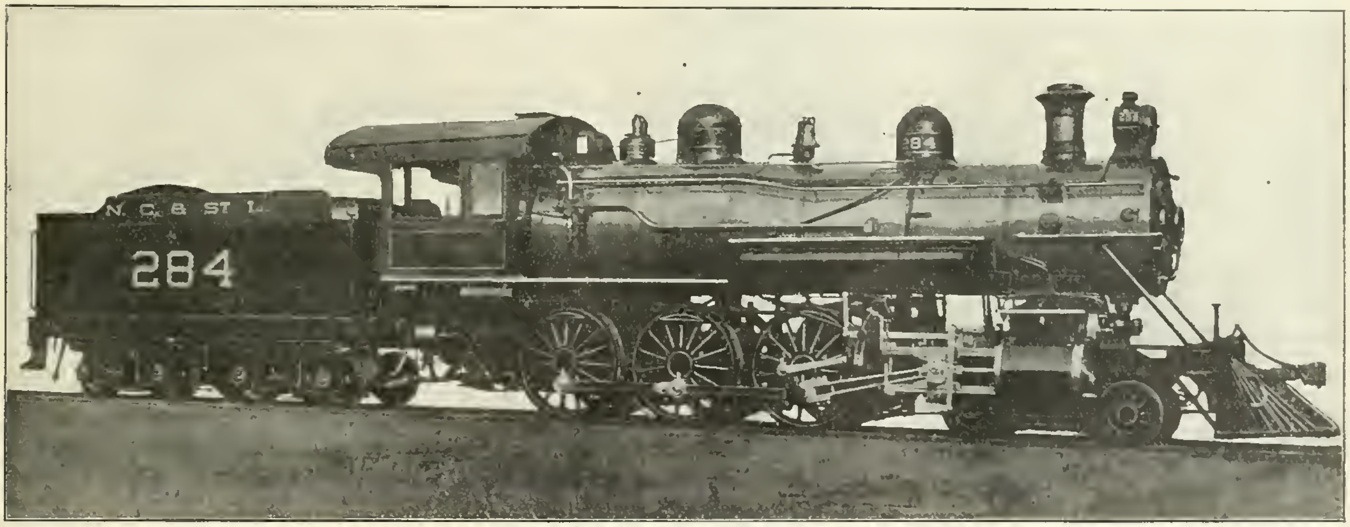
In the latter part of 1905, the Baldwin Locomotive Works built three balanced compound locomotives for the Nashville, Chattanooga & St. Louis Railway. These engines were of the ten-wheel type, and were designed for passenger service. They were followed in 1906 by a fourth locomotive which was built to the same drawings. Three additional locomotives of similar type have recently been supplied to this road by the same builders. The new engines differ from those above referred to, principally in that they are equipped with the Walschaerts valve gear instead of the Stephenson, and these engines can exert a tractive force of 29,300 lbs. when working compound.

The cylinders are of the design regularly used on balanced compound locomotives built at these works. They are 16 and 27 by 26 in. The high pressure cylinders are inside, and the low pressure cylinders outside, and each pair of cylinders is served by a single piston valve 15 in. in diameter. The steam chests are placed above the engine frames, and are lined with cast iron bushings ⅝ in. thick. The guides are of the two-bar type, and are braced by a wrought iron guide yoke which is made in one piece and spans the frames immediately in front of the leading driving wheels. The crosshead bodies are of cast steel, while the gibs are of brass. All four main rods are connected to the leading pair of driving wheels, which have a built up crank axle with cast steel central web. The crank pin and driving axle journals are arranged for grease lubrication.

This design presents a compact arrangement of valve gear, necessitated by the limited space between the cylinders and leading driving wheels. The link bearings are bolted to the back of the guide yoke, which supports the reverse shaft bearings also. The position of the steam chests necessitates the use of rockers. The bearings of these are bolted to the frames immediately back of the cylinders. These rockers have both arms pointing upward, and the combining levers are coupled directly to the outside rocker arms. The piston valves have outside admission with reference to the low pressure cylinders, hence each radius rod is coupled to its combining lever below the latter's connection to the rocker arm. The frames are of cast steel, 4 in. wide. The front rails are of wrought iron, hooked and double-keyed to the main frames. Owing to the reduced frame stresses which occur in a balanced locomotive, single front rails of comparatively light section have been used. The pedestal binders are lugged and bolted to the lower ends of the pedestals.

The boiler is of the wagon-top type, with a narrow firebox, which is radially stayed. The mud ring is placed above the frames, and is sloped to give sufficient depth under the tubes. Flexible stay-bolts are used in the throat and sides to a limited extent. The firebox is supported, on each side, by an expansion link and a sliding bearing. The heating surface is 2,735 sq. ft. in all. This is made up of 185 sq. ft. in the firebox and 2,550 in the tubes. These tubes are 256 in number, each 2¼ in. diameter and 17 ft. long. The grate area is 34.8 sq. ft., which gives a ratio of grate to heating surface as 1 is to 78½.

The tender frame is built of 10 in. steel channels, and the tank is U-shaped with gravity sides and back in the fuel space. The trucks are equipped with solid rolled steel wheels, which were supplied by the Standard Steel Works



BALANCED COMPOUND FOR THE NASHVILLE, CHATTANOOGA & ST. LOUIS RAILWAY.

F. E. Scheffet, Superintendent of Machinery. Baldwin Locomotive Works, Builders.

Co. The tender has a fuel capacity of 9½ tons of coal, and the tank contains 5,500 gallons.

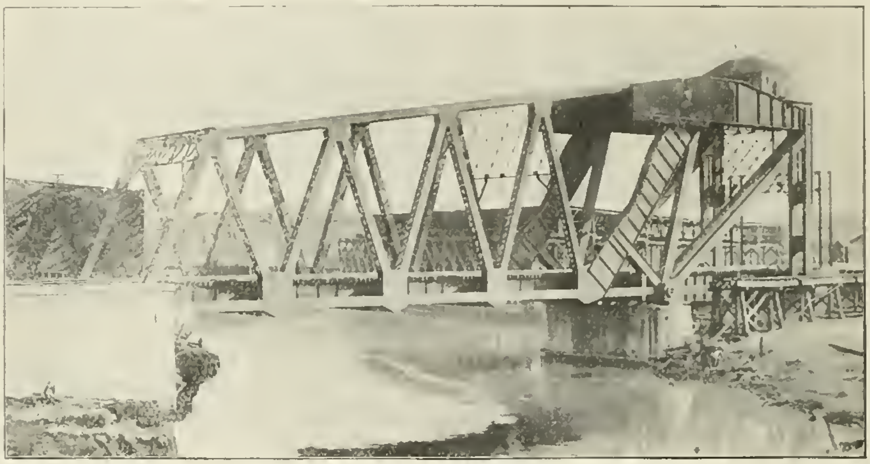
The builders feel that the duplication of an order for compound locomotives is of interest, as proving that these engines, when properly maintained and handled, are successful and economical. The fact that the new locomotives are equipped with the Walschaerts motion is also of interest, as indicating the increasing favor with which this gear is regarded. A few of the principal dimensions are here offered for reference.

Boiler—Type, wagon top; material, steel; diam., 64 ins.; thickness of sheets, 11/16 & ¾ ins.; working pressure, 210 lbs.; fuel, soft coal; staying, radial.
Firebox—Material, steel; length, 120 ins.; width, 41⅞ ins.; depth, front, 75½ ins.; back, 68¼ ins.; thickness of sheets, sides, ⅜ ins.; back, ⅜ ins.; crown, 7/16 ins.; tube, ½ ins.
Water Space—Front, 4 ins.; sides, 3 ins.; back, 3 ins.
Tubes—Material, iron; wire gauge, No. 11.
Driving Wheels—Outside diam., 66 ins.; journals, main, 10 x 10½ ins.; others, 9 x 12 ins.
Engine Truck Wheels—Front diam., 30 ins.; journals, 5½ x 12 ins.
Wheel Base—Driving, 12 ft.; total engine, 26 ft.; engine and tender, 55 ft. 2 ins.
Weight—On driving wheels, 125,000 lbs.; on truck, front, 45,000 lbs.; total engine, 170,000 lbs.; with tender, about 280,000 lbs.
Tender—Wheels, diam., 33 ins.; journals, 5 x 9 ins.; service, passenger.

Bascule Bridge on the C. & A.

If you have ever stepped on the upturned pointed end of a crowbar and seen the handle rise up or if you have ever put your foot on the edge of a barrel hoop and brought the circle up standing, you may easily get in a general way some idea of the principle upon which the Page Bascule Bridge on the Chicago & Alton works. This bridge was built under the direction of Mr. W. D. Taylor, chief engineer of the Alton.

The bridge is of the bascule type, and this word bascule is French for seesaw. This kind of structure is practically a counterweighted draw bridge so arranged that when the weight goes down the footway goes up, and vice versa. The bridge of which we write is at Bridgeport, Chicago, and not only carries trains of the Chicago & Alton, but also those of the Illinois Central, the Atchison, Topeka & Santa Fe, and the Wisconsin Central over the Chicago river. It contains a double track.

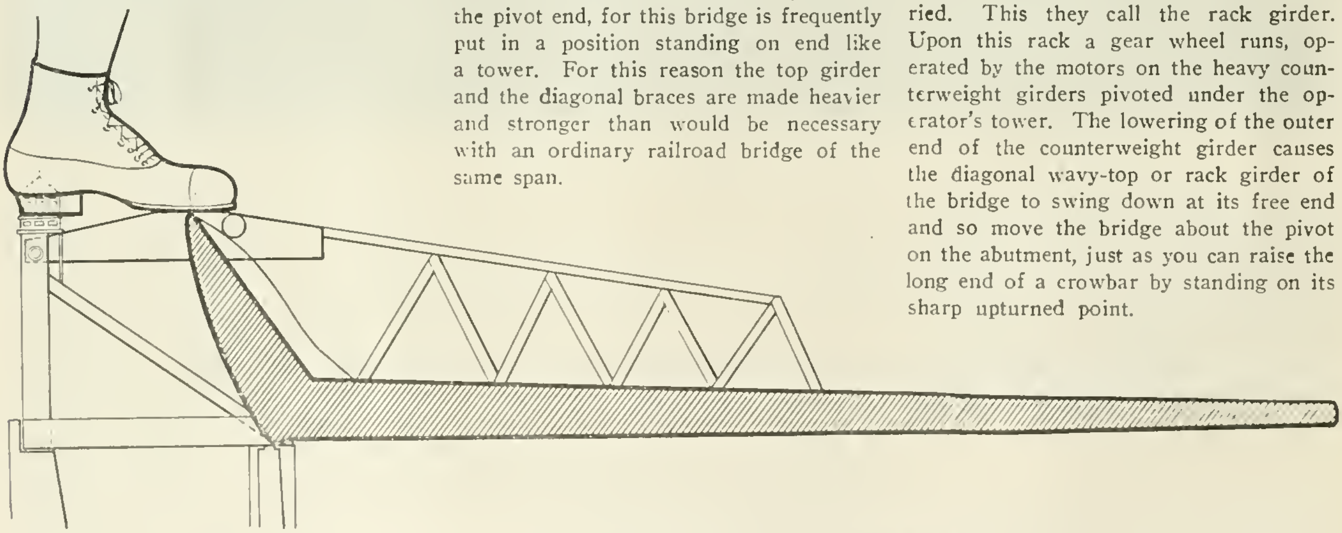


BRIDGE IN POSITION FOR THE PASSAGE OF TRAINS.

The bridge itself is a heavy open truss through bridge, sometimes called the movable leaf, and it is hinged on one abutment. When the bridge is moved it does not roll up on a curved base after the manner of a rocking chair as some bascule bridges do. This one turns on a pivot or pin and swings directly up or down just like the motion of trap door. The lower chord is a strong stiff girder, and the top chord slopes up from the small end to the base, if we may so call the pivot end, for this bridge is frequently put in a position standing on end like a tower. For this reason the top girder and the diagonal braces are made heavier and stronger than would be necessary with an ordinary railroad bridge of the same span.

The operator's tower is on top of 4 upright posts, the nearest 64 ft. back of the pivot abutment of the bridge, and these posts are 48 ft. 6 ins. high. Immediately under the tower and supported by these upright posts is the pivot of a pair of heavy horizontal girders; the ends farthest away from the pivots carry cast iron weights. This is a counterweight girder. Between these heavy girders and mounted on a suitable frame is placed the electric motors and gears used in operating the bridge. About 60 h. p. is consumed in the work, and the time required for opening is one minute, and the same time is occupied in closing. The bridge is placed diagonally over the river and is 150 ft. span, giving a clear 100 ft. channel below. The line of clearance through the bridge is 24 ft. above rail level.

The operation of opening and closing the bridge is effected in a very ingenious way. Placed diagonally between the top and bottom chords of the bridge on each side is a heavy girder, the top of which is a wavy line upon which a rack is carried. This they call the rack girder. Upon this rack a gear wheel runs, operated by the motors on the heavy counterweight girders pivoted under the operator's tower. The lowering of the outer end of the counterweight girder causes the diagonal wavy-top or rack girder of the bridge to swing down at its free end and so move the bridge about the pivot on the abutment, just as you can raise the long end of a crowbar by standing on its sharp upturned point.



BRIDGE RISES AS THE COUNTERWEIGHT GOES DOWN JUST AS THE CROWBAR COMES UP WHEN THE TOE OF THE BOOT IS PRESSED DOWN WITH THE HEEL AS FULCRUM.

The form of curve employed in making the wavy line on the rack or diagonal connecting girder at what we have called the base of the bridge when it stands on end, is designed with a particular purpose in view. Mr. W. M. Hughes of Chicago, the consulting bridge engineer from whose designs the bridge was made, writes us as follows concerning this curved or wavy line. He says:

"The curve of the rack girder is so formed as to keep the movable leaf or movable part of the bridge in equilibrium in any position so that the only power required to operate is that necessary to start the bridge in motion and to overcome wind and friction. In the case of the C. & A. bridge, the center of gravity of the movable leaf is 42 ft. 9 ins. horizontal distance and 18 ft. 2 ins. vertical distance from the center of the trunnion. The total weight of the movable leaf, multiplied by the rise of the center of gravity, divided by the drop of the counterweight, equals the amount of the counterweight required to keep the bridge in balance, and in this case the rise and fall are equal. The curve reverses near the lower end; this is at a point where the center of gravity passes a vertical line through the center of the trunnion. Here the counterweight comes into action to prevent the bridge from dropping back, and on the reverse assists in lowering it to a horizontal position."

When it is desired to raise the bridge the driving gear is put in motion and the two gears which engage with the racks begin to move. This causes the weighted girder carrying the motors, etc., to go down as the gears traverse the rack and the bridge is raised by the pull of the gear wheels as they move along the rack girder. The fact that the heavy girder carrying the cast iron weights also carries the motor, gears, shafts, etc., adds their weight to the others and so an effective counterweight for the bridge is economically secured.

The bridge is locked by means of two wedges moving horizontally at the end and in the center of the bottom chords. These wedges slide under rollers mounted on uprights which are anchored to the abutment, so that locking the bridge tends to gradually draw the bridge down during the operation. The end lock is worked by a 3 h. p. motor carried on a platform under the track.

Welding a Mud Ring.

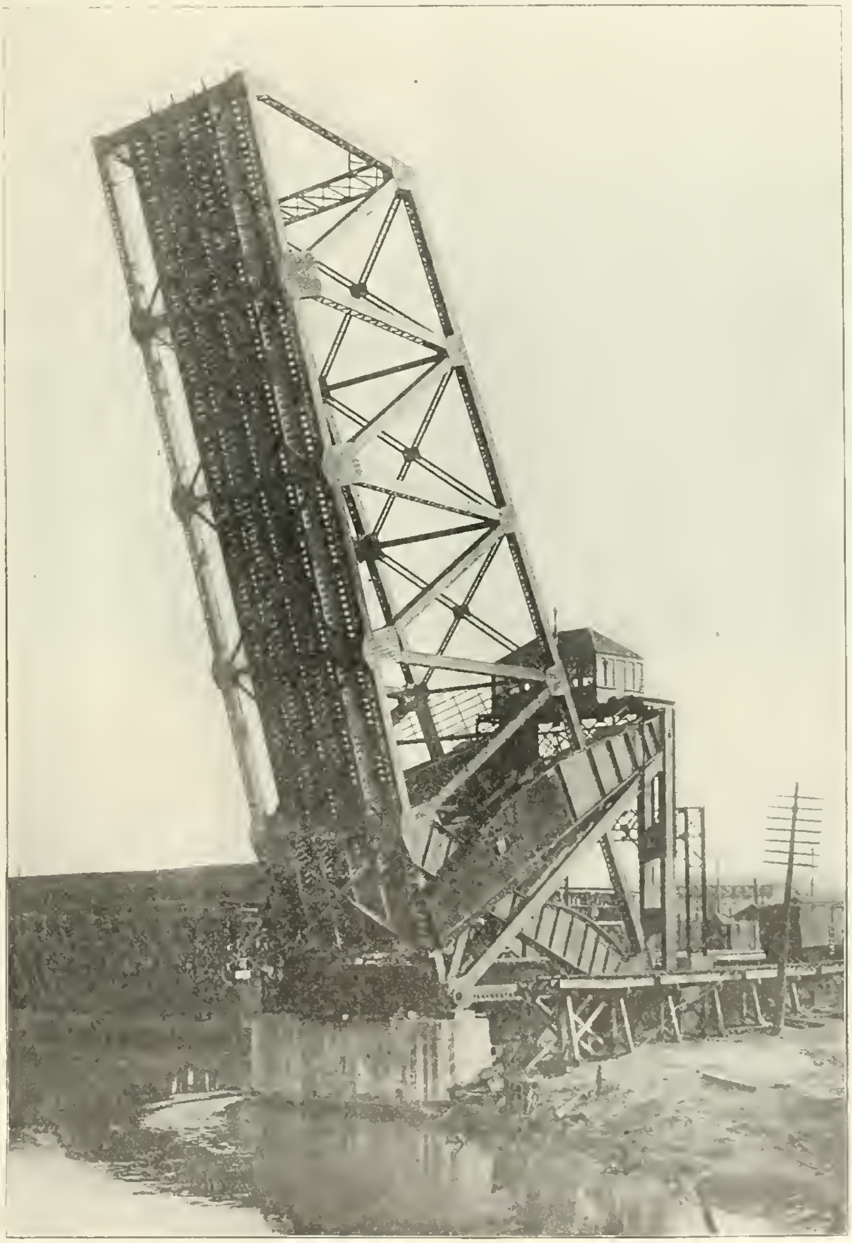
Not long ago an interesting piece of work was done at the St. Augustine shops of the Florida East Coast Railway. It was the welding of a broken mud ring without removing it from the boiler, and without any serious dismantling of the engine.

When the work came to be done it was necessary to cut a piece out of the throat sheet 10 x 14 in.; also a piece out of the flue sheet 8 in. wide and running up to the top of the grate bars. This did not necessitate bringing the patch into the fire. When this was done a line of 1-in. holes was drilled along the fracture in the mud ring, so as to allow for a free flow of Thermit steel, by which the welding was effected. The ends were then cleaned to a distance of 2 in. from the fracture, after which the ring was expanded 3-16 in. to allow for shrinkage.

A sort of cup of beeswax was shaped up about the fracture in the form of a collar 4 in. wide and 1 in. thick at the middle part.

The operation of welding the mud ring was in accordance with standard Thermit practice. The method adopted for suspending the crucible was cleverly accomplished. This was done by what is commonly known in the shops as an "old man" clamped to the running board bracket of the locomotive, with its arm down. Then a shank was taken from an automatic coupler, drilled, and slipped on to the arm, while another arm with the crucible ring welded to it was placed in the hole drilled in the shank. This arrangement held the crucible in position, and it was possible to adjust it in any position desired.

The ring was heated by means of a gasoline torch for about 50 minutes until it was brought to a white heat, after which the Thermit was ignited and the Thermit steel poured into the mold. The weld was a most successful one in every respect, and it is estimated that the cost of the entire job with sheets replaced did not exceed $75.



PAGE BASCULE BRIDGE ON THE CHICAGO & ALTON.

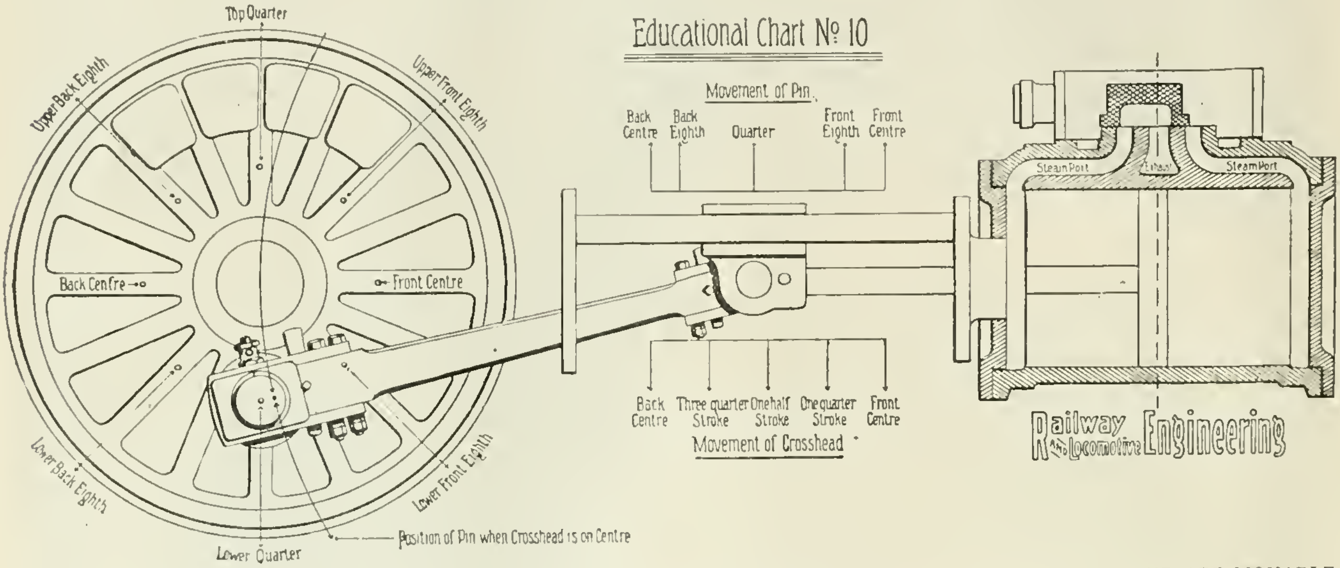
It is not what people eat but what they digest that makes them strong. It is not what they read but what they remember that makes them learned. It is not what they profess but what they practice that makes them righteous.—*Watchman.*

It's no use calling people to happiness in a sepulchral tone.

Answers to Questions on Our Educational Chart No. 10

It is very gratifying to the publishers of Railway and Locomotive Engineering to mark the enthusiastic appreciation with which the publication of our new combination model and chart No. 10 is being received by our readers. We have endeavored to meet the demands as promptly as possible, but take the opportunity to again state that No. 10 is not for sale. It is presented to subscribers who pay in advance for 1909, and may be ordered when subscribing through any of our agents, or directly to this office.

As stated in our original announcement in regard to the publication of the new chart, there are a series of thirty-six questions printed upon the back of the chart, and referring chiefly to the problems involved in the motion of the piston, main-rod and sliding valve. We stated that answers to these questions would begin in the January issue, and the first series is hereby appended, and we would particularly call the attention of the younger railroad men to an attentive perusal of these questions and answers, to the end that a thorough familiarity with the important lessons which the chart conveys may be fully mastered by the thoughtful student.



FAC-SIMILIE OF OUR EDUCATIONAL CHART No. 10— THE PISTON, CROSSHEAD AND VALVE ARE CELLULOID AND ARE MOVABLE.

It should be readily understood by intending subscribers that while the great body of our renewed subscribers at this season of the year are asking for the new chart, they are at liberty, if they prefer, to select either of our locomotive charts, showing an Atlantic, an American, or a Consolidation, the latter equipped with the Walschaerts valve gear. We have also a chart showing a combination passenger and sleeping coach, which has met with much popular favor. The Consolidation locomotive chart, which was published a year ago, met with special favor on account of its fine illustration of the details of the Walschaerts valve gear, and it is still being much called for. As will be seen in our advertising columns, these charts are on sale, and may be purchased through our agents or from us.

Both renewed as well as new subscribers should express their preference in regard to the charts, and a copy of the chart chosen by them will be forwarded promptly. Meanwhile we proceed, as promised, to answer the first section of questions attached to Chart No. 10, and will furnish answers to the remaining questions in successive issues of Railway and Locomotive Engineering.

ANSWERS TO QUESTIONS ON EDUCATIONAL CARD CHART NO. 10.

1. What is clearance?

A. The distance between the piston and the cylinder head when cross-head is at the end of the stroke, a position known as the dead center.

2. What is lead?

A. The distance the valve has uncovered the steam port at the beginning of the piston stroke.

3. Show position of valve and piston when cutting off at half stroke.

A. This is shown by the use of movable parts on the chart. The piston is set in the middle of the stroke by the indication below the cross-head. Then the valve is placed at the position in which it would cut off admission to the steam port.

4. How does this make steam work expansively?

A. The admission of steam from the boiler being cut off, the steam in the cylinder pushes the piston by expanding.

5. Has this valve inside lap?

A. No.

6. What is lap? What does it mean?

A. Lap is the distance the valve edge extends over the steam ports when set on the middle of the valve seat.

7. Why is lap given to a valve?

A. Lap is put on the valve to make the engine work steam expansively, by cutting off steam before the piston reaches the end of its stroke.

8. Where would you place the valve if you had to disconnect for a broken eccentric?

A. On the middle of the seat.

9. Where would you place it if you broke the steam chest?

A. In the same position, but it would be necessary to prevent the passing of steam into the steam chest.

10. Where would the valve be when compression commenced on forward stroke?

A. At the point of closing the forward steam port when moving backward.

11. What is pre-admission?

A. The steam admitted by the lead opening before the piston had reached the beginning of its stroke.

12. Show point of release.

A. The point of release would depend upon how far the motion was linked up. In the motion of this chart release and compression would begin at the same time.

13. What is changed about the valve when the reverse lever is hooked up?

A. The travel of the valve is reduced.

14. How would you place piston and valve if disconnecting a mogul or ten-wheeler where side rod pin would strike crosshead key if it was blocked in the center of guides?

A. Block the piston at the front of cylinder and valve at front end of its travel.

General Correspondence

The N. & M. Limited Express.

Editor:

Please find enclosed two postcards of the Newark & Marion Railroad, which is the best I could do. The driving wheels are 4 ft. in diameter. I do not know size of the cylinders, if they are not 18 by 24 in., but may be a little smaller; they look large according to size of engine, and she is very strong for her size. The regular engineman was sick and fireman did not seem to know anything about her. I tried to find out where she was built; fireman thought somewhere near Buffalo. There was no plate on the smoke box or anywhere else that told. She is making three round trips daily. Hoping the cards will be of use,

Sodus Point, N. Y. H. F. Davison.

[From the appearance of this engine and some of the details about it and the plate iron diamond stack, we would say this engine was built at Schenectady quite a number of years ago.—Editor.]

Some Railroad Troubles.

Editor:

In a previous letter, the writer briefly referred to one of the most serious difficulties which has ever beset the railroads. There are certain other troubles, a few of which may be mentioned here with profit to all concerned. For instance, the problem of dealing with tramps, trespassers, rowdies and other miscreants who infest freight yards, rob box cars and steal rides. It is obvious that rigorous measures must be adopted if the activities of these rogues are to be suppressed.

N. & M. DIAMOND STACK ENGINE.

It would appear, however, that although the railroads are willing to do their share in the work of solving this problem, the public authorities are not disposed to render effectual assistance. The trouble is that the marauders are not punished with sufficient severity. In view of these circumstances, the writer cannot forbear the remark that the government is so busy "regulating" the railroads that it has no time to give them the protection which they need, and to which they are manifestly entitled.

Another difficulty which confronts the railroads is the grade crossing problem. This question has reached an acute stage in certain localities, owing to the recklessness and lawlessness of automobilists, who have no regard for the rights of the railroads, or anyone else, and dash across railroad tracks without stopping to see if a train is approaching. Many automobilists of this kind pay with their lives the penalty of their folly. They do not deserve any sympathy, but their friends or relatives usually attempt to place the blame on the railroads. Meddlesome newspapers set up the old, familiar cry that "all grade crossings must be abolished." The tremendous expense and labor involved would preclude the possibility of such a task at the present time, but unthinking persons ignore this.

If automobilists and others who cross railroad tracks would exercise a little common sense and ordinary caution, there would be no more grade crossing accidents.

Irresponsible newspapers have frequently accused the railroads of being accountable for a great loss of life each year, but it is reasonably certain that a fair and impartial investigation would disclose the fact that a large number of those killed were either trespassers or careless persons.

New York, N. Y. Arthur Curran.

THE NEWARK & MARION "LIMITED."

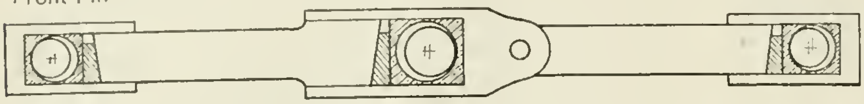
Left Driving Box Pound.

Editor:

Having read with interest the article in the September number of Railway and Locomotive Engineering, under the head of "Left Driving Box Pound," giving a synopsis of the discussion of the subject at the General Foreman's Convention, I wish to take advantage of your invitation to engineers to give their experience. Mr. C. H. Voges' explanation of the reactions from the engine on the opposite side annulling the pound in the backing engine and aggravating the pound on the following side is very clear, but does not go far enough. It will be noticed that when the pound first begins to develop in a new engine that she pounds at the left front center, and not at the back center. The reaction from the force delivered at the point where the driving wheel rests on the rail must be considered, as this force on the side that has the crank pin approaching the center and doing no work, will tend to hold the axle to the front of the box. This will tend to annul the bad influence of the right side on the left side, at the left back center and aggravate the same at the left front center. So much for the cause.

The remedy that will greatly mitigate but cannot entirely cure, is the proper lining of the left parallel rod. First bore all parallel rod brasses at least 1-32 in. larger than the pins for a new engine and never have them filed "close" at any time. Then line the sections back of the main pin long (as was the old practice with the eight-wheeler), and line the sections as short as possible ahead of the main pin. This practically puts the main connection brasses ahead of tram to the amount of clearance in all the parallel rod brasses.

The accompanying sketch shows the proper way to line the rod. This will cause the rod to bring the main journal up easy at the front center and the clearance in the rod brasses will keep the rod out of the way at the back center and allow the reaction from the force delivered at the rail to ease the pound at the back center. The writer has practiced when trading liners (after the adjustment had worn out), pulling down the wedges at front and back boxes, and lining the rod a trifle more in the recommended way than could be done with the wedges up. The main wedge to be adjusted normally.



BALE'S METHOD OF LINING THE SIDE ROD.

After the rod liners "bed" the front and back wedges can be pushed up. Nothing whatever is gained by trying to squeeze the pound out of the left side with tight wedges. The writer has practiced this method on engines of all kinds, heavy and light, with success. When the eight-wheeler with solid rods has got to the stage when the blades are too long and the main wedges and lining down, kill two birds with one stone by lining both main shoes instead of the wedges. Anyone who believes that the pound on the left side is due to the engineer neglecting that side of the engine should note how nice the right side behaves going ahead and how bad she pounds at the right back center backing up. The exaggerated clearance in my sketch is to make the subject clear. If the adjustment of the rod is made by trading liners, once in six months, the left side will not get very bad.

EDWARD BALES,
Air Bk. Insr., Ill. Central R. R.
Centralia, Ill.

Old Jersey Central Engine.

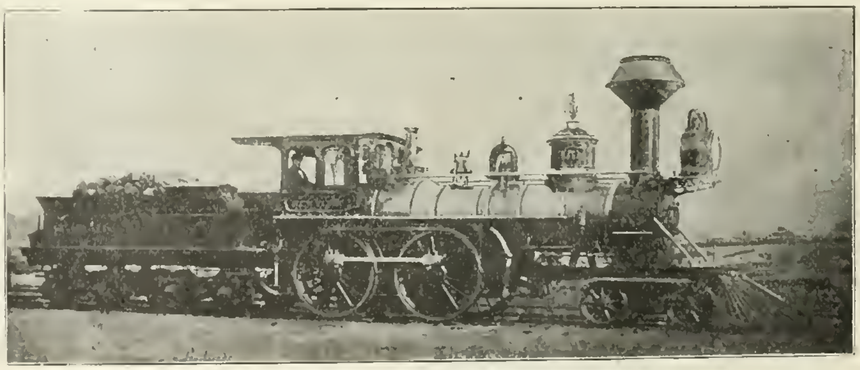
Editor:

I note in the December number of your journal an inquiry from one of your correspondents as to whether any of the engines using the old-time diamond stacks are still in service, and your request for a photograph of one of them for reproduction. I cannot answer your correspondent's question, but write to say that I have the necessary photo, which I take pleasure in sending you herewith, and which, I trust, will answer your purpose. The gentleman seated in the cab is Mr. C. G. Williams, at one time master mechanic of the Jersey Central at the Communipaw shops.

The engine, No. 35, otherwise known as the "New York," was one of several wood burners built in the early sixties by the Taunton Locomotive Works for the Central R. R. of New Jersey; they went out of existence many years ago, No. 35 surviving all the others.

As you will see, the cylinders were inside the frame under the smokebox, with the main connections on the front driving axle; if my memory serves me right, the cylinders were 15 x 22 in., driving wheels 5 ft. 6 in. in diameter, and the engine weighed about 35 tons; when it first came on the road it was equipped, as they all were, with the old-fashioned broad or flaring smokestack, and had what might be called low running boards; these were made of heavy sheets of iron flanged on the edge, and were turned down over the front drivers, with two or three steps on the incline, to a point on a line with the frame and ran all the way around the engine, forming a square front across the breastbeam, the hand-rail, a fencelike affair nearly as high as a man's hips, was supported on uprights about three feet apart, and was also carried all the way around on the outer edge of the running board, so that one could walk between the boiler and the railing from the front door of the cab on one side to the other. As far as I can remember, No. 35 was the only one on which the running boards, hand-rail and smokestack were changed; this was done in the seventies, when Col. R. E. Ricker was superintendent and general manager of the Jersey Central. In other respects the original appearance of the engine is unchanged.

Of course, I was only a small boy when these engines were built, but I knew them pretty well for many years, and as I write it brings back pleasant recollections of the many happy hours spent on old 35. I recall, however, one incident in connection with this engine which for a few minutes was not altogether as pleasant or agreeable as one might wish for; it was on the evening of Dec. 31, 1864. I was going to Easton, Pa., and, as usual, was riding on the engine; it being the night before a holiday, we had a heavy train of ten cars, and in those days nothing but hand brakes. The night was dark and we were plugging along in a driving snowstorm, making it difficult to see ahead. As we reached the summit of a slight grade running west into Cranford, N. J., we saw the faint glimmer of a headlight approaching us. I remarked that it looked as if it was on our track. The engineer said in reply: "That's the mail coming east; you know the position of a headlight is rather deceiving at such a distance," but we hadn't gone much further before we discovered that it was on our track. At that time two short blasts of the whistle was the signal for brakes; they were given several times in quick succession, the engine was reversed, and the engineer, pointing to the tender brake, said to his fireman, "Bill!" and Bill got busy; poor fellow, he was killed only a few years ago in a collision after running this same train for 33 years. The engineer, as good a man as ever pulled a throttle, is still living, and is now nearly 83 years old. But to resume my story; matters were getting serious about this time, and there was a small boy in that cab who suddenly had an engagement somewhere else, because he preferred to be "a live coward rather than a dead hero," so I dropped down on the step on the left hand side and hung there until they got too close for comfort, then jumped, throwing myself as far from the engine as possible, and landed in a heap in the snow clear of the train. After rolling over a few times I picked myself up, fortunately none the worse for my experience.



INSIDE CONNECTED 4-4-0 ENGINE, C. R. R. OF N. J.

It seems a coal train had crossed over to let the mail pass; they sent a man out with a red light to flag us, but the wind blew his light out, and he might as well have been in Texas as there, for all the good it did us. However, they did not collide; but it was a close shave, and a collision was only prevented by the coal train engineer backing his train. Some one told him he took an even chance of a rear-end collision by backing without knowing how the crossover was set, and he said "he would have backed them into h—ll rather than let us hit him"; as it was, he did not give us any too much room, and those engines did not look at all interesting standing so close together with their headlights glaring at each other like a couple of one-eyed monsters ready to grapple in a fight.

When things were straightened out I got on the engine again and we proceeded, but had only gone a few stations when the engineer turned and said: "My boy, don't you think it would be safer and better for you to ride in the cars until you are a little older and your legs grow longer?" So I went back at the next station, although I didn't want to one bit, but not many moons had passed before I was in the cab again, and I have been there ever since whenever the opportunity offered.

In closing, I want to say that I did not originally take the photo of No. 35; the one I am sending is a copy I made from an old one that came into my possession in pretty bad condition several years ago. I thought it was worth saving, because as I look at it, it seems like gazing upon the portrait of an old friend long since passed away.

F. W. Blauvelt.

New York, N. Y.

Boston & Albany Engines.

Editor:

I noticed in this month's issue a request for a picture of an engine with the old diamond stack. I am enclosing you two pictures of engines with the

B. & A. ENGINE NO. 752, AT BOSTON, MASS.

diamond stack, one of which is not very good.

Number 752 is in active service, being used in construction and utility work, with headquarters at the Beacon Park (Boston, Mass.) roundhouse of the Boston & Albany Railroad. She has cylinders 18 x 24 in. I think, and 50 in. wheel centers. Number 739, the other engine, is the same size, and is waiting to be broken up with others of the same kind.

I am also sending you a picture of one of the new Pacific type, which was built in August, 1908. The sandbox on this engine is very large, and is oval in shape. This class has cylinder 22 x 28 in.

Hoping that some one of these will prove of interest to you and the readers of Railway and Locomotive Engineering.

F. S. Wyman.

Waltham, Mass.

Extension Piston Rods.

Editor:

Reading over the December number of Railway and Locomotive Engineering in regard to extension piston rods, I will give you our experience. We received about seven years ago 10 engines 22 x 28 cylinders, with 4 in. piston rods, with the extension made like Fig. 1.

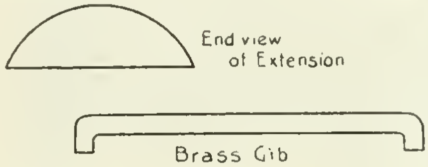


FIG. 1.

This brass gib went in at front head and was put in place before tube went over piston. The lip on end of gib was about 3/8 in. and about 3 in. wide by 1/2 x 6 in. long. The hub on end of tube was cut out to take gib after hub was bored out; that made the extension piston a neat fit in hub, with the gib at bottom side of extension.

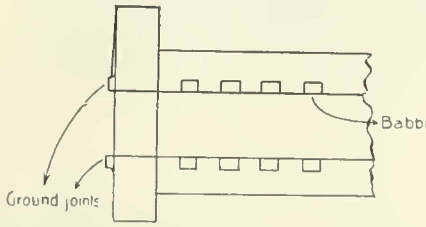
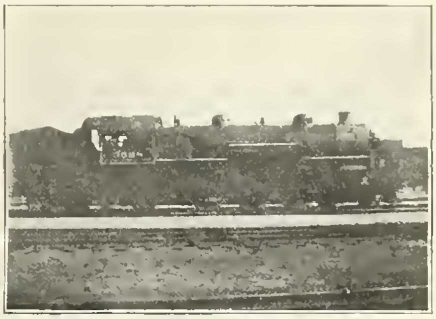


FIG. 2.

Now our trouble came. In a short time, when the gib wore off about 3-16 in. and the cylinder and piston wore a little more, the brass gib lifted up and went down in the cylinder, knocked out front head, broke piston head, bent piston rod, and laid out engine for about two days, getting things back in shape again. I will tell you a little more about this on some 24 x 32 in. cylinder engines. These were made somewhat differently. The piston was round and the end of tube had a cast hub like Fig. 2, with 4½ in. piston rods. This hole was bored out about 1-32 in. larger than piston, and slipped on after head and piston were in place, but on those engines this tube would hit the pilot beam if the crosshead was on the front end of guide when putting on. Now, you see, when the piston and cylinder wore, say, 1/8 in., and the roundhouse man would line down piston head to center of cylinder the extension would not bear on top of hub on tube. What was the good of making this extension to carry piston



NEW PACIFIC TYPE ON THE B. & A.

head when about all the wear is on the top or the 1/8 in. of top of cylinder? Those engines ran about two years with them, and we had them in the shop for piston failures about every week or two.

We then took off the front head, placed the piston at front of cylinder, took a hack saw and sawed in this piston just ahead of the spider nut; went in with saw about 1 in., took a sledge, hit the extension a few good clouts on the end of the nose and smiled. After this, of course, Bill then looked around, and everybody was smiling in the roundhouse. Then he put on front head and with a blank flange to take the place of tube hub, the engine was O. K. for good, and they removed the remains to the scrap bin, where it should have been about the day the engine came from the makers. Hoping this will help you tell some one our trouble, I don't think the man who invented this extension understood piston head and cylinder wear.

P. J. Connors,
Foreman B. & L. E. Ry.

Greenville, Pa.

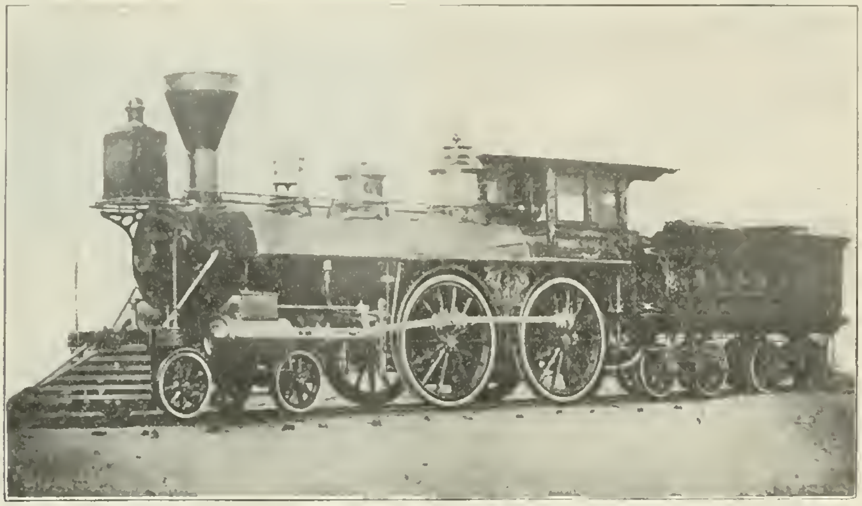
The Nashua & Lowell Railroad.

Editor:

A schedule of the motive power on the old Nashua & Lowell Railroad in 1850, a copy of which is annexed, may be of interest to those who care to see an occasional reference to the early days of railroading. This road was opened for travel in 1838 with an equipment consisting of three locomotives, three passenger cars, with a capacity for sixty passengers each, and twenty-four freight cars. Charles J. Fox, treasurer of the road, in a report to the directors in 1839, wrote as follows:

"In our engines we have been very fortunate. The 'Mars' and 'Jehu' were built by H. R. Dunham & Co. of New York, and the 'Roebuck' at Lowell.

They combine speed and power, two essential requisites in a good locomotive. Our freight cars are moved at the rate of 12 miles per hour, and our passenger cars at the rate of 25 miles per hour, not including stops. Since opening of our road, Oct. 8, 1838, the engines have run over 30,000 miles, carrying more than 58,000 passengers and 8,000 tons of merchandise, and making over 1,000 regular trips. Not a trip has



BOSTON, LOWELL & NASHUA ENGINE, "SOMERVILLE."

been lost from any cause, nor has the slightest accident occurred to any passenger or car. This fact, while it shows the safety of this mode of transportation, is conclusive proof of the thorough construction of our road, the excellence of our machinery, and the skill and practice of the individuals in our employment."

The number of engines on this road had been increased in 1857 by the addition of some larger and more modern locomotives than those given on the list, and these were named Jesse Bowers, Milford, Pennichuck, Daniel Abbot and Boardman, while the Jehu and Roebuck and the "old and useless" Mars, of which such goods things were said of old, had gone into the primitive scrap heap.

In 1857 the Boston & Lowell Railroad and the Nashua & Lowell companies entered into a twenty-year agreement for the joint working of the two companies as one line, under the title of Boston, Lowell & Nashua Railroad. Just previous to this arrangement the locomotives on the Boston & Lowell and their appraised valuations were as follows:

Leader	$7,800	Woburn	$5,800
Storrow	7,800	Vulcan	5,250
Higginson	7,500	Milo	4,500
Cloud	7,000	Vesta	4,250
Eagle	7,000	Rumford	4,200
Essex	7,000	Ajax	4,000
Mars	6,500	McNeil	4,000
Pawtucket	6,000	Hector	3,500
Remains of the Engine Baldwin			1,000

The Milo is known to fame as one of the victorious engines in the historic Lowell trials of locomotive speed and power in 1851. Particulars and dimensions of this engine furnished in 1851 for the official report of the tests by Mr. G. B. King, then master mechanic on the Boston & Lowell, were, in part, as follows: Milo—Freight engine, built by Hinkley & Drury; rebuilt by the Boston & Lowell in 1851; cylinders, 13½ x 20 ins., outside connected; diameter of boiler 38 in.; length of same 11 ft. 2½ in.; 88 tubes, 10 ft. 8 in. long and 2 in. in diameter. The top of the stack was 13 ft. 3 in. from the rail, and was 14 in. in diameter. There were 6 driving wheels four ft. in diameter, and no truck or trailing wheels. It would appear from the information quoted above that to the mechanical department of by-gone days of the Boston & Lowell Railroad, rather than to Hinkley & Drury, belongs the credit for the efficiency of The Milo. A four-wheel shifter built by Hinkley, named Milo, replaced the old engine in 1873.

Boston, Lowell & Nashua locomotive "Somerville," a photograph of which accompanies this sketch, was a representative Rhode Island engine of the late 60s. Its weight was 63,800 lbs. cylinders 16 x 24 ins., and drivers 5½ ft.

Passenger engines—Nashville, bought December, 1847, 18 tons; Indian Head, bought February, 1848, 18 tons; Wilton, bought March, 1848, 19 tons; Rolla, bought January, 1849, 18 tons; Roebuck, bought in 1838, 9½ tons; Mars (old and useless), 1838, 10 tons. Freight engines—Paugus, bought October, 1849, 23 tons; Logan, bought January, 1850, 23 tons.

W. A. HAZELBOOM.
Boston, Mass.

Diamond Stack Engines.

Editor:

I notice in the December issue of RAILWAY AND LOCOMOTIVE ENGINEERING that a correspondent writes you for information regarding diamond stacks on locomotives at the present time.

The article on page 553 asks if your readers can give the desired information. I hereby volunteer information that may be of use to your correspondent.

In the West Bay City jurisdiction of the Michigan Central (N. Y. C. Lines), under supervision of Mr. T. J. Hennessy, master mechanic, there are three 0-4-0 Hinkley switching engines, the 8074, 8082 and 8084, respectively, that are equipped with diamond stacks, and have come under my notice. I think possibly there are some 4-4-0 engines on the north end of Mackinaw division that are in service under Mr. Hennessy, whom I think would give information in regard to them.

W. A. CLARK,
Detroit, Mich. Engr. Mich. Cent.

STEWARTSTOWN RAILROAD ENGINE, "HOPEWELL," AT STEWARTSTOWN, PA.

Old Diamond Smoke Stack Engine.

Editor:

In response to your call for photograph of locomotive with diamond stack, I enclose negative of such a locomotive, now running on the Stewartstown Railroad, from Stewartstown, Pa., to New Freedom, Pa., on the Northern Central. This is a Baldwin engine, 15 x 22 in. cylinders, built in 1882.

Hoping it will be useful to you,

E. W. GREGORY.

Hoffmanville, Md.

Ferrocarril de Guatemala.

Editor:

The 21st of November was celebrated in Guatemala in three ways this year, one being that of the birthday of their President, and as birthdays are religiously kept here, this day is, on that account, celebrated throughout the republic. Another, the dedication of their postoffice, which has just been rebuilt and remodeled, but the celebration that is of most interest to the readers of THE RAILWAY AND LOCOMOTIVE ENGINEERING was the driving of the first spike at the little town of Zacapa. This was the celebration of the commencement of the branch of the Guatemala Railroad that is to run from Zacapa to Santa Ana, Salvador, and when completed will be another link in the chain which is to connect Central America with the United States by rail. This road will also give Salvador an outlet to the Atlantic coast, thereby giving them close connections with New York and all parts of Europe.

From Zacapa to Santa Ana the distance is 96 miles, and though the country is somewhat mountainous in parts, the line of railroad will be practically an easy one to build, as it follows the line of the river most of the way. That part of Salvador reached by this new branch is one of the richest coffee growing districts of Central America, and will allow the grower to load his products on the cars and ship them direct to Puerto Barrios, where the cars are run alongside of the vessels and transferred directly to the steamer bound for New Orleans, New York, Hamburg, or Liverpool. Now they must ship to the Pacific coast, and as the Pacific ports are open roadsteads, the shippers must pay lighterage and transfer, and again at Panama. The road will also tap the banana growing districts of Salvador, and give the people closer intercourse with the outside world.

The Guatemala Railroad was commenced in 1884, and completed last January. It affords the people of Guatemala a close connection with the outside world. Mail now reaches the United States as far as New York or San Francisco in eight days, where formerly it took from fifteen to thirty. A merchant can now go to New Orleans, buy his goods and bring them back with him and not be gone more than ten days, while before it took him fifteen to twenty-two days to make the trip one way.

The distance from Guatemala City to Zacapa is ninety-three miles, and from Zacapa to Puerto Barrios is 102. The construction from Zacapa to Guatemala was one of great difficulty, there being so many canyons to cross and many high bridges to build. The last and worst of these canyons, known as Las Vacas, is crossed two miles outside of Guatemala City by a bridge 750 ft. long and 240 ft. high.

The Guatemala Central Railroad, which is the property of the Pacific Improvement Company, runs from the city of Guatemala to the Pacific coast, and their northern terminal, Mazatenango, will soon begin the construction of the extension of their branch from Mazatenango to the Mexican border, there to connect with the Pan-American. When this is done the bad impression that the public have formerly had of Central America will quickly become a thing of the past. From the fact that the country has had no commercial intercourse with the world, it is yet in its infancy, but the country is fitted to grow everything known on any other part of the earth, and one can find a climate that will suit him exactly at all times of the year. W. W. COLLINS.

Zacapa, Guatemala.

OLD "EDDY CLOCK" NO. 15, NOW AT PURDUE UNIVERSITY.

Old "Eddy Clock" for Purdue.

Editor:

I am sending you a photograph of one of the "Eddy Clocks" in connection with an article which I should like very much to have you publish, as I think it will be of interest to readers of your paper. Through the generosity of the New York Central directors, Purdue University is to become the owners of an old Eddy engine, which was for many years in daily freight service on the Boston & Albany Railroad. This is a valuable addition to the Purdue collection, and Prof. Charles H. Benjamin, Dean of the Schools of Engineering, is to be congratulated on his good luck in obtaining it. The road at one time had over one hundred of this type. For passenger service a very large wheel was used on some of the engines, 75 in. in diameter. A number of others had 72-in. wheels, and the majority 66-in.; cylinders 18 by 24 in., a total weight of 34 tons. For freight service there were two types, a very large number like the No. 39, the locomotive donated to Purdue, and another type with 18¾ by 28-in. cylinders, and 54-in. driving wheels, weighing 39 tons. The No. 39 was built in 1876, has 18 by 26 cylinders, 60-in. drivers, and weighs 34 tons. Mr. Wilson Eddy built his type as late as 1881, and some would have undoubtedly been in service within a few years, had it not been for the great expense in keeping them in service, due to the fact that contraction and expansion were allowed for in the saddle instead of at the firebox. Of course the engines leaked very badly and were finally put out of service. The "Eddy Clocks" were remarkably smart engines and the writer has seen many a large passenger and freight train hauled by these machines. One of the 18¾ by 28-in. eight-wheelers was put to the test with a Mogul, built by the Rhode Island Works, and came out victorious. The No. 39 has for a number of years been used to heat cars at the Worcester, Mass., station, and I have been very desirous that it be preserved. I am naturally much gratified that it has come to pass.

JOHN WORCESTER MERRILL.

Newtonville, Mass.

[A letter concerning this engine was written by Mr. Merrill some years ago and may be found in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING for February, 1905, page 65. Editor.]

Derailment of Tenders.

Editor:

The subject of derailment of tenders has appeared in your journal a number of times, and I am wondering if you will give space for one more interested mechanic's ideas, as well as the presentation of some past experiences and observations.

I would refer correspondents to the Vanderbilt tank of seven and eight thousand gallon capacity and ask them if any improvement has been made regarding the splashing of water. Also I ask writers to note the four side bearings on the Vanderbilt tank, and if side bearings should be left off one set of trucks of tenders, why should the same idea not work on box cars or coaches? The front of any tender, or at least the majority of them, are more heavily loaded when full of coal than the rear. A great many tenders have the same capacity springs in each truck; why let the back truck stand all the rolling of the tender and break a dozen springs in that truck to one in the front truck?

A tender is virtually a pendulum between the power and the load, and it is the first and worst load a locomotive must handle because of the constant shifting of the water load. Since we know the load shifts badly, particularly side ways, it should not be encouraged by giving it half support with only one set of side bearings on the rear truck. This kind of a load also shifts badly if track conditions are not up to standard. Why do we condemn the construction of tenders when we know of numerous derailments which have occurred after a tender has been running successfully for days, months and years?

Do tenders pick out particular spots to get off the track? No; very often a tender is derailed and re-railed in twenty to thirty minutes, goes into the terminal, where a number of officials await the tender for examination. After the examination has been completed and a comparison made of fifteen other tenders with the guilty one, which by the way, is a 7,000-gallon tank, no remedy can be applied to the tender, as nothing is found wrong. Then after fifteen days, while the same tender is still making one hundred and thirty miles per day, all kinds of speed, curves, also considering the fluctuation of the load, the correspondence gets to the roundhouse foreman, general foreman and master mechanic, and they then begin to stand pat and conclude that the examination was held at the wrong place, and wonder why that tender ever picked out that spot to get off.

I know of a road which has equalizer trucks, arch bar trucks, Bettendorf trucks, and home made trucks (which would be hard to describe), and I know of but one tender being derailed in one year, and that was caused by a switch, which let the tender down two tracks at once. This road also has several hundred 7,500-gallon tanks. The brother, "who is a rider on engines," intimates a rigid truck on account of no lubrication on center castings. They should be lubricated, but how about a Mogul locomotive which has been wrecked, is minus an engine truck and the spring rigging useless on account of frame being blocked up on driving boxes with so much weight on the No. 1 pair of drivers that if a little boy were to step on cylinders the back wheels would rise off the rail. All the six or eight-wheel connected engines are rigid, and many of us can say we have seen them hauled at ten or twenty miles per hour over a division, and only the front flanges are any the worse for the usage, and no derailment.

The case referred to is simply the weight holding wheels to the rail, and a tender which rolls badly and puts weight with a blow to an outside bearing, like a tender truck has, must have some tendency to lift the opposite side and cause the flange to mount the rail, particularly a new cast flange which is but 15-16 in. high, and a back side bearing carry the force of the blow.

MODERN LOAD HAULERS.

I have ridden on two engines which have run scarcely two miles after taking a full tank of water when the tender was derailed, as on account of the height of the center of gravity they are more susceptible to derailments than a tank half full of water, as the center of gravity was lowered with the use of water. I remember an instance where one side bearing was lost and the water ran to one side in the cistern, and the engineer thought the tank would tip over before he could stop. This instance caused the replacing of front side bearings.

It never occurred to me that any mechanical men were in the "woods" relative to knowing how to build a tender complete, but it has occurred to me that many imagine that derailment is due to one cause when it is due to another. It appears that at every tender derailment a suggestion is made to change the construction of tenders. I would say to change the defect which started the water splashing and the tender rolling.

Some say, "How about a tender that gets off on good track?" I would suggest that we do not look at the good track where the tender got off, but go back a short distance and take a good look at the place where the rolling began.

One operation that has never been performed, is the application of the track level to a low joint or swingy track, while a large 7,500-gallon tank, in working order, ran over it and water rushed to one side, which put the rail down to its foundation and which rail came back to deceive us after the derailment had occurred.

F. W. SCHULTZ.

McGhee, Ark.

Harmony Has a Cash Value.

Editor:

Very little pains or judgment seem to be used in hiring new men for firemen. Whether they are mentally or physically capable of ever making first-class enginemen. Has the development of the locomotive brought this on, as one of its results?

What are the results of newly promoted engineers? What are the first year's results in most cases? It is usually expense for making a new enginemen to each company. There are exceptions, and some newly promoted men are just as good as any old man, but they are very few nowadays. Who is to blame for this condition of things?

Is there enough pains or instruction given at the right time, or is this instruction followed out if given by an engineer in most cases or not? A man who dares to insist on the fireman doing his work right in every way and trying to teach him to fire properly and to be economical in the use of fuel will be put down by almost every fireman as a crank, and don't want to fire for him. Most of the newly hired men work with extra engineers who will not insist in most cases on his doing his work properly, and when he comes to be old enough to hold a regular run or engine, you have to make most of them over again and be very careful that you do not ask anything of him to do that may be his work that he has not been instructed to do before. As most men hired nowadays come from the roundhouses, they, by hearing some inexperienced persons telling them what they are supposed to do and what not to do when they become firemen. Most of this is not what is calculated to make a first-class man out of him.

There are a great many engineers who do not try to help their firemen or instruct them in their work. That is, a great many pounds of coal can be saved in a trip if an engineer will tell the fireman when they are almost ready to leave so that he can get his fire in shape: also before shutting off for a station, so he can let his fire run down a little, so the engine will not be wasting steam at the safety valves.

So little attention is also paid by some men as to the condition of the firebox and flues; whether they are kept cleaned out; that is, grate openings are open and flues not stopped up. A great deal of fuel is wasted in this way. Also allowing engines to run with valves, cylinder packing, vacuum and relief valves; water valve, valve stems and piston packing, blowing, wasting a great deal of steam and coal. Why would it not pay to give a little more attention to these parts and keep them in first-class condition, as it would pay for itself many times over.

Would it not be of benefit to all companies if a little more thought and more interest was shown in the human factor of the operation of the roads. Would it not pay for itself in better services and more interest for the company's welfare and bigger dividends to the owners of the same?

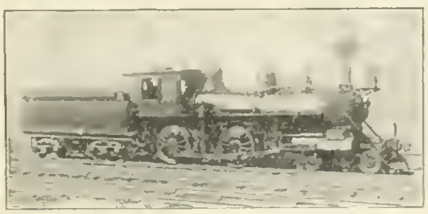
Why is it that some departments of a road think it is the only one? This is especially true of the transportation and mechanical departments of some roads; they are always pulling apart and not trying to help one another out, when if they work together money could and would be saved for the company. Is it not about time that this kind of work was drawing to a close and all parties work for the same interest—the owners of the road? C. F. Sundberg.

Sioux City, Iowa.

The Diamond Stack.

Editor:

I have been a regular subscriber to your paper for fifteen years, and think it the best railroad paper published. It is certainly very interesting. On looking over your December number I notice an article about "diamond stacks"; what roads have locomotives with this form of stack and where they are running?



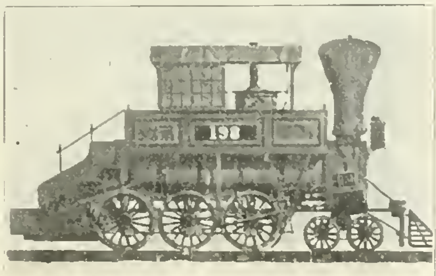
OLD B. & M. "SAND GRINDER."

The Boston & Maine have some six-wheel switchers, the Montpelier & Wells River Railroad a tank engine in passenger service, and the Boston & Albany are running a number. Enclosed please find photo of one of the old "sand grinders," so called, on the latter road. This engine is still in service on a short freight haul, and there are a number of others in gravel service. The road had 40 like this one, 20 built at Springfield by the B. & A., and 20 by the Rhode Island Locomotive Works, the only difference being that the latter had smooth dome casings, like that shown in the illustration. These machines had 20 x 26 in. cylinders, 54 in. drivers; they weighed 45 tons, and had 52 in. boilers. They could pull heavy freight trains at slow speed, but needed as much sand as the large sandbox would hold to start a load; hence the name. The bells on the 20 built by the road had most peculiar tone, and nearly all had stacks like the 743. The Concord & Montreal had a similar stack on their ten-wheel Manchester engines.

The Harriman Lines engines illustrated in your paper are very handsome machines, and I notice the headlights are not placed at the center of the boiler. Of all the changes made on the locomotive in recent years this changing the location of the headlight is the most hideous. Only a few roads seem to be willing to deform their locomotives to such an extent.

John Worcester Merrill.

Boston, Mass.



OLD TIMER ON THE B. & O.

Old Timer on the B. & O.

Editor:

I take particular interest in the views and accounts of historic locomotives, which appear from time to time in the pages of Railway and Locomotive Engineering.

Believing that it will prove of interest to fellow readers, I am sending a picture of old B. & O. engine 198. It is a photographic reproduction of a large drawing, which hangs in the office of the Dean of the Engineering Schools, Purdue University. This drawing is the original, made of the engine by Mr. W. S. G. Baker, while he was an apprentice in the B. & O. drafting room, and was presented by him to Purdue University soon after engine 173 was installed in the museum there. The drawing was pasted on cardboard and framed. The head of Washington, shown on the headlight, was cut from an old postage stamp.

Engine 198 was designed by Mr. Samuel J. Hayes, M. M., of the B. & O., and was the first of the ten-wheel class to be built for that road. It was built in 1853 at the shops of W. Dunmead & Co., Baltimore, Md. It was the forerunner of a popular class, and many more were built. This type was a sort of sequel to the Winans camel backs, which were eight-coupled, without trucks. The centrally located cab and overhanging firebox were retained on the Hayes engines.

MICHIGAN CENTRAL ENGINE NO. 8082, AT OWASSA, MICH.

The 198 is described by Mr. Baker as being the first ten-wheel engine ever built, but he is no doubt mistaken in this. The Norris engine "Chesapeake," built for the Philadelphia & Reading in 1847, claims this distinction. Possibly there are some old railroad men who can tell something more about these old B. & O. engines.

Gary, Ind. Robt. C. Schmid.

Diamond Stack Switcher.

Editor:

I enclose a photograph of a diamond stack engine that is in service on the Michigan Central at Owossa, Mich., and which I have been running for the past eight months. She is a plain slide-valve engine without the balance, and you can't hook her over without opening the cylinder cocks when she is full of steam. She is also equipped with a steam brake that is the cause of much profanity these frosty mornings. Nevertheless, she is in good shape and does her work equally as well as her sisters with more modern stacks. Hoping that this will be satisfactory to the correspondent in the December Railway and Locomotive Engineering

J. E. Phillips.

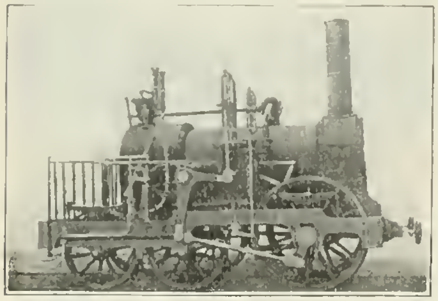
Bay City, W. S., Mich.

A Locomotive Monstrosity.

Editor,

Although they never had anything to do with it, the Midland Railway Company have lately issued, with their packets of six photographic post-cards of Midland engines, a card representing one of the earliest Scottish engines. This is the "Earl of Airlie," an extraordinary machine, built by Messrs. J. & G. Carmichael, of Dundee, and put to work in September, 1833. It will readily be conceived from the construction of the engine that it was not expected to run either far or fast. In fact, it was intended only to run to and fro on a level stretch of line 4¾ miles long, on the Dundee & Newtyle Railway.

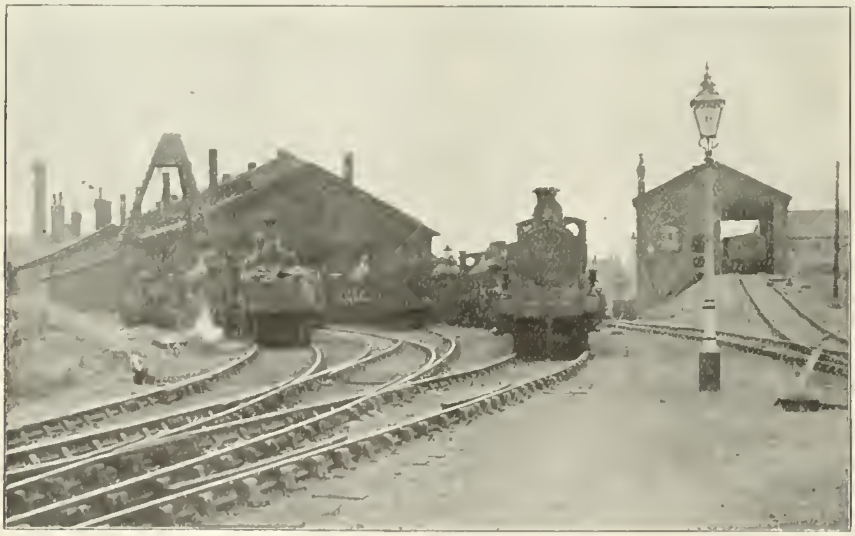
This line was opened in December, 1831, its short length of only 11½ miles comprising two very steep inclines rising from Dundee, and one pulling into Newtyle, whilst there were two levels each 4¾ miles. At first horse traction was used upon these, then stationary engines of varying power being supplied for working the heavy gradients. The latter were straight, but the level sections contained some severe curves. To render the working of these safer



THE "EARL OF AIRLIE," BUILT 1833.

the "Earl of Airlie" and its mate, the "Lord Wharncliffe," built at the same time, were provided with bogies or swivelling trucks under the trailing end. They were certainly the first bogie engines in Scotland; in fact, there were no others then running in the kingdom.

It is known that Hedley's "Puffing Billy" geared engine of 1813 ran on two 4-wheeled bogies for some years, the road being too weak to carry it upon fewer than 8 wheels, and early in 1833 R. Stephenson & Co. had sent over an engine for the Schenectady & Saratoga line, fitted with a leading bogie.



COALVILLE ENGINE HOUSE, MIDLAND RAILWAY, ENGLAND.

"Puffing Billy," however, had been restored to its original 4-wheeled state in 1830, and for all practical purposes these curious machines were the first bogie engines in Great Britain.

Why the bell-crank arrangement was adopted is not very clear, though it was neither the first nor the last example. Horizontal cylinders working the leading wheels could, apparently, have been arranged outside the frames. The cylinders were 11 x 18 in. working upwards in double guide-bars, the result being that two connecting rods were required for each cylinder, instead of one. The slide-valves resemble, and

ROPE AND DRUM USED ON THE SWANNINGTON INCLINE.

doubtless were, of the cylindrical form patented by Richard Roberts, of Manchester, in 1832. These valves, of wrought iron, were formed of two tubes, one within the other, the larger one having holes to admit direct steam into the space between the tubes. The space being closed at both ends, the steam escaped through slots at top and bottom into the working cylinder. From one end of the latter the exhaust steam went directly to the blast-pipe, from the other it made its way through the inner valve-tube.

The driving wheels were 54 in. in diameter; the bogie wheels look like 42 in. No particulars are available as to the heating surface. Fifty lbs. was the working pressure, coke being burned. The engines were very small, weighing but 9½ tons, which was no doubt enough for rails of only 35 lbs. per yard. They cost but $3,500 each, and had small, roughly built tenders carrying a water cask.

The Dundee & Newtyle Railway, like some other early Scottish lines, was laid to a gauge of 54 in., nominally, actually 54½ in. It proved a heavy loss, the traffic being very small, and the cost of keeping three stationary and two locomotive engines, besides horses on the dock branch at Dundee, was perfectly ruinous. In later years it was virtually laid out afresh, and the inclines eliminated. It now belongs to the Caledonian.

The "Earl of Airlie" ran till 1850, when it was set to pumping water. The spring buffers must be later additions. A third engine of the same kind, called the "Trotter," was built in 1834.

W. B. PALEY.

Chelsea, S. W., England.

Swannington Incline at Leicester.

Editor:

The Railway Club recently paid a visit to the Leicester & Swannington Railway, which was partly opened as long ago as the 17th of July, 1832, and completed in 1833. The Swannington Incline, of 1 in 17, has been worked by rope and fixed engine from 1833 to the present day. I am in the group sent, at the extreme right, with my hat off.

The Coalville engine shed of the Midland Railway was also visited, and the view gives a very good illustration of English track.

The ticket enclosed is the outward half of one printed specially for a visit to Groby Junction, a place at which trains do not stop, in regular working; it is not a passenger station.

CLEMENT E. STRETTON.

Leicester, England.

Grinding Triple Valve Piston Rings.

Editor:

Every mechanic has a certain method in doing a piece of work and consumes a certain amount of time in doing it, and it is not often that any two men will agree as to method or time consumed.

Not long ago I read a description of a machine for grinding in triple value piston rings, in which the author made the statement that with the machine a ring could be ground to a bearing in 20 or 30 minutes, while it would take from 1 to 3 hours to do it by hand. While I agree that a machine of this kind might be an advantage when 8 or 10 could be kept in operation continuously, I do not agree that the work could be any better or more quickly done by their use in the average size railroad repair shop.

My excuse for writing this article is the hope that it may be printed in Railway and Locomotive Engineering, and perhaps bring out the experiences of other men engaged in this line of work.

In working up a triple piston ring, it is well to remember that the condition of the slide valve and its seat plays a very important part in the operation of releasing the triple. If the value and seat are in poor condition, there may be so much friction between them that the force, acting through the piston, cannot overcome it and release the triple, even though it pass the ring test by a good margin.

The first thing to do, then, is to put valve and seat in first class condition before working on the ring. In fitting the ring there are four points to remember, any one of them being at fault, may cause the triple to fail to release: (1) Condition of the bushing or piston chamber. (2) Ring fit in the piston slot. (3) Ring fit in the bushing. (4) Grinding the ring to a bearing.

If the bushing has a shoulder or is out of round, roll it, scrape it or scrap it; never let a triple valve with a bad bushing get past you, even if it stands the release test, as it is almost certain to cause trouble on the road sooner or later.

If the ring is too thick for the piston slot, it may be dressed down by rubbing it on a piece of fine emery cloth, placed on a flat surface. Press the ring down with the fingers, using a circular motion, the same as if you were using an eraser on a blackboard. This is much better than filing, and leaves a finer finish. If there are burrs on the edges of the slot they may be removed with a fine file. The ring should fit the slot just so it can be turned with the fingers when in place.

In fitting the ring to the bushing be very careful to get the ends filed perfectly parallel and fit it to the bushing just a trifle tight. Now put the ring in place, with the opening at the bottom and about one-half inch to either side of the lowest point of the piston, and attach the valve and spring to the piston just as it is in service. Drop a little lard or signal oil on valve and ring, but never use abraisive material of any kind on the ring, as it is not necessary . Grasp the boss on the end of the piston firmly with a short pair of tongs, and you are ready for grinding. Of course with the New York quick-action triple you will use an eyebolt or handle in place of the tongs. Now push the piston in place and move it back and forth, pulling the ring clear out of the bushing each time. If the ring will not spring into the bushing without forcing down the ends it is not fit to use, and should be thrown away, as it will cause too much friction and wear of the bushing.

The slide valve and spring guides the piston perfectly true in the bushing, just as it does in service. By placing the widest and heaviest part of the ring at the top, it will naturally work around to the bottom, and by placing the opening at the bottom again as you did before, except on the other side of the lowest point of the piston, you will grind the ring equally all around the bushing. The reciprocating motions may be made as fast as you can work your arms, and it should not take over five minutes to get a perfect bearing. It is not at all necessary to grind all the tool marks out, as by so doing you simply grind the ring away and increase the ring opening.

If the ring bears heavy on the points, they may be eased off slightly with a file. When through grinding, the slide valve, ring and bushing should be wiped out clean and then oiled, a very little with thin valve oil or something equally good.

I will say that I have heard a great deal of adverse criticism of this method of grinding a ring, many claiming that the ring should not be ground in with the slide valve attached to the piston, and the ring should never be pulled clear of the bushing, but I have never seen a triple injured in any way by doing so.

It is certainly this, the quickest way, and, I think, the best way in which it can be done, and when ground will pass the most rigid test.

A. W. Vestal,
Danville, Ill. C. & E. I. R. R.

NARROW GAUGE ENGINE ON THE C. & S.

Narrow Gauge C. & S. Engine.

Editor:

I enclose you photograph of Colorado & Southern narrow gauge passenger locomotive No. 7, which was built at the Denver shops of this company a few years ago. This is one of the engines that runs between Denver and Silver Plume, over the famous "Georgetown Loop," and this type of locomotive handles six narrow gauge coaches over a four per cent. grade. Engine carries 180 lbs. of steam at the present time; it carried 190 lbs. when originally built. These engines have 15 x 18-in. cylinders, weight on drivers, 64,000 lbs., and the total weight of engine and tender loaded and ready for service is 123,350 lbs. C. A. Pratt.

Denver, Col.

New Mono-Rail Line.

People with defective engineering knowledge imagine that great reduction of friction could be secured by running vehicles upon a single rail. Some experience with a single rail railway was obtained with a line built near Coney Island a few years ago, but the operation of the road was not encouraging. There are some monorail lines in operation in Ireland, but the best that can be said about them is that the first cost is low.

Recent reports say that a monorail line will soon be built between Bartow station on the New York, New Haven & Hartford Railroad to Belden Point, City Island, and will take the place of an old horse-car line. The Public Service Commission gave permission last month for changing the motive power, and immediately afterward Bion L. Burrows, president of the American Monorail Company, announced that the construction work would begin soon.

MONO-RAIL LINE IN IRELAND.

Every human being is intended to have a character of his own, to be what no other is, to do what no other can. This does not urge you to be known as the greatest liar or a sword eater.

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Work of the M. C. B. Association.

The organizing of associations, societies and clubs for the purpose of promoting the interests of railroads, combinations undertaken and entered upon voluntarily represents elements of self-denial and unselfish devotion that have never received deserved appreciation. Associations of subordinate railroad officials formed to better the business and to act as a shield against unscrupulous dealings on the part of competitors was a new departure, yet this was the purpose of the men who formed the Master Car Builders' Association.

During the first thirty years of railroad operating there was comparatively little interchange of cars because the lines were mostly short, with few junction points. As extensions and consolidations progressed, cars began to make journeys away from the home lines, and no provisions were made for repairs or for adjusting compensation for damages sustained in wrecks or from bad usage. Damaged cars would be sent home as long as they would hold together, and no person was authorized to refuse bad order cars or to trace the damage to the point of its origin.

It was obviously the duty of the general managers of the various railroads to establish rules governing the movement of all freight cars belonging to foreign companies, but that was not done, and the confusion in the interchange of cars was becoming a crying evil. The disputes that arose concerning damage to cars were naturally referred to the class known as Car Masters, the men who attended to the building and repair of cars.

The region of greatest trouble with car interchange was along the Erie Canal, which embraced all the junctions that witnessed the interchange of cars between New England railroads and the rest of the country. As early as 1864 we find Car Masters holding meetings at Albany and other points to talk about Car Questions. Some of the Car Masters displayed the characteristics that made them masters of men and the desultory coming together of men having common interests was changed to regular meetings with responsible officers. John Kirby of the Lake Shore, who is still alive, was one of the active moving spirits.

As the railroad managers of that day did not rise to the occasion of establishing rules for the interchange of cars, the Car Masters in 1866 formulated rules of interchange of cars which were accepted by railroad companies, although the body issuing them had no authority to dictate rules to others. It was a case very frequently duplicated in America. The assumption of authority made the authority good.

The Car Masters were fond of whereas, resolved, and other introductions to decided expressions of opinion. The most important of these was:

Resolved, That in case of any damage or repairs of any kind whatever, it shall be the duty of each Car Master to instruct his inspector to place on such cars a card stating where such damage or repair was done, signed by the Car Master of each road on which it was done, thereby enabling all interested to readily ascertain where the damage or repair was done.

This robust body of Car Masters met in convention in Springfield, Mass., May 15, 1867, and formed the Master Car Builders' Association. Those familiar with the work done by the Master Car Builders' Association have good grounds for believing that no voluntary organization the world has ever seen performed services of equal magnitude or importance. The dominating purpose of the Master Car Builders' Association when formed was to reduce the prevailing friction connected with car interchange, but other questions soon arose that almost pushed interchange matters into the background. The questions relating to car interchange were harmoniously settled at the first few meetings, a spirit of fairness having prevailed, and the members found themselves free to devote attention to numerous unsettled questions relative to the construction details of railroad rolling stock.

When the Master Car Builders' Association was formed the utmost confusion prevailed in the form and dimensions of screw threads used in making bolts and nuts. The screw is as old as civilization, improved forms having been used by Archimedes, 250 B. C. It came to be an important element in the mechanic arts, but there was no uniformity of construction details. With the great development of the metal trades in the 19th century makers of screw threads began to have their "standards," the sizes and shapes being chosen to suit the taste or prejudice of the men in charge. Diversity in the shapes and dimensions of screw threads did not cause much inconvenience while the product was confined to a particular establishment or to its branches, but when similar machines were sent out from different establishments with diversity of screw threads, prompt repairing became difficult. William Sellers, the famous machine tool maker, made the subject of screw threads a special study and devised a set of forms and dimensions which was indorsed by the Franklin Institute of Philadelphia, and recommended by that organization for general adoption. That system of screw threads was adopted by the U. S. Government, and now forms the United States standard.

The Master Car Builders' Association had hardly got into working order when the agitation favoring the adoption of the Sellers screw thread began. At that time there was great confusion in car shops with screw threads, the variety of patterns sometimes moving superintendents, foremen and others to select dimensions that were a little different from the sizes used by other people. This proved particularly awkward in cars that required repairs at points far away from the owners' lines, and frequently led to tedious delay, the cars being kept waiting for nuts and bolts of the original dimensions. The Master Car Builders' Association adopted the Sellers screw threads very promptly, making them one of its first standards. This action had a very powerful influence in promoting the general adoption of the standard screw threads, for every car that sustained damage on a foreign line was a missionary preaching the advantage of improvement in car construction.

Uniformity in car construction became a favorite subject of investigation and discussion with the Master Car Builders' Association for many years. They never succeeded in agreeing upon a standard form of car, but the light thrown upon the subject had a very powerful influence in improving the design of freight cars. If they failed to agree upon a finished car, they succeeded in establishing standard parts that greatly facilitated the work of repairs on cars away from the roads of the owners. One of the first moves made towards uniformity was establishing a form of tread for cast iron wheels, which threw various dangerous shapes out of use. Standards of axles have been established several times, changes having been made from time to time to keep pace with the growing capacity of cars. In connection with the axle and size of journals, standard bearings with oil box, wedges and lid were made uniform to suit the size of axle used, standard details that greatly facilitated repairs. Another useful move was adopting a standard brake head, shoe and wedge, things that were frequently needing renewal. It is needless to follow in detail the useful work done by the association, which steadily exerted its powerful influence on lines of sound progress.

Having devised the rules of car in interchange and decided upon certain standard parts, it was only natural that misunderstandings and disputes as to the interpretation and application of the interchange rules should arise as the work of the association in the matter of car interchange grew and widened. The Master Car Builders at length appointed a standing committee whose duty it was to report at each convention as to what changes, if any, should be made in the rules. This committee had also the duty of deciding what was the specific meaning of the rules in case any two railways failed to agree in adjusting a claim for damage to cars. The committee only rendered a decision when the matter was referred to them. In this way there grew up what one might almost call a systematic and uniform interpretation of the rules which has been of great value to railways. The decisions rendered were like judgments of the court, and formed a basis of interpretation which actually reduced the amount of car litigation between companies. Cases similar to those already decided were not tediously argued out by the parties concerned, as it was known from the record what the decision of the arbitration committee would be. This was the result of the automatic working of the system, though the committee were and are at all times ready to hear and judge the merits of every case presented.

Accidents to trainmen and to yardmen had become painfully frequent in the coupling of cars, and a demand arose for an automatic coupler that could be operated without having people go between the cars. Various State railroad commissions and humanitarian people kept agitating for the introduction of this improvement. The diversity of car couplers in use was legion, the link and pin types being by far the most common, the cheapest and the least capable of being rendered automatic. The Pennsylvania and a few other railroads had introduced couplers of a knuckle pattern joining on a vertical plane, a type that lent itself readily to automatic coupling. When pressure upon the railroads for the adoption of an automatic coupler could no longer be resisted the railroad companies put upon the Master Car Builders' Association the duty of deciding upon the form of coupler to be adopted. A protracted conflict waged for several years between the advocates of the different types of couplers, with the result that the knuckle coupler became the standard. In this decision the Master Car Builders' Association performed a great duty towards humanity. Much sacrifice of personal interests was made when the association decided to adopt what was known as the Janney type of coupler, for a vast majority of the couplers in service were of the link and pin form.

The next contribution to the cause of humanity which the Master Car Builders' Association was called upon to make was selecting a continuous brake for the control of freight trains. The Westinghouse air brake had been applied to nearly all passenger train equipment of the country, and was perfectly capable of controlling freight trains, but an idea was widespread that a cheaper form of brake could be used satisfactorily on freight trains. It was finally left for the Master Car Builders' Association to decide on the form of brake best adapted for the work to be done. Very exhaustive tests of various brakes were made, tests that left no doubt about the most efficient brake for controlling freight trains. It is needless to say that the air brake came out victorious, and is now in general use.

Newspaper Railroad Happenings.

There is a time-honored old saying that "talk is cheap." So it is; that is, of course, a certain kind of talk. A good deal of what one sees in the daily newspapers is very cheap talk, and it often happens that when the newspaper talk turns to railroad matters it is not only very cheap, but it is not worth a rap. As an example of this kind of thing we can give an instance or two which have come under our own notice in pursuing a what the police would call a "clue."

Not long ago a very respectable daily paper published in that home of culture and refinement, generally called Boston, had the portrait of a well-known superintendent of motive power of one of our leading railways, and the letterpress surrounding the portrait gave details of a marvelous invention which he had made, and which, the paper stated, would soon be tried on his road. It would revolutionize everything. Knowing the gentleman very well, we interviewed him and showed him the portrait with his clean-cut features and forceful face, and the account of his marvelous doings aforesaid. He smiled sadly and looked at us with wondering eyes as he disposed of the whole matter by saying, "I wonder how such things get into the papers." He had not invented anything and no such contrivance as was described was even in existence anywhere.

Another epoch-making discovery was attributed to a poor fireman on a Western road by several of the New York dailies. The sums to be paid, mind you not yet handed over, but coming his way, ran into six figures, with the dollar mark in front of them. His poverty was vividly contrasted with his prospective opulence, but on running the thing to earth, by writing to the superintendent of motive power of the road on which the poor fireman worked, we found that he was not so miserably poor and that he had not invented, designed, constructed or offered for sale anything at all.

These are examples of tales "made out of whole cloth," for the consumption of people who live on the record of death, disaster, foolishness and crime which forms the staple of the so-called "news" of the day.

There is another class of "stories" in which something is true, namely, that somebody has invented something, or that there is something that somebody is eager to sell. This kind of "story" has a substratum of truth, and we have had some good examples of this kind. Not long ago we were told of a splendid device which had been enthusiastically adopted by a Western road, and this road was represented as going ahead with the new device in great shape. Investigation proved that the road was "considering" the device and might possibly give it a limited trial. No adopting it as a standard offhand, and no mad rush to equip the road with it from end to end.

The kind if devices which are most enthusiastically boomed by the sellers while really being only calmly "considered," and that with the aid and use of a powerful microscope by the alleged eager purchaser, reminds us of the doughty salesman of whom John A. Hill wrote in Locomotive Engineering long ago, when he said that this man was prepared to demonstrate either with a hard pencil or a soft one, on any kind of paper, that he could save 30 per cent of the outlay now being made by the railways.

Bernard Shaw says if you want to get at the truth of a matter, you ought to have it put before you by both sides, and "argued with the reckless bias of the partisan." That is all right, for then you get both sides in some kind of style. The trouble with the "stories" of which we are speaking is that you only get the reckless bias of one side, with the truth entirely out of sight. There is one thing in railroad matters as in many other unexpected things which crop up in daily life which puts the man with the pencil and any old piece of paper very severely out of business, and which takes no notice of reckless bias, however praiseworthy, and that is the cool, quiet, deliberate judgment, based solely on that rather cruel but wholesome process of investigation on railways known as the service test.

Keeping Arms of Semaphones Bright.

For some time past the signal and paint departments of the Baltimore & Ohio Railroad have been experimenting with gold leaf as a covering for signal arms in an effort to retain distinctness of color without having to resort to painting the arms three or four times a year. Mr. F. P. Patenall, signal engineer of the road, is greatly pleased with the results of the experiment, which seems to justify continuance as standard practice, for the reason that under all varieties of background the arm so prepared presents a more distinct aspect, which consequently is very favorable to the runner, as the aspect, which is most clearly defined, is none too good.

The question of the color of the arm has no governing importance, as instructions to the runner are transmitted by the position of the arm, under the three-position method of signaling which is in use on the Baltimore & Ohio. The use of gold leaf in covering signal arms was suggested by Mr. W. S. Scheneck, master carpenter of the Connellsville division, and Mr. J. D. Wright, general foreman painter of the Mt. Clare shops at Baltimore, has made a special study of this application.

In order to prepare a suitable foundation and ground for the gold leaf, new signal arms receive three or four coats of paint, according to the roughness of the surface, and are sandpapered down thoroughly. The first two or three coats are surfaced similar to that used for the foundation coats of passenger cars, and applied in the same manner, or they may be made with white lead tinted with yellow. When the latter is used the first coat of lead is thinned with one-half linseed oil and one-half turpentine, and the subsequent coats with one-fourth linseed oil and three-fourths turpentine, each coat being sandpapered. In either case, it is recommended that the last coat be made of gold color, so that the ground will not show badly when the leaf begins to wear off. After the foundation, or ground, has been prepared, a coat of fatty linseed oil sizing is applied. This is allowed to stand about twenty-four hours, when it has sufficient adhesiveness to hold the leaf without dimming its lustre. The gold leaf is then laid on the sizing, and the surface burnished with raw cotton. Gold leaf applied in this manner, it is claimed, will stand weather exposure for fifteen or twenty years.

The cost of preparing the arms in this manner averages 90 cents each in quantities, and it is believed will result in considerable economy in avoiding the necessity of painting arms, which in order to obtain results equal to the use of gold leaf arms, would require the painting of the same six times a year, at a cost of approximately 25 cents per arm, or a total of $1.50 per annum per arm.

To maintain these gold leaf arms in good condition a mild solution of oxalic acid is used, with which the arm is sponged off at intervals as may be found necessary by the men engaged in the maintenance of signal appliances on each district.

Railroad Extension Needed in the South

The Southern Commercial Congress, with delegates representing sixty-four commercial organizations in fourteen Southern States, assembled in Washington on December 8, unanimously and with spontaneous and enthusiastic applause passed the following resolution, expressing its attitude toward railroads:

"Railroad construction has been extensive, but the rapid commercial growth of the South requires an enormous increase in its railroad facilities to transport to market its many and varied products. The construction of such adequate facilities can be accomplished only by assuring the holders of capital that such enterprises will be sefeguarded by conservative and constructive legislation, and we urge upon our Southern legislators the wisdom of such policy, and condemn any agitation leading to the contrary.

"We favor a spirit of co-operation between the people and railroads and other corporate interests, to the end that the required confidence of investors may be established in the securities of the corporations of the South."

That was very timely advice, for some of the Southern States Legislatures have displayed as much antipathy to railroads as if the lines of transportation were useless enterprises eating up the people's money without giving a proper equivalent. The prosperity of every region on this continent is gauged by the mileage of railroads for each inhabitant. The numbskulls who throw obstacles against the extension of railroads are enemies to the community in which they live.

The proper way to remedy the vicious legislation of the past is to work up public sentiment in favor of the railroad enterprises which have converted wildernesses into fruitful gardens and fertile farms, to acknowledge publicly the good work of the past and to encourage pending enterprises.

We feel that the moment is auspicious for a long and strong pull by all who are directly interested in the resumption of railroad activity. The rank and file of railroad men can give substantial aid in the regeneration of business if they lay resolutions before their local boards of trade and write letters to their senators and representatives, national and state.

Industrial Accidents.

It is customary for a certain class of journalists to make occasional and sometimes strongly worded comments on the frequency of accidents on railways and the consequent disasters resulting therefrom to the employees and public who may unfortunately be the innocent victims. Anything endangering the safety of human life and limb is deplorable, but it is unjust to magnify or distort the dangers attending the operation of one kind of industrial activity, and ignore or minimize the danger attending other classes. When it is borne in mind that there are nearly two million men employed in railroad work in America and that their work consists mainly in operating mechanical appliances of the most intricate and powerful kind, accidents are not to be wondered at, and the best engineering skill is constantly employed devising new methods of conserving the safety of railway men and the public.

From the census reports just issued by the Department of Commerce and Labor covering the first six years of the present century, it appears that among the one million deaths of males, 9 per cent were due to accident. It may be stated that a large majority of these accidental deaths were due to causes more or less related to the occupations of the injured persons. In the case of sailors 17 per cent. of the deaths recorded were due to accident. Among electricians the rate was 14 per cent., while among linemen, who might be classified as electric workers, no less than 46 per cent. of the deaths were due to accidents almost entirely occurring in their occupation.

In the case of railway trainmen, the report covers a period of ten years, and shows that the death rate due to accidents during that period did not at any time exceed 7 per cent., and it is gratifying to observe that there is a gradual lessening of the death rate due to accidental causes among railway men. It is evident that the reduction of accident is keeping pace with the improvement in mechanical devices and the more substantial construction of roadbeds and methods of signaling. The introduction of the air brake marked an epoch in life-saving among railway men. The same is true of the adoption of the automatic coupler, and doubtless further improvements will continue to work for the safeguarding of human life in the great and growing field of railroad operation.

It may be added that in some of the industries allied to railroad work the death rate, owing to accidents, is nearly as high as among the railway men themselves. Among the bolt and nut workers in Pennsylvania the fatal accident rate approaches 6 per cent., and in miscellaneous steel and iron work generally the rate is nearly 5 per cent.

From these figures it will be seen that the accidental death rate among railway men is below the average, and very far below the rate prevalent among men engaged in some other industries, and of which we hear little. The census report is very valuable in calling public attention to these facts, and it is to be hoped that less acrimony will be shown in the future by the press towards that large and important body of men engaged in railroad work.

In calling attention to these facts and figures, we may say that we are strongly of opinion that in addition to the valuable improvements in the mechanical devices used on railways and which tend in the direction of safety, there is a spirit of growing thoughtfulness among railway men, partly the result of better educational facilities, and partly arising from the very fact that the importance and magnitude of their operations are such that the public eye has become focused upon them almost to the exclusion of other industrial occupations, where there is as much if not more need of a spirit of incessant watchfulness. We believe that out of these conditions has grown a serious determination among railway men to exert themselves to the utmost to the end that a reproach, which is not wholly deserved, may be taken away, and further, that the safety of the general public and their own safety may be more fully conserved, and it is the growth and steady upbuilding of this serious desire on the part of the men themselves to maintain a high standard of safe railroad operation that the hope of the future must largely depend.

Technical Rulings.

The Interstate Commerce Commission has ruled that the sale by the railroad companies of special rate commutation tickets to school children and students is discrimination against the general traveling public and must be stopped. If there is any act of stupid meddling that can be done to annoy or oppress the patrons of railroads the high dignitaries forming the Interstate Commerce Commission may be depended upon to perform it and to claim credit for actions that would bring the blush of shame to ordinary people.

One of the remarks contained in the judgment of the United States Supreme Court recently delivered in the Harriman case seems to be clear as to the functions of the Commission. Speaking of the law which called the Interstate Commerce Commission into being the court says:

"The main purpose of the act was to regulate the interstate business of carriers, and the secondary purpose, that for which the Commission was established, was to enforce the regulations enacted."

In the matter of freight rates, railways are not allowed to charge a less rate to the large shipper or a higher rate to the small shipper. As a general proposition this is approved of by the public as fair. When it comes to local passenger travel, the lesser rate given to those who travel regularly day by day, and the higher rate charged to the occasional traveler is regarded as fair by the general public, because anyone can become a "commuter," if he so desires it. The school children's case would seem to be analogous as no student was heretofore excluded. Now the Commission regards the school rate as an infraction of the law. There seems to be a tendency to lean toward the technical interpretation of the law rather than be governed by its spirit in this ruling about the school tickets. If one set of men only were allowed to "commute," or if only one set of students could buy school tickets, there would, to our way of thinking, be a deviation from the spirit of the law. But we fail to see how commuters' rates or school tickets create any hardship to the public.

What appears to particularly delight the hearts of the men forming the Interstate Commerce Commission is to declare as illegal, acts of benevolence performed by railroad officials. Railroad managers have always been noted for kindly acts towards old employes and their families, but such acts are gall and bitterness to the members of the Interstate Commerce Commission and they have been pointed out with skulking persistence and denounced as violation of law. The law permits railroad managers to grant transportation for their own employes and to other railroad people, but as soon as a person retires under the burden of years he is a pariah in the eyes of the Interstate Commerce Commission and any courtesies extended to him or to his family by his old employer subjects the benevolent official to pains and penalties. Talk about white men's burdens. The Interstate Commerce Commission forms one of the most harrassing burdens placed upon the American people.

Capital and Labor Reasoning Together.

There was a great display of speechmaking ability at the annual banquet of the National Civic Federation held in New York last month. Among the popular speakers were President-elect Taft, Andrew Carnegie, John Mitchell, M. E. Ingalls and others. The relations bebetween capital and labor were freely discussed and the President-elect showed that he had the interests of the working people very much at heart. One of the worst iniquities that workmen of all classes, railroad men included, suffer is the difficulty of collecting damages for injuries caused by the fault of the employers. The speaker intimated that means for effecting remedies against this species of injustice would receive his hearty support.

Mr. M. E. Ingalls made an energetic plea for the repeal of the Sherman Law which, he asserted, did great injustice to people carrying on a legitimate business. He said that if the law was strictly enforced every person who has organizing ability is liable to get into the penitentiary.

John Mitchell and Samuel Gompers talked on a subject that has excited considerable controversy. They both asserted that when the business panic came on they exercised all their influence to prevent the reduction of wages and that their efforts had been particularly successful with railroad companies. They claimed to be the authors of the new economic doctrine that preventing the reduction of wages maintained the high prices of commodities which is accelerating the return of prosperity. The wage scale was very generally maintained, that is true. But an immense number of wage earners lost their jobs. Reduction of labor cost, that is, a readjustment of prices or liquidation, was forced upon employers as the alternative to shutting down or to bankruptcy. In the first seven months of the year the railroads cut down their operating expenses $100,000,000. Of the gross earnings of the railroads of the country rather more than 40 per cent. goes to labor. In the operating expense account, of course, labor stands for a larger percentage. Probably 50 per cent. of the $100,000,000 reduction in operating expenses was due to saving in labor cost. Since wages were not reduced, or were reduced in very few cases, this saving must have been effected by the discharge of employes. It would appear, therefore, that the wage earners, after all, had to submit to their proportionate share of liquidation or readjustment.

The question now in controversy is: whether it was best for many railroad men and others to lose their employment altogether while a reduced force was receiving full pay, or whether it would have been better to have held on a full force with less pay. We think that keeping up pay and prices was the better policy for the country at large, although it inflicted much hardship upon part of the community.

To Detect Overheated Boiler Sheets.

When that supreme accident—a boiler explosion—happens to a locomotive we are frequently asked to give an opinion as to the cause of the accident, especially when the rupture has begun in the firebox. When that happens the officials of the road nearly always charge the explosion to low water and try to saddle the blame upon the engineer. Boiler explosions are much oftener caused by broken staybolts or furrowed seams than by low water; but low water is an easy explanation that is readily understood and it tends to relieve the company from the payment of damages caused by the accident. When a boiler explosion happens we are always ready to assist those investigating the case, but opinions are worth very little unless the person has been able to make a thorough investigation on the spot and to subject the fractured parts to a most searching examination.

There is much popular misconseption concerning the probable cause of boiler explosions and enginemen are very little better informed than the loquacious head brakeman about the causes that are most liable to convert a boiler into destructive fragments flying through the air with disaster on their wings. Examination catechisms designed to find out the extent of an engineman's knowledge never questions him concerning what he knows about boiler explosions. Nevertheless every intelligent engineer ought to be familiar with the literature of boiler explosions for his own protection or defence. The best condensed information upon this subject that we know of is the book, "Twentieth Century Locomotives," published by the Angus Sinclair Publishing Company. Much useful information is also to be found in the annual reports of the Master Mechanics' Association and in the back volumes of RAILWAY AND LOCOMOTIVE ENGINEERING.

When a boiler explosion happens it is of the very greatest importance that particular notice be taken of the fractures and notes made of the appearance of the sheets. Low water always produces excessive heating. If the temperature rises sufficiently to weaken the material, failure may occur by stripping of the stay bolts or rupture of the sheets by bulging between the stay bolts or otherwise. If the temperature has raised the material to a low red or bright red color the effects of this can be readily determined by superficial inspection. While the fire side will show red rust or a black color, the water or steam side will invariably show a typical steel blue scale, which will not disappear even after years, as it is a so-called rustless coating. If this be once oiled it will always be distinguishable, even if the plates should be exposed to moisture and gases for years. The color of this scale will depend somewhat upon the temperature at which it was produced, being brightest at those points where temperature was highest.

The foregoing paragraph is copied from an article in "Twentieth Century Locomotives," the whole of which ought to be familar to every engineman, for the information given will enable any intelligent man to tell when a sheet has been overheated. Information of this character is of much greater practical value to railroad men than 90 per cent. of the stuff given out in the text books of the most pretentious correspondence schools.

To Defend Railroad Interests.

The Railway Business Association has taken up the work of urging that everyone interested in speedy return to activity of transportation interests, and a resumption on the part of the railroads of purchases of material and equipment, will at once address demands upon their legislative representatives in State and national capitals for reasonable enactments and for a favorable attitude toward a fair adjustment of rates. That the campaign is to be an aggressive one is indicated by the selection of Mr. G. M. Basford, assistant to the president of the American Locomotive Company, as acting secretary. Mr. Basford will give undivided attention for several months to the effort which the association is making to show the public that anything hurting railroads also hurts whole communities of people directly and hosts of others indirectly, and that there is immediate necessity for a change toward moderation and calmness in railroad legislation.

Book Notices

Valve Setting, by Herbert E. Collins. Published by the Hill Publishing Co., New York. 209 pages, 6 in. x 9 in. Profusely illustrated, cloth. Price, $2.00.

There are a number of books giving particulars in regard to the proper adjustment of some particular system of valve-gearing, but there are very few that even attempt to give a general description of the various gearings most commonly in use. In the work before us there is a very extensive variety of movements fully described and illustrated, and the work cannot fail to meet with the warm approval of those expert mechanicians who give their attention to the important problem of the proper adjustment of the valve-gearing of steam engines. Valuable chapters are also added in relation to the duplex pump and air compressors.

Machine Shop Calculations, by Fred. H. Colvin. Published by the Hill Publishing Co., New York. 174 pages, cloth binding, numerous illustrations. Price, $1.00.

The reduction of manual labor and the rapid introduction of labor-saving machinery render machine shop calculations of much more frequent occurrence than formerly, and hence a book of this kind has become an absolute necessity to every well-equipped machinist. The work shows a mastery of the subject. The size is well adapted for handy use, while the letterpress, paper and binding are all in the usually substantial and elegant style of the Hill publications.

Power Railway Signalling, by H. Raynor Wilson. Published by the Railway Engineer, London, Eng. Price, foreign, 19 shillings.

This book, which is a large quarto volume, beautifully illustrated and finely printed, contains 342 pages. The book opens with the consideration of instruments, the lock and block system, early history, British and foreign. Next come contact makers, slots replacers, detectors and insulated joints, interlocking, the working of a single lines, tablet and electric staff systems. The progress of automatic signaling in America is described and reasons are given for the slow progress made in Great Britain. The signals for electric tramways, accessories, etc. Various kinds of locomotive cab signals are described, and a very full review of the construction and working of signaling and interlocking power plants. The work, which is the result of painstaking and careful work on the part of the author, forms a valuable compendium of power signaling as used in Great Britain and America.

An Irish engineer having been asked to explain what steam was, said: "Stame is water gone crazy wid de heat."

Applied Science Department

Elements of Physical Science.

Second Series.

IV. Heat Applied to Water.

Water is composed of the two gases known as hydrogen and oxygen. The gases combine in the proportion of two volumes of hydrogen to one of oxygen. Hence, in scientific chemical symbols the substance known as water is described as H_2O.

When heat is applied under a vessel containing water, the water begins to assume a gaseous state known as steam. The composition of steam coincides exactly with water, the original gases from which it is formed retaining the same relation to each other. The formation of steam assumes the form of bubbles rising towards the surface. The upper layers of water condense the heated bubbles until the whole of the body of water is heated until it reaches a temperature of 212 deg. Fahrenheit, when the bubbles break through the surface and boiling begins.

It may be noted that the variations in pressure on the surface of the water affect the temperature at which water boils. On the surface of the earth, the weight of the atmosphere is about 14.7 lbs. per sq. in. near the level of the sea. In higher altitudes, where the air is correspondingly lighter, the pressure on all bodies is lessened, and consequently the boiling of water, or the breaking through of the heated bubbles, will occur at a lower temperature. At a pressure of 10 lbs. per sq. in. water will boil at 193 deg., and at 5 lbs. the boiling point will be reached at 162 deg. On the top of high mountains it is found that in the rare atmospheres water can be made to boil by the absorption of so little heat as not to properly cook an egg. The increase of pressure above the atmosphere has a corresponding effect in retarding the point at which boiling occurs. At a pressure of 30 lbs. per sq. in. water boils at 250 deg. F., at 60 lbs. it requires 295 deg., and at 150 lbs., 360 deg. F. are necessary to produce the ebullition known as boiling. It should be remembered that in the case of steam gauges, pressure is calculated from that of the atmosphere, so that whatever a gauge indicates in steam pressure, about 15 lbs. should be added to ascertain the actual pressure.

In all calculations regarding the transforming of heat through water into mechanical work, the heat unit, so-called, is used. This unit is the quantity of heat required to raise the temperature of one pound of water one degree of heat, the water being at a temperature slightly above the freezing point. It should be remembered that as water increases in temperature an increasing quantity of heat is required to raise the temperature one degree. This is owing in some measure to the expansion of the water and consequent disappearance of heat in internal as well as external work.

A simple process in noting the phenomena connected with the mechanical power developed by the application of heat to water and the resultant conversion of water into steam may be observed by placing one pound of water at a temperature of 32 deg. F. in a glass tube of indefinite length and open at the top, the cross sectional area of the tube being 1 sq. ft., or 144 sq. in. As one pound of water measures 27.7 cu. in., the depth of the water in the bottom of the tube will be a little less than one-fifth of an inch, or .1923 in. A flame of a spirit lamp or other steady heat applied beneath the tube will cause an increase in temperature of the water until 212 deg. F. is reached. It will be noted that 180 units of heat have been already expended in raising the water to this temperature. The water will then begin boiling and will be gradually evaporated into steam, but the temperature will continue the same until vaporization is completed. It is interesting to note the exact time taken in the process of raising the temperature of the water from 32 deg. to 212 deg., and compare it with the time taken for the vaporization of the water. It will be found that if it took 10 minutes to reach the boiling point, it will take 55 minutes for the water to disappear in the form of vapor. This ratio of 1 to 5½ will manifest itself with any quantity of water subjected to any constant amount of heat. The number of heat units expended in vaporizing the water will, therefore, be 180 units, necessary to produce boiling water, added to 990 units used in changing the water into steam, making a total of 1170 units.

The space occupied by the steam amounts to 1644 times more than the space originally occupied by the water, and in a tube of the size referred to, would form a column 26.36 ft. in height. Calculating the weight of the atmosphere at sea level as 14.7 lbs. per sq. in., the atmospheric pressure in the tube would amount to 2,116.8 lbs. Raising this weight a height of 26.36 ft. amounts to 55,798 foot-lbs. of actual work accomplished by the evaporation of one pound of water at atmospheric pressure.

It will be readily noted that while this large volume of steam has exhibited a great amount of energy in raising and suspending the atmosphere, it could not be used at this low pressure for the lightest kind of motive power, but instead of allowing the steam to exert its

LOCOMOTIVE ON SKATES WITH HELMSMAN IN FRONT.

expansive quality on the atmosphere limited to the tube referred to, we shall suppose a condition where the tube would be enclosed at the upper end and a piston filling the tube and weighing 130 lbs. per sq. in. was placed on the surface of the water, it would be found that the water would not boil until 355 deg. F. had been reached. Steam will then be formed and the piston slowly raised until the water has become completely vaporized. The volume now occupied by the steam would be 192 times greater than that occupied by the water, and the piston with its weight of 20,880 lbs. would be raised and suspended over 3 ft. This is exactly what occurs in the steam engine, the difference being that in our experimental calculation there is no allowance for loss by condensation or leakage, both important factors in the transference of steam into mechanical energy. Under the best conditions the loss is very great, although the many improvements in steam engine construction have made the loss much less than in the earlier forms in which the steam engine was used.

Celebrated Steam Engineers.

XV.—Mark and Isambard Brunel.

Another noteworthy illustration of the engineering talent descending from father to son occurs in the case of the Brunel family. They were of Norman descent and the elder Brunel was a fugitive from France during the Revolution in 1792. His qualities as an engineer found ready employment in the United States, and he was engaged in canal construction and other work. The beginning of the nineteenth century saw him in England, where he successfully introduced the manufacture of ship's blocks by machinery, from which the inventor derived much profit. He was warmly encouraged by the British government and introduced many improvements in sawmills, nail-making machines and cotton-winding machines. He invented the first machine used in making shoes, his machines furnishing shoes for the British navy. He introduced steam vessels on the river Thames, and his steam launches were the first steam vessels used in towing ships out to sea. He was also the first to experiment with liquid gases as a source of motive power, and this was greatly helped by his son Isambard, who also was of great assistance to his father in the attempt to construct a tunnel under the Thames. This was the first attempt at tunnel construction under a river, and after meeting with many disasters was finally completed and opened to the public in 1843.

Isambard, after his experience with the Thames tunnel, gave his attention to railroad work, and after showing much skill in various engineering projects he was appointed engineer of the newly projected Great Western Railway of England. This great work was so far in advance of anything of a similar kind that Isambard Brunel was universally recognized as the leading railroad engineer of his time. For solidity of construction and for skill and beauty of design the railroad is still among the foremost examples of railroad engineering. The great bridges are particularly beautiful, and after sixty years of growing service are as changeless as the Pyramids. At this time Brunel introduced the broadest gauge ever used on railways. He maintained that a seven-foot gauge was a great and growing necessity. It is now generally conceded that Brunel was right, but as the locomotives constructed by the Stephensons and others were nearly all of the 4 ft. 8½-in. gauge, it was found impossible to change the standard already adopted.

Mr. Brunel had also followed his father's footsteps in the matter of developing steam navigation. As early as 1835 he suggested the construction of a steamboat calculated to make voyages from Bristol, England, to New York. This seemed so impracticable to the legislators of the time that it was with much difficulty that Brunel's scheme was allowed to take form. The *Great Western* was launched in 1838, and was speedily followed by the *Great Britain*, the first large iron steamship, and the first in which the screw propeller was successfully used. The success attending the introduction of these great ships induced Brunel to further advance in the same direction, and after encountering many obstacles he constructed for the Australia Mail Company the *Great Eastern*. This ship, 680 ft. in length, 83 ft. in breadth and 53 ft. in depth, was of such surpassing dimensions that its first voyage to New York was hailed as an international event of the highest importance. It need hardly be stated in the fifty years that have elapsed since the launching of Brunel's great ship, there has been great progress made in naval construction, especially in the matter of speed, but the gross size of the *Great Eastern* has not been materially surpassed.

As a general engineering constructor Brunel's activity was marvellous. He was generally occupied in several important problems at the same time. In the construction of docks and piers and floating batteries and temporary hospitals and labor-saving devices he performed the work of a dozen men. He died shortly after the launching of his great ship at the early age of fifty-three. Between the father and son there is great similarity. If the young son accomplished more, his opportunities were greater. Both were engineers of great natural aptitude perfected by education and broadened by the widest experience.

Questions Answered

ENGINE TRUCK CENTER CASTING WEAR.

1. L. C. B., Covington, Ky., writes: We have some Atlantic pipe engines that are cutting out the back of the center plate on the engine truck. One would naturally suppose that inasmuch as the truck is pushed by the engine, the front part of the center plate would wear first, but it does not. The engine-truck carries its portion of the weight, and it also has a brake on the truck. Why is the back portion of the center casting worn on this engine?—A. It is not easy to give you an authoritative answer without more data, but a probable cause for this wear of the back portion of the center casting is that the truck may be high and the front end of the engine carried so that the weight comes more on the back portion. This would hold the truck so that it would be pushed from the back. The trailing truck may not fully carry its quota of weight, which would help to cause the weight on the front to be on the back portion of the engine truck center plate. The counterbalancing of the engine may not be as good as it might be, and these things might cause the engine to work up and down slightly at the front, and thus cause the wear of which you write.

COMPRESSION OF AIR.

2. A. H., Wheeling, W. Va., asks: 1. What decimal is used to reduce the cubical contents of a reservoir filled with compressed air to cubic inches of free air?—A. To find the number of cubic inches of free air in a reservoir charged with compressed air, multiply the capacity of the reservoir in cubic inches by the number of atmospheres it contains. 2. How do you find the number of cubic inches or feet of free air it will take to charge a reservoir to a given pressure?—A. Multiply the capacity of the reservoir in cubic inches by the number of atmospheres required. For instance, to charge a reservoir to 70 lbs. will require about six atmospheres; to charge it to 110 lbs. will require over eight atmospheres, or eight times the capacity of the reservoir.

A pressure of 14.7 lbs. is referred to as an atmosphere; 15 lbs. will answer for practical purposes, although tables giving the exact number of atmospheres required to compress air to different pressures can be found in Kent's Mechanical Engineers' Pocketbook. In calculations of this kind it should be remembered that in charging a locomotive reservoir or a train of cars, say to 70 lbs. pressure, requires approximately 5 atmospheres, and as the reservoir of the train contains 1 atmosphere before the compressor is started, it will only be necessary to compress about 5 times the amount of atmospheric pressure already contained.

BRAZING PIPES.

3. C. E. R., Dansville, N. Y., writes: Please give me a receipt for brazing copper and brass and iron pipe.—A good brazing metal for copper pipes and flanges can be made by melting 16 parts of copper with 3 of zinc. Brazing solder for copper and brass or iron pipes is made of equal parts of copper and zinc.

Photographing Moving Objects.

By Geo. S. Hodgins.

In that fascinating book "Looking Backward," written hopefully by Edward Bellamy, and picturing the time when mankind will live under ideal conditions, there is a striking passage, which are the words of the householder in the model city there described. He of the distant future, addressing a man of our day, who by a strange accident has survived until the time when enlightened civilization shall have swept away much of the selfishness and the toil of life. He says in answer to the wondering admiration of his guest, as some new triumph of physical science is revealed. "No doubt you have yourself made the observation that nothing in this world can be truly said to be more wonderful than anything else. The causes of all phenomena are equally adequate, and their results equally matters of course."

Among the many triumphs of physical science at which, like the man in the story, we are constrained to express delighted admiration, there are none more cleverly worked out than the achievements of modern photography. Not only has the telescope-lens brought distant objects near and mapped and measured the inaccessible mountain regions, but at the bidding of the camera and the flashlight, moving objects stand still, so that even the minute details of the momentary swirl of a white plume of hot steam, or the flutter of a flag, are caught and reproduced with unerring fidelity.

Speaking of the photographing of a fast train some details were given in the columns of this paper concerning the way the Twentieth Century Limited on the New York Central was snapped by a camera, where the total exposure of the sensitive plate lasted but the one-thousandth of a second. At the speed the train was then moving, 90 miles an hour, it passed over one hundred and thirty-two feet in each second, and during the brief time the eye of the camera was focused on the flying train, it was nevertheless able to pass over a space of one and one-half inches, or a little less than the width of two postage stamps placed side by side. In comparison to this comparatively insignificant movement of the train, a ray of sunlight 186 miles long had dashed in through the shutter-slit, and had written the record of the train on the silver salts of the plate.

The wonders of the kinetograph are well known to theatre-goers nowadays. This machine, which takes the photographs for the projecting apparatus used indoors, is able to secure negatives at the rate of about 40 per second on a continuous ribbon of transparent sensitized celluloid. Each photograph is about 1 inch wide by ¾ of an inch high. These are really separate pictures, of what one might call momentary poses each differing from the preceding one in an almost imperceptible degree, yet no two exactly alike. Although these photographs are taken at the rate of about 40 a second, the actual time of exposure is very much less than this, for the reason that after the shutter of the lens has admitted light to the tiny "plate" a period of darkness must intervene, in which the mechanism shifts the ribbon and places a new "plate" before the eye of the camera. A moving picture lasting 45 seconds would at this rate require a band of celluloid about 130 ft. long. The spectator as he views such a picture full of varied life and activity, showing perhaps a gang of section men getting clear of an express train, just in time to avoid accident, will see the whole train move past with the flash and play of light and shade on the moving parts, but he will probably not realize that the laws of optics and mechanics have been acting together, while they provide entertainment for three-quarters of a minute. The picture so full of swing and go, short as it lasts, nevertheless requires the illumination, obscuring and shifting of no less than 2,070 separate photographs.

The crowning achievement in the photographing of moving objects has been that of Prof. A. M. Worthington, head master of the Royal Naval Engineering College at Devenport, England. He has made an exhaustive "Study of Splashes," the records of which are embodied in a work bearing that title. Prof. Worthington has been able to photograph a drop of water or other liquid as it falls from a little smoked-glass dish into a bowl of milk, and he has been able to reproduce the minute oscellations of the drop itself as it changes from egg to orange-shape in its fall of 16 ins., and he has shown us the drop at the moment of contact with the surface of the milk, then as it penetrates the surface and throws up a liquid coronet around it, then after it has disappeared, the liquid coronet subsides and the rebound sets in, producing a momentarily standing column of milk with the particle of the original drop on top and the outward motion of the circular ripple as the column of milk sinks down. The sequence of events is wonderfully portrayed in the series of separately taken photographs. The pictures are not those of one particular drop followed through the cycle of its changes, but are a series made up of the photographs of the behavior of succeeding drops taken, each one at a later phase, but so timed as to present an orderly array of progressive movements. In this work the moving picture machine or the snap-shot camera, rapid as they both undoubtedly are, would be far too slow to catch the movements of the fluid and hold them for investigation under the eyes of the trained specialist. The splash photographs are taken by means of a brilliant electric spark, derived from a pair of Leyden jars, the light focused by a strong lens on the surface of the liquid. The camera, provided with a highly sensitive plate, is uncovered all the time, in complete darkness, awaiting the illumination of the electric spark.

At the precise moment when the splash has developed to the required stage the electric condensers discharge and the record is complete. No mechanical contrivance of shutter or cap could compare in startling rapidity with the fleeting illumination which Prof. Worthington has been able to get with this accurately timed electric spark. The duration of the flash is less than the three one-millionth of a second, a period of time so almost inconceivably brief that it can only be figured in the mind by comparison with things with which we are familiar. The time in which the sensitive salts on the plate are attacked by the actinic rays of light, is to one whole second, in the same proportion as one day is to a thousand years. This infinitesimal fraction of a second is nevertheless long enough for a ray of light more than half a mile long to stream in and fully record and fix one passing phase in the short and evanescent life of the splash.

The work of Prof. Worthington which has extended over a period of about fourteen years has been pursued for a serious scientific purpose. A glimpse at the import of the experiments with the splash of a drop, is gained by a study of two very striking photographs which he reproduces. They show the permanent splashes made by a heavy projectile entering a ship's armor-plate. The coronal form of the water splash is approximately present in the hard steel and the ring of disturbed metal surrounds the cavity made by the shot. The armor-plate splash and that of the drop in the bowl of milk show something of the same characteristics and the study of splashes removes as it were that sharp line of demarcation which we are accustomed to suppose divides the solid from the fluid and it throws a strong light on the doctrine of the fundamental oneness of all forms of matter.

Air Brake Department

High Brake Cylinder Pressures.

By G. W. Kiehm.

With a brake pipe pressure of 110 lbs. an emergency application of the brake will result in a brake cylinder pressure of 85 to 88 lbs. per square inch where the quick action triple valves are used. The high-speed reducing valves will then reduce this pressure to 60 lbs. in from 18 to 33 seconds, depending upon the amount of brake pipe reduction, and it is roughly estimated that it will reduce this pressure in about the same time the speed of the train will have reduced from 60 or 70 miles per hour to about 20. This action is intended to prevent the liability of wheel sliding as the coefficient of brake-shoe friction increases rapidly with the decrease in the speed of the train.

A high initial brake cylinder pressure is reduced slowly at first, increasing in volume until a wide open port in the reducing valve is attained, when the pressure is reduced rapidly to the tension of the adjusting spring.

This action occurs regardless of the speed of the train; if the speed is 70 miles per hour the brake cylinder pressure will have reduced to 60 lbs. by the time the train is brought to a stop, but if the speed is but 30 or 35 miles per hour and the brake is used in the emergency, as it often is, the train will be stopped before the reducing valves have had sufficient time in which to reduce the brake cylinder pressure to any appreciable extent, yet the introduction of the high-speed brake has been the means of greatly reducing the number of slid flat wheels.

The condition of some reducing valves and the number of valves found with corks and other obstructions in the port through the bottom cap show that they have been inoperative, that, if they have reduced the brake cylinder pressure at all it has been but a very small amount and the train has been stopped with the high-brake cylinder pressure on this car whenever it has entered the cylinder, yet the wheels of the car show no indication of the wheel sliding.

With the Westinghouse Air Brake Company's L. N. passenger car equipment a 110-lb. brake pipe pressure and an emergency or quick action application of the brake results in a brake cylinder pressure of approximately 100 lbs. per square inch, and is retained in the cylinder until the stop is completed, unless a portion of it is intentionally exhausted and this does not result in wheel sliding, or if the wheel is picked up and slid it occurs so near the end of the stop that no injury to the wheel results.

It is, however, a well-known fact that wheels have been slid and ruined when the brake-pipe pressure was but 70 or 90 lbs., and it is also a well-know fact that simply increasing the pressure in the brake pipe will not in all cases prevent wheel sliding, although the action of the high-speed reducing valves in blowing down the pressure in the brake cylinders with short piston travel while the heavy brake pipe reduction at the same time brings the pressure in the cylinder with the long piston travel up to the adjustment of the reducing valve, equalizing the braking power to a certain extent, and compelling each car to do its own share of the braking to stop the train, has a tendency to prevent wheel sliding.

There is no logical reason for opposing a high-brake cylinder pressure on the ground that it endangers wheel sliding, inasmuch, as it has never been clearly shown that a high-brake cylinder pressure alone has been the cause of a flat wheel, but it has been demonstrated, beyond question, that unequal braking power, or rather the braked weight of the train in stopping the unbraked weight when this weight is excessive, is responsible for wheel sliding, and if every wheel in the train is properly braked and each brake is doing its own share of the work in stopping the train the wheels cannot be injured by any brake cylinder pressure yet developed.

The principal argument in favor of the high-brake cylinder pressure is the increased weight of the modern passenger car and consequently the increased losses in braking power.

If the 50,000-lb. passenger car is braked at 90 per cent. of its weight, the unbraked weight is 5,000 lbs, while the 100,000-lb. car braked at 90 per cent. of its weight has an unbraked weight of 10,000 lbs., and in calculating the braking power of the car, the square of the brake cylinder multiplied by the pressure per square inch is supposed to be the cylinder value, and this multiplied by the total leverage of the car is supposed to represent the power transmitted to the brake shoes.

There is, however, a serious loss of braking power due to the tension of brake-beam release springs, resistance of brake gear attached to the car body, to the car trucks, and a loss due to brake cylinder packing leather friction and the compression of the cylinder release spring.

A paper setting forth those losses in detail was read at the 1908 convention of the Air Brake Association, and in selecting two cars from a table, accompanying the paper, one with a 10-in. cylinder and a calculated power of 4,712 lbs. shows a loss of 477 lbs., due to packing leather friction and the tension of the cylinder release spring at 8 ins. piston travel, while a car with an 18-in. cylinder and a calculated cylinder value of 15,268 lbs. shows a loss of 1,488 lbs. from the same cause, which is a loss in the cylinder itself, and must be multiplied by the total leverage of the car to find the total loss at the brake shoes or rather to show a calculated braking power that never existed.

The remaining efficiency of the cylinder multiplied by the total leverage was shown to suffer another loss of 1,620 lbs. for the car with the 10-in. cylinder and 2,880 lbs. for the car with the 18-in. cylinder due to the resistance of the car body levers, special release springs, brake-beam levers and compressing-brake beam release springs.

Another car equipped with a 14-in. cylinder, developing a calculated force of 9,236 lbs. and transmitting to the brake shoes a calculated force of 92,360 lbs., shows a loss of 18 per cent. of the calculated braking power and at a brake cylinder pressure of 15 lbs, per square inch, the actual braking power is but 37 per cent. of the calculated efficiency, showing a loss of 63 per cent.

This alone furnishes sufficient cause for either higher brake cylinder pressure, higher percentage of braking power or increased leverage, the latter being the most undesirable.

Another reason the higher brake cylinder pressure can be employed without injury to the wheel is on account of the varying coefficient of brake shoe friction.

It appears that prior to the year 1878, calculating the resistance to motion between the surfaces of two metals when pressed together consisted merely of once establishing a coefficient of friction for the particular metals, which, multiplied by the force pressing the surfaces together, was the resistance to motion; it was, of course, recognized that added adhesion increased the friction and lubricating the surfaces reduced it.

The Westinghouse-Galton tests in that year upset the theory that the frictional resistance of two rubbing surfaces remained constant under all other conditions, and it was discovered among other facts that the coefficient of brake-shoe friction, while it increased with the decrease in the speed of the wheel, decreased with the time of application and with the increase of the pressure forcing the shoe against the wheel.

This coefficient of friction is the actual resistance exerted to prevent the wheel from revolving; a percentage of the pressure forcing the shoe against the wheel reduces proportionally the efficiency of the higher brake cylinder pressure, or if the actual holding power of the shoe pressed against the wheel by the force resulting from a 60-lb. brake cylinder pressure is a certain per cent. of the pressure forcing it against the wheel, increasing the pressure to 85 or 100 lbs. will result in a holding power of a less per cent. of the force pressing the shoe against the wheel, all other conditions being equal.

To just what extent the decrease in the coefficient of friction due to the increase in the time of application at a constant speed affects the coefficient of friction during the stop has not yet been fully determined; however, a loss due to the length of time of the application exists. Again, the hard or heavily chilled brake shoes necessary in the high-speed service have a lower coefficient of friction at the beginning of the stop than the softer cast-iron shoes, and while the last 50 or 100 ft. of the stop may be of the utmost importance in case of an open draw-bridge or danger of a rear-end collision, the advantage of the high-brake cylinder pressure, at the beginning of the stop, where time is the chief consideration, should not be overlooked, for, in order to make the shortest possible stop, the brake must become highly efficient in the first few seconds of time after the application, a speed of 60 miles per hour means 88 ft, per second. If there is any expense and annoyance due to wheel sliding, the cause of sliding should first be removed and the brake cylinder pressure looked after later on if found necessary, for instances are known where wheels were slid 1,000 ft. during a stop and showed a flat spot of less than an inch, proving conclusively that there was practically no weight resting on the wheel when it was slid.

Brake Cylinder Leakage.

A paper upon the subject of a "Practical and Efficient Test for Brake Cylinder Leakage to Be Made While on Shop and Repair Work" was discussed at the 1908 convention of the Air Brake Association, a copy of the proceedings of which should be in the possession of everyone connected with the operation and maintenance of the air brake.

The discussion concluded with the recommendation that "Brake cylinders on all cars and engines should be tested for leakage after being cleaned, which leakage must not exceed five pounds per minute from a cylinder pressure of 50 lbs. with the triple valve in release position; if a test for cylinder leakage is made without a gauge, the brake piston must not move back over one-quarter of an inch in three minutes after brake has been applied."

The test of 5 lbs. leakage per minute consists of screwing an air gauge into the exhaust port of the triple valve, applying the brakes in full and releasing to note the fall of pressure as indicated by the gauge.

The sliding back movement of the piston, or the receding piston test is not so accurate or reliable, for the reason that the test is based upon the assumption that the piston will recede into the brake cylinder a certain distance for a certain number of pounds decrease of pressure in the cylinder.

The piston should, of course, remain out the maximum distance of its travel during the test, but if there is any receding movement of the piston, it should not be over one-fourth of an inch in three minutes.

This movement is, of course, affected by the brake cylinder pressure, piston travel, total leverage of the car, and packing leather friction for leakage from the brake pipe may prevent the separation of the brake cylinder and auxiliary reservoir; pressures which would increase the volume of brake cylinder pressure or leakage from the brake cylinder into the brake pipe would affect the movement.

There would be different cylinder pressures for difference in piston travel, the higher leveraged car would, under ordinary conditions, show more movement from the same reduction in cylinder pressure than the low leveraged car, and considerable packing leather friction, resulting from improperly lubricated cylinders or unnecessarily wide packing leathers, would prevent the piston from receding the same distance into a cylinder that it ordinarily would; nevertheless, it is a good test where there is not sufficient time to attach a gauge.

It has been found from a number of tests that the average loss of brake cylinder pressure at ¼ in. piston recession is about 15 lbs.

This is far from a severe test, for the brake cylinder and its connections should be absolutely tight and free from leakage, and at a first glance it would appear that any instructions or recommendations that refer to a permissible leakage from the brake cylinder are wrong, but if the recommendation is followed out to the letter, or in good faith, the efficiency of the air brake will be greatly increased in some quarters where not only the brake cylinder but all parts of the air brake equipment are neglected.

Sometimes a great deal of attention is paid to the triple valve; it is cleaned regularly, and care is taken to see that all parts of the valve are in good condition, that the valve is entirely free from leakage, and will pass a specified test, while the brake cylinder is scarcely given a thought until it is in such condition that the brake will not apply.

The brake cylinder is intended to utilize the power of the compressed air, and whether it does this must be determined by test; if it does not, the triple valve can create no braking power, and the attention given the triple valve is a waste of time, considering its effect in stopping the car, but the care of the triple valve should always be encouraged; it will at least have a tendency to prevent the undesired quick action, but it is safe to say that the damage to lading and equipment resulting from undesired quick action is slight compared with that resulting from a lack of braking power due to brake cylinder leakage.

Brake cylinders on cars and locomotives in freight service do not receive the attention they should, and locomotive brake cylinder leakage sometimes occurs under peculiar conditions. It would be an advantage if every locomotive was equipped with a gauge showing brake cylinder pressure, but as this cannot very well be done, a gauge should be attached at certain periods by the inspector, and a gauge will often show leakage that is difficult to locate, even after knowing that it does exist. Owing to their different locations, some locomotive brake cylinders require more lubrication, or, rather, more frequent lubrication and attention than others, and when they are given attention the studs in the piston and the expander ring should also be given attention as well as the packing leather.

There is often a serious loss of braking power on the locomotive on account of a considerable amount of the auxiliary reservoir air escaping past the packing leathers before they have set firmly against the walls of the cylinder; this will result in no serious loss of brake cylinder pressure if the E. T. equipment is used, but the good features of the distributing valve are no excuse for brake cylinder leakage. The difference in the number of strokes per minute of the pump when the independent brake is applied and when released represents the amount of brake cylinder leakage and this leakage is very undesirable, as the engine and tender brake are usually held applied on descending grades, while the train brakes are released and recharged and brake cylinder leakage at this time has the same effect as brake pipe leakage, and excessive brake cylinder leakage on the engine equipped with the E. T. brake is liable to prevent an otherwise prompt recharge of the train brakes and result in a loss of train control.

Electrical Department

Transformers.

By W. B. Kouwenhoven.

The name transformers is applied by electricians to devices for changing the voltage or pressure of an electrical circuit. The term transformer in its broadest sense may be applied to any piece of apparatus that is used for either decreasing or increasing the voltage of either direct or alternating current systems. There are two electrical currents in commercial use to-day, direct and alternating. The direct current is one that flows in one direction and one direction only. An alternating current flows first in one direction and then in the opposite, changing its direction of flow at regular intervals.

Consider for a moment a simple direct current circuit, consisting of one generator, one motor and two wires for carrying the current. The direct current flows out of one terminal, which is called the plus or positive terminal of the generator, and through one wire to the motor. It drives the motor and returns through the other wire to the negative terminal of the generator, thus completing the circuit. This direct current circuit may be compared to a water pumping system, where a steam-driven pump supplies water through a pipe to a water wheel. From the wheel the water is returned to the suction end of the pump through another pipe. The steam-driven pump corresponds to the direct-current generator of the electrical circuit, the water wheel to the motor, and the two pipes, one for delivery and the other for the return of the water, to the two wires of the electrical circuit.

An alternating current flows first in one direction and then in the opposite direction. The current alternates or pulsates back and forth at regular intervals. The number of these alternations in one second divided by two is known to electricians as the frequency in cycles per second. Consider an alternating current circuit similar to the simple direct current circuit just described. The difference being that the generator produces alternating instead of direct current, and that the motor is an alternating current motor. Now the current would flow first from one terminal of the generator for a fraction of a second, and then from the other terminal for an equal time. This current alternating back and forth through the circuit would drive the motor. A pumping system similar to this would consist of a pump without any valves; both ends of the water cylinder being connected to separate pipes. On the forward stroke of the pump the water would flow out through one pipe and in through the other, and on the back stroke the direction of the flow would be reversed. Suppose the ends of these two pipes to be conencted to a peculiar water wheel, built to handle this current of water flowing first in one direction and then in the opposite. The water wheel would correspond to the motor of the alternating current circuit, and the water flowing first in one direction through the pipe and then in the opposite, would correspond to the alternating current of the electrical circuit, and would drive the water wheel or motor steadily round in one direction. The number of strokes or alternations of the pump per second divided by two would equal the frequency in cycles per second of the pumping system.

PRIMARY AND SECONDARY COILS.

A transformer, as was stated before, is a piece of electrical apparatus for increasing or decreasing the voltage or pressure of an electrical circuit. One of the most important, if not the greatest advantage possessed by alternating over direct current is the ease and simplicity with which it may be transformed or changed from a low voltage to a higher voltage, or vice versa. It is necessary to use a rotating machine to transform or change the voltage of a direct current circuit. Rotating machines are more or less complicated, and require a starting device, and demand constant care and attention. These rotating transformers for direct current are usually not called transformers, but are known as motor generators and dynamotors. Space is here too limited to describe these machines.

Transformers for changing the voltage of an alternating current circuit are stationary, and contain no moving parts. They require no starting device, and are very compact and simple in construction, and their maintenance cost is low. Alternating current transformers are technically known as static transformers, but this name is usually abbreviated to the simple term transformer. They are the most efficient piece of electrical apparatus in commercial use.

It is very often necessary in electrical work to send the current some distance from the power house to the place where it is to be used. This is due to the fact that the best position for a power house is the place where its supplies of coal and water may be obtained most easily and economically, while the point of application is often at a distance. A line of wire is used to transmit the power from the generators to its destination. These lines are called transmission lines. Now the copper wire which is employed in constructing the line offers a resistance to the passage of the electrical current in much the same way that a water pipe offers resistance to the passage of water through it, due to friction. This resistance to the passage of the electric current is overcome by the voltage or pressure, and a certain amount of electrical power is lost in the line as a result. The amount of power lost depends upon the current flowing and the resistance of the wire. In the pipe line, the resistance or friction offered by the pipe is overcome by the pressure and the amount of water power lost depends also upon the resistance offered by the pipe and the quantity of water flowing. The quantity of water flowing through the pipe is similar to the quantity of the electric current flowing through the wire, the terms voltage and pressure are analogous, and the power lost is due to the resistance.

The value of the horse power represented by the water in the pipe is equal to the quantity of the water delivered in a given time, multiplied by its pressure, and in the electrical current the same is true, namely, that the power equals the quantity of current, or simply the current, as it is usually called, multiplied by its voltage. Thus, as the power lost in the transmission system depends upon its resistance and the current, it follows that if the pressure of voltage be increased the current will decrease for the same amount of power, and the loss in the transmission line will be less. Therefore it is economical to send power over a transmission line at a high voltage with a small current value, because the loss in the line will depend upon the value of the current.

Alternating current generators are built that will generate current at a pressure as high as 11 thousand volts, but this is not high enough for economical transmission purposes where voltages as high as 66,000 volts are used. It would be very difficult, even if possible, to build machine that would generate a voltage as high as that demanded by the line, and it becomes necessary to employ transformers to raise the generator voltage high enough for economical transmission of the power.

When a wire passes through a magnetic field it is said to cut the magnetism or magnetic lines, as they are called, that come from the magnet, and a voltage is induced or generated in the wire. If the wire is held stationary and the magnetic field be moved the same result is produced. Nearly all generators are built with moving conductors and a stationary magnet field. But a transformer depends upon the second method for its operation, that of moving its magnetism while its wires remain stationary.

To make the principle upon which a transformer operates clear, suppose that a coil of 100 turns of wire is wound upon an iron core. This coil is supplied with current from a generator that produces alternating current at a pressure of 100 volts, thus giving one volt to each turn of the coil. The current will set up in the iron core a magnetic field, and this magnetic field will change its direction every time the current alternates from one direction to the opposite. First one end of the core will be a north pole and then the opposite end; the frequency of the changes would be the same as that of the supply current. Now wind on this same iron core a second coil of 200 turns. The magnetic field of the first coil would cut the 200 turns of the second coil first in one direction and then in the other, and would induce or generate one volt for every turn, or a total of 200 volts for the 200 turns. This 200 volts could be used to light an incandescent lamp.

These two coils wound on the iron core constitute a simple transformer. The first coil is called the primary coil because the electrical energy is supplied to it, and the second coil is called a secondary, because it delivers electrical energy. The secondary voltage divided by the primary voltage is called the ratio of transformation, and in this case is 1 to 2; it is equal to the amount of change produced in the voltage by a transformer. As the voltage depends directly upon the number of turns, the ratio of transmission may also be considered to be practically equal to the ratio of the turns in the secondary to the turns in the primary coil. This may be expressed as follows:

$$\frac{\text{No. Secondary Turns}}{\text{No. Primary Turns}} = \frac{\text{Secondary Voltage}}{\text{Primary Voltage}}$$

If in the simple transformer, just described, the 100 volt had been supplied to the coil of 200 turns, there would be but one-half a volt to each turn, and in the first coil there would be induced only 50 volts. The ratio of the transformer would now be 2 to 1, the 200-turn coil being the primary and the 100 turn coil the secondary. In the first case the transformer raised the voltage and it would be called a step-up transformer; when its conections are reversed, as in the second case, it would become a step-down transformer, because it lowered the voltage.

The static transformer consists of two electrical and one magnetic circuit; the primary coil receives the electrical energy from the generator, and forms one electrical circuit; the secondary delivers it to the line, and forms the other electrical circuit; and the iron forms the magnetic circuit between the two. The two electrical circuits are surrounded or linked, as it is called, by the one magnetic circuit.

Commercial transformers are of two types, the core and the shell. In the core type the coils are wound upon the iron core, from which they derive their name. In the shell type the iron surrounds the coils like a shell. As to their relative advantages there has been an almost endless discussion by the manufacturers; however, their principal difference relates more to the ease of manufacture than to operating conditions. Neither the iron core nor the shell is made from one solid piece of metal, because the alternating magnetic field which sets up the voltage in the secondary coil would at the same time produce a voltage in the iron. This voltage produced in the iron would cause a current to flow first around through the iron in one direction and then in the other. These currents are called eddy currents, because their rise and fall resembles that of the tide at the seashore. To reduce these eddy currents the iron is built up of laminations of thin sheets, which are usually painted with Japan lacquer to insulate them electrically from each other. The lacquer does not interfere with the magnetic properties of the iron. These laminations are a few thousandths of an inch in thickness, and serve to break up the eddy currents so that the loss due to them is very small.

The secondary and primary coils of a transformer are usually wound on bobbins. The layers of wire are carefully insulated from each other, and the whole coil is shellaced and dried in a vacuum. This removes completely any moisture that may be present. The low voltage coils or low tension side, as it is called, of a large transformer, are sometimes wound with rectangular wires to economize space. Either the primary coil or the secondary coil, or both, are usually divided into two separate coils. This not only simplifies their construction, but permits the use of the transformer for more than one ratio. The coils and the core are mounted in a case, usually made of cast or sheet iron.

As transformers are generally subjected to almost continual operation, and as they are inclosed in a case, some method of cooling them is necessary. On the small sizes oil or air is depended upon. When oil is used it serves not only to absorb the heat, but also acts as an insulator. The oil used is a mineral oil, and the presence of water, even in very minute quantities, reduces materially the insulating properties of the oil. An excellent test for the presence of water is to dip a red hot nail into the oil. If a crackling is heard, water is present.

In the large transformer oil alone is not sufficient for keeping them cool, and a coil of brass or copper water piping is introduced into the upper part of the transformer case. Cold water is circulated through the piping and serves to absorb the heat from the oil. Sometimes no oil is used, but the transformer is built with ventilating passages or ducts, and a blast of air is forced through them, serving to keep the temperature low.

Suppose that in a certain railway system the alternating current generators in the powerhouse generated current at a voltage of 6,600 volts. This current is led to step-up transformers whose ratio is 1 to 5. These step-up the voltage to 33,000 volts, and deliver it to the transmission line, which carries the current to the substations. Before the current can be fed to the rotary converters its voltage must be lowered, so it is fed to step-down transformers, whose ratio is 10 to 1; then to the converters.

In steam engineering there is a fairly good analogy in the reducing valve on the locomotive, which reduces the boiler pressure to a low pressure suitable for heating the cars. The high steam pressure in the boiler corresponds to the high voltage of the line. The voltage must be reduced or stepped down before it is suitable for the converters, and the steam pressure must also be reduced before supplying it to the heating pipes in the cars. A small volume of steam at high pressure becomes a large volume at a low pressure, and in the same manner a small current at a high voltage becomes a large current at a low voltage.

THE WHEEL BASE OF RAILWAY ROLLING STOCK

By Roger Atkinson

The annual cost for maintenance of track, both as to road bed as well as ties and rails, depends largely upon the arrangement of engine wheel base and trucks, as well as upon trucks under cars. This is not so obvious to the majority of mechanical department officials, as they do not usually have the opportunity to observe and study the signs of gradual destruction and consequent expense so involved, for, as a

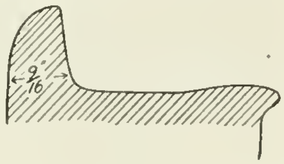


FIG. 1.

rule, they only see the results of an extreme case, such as when a derailment occurs, and then they rarely have a chance to examine the track as well as the rolling stock, on account of the road gang having to get the former into working condition again in the shortest possible time, and the blame for derailment is usually put upon the rolling stock without any competent "devil's advocate" for the accused being present, so as to get at the remote and probable true cause. Under these conditions the charge is commonly formulated by an official, who, while perfectly able in his own department, cannot be expected to know the mechanics of the machine, or the effect of certain forms of construction in detail.

We are all perfectly familiar with the difficulty of pulling out, or pushing in, a drawer in a piece of furniture when the drawer is very wide and short, the least angularity in the moving force, or friction, causing it to bind and lock in a diagonal position. This tendency is absent with a narrow, deep drawer, on account of the length of the guiding slide, but in one that is square, or nearly so, the locking tendency depends upon the lateral play in the guides, to a great extent in a direct ratio, and also to the point of ap-

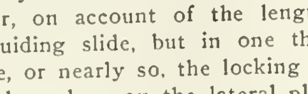


FIG. 2.

plication of the pull, and the direction of pull. When a drawer is once locked diagonally enough force to wreck the drawer, or burst out the guides laterally may be applied without getting it to slide.

From the foregoing illustration we may derive a comprehension of the effect of a truck under a freight car or tender, having a wheel base of 4 ft. 10 in., on a track of standard 4 ft. 8½ in. gauge, when the truck is out of square, causing one of the leading pair of wheels to bind on the flange against the rail, and by its own friction increases the locking effect, pushes the truck still further out of square, and tends to spread the track, while the leading edge of the flange on the binding wheel tries to mount the rail, and failing to do so acts like a pair of scissors or shear blades, destroying both its own flange and the rail head. This flange pressure increases greatly with increase of gauge, as is usual on curves, and when a sharp flange is formed it will actually shear strips off the rail. The flange of a steel tired wheel will cut away and form a sharp flange quicker than a cast iron wheel under these conditions, and the writer has had cases where the flange was only 9-16 in. thick at the root, as in sketch, Fig. 1.

It will be obvious that this action is increased on such curves as are opposite in curvature to the direction which the wheels tend to take (Fig. 2), as well as by the widening of the gauge, which is therefore undesirable, but is rendered necessary to some extent as a

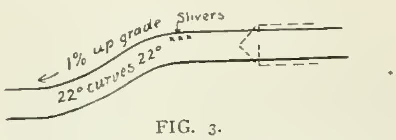


FIG. 3.

compromise for the impossibility of making an engine with a straight centre line conform theoretically to a curved track, and the less it is adopted or required, the more easily can the cars be hauled, thus saving power, and with less damage both to themselves and the track. The reluctance or resistance of the trucks to curving is also greatly increased when the load is carried on the side bearings, and the locking effect may be thus produced with trucks which are perfectly square.

To illustrate this point, an instance may be quoted where trouble was experienced on a wharf track, having a 22 deg. reverse curve on a 1 per cent. grade. Two locomotives, eight-wheel type, one having 16 x 24 in. cylinders, with 8 ft. fixed wheel base, and rigid centre truck, and the other 17 x 24 in. cylinders, with 8½ ft. fixed wheel base and swing truck, could only haul 30 empty freight cars of 40,000 to 60,000 lbs. capacity, at about 2 miles an hour. On inspection, after the train passed, slivers of rail up to about 5 in. long, wedge shaped in section, and hot, were found inside the outer rail on the curve (see Fig. 3), and the gauge of track was found to be 4 x 9¾ in., having to be so made to allow the locomotive with the rigid truck to work without derailment.

An 18 x 24 in. six-wheel switcher with 10 ft. 0 in. fixed wheel base, and blind tires on centre pair, was put on the service, and easily hauled such trains with the curve closed to nearly standard gauge. As the driving wheels of the engines taken off did not show any indications of striking the outer rail, and their flanges were not cut sharp, the cutting could only be done by the freight cars, as it did not occur after the gauge was closed.

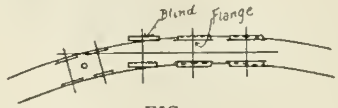


FIG. 4.

As widening on curves, then, is a modification required on account of the engine wheel base, it is advisable to look into and analyze as far as possible the design and results of various arrangements. Something like twenty years ago some ten-wheel passenger engines were built which had swing trucks and blind tires on the front pair of drivers. These engines when they struck a curve had too little guidance from the truck till they got well on the curve, and consequently headed for the ditch until they reached the limit of play of the truck (see Fig. 4), with the main driver flange binding on the outer rail, and remained in this posture through the curve when they righted with a wriggle. The opposite curve produced the complementary effect, and the result was two treads on the blind front tires about 2½ in. center to center, and cut flanges on the main drivers, and eventually broken main axles, due to heavy flange pressure.

In the meantime, however, some of these engines were equipped with a rigid center truck, and the result was that they went round curves with a saw-tooth motion, like a fish in an aquarium tank, bobbing its nose against the glass as it goes. The wheel base

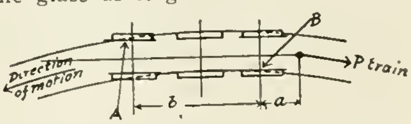


FIG. 5.

was too rigid and the main drivers cut their flanges against the inside rail, while the truck wheels rapidly acquired side play, sometimes as much as 2½ in., and the repairs to truck boxes on account of side wear, up to ¾ in. and even ⅞ in. deep, could not be kept up with in the shops.

During this period a couple of engines were equipped with blind tires on center drivers instead of on the front, and swing trucks with lateral spring control, and were operated on a very crooked division with perfect satisfaction, so that it became standard practice, and not too soon, as the crop of cracked main axles which were removed soon after indicated.

If we pause for a little time to consider the action and direction of the forces called into play, it is plain that if a six-wheel switcher with main wheels having blind tires is placed upon

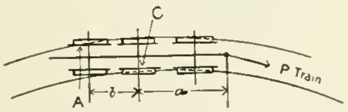


FIG 6.

a curved track, the center line of the engine will form a chord to the curve, extending from the center of the front axle to the center of the back axle, at right angles to a radius of the curve which bisects the fixed wheel base, and there will be no lateral strain upon the flanges and rails (other than any wedging action, which may be caused by tight flanges), and also no bending of the engine frame.

If this engine pulls a train on the curve, then the angular pull of train, P (see Fig. 5), will cause the back wheels to bind on the inner rail at B, and the front wheels to bind on the outer rail at A. The resistance of the point B will form a fulcrum, and the force at A will depend on the ratio of the leverages *a* and *b*, that is, if *a* is small and *b* great. the turning effect on the engine will be small, and also the flange pressure at A, and vice versa, so that a long overhang from B to the draw

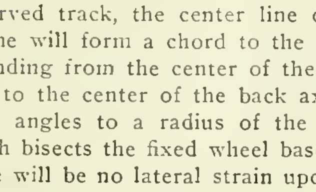


FIG. 7.

bar pin will tend to cut the front flange, also to bend the frame and spread the track.

Now suppose the engine to have a front truck, either two or four-wheel, as a mogul or ten-wheeler; then, in order to get the truck on the track, it must be jacked over to the correct position with a force depending upon the method of truck suspension and degree of curvature, and when in place it exerts the same force to tend to swivel the engine round until the lateral force is divided between the truck and the back wheel against the outer rail and resisted by the front driver against the inner rail.

This is how the guiding force of the truck is provided, and it tends to pull the outer front wheel away from the outer rail, against which it would naturally run, on account of the center line of the engine being a chord on the curve; it also tends to bend the engine frame to suit the curve. There is another force also tending to cause the outer leading wheel to hug the outer rail, and that is the angular pull of the train on the curve pulling the back end of the engine against the inner rail. If, therefore, the outer front driver flange is to be prevented from cutting, the lateral force of the truck inward must be sufficient to overbalance both of these outward tendencies, and should increase with the degree of curvature. If the guiding power of the truck is too small, the inertia of the engine tending to make it travel in a straight line, also causes it to be projected against the outer rail on entering a curve and tends to overturn the rail, or disturb the track sideways.

Let us now go back to the six-wheel switcher and consider the forces when the center tires have flanges, as well as the front and back tires. It is evident that the middle flange on the inside, when on a curve, binds on the inner rail, tending to bend the frame to the curve, and to open the gauge; when the engine hauls a train the angular pull of the train acts on the inner main flange as a fulcrum, see Fig. 6, at C, with the distance *a* as a lever, and forces the front outer flange at A against the rail on the short lever *b*. There is, therefore, a great force tending to spread the track, and this turning movement is limited when the back inside driver comes against the inner rail at B. Otherwise it would derail the engine if the curve was great. This action is not relieved to any extent by setting the front and back tires in, because the inset back tire lets the engine turn just as much as the front tire is set in; but the engine is then at a greater angle to the direction of motion, and the outer flanges are at a worse cutting angle. The same reasoning holds good for a mogul, or 10 wheel, engine wheel base, as the turning fulcrum point is shifted by the main flange from the back wheels to the main wheels, so that the truck loses in guiding power by acting on a shorter distance, while the angular train pull has a longer lever to act upon and force the front of the engine outwards.

In addition to the wear and tear produced in the above manner, the inset of front and back tires permits the engine, when on straight track, to run with a nosing or twisting motion, especially if the counterbalance is not very perfect. This soon develops side wear on the truck boxes, and looseness in the truck, thereby losing guiding power, which reacts on both track and engine. The insetting of front and back tires also induces more wear on frogs and guard rails by contact with the inner wheel flange; the steady or constantly active destructive action thus produced is not visible, but exists, and is important.

It is easy to persuade ourselves that these flange strains are not important because they are far below any immediate breaking strain, but it is the perpetual repetition which causes failure and the consequent expense.

The writer has seen a case where a mogul engine with all flanged tires newly turned to gauge, and to the M. M. Association form of tread, that in less than 400 miles' running caused the corner of the rail to wear the root of the flange so heavily that the flow of metal formed fins, as shown in sketch (Fig. 7), and of course there was equivalent wear of rail over the 400 miles.

It should also be borne in mind that the whole lateral force of the truck which is useful to bring the engine into line with the track when running forwards is detrimental to it when running backwards, causing the outer back flange to bind on the outer rail, and this

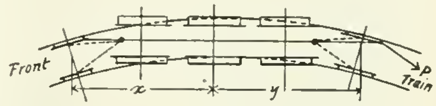


FIG. 8.

is increased when the engine is equipped with flange tires on the main drivers, and still more so by the resistance of the train if it is backing up by the angularity of the pushing force tending to make the back end buck out sideways.

It will therefore now be evident that if we find it is necessary to equip an engine with a rear truck, either to protect the back wheels for backward running, or to carry the back overhang of the engine, that the lateral force required to put this truck on the track on a curve will neutralize the guiding force of the front truck when running forward, because it assists the angular force or pull of the train to keep the

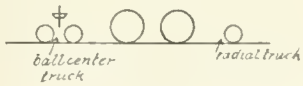


FIG. 9.

engine in line with itself, causing the engine to swing round its center as a pivot, and bring the outer front driving flange hard against the outer rail.

This action is more powerful when main drivers are flanged than when blind, as shown previously by the difference in leverage; and that truck which has the greater distance from the main drivers, x or y, (Fig. 8), will (if the weight on each be the same) bring the engine nearer its own center line; so that a heavily loaded distant back truck will (both by leverage and weight) exercise control over a lightly loaded, closely set, front truck, and vice versa. The swing hangers or other lateral provision for side resistance may be carefully designed to avoid pulling the back end of the engine into line with the train, which in turn renders it useless as a leading truck.

The writer knows of a case in which an eight-wheel engine, with front truck having a ball center, was converted into a double-ender tank engine (Fig. 9), with a radial truck at the back to carry the coal bunker and part of the water tank. When operated, this engine constantly gave trouble when running backwards by the back truck jumping the track, until its guiding power was practically dispensed with by giving it very free lateral motion.

Engines which have a long overhang at the back end, from the fixed wheel base to the pin in front end of the tender drawbar (see Fig. 10), are therefore most easily deflected from the desired direction by the pull of the tender, and in turn exercise a strong lateral force, F, tending to throw the tender off the track towards the outside of the track on a curve, especially at a frog, which may explain some of the derailments which have been under discussion of late. To illustrate this, on one occasion a coach about 70 ft. long in the body was being turned by an ordinary 10-wheel engine on a Y, which had a rather short curve, connecting two main lines. The engine and coach were backing, and when the back truck of the tender reached the frog at the entrance to the curve, it promptly derailed on the outside of the curve. It was pulled on again, and pushed slowly, but mounted the frog again. The coach was then disconnected, and the tender pushed against it without coupling, as the couplings were quite a distance apart, and no derailment occurred.

As the average tires and rails may be taken to be of about equal hardness, and as a revolving or moving body

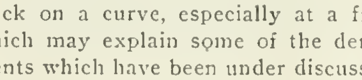


FIG. 10.

working upon a standing body is usually less detruded or affected than the standing body, for example, in the blind saw used for cutting rails, etc., which has usually less material removed than the work operated upon), we may take for granted that more material is removed from the rails than from the wheels, and also that the rails, frogs, etc., suffer more damage by displacement than the engine shows, so consequently the cost of maintenance is increased if such wheel base and other arrangements are not adopted as conform with the least strain to the nearest theoretical conditions to reduce curve resistance.

So far as the locomotive is concerned, one of the clearest indications of excessive flange pressure on curves is found in the breaking of main axles, either under the wheel seat or between the wheel and the center of the journal. This type of failure does not often occur with a back driving axle, and even more rarely with a front axle, and is usually construed as being caused by the cylinder pressure acting on the long main crank pin as a lever. There are two important reasons why this is not entirely the case, firstly, that sometimes the front or back axles fail, which cannot be caused by cylinder pressure, and, secondly, if the cylinder pressure were the only cause, the cracks in the axle would be developed on both sides at right angles to the crank pin (see Fig. 11), which has never been the case in the writer's experience in many years. The cracks are always found to be at an angle such as indicated in Fig. 12. This seems to show that the maximum bending stress is a combination of the cylinder pressure and a regular

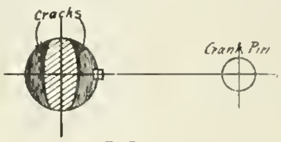


FIG. 11.

recurring flange pressure, due to the lateral twist of the engine, probably due to defective counterbalancing, and which would be naturally increased by such an arrangement as insetting the front and back tires, as it permits a pressure to become a blow by providing distance in which to operate. The breaking of a main axle in the location and manner shown where the driving wheels have blind tires is practically unknown; whereas, both driving wheels, having flanges, have been known to break off one axle in the same accident.

The writer had on one occasion an opportunity to examine a very heavy passenger engine which was under repair, the principal trouble being that sharp flanges had developed on all driving wheels to such an extent that the tires had to be turned down about ¼ in. in order to get a good flange again. All drivers had flanges, and the front and back tires had been set in, as is common practice on some roads. The engine was new and had only been in service for a period of about four months, but not continuously. It would appear that there must have been great wear upon the track, and expense, with risk of derailment, and it is reasonable to think that such a result shows defective engineering.

In mediaeval times, when knights wore plate armor, the best point of attack and most liable to produce effective results, was to strike at the joints; and the point where departments overlap, or should do so, is the joint where the general manager can penetrate and get in his lance called "Please explain,"

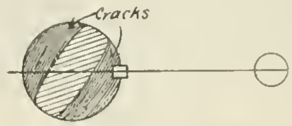


FIG. 12.

and while he may have too many irons in the fire to spare more than one or two of his "argus eyes" for the purpose, he could well be represented by a qualified champion who was both knight and armorer, and expert at both making and breaking joints.

1908 Master Mechanics' Proceedings.

The Report of the Proceedings of the Forty-first Annual Convention of the American Railway Master Mechanics' Association. 456 pages, cloth, with leather back and corners. Numerous illustrations and folding plates. Price $1.50. The annual volumes published by the Master Mechanics' Association under the able supervision of the secretary, Mr. Jos. W. Taylor, has come to be recognized as among the most valuable contributions to railroad literature. The variety and importance of the subjects discussed, and the recognized ability of the accomplished railway men taking part in the discussions, render the work of much real value. It should be in the hands of all the leading railway men who desire to keep abreast of the marked improvements in the mechanical railway appliances of our time. The book can be had on application to Mr. J. W. Taylor, Old Colony Building, Chicago.

1908 M. C. B. Association Proceedings.

The Report of the Proceedings of the Forty-second Annual Convention of the Master Car Builders' Association. 708 pages, cloth, with numerous illustrations and folding plates. Price $1.50. The growing importance of the annual meetings of the Car Builders' Association finds its reflex in the growing size of the annual report of the proceedings. There is a marked improvement this year in the excellence of the drawings illustrating the various subjects. The paper and presswork are of the best, and the volume is altogether the high-water mark in literary and artistic expression of the Master Car Builders' Association. The book can be had on application to Mr. J. W. Taylor, secretary, Old Colony Building, Chicago, Ill.

AMONG THE WESTERN RAILROAD MEN

By James Kennedy

The Western railway men of the twentieth century, equipped with all modern appliances, and furnished with every facility for work, are, comparatively speaking, among the most comfortably situated of working men. Travellers from the East have their eyes opened at the magnificence of the palace cars. This luxuriance of equipment seems to run into the offices of the mechanical department, and the visitor in the shop finds not only the best that the East can show, but much that is only to be seen in the West. Apart from the superbly equipped shops and roundhouses, there is a newness and elegance about the finely furnished dining rooms, the commodious lavatories, or dressing rooms, as they might properly be called, that amazes one not accustomed to the new order of things. What, with reading rooms and smoking rooms and gymnasiums and bath rooms, not to speak of the instructing rooms, where the arts and sciences are taught by accomplished and gentlemanly instructors, one cannot help envying the young railway men of the West and contrasting their condition with the melancholy bareness of our vanished youth when we lived and moved and had our troublous being, like overworked quadrupeds, in the slimy pits and ramshackle railroad rookeries of the last century.

Then the piecework that used to haunt our waking hours like Banquo's ghost, and would not down, has now become a source of mutual satisfaction to employer and employee. Expert committees fix the rate, generous bonuses are allowed to those clever mechanics who finish a job in less than the specified time. The incentive to industry is great. One can see it in the increased velocity of the myriad machines, but mere muscular activity seems relaxed. The thoughtful faces of the intelligent mechanics are not the faces of overworked men. There is an air of studiousness and even elegance about many of them. This is particularly so in the case of the younger engineers, who, when their trips are completed and their overalls are laid aside, adjourn to the finely furnished club rooms, or walk out in public places clothed and in their right mind. The saloon has little or no part in their existence. It is the reading room or the home circle that attracts and interests them.

ON THE SANTA FE.

We had the pleasure of meeting Mr. E. P. Ripley, the worthy president of the Santa Fe system. His work has been largely in the operating department of several leading railways, but his studious and trained mind has mastered all the engineering problems of railroad work. We were agreeably surprised at his complete knowledge of locomotive engineering and the mechanical appliances used in machine shops. He is a thoroughly accomplished all round railroad man, polished by Eastern education and experience, and broadened by the vastness of Western enterprise. He spoke hopefully of the future of the great Southwest which owes so much to the Santa Fe system. The road is now operated in twelve States and territories, and there are millions of acres of land in that section of the country that is still in much need of transportation facilities. The Santa Fe is ready to make the extensions, but has been met by the Legislature of several States in a spirit not calculated to encourage the construction of new branches. It is difficult to understand what possesses the legislative mind when laws are passed increasing the operating expenses of railroads and decreasing their possibility of earnings. The result is of the most pernicious kind. Enterprises of great pith and moment are turned aside. Skilled engineers and artisans are compelled to look elsewhere for employment, and capital already invested finds a shrinkage in earned interest that does not attract the money market. Mr. Ripley seemed confident that some measure of common sense would come back to the legislative bodies in the fulness of time, but, like the sensible man that he is, he is not praying for miracles.

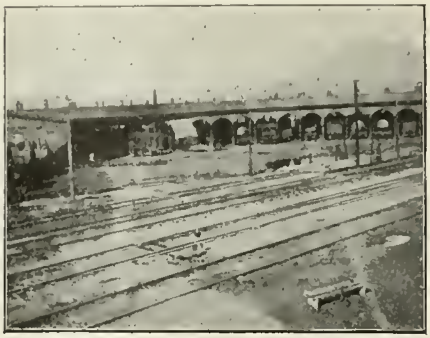
In spite of the legislative hindrances, however, very great advances are being made in the condition of the road, and the mechanical appliances in the repair shops. All along the vast railroad the improvement in construction work is particularly marked. Steel bridges and concrete culverts, massive as granite, were numerous. Many of the roundhouses also were of concrete, and the engine pits and flooring were smooth as alabaster. Every known mechanical equipment was in polished profusion, and a spirit of intelligent activity heightened by the assurance of a revival of industrial growth was everywhere manifest.

THE "CHICAGO SPECIAL" LEAVING DENVER, COL.

At the company's shops at Topeka, Kan., we had the opportunity of observing an interesting experiment in flue welding. Not the welding of a short new piece to an old flue, but a welding of the flue to the flue sheet. Mr. H. W. Jacobs, assistant superintendent of motive power, had been experimenting for some time with an improved superheater of his own designing. Part of this superheater apparatus resembled a short section of the barrel of the boiler constructed with a view of being fitted into the smoke-box. It consisted of two flue sheets not more than one foot apart enclosed by a circular band riveted to the flue sheets. Into this shell two or three hundred flues were fitted and expanded in the usual way. Mr. George Fraser, the foreman blacksmith, was superintending the operation of welding the ends of the flues to the flue sheet. A blast pipe attached to an acetylene generator and a compressed air tank conducted the necessary heating blast, which was regulated by two adjustable valves and applied through a porcelain nozzle around the outer edge of the projecting flue end. It was surprising how rapidly this end of the flue whitened and fell away from the intense heat of the small jet of dazzling flame. Presently the steel sheet, half an inch thick, brightened into incandescence and emitted fiery sparkles, the flue and the flue sheet fusing into one solid mass. A piece of three-eighths round iron in the hand of the operator helped to feed the fusing metal like soldering. It looked as if much of the metal would be burned away, but Mr. Fraser assured us that the half inch flue sheet was over five-eighths thick when the operation was completed. It looked like a solid piece of metal. This work is especially severe on the eyes of the operators, but if the flues can be securely welded to the flue sheets in this way beyond the possibility of leaking, it would be a gain of inestimable value, not only in the construction of an auxiliary superheater, but in securing flues to flue sheets generally. As may be imagined, the use of the shell so constructed was to act as a reservoir for the steam while passing from the dry pipe to the steam pipes, the flues allowing the gases from the firebox to pass through and adding whatever extra modicum of heat they possessed to the enclosed steam.

Machine forging in the blacksmiths' shops of the Santa Fe has reached a degree of intricacy in design and a perfection in detail that leaves little for the finishing machines to do, except polishing. Eccentric rod jaws, link hangers, and even link saddles are squeezed into being at one stroke of the ponderous machines. Spring bands are welded and placed loosely on the spring leaves and pressed into enduring fastness at one heat. The skilled workmen become practically mere spectators of the modern process of machine forging.

In passing along the far stretching railway, which rivals the Canadian Pacific in approaching 10,000 miles in length, a stranger cannot fail to be struck with the clocklike exactness of the arrival and departure of trains. The stories we have heard of Western trains running four or five days behind time fall into their proper province as romances in view of our experience on the Santa Fe. An Eastern watch as it falls behind time as we approach the land of the setting sun can be safely set by watching the names of the stations and referring to the Santa Fe time tables.



ROUNDHOUSE AT SAN LUIS OBISPO.

To one having an eye to scenic marvels the Santa Fe has wonders peculiarly its own. Mountains in purple splendor, the silvery flash of lake and stream, the far stretching, flower spangled prairies, the ever changing fantasies in azure, damask, emerald and gold, are all over the West, but it is only on the Santa Fe that you come on that wonder of wonders.

AMONG THE WESTERN RAILWAY MEN AT THE MACHINE SHOPS OF THE COLORADO & SOUTHERN AT DENVER, COL.

THE GRAND CANYON OF ARIZONA.

Like Niagara, you come on the awful scene unexpectedly. The country is slightly undulating, and suddenly you are on the brink of a dread abyss, and the appalled vision is presented with a spectacle of natural grandeur at once beautiful and terrible. The cleft in the earth is a mile deep and nearly fifteen miles wide. As you look across the great gorge the stupendous magnificence of the scene seems to grow beyond the reach of human vision. The jutting capes and storied-towers and pinnacled-castles cluster confusedly. Lengthwise the amazing scene stretches into infinitude. Far as the eye can reach are precipitous crags upon crags. The rifted rocks, rainbow hued, show layers of green and red, russet, blue, orange and alabaster. Beneath are gloomy forests, through which the Colorado river foams and flashes. To explore the myriad recesses of this marvellous mystery of nature seems utterly beyond human endeavor and, like a lurid lightning flash, one brief look at this overwhelming panorama of colossal grandeur, and it has burned itself into the memory forever.

The Men Can Speak.

The Erie Railroad have, in a general notice to their new book of rules, stated that all employees are in line for promotion, and will be given increased responsibilities and compensation as their ability may warrant and the requirements of the company demand. The duty of being good citizens as well as good railroad men is also pointed out as a necessity, and care and diligence in the performance of their duties is inculcated. An employee is expected to be prudent and careful concerning his own safety, the safety of the patrons of the road, and of his fellow employees.

The old idea prevalent on many roads that some railroad rules are made to protect the company in court and not necessarily to be obeyed on the road is squarely dealt with by the Erie. The general notice says: "When it is the opinion of any person whose duty it is to enforce a rule that the rule cannot be enforced in the interest of the company or in fairness to employees, he is required to bring the rule to the attention of his superior officer. Employees are invited to call the attention of their superior to any rule which, in their opinion, is superfluous, impracticable, or unfair."

Colorado claims the distinction of having the highest railways in the world. There are over a dozen stations on the various railways where the height is over 10,000 feet above the sea level, the highest being at Pike's Peak, where the altitude is given as 14,108 feet.

Items of Personal Interest

Mr. S. B. Pugh has been placed in charge of the car department of the Denver & Rio Grande at Denver, Col.

Mr. J. W. Sasser has been appointed master mechanic of the Seaboard Air Line, with headquarters at Savannah, Ga.

Mr. Manual Parra has been appointed master mechanic on the Mexican Railway, with headquarters at Apizaco, Mex.

Mr. H. Carrick has been appointed assistant division master mechanic of the Oregon Short Line, with offices at Pocatello, Idaho.

Mr. Bay B. Fisk has been appointed traveling fireman on the West Iowa division for the Chicago & Northwestern Railway, at Boone, Ia.

Mr. T. N. Ely, chief of motive power of the Pennsylvania, has been granted a protracted leave of absence to visit Italy, France and Egypt.

Mr. Calvin Sebreck, formerly an engineer on the Big Four, has been appointed road foreman of engines for the Indianapolis division of that road.

Mr. B. H. Lent has been reappointed road foreman of engines of the Arizona division of the Atchison, Topeka & Santa Fé, with office at Needles, Cal.

Mr. J. B. Cozart, formerly master mechanic of the Mexican Railway at Apizaco, has resigned to accept a similar position with the Pan-American Railroad.

Mr. J. T. Robinson, master mechanic of the Seaboard Air Line at Savannah, Ga., has been appointed master mechanic on the same road at Jacksonville, Fla.

Mr. John Bowden, formerly master mechanic on the Baltimore & Ohio Railroad at Parkersburg, W. Va., has been transferred on the same road to Garrett, Ind.

Mr. G. T. Fulton has been appointed district master mechanic of the Lake Superior division of the Canadian Pacific Railway, with office at Carleton Junction, Ont.

Mr. George K. Anderson has been appointed road foreman of engines of the Albuquerque division of the Atchison, Topeka & Santa Fé, with office at Winslow, N. M.

Mr. George S. Hodgins, managing editor of RAILWAY AND LOCOMOTIVE ENGINEERING, has recently been elected a member of the American Society of Mechanical Engineers.

Mr. J. M. Burke, formerly road foreman of engines, has been appointed district master mechanic on the Canadian Pacific Railway, with office at Brownsville Junction, Me.

Mr. W. C. Brown, vice-president New York Central Lines, will very probably succeed to the position vacated by Mr. W. H. Newman as president. Mr. Brown entered railway service June, 1869, as a section hand on the Chicago, Milwaukee & St. Paul Railway; from March, 1870, to June, 1872, he was telegraph operator on the same road; from June, 1872, to March, 1875, train dispatcher on Illinois Central Railroad; from 1875 to 1881 he was train dispatcher on several railroads. January, 1881, to July, 1884, trainmaster; July, 1884, to January, 1887, as-

W. C. BROWN.

sistant superintendent of the C., B. & Q.; January, 1887, to August, 1890, superintendent same road; August, 1890, to January, 1896, general manager of the Hannibal & St. Joseph and Kansas City, St. Joseph & Council Bluffs roads (Burlington system); May, 1891, to January, 1896, also general manager Chicago, Burlington & Kansas City Railway, and the St. Louis, Keokuk & Northwestern Railroad; January, 1896, to July, 1901, general manager Chicago, Burlington & Quincy Railroad; July, 1901, to February, 1902, vice-president and general manager Lake Shore & Michigan Southern Railway; February, 1902, to date, vice-president New York Central & Hudson River Railroad and Lake Shore & Michigan Southern Railway; also vice-president Michigan Central Railroad, Cleveland, Cincinnati, Chicago & St. Louis Railway, West Shore Railroad, New York & Ottawa and Rutland and the Indiana, Illinois & Iowa. Mr. Brown has been a practical railroad man and his varied experience and his work will admirably fit him for the office of president of the New York Central lines if the board of directors make the appointment, as it is expected that they will.

Mr. W. J. Spearman has been appointed general foreman of the Missouri Pacific Railroad and the St. Louis, Iron Mountain & Southern, with headquarters at Kansas City, Mo., vice Mr. A. Hewitt, assigned to other duties.

The offices of Mr. M. S. Monroe, master mechanic, and J. P. Callahan, master car builder, of the Chicago, Lake Shore & Eastern, have been moved from South Chicago, Ill., to Gary, Ind.

Mr. C. A. Stark, formerly division master mechanic on the Canadian Pacific Railway at North Bay, Ont., has been appointed general foreman on that road, with headquarters at Carleton Junction, Ont.

Mr. John L. Walker, formerly auditor for the Buda Foundry & Mfg. Co., has resigned to accept a position as manager of the "Use-Em-Up" Socket department of the American Specialty Company, Chicago, Ill.

Mr. Willis C. Squire has accepted the agency for the railway trade in the Chicago territory of the Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio. His headquarters will be at 209 Western Union Building, Chicago, Ill.

Mr. J. F. Tilton, superintendent of the general shops of the Mexican Central Aguascalientes, has been assigned to other duties and has been succeeded by Mr. J. E. Hickey, who has been master mechanic of the International at Durango.

Mr. A. N. McGill, formerly master mechanic on the Lehigh Valley Railroad at Wilkes-Barre, has been appointed assistant superintendent of motive power on that road, with headquarters at South Bethlehem, Pa.

Mr. J. E. Hickey, master mechanic of the International Railway of Mexico, has been appointed superintendent of shops of the Mexican Central at Aguascalientes, Aguas, Mex., vice Mr. G. F. Tilton, assigned to other duties.

Mr. H. F. Staley, general foreman of the Norfolk & Western at Bluefield, W. Va., has been appointed master mechanic of the Carolina, Clinchfield & Ohio, with offices at Johnson City, Tenn., vice Mr. H. L. Hobbs, transferred.

Mr. J. H. Hines has been appointed general foreman of the car department of the Pennsylvania division of the New York Central & Hudson River Railroad at Jersey Shore, Pa., vice Mr. J. Q. Simcox, resigned on account of ill health.

Mr. John Burns, formerly general foreman on the Canadian Pacific Railway at North Bay, Ont., has been appointed district master mechanic of the Lake Superior division on that road at North Bay, vice Mr. H. Gates Reid, promoted.

Mr. Alexander S. Mitchell has accepted the agency of the railway and boiler trade in the New York territory of the Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio, with headquarters at 45 Broadway, New York City.

Mr. Frederick Regan, for some years with the Chicago & Alton Railroad in the mechanical department, has been appointed master mechanic for the southern division of the Kansas City Southern Railway, with headquarters at Shreveport, La.

Mr. H. D. Van Valin, general foreman at the Baltimore & Ohio shops at Parkersburg, W. Va., has been promoted to the position of master mechanic, and placed in charge of the Ohio division shops, vice Mr. John Bowden, transferred.

Mr. R. D. Smith, formerly road foreman of locomotives on the Canadian Pacific Railway at Medicine Hat, Alta., has been appointed master mechanic of the Western division of that road. The position of road foreman and locomotives has been abolished.

Mr. D. D. Robertson, formerly master mechanic on the Lehigh Valley Railroad at Sayre, Pa., has been transferred as master mechanic on that road to Wilkes-Barre, Pa., with jurisdiction between Sayre and Mauch Chunk, vice Mr. A. M. McGill, promoted.

Mr. W. D. Knott has been appointed purchasing agent of the Atlanta, Birmingham & Atlantic, with offices at Atlanta, Ga. The duties of purchasing agent have previously been performed by Mr. Alexander Bonnyman, the general manager of the road.

Mr. C. F. Smith has been appointed master mechanic of the Tombigbee Valley Railroad Company, with headquarters at Calvert, Ala., in charge of all steam and electrical appliances of the company. Mr. Smith formerly occupied the position of railway representative of the Cataract Refining Company, of Buffalo, N. Y., and is well known in the mercantile world.

The International Railway Fuel Association has recently been organized. The object of this association is to advance the interests of the employer by recommending the adoption of the best methods of purchasing, inspection, weighing, distributing, handling and accounting for fuel.

The officers of the new association are as follows: Messrs. Eugene McAuliffe, president, general fuel agent Rock Island Frisco Lines, Chicago, Ill.; Thomas Britt, first vice-president, general fuel agent Canadian Pacific, Montreal, Canada; G. R. Ingersoll, second vice-president, purchasing agent L. S. & M. S. Ry., Cleveland, Ohio; D. B. Sebastian, secretary, fuel supervisor, C. & E. I. R. R., and E. & T. H. R. R., Chicago, Ill.; J. McManamy, treasurer, road foreman of engines, Pere Marquette Ry., Grand Rapids, Mich. In addition to the above named, the following gentlemen were elected to serve on the Executive Committee for two years: Messrs. C. F. Richardson, fuel agent, St. L. & S. F. R. R., St. Louis, Mo.; S. L. Yerkes, fuel agent, Queen & Crescent System, Lexington, Ky.; J. H. Hibben, fuel agent, M. K. & T. R. R., Parsons, Kan.

Mr. W. H. Newman has resigned from the presidency of the New York Central Lines after forty years of continuous railroad service. He began railroad work in 1869 as station agent on the Texas & Pacific. He subsequently passed through the higher grade as general freight agent on the same road. Later he became traffic manager of the Southwestern system lines in Texas and Louisiana. In 1887 he became traffic manager of the Missouri Pacific System, and later was elected third vice-president of the same company. He was also elected third vice-president of the Chicago & Northwestern in 1896 and second vice-president of the Great Northern in 1898. In 1901 he was elected president of the Lake Shore & Michigan Southern, and in 1905 became president of the N. Y. C. & H. R. R. R. He was also president of the Michigan Central, Big Four, the Indiana Harbor R. R., the Lake Erie & Western R. R., and the Indiana, Illinois & Iowa. Mr. Newman has held these important offices with credit to himself and benefit to the companies he has served, and has retired voluntarily for the purpose of securing to himself more leisure and freedom than would be possible as a chief executive officer of the New York Central lines.

Mr. Thomas Tait, who at one time was manager of transportation on the Canadian Pacific Railway in Montreal, has been for a number of years chief commissioner of railways for the government, of the Victorian Railways of Australia. Mr. Tait was known on the C. P. R. as a painstaking and conscientious officer, who had passed through the various grades of service and who knew his business thoroughly. He was at all times an approachable man, and his clear and quick appreciation of conditions, together with his ready ability to meet them, has made him a valuable acquisition of the Victorian Government. During the five years that Mr. Tait has had charge of the Victorian railways he has gradually effected reforms and changes in methods of operation which have been most successful. The increase in net revenue during that period has been over $11,000,000. Some additional expenses have been incurred in order to produce the paying result that Mr. Tait has achieved, but after they have been deducted there stands a balance of net revenue of $8,899,402 to the credit of careful, thoughtful and intelligent management. In other words Mr. Tait took charge, practically as general manager five years ago, at a time when the roads showed a heavy annual deficit, and has been able not only to wipe out the deficit, but create a substantial revenue for the government. Mr. Tait's administration forms an argument on the side of those who ask, is government ownership a failure? It may not be successful in all cases, but the Victorian Railways, as now managed, is an example of what is possible to achieve.

Obituary.

It is with deep regret, that, as we go to press, we have to record the death of George W. West, superintendent of motive power of the New York, Ontario & Western, at Middletown, N. Y.

Compound for the Eastern of France.

The Eastern Railway of France have recently received two articulated compound locomotives built at the Schenectady works of the American Locomotive Company. The articulated principle of steam locomotive construction was first developed by M. Anatole Mallet of Paris, a French engineer. The first articulated compound locomotive designed and built in this country, a product of the Schenectady plant, completed in 1903-4, was a development along the lines first introduced by M. Mallet, but modified to suit American conditions. Four years later, one of the leading railways of France has now placed an order with an American builder for the construction of two Mallet compound locomotives, specifying that they should be built in general after the builder's design, and in accordance with the usual American practice for this type of locomotive. With the exception of threads, stay bolts and boiler tubes, bolts and nuts, driving wheel tires, engine truck tires, which are in the metric system, these engines have been built to the English system of measurements.

They are intended for road service and will handle freight of upwards of 600 metric tons behind the tender on 1½ to 2 per cent. grade, on the mining division of the road between Meuthre and Moselle, and will take the place of four cylinder compound consolidation locomotives built at the Espernay works of the Eastern Railway of France and weighing in working order 170,000 lbs., which now handle this traffic. The location of the lowest gauge cock is such as to give 60 millimeters of water above the crown sheet on a 2½ per cent grade. With the exception of the application of a two-wheel leading truck and the consequent modifications in design, they are in general similar to the engines of this type built last year by these same builders for the Central Railway of Brazil, which are reported to be giving every satisfaction. In the case of the engine under consideration, the use of the front truck was specified, in order to keep the weight on the drivers within the limits of the rail capacity. It was also the opinion of M. Salomon, chief engineer of the Eastern Railway of France, that the engine would ride more smoothly on the down grade and take the curves more easily with a truck than without.

The exhaust passages of the low-pressure cylinders, instead of leading up through the cylinder saddle to the openings in the center of the castings, as in previous designs of articulated lolocomotives built by the American Locomotive Company, are brought forward to exhaust the steam through openings in front of each of the low-pressure cylinders which connect to a Y pipe, which is in turn connected by means of elbows and jointed pipe to the common exhaust pipe in the smoke pipe. This arrangement produced a somewhat tortuous design of steam passages in the low-pressure cylinder, but was necessary, in order to increase the length of the exhaust pipe, so as to reduce the angle of its deflection when rounding sharp curves. The steam passages are cored out with large radii, to counteract as far as possible the friction of the steam in passing through these tortuous passages.

Another modification in this design differing from some of the other examples of this type of engine built by this company, is the intercepting valve. In the engines under consideration, the design of this valve is a reversion to the original form of Richmond compound intercepting valve, in which the emergency exhaust valve is contained in the same chamber as the intercepting valve, instead of being a separate mechanism attached to the outside face of the cylinder casting.

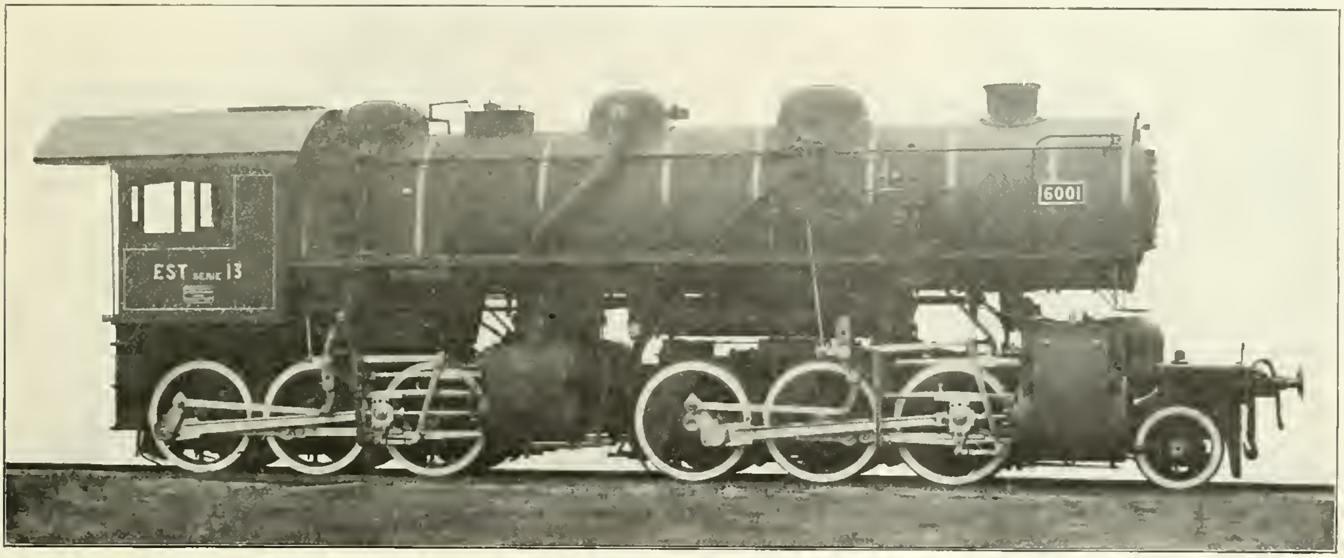
The boiler follows American locomotive practice throughout, except for the use of copper inside firebox and copper stay bolts in the water legs, and the fact that the tubes are made to the metric measurements. The copper firebox and stay bolts, of course, are in conformity with the usual continental locomotive practice. The dome, which is of cast steel, is of similar design to that which was used on the first engine of this type in America, namely, the Mallet Articulated Compound, for the Baltimore & Ohio Railroad. The throttle valve is of the combination of throttle and steam separator design, which is practically the same as was applied to the articulated compound built for the Erie Railroad, and which was shown on page 423 of the September, 1907, issue of RAILWAY AND LOCOMOTIVE ENGINEERING.

The arrangement of steam and exhaust pipe is similar to that used in previous examples of the articulated locomotive, the results from the performance of those engines which have long been in service having proved that the ball and slip joints previously used required no modification. The exhaust pipe, as above mentioned, is somewhat different in design from the builder's previous practice, and is made up of two sections bolted together in the center, with a slip joint arrangement so as to allow for the necessary elongation when the engine is rounding curves.

There is but one front boiler support, which also includes spring center arrangement, whereas in previous designs of articulated engines there have been at least two and sometimes three front boiler bearings, although only one carried weight, excepting under abnormal conditions. The use of one boiler support, in the case of the engine here illustrated, was due to the fact of the application of the front truck and the distribution of the weight thereby resulting. The valve gear is of the Walschaerts type, driven by return cranks on the main axle and by the crossheads of the respective engines.

The arrangement of the gear is such that the weights of the parts of the valve motion of the front and back engines counterbalance each other. The valve gear, as operated by the railroad company's design of screw reversing gear, which is very similar to that in use on other continental roads, and which precludes the use of the power reversing gear.

One of the advantages of this type of engine is, namely, that the weights of the moving and wearing parts can be made approximately the same as those of an engine of the ordinary type of half the tractive power, is clearly known, but the following tabular comparison between the weights of some of the parts of the engines here illustrated and those of the standard consolidation engine in use on the New York Central Lines is interesting.



MALLET ARTICULATED COMPOUND ENGINE FOR THE EASTERN RAILWAY OF FRANCE.

M. Salomon, Chief Engineer. American Locomotive Works, Builders.

	Eastern Railway of France.	N. Y. C. Lines.
Total weight ..	206,000 lbs.	234,000 lbs.
Weight on drivers	182,000 "	208,700 "
Cylinders	17½ & 28 x 26 ins.	23 x 32 ins.
Driving wheels.	50 3/32 "	63 "
Boiler pressure.	214 lbs.	200 lbs.
Tractive power	42,300 " (work'g comp.)	45,700 "
Factor adhesion	4.32 lbs.	4.57 lbs.
Weight of main rod.....	417 "	850 "
Weight of front rod....	208 "	181 "
Weight of back rods...	92 "	310 "
Weight of intermediate rod		391 "
Weight of high pressure piston and rod	297 "	664 "
Weight of low pressure piston and rod	459 "	
Weight of cross heads.	228 "	375 "
Wt. of crk. pins (1 side)	184 "	400 "
Average wheel load...	15,175 "	26,088 "
Tractive power in pounds 100 average wheel load	2,782 "	1,750 "

The principal dimensions of the engines for France are as follows:

Cylinder—Type, compound; 17½ and 28 x 26 ins.
Track—Gauge, 1m, 445mm.; tractive power, 42,300 lbs..
Wheel Base—Driving, 9 ft.; total, 34 ft. 10 ins.; total, engine and tender, 41 ft. 10 ins.
Weight—In working order, 206,000 lbs.; on drivers, 182,000 lbs.
Heating Surface—Tubes, 2,414 sq. ft.; firebox, 133 sq. ft.; total, 2,547 sq. ft.
Grate—Area, 40.5 sq. ft.
Axles—Driving journals, main, 7½ x 9 ins.; others, 7 x 9 ins.; engine truck journals, diameter, 6 ins.; length, 10 ins.
Boiler—Type, straight top; O. D. first ring, 66¾ ins.; fuel, soft coal.
Firebox—Type, wide; length, 89⅞ ins.; width, 64⅞ ins.; water space, front, 4 ins.; sides, 4 ins.; back, 4 ins.
Crown—Staying, radial.
Tubes—Material, steel; No. 269; length, 18 ft.
Piston Rod—diam., 3 ins.; piston packing, C. I. rings.
Smokestack—Diam., 17 ins.; top above rail, 13 ft. 9½ ins.
Valves—Type, piston; travel, 5¼ ins. LP., 5 ins. HP.; steam lap, ⅞ ins. LP.; 1 in. HP.; extra lap, ⅛ in.
Setting—⅛ in. lead on high and low pressure.
Wheels—Driv. diam. outside tire, 44 ins.; material, cast steel; engine truck, diam., 33½ ins.; kind, C. S. spoke.

Vapor Car Heating System.

The Combination Pressure and Vapor Car Heating System here described is the invention of Mr. Edward E. Gold, president of the Gold Car Heating & Lighting Company of New York, who has devoted a great many years of thought and labor to car heating, having taken out over 100 letters patent. The use of steam heat on passenger cars has been quite generally attended by an undue rise of temperature inside of the car, and this is particularly true of the average sleeping car. With the old heaters the porter could do very well with a low fire at night, but with steam heat the ordinary coaches require even more pressure during the night than during the day, and the train line pressure must be maintained sufficiently high to keep these cars comfortable. In moderate weather less heat is required than when a low temperature prevails, but, on the other hand, the length of the train largely regulates the main pipe pressure. Most of the cars in this country are piped on the simplest systems, using two rows of two-inch pipe on each side of the car, and a steam valve and a blow-off cock for each section. With this arrangement, the heating pipes must be at the temperature of the steam in the train pipe, even if this temperature is too high for comfort in moderate weather. This necessitates a continual heating and cooling by opening and closing the steam valve, the trap automatically discharging the condensed water as it accumulates.

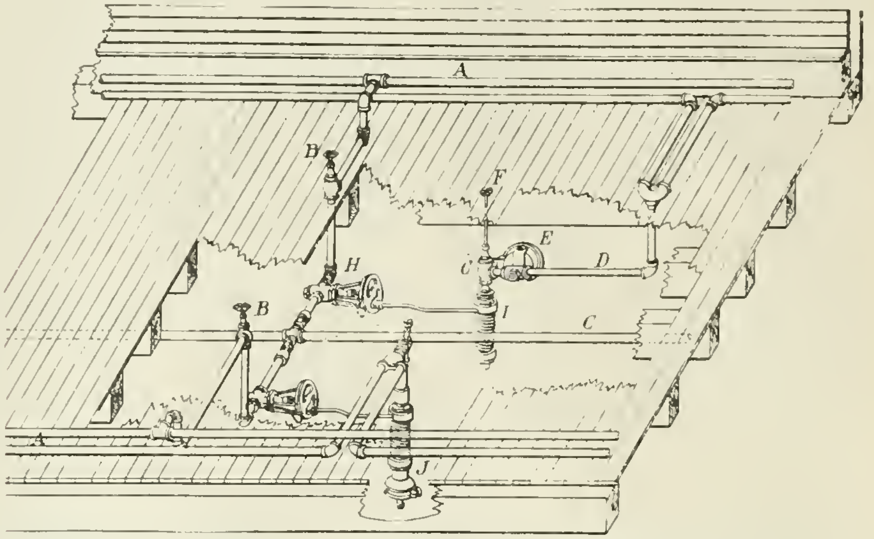
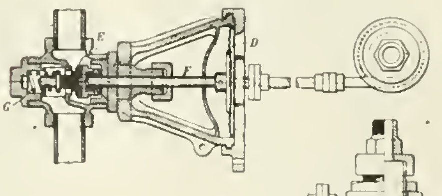


FIG. 1.

The combination pressure and vapor system of the Gold Car Heating & Lighting Company affords an opportunity to heat the car at different temperatures without increasing the attention of the trainmen or by making changes in the piping inside the car, the additional mechanism required being merely the special automatic valve in the steam pipes below the present steam throttle and a drip outlet connected to the blow-off cock, all of the attachments being applied below the bottom of the floor and requiring only a couple of hours' work for their addition to a car. The arrangement and operation will be made clear by reference to the following figures.

Fig. 1 represents a part sectional and interior view of a car which has originally been equipped with the simple heating arrangement, and to which additional parts have been applied in order to convert the equipment into a combination system. The heating pipes are indicated at AA, supplied by the steam valves BB, which obtain steam from the main steam line C. The water of condensation accumulates in the drip pipe D, and is relieved as it accumulates by the trap E. In case of desiring to heat the car quickly, or when blowing out at the end of a run, the hand wheel F is turned, opening the blow-off cock G. When it is desired to convert this direct steam system into a combined pressure and vapor system, it is merely necessary to insert the automatic steam valve H in the branch pipe, between the main steam line C and the steam valve B, and to attach to the blow-off cock, immediately below its extremity, the expansion chamber or worm I.



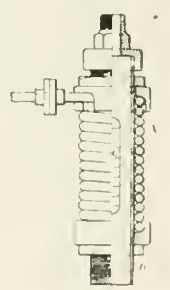


FIG. 2.

The operation of the automatic valve and the expansion worm will be understood by reference to Fig. 2. The expansion worm, which is placed below the blow-off or drip cock and forms an extension to the same, consists of a spiral coil of copper piping, A, surrounding the drip pipe B. This pipe B has several slots, C, cut through to allow the hot water escaping from the system to trickle over the spiral copper pipe. This spiral pipe is filled with a liquid that boils at a low temperature, and an extension of the pipe is connected to a diaphragm in chamber D, in the frame of the automatic valve. One of more joints are used to connect the worm and the diaphragm-chamber, these joints being made of the well-known type for securing tight connections under high pressures. The extension of the diaphragm D closes the steam valve E by means of the stem F. As soon as the liquid in the worm reaches the temperature at which it boils, and the vapor generated acting on the diaphragm closes the valve E against the spring G. When the liquid in the worm cools, which follows the cutting off of the steam supplied to the coils, the vapor of this liquid condenses and the spring G forces the valve open, allowing a fresh supply of steam to enter the heating pipes and supply additional heat to the car.

By referring again to Fig. 1, it will be seen that under these conditions of operation the heating system is run with a drip that is open to the atmosphere continually, and therefore there can be no pressure in any of the pipes in the car or beyond the valve H, which can exceed atmospheric pressure, and also that the steam supply is regulated by the automatic valve H admitting such quantity as may be necessary to keep the pipes sufficiently warm with steam, of low pressure and corresponding temperature, and that this valve will be closed when the pipes and the drip become sufficiently heated to generate pressure in the spiral pipe. Under these conditions the temperature of steam in the heating pipes will be in the neighborhood of 200 deg. Fahr., and with moderate outside temperature or if a moderate inside temperature is desired at night for sleeping cars, a comfortable temperature can be maintained without a continual opening and closing of the steam valve.

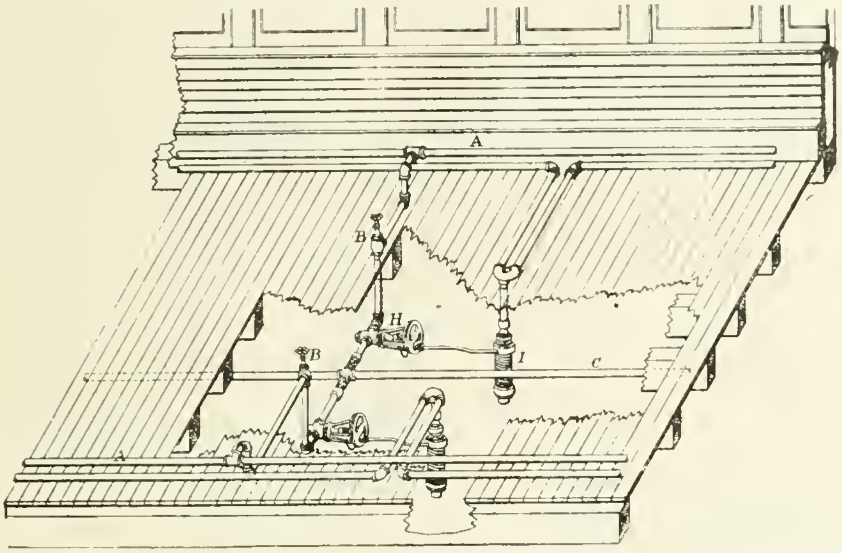


FIG. 3.

In cold weather, if it be desired to increase the heating capacity of the system, then by closing the drip valve F, the water of condensation must pass through the trap E. This device is well known, and is the trap that has been used with the Gold system for years, and which is called the horizontal trap or automatic Tee trap. This trap is opened and closed by an expansion chamber, the movement of which is governed by the temperature of the water which passes over and around it in escaping from the heating pipes, and as soon as the temperature is sufficient, the trap closes, thus retaining in the heating pipes such pressure as may be brought to them through the steam valve B. If, therefore, the pressure in the train line is in the neighborhood of 30 lbs. the temperature of steam in the pipes will be about 275 deg. Fahr., or about 75 deg. higher temperature than with the vapor system. With this arrangement, all the drip or condensed steam will be compelled to pass through the trap E, as the valve G is now closed, and the spiral coil will, therefore, become cool and the steam valve H will remain fully open. It is thus seen that in order to change from the pressure or high temperature system to the vapor or low temperature system, it is only necessary to open the valve G by means of the hand-wheel F, and that no further attention is required until more heat is desired. Thus at night in a sleeping car, when a lower interior temperature is desired, the porter simply opens the valve G, and this allows the steam pipes to cool to about 200 deg. Fahr., thus maintaining a moderate temperature throughout the night.

In Fig. 1 the trap shown at E is of the horizontal type, but at J there has been indicated the vertical type of trap which has the copper spiral wound around the outside of the vertical drip pipe. The vertical type produces an action identical with that described in connection with the horizontal trap.

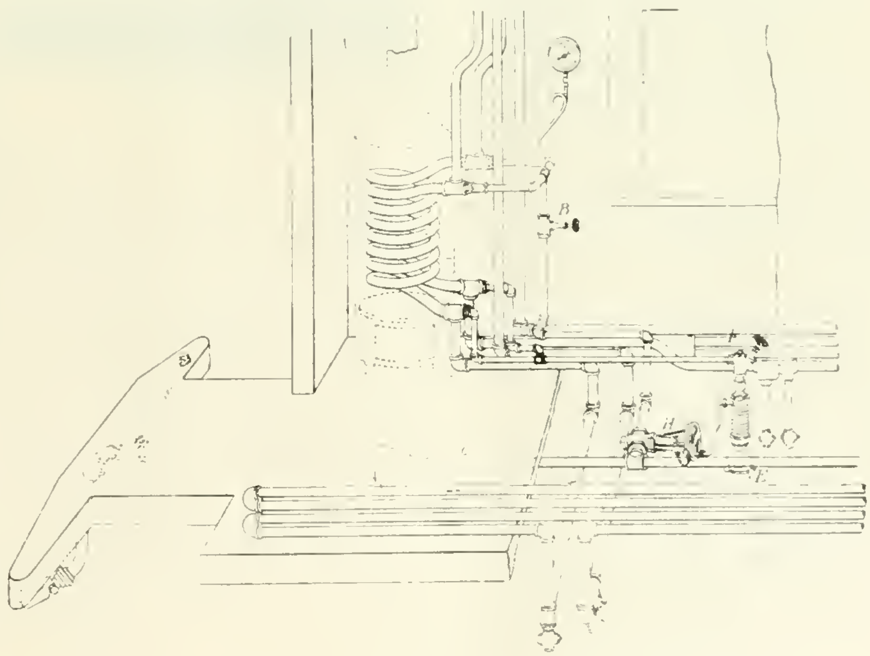


FIG. 4.

There are other incidental advantages claimed in connection with this combination system that are of considerable interest relative to the cars standing in the yards in cool weather. With cars not having the automatic valve H and the worm I, but equipped as the direct systems are generally installed. When it is desired to heat the cars at the terminals before placing them in service, it is customary to connect them with the steam pipe leading from the power plant or stationary boiler and open the drip cocks in order to quickly warm the cars. Soon there is a strong current of steam emitted from these drip cocks which blows out from under the cars to the detriment of the varnish on the exterior surface, besides wasting steam and fuel. With the automatic valve and the coil used with the vapor system, as soon as the pipes become warm and steam issues from the drip, the valve will be automatically closed, and only sufficient drip will be emitted to keep a circulation in the pipes. The economy, not only in fuel, but also in the protection to the exteriors of the cars will be at once apparent. The alternate heating and cooling of pipes is not an economical or a scientific way of providing heat for cars. The regulation of the drip by the trap is more satisfactory and regular, providing that the proper temperatures can be maintained. The locomotive is often using steam to the limit of its boiler capacity, and the saving of even a small amount of steam, as explained above, may be of assistance in maintaining the schedule. This also applies when changing engines, as the automatic valve practically takes care that sufficient steam is used to reheat the cars, but none is wasted.

When cars are run continually in a warm climate, and only a moderate degree of heating is required, the vapor system alone may be used, as illustrated in Fig. 3. Thus the arrangement of the interior pipes is the same as in Fig. 1, but there is no trap or drip valve used, so that the steam valve is the only piece of apparatus inside the car which has to be operated by the trainmen. It is simply a question of opening the valve B when desiring heat and closing it when no warmth is needed from the heating pipes. The automatic steam valve H and the spiral pipe I, are used in the same manner as in Fig. 1, but under these conditions it is only possible to obtain an amount of heat equal to steam and atmospheric pressure. In many parts of the country this is sufficient. Reducing the waste of steam when heating trains at terminals and the protection of varnish are also obtained. In Fig. 3, the same letters designate the corresponding parts as in Fig. 1.

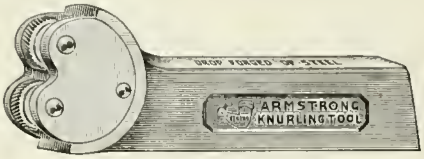
There are conditions under which the use of a heater and hot water system are advisable, so that should the car be detached from the engine for any length of time, a coal fire may be started in the heater. The combination vapor and pressure system is also applicable to the hot water system, and the arrangement is illustrated by Fig. 4. In this case steam is admitted from the train line C into the interior pipes of the double coils in the heater or stove, through the valve B, the drip from the two coils being united and discharged from the car through the vertical trap E. With the valve F closed, there would be the same pressure in the coil of the heater as in the train pipe, but by opening the valve F, communication with the atmosphere is established and the pressure immediately falls to that of the atmosphere and the temperature of the steam is reduced accordingly. The automatic valve then comes into operation and maintains a low temperature steam supply in the interior coil of the heater, thus reducing the temperature of the circulating water in the pipes. A The regular connection to expansion drum, etc., is shown as ordinarily applied to the hot water heating system, and it is again seen that no alteration of the interior piping of the car is necessary in order to change the single temperature system to the combination pressure and vapor system. The Gold Car Heating and Lighting Company have this apparatus on view and for demonstrating purposes in their repair shop close to their offices in the Whitehall building, New York. They are equipping trains on several railroads.

The Report of the Proceedings of the Sixteenth Annual Convention of the International Railroad Master Blacksmiths' Association. Edited by A. L. Woodworth, Lima, O., has just been issued, 192 pages, cloth binding. Price, $1.50.

The annual meetings of the Railroad Master Blacksmiths' Association are assuming a degree of importance that warrants the publication of their transactions in book form. The marked changes that have taken place in recent years, especially in the methods of welding the larger fractures incident to locomotive work, besides the multiform appliances used in the smaller forgings, render the various papers presented by the members and the debates incident thereto of much real value. The welding and handling of flues forms a very important part in the publication, and is itself well worth the price of the book.

Knurling Tool.

Our illustration shows what is called the Armstrong knurling tool, for use in lathe work. The object which the Armstrong Brothers Tool Company of Chicago have in view in designing this useful appliance is to obtain lasting



KNURLING TOOL.

qualities in the tool itself and uniformity in the work it produces. This knurling tool is self-centering, and the bearing surface is large enough to meet the strains of end and side thrust to which the tool may be subjected when at work. The knurls and pins are accurately made from tool steel suitably tempered. The other parts are of drop forged or bar steel, hardened. The size known as 1-K has a shank 1½ x ½ in. The knurls are made coarse, medium or fine, as desired, the medium finish, however, being the most commonly used. The device is strong, convenient and efficient. Write to this company for descriptive circular if you are interested. These are "the tool holder people," 104 North Francisco avenue, Chicago, Ill.

Thousands of dollars are spent every year replacing machinery and parts, automobile cylinders, castings, radiators, boilers, firepots, pipes, and a thousand and one other things which have become useless because of cracks, spongy spots, sand holes or blow holes. There is hardly a factory or railway shop of any size that does not send something to the scrap heap which could be still used if repairs could be made to iron and steel. This is possible by the use of a product which the H. W. Johns-Manville Co., New York, is placing on the market under the name "Leak-No Metallic Compound."

This substance is a chemical compound resembling powdered iron. When mixed with water and applied like putty to defects in iron or steel articles, the manufacturers claim that it metallizes and becomes a permanent part of the article to which it is applied. In color it very much resembles iron, when hard. The manufacturers show their faith in this material by offering to refund the purchase price in case it fails to stop any ordinary leak in anything made of iron or steel against any pressure of oil, steam, gas, air, ammonia or water; and to stand any heat or any chemical action that iron will stand, when applied according to directions. A neat folder issued by this company fully describes this material, and can be had for the asking.

Knew Why He Succeeded.

Mr. M. E. Ingalls, chairman of the Board of Directors of the C. C. C. & St. L. Railway, is a very humorous speaker and does not hesitate to tell a funny story at his own expense. On one occasion he told that he had been away on a visit to his native village in New England and found the same old crowd about the grocery store discussing the same worn out political questions in the same old fashion.

"We hear that you have got on in the world, Ingalls, since you left the lawyer's office here," remarked the veteran; "shouldn't wonder if you are making more than a hundred dollars a month."

"A good deal more than that," was the reply. "I am a railroad president now."

"A railroad president, eh! Well, it's wonderful what some ability and a great deal of cheek will do for some people."

A very good form of railroad wrench has been got out by the Uwanta Wrench Company, of Meadville, Pa. It is a very rigid wrench with the moveable jaw provided with a tie-piece sliding on the haft of the wrench and adjusting nut at its lower end. A hexagon lock nut can be tightly put up against the end of the tie-piece of the moveable jaw, and this gives additional holding power to the wrench. This locking nut can be tightened up with another wrench in case the wrench is put to very hard service. Ordinarily the lock nut tightens or loosens by hand. The Uwanta Wrench is made in five sizes and has in it the very best material. The company have issued a very neat little descriptive circular which they will be happy to send to any one who will let them know by post card that they desire information about it.

The Trenton Flush Door.

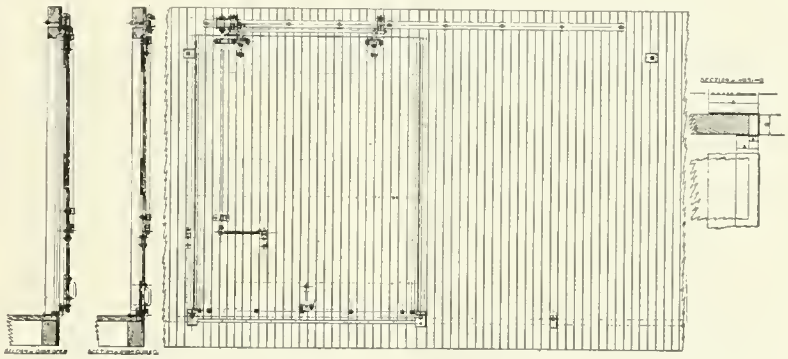
The Trenton flush door (Johnson patent), which is handled by the Trenton Malleable Iron Co. of Trenton, N. J., and at 50 Church street, New York, is covered by the same patents as the refrigerator car door referred to in our last issue. The Trenton flush door, it is claimed by the makers, is even less in first cost than the ordinary car door. It will be seen from our illustration that this door is hung to trolleys on a track, connected with a rocker shaft with arms hinged to the door, and has also a vertical rocker shaft pivotly connected with a horizontal rocker shaft; this horizontal rocker shaft has a crank at the top connecting with the pivot which works in a cam on the door, so that when the vertical rocker shaft is rotated it throws the door out at the top, and this outward motion of the door at the top causes the rotation of a horizontal shaft, which raises the door up, relieving it from the fastening at the bottom.

These fastenings at the bottom consist of a guide rail on the inside of the bottom of the door, the ends of which lock behind the castings at the corners of the doorway. When the door is raised by the rotation of the vertical shaft it relieves the guide rail from the locked position in the casting, and the door drops out until the guide rail strikes against the projection of the casting, thus preventing it from swinging out any further than the casting permits, and it can then be slid away from the opening just as any other door can be. It will be noticed that there is a lever rest on the door-jamb. This is for the purpose of ventilating the car. The lever is thrown around to the position to open the door, and is sealed on this lever rest, leaving an opening sufficient to ventilate the car. As stated above, the door cannot swing out at the bottom, but if freight in the car shifts and prevents the door from sliding away, the stop at the top of the door on the door-jamb can be removed and the door released.

Taking off the clip allows the door to be shifted far enough to relieve the guide rail at bottom from the projection on the casting, when the door can be readily swung out any distance at the bottom, thus relieving the pressure of freight lying against it inside, and thus making it possible to open the door. When the door is put back in position and the stop again replaced, it will be in a secure position. This obviates any damage to the door or injury of the freight that may be lying against the door.

The claims made concerning this door are simplicity and positive operation, no loose or disconnected parts to get out of order, automatically locking itself, closed by its own weight, and the means for locking the door closed and keeping the door from swinging out at the bottom also strengthens the bottom. This door provides for opening when freight has fallen against it. This is an important consideration, and it can be done without damage to either the door or the freight. Its locking on the inside of the car makes it burglar proof. The door irons, shown in our small illustration, are fastened to the battens of the door, and permit the sheathing to swell or contract without changing the size or fit of the door. Besides, the flush door with these irons on, can be fitted very closely, so as to thoroughly prevent dust, rain, snow or sparks from being driven into the car.

There is a great deal of damage done to freight because of poorly fitting doors, when they gape sufficiently to permit rain, snow, etc., to get in. With shipments of flour the damage done in this way has been a source of great expense to railroads, both in claims for damages and also in the expense of cleaning and repacking the flour so that it will be received. It was stated by the late Mr. Bradley, the expert claim adjuster, that he collected over $50,000 damage in one year for the damage done to flour and that amount came from the port of New York, and only on export shipments. Many of the railroads terminating in large centers have a regular force of men employed to look after carloads of flour that are damaged in this way, especially where it has got wet. The work of emptying the flour from the sacks, cleaning and resacking the flour entails a heavy outlay, and this expense is very greatly in excess of the cost of good doors.



TRENTON FLUSH CAR DOOR.

Much Better Above.

On one of our through trunk lines a Pullman sleeper on a west-bound train was very crowded and preparations for the night were in progress. Puffing and blowing, the fat passenger began to climb to the upper berth in the sleeping car.

"Pretty hard work isn't it?" said the man in the lower berth.

"It is," answered the fat pasenger, "for a man of my weight."

"How much do you weigh, may I ask?"

"Three hundred and eighty-seven pounds?"

"Hold on. Take this berth," exclaimed the other, his hair beginning to stand on end. "Do you know I'd rather sleep in the upper berth, anyway. I believe the ventilation is better."—*Montreal Witness.*

Pickled Castings

The use of hydrofluoric acid in pickling castings is coming into use and is in some respects superior to sulphuric and hydrochloric acids. The latter attack the metals. Before pickling in the fluoric acid it is desirable, of course, that the castings be brushed clean and all fins and cores removed. The solution of acid and water is effective in a ratio of 1 to 10, but as the pickling bath becomes weakened, a supply of fresh acid is necessary to maintain the strength of the pickle. It is noted that the sand is speedily loosened from the castings by the action of the acid and that the silica in the metal is also attacked so that the machining of the casting is rendered very easy. It is also noted that in painting castings that have been treated by fluoric acids the paint is much more enduring than when applied to the surface of unpickled castings. The cost is much less than in the use of sulphuric acid, about 10 cents per gallon being about the average price of the pickle, sufficiently strong for ordinary use. Fluorine gas, from which this acid is made, is the principal reagent used in etching upon glass, as its affinity for sand is very great. Hydrofluoric acid takes the sand off castings very quickly.

The currency of kindness is cash in any country.

Emergency Flue Nipple.

In an interesting estimate of the monetary loss entailed by locomotives being in the shop for boiler repairs, particularly those connected with leaky flues, Mr. W. P. Raidler, master mechanic of the Green Bay & Western Railroad, takes as an example an engine with 19 x 26 in. cylinders, 56 in. driving wheels and steam pressure 180 lbs. This engine can exert a maximum tractive effort of about 25,000 lbs. This engine has perhaps as many as 220 flues.

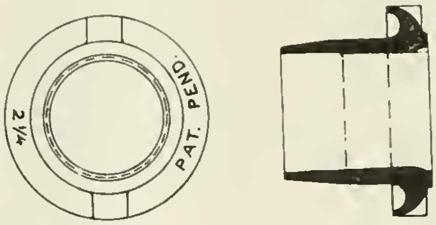
This tractive power is that which will be expended in hauling 1,000 gross tons along a straight track up a grade of 1 per cent. The tare weight he estimates at 330 tons, leaving a net or paying load of 670 tons behind the tender. On the assumption that after the freight rates have been paid and the cost of the running the train has been deducted, the engine earns one cent per ton mile hauling this load, he finds that the revenue for 100 miles, or a day's run, is $670. The inference, therefore, is that a loss of revenue to the company equal to this amount is caused by the idle day in the shop, owing to the necessity of repairs. This would seem for all practical purposes to be a fairly accurate estimate of an average locomotive's daily performance as computed by Mr. Raidler.

The water conditions on the Green Bay & Western Railroad are good, and Mr. Raidler states the average life of flues on his road as, freight, 28 months; passenger, 56 months; switch engine, Green Bay yard, 54 months; switch engine, Grand Rapids yard, 109 months; and the average approximate cost of repairing the 220 flues when burned out, or replacing new ones, is given by him in the table below:

Removing 160 flues		$7.80
Replacing 160 flues (2nd hand)		13.50
A——93 feet 2" tubing, safe ends		14.88
160 2" ferrules		9.60
B——Cleaning, welding on safe ends, marking, cutting, swedging annealing, 160 flues		27.00
Removing draft rigging and replacing same		3.60
Removing, grinding and replacing dry pipe, throttle valve rigging, steam pipes, exhaust pipes, etc.		24.60
		$100.98
Less A and B for new flues		41.88
		$59.10
160 Locomotive flues, 2" diam., 12' long, 1920"	16c.	307.20
Preparing 160 new flues for boiler,	30c.	14.40
		$380.70

(Ten flues, more or less, will not materially affect the footings indicated above, new material excepted.)

These figures, which are not extreme in any way, are quoted by the Emergency Flue Nipple people, who have recently put upon the market the emergency flue nipple, which was illustrated in the September, 1908, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 375. This emergency nipple is made of malleable iron, tapered so that when driven into a flue it may be rolled or expanded in the usual way. The object of the emergency nipple is to prolong the life of the flues by taking care of leaky or injured flues. The nipple being open, does not reduce the

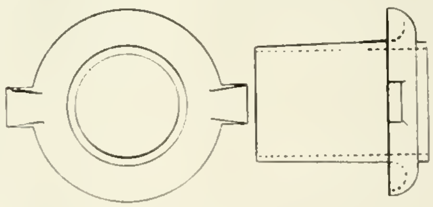


EMERGENCY NIPPLE FOR 2-IN. FLUE.

heating surface of the flue as a solid plug would do, and is a practical effort to meet a condition which constantly arises on all railways.

The object of this device is to make what is practically a hollow thimble which may be readily put in or withdrawn from a locomotive boiler tube at the firebox end when leakage has begun or when the bead has been burned away or otherwise damaged. This thimble is designed to completely cover the damaged parts, and so add materially to the life of the flue as a whole. A flue with a damaged end is usually stopped up with a solid plug and in this way, while the removal of the flue is temporarily avoided, the usefulness of the whole flue is impaired by reason of the cutting off of its heating surface from the action of the hot gases from the fire.

Commenting on some of the incidents regarding boiler work as found in an ordinary roundhouse, Mr. Raidler says: "Visit any terminal round house in the United States, Canada or Mexico of any importance and you will read on the pages of the work book



EMERGENCY NIPPLE SHOWING LUGS.

'Calk Flues in Firebox,' 'Flues Leaking in Firebox,' 'Engine Don't Steam.' Comparing dates, you will find that these reports appeared a comparatively short time after the engine has been put in service after having undergone general repairs or new from the builder. We will not here enumerate the details of calling the boilermaker at all hours of the night, to calk or roll out the leaky flues, doing them more harm than good in his haste to get through with a disagreeable, hot and unsatisfactory job. According to the law of averages he will simply drive in a solid plug (the old kind) and report the engine all right. The solid plug stops the leak, but puts a tremendous strain on flue sheet bridges, and in a short period of time twenty-five flues, more or less, are plugged. The locomotive is robbed of a portion of her heating surface, and correspondingly her hauling capacity is impaired."

The emergency thimble or nipple is, after being driven in, capable of being expanded or rolled in the flue so as to make a tight fit, and thus effectually seal up the leaky end of the tube. To facilitate the withdrawal of the nipple, it is made with two laterally projecting lugs, one at each side. By driving a wedge-shaped tool between the flue-sheet and the lugs the nipple can be started. This thimble or nipple or whatever it may be called, is, as its name implies, a temporary and not a permanent accessory in boiler repairs, and is intended to take the place of the objectional solid plug where a flue leaks constantly, or where the bead has been damaged. Properly and judiciously used, it is likely to become very popular on railways.

Further information may be had by direct communication with Mr. T. H. Price, 806 Great Northern Building, Chicago.

Ancient Chinese Bridges.

Suspension bridges which were built in the time of the Han dynasty (202 B. C. to 220 A. D.) are still standing, striking examples of oriental engineering skill. According to historical and geographical writers of China, it was Shang Lieng, Kaen Tsu's chief of command, who undertook to construct the first public roads in the flowery empire. At that time it was almost impossible for the province of Shense to communicate with the capital. Lieng took an army of 10,000 workmen and cut great gorges through the mountains, filling up the canyons and valleys with the debris from his excavations. At places where deep gorges were traversed by large and rapidly flowing streams he actually carried out his plan of throwing suspension bridges, stretching from one slope to the other.

These crossings, appropriately styled "flying bridges" by early Chinese writers, are high and dangerous looking in the extreme. At the present day a bridge may still be seen in the Shense which is 400 feet long and is stretched over a chasm more than 1,000 feet deep. How those early engineers erected such a structure with the tools and appliances at their command is a mystery which will probably never be explained.

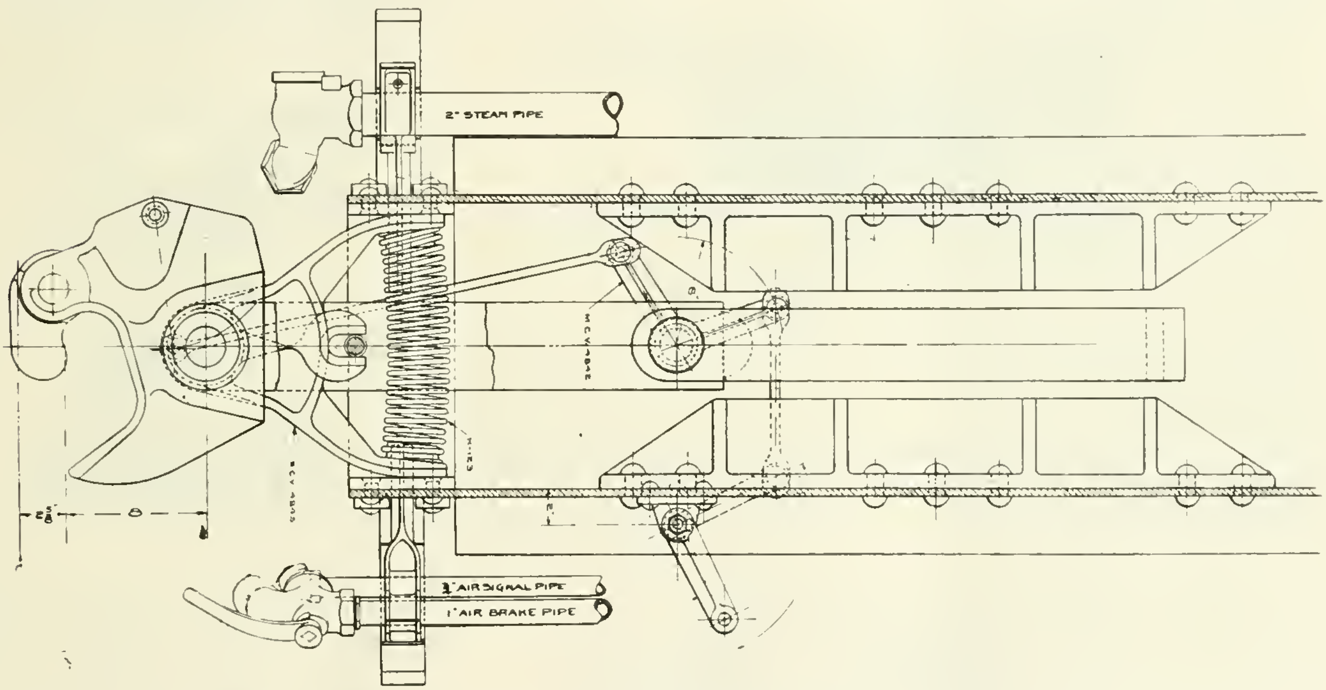
Polar Coupler on the Pennsylvania.

The rapid advance in the design of railroad equipment during the last few years has been very noticeable, and as an example, we may cite the new Polar Coupler, recently designed by the Pennsylvania. Very little had been done to increase the strength of passenger car couplers commensurate with the increase in size and weight of locomotives and cars. For this reason, when the new steel passenger equipment of that road was contemplated it was decided to design a coupler which in every respect, except parts limited by the M. C. B. contour lines, would be nearly twice as strong as the couplers used on wooden cars. In steel passenger equipment cars the platform center sills are made integral with the car center sills, which precluded pulling the platform sidewise, as often happens with wooden cars, but this necessitated providing increase of side motion of coupler head.

The coupler and centering device arrangement shown in our illustration consists of a coupler head pivotally mounted on the outer end of a bifurcated drawbar extending back to the spring yoke, to which the drawbar is attached by means of a pin. The pin connecting the head to the drawbar is $2\frac{1}{4}$ in. in diameter, the largest pin used before in similar position was $1\frac{3}{4}$ in. The pin connecting the drawbars to the spring yoke is also $2\frac{1}{4}$ in., replacing a $1\frac{3}{4}$ in. pin formerly used. The spring yoke and drawbar are proportionally increased. After careful investigation of curves, cross-overs, etc., it was determined that the possible side motion of coupler at the knuckle would be at least 6 in. on each side of center line. In order to have sufficient side motion, it was decided to arbitrarily provide a side motion of 8 in. on each side of the center line, or a total of 16 in. The conditions thus set precluded the possibility of using side stems, which were standard on wooden equipment, and necessitated designing an entirely new centering device. This device consists of two spring follower castings, which are pivoted on the coupler head pivot pin. Each of these castings is provided with a stop, which bears against a pin passing through the center of the bifurcated drawbar. The stop prevents the motion of the follower casting in one direction. Between the ends of the follower casting is placed a spring having a free height of 18 5-16 in, $3\frac{3}{8}$ in. diameter of coil, and $\frac{3}{8}$ in. diameter of wire. The function of this spring is to center both the coupler head and the drawbar. The spring has been so designed that its capacity is sufficient to center the head and drawbar.

With a total possible side motion of 16 in. there was some danger of coupler head coming in contact with the steam heat valve and the air and signal angle cocks, if they are placed in the standard position. To overcome this difficulty, and also to provide flexibility to the piping, for the purpose of preventing damage to hose connections, the ends of steam heat and air pipes are provided with clamps supported by V-shaped castings, with extensions passing through the center sills, which, when the drawbar moves sidewise, provide a bearing point, permitting the coupler to move the pipes sidewise, thereby escaping contact with the coupler head. With this arrangement it becomes necessary to space the clamps for the various pipes at a distance of 7 or 8 ft. from the platform end sill so that there will be no damage to the pipes themselves.

The large amount of coupler side motion also necessitated a special coupler operating device which would not interfere with the proper movement of the coupler nor release the knuckle in the extreme positions of either drawbar or coupler head. This was accomplished in a very neat manner by placing the attachment to the lock-block under the center of the coupler pivot pin, so that the coupler head could swivel in any direction without materially moving the lock-block attachment.



NEW POLAR COUPLER DESIGNED BY THE PENNSYLVANIA RAILROAD FOR NEW STEEL CARS.

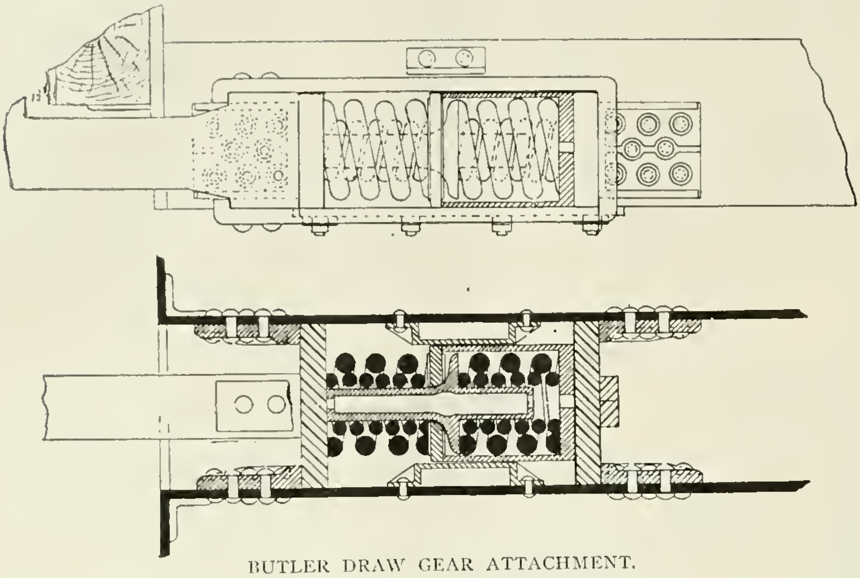
As the total longitudinal motion of coupler head and drawbar is closely $5\frac{1}{2}$ in., it was necessary to provide means for allowing the coupler operating rigging to move the same amount without disturbing the lock-block attachment. This was done by hanging a bell-crank from the bottom of the pivot pin connecting the drawbar and spring yoke, and connecting this crank with a secondary bell-crank attached to one center sill. The attachment beyond the secondary bell-crank is made by means of a small rod. All of these features have given perfect satisfaction, and permit the entire elimination of chain connections. The coupler head itself consists of one head casting, one knuckle, one lock-block and operating lever combined, one spring and two pins, one of which is the standard knuckle pin, and the other being a fulcrum pin for the lock-block.

Butler Draw Gear.

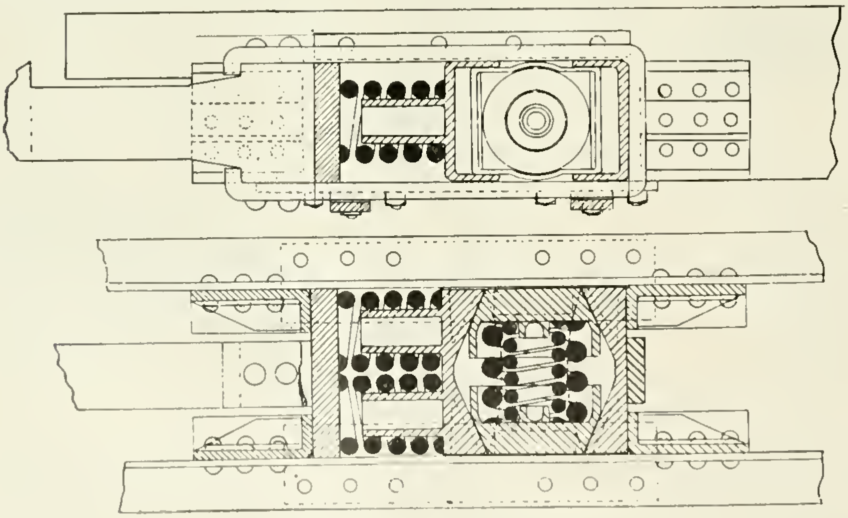
The Butler Drawbar Attachment Company of Cleveland, Ohio, have issued a beautifully illustrated catalogue of their attachments. It is hardly necessary to minutely describe this well-known mechanism for use on railroad cars. The essential feature of the Butler attachments are the double tandem springs, applied with what may be called the telescoping idea. With this arrangement the compression of the springs is accomplished always in a straight line and without reference to the angle which the drawbar may happen to occupy with reference to the springs. The strain on the yoke with this arrangement is tensile only, and only comes into play when the car is being pulled. The springs occupy the space provided between the draw lugs.

The company have recently issued Supplement No. 1 to their catalogue, which deals with friction draw gear. As early as 1860 inventors turned their attention to the problem of absorbing shocks by frictional resistance. A patent was issued to a Mr. Pennock in 1867 which combined the idea of absorbing shocks not only by the initial spring resistance, but also by the frictional resistance produced by the movement of yielding wedges. Later Mr. W. M. Piper employed a similar plan, and the Butler Company having acquired the Piper patents, presents a friction draw gear in which the ideas of these pioneer inventors is preserved, though with a range of design suitable to all modern requirements.

It is possible with suitable equipment to absorb 200,000 lbs. pressure in one inch of travel of the drawbar. This is equal to a complete absorption of 16,666 foot-pounds of energy. This applies to severe shocks, but the design of friction draw gear which the Butler Company manufacture is capable of dealing with everyday conditions in which a large number of comparatively slight shocks can be absorbed, and also that there shall be the reserve capability of adequately handling the severe shocks to which heavy car equipment is subject. The Butler design of friction draw gear absorbs shocks from

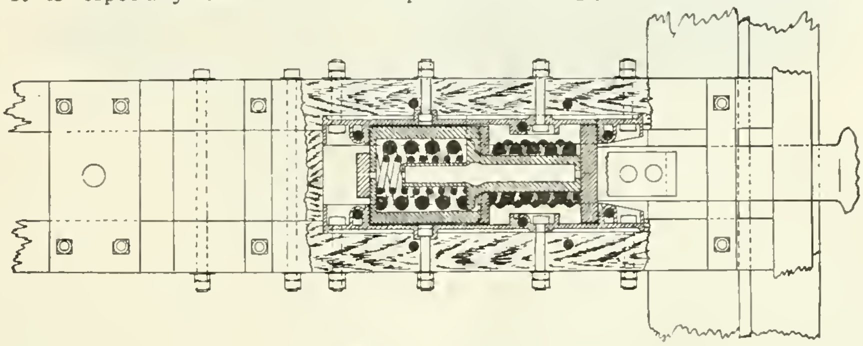


BUTLER DRAW GEAR ATTACHMENT.



BUTLER FRICTION DRAW GEAR.

25,000 lbs. up to 250,000 lbs in 2 in. travel. This means that a maximum of 41,666 foot-pounds of energy can be successfully taken care of. Our illustrations show the ordinary Butler draw gear and the Butler friction gear with movable wedge-shaped followers, and also the Butler gear as applied with the Harvey friction springs. The Butler Drawbar Attachment Company will be happy to send their catalogue and Supplement No. 1 to anyone who writes to them for copies.



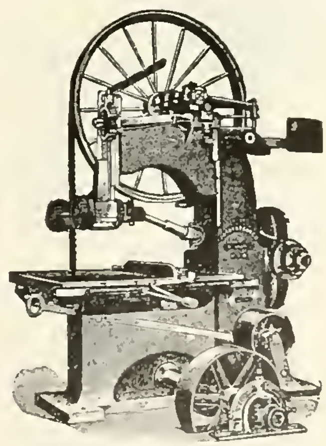
BUTLER GEAR WITH HARVEY FRICTION SPRING.

Car Shop Band Rip Saw.

The J. A. Fay & Egan Co., Cincinnati, O., make a machine that is popular among car manufacturers. It is their No. 109 Automatic Band Rip Saw, which we illustrate.

It is especially built for car shop work, and is used in the leading car shops of America. The frame is cored, but is of considerable weight, being cast in one piece with broad floor support, which practically eliminates vibration.

While the machine is adapted for heavy work, it is equally good for ripping the finest lumber into small strips. It will easily rip material of any thickness of from 1 to 14 in. and 28 in. wide between the saw blade and the fence.



CAR SHOP BAND RIP SAW.

The Company's Patent Knife-Edge Straining Device enables the machine to run an extremely thin blade at a very high speed without danger of breaking. This device not only means a saving of blades, but insures a very light kerf.

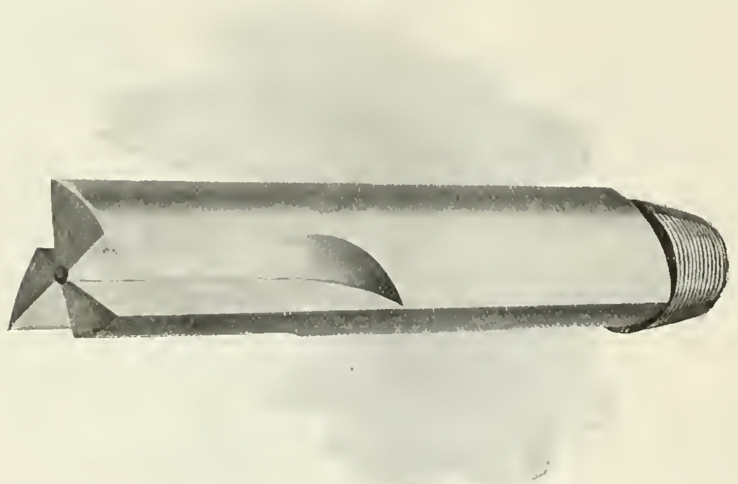
The feed is strong, and consists of two heavy fluted upper rolls and three lower ones of large diameter, all power driven. The upper rolls are adjustable up and down, and may be raised from the board, stopping the feed or lifted instantly out of the way for use as a hand feed rip saw.

For further information concerning this tool, you are requested to write the manufacturers, who will be glad to send you a descriptive circular showing a large half-tone photograph of the machine.

The advent of the expensive high-speed drills has brought before all drill users more strongly than ever before the problem of the loss occasioned by twisted tangs and broken shanks. With the ordinary carbon steel drills, notwithstanding the fact that the loss was considerable from this source, it was generally neglected, and considered as an unavoidable evil. However, when the tang was twisted off, or the shank broken on a high-speed drill of approximately four times the value of an ordinary drill, and this expensive tool thereby rendered useless, the men in charge of such matters began to give the subject some serious thought. The American Specialty Company has come forward with the "Use-Em-Up" Drill Socket. It will be noted that this socket is similar to the standard taper socket, with two exceptions. One, that it has a flat on its inside surface, and the other, that the drift slot is somewhat longer than on the ordinary socket, to facilitate the driving out of tangless drills. With the socket described it. is only necessary to grind a flat on the remaining portion of the shank after it had been broken off, or the tang twisted off, in order to put the drill into immediate use, or if a flat is ground on a new drill the liability of trouble from this source is entirely eliminated. Several of the standard drill makers are now furnishing their drills flatted to fit this socket at the same price as the ordinary drill. It will be noted that flattening drill shank to fit this socket does not in any way interfere with its use in the standard taper socket. This socket is manufactured and sold by the American Specialty Company of Chicago. Write them for further particulars.

Drilling Square Holes.

There is something remarkable in actually seeing a square hole bored through a piece of steel by what looks like a combined drill and reamer with only three cutting edges. A representative of Railway and Locomotive Engineering witnessed this performance in the room occupied by the Radical Angular Drill Company, in the same building we are in, viz.: 114 Liberty street, New York.

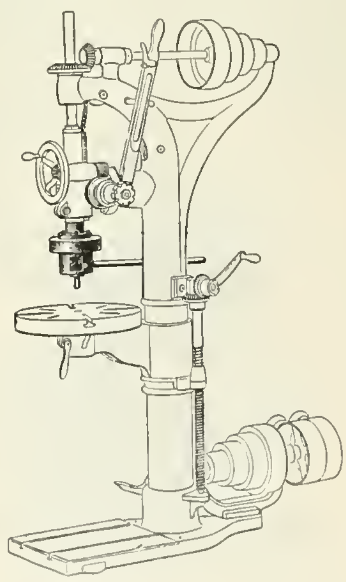


THE CUTTING TOOL OR BIT.

The device, which is the invention of Mr. Charles Philgus, is an attachment which can easily be applied to a lathe, an ordinary drill press, or a milling machine, and it cuts triangular, square, pentagonal or hexagonal holes in iron, steel, wood or stone in a remarkably short time and in a thoroughly workmanlike and accurate way. While the square hole is perhaps the most useful in railway and general work, the tools can be made to cut any odd shaped hole that is desired.

The principle upon which the tool operates is the combination of a specially shaped drill, turning in an adjustable guide formed in accordance to the shape of the drill. The drill continually changes its position with regard to the center axis of the spindle on which the tool is attached, with the result that the cutting edges of the drill follow a course precisely coinciding with the form of the hole presented by the drill guide. Different sized holes can be obtained by simply changing the drill, the guide being adjustable. The apparatus consists of two parts fitted together by a nut ring in one body; these two parts each serve a special purpose. It goes without saying that for a solid tool to bore anything but round holes it must have something more than a purely rotary motion about a fixed axis, and the striking peculiarity of this appliance consists in the mechanism by which the proper motion is obtained.

This is a special chuck, consisting essentially of three parts; first, a driving part, which is screwed to the spindle of the machine upon which the work is done; second, a stationary part, which may either ride upon the first or driving part by means of a bearing, or it may be fastened directly to the frame of the machine, and third, the part into which the shank of the drill is screwed and which is caused to rotate by the driving part, but which is also free to move sidewise to a certain extent. This sidewise motion is limited by a guide or matrix



ATTACHMENT ON A DRILL PRESS.

in the second or stationary part, the exact amount and form of the motion being determined by the shape of this guide and by the form of the shank of the boring tool.

The tool used in boring square holes has a three-cornered shank, the sides being segments of circles struck from the opposite angles or edges, as centers, and the radius of all three curves thus described are equal to one side of the square guide in which the shank turns about. When one side of the shank is either rolling or sliding upon one side of the square guide, the opposite edge of the shank moves in a straight line. This holds true for all positions of the shank except for a very small distance at the corners, and this tool bores a square hole with slightly rounded corners. If it is desired to bore a square hole with sharp corners a special bit is employed having a shank considerably larger than the cutting head, one of the corners of the shank being rounded instead of angular. The exact form of this shank has been worked out imperically, and standards have been made for all the sizes of holes likely to be needed in practical work.

The cutting edges of the tool are on its end as in the case of flat or twist drills. To do commercial work with this device, it is necessary to have as many different drills as there are sizes of holes to be bored, but the guide in the stationary part of the chuck can be adjusted to a considerable range of sizes, making only one chuck necessary. Where it is desired to bore triangular, pentagonal, or hexagonal, or other forms of holes, a suitable tool and corresponding guide are supplied. The square hole is, of course, the most generally used. A large number of these chucks, practically all of which are of the square hole type, have been sold in Germany to such firms as Friedrich Krupp, Siemens & Halske, etc.

The convenience of square holes and of square countersinks in certain classes of construction has long since directed the attention of inventors to the problem of producing such holes in wood and metal at a single operation. With this device it is possible to bore such holes upon any ordinary lathe, milling machine, or drill press at a rate nearly equal to the speed at which ordinary round holes can be drilled with a flat or twist drill.

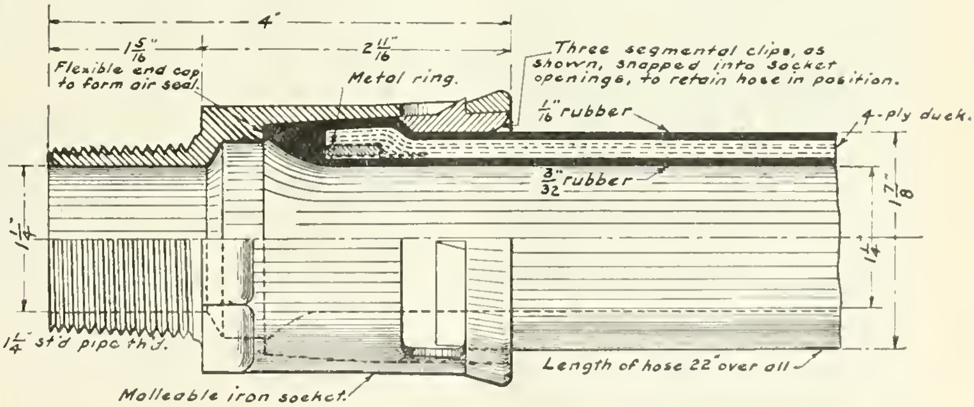
The machine is certainly unique and cannot fail to interest the mathematician if he is desirous of seeing the principle of Cardan suspension practically applied. It cannot fail to delight the lover of cleverly devised mechanical motions, for it is easily comprehended. The practical shopman, be he official or operative, will be more than repaid by a visit to the demonstrating room at 114 Liberty street, as he will there see a simple device, applicable to ordinary shop tools, easily and quickly doing the work which is difficult of accomplishment in any other way. The new tool has great possibilities and information or a descriptive circular can be had by writing to the Radical Angular Drill Company at New York.

Air Brake and Signal Hose.

The George M. Newhall Engineering Co., Ltd., of Philadelphia, Pa., are putting on the market a device designated as the "NB" Air Brake and Signal Hose Connection. It was designed by Messrs. E. D. Nelson, engineer of tests, Pennsylvania Railroad, and W. L. Brown, his assistant. The objects sought in designing this coupling were to overcome injury to the soft inner tube of the hose by the nipples used in the ordinary form of mounting and to secure a method of fastening the hose to the metal parts, which would be free from the danger resulting from a hose pulled off the fitting.

THE "NB" HOSE COUPLING.

The "NB" coupling is so designed as to avoid any contact of the metal parts with the soft rubber lining of the hose, and, therefore, preserves it against injury, thus leaving it free to perform its important function of sealing the hose structure against small leaks, which eventually cause bursting. When the hose is inserted in the coupling, as shown in our illustration, the clip is driven against the shoulder of the hose until the lug on the clip springs into place through the aperature in the coupling. The hose is thus securely



SECTION OF THE "NB" HOSE COUPLING.

mounted without having anything in contact with the inner tube.

The strength of the hose depends primarily upon the ability of the duck wrapping or jacket to hold the pressure, the safety of the hose against bursting depends on the integrity of the inner tube. A defect in the rubber lining permits air to find its way between and into the layers of duck,, and thus causing a rupture. It is said that about 60 per cent. of hose failures in freight service are due to the bursting of hose at the nipples, and in passenger service the percentage is still higher. The "NB" coupling is an effort to eliminate failures from this source.

Hose mounted with the present standard fittings and with this improved form of fitting have been pulled apart in the same way that it occurs in service, when cars are separated, but with the air brake coupling not uncoupled by hand. The makers state that the result of repeating this test a very large number of times showed marked cutting of the nipple in the inner tube with the standard fitting, and no injury to the inner tube with the improved form of fitting.

As to security against pulling off, it is said that repeated trials have demonstrated that when mounted with the "NB" coupling the body of the hose has torn apart in every case, leaving the end of the hose still attached to the fitting.

The form of the air brake and signal couplings and threaded nipples are, of course, the same as those in common use, so that there is no change in standard, so far as the couplings and car fittings are concerned. "NB" hose and couplings can be mounted as quickly and as easily as the present M. C. B. standard. All the parts can be used over and over again. Arrangements have been made with several of the largest hose manufacturers to make this special end on the M. C. B. or individual railroad specifications hose, and sell them direct to the railroad companies. It can also be procured through the George M. Newhall Engineering Company, Ltd., at 136 South Fourth street, Philadelphia. This company will be happy to answer any inquiries on the subject.

A comprehensive circular recently issued by the Independent Pneumatic Company of Chicago, is called by them "Circular L." It gives in a number of illustrations the varieties of the "Thor" pneumatic appliances made by this company, among which may be mentioned their Nos. 2 and 3 clipping, caulking and beading hammers. No. 1 piston air drill and reamer, No. 10 breast and screw feed drill, No. 5 reversible wood boring machine, No. 80

long stroke riveting hammer, No. 1 non-reversible piston air drill, No. 25 reversible compound slow-speed piston air drill, No. 7 pneumatic portable grinding machine, etc., etc. The "Thor" hose coupling for shop use is also illustrated. This is a simple and most effective device by which hose pipes can be coupled and uncoupled very readily, and when coupled a thoroughly air-tight joint is made. This circular will be sent to anyone on request addressed to the Company.

The Erie Railroad believe in educating their employees, and as an evidence of that fact we may mention that they have recently issued a pocket pamphlet, 55 pages on "Good Firing." The book is loaned to firemen and engineers, and this practically amounts to a gift to the permanent employees of the road. In the pages of this pamphlet are set down the correct methods of firing, and also, as Dickens, the great novelist would say, "how not to do it," is incidentally brought to the notice of the reader. The little book is illustrated, and with the letter press containing the accumulated experience of those who "know how," the book should be of great assistance to the men who do the work. The Erie has shown a serious desire to help their employees, and they deserve to reap the benefit of coal economy. Other railways that desire such results might profitably take several leaves from the Erie's booklet on good firing.

Last month we referred to the "Peerless" reamers. This month we wish to say that the Cleveland Twist Drill Company have issued a comprehensive catalogue on the subject of these reamers. The blades used are made of selected high-speed steel and joined to the body of the reamers by what the makers call their "Brazo-Hardening" process, which unites the blades with the soft-steel body so that there is no danger of the blades becoming loose. In fact, the makers offer to replace any "Peerless" reamer where the blades work loose. The reamers are made as hand, core, chucking, shell-core and shell-chucking reamers, and in each style they can be furnished as solid or expansion tools. The expansion reamers have as many cutting edges as a solid reamer. Write to the Cleveland Twist Drill Company, of Cleveland, Ohio, if you want a catalogue, and they will be pleased to send you one. These high-speed reamers are useful and efficient tools.

We have received a model of the G 6 Westinghouse brake valve carved out of small pieces of wood with an ordinary penknife by Mr. John W. Graybill, a locomotive engineer, of the Baltimore & Ohio Railroad, at Bridgeport, Ohio. The model which shows the various ports and passages in this brake valve is about 1 inch high and about 4 inches wide, made in the form of a circular disc held together by a pin. The manner in which the ports and cavities in the rotary valve and seat are brought to register in the different positions of the brake valve handle is shown by shifting the discs. This is a cleverly arranged device by which the construction and operation of the brake valve is made clear and one cannot help but admire the ingenuity of Mr. Graybill in preparing this model, which no doubt has been of valuable assistance to him in comprehending the construction and retaining information concerning the brake valve as well as imparting this knowledge to others.

A good many illustrated catalogues come to the office of RAILWAY AND LOCOMOTIVE ENGINEERING, and out of that number we cannot omit to mention one just issued by the Pratt & Whitney Company, of Hartford, Conn. It is a concrete presentation, one may say, of a very high grade of milling machines, die sinkers and profilers. The catalogue is standard railroad size, the same as our paper, and contains 40 beautifully illustrated and superbly printed pages. The machines described and illustrated are tools of precision and are especially adapted for the kind of milling that is required in producing accurate work. The examples of work done are of great interest to those who love a finished product of high grade. The work done by the profiling machines is truly remarkable. The company is willing to send this catalogue, which is one of value, or, indeed, any information regarding their other kinds of machine tools, machinists' small tools, gauges, etc., to anyone who sends them a request by post card.

A very artistic folder has recently come to our office from the the Hicks Locomotive and Car Works of Chicago Heights, Ill. In it they show by a number of half-tones the kind of work they do. They give a general specification of a passenger car as a sample, and reprint several letters from officials they have served. They have now a number of 80,000-lb. capacity gondola cars for immediate delivery and two modern 19 x 24-in. cylinder 50-ton mogul engines. Those who require this or any other similar equipment should write to the company. Their Chicago office is in the Fisher Building.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

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Grade Reduction in the Rockies.

When one considers the cost of train operation in detail, the amount expended in lifting a train upward while pulling it along the road, as when ascending a grade, it is an item expense which is constantly in evidence. A steep grade may facilitate the construction of a line and may reduce the first cost of the road, but it is forever after a conspicuous bill of expense for the operating and mechanical departments. A heavy outlay may therefore be justified in reconstructing a portion of road. It is like a costly but efficient tool in the shop, where increased output, in time completely wipes out the purchase cost.

On the line of the Canadian Pacific Railway through the Rocky Mountains there is one conspicuously heavy grade between the stations of Hector and Field, B. C., in the Kicking Horse Valley. The distance between the two points is eight miles, and coming east there is a compensated grade 3.2 miles long of 4.5 per cent. This means that while the train proceeds along the road a distance of 3 1-5 miles it makes a vertical rise of 700 ft. The summit of this grade is 5,168 ft. above sea level and the snow-crowned crest of Mount Stephen is about 6,000 ft. above the track. The Canadian Pacific has been pushing forward the work of re-constructing this part of the line, so that a longer grade 2.2 per cent. will replace the present one on the "big hill."

In order to get the longer piece of road in, two points on the existing line have been selected. These points are 4.1 miles apart, and the new line between these points has a total length of 8.2 miles. In other words, the grade is reduced about half, and the road is made twice as long. Our line engraving shows the plan of the existing and the new lines. On the present road there are three safety switches and a straight tunnel 170 ft. long. The new line has two spiral tunnels driven through solid rock. This divides the new line into three sections like a switchback railway, only as the spiral tunnels unite

KICKING HORSE PASS NEAR FIELD, B. C., ON THE CANADIAN PACIFIC RAILWAY the ends of these sections there is no reversal of motion. By that we mean that an engine ascending the grade and run in forward gear will be in forward gear all through, but it will move east on the lower section, pass through the first spiral, move west over the second section, pass through the second spiral, and travel east again on the third section.

Each spiral tunnel, with approaches, makes a complete loop of track. The easterly tunnel is 2,800 ft. long, and the westerly one, under Mt. Stephen, is 3,200 ft. long. The grade in these spirals is about 1.6 per cent., and the curvature is on a radius of about 573 ft. The rise in the roadbed made by the spiral tunnels is 45 and 48 ft., respectively. A straight tunnel about 170 ft. long is driven through the rock not far from the third safety switch on the existing line. The portals of the spiral tunnels are so located that no bridge crossings of the tracks is required. The canyon of the Kicking Horse River is crossed twice in making the ascent, two substantial steel bridges spanning the gorge. The driving of the three tunnels has necessitated the removal of about 400,000 cubic yards of rock, and cost of the whole undertaking is estimated at $1,270,000.

C. P. R. BRIDGE OVER THE SKUZZY RIVER, FRASER CANYON, B. C.

At the present time four consolidation engines rated at 710 tons take a train up the big hill. On the new track two similar consolidation engines will haul 982 tons. The economy which will be developed on the new line, from an operating standpoint, is obvious. On one occasion a representative of Railway and Locomotive Engineering traveled on the Imperial Limited, and in passing over this portion of the line eleven coaches were pulled and pushed up the grade. The total weight of these coaches was about 491 tons, and the four engines together weighed about 709 tons, or a total of 1,200 tons weight was moved along the track, and at the same time lifted 760 ft. The engines and cars were arranged in the following order. In front, one 2-8-0 Richmond compound, followed by five coaches, then two simple consolidation engines followed by six coaches, and one simple 2-8-0 engine in the rear. On the new line some time will be saved in the switching of the trains on account of not putting the two engines in the middle of the train and taking them out at the top of the grade, though the longer mileage of the new line may more than compensate for this gain. A good deal of light mileage of engines working on the grade is likely to be obviated by the new line as well. It is expected that the spiral tunnels will be completed by the spring, but there is a good deal of work to be done on the road before it will be open for regular traffic. We are indebted to Mr. J. E. Schwitzer, assistant chief engineer of the C. P. R. at Winnipeg, for the information concerning the new line, and our halftones were made from photographs sent us by Mr. Bronson, the advertising agent of the company.

WHITE MAN'S PASS, CANMORE, ALBERTA, CANADIAN PACIFIC.

The Brick Arch.

At the November meeting of the Central Railroad Club, Mr. George Wagstaff read a paper on "The Relation of the Brick Arch to the Efficiency of the Present Day Locomotive Boiler," after briefly reviewing the development of the locomotive boiler.

A review of the history of the Bituminous Coal Burning Locomotive brings forth most prominently the importance that the brick arch played in the earliest attempts to burn bituminous coal, and when the problem of changing from wood to coal necessitated the successful burning of bituminous coal, the motive power officials used the brick arch as one of the efficient appliances to bring about that result and a careful review of the opinions of motive power men of that period shows the high regard in which the brick arch was held, and clearly demonstrates its recognized value in locomotive operation at that time.

As the burning of bituminous coal became an easier problem with the increased knowledge, gained from experience, the brick arch commenced to receive less attention, and, as the efficiency of the locomotive boiler was not a relatively important factor, the importance of the arch began to decline and it commenced to be attacked in the house of its friends, as it became easier to obtain larger boiler capacity by the simple means of increasing the size of the boiler without necessitating particular attention to its efficiency. This condition continued until recent years when we have come face to face with the proposition that the larger boiler capacity cannot be obtained by this simple means and we must work in other directions to obtain increased efficiency for which motive power officials are being called upon to-day as strongly as in former years.

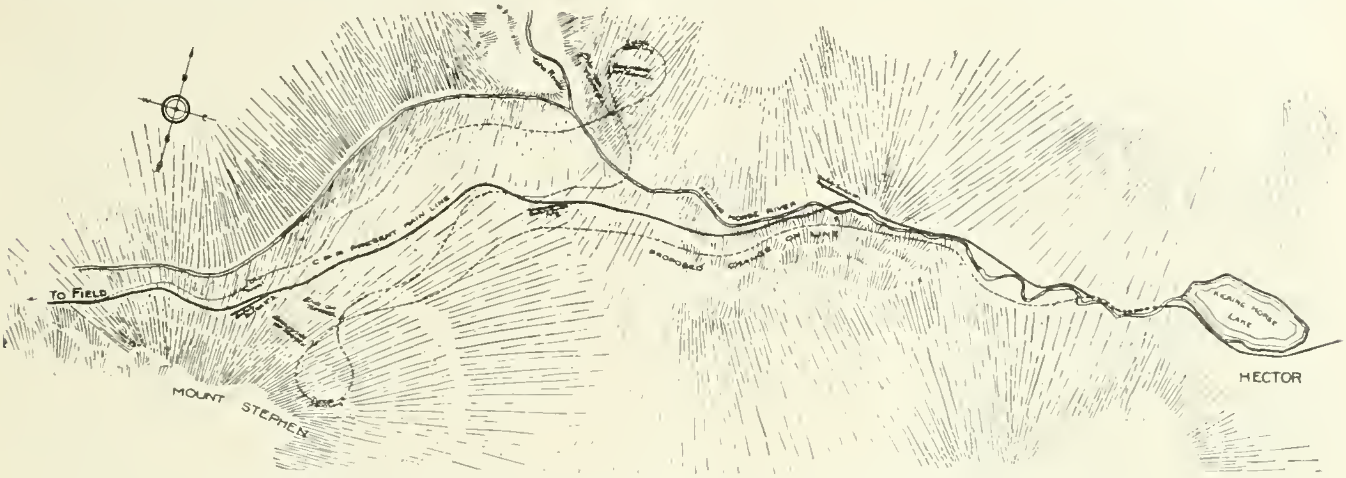
The value of the brick arch in this latter period of the history of the modern locomotive boiler, as a means of further increasing its capacity, has already commenced to be recognized by many of the best railway systems in the country. At the present time, if we may judge from the discussions of this subject by leading mechanical experts and organizations interested, we must conclude that the brick arch has again come into its own and must be reckoned with as an important aid in operating efficiently the modern locomotive.

In studying this subject from all its various standpoints, weighing the advantages and disadvantages and the opinion, pro and con, of those who have used brick arches, I cannot help but express myself strongly in my belief, that, in view of the recent great improvement in boiler care and maintenance, in addition to the successful treatment of water, and the successful improvements in hot water boiler-washing plant, etc., that the disadvantages claimed for the brick arch have almost been practically overcome.

From the earliest history of the arch there does not seem to have been any question about its advantages and its value in locomotive operation, and therefore, with the wiping out of the disadvantages, the non-use of the brick arch means the practical throwing away of a large amount of valuable power. The arch is recognized as the most efficient device for reducing the quantity of sparks thrown from the stack, and, on this account, it becomes directly valuable as a fuel saver. It increases the length of the flameway, and the finer fuel, when lifted from the grate, is baffled by the arch, and is consumed, instead of passing directly to the tubes and out of the stack in the form of sparks. It causes more equal distribution of the draft over the grate and thus improves the furnace action. Its function in the firebox being that of a mixer and baffle, bringing about a more complete mingling of the gases, and, thereby aiding combustion resulting in the higher temperature, and the production of a smaller proportion of carbonic oxide. These claims have been fully sustained by the analysis made in the locomotive tests conducted by the Pennsylvania Railroad, at St. Louis in 1904.

The two consolidation locomotives there tested were almost identical in grate area and heating surface, but one of them was equipped with the brick arch and the other was not. The draft riggings in the smoke boxes were not alike; one being arranged to clear the box of cinders, while the other allowed them to remain in the front end. However, the effect of the brick arch on sparks and cinders is shown in the total amount drawn through the tubes, which is given as an average (for the four tests at 160 revolutions) of 380 pounds for the boiler with the brick arch and 505 pounds for the one without.

The temperature of the firebox as an average of the above four tests was 2,202 degrees F. for the brick arch, and 1,982 degrees F. for the tests without it. The maximum temperature was 2,312 degrees F. with the brick arch, and 2,112 degrees F. without it. The firebox with lowest temperature had the highest amount of



PRESENT AND PROPOSED LINE OF THE CANADIAN PACIFIC RAILWAY THROUGH THE KICKING HORSE PASS, B. C.
BLACK LINE SHOWS PRESENT LOCATION. DOTTED LINE SHOWS NEW ROUTE.


MOUNT STEPHEN AND THE KICKING HORSE RIVER, CANADIAN PACIFIC.

CO due to imperfect combustion. The maximum percentage of loss of heat in coal fired due to imperfect combustion of CO was only 2.09 for the brick arch and 16.33 per cent. for the firebox without it.

The above advantages of better combustion and consequent fuel economy are only a part of the advantages to be obtained from the use of the brick arch, and to my mind, in view of the problem of the present day operation, they are the smallest. We know that the first requirements made of the motive power department, by the operating department, are to furnish efficient power in order to move the traffic, next to move it expeditiously and, last, as economically as possible.

Mr. C. H. Hogan, discussing the matter, said: I was in hopes you might call upon someone else to open this discussion. Mr. Wagstaff has prepared a paper on a subject that is most important in the proper maintenance of locomotives to-day. Knowing his experience in the proper care of locomotive boilers, I am sorry that he did not have time to deal with the subject at greater length, explaining to us just how the arch should be applied, particularly in its relation to the crown sheet, flue sheet, which play an important part in equipping our locomotives with brick arches. We know that many roads have rules governing the application of brick arches, and we might say that while until recently a standard size brick has been furnished by the brickmakers, some roads have adopted smaller sizes which are more convenient to handle. They advocate running four rows of brick, others five rows, some six. Engineers will tell you, "Well, the engine I am running isn't steaming as well with four rows of brick as she does with five." Now I am satisfied that Mr. Wagstaff can explain to us just the proper location and how they should be supported. Many roads are supporting them with lugs in the side sheet, others with arch tubes or water bars.

In the first paragraph on the third page of his paper, Mr. Wagstaff very truthfully says: "The arch is recognized as the most efficient device for reducing the quantity of sparks thrown from the stack, and, on this account, it becomes directly valuable as a fuel saver." Now any man who has ever run a locomotive and given it the proper attention knows that the brick arch is a fuel saver, and knows that if the locomotive is properly drafted and the firebox is in good condition, it makes a better steaming engine. I know from experience, and many here in this room also know it. Therefore, advice from a man of Mr. Wagstaff's experience, as to how to properly maintain and apply the arch, would be very valuable to the members.

The figures that he gives in his paper in connection with a test at St. Louis, seems to me very flattering for the brick arch. In fact, I believe that more flattering results have been obtained on railroads where the arch is in use. years ago many roads adopted the brick arch and, after what they thought was a fair test, abandoned its use. After a while they returned to it and found that they were getting much better service with the use of the arch than without it. I know from my experience in running locomotives with and without the brick arch, and having charge of locomotives under the same conditions, that there is no question but that great economy is assured in the use of the brick arch if properly applied and maintained. But we must, as Mr. Wagstaff states in his paper, give proper attention to the care of the boiler, to the feed water, and in doing that, as I said before, we unquestionably derive great economy from the use of the brick arch.

Mr. D. R. MacBain said: Not being a member of the club, I had not intended to make any remarks, but since you have kindly given me the opportunity, I feel that as an advocate of the brick arch that it would be proper for me to let you have my views on the matter. I have been connected with locomotive service all my life, have had experience with brick arches more or less for the past 25 years, as an engineer, a road foreman, master mechanic and assistant superintendent of motive power. As Mr. Wagstaff says in his paper, a great many difficulties were in the way of the proper use of the brick arch in the years that have passed; difficulties that at that time seemed insurmountable, owing to improved methods, as alluded to in the paper, together with a little better organization in engine houses to take care of the proper cleaning of grates, adjusting of arches and cleaning out flues, and in so far as we are concerned we do not find any difficulty, or, at least, not 5 per cent. of the difficulty at the present time that we used to have in maintaining arches in our locomotives. I wish to say, too, that after you have drafted your locomotive as fine as skill can possibly do it, without a brick arch, that by a slight readjustment and the application of a properly proportioned brick arch into that engine, you can increase its efficiency, especially in high-speed passenger service, not less than 10 per cent., and at the same time effect an economy of anywhere from 5 to 15 per cent.

ANGUS SINCLAIR SPEAKS.

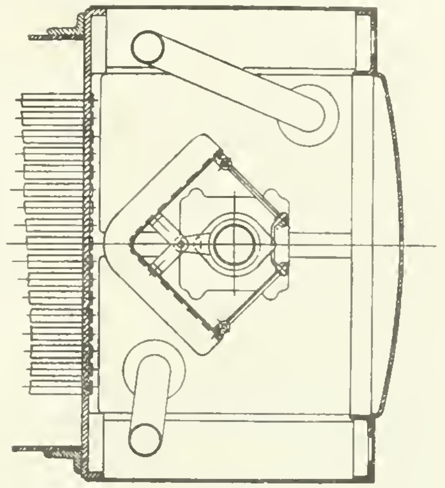
Dr. Sinclair, when called upon by the president, to speak on the subject, said: "Mr. President and the gentlemen of the Central Railway Club, I am one who is in with the best of the brick arch and at one time it had a great deal to do with it. Consequently, I may be able to say something of value to the club, something that will coincide with the views of some of the speakers and something that will be against others. It is very gratifying to find so much intelligent discussion of this subject, which has always been a difficult one, one that aroused great conflict of opinion among those operating locomotives. When I went firing a locomotive first, the brick arch had just been introduced into Scotland; it was about the same time as it was introduced into New England by George S. Griggs, who is entitled to be considered the father of the brick arch. Under the system that I fired, enginemen were allowed a premium for fuel saving; he was allowed a certain amount of fuel per hundred miles and it was regulated according to the trains; the ton mileage had not come into use, but they struck an average of the amount of coal necessary to run certain trains and the premiums were established on that. Consequently it was a fair, practical way of establishing a premium; the men had very little to say against the justice of the premium, consequently you may infer that it was fair. Well, every engineman on the road was interested in saving coal and we would no more think of running without a brick arch than we would without a fire scoop. If the brick arch came down no one would think of taking the engine out again until the brick arch was renewed. In the first place, I suppose it was on the account of draft appliances being adjusted for the brick arch that it worked to perfection. An engine would always steam better with the brick arch than without it.

I think where there have been difficulties with the brick arch, in any country, or on any railroad, it has been for want of proper adjustment between it and the other draft appliances. The brick arch is to be taken into consideration when an engine is being drafted. To draft it in a standard way without the brick arch, it will not be satisfactory. The brick arch has been considered beneficial in two ways. That is, I am speaking of my own experience with brick arches. The public authorities were very strict with us regarding causing smoke; they were inclined to pull a fireman off the engine if he made much smoke with the engine, and the principal smoke-consuming device was the brick arch and methods of admitting air above the fire—a baffle plate or something of that kind, and my own experience was that you could prevent smoke much more readily when the brick arch was in use than without it. The philosophy of that is very well understood; you have a higher firebox temperature where gases are mingling and consequently there will be a better combustion than without the brick arch. As a reservoir of heat in a place where the gases pass over, it has a very great value. So far as the difficulty of keeping it in condition is concerned, that has happened, to a great extent, from want of care. If you put a brick arch into a locomotive—as I have seen done in this country—and say, "There you are!" and do no more about it, do nothing about the draft appliance, but just say, "There's the brick arch," it is sure not to do well. The thing requires care and attention just the same as every other appliance about a locomotive. Someone said that those who abandoned the brick arch probably knew what they were about. I have seen a great many things abandoned by people who thought they knew what they were about and they didn't know what they were about."

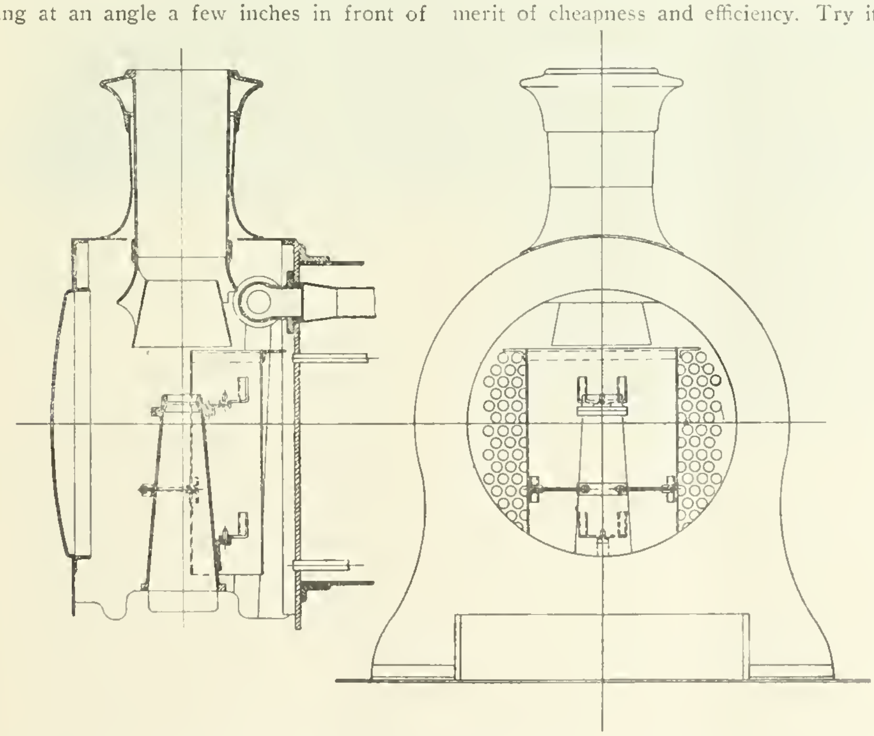
Spark Deflector on the Caledonian.

The Caledonian Railway engines are equipped with a novel form of spark arrester, or spark deflector, which has given every satisfaction. It is an example of design where easy removal is a prominent and valuable feature. Mr. John F. McIntosh is locomotive superintendent of the railway.

The spark arrester consists of two vertical planes formed of steel plates meeting at an angle a few inches in front of the vertical center line of the tube plate. In plan the section of the planes is a V with the apex next the tubes, and the blast pipe in the opening of the angle. The arrester extends from the bottom of the hood down to the level of the lowest row of tubes. To permit of the cleaning of the tubes, the V-shaped deflector is pivoted on its supports on the blast pipe, and so can be easily turned to either side, to give free access to the tubes. Two diagonal stays at the front lock it in the central position; and it can very readily be removed from the smoke box by lifting it off the pivots. The main purpose of the invention is to deflect live sparks away from the current of steam issuing from the blast pipe, and to induce piling up of the cinders in the front portion of the smoke box away from the tube plate, and so keep the lower rows of tubes clear. As the cinders are piled up at the front they gradually roll back, but as they are within the angle of the deflector plate they are largely kept away from the tube plate. Experience has shown that the live cinders are broken up on striking the deflector plate, and that whatever cinders are thrown out are black, and consequently harmless.



PLAN OF CALEDONIAN SPARK DEFLECTOR.



SPARK DEFLECTOR ON THE CALEDONIAN RAILWAY.

The best correspondence school course a railroad mechanical man can undertake is the careful study of first "Locomotive Engine Running," and second, "Twentieth Century Locomotives." These two books form an elementary course; then an advanced course in engineering. Both books give the instruction in attractive form which prevents the student from becoming weary in well doing. This course combines the merit of cheapness and efficiency. Try it.

The Danish Parliament has approved a bill providing for the construction of a railway bridge, two and a half miles long between the islands of Seeland and Falster. The work will cost about two and a half million dollars, and is expected to be completed in three years. The bridge will be provided with an opening span to allow for the passage of vessels.

Locomotive Works at Gary.

The American Locomotive Company have purchased a plot of 130 acres of land at Gary, Ind., and plans are being drawn for a new plant which officers of the company say will be the most complete and best equipped locomotive works in the world. The land purchased is twice the extent of that of the largest of its present plants, and when fully occupied will give employment to from 12,000 to 15,000 workmen. The land adjoins that of the new works of the United States Steel Corporation. This site was selected at Gary, 24 miles from Chicago, to provide for the territory where the largest number of railroads converge to a single commercial center. The Chicago district is a great railroad center, and that district is rapidly developing in manufacturing importance. This fact renders it favorable as a location for securing material for building locomotives. This company now operates plants in Schenectady and Dunkirk, N. Y.; Pittsburgh and Scranton, Pa.; Richmond, Va.; Paterson, N. J.; Manchester, N. H., and Montreal, Canada. At present there is no large locomotive plant west of Pittsburgh, and the selection of a site in the Chicago district provides additional locomotive building capacity where it is most needed for prompt and direct delivery to a large number of railroads. The size of the new plant will, it is said, be sufficient to provide liberally for the growing needs of the railroads for years to come.

The new files produced by a Sheffield firm are stated to be the result of much experimenting, in which a special chrome steel has been developed. Under test, one of the files, making 270,000 strokes in eighty-eight and one-quarter hours, has removed ten and one-quarter pounds of filings—a much greater efficiency than the ordinary files can show.

2-8-0 for the Lehigh and Hudson River.

The Lehigh & Hudson River Railway have recently received from the Baldwin Locomotive Works twelve Consolidation type locomotives for use in heavy freight and coal traffic. These engines are employed in the anthracite regions, and are equipped with boilers of the modified Wootten type. The tractive force exerted by one of these engines is 41,140 lbs. The cylinders are single expansion, 22 x 28 ins., equipped with balanced slide valves which are driven by the Stephenson link motion. The driving wheels are 56 ins. in diameter. The eccentrics are placed on the third driving axle, and the link-blocks are connected to the rocker shafts by transmission bars which span the second axle. The guides are of the alligator type, and are braced by a wrought iron yoke which is made in one piece. The pistons are packed with cast iron snap rings, which are carried in a bull ring, and the piston heads and followers are made of cast steel. This material is also used for the frames, driving boxes, main wheel centers, back cylinder heads and crosshead bodies. Brass hub-liners are fitted to the wheel centers, and are held in place by through bolts which are countersunk in the liners, and have nuts on the outside. Grease lubrication is provided for the crank pins, with cups forged on the rods.

The fuel used by these engines is a mixture composed of buckwheat anthracite and bituminous coal in proportion of about two to one. The grate is made of water tubes and drop bars. The firebox cross section shows an almost entire absence of flat surfaces in the side sheets, and a most favorable disposition of staybolts. The application of flexible staybolts is limited, in this boiler, to the throat sheet, where 48 are applied. The two fire door openings are 16 ins. in diameter, and are spaced 37½ ins. between centers. The mud ring is of cast steel, and is supported by buckle plates at each end, and also at mid length, by cross bearer supported on the engine frames.

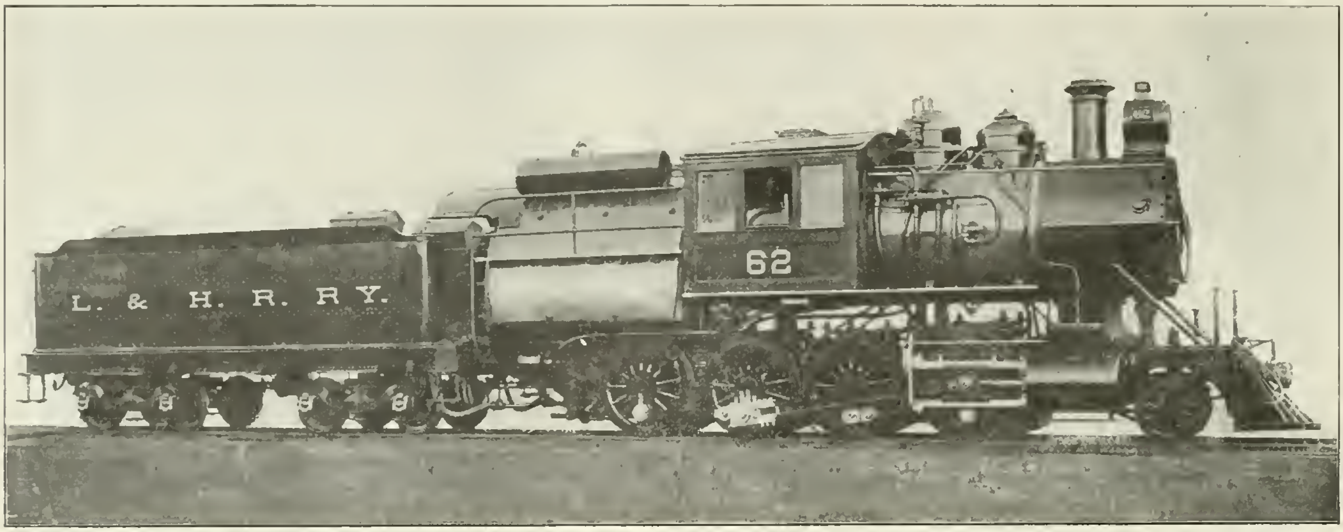
As originally built, the Wootten boiler was fitted with a combustion chamber, but this feature is omitted in the design under consideration, and the back tube sheet is straight. The flat surface under the tubes is stayed by two long tie rods with turnbuckles in the center, which are anchored on the front tube sheet. The barrel of the boiler is built with two rings. The diameter of the front ring is 70 ins. These rings have quadruple riveted longitudinal seams. The dome is placed on the first ring, forward of the cab. The smokebox has a short extension, under which is placed a cinder pocket. The diaphragm plate has two rows of horizontal draft openings cut in it, and is provided with an adjustable plate at its lower end. A high blast nozzle is used with a straight stack. The heating surface amounts to 2,864 sq. ft. This is made up of 178 sq. ft. in the fire box and 2,868 in the tubes, of which there are 336, each 15 ft. 4½ ins. long and 2 ins. outside diameter. The tubes are iron, No. 11 gauge. The grate area is 75.6 sq. ft., and this gives a proportion to the total heating surface as 1 is to 38, very nearly.

The weight of the engine itself is 189,650 lbs., and of this 170,600 rests on the driving wheels, while the truck carries 19,050 lbs. When the weight of the tender is added, the total comes up to about 329,000 lbs. The wheel base of the engine is 23 ft. 8 ins. The driving wheel base is 15 ft. 4 ins., and the wheel base of engine and tender is 55 ft. 9 ins.

This locomotive is equipped with two air pumps, both of which are placed on the left side, in front of the cab. The air drums are mounted above the fire box. Both injectors are placed on the right side, while the checks are located right and left, near the front end of the barrel. The tender carries 7,000 gallons of water and 12 tons of coal. The frame is built of 12-in. channels, and the trucks are of the equalized type, with chilled cast iron wheels.

Our half-tone illustration shows the principal features of this design, while the general dimensions are given in the table below:

Boiler—Material, steel; thickness of sheets, ¾ in.; working pressure, 200 lbs.; staying, radial.
Fire Box—Material, steel; length, 114 7-16 ins.; width, 95⅞ ins.; depth, front, 57 ins.; depth back, 54 ins.; thickness of sheets, sides, 5-16 in.; thickness of sheets, back, 5-16 in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.
Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Driving Wheels—Outside diameter, 56 ins.; journals, 9 x 10 ins.
Engine Truck Wheels—Diameter, 30 ins.; journals, 6 x 10 ins.



CONSOLIDATION ENGINE FOR THE LEHIGH AND HUDSON RIVER RAILWAY.
R. T. Jaynes, Master Mechanic. Baldwin Locomotive Works, Builders.

Compressed by Falling Water.

In a novel American plan for driving motors by compressed air from a fall of water, three five-foot shafts are sunk behind a dam to a depth of 330 feet, ending in a chamber having a capacity of 70,000 feet. As the water falls down the shaft it carries air and compresses it in the underground chamber to as much as seven and three-quarters atmospheres. The compressed air is carried to the motors by a pipe, and the water rises through a tail-race to a level above the dam. The water is allowed to fall in such a way as to entrain, or one may say entangle, particles of air—the weight of the water compresses the air particles. In developing 5,000 h. p. 82 per cent. of the theoretical power is realized. The first cost of such a plant is large, but the expense of maintenance is quite insignificant.

General Correspondence

Locomotive Firemen's Association.

Editor:

Again referring to the Roundhouse Foremen's Association proposition I wish to say: There was published in the November issue of the *Railway Journal* an article from Mr. E. F. Fay, president of the International Railway General Foremen's Association, in which he says he cannot see what could be gained by the formation of a Roundhouse Foremen's Association as long as the organization of which he is the president is already here. He extends the "glad hand" to us now, though I have never heard of its being extended before this talk commenced.

However, for those who who did not see his letter and possibly will not see my reply to it in that publication, I enclose a copy of my reply, which I wish you would publish, if consistent, in RAILWAY AND LOCOMOTIVE ENGINEERING in order that our men may see from which direction opposition may be expected. It is very nice of Mr. Fay to welcome us to the general foremen's organization, but the New England Association of which Mr. Avery is the secretary looks vastly better to me for our business.

A. B. GLOVER,
Roundhouse Foreman Perre Marquette Railroad.
Toledo, O.

MR. GLOVER'S REPLY TO MR. FAY IN THE RAILWAY JOURNAL:

Replying to an article in your November number from Mr. E. F. Fay, President International Railway General Foremen's Association, will say: The "welcome" sign hung out by him to roundhouse foremen to join the General Foremen's Association is the first one I have ever seen, nor can I find one of the 15 roundhouse foremen on our system who has been invited to join them. While I agree with him that any man can gain useful knowledge from the reading of the General Foremen's Association papers, still I maintain the work is vastly different.

The roundhouse mechanic should be trained along the lines of "resourcefulness." He should be taught to do things with the means at hand, and do it in a hurry, and still do it well.

I guess most of us have seen some good roundhouse man grab up "something" and do a job, and get the engine going while a back shop man would be trying to explain to his helper just what tools he needed. How many back shop men would think, when an engine returns to the house with a pin collar broken, and none in stock, to grab a large truss rod washer off a car and put it on and get her going again.

No! Nine times out of ten he would get a lot of tools and begin to get measurements and tie the engine up until another was made. While I do not recommend this kind of work when proper repairs can be made, still I maintain that the successful roundhouse foreman is the man who can quickly make necessary repairs and get the power going with due regard to safety.

Anyone can make a good looking job when business is slow and engines are not badly needed. But when the wires are being burned up with messages such as "No power available at ———," it is time to forget the fancy jobs and get 'em going.

I do not believe that the General Foremen's Association would care to bother with ideas of this kind, for who has not seen the looks, and heard the sarcastic remarks of some back shop foreman directed at a job more useful than ornamental, that has been done by some good roundhouse man in a pinch.

A. B. GLOVER.

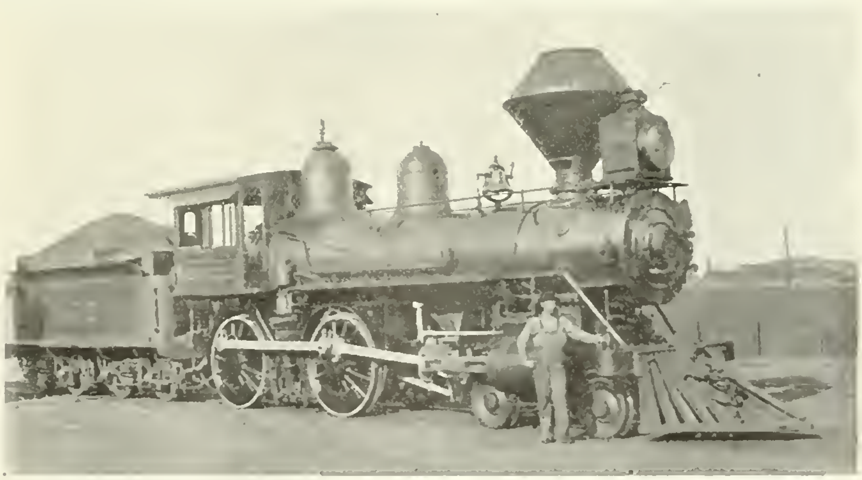
[We are sorry that Mr. Fay did not send us his opinions for publication. The columns of RAILWAY AND LOCOMOTIVE ENGINEERING are open for the fair, candid and free discussion of any topic of this kind and we would like to hear the opinions of others on this subject. If there are good arguments against the formation of the Locomotive Foremen's Association now is the time and this is the place in which to state them.—Editor.]

Southern Pacific Diamond Stack.

Editor:

Seeing your article in the December issue of your valuable paper, "Where Are the Diamond Stacks?" If you can use this photograph I gladly contribute it. This locomotive is still in service, and was running out of Oakland, Cal., Western Division, Southern Pacific Company, at the time this photograph was taken, but has since been converted into a straight stack oil burner. Respectfully yours, a subscriber.

E. T. FRICK.
West Oakland, Cal.



4-4-0 WITH DIAMOND STACK ON THE SOUTHERN PACIFIC.

Position for Headlight.

Editor:

Dear Sir:—Referring to the article on "The Diamond Stack" on page 13 of your January number, your correspondent closes his letter with a paragraph in which he attacks the practice of locating the headlight on the smokebox door.

The enclosed cuts show the development of the locomotive on the Illinois Central Railroad from 1836 to 1909 and one of those developments was changing the location of the headlight to the smokebox door on the pacific type engine, which was done also on all large passenger and freight engines on this road.

This may not appeal to the person with an appreciation for the artistic, but it does appeal very strongly to the persons who are interested in having a well-burning and effective headlight.

In this position there is much less tendency toward letting the light remain uncared for, and the reflector uncleaned, on account of being more easily accessible. The light is much more effective on account of being nearer the track, and last (and also greatest), with the light located here much less trouble is experienced with lamps smoking and being extinguished due to wind and to currents of air at high speeds.

After having given this a thorough trial, master mechanics, roundhouse foremen, enginemen and all concerned agree that the proper place for the headlight on a large locomotive is on the smokebox door.

H. O. McClain,
Chicago, Ill. Draftsman I. C. R. R.

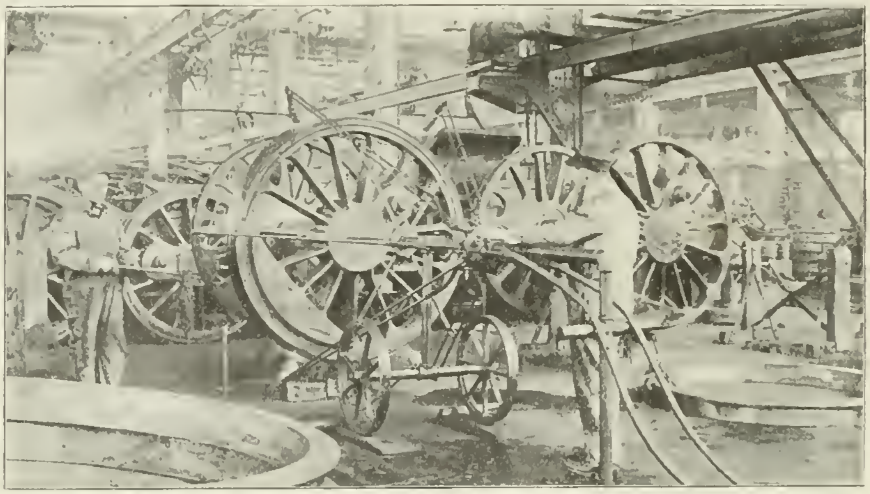
Crude Oil Tire Heaters.

Editor:

The Lehigh Valley Railroad Company have recently introduced crude oil tire heaters at their repair shops at Sayre, Pa. These heaters have been found far superior to the former method of using gasoline and perforated rings for the application and removal of tires. The heater for removing tires consists of six oil burners mounted on an adjustable frame, the operator being able to adjust the burners to any desired diameter.

The frame consists of an arrangement of wrought iron pipe mounted on a pair of wheels. On the main part of the frame a combination air and oil chamber is arranged to slide forward and back, and, in conjunction with a six-point star the various adjustments of the burners are produced. On the front side of the supply chamber six ball joint connections are made to connect the air supply with the burners and piping arranged to connect the burners with the supply chamber. When using gasoline for removing tires, two men would take from 20 to 50 minutes in removing a tire, while with this heater from 7 to 11 minutes are required.

While the old tires are being removed new ones are piled up on the three cast iron blocks and a large crude oil burner is placed underneath, the burner having the capacity to fill the inside of eight tires with flame, and heat them for application in 20 minutes. Inasmuch as both heaters are comparatively smokeless, there is perfect satisfaction.



CRUDE OIL TIRE HEATERS, L. V. R. R. SHOPS, SAYRE, PA.

During a test six old tires were removed and six new tires were applied in one hour and 52 minutes.

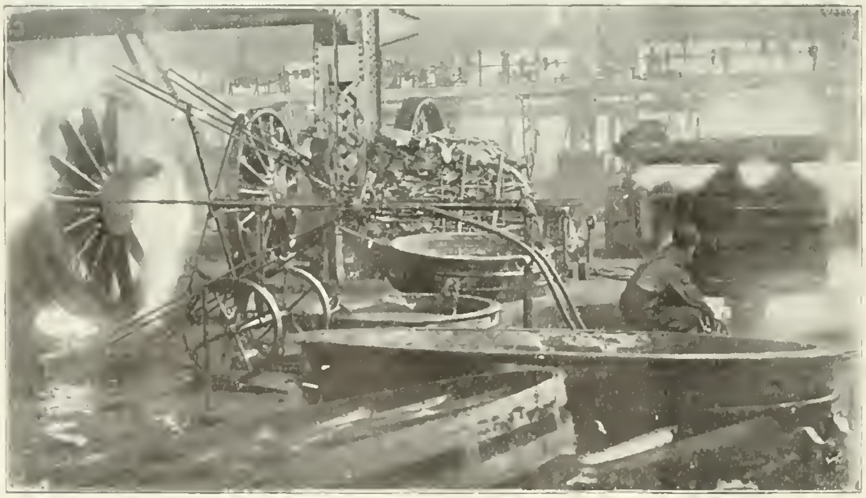
J. M. Hamm,
Sayre, Pa. Machine Foreman.

Bank vs. Level Firing.

Editor:

Having read the article written by Mr. Lee on "Bank vs. Level Firing," I am at a loss to understand how Mr. Lee's system can be adopted with any advantage where bituminous coal is used. The most difficult problem we have to contend with in the burning of bituminous coal is the bringing about the perfect combustion of volatile matter, or of the gaseous portion of the coal, which is most difficult to burn. My thirteen years' of experience with all kinds of bituminous coal has taught me that in order to accomplish this, small charges must be added at frequent intervals in order that the igniting temperature of the volatile matter will be maintained in the firebox at all times. In other words, heavy charges of coal consume large quantities of heat, and also give forth large volumes of gases at a time when the temperature has been lowered below the igniting temperature. Combustion is a subject most interesting to me, and I would like to hear a further discussion from Mr. Lee and others.

J. A. Brothers,
Minot, N. D. Engineer.



HEATING TIRES AT THE SAYRE SHOPS OF THE LEHIGH.

Air Brake Association Matters.

Editor:

For the information of your readers we beg to say that the next and Sixteenth Annual Convention of the Air Brake Association will be held in Richmond, Va., beginning May 11, and lasting through three or four days' sessions. The Hotel Jefferson has been selected by the Executive Committee as headquarters for the convention. This is the first air brake convention held in that vicinity and it will no doubt be very well attended.

Under separate cover we are sending you for review a copy of the proceedings of the fifteenth annual convention, held in St. Paul, beginning June 9, last year. There are some features about this that will doubtless be interesting to your readers should you care to give it an ordinary notice. As you are doubtless aware the Air Brake Association's membership is composed of men from all branches of the air brake service, and all of them from the firing line of daily experience. In such capacities they are well adapted to know what is going on in the air brake service and therefore to be in a position to make certain recommendations regarding practices, etc. We believe that it has been through their services that the air brakes on freight equipment throughout the country has been so greatly improved and reclaimed, assisted by the efforts of the Interstate Commerce Commission, which invariably has representatives at all of the air brake conventions. Another feature is the recommended practice of the association, which is being gradually built up from the experience of its members, and which will doubtless be of considerable value in the future in co-operative work between the Air Brake Association and the Master Car Builders' Association.

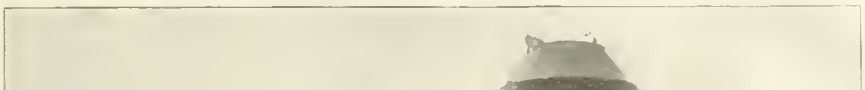
Another important and growing function of the Air Brake Association is the preparing and supplying of proper air brake instruction material to railroad employees. This feature is the outgrowth of published deliberations of the Air Brake conventions whose members are so intimately engaged in daily practical work and are eminently fitted to furnish such instruction. To meet this demand an able Instruction Committee has been appointed to construct and formulate air brake instruction matter. The 400 questions and answers on the ET equipment is the important product of this committee, and the Westinghouse 8½ in. cross compound pump, also the L and R types of triples, will be reported on at the next convention. A committee has also been appointed to formulate questions and answers on the latest N. Y. A. B. Co.'s devices. F. M. Nellis,

Boston, Mass. Secretary A. B. Assn.

Diamond Stack Engine on the C. & E.

Editor:

In the December number of your paper I saw where a correspondent wished to see an old diamond stack again, and I hope there will be a large number of pictures contributed, for they "look good" to me. I enclose a photograph of an engine that I took at Corvallis, Ore., a short time ago. The engine runs on the Corvallis & Eastern Railroad; they have seven engines, all with smokestacks like this one.


ENGINE NO. 4 ON THE COALVILLE & EASTERN.

The engines are clean, and appear to be in first class shape, and make a man that has to run heavy engines in pool service sigh for the good old days when each man ran one engine.

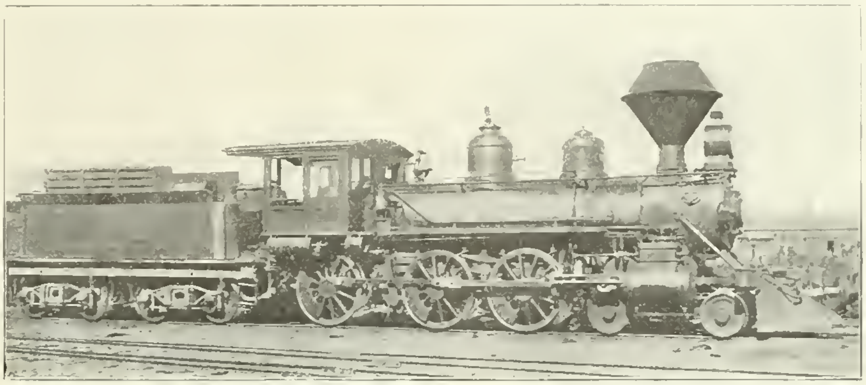
The person standing beside the engine is Jess Brown, the fireman. I regret that Mr. R. E. Moore, the engineer, was not there to appear in the picture. Wishing you and all employed on your valuable paper a Merry Christmas and a Happy New Year. H. L. Arey,

Portland, Ore. Engr. So. Pac.

The Diamond Stack in the West.

Editor:

I noticed an inquiry by one of your correspondents in the December issue of Railway and Locomotive Engineering relative to engines equipped with diamond stacks and your request for a picture of a locomotive so equipped.


4-6-0 ON THE MARICOPA & PHOENIX RAILROAD.

I enclose herewith a picture of engine No. 2, M. & P., equipped with a diamond smokestack, which was taken about a year ago, while the engine was being used on the Maricopa & Phœnix Railroad in work-train service. Since that time the diamond stack has been removed and replaced with a straight stack, and the engine renumbered 199, M. & P. This engine is now being used on the Arizona & Colorado Railroad between Cochise and Pearce, Ariz. Trusting this will give your correspondent the information desired. C. M. Hornbaker,

Chief Clerk Shops, M. & P. R'd.

Phœnix, Ariz.

History of Old Timers.

Editor:

Wishing you and yours a happy New Year, I will commence my regular business of faultfinding. As you are well aware, it is something I enjoy, and there is little else for me now in this world that I can take any pleasure in. You know my weakness for locomotive history, especially concerning those in my boyhood days, and it would do me much good to have such things correct, for the benefit of those that will come after me. I see that our friend Mr. Blauvelt has furnished some history that will not stand the test of investigation. He can easily find out if he will only consult his old friend of 83 years of age. The "New York" was one of a lot that was built in the early 50's, not 60's. There was the "Pennsylvania," "Elizabeth," "Westfield," "Plainfield," etc. They all had cylinders 15 x 20 ins. and weighed about 25 tons each. The "New York" differed from the others in having the drop hook motion and independent cut-off; the rest had a V-hook with the graduating cut-off. The passenger engines had a 5½-ft. driver, and the engines used on freight, of the Raritan class, had 4½-ft. drivers. If you will go to the trouble to see Mr. Blauvelt and mention some of these things, I am quite sure he will remember them. The photograph shows the "New York" as rebuilt, with, I think, a link motion. The photograph of the "Somerville" on the B. L. & N. R. R., is good; it went there in March, 1870, and a mate with 5-ft driver, name "Groton," went at the same time. About the "Eddy Clock" I will say much of it is fairly correct. Engines with the 75-ins. drivers had cylinders of 17x22 ins. There were a few passenger engines with 5½-ft. wheel that had 26-in. stroke. One was the "Plymouth," 16 x 26 ins., and another 17 x 26 ins., which was run by Joe Desoe. So far as the expansion being allowed in the saddle, it was not. These engines did not have any saddle; the cylinders were bolted to the smokebox and frame; the expansion of boiler was provided for where the smoke box was attached to the boiler by means of slotted holes. If any trouble came from this arrangement, it was not made known to those that worked on and around those engines.

The statement that "one of the 18¾ x 28 ins. eight-wheelers was put to the test with a mogul, built by the Rhode Island Works," is, to say the least, misleading. There were two of Eddy's engines that were tested, but their cylinders were 18 x 26 ins., the "Virginia" having a 5-ft. wheel, and the "Adirondack" a 4½-ft wheel, same as the mogul. Joe Desoe, engineer, ran the Eddy engines on these trials, which is on record, and can be found by anyone interested in getting facts for themselves, in the Locomotive Engineer's Journal for December, 1876, page 541.

If you think such things should be nearer correct, you may fix them as appears the better way, if they are good enough to suit you, I will not do any more kicking about them. HENRY F. COLVIN.

Philadelphia, Pa.

Locomotive Frame Failures.

Editor:

The article on locomotive frame failures by Mr. F. P. Roesch in the December number of RAILWAY AND LOCOMOTIVE ENGINEERING is very interesting and bears on a subject of great importance to all motive power men, especially since the advent of the heavy engines now in general use.

Repairing a broken engine frame is not an inexpensive job by any means, to say nothing of the inconvenience and loss caused by taking this engine out of service while the repairs are being made, and it seems rather strange that men in charge of motive power have not given more attention to the causes of such frame failures. As it is, the engine is generally

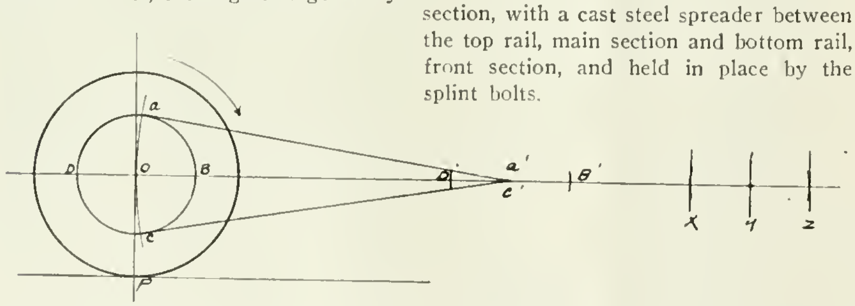


FIG. 1.

rushed into the shop or roundhouse, repairs hurriedly made, and rushed out again with very little investigation of the cause and means to prevent a repetition of the failure.

There is little doubt that, if the unknown causes of all frame failures in the country in one year were known, the railway curve would claim by far the greater part of them.

While Mr. Roesch states that the 4-6-0 type of engine has been observed to have the most frame failures from unknown causes, my own more limited observations would seem to indicate that the Atlantic type engine 4-4-2 and 4-6-2 are the worst offenders, especially the former, and I have known engines of this type to repeatedly break frames when there were practically no curves of any consequence on the division over which they ran.

I remember one instance especially

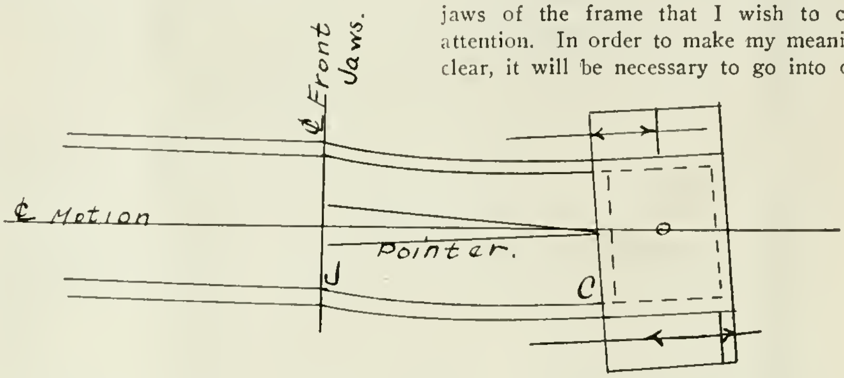


FIG. 2.

since it fell to my lot to get the engine ready for welding the frame. This was a 4-4-2 engine in fast passenger service with practically no curves to contend with.

In talking with the engineer in charge of the engine when the frame was broken, he informed me that after getting up speed from a station stop, he had suddenly hooked the reverse lever up in the running notch and at the same instant had felt a violent jar and lurch of the engine, but as everything seemed to be all right he went on to the terminal, where it was found that the top rail of the right frame was broken just in front of the forward pedestals. In removing the splin bolts, about half of them were found to be broken, some of them in two or three pieces.

The frame was of cast steel, 4½ x 4½ in. section, with a cast steel spreader between the top rail, main section and bottom rail, front section, and held in place by the splint bolts.

It is evident that the broken bolts were a large factor in the ultimate cause of the frame failure, but what caused the bolts to break? The were not broken in tension as they did not show the slightest elongation or reduction of area at the fracture, neither did they have any of the earmarks of wear.

In examining the character of the fracture, however, they were found to be crystallized and very brittle, and curiously enough some of them were broken lengthwise, showing the fibrous character of the iron and resembling pieces of petrified wood. What caused the crystallization is not clear unless it was due to the constant vibration of the frame and a sudden shock snapped them off.

It is of the vibration set up in the frames and the shocks absorbed by them due to the varying forces acting on the crank pins and counteracting on the jaws of the frame that I wish to call attention. In order to make my meaning clear, it will be necessary to go into details rather carefully, although the crankpin forces, their relative amount, direction, and the part they play in the motion of the engine are more or less familiar to all students of the locomotive.

In the Fig. 1 it is assumed we are dealing with the right side primarily, and for clearness the main rod is connected to the front driver, although of course it is understood that the force acting on the main pin is distributed equally on all the crankpins on the side.

A B C D is the path of the center of the crankpin, A, B, C and D show the quarter position of the crank, and A', B', C' and D' the corresponding positions of the wrist or crosshead pin. B is the point of contact between wheel and rail, and O, the center of the driving axle may be considered as the point of reaction on the jaws of the frame; X, Y and Z are the positions of the piston corresponding with the positions of the crosshead pin. It is assumed that the valves have a certain amount of lead and that the engine is moving forward.

Now if we consider steam as acting on the front fore of piston at Z, the reaction at O will be maximum when the pin is at B, decrease to a minimum at C and again increase as it approaches D to the point of release. When steam is admitted behind the piston at X, the reaction at O is maximum at D, decreases to a minimum at A, and again decreases to the point of release, but the motion is in the opposite direction, as the pin moves from C to D, and from A to B, the force reacting at O will not increase in the same proportion as it decreases from B to C and D to A, owing to the decreasing effective pressure acting on the piston after cut-off takes place.

The main point to bring out, however, is that the entire force applied to the crankpin at D in the forward stroke and at B in the back stroke, is absorbed by the frame, the former tending to telescope the frame, the latter to pull it apart.

Right here it may be said that many men do not recognize the fact that the two forces acting on the pin at A and C impart motion to the engine in two entirely different ways. In the backward stroke of the piston and as the pin moves from B around to D, it is the steam acting on the front cylinder head that moves the engine ahead, while the piston and crank end of main rod remain almost stationary in relation to the ground, for the crank end of the main rod could be dropped to the ground and braced against a tie, and the engine would move forward the full stroke of the piston just the same, and, in fact, far more effectively, since there would be no reaction of the crankpin force at O. In the forward stroke from D to A the force is applied by means of a lever, A being the force applied, the reaction on the frame join at O the delivered force, and P the fulcrum.

If now we consider the left side of the engine in conjunction with the right, we find that if the right pin is at B, with a maximum reaction at O, backward, the left pin is at A with the reaction at O, in the opposite direction. With the left pin at B and the right at C, the reaction at O will be in the same direction, and so on around.

From this bewildering slough of acting and counteracting forces, two facts stand out plainly. (1) That in one revolution of the driving wheel the frame is subjected to a strain in both tension and compression, due to the reciprocating forces on the crank pin, and, in addition to this, a continuous tensional strain due to the resistance of the engine's load, represented by the draw-bar pull. (2) That in one revolution of the driver, the frame is subjected to a horizontal bending strain perpendicular to the center line of motion, caused by the forces absorbed by one frame being of different direction and intensity to the forces absorbed by the other, and to the corresponding reactions on the cylinder heads, which results in a momentary twisting of the cylinders and cylinder saddle around their center. This is shown in an exaggerated way in Fig. 2.

The point of greatest resistance to this bending or twisting movement is evidently just over or just ahead of the front pedestals, since this is the point of first support. It is evident that as the length J to C is increased, the bending strain on the frame at J will increase also. This also holds true in the case of an engine going through a curve.

An increase in wheel diameter will increase the reaction between the frames and cylinders without increasing the tractive power. I mention these two facts because they are apparently two reasons why more frames fail on passenger engines than those built for freight service.

I have heard motive power men contend that no force acting on the pistons could cause a noticeable twisting of the cylinders and saddle, but anyone having the inclination and opportunity to do so, can prove the fact by fixing a pointer to the center of the back end of the saddle and extending it back to a marker board braced across the front jaws.

The twisting movement of the saddle will be traced on the board by the end of the pointer.

Right here let it be understood that in speaking of frame distortions and cylinders out of line, we are not dealing in inches, or half-inches, necessarily.

We all know what a side rod that is ⅛ in. too long or too short will do, and when we consider the fact that the length of the side rods, main rods and frames, etc., all have a distinct relation to each other, it follows that any undue disturbance of the relation is likely to produce serious results. When cylinders and frames are forced out of their true alignment ⅛ in. or even 1-16 in., many, many thousand

WAITING FOR THE TRANSCONTINENTAL EXPRESS ON THE CANADIAN PACIFIC.

times in the course of one trip, some part of them certainly must suffer from fatigue which sooner or later must result in rupture. As long as the reciprocating motion is used in our locomotives, these varying forms with their evil results are bound to occur, and it seems that the only remedy lies in a better design of frames and more rigid inspection in service.

Many heavy passenger engines, especially those with piston valves, are now being built in which the top rail over the cylinders is done away with, thus eliminating the objectionable splice. A broken splice bolt takes just that much metal from a frame, and should be replaced as soon as found. Then there is the question of excessive load. Now every man of a mechanical turn of mind has his own pet theory concerning lead, and a bare mention of it will often start a fight in a meeting of railroad men.

In the example cited at the beginning of this article, there can be no doubt that excessive lead was the immediate cause of the failure of an already weakened frame. The slogan of this road in valve setting was, "if in doubt, give her more," and I believe they have more blown out cylinder heads, broken crank pins, rod straps, driving boxes, pistons and frames than any road in the country.

While many engines have valves which will lift under the influence of excessive cylinder pressure, still a high instantaneous pressure might obtain in the cylinder before the inertia of the valve would be overcome. This is proved by the indicator card and the initial cylinder pressure may be, and often is, considerably higher than boiler pressure.

As to whether the frame or cylinder had studs would give way first, it might be said that if there is any lost motion in the rod brasses or in or around the driving boxes, a sudden increase of cylinder pressure might cause a shock which would rupture a frame already weak before its effect could be communicated to the cylinder head through the cushion of the water or steam.

In all cases where steel does not fail from loading beyond its ultimate strength it may be laid down as a fact that it is a gradual weakening of the metal by fatigue followed by a sudden shock that causes rupture. A. W. VESTAL.

Danville, Ill. C. & E. I. Ry.

Fire Brick Arches.

Editor:

The brick arch as applied to the locomotive firebox was first introduced as a means of preventing smoke, because of numerous complaints and law suits brought on railroads on account of the objection of bituminous coal smoke, which directly caused the value of residential property to lessen and the injurious effect on animal life.

To overcome the many costly complaints, numerous devices were designed and tried, namely: air injectors, air tubes, baffle plates, and various designs of grates to give greater air space with the object of getting perfect combustion. It has been found that the brick arch has been the greatest aid in the overcoming of smoke without the use of any of the above mentioned devices.

While the law suits against railroads are very costly, fires caused by live sparks falling on buildings, fields and forests and to the railroads' own property are even more costly. The fire brick arch has also decreased this expense, owing to the fact that 20 per cent. less sparks are thrown from the stacks, and it is safe to say that by the use of the arch more than 20 per cent. of these cases can be reduced for the reason the sparks are smaller and less dangerous.

Besides being of prime importance in regard to smoke and spark throwing, it has been found that by the use of the arch a saving in fuel is approximately 15 per cent.

The following will show some of the advantages which are gained by the use of the fire brick arch: 1st., 15 per cent. reduction in coal consumed; 2d, 15 per cent. reduction in ton miles of company's coal hauled; 3d, 15 per cent. reduction in labor of handling coal at tipple; 4th, 15 per cent. reduction in the fireman's labor in shoveling; 5th, 20 per cent. reduction in sparks thrown from the stack, thereby reducing the liability of fires along line of road, cars and buildings; 6th, a great reduction in smoke issuing from stacks, which is particularly desirable on account of passenger service and in cities where there are laws regarding suppression of smoke; 7th, less boiler work at roundhouses and shops; 8th, greater life of flues; 9th, less liability of engine failures or cars being set off along line of road account of leaking flues; 10th, less delays to locomotives at terminals on account of fires drawn for the re-rolling of flues; 11th, greater mileage for a given period of time; 12th, an improvement in the steaming qualities of the locomotive.

The total saving with respect to the use of the arch cannot be given for all items, but the following may be relied on as a saving effected in the use of bituminous coal: With the arch tubes installed, the cost of applying a brick arch to a modern wide firebox locomotive being $12, the average life of arch is 30 days, locomotive burning 12 tons of coal per day, coal at $1.50 per ton, the saving would be $69 or an estimated saving of $70 per locomotive per month. J. B. Emory.

Baltimore, Md.

Diamond Stacks at the Pacific Coast.

Editor:

Having seen the item in the December number of Railway and Locomotive Engineering, to which paper I am a subscriber, concerning the diamond smokestacks, I take pleasure in sending herewith two snapshots of the same which I took at this place. The engine at the water tank does the switching at Walla Walla for the O. R. & N. The other type, of which there are quite a few, pull the passenger trains between Starbuck and Pendleton.

OREGON RAILWAY AND NAVIGATION CO. DIAMOND STACK.

As soon as possible—it is very stormy here at the present time—I will secure a better photograph of the larger engines which pull these passenger trains for the O. R. & N. I have a large collection of films of engines, trains, yards, etc., which I would be pleased to make into postals to exchange for other railroad pictures with any person who is interested in this. Hoping you and your valuable magazine will have success. Geo. A. Kelly, Jr.

Walla Walla, Wash.

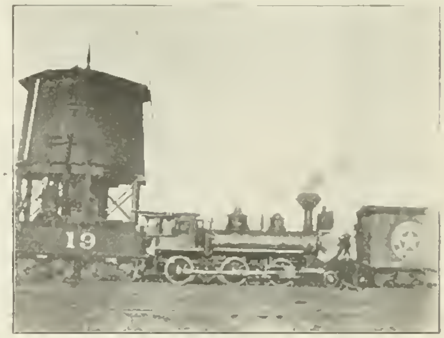
Derailments from Broken Rails.

Editor:

Wrecks and derailments caused by broken rails, and the numerous discussions on this subject held of late, make an interesting topic. In some instances the blame was said to fall upon the Master Car Builders' rules for permitting a flat spot to exist on the wheel of a 100-ton capacity car the same as it was when the 40-ton capacity car was the maximum.

At one of the recent meetings of railway officers which I attended it was theoretically demonstrated, so to speak, that the cause of the trouble was absolutely from the hammer blow subjected to the track by the flat car-wheel, and it was shown that the blow struck was in proportion to the weight and velocity of the car and the size of the flat spot upon the wheel.

The opinion of the writer, taken from a practical standpoint, differs very materially on this subject, when it refers to steam railroads. My opinion is that the trouble should be sought farther ahead in the train. In the first place, a flat spot will occur on the left main tire of a steam locomotive soon after it is put in service, and this flat spot occurs at the point of contact of the left main driving tire when the left main piston is taking steam at the forward end of the stroke, and while in this position the right crank on an American locomotive, is on the lower quarter with the steam port wide open. This flat spot is brought about by the slip of the tire upon the track, caused by the steam at the forward end of the cylinder taking up slack between the shoe and box, the wedge and box, or within the driving box, and it becomes greater, and never less, until it has reached such a size that it is considered



AT THE WATER TANK.

dangerous, and then the wheels are either put in a wheel lathe and turned, or the tires are removed and turned.

The actual hammer blow occurring on a steam locomotive is caused by the counterbalance effect, as a steam locomotive is counterbalanced to run at one certain speed, and the hammer blow therefore exists when the speed is less or more than the speed for which the locomotive is counterbalanced. This trouble cannot exist on an electric locomotive, but it will always exist upon a reciprocating steam locomotive unless the designers prepare a shell or box-shaped counterbalance within the wheel center proper, and within this box-shaped receptacle place a movable weight, balanced in springs, to act the same as a governor. The centrifugal force, caused by increased speed, will tend to force this weight out towards the rim of the wheel, and therefore offset the increased weight of the reciprocating parts, which are, in my opinion, the cause of broken rails on steam railroads. J. E. Osmer,

M. M. Northwestern Elevated R. R.

Chicago, Ill.

Engine Trucks and Firing.

Editor:

I noticed in the December number of your valuable paper a query from one of the subscribers as to the success of the swinging truck center for a "Pony" truck on engines of the 2-6-0 and the 2-8-0 type. I am, and have been running a 2-8-0 or consolidation engine for the past five years on a road where some of the curves run as high as 16 degs.

The rigid wheel base of the engine is 15 ft., the weight on the drivers is 104,800 lbs. and and the truck 16,200 lbs. The engine truck is the Bissell pattern, with swinging truck center. The top cradle bolts are 22 ins. apart, the bottom bolts are 24 ins. apart. I have never had a derailment where the fault was in the truck. I have had two derailments, but in both instances the fault was in switch points which were in bad shape. The swinging center casting of the truck just clears the cross braces of the truck frame.

I had quite a lot of trouble for a while on account of derailments backing up. I cured this by having the back tires on both sides set in 3-16 of an inch each from gauge. The four back driving wheels are flanged and the main driving wheels are bald. I noticed the two back driving wheel flanges were wearing very fast, whereas there was scarcely any wear on flanges next to the back one. After making the change as stated above the wear on flanges were more uniform. The run is 20 miles long and we back over it in one direction, or in other words, half of our work is done backing up. I will further say, I have been running a locomotive for the past 26 years. The principal part of it has been on the consolidation type, and I have never experienced any trouble from derailments where the truck was the cause.

Now a few words as to light and bank firing. I have found with the kind of coal we use here in this country—bituminous or splint coal—light firing gives the greatest satisfaction as to steam and economy. The best result is obtained from a light, bright level fire. The slash bar or poker is only used at the start to hook up and spread the fire evenly over the grates. Then the fire is fed as it needs it in the brightest and hottest places. The coal ignites quickly, bringing out the gases which are also ignited, and enter the flues in a flame that makes combustion as complete as it can be in a locomotive firebox.

Of course the fire must be kept bright on the grates, which can be done by a slight pull at the grate shaker when it is necessary. It is true the fire must be watched closely to see that no air holes get in it, especially near the flues. I claim by light firing where the grates are properly designed to let in the necessary amount of air, combustion will be more complete than with the banking system. I never could see how anyone could expect to burn green coal on top of green coal. In the banking system the door is bound to be kept open for too long a time in hooking up or spreading the fire, which I have found very objectionable.

I have never got good results from red ash coal, as it is too slow in igniting in a locomotive firebox. I have heard of cases where the firebox was well filled with red ash coal, the blower put on, and the engine standing for thirty or forty minutes until the fire was in a red heat and then make the bank and burn it successfully, but I have never experienced it. I remember once firing a few trips on a passenger run between Hinton and Clifton Forge on the C. & O. Ry. I was firing for engineer Simon Ailstalk, his regular fireman had laid off. He was a bank fireman. As we were coming up the east slope of the Alleghany Mountains he said to me: "Why is it you keep more steam and burn less coal than Thompson?" The only answer I gave him was: "I give her time to burn the coal." Thompson was a bank fireman and a poker user, dubbed sometimes a "puddler."

FRED. NIHOOF.

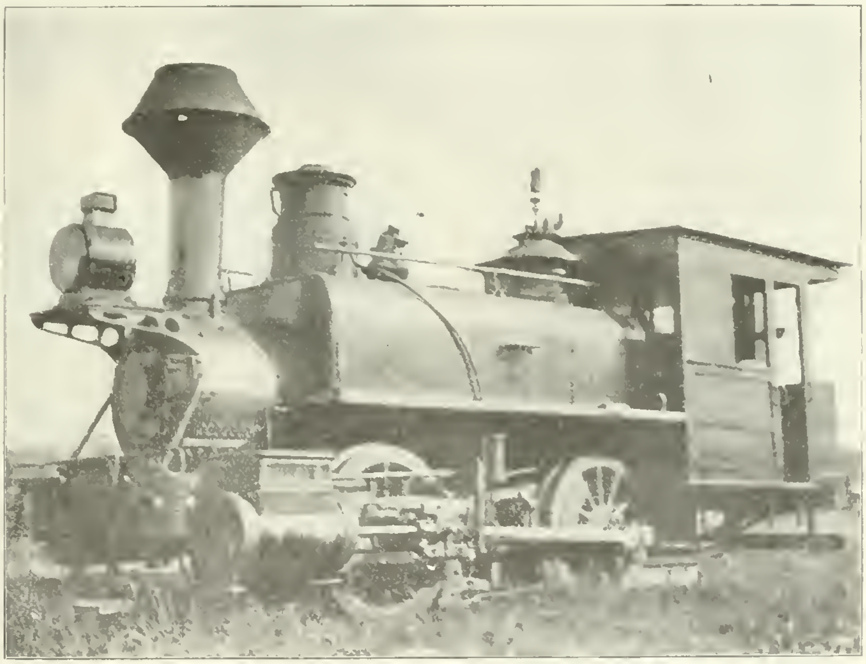
White Sulphur Springs, W. Va.

Saddle Back, Diamond Stack.

Editor:

In response to your request for pictures of old diamond-stack locomotives, I am enclosing herewith a picture of an old saddle tank engine owned by this company, No. 401. This engine has been in service since 1872 and is still used in shifting service around the quarries of the Dolese & Shepard Company, who own and operate large stone crushing plants in the vicinity of Chicago. Trusting you will find this picture to be of interest and will be able to use same.

C. H. TERPENING,
Secy. to Prest., Chicago & Illinois Western.
Chicago, Ill.



SADDLE BACK ENGINE ON CHICAGO & ILLINOIS.

Time and Money Saver.

Editor:

There was a time when a broken casting was considered a total loss and fit only to be remelted and cast anew or laid on the scrap heap until the junk dealer came along and offered the munificent sum of 30c. a hundred to remove it out of sight. It seems as if this old custom, like many others, is to be relegated to a back seat by a new process of brazing, recently put on the market, which is destined to work a material change in railroad repairs and the expense attached to broken iron and steel castings.

It was my good fortune to be one of the first mechanics in this country to give the Swiss preparations a trial on broken gray iron castings, and the simplicity of the preparations and processes, the strong joint made impressed me with wonder at the possibilities of its economy and worth.

The first test was on a simple rack, which after brazing proved so strong in the joint as to break in several other places, but absolutely refused to part in the braze. Our next job was a cast side arm for an air compressor which had to go together absolutely the same as before it broke, as it was machined and fitted when new. After brazing carefully it was put on without the least trouble and after three months' wear and tear is still doing business at the old stand.

I could give other instances of the usefulness of these substances as we never think of throwing away a casting now in the shape of broken sprockets, gears or friction clutch shoes, that are possible to fix. This work was done in an open forge with charcoal for fuel and would have cost quite a tidy sum to replace with new ones, besides the loss of time to replace them, as no special outfit is required and the first cost of $10 for the flux and special spelter is sufficient for about 2,000 lbs. of castings or more, the cost per job is very small, besides the saving on fitting new castings. Having worked long years at railroad repair work, it seems the saving to them would be enormous where large systems adopted this means of economy.

Even having their own foundries to make their own castings cuts no figure, as the repairs can be made more cheaply than it is possible to handle and remelt and recast them, and besides when machined and worn slightly they are in better working condition, especially for engines, than new castings. From my experience in doing the work and testing the finished joints, they seem unbreakable, except at some other point.

It requires no skill to speak of to do the work, as any smith with a knowledge of heating and the care of a forge fire can do it as well as an expert, but from my past experience of six months in brazing all sorts and sizes of castings, a simple gasoline burner with compressed air would be more clean and avoid any possibility of failure, as cleanliness of fuel and fracture are very essential factors in the case.

The preparations certainly fill a long-felt want in our case and it seems to me in time they will be as common as borax and be found in every shop where repairing is done.

THOS. BEASLEY.

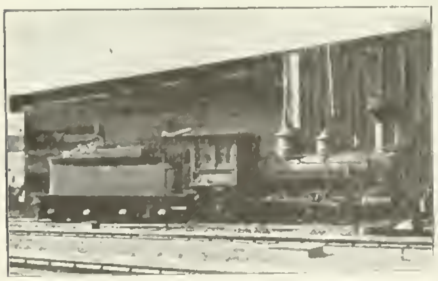
St. Louis, Mo.

Diamond Stacks in the West.

Editor:

Having noticed your request in the December issue of your paper for pictures of diamond stacks on engines in service, and there being no engines in road service near here, I have sent you photographs of yard engines, some of which have been road engines, but all are still in service.

No. 1369 C. B. & Q. switch engine, with a diamond stack, is arranged for burning lignite coal (called alfalfa here), which is very light, and when the engine is working you can never get enough in the firebox. The above named company had some of their road engines fitted up to burn lignite coal, but they were taken off, as they could



ENGINE 503, D. & R. G. RAILROAD.

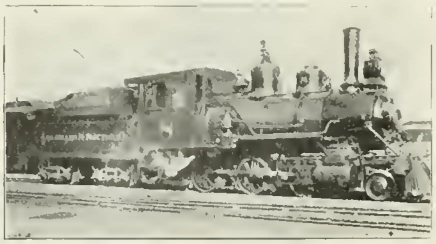
not carry enough coal to get from one chute to another—it all went out of the stack.

No. 503 was an early standard gauge engine on the D. & R. G., which has a diamond stack. A year or so ago it was sold to some lumber company after being in road service for about 25 years.

No. 554 was a Baldwin narrow gauge road engine, built for the D. & R. G. about 1880, I think; had an eight-wheel tender, no saddle tank. It was fitted with the old three-way cock for straight air, which is still on it. Some years ago she was changed to standard gauge and used as a switch engine, then about three years ago was again changed as shown, for shop service.

No. 8 C. & S. narrow gauge passengen engine, used on the famous loop. I do not know when she was built, or if she was a Grant or Baldwin, but she used to have a sunflower stack, same as the No. 64, which is now changed to a straight stack.

There were two styles of stack here, one called the diamond and the other called the sunflower stack, which originated on the Union Pacific in the early days to guard against fire on the plains. There are some very interesting stories connected with some of the old D. &



ENGINE NO. 8 ON THE C. & S.

R. G. engines used on the narrow gauge divisions in the old straight air days.

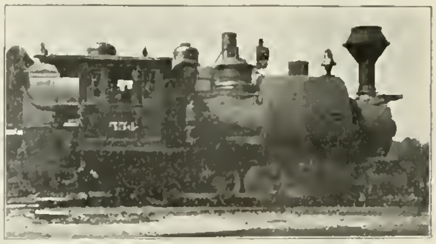
A. W. AINSWORTH.

Denver, Col.

Not Smoke but Soot.

Editor:

I know your paper used to be interested in combustion, so am sending herewith an "object lesson." The picture is taken in the upper Sacramento River Canyon, near Dunsmuir, Cal. The puff of what seems to be smoke above the cloud of steam is soot from the flues, and is the result of a sugar scoop of sand applied at fire door. The stack is quite clean after the sanding out. The engine is a Baldwin Con-



BALDWIN NARROW GAUGE ENGINE.

solidation, 22 x 30 in., 180,000 lbs. on drivers, 200 lbs steam, is equipped as an S. P. Co. oil burner, with T. W. Hientzelman arrangement, and Ingles & Von Boden burner.

W. B. VAN HORN,
Dunsmuir, Cal. Loco. Eng'r.

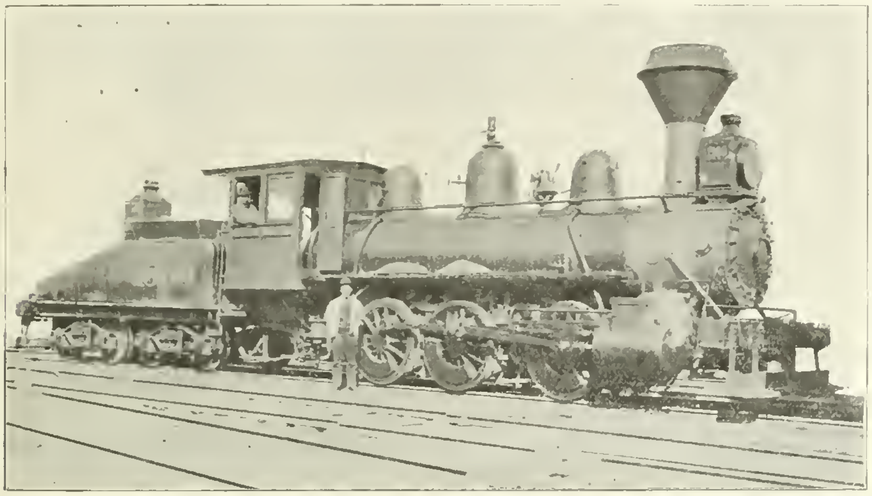
Derailment of Tenders.

Editor:

While reading over the subject on the derailment of tenders, it calls to my mind that once upon a time, when the writer had the "say so" in the mechanical department of a small road in Indiana, we were having trouble with derailments when side-tracking the cars of a certain road. On looking into the matter I found that the cars giving the most trouble were those with side bearings well outboard; in fact, the friction on the side bearings was enough to prevent the truck pivoting on its center bearing and to such an extent that it required the addition of very little flange friction to make the wheels climb the rail. Some months ago while on a train, we were delayed by a train ahead trying to get into a side track; the cause of this delay was that one of the side bearings of the tender truck had come off, causing such a list to the

TRAIN ON THE SOUTHERN PACIFIC. CLOUD OF SOOT BLOWN OUT BY SAND.

tender, making it unsafe to use. I believe that the forward truck should be center bearing, and the bearing well lubricated, but having side bearings only as a factor of safety, but not carrying any weight. The rear truck to carry about 90 per cent. of the weight of back end, the side bearing to carry



C. B. & Q. SWITCHER NO. 1369 WITH DIAMOND STACK.

the other 10 per cent., and having all safety chains as short as possible. If boiler head extends as far back as to prevent a long drawbar under foot board the drawbar should extend as far back as possible under tender. If we drop a line from center of back cross beam or center of chafe plate between engine and tender while on a curve we will find it a long way outside the center of the rails; hence, if a short drawbar is used its tendency is to throw the tender toward the outside of the curve, and with dangerous results. With the old deep fireboxes, the forward end of drawbar was up to the boiler head, and tenders remained on the track. We all know, especially the editor, that many ships founder as the result of shifting cargo in a gale, especially when the cargo is grain. She rolls over to leeward. The cargo follows, making it impossible for her to recover herself. The same rule applies to the water in the cistern, centrifugal force throwing the water to the outside of the curve, increasing the weight on the outboard bearing of the truck, causing a derailment. Now why not put a fore and aft bulkhead in back part of the cistern immediately under the manhole, but leaving room enough for a man to pass in and out? This bulkhead could be bolted to the vertical angle irons; it should have about a 4-in. hole in bottom to allow water in both legs to equalize, at the same time prevent the body of water from surging back and forth when train strikes a curve. A similar bulkhead in reservoir of oil-burning locomotives would be in order. From information at hand, the very large oil tank cars make trouble on curves, which is no doubt caused by the surging of the oil, which could be prevented by fore and aft and transverse bulkheads, not absolutely tight, but as a breakwater when they lurch on a curve. The inventor of the "Rue little giant injector" told the writer many years ago that injectors would work better if there was a dash plate in each leg of the cistern. When oil was first transported over the road the Union Tank Line built round wood tanks (covered) in either end of box cars; an en-

DIAMOND SWITCHER ON THE D. & R. G.
Photograph by Mr. R. W. Yates. He is standing at the gangway, and is indicated by a small cross on the picture at his foot.

gineer told me they were hard trains to start on account of the oil surging back and forth. WALTER DE SANNO.

Oakland, Cal.

No Souvenirs.

The joint committee of the Master Car Builders' and Master Mechanics' Associations have passed a resolution requesting the railroad supply people to give no souvenirs at the next convention.

Men Who Want to Be Editors.

Universities have done much for literature. Almost without exception the great writers have been men who enjoyed considerable educational opportunities. Generally speaking, they made about as little of the opportunities, in a strictly and formally educational way, as they could without being sent home in disgrace. In their formative years, that is, they had a certain space to loaf about in rather pleasantly, with enough work to keep them from utter dissipation and enough liberty to nourish fancy and reflection. Many a talent, no doubt, was thus brought to fruition which would have become barren if its possessor had been thrust into a hard daily regimen.

A large proportion of college graduates are ambitious to pursue a literary career, exploiting fields of engineering being a favorite line with many young men. We frequently receive letters from engineering college graduates asking how they can best prepare themselves for an engineering literary career. The first step of progress for such people is to learn to write good English. That is the most useful tool an aspiring literary man can possess; yet it is one whose value is habitually neglected by people otherwise well educated. We frequently meet men and women who have studied details and style of foreign languages without possessing a decent vocabulary of English, or the art of using the words they know to tell things in an attractive fashion.

When a person has learned to express himself fluently in English, the cultivation of habits of observation is the next requisite for working towards success as an engineering writer. The ambition to reach a desired goal does no good unless accompanied by industry and self-denying perseverance, and this means hard work.

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Ability and Work the Requisites.

There was once a saying in the French army that every soldier carried in his knapsack a marshal's baton. This had reference to the possibility of a private soldier rising through the various ranks up to that of the general officer, or even to become the commander-in-chief. As a matter of fact, very few did so rise, and it would be a physical impossibility for every man in an army to become an officer, but there was no barrier to his progress upward if he worked and strove diligently for it. There was thus nothing to damp the enthusiasm of the private soldier or to quench his ambition. We are glad to see something of the same spirit imported into the railroad world.

The Pennsylvania Railroad have now broken a long-standing precedent in promoting Mr. John S. Considine of Columbia, Pa., to become assistant supervisor. Mr. Considine had previously been a track foreman, which may be considered the highest rank of non-commissioned officers on that road. A laborer could eventually become a track foreman, but it has not hitherto been the policy of the company to promote track foremen to a higher rank.

The Pennsylvania Railroad have employed graduates of technical institutions both in its maintenance of way and mechanical departments, to be trained for promotion to the important positions. A graduate civil engineer was employed as a rodman, and was considered in direct line for the positions of assistant supervisor, supervisor, assistant engineer, superintendent, general superintendent, general manager, or vice-president. In like manner mechanical engineers were given a special course of training for the motive power department. Outside of these two lines of promotion it had been impossible to rise beyond certain limits in the operating department.

Realizing that many employees who have not had the advantages of a college education apply themselves so diligently to their work that they acquire a proficiency which should be recognized, the management of the Pennsylvania has been carefully observing the work of all grades of men in the service with a view to promoting those who showed exceptional ability, no matter what their start with the company had been.

Mr. John S. Considine is the first to be promoted under the new rule. He did not have a college education, but he entered the service of the company as a track laborer when fifteen years of age. After five years at this arduous work he was assigned to duty in the supervisor's office. There he acquired the rudiments of civil engineering. Later he was sent out on the road as track foreman, and his work in that capacity was of such a character that the title of general foreman of track laying was created for him. In this position Mr. Considine would have remained had it not been for the change of policy by the company. He had reached his limit unless he could gain a "commission" as assistant supervisor, the place to which he has now been advanced.

There are some 1,500 track foremen on the Pennsylvania Railroad, and this removal of a long-standing barrier will make it possible for any one of them to be promoted to the company's higher ranks. The actual effect of the new policy is to open to every man in the service the privilege of promotion to any place for which he may be fitted.

There is nothing in all this to belittle the college man or to cast any reflection on his training or his ability. The educated man is bound to be the important man, and the man likely to succeed. But to be educated does not always or necessarily imply a special scholastic training. The real point about it all is the possession of the requisite knowledge to ably and satisfactorily perform the work, and the possession of a mind so disciplined as to be able to go forward, and legitimately reach out for and grasp, the principles of the profession or calling in which one is engaged. The college man should have this; the other man may certainly acquire it.

There are many men who highly prize the recognition of their ability by membership in a professional society, which is based on work done, and even prefer it to the honors of academic graduation. The Pennsylvania Railroad management are to be congratulated on their policy, inaugurated by the promotion of Mr. Considine, of opening the way to higher positions, ability and good work being the only requisites.

Grinding Reamers.

If grinding a reamer was as easy of accomplishment as the grinding of a drill, reamers would not only cut better than they do, but they would cut quicker and last longer. The practice which is becoming prevalent in some of the larger machine shops to set aside the grinding of tools in a section by itself is a good one and worthy of imitation. This is particularly true in the care of grinding reamers. The operation requires the nicest skill and is akin to diamond polishing in the exactness with which the facets are applied to the grinding wheel.

It is safe to assume that new reamers coming from the workshops of the leading tool makers are as nearly perfect in construction as it is possible for them to be, and in sharpening the tool after service it will be readily noticed that the reamer has become worn in a greater degree towards the point or smaller end than it is at the large or upper end. This is to be expected from the fact that the point of the reamer frequently has to work its way through surfaces that are uneven or partially overlapping each other, whereas the general body of the reamer operates on a comparatively even surface. The tendency on the part of the mechanic engaged in sharpening the tool is to grind the dull portion of the reamer more than the part showing less indication of wear. A few sharpenings of this kind and the reamer becomes almost useless, as the exact taper corresponding to the standard gauge cannot long exist under such conditions.

This is not the only evil. In grinding each tooth the tendency to effect variations in the angle of clearance is very great, and it is only by long practice and exercising the utmost care that the hand and eye become perfect in retaining the original angle calculated to properly relieve the cutting edge. If too great a degree of clearance is given, the tooth will be materially weakened and the tendency to chatter will manifest itself. It will be noted that in new reamers the clearance is usually slightly concave, the degree of concavity, of course, depending on the size of the emery wheel used in grinding. An emery wheel of small diameter has the saving faculty of avoiding collision with the cutting edge of the adjoining tooth. Cup-shaped emery wheels are used by some tool grinders with good results, as it gives a straight face and also avoids any abrasion of the other tooth.

It may be added that the practice in some large shops of attaching collars to reamers is approved of in certain classes of standard work. These collars are adjustable and can be reduced or changed to allow the reamer when worn below the standard to be lengthened to make up the accumulated deficiency and so prolong the working life of the tool. In fact a reamer made to clean out the hole for a bolt having what is called a "driving fit," may have the collar so placed that when the collar comes down on the work, the hole is reamed to suit the bolt. Anything more would cause a looser fit for the bolt and anything less would be too tight. The collar can be altered as the reamer wears, if desired, but the presence of the collar insures the reamer being inserted to exactly the right depth.

Edison's Latest Coming Event.

The publicity agents who receive so much free advertising by contriving to have the predictions of Thomas A. Edison published as news, are out with a new and original chapter of prophesies according to Edison. Edison is wonderfully powerful in prophesies of coming events, which generally become short-circuited on their way to reality. Inventions that, according to Edison, were to revolutionize the methods and means of transportation are long overdue, while the various transportation companies continue to do business at the old stands and in the old manner. A prophet is said to have no honor in his own country, which is no doubt the cause for spreading grins bathing the faces of many people when they hear about a new Edison prophecy. There once was a famous preacher in London whose specialty was prophesying the day on which the end of the world would come. A writer in *Punch* once gravely announced that Doctor Cummings had become so certain that the end of the world would come next month that he had begun buying coal by the bushel. That is the spirit in which rabid humorists regard the earnest prophet, and even the high name of Edison is not exempt from the joker.

The latest pronunciamento by the Edison publicity people is that the bob-tail car must go, and its woe-begone horse must trot to the knockers' yard, and to stand not on the order of their going. The motive power for this change is a new electric storage battery, the latest invention of the wizard's brain.

The change is one very much to be desired in the interests of the miserable overworked horse, the knocker and the bob-tail car passenger, but we do not consider the desirable change at hand merely because people have spread the report that Edison has perfected a storeage battery that would chase the horse to its fate. We remember that much of a furore was raised many years ago about a wonderful storage battery reported to have been perfected by Edison that was going to revolutionize the operating of automobiles. A storage battery was put upon the market, but it was no more efficient than others that had preceded it, without tuck of drum or scream of trumpet. Like many other Edison inventions, that battery is under the developing process. The mercy to the bob-tail car horse is also likely to go through the developing process for a good many years.

Slaughter of the Real Innocents.

Any legislation or agitation that will reduce the danger to people engaged in industrial pursuits deserves to be commended by every lover of mankind. The movements in this direction have produced very gratifying results in some countries and in some industries, but others have been cruelly neglected. For years the United States Congresses have enacted laws for the safeguarding of railroad trainmen, a very laudable purpose, a form of action which has saved many lives. The precautions that had to be taken to prevent accidents involved the introduction of expensive safety appliances, which the average Congressman had no hesitation in forcing into use, because the hated railroad companies had to bear the expense. When, however, humanitarians urged that all hazardous industries should be kept under strict inspection to prevent dangerous practices, our lawmakers have always displayed extreme reluctance to do anything that might embarrass manufacturers. Such action would in many cases be putting restrictions upon operations in which they themselves were directly interested.

It might be expected in a country where the masses of the people were the real rulers that the protection of the toiling workers would receive greater attention than such people receive in any other country, where aristocratic rule prevails, but such is not the case. Quite the contrary. It is a sad confession to make, when truth compels us to say that less attention has been bestowed upon the protection of American workmen than upon the workmen of any other country. A sad commentary in this connection is that human life is held cheaper in the United States than in any other civilized country.

Some timid movements have been made to collect information concerning the conditions under which our industries are carried on, the most hopeful action having been the creation of a Bureau of Labor. In a report on accidents to workers recently made by this bureau, recommendations are made that the United States should profit by the industrial methods of European countries in the protection of workers. It is the boast of managers of nearly all American industries that by superior methods of production, they can turn out finished goods cheaper than their foreign rivals who employ labor that is paid less than half what American workers receive. At least such brag is regularly made when there is no talk of reducing the tariff on foreign goods. Then different kinds of claims are made. The action of cheap production is frequently carried out with reckless disregard for life and limb of the employees. The sentiment ruling not a few industries is to do the work quickly and safely if you can, but keep up the output.

The recent report of the Bureau of Labor says: "'The total annual mortality from accidents in the United States among adult wage-earning men is between 30,000 and 35,000, of which at least one-third, and perhaps one-half should be saved by intelligent and rational methods of factory inspection, legislation and control. There are also approximately 2,000,000 accidents not fatal."

More Steel Passenger Cars.

In continuance of its declared policy to make future additions to its passenger equipment as nearly fireproof and collision-proof as possible, the Pennsylvania Railroad Company recently placed orders for seventy-seven all-steel passenger cars. This is in addition to orders for two hundred of these cars which have been placed already, and of which about one hundred and ten have now been received and placed in service on regular through trains. Thirty-one of the newly ordered cars will be made by the Pressed Steel Car Company; the allotment to this company being divided into twenty-four 70-ft. combination passenger and baggage cars, four 60-ft. baggage cars, and three 70-ft. combination baggage and mail cars. To the American Car and Foundry Company is awarded a contract for twenty-nine of the new cars, consisting of twenty-three 70-ft. passenger coaches, and six 60-ft. baggage cars. The Standard Steel Car Company will construct seventeen 70-ft. passenger coaches. These coaches will provide seats for 88 passengers.

All of these cars are to represent the latest improvements in the art. A number of minor alterations have been made in the former design with a view to increasing the comfort of the passengers. Some further progress has also been made in the elimination of wood and other inflammable material from use in building the cars. Aside from the mahogany window sash and seat frame there is to be no wood whatever in the cars. Out of a gross weight of about 116,000 lbs. for the entire car, the wood in it will weigh only about 300 lbs. The new cars will have 1,300 lbs. of open-hearth steel for every passenger carried. The feature of construction, the factor which will secure these cars against the dangers of collision, is a central box girder 24 ins. wide and 9 ins. deep, extending throughout the length of the coach. To further insure the car against collapsing its frame structure is designed upon the principle of the cantilever bridge, with the trucks as piers.

These passenger coaches will be equipped with a ventilating system by which, with all windows and doors closed, will give each passenger 1,000 cu. ft. of fresh air per hour, which is equivalent to a complete change of air in the car every four minutes. To change the air completely in this time without producing draughts is made difficult by the fact that in cold weather all the air must be thoroughly warmed before entering the car.

Air is taken in by two hoods situated on diagonally opposite corners of the car roof. From each hood a vertical duct leads down within the side of the car, to a horizontal duct which runs the entire length of the car, between the floor and the sub-floor next to the side sill. Above the floor of the car, and running its entire length along the sides, are rectangular ducts containing the steam heating pipes. Air entering the hood passes down to the duct beneath floor and along this to openings into the duct containing the heating pipes. After circulating about the heating pipes and becoming thoroughly warmed, it is delivered into the aisle of the car through tubular outlets beneath each seat.

Air is discharged from the car through ventilators in the roof, which are provided with valves to limit the amount of air escaping. The movement of the car forces the air in under slight pressure, and limiting the discharge maintains the pressure and prevents the entrance of cold air through cracks about the doors and windows.

A coupler of a new type, stronger than anything used before, has been designed for these cars to avoid breakage and the parting of trains. The floor of the car is of magnesium cement, laid on corrugated iron. The coach is lighted by electricity, derived from train generators or storage batteries.

Board of Trade Against Long Hours.

The British Board of Trade have recently been making inquiries into the number of consecutive hours worked by men on several of the railways in the United Kingdom. In all cases the length of time for continuous employment has been shortened. The Board of Trade, which is a department of the British government, called for reports, and in some cases periodical returns from the railway companies, where it was believed that the time on duty of signalmen and trainmen was unduly prolonged. The result of these inquiries has been published in the form of a report by the Railway Department of the Board of Trade. This report deals with the hours of labor of railway servants.

It is stated in the report that the board communicated with the various railway companies concerned, upon the subject of the hours of labor of their servants without in general making known the source of the representation upon which their action was based. The board, so says the report, have no reason to think that the railway companies would visit displeasure upon servants who make representations to the department, but the men are held to be entitled to an assurance that communications addressed to the board will be treated as confidential, unless they are willing that the origin of their representations should be disclosed.

Steel Bridges.

It was to be expected that the collapse of the Quebec bridge would lead to an investigation in regard to other bridges in course of construction, and it is well that the lesson taught by the disaster on the St. Lawrence River is likely to add materially in insuring the safety of similar structures in all parts of the world.

The Blackwell's Island bridge over the East River at New York, now near completion, has been the subject of two separate investigations in regard to its capacity for the designed loads, and both reports are of a kind that tend to discredit the estimates originally given by the constructing engineers. Certain specific limitations as to the amount of vehicular and railway traffic will necessarily be placed on the use of the structure, the reports agreeing that the bridge should not be loaded to little more than half its designed capacity.

It is certain that important errors have been made both at Quebec and New York in regard to the relatively simple matter of stresses. At Quebec the actual stresses would have exceeded the designed stresses by as much as 20 per cent., while at the Blackwell's Island bridge the excess of stress over the estimated would have amounted to about 30 per cent.

It is difficult to understand, in the light of twentieth century engineering, how such errors could occur. The tensile strength of metals is as well known as the multiplication table. The weight of a structure, to which can be easily superadded the live load, should not be hard to determine, and the problem is simply one of how near is it safe to approach the danger line. In boiler construction the factor of safety is placed at 5; in other words, a boiler working at a pressure of 100 lbs. per sq. in. is calculated to be able to hold at 500 lbs. per sq. in. Boilers, under any condition, are short lived, and are, under proper conditions, being constantly tested, and the working pressure reduced with advancing years of service. Bridges, properly speaking, are not tested in the same way that boilers are, and the amount of service in most cases is increased, owing to the growing needs of the community. For this reason the factor of safety in bridge construction ought to be high.

Origin of the Word "Crucible."

In the November, 1908, number of a little publication called *Graphite*, got out by the Joseph Dixon Crucible Company of Jersey City, there is a humorous description of the misapprehension of the word "crucible." Here is what *Graphite* has to say on the subject:

"From all we know and read of Boston's culture, we were not surprised that the word crucible suggested something concerning the cross and religious matters.

"The following letter, it is needless to say, is from Boston:

"'Joseph Dixon Crucible Company: Kindly send us a catalogue of your crucible specialties, with lowest prices.

"'Let us know if you keep this one in particular, viz.: A statue of Christ on a wooden cross with a number of holy pictures that revolve by turning a wooden knob. This article is sold extensively by a number of firms on installments for five or six dollars each.

"'If any of your goods are suitable for our trade we can use them in quantities.'

"The Latin word crux was thought to be the derivation, in several languages, of the word crucible. The story (probably false) was in vogue that crucibles were marked with a cross to prevent the devil from interfering with the chemical operations performed in them. This story fails to account for the use of 'crucibulum' in the sense of a hanging lamp, which seems to have been the original one."

The explanation given by the Dixon Company is practically that which is to be found in the dictionaries, but it is more than likely that the word "crucible" does not come from the Latin word "crux," meaning a cross. A more probable derivation for the word "crucible" is the Icelandic word "krus," meaning a pot or cup, and from it our word "cruse," also spelled "cruce," comes. The word "cruse" is to be found in the Bible, I. Kings, xvii.: 12, where the widow's cruse of oil is referred to. The Scottish word "cruisie," a kind of lamp, probably a diminutive from "cruse," is the original rush-light, being, in fact, a small pot with the pith of a rush used as a wick. The Irish word "cruiskeen" is a small measure, usually applied to whiskey, and seems to be a diminutive, possibly formed from the word "cruisie." There is a French word "cruche," meaning a pitcher or earthen pot, and a Gaelic word "crog," seen in our word "crock."

These words, all more or less indicating a small cup or pot, appear to us to point to the probable origin of "crucible," and seem to have referred originally, not to the shape of the vessel in question, or to any mark on it, but rather to its material or use. The word "crucibulum" is not older than the twelfth century, and is not a Latin word, though probably connected with the Latin word "crux." The crucibulum was a hanging lamp, and may have been called so on account of the fact that the bowl or pot which contained the oil and wick was supported on a frame made in the form of a cross with chains attached to the ends of arms, or indeed the ends of the four arms of the cross may have carried, each a small lamp, and the supporting chain have been attached to the centre or intersection of the cross arms.

A crucible is a melting pot, and the words "krus," "cruse," "cruce," "cruisie," "cruiskeen," "cruche," "crog," all contain the conception of a small primitive vessel of the pot or cup variety. None of them indicate the cross form. "Crucibulum," therefore, as a hanging lamp, suggests the pot or cup used as a lamp, carried on a frame made in the form of a cross, and our Boston friends will probably find it a far cry from the old "cruse" or pot, to the more modern and very different word "crucifix."

The Panama Canal Construction.

A peculiar characteristic of American freedom is the assurance with which many people express opinions of technical operations of which they know absolutely nothing. This is particularly the case in regard to engineering work. Persons that no owners of property would trust with the designing of a mill dam assume the right of criticising the most important engineering operations in this or any other country. We have found the man who never could true a set of guides the most ready to criticise the manner in which the foreman directed work to be done.

At present the construction of the Panama Canal is under violent criticism by a set of novice engineers and crack-brain amateurs who could not tell a transit from a kodak, and otherwise respectable papers lend their pages for circulation of professional slanders. Bunan-Varilla, the French engineer, whose inefficiency helped to lead the old French Panama Canal Company to bankruptcy, is now trying to figure as an authority as to how the work he spoiled should be done, and many of our faultfinders in high places are trying to use the Frenchman of the divided name to discredit the engineers who have pushed the Panama Canal digging operations as no such work was ever done before.

Book Notices

Twentieth Century Locomotives. Treating on the Designing, Construction, Repairing and Operating of Railway Machinery, by Angus Sinclair Company, second edition; cloth, price $2.00.

This is one of the most valuable books ever compiled for the instruction of people in the department of railroad rolling stock, on which it treats. The original purpose of the book was to provide means of self help for the men who had become mechanics without acquiring knowledge of the principles underlying their business, and were in need of plain, practical information about railroad mechanical practice. It forms a natural supplement to Locomotive Engine Running and Management, by Angus Sinclair, a book that has helped more officials up the ladder of promotion than all other intellectual aids. Twentieth Century Locomotives is calculated to accelerate the ladder climbing process. The price has been reduced from $3.00 to $2.00, to meet the spirit of the prevailing money stringency.

The book is finely illustrated, various shop operations being made very plain by wood-cut engravings. The illustration of locomotives are so profuse that the pictures in themselves constitute a graphic story of modern locomotive practice.

Proceedings of the 15th Annual Convention of the Air Brake Association. Published by the Air Brake Association, Boston, Mass. 303 pages. 6 x 8½ ins., with numerous illustrations, leather binding. Price $1.50.

The proceedings of the Air Brake Association at the convention held at St. Paul, Minn., last June have just been published and form a goodly volume printed on toned paper and handsomely bound in fine leather. It is gratifying to observe the excellent taste shown by the worthy secretary of the association, Mr. F. M. Nellis, in preparing and presenting the volumes issued under his supervision. The typography is of the best while the illustrations are even better than those shown in the previously published volumes. It need hardly be said that the general public and legislators have become deeply interested in the air brake and other safety devices. Improvements are constantly being added to meet the changed conditions and the meetings of the Air Brake Association have assumed an importance that is national in character. The work is largely educational in its scope and should be in the hands of all who are in any way connected with the use of the air brake.

Accurate Tool Work. By C. L. Goodrich and F. A. Stanley. Published by the Hill Publishing Company, New York. 217 pages, 6 x 9 ins., with 221 illustrations. Cloth extra. Price $2.00.

This work, which is the joint product of Mr. Goodrich, of the Pratt and Whitney Co., and Mr. Stanley, a well-known writer in the employ of the Hill Publishing Co., deals with processes and devices made use of by toolmakers in making accurate jigs and special tools which have become necessary in the growing demand for interchangeability of parts in mechanical construction. There is much that is of real value to the toolmaker in this work, as it is a well-known fact that for many years much secrecy was exercised in the methods and devices used in many factories where small machinery was constructed. The light of the twentieth century has illumined these dark places, and the most accomplished mechanics now vie with each other in laying before their fellow workers the means and methods used in the most intricate work. In machine shop work jig-making is progressing with great swiftness and we commend this book to all interested in this branch of exact mechanical work.

Four Hundred Questions and Answers on the Westinghouse No. 6, E. T. Published by the Air Brake Association, Boston, Mass. 88 pages, flexible covers, cloth back. Price 50 cents.

The importance of the No. 6 E. T. brake equipment recently placed in use on the engine and tender of the best-equipped locomotives is well understood by railroad men, but it is not to be expected that a general knowledge of the details of the important improvement could become known except by a systematic study of the subject. The work before us may therefore properly be said to fill a want that is generally felt. The work is in a handy form adapted for the pocket. The typography and illustrations are excellent in every way.

Gauging Worn Flanges.

According to the M.C.B. code of rules for the interchange of traffic, revised June, 1908, Rule 10 reads: "Defects of wheels which justify renewal; worn flange; cast wheels under cars of less than 80,000 lbs. capacity, with flanges having flat vertical surfaces extending more than 1 in. from tread, or flange 15-16 in. thick or less, gauged at a point 17-64 in. above tread. Wheels

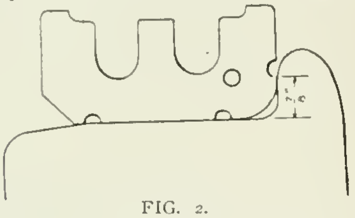


FIG. 2.
WORN FLANGES, CARS OVER 80,000 LBS. CAPACITY.

under cars of 80,000 lbs. capacity or over, with flanges having flat vertical surfaces extending more than 7/8 in. from tread, or flange less than 1 in. thick, gauged at a point 17-64 in. above tread. Steel and steel-tired wheels with flanges having flat vertical surfaces extending more than 1 in. from tread or flange 1 in. thick or less.

In this rule there are three kinds of wheels dealt with. They are (1) cast iron wheels under cars with capacities less than 80,000 lbs.; (2) cast iron wheels under cars of 80,000 lbs. or over that capacity; (3) steel or steel-tired wheels. The M.C.B. wheel gauge, as applied to these wheels indicates the limiting thickness of the flange, and it indicates the limit of the flat vertical surface on the flange, or, as it is often called, the sharp flange. There are thus three kinds of wheels and two kinds of gauging to which each may be subjected. When the limit of flange thickness is to be determined, the gauge is put on so that one or other of the arches that are cut in the gauge will go over the flange to be tested. When cars of capacity less than 80,000 lbs. are under examination, the smaller arch, the one 15-16 in. wide, is used, and if it goes on, down to the tread, the flange is considered too thin for service. The notch in the gauge 1/4 in. deep takes care of the provision in the rule regarding the point where this cross measurement of the flange shall apply. Wheels under cars of 80,000 lbs. capacity or over are tested for thickness with the arch cut in the gauge, 1 in. wide. The 1/4 in. notch taking care of the place of measurement as before, as 17-64 in. is the point just above the edge of the 1/4 in. notch.

The gauging of the extent of the flat vertical surface is made with the curved corner of the gauge, between the two 3/8-in. grooves, which separate the curve from the flat edges of the gauge. Cast iron wheels under cars less than 80,000 lbs. capacity are gauged as shown in Fig. 1, which is an illustration taken from the M.C.B. code. These wheels should be taken out if the flat vertical worn surface extends at all above the 1 in. limit from the tread, as indicated by the gauge. Steel-tired or steel wheels are tested this way for flat vertical surfaces on flanges. Cars of 80,000 lbs. capacity and over are tested by the gauge applied in the position shown in Fig. 2, as the flat vertical surfaces for cast wheels under the heavier capacity cars are limited to anything over 7/8 of an inch.

The reason why the limit of sharp flanges for the lighter capacity car wheels is made 1 in. and is 7/8 in. for the heavier capacity car wheels is that when a flat vertical surface appears on a flange a portion of good metal has been cut away and the part of the flange near the point becomes comparatively thin. The gauging of the flat vertical surface on the flange of a car wheel practically ascertains the limiting thickness of the flange near the point or edge, and the gauging of the flange for thickness by the arches cut in the gauge practically ascertains the limiting thickness near the throat of the flange. These are the two defects which the flange-gauge is intended to reveal.

When gauging for the extent of the flat vertical surface, it is evident that when the limit is taken at 7/8 in. from the tread, the thickness of the flange

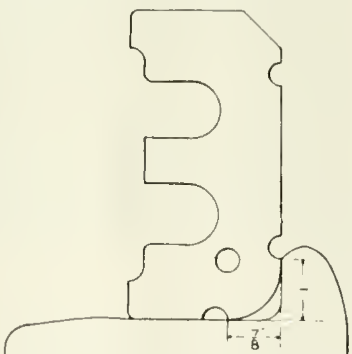
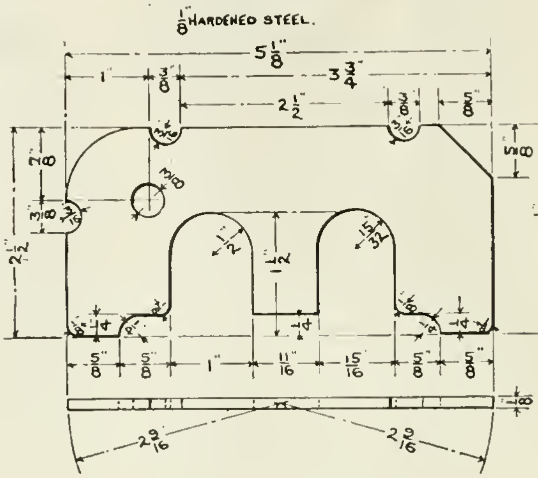


FIG. 1.
WORN FLANGES UNDER CARS LESS THAN 80,000 LBS. CAPACITY.

near the point will be greater than when the limit is 1 in. from the tread, so that a wheel which has reached its limit under cars of 80,000 lbs. capacity and over might be still serviceable if it had been found under a car of less capacity than 80,000 lbs. The object in the difference in each method of gauging is to compel the maintenance of thicker flanges, both at the throat and near the point for the higher capacity cars, than for cars of the lower capacities.

The Hard and the Easy Way.

We frequently wonder if there are any searchers after truth nowadays who experience the curiosity to find out all about valve motion that possessed us in our callow youth. We remember watching with keen curiosity the mysterious movements of the valve setter and wondering how his small head did not burst open with the prodigious amount of important knowledge bottled



WHEEL DEFECT GAUGE.

therein. Then came like a vision Clark's book on Railway Machinery, which revealed the hidden secrets of valve motion with all its mysteries. Mysteries, however, that did not give themselves up except at the cost of arduous toil. That toil was cheerfully expended and the valve setter's hidden art was revealed.

A royal road to learning has not yet been found, but Halsey's book on Slide Valve Gears makes the path to clear knowledge of valve motion about as free from thorns, rocks or pitfalls as anything can be made.

Utility of Aeroplanes.

So far we have seen the principal merit claimed for aeroplanes is the help they will give in killing people. Not through the accidental failure of the motive power, that would result in fatally precipitate descents, but in helping to destroy ships and armies. There is a belief that every increase in the cost of weapons of war makes a move toward peace. The aeroplane may be a blessing from this standpoint.

Let us beware of losing our enthusiasm. Let us ever glory in something; and strive to retain our admiration for all that would ennoble, and our interest in all that would enrich and beautify our life.

Applied Science Department

Elements of Physical Science.

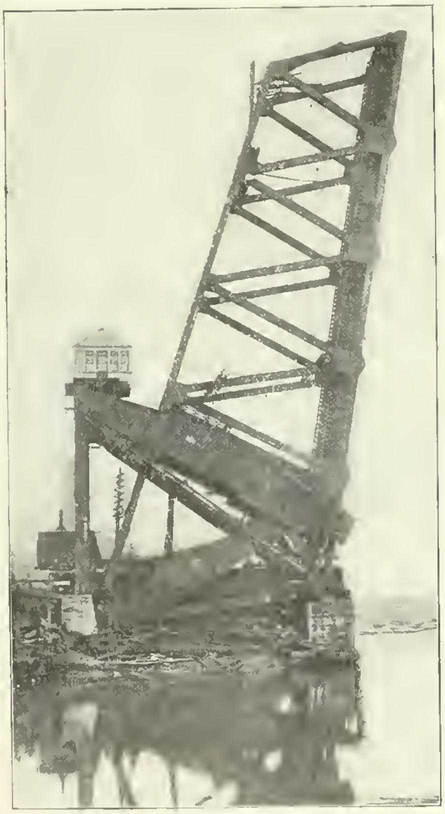
Second Series.

V.—Steam Working Expansively.

It will be readily understood that if steam is introduced into a cylinder which is closed at the ends and fitted with a movable piston, the steam will fill the entire space that may be open at that end of the cylinder at which it is admitted. Whatever the pressure of the steam may be, it will press equally on every portion of the cylinder and piston with which it comes in contact. If the supply of steam is cut off and the piston is moved in the cylinder so that the space occupied by the steam is increased, the steam will still continue to fill the space, but the density or pressure of the steam will be diminished in a corresponding ratio to the increased amount of space. Not only the pressure of the steam will be diminished, but it will weigh less per cubic foot. On the other hand, if the piston is moved in the other direction diminishing the space occupied by the steam, it will have the effect of increasing the pressure of the steam in a corresponding degree, and adding to its density and weight per cubic inch.

The relation between the pressure of the steam and its increase or diminution, is in exact proportion to the space occupied. Suppose the admission of steam is cut off after the piston has moved six inches from the end of the stroke and the initial pressure is 120 lbs per sq. in., it will be found that when the piston has moved twelve inches the pressure will be reduced to 60 lbs. per sq. in. At 18 ins. the pressure will be reduced to 40 lbs. per sq. in., while at 24 ins. the pressure will have been reduced to 30 lbs. per sq. in. In actual working the decrease will be in excess of these figures, owing to the rapid cooling of the cylinder from contact with the outer air, and the consequent rapid condensation of steam. From these varying points of piston travel and consequent variation in steam pressure, a diagram may be readily made showing the actual work performed by the steam in a graphic manner, as is done by an instrument known as the indicator, which describes with an attached movable pencil a curved line forming a rectangular hyperbole.

Railway men are well aware that when a locomotive is required to exert its full power for a short time, as when starting a heavy train, or in moving up an incline, steam is admitted to the cylinder at the fullest pressure through almost the entire length of the piston stroke. There is considerable loss of steam during these periods, as the steam is released while at a comparatively high pressure and is consequently wasted with a corresponding waste of fuel. The careful engineer, recognizing the seriousness of such loss, shortens the period of admission of steam as soon as practicable. This is a matter that can be learned from experience, but it is easily understood



BRIDGE STANDS ON END LIKE A TOWER.

that the momentum acquired after a train has been in motion a short distance, or the fact that the summit of an incline has been reached renders the continued motion of the train more easy of accomplishment, and consequently requires less steam to keep the piston in motion.

It must also be noted that in the movement of the piston, while the steam pressure is acting on one side of it, the other side is open to the atmosphere, and is consequently subject at all times to an atmospheric pressure of nearly 15 lbs. per sq. in. In all steam engine practice there is an additional back pressure varying according to the amount of pressure in the released steam, but which, under any condition, is always several pounds in excess of the atmospheric pressure. This is due to incompleteness of exhaust in high-pressure engines, and which is almost completely overcome in the case of engines when the exhaust is connected to a condenser. The loss by back pressure is consequently greatest when steam is released at a high pressure and at high piston speed, and in all steam engine practice steam is cut off at less than half of the piston stroke, the remainder of the stroke being accomplished partly by the acquired momentum of the engine, and partly by the expansion of the steam already admitted to the cylinder.

Under ordinary conditions, therefore, the average or mean pressure exerted by the steam on the face of the piston during the entire stroke is much less than the pressure of the steam in the boiler. Diagrams showing the point of release with accompanying hyperbolic downward curve, as marked by the indicator, are very useful in determining the actual work accomplished by the steam in moving the piston from end to end of the cylinder. The common practice is to divide the diagram into ten equal parts, then measure the width of the figure at the center of each division by the scale of pressures, and after adding the measurements together, divide the sum by ten. The result will be the average effective pressure per square inch on the piston.

In using steam expansively there are losses besides what we have already referred to, which must be taken into account in calculating the available strength or working power of the steam engine. It will be noted that when the piston in a cylinder is at the end of the stroke the piston does not touch the cylinder cover. There is always a space left known as clearance, the purpose of which is to prevent the danger of contact between the piston and cylinder head. The less this space is the less waste steam there will be from this source, but it is necessary that there should be a safe space to make allowance for the lengthening of driving rods or the wearing of parts, and the admission of liners or other causes affecting the exact position of the piston at the end of the stroke. This clearance space, together with the passageway leading from the cylinder to the steam chest is of considerable extent, and in many instances amounts to one-tenth of the entire steam space in the cylinder. It will thus be readily observed that the steam occupying this space passes through the engine without doing any work. When the cut-off occurs at an early part of the stroke the loss of steam is not so great as the amount of steam in the clearance space is also used expansively during the remainder of the stroke, and is consequently reduced in pressure before being released.

This loss of steam has been cleverly met by engineers in the construction of valves by means of which the exhaust port closes before the end of the stroke of the piston, and thereby allowing the piston to compress the steam, thereby raising its pressure and temperature before the new steam is admitted. This also has the beneficent effect of acting as a cushion to take up the motion of the reciprocating parts when they change their direction at the end of the stroke. The actual gain or loss by compression has been a fruitful source of controversy among many engineers, and out of this controversy has come the compounding of steam, whereby steam released at a comparatively high pressure is admitted to another cylinder and caused to do effective work before being released at or near atmospheric pressure.

Heat and Cold.

When an ordinary person is told that the temperature inside of a locomotive cylinder varies as much in some conditions of the engine's working as the difference of temperature between a winter and a summer's day, incredulity is shown. Yet heat and cold are merely relative terms.

The householder who pays the ice trust an extortionate number of dollars every year to keep his refrigerator cold is apt to assume a smile of scornful skepticism when you talk to him about the hotness of ice.

As a matter of fact, however, if the physicist is to be trusted, ice is a hot substance, averaging about 492 degrees absolute.

The physicist ostensibly proved this to us a few years ago by setting a pail of liquid air on a cake of ice, where it boiled away as merrily as Mrs. Perrybingle's teakettle. He further told us that heat as used in ordinary conversation is a purely relative term. Ice is red hot compared to liquid air, and the temperature of the electric furnace so chilly that it would cause an immediate attack of pneumonia to a dweller in the sun.

"All right," said the common man, "seeing is believing," and "adjusted" himself to the new standard of coldness. He had no sooner done this than down went the thermometer, and again the liquid air was turned into solid air. Then by taking away still more heat the same process was repeated with pure hydrogen, and finally we were given to understand that real cold is not reached until a temperature approximately 492 degrees Fahr. below the freezing point of water is attained. This is called absolute zero, because it is the lowest possible temperature which the nature of heat admits.

Celebrated Steam Engines.

XV. Isaac Dripps.

While the priority of claim to running the first locomotive is usually credited to British enterprise, there can be no question about the incorporation of the first company in the world formed to build a railroad for transportation purposes. This was the Camden and Amboy Railroad, chartered by the Legislature of New Jersey in 1815. It must be admitted that over a dozen of years elapsed before there was much work done on the construction of the road. It was difficult securing financial support, but at last the younger Stevens, whose engineering skill and enterprise

SNOW BUCKING ON THE CALEDONIAN.

have been already alluded to in these pages, was elected president of the company, and the work began. One of the first things done by Mr. Robert L. Stevens was the appointment of Mr. Isaac Dripps as master mechanic. Mr. Dripps was destined to exert a powerful influence on the development of the locomotive engine.

Under his supervision the first rails made entirely of metal, were laid. A locomotive was ordered from England, which arrived at Bordentown, N. J., in August, 1831. Mr. Dripps had never seen a locomotive, but he soon put the machine in place. The engine was not equipped with a tender, but a small four-wheeled car was attached, and a cask from a grocery store served to hold the water. A shoemaker was engaged to make a leather pipe conveying the water from the cask to the engine pumps. Mr. Dripps was so successful in managing the initial operations of this engine, named the "John Bull," that he was appointed to take charge of the locomotive works being constructed at Hoboken. Mr. Dripps began building boilers without the hemispherical dome which characterized the early British locomotives. He was the first to attach the so-called cow-catcher to the locomotive, and which has been a marked feature of the American locomotive ever since.

Three locomotives built by Mr. Dripps were used in addition to hauling passengers and material on the Camden and Amboy Railroad, as a part of schools of instruction to men from all over the east coast of America in the art of locomotive engine running. Under the liberal policy of Mr. Stevens, Mr. Dripps was encouraged in the construction of locomotives more powerful than anything hitherto attempted. The result was that in 1836 a class of engines known as the "monsters," was produced. The changes effected in this design were of the most sweeping kind. In sheer weight Mr. Dripps raised the locomotive from a comparatively light machine of four or five tons to twenty-five tons. In place of the light bogie and single driven wheels of Stephenson's locomotive, Mr. Dripps produced an eight-wheeled engine similar to the best equipped freight engines of our own day. The steam dome placed on the cylindrical part of the boiler was also an innovation, which immediately superseded the earlier forms. The entire boiler, as produced by Mr. Dripps, has not been greatly modified since. In his first experience with the large locomotive, the furnace of his boiler had a bridge wall or water space near its front end, extending upwards within one foot of the crown sheet. Between this bridge wall and the flue sheet there was a combustion chamber. In his later experiments he left this wall out, with better steaming results. He introduced crow-foot stays between the crown sheet and outer shell and also adopted conical jets leading the exhaust steam to the center of the smoke stack.

In many respects the "monsters" were the most important advance made in many years of locomotive construction. The cylinders, which were 18 x 30 in., were set on the sides of the boiler sloping forward and downward at an angle of 30 deg. The cross-head connected with a vibrating beam that moved like a pendulum. A main rod was attached to this and transmitted power to the third pair of wheels, which were the driving wheels. Between the second and third pair of wheels there was a supplementary shaft equipped with a spur wheel which engaged the second and third axles, thereby transmitting the power to the forward wheels. Each set of four wheels was provided with connecting rods, and as there were no frames the pedestals were riveted to the boilers.

The four back driving boxes had wedges, but the front boxes had none, and fitted loosely in the pedestal, so that the front pairs of wheels were flexibly adapted to rounding curves. Mr. Dripps seemed to have had visions of the Mallet compound of our own day. Some of his engines in a modified form were in use as late as 1875.

The remarkable feature of his work was in immediately recognizing the need of locomotives of much greater strength than anything dreamed of by any other engineer up to that time. His important changes in locomotive boiler construction alone entitle him to high rank among the celebrated steam engineers who have made the locomotive what it is, the most important engine ever devised by human ingenuity.

Mr. Dripps was born in Belfast, Ireland, in 1810, and died at Philadelphia, Pa., in 1892. He was the first working locomotive engineer, the first railway master mechanic, and the first superintendent of machinery of an American railway.

Questions Answered

NEW YORK AIR PUMP GOVERNOR.

4. M. W., Cleveland, O., asks: On an engine equipped with the New York brake when coupled to a train the pressure stood 70 and 90 lbs., but with the engine alone the red hand would fall until both hands were below 70 lbs., when the governor would allow the pump to go to work and pump up to 70 and 90 lbs., the steam body of the governor was changed and the trouble disappeared, what was wrong with the governor?—A. The governor that was removed was no doubt in better condition than the one that replaced it, with the style A, brake valve, the red hand falling to 70 lbs, and the governor remaining closed would indicate leakage from the main reservoir past the slide valve or excess pressure valve into the brake pipe faster than it could escape from the brake pipe by leakage or through the relief port or past the packing ring of the governor. As changing the governor at this time resulted in the pressures remaining at 70 and 90 lbs., the conditions must have been reversed, that is, the leakage past the packing ring or from the union connection must then have been in excess of that leaking into the brake pipe. Changing the governor has about the same effect as making a leak in a brake pipe to keep a leaking rotary valve from forcing a triple valve to release position. or, suppose we have water dripping from a faucet into a bucket and do not wish the bucket to overflow, if we bore a hole in the bucket instead of closing the faucet, it is equivalent to using a leaking governor to offset a leaky brake valve or controller valve.

STRUCTURAL AND OPERATING EQUALITY.

5. H. H. S., East Broadtop, writes: I would like to have you answer this question through the columns of your valuable paper. Two locomotives built in the same shop; can one haul more than the other if the cylinders are the same size, say 16 x 22 in., with a 48-in. wheel and a steam pressure of 150 lbs.? I always said no; am I right? Our engines are Baldwins, 40 tons weight.—A. You are practically right, as these exactly similar engines are theoretically of the same power and the calculated tractive effort of each is equal. There are, however, minor differences which in daily service on the road make some difference. One may be in the hands of a better engineer than the other. One may steam more freely, it may be better draughted, and it may be more scientifically fired. In short, it may be better handled. The two machines are equal as far as design and build go, but the work either may be made to do depends on how either of them is operated. The operation, however, may be unequal, while the engines are equal as regards to power. One man may be able to make a bull's eye every shot with a rifle that another man shoots wide with. That is not the fault of the rifle. The engines are equal as far as the builder can make them and they are supposed to pull equal loads.

CHECK VALVE SPRINGS.

6. G. E., St. Louis, Mo., asks: On an engine equipped with the new Westinghouse brake, if the signal whistle pressure is set at 45 lbs., the pressure in the brake cylinders goes up to 70 lbs. when the independent brake is applied, if the brake cylinder pressure is set at 45 lbs. by the reducing valve, the signal line pressure is only about 20 lbs., and the gauges are correct, what is the trouble?—A. If the reducing valve is in good condition and there is no obstruction in the ports of the combined strainer and check valve, it is quite likely that the spring holding the check valve is too strong, or, rather, that spring was intended to be used in the check valve of the "dead engine feature" instead of the signal line check valve. The only difference in these check valves is the spring, that in the signal line check being very light, so as to create no appreciable difference in pressure on either side of it. The spring in the check valve of the "dead engine feature" being rather heavy, so as to maintain a difference of 20 or 25 lbs. in main reservoir and brake pipe pressure when this feature is in use.

INTERMEDIATE SIDE ROD BROKEN.

7. Subscriber, Urbana, Ill., writes: I have had several arguments in regard to a certain breakdown and would like you to answer the question through the columns of your valuable magazine. It is this: If an intermediate side rod should break on a consolidation engine with the second pair of wheels as motion wheels and the third pair as main wheels, can the engine be run to terminal, and in case the main wheels should slip, will the steam in the cylinders right them again so the engine can be kept going? Please explain.—A. We suppose you mean that the second axle carries the eccentrics, and the third is the main driving axle. This form of construction is not the usual one, and the percentage of engines so built must be very small. The safe course is to take down both side rods and have engine towed in. The risk involved in leaving one side rod up is very great, and a slip of the main drivers would almost certainly bend or buckle the side rod at the joints. In that case serious damage would probably be done, and the engine would then have to be towed in anyway. With a buckled rod, even if nothing broke, the wheels would not right themselves.

AIR BRAKE LEAKS.

8. G. E., St. Louis, Mo., asks: What is wrong with the H 6 brake when the governor stops the pump at 70 and 90 lbs., then allows the pump to run slowly until the red hand and the black hands of both gauges go up to 130 lbs. —A. There must be a leak from the main reservoir pressure into the brake pipe, which could occur through the feed valve, through the rotary valve seat, or body gaskets of the brake valve, through the "dead engine feature," through the excess pressure top of the pump governor, or through the brake valve cut-out cock if it is located in the reservoir pipe. The leak through the "dead engine feature" could occur from dirt on the seat of the valve and having the stop-cock open, the leak through the governor would occur through the diaphragms or past their edges, as they separate main reservoir and brake pipe pressures when the brake valve is in running position. A leaky plug valve in the Pennsylvania Railroad standard cut-out cock would allow main reservoir pressure to enter the brake pipe. If the brake pipe pressure increases when the brake valve is in running position and remains stationary or falls when the valve handle is placed in lap position, it indicates feed valve or governor leakage. If the brake pipe pressure increases when the valve handle is on lap position it indicates brake valve leakage, leakage through the "dead engine feature," or brake valve cut-out cock leaking.

Air Brake Department

Broken Air Pipes With H. 6 Brake.

By G. W. Kiehm.

Part I.

This subject is not a new one in these columns, but matters pertaining to broken air pipes in nearly all instances had reference to the Westinghouse H 5 brake equipment. When the H 6 equipment was referred to it was only in a general way as the manufacturers were not prepared at that time to furnish any printed matter which would explain the construction and operation of the H 6 brake and of course the names that would be given the pipes connecting the various valves were not known. The Westinghouse Air Brake Company has since distributed thousands of copies of a pamphlet describing their H 6 brake, and the operation and construction of the brake, and the piping arrangement is pretty well known.

Engine failures and detentions due to leaky and broken air pipes are more numerous with the large, modern locomotives, especially if they are not given sufficient attention, as the engine develops lost motion and pounds, the jar has a tendency to loosen the reservoirs, cylinders, the various valves and pipe clamps.

Even with all parts of the brake equipment securely fastened and the engine in good condition faulty pipe fitting is often the cause of a broken pipe and the engineer should make an effort to reason out what can be done to bring the train to the terminal in cases of different air pipes breaking. The H 6 equipment differs somewhat from the H 5, the application chamber and application cylinders of the No. 6 distributing valve are open to the atmosphere through the exhaust cavity of the equalizing slide valve and both brake valves, when the valve handles are in running position and the equalizing vale in release position. If the equalizing valve is moved to application position this communication is cut off by the movement of the slide valve, and with the brake valve handles in running position the brake will apply in the event of a conductor's valve being opened or a brake hose bursting.

With the H 5 brake the application chamber of the distributing valve is open directly to the atmosphere when both brake valve handles are in their running positions regardless of the position of the equalizing valve, and in case of an opening in the brake pipe one of the valve handles must be moved to prevent the escape of the application chamber pressure.

With the No. 5 distributing valve the equalizing valve traveling its full stroke from a heavy brake pipe reduction permits a flow of main reservoir pressure through ports in its slide valve and seat to the pressure and application chambers, it is then necessary to hold the handle of the independent brake valve in release position to prevent the application of the engine brake. When making repairs with the brake system charged this is sometimes very annoying in the shop as well as on the road.

With the H 6 brake the pressure is maintained in the application cylinder from the feed valve pipe through the rotary valve and seat of the automatic brake valve when its handle is in emergency position only. On the second engine in double heading instead of the equalizing valve exhausting through the double cut-out cock, and the automatic brake valve when it is on lap position, the valve handle of the H 6 valve is allowed to remain in running position and the equalizing valve exhausts the application cylinder and application chamber pressures through both brake valves.

XMAS GREETINGS FROM THE GREAT INDIAN PENINSULAR RAILWAY.

The smaller gauge will show at all times the brake pipe pressure, but the train brake cannot be applied from the second engine unless a special cut-out cock is located in the reservoir pipe. If this cock is used the train brake can be applied from the second engine by placing the automatic brake valve handle in emergency position.

Sometimes both brake equipments are found on the same class of engines, and if the engineer does not understand thoroughly the construction of the brake valves and the distributing valve of both brakes he is apt to become confused in case of a broken air pipe while out on the road.

Each distributing valve has two ⅜-in. pipe connections on the left hand side of the distributing valve reservoir; the upper pipe of the No. 5 is the double heading pipe, the lower one is the application chamber pipe, the upper pipe of the No. 6 valve is the application cylinder pipe, the lower one the release pipe.

If the application cylinder pipe should break off it is only necessary to plug the break toward the application cylinder and proceed; it will not interfere with the automatic brake but will destroy the independent brake.

If the application chamber pipe should break the break toward the application chamber should be plugged and the double-heading pipe disconnected to form an exhaust for the application chamber pressure when the brake is released; the independent brake cannot be applied and the driver-brake-holding feature will be destroyed.

If the release pipe should be broken the pipe should be left open, the holding feature of the automatic brake will be destroyed but the independent brake can be applied in quick application position, and if the handle is brought back to lap or slow application position the brake will release.

If the double-heading pipe should be broken it can be plugged except when double heading; it should then be left open. The independent brake can be applied in quick application position in either case.

If the brake cylinder pipe is broken off the driver brake cannot be operated and the distributing valve should be cut out to prevent the escape of main reservoir pressure when the train brakes are applied.

A broken supply pipe will also prevent the operation of the driver brake, and all that can be done is to stop the leak by plugging the pipe or closing the stop cock.

If the brake pipe is broken off at the distributing valve it is only necessary to stop the brake pipe leak and proceed; the independent brake can be operated in conjunction with the train brake. With the H 5 equipment there will be a continuous blow at the exhaust port of the automatic brake valve when the handles are in running position; when the handles of either brake valve is moved to lap position the blow will stop, and this blow coming from the main reservoir through ports m and n in the equalizing slide valve and seat will build up in the application chamber and apply the brake.

In this case of a broken brake pipe with the No. 6 distributing valve, the action is the same whether the plain or the quick-action cylinder cap is used, but when the quick action cap is put in use a stop cock should be placed in this branch of the brake pipe near the distributing valve, so that in case the quick-action valve was held open or the equalizing piston graduating spring was broken the brake pipe pressure could be cut off from the distributing valve. If this did occur the brake pipe pressure would be free to enter the brake cylinders and pass out the distributing valve exhaust port when the brake was released, and with no stop cock to cut off brake pipe pressure all the pressure would have to be withdrawn from the brake pipe and the branch pipe disconnected and a blind gasket inserted in the union connection; after doing this the train brakes can be released, and in making the next stop the independent brake would be used to apply the driver brake.

The slide valve in this quick action cap is liable to become leaky from dirt on its seat or being unevenly worn, and the leakage will escape past the check valve and to the atmosphere through the exhaust valve when the brake is not applied. The effect is similar to a leaky application valve, both leaking through the distributing valve exhaust port when the brake is in release and increasing the brake cylinder pressure when the brake is applied. If the volume of leakage is sufficient and the brake cylinders and pipe connections are practically free from leakage, the main piston will be moved toward release position and exhaust the increasing brake cylinder pressure to the atmosphere.

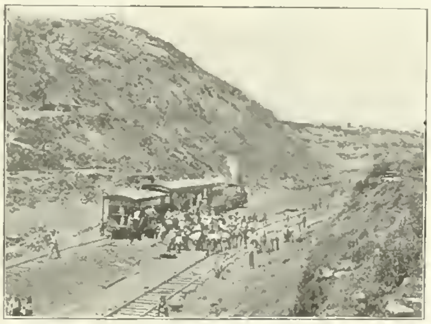
If the leakage affects the main piston in this manner the leaky valve can be detected by reducing the brake pipe pressure slightly below the adjustment of the safety valve; if the leakage then ceases it indicates a leaky quick-action valve; if the leakage at the exhaust port continues it indicates a leaky application valve.

If the leakage does not affect the main piston when the brake is applied the brake can be released and the stop cock in the supply pipe closed; after waiting a reasonable length of time for the pressure surrounding the application valve to escape, the leakage should cease if the application valve is at fault, if the leakage continues it indicates a leaky quick-action valve. During the test it should be remembered that the exhaust valve itself can leak only when there is pressure surrounding it, and at such times the brake will be applied.

The undesired quick action has been discussed to such an extent that the plain triple valve is blamed for having thrown the brakes on a train into quick action at times, therefore it is not surprising to hear that the H 5 distributing valve or the H 6 valve with the plain cylinder cap is accused of "dynamiting."

When the distributing valve is neglected until the pistons become "sticky" and hard to move, the action of the valve is sometimes similar to that of a "sticky" triple valve. The pistons of the distributing valve are sometimes allowed to get into such a condition that they cannot be moved until the gauge registers a reduction of 15 or 20 pounds, and when the piston is moved it will remain in application position until the pressure is 10 or 15 pounds stronger on the opposite side of the piston, consequently the brake will not apply promptly, and when it does apply it applies fully.

If this occurs with the automatic brake and the main piston responds promptly to the independent brake valve it indicates a sticky equalizing valve; if the condition of the equalizing valve is in question, the safety valve can be removed and the automatic brake valve used in light successive reductions, a flow of air into the passage into which the safety valve is



PAY DAY IN THE CULEBRA CUT, PANAMA.

screwed will occur the instant the equalizing valve is moved to application position.

This should not be confounded with a brake that applies in full after a light reduction due to brake pipe or other leakage, such as a leaky equalizing slide valve, independent rotary valve or a leaky graduating valve in conjunction with equalizing valve packing ring leakage.

The pipes connecting the distributing valve and brake valves must be kept absolutely tight in order to maintain the brake cylinder pressure when the valve handles are on lap position; the pipes should be tested with the air pump working and excess pressure in the main reservoir; the independent brake should be applied in full, the automatic brake valve placed in driver brake holding position, and the independent valve handle returned to running position; with the H 6 brake the application cylinder pipe, the release pipe and the pipes connecting the brake valves will contain air pressure, the pump governor and feed valve maintaining the reservoir, and brake pipe pressures will prevent the equalizing valve from cutting off the application cylinder from the release pipe.

The corresponding pipes of the H 5 brake will be tested in the same manner and under the same conditions, and the double cut-out cock under the brake valve should be turned to admit air pressure to that portion of the double-heading pipe between the cut-out cock and the brake valve. Leakage in the pipes referred to or leakage past the packing leather of the application piston also has a tendency to prevent the independent brake from applying in slow application position, although this is usually found to be due to the slow application port in the independent brake valve being closed by an accumulation of dirt.

Air and Vacuum Brakes.

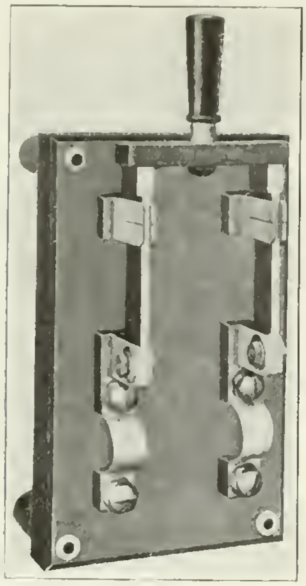
It is difficult to realize the amount of energy that must be destroyed by the air brake in stopping a train of cars on descending grades. The weight of the trains are often from 2,500 to 4,000 tons, and nothing but the modern air brake can be fully depended on for this work. The vacuum brake has been tested and run in competition to the air brake, but it cannot seriously compete with the former on account of the many advantages of the air brake, which deals with substance rather than void space. The air brake is more flexible; it can be applied from any portion of the train, where an opening can be made in the brake pipe; each car furnishes its own braking power, and leakage from the brake pipe has a tendency to apply the brake rather than result in a loss of train control. It can be applied instantly and released promptly on the entire train, and in stopping freight trains, the comparatively low brake pipe pressure of 70 lbs. is usually employed, and when the Westinghouse brake is used in the quick-action or emergency, position, it results in a brake cylinder pressure of approximately 60 lbs. per sq. in.; the cylinders are of 8 and 10 in., and the storage capacity of the equipments are proportioned to the size of the cylinders. The maximum pressure developed in the cylinders depends upon the amount of air that enters from the brake pipe; it is considered that the maximum pressure is about 60 lbs., whether 8 or 10-in. equipments are used, although on a train of 10 in. equipments, the cylinders would absorb more brake pipe air and have a tendency to result in a lower final equalization, the brake pipe being the same size in both cases. With the vacuum brake the higher pressures required in modern railroad service would have to be secured by increase in the size of the diaphragm and its parts.

Electrical Department

Electric Switches.

By W. B. Kouwenhoven.

A switch is a device employed for opening or closing an electrical circuit. Switches are sometimes confused with fuses and circuit breakers, which were described on page 303 of the July, 1908, issue of The Railway and Locomotive Engineering. Switches, fuses and circuit breakers all serve to open the circuit, but each has certain peculiar characteristics of its own. Fuses are always automatic in their action, switches never, and circuit breakers either automatic or non-automatic, depending upon their construction. A circuit breaker is constructed so that a trigger or toggle locks it closed against a spring or against gravity, and this toggle must be tripped before the breaker opens. A switch, on the other hand, is simply held closed by the pressure of the jaws on the blade, and there is no locking device. It is usually operated by hand. There is nothing on a steam locomotive analogous to a switch. It is true that it serves to close the circuit and throw on the electrical power and to open the circuit and cut off the power. But it does not perform this service for the electrical circuit in the gradual manner that the throttle valve performs it for the steam engine. There is no half-way position for a switch; it is either closed or open. It is best compared to the track switches, which, like itself, are either fully open or fully closed.



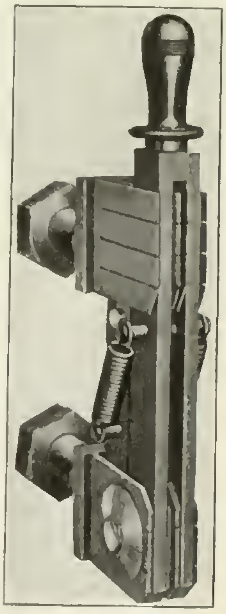
LEVER SWITCH WITH FUSES.

Switches for electrical purposes range all the way from the simple push button, serving to open and close a circuit of low voltage and current, and costing but a few cents, to the oil switch, with its complicated mechanism, controlling large currents at a pressure of thousands of volts and costing a considerable amount of money. Between these two extremes there are many switches that are used for special purposes.

The push button is the simplest form of switch, and it is used to operate an ordinary call-bell circuit. The next class of switches are those which are employed in office buildings, residences, and numerous other places, to control either the individual incandescent lamp or groups of lamps. From these we pass to the knife switch, as it is called, which is found in motor cars, in substations, in central power stations, and in almost every place where currents of any magnitude are handled. Next in order comes the oil switch, which serves to handle still higher voltages and currents. The oil switch is used mainly to control the alternating current circuits in the central stations, and in the substations. This article deals principally with the knife switch, and some of its special forms. Oil switches will be discussed in a later article in conjunction with oil circuit breakers.

There are five important factors that enter into the design of any switch: first, the switch must be of a simple, strong and rugged construction; second, it must open and close the circuit; third, must carry its rated current without overheating; fourth, all live parts must be thoroughly insulated from each other; fifth, it must prevent or render harmless any arcs that may form. The term *alive* is applied by electricians to any part of a circuit where the current is on; for example, the third rail is said to be alive when the current is turned on. The relative importance of these five factors in the design of a switch depends upon the class of service for which the switch is to be used.

Knife switches are usually mounted on a base of slate or porcelain. The large switches used in power stations are mounted directly upon the panel or switchboard in the station. These boards are of slate or marble. The contact jaws and the hinge clips which carry the blades are secured to the base or panel board in a manner that prevents their possible turning. The blades are secured to the hinges by means of spring washers, held by lock-nuts or pins, which at all times insure a good electrical connection between the hinges and the blades. The terminal lugs to which the leads are soldered are either of brass or copper. On the small size switches these are mounted on the front of the base or board, and the switches are called front connection switches, but in the large sizes they are carried at the back of the board, and are called rear connections. Very few switches of over 300 ampere capacity are of the front connection type, as the terminal lugs become so large that the jaws and hinges would have to be set high in order to clear them, and this would give the switch a clumsy appearance. The switch blade is usually made of hard drawn copper, which combines stiffness and strength. The crossbar, as the piece is called, that serves to connect the blades together, when there are more than one, is best made of the roughly seasoned wood, treated so as to be moisture proof. Fiber is often used, and it possesses the necessary strength and insulating properties for this work, but it is liable to absorb moisture. Traces of acid often remain after the process of manufacture, and long crossbars sometimes warp badly. The handle for operating the switch is attached to the crossbars.



QUICK BREAK SWITCH.

Switches are designed to prevent a temperature rise higher than 50 deg. F. In wire conductors that are in the open air, a carrying capacity of 1,000 amperes per sq. in. is allowed, and even in underground cables where radiation is prevented by the insulation and the lead sheath, a current capacity of 800 amperes per sq. in. is used. It would seem natural to use the higher value in knife switches, as they are exposed to the atmosphere, as any heat has an excellent chance to radiate. But in knife switches almost all the heating occurs at the contact jaws, and at the hinges, and it is safe to use only about 75 amperes per sq. in. of contact surface. The United States Government specifies a current carrying capacity of 50 amperes per sq. in. of contact surface for all switches that are used on government work. Single blades rarely carry more than 1,000 amperes, and where 2,000 or 3,000 amperes are to be handled, two or three 1,000 ampere blades will be mounted together on one hinge, and form what is known as a multi-blade switch.

Switches may be of the single pole, the double pole, and of the three- or four-pole types, depending upon the number of conductors that they control. For example: in a three-wire system a three-pole switch is necessary to throw on or off the current; in a two-wire system a double pole switch will suffice. Any one of these types of switches may be either single or double throw. A single throw switch has but one set of jaws, and one set of blades, and simply serves to cut a piece of electrical apparatus in or out of a circuit; a double throw switch has one set of blades and two sets of jaws. When the switch is thrown one way it connects a piece of apparatus to one circuit, when thrown the opposite way it connects to another circuit. Multiple blade swiches may have from one to four poles, and be of either the single or double-throw types. The four-pole type switch is not a very common one.

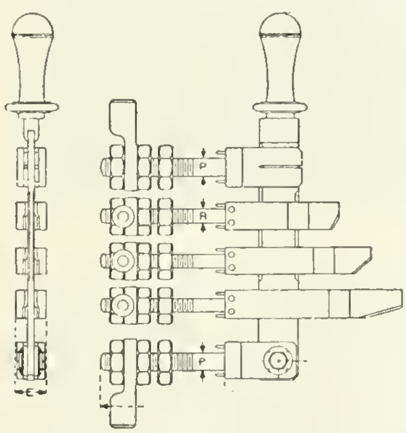
The rules for the spacings between the opposite poles, and for the break distances, are laid down by the National Board of Fire Underwriters. The break distance is the minimum distance that the blades clear the contact jaws. These rules are published by the underwriters in their National Electrical code. The rules govern the design, construction, application, installation and operation of electrical apparatus. Their object is to produce standard apparatus, with the intention of lowering the fire risk involved. The spacings vary with the voltage and the current.

Switches must open the circuit successfully at 50 per cent. over-load and at 25 per cent. excess voltage above their normal rating.

In mounting a switch it is good practice to place it so that gravity tends to open it; that is, the contact jaws or break jaws are placed above the hinge jaws. This makes it necessary to throw the handle up to close the switch. Double-throw switches may be mounted horizontally, but this is awkward, and they are usually mounted vertically. A stop is placed so as to hold them in the open position. The contact jaws are usually connected so that they are alive. This is preferable, because the blades stick out so far that a much greater risk is incurred of coming into contact with them or of producing a short circuit by dropping something upon them.

The operation of a knife switch is really a very simple matter, but the inexperienced man is very likely to do the wrong thing. In opening the switch he will gradually withdraw the blades from the contact jaws, thus producing an arc and burning the switch. The correct way to operate a switch is to throw it in or pull it out quickly. It is customary to use circuit-breakers and switches connected in series on the direct current side of a railway system. In closing the circuit, the circuit-breaker is closed first and then the switch. If there is an overload or a short circuit on the line, the breaker will open and protect the machine. In opening the circuit, the breaker is opened first and then the switch.

A knife switch that will open or break a given current and voltage on



STARTING SWITCH.

a direct current circuit, will successfully open the same current at twice the voltage on an alternating current circuit. An alternating current flows first in one direction and then in the opposite, as was explained in last month's issue. The alternating current in changing its direction of flow passes through zero and at this point the arc that is formed by opening the switch goes out, and the disappearance of the arc opens the circuit. It is due to this fact that the underwriters make the following statement in their rules for spacing: "For 100 ampere switches and larger, the spacings for 250 volt direct current are also approved for 500 volt alternating current."

QUICK BREAK SWITCHES.

Quick break or auxiliary break switches, as they are called, make it impossible to open a switch slowly, and thereby draw a dangerous arc. The switch blade of the single-throw switch consists of a leading and a following blade. The switch handle is attached to the leading blade. The blades are set in a steel ring which turns on a pivot or hinge. The following blade is fastened to the leading blade by means of a stiff coiled spring. On opening the switch the leading blade is withdrawn from the jaws through an angle of about 30 deg., when its heel releases the following blade, which is instantly withdrawn by the spring. This style of switch gives a very quick break and prevents the drawing of an arc, as was explained. On the double-throw type there are two following blades, one on either side of the leading blade. All the blades are of equal current carrying capacity. On the double-throw switch one of the following blades is always idle.

The fire underwriters require that the quick break switch be used wherever a switch has to open a circuit carrying a moderate or high current. All of the switches mounted on the switch panel in the motor cars of the New York subway are quick break switches.

STARTING SWITCHES.

Starting switches are single-pole switches with extra contact jaws. They are used to start motor generators, rotary converters and other electrical apparatus where the starting current is only a small percentage of the load current, and where it is desired to cut the starting device out of circuit when speed is attained. Resistance grids are connected between the several break jaws. When the blade comes in contact with the first jaw all the resistance is connected in series with the machine. As the blade is advanced to the successive jaws, the grids are short-circuited one by one, until on the last contact the full voltage is applied to the machine. These starting switches are similar in operation to the starting rheostats that are found on the electric motor cars. They are, however, very simple, and their cost is low.

FIELD DISCHARGE SWITCH.

There are several types of field discharge switches. When the field circuit of a generator or of a rotary converter is opened, there is a sudden rise of voltage, due to what is called the self-induction of the windings. The high voltage produced may puncture the insulation of the field coils and ruin them. A field discharge switch connects a resistance across the field before the circuit is opened. This resistance is called a discharge resistance, and serves to absorb the voltage and thus prevent any damage. Field discharge switches are always of the quick-break type, and have an additional blade and contact jaw, called the discharge contact. As the leading blades are withdrawn from the contacts, the additional blade makes contact with the discharge attachment before the switch opens.

Rough Railroading on the Plug in Days Long Past

By Angus Sinclair

Many grave comedies have been enacted through the ambition of the people in many locations of rustic bowers coming to imagine that the dales and hillsides about their homes would become centers of a teeming population if railroad companies could only be induced to bless the locality with the fructifying force of a railroad. For many years when railroad extensions were getting pushed in every direction without any clear idea of their goal, very wild ideas prevailed concerning what a railroad could do for a town or village. The wildcat railroad scheme flourished in those days like a green bay tree, and not a few rogues succeeded in extracting money out of towns and counties through unfulfilled promises to locate railroad tracks that never rose above the location maps.

When the natural recuperative forces began to make the country prosperous after the devastation of the Civil War, a remarkably speculative period opened with railroad construction offered as a panacea that would bring general prosperity upon its wings. The end came suddenly, as happens with all periods of inflation, and hundreds of unfinished railroads were to be found all over the country, their bare slopes and rugged beds resembling the financial condition of their promoters.

Among the ruined fragments of an overweening ambition were a few scattered remnants of what was called the Chicago, Clinton & Western Railroad, that was promoted to start from Chicago, cross the Mississippi River at Clinton, Iowa, and then ramble away westward, following a route which varied according to the encouragement received by townships in fertile Iowa

It may be mentioned that in those days many railroads were put into operation by towns, villages and townships providing means to pay for the construction of the roadbed, after which the promoters could generally sell bonds that paid for tracklaying and rolling stock.

Some work had been done on the road bed of the Chicago, Clinton & Western Railroad near Iowa City, Iowa, and it came to pass through the progress of time that the effects of the panic of 1873 were forgotten, and certain citizens of Iowa City began hustling themselves to inspire new life into the moribund railroad that was temptingly sleeping near their doors. Iowa City was served by one good railroad, the Chicago, Rock Island & Pacific, but the place was woefully somnambulent, and the more enterprising citizens imagined that all the ills suffered were due to the absence of railroad competition.

The enterprising portion of the people had so much faith in their own convictions that they raised sufficient money to finish that portion of the Chicago, Clinton & Western Railroad between Iowa City and the main line of the Burlington, Cedar Rapids & Northern Railway, by which they expected to enjoy the blessings of two competing lines.

ANGUS SINCLAIR'S FIRST ENGINE IN AMERICA.

During the first part of the year when the work on the Chicago, Clinton & Western section was resumed, I had been engaged on the location of a railroad in Wisconsin which faded before coming to bloom. When that enterprise suddenly "busted," leaving its adherents penniless and boardless, I went to Iowa City and obtained a job as assistant engineer from the engineer in charge of the job. As the time for tracklaying approached, I began to think that my fortunes would be fairer and my prospects of earning a livelihood would be better running a locomotive than pulling a surveyor's chain, so I managed to obtain the appointment of locomotive engineer. My ambition for more education was then active, and I concluded that the duties of engineer of this short railroad would leave me time to attend the classes of the Iowa State University, a hope that was well founded, for I afterwards attended classes between trains and acquired sufficient knowledge of chemistry to help me into the position of chemist for the Burlington, Cedar Rapids & Northern Railway.

By direction of the receiver of the railroad, I went to Aurora, Ill., for the engine, and track laying was at once begun. No accommodation whatever was made for engine or car. After the coal that was on the tender when I arrived with the outfit was exhausted, I was left to my own resources in getting fuel. I first bought a few loads of cord wood from neighboring farmers. Hearing that the Cedar Rapids line had put off coal laden cars in a neighboring siding, I went and took one of them. We had a dispute at the time between the relative meaning of "taking" and "stealing." Anyhow, I had used the coal when a threat came along of replevin.

There was no siding to hold the car and no switches to connect with one, but we put down some rails and made connection, pulling the spikes of a set of main line rails and moving them over to connect with the siding.

No water tank was provided, and I had to provide the means of raising water from a creek to the tender. Making a steam syphon is not a difficult job when one has the necessary tools and material, but I had neither pipe, taps nor dies, to say nothing of a vise bench. Hannibal crossing the Alps with an army was a small job compared to my steam syphon making performance.

The engine was equipped with one headlight. As work was done frequently after dark the headlight was moved to the end that was leading, an amusing little operation on a sticky embankment or muddy cutting with neither platform or ladders.

The track of the Plug, as this short line was popularly called, was laid upon the roadbed without any surfacing or ballast, and it formed an exceedingly rough road to travel over. The rolling stock consisted of one excellent Pittsburgh engine and one combination car, which made three round trips daily to the junction. The trips were made with little difficulty at first, but the winter proved very wet, and every cutting became a quagmire. At seven of these cuttings the rails were out of sight in the mud most of the winter, and it was only by exercising the greatest care that they were safely passed over. My first accident was the tender wheels jumping the track in one of these sloughs. The car was full of passengers, and I feared from my Scottish experience that they would hurl rocks at the unfortunate engineer, but they acted with charming good nature, cracked jokes about the Plug, and helped me to get the wheels back upon the rails.

There were many amusing incidents happened in the operating of the Plug. We stopped for passengers or produce anywhere along the line, waiting until farmers and others loaded such things as hogs, chickens, potatoes, corn or anything else that they wanted to send to the city. The people along the wayside waxed very familiar, and some of them stopped the train occasionally to ask if we knew the latest price of hogs.

One day I had to stop in one of the sloughs to repair an accident to a brake beam, and an inquisitive fat German jumped down to see what was the matter, and he sank nearly to the waist in the sticky mud. Several of the good-natured passengers tried to help the man out, but failed. After various efforts in which the man was trailed deeper into the slough, we attached a rope to his waist and pulled him out with the engine.

One very stormy night as I was using the greatest care to avoid accidents, the passenger car jumped the track in one of the worst places on the road. I went back and floundered in the mud, sticking my arms up to the shoulders in the mire feeling for the position of the wheels. They were slewed so badly that getting them on the track was hopeless in that dark night, with the rain pouring in torrents. I took all of the passengers upon the engine and tender and carried them to Iowa City in that position. In getting the people transferred from the car to the engine some of them narrowly escaped falling into the German's plight. One lady stumbled off the ties and one leg went down in the mud. I reached down and caught her ankle, thereby helping her out, but she lost her shoe. With all the hardships endured there was very little complaint heard from the passengers.

After about two years of this kind of operating the Chicago, Clinton & Western was bought by the Burlington, Cedar Rapids & Northern Railway Company, and our hardships soon ended.

Before closing this record of railroading under difficulties, I will mention an amusing side incident which happened when I was engineer of the Plug. One evening when I was living in Iowa City, I went with a few other young men to hear service in a negro church. The preacher, a huge colored man, as black as an engine smokestack, got up and said: "Now, my brudders an' sisters, I hopes you will be liberal in de collection to-night. Ise got ma grocer's bill to pay to-morrow, an' I mus' hab five dollars. No less dan five dollars, but as much more as your genamosity will gib. Brudder Slim will take round de hat."

Brudder Slim went round with an ancient plug hat, and when he was finished, took the offering up to the preacher, where they counted it.

"Free dollar, thirty-seven cents and two buttons," announced the domine. "Dat won' do, ma brudders. Dat won' pay ma grocery bill to-morrow mornin'. Perhaps de white brudders in de back seat will show ma beeble example of genamosity?" Brudder Slim came round and I gave him a quarter, while the other boys chipped in about a nickel each. Brudder Slim then went up and whispered something to the domine, who stepped to the front of the platform towering in his six feet three, and solemnly announced: "De engineer ob de Plug am gib a quarter, de Lawd bress de engineer ob de Plug."

The time and place made the incident so ludicrous that I had to think of very serious things in order to suppress the emotion that was rending my sides.

We are requested by the Pennsylvania Railroad Company to state that in view of the widespread publicity which has been given to the unauthorized newspaper report that the company was considering the advisability of numbering their stations instead of using the present names, the Pennsylvania Railroad Company authorizes the statement that no such plan has been considered.

A marked increase in the use of all-steel cars on several of the largest railway systems in America is observable. It is reported that there are now over 1,300 in operation throughout the country, and large orders are being received by the various manufacturers.

Development of the Locomotive Engine

A well known railroad man, after carefully reading the "History of the Development of the Locomotive Engine," by Angus Sinclair, among other complimentary things, wrote:

"The completed book is a monument to his industry and ability, and is altogether the most important contribution to railway engineering literature in the particular field which it covers.

"Beginning with the earliest attempts at harnessing steam, the narrative unfolds itself with the interesting grace of a romance. The entrancing story is epical in the greatness of events. The characters that follow each other in rapid succession are all heroic. There is an aptness and justness in the space given to the biographical parts of the work. The reader is never wearied with unimportant details. In the development of the locomotive a thousand busy hands have worked, and it has been left to Dr. Sinclair to point out the contribution made by each to the perfected mechanical marvel of to-day. He has brought to his work not only a mind stored with personal recollections of many of these gifted engineers who aided in the development of the locomotive, but his long experience as a writer has perfected him in the art of classifying the mass of material and presenting the salient features of the interesting subjects in their proper place and in the best possible light.

"Passing over the familiar ground of the beginning of the work, we are led to the Genesis of American Railways, an important and interesting chapter, which ought to be read in the public schools. The connecting of the Atlantic Ocean with the western rivers follows. The story of locomotives pushing their way toward the West fill many interesting pages that shed a flood of light on a great group of admirable characters, pioneer engineers, chivalrous adventurers, some of them battling on through trial to triumph, others falling, soldier-like, in action, but whose deeds are fittingly commemorated in this notable book."

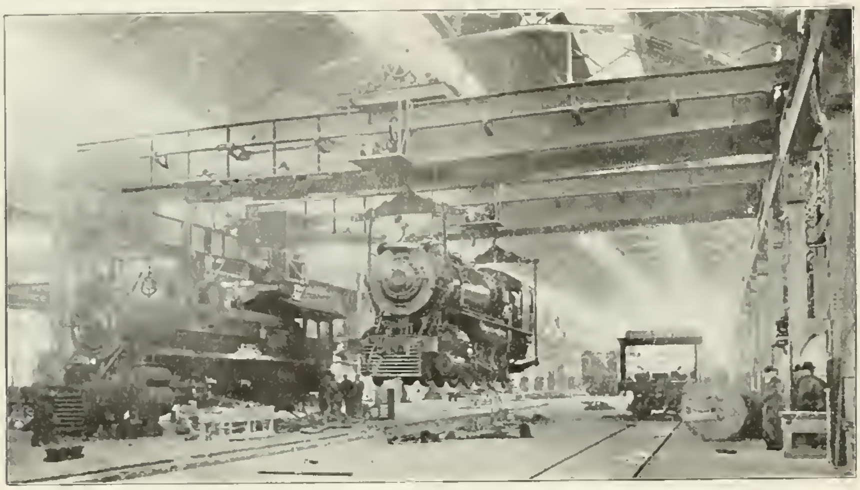
SEASON'S GREETINGS TO DR. SINCLAIR FROM THE CALEDONIAN.

AMONG THE WESTERN RAILROAD MEN

By James Kennedy

ON THE SANTA FE.

As we stated in our last month's notes on the Santa Fe, the city of Topeka is an important point on that great railway system. It may properly be said to be the beginning of the trail across the Great American Desert to the Pacific slope. There it was that Mr. Albert A. Robinson, the first chief engineer of the road, began his weary journey across the plains, staking out the line of the road nearly forty years ago. They certainly were heroic men who ventured across that wilderness, the haunt of hostile Indians and where innumerable other dangers existed, of which we now happily know nothing. It is gratifying to know that Mr. Robinson is hale and hearty as ever, and looks as if he was ready to lay out another path through Oklahoma and Texas across the Rio Grande to the Gulf of Mexico. The extensive additions to the shops at Topeka keep him busy in the meantime, and the equipment already in operation there is unquestionably among the best in the world.



CRANE IN THE SANTA FE SHOPS, MADE BY THE WHITING FOUNDRY EQUIPMENT COMPANY, OF HARVEY, ILL.

ON THE UNION PACIFIC.

Forty years have nearly elapsed since the opening of this great iron pathway, the first of its kind that stretched from the highways of the East through the American Desert and across the Rocky Mountains to the Pacific Ocean. There is still a newness about the road, and particularly about the shops and roundhouses that would give one the impression that it was an outgrowth of the twentieth century. To the Eastern railway man there is something splendid about the vast spaces that surround these western shops. There is so much room for everything. The yards stretch one might almost say, into immensity. The roundhouses are wide as the Roman Coliseum, and the mighty engines really look small in their spacious quarters. The railway men themselves seem to be better taken care of. Their hours of work are shorter, rarely exceeding 50 hours a week. They are paid more. There is less complaining. There appear to be more fair play, or such approach to it as we can expect among human society organized, as it is, largely to the advantage of the children of the rich. Many of the railway men own farms that are very productive, and are rapidly increasing in value. These railway owners of farms possess knowledge of horses and cattle and other live stock that is as complete as their skill in the mechanical appliances used on railways. One might marvel how they find time to manage all their affairs, but the men are very active, and the cattle in great measure look out for themselves.

A large number of the railway men in the West have grown up in the employ of the companies. It is not uncommon to meet men who have been over thirty years in the same shop, or running a locomotive on the same division even longer than that. A world of tales of adventure and of peril could be collected out of the stirring stories of the lives of these men—stories of daring and of bravery that would make interesting reading.

At Armstrong, Kansas, one of the first Union Pacific men we met was Mr. R. A. Rogers, a fine specimen of the well-bred, well-educated athletic, thoroughly accomplished railway man. He is roundhouse foreman, and had been twenty-six years in the service of the company. The roundhouse was a sample of nearly all that one sees on the Union Pacific. We had the opportunity of witnessing the dropping of the driving wheels out of one of the passenger engines. The wheels were about 8 ft. in height, and the uncoupling of the rods outside and the eccentric straps and bottom binders inside was accomplished in jig time, and then by a compressed air contrivance that part of the floor beneath the wheels dropped nine or ten feet, taking with it a corresponding space of the flooring alongside. In less time than it takes to tell it, the wheels were on the surface of the shop again, surrounded by a circle of fire fed by gasoline and compressed air, and in fourteen minutes the old tires were slid off the wheels, and a new pair slid on in an equally short space of time. The big lathe was ready for them, and the rejuvenated wheels were back under the engine again and ready for the road the same afternoon.

There were about 250 men in the finely equipped shops, and every modern appliance was in full operation. Under the enterprising supervision of Mr. Joseph Roberts, the master mechanic, there is no penny wise and pound foolish methods. New machines are being constantly installed, and while the Omaha shops continue to be the chief mechanical center of the Union Pacific road, there are extensive shops at Cheyenne and Evanston, in Wyoming, as well as those at Denver, to which we have already briefly alluded, and at all of these, as well as at Kansas City, every mechanical operation involved in locomotive and car construction and maintenance is constantly carried on with marked success, with the result that along the entire 4,000 miles of road the equipment, especially the 700 locomotives, is in excellent condition.

ON THE CHICAGO, BURLINGTON & QUINCY.

It is a noteworthy fact that there is scarcely a railroad in America that has not some mechanical feature peculiarly its own. The engines of the C., B. & Q. are noted for the continuing tightness of their piston and valve rod packing. No cloud of steam obscures the flying crossheads. Mr. J. H. Lewis, locomotive foreman at Chicago, who has invented many clever devices, has perfected a sytem of piston packing that is very effective. We had the pleasure of examining a number of his contrivances, among others a tallow cup screw that is claimed to stick to its place, which is more than can be said of many screws. The device consists of a small groove being cut on the threads of the bolt or screw, and in a recess in the brass cup there is inserted a short bent band or strip of flexible steel, in the center of which there is a slight protuberance adapted to fit into the groove or slot that runs along the bolt. The effect is that while the bolt may be turned by a wrench in the usual way without breaking or even bending the piece of steel, the bolt cannot move by mere vibration as is often the case during long runs.

At St. Joseph, Mo., we had an opportunity of witnessing another example of taking off and replacing the driving wheel tires of passenger locomotives. It differed somewhat from the Union Pacific method, in the fact that the new tires were already turned on another pair of wheels that acted as a kind of mandrel to hold the new tires while being turned. The wheels of a certain class of passenger engine being all of a standard size, it can readily be imagined that the tires would suit any pair of wheels, so long as their peripheries also exactly agreed. In the instance under our observation, the old tires were no sooner off than the new tires already turned were placed in position and in fifteen minutes they were sufficiently heated to be drawn into place.

The rapid growth of this great railway, now nearly 10,000 miles in length, with 1,700 locomotives, is taxing the repair shops to their utmost capacity, and extensive additions are inevitable. Meanwhile, the equipment is being kept in splendid condition, involving in many cases extra hours of labor. The general feeling among the railway men in the company's employ is of the best. The master mechanics like Mr. W. W. Lowell, at St. Joseph, are nearly all men who have grown up in the service of the company, and are kindly, approachable men, who, having no fear of those over them, show no senseless pride towards those who happen to be beneath them.

ON THE CHICAGO, ROCK ISLAND & PACIFIC.

It is readily seen in the middle West that the railways not only precede civilization, but they sustain it in many growing towns where the natural advantages are not apparent to the naked eye. When one ventures to leave the railway a few miles, one is in the untrodden wilderness again. Hence the interminable network of railways that we see on the map are not only essential to the commercial welfare of the States through which they pass, but they are themselves the vitalizing influence, just as the arteries are in animal life, and without which there would be no sustaining force. Among these railways west of Chicago the Rock Island covers a vast area with an all-embracing system that leaves very few commercial centers untouched. The equipment is in fine condition, and the numerous repair shops are abreast of the times in modern appliances. At Chicago we had the pleasure of thoroughly inspecting the extensive works under the guiding eye of Mr. J. B. Kilpatrick, the motive power superintendent of the central district. About 300 men are employed in the machine shops, while over 1,000 more are employed in the adjoining car shops. Among the fine locomotives there are a number of examples of the balanced compound type which have done excellent work, running as much as 135,000 miles between the periods of general repair. Nearly 300 of these fine locomotives are equipped with the Walschaerts valve gearing, and its excellence is acknowledged by all who have had the opportunity of observing its efficiency and stability through prolonged service. Six of the larger locomotives are also equipped with the Cole superheater, and the results so far are of the most gratifying kind.

In the machine shop every machine seemed to be of the high-speed variety, the few older machines keeping pace with the newer ones. Large planing machines were moving at a velocity of 40 ft. per minute, and lathes were making 110 revolutions per minute. The 90-in. wheel lathes were making up for their slower motion by being equipped with a double set of cutting tools, one following the other, with a rapid feed, the second tool giving a finishing cut that left nothing to be desired. The tool-grinding section revealed a new feature in the fact that the lathe tools were nearly all ground by machinery, the adjustable holder being set at the requisite angle, producing a perfection in the relative degrees of the cutting angles that could not be approached by hand.

A feature in the shops generally was the adaptation of crude oil motors to every variety of work and in this matter it seems that they had long passed the experimental stage, the supply of the fuel evidently being at a nominal cost. It may be added that compressed air seemed also to be "pressed" into new and important services, among which was the admirable arrangement of powerful air hammers in the blacksmith shop. These hammers were not encumbered by ponderous supports in the vicinity of the hammer block or anvil. A wide, clear space around the anvil being available for the free handling of locomotive frames or other large work. The chief supports of the hammers were attached to the steel roof girders, with wide, spreading superstructures of sufficient strength to overcome the vibration incident to the heaviest service.

In the boiler shop the compressed air was also much in evidence. One powerful machine was cutting at one stroke the two rivets that attach the drawbar ends to the strap. This work is usually accomplished by hand at a cost of about ten cents for each drawbar. Mr. Kilpatrick's machine has reduced the cost to less than two cents. Indeed it is noteworthy that the intelligent spirit of economy as manifested in the multitudinous mechanical operations is never adding to mere manual labor, but, on the other hand, is always for the saving of labor by the clever application of cleverly designed devices. It is gratifying to know that the great army of skilled mechanics are to a large extent partakers in the improvements that are going on. The hours of labor are shortened, and the reciprocal feeling of good will is admirable.

A HEAVY FREIGHTER ON THE "Q."

Educational Chart No. 10.

During January the demand for copies of our new combination chart and model has exceeded the call during the same period for any of our previously published charts. We are promptly meeting the demand, and are prepared to supply every railroad man in America with a copy if it takes all summer. A special consignment has been called for from our European readers, who seem to be as keenly alive to the merits of our new chart as are our friends on the American Continent.

The educational value of the chart is enhanced by the series of questions in regard to the motion of the piston, main rod and slide valve. A careful study of these questions with the movement of the piston, crosshead or slide valve that are necessary in properly solving the question will aid the young fireman or engineer or machinist in obtaining a thoroughly practical knowledge of the intricate movements of the chief parts of the steam engine.

The first installment of the answers to the questions were published in the January issue of Railway and Locomotive Engineering, and we append a further installment this month. The series will be completed in the March issue, and as many of our subscribers will prefer to begin with the January issue, we are prepared to supply copies on request. We commend to our readers a careful study of the new chart and a repeated perusal of the questions and answers.

ANSWERS TO QUESTIONS ON EDUCATIONAL CARD CHART NO. 10.

15. How would you block valve if one of the bridges was broken?

A. On the middle of the seat.

16. How if a rocker broke?

A. In the same position.

17. What is the reason that the crosshead is not in the center of the guides when the crank pin is on the top quarter?

A. The difference is due to the angularity of the main rod.

18. Why does the piston travel unevenly?

A. Because the crank pin with which the piston is connected does not move in a horizontal line. Towards the beginning and end of the stroke the crank pin motion is nearly perpendicular, while in its journey between the eighths it is nearly horizontal.

19. Does this cause the valve to travel unevenly? If so, why?

A. The valve travels unevenly because it is operated by an eccentric, which has the same motion as a crank of small throw.

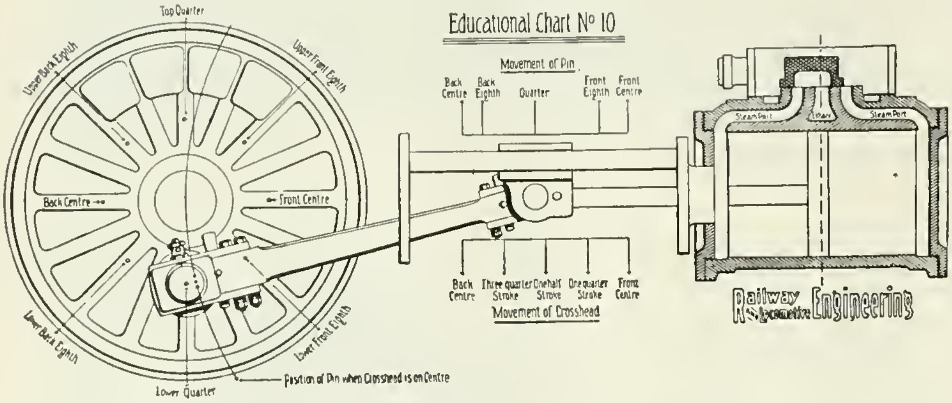
20. What effect has the length of the main rod upon the piston travel?

A. None.

21. Suppose you were running ahead shut off, with the reverse lever hooked close to the center, what would the valve do?

A. The valve would be forced off the seat at certain parts of the stroke, while at other parts it would aid the piston to suck in dust and hot gases through the exhaust port.

22. Why is the valve placed over the center of ports when engine is disconnected?



A. To prevent the admission of steam into the cylinders.

23. What could happen that would cause you to disconnect without covering the ports?

A. Any failure in the supply of steam, such as a safety valve blowing out or the dry pipe collapsing.

24. When an engine is running, at what part of the travel does the piston move the fastest?

A. When the crank pin is passing the quarters. At those points the pin movement is nearly horizontal.

25. Does the piston stop at each stroke, and when?

A. The piston stops at the end of each stroke, the point where it changes direction of movement.

26. At what part of the piston travel is the greatest pressure exerted on the crank pins?

A. At the beginning of each stroke.

27. In running ahead, why does the top guide wear most?

A. Because the main rod pushes the crosshead upwards.

Station Indicators.

There has been considerable discussion in daily papers lately about the desirability of introducing station indicators into railroad cars that would automatically show the name of each station the train was about to stop at. To the inexperienced the problem appears very simple. The Pennsylvania Railroad Company was reported to be not only about to introduce station indicators, but also numbers to take the place of station names. The New York *Times* having published articles on the subject, Angus Sinclair wrote:

I doubt the wisdom of substituting numbers for names, as it would add a new cause of bewilderment to a nervous passenger, and I doubt that the Pennsylvania Railroad Company contemplates introducing automatic indicators for the ancient Greek vernacular employed by the average trainman in shouting the name of the next station. The change is very desirable, but it is not so easily carried out as might appear on superficial inspection, and the Pennsylvania Railroad Company's officials are not the people to introduce a system possessing inherent weakness likely to produce failure.

I am one of the old guard of railroad men who has seen a multitude of ingenius devices introduced into train service that promised unfailing success yet turn out to be hopeless failures. Station indicators have been one of these inventions. I remember a case in point. An up-to-date Western railroad was wrestling with a station indicator device, invented by a friend of the president. Citizen Bartlett was on his way to Liberty, where a bridal party awaited his presence as principal personage in an interesting ceremony. Well, the indicator had been behaving in a most satisfactory manner, turning on the right name as regularly as the advent of a grocer's bill; but this morning it happened that one of Farmer Huxley's cows was grazing upon the track, and it held to the right of way so persistently that Engineer Myers had to stop in showing mercy to the stray bovine. The stop tripped the station number, with the result that Liberty appeared when it ought to have been Summit. Citizen Bartlett descended from the train at the instigation of the station indicator, and after the train had departed found that he was nine miles short of his proper destination. The mistake led to the marriage being broken off, and the disappointed bridegroom sued the railroad company for $25,000 damages and consolation.

This indicator system disappeared from that road suddenly, and when any person wished to hear the president snort he had only to ask permission to try a new station indicator invention.

Items of Personal Interest

Mr. J. Milner has recently been elected vice-president of the Standard Car Truck Company of Chicago, Ill.

Mr. L. E. Bailey has been appointed road foreman of engines of the Western division of the Canadian Pacific Railway.

Mr. J. L. Brummel has been appointed road foreman of equipment on the Iowa Central Railroad, with headquarters at Peoria, Ill.

Mr. O. D. Greenwalt has been appointed master mechanic of the Williamsville, Greenville & St. Louis, with office at Greenville, Mo.

Mr. Joseph Coffin has recently been elected vice-president of the American Brake Shoe & Foundry Company of New York and Chicago.

Mr. M. J. Powers has been appointed master mechanic of the Denver & Rio Grande at Pueblo, Colo., vice Mr. W. A. Randow, transferred.

Mr. Horace G. Burt has been appointed receiver of the Chicago Great Western Railway at St. Paul, Minn., vice Mr. A. B. Stickney, resigned.

Mr. Frank Rusch has been appointed master mechanic of the Chicago, Milwaukee & St. Paul Railway, with headquarters at Seattle, Wash.

Mr. T. L. Burton has been appointed general inspector in charge of airbrake, steamheating and car lighting equipment of the entire Reading system.

Mr. W. W. Shope has been appointed traveling engineer of the middle division of the Pennsylvania Railroad with headquarters at East Altoona, Pa.

Mr. A. West has been appointed master mechanic of District 1 of the Canadian Pacific Railway, with office at Kenora, Ont., succeeding Mr. A. H. Eager.

Mr. Henry E. Norton has been appointed purchasing agent of the St. Paul Union Stock Yards Co. Terminal Railway, vice Mr. C. E. Weber, resigned.

Mr. Fred Regan has been appointed master mechanic of the Southern division of the Kansas City Southern Railway, with headquarters at Shreveport, La.

Mr. D. L. Forsythe has been appointed road foreman of equipment of the Southeastern division of the Frisco System, with headquarters at Memphis, Tenn.

Mr. E. F. Jones, acting master mechanic of the Chicago & Western Indiana Railroad, has been appointed master mechanic on the same road at Chicago, Ill.

Mr. J. W. Pringle has been appointed acting locomotive foreman on the Grand Trunk Pacaific Railway, in charge of all matters pertaining to motive power and car departments, vice Mr. O. C. Fraser, resigned.

Mr. Calvin Schreck has been appointed road foreman of engines of the Cleveland, Cincinnati, Chicago & St. Louis Railway, with headquarters at Bellefontaine, Ohio.

Mr. W. L. Hudson has been appointed road foreman of engines of the Pittsburgh division of the Pennsylvania, with headquarters at Pittsburgh, Pa., vice Mr. J. K. Russell, retired.

Mr. J. R. Cook has been appointed mechanical superintendent of the Pesos & Northern Texas and of the Southern Kansas Railway Company of Texas, vice Mr. Thomas Booth, retired.

Mr. A. E. Harvey has been appointed superintendent of the Fort Dodge division of the Chicago, Great Western Railway, with headquarters at Clarion, Ia., vice Mr. L. M. Shipley, transferred.

Mr. Clarence Roberts has been appointed assistant road foreman of engines of the Pennsylvania Railroad Company, with offices at Philadelphia, Pa., vice Mr. William Colledge, promoted.

Mr. Geo. E. Coolidge has been appointed superintendent of dining car service on the Lehigh Valley Railroad with headquarters at Easton, Pa., vice Mr. J. Howard Seal, retired.

Mr. L. M. Shipley has been appointed superintendent of the southwest division of the Chicago, Great Western Railway, with headquarters at Des Moines, Ia., vice Mr. C. S. Weston, resigned.

Mr. S. C. Graham has been appointed master mechanic of lines west of Missouri River on the Chicago & North-Western Railway, with headquarters at Missouri Valley, vice Mr. E. W. Pratt, promoted.

Mr. Geo. P. Smith, formerly chief engineer of the Lake Erie & Western, has been appointed chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway, vice Mr. Wm. Duane, resigned.

Mr. William Hutchinson has been appointed master mechanic of the Ashland division of the Chicago & North-Western Railway, with headquarters in Kaukana, Wis., vice Mr. S. C. Graham, promoted.

Mr. Frank Hopper, formerly road foreman of equipment of the Chicago Rock Island & Pacific at Dalhart, Texas, has been appointed road foreman of equipment of the Dakota division of the same road, with office at Estherville, Ia.

Mr. V. T. Bartram having resigned, the position of purchasing agent of the Temiskaming & Northern Ontario Railway is abolished. All matters pertaining to the purchasing department are now in charge of Mr. W. A. Graham, storekeeper.

Mr. E. J. Shoffner, foreman of the Frog and Rail Mill of the Norfolk & Western, at the Roanoke shops, has been appointed general foreman on that road at Cleveland, Ohio, vice Mr. H. F. Staley, promoted.

Mr. A. W. Horsey, formerly mechanical engineer of the Canadian Pacific at Montreal, has been appointed master mechanic of the Chalk River division of the same road, with headquarters at Smith's Falls, Ont.

Mr. F. C. Fosdick has been appointed master mechanic of the Iowa and Minnesota division of the Chicago & North-Western Railway, with headquarters at Mason City, Iowa, vice Mr. William Hutchinson, promoted.

Mr. A. L. Kendall, formerly general foreman of the car department of the New York Central & Hudson River Railroad at West Albany, N. Y., has resigned to take a position with Messrs. Bingham & Taylor of Buffalo.

Mr. W. A. Bennett has been appointed road foreman of the Chicago, Burlington & Quincy, at Edgemont, South Dakota, with jurisdiction over the line from Alliance, South Dakota to Deadwood, and over all branches in the Black Hills.

Mr. D. Gallaudet, formerly master mechanic of the Chicago division of the Baltimore & Ohio Railroad at Garrett, Ind., has been appointed master mechanic of the Grand Junction Terminal of the Denver & Rio Grande, with headquarters at Grand Junction, Colo.

Mr. E. W. Pratt has been appointed assistant superintendent of motive power and machinery of the Chicago & North-Western Railway, with headquarters at the Chicago shops, vice Mr. E. B. Thompson, resigned to accept service with the C. St. P. M. & O. Railway.

Mr. J. F. Bowden, formerly master mechanic of the Baltimore & Ohio at Parkersburg, W. Va., has been appointed master mechanic of the Chicago division on that road at Garrett, Ind., vice Mr. D. Gallaudet, resigned to accept position at the Grand Junction Terminal, Col.

Mr. G. W. Rink has been appointed mechanical engineer of the Central Railroad of New Jersey with offices at Elizabethport shop, N. J., vice Mr. B. P. Flory, resigned to accept a position with the New York, Ontario & Western. Mr. Rink was formerly chief draughtsman of the C. R. R. of N. J.

Mr. Charles E. Sargeant has been appointed road foreman of engines for the Iowa division of the Chicago & North-Western Railway, with headquarters at Boone, Iowa. He comes from the ranks of the locomotive engineers, and his promotion is a recognition of efficient and faithful service.

The address of our Scottish representative, Mr. A. F. Sinclair, has been changed from 15 Manor Road to 37 Jamaica street, Glasgow. The new office is in a central part of the city and will be highly convenient for callers. Any of our readers requiring books published in Europe would do well to consult our Scottish representative.

At the annual meeting of the New England Locomotive Foremen Association, recently held at Keene, N. H., Mr. John J. McNulty was elected president; Mr. W. W. Greene, vice-president, and Mr. Fred D. Avery, secretary and treasurer. There was a large attendance of members, and a banquet was held in the Quincy House. The association starts this year with several new members, and all the members in good standing. A prosperous year is expected.

Mr. Charles J. Drury, heretofore bonus supervisor of the Western Grand Division on the Atchison, Topeka & Santa Fé at La Junta, has been made general roundhouse foreman at Albuquerque, reporting direct to Mr. W. A. Daze, master mechanic at Winslow. In the past the roundhouse work at that point, as well as all others on the line of the Santa Fé, has been directly under the master mechanic, but it is thought that more satisfactory results will be obtained by making this change.

At the annual meeting of the stockholders of the Independent Pneumatic Tool Company, held at Jersey City, N. J., the following directors were elected: Messrs. Jas. B. Brady and W. O. Jacquette, New York; John P. Hopkins, M. B. Rosenwald, Jas. J. McCarthy, S. Florsheim, Chicago; John M. Glenn, John D. Hurley, John R. Turner, Jersey City, N. J. At the annual meeting of the directors recently held in Chicago, the following officers were elected: Messrs. Jas. B. Brady, president, New York; W. O. Jacquette, 1st vice-president, New York; John D. Hurley, 2nd vice-president, Chicago; A. B. Holmes, secretary and treasurer, Chicago.

Mr. P. B. Flory has been appointed superintendent of motive power on the New York, Ontario & Western Railway, at Middletown, N. Y., vice George W. West, deceased. Mr. Flory was born in Susquehanna, Pa., in 1873. In 1895 graduated at Cornell University with the degree of mechanical engineer. In 1899 he began work on the Lehigh Valley Railroad as an inspector, and in 1902 was made chief draughtsman, and shortly after he was advanced to the position of mechanical engineer. On March 10, 1904, he was appointed mechanical engineer of the Central Railroad of New Jersey, which position he has held with credit to himself until called to fill the more responsible office of superintendent of motive power of the N. Y., O. & W.

Mr. Thomas Booth, mechanical superintendent of the Pecos & Northern Texas Railway and of the Southern Kansas Railway Company of Texas at Amarillo, Tex., recently retired from the service of these roads. On the occasion of his retirement he was made the recipient of a diamond, by the railway men of Amarillo, and indeed the ceremony of presentation which took place at the close of a complimentary banquet to Mr. Booth was witnessed by representatives from all walks of life in the city. During the evening it was pointed out that in all the years of service by Mr. Booth in Amarillo there has been no strike, no walkout, no strife. At the first showing of trouble the master hand of the man was present and the rough places straightened and made smooth. This is a strong compliment to the ability of the man, a fact well appreciated by those acquainted with the various causes from which strifes and contentions may readily arise in railroad work. Mr. Booth leaves with his family for Clovis, N. M.

Obituary.

Just as our paper was going to press last month, and too late for extended comment, we received word of the death of our old friend, George W. West, superintendent of motive power of the New York, Ontario & Western He died December 24th at his home in Middletown, N. Y. Mr. West was born in 1847, at Troy, N. Y. After a public school education he began railway work in 1865 as a machinist on the New York Central at Schenectady, N. Y., and two years later was made a gang foreman. In 1873 he became a master mechanic of the Chenango Valley Railway, now part of the New York Central & Hudson River Railroad. A year later he was made master mechanic of the Buffalo division of the New York, West Shore & Buffalo. In 1886 he accepted the position of master mechanic of the Mahoning division of the New York, Lake Erie & Western, now part of the Erie Railroad, and a year later he was transferred as master mechanic to the middle division on the same road, and in 1888 he was transferred in the same capacity to the eastern division, with office at Jersey City. In 1890 he was appointed superintendent of motive power of the New York, Ontario & Western, which position he held up to the day of his death. Mr. West was prominent in various railway mechanical organizations and he was well known in all parts of the country as an able and efficient mechanical department officer. He was president of the American Railway Master Mechanics' Association in 1894, and contributed much to the advancement and usefulness of that organization. In 1899 he became a member of the New York Railroad Club, and in 1892 was elected an executive member, and president of the club in 1894 and 1895. For the last seven years he has been chairman of the executive committee. He was re-elected for an eighth term of office on December 18th. During this time he was also a member of the Central Railway Club, of which he was president in 1901 and 1902, and for several years was also a member of the executive committee. All who came in contact with Mr. West respected him. He had a kindly manner and his stirling honesty and ability made his friendship prized by all who received it. The whole railroad community as well as a large circle of friends most sincerely sorrow at his death.

Charles R. Herron, of Chattanooga, Tenn., late Southern sales manager of the American Brake Shoe and Foundry Company, died at his home in Chattanooga, December 6, 1908. Mr. Herron was a highly respected citizen and a noted business man of Chattanooga, with a wide acquaintance throughout the South; his friends were legion in all walks of life. Born in Ireland in 1844, he came to America with his parents in 1848 and located in St. Louis. At the age of fifteen he became a foundry apprentice, and after serving his apprenticeship, became a journeyman moulder, traveling through the United States and Canada. In 1873 he started a stove factory in Indianapolis. He then became connected with the Eureka Foundry Company of Cincinnati, and served a term as a member of the Board of Public Works of Cincinnati. His connection with the brake shoe business began in 1889, when he took charge of the Ross-Meehan foundry at Chattanooga in the manufacture of brake shoes and malleable iron castings. He became connected with the American Brake Shoe Company, and in 1902 with the American Brake Shoe and Foundry Company, where he continued as Southern sales manager until the time of his death. He was also largely interested in the Herron Pump and Foundry Company of Chattanooga. Charley Herron, as he was called by his friends, was a good man, honest, straightforward and energetic, yet modest and kind hearted, a friend of everybody, and his death is a loss to all his friends North and South.

Our judgments are so liable to be influenced by many considerations, which almost, without our knowing it, are unfair, that it is necessary to keep a guard upon them.—*Little Dorrit.*

Mallet Engine for the D. N. W. & P.

During the last two years the articulated type of compound locomotive has so increased in popularity among railroads in this country, as well as in South America, that it is no longer the novelty it was five years ago, when the first one of this type built in this country was turned out at the Schenectady plant of the American Locomotive Company.

This type having been introduced to handle increased tonnage on heavy grades, has so far been confined principally to roads having such grades. Of roads of this character, the Denver, Northwestern & Pacific Railroad, more often called the Moffat Road, has perhaps some of the heaviest grades of any road in the United States. In spite of this fact, however, the officials of this road have waited to see whether the Mallet type would prove as successful as its advocators prophesied. Up to the present time, therefore, although well adapted to their practice, they have purchased no articulated locomotives.

The service given by engines of this class which have now been in operation for two or three years on several of the most prominent roads, have so proved its practicability and adaptability for service under conditions similar to those on the Moffat road that they recently placed an order with the American Locomotive Company for one 0-6-6-0 type locomotive, the half-tone illustration of which is presented here.

As far as the design is concerned, in general, it is similar to its prototype, the one built for the Baltimore & Ohio Railroad. The engine under consideration, however, weighs only 327,500 lbs., whereas the former locomotive weighed 334,500 lbs. This difference in weight is due in part to a smaller number of tubes of the same diameter in the Northwestern & Pacific engine than in the Baltimore & Ohio, there being only 409 tubes 2¼ ins. in diameter in this engine, as against 436 tubes in the B. & O. engine. There is also a difference in the diameter of drivers, those of the engine here illustrated being 55 ins. in diameter, while those of its predecessor are 56 ins. in diameter.

The cylinders of both engines have the same stroke of 32 ins., but in this latter design the high-pressure cylinders are 20½ ins. in diameter, and the low-pressure cylinder 33 ins. in diameter. Both engines have 10-in. piston valves; those on the Denver, Northwestern & Pacific having a maximum travel of 6⅛ ins.

There is also a difference in the lead of the valve which, with the Walschaert Valve Gear, is, of course, constant. In the engines here described the valves have a 3-16 in. constant lead with 1-in. outside lap on both the high and low-pressure cylinders, while the valves on the Baltimore & Ohio articulated locomotive had a ⅛-in. lead in full gear, with 1⅛-in. lap on the high-pressure and 1-in. lap on the low-pressure cylinders. The result of this change in the valve motion is that the cut-off point occurs at a later period in the stroke in the Northwestern & Pacific locomotive than in the Baltimore & Ohio, thereby giving a longer steam admission, which, considering the fact of the service for which this engine is intended, would seem an advantageous change.

As far as the characteristic features of the design are concerned, namely, exhaust pipe connections between the high-pressure and low-pressure cylinders, intercepting valve, exhaust pipe connection between the low-pressure cylinder and the exhaust pipe, articulated joint and weight distribution are concerned, both engines are practically identical in design, which speaks well for the success of these features on the B. & O. engine.

The most interesting thing in connection with these engines is the service for which they are intended, and this service opens up a new field for the Mallet type of locomotive which does not seem to have previously been thought of in connection with it. The engine here illustrated will be used principally as helper and pusher with the rotary snow plows in use on this road. As our readers well know, the snow plow plays a most important part in the operation of this road, as without it, it would be practically impossible to keep the right-of-way open during the winter season, which at the altitude to which the road ascends continues from September to May, or nine months out of the twelve.

One of the most essential things in the operation of the rotary snow plow is that it should be handled by as few engines as possible in order that starting and stopping may be done quickly, so as to avoid danger of bucking the plow into a hard packed mass of snow or ice. Heretofore it has been necessary to use as many as five consolidation engines in pushing the rotary during the most severe weather. It is expected, however, that this Mallet engine, being able to work as slow as four or five miles per hour without danger of stalling, and at its maximum of power, and in fact at an increased power, if necessary, by working it simple, will greatly reduce the number of engines necessary in this kind of service, and so increase the efficiency of the plow. It must be understood, however, that this engine will also be used in regular road service.

As far as the physical characteristics of the road are concerned, there is practically a continuous grade of a maximum of 4 per cent. from Boulder to the summit of the rise, about 17 miles on the eastern side and an approximately equal grade of the same

MALLET ARTICULATED LOCOMOTIVE FOR THE DENVER, NORTH-WESTERN & PACIFIC RAILWAY.
G. Thompson, Superintendent of Motive Power. American Locomotive Works, Builders.

distance on the western side. The right-of-way over this distance is practically full of curves, the sharpest being 16 degs., and there is no widening of the track on the curves, and a very little elevation of the outer rail. It is expected that under these service conditions this engine will haul 500 tons at a speed of not over 12 miles per hour. At present they will handle general merchandise, but it is hoped that in the near future the road will reach a coal region and ultimately be extended to Salt Lake City, at which time the freight will be very heavy.

If these plans are carried through, however, this entire distance of some thirty miles will probably be cut out with a six-mile tunnel; from foot to foot of the 4 per cent. grade, which will reduce the maximum grade to 2 per cent., but the curves will still practically be about the same. Trains of 500 tons are at present being taken up the grade by two consolidation engines, one at the front and one at the rear as a pusher, although in cold weather three engines are often used.

Officials of the C. N. W. & P. expect that with the use of this type of machine the number of engines can be reduced, or the load increased as the traffic becomes greater, without increasing the number of trains.

They say, however, that the purchase of this one locomotive does not argue that the type has been adopted, but that this engine is purely an experiment, with the hope that better results will be obtained with it than from the consolidation type. In view of the successful results obtained from the Baltimore & Ohio engine of this type and other Mallet locomotives for various roads on this continent and abroad, the manufacturers have every reason to feel confident that the purchase of this engine will, however, eventually result in the further purchase of similar engines. Some of the principal dimensions are here appended for reference:

VIEW FROM ONE OF THE MANY SHORT TUNNELS ON THE DENVER, NORTH-WESTERN & PACIFIC.

Cylinder—Type, compound; diam., 20½ x 33 ins.; stroke, 32 ins.; tractive power, 73,900.
Wheel Base—Driving, 10 ft. 10 ins. and 10 ft. 10 ins.; rigid, 10 ft. 10 ins.; total, 30 ft. 8 ins.; total, engine and tender, 64 ft. 4 ins.
Weight—In working order, 327,500 lbs.; on drivers, 327,500 lbs.; engine and tender, 487,300 lbs.
Heating Surface—Tubes, 5,035 sq. ft.; firebox, 206 sq. ft.; total, 5,241 sq. ft.

Grate Area—72.2 sq. ft.
Axles—Driving journals, 9 x 13 ins.; tender, truck journals, diam., 5½ ins, length 10 ins.
Boiler—Type, straight top radial stay; O. D. first ring, 84 ins.; working pressure, 225 lbs.; fuel, bituminous coal.
Firebox—Type, wide; length, 108 ins.; width, 96 ins.; thickness of crown, 7/16 ins.; tube, 9/16 in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 4½ ins.; back, 4½ ins.
Tubes—Material, iron; Number 409; diam., 2¼ ins.; length, 21 ft.; gauge No. 11 BWG.
Air Pump—29½ ins.; main reservoir, 18½ x 140 ins.
Piston Rod—Diam., 3¾ ins.; piston packing, cast iron rings.
Smoke Stack—Diam., 16½ ins.; top above rail, 15 ft. 9½ ins.
Tank—Style, water bottom; capacity, 9,000 gallons; capacity fuel, 12 tons.
Valves—Type, LP Allan-Porter; HP., piston type 6 ins.; clearance LP., ¼ in.
Wheels—Driving, diam. outside tire, 55 ins.

The Baker-Pilliod Valve Gear.

The Baker-Pilliod locomotive valve gear is a constant lead gear, like the Walschaerts gear, and like the Walschaerts gear it is all outside, and has its motion derived from a return crank attached to the main crank pin, and also from the movement of the crosshead, these combined motions being altered and modified by levers and cranks. The general appearance of the motion shows it as somewhat complicated, and with a view of rendering its component parts more clear to the eye, we have made a skeleton drawing, reproduced in our line-cut Fig. 1, in which the various parts are appropriately shaded so as to be easily picked out as separate articles. Fig. 1 is purposely made out of proportion to show the parts. The drawings show the gear as arranged for an ordinary slide valve having, as such valves usually have, outside admission.

The return crank A in Fig. 1 operates an eccentric rod B and the point C at the end of the eccentric rod is supported by a link, D, which hangs from the short arm of a bell crank, E E. The lower end of the bell crank E receives its motion from the crosshead. The pivot point of this bell crank is a fixed point. The crosshead motion causes the link D to rise and fall, and the eccentric-rod motion is practically a backward and a forward motion. These two separate motions are combined at the point C, and this point C moves in either a circular or an elliptical path, according to the relative proportions of the bell crank arms E and E.

The motion of the point C actuates the eccentric arm C F, and at the point F this eccentric arm is supported by a link or radius arm, G, and this arm G swings about the point H. The point H is held up by the reverse yoke J, and the supporting point of yoke J is K, which is a fixed point in the motion. The top of the reverse yoke point H is shifted by the movement of the reverse yoke J, and this is accomplished by the reverse lever in the cab and the reversing gear. We now see that the engineer can alter the position of the supporting point H from which hangs the radius arm G, and so vary the curve made by the point F.

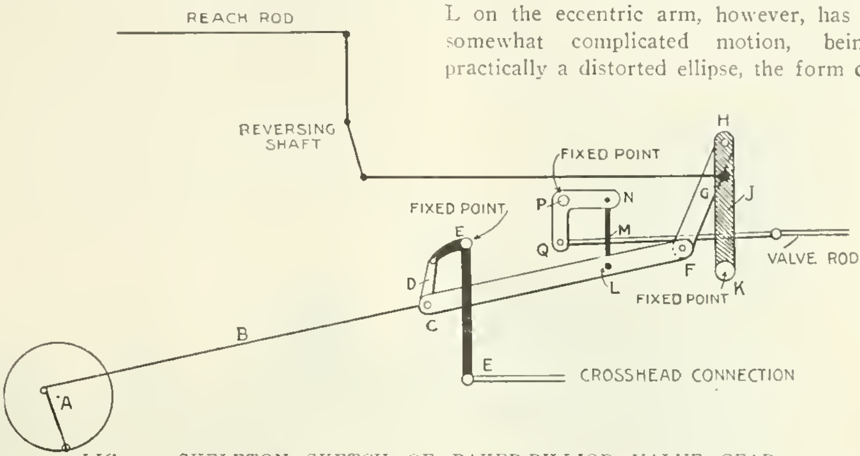


FIG. 1. SKELETON SKETCH OF BAKER-PILLIOD VALVE GEAR.

The motion of C, as previously described, is either circular or elliptical, according to the design of the bell crank E E, and the motion of G is radial, the inclination of the curve it swings on being alterable by the engineer as he shifts the supporting point H. We now have the eccentric arm C F with a circular or elliptical motion at one end, C, and a radial motion of the other, F, consequently all intermediate points along C F will have motions compounded, if we may so say, of the motion of C and the motion of F.

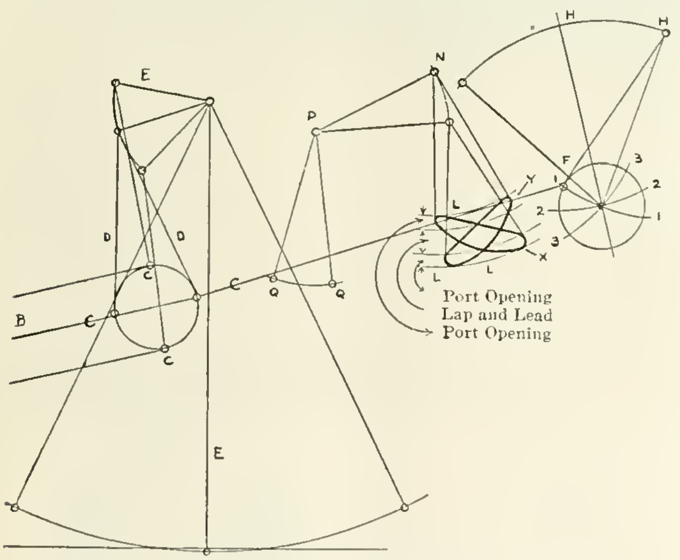


FIG. 2. DIAGRAM OF BAKER-PILLIOD GEAR.

Now we come to the method of actuating the valve rod. At a suitable point, L., on the eccentric arm C F, an upright link, M, is placed. The upper end of this link is attached at N to one end of a bell crank which is pivoted at P. This point P is another fixed point on the motion. The point Q at the lower end of the vertical arm of this bell crank is where the valve rod is attached. The motion of the point L on the eccentric arm actuates the bell crank and the point Q swings on a curved path in obedience to the movement of the bell crank.

The point Q has a radial motion about the pivot point P, and the movement is one of approximately horizontal travel of the valve rod similar to that produced by an ordinary link motion. The point L on the eccentric arm, however, has a somewhat complicated motion, being practically a distorted ellipse, the form of which is dependent on the motions of C and F. The motion of F is modified by the position of the supporting point H, which is controlled from the cab for forward or backward running and for all intermediate cut-off points.

The diagram Fig. 2 shows the shape of the distorted elliptical path of point L, and the portions of the ellipse passed over by the point L for port openings and for lap and lead. The same letters that are used in Fig. 1 are used in Fig. 2. The ellipse marked Y is the path followed by point L when in forward gear, and the ellipse X is that followed in backward gear. The curves in Fig. 2 marked 1, 1, is that followed by the point F in full forward gear, the curve 2, 2 is that followed when the reverse lever is in the center, and curve 3, 3 is that for full backward gear.

Among other things the makers say of this gear that, "It maintains uniform lead at all points of cut-off; a larger port opening at all points of cut-off; 5 per cent. travel of the piston required for full port openings; uniform cut-off; any cut-off from 75 to 85 per cent. can be had at full gear, by lengthening the quadrant so that the reverse lever can be moved down, thus dropping reverse yoke J down lower, which increases the travel of the valve and increases the cut-off at full stroke; late release, at quarter stroke, releases at 85 per cent., that is, on 24-in. stroke with 6-in. cut-off; exhaust port opens when piston has traveled 20½ ins. or 85 per cent. of stroke; late and balanced compression; excessive compression in the short cut-off is entirely eliminated; reduced back pressure because of quick complete release; lower terminal pressure which permits of larger exhaust nozzle; total absence of pre-admission; produces 25 per cent. higher range of temperatures."

This valve gear has been tested on Toledo, St. Louis & Western Railroad engines No. 42 and 157, also on Chicago & Alton engine No. 602. Further information concerning the gearing may be had by applying to the Pilliod Company of Swanton, Ohio.

Guides, Pistons, Cylinders, Etc.

By A Shop Foreman.

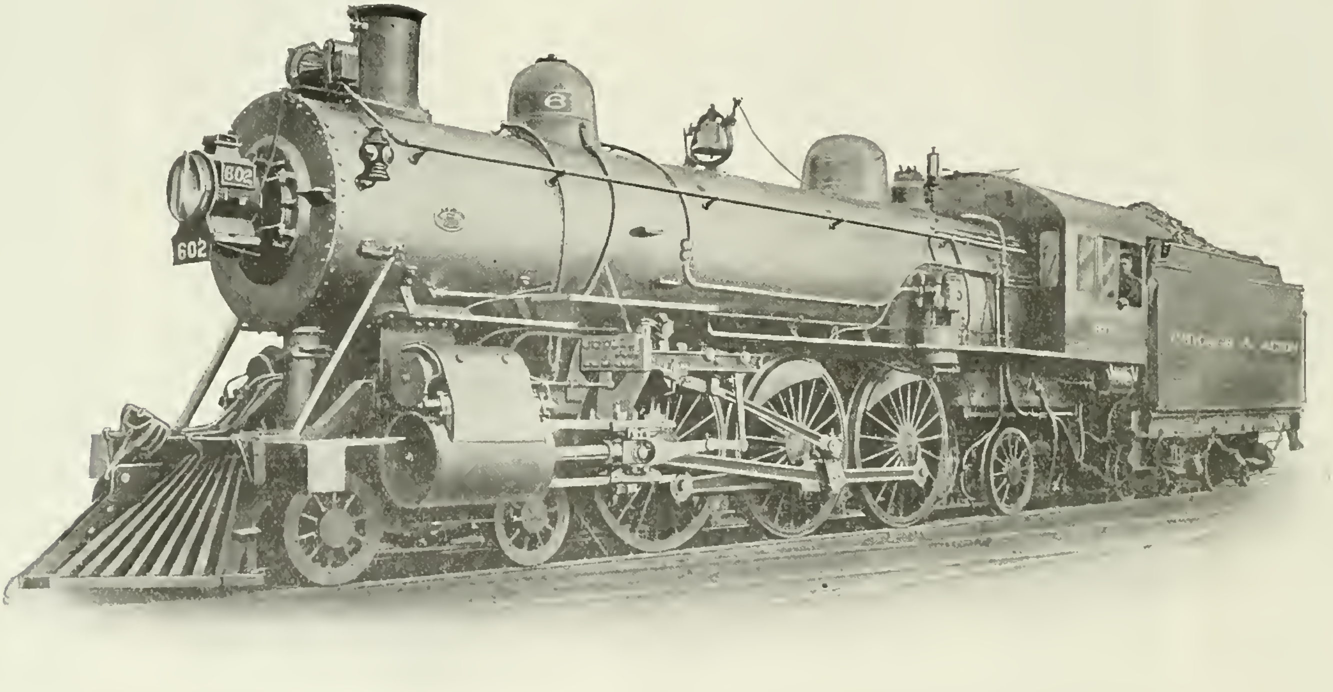
These three items of locomotive construction are so closely related that we may as well speak of them at one time, and give a general outline of their importance in shop work. The rods, guides, crossheads, pistons are stripped by the men in the stripping gang, who are usually classed as machinist helpers. After the parts have been cleaned, the first detail to receive attention is the cylinder, the machinist having charge of this work examining the cylinder for cracks and calipering the bore to determine if boring out is required. This also refers to the valve chamber bushings where piston valves are used. By doing this work as soon as engine is stripped, gives the machine shop foreman plenty of time to turn up new pistons and division rings for the piston valves. This being taken care of, joints faced, if necessary, studs applied and back cylinder heads put up, the next step is to hang the guides.

In order to insure piston head and crosshead working smoothly in the same plane, a centre line must be run from front end of cylinder through back head and through the crosshead fit of piston rod, being fastened at some convenient point back of the guides. This line is centered at front end of cylinder and at hole in centre of back head. By bringing the bottom guides to the proper height, all that remains to complete the operation is to line the top guides so that the crosshead can be moved back and forth freely without having too much play in guides. The guides and crosshead gibs should have been machined so that surfaces are true and in line, thus making it possible to put the guides up close and still have crosshead quite free.

One large railroad does not allow its engine house to "close" guides, but when there is too much lost motion between guides and crosshead gibs, it removes the crosshead shoe and relines them to the standard thickness, and in that way, it keeps its guides in alignment with the cylinder. We all know that the practice in engine houses in "closing" guides is not a very accurate proceedure and that the results are merely serviceable and nothing to be proud of. Of course, with the four-bar guides and brass gibs, it would be too costly to renew gibs each time there was occasion to take up this lost motion, and the shoes we referred to as being relined were those using a soft metal lining such as the Alligator type or Laird type of crossheads. On stationary engines, various devices have been used for taking up this lost motion without closing the guides, but the only one we know of that was used to any extent on locomotives was on four-bar guides having a brass gib that could be packed out with liners. The objection to it was that there was no certainty of its being held in position tightly. On the alligator type of crosshead, the bottom guide can be oiled nicely by drilling suitable opening in centre of bottom shoe, under the crosshead pin, as quite an amount of oil will drop from front end of main rod.

After guides are lined and bolted, the piston should be put in cylinder and piston rod keyed in crosshead, front cylinder head put up and the striking points located clearly on guides. By measuring the stroke by these marks, it can be found whether there will be sufficient clearance in cylinders to avoid danger of breaking the heads in service. While clearance spaces are a detriment when steam distribution is considered, because the greater the clearance spaces the greater the condensation and the more the loss from expansion, still if we are not liberal with our clearance we will have trouble with broken cylinders and heads, from water in cylinders. There should never be less than $\frac{1}{4}$ in. on an end, and more is better still. Generally, it is best to divide the clearance so as to have more in front than at back end because of the general arrangement of rod keys or edges, which lengthen rod as they are adjusted.

With the piston valve, the usual method after fitting it up and knowing that bushings are spaced properly and that the rings measure up to the gauge, is to get the port openings by using the peep-holes in walls of chamber, marking same on valve stem or valve rod, with the usual tram. Many people have a wrong impression of valve packing rings, thinking it is necessary to have the steam set them out tightly against the walls of the bushing. The most successful piston



CHICAGO & ALTON 4-6-2 WITH BAKER-PILLIOD VALVE GEAR.

valve in use to-day is made by a firm which locks the rings so as to prevent the steam setting the rings out, the expansion used being only the natural set of the rings.

In the case of a slide valve locomotive, after assembling steam chest, valve, yoke, etc., and before the steam chest cover is placed in position, the port openings are located as above. The various opinions in regard to valve packing strips and rings are so numerous that the subject really requires separate consideration. Packing strips, to be a good job, should not only have a perfect bearing on pressure plate, but should also make a joint with the other strips at the ends and should be free enough to come up against the walls of valve toward its centre. This can easily be tested by forcing strips down to their normal position. These last remarks have reference to the Richardson balance.

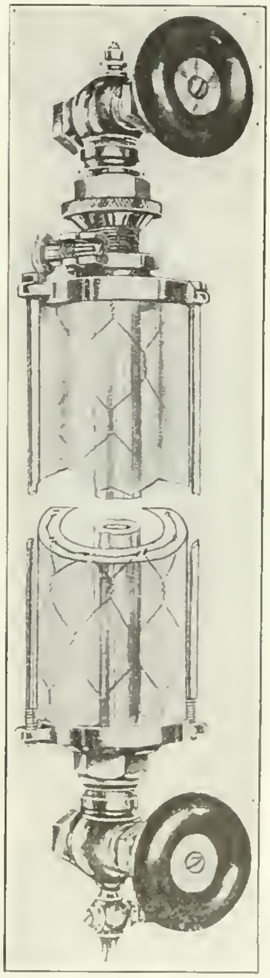
In connection with the subject of cylinders and guides, comes the very important one of packing for valve stems and piston rods. If the guides are not properly lined, it will be a difficult matter to keep the piston rod packing from blowing, no matter what kind of packing is used. One railroad is experimenting with moulding the packing on piston rod while in position on engine, the packing being all one piece with short vibrating cups on each outer end of packing, these vibrating cups being forced together by springs. A special mould must be clamped around piston rod to accomplish this. This packing has been in service nearly two months and it is claimed it is giving satisfaction. The same metal is used for this new packing as is used for the regular United States packing. It would seem that if the packing were quite soft, this might work all right, but being the usual hard metal, it is difficult to understand the reported success.

These subjects should be of special interest to locomotive engineers because it will be through their efforts in handling engines carefully working condensation out of ports and cylinders gradually, lubricating valves and cylinders regularly, keeping swabs in shape on valve stems and piston rods, watching guides and travel of crosshead, with reference to striking points, that will keep these very important parts in good condition and ready to do proper service on the road.

Transparent and Strong.

Our illustration shows what the makers call the "Ironclad" water gauge glass protector. It is simply the ordinary water glass shielded by an outer coat or tube of glass, in which soft steel wire is embedded. The "protector," if we may so speak of the outer sheath of glass, is, in fact, similar to the glass used in the doors of elevators in office buildings or apartment houses, so far as the wire netting in the center of the glass is concerned. As applied to locomotive water gauges, the protector is made of best quality of annealed plate glass, and is therefore capable of standing sudden changes of temperature, just like a good tumbler stands them.

The object of embedding the soft wire, open-mesh netting in the center of the glass is to hold it in place and in form, if by any cause it should be broken. Being clear plate glass it is of course transparent, whether whole or broken. It is open at the back or portion nearest the boiler head. This opening is for the purpose of easily applying or removing the protector, and the opening would act as a vent for steam and water in case the water gauge



PROTECTED GAUGE GLASS.

glass itself broke. The space also affords means of ventilation.

This opening would prevent the protector from being filled with water and steam, but would compel them, together with the fragmens of the water glass, to blow out at the back, and not towards the persons in the cab. The water guage valves could then easily be shut off by the hand without the risk usually incurred by fireman or engineer when a gauge glass breaks.

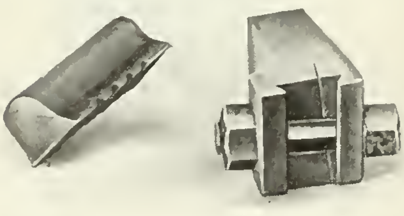
The Ironclad protector is thus always ready for an emergency, but even when no accident takes place, the outer glass shields the water glass from currents of cold air, which often cause the breakage of a hot gauge glass. The protector being on the outside, would take the shock of any object which would otherwise have struck the gauge glass, and though the protector might suffer injury or be broken in this way, the wire netting in it would hold it together sufficiently to secure the water glass from damage.

The Sargent-Hollingshead Company of Chicago handle the Ironclad protector, and Mr. T. J. Berry, New York, is the Eastern agent. Write to either for any further information on the subject, and they will be glad to give it to you and to have you look through their whole assortment if you feel so disposed.

Tool Holder and Cutters for Tires.

There is a very useful tool-holder on the market at the present time, which is intended for the work of removing metal in plain lathe turning, or on a vertical mill or on a planer. The cutters, which are usually supplied with the holders, are made of drop forged high-speed steel, the points of which are air hardened and are ground ready for use. The idea of the tool-holder, which is made by the G. R. Lang Company, of Meadville, Pa., is that the cutter is held up to the work, so that no cross strain comes on the metal. The grip of the cutter is strong and the tool is held in the cutting position very much like a chisel is held, that is, the whole strain of the cut is borne logitudinally by the tool, and the holder takes the cross strain.

This is advantageous where a heavy, rapid cut is taken on worn driving-wheel tires. The makers say that their cutter, when held in the tool-holder, is able to take a cut ⅝ in. deep with



FRONT VIEW LANG PATENT TOOL HOLDER.

¼ in. feed on a pair of 72 in. driving wheels, and take off from 10 to 15 ft. per minute. Solid tools, where the cross strain comes on the metal between the cutting point and the tool rest, very frequently fail in this kind of service. The cutter furnished with these tool-holders are made for forming sides and flanges and for finishing cuts.

It is, however, possible to get only the tool-holders from the Lang Company. Therefore any railroad shop foreman or manager can, if he prefers it, make his own cutters in his own way and out of the particular brand of high-speed steel which he may think most desirable. In this way all sorts of short pieces can be used up. These points or cutters are readily forged under a steam hammer by using a form easily made in the shop or by using a form supplied by the Lang Company.

THE LANG TOOL HOLDER, PATENTED.

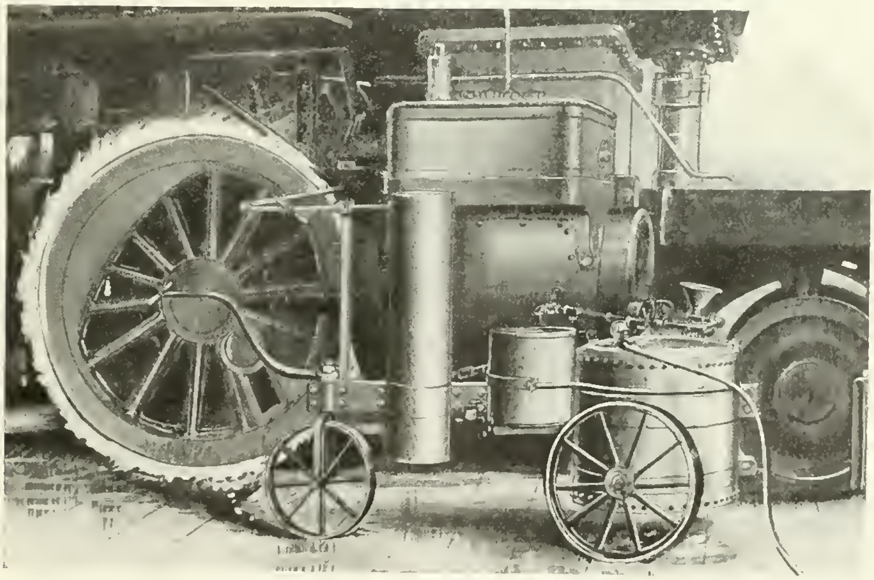
This company can furnish annealed cutter points which can be planed up to the standard gauge and by grinding them entirely on the top, the true radius can be maintained until the point is entirely worn away. In roughing out the tread, the turning point can be fed right up into the flange as the point projects far enough out from the holder to allow the latter to clear flange on the deepest cuts.

The G. R. Lang Company have issued a descriptive circular on the subject which is well worth looking at, and it can be had on direct application. The cutters are sent on thirty days' approval, and you can get both holder and cutters of any desired shape, or you can get the holder and a former for the cutter, or you can have the holder alone and make the cutter to suit yourself. Write to the company if you are at all interested.

In reply to the inquiry concerning the supporting of heavy piston rods by means of tail rods, which appeared in our General Correspondence columns in the December, 1908, issue, and signed "Master Mechanic," one of our correspondents, Mr. H. M. Hunt, of Indianapolis, Ind., sends us particulars of patent No. 587,394 (Aug. 3, '07). There is no tail rod, but in the bottom portion of the bull-ring is formed a chamber, into which the steam under pressure is introduced from either or both ends of the cylinder at a pressure sufficient to counterbalance the weight of the piston and attachments connected therewith. The chamber is bounded by a series of grooves or recesses arranged in rectangular form completely enclosing the chamber, and in these grooves are fitted the packing-strips, which are forced outwardly to a bearing against the cylinder by their springs and form a steam-tight joint. The pressure of the steam contained in the chamber must be maintained at a fixed and uniform pressure, which pressure is secured by a suitable pressure regulator and reducer in the piston. A copy of this patent may be secured on application to the U. S. Patent Office, in the usual way, by anyone interested.

Ideal Tire Remover.

We show a useful appliance for railroads which is called the Buckeye Locomotive Tire Heater. This tire expander is giving great satisfaction in many railroad shops, and it can so far be termed a necessity as to say that a railroad shop is incomplete without it. The outfit, as designed, is made in a number of different types, so that it can be used horizontally or vertically. Gasoline or kerosene may be used for fuel. It has even been operated successfully with crude oil and common headlight oil. Our illustration shows what is termed the "Type F," which is in one of the largest railroad shops in the East, and which outfit is now being adapted for use in all the shops of that road. The makers are receiving inquiries from other railroads who are interested in the matter, and who may adopt this appliance in their shops.



BUCKEYE HEATER AT WORK.

A recent test showed that one type of this tire heater removed ten tires and put on four in nine hours, thickness of tires ranging from 2 to 3⅓ ins. With the Buckeye heater, we are told, a locomotive was "tired" in one day, removing all of its tires and replacing them with a new set. It is believed to be possible to do better than this when the operators get used to the heater.

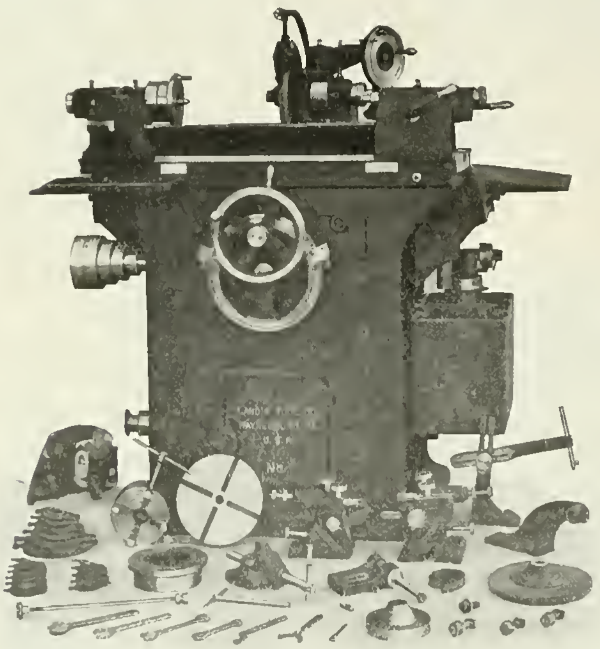
A very interesting pamphlet has been issued by the manufacturers, Walter Macleod & Company, of 213 East Pearl street, Cincinnati, O. It will no doubt be to the advantage of railroad officials in charge of shops to secure this pamphlet, which they can do by writing direct to the makers.

The Independent Pneumatic Tool Company of Chicago are not exactly before the footlights, but a number of their "Thor" pneumatic hammers are on the stage. The importance of pneumatic tools is now more generally recognized by the public at large than ever before, and this is shown by the use of "Thor" hammers in Frederick Tompson's latest production "Via Wireless," recently shown at the Liberty Theatre, New York. The plot of the play revolves about the over-tempering of a huge experimental gun, so that it will explode under test. The effect of this would be to divert a large government contract for another gun, and place it in the hands of the steel works holding the patents on a second gun.

The second act of the play is realistic. The scene is, in fact, an exact reproduction of the forge room of one of the largest steel plants in the country. Each side of the stage shows a row of furnaces from which large billets of white-hot steel are carried on overhead trolleys to the immense steam hammers in the center of the stage, and forged into shape. During the action of the scene, the heavy thud and vibration of the steam hammers and the rapid blows of the "Thor" Pneumatic Hammers indicate that the shop force works on, utterly unconscious of the villainy of the higher officials. Just before the curtain falls, the much overheated gun forging is swung across the stage and dropped with a hiss and a cloud of vapor into the tempering bath. Mr. Tompson has carefully gone into all details of this scene and made it a most thrilling and lifelike production. The play works out to the condemnation of villainy and the exaltation of truth and honesty, but the "Thor" hammers are all right all the way through.

Universal Grinders.

Grinding machines have become a recognized feature of railroad shop equipment, and are now practically considered as indispensable for finishing tools, hardened parts, etc., where accuracy is required. This result is also obtained in probably a shorter time than by any other method.



NO. 1 UNIVERSAL GRINDING MACHINE.

The Landis Tool Company of Waynesboro, Pa., make a great variety of grinders, and their universal machines, taken as an example, are undoubtedly high grade tools. In order to produce a thoroughly solid machine the metal of which it is composed is liberally distributed, the spindles are accurately finished, and the bearings are made adjustable, and all the flat surfaces are scraped to surface plates.

The Nos. 1 and 1½ are principally used for finishing tools and for a variety of articles which usually come to the tool room, or for other small work. Pieces up to 1¼ ins. in diameter and 12 ins. long can be handled on these machines. The sizes known as Nos. 2, 3 and 4 are adapted for the finishing tools and for small parts. They can be used economically on material 2½ ins. in diameter and 36 ins. long. Nos. 7, 8 and 9 are intended for the heavier class of work, and while generally used on large tools, they are well suited for finishing a variety of the larger parts where grinding is the economical and expeditious method of treatment. The Landis Company have issued a very comprehensive catalogue on the subject, which they will be happy to send to anyone who applies to them.

Conscientious Effort.

A persistent lawyer, who had been trying hard to establish a witness's suspicious connection with an offending railway was at last elated by the witness's admission that he "had worked on the railway."

"Ah!" said the attorney, with a satisfied smile. "You say you have worked on the P., T. & X.?" "Yes." "For how long a period?" "Off and on for seven years, or since I have lived at Peacedale on their line."

"Ah! You say you were in the employ of the P., T. & X. for seven years off and on?"

"No. I did not say that I was employed by the P., T. & X. I said that I worked on the road, off and on, for that length of time."

"Did you work without reward?"

"Absolutely without reward," the witness answered, calmly. "For seven years, off and on, I've tried to open the windows in the P., T. & X. cars, and never once have I succeeded."—*Youth's Companion.*

One of the best of the many good catalogues of machine tools which come to this office is the one lately issued by the National - Acme Manufacturing Company of Cleveland, O. The book has been in the course of preparation for some time, and illustrates the complete line of Single Belt Driven Acme Automatics, as well as the Motor Driven and plain machines, and the Acme Semi-Automatic Screw Slotting Machines. It has been the company's aim throughout the book, to make the illustrations so clear and plain that to the mechanical man they need little explanation or comment, that he may be able to understand them as he would the machine, and the letterpress concerning each machine has been limited to a brief statement of facts about the important parts. The National-Acme Company state that they will be pleased to send a copy of this catalogue to anyone referred to them by RAILWAY AND LOCOMOTIVE ENGINEERING. The catalogue is a most excellent one of 92 pages, beautifully printed on the finest paper.

As far as trade catalogues are concerned, some people may not consider them very instructive, but nowadays the catalogues that come to this office possess quite an educational value if looked at and studied intelligently. Take, for example, the 1908 catalogue of the Hancock valves made by the Hancock Inspirator Company of New York, which is a subsidiary corporation controlled by Manning, Maxwell & Moore. The catalogue of Hancock valves is illustrated with half-tones, which not only show what each valve is like, but have an artistic touch about them which puts the valve before the reader quite as clearly as if he had the valve in his hands. There are thirty-seven pages the same size as the Railroad Club Proceedings, with sizes, measurements, and prices for each style. If you require any sort of valve, write to this company for a copy of the catalogue, and they will be happy to send you one.

The new edition of Sinclair's Locomotive Engine Running is proving nearly as popular as was the first edition. The first edition came out twenty-four years ago, and its pages taught many railroad men that mechanical writing could be made clear enough for ordinary people to understand.

Indian Railway Bands.

The Great Indian Peninsula Railway has a volunteer force of 1,500 men, and at each station a military band is to be found. Naturally, the headquarters at Bombay has the largest. The band shown in our illustration is grouped about one of the large G. I. P. engines. The band consists of 52 men when complete, and they perform regularly at the shops at Parel. They are all of Indian birth, trained under an English military bandmaster. Their performance is very popular in the city of Bombay.

GREAT INDIA PENINSULA RAILWAY, MILITARY BAND.

We had a letter recently from a master mechanic who was in search of a pocket book of reference that would give rules and information on all the varied engineering questions that were daily coming up for solution or answer. That reminded us of difficulties that we used to experience under inquisitive railroad managers and superintendents. There was no "favorite railroad paper" in those days to consult, but we happened accidentally upon Haswell's Engineering Hand Book, which proved worth its weight in gold. Even better help is now to be found, which is Kent's Pocket Book, the most wonderful compendium of useful engineering information.

The Pratt & Whitney Company of Hartford, Conn., have issued a neat little pocket catalogue of their turret lathes. It is, in fact, a small reference booklet; the complete "Turret Lathe" catalogue, may be had upon application to the company, but the one of which we write is a helpful little guide in picking out the style you want. The variety of sizes of these Pratt & Whitney Turret Lathes enables the manufacturer to install a machine particularly applicable to the work to be done. These machines embody the latest and most approved designs, are especially efficient for all kinds of work from the bar, and are powerful and accurate.

The Rockwell Furnace Company have been awarded the contract covering the complete furnace equipment for the new locomotive shops of the Delaware, Lackawanna & Western Railroad at Scranton, Pa. The furnace equipment consists of thirty-five of the latest type furnaces operated with 300 B. T. U. water gas, which is made in Loomis, Pettibone producers. These shops will be capable of turning out complete locomotives, and are to be in operation in three months. No pains or expense has been spared to make them up to date, as they embody the latest and most improved machinery and equipment selected after thoroughly inspecting a large number of modern railway and industrial plants throughout the country.

The H. W. Johns-Manville Co., of New York, are constantly adding something new to their extensive stock of railway supplies. The latest is known as "Lino-lite" desk lamps. This lamp is 12 ins. long between centres, and distributes the light more evenly and over a larger area of the desk than the common bulb lamps are capable of doing. The light is also placed within the focus of the reflector with the result that the light is at its greatest brightness where it is really useful. The lamps are made in burnished brass finish, oxidized copper and gun metal finished, and are of an elegantly artistic appearance.

The McConway & Torley Company, of Pittsburgh, Pa., the well-known makers of the Janney, the Kelso and the Pitt couplers, etc., have issued a very useful booklet which they appropriately call the "Car Interchange Manual." It is one of the handiest "tools" which anyone dealing with freight car interchange can work with. Among other things in the manual is a concise epitome of the decisions of the Arbitration Committee of the M. C. B. Association. The McConway & Torley Co. have just issued a supplement to the manual which contains cases 739 to 755, which brings the work up to date. This company is willing to send a copy, gratis, to anyone who would find such a work useful. All you have to do to obtain a copy of the Manual of Car Interchange and the Supplement is to drop a post card to the McConway & Torley Co., of Pittsburgh, and ask them to send you a copy.

Trees to be grown by the Aransas Pass are said to absorb antiseptic qualities and yield a quality of tie timber that is sufficiently creosoted and impregnated to repel decay. They are a special variety of catalpa grown successfully in southern States east of the Mississippi River. Their strange quality was discovered only a few years ago, and is being tested by the Illinois Central, the Louisville & Nashville and other roads.

We have received a striking office calendar from the Railway Equipment Company of Portland, Ore. The calendar is about 20 x 27 ins. and has the figures for the days of the months in clear block type which can be easily seen across the room. The calendar is printed in red and blue and presents a very clear, plain and effective appearance. If you want a good office or shop calendar write direct to this company and ask for one.

Simple Lessons In Drawing is an excellent book sold for fifty cents, which we would have considered cheap at five dollars when our apprentice hand was striving to acquire the art of delineating the mechanical parts that make up the finished locomotive.

Railroad Men Join in Honoring Burns.

The admirers of the immortal genius of Robert Burns, the sweet singer for every lover of poetic sentiment, are so numerous among the readers of Railway and Locomotive Engineering, that we need offer no apology in putting before them the following verses composed and read by our associate editor, Mr. James Kennedy, at the annual banquet of the Burns Society of New York, held at Delmonico's on Fifth avenue, to commemorate the one hundred and fiftieth birthday of the bard who gave to the world, "A Man's a Man for a' That."

TO THE SCOTS IN AMERICA.

Scots, my brothers, let us be
Joined in jocund jollity;
Come and swell the happy throng
Breaking into soulful song,
Hail the day that blithe returns,—
Happy day that gave us Burns,
He whose mighty heart and mind
Marked him noblest of our kind,
Prince of poets, king of men,
Wielder of the magic pen,
Master of the tuneful lyre,
Utterer of the words of fire!

Though we cross the weary main,
Tread the dismal, desert plain,
Though our feet may wander far
Underneath the Western star,
Never can the dull distress
Of forsaken loneliness
Reach us on the earth or air,—
He, our deathless Bard, is there
Chanting in our charmed ear
Songs of fellowship and cheer,
Songs whose warbled words express
Love and truth and tenderness.

His the master song that brings,
Bright on fancy's fairy wings,
Visions of the heath-clad hills,
Hoary cliffs and crystal rills,
Fairest flowers the fields among,
Curlew's call and skylark's song,
Happy hamlets, leaf-embowered,
Castles turreted and towered,
Straw-roofed cots where honest worth,
King-like, undismayed, comes forth,
Homes where grace in modest mood
Dwells in queen-like womanhood.

Burns it is whose wondrous words
Arm us as with sharpened swords,
His the hand that sowed the seeds
Blossoming into dauntless deeds,
He, our leader, in the van,
Hailed the brotherhood of man!
We, the freemen of the world,
Follow on with flag unfurled,
Hastening on the golden age,
Ours the matchless heritage,
Ours the splendor of his name,
His, the everlasting fame!

New York, January 25, 1909.

John Robertson.

Among the many eminent engineers that came into notice in the early part of the last century it is interesting to recall Mr. John Robertson, who constructed what was known as the Comet

JOHN ROBERTSON.

engine in 1812. He was a native of Glasgow, and was on intimate terms with James Watt and other inventors. He was born in 1782, and died in 1868.

Twentieth Century Locomotives.

The author's purpose in writing the book "Twentieth Century Locomotives" was to provide for studious mechanics a work full of useful information. The important facts concerning the principles of locomotive construction and operation will do more than a course in an expensive correspondence school for a person ambitious to succeed in business connected with the mechanical department of railroads. A new edition of the book has recently been published which sells for two dollars. The men who have found "Locomotive Engine Running and Management" an instructive book should lose no time in getting possession of "Twentieth Century Locomotives," as its pages form a supplement to the other.

One of the illusions is that the present hour is not the critical, decisive hour. Write it on your heart that every day is the best day in the whole year. No man learned anything rightly until he knows that every day is Doomsday.—*Emerson.*

Keep yourself cool and equal for anything that may happen, and it will be better for you.—*Bleak House.*

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Railway and Locomotive Engineering

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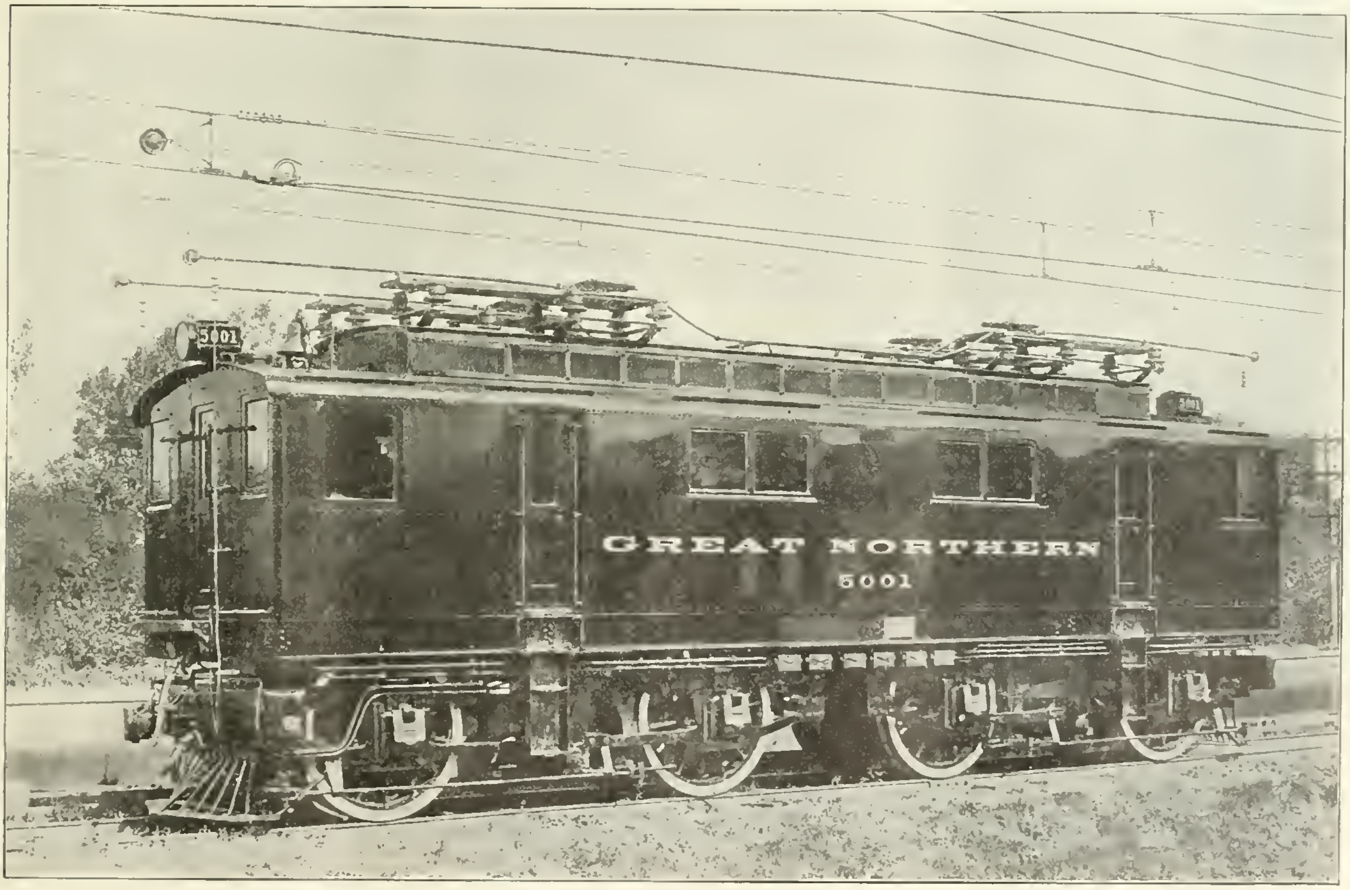
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXII. 114 Liberty Street, New York, March, 1909 No. 3

Electric Locomotives for the G. N.

For the purpose of operating trains through the Cascade tunnel the Great Northern recently ordered four electric locomotives. These have just been completed, and were built by the American Locomotive Company in conjunction with the General Electric Company and under the supervision of Dr. Cary T. Hutchinson, the consulting engineer for the road.



MODERN TYPE OF ELECTRIC LOCOMOTIVE FOR THE GREAT NORTHERN RAILWAY.

G. H. Emerson, Superintendent of Motive Power. General Electric and American Loco. Cos., Builders.

Each of these locomotives has a total weight in working order of 230,000 lbs., all of which is carried on the drivers. The overall length is 44 ft. 2 ins. and the rigid wheel base is 11 ft. and the driving wheels are 60 ins. in diameter. The motors are of the three-phase induction type, with plain secondary circuit rheostatic control, and are capable of exerting a maximum torque of at least three times the guaranteed full load running torque.

Each truck is equipped with two motors and on account of the large size of the geared motors a special form of drive is used, there being a pinion on each end of the motor shaft. These pinions engage gear bands shrunk on the extension of the driving wheel centers. The gear bands are cut in pairs and are set so that the teeth on the two wheels line up accurately. The pinions on the motor shaft are, of course, set in accurate line. By this form of drive there is no tendency to tilt the motor, as there is with the pinion on one end of the shaft, and moreover, the gears do not have an excessive width of face, as the driving strain of each motor is divided between the two sets of gears. The gear ratio is 1 to 4.28.

As far as the mechanical features are concerned, the design represents a distinct departure from previous practice in electric locomotive construction. It also represents the adaptability of steam locomotive practice to electric locomotive construction. The wheel arrangement, as is clearly seen from the illustrations, is a modification to suit the requirements of electric service of the builders' practice in the design of articulated steam locomotives.

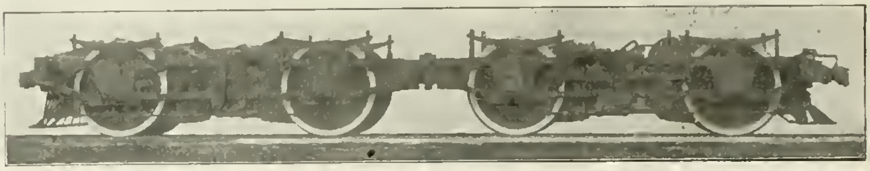
The locomotive under consideration is mounted on two 4-wheel trucks articulated together by means of a center pivot connection. This is placed in the center of the engine, midway between the inside axles of the No. 1 and the No. 2 truck. With this form of construction, the distance between the center pins supporting the cab platform varies, of course, as the trucks pass through the curves. One center pin, therefore, is so designed as to allow sufficient longitudinal movement to take care of this.

The advantage of this articulated design is that all the drawbar pull is thus directed through the truck frames permitting a much lighter form of cab platform than in those designs where the pull is through the platform sills. Moreover, the only strain which this puts on the center pins is that due to the weight of the cab and its equipment and the cab platform. The truck frames are made of cast steel, and those of the front and back trucks are interchangeable. As all the pulling and buffing is done through the truck frames, these are made large and heavy. Some of the weight of the frames and all the weight of the truck is accounted for by the fact that on these locomotives it is necessary to add weight in order to obtain the necessary adhesion. A certain amount of ballast is also used on the cab platform for the same purpose. The features of the truck construction are clearly shown in the engravings.

The method of weight equalization is interesting. On the No. 1 end truck the weight is carried by semi-elliptic springs resting on saddles on top of the journal boxes and straddling the frame. The two drivers on each side are equalized together by means of a wrought iron equalizing beam between the upper and lower rails of the frame, similar to steam locomotive practice. The weight on the drivers of the No. 2 end truck is also carried on the same style of springs, supported on the driving boxes in like manner, but in this case there is no equalizing beam between the two drivers on one side, but the two front drivers are equalized together by means of a cross equalizing beam. The truck bolsters are made of cast steel of box construction, very rigidly connected to the frames and with center plates cast integral.

The cab, which carries the controlling apparatus, as well as air compressors other accessories, is made of angle iron framing with a covering of 1/8-in. sheet steel, all securely riveted together. The arrangement of car body and end hoods is such as to afford the engineman a clear view of the track.

These locomotives are now being tried in a series of tests under service conditions. At present it is planned to use them through the Cascade tunnel only, which is somewhat less than three miles in length, and has a uniform grade in one direction of about 1.7 per cent. The electrification of this division and the probability of extending the electric zone to include at least two grades in the immediate neighborhood of the tunnel has been considered by the Great Northern officials.



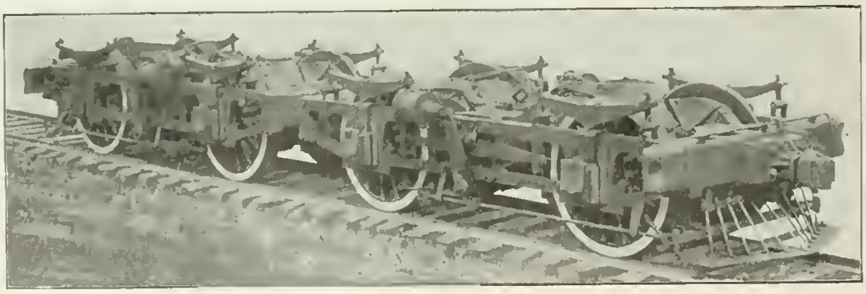
SIDE VIEW OF TRUCKS, SHOWING PIVOT CONNECTION.

The following are the principal dimensions of the locomotive illustrated:

Length over cab	40 ft. 1¾ ins.
Height over cab	14 ft.
Width over all	10 ft.
Total wheel base	31 ft. 9 ins.
Rigid wheel base	11 ft.
Weight of mechanical equipment	112,599 lbs.
Weight of electrical equipment	117,401 lbs.

Development of the Locomotive Engine

Mr. G. A. Sekon, editor of the *Railway Magazine* of London, is author of the "Evolution of the Steam Locomotive," one of the best works on the subject ever written. Mr. Sekon has lately published in his magazine a highly complimentary review of "Development of the Locomotive Engine," by Angus Sinclair, in which he says:



PERSPECTIVE VIEW OF GREAT NORTHERN ELECTRIC LOCOMOTIVE TRUCKS.

Americans interested in the evolution of the railway engine, owe a debt of gratitude to our confrère, the editor of Railway and Locomotive Engineering, for the exhaustive work he has written on this fascinating subject.

It is somewhat difficult to compare Mr. Sinclair's book with others on the same subject, because the author occupies a position more fortunate than most writers. Born a Scotsman, his early experience of the steam locomotive was gained on a Scottish railway. Then becoming a naturalized citizen of the United States, the standpoint from which he viewed the growth of the locomotive became changed, and he commenced to trace the development as it occurred in the United States; and the main part of the book deals with the history of the railway engine in the States. But as the first three chapters, which deal with the origin and growth of the steam engine, give the history of the engine from its invention, and traces the main features of its development in Great Britain almost to the present time, the book has a twofold value to American readers; while the main portion of the book—that dealing with locomotive development in the States—is a valuable addition to the history of the railway engine the world over.

Mr. Sinclair has adopted a novel method of dealing with the evolution of the locomotive in the United States; he does not treat the whole country as being concerned in the development, but traces the growth of the machine on various railroads, apart from one another. Thus the several improvements initiated on the Erie Railroad are described in one section, its development on the New York Central in another, and its growth on the Philadelphia and Columbia in a third, while other railroads are dealt with in like manner. Then chapters are set apart showing how certain locomotive builders assisted in the improvement of the railway engine—Baldwin, for instance, receiving due recognition in this category.

Other chapters deal with the development of certain parts of the engine, such as the boiler, the valve gear, spark arresters, etc. "Freak" locomotives are not forgotten, many curious specimens of engines being described and illustrated. A chapter is also devoted to the evolution of the locomotive in Canada.

From the above brief notes it will be seen that Mr. Sinclair has produced an important work on an important subject, and while much of the book is of universal interest, the work as a whole undoubtedly supplies Americans with a standard book on the subject of locomotive development in the States.

Mr. Angus Sinclair is entitled to hearty commendation for his instructive contribution to the literature of the "iron horse."

WHAT CAN BE DONE WITH A COLD SAW

By Roger Atkinson

A great portion of the intellect and time of a large part of civilized nations is always being devoted to devising methods and means whereby manufacturing operations may be performed in less time, with less exertion, and at less cost, all of which enables the benefits derived to become serviceable to a larger section of humanity. Machines and tools are constantly being invented and manufactured which cause changes in the system by which other things are made, and render further developments possible in different lines of work; and among these the development of the cold circular saw has been the means of effecting very considerable economy.

Twenty years ago or so, the parting of masses of metal by means of a narrow strip being cut out was not common, and was avoided when possible, but when indispensible it was done by slotting with a narrow tool which was a slow and expensive process. Thus, for instance, forgings were demanded which were to be made close to the sizes required when finished, as the cost of removing the excess metal during the operation of finishing was very great and took considerable time. It was necessary to employ forge-

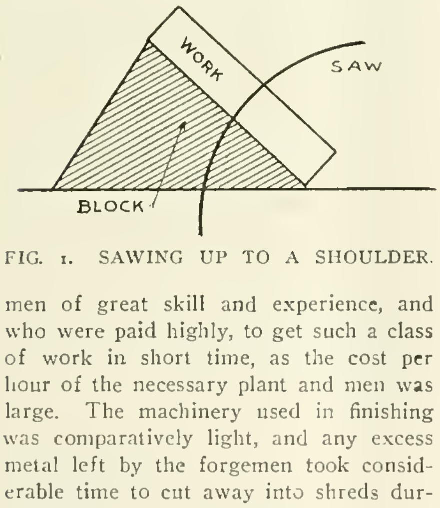
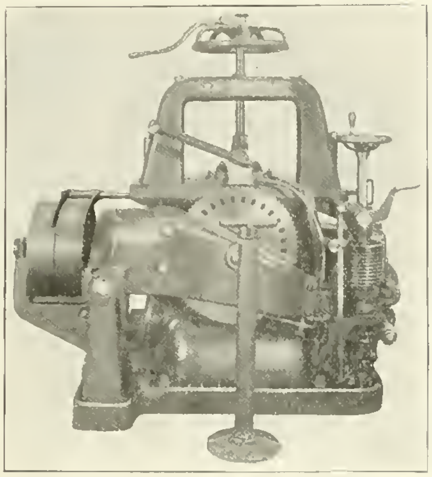


FIG. 1. SAWING UP TO A SHOULDER.

men of great skill and experience, and who were paid highly, to get such a class of work in short time, as the cost per hour of the necessary plant and men was large. The machinery used in finishing was comparatively light, and any excess metal left by the forgemen took considerable time to cut away into shreds during removal, an excess in length probably cost highest per pound of metal removed. This trouble was largely overcome by the use of heavier machinery and better tool steel, but the cutting to shreds of the excess metal still takes time and is expensive. In some classes of operations, however, it has been considerably diminished by the use of the cold saw.

For a long time the use of the saw was confined to cutting off such material as pipes, round bars or axles, gates from steel castings, etc. This was probably largely due to the saw being laterally flexible, and consequently any defects encountered in the metal or a difference of resistance on either side, would cause the saw to deflect and run off from a straight line. This would probably break the saw, if not promptly attended to, and in any case the saw could only be used for the roughest class of work. Experience has shown, however, that considerable economy can be effected by leaving more excess metal on forgings, less care and skill being necessary in the forging, thus economizing on the time and cost of a high-priced plant, viz.: furnace, hammer, etc. The high-priced men can turn out much more work in a given time, and this move offsets the cost of the metal wasted and of the cost of removing it in the machine shop.



TYPE OF MODERN COLD SAW.

Some of the circular cold-saw machines have the saw driven by the arbor, by means of flanged discs on each side and bolts through the saw. The advantage of this style of driving is that the saw is held rigidly in a line and does not easily deflect, but it has two disadvantages for some purposes. These are, the diameter of the driving flanges reduces the useful diameter of the saw by restricting the depth it can cut, and for a given depth of cut compels the use of a large saw, which in turn increases the power consumed, as all the work is done at the periphery of the saw, and in addition as the power is transmitted by the arbor it must be large enough to stand the twisting strain, not only without breaking but without jerking when the cut is unsteady. This trouble is almost impossible to overcome, and it is worse with large saws than with small ones.

In other types the arbor is small and the nuts holding the saw are also small, as they are only required to keep the saw in position, while the driving power is transmitted to the saw by a sprocket pinion working in slots in the saw itself, and placed near the rim, thus giving great useful depth of cut, with low driving power required. This form of drive eliminates jerking, as the sprocket pinion literally pulls the saw through the metal by tension, while the saw runs in guides which prevent lateral deflection and gives it steadiness. This system also permits of a more vertical cut in some classes of work, which is advantageous when cutting up to a shoulder. If the saw table is large and the work is small it may be placed on an angular block so as to cut square up to a shoulder, as shown in our illustration Fig. 1. For some classes of work it is found desirable to put two saws on the arbor, adjustable as to distance apart, which increases economy and accuracy.

A third type of saw was formerly made, in which the saw is carried on a swinging head adjustable in different directions, and attached to a heavy overhanging bar of hexagonal or square section, the driving shaft being in the centre of this bar, and the whole can be extended or withdrawn as required, while the saw can be set to work at any angle round the bar, which was convenient and quick for many purposes.

In most of these types the feed arrangement is made to advance the saw while the work is fixed, but in all cases it is better to have a steady continuous feed than to feed by ratchet, and an automatic friction feed which can be set to work rapidly in light sections, but will slip or feed more slowly where the work is heavy, materially increases the output of the machine and is not so destructive to the saw. The friction feed automatically adjusts itself to the varying thicknesses of the work which may be encountered or to the varying hardness or to the core spaces through

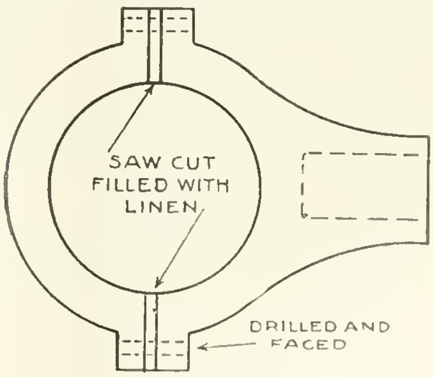


FIG. 2. SAWING SOLID ECCENTRIC.

which the saw cuts. In this way, one man can easily attend to two machines, setting work on one while the other is in operation.

These saws enable new methods of doing work to be adopted, for instance, eccentric straps are sometimes cast whole, as shown in Fig. 2. This saves time in the foundry, and avoids deformation by shrinkage. In the machine shop the bolt holes are drilled through the lugs, and sides of lugs faced. The halves are then parted by the saw in a few minutes, and no further work is necessary on the joint. Permanent liners equal to the thickness of the saw kerf are inserted to allow for reduction in service and the halves are bolted together with their own finished bolts, and the strap is ready for boring out.

A very economical method of making main rod straps is to take a slab of mild steel large enough for two straps Fig. 3. These are planed to the required thickness, and marked out, then clearance holes are drilled as shown, and the surplus metal can be cut off by sawing along the dotted lines. After that only finishing work is required. The blocks of metal thus cut away can be flattened and used for smaller straps or other parts.

The ordinary defect of rod straps is failure in the corner. This is very common in straps which are forged and bent.

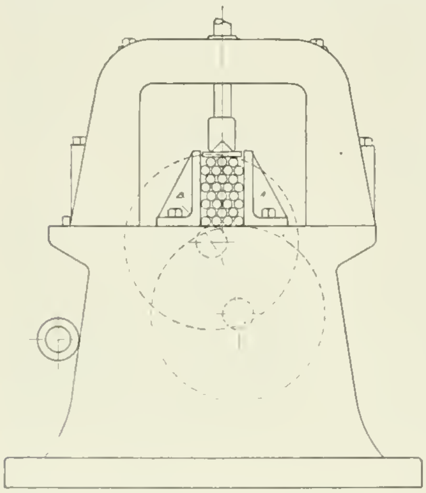


FIG. 4. SAWING A SHEAF OF BARS.

The use of the saw produces straps in which the defect is entirely overcome, as there is no detrusion of the metal caused by bending. After many years of service the writer has never known straps so made to fail. The cost of straps produced in this way is less than forged and bent straps, and it may be said that the saw method is more scientific.

In Fig. 4 we show a method of sawing a sheaf of iron or steel bars. One of the jaws A, is set with a dowel, the other, marked B, is adjustable so that a number of bars can be evenly placed between the jaws. When all are in place the bars are clamped down and the saw soon cuts off the projecting ends.

The peripherally driven cold saw with friction feed is a very useful tool, but the method of setting work is also important, as the output of the saw can be affected by what musicians would call the "attack." In the shop the point of attack is determined by the way the work is presented to the saw. In Fig. 5 the saw is cutting into a stepped mass of metal and it is moving from left to right. The zone A represents the minimum depth of cut in the stepped piece. This increases through zone B where the medium depth of cut is carried through zone C. In-

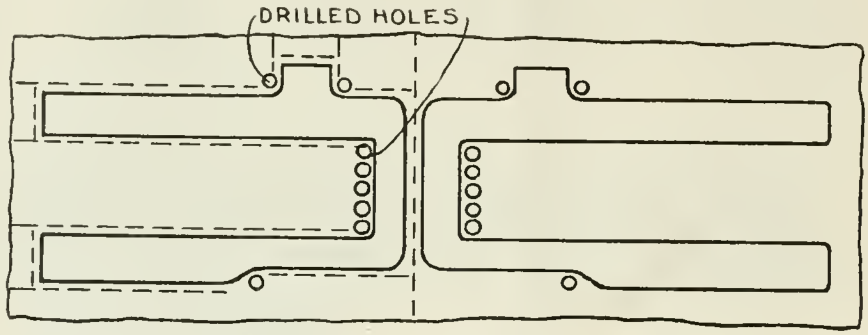


FIG. 3. MAIN ROD STRAPS SAWED OUT OF A STEEL SLAB.

crease in depth takes place in zone D, and maximum cut exists all through zone E.

That the method of attack is worth considering is apparent from a glance at Fig. 6, which represents the same stepped piece of metal being sawed through from the large end, the saw moving from right to left. The saw begins at the lower right hand corner and the depth of the cut increases through zone F and the maximum is reached and held through zone G. The depth of cut decreases as the saw proceeds and the medium cut is encountered in zone H, and further decrease occurs at and through zône J. The relative widths of the maximum, medium, and minimum cuts is approximately shown by the width of the zones.

In both cases the saw has cut through exactly the same amount of metal, but it has had harder work to do in one case than the other and the time taken in doing the easier task is shorter than that required to perform the more difficult. If the saw could express an opinion in words of the right or left attack in this case it would probably repeat the old saying, "There is no substitute for brains," but not being able to speak its actions spell the word economy.

Valve Motion Design.

By Sidney C. Carpenter.

In this article I desire to consider link motion design, not from the valve setter's point of view, but from the standpoint of the strain on the various parts. When designing parts where strength is an important consideration it is always best to take account of all the principal strains to which the piece is subjected and design it to meet the greatest strain it will have to bear in service. This often involves considerable calculation, and when designs are made in a number of different sizes formulas are often used in which some one dimension is taken as a standard, and the others are taken as a certain proportion of this one. For example, the diameter of the piston rod may be a certain fraction of the cylinder diameter; the length of the main rod is so many times the length of the crank. I wish some of the readers of Railway and Locomotive Engineering who are in a position to do so would give some of these approximate formulas which have been tried out in practice and adopted as standard by locomotive builders.

The power required to move the valve depends on the load imposed on the valve by the steam pressure. This load is difficult to calculate. The downward pressure is due to the steam acting on the back of the valve, but it is opposed by a variable upward pressure, due to the steam in the ports, which depends on the pressure in the cylinder at different points of the stroke. If the valve is 10 in. x 18 in. and is subjected to a pressure of 180 lbs., it will be held on its seat with a pressure of 16¼ tons. Assuming that ¼ of this is balanced by the steam under the valve, we have a load of 12 tons to be moved twice at every revolution of the drivers for each side of the engine. The force required to move this load depends upon the condition of the valve and seat. Assuming a coefficient of friction of .08, we have 1,930 lbs., or, say, a force of 2,000 lbs., which must be applied to the valve. If the valve makes 10 strokes per second, 4 in. to a stroke, it will travel 200 feet per minute, which would require approximately 12 horse power to move each

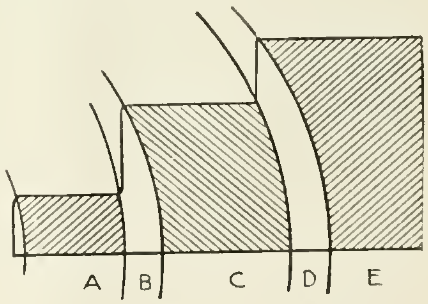


FIG. 5. SAW MOVING FROM LEFT TO RIGHT.

valve. Balanced valves, of course, require less power, but the saving is variable on account of leakage, and for purposes of design they should be considered as unbalanced.

When the valve is moving back the

strain on the rod is simply tension, but when moving forward the rod becomes a column under compression and tends to spring or buckle. In the rocker and rocker box we have a variety of strains. The pins in the valve rod and link block are in shear, the rocker arms tend to bend and the rocker shaft is subject to torsion, or tends to twist. The arms are cantilevers, and their tapered form is characteristic of this class of beams. The bending moment is greatest at the shaft and the section is, therefore, greatest at this point. In the theoretical beam, bearing a load at the end, the sides would curve to a point, but there are practical considerations which determine the size of the end. The pin for the valve rod must be thick enough to prevent it from

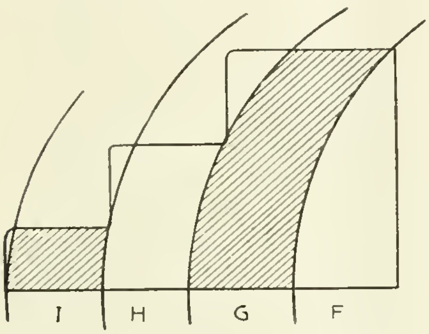


FIG. 6. SAW MOVING FROM RIGHT TO LEFT.

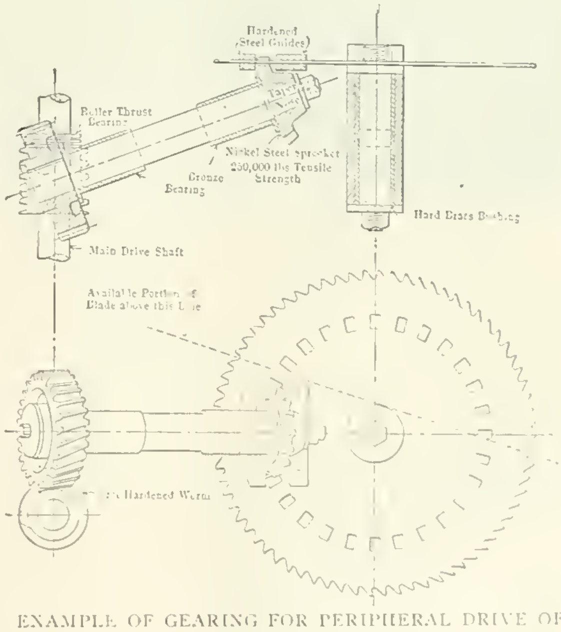
breaking out, and the length of the boss must be sufficient to hold the pin and prevent it from working in the hole. The web must be sufficiently strong to resist the bending moments at the different points, and it must also meet a twisting strain due to the offset of the valve rod. Suppose the length of the arm is 12 in., with a strain of 2,000 lbs., on the rod, there would be 24,000 lbs. bending moment at the shaft, 12,000 lbs. at 6 in. from the center, etc. If it is 6 in. from the center line of the valve rod to the center line of the web, there will be a force of 12,000 lbs. tending to twist the web around.

The rocker shaft is subject to torsion and shear. When the link block goes forward the load at the valve rod tends to twist the shaft, and this causes a shearing strain at the base of the arms. The whole rocker has a tendency to swing around the end of the valve rod, and this tendency is increased by the offset between the link block and valve rod. The effect of this offset is to form a lever with the power at the link block, and fulcrum at the valve rod and the rocker box as the weight to be moved. We will assume dimensions as follows: The power arm is the horizontal distance between the center of the valve rod and the center line of the link, or 30 ins. The weight arm is the distance from the valve rod to the center of the rocker box, or 12 ins. If the two rocker arms are equal it will require 2,000 lbs. at the link block to move 2,000 lbs. at the valve rod, and the force tending to push the rocker box out of place is $\frac{30 \times 2{,}000}{12} = 5{,}000$ lbs. We might call this the offset leverage. It tends to swing the rocker in a horizontal plane, and can be reduced by bringing the valve rod more nearly over the link, as in the case where the valves are between the cylinders. Another leverage acts in a vertical direction, and tends to swing the rocker like a pendulum from the valve rod as a pivot. Assuming 12 in. arms, with the same force as before, this leverage will give 4,000 lbs. at the rocker box. When the engine is running at high speed, all these forces act practically as blows, first in one direction, then the other, and a good many to a second. A certain force applied suddenly is much more destructive than the same force applied gradually.

In the link we have another complication of forces. Considering one-half of the link only, the front piece is a beam fastened at each end with the load occupying various positions. It is strained only when the half link is going back and the greatest bending moment occurs when the block is about half way between the center and the end. The back of the link may also be considered a beam fastened at the ends when the half link is going back. There is no strain from the block, but the pull of the eccentric blade acts as a load near one end. When the end of the link is moving forward the back is practically a lever with the eccentric blade pin at the opposite end as a fulcrum, and the eccentric at the end which is moving forward as the power. In other words, all parts of the link except the back could be removed without affecting the force applied to the link block. The link, as a whole, may also be considered a lever, with the eccentric blade which controls the motion of the valve acting as the power and the other as the fulcrum.

The eccentric rods are subject to alternate tension and compression, or rather, bending, and if the rod is bent to pass an axle the strains are still more complicated. The greatest strain comes on the rod in full gear; at other points it has the advantage of the leverage afforded by the link. The rod should be designed as a long column. The power required to move the valve and the length of the rod being given, the problem is to determine a suitable section which will prevent excessive deflection or spring in the rod. The bolts at the eccentric end are in shear. The eccentric strap is alternately in tension across the top and bottom and compression at the front.

The eccentric itself is one arm of a lever, of which the crank is the other arm, and the strain is taken by the points of the set screws and the key. The principal strains acting on the eccentric are the power required to reverse the weight of the moving parts and the power required to move the valve. To determine the power required to operate the valve gear we will assume the total weight of the moving parts for both cylinders to be 2,000 lbs., which is not excessive, as valve gears go on large locomotives. In full gear all parts have approximately the same motion as the valve, and for simplicity, we will take the motion of the whole valve gear equal to the throw of the eccentric. At 5 revolutions a second the valve gear will make a stroke in one direction every tenth of a second. The velocity of motion varies from 0 at each end of the stroke to the maximum in the middle, so that the whole mass must be brought from rest to its maximum velocity in 1-20 of a second. To determine the maximum velocity we will take the throw of the eccentric at 6 in., and the center of the eccentric travels a distance of 18.85 in. at each revolution. In 5 revolutions this equals 7.85 ft., which is the maximum velocity per second transmitted to the valve motion. The energy required to move the parts at this velocity is 2,000 x 7.85 2-64.32, or 1,916 foot-pounds. But this



EXAMPLE OF GEARING FOR PERIPHERAL DRIVE OF COLD SAW.

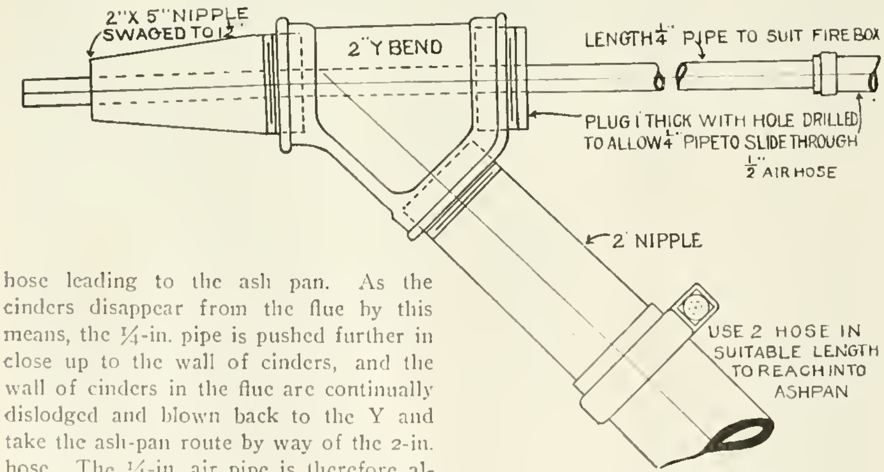
energy must be developed in 1-20 of a second, which is equal to 2,299,200 foot-pounds per minute, or 69.66 horse power. This calculation does not take account of the further exertion of power owing to friction due to the heavy pressure on the different wearing surfaces.

Air Flue Cleaner.

A locomotive flue cleaner, which does away with the auger for boring out flues clogged up with cinders and soot, has been got up by Mr. C. E. Lumsden, foreman at the Council Bluffs shops of the Chicago, Rock Island & Pacific. Instead of boring out the flue this air-operated apparatus blows them out and the point about this device is that it provides an exit or way of escape for the cinders when they are so tightly lodged that they will not readily blow through into the smokebox.

The apparatus is simple and easily and cheaply made, being in fact a 2-in. Y-pipe fitting. The back of the straight end of the Y is filled with a 1-in. plug, in which a hole is drilled, which allows a ¼-in. pipe to slide easily. The forward end of the straight portion of the Y has a 2-in. nipple 5 ins. long swaged down to 1½ ins. diameter. A ¼-in. pipe connected with the compressed air supply in the shop is thrust through the plug at the back of the straight end of the Y. The angle of the Y is provided with a straight nipple, on which is fastened a 2-in. rubber hose, and this hose is allowed to drop down into the firebox, and if desired, into the ash pan. This is the cinder exit. When the flue cleaner or blower is in place, the tapered nipple at the front enters the flue and is pushed in as far as it can be, which is ultimately up to the front of the Y. The ¼-in. air pipe is then pushed forward up to or beyond the mouth of the tapered nipple and air is turned on.

The cinders may blow through to the smokebox if they are only loosely in the flue, but if they are packed tight the annular opening around the ¼-in. pipe in the tapered nipple forces the first handful of cinders to blow back into the Y. They then pass down the angle opening into the hose leading to the ash pan. As the cinders disappear from the flue by this means, the ¼-in. pipe is pushed further in close up to the wall of cinders, and the wall of cinders in the flue are continually dislodged and blown back to the Y and take the ash-pan route by way of the 2-in. hose. The ¼-in. air pipe is therefore always like a good soldier in battle, fighting at the front, and the ultimate defeat of the cinders is only a matter of a short time. In fact our correspondent, Mr. C. W. Miller, of Horton, Kan., tells us that a set of locomotive flues can be cleaned out in about 15 minutes and the cinders do not go to the smoke box, but make their way to a more suitable place, viz.: the ash pan. There is no dust or soot blowing around to bother the operator, the air from the small central pipe causes an enthusiastic movement among the cinders toward the ash pan.



AIR FLUE CLEANER.

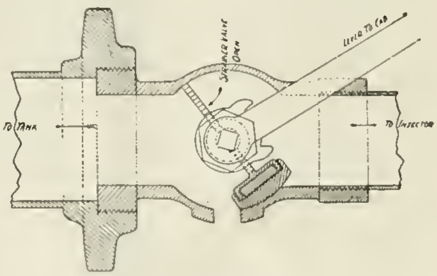
Combined Strainer and Water Valve.

The Georgia Railroad is using what may be called a combined strainer and water valve which provides a very easy and expeditious method of cleaning the tank strainer without taking down the hose or disconnecting anything in the feed-water system between the tank and the supply pipe to the injector. The device has been patented by Mr. J. H. Waters, the assistant master mechanic of the road, and he is prepared to supply his device to anyone who wants it.

The strainer-valve is placed in a convenient place and is at the lowest point between the tank valve and the supply pipe to the injector. The principle involved is simply that of making of the strainer practically an upright wall, which can be rocked about its centre line by a crank and lever operated from the cap. When the strainer is operative it stands in a vertical position. The bottom edge of the strainer has a foot which carries a valve, which opens or closes a port in the bottom of the strainer-valve chamber according to whether the strainer is inclined or is standing in the vertical position.

When the strainer is vertical the port is closed and the water on its way from the tank to the injector supply pipe passes through the strainer. When the strainer is placed in the inclined position, the valve uncovers the port in the bottom of the chamber and the water from the tank flows out of it, and in this way washes the strainer clean. If the injector "breaks," owing to insufficient water supply, the engineer moves his valve handle and the strainer is washed off. In the winter when it is necessary to drain the hose and the supply pipe opening this valve is all that is necessary. When it is desired to clean the strainer it can be done with the engine in motion and the engineer's work and attention is reduced to a minimum. In this way it is a time-saver and the engineer can, probably does, clean off the strainer more often than when he had to get down and uncouple the hose.

All sorts of small obstructions, like



STRAINER AND WATER VALVE.

cinders, grit and the like find a sort of "exit here" direction when the strainer valve is open, much the same as people do when trying to get out of an unfamiliar railway station. When it is necessary to drain the tank the strainer valve provides an easy way, and if the flushing of the water does not thoroughly clean the strainer, the blow-back from the injector may help, for whether the drainage port is open or closed, the perforations of the strainer are ready to receive the flow of water or steam. Mr. J. H. Waters, who is stationed at Augusta, Ga., will be happy to give further information to those interested.

Under the Hepburn rate law the railroads are requested to keep nearly every scrap of paper connected with their business. These papers have added such a burden to the railroads that the House Committee on Interstate and Foreign Commerce has reported a bill authorizing the Interstate Commission to grant permission to destroy these useless papers.

A So-Called Lost Art.

It has been claimed that tempering copper is one of the "lost arts." According to Professor Hopkins, of the department of chemistry at Amherst College, the idea that copper was tempered in ancient times arises from a thirteenth century misunderstanding of the Greek word *baphé*—a word used by the Græco-Egyptian alchemist writers of the third century. Professor Hopkins states that Berthelot, the eminent authority on alchemy, has shown that this word tempering may mean coloring cloth, glass and metals, coloring materials, or the coloring bath. He says that Egyptian alchemy busied itself originally in producing brilliant bronzes on copper and the copper alloys, and that this expression "the tempering of copper" means and always has meant, bronzing copper so that it may simulate silver or gold. It would thus appear that copper may never have been tempered, after all. This is a more probable conclusion than that the way to do it has been lost.

General Correspondence

Gauging Worn Wheels.

Editor:

In your article on Gauging Worn Flanges on page 68 of the February issue of RAILWAY AND LOCOMOTIVE ENGINEERING you speak of three kinds of wheels and two kinds of gauging. This is all right, but it seems to me that rule 10 itself and the explanation of it given by the M. C. B. Association in the illustration they use on pages 10 and 11 of the 1908 code of interchanges are not quite as clear as they might be. Now is the time that the various railway clubs are preparing to make suggestions regarding the rules of interchange and I therefore wish to point out one thing that might be improved.

Rule 10 states that cast wheels under cars less than 80,000 lbs. capacity are to be taken out if the flat vertical wear of the flange exceeds 1 in. or if this flange is 15/16 ins. thick, as measured by the gauge. Cast iron wheels under cars of more than 80,000 lbs. capacity may only have a flat vertical surface ⅞ from tread or a flange less than 1 in. thick as measured by the gauge, and further, as I understand it, steel or steel-tired wheels, without reference to what capacity car they may be under, should be removed for a flat vertical worn surface 1 in. up from tread or a flange 1 in. or less in thickness. As the rules states it all the steel or steel-tired wheels take the sharp flange limit equal to the cast wheel under cars of less capacity than 80,000 lbs., and all the steel or steel-tired wheels take the thickness limit of the cast wheels under cars of over 80,000 lbs. capacity.

In other words, for cast wheels you use the gauge as determined by the capacity of the cars, but with steel or steel-tired wheels you use the gauge as directed without reference to the capacity of the cars under which the steel or steel-tired wheel may be. This is apparently the meaning of the rule but when it comes to the interpretation of the rule as shown in the figures in the code we find that in Fig. 4 the limit of thickness of steel-tired wheels is shown as 15/16 ins. or less. Rule 10 says limit of thickness of all the steel or steel-tired wheels is 1 in. or less. Fig. 4 makes it look as if the steel or steel-tired wheel was gauged because under an 80,000 lb. capacity car. Also in Fig. 4a, the presumption is that for cars over 80,000 lbs. capacity the steel wheel is treated like the cast, with a sharp flange limit of ⅞ ins., though Fig. 4a does not exactly say so.

The point I wish to bring out is that there is ambiguity between the last clause of rule 10 relating to steel or steel-tired wheels and the directions under Fig. 4 in the code. If steel or steel-tired wheels are to be treated like cast-iron wheels it should be plainly stated so in the rules. If steel or steel-tired wheels are in a class by themselves without reference to capacity of car, then the illustration, Fig. 4, should be made to conform to the rule.

A. O. BROOKSIDE.

New York, N. Y.

Proposal for Foremen to Get Together.

Editor:

I note in your February issue that a little controversy has arisen between Mr. E. F. Fay, president of the International Railway General Foremen's Association, and Mr. A. B. Glover, of Marquette, relative to the merits and demerits of the General Foremen's Association and the New England Locomotive Foremen's Association.

If all locomotive foremen are entitled to membership in the General Foremen's Association it is not known or so understood in this part of the country.

The term general foreman is an elastic one and may apply to any man that has supervision of men and work, from a track foreman to and including a master mechanic, depending on the railway and the locality. Nevertheless, locally the term does sometimes draw the line and make a distinction between the different classes of locomotive foremen.

Mr. Glover seems to put special stress on the fact that a roundhouse foreman, in order to be successful, must have special qualifications, such as lots of grit, a thick skin and the get-there-quick ability. No doubt this is true. On the other hand the machine shop foremen, boiler shop foremen, etc., must also have special qualifications to be successful in their particular line, and in order to promote such qualifications it is necessary that we get together occasionally to discuss subjects pertaining to our profession.

As president of the N. E. Locomotive Foremen's Association for the last two years, I am able to state that the mingling together of the different classes of locomotive foremen has been of general benefit not only to the members of our association, but the railroad as well.

ENGINE WITH "SUNFLOWER" SMOKESTACK.
(Photographed by A. W. Ainsworth, Denver, Col.)

In order to further improve the standing of all locomotive foremen let the officers of the International General Foremen's Association and the New England Locomotive Foremen's Association get together and discuss the question with a view of forming a national association open to all locomotive foremen with a local association for each railroad or division of railroad.

Such an association could adopt a name and by-laws that would eliminate all suggestions of class distinction. I would be glad to have Mr. Fay give us his view of this question through the columns of the RAILWAY AND LOCOMOTIVE ENGINEERING.

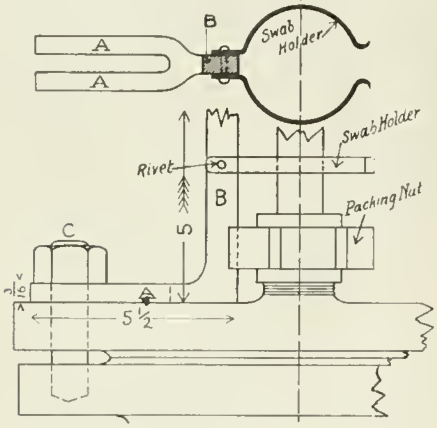
LLEWELYN MORGAN,
Engine House Foreman,
Boston & Maine.

Fitchburg, Mass.

Air Pump Gland-Nut Lock.

Editor:

Thinking that it may be of interest to your readers I am sending you a sketch of a "square" packing nut-lock and swab-holder for use on air pumps. In the sketch the device is shown as applied. It keeps the two packing nuts of the air pump from working off and



GLAND NUT-LOCK AND SWAB HOLDER.

it holds a swab around the piston rod. The swab-holder may or may not be applied to the nut-lock as may be desired.

In the sketch the part marked A is made something like a tuning fork and is slotted so as to slip under the nut of a cylinder head stud. The horizontal part A is 5½ ins. long and the vertical part B is 5 ins. high. The swab-holder is riveted to B at any convenient part and is made of thin flat spring steel. This spring holds the swab closely to the rod and is easy of access at all times. The upright part B is made long enough to slip into the vertical slot of both the gland-nuts so that air and steam piston rod packing is taken care of.

After the pump has been packed and the gland-nuts tightened to place, a slot in each gland-nut is brought into vertical line. Part B of the nut-lock is pushed in the slots and the nut of stud C is tightened down, thus locking the gland-nuts in position. The nut-lock prevents a pump failure from loss of packing due to nuts working off, and it lessens the tendency of the engineer to squeeze the life out of packing in giving the gland-nuts that "extra turn" he so often gives in order to be sure they will not come off. These "square" nut-locks can be made from malleable cast iron at a trifling cost, and the good they accomplish soon more than compensates for the outlay. Without doubt standard forms of pump packing would give better service if the gland-nuts were locked. Do you not think the packing makers would be money ahead if they would furnish something of this kind with their standard sets of packing? A. H.

Wheeling, W. Va.

English Pullman Train.

Editor:

The Pullman Car Company, in conjunction with the London, Brighton & South Coast Railway, have introduced a most luxurious train of seven cars vestibuled throughout, for the London-Brighton service. The train affords liberal accommodation for 219 passengers. The cars differ from the standard Pullman pattern, in having elliptical roofs in place of the usual clerestory type, thereby giving increased internal space. Each car runs on six wheeled bogies and measures 63 ft. 10 in. long, 8 ft. 8¾ in. wide, and 13 ft. 6 in. high from the rail to the top of the roof. The equipments include independent hot water heating apparatus, electric light and bells, improved systems of ventilating with warmed air, etc.

The interior decorations are more artistic, combining elegant design with the maximum of comfort. The wood carving hitherto so frequently used for interiors has been entirely eliminated and delicate inlaid work has been substituted. Each car has distinct treatment in the species of wood used, among them being oak and Spanish mahogany inlaid with satinwood; satinwood inlaid with sycamore and boxwood, pearlwood inlaid with hollywood. The upholstering has been carefully studied to harmonize with the woodwork in each car. The first and last cars are for smokers, the middle car is also for smokers, and has a buffet. The electric lights are arranged to give the fullest effect of height to the ceilings. Standard lamps are also provided on the tables. The cars are named as follows: "Verona" (with brake compartment), "Princess Helen," "Belgravia," "Grosvenor," "Cleopatra," "Bessborough" and "Alberta" (with brake compartment).

The bodies, bogies and underframes were built by the Amalgamated Railway Carriage & Wagon Co., Ltd., the decorations being designed by Mr. G. F. Milne and executed by Messrs. W. S. Laycock, Ltd., of Sheffield. A. R. BELL.

Ridgway, England.

An optimist is a man who never stops to open a sandwich.

Western Maryland, No. 50.

Editor:

I am enclosing you a photograph of an old Wootten type passenger locomotive, belonging to the Western Maryland Railroad, and built by the Baldwin Locomotive Works in 1884. I think this engine is the only one of its type running out of Baltimore. The photograph was taken in the Western Maryland yards here. I have no data in reference to this engine, but surmise the following figures may give an idea of its size and capacity: Cylinders 17x24 ins. Steam pressure 160 lbs. drivers' diameter 62 ins. Weight on drivers 95,000 lbs., which would create a draw bar pull of a little more than 15,000 lbs. Should you consider this of sufficient

WOOTTEN FIREBOX ENGINE.

interest to yourselves and your readers, you may publish it. With the compliments of the season. L. J. LAPSLEY,

Telegrapher, Gen'l Offices B. & O.

Baltimore, Md.

Old Jersey Central Engine.

Editor:

In reply to your correspondent, Mr. Colvin, who in the February number of RAILWAY AND LOCOMOTIVE ENGINEERING takes me to task for errors in stating particulars concerning the old Jersey Central engine "New York" in the January number, I beg to say that having been requested by you to write something to accompany the reproduction of the photograph of that engine, I reluctantly did so, and very much appreciate the fact that it was

ENGLISH PULLMAN TRAIN, "SOUTHERN BELLE."

accepted, and therefore was, and I believe still, is approved of by you.

In stating the particulars in question I was careful to say, "if my memory serves me right," so that I made no pretense of being absolutely correct either technically or mechanically.

As to whether the engines were built in the fifties or sixties, I can only say that I went to Phillipsburg, N. J., to live in 1858, at which time the trains, afterwards hauled by the "Taunton" engines, were then being hauled by such engines as the "Delaware," "New Jersey" and "Lehigh," to the best of my recollection all Rogers engines, and I have no recollection of seeing the "Tauntons" until some time in 1860.

However, I do not claim to know it all; am willing to be corrected, and it is probable that your correspondent is right on the points he questions. At any rate, we will take it for granted he is, for I have had no time to look up my "old friend of eighty three years of age" to verify what your correspondent says, but even if he is right, and I am wrong, it would seem that if he had read my article in the sense it was intended, he would readily have seen that it was written more in the nature of a reminiscence of boyhood than anything else, and, therefore, in making his corrections would have refrained from commenting in the way he did.

F. W. Blauvelt.

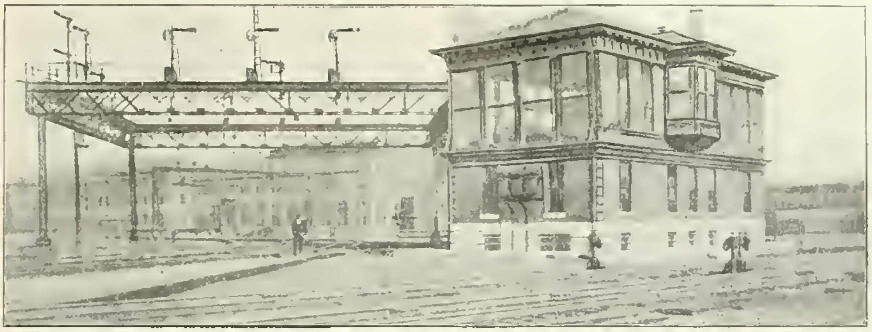
Union Station and St. Louis Terminals.

Editor:

The Union Station at St. Louis, including the train shed, covers an area of four square blocks. Besides the train shed containing 32 tracks, each track having a capacity of 15 cars, the station is occupied by the general offices of the Terminal Railroad Association of St. Louis, as well as those of some of the other railroads centering here, of which there are 26 in

LOOKING NORTH TOWARD TRAIN SHED, EAST SIDE, ST. LOUIS TERMINAL.

number. The station affords the traveler every desirable modern convenience. Baggage and parcel check rooms are under the station roof. The station has possibly two of the finest waiting rooms in the country, very roomy and with plenty of light. A separate room is set aside at one end of the second floor waiting room for ladies; tables, etc., are pro-

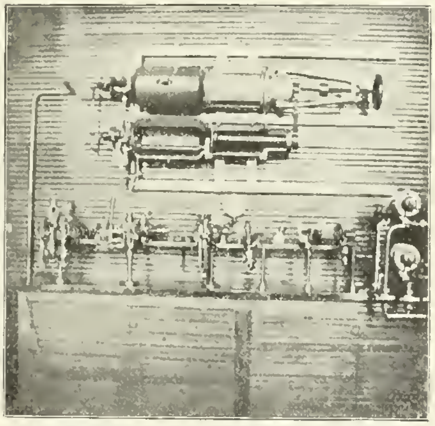


INTERLOCKING TOWER AT ENTRANCE TO ST. LOUIS TERMINAL.

vided where reading and writing can be done.

In January a bank was opened in the station, which affords the traveler a great convenience.

The train shed, with its 32 tracks, en-



MODELS IN AIR BRAKE ROOM.

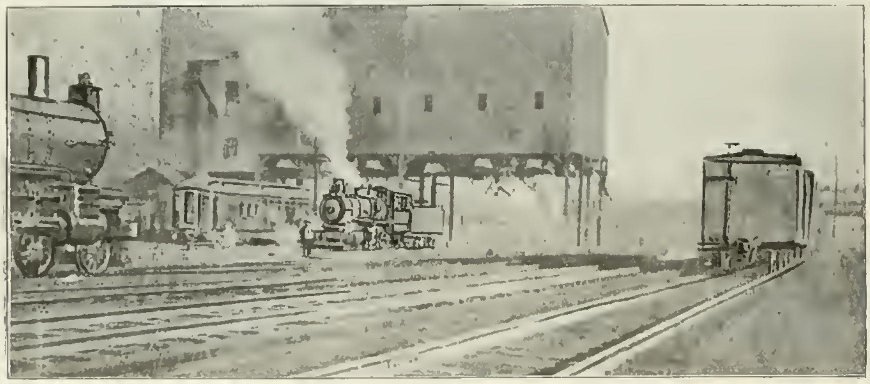
ables the association to handle trains with the necessary promptness and safety, the average day's business in and out of station being 1,500 cars.

Each track is equipped with two plungers, placed opposite each platform, one being about the center of the shed and the other at the south end of shed, by which conductors in charge of trains signify to the tower their readiness to depart, upon which notice clear signals are displayed for the train, providing of course, route is clear. This plunger is connected to a cabinet of numbers in the tower by electricity, and when conductor plunges, the number of track from which he plunges shows up in this cabinet, and at the same time a buzzer is sounded to attract the attention of leverman. This track number remains visible until released by the leverman. The rear end of each track is equipped with steam, air and electric current connections, so that cars can be heated, lighted and brakes tested for leaks before engine assigned to handle train arrives. Some of the tracks are also equipped with telephone connection for the benefit of trains having such service. Train callers are provided to call out the departure of trains, such call being made about 40 minutes before such train departs, notice being given at the same time as to whether train is ready for the reception of passengers.

The train shed tracks are divided into two parts known as the east and west side; each of the 16 tracks are run into three and then again widened into six main leads on the east, and the same on the west side. Three of these six leads from each side are diverted to the east and three from each side to the west. All tracks within a radius of four blocks east and four blocks west as well as the entrance to the shed are controlled by the interlocking tower. There are 15 signal bridges in the territory described above, to say nothing of the many dwarf signals and single arm semaphore signals not on the bridges.

The interlocking tower shown contains about 200 switch and signal levers which are in use almost incessantly. All of the bridges in this plant contain from three to eight semaphore posts and each post carries from two to four masts. On the entire property there are 16 telegraph offices and interlocking towers. In addition to the entire property being protected by the interlocking system, it is also protected by automatic block signals. Air and electricity are used in the handling of switches and signals, and all semaphore signals as well as all dwarf signals in the vicinity of the Union Station are lighted by electricity. No switch that connects with the main line at any point on the property is controlled by hand. It will be noted that promotion of safety is uppermost at all times.

Under the train shed at the southern end we observe the subway for the handling of mail and baggage, the handling of which is all done under ground. Each platform has two elevators; this, of course, makes crossing the tracks with baggage or mail unnecessary, and naturally there is no such thing as injury to handlers. On the west side and immediately south of shed are the express houses, and on the east side is the annex station Post Office and the Union Station power house. This power house furnishes all heat, light and air used by the Terminal Company in St. Louis, with very few exceptions.



COALING STATION AT THE ST. LOUIS TERMINAL.

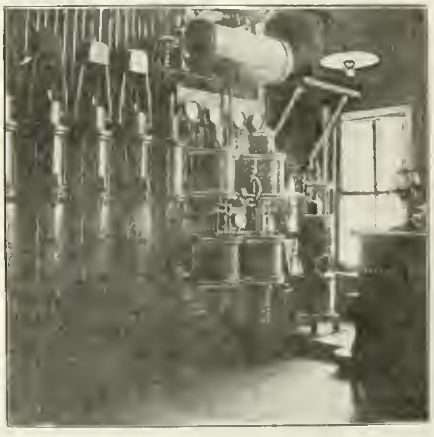
There are two main lines of track north via Merchants' Bridge and two main lines east via Eads Bridge and tunnel.

Three engine houses are about one-quarter mile from the Union Station. These houses contain about 45 stalls, most of which are equipped with pits. The shop located in the engine house is not large but affords ample facilities for all necessary repair work to locomotives of the Terminal Company and also those of other lines housing there. In addition to the shops, the terminal has the largest coaling station in this part of the country and possibly in the States. Engines can be supplied with coal, water and sand, and their fires can be cleaned or knocked out all at the same time and without moving engine. An idea of the coal handling may be of interest to your readers.

A bottom dump loaded car is placed over a large hopper and dumped, while at the same time it is leaving the bottom of this hopper and passes through a crusher or rather a cracker, where coal is crushed to fist size; from this plant it is carried to the third floor of the building in buckets or carriers and dumped into storage bins; from this point it reaches the locomotive through a chute, there being about 12 chutes and about the same number of water spouts around the building. The storage bins hold about 800 tons of coal. Sand is handled the same way, except that it is dried by the use of a sand stove and shoveled by hand to the chute leading to storage bins. The two water tanks run the entire length of the building and hold about 1,000,000 gallons.

On the second floor of the building are scales opposite each chute by which all coal delivered to engines is weighed. This building is of steel and iron and is fireproof throughout. The ashes pass from the ash pan to buggies, from which they are dumped into carriers that pass under these pits in which buggies are located; the ashes are carried up to the second floor and dumped into a large bin, from which they are dumped into cars by means of a chute when necessary. The machinery can be handled by one man, and it will be observed that little manual labor is required about the building.

The air brake instruction room is in the service building about one-half mile from the Union Station and is equipped with all modern Westinghouse Air Brake equipment. The 11-in. air pump, engine, tender and equipment of ten cars are operative. It also contains a brake cylinder and triple valve cut in two and connected to one in operation so that the inside working parts can be seen. It has a rack on which are many other cuts such as the lubricator, injector, etc. A rack connected with the ten car train line is equipped with four triple valves, three of which are defective for three different reasons. These can be cut out or cut in as desired by the manipulator. Aside from this the room has many charts and designs. Mr. C. F. Smith, the able instructor is, by the way, a constant reader of RAILWAY AND LOCOMOTIVE ENGINEERING.



AIR BRAKE INSTRUCTION ROOM.

The service building also contains toilet and washroom for shop and enginemen as well as a sleeping and reading room for the enginemen, and a small storeroom. The locomotives used by the Terminal Company are mostly 70-ton 6-wheel switchers, 20 x 26-in. cylinders, and a boiler pressure of 200 lbs. The maximum tractive effort of these engines is about 34,000 lbs. The tenders are square shaped and have a capacity of 10 tons coal and 5,000 gals. water. MISSOURIAN.

St. Louis, Mo.

Derailment of Tenders.

Editor:

I have read with interest the articles in your paper on engine tanks leaving the track, and will say I have had some trouble in this line, and found mine in the draw castings between engine and tender, and by lowering draw casting on tender about inch to inch and a half I had no more trouble. I have had this happen on a new engine as well as old ones.

Maplesville, Ala. F. C. LEAVITT.

Kink in Laying Off Work.

Editor:

In this age of steel cars there is always more or less repairs to make on them, and as these repairs consist in handling channels, bulbs, angles and other irregular shapes that have to be replaced with new ones, it is often an expensive piece of work to lay out the holes to exactly correspond with those in the old piece, and it is vexatious to find some of the holes away off when drilled or punched. This being the case, it calls for considerable chiseling, and is a poor job to boot.

A channel or angle-bar that is bent or twisted presents considerable difficulty for accurate measurement, but the problem becomes both easy and accurate if the simple means I here present is adopted, and while it has been in use in some shops for years, it is not so easy to think of until suggested by one who knows how.

Any surface or any variety and number and shape of holes can be reproduced as in the original piece by taking a piece of drawing paper or cardboard and clamping it on the old piece as smoothly as possible, avoiding all wrinkles or kinks in the paper as nearly as possible. When clamped securely, go over the holes with the pein of a hammer, impressing the holes, slots or countersinks on the paper and when this is done, be sure to mark the end of the paper pattern to correspond with the end of the old iron leaving no possibility for getting the new piece wrong end to.

Where a hole has a countersink, take a

pipe nipple to go in the hole and make the impression from this with a pencil on outside, to denote the countersink. This will avoid any mistake. Some prefer to mark the paper through the holes with a pencil, but this often proves inaccurate and shifts the centers, but with the hammer pein or bob punch one gets an exact reproduction of the original, provided the clamps hold the paper securely in place.

If desired you can cut out the holes in the paper with a sharp knife blade. Of course, nothing should be left to chance and it will be found sometimes better to use clamps close together where an abrupt turn or angle occurs or where the bar is badly twisted.

This method can be used also to reproduce holes in boiler plates or in laying off a new frame from an old one.. The paper needs to be tough and yet pliable and, of course, pressed closely in the corners and angles of the work so that there will be no possibility of variation in measurement. If needed for future use, the paper can be carefully marked and filed away. The varied uses this method can be put to in a railroad shop, and the economy and simplicity of it will commend it to repair men in general, because as no great skill is required in doing it, a man can almost do it, with his eyes shut, with very little possibility of mistake.

St. Louis, Mo. T. Toot.

Canal Zone Diamond Stack.

Editor:

I notice your correspondent's inquiry about the diamond stacks in the December number of Railway and Locomotive Engineering. The Isthmian Canal Commission and Panama Railroad Company have six locomotives

DIAMOND STACK SWITCHER IN THE CANAL ZONE.

with diamond stacks in service, all switch engines. Here is a picture of one of them. If you see fit to publish this picture, please mark photograph as taken by me at Gatun, Canal Zone, Panama. C. C. Daly.

Gatun.

Information Wanted About Crossheads

Editor:

I read with much interest in your February, 1909, issue entitled "Guides, Pistons, Cylinders, etc., by a Shop Foreman," page 86. I would be much pleased if you would have the "Shop Foreman" continue his articles in the future numbers of Railway and Locomotive Engineering.

I am on a small railroad as a locomotive engineer where we have to do all our own work and repairs, have no shop tools of any description, simply hand tools and not much of those, consisting of hammers, monkey wrenches, etc.; simply the tools carried on the locomotives in addition to a few we engineers own. Our freight engines are 20 x 24 ins. cylinders and 125 lbs. steam pressure.

What I wish the "Shop Foreman" to tell me is this: Our engines have the alligator crossheads P. R. R. style. The top and bottom shoes of crosshead when they came from the shop had ¼-in. lining of tin or babbitt metal, and after two or three years lining is worn out.

Having no tools we simply take off the guides and both shoes and re-babbitt them, line up the guides and put the engine to work. Sometimes the babbitt will stay in for several months and again it will only last a few days. I have tried warming the shoes before running in the babbitt, but it does not seem to help much.

What I wish to know is this: Should we use tin, that is block tin instead of babbitt? Please have "Shop Foreman" tell me how to get the tin or babbitt to stay on shoe. I line up the guides as close as I can. When crosshead is at each end of stroke it is as tight as it can be run, but at the middle of stroke it stands away from top guide ⅛ to ¼ in., usually about 3/16 in., as our guides are badly worn. Any information you can publish in Railway and Locomotive Engineering will be greatly appreciated by me.

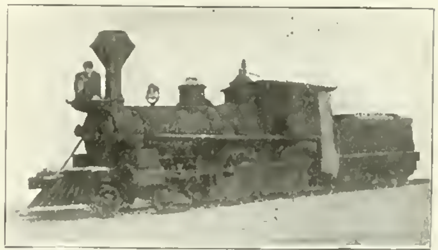
I consider your magazine the best paper I take, as it contains so much information for engineers who do their own work. I received copy of the Railway and Locomotive Engineering Vol. 1., No. 1, from Frederick Keppy, book publisher, Bridgeport, Conn., and have read it ever since, either by subscription or from news stands, but find the only satisfactory way is by subscription. I have lots of back numbers which are not complete files, but could be used to complete other files for someone else. Jay W. Moorhead.

Clarion, Pa.

Diamond Stack on the N. Y., O. & W.

Editor:

The enclosed photograph was recently handed to me by one of the engineers of



DIAMOND STACK ON THE N. Y., O. & W.

the New York, Ontario & Western Railway. While too late for the first edition of Railway and Locomotive Engineering having pictures of this class of engine, if it is now any use to you, you are welcome to use it. It is engine No. 28 and is in active service at Walton, N. Y., on the N. Y., O. & W. system.

F. P. Browne,

Norwich, N. Y. Sec. Y. M. C. A.

Pound on the Left Side.

Editor:

To deal with questions of this kind it is necessary that the different positions of the engine should be defined by some rule so that any part of the driving wheel could be located at once, and, as you have used the clock face to describe the positions of eccentrics with relation to the crank pin previously, I will use same in this case and will suppose that I am standing at the right side of a locomotive and picture the driving wheel as being marked off similar to a clock face; that is, 12 the top, 6 the bottom, 3 the front and 9 the back. These are the four quarters, but any part of the circle with its 60 divisions can be referred to.

If the engine is right-leading and right crank is at 3, the left crank would be on top quarter at 12 and in the position to exert its greatest power, and would pull left end of axle forward and right end, back equal to the amount of lost motion due to worn parts in axle boxes and all parts of the bearings; and when steam entering front R port would act on piston, all lost motion being in front of the box.

no pound could take place when passing the front centre at 3, but when the R crank comes down to 6 and is exerting its full power it seems to keep the axle and lost motion in the same position as when the left side had the power acting on its top quarter. But when the left side takes steam through front port and crank at 3, the axle and box is pressing front pedestal, steam acting on piston causes wheel to slip back, or stop, until back pedestal and the box meet and a pound takes place equal to the amount of lost motion in left side every time the left side is passing 3, the front centre.

If an examination is made of left driving tire about 11 minutes in front of left crank it will be seen that a flat spot will develop at that point, showing that that part of the tire is on the rail when the pound takes place and seems to show that lead opening does not admit steam to the L cylinder soon enough to cause the pound to take place until left crank almost reached figure 4 of our clock. When L crank is passing 9, the back center, the pound does not seem to have the same effect, being lighter, the wheel turning forward adjusts slack almost without a pound. Now, how can the power exerted on right side and using the axle for a lever, R pedestal as a fulcrum, keep L end of axle and box pressing front pedestal in spite of the tendency the wheels have to lag back and the compression which takes place in the cylinder as the piston approaches front end and when front port is closed to exhaust while crank is moving, say from 1 to 3?

There appears to be a period while the piston is finishing forward stroke and before commencing its return stroke in the cylinder when no pressure is exerted, compression has ended and before the steam entering the cylinder owing to lead opening has any influence on the piston that the left end of the axle is moved forward by the pressure exerted on R piston if some pressure could be kept in front of L piston until steam of sufficient pressure was admitted, then there would be no pound on the left side when passing front centre at 3. We have right and left hand leading engines here. Right leading engine pounds on left side and wears a hole or flat spot in tire tread about 10 minutes in front of L crank; the L leading engine pounds on R side and wears a hole in R tire tread. The flat on the tire and the pound seems to be aggravated by cutting off short, and on straight track I have often noticed when pounding, hooked up, the pound will diminish when the lever is moving away from the centre. I don't think that inside cylinder engine would pound in this way as much as outside cylinder engine, and would pound on leading engine and on back centre at 9, and would not do so much damage. I think that all driving box bearings should be increased because the pound due to worn parts is in all boxes. This is proved by the pound changing from left to right side when backing up. E. E.

Rockhampton, Queensland, Australia.

Old Time Table.

Editor:

I herewith send you a time table and rules of instruction of the Western Railroad, now a portion of the Boston & Albany Railroad, which will be fifty years old this March. Thinking that this may be of interest to some and most of your readers, I send it to you to enable you to make use of it for your valuable publication. This being an original copy which was given me by an old friend, I would ask you to return it to me.

The station names missing owing to the torn edge of the time table are: Shaker Village, Richmond, State Line, East Tunnel, West Tunnel and Canaan.

W. Springfield, Mass. S. P. FAAS.

[On the back of the time table are printed a number of instructions; a few of which we quote as in a way indicating the condition of affairs in the days when this time table was in force. The instructions are signed by Henry Gray, Sup't. Western R. R. office, Springfield, March 14th, 1859.

"No. 6. If it shall be found impracticable, from any cause, for a freight train, in passing from one station to another, to reach the station to which it is proceeding in season, and another train is expected, then the conductor will be careful to send a man very far ahead with a flag by day, or a lantern by night, to give notice of his approach.

"No. 12. In running one train behind another, each engineman must so run as to keep the train ahead of him out-of-sight, and in approaching a station, particular caution will be used so to slacken the speed as to avoid the possibility of running into the leading train. No excuse as to being deceived about the distance will be received for neglect of this rule.

WESTERN RAIL ROAD TIME TABLE FOR WESTERN TRAINS.

MONDAY MARCH 14th, 1859.

No Train will be allowed, under any circumstances, to leave a Station BEFORE THE TIME specified in this Table, as regulated by the clock at Springfield Station.

No Train will be allowed, under any circumstances, to run at a greater speed than the time specified in the Time Table "Special Notice." In case a Passenger Train, following another Passenger Train, which has not passed a Station TEN MINUTES previous to the arrival of the following Train, it will be the duty of the Agent at the Station, to raise a Red Flag by day or a Red Lantern by night and the following Train will wait until the TEN MINUTES EXPIRES, before proceeding.

LEAVE	Springfield to Greenbush. 1st Pass. Accom	2d Pass Accom	3d Pass Accom.	1st Freight.	2d or n't Freight.	Chatham to Greenbush.	Greenbush to Springfield. 1st Pass Accom	2d Pass Accom	1st Freight.	2d Freight	3d or n't Freight.	Greenbush to Chatham.
Springfield	7.00 A.M	12 15 P.M.	6.30 P.M	5.00 A.M		Pass'r Express	12.30 P.M	7.55 P.M	3 30 P.M		2 35 A.M	Pass'r Express
West Springfield	7 10	12.22	6 36	5 15			12.22	7 48	3 18		2.20	
Westfield	7.30	12 45	6 55	6.00			12.00	7.28	2 45		1 55	
Russell	7.48	1.03	7.10	6.55			11 42	7 10	2 15		1.30	
Huntington	7.59	1.14	7.19	7.13			11.32	7.00	1.55		1 15	
Chester	8.18	1.33	7 38	7 30			11 19	6 44	1.33		12 55	
Middlefield	8 38	1 53	7.57	8 36			11 02	6 26	1 03		12 30	
Becket	8 49	2 06	8.09	9.06			10 54	6 16	12 47		12 10	
Washington	9.03	2 20	8 21	9 31			10 45	6 07	12 18		11 55	
Hinsdale	9.14	2 31	8 31	9 58			10 35	5 55	11.55		11 35	
Dalton	9 23	2.40	8 40	10.23			10.23	5.42	11.20		11 15	
Pittsfield	9 43	2.58	8 57	10 41 ar 10 45 le.	10.45 P.M		10.09	5 25	10 45 lv 9 15 ar	4 40 P.M	10 45 lv 10 20 ar	
haker Village	9.56	3 09	9 07	11.10	11.10		9.56	5 09	8 52	4 25	10 00	
mond	10.07	3 20	9.16	11.35	11.30		9 44	4 57	8 27	3 55	8.30	
ine	10.16	3 29	9 24	12 05	11 45		9 34	4 48	8 07	3.35	9 05	
nel	10 23	3.37	9 31	12 20	11 55		9 27	4 40	7 50	3 18	8 48	
nel	10.25	3.39	9 33	12 24	12 05		9 25	4 38	7.46	3 14	8 44	
anaan	10.32	3 46	9.39	12 40	12 25		9 19	4 31	7 32	3.00	8.30	
East Chatham	10.43	3.57	9 49	1.05	12 35		9 06	4 20	6 57	2 35	8 05	
Chatham	11.01	4 15	10.07	1.38	12.50	8.30 P.M	8 51	4 03	6 22	2 00	7 30	4 35 P.M
Chatham Centre	11 11	4 26	10.17	2.04	1 10	8 40	8 30	3 44	5.52	1 35	7 05	4 25
Kinderhook	11 19	4 34	10 24	2.20	1.22	8 47	8 23	3.36	5 30	1 20	6 50	4 18
Schodack	11.37	4 52	10 42	2 58	1.47	9.04	8 04	3 18	4 45	12 40	6,10	4 01
Greenbush	11 55 A.M	5 10 P.M	11 00 P.M	3.35 P.M	2.15 A.M	9 20 P.M	7 45 A.M	3 00 P.M	4 00 A.M	12 00 M	5.30 P.M	3 45 P.M

The Passenger Trains between Chatham 4 Corners and Greenbush, are Regular Passenger Trains, and will be governed by the same Rules as other Passenger Trains.

The Passenger Trains between Chatham 4 Corners and Greenbush, are Regular Passenger Trains, and will be governed by the same Rules as other Passenger Trains.

RULES FOR PASSING THE CANAAN TUNNEL.

All Trains from Greenbush to Springfield will come to a full stop at the sign marked "West Tunnel Station," before entering the Tunnel.

All Trains from Springfield to Greenbush will come to a full stop at the sign marked "East Tunnel Station," before entering the Tunnel.

Passenger Trains from Springfield to Greenbush will not attempt to pass the Tunnel, when another Passenger Train is due from Greenbush, until they have sent a Red Flag by day or a Red Lantern by night, to stop the expected Train.

Freight Trains from Springfield to Greenbush will not attempt to pass the Tunnel when another Freight Train is due from Greenbush, until they have sent a Red Flag by day or Red Lantern by night, to stop the expected Train

Freight Trains will in no case attempt to pass the Tunnel on the time of a Passenger Train.

Extra Trains will not pass the Tunnel on the time of any Regular Trains, "whether Passenger or Freight," and in passing the Tunnel will take double of the length of time of regular Trains as specified in the Time Tables in passing between the East and West Tunnel Stations.

No Train, under any circumstances, will run at a greater speed between the East and West Tunnel Stations than specified in the Time Tables

Great care must be taken at all times by the Trains in passing the Tunnel, to avoid danger.

TRAINS FROM SPRINGFIELD TO GREENBUSH.

1st Passenger Train to Greenbush will pass 1st Freight Train to Greenbush at Middlefield at 8 36 A. M. and will meet 1st Freight Train from Greenbush at Pittsfield at 9 43 A. M., and will meet 1st Passenger Train from Greenbush at Shaker Village at 9.56, A. M

2d Passenger Train to Greenbush will meet 1st Passenger Train from Greenbush at West Springfield at 12 22 P. M., and will meet 1st Freight Train from Greenbush at Chester at 1 33 P. M., and will meet 2d Freight Train on Double Track, between Richmond and Greenbush, and will meet 2d Passenger Train from Greenbush on the Double Track between Richmond and Greenbush.

3d Passenger Train to Greenbush will meet 2d Passenger Train from Greenbush at Russell at 7.10 P. M and will meet 3d Freight Train from Greenbush on the Double Track between Richmond and Greenbush.

1st Freight Train to Greenbush will be passed by 1st Passenger Train to Greenbush at Middlefield, at 8.36 A. M., and will meet 1st Passenger Train from Greenbush at Dalton at 10 23 A. M., and will meet 1st Freight Train from Greenbush at Pittsfield, at 10.41, A. M., and will meet 2d Freight and 2d Passenger Trains from Greenbush on the Double Track between Richmond and Greenbush

TRAINS FROM GREENBUSH TO SPRINGFIELD

1st Passenger Train to Springfield will meet 1st Passenger Train from Springfield at Shaker Village at 9.56, A. M and will pass 1st Freight Train to Springfield, at Pittsfield at 10 09, and will meet 1st Freight Train from Springfield at Dalton, at 10 23, A. M., and will meet 2d Passenger Train from Springfield at West Springfield at 12 22 P. M

2d Passenger Train to Springfield will meet 2d Passenger Train from Springfield on the Double Track between Greenbush and Richmond, and will meet 3d Passenger Train from Springfield at Russell at 7.10 P. M.

1st Freight Train to Springfield will meet 1st Passenger Train from Springfield, and will be passed by 1st Passenger Train to Springfield at Pittsfield at 9.15 A. M., and will meet 2d Passenger Train from Springfield at Chester at 1 33 P. M

3d Freight Train to Pittsfield will meet 1st Freight Train and 2d Passenger Train from Springfield on the Double Track between Greenbush and Richmond

3d Freight Train to Springfield will meet 3d Passenger Train from Springfield on the Double Track between Greenbush and Richmond

No Train will Cross Connecticut River Bridge in less time than *Two Minutes*

If the Night Freight Trains cannot arrive at any Station in season to avoid a regular Train, it will become an irregular Train, and be kept out of the way of all regular Trains, whether Passenger or Freight.

☞ FOR INSTRUCTIONS, SEE OPPOSITE PAGE.

REPRODUCTION OF TIME TABLE NOW 50 YEARS OLD.

"No. 13. Every engineman is authorized to require the conductor and brakemen of his train to be at their posts. No brakeman will be allowed to leave his post, or to be in a car when the train is running, upon any consideration whatever.

"No. 14. Each conductor or assistant conductor of a freight train will be held strictly responsible for the correct performance of duty of the brakemen of his train. He will require the doors of freight cars always to be closed and locked and keep the brakemen always at their posts.

"No. 16. Enginemen before crossing a

OLD CURIOSITY SHOP, LONDON. IMMORTALIZED BY DICKENS. SOON TO BE REMOVED FOR NEW BUILDING.

railroad at grade, will stop their engines within a distance of five hundred feet of such crossing, and when he resumes his course, pass slowly over such crossing."

These are a few extracts.—EDITOR.]

Stationary and Locomotive Practice.

Editor:

The stationary engine and boiler would be almost a complete failure if they used cold water, but they use their by-products; that is, they save the steam after it has done its work to get the heat and water that is in it. The locomotive uses its steam after it has done its work in the cylinders to make draught for the fire. Now why do we have to have such a strong draught? It is to heat the water from the low temperature we use. The stationary engine or boiler reduces their fuel bill almost one-half by heating the water. Why should not the locomotive do the same? The locomotive man says I cannot do that, I need the steam to make draught for the fire. True you need most of it, but do you need it all, even with cold water? You would not need as much draught with hot water as with cold. We have all kinds of opportunities to heat the water on the locomotive. Heat is what we are after. The whole machine is useless without it. See the amount of heat that is required to bring the water up to 212 deg. Water below 212 deg. is of no use, while all this time the engine is after your steam. The engine don't wait on the steam or fuel. See the effect of green wood or coal. It is just the same as cold water. The last issue of RAILWAY AND LOCOMOTIVE ENGINEERING had views of a lot of old diamond stack, saddle tank engines with a lot of the men that run them, but in the whole outfit not one of them brings out a thing to improve present conditions. The bank firing man must have a very high draught in front.

WILLIAM WILY,
Sioux City, Ia. Loco. Engineer.

Trip Through the Great West.

Editor:

I was called on a few months ago for the purpose of going to Shasta County, California, with a locomotive for the Balaklala Consolidated Copper Company of Coram, Cal. I arrived in Chicago on Sept. 20 via the Lake Shore, thence by C. & N. W. to Omaha, Neb., from there I was transferred to the U. P.

For the benefit of those who have never had the pleasure of a trip over this line I have this to say: Some 6 years having passed since I was over this line I was much surprised to find the road so greatly changed. The road is practically a double track from Omaha to North Platte, all stone ballast and 90 lb. rails. I was very much surprised to see so many fruit trains coming east. One day I counted 12 trains with 30 cars of solid fruit, all running on a fast schedule to Omaha. I think it is less than a quarter of a century ago when the first carload of fruit was sent over this line to an eastern market. It is a wonderful advance since those days.

I arrived at Cheyenne and after a good night's rest I was off to Ogden, Utah. Leaving Ogden on Sunday morning I had the pleasure of crossing the Great Salt Lake by daylight.

My next important stop was Winnemuka, Nevada. A strange thing presented itself at this point. While waiting I looked off through the sage brush and saw an object approaching me at a very rapid rate which proved to be an automobile containing six men. They went by me at the rate of 30 miles an hour. I appealed to the yardmaster and he told me they were going 75 miles and expected to be there for dinner. I thought then if some of the old Forty-Niners could come back and see this sight I should hate to guess what they would think. The next place of any importance is Sparks, a division point of the Southern Pacific four miles this side of Reno. There is a roundhouse there with stalls for 60 engines and a large machine shop for heavy repairs to locomotives, employing about 1,500 men. This place is only 8 years old and is an incorporated city. I was soon off for Truchey and through the great snow sheds across the mountains. These sheds are 40 miles long and are maintained at an immense expense to the company, but they are as necessary as the rails themselves.

My next trip will probably be through the great Sacramento Valley. It is 700 miles long and 200 miles wide and is the greatest fruit region in the world. Hundreds of cars on side tracks were loaded with grapes, being sold at $6 a ton. I arrived at Coram, California, on October 2 and found the largest copper mine in this country. They had 12,000,000 tons of ore in sight, with all modern machinery and a grand supply of water. After installing

SWANNINGTON INCLINE, LEICESTER & SWANNINGTON RAILWAY, ENGLAND. GRADE 1 IN 17; PULLEYS FOR ROPE IN CENTRE OF TRACK.

the locomotive I was ready to retrace my steps. Going to Sacramento it was my privilege to come on the Overland Limited. This I considered the greatest trip of my life. The train is first-class in every sense of the word. We arrived in Chicago in 3 days. The train was not over 15 minutes late at any time during the 2,500 mile trip.

Philadelphia, Pa. G. H. JACKSON.

Above the Snow Line in Norway.

By A. R. Bell.

The line from Bergen to Gulsvik forms a portion of the eventual trunk communication between the former important port and the Norwegian capital, Christiania. The route followed, which was chosen as being the most direct and offering the fewest obstacles from an engineering point of view, abounds in wonderful features only to be found in mountainous countries.

The Norwegian government voted funds for constructing the line in the summer of 1875, and work was commenced in that section, from Bergen to Voss, the same year. This line was originally constructed on the metre gauge and was opened for traffic in 1883. In 1894 another grant of funds was made for the section from Voss to Tangevand, which lies near the summit, and in 1898 the section from Tangevand to Gulsvik was provided for. The lines between Voss and Gulsvik were laid on the 4 ft. 8½ in. gauge, so that for running through trains the section between Bergen and Voss had to be converted. This was done in 1904. The total length of the line from Bergen to Christiania will be 305 miles, of which the Bergen-Gulsvik section contributes 218 miles. At present through communication is afforded by steamer from Gulsvik to Kroderen, and thence by metre gauge railway to Christiania via Drammen.

Soon after leaving Bergen on the Voss line, the Oster Fjord is reached, along the side of which the railway is built, passing through numerous tunnels, long and short. After Dale, 42 miles further on, a long tunnel is passed through which is 4,365 feet in length, under the Hyvingen. Voss is 66½ miles from Bergen, and is one of the most frequented places in Norway. From Voss, the line rises again, and traverses the Sverreskar Ravine into Raundal. Raundal Valley was, until the railway passed through it, almost isolated, through being entirely shut off by mountains and forests. The line passes through numerous tunnels going along the valley; and as it narrows, the trees become scarcer, and at Opset they entirely disappear. A tunnel is then passed through into one of the wild valleys of the Sogne Fjord, after which the bleak mountain plateau is reached. The scenery from the carriage window here is very wild and desolate. The making of the railway through this section was extremely trying to the engineers, as for fully nine months of the year the ground is entirely covered with snow. The highest railway, excluding Rack rail systems, in the Alps, is that over the Albula pass, which rises to a height of 5,979 feet, whereas the highest point on the Bergen-Voss line is over 6,550 feet.

ROTARY SNOW PLOW AT MYRDAL STATION—CHRISTIANIA-BERGEN RAILWAY.

Near Opset is the longest tunnel on the line, being 17,384 ft. long, mostly through hard rock. Near the Eastern end of the tunnel is Myrdal station. After Myrdal a point is reached from which one of the grandest views from a railway train can be witnessed. Looking down a precipice of nearly 2,000 ft. into the valley with the Flaamsdal Ravine in the background. The view is suddenly cut short by the train entering another tunnel, and upon emerging the scenery is quite changed, although not lacking in beauty. Passing through numerous tunnels and cuttings, the line again rises steadily into more desolate regions. The curiously dome-shaped Hardanger jokel, over 6,000 ft. in height, is passed, besides numerous lakes on which floating ice may be seen often in the late summer. The outlook becomes wilder and less hospitable—snow is more abundant. Although the mountains are very high, they do not appear to be, as the railway is at a considerable altitude. The line now approaches the highest point, Finse, 118 miles from Bergen.

The ground here is almost perpetually covered with snow, and the lakes are rarely free from ice. The railway follows the border of Lake Finse and descends to the Sanabotn Valley into Hangastol. When the more thickly populated district near Usteosen is

AT TIMGA ON THE CHRISTIANIA-BERGEN RAILWAY.

reached, trees again reach the eye. The country now becomes less romantic and the wide valley of Hallingdal is passed through. This part was entire-

ROTARY EMERGING FROM A SNOW SHED—CHRISTIANIA-BERGEN RAILWAY.

ly shut off from the outer world, being so inaccessible, until the end of the last century, when good roads were made. The line presently crosses the Breifoss, one of the many waterfalls seen from the train, and soon after a point is reached from which a fine view of Holsdal is obtained. Here the line is at an altitude of about 1,990 feet. It may be mentioned that the highest commercial railway in the world is at a point 490 miles from Mombasa, on the Uganda Railway, in South Africa, where a height of 8,320 ft. above sea level is reached.

Gradually descending, Aal is reached, where some old Norwegian buildings are to be seen. After passing Torpe (170 miles) Gol is reached, which is only 678 ft. above sea level. The mountains are now only visible in the distance, and after crossing the Halling

SNOW PLOW TRAIN AT MYRDAL, ON THE BERGEN RAILWAY, NORWAY.

River, the line wends its way alongside it, through picturesque wooded country, to Nesbjen (190 miles), continuing along the banks of Lake Bromma and again the Halling River, then through tunnels and a few minor stations to Gulsvik, 218 miles from Bergen.

We are indebted to Mr. Sunde of the Norwegian State Railways for the excellent photographs reproduced, and for many of the particulars given. Our illustrations are seasonable, as they show the working of the line amid plenty of snow. Plows have often to be used in May. The rotary plow has done excellent work in the snowy regions of the Rocky Mountains, where the transcontinental railways of the United States and Canada cross the "Great Divide." The rotary is also to be seen in the mountainous and snow-covered regions in Norway. The rotary is the king of the railway domain in mountain land.

THE ROTARY HARD AT WORK—CHRISTIANIA-BERGEN RAILWAY.

General Foremen's Convention.

The executive committee of the International Railway General Foremen's Association has selected Chicago as the place of holding the convention in 1909, on June 1, 2, 3, 4 and 5. The Lexington Hotel has been chosen as the official headquarters, at which the following rates have been granted: $1 to $2 a day, single, without bath; $2 to $3 per day, double, without bath; pleasant outside rooms with bath, $2 to $3 per day, single; $3 to $4 per day, double. A club breakfast can be secured from twenty cents up. A table d'hote luncheon can be secured for fifty cents. Arrangements have been made with the supply firms for exhibits, particulars of which can be secured from Mr. J. Will Johnson, 427 Monadnock Block, Chicago. Applications for membership can be secured from any of the members of the organization, or from the secretary-treasurer, Mr. E. C. Cook, Royal Insurance Building, Chicago.

Am. Soc. Mech. Engs.

The regular monthly meeting of The American Society of Mechanical Engineers was held on February 23. The subject of the evening's discussion was Safety Valves, introduced by a brief paper by Mr. Frederic M. Whyte, General Mechanical Engineer of the New York Central Lines. Mr. Whyte discussed the principles of the application of safety valves to steam boilers with special reference to locomotive practice, including questions of design and construction, and the requirements and limitations of valves. His paper was followed by a general discussion covering marine and stationary practice and the conditions existing in connection with low-pressure heating boilers.

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Help in Bringing Back Prosperity.

Many years have passed since the demagogue form of politician found that abusing railroads and disparaging railroad interests was a cheap means of acquiring popularity among unthinking people. Strangely enough, it took a long time for the railroad rank and file to realize that wanton attacks made upon their employers were really assaults upon themselves. This truth has been forcing itself upon railroad employees during the last year or two and indications are daily becoming apparent that they are determined to resent abuse of the interests through which their livelihood is earned. To make their power properly felt against their enemies, railroad people ought to combine and work systematically as has been done by the Railroad Business Association, an organization composed principally of people engaged in making or selling railroad supplies. An open letter recently issued by that association reads:

For very well understood reasons the railroads have not yet begun to share in the return of prosperity, and while many commercial interests are busier than they were, those concerned in supplying railroads with material and equipment have been unable to secure orders sufficient to put their men back on full time. This serious situation brought together our members in an effort to effect a change in public opinion which would lead to an improvement of the general railroad situation and aid in restoring normal conditions.

This movement was not only necessary but timely. The pendulum of popular sentiment had swung adversely to the railroads and swung too far, as indicated by a large amount of legislation which affected the transportation interests by increasing the cost of railroad operation, while curtailing revenues.

At a recent dinner in New York the statement was made that during the years 1906 and 1907 the British parliament enacted 114 laws for the government of Great Britain and Ireland, whereas during the same time Congress and the State legislatures of the United States enacted 25,000 laws. It is reasonable to doubt that 12,000 wise laws, per year, can be enacted in any country. The thinking people who constitute the safeguard of the nation have begun to recognize that the railroad interests could not be adversely affected by restrictive legislation without affecting all other human interests. There has been no general sentiment in favor of weakening restriction of railroads, but there is a growing conviction that restriction must be intelligent.

The way in which the members of the association rallied to the call is scarcely more impressive than the ready support of the commercial public. By a combination of very important manufacturing concerns into a good-natured association, public opinion has crystallized to a gratifying extent, and legislators, both State and national, have heard from the people in a voice devoid of quavering.

Some of the largest commercial associations have been ready and willing, at the suggestion of the association, to make pacific utterances. Responses from the largest cities and from national associations covering the entire country have been surprising. The voice asking for legislative quiet and for true statesmanship with respect to railroad enactments has come from many directions and from many interests, some of them being entirely separated from railroad affairs. Those for instance, who make and sell shoes have co-operated through their national organizations to indicate appreciation of the fact that the welfare of those concerned in transportation is involved with their own welfare to such an extent as to justify a long step from their beaten paths to correct the unfortunate situation in which our members find themselves.

One reason for this co-operation lies in the recognition of the fact that the personnel of the association is remarkable in including men known for the most successful engineering, manufacturing and commercial achievements. Some of our constituent concerns are as large commercially as a fairly large railroad. The number of men employed by such concerns as are represented in our membership is as great as the number employed by the railroads. Our association has conflicting competitive interests, all united in the bond of good fellowship to carry out the plan which makes for the common good. This plan is conducted absolutely independently of the railroads. It has been shown for the first time to be possible for influences outside of the railroads to band together to promote by organized action a realization of the interdependence between the public and the transportation interests.

Our activities are by this time very well known. In four months the fact has been demonstrated that the people are ready not only to acknowledge what the railroads have done for the country, but to give transportation questions the consideration which they deserve. To turn the light on obscure questions affecting the relations between people and the railroads, tending to prevent extremes in legislation constitutes a permanent work for this organization.

Not all the work already accomplished has been easy. The railroads as well as the public have their part to do and the work of the association will include efforts to bring about a permanent friendly relationship. This cannot be done in a short time.

One of the most effective elements of the success of this association is the generous good fellowship of its members. The organization already extends into sixteen States and often competitive interests in the same city are united in local achievements. No discordant notes are heard in the conduct of its affairs and it is inconceivable that any will be heard under the leadership of such a personality as that of the president of the association, sustained by and enjoying the constant counsel of the able, energetic and potential men who compose its general executive committee. These two months in the executive office have been so crowded with important developments that they seemed exceedingly short.

At the outset reasonable doubt of the possibilities of the movement have been justified. Some may have felt that it was too intangible and experimental to win their instant support. Now there is no room for doubt. It is no longer experimental. The writer regrets that because of compelling business obligations, he cannot continue in direct co-operation with a work so inspiring. This brief time has convinced him that the need for the organization was great, the field for its efforts wide, the plan of its work effective.

It is equally clear that so much remains to be done as to justify the question: How can any concern engaged in supplying the railroads with their requirements delay enrollment in the Railway Business Association? Their offices are in the Whitehall Building, New York, close to Battery Park.

Electric Locomotive Inspection Trip.

Early last month a party of gentlemen connected with the technical press of this city were invited to accompany Mr. W. S. Murray, the electrical engineer of the New York, New Haven & Hartford, on a trip to Stamford, Conn., and return. The party were taken on the electric locomotives which drew the train and were given every facility for the fullest inspection of the locomotives which were hauling the train. At Stamford the small but well-managed shop for electric locomotive maintenance and repairs was visited by the party and the various operations carried on at that point were explained by Mr. Murray and his able assistants.

The N. Y., N. H. & H. trains run over the tracks of the New York Central as far as Mott Haven, and the locomotives are equipped with contact shoes for the third rail and other necessary electrical equipment for the direct current used by the N. Y. C. At Mott Haven the New Haven tracks are reached and here the overhead wire and the alternating current used by the N. Y., N. H. & H. are encountered. The locomotives are of course designed to meet these conditions, and for that reason carry more apparatus than the ordinary electric locomotive. The overhead conductor carrying alternating current is a level steel wire supported by three copper wires, which hang in graceful catenary curves from the series of steel bridges placed about every 200 feet along the road.

The motors used under these locomotives can be operated by direct or by alternating current, but give their greatest efficiency with the alternating current for which they were designed. The coaches are heated by steam in the usual way, and this is supplied from a small upright boiler, burning oil fuel, all of which is carried on the electric locomotive. In appearance these N. Y., N. H. & H. electric locomotives are very similar to those used on the Great Northern, and which form the subject of our frontispiece illustration this month.

The object of the inspection trip was, as Mr. Murray explained, to give a practical demonstration of the working of these locomotives hauling passenger trains in and out of New York under regular service conditions. The trip was much enjoyed by those who had the privilege of being on the electrical iron horse. In a subsequent issue we hope to be able to present to our readers some of the interesting features concerning train operation by these machines in which direct and alternating current for propulsion is used with equal facility. These engines have a leading and a trailing truck of the pony type like that used under a consolidation engine. This type of electric locomotive is most interesting from several points of view.

Leaky Steam Pipes.

Among the chronic troubles that affect the modern locomotive it is safe to say that leaky flues and leaky steam pipes are among the most persistent. It may not be generally observed that when steam pipes begin leaking the flues follow soon after, as if there was some sympathetic co-relation existing between the insensate metallic molecules. The cause and effect are not far to seek. The constant changes of temperature to which the steam pipes are subjected is not only a severe strain on the bolts holding the pipe joints together, but the pipes and rings are rapidly affected by the sheer pressure of the bolts, and in time the lugs of the pipes and T-head will begin to lean toward each other at the extremities. This is when the joints begin to leak at the centre of the bearing, the point farthest away from the bolts, and the tightening of the bolts by the roundhouse mechanics often increases the evil.

It will be readily noted that when the steam pipes are leaking, especially if the escaping steam is blowing toward the flues, the effect on the fire is of the most pernicious kind. A certain number of flues cease to be of any service, the blast of escaping steam being stronger than the draft through the flues, consequently the number of flues affected cease to be operative. This brings a train of evils of which the leaking of the flues seems to be the natural outgrowth. Very often the boilermaker gets the worst of it, as if a leaky flue was proof of poor workmanship, when it is not by any means the case.

The original fitting of the steam pipes is a matter of much inportance in the reliability of the joints during the service. The faces of the joints should be carefully squared to face each other exactly, for while convex rings and concave bearings readily afford some measure of flexible adaptability, the pressure on joints that are not well matched is apt to be unequal, with a tendency to leak at the widest space in the fitting. It will be found that thin rings also have a greater tendency to leak than those that are thicker. In ordinary practice one inch in thickness should be the minimum.

When steam pipe joints have shown a tendency to leak, the earliest opportunity should be taken to refit the joints. With proper tools at hand the operation is not as ponderous as it looks. It is hardly proper to expect a good job to be done while the boiler is still heated. Good fitting requires good physical conditions, and the most skilled workmen are generally very susceptible to extreme climatic changes, but it will be found that a careful refitting of the steam pipes when necessary will in the end be much more conducive to good railway engineering than any number of efforts with a roundhouse wrench.

Co-ordination Without Subordination.

A curious psychological phenomenon is the certainty that many people who are strictly honest and fair in their own personal dealings will be guilty of fraudulent practices on behalf of an employer. This truth became conspicuously apparent in the development of car interchange after railroads had been operating about thirty years. For a short period the movement of freight cars was confined to the owner's lines, where they were cared for, repaired when necessary and distributed as the business required. But the course of development required that cars should be sent to the destination of the goods with which they were loaded and this first gave opportunity for dishonest dealings on the part of people who failed to perceive any iniquity in taking advantage of connecting lines. It did not require much reasoning to understand that the spirit of equity demanded the return of cars to the owners in the same condition they were in when received by a foreign railroad, but many railroad companies adopted the practice of putting no more work upon foreign cars than what was absolutely necessary to enable them to hold together. Other companies acted honestly, the result being that the unscrupulous official cheated connecting lines and frequently rejoiced in his roguery.

As new transportation problems arose it was the duty of the several State legislatures to establish laws for the protection of honest owners of cars, but that never was the way of legislators, State or national. The making of laws relating to railroads has never been suspended, but they have generally taken the form of persecution, the idea of helping railroad companies to carry on their business with profit to themselves was repugnant to the rustic mind. Legislators having failed to meet the growing requirements of transportation by passing needful laws, matters connected with the interchange of freight cars, were drifting into a serious condition when a number of gentlemen connected with the car departments of various railroads met and formulated rules to be observed in the interchange of freight cars. This meeting eventuated in the organization of the Master Car Builders' Association which has performed extraordinarily valuable services to railroads and to the country, in promoting uniformity in car construction and in establishing standard parts.

Organizing and holding in operation the Master Car Builders' Association was one of the greatest self-denying movements ever known in industrial history. A body of busy men held regular meetings for many years, spending their valuable time and in many cases paying their own expenses for the purpose of lessening the cost of car construction or for preventing of or settling disputes that arose in the dealings of one railroad company with another. There has never been any question that the voluntary duties involved have been properly and satisfactorily performed. Yet of late a tendency has been manifested among the higher railroad officials to curtail the privileges of the Master Car Builders' Association and to subordinate its action to the American Railway Association or to some other organization in close touch with the railroad managers. This is a very ungrateful move to say the least. There is no complaint of the Master Car Builders' Association having failed to perform efficiently the duties of promoting uniformity in car construction and in dealing equitably with questions arising in connection with car interchange. The spirit of meddling that has arisen in connection with the voluntary duties performed so satisfactorily by the Master Car Builders' Association is not calculated to promote railroad interests, to say the least. The heads of mechanical departments are now the controlling power in the Master Car Builders' Association and their action ought to be entirely unrestrained. If the higher officials wish to act in co-ordination with those in charge of the car department, well and good, but that ought to be no thought of subordination.

The same spirit ought to be manifested in the dealings of superior officers with the various voluntary organizations formed to promote efficiency in various lines of railroad work without thought of personal gain. The American Railway Master Mechanics' Association has done work scarcely second in importance to that done by the Master Car Builders' Association, and the members ought to be encouraged in pursuing their self-denying labors. Co-ordination of the higher officials is desirable in the case, but no thoughts of subordination.

The same rule ought to apply to all other organizations voluntarily promoted for betterment of different departments, such as the Master Car and Locomotive Painters' Association, the Traveling Engineers' Association, the Air Brake Association, the International Railway General Foremen's Association, the Boilermakers' and the Blacksmiths' Associations. Sometimes such associations have assumed expressions of authority that were injudicious and undesirable, but small mistakes ought not to be held up in disparagement of bodies trying to do their best for their employers, and a safe motto to make conspicuous in dealing with such organizations is Co-ordination without subordination.

Cultivating Mental Growth.

Development of one's own powers, was practically the keynote of an interesting address recently given by. Mr. J. E. Muhlfeld before the New York Railroad Club, on the subject of "The Education and Organization of Railway Engineering Labor." Speaking on this subject he said: In this age of civilization and specialization, that man is in demand who, unique in financial and administrative genius can expand his powers through executive ability to organize and direct large bodies of men, and to evolve and consummate great undertakings or concentrate all his energies upon, and excell in, one profession or trade-learning.

Dealing more particularly with the latter class, he held that the problem of today is not only to develop inanimate mechanical forces, method and materials, many of which may be standardized, but to study, select, train or manage the animate human element, which cannot be standardized, and is the potent and controlling factor in the man-machine unit. The supervision of this unit must be such as will inspire a personal interest and enthusiasm of the animate in the inanimate and stimulate individuality, without which superior intelligence and skill in the subordination and utilization of means would not result.

Coming closer to the subject of development he believed that every man who looks for success should learn to appreciate the immense power of his personal equipment, such as instinct, perception, ingenuity, initiative, determination, self-reliance, prudence, courage, knowledge and experience, and of some particular ability which enables him to accomplish with ease that which it is difficult or impossible for others to do. To expand these faculties, the first requisite is moral strength, which naturally applies that mental and physical vigor, which is the measure for the cultivation of knowledge, capacity and resolution, as only the healthy intellect is capable of receiving and retaining impressions necessary for the execution of ideas and to evolve concentration of thought, freedom of action and personal power. To develop the mind, body and morals of young men during the scholastic period, plenty of open air, pure water and nourishing food in combination with systematic gymnastic, athletic and military recreation are factors which should be correlative with the elementary, technical and engineering teaching.

For all practical purposes, the elementary, technical and engineering education need not exceed a term of twelve years, during which period a certain proportion of the industrial shop apprenticeship time should also have been served and the more advanced schooling proportioned twenty-five per cent. each, technical study and instruction and fifty per cent. engineering practice. With engineering work a clear and concise style of language is of particular importance in the preparation of technical correspondence, reports, specifications, and contracts, as well as in the promulgation of rules, regulations and instructions for the guidance of others, and a command of good speech not only exhibits breeding of social accomplishment but will facilitate administration, avoid unnecessary discussion, reduce the liability for error and lessen the need of lawyers and the courts. Frequent attendance at good lectures and the reading of standard books will result in a greater knowledge of pronunciation and of the distinction in the meaning and use of words as well as to increase the vocabulary.

Clubs and organizations organized for the promoting of knowledge and mental culture through the reading, discussion and circulation of appropriate papers at meetings and conventions are also invaluable in securing an interchange of engineering ideas from men whose professional and practical research and experience may establish a basis for the determination of disputed questions. By means of the liberal and demonstrative training as set forth, the mental and physical powers of ambitious and aspiring young men will be developed and disciplined to effective action, and they will gain the advantage of being able to reason and analyze administrative, financial and commercial questions and withal, the infinite worth of broad knowledge, friendly companionship, moral character, good address and culture.

Young men instructed along such lines, while appreciating the value of schooling, will more particularly esteem that knowledge which enables them to find and make use of the information contained in books rather than to actually absorb their contents. Their minds will be receptive and have the faculties of insight, calculation, arrangement and generalization. They will have the ability to concentrate their force and effort on the task at hand. They will have the courage to maintain their own convictions and to acknowledge when they are wrong.

In this brief and necessarily fragmentary account of Mr. Muhlfeld's admirable paper we can quote or paraphrase only some of the salient passages. Dealing with what may be called investigation he said: The primary reason for engineering research is to establish facts so as to direct and control the forces of nature, for the use and convenience of mankind and the training necessary to master this great branch of science, combined with commercial ability, should develop qualifications for honest and constructive administration. Intelligence and integrity not only inspire confidence, but as a matter of self-preservation enhance competition and compel progress by encouraging rivalry in multiplying and improving methods, processes and mechanisms.

The primary reason for discipline is to

effect improvement in personal conduct and in the service and not as a matter of punishment. The cumulative efficiency and deficiency methods of discipline now in vogue should promote a feeling of greater security and confidence between American labor and capital inasmuch as good service rendered is recognized and rewarded by continued employment and promotion. Therefore, with just methods of administration and negotiation; high average wages; loan, savings, medical, sick, injury pension and death benefits; rest, lunch, toilet, recreation, athletic, education and entertainment facilities; free transportation and other benefits now generally enjoyed by railroad employes, whereby they can spend their time off duty comfortably, pleasurably and profitably at a minimum cost, there is no good reason why the improved moral tone, personal cleanliness, honesty and courtesy, should not promote the lasting friendly, charitable, benevolent and protective relations between the employer and employees so necessary to bring about industrial peace, higher standards and a proper degree of safety, efficiency and economy.

Book Notices

Proceedings of the 39th Annual Convention of the Master Car and Locomotive Painters' Association of the United States and Canada. Published for the Association by Messrs. Twombly, Reading, Mass. 106 pages, 6 ins. by 9 ins. Price $1.00.

The convention of this association held at Atlantic City last September was one of the most important ever held under the auspices of the association, in the number and importance of the papers read and discussed, in the presentation of the results of important tests and in the features as presented in the painting of steel cars and other new work. The value of the publication of the proceedings to all interested is pre-eminently apparent. It would be invidious to select special papers as worthy of special notice when all were of real value and should be carefully perused by those who are interested in the work of this association. Many of our readers are not aware that this association has been so many years in existence. It has kept quietly but persistently on its way, and is doing a great and good work for the railroads. In its special field it has relieved several of the other associations of much detail work, while the annual publication becomes a noteworthy contribution to the mechanical literature of our time.

General Lectures on Electrical Engineering by Prof. C. P. Steinmetz, A. M. Ph. D. Published by Robson and Adee, Schenectady, N. Y. 284 pages. 6 ins. by 9 ins. Cloth, gilt top, illustrated. Price $2.00.

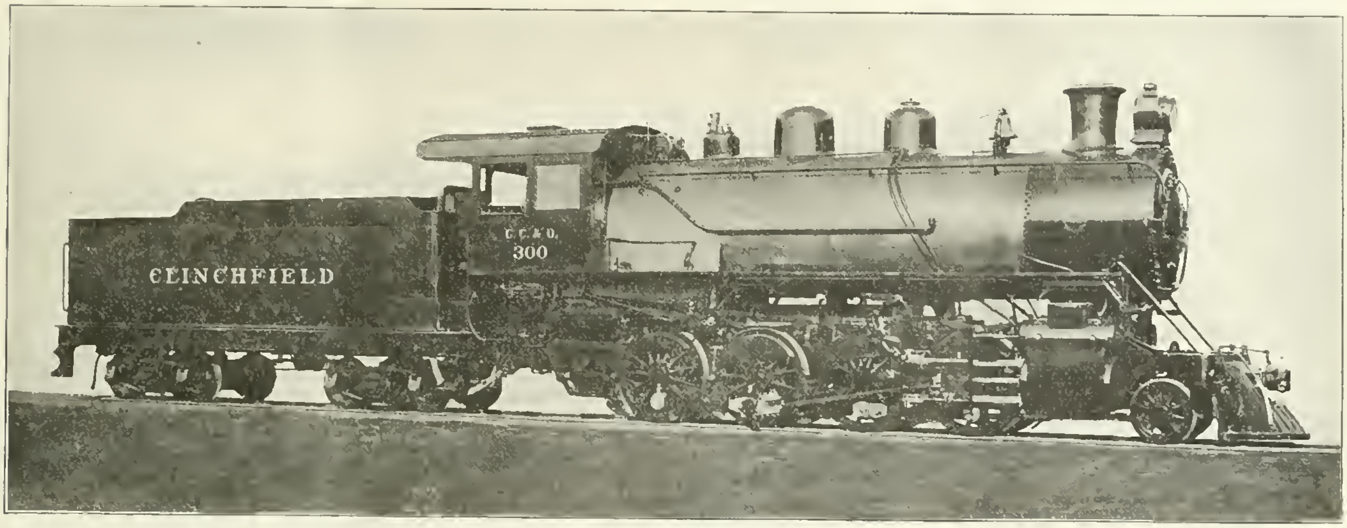
Professor Steinmetz has been long and favorably known as one of the foremost authorities in electric engineering, and the sixteen lectures which are collected and published for the first time in this handsome volume will be found to embrace an elucidation of the problems of generation, control, transmission, distribution and utilization of electric energy. The treatment of the various subjects is essentially descriptive and is adapted to the needs of the beginner as well as to the advanced student. The typography and binding reflect great credit on the publishers and the work is sure to meet with a popular reception from among the large and rapidly expanding body of electric workers.

A very sublime and grand thing is Truth, in its way, though like other sublime and grand things, such as thunderstorms and that, we're not always over and above glad to see it.—*Old Curiosity Shop.*

Carolina, Clinchfield & Ohio Engines.

The Carolina, Clinchfield & Ohio Ry., formerly known as the South and Western, is now being built from Elkhorn, Ky., to Spartansburg, S. C. This road will open up valuable coal fields in Kentucky and Virginia. It traverses a mountainous country, and is notable from an engineering standpoint. The line, throughout, is being built in the most substantial manner. The maximum grade against loaded traffic is only one-half of one per cent., with curves compensated. This gives excellent opportunity for handling heavy tonnage on an economical basis. The road has recently received nineteen locomotives from the Baldwin Locomotive Works. Fifteen of these engines are of the consolidation type for freight service, while the remaining four are of the ten-wheel type, for passenger service. Both designs embody single expansion cylinders, inside admission piston valves and Walschaerts valve gear.

The consolidation type locomotives exert a tractive force of 43,900 lbs., and are an excellent example of modern heavy power. The cylinders are 22 x 32 ins., driving wheels 57 ins. and steam pressure 190 lbs. The engines are designed to traverse 16-deg. curves, and to assist in this the front and back driving tires are given ¼ inch more play between the rails than those on the two middle pairs of wheels. All the tires are flanged. The cylinders are built with heavy walls to insure ample strength and are lined with cast iron bushings, ⅝ in. thick. The cylinder castings are secured to the smokebox, and to each other by a double row of bolts. The piston valves are 12 ins. in diameter. They have cast iron bodies and cast steel heads, and are fitted with L-shaped packing rings. The steam chest center lines are placed outside



H. F. Stanley, Master Mechanic. 2-8-0 CAROLINA, CLINCHFIELD & OHIO RAILWAY. Baldwin Locomotive Works, Builders.

the cylinder center lines, thus permitting all parts of the motion to be in the same vertical plane. The link and reversing shaft bearings are bolted to the guide yoke, and the gear is so connected that the link blocks are down when running ahead. The valves are set with a maximum travel of 5¾ ins. and a lead of ¼ in. Circulating valves are provided for the steam chests. These valves are of the Pennsylvania Railroad style, with flat plates over the relief ports.

The main frames are of cast steel, 4½ ins. wide. They are finished, on the sides, only where fitting is necessary, and at these points the width is increased. In this way superfluous finish is dispensed with wherever possible. The transverse frame braces include a deep steel casting which is placed between the second and third pairs of driving wheels, and is bolted to both the main and lower frame rails. Advantage is taken of the absence of any inside valve gear, by placing two large air drums between the frames and over the second and third driving axles.

The boiler is of the straight top type with wide firebox. The mud ring is of forged iron, double riveted, and thickened at the corners. It is supported on sliding shoes in front and a buckle plate at the rear. A brick arch, supported on water tubes, is provided. Flexible staybolts are used to a moderate extent, 200 being disposed in the outside rows in the throat, sides and back head. The barrel is built with two rings, and has a welded longitudinal seam under the dome, with a reenforcing liner inside. The diameter of the boiler at the smokebox end is 76¾ ins. The heating surface amounts in all to 3,482 sq. ft. This is made up of 182 sq. ft. in the firebox and 3,272 in the tubes, to which must be added 28 sq. ft. gained by use of water tubes which carry the brick arch. The grate area is 54 sq. ft., which gives a ratio between grate and total heating surface of very nearly as 1 is to 64½. The tubes in this 2-8-0 engine boiler number 412, each 2 ins. outside diameter and 15 ft. 3 ins. long. They are .11 of an inch thick and are made of steel. The front end is arranged in accordance with the recommendations of the Master Mechanics' Association. It has a single high exhaust nozzle, in front of which is placed an adjustable diaphragm. A perforated plate is used instead of netting. The stack is of cast iron, tapered, with a minimum internal diameter of 21½ ins.

The tender is equipped with a water-bottom tank, and the frame is built of 12-in. channels. The trucks are of the arch bar type, with forged and rolled steel wheels supplied by the Standard Steel Works Co. The tank holds 7,500 gallons of water and 12½ tons of coal.

The ten-wheel passenger locomotives have wagon top boilers with narrow fireboxes, which are placed above the frames. The engines, as built, have driving wheels 63 ins. in diameter, but they are so designed that 69-in. wheels may be substituted if desired. The equipment throughout is generally similar to that of the consolidation engines. As in the case of the freight locomotives, a brick arch is provided, but it is supported on studs which are tapped into the side sheets.

In the design of these two classes special attention has been paid to making the details interchangeable where possible. A minimum number of patterns is thus required, and the problem of effecting repairs is simplified. The principal dimensions of both types are appended for reference.

DIMENSIONS OF 2-8-0 TYPE ENGINE.

Boiler—Thickness of sheets, 11/16 in.; working pressure, 190 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 108 3/16 ins.; width, 71¾ ins.; depth, front, 74½ ins.; depth, back, 65½ ins.; thickness of sheets, sides, ⅜ in.; back, 5/16 in.; crown, ⅜ in.; tube, ½ in.

Water Space—Front, 5 ins.; sides, 4 ins.; back, 4 ins.

Driving Wheels—Outside diameter, 57 ins.; journals, main, 9½ ins. x 13 ins.; journals, others, 9 ins. x 13 ins.

Engine Truck Wheels—Front diameter, 33 ins.; journals, 6½ ins. x 12 ins.

Wheel Base—Driving, 16 ft.; total engine, 24 ft. 6 ins.; total engine and tender, 56 ft. 9½ ins.

Weight—On driving wheels, 178,650 lbs.; on truck, front, 20,500 lbs.; total engine, 199,150 lbs.; total engine and tender, about 350,000 lbs.; service, freight.

DIMENSIONS OF 4-6-0 TYPE.

Cylinder—20 ins. x 26 ins.; valve, balanced Piston.

Boiler—Type, Wagon Top; material, steel; diameter 60 ins.; thickness of sheets, 9/16 ins. and ⅝ ins.; working pressure, 190 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 120 3/16 ins.; width, 40 ins.; depth, front, 73 ins.; depth, back, 62 ins.; thickness of sheets, sides, ⅜ in.; back, 5/16 in.; crown, ⅜ in.; tube, ½ in.

Water Space—Front, 5 ins.; sides, 4 ins.; back, 4 ins.

Tubes—Material, steel; .11 thick; number, 298; diameter, 2 ins.; length, 15 ft. 3 ins.

Heating Surface—Fire-box, 174 sq. ft.; tubes, 2,343 sq. ft.; total, 2,517 sq. ft.; grate area, 33.3 sq. ft.

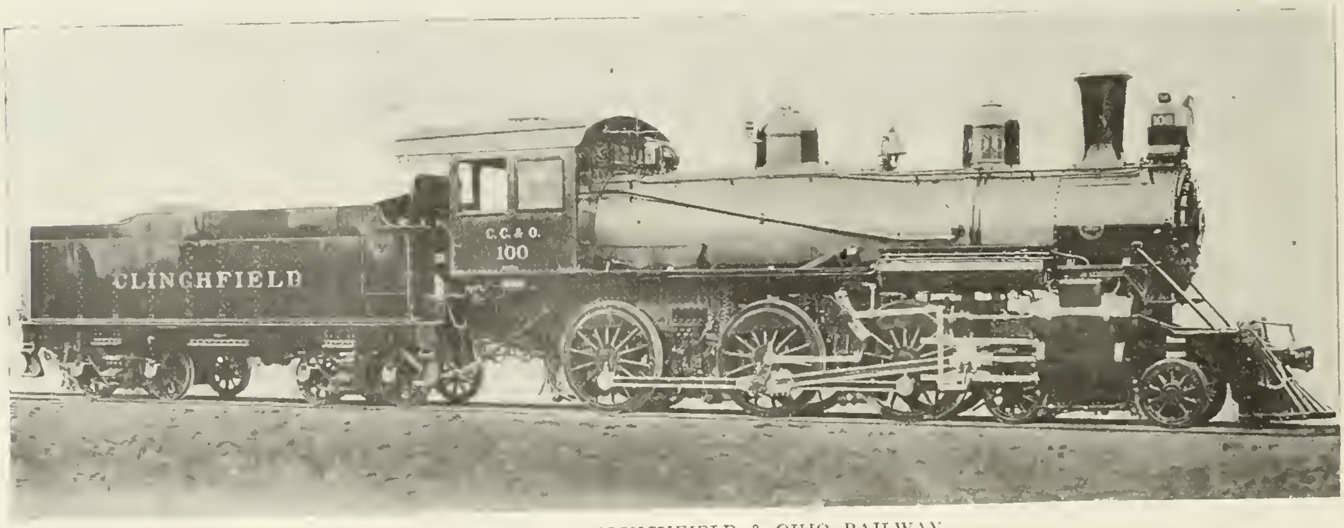
Driving Wheels—Outside diameter, 63 ins.; journals, 9 ins. x 13 ins.

Engine Truck Wheels—Front diameter, 33 ins.; journals, 6½ ins. x 12 ins.

Wheel Base—Driving, 15 ft.; total engine, 26 ft. 5 ins.; total engine and tender, 59 ft. 8¾ ins.

Weight—On driving wheels, 125,300 lbs.; on truck, front, 38,300 lbs.; total engine, 163,600 lbs.; total engine and tender, about 284,000 lbs.

Tender—Wheels, diameter, 36 ins.; journals, 5½ ins. x 10 ins.; tank capacity, water, 6,000 gals.; tank capacity, coal, 12 tons.; service, passenger.



H. F. Stanley, Master Mechanic. 4-6-0 CAROLINA, CLINCHFIELD & OHIO RAILWAY. Baldwin Locomotive Works, Builders.

Vibratory.

A traveler in a dining-car of a Georgia railway had ordered fried eggs for breakfast.

"Can't give you fried eggs, boss," the negro waiter informed him, "lessen yo' want to wait till we stops."

"Why, how is that?"

"Well, de cook he says de road's so rough dat ebery time he tries to fry aigs dey scrambles."—*S. S. Messenger.*

There is nothing we may not hope to repair; it is never too late to mend.—*Dombey & Son.*

Applied Science Department

Elements of Physical Science.

Second Series.

VI. The Steam Engine.

Apart from the many varieties of form in which steam engines are made, there are two general divisions into which they may be classified those of the condensing and non-condensing engines. The locomotive and nearly all the factory engines are of the non-condensing type. In this class the steam after it has done its work in moving the piston, is exhausted into the open air. An engine of this kind is readily discerned by the puffing sound of

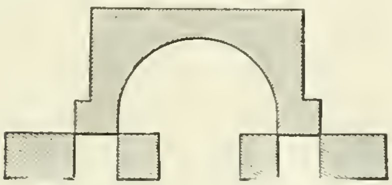


FIG. 1. SLIDE VALVE WITHOUT LAP.

the exhausted steam, each re-percussion indicating the completion of the piston stroke, and sudden release of the pent-up steam, which it may be observed has still much more than sufficient force left in it to overcome the pressure of the atmosphere. In a condensing engine the steam after passing through the cylinder is admitted into a box or receptable called a condenser on account of its being cooled by contact with water or with pipes through which cold water is passing. The condensation of the exhausted steam has the effect of producing a partial vacuum in the condenser, which permits the steam being used until it has reached a lower pressure than in a non-condensing engine. Marine engines are mostly of this type, as a constant supply of cold water can readily be obtained.

It will be remembered that the atmospheric engine previous to James Watt's invention of the steam engine, was operated by the admission of steam into a vertical cylinder, while the piston was at the upper end of the stroke and when a jet of cold water was admitted into the cylinder, the steam was condensed, thereby producing a vacuum and the weight of the atmosphere acting on the uncovered upper face of the piston was sufficient to press down the piston. Watt conceived the idea of condensing the steam in a separate vessel, thereby effecting a great saving, and also made the important advance in applying steam alternately to both sides of the piston, thereby creating or inventing an entirely different engine from that of Newcomen.

The rapid condensation of steam into water renders suitable openings into all steam cylinders a necessity. These openings, or cylinder cocks, as they are called, are usually operated by a hand lever which is placed in the open position when starting the engine. This should be carefully attended to, as water unavoidably gathers in the cylinders while engines are not running, that is if a pressure of steam is in the boiler.

The most important openings into the cylinder, however, are the ports by which the steam is admitted and that by which it escapes after its work is accomplished. This leads us to the slide valve, the most common form of valve used in steam engines, and although simple in construction it is a most ingenious contrivance for admitting and cutting off the supply of steam at the desired instant of time. The cylinder is so constructed as to form a flat portion on a part of its outer surface on which there are three rectangular openings, the middle being the exhaust port, is wider than the other two, and leads directly from the cylinder face to an opening on which the exhaust pipe may be bolted. The two other ports are the steam ports, one leading to one end of the cylinder and the other to the other end. The slide valve is so constructed as to cover these three openings and is shaped like a hollow rectangular dish with an inner cavity, the edges of the dish forming the face of the valve. This face is carefully fitted so that when the valve is placed in position it forms, in conjunction with the surface of the cylinder, a steam-tight joint. It may be added that in the early days of the steam engine much care was taken in fitting the valve face and valve seat together so that every part of the metals were bearing equally on each other. It was latterly found that the friction incident to the movement of the valve very quickly caused the valve to adjust itself to the valve seat so that a fine bearing at the start is not essential, the bearing being perfected in the course of a few hours' service.

The slide valve, when in the central position, covers the two steam ports and leaves the middle port open in the inner cavity of the valve. If the valve was so constructed as to cover the two steam ports exactly it can be readily perceived that a movement of the valve in either direction would open one of the steam ports leading to the cylinder and open the other steam port to the inner cavity of the valve, thereby opening the communication to the exhaust pipe. A valve so constructed would admit steam during the entire length of the piston stroke, so that when the piston stroke was completed the steam in the cylinder would be at or near boiler pressure and when released by the opening of the exhaust port, as already alluded to, the loss of steam at each stroke would be equal to the full capacity of the cylinder and steam spaces. In its primitive form the slide valve was constructed in this way and was used on some of the earlier engines of James Watt. Fig. 1 shows such a valve in the central position.

This form of valve had several serious objections. The smallest degree of lost motion had the effect of admitting the steam in a sufficient quantity to obstruct the piston at the end of the stroke. The tendency to create severe pounding was very great. The most important drawback was in the fact, already alluded to, that the steam was released while at full pressure, and no advantage could be taken of the expansive power of steam. During Watt's lifetime the pressure of steam as applied to steam engines was extremely low, so that the loss was not so very great as it became when, with the improvement in boiler construction, higher pressures of steam became available. In the early days of the locomotive fifty pounds pressure of steam per square inch did not admit of much advantage being taken of the expansion of steam in the cylinder. The change of the form of the slide valve was very simple, but very important. It consisted merely of lengthening the valve face, so that when the valve stood in the center of the seat the edges of the valve extended a certain distance over the steam ports, as shown in Fig. 2.

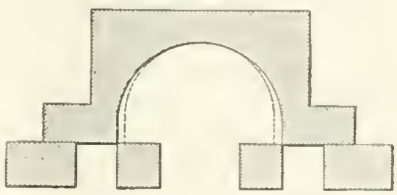


FIG. 2. VALVE WITH OUTSIDE LAP.

This extension of the valve faces is called outside lap, or simply lap. It has the effect of closing the steam port at a certain distance before the piston reaches the end of the stroke, and this point, which with the variations incident to the action of the radial link is a variable point, usually called the point of cut off. It can be readily understood that when the supply of steam is cut off from the boiler before the piston stroke is completed, the piston is moved on its further course by the expansive power of steam, and when the stroke is completed the steam in the cylinder having increased in volume is correspondingly reduced in pressure and when released the loss is not great, as the pressure of the steam is not greatly in excess of the pressure of the atmosphere.

Celebrated Steam Engineers.

XVI. MATTHIAS W. BALDWIN.

The introduction of the locomotive engine into American industrial life called into prominence many clever engineers. While the Stephensons had literally control of the new industry in Europe, many claimants for recognition appeared in America. Almost every machine shop on the Atlantic coast produced something new and strange in the name of a locomotive. In Dr. Angus Sinclair's "Development of the Locomotive Engine" there is described and illustrated an extensive collection of these mechanical curiosities, some of them fearfully and wonderfully made, but all of them illustrative of that mercurial inventive faculty begotten in the free air of American enterprise. As usual the unexpected happened and the master minds destined to improve and leave their mark on the new machine came from the most unlooked for quarters.

Matthias W. Baldwin, a colossal bronze statue of whom now majestically adorns a public square in the city of Philadelphia, was a working jeweller who early gave his attention to the improvement of the locomotive engine, and who may properly be said to have established the American type of locomotive. Beginning with the production of a museum curiosity the exact mechanism and design of which attracted much attention, he was soon engaged by railway promoters in constructing something more important than miniature locomotives.

In 1832 Mr. Baldwin's first locomotive was tried on the Philadelphia, Germantown and Norristown Railroad. It was named "Old Ironsides." It was a complete departure from the British type of locomotive. The driving wheels were in front of the firebox and the carrying wheels immediately behind the smokebox. The drivers were 54 ins. in diameter, and the front wheels 45 ins. The boiler was 30 ins. in diameter and contained 72 flues, made of copper. The flues were 1½ ins. in diameter and 7 ft. in length. The locomotive weighed about 6 tons and while its tractive capacity was not great it created a new record in transportation which has not been greatly surpassed. It ran a mile in 58 seconds or over 62 miles an hour.

The next important venture in locomotive construction was the "E. L. Miller," which appeared in 1834. This locomotive weighed about 9 tons. It had outside frames and a single pair of drivers behind the horizontal boiler and a swivelling four-wheel truck under the smokebox. The cylinders were bolted on the top of the frames at the sides of the smokebox, and the power was transmitted to half-cranks inside the driving wheels. It immediately became the most famous locomotive in America. It ran on the South Carolina Railroad which was at that time the largest railroad in existence. The locomotive was not only the best constructed, but it was the simplest and most durable locomotive engine in use up to that time, and it may be said to have laid the foundation of the Baldwin Locomotive Works.

Of equal importance with the improvement of the design and construction of the locomotive, the introduction of new machinery engaged in the work of constructing the locomotive marked the beginning of that rapid advance in machine tools, which has since kept American machines in the forefront of

SCENE ON THE BERGEN RAILWAY IN NORWAY.

the world's manufactures. Mr. Baldwin resembled James Watt in many particulars, especially as an exact mechanician. Both were singularly gifted with the inventive faculty and both were accomplished mechanics. Both aimed at simplicity in design, and in this latter regard Mr. Baldwin was particularly successful. In the important feature of boiler making, Mr. Baldwin's boilers were so simple that any one could understand them and any boilermaker could easily repair them. The valve motion as perfected by him was not shrouded in mystery. There was a single fixed eccentric for each cylinder. The eccentric strap had two arms attached to it, one above and the other below. There was a hook on the inner side of each. The rocking shaft had arms above and below its axis, and the hooks of the two rods of each eccentric were moved by hand levers so as to engage either arm, thus producing forward or backward motion. This form of valve gearing was used for a number of years previous to the introduction of the radial link.

Of Mr. Baldwin's many marked improvements mention may be made of his use of cast iron wheels with wooden felloes between the spokes and outer rim, making the wheels slightly elastic. The great weight of the modern locomotive has rendered the use of this combination impossible, but it served a good purpose in the early days of locomotive engineering. The introduction of ground pipe joints with adjustable rings, the use of copper ferrules on the outside of the ends of flues, with the result that steam could be raised, and kept at a pressure unprecedented in British locomotive practice and without the constant appearance of leaky flues, were some of Mr. Baldwin's improvements. To these may be added the use of metallic packing, the placing of springs over the truck and engine wheels, the use of spiral springs, the invention of detachable grates, the construction of solid frames with pedestals attached, and latterly the substitution of steel in place of iron in nearly every part of the locomotive. Variable exhaust nozzles and spark arresters began with Mr. Baldwin, and indeed there is scarcely a part of the twentieth century locomotive that does not show some mark of his master hand.

He lived to see one of the largest and most perfectly equipped industrial establishments that ever blossomed into being by the intelligent enterprise of one man, and it is gratifying to know that those who have succeeded to the noble heritage have worthily maintained the high reputation which has always characterized the Baldwin Locomotive Works of Philadelphia.

Questions Answered

TROUBLE WITH E. T. EQUIPMENT.

9. B. S., Whitefish, Mont., asks: What is the trouble with the E. T. equipment if the brake sets on the whole train when the independent brake is used? Weather was very cold and independent brake worked O. K. up to this time?—A. At a time when there is no excess pressure in the main reservoir or if the main reservoir is full of water, or if the air cylinder of the pump is in a poor condition, excessive brake cylinder leakage on the engine or tender is liable to reduce main reservoir pressure below the pressure in the brake pipe when the independent brake is applied. If it does, the brake pipe pressure would be reduced by flowing back into the main reservoir and the brakes on the train would be applied. In your case it was quite likely that there was considerable brake pipe leakage, owing to the hose being frozen stiff, and this, together with brake cylinder leakage, exceeded the capacity of

the air pump when the independent brake was applied. The brake cylinder leakage may have been due to a frozen packing leather in the tender brake cylinder which would allow air to escape from the cylinder as fast as it could enter. There should be a choked fitting in the brake cylinder pipes on the engine next to the hose connection between the engine and tender, and one next to the hose connection to the engine truck brake cylinder if one is used.

PUSHING OR PULLING.

10. C. A. R., El Paso, Texas, asks: Can an engine pull as much as it can push?—A. We have had several articles on this subject before now, but for the information of those who are not up in the subject we may say that an engine can more easily pull a given load than it can push it over the same piece of level, straight track. The reason is that running forward there is less tendency for the driving wheels to slip, as the pull and push of the main rod is more or less downward on the wheels. The reaction caused by this, as you know, puts the pressure of the crosshead on the top guide bars. There is, however, another reason why pulling is easier than pushing. A train is made up of separate cars like links in a chain, and when pushed the couplings do not always transmit the push along the exact centre line, and the trucks have more of a tendency to slew. It is something like the pushing or pulling of a chain along a groove. The chain pulls readily enough but shows a tendency to buckle or kink when pushed even in a well lubricated groove.

AUTOMATIC AND NON-AUTOMATIC PARTS.

11. M. W., Cleveland, O., asks: What parts of the air brake and signal system are automatic, and what parts are not?—A. By automatic you no doubt mean the parts moved by air or steam pressures and by non-automatic you probably mean the movable parts operated by some other piece of mechanism or by hand. The pump throttle, brake valve handles, angle cocks, stop cocks, release valves, conductors' valves, car discharge valves, and the regulating or adjusting parts of the apparatus are of course operated by hand and are non-automatic. Beginning with the air pump, the automatic parts are the differential piston, the steam piston and the air valves. The air piston, piston rod, reversing valve and rod and slide valve being operated by the movement of the steam pistons. In the pump governor the diaphragms and governor piston are automatic, the steam valve being moved by the governor piston, and the pin valve by the diaphragms are non-automatic. Of the brake valve, the equalizing piston is automatic, the rotary valves and rotary keys being moved by the brake valve handles. The tubes of the air guage are moved by air pressure, the hands of the gauge are moved by the tubes. Of the triple valve, the triple piston, emergency piston and check valve are automatic, the graduating valve, slide valve and graduating stem being moved by the triple piston and the emergency valve being unseated by the emergency piston. A cut of the high-speed reducing valve and distributing valve compared with the above will show you what parts are operated by a change of air pressures and what parts depend upon the movement of other parts. In the quick action cap of a distributing valve the check valve is automatic, the slide valve is displaced by the equalizing valve piston. The piston valve of the safety valve is unseated by air pressure, the stem is moved by the piston. The movement of the brake cylinder piston is automatic. The piston of a slack adjuster operates automatically, the pawl and ratchet operate mechanically. Of the signal reducing valve or feed valve the movement of the supply valve piston and diaphragms are automatic, the supply valve is moved by the piston and the regulating valve and diaphragm spindle by the diaphragms. In the signal valve the diaphragm is moved by air pressure, the diaphragm stem by the action of the diaphragm.

BY-PASS VALVES BLOWING.

12. G. C. M., Pueblo, Colo., asks: Will the by-pass or over-pass valves on each end of the valve chambers of a heavy freight engine, bought within the past year, blow to the exhaust? Experts who do not run engines say they will not. Fellows who are not experts, but who must pull tonnage with as much steam blowing through stack as goes out of cylinders, think they do. If they do blow, please tell us how to test for the blows.—A. By-pass valves open communication between the cylinder steam ports so that excess pressure at one end can escape by the other, one port being always in communication with the exhaust port. These valves are closed when live steam pressure is in the steam chest, by that pressure, consequently no steam can escape so long as the by-pass valves remain in good order. However these valves usually get out of order very quickly and are very much neglected as a rule, so that there is generally a great loss of steam. A plug hole in the casing or space between these valves is the best method of ascertaining their condition quickly.

TO HARDEN DRILLS.

13. R. W. S., Scranton, Pa., writes: Some of the special steel used nowadays is sometimes so hard that an ordinary hardened drill makes little impression upon it. Can you tell of anything to help the drill?—A. Heat the drill to cherry red and temper by driving the point into a bar of lead. If that treatment does not make it cut nothing will.

QUALITIES OF VARIOUS GEARS.

14. B. M., Chicago, Ill., writes: We have some engines that have Walschaerts valve motion and all the rest have link motion. A common subject of dispute among the boys is, Which style of motion is most economical in the use of steam? We had a meeting this morning where the subject was discussed at great length and decided to leave the verdict to you. What do you say?—A. From the examination of a great many indicator diagrams of valve motion engines and of Walschaerts motion engines we believe there is no difference between the two. It is like examining the diagrams taken from two valve motion engines of the same general dimensions. One would show a little better steam distribution than the other, but the cause of the difference could not easily be identified. The most valuable feature about the Walschaerts valve motion, is that the lead is constant and people cannot spoil the steam distribution by altering the lead.

ACTION OF VARIOUS VALVE GEARS.

15. A. H., Wheeling, W. Va., asks: How can the Joy, Walschaerts or Baker-Pilliod valve gears affect the steam distribution more that the Stephenson gear, when using the same style or kind of, and only one valve?—A. The direction and speed of movement, as well as the time of movement of a valve with respect to the movement of the piston is its most important function, or else the same valves could not make an engine go both backward or forward. The Joy, Walschaerts and the Baker-Pilliod gears give constant lead, while the Stephenson gives an increasing lead. The Joy and Walschaerts, in most designs, open and close the valve slightly more rapidly than the Stephenson, dwelling somewhat longer on the full open position. The Baker-Pilliod is claimed to have these features in a more pronounced degree.

TEST FOR BLOWS.

16. C. A. R., El Paso, Texas, asks: Can an engine be placed in one position so as to test both sides for piston packing and valve blows, without moving, and how, and in what position?—A. If the engine had been out of the shop for a considerable length of time and had cylinder and valves badly worn you could not make a satisfactory test of both sides in one position for the reason that cylinder wear is usually greater at the ends, and generally greatest at the front end, therefore the packing should be tested with piston in position in which you expect to get the worst blow. If the engine was new out of the shop and cylinders not worn at all you might be able to make a test for both sides in same position, say right side or lower forward eighth and left or upper

forward eighth. Slide valves wear most in the center of their travel, and they should be placed at center and at either end of travel in order to ascertain where blow was greatest.

GREASE LUBRICATION ON LINKLESS GEARS.

17. A. H., Wheeling, W. Va., asks: Can grease lubrication be successfully used on the linkless types of gear?—A. Grease lubrication does not work well on pins that have only partial rotation, or on reciprocating surfaces.

FRONT END CLINKERS.

18. J. B., Peoria, Ill., writes: I am running engine with self-cleaning front end: one end of the lower moveable apron or deflector plate got loose and fell down. The front end got filled up, and when I opened the door in front end the sparks were clinkered so hard we could not get them out with a shovel, but had to get a steel bar to dig a hole and poke them out. The clinkers were red, about the color of brick. What was the cause of sparks clinkering?—A. It is probable that the coal you were using contained a certain amount of alumina and silica, and a trace of iron. The presence of a small quantity of iron would account for the color, and the other two substances in the required quantities heated in the closed smoke box with an insufficient supply of oxygen would cause them to fuse sufficiently to produce a clinker. In the firebox the coal burns presumably with sufficient oxygen and the coal is constantly broken up and stirred there. The conditions, under the circumstances you state, were favorable to the production of the front end clinker and the cinders contained the necessary ingredients.

CALCULATING STEAM USED IN CYLINDERS.

19. Apprentice, Buffalo, N. Y., writes: In reading engineering publications I have noticed remarks about measuring the amount of steam used per stroke. Could you give me any help in learning how to make calculations of that kind?—A. Study the section called Steam and Motive Power, in *Twentieth Century Locomotives*.

JOY GEAR WITHOUT A LINK.

20. A. H., Wheeling, W. Va., writes: In a number of the B. L. F. & E. Magazine, 1908, Mr. W. W. Wood says the Joy gear can be made without a link, and do the same work. Can this be done?—A. Yes, the curved slot of the Joy gear can be equalled by a radius link as a guide, but it is much more complicated in construction. The Baker-Pilliod does it (see radius link F H, Fig. 2, p. 85, RAILWAY AND LOCOMOTIVE ENGINEERING for February). This link swings on point H, and point H is shifted by the reversing lever.

Perhaps it's a good thing to have an unsound hobby ridden hard, for it is sooner ridden to death.—*David Copperfield*.

Turn Tables Electrically Turned.

Nearly every railroad man is familiar with the unhappy conditions which often prevail at a round house where a heavy engine on a turntable is slowly and laboriously turned by a couple of squads of men pushing hard at the handles of the table. The table goes round slowly, and, when set for the proper track, the extra men who have been hurriedly pressed into the service, go off to their own work with exasperating slowness. Loss of time prevails all through the performance, to say nothing of the cost of it all.

It has long been known that for doing work of a purely laborious sort, that is,

SCENE ON MOTOR-DRIVEN TABLE.

requiring merely strength, such as the turning of an engine on the table, the human animal is a very inefficient piece of apparatus when compared with a mechanical power-producer such as an electric motor. Man is inefficient in point of size, weight and cost of operation. Nevertheless, it has long been the almost universal custom to operate turntables and transfer tables on steam railroads by man power. A striking example of the economy and convenience which results from the use of electric power for this kind of work is shown by the installation of a motor on a turntable on one of the railroads in New York State.

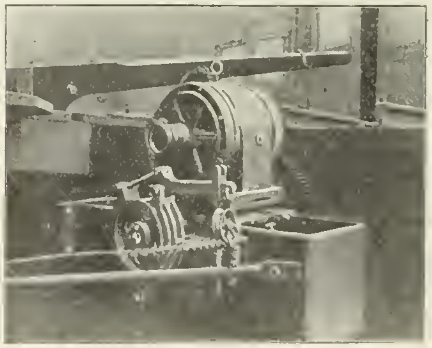
A turntable on this road was formerly operated by hand, requiring the time of a number of men at intervals, which averaged the continuous service of two men for 24 hours a day. A transformation was effected when a hinged projection from the table called a donkey was equipped with a standard Westinghouse induction motor, known as type "F" high torque, rated at 20 h. p., 200 volts, two-phase, 60 cycles. This arrangement reduced the labor required to one man per day of 24 hours.

As the men formerly employed at this work were paid 15 cents an hour in each case, this motor produced a saving of $3.60 a day, or $1,314 per year of 365 days. As the cost of power for the motor averaged $8 a month, or a total of $96 a year, the net saving is $1,218 a year. The total cost of the electrical equipment, including the cost of installing the outfit, was approximately $1,500, which is slightly greater than the actual saving in one year. The success of this installation was so marked that four other turntables have been supplied with electrical equipment by the same railroad, and plans are on foot for similarly equipping several more.

Cash economy is not the only point in favor of the motor-driven table. The work of a turntable is intermittent. It is usually busy for a short time and then at a standstill, especially at terminals, where many locomotives often come in at the same time. The length of time required to turn a locomotive by hand depends largely upon the number of men available to do the turning, but even with the handles full, which condition requires from four to eight men, it is impossible to do the work as rapidly as with the motor. Hence the saving in time at such periods is of great importance. The congestion near the turntable is thus relieved and the movement of traffic is expedited.

The method of supplying power to the table is interesting. A bridge is used with overhead wires, which run to a standard Westinghouse overhead collecting switch. This switch is made with brushes and collector rings so that contact is maintained at all times and in all positions of the turntable. This switch is so arranged that there is no strain on the line wires. The cross arm to which they run does not move with the table, but is stationary while the table revolves.

In the installation of which we write the operator's cab is mounted on the center of the turntable, so that the wires run directly from the overhead bridge to



MOTOR FOR TURNING TABLE.

the cab and to the motor. In many instances the cab is mounted at one end, but instead of being directly on the table, it is mounted on the donkey, or projecting frames, and is over the motor. This is done to overcome the jolting which the operator would experience when a locomotive was run on or off. In many cases, especially in a new installation, the feed wires are run underground in conduits and brought up through the king-pin in the center of the table. The same type of switch mentioned above is placed between the tracks and the connections are made from it in the usual way

Air Brake Department

Conducted by G. W. Kiehm

Broken Air Pipes. H 6 Brake.

Part II.

In release position, the flow of air from the main reservoir to the brake pipe is direct through the H6, H5 or G6 brake valves, but when the handles of the H6 or H5 are moved to running position, the pressure is reduced by the feed valve, and passes through a separate piece of pipe, then through the brake valve into the brake pipe, and it is evident that if either pipe should be broken, the remaining pipe will still be free to conduct reservoir pressure to the brake valve. Should the reservoir pipe of either the H5 or the H6 brake be broken while out on the road, the break can be plugged and a blind gasket placed in the union connection at the brake valve. The train brakes must then be released in running position, and at such times the pump governor will stop the pump for a few seconds if the reduction has been a heavy one. When the main reservoir pressure has reduced until it is nearly equal to the pressure in the brake pipe, or feed-valve pipe, the diaphragm valve of the governor will be seated, and the pump will start. If a slight leak exists at the union connection, or at the rotary key gasket, it may result in an occasional flash of air at the emergency exhaust post of the brake valve, due to the rotary valve being forced from its seat, but the pressures will equalize promptly and seat the value without affecting the operation of the brake.

If the feed-valve pipe should be broken, unscrewing the adjusting nut of the feed valve will stop the escape of main reservoir pressure. The other end of the break must then be plugged and the lower connection to the excess pressure head of the governor must be blanked to prevent the governor from stopping the pump, as the pressure used to assist the adjusting spring to hold the diaphragm valve to its seat is taken from the feed-valve pipe. The high pressure governor top can then be adjusted for the desired number of pounds brake-pipe pressure. The handle being carried in release position will permit no excess pressure in the main reservoir.

From this it will be observed that if at any time the excess pressure governor pipe should be broken, it would be necessary to plug the lower connection as well to prevent the action just referred to.

A peculiarity of this governor is, that if the feed valve does not constantly maintain a predetermined pressure in the brake pipe, and above the diaphragms of the governor, the main reservoir pressure is likely to unseat the diaphragm valve, and stop the pump. The feed valve may maintain the pressure on the engine alone, but if coupled to a train with the brake-valve handle in running position, the governor will stop the pump until the reservoir pressure has nearly equalized with the brake pipe, or it might be said that pump will stop until the brake-valve handle is placed in release position, the proper place for releasing the brake, and charging a train. This action of the governor has been criticised, and no doubt some time has been spent working on the governor, and sometimes the air pump, because of this action, which, when understood, calls attention to the fact that the manipulation of the brake valve is faulty; and by stopping the pump for a short space of time, if the feed valve does not open and supply the brake-pipe leakage promptly, it calls the engineer's attention to the erratic action of the feed valve.

This feature should be considered desirable instead of being the subject for criticism.

If the lower connection to the excess pressure governor top is broken off at the governor, or the brake valve, the high-pressure governor pipe, which is connected directly with the main reservoir, can be connected to the excess-pressure top, and the proper amount of excess pressure will be maintained in all positions of the brake-valve handle, the broken pipe must be plugged, and there will be no high main reservoir accumulated when the valve handle is on lap, or in the application positions.

If the high-pressure governor pipe is broken off, and the leak stopped, it might be necessary to throttle the pump if the brake-valve handle is allowed to remain on lap an unusual length of time.

It is not necessary for the brake-valve handle to be on lap position for any considerable length of time, unless possibly in heavy grade work with freight trains, and the pump is then usually taxed to its utmost capacity, and there is very little danger of accumulating too high a main reservoir pressure.

If this high-pressure governor pipe was broken off on the second engine, when double heading, air in the main reservoir would not be compressed to a greater pressure than that which the excess-pressure governor top is adjusted for, as the hand of the brake valve will be in running position.

However, if the H5 equipment was on the engine, the brake-valve handle would be on lap position, and if there are a few minutes time to spare, and, if the union connections in the pipes at the feed-valve pipe and at the brake valve are the same, the pipe connecting the feed valve with the governor can be connected to the fitting at the brake valve, and the pipe leading from the brake valve to the governor can be connected to the feed-valve pipe then by plugging the broken pipe, and connecting the lower pipe of the excess-pressure top to the high-pressure top, the governor will stop the pump if the governor is adjusted to a figure slightly less than that maintained by the feed valve, or if the tension on the regulating spring of the feed valve is increased to regulate the pressure at a figure beyond that for which the governor is adjusted. It is merely a matter of using the pipe which connects the brake valve and governor to connect the feed-valve pipe with the high-pressure governor, plugging the break, and setting the governor.

The excess-pressure governor top is intended to control the pump in the first three positions of the brake valve and with the H5 brake it was noticed that at times the excess pressure top would operate in running and driver brake holding positions, and in train brake release position the high pressure top would stop the pump.

This was due to leakage into the feed-valve pipe, which increased the pressure beyond the figure for which the feed valve was adjusted, for in this position of the brake valve the feed valve maintains the pressure in the short feed-valve pipe only, and the leakage was usually found to be from the supply or regulating valves of the feed valve. This disorder, although not serious, has been corrected in the H6 equipment, by taking the air discharged through the brake valve warning port, from the feed valve pipe, the amount of which is more than the permissible leakage through the feed valve

If the reducing valve pipe should be broken, slackening off the adjusting nut of the reducing valve would stop the reservoir leak and at the same time cut off the pressure for the signal whistle and the independent brake; a blind joint could then be made in the union connection at the reducing valve. With either equipment pressure from the application cylinder or the application chamber, as the case may be, is free to pass to the under surface of the rotary valve of the independent brake valve, and with the handle in running position the valve is likely to be forced off its seat occasionally, when the automatic brake is applied, which will result in the escape of air at the independent brake-valve exhaust port.

This action can be avoided by placing the independent valve handle in quick application position before applying the automatic brake and when the brake is applied application cylinder pressure will flow through the rotary valve and to its upper surface also and after the train brake is released and the automatic brake valve brought to running position, the handle of the independent brake can be brought to running position, which will release the engine brake.

The independent brake is intended to apply the brake on the engine and tender only, and when the brake on the entire train is applied by the use of the independent brake valve it must be due to an equalization of main reservoir and brake-pipe pressures, insufficient main reservoir volume or excess pressure. Excessive brake-cylinder leakage or a reduced capacity of the air pump are doubtless important factors in bringing about this equalization of pressure and the reduction of brake pipe pressure.

If the brake pipe was broken off at the brake valve while out on the road it could be overcome and the train brought to the terminal with the brake pipe charged, and the train brakes could be applied and released, but the driver brake would be cut out.

It has been explained some time ago how the H5 brake can be operated under such circumstances, and the H6 brake can be operated in a smilar manner, provided that the standard connections are used between the engine and tender. As the brake-pipe is broken the automatic brake valve handle will be placed on lap position to prevent the loss of main reservoir pressure, and the driver brake will be released with the independent brake valve. The brake-pipe leak can then be stopped by closing the brake-valve cut-out cock and the hose on the brake cylinder pipe at the rear of the engine can be coupled to the brake-pipe hose at the front of the tender by hammering the hose couplings together. The stop cocks in the driver brake-cylinder pipes can then be closed and the adjusting nut of the safety valve of the distributing valve screwed down to prevent it from popping when the reducing valve is adjusted for the brake-pipe pressure desired, which will be done when the handle of the independent brake valve is placed in quick application position. As the pressure is increased in the application cylinder a like amount of main reservoir pressure, provided the volume is sufficient, will pass the application valve into the brake-cylinder pipes on the engine and to the brake pipe on the tender and train, releasing the brake and recharging the auxiliaries. The stop cock in the signal pipe at the rear of the tender should be closed.

When the independent brake-valve handle is placed in release position, the pressure will be exhausted from the application cylinder and brake-pipe pressure will force the application piston to release position, exhaust brake-pipe pressure and apply the train brake.

The brake hose, and signal hose, which are standard connections for brake-cylinder pipes between the engine and tender, can be coupled by driving the hose couplings together, but are likely to be sprung in the couplings, and should be gauged before again being put in service after being used in this manner.

If the brake pipe was broken below the cut-out cock the break could be used in the same manner, but the brake would be plugged; it could be used in this manner if both the reservoir and feed-valve pipe were broken off or if the brake valve was broken or in any way disabled so that it could not be operated, it would only be necessary to stop the flow of air between the main reservoir and brake valve, and close the stop cock under the brake valve. With no air pressure on the brake valve the excess pressure top of the governor could not interfere with the work of the air pump, and the reducing valve would in all cases govern the brake-pipe pressure, and it would not matter whether the equalizing cylinder cap of the distributing valve was of the plain or quick-action pattern.

Cleaning and Repairing Triples.

The recommendations of the Air Brake Association are not the opinions of an individual but rather the opinions of a large number of air brake men, including the experts of both the Westinghouse and New York Air Brake Companies as well as the experts of all the large railroad systems in the United States and Canada.

It is needless to say that every air brake man in the country should be familiar with the recommendations of the Association and carry them out as far as lies in his power, and in doing so he can rest assured that he is making no mistake. The following concerning the cleaning and the repairing of triple valves is taken from the Association's Recommended Practice.

(1) The triple valve to be removed from the car for cleaning in the shop and should be replaced by one in good condition.

(2) It must be dismantled, and all the internal parts, except those with rubber seats or gaskets, immersed in kerosene oil to soften the accumulated oil and grease.

(3) No hard metal to be used to remove gum or dirt, or to loosen the piston packing ring in its groove, as the almost inevitable result will be damage to some vital part of the triple.

(4) Particular pains to be taken in cleaning the feed groove, not to enlarge it.

(5) Cloth, or better still, chamois skin, to be used rather than waste, as the latter invariably leaves lint on the parts on which it has been used.

(6) Particular attention to be given to the triple piston packing-ring. It should fit its groove in the piston snugly and without binding and have a full accurate bearing on the triple piston cylinder.

(7) The slide valve triple piston packing-ring and bushing should be lubricated with a small amount of good triple valve lubricant, but the emergency piston, valve and check valve should not be lubricated.

(8) Should the triple piston cylinder-bushing or slide valve bushing require renewing, it is recommended that such work be done by the manufacturers.

(9) The cylinder cap gasket and check valve case gasket to be carefully examined and cleaned by using a cloth, but should not be scraped with a sharp tool. All gaskets, hard or cracked, must not be used.

(10) Before assembling the parts after cleaning the castings and body of the triple valve should be thoroughly blown out with compressed air.

(11) When applying the triple valve on the auxiliary reservoir the gasket should be placed on the triple valve, not the reservoir.

(12) Standard gaskets as furnished by the manufacturers should be used. Home-made gaskets should be avoided, as the irregular thickness results in leakage and the bending of the triple pistons.

(13) All triple valves after being cleaned or repaired must be tested on standard rack and pass the prescribed test before being placed in service.

(14) Freight car brake cylinders and triple valves should be cleaned at periods not to exceed twelve months apart.

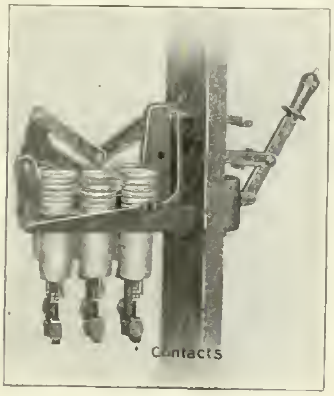
(15) When cleaning freight car brakes the drain cup strainer and branch pipe strainer should be thoroughly cleaned out. Before the branch pipe is connected to the triple valve, the main brake pipe and branch pipe should be thoroughly blown out.

Electrical Department

Oil Switches and Oil Circuit Breakers.

Wm. B. Kouwenhoven.

The growth of large power stations and the application of high voltages to transmission lines called for the design of a special form of switching apparatus that would satisfactorily and conveniently handle large currents at high voltages. It must be remembered that an electrical circuit is not opened until the spark or arc as it is called, that was formed upon pulling the switch or circuit breaker, has gone out. The opening of an electrical circuit may be compared to the opening of a door that is locked. The key must first be turned and then the door opened. In an electrical circuit the switch or circuit breaker must be first pulled or tripped out, but the circuit is not actually broken until the arc has completely disappeared. The arc usually goes out from the simple inability of the voltage to maintain it. The simple act of pulling a switch will not open an electrical circuit if the voltage be high enough to continue the arc across the gap formed by opening the switch.



HAND OPERATED OIL SWITCH.

Fuses and the simplest knife switches were able to easily handle the low voltage and the small amounts of power that were used on the earliest electric systems. As the voltage and the current increased fuses were found inadequate and circuit breaker and heavier switches were built. When high voltages were first applied to transmission lines and heavy currents came into use, circuit breakers with arms several feet in length were employed to handle them. These long swinging arms were provided with carbon contacts or breaks as they are known, between which the arc took place. On opening the circuit a very long arc was produced in the open air between these contacts. This arc broke simply from the fact that the voltage could not maintain it over such a great distance. The long arc in the open air was very objectionable, and made it impossible to place any other apparatus in close proximity. These switches were very cumbersome and occupied much valuable space.

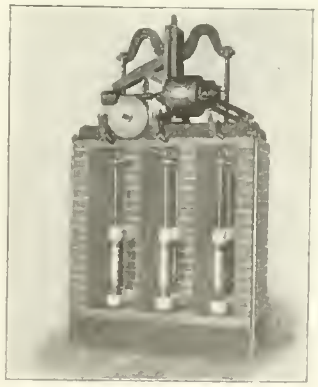
The problem of handling high voltages and currents by means of a compact device was solved by the oil switch and the oil circuit breaker. An ordinary knife switch, if provided with a suitable handle and placed under oil becomes an oil switch. Upon the opening of the switch the oil smothers out the arc. Oil is a very much better insulation than air, and its action in smothering the arc may be compared to the throwing of water upon a fire. The water cools the flames and keeps away the oxygen of the air. The oil in much the same way cools the arc and excludes the air. The good qualities of oil both as an insulator and as an arc-suppressing medium make the oil switch a very compact device when the enormous voltages and currents that it is capable of handling are considered. The properties of a good oil for use in an oil switch or an oil circuit-breaker are as follows: High break down voltage, high flashing point, high burning point, small evaporation, freedom from sediment, and moisture.

As was stated in the February issue of Railway and Locomotive Engineering, a circuit breaker is held closed by a trigger and in case of an over load or a short circuit taking place, the trigger automatically releases the arm which is opened by a spring or by some other means. A switch, on the other hand, does not possess any automatic features, but must be opened or closed by some outside means. Exactly the same principles apply to the operation of oil switches and oil circuit breakers. The most important parts of an oil switch, aside from the oil, are the contacts corresponding to the contact jaws of the ordinary open knife switch, the blades, the insulation which separates the contacts from each other and from the ground, and the handle or operating mechanism. In addition to the parts already mentioned the oil circuit breaker possesses a spring or weight tending to open the contacts, a toggle or trigger for holding the breaker closed, and a trip coil for releasing the breaker.

CONTACTS AND BLADES.

The contacts carry the current, and when separated from the blades by the operating mechanism open the circuit. There are usually two contact jaws or contacts to each pole of the switch. The blade is carried on an insulating rod, and when the switch or breaker is closed connects the two contacts together. On opening the switch the circuit is interrupted in two places simultaneously. The term contact, when applied to an oil switch or circuit breaker is generally considered to embrace both the contact jaws and the blade that serves to connect them. The current-carrying capacity of the contacts depends upon the pressure between the blades and the jaws as was explained in last month's article. On oil switches a higher current density is allowed per square inch of contact surface than in open air switches because it is possible to use greater pressures between the blade and the contact, due to the fact that they are usually operated by power. The contact jaws are sometimes reinforced by powerful springs which increase the pressure. These springs do not carry any current, because the current might raise their temperature sufficiently to ruin the temper.

As the contacts are used to open the circuit under load they are often provided with small auxiliary contacts or fingers between which the arc takes place; this prevents the burning of the main contacts. The contacts are subjected to more or less wear and are usually adjustable, both as to pressure and alignment. A very good form of contact is one made up of laminations of spring copper. These brush contacts as they are called will take up a considerable amount of wear. Another excellent contact is the butt contact. It consists of a copper wedge that fits into sets of copper-laminated jaws. This style will compensate for a large amount of wear. A very important point in the design of the contacts is that they be constructed so that pitting and burning will not cause sticking or jamming, thus preventing the opening and closing of the switch. The oil receptacle



OIL CIRCUIT BREAKER.

which is usually made of some moulded material or of sheet iron, should be easily removable so that the contacts may be readily inspected. When an oil circuit breaker has opened a line on which a bad short circuit existed, the contacts should be examined before the circuit breaker is closed again, in order that any damage may be repaired.

There are three different methods of arranging the contact and their blades in the oil. Some manufacturers place the contact jaws at the bottom of the oil receptacle, and the contact blade moving vertically above them. This insures a large amount of oil around the point at which the arc takes place and a pressure that tends to force the oil into the space or bubble formed by the arc. Another type of switch has the contact jaws near the surface, the contact blade moving in a vertical plane below them. This provides plenty of clear oil at the point where the arc takes place and any sediment that forms will sink to the bottom of the tank, lowering the insulation value of the oil at that point only. In the first type the blades or moving contacts are drawn up to open the circuit, in the second they drop down. The third arrangement places the contact jaws and the moving blades so that they move in a horizontal plane, claiming that the disturbance is more distributed than when confined to the vertical plane. The arc also tends to flare upward and increase in length. Oil switches and oil circuit breakers in which the contact jaws and the moveable contacts are set one above the other, and where the motion takes place in a vertical line are the most common.

INSULATION.

The insulation plays a very important part in all devices that are used for high voltage work, and therefore great care must be taken in the choice of insulating materials that are to be used in oil switch or circuit breaker construction. In an oil switch or circuit breaker all of the contacts are mounted or attached to a base as in the ordinary knife switch, only the contacts and moveable parts of an oil switch or circuit breaker are fastened to the lower side of the base and immersed under the oil. The receptacle containing the oil is simply attached to the base in such a way as to be easily removed. Where the voltage handled is only moderately high, and the switch or circuit breaker has more than one pole, all of the poles dip into the same oil tanks, and between each is a barrier composed of some insulating material. If the voltage is very high, then it is unsafe to mount all of the poles in one oil receptacle, and each pole is provided with its own individual oil tank, and heavy barriers of soap stone or slate separate the tanks. All of the poles, however, operate together. The qualifications of a good insulating material for oil switch work are that it must be permanent, possess mechanical strength and must withstand rough usage and a considerable degree of heat, and possess a high break down voltage.

One of the best materials is well glazed porcelain; while it does not possess great mechanical strength and is liable to crack, if properly installed and with the strains well distributed, it will form an insulation that is absolutely permanent. It is equally good either under oil or exposed to the atmosphere. Hard rubber, while possessing the necessary mechanical strength, deteriorates very rapidly when placed under oil. Fibre is liable to warp and go to pieces when exposed to the atmosphere as was explained in the last issue. Wood when properly treated forms an excellent insulator as it has the requisite mechanical strength and a capacity for withstanding shocks. If the wood, during the seasoning process has been well soaked in water, thus removing any salts that may be present, then dried, and the pores filled with some insulating compound, sealing them against the absorption of moisture, it forms an insulating material that is only second to porcelain in insulating properties and far superior to it in withstanding shocks and strains. Soapstone is a good material for insulating purposes where the voltage is low. It is liable to have running through it metallic streaks which are objectionable for high voltage work.

OPERATING MECHANISM.

There are three different methods for operating oil switches and oil circuit breakers: Manual, pneumatic, and electrical. Manual operation or operation by hand is applied to only small sizes of oil switches and circuit breakers, because a man's strength is not sufficient to operate the large ones. The hand operating device is simply a handle, which raises or lowers the contact blades, and may be compared to the common pump handle. It is simple and effective where the distance through which the contact blades are moved up and down is short and where a straight line action is not necessary.

Pneumatic operation, as the name implies, requires compressed air. Compressed air can furnish the required power and a straight line action, but it has not come into favor for the operation of oil switches and circuit breakers, as there is very little demand for the use of compressed air for other purposes in sub-stations and central stations. Where available, it offers an excellent means for the operation of oil switching devices.

Electrical operation is obtained by two methods: motor and solenoid. There is considerable difference of opinion as to which method is the better. The motor operates the contacts by means of gearing. The motors used are small direct-current motors which are controlled by the switchboard operator, and they can close a switch under great pressures. They take some little time to close the oil switch or circuit breaker. The solenoids are usually supplied with direct current, and close the switch by means of a system of levers and a toggle. Solenoids are instantaneous in action and a straight line action is possible. The solenoid is also free from commutator and gearing troubles.

The oil circuit breaker has the same form of contacts, blades and operating mechanism as the oil switch, but in addition to these, as was explained, it possesses a spring or some other device tending to separate the contacts. It is held closed by a toggle or trigger that is released by a trip coil. This trip coil may be operated automatically by a short circuit or an overload, or by the operator himself when desiring to open the circuit.

REMOTE CONTROL.

The voltage for which oil switching apparatus is used is often very high, too high to be carried to the switchboard, because of the danger of injury to the men operating the board. The oil switch and circuit breakers are placed in a safe place, at a distance from the board, where there is little danger of any one coming in ctontact with them. On the switchboard is placed a small switch or handle for controlling the operating mechanism. The operator controls the position of the main switch by means of this handle and a system of colored lights or an indicator is provided for indicating the position of the oil switch.

PRACTICE.

Oil switches and circuit breakers may be single pole or of any number of poles. As they are usually employed to handle high voltage, it is considered the best practice to provide a pole for each and every lead or wire of the circuit. These poles may be closed one by one or all together. They all open simultaneously, however.

In practice it is not customary to install both an oil switch and an oil circuit breaker on the same circuit, as in low voltage direct current work, where the breaker is first closed then the switch, and in case a short circuit exists the breaker opens upon the closing of the switch. As only the oil circuit breaker is used in high voltage alternating current work, it is so constructed that if closed under conditions of short circuit it will open even if the handle controlling the operating mechanism is held in a closed position. This is obtained by constructing the operating mechanism in two parts held together by a catch or lock. This catch is automatically released when the breaker is closed under conditions of short circuit, permitting the breaker to open even if the handle remains in the closed position.

AMONG THE WESTERN RAILROAD MEN

By James Kennedy

The monotony of the Great American Desert, so depressing to a tenderfoot, seems to sit lightly on the philosophic Westerner. There is a comradeship which is invisible to the common eye, but when something happens on the plains crowds of men come clustering from what seems to be the uttermost ends of the earth. An incident occurred in Utah that will be remembered for a long time: The train was proceeding at a high speed, some distance beyond a place called Green River, when suddenly an appalling crash rent the startled air. The cars jostled each other fiercely, but to one accustomed to the stopping of some of the trains on the Interborough Railroad in New York, this was no great matter. The train sped on through a terrifying cloud of white vapor accompanied with a deluge of water that rattled on the car roofs like the spray of a hurricane in mid-winter on the North Atlantic. Women shrieked and strong men stood still. Presently the train slackened its speed and came to a stop, and everybody hurried out to see what had happened. The clouded air was hot and sulphurous, but in spite of which the teeth of many of the amazed passengers were rattling like dice. When the air cleared it was found that the locomotive boiler had exploded and had parted its fastenings, and lay half buried in the earth about fifty yards away. The engine was left intact. The engineer and fireman stood without a scratch, and looked like men that woke up suddenly out of a strange dream. Inside the firebox the flue sheet was riven across and the crown sheet folded like a piece of paper, back towards the furnace door. When the rupture had occurred, the escaping steam, after striking the ashpan to the earth, had recoiled and lifted the boiler into the air. Not a wheel had left the rails. With the exception of a few broken bolts and the forlorn spectacle of an unattached smoke box to which the smokestack still stuck, the engine seemed ready for a new boiler.

ENGINE STANDING ON TRACK WITH BOILER BLOWN AWAY.

EXPLODED BOILER LYING ON THE PRAIRIE AWAY TO ONE SIDE OF TRACK.

Before the ruins of the explosion could be fully examined, visitors began to gather around from the neighboring counties. They were mostly mounted on small ewe-necked horses that seemed to be strangers alike to the corn crib and the currycomb. They stood more in need of good grazing than hard galloping. Most of the visitors seemed disappointed when they learned that there was nobody killed or even hurt. Some of them, after a cursory glance, turned sullenly away, and after remounting their steeds, cantered leisurely towards the rim of the horizon. A delegation, evidently from the cold North, hung around the hot boiler as if resolved to stay all night. Presently the wrecking train was upon us, and the passengers climbed back to their comfortable seats, and the last seen of the exploded boiler resembled the remains of a dead buffalo with his head in the earth, and a hungry flock of vultures hovering around the remains.

Such accidents are, happily, few and far between, and it is gratifying to know that while the number of locomotives is increasing at the rate of over 7 per cent. each year, the number of boiler explosions is diminishing at a more rapidly vanishing ratio. The coolness of the train crew was complete, while the wrecking gang were models of physical manhood, supple and sinewy. The velocity with which they rid what remained of the locomotive of warped entanglements was great. The exhibition of noisy authority was refreshingly conspicuous by its absence. The men seemed to work by an instinct that was unerring, and showed how carefully the gang had been selected from the brightest and best and most accomplished of the Western railway men.

MISSOURI PACIFIC SHOPS AT ATCHISON, KAN.

It was interesting to look in for a brief hour at the repair shops of the Missouri Pacific at Atchison, Kansas, and to observe how one of the earlier roundhouses, built over forty years ago, is still doing good service, although the locomotives have outgrown the dimensions of the building and are here and there projecting themselves into the outer air. The adjoining machine shop which was evidently originally intended as an ash pit where the engines could pause a moment and have their fires quenched or cleaned out before entering the roundhouse, is crowded with fine machines, and the work accomplished is of the very best, in spite of the limited space and unpromising conditions under which it is performed.

We were reminded of an Eastern master mechanic, who, on being appealed to for certain tools necessary to the execution of some difficult mechanical operation, replied that anyone could do a job with fine tools, but it took a skilled mechanic to work without tools. There is some truth in this, but it is not altogether truth. Work can be done much better and quicker under all conditions with good tools, and it is the poorest kind of economy to keep even skilled workmen wasting their time struggling with their bare hands or even with antiquated tools. At the Atchison roundhouse there are many fine tools and all that is necessary is better housing and more spacious accommodation. Mr. J. L. Butler, the scholarly and accomplished master mechanic, has surrounded himself with a fine body of men. In the limited space at his disposal there are 280 men at work, mostly fine types of physical manhood, with the rough and ready characteristics of the Westerner to which is added the ingenuity and skill of the Eastern trained mechanician. They seemed contented, and the kindly cordiality existing between the workmen and the heads of the various sections was pleasant to witness, the only drawback being, as we have already stated, the lack of sufficient accommodation which is really essential to the performance of the best work.

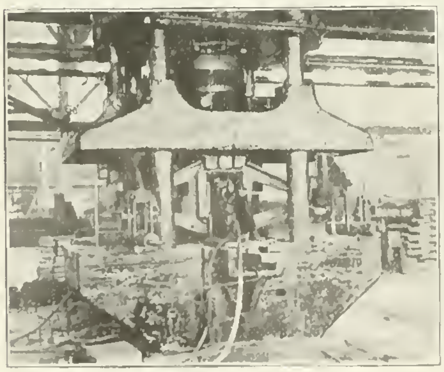


FIG. 1. SQUARING AND TESTING SIDE FRAMES.

The situation of the roundhouse is of the most picturesque kind, the approach in the ordinary way being over a small footbridge extended over a deep gulley where a fierce torrent foamed and tumbled towards the near Missouri. The trembling of the frail bridge and the turbulence of the wilderness of waters beneath were not conducive to that tranquility of mind essential to the proper contemplation of nature on her beauty and solitude. It was comforting to learn that the tumultuous torrent was not always like that. It was usually a mere creek. Whether it swelled up at the approach of a stranger, or whether a forty-eight hours' rain storm preceding our visit had superinduced the rising of the foaming flood, we were pleased to be safely over it again, and are hopeful that there will be a new bridge, a new roundhouse and a new machine shop when we again retrace our steps.

Cast Steel Truck Frames.

The first step in the manufacture of cast steel truck frames is to obtain a metal of the requisite composition. Basic open hearth cast steel is used in the Bettendorf truck frame and is of a composition which affords a high elastic limit. In a derailment the frames may be bent out

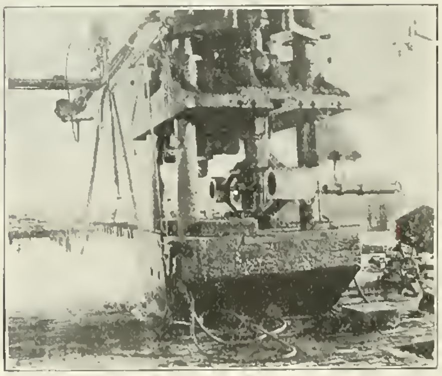


FIG. 2. FRAME SUSPENDED ON SPRING SEAT.

of shape, but they do not readily break, and in most cases may be straightened and put into service again. The truck frame, which is taken as an example, is a one-piece casting with arch bars, columns, spring seat and journal boxes cast integral with the frame. This form of construction eliminates bolts and rivets. This feature is a good point in truck frames and simplicity of design generally means a reduced cost of maintenance. Another point is the reduction in weight which the one-piece frame affords. These frames give a reduction in weight of about 1,000 lbs. per car.

The distribution of metal is such as to resist all stresses, allowing moreover a high factor of safety. Metal is not wasted in the frame, so that they will still carry a greater number of load pounds per pound of truck frame than the ordinary arch bar frame. This feature is not due entirely to careful designing, but is made possible by the construction of the frames. The truck frame is built so as to be interchangeable with any standard truck frame. Any width of wheel base, design of journal box, height of bolster opening, etc., is possible without interfering with the general features of the design. With these frames a distance of at least 4 ins. is obtained between lower arch bar and the top of rail. In case of derailment the frame will skid along the roadbed and will

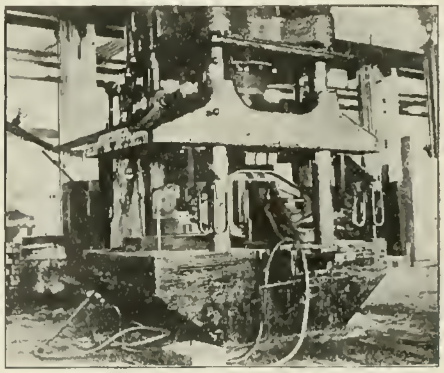


FIG. 3. SQUARING TRUCK FRAME.

not tear up the track, owing to the absence of bolts, nuts and parts of frame.

The journal boxes are cast integral with the frame and may be made of any standard design. The strength of the connection between arch bars and journal boxes is ample. There is a lug on the bottom of journal box which may be used for jacking up when the truck is under a car.

The Bettendorf Company is willing to replace the entire frame if the journal boxes should fail in normal service or in derailment. In most cases where these journal boxes are damaged in wreck or derailment, they can be restraightened in the railroad shops.

The bolster openings are of the shape illustrated for the rigid bolster. The designs for Barber roller construction and swing motion bolster provide straight column guides. There is a hole cast in the bottom arch bar, in which a projection on the spring plank is secured. In this way rigidity is overcome to the extent that the truck is adjustable to track irregularities, and at the same time flange wear on wheels and end wear on brasses are reduced to a minimum.

The machine for squaring and testing side frames is a press of 975-ton capacity. The first operation is straightening the spring seat, and in Fig. 1 the press is shown with the dies on the platen pressing down upon the spring seat. After the spring seat is straightened the frame is suspended on the spring seat as shown in Fig. 2, is ready to have the false journals slid in position in the journal boxes. Fig. 3 shows the press in the act of squaring and testing the truck frame. The upper portion of journal box, where wedge bears against top wall of journal box, must be in line with the spring seat. Fig. 4 shows the top platen of press returned, the false journals slipped out of journal boxes and gauges in journal boxes to ascertain if the top walls of journal boxes are square with the spring seat. The load, applied to the axles as in Fig. 3, is equal to the capacity of car with which the frame is to be used and is, therefore, four times the load which the frame is to carry in service. The truck frame is then turned upon its side, and is straightened trans-

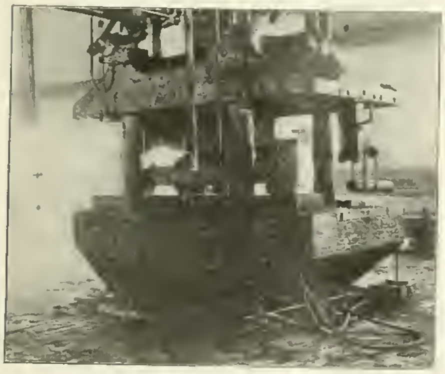


FIG. 4. PRESS WITH TOP PLATEN UP.

versely so that the lugs for brasses on inside of journal box and the face of column guide are the proper distances from each other. The gauge is applied to ascertain if the truck frame is straightened transversely.

From the testing department the frames are removed to the finishing and inspecting department. The inspector gauges the wheel base and again tests the frames to see that they are square. In this department pneumatic tools are used to chip to gauge the column guides and dust guard openings and to chip up the journal box openings so as to produce a good fit between box and cover.

The number of operations required to assemble a Bettendorf truck have been reduced to a minimum because of the small number of parts. All parts of the truck, including side frames, bolsters, brake beams, etc., are placed within access of the workmen, so as to be handled by a 1,000-lb. traveling hoist. A pair of mounted wheels are run up on the elevated track and one side frame is placed in position. The wedges and brasses are then inserted in the journal boxes and the truck bolster set in position, after which the second side frame, together with brasses and wedges, is added. Next, the bolster is raised up against the top arch bar and the spring plank and springs are slipped into position. Then, after the brake beam is hung and brake rigging attached, the truck is completely assembled and ready to be placed under a car. The makers say it requires about 8 minutes to assemble such a truck and about 9 minutes to dismantle it after the truck has been placed under a car.

Side Door Steel Cars.

The Interborough Rapid Transit Company are experimenting with a train of eight steel cars equipped with eight doors each. This train is in the New York subway and the side doors are arranged at each end something like the pay-as-you-enter street cars now familiar in many cities.

The subway cars have closed vestibuled platforms with side doors as usually provided. In addition to these four doors which open to the station platforms, there are four other side doors also opening to the station platforms and these four extra doors are placed each about 3 ft. from the original doors. The cars therefore have four doors on each side, placed at and near each end.

The ordinary vestibule doors are operated by hand levers and are intended for the entrance of passengers. The new side doors, operated by air are placed near the ends of the body of the car and are for the exit of passengers. When a car stops at a station, passengers enter by the ordinary vestibule doors, and those within the car leave it through the new side doors in the ends of the car body. The movement of passengers will resemble that of passengers getting on and off the pay-as-you-enter street cars.

The intention of the Public Service

INSPECTING AND FINISHING DEPARTMENT.

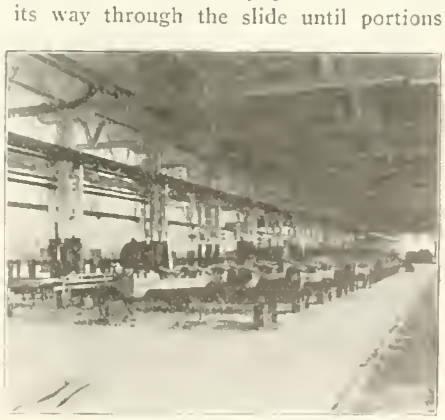
Commission in introducing this design into subway cars is to keep separate the entering and departing streams of people, and thus diminish the crowding and jostling which takes place when one door is used for out-going and in-coming passengers. Whether the hopes of the designer, Mr. B. J. Arnold, are to be realized or not will be determined by the severe service test entailed by operating this train in the heavy rush hours of New York subway traffic.

The new side doors are operated by compressed air, and a neatly designed piece of mechanism for that purpose is placed under the "seat-for-two" which is situated in the wall space between the new door and the ordinary vestibule door. The air operating mechanism was designed by Mr. J. F. McElroy, consulting engineer of the Consolidatel Car Heating and Lighting Company. The usual method of notifying the motorman of a subway train is by bell. Each guard, beginning at the rear, ringing a bell on the car ahead, the signal ultimately reaching the motorman. On the experimental train the closing of each door makes an electric contact, and the last door to be closed, without reference to its position in the train, completes the circuit and sounds a buzzer in the motorman's cab. A button on the buzzer is held down by the motorman in anticipation of the signal to start, as soon as the train stops, and the release of this button breaks the door circuit made by the closed doors after the signal has been received, and this prevents the continuous sounding of the buzzer with closed doors while the train is in motion. In this way the motorman is compelled to be on the alert for the signal to start, which he gets when the last door is shut.

Hard Weather in the West.

The Southern Pacific Company had hard luck last month. Severe weather set in early in November and had with little abatement continued until well on in February. Snow and rain fell in large quantities, and local papers in California state that the Sacramento River has risen considerably in consequence. Southern Pacific trains were run with great caution at a speed of not more than 12 miles an hour for a considerable period of time.

At Gibson a heavy snow slide covered the track early in January and the heavy and laborious work of cutting through it was prosecuted with vigor by the railway officers and employees. Scarcely had the line been opened for traffic when a second heavy snow slide submerged the track at the same place, but the work of clearing it away went on without hesitation or delay. Those who live in the comparatively flat parts of the country and who see only falls of light snow or drifts fill the railway cuttings have no idea of the intensely ice-like mass which wet snow makes on the track when it comes down from even a comparatively insignificant fisure or crevice in the mountains. This heavy, solidly packed snow cannot be shoveled out in the ordinary way and the wedge plow is useless against it. Many times the rotary plow cannot cut its way through the slide until portions



TRUCK ASSEMBLING DEPARTMENT.

of it are broken by the use of the pick and even dynamite has been used to dislodge solidly frozen portions of the slide which usually contain earth, stones, fragments of trees and other matter, difficult to deal with.

Eduactional Chart No. 10.

The appended list of questions and answers in connection with our Educational Chart No. 10 completes the series which was begun in the January issue of the present year. As the call for copies of the January issue of RAILWAY AND LOCOMOTIVE ENGINEERING has surpassed our expectations we would state that we are unable to fill further orders in regard to that particular issue. We hope, however, to be able to find space in the April issue to republish the complete list of questions and answers in connection with our new chart. By this means those who cannot secure copies of the January and February issues may obtain the entire series of questions and answers when republished in the April issue.

It is very gratifying to observe the warm and intelligent interest which has been taken in our new chart. It has proved itself to be a valuable aid to railway men in preparing themselves for the severe examinations which are now held on all railways preparatory to making promotion, and the thousands of railway men, whose testimony cannot be gainsaid, given ample proof of the educational advantages afforded them of obtaining important information at a nominal cost. This is in line with the policy established by us and maintained with growing success. It will continue to be our aim to furnish the very fullest and best information in regard to the mechanical appliances used on railways, and to this end we are keeping abreast of the times, and meeting with gratifying encouragement at home, while new and untried fields are opening to us abroad.

It should be remembered that our subscribers, whether new or renewed, have their choice of either of our three locomotive charts, the American, the Atlantic or the Consolidation types, or our combination passenger and sleeping coach chart, or our new combination chart and model, No. 10. The answers to the remaining questions are given below.

QUESTIONS ON CHART NO. 10.

28. What is back pressure?

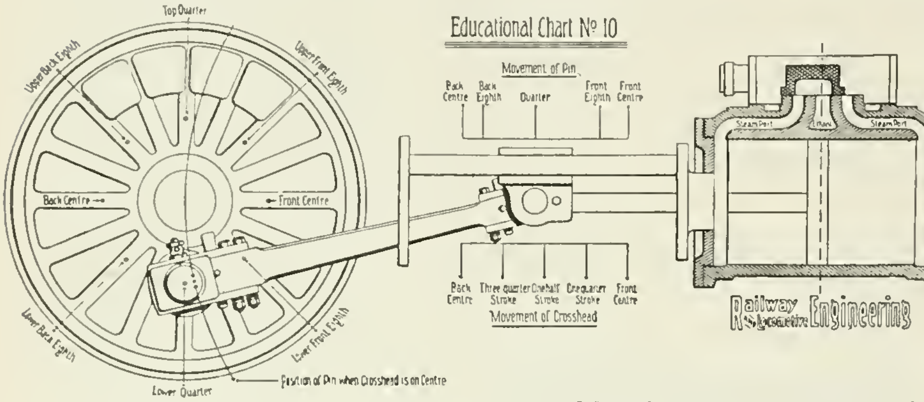
A. The pressure that obstructs the piston on the return stroke, due to steam, moisture or air left in the cylinder after the exhaust port has opened.

29. What is the difference between back pressure and compression?

A. Back pressure has just been explained. Compression occurs when the valve closes toward the end of the return stroke, permitting the piston to squeeze the gases in the cylinder into a diminishing space.

30. What is the cavity under the valve for?

A. It provides a passage for the exhaust steam to escape from the cylinder into the exhaust pipe.



31. What is meant by the expression, "cutting off at six inches?"

A. It means that when the steam has pushed the piston six inches of its stroke the valve cuts off further admission of steam.

32. Could you change the lap of the valve by changing the eccentrics?

A. No.

33. When a valve blows, where does the steam go to?

A. Into the exhaust passage, thence to the atmosphere.

34. What is inside clearance?

A. The cutting away of the inside edges of the valve cavity, so that there is an opening to the cavity from both ends of the cylinder where the valve is on the middle of the seat.

35. Could steam be worked expansively with a valve without lap?

A. No, because release of the steam would happen at the same time as cut off.

36. Suppose this piston was on the forward dead center and the reverse lever was put in full forward gear, where would the valve be? Where would the valve be if the lever was put in full back gear?

A. In both cases the valve would be in the position to begin admitting steam at the forward end of the cylinder.

The first improvement in railway signals was made by a lazy Scotsman at Glasgow. The vane signal, then in use, was worked by hand, and was placed at some distance from the signalman's box. The canny Scot was compelled to walk to and fro from the signal every time it was required to operate the signal. He rigged up a primitive wire arrangement and sat still.

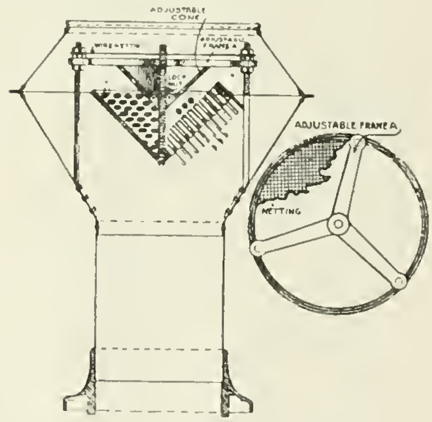
Double Cone for Diamond Stack.

Since a number of our readers have given information concerning diamond-stack engines still in use in various parts of the country it may be of interest to state that a spark arrester or modification of the old-fashioned diamond-stack cone is being used by Alberta Railway and Irrigation Company of Lethbridge, Alta., Canada.

The spark arrester is made of cast iron, being really two cones, one placed above the other. The lower one contains outwardly-pointing projections with holes through them. The lower cone is made in sections and the projections in each section are cast in the form of half tubes and when the sections are bolted together they make the full tube through each projection. It is, in fact, as if the lower cone was pierced by a number of short nipples, which provide means for the smoke and hot gases to go through, but have a tendency to baffle and break up the live cinders which come through the tubes.

The upper cone is made with just the ordinary rough surface of cast iron, and by changing the direction of the smoke and cinders which get through the lower cone, forms, as it were, a second baffle against which the cinders are still further broken up or killed. The cones are adjustable with relation to the stack and to each other. The use of this double cone arrangement does not make it necessary to alter the front end of the locomotive in any way.

This arrangement, which is made by the Hall Patent Stack Company of Edmonton, Alta., Canada, has been designed in response to the call for the effective preservation of the magnificent forest areas of the United States and Canada through which railroads pass.



DOUBLE CONE DIAMOND STACK.

As the flint contains the spark, unknown to itself, which the steel alone can awaken to life, so adversity often reveals to us hidden gems, which prosperity or negligence would forever have hidden.—*H. W. Shaw.*

Items of Personal Interest

Mr. James Butler has been appointed road foreman of engines of the Chicago & Alton Railroad, vice Mr. A. S. Work, resigned.

Mr. A. Maynes, formerly district master mechanic on the Canadian Pacific Railway, has been appointed rule examiner on that road.

Mr. Alfred Anderson has been appointed purchasing agent of the Metropolitan Street Railway, with headquarters at New York.

Mr. A. F. Hull has been appointed purchasing agent of the Rock Island-Frisco lines, with headquarters at Ft. Worth, Texas.

Mr. George F. Hennessey has been appointed roundhouse foreman of the Chicago, Milwaukee & St. Paul Railway at Janesville, Wis.

Mr. A. J. Wade has been appointed master mechanic on the Louisiana & Arkansas Railway, vice Mr. F. A. Symonds, resigned.

Mr. W. F. Lowe has been appointed locomotive foreman on the Canadian Pacific Railway at Ignace, Ont., vice Mr. A. E. Hough, transferred.

Mr. D. L. Jones has been appointed locomotive foreman on the Canadian Pacific Railway at Smith's Falls, Ont., vice Mr. B. Pendleton, transferred.

Mr. E. G. Osgood has been appointed master mechanic of the Williamville, Greenville & St. Louis Railway, vice Mr. O. D. Greenwalt, resigned.

Mr. W. G. Hunter has been appointed assistant superintendent on the Chicago Great Western Railway with headquarters at Des Moines, Ia.

Mr. P. B. Vermillion has been appointed assistant superintendent on the Chicago Great Western Railway with headquarters at St. Joseph, Mo.

Mr. A. E. Hough, formerly locomotive foreman on the Canadian Pacific Railway at Ignace, Ont., has been appointed night shop foreman, at Fort William, Ont.

Mr. F. W. Sadlier has been appointed locomotive foreman on the Canadian Pacific Railway at Field, B. C., vice Mr. J. Archibald, transferred to Vancouver.

Mr. E. T. Reisler has been appointed division engineer on the Lehigh Valley Railroad Company with offices at Auburn, N. Y., vice Mr. F. K. Bennett, resigned.

Mr. J. Archbald, formerly locomotive foreman on the Canadian Pacific Railway at Field, B. C., has been appointed shop foreman on that road at Vancouver, B. C.

Mr. G. L. Moore has been appointed engineer of maintenance of way on the Lehigh Valley Railroad with offices at South Bethlehem, Pa., vice Mr. R. G. Kenly, resigned.

Mr. G. Hebb has been appointed road foreman of the Central division of the Canadian Pacific Railway, vice Mr. A. West, appointed district master mechanic, at Kenora, Ont.

Mr. A. H. Eager, formerly district master mechanic on the Canadian Pacific Railway at Kenora, Ont., has been appointed locomotive foreman on that road at Calgary, Alta.

Mr. Charles L. Gasper, mechanical engineer of the Wisconsin Central, has been appointed superintendent of the mechanical department of the Canton & Hankow, at Canton, China.

Mr. J. J. Keefe, well known in the pneumatic tool trade has entered the employ of the Independent Pneumatic Tool Company as salesmen and will travel from their Chicago office.

Mr. S. S. Reigel has been appointed mechanical engineer on the Delaware, Lackawanna & Western Railroad with headquarters at Scranton, Pa., vice Mr. J. A. Mellon, resigned.

Mr. B. J. Peasley, master mechanic of the St. Louis, Iron Mountain & Southern at Ferriday, La., has been appointed master mechanic at De Soto, Mo., vice Mr. P. J. Conrath, resigned.

Mr. Marvin Howe has been appointed general foreman of the Rome, Watertown and Ogdensburg division shop of the New York Central at Oswego, N. Y., vice Mr. R. G. Cullvan transferred.

Mr. W. Josselyn, formerly storekeeper of the Chicago, Burlington & Quincy at Plattsmouth, Neb., has been appointed storekeeper on that road at Sheridan, Wyo., vice Mr. B. G. McKeen, resigned.

Mr. W. H. Markland, for many years foreman of the electrical department in charge of the Altoona machine shops of the Pennsylvania, has been appointed superintendent of the labor-saving devices.

Mr. J. C. Garden, formerly general shop foreman on the Grand Trunk Railway at Toronto, has been appointed master mechanic on that road at Montreal, Que., vice Mr. T. McHattie, resigned to accept another position.

Mr. F. C. Pickard, master mechanic of the Mississippi Central, has been appointed master mechanic of the Cincinnati, Hamilton & Dayton, with headquarters at Moorefield, Ind., vice Mr C. B. Cadman, resigned.

Mr. F. Rowlandson, formerly locomotive foreman on the Canadian Pacific Railway at Brownville Jct., Me., has been appointed locomotive foreman on that road at West Toronto Jct., Ont., vice Mr. T. Reynolds, resigned.

Mr. J. R. Spragge, formerly district master mechanic on the Canadian Pacific Railway has been transferred to the Ontario division of that road, vice Mr. A. Maynes, promoted. Headquarters at West Toronto, Jct., Ont.

Mr. R. G. Cullivan, formerly general foreman of the locomotive department of the New York Central at West Albany, N. Y., has been appointed division superintendent of motive power on that road, vice Mr. E. A. Walton, resigned.

Mr. J. H. Mills, formerly district master mechanic of the Canadian Pacific Railway at Farnham, Que., has been appointed acting master mechanic on that road, vice Mr. R. Preston, who has been granted leave of absence. Mr. Mills' headquarters will be in West Toronto Jct., Ont.

Mr. T. McHattie, formerly master mechanic of the Eastern division of the Grand Trunk Railway at Montreal has been appointed superintendent of motive power and car department on the Central Vermont Railroad, vice Mr. W. Kennedy, resigned. Headquarters at St. Albans, Vt.

The duties of mechanical engineer, locomotive branch, at the Angus shops of the Canadian Pacific Railway at Montreal, heretofore performed by Mr. A. W. Horsey, who has been appointed master mechanic on that road at Smith's Falls, Ont., will hereafter be carried on by Mr. G. I. Evans, chief draughtsman.

Mr. J. E. Irwin, master mechanic of the Marietta, Columbus & Cleveland Railway, has resigned to become superintendent of equipment of the Indian Refining Co., at Georgetown, Ky., and Lawrenceville, Ind., and the position of master mechanic has been abolished.

Mr. Edgar B. Thompson, formerly assistant superintendent of motive power and machinery of the Chicago & North Western, has been appointed superintendent of motive power and machinery of the Chicago, St. Paul, Minneapolis & Omaha, vice Mr. John J. Ellis, retired on account of having reached the age limit.

Mr. William Kent, author of the Mechanical Engineers' Pocket Book, and for five years prior to June, 1908, dean and professor of mechanical engineering in the College of Applied Science, Syracuse University, has moved to Sandusky, Ohio, to take the position of general manager of The Sandusky Foundry and Machine Co., manufacturers of triplex power pumps, threading machines and specialties in machinery for paper mills.

Mr. Alexander B. Wetmore has accepted the position of sales manager of the Monarch Steel Castings Company, of Detroit, Mich., effective March 1. Mr. Wetmore leaves a long period of service with the Detroit Lubricator Company to take up the sales of the well-known "Monarch" couplers and "Monarch" graduated draft gear, made by the Monarch corporation.

Mr. Patrick Fennell, better known to the railway world as "Shandy Maguire," the Railroad Poet, who for almost forty years has been in the employ of the Delaware, Lackawanna & Western Railroad at Oswego, has retired from active service and has been placed on the company's pension list. Mr. Fennell entered the employ of the D. L. & W. as a locomotive fireman June 18th, 1869, and was promoted to the position of engineer June 18th, 1870. In 1876 he was appointed roundhouse foreman at Oswego, N. Y., and has held that position up to the time of his retirement. At the 1892 Convention of the Brotherhood of Locomotive Engineers he was made a grand honorary member of the order. He began work in the early days of railroading and soon won for himself general recognition as a most faithful and trustworthy employe. Mr. Fennell belongs to a class of enterprising and progressive railroad men who, while physically hardened by toil, are kind and tender of heart and ever watchful for the comfort and the safety of others. He has for some time filled various positions on the Oswego Board of Education. The name of "Shandy Maguire" has become a household word in the home of thousands of railroad men. In his poetical work can be found some of the richest and most meritorious of its kind ever written. Some of his first productions were composed in the cab of his engine. We learn that now that he has retired from work the poet-railroader has arranged for a trip to the "old country." The greater part of his vacation will be spent in Great Britain and Ireland, and much of it will be devoted to visiting the scenes of his boyhood in Erin's Isle, where he first saw the light of day. While in the United Kingdom he will be the guest of the Associated Society of Locomotive Engineers and Firemen. Mr. Fennell's book of railroad poetry called Random Rhymes and Rhapsodies was reviewed in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING for June, 1907. "Shandy" has been a valuable and interesting contributor to our pages and we hope that the leisure he will now enjoy will give his gifted pen even greater scope than formerly. All we can say on hearing of Mr. Fennell's retirement is to wish him good luck and in the words of the inhabitants of his native land we say, "Shandy, may your shadow never be less."

Obituary.

Death has recently removed, at the age of 93, one who played an important part in the early history of the Swindon Locomotive Works of the Great Western Railway of England. At the age of 16, Mr. Archibold Sturrock entered the shops of the East Foundry, at Dundee, as an apprentice, and eight years later was appointed assistant locomotive superintendent, G. W. R. In 1843, when it decided to start the Swindon Locomotive Works, Mr. Sturrock was sent down to take charge of them. The machinery at Swindon was started on November 28th, 1842, the works being brought into regular operation on January 2nd, 1843. Mr. Sturrock stayed at Swindon until 1850, when, on the recommendation of Mr. Brunel, he was appointed locomotive engineer to the Great Northern Railway Company, from which position he retired in 1866. Mr. Sturrock was an able engineer whose energy and zeal did much for the locomotive in the earlier days of railroading.

The first annual meeting of the International Railway Fuel Association will be held in the Auditorium Hotel, Chicago, 6th floor banquet hall on Monday, Tuesday and Wednesday, June 21st, 22nd, and 23 respectively. There are to be five subjects upon which papers are now being prepared and which will be read and discussed at the meeting. These subjects are. First—Proper method of purchasing fuel with regard to operating and traffic conditions, considering also the permanent interests of the producer when located on the consumers' rails. Second—Standard type or types of coaling stations. Best design and most economical coal chute for handling coal from cars to locomotives. Third—Best method of accounting for railway fuel, including movement from mine through coaling station to engines, up to monthly balance sheet. Fourth—Difference in mine and destination weights. Legitimate shrinkage allowable on car lots. Correct weighing of coal at mines and on railroad track scales. Importance of tare weights being correct. Fifth—Difficulties encountered in producing clean coal for locomotive use.

The officers of this association are Messrs. Eugene McAuliffe, president, Rock Island-Frisco Lines, Chicago, Ill.; Thomas Britt, 1st vice-president, Canadian Pacific Ry., Montreal, Que.; G. R. Ingersoll, 2nd vice-president, L. S. & M. S. Ry., Cleveland, Ohio; D. B. Sebastian, secretary, C. & E. I. R. R. and E. &. T. H. R. R., 327 La Salle Station, Chicago; J. McManamy, treasurer, Pere Marquette R. R., Grand Rapids, Mich.

The Railway Business Association, which a month ago sent a circular to commercial organizations all over the country, asking them to pass resolutions favorable to calmness and moderation in the restriction of railroads, reports about a score already adopted and about sixty formally referred for action at forthcoming meetings. Officials of the association say the most significant phase of the resolutions campaign is the enthusiasm with which business men seize the opportunity to declare themselves for conservative measures affecting railroads.

Directions for Welding Frames.

Directions for welding locomotive frames by the Thermit process have been prepared in the form of a set of blue prints which may be had for the asking by those who are interested in the subject. Every type of fracture has been very carefully treated and a separate drawing is furnished for each repair, showing just what procedure should be adopted if the fracture is in a vertical member, horizontal member or other part of the frame; also how to allow for contraction, expansion and other points to be considered in welding a locomotive frame without removing it from the engine.

The advantages of welding a locomotive frame in one or two days and without dismantling the locomotive are now generally recognized, and the blueprints mentioned above have been prepared at the request of some of the railroads which make a general practice of welding their broken frames with Thermit, so that a full set of directions and drawings may be placed in the hands of their shop men. To obtain a set, simply write to the Goldschmidt Thermit Co., 90 West street, New York, which is distributing them free of charge.

Other repairs for which the Thermit Process offers special advantages are the welding of driving wheel spokes, connecting rods and mud rings, the latter of which being of particular interest owing to the very great saving which may be effected. In the case of a mud ring welded some time ago for the Florida East Coast Railway and described in the December issue of RAILWAY AND LOCOMOTIVE ENGINEERING, it was found that the Thermit Process enabled the repair to be made at less than one-fifth of the cost by any other method. This is not the only advantage obtained by using the process, however, as a reinforcement of Thermit Steel is left around each weld which so increases the cross-section of the piece at point of fracture that it is made stronger than ever at that point and less likely to break when subjected to the same strains that caused the first fracture. A large number of interesting repairs are described in the quarterly paper, "Reactions," published by the Goldschmidt Thermit Co., 90 West street, New York.

Locomotives for the Central Northern Railway of Argentine.

The American Locomotive Company have recently completed twenty Pacific type and ten 4-6-0 type locomotives for the Central Northern Railway of Argentine, both of which orders were completed at the Brooks Works of that company. The first mentioned engines will be used in fast passenger service and are the first engine of this type built by this company for one metre or 39⅜ ins. gauge, and are the lightest engines of this class of passenger power ever built by them. In working order they have a total weight of 113,000 lbs., 75,100 lbs. of which is on the driving wheels, while 21,000 lbs. is carried by the leading trucks and 16,900 lbs. by the trailing trucks.

Although merely a straight forward design of Pacific type engine, there are several features which are of considerable interest. One of the most striking of these in connection with both types of engines is their general attractive appearance. The engines in general follow the locomotive practice of this country, but as far as their appearance is concerned they resemble more the highly finished foreign locomotive than they do the ordinary engine seen on our railroads. This has been accomplished without any great expense, and merely by attention to, as might be said, the artistic character of the design. For example, the style of the boiler jacket and the continuous running boards with their graceful curves cover up the unsightly lines of the air drum. The boiler jacket is striped with gold leaf of the same color as the wheels. Running along the right-of-way at speed of 40 to 50 miles an hour, the Pacific type must make a very pleasing spectacle. Other features in which these engines follow European rather than American practice are copper firebox and staybolts; and double screw reverse gear. The reverse gear, however, is on the right side of the engine instead of the left, which is in accordance with the practice in this country. The ten-wheel engines have brass tubes, while the Pacific type are fitted with charcoal iron tubes.

With the exception of the tubes, axles and copper water supply pipe, all of the material was made to the American Locomotive Company's standing material specifications. All holes in boiler and firebox were drilled instead of punched which is the customary practice in foreign specifications, but is not so general in this country. The roof and sides of boiler and the crown and sides of the firebox are each in one piece, which practice is now becoming somewhat general in American locomotive designs, but is limited to some extent by the size of these sheets.

Both types have a special form of front truck, which is of the plate frame type. Moreover, the equalizer bars instead of resting upon the tops of the boxes, as is the usual practice, are suspended from the bottom of the boxes, thus giving an underhung system of spring support. This arrangement was necessary in order to provide proper clearance between the cylinders and the engine truck. The bottom inside corners of the front frame rail of which has the same effect as brass jacket bands without the additional expense of that feature.

Both types of engines are painted an olive green, with the exception of the engine and tender frames, wheels, smoke, stack top, headlight and front bumper. All wheel centers are painted a Hessian red, and with the exception of the tender wheels, are striped with gold. The engine front bumper and the smokestack top are a vermillion and the headlight is the ten-wheel engines are beveled off for the same reason.

The ten-wheel engines will be used for freight service. They have a total weight in working order of 90,000 lbs., 70,000 lbs. of which is carried on the driving wheels and the remainder on the truck. They are equipped with cylinders 15 in. in diameter by 22 in. in stroke, which, with driving wheels 43 in. in diameter and working pressure of 170 lbs., gives a tractive power of 16,630 lbs. This gives a factor of adhesion of about 4.25 which is ample, while at the same time there is about 1 lb. of tractive power for every 5½ lbs. of weight of engine. This is an unusually high proportion for this class of engine and shows that in the preparation of the design, the purpose was to provide a maximum of power for a minimum of weight. The principal dimensions of each type are given in the following tables.

4-6-0 TYPE.

Cylinder,—Diameter 15 ins.; stroke, 22 ins.; tractive power, 16,630 lbs.
Wheel Base—Driving, 10 ft. 6 ins.; total, 19 ft. 8½ ins.; total, engine and tender, 43 ft. 8¾ ins.
Weight—In working order, 90,000 lbs.; on drivers, 70,000 lbs.; engine and tender, 167,300 lbs.
Heating Surface—Tubes, 958.7 sq. ft.; arch tubes, 100 sq. ft.; total, 1,058.7 sq. ft.
Axles—Driving journals, 6½ x 8 ins.; engine truck journals, diameter 4 ins.; length, 7 ins.; tender, 4¼ ins.; length 8 ins.
Boiler—Type, Belpaire; O. D. first ring, 48⅞ ins. working pressure, 170 lbs.; fuel, coal or wood.
Firebox—Type, narrow; length, 88 ins.; width, 26 ins.; thickness of crown, ½ in.; tube, 1½ ins.; sides, ½ in.; back, ½ in.; water space, front, 4 ins.; sides, 3 ins.; back, 3 ins.
Crown Staying—Radial.
Tubes—Material, brass; number, 155; diameter, 2 ins.; length, 11 ft. 11½ ins.; gauge, No. 13 I. W. G.
Pump 9½ ins. L. H.; 1 reservoir, 6 x 96 ins.
Engine Truck—Swing center bearing.
Exhaust Pipe—Single.
Grate—Style, stationary English type.
Piston—Rod diameter, 2¾ ins.; piston packing, C. I. rings.
Smokestack—Diameter, 14 ft. ¼ in.; top above rail, 11 ft. 2½ ins.
Tender Frame—Steel channels.
Tank—Style, water bottom; capacity, 2,650 gallons; capacity fuel 10 metric tons.
Valve—Type, piston; travel, 4 9-16 ins.; steam lap ¾ in.; extra lap, 0.
Setting—Line and line.
Wheels—Driving diameter outside tire, 43 ins.; engine truck, diameter, 29½ ins.; kind, spoke center; tender truck, diameter, 33 ins.; kind, spoke center.

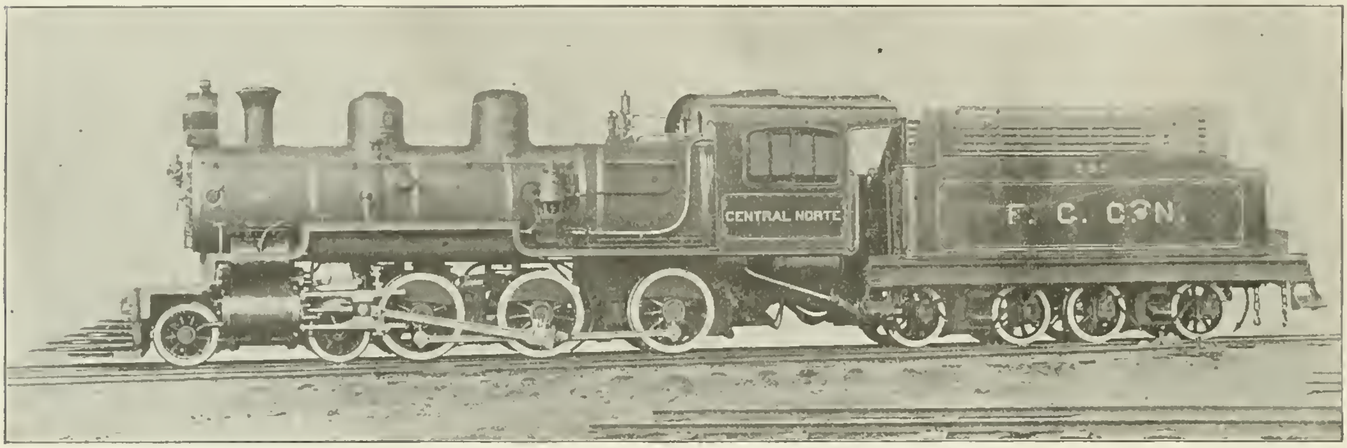
4-6-2 TYPE.

Cylinder Diameter, 17 x 26 ins.
Track Gauge, 39⅜ ins.; tractive power, 20,130 lbs., estimated.
Wheel Base—Driving, 9 ft. 6 ins.; total, 25 ft. 10 ins.; total, engine tender, 50 ft. ½ in.
Weight—In working order, 113,000 lbs.; on drivers, 75,100 lbs.; engine and tender, 207,700 lbs.
Heat Surface—Tubes, 1,685 sq. ft.; fire box, 90 sq. ft.; total, 1,775 sq. ft.
Grate area, 24.5 sq. ft.
Axles—Driving journals, main, 7½ x 8 ins.; others 7 x 8 ins.; engine truck journals, diameter, 4½ x 7 ins.; trailing, 5½ x 8 ins.; tender, 5 x 9 ins.
Boiler—Type, Belpaire straight top; O. D. first ring, 56¾ ins.; working pressure, 170 lbs.; fuel, bituminous coal.
Firebox—Type, wide; length, 66⅛ ins.; width, 53¼ ins.; thickness of crown, ⅜ in.; tube ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4 ins.; sides, 3 ins.; back, 3 ins.
Crown Staying—Radial.

4-6-2 FOR CENTRAL NORTHERN RAILWAY OF ARGENTINE.

Louis Rapelli, General Manager. American Locomotive Company, Builders.

Tubes—Material, charcoal iron; number, 206; diameter, 2 ins.; length 15 ft. 8¾ ins.; gauge, No. 12 I. W. G.
Pump, 1 ft. 9½ ins. L. H.; reservoir, 1-16 x 108 ins.
Engine Truck—Swing center bearing.
Trailing Truck—Lateral motion.
Exhaust Pipe—Single.
Grate—Style, stationary English type.
Piston—Rod diameter, 2¾ in.; piston packing, C. Ir. rings.
Smoke Stack—Diameter, 15 ins.; top above rail, 11 ft. 10 ins.
Tender Frame—Steel channel.
Tank—Style, Water botton U-shape; capacity, 4,000 gallons; capacity fuel, 10 metric tons.



4-6-0 FOR CENTRAL NORTHERN RAILWAY OF ARGENTINE.

Louis Rapelli, General Manager. American Locomotive Company, Builders.

Valves—Type, piston; travel, 5½ ins.; steam lap, 1 in.; extra lap, ⅛ in.
Setting—Line and line.
Wheels—Driving diameter, outside tire, 54 ins.; driving material, main, Siemens Martin steel; engine truck, diameter, 29½ ins.; kind, spoke center; trailing truck, diameter, 36 ins.; tender truck, diameter, 33 ins.; kind, spoke center.

Signal Lights.

By J. F. Springer.

There is probably no subject which deserves greater attention from those responsible for railway management than that which relates to signalling. The principal thing which makes this true is the fact that upon the correct setting and correct interpretation of signals depend the lives and safety of passengers and employees. If a certain headway is necessary under certain given conditions, then that headway may be reduced when the conditions guarantee an increase in the certainty with which orders may reach to the engineer. These things are true at all times, but especially so at night. The present article deals with the relation of the engineer to the signal colors now in general use for signal lights at night.

First, let us consider the colors themselves. The subject has received considerable attention from Prof. George M. Stratton, of Johns Hopkins University, Baltimore, who is an expert in the psychology of vision. Red is the color of danger, and when displayed should be capable of arresting the instant attention of the engineer. This employee's duties are so many and demand such alertness and such quickness and soundness of judgment that a signal light warning of danger should not present a problem to be worked. For some reasons red would appear to be a good color. It has a distinctness of hue that is no doubt very valuable. At the same time, it cannot be denied that it labors under a very serious disadvantage. A red light is ordinarily a dim light, as compared with the intensity of the flame generating it. In order to make this clear, attention is called to the fact that the light which proceeds from the flame is composed in reality of a number of colors. In producing the red signal light the usual method is to place a red glass in front of a flame made from oil or by other means. This red glass stops all the other colors and permits red alone to pass. Such a method cannot, of course, do otherwise than weaken greatly the amount of light that reaches the engineer's eye. All the light stopped, or strained out, is rendered useless. Only the red rays which the "strainer" allows to pass are serviceable.

It appears that about four-fifths of the light is thus destroyed, leaving one-fifth for actual service. But Prof. Stratton has found reason to question whether even this much is really available. He finds that if a white light be reduced to the point where it is just visible and then strained by a red glass, no light at all will be visible. This is as we should expect. But then he tells us that he has never been able to get visibility for the red with less than an increase of eighteen times in the laboratory.

Experimenting outside over a stretch of 4,000 ft. and under conditions by which the red was favored relatively by smoke, he has never been able to get visibility short of an increase of fourteen times. These, he states, to be the best results. On the average the light has to be increased about thirty times to bring out the red. This is not a question of color-blindness, but of the relative value of red and white lights for normal persons. Whether this same average of relative value would be increased or decreased for stronger lights, we are not told. This is apparently an important condition which it would seem should be tried in some future experiments. In the meantime, however, it is not to be denied that red is probably an exceedingly weak light under all conditions as compared with the intensity of the white light back of the glass. The matter seems to vary for different persons. He mentions the case of a man capable of passing the regulation color examination who was unable to detect the red light until the intensity was made seventy times that required for the white.

The ordinary white light and for safety signals is bright and consequently effective from the point of view of intensity, but it meets with objection for another reason. That is, it is the same light as that used by the public generally. Consequently, when a white safety signal is really out and the engineer should be on the alert because of its absence, he is liable to think he sees it and has a safe track because of an ordinary house-light burning in a dwelling nearby or in line with the usual location of the safety light. Prof. Stratton cites the case of the wreck at Whittenton Junction, Mass., several years ago. Here the engineer thought he saw the safety light, only to find upon collision with another train that something was indeed wrong. The lantern depending from a street-crossing gate had been mistaken for the safety light. Another instance occurred in the South. A light in a bay-window was in line with the railway safety light. This house light the engineer mistook for his safety signal when one night the latter was in reality out. This mistake entailed a serious accident.

As was stated before, smoke favors red. Indeed, it has the effect of giving a reddish cast to white lights. This would hardly be considered dangerous as it would merely lead to over-caution. Unless, indeed, we take into account the psychologic tendency of rendering a man careless who has been often made alert to no purpose by safety lights showing reddish. But smoke has a very serious effect upon green lights, tending to render them pale and ineffectual. They are then liable to be mistaken for white safety lights, and so lead to trouble.

Now, if the difficulties arising from the lights themselves are so great, it becomes a question of very great importance that the eye to which they are presented shall be fully competent for its duty. But what is that duty? Is it simply to be able to tell green from red and yellow, and so on? By no manner of means. The engineer is oftentimes called upon to discern correctly a light and do it with quickness and certainty. This must be accomplished in addition to the performance of a great multitude of other duties. In the engine-cab he has something more to do than merely assort skeins of worsted and the like. His attention is taken up with many things. It is requisite therefore that the appeal of the signal be emphatic. But then, the light itself may be burning dimly or the glass may be covered with the effects of smoke. Or, the atmosphere itself may be full of mist or rain or snow or smoke. Instead of a bright red light there may be dimly burning flame losing the bulk of its rays at the smoky, red strainer, and compelled to send the feeble remaining rays through a cloud of smoke and haze. If these reach an engineer who is with difficulty able to pick out the colors when in a comfortable room with the examiner, and having all the time he requires, can we expect that he will be put sharply on the alert for danger?

How about the man who cannot be described as color-blind and who is yet to be considered normal? He is technically known as the "abnormal." He can distinguish the colors, if the conditions are good. But if the conditions are unfavorable he is very liable to fall into error. Such men are usually able to discern correctly the three colors, red, green and white, when the light is fairly strong and some little time is given, provided the colors are shown separately. When combinations of colors and also combinations of brightness are presented to them, they are apt to become confused or irresolute.

This subject of the unreliability of the so-called "abnormal" man has received the expert attention of one of the most prominent of the psychologists of Germany. Prof. W. A. Nagel is the editor of *Zeitschrift für Sinnesphysiologie* and is himself color-blind, being a green dichromat. But his experiments, not upon the color-blind, but upon the color-weak, the "abnormal," are of importance as helping to elucidate an obscure subject. Prof. Nagel seeks to imitate very closely, conditions as they are realized in actual service, although his experiments are laboratory ones. Thus the varying distances of a signal light he imitates by passing the light through holes of varying sizes. In fact, he uses six different sizes of field varying from about 1/25 in. in diameter to about ¼ in. To vary the intensities, he uses ground glass, inserting one or two pieces, then securing in all three variations of intensity. Combined with the six variations for distance, he is thus able to produce for each color 18 combinations of intensity and distance. The colors are obtained by standard railway glass.

The table which is subjoined represents three experiments upon three different subjects, none color-blind, but all "abnormal." The letters used indicate the colors, the numerals after the letters, the size of field (representing six varying distances). The mark (′) and (″) are to be understood as indicating degrees of dimness, secured by inserting one and two pieces of ground glass.

It will be observed that mistakes were made. Thus in experiment No. 12, a dim and "distant" red (r2″) is actually called green after the subject apparently began by calling it correctly, but subsequently changed his mind. The same person calls a "nearby," but dim, white (w6″) a green. In the other experiments errors are also made of a similar character. These are for lights shown separately. Upon considering the displays of three lights at a time, there are numerous mistakes to be found. This is the point where the "abnormal" is very weak, that is, where differently colored lights are simultaneously shown.

Experiments Upon Three "Abnormals" or Color-Weak Persons.

Experiment 12 Subject: K. (red-abnormal)		Experiment 15 Subject: S. (red-abnormal)		Experiment 14 Subject: Dr. A. (green-abnormal)	
Shown	Named	Shown	Named	Shown	Named
w 2	w	r3 r4 w3′	r? r? g	g 3	w
r 2	r	w3 g4 g3	r w(g) w(g)	w 5′	w
r 3	r	g6 w6′ r3	g w r	r 3′	r
g 3	g	r6 r6 w3	r r g	g 2	g
g 2	g	r5 r3″ r6	r g r	g 4′	g
w 1	w	g6 g3″ g6	g g g	g 6″	w
r 4″	r	w2 r3 w6	? r w	r 6″	r
r 2″	(r?)g	w4 r6 w6″	g r g	w 5″	r(w)
g 1	g	w2 w6 w6	? w w	g 3	r
r 2	r	r4 r2′ r6	r g r	g 3′	r
r3 w3 r3′	r w g	r6 r2′ r6	r g r	w 3″	g
r2 w2 r2	r(g) w g(r)	r 2	r ?	w3′ r4 r5	g w w
r2 w1 r2	r g r	g 6	g	w3 w5 w6′	g g w
g 1′	g	g 5″	g ?	r3 r5′ r6′	r r r
w3″ r3 r3	g r g	r 2	r	r3 w5 r6	r g r
r3 w3″ r3	r g g	w 4′	(w, r?)	r6 w6″ r6	w g r
w3 w3″ w3	w r w	w 2′	(w, g?)	r6 r3″ r6	r g r
g3 r3″ g2	w r g	w 3	r		
r6 w3″ r5	(w)r g r				
r6 w3 r5	r w r				
w3″ r3 r5	g r(g) r				
w3″ r3 r5	g r (g)r				
w6 r6 g6	g r 6				
w 6	w				
w 6″	g				

What the table does not show very well, and what Prof. Nagel emphasizes is the vacillation of the "abnormal." Thus where the table may indicate the correct reply, observation of the subject frequently showed that he was very hesitant.

The exact apertures were 1, 2, 3, 4, 5 and 6 millimeters. The numerals in the table are these numbers. This aspect of the question of signalling is full of difficulty. Perhaps the ideal thing to do would be to abolish colored lights and adopt a suggestion of Prof. Stratton. He thinks that there should be movement of the signal, as motion is something to which we are all very alert. Or, to have a luminous signal whose form would convey its message, as for instance, a horizontal, a slant and a vertical line of light. This lines would of course have to be brilliantly illuminated.

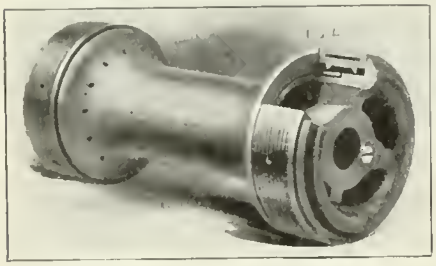
Perhaps the best method would be automatic devices operating in case of danger to bring the train to a standstill independently of the engineer. Such a device is used in the Hudson tunnel and in the New York subway and on the Boston elevated. A device which would make it impossible for the railway train to proceed in the face of danger is the ideal danger signal.

An interesting circular has been got out on the subject of sight feed oil pumps, by the Sight Feed Oil Pump Company of Milwaukee, Wis., and they show the appearance and mechanism of the Richardson automatic pump, model M. in this circular. The beauty of the pump sight feed is that if one bearing requires more oil than another it can get it and the man in charge can see how much it gets compared with the others. In this connection they say: "A Richardson pump contains a combination of simple and efficient pumping units, each one actuated by a common gear, each one pumping just the quantity for which that feed may be set to that particular part of the engine to which it may be piped, independently of pressures or temperatures at these points." The circular or small catalogue, if you wish to call it so, gives concise information, sizes and prices. If you are interested write to the company for a copy.

A grateful correspondent writes: "I have not enjoyed the benefit of an engineering education, and although I am considered a good fireman, I never could understand how the steam got in and out of the cylinders. When I received what you call chart No. 10 with my January number of RAILWAY AND LOCOMOTIVE ENGINEERING, I proceeded to study it, and now the puzzle of steam admission and release has been made clear. It is no longer a puzzle. I consider the information gained is worth much more than the price of the paper for five years."

Semi-Plug Valves.

The name semi-plug valve has more or less puzzled some of our readers, and the description which follows explains why the makers use this name as well as the general characteristics and operation of this form of piston valve. One of the types of locomotive valves made by the



SEMI-PLUG PISTON.

American Balance Valve Company, of Jersey Shore, Pa., is called semi-plug, because, while it is without steam, it is a snap-ring valve, that is, the packing rings are expansible and fit themselves to the valve chamber, but when the throttle is opened the steam admitted to the chest is allowed to enter the space below the rings, and the action of this pressure is to lock the snap rings at a fixed diameter, making practically a plug of it during the time the pressure is on. In order to secure proper service, it is necessary to maintain the cages true so as to have steam-tight valves.

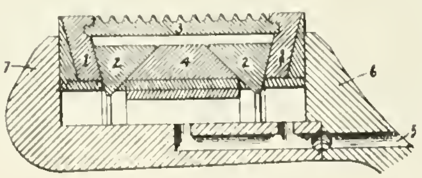
In addition to this it is necessary to prevent lateral wear. In order to accomplish these results the company have designed the semi-plug piston valve on the principle of leverage by wedges, the pressure acting upon the wedges. In the valve the wedges take the form of cones, or circular wedges.

The outside walls of the snap rings, 1, 1, are straight, and fit against the straight wall of the follower and spool. The inner walls of these snap rings are beveled, forming a cone. Next to the snap rings are wall rings, 2, 2, the sides of which are beveled to fit the cones of the snap rings. These are called wall rings, because they form the inner walls for the snap rings. These wall rings are uncut, non-expansible, steel rings. Between these wall rings, in the center, is placed a double-coned expansible ring, called a wedge ring, 4, and which, with the wide ring, 3, interlocked into each snap ring forms the complete packing. The wide ring, 3, has two functions: it carries the snap rings across ports while drifting, and it keeps the snap rings parallel with each other.

When we examine the operation of the semi-plug valve we find wedge ring, 4, is put in under tension; its tendency therefore, is to crowd the two solid wall rings laterally against the cone sides of the snap rings, 1, 1. This prevents lateral wear of all rings. The degree of angle on the cones is much greater on the double-tapered wedge ring than on the snap rings. These angles are so calculated that, while the pressure is underneath all the rings, the leverage of the double-tapered wedge ring, crowding the solid wall rings against the cones of the snap rings, is just sufficient to prevent the snap rings from further expansion, but not sufficient to reduce the snap rings in diameter. The frictional contact of the snap rings against the valve chamber depends entirely upon these angles, and it can, therefore, be regulated to any desired degree.

When steam is admitted to the steam chest, it passes through the small holes around the spool and finds an outlet, first under the first snap ring, and, second, under the central wedge ring. There are from 14 to 18 holes in the end of a valve. The pressure of the steam passing through these holes on the first snap ring insures its fitting the valve chamber, and the action against the wedge ring is to place it in position for the pressure to lock up the rings.

The packing consists of the combination of rings, which are free to move up and down on the spool, so that the rings may fit the cage perfectly correct, regardless of any variation in the position of the spool. As it is injurious to the valve cage to allow the spool to ride on it, the spool is carried on the valve rod. This may be accomplished in any desired



DETAILS OF PACKING RINGS.

way, but is the one essential feature in using this valve.

The locking effect of the double-tapered wedge ring, 4, when it is expanded by pressure underneath, thus crowding the two solid wall rings, 2, 2, laterally and holds them, as it were, with a predetermined force against the cone sides of the snap rings, 1, 1. It will be understood that by putting sharper cones on the sides of the snap rings and making the solid wall rings to correspond, the force of the double-tapered wedge ring, crowding the wall rings laterally on a sharper cone, would decrease the diameter of the snap ring, regardless of the pressure beneath it, under which conditions the leverage would be too great and would permit a blow over the outside of the snap ring. On the other hand, if the angle on the snap ring was lessened and the cone made flatter, with wall rings to correspond, then the wedging action of the central wedge ring would not be sufficient to hold the snap rings from expanding by the pressure underneath them, and this would result in excess friction against the valve chamber, caused by inefficient leverage to lock the rings. The same effect can be produced by changing the degree of angle on the double-tapered wedge ring.

It will be seen that at whatever diameter of the cage the snap ring is locked up, in that diameter it will remain, unless it is locked up in the large part of a worn cage, and the movement of the valve would force it down into the smaller part of the cage, under which conditions the snap ring would be forced down to the diameter of the cage at the smallest part. The snap ring would then remain equal to the smallest diameter of the cage, and when the valve traveled back to the large part of the cage, there would be a blow over the outside diameter of the snap ring. This valve is intended not to wear a cage out of true, and it is important that the valve be put into a true cage in the first place.

The valves are made for inside or outside admission, and have been made for both, that is, reversible. The rings of this valve are all machined in their working diameters. The packing rings are properly lapped with a solid steel joint-plate, the side of which is beveled, bringing it to a sharpe edge at the periphery of the ring, thereby avoiding any notches in the steam or in the exhaust lines of the valve.

Awfully Clever.

The clever young man was wandering up and down the platform of the railway station, intent upon finding an empty carriage in the express which was almost due to start. But, alas, his search was in vain. Still, it is difficult to disappoint a clever young man when he is intent upon getting something. An idea occurred to him, and, assuming an official air, he stalked up to the last carriage, and cried in a stentorian voice:

"All change here! This carriage isn't going!"

There were exclamations low but deep from the occupants of the crowded compartment; but nevertheless they scurried out of the carriage, and packed themselves away in other parts of the train.

The smile on the face of the young man was childlike and bland as he settled himself spaciously in the corner of the empty carriage, and lit a cigar.

"Ah," he murmured, "it's a grand thing for me that I was born clever! I wish that they'd hurry up and start!"

Presently the station master put his head in the window and said:

"I s'pose you're the smart young feller what told the people this here carriage were not going?"

"Yes," said the clever one. And he smiled a dazzling, seven-carat smile.

"Well," said the station master, who was somewhat of a smiler himself, "she ain't. The porter heard you telling them people, and he cut her off. He thought you was a director of the road."—*Sunday School Messenger.*

Bulletin No. 26, High Steam-Pressures in Locomotive Service, has just been issued by the University of Illinois Engineering Experiment Station. It is an abstract of a report upon the same subject which was published last year by the Carnegie Institution of Washington, D. C. It summarizes the results of one hundred locomotive tests conducted by Dr. W. F. M. Goss under the patronage of the Carnegie Institution in co-operation with the authorities of Purdue University. The tests were run in six different series, the boiler pressures for the several series varying from 120 to 240 lbs. The results presented include concise statements concerning the effect of changes in boiler pressure upon power capacity and upon steam and coal consumption per unit power developed. The general question as to whether it is better to increase the weight of a boiler thus making it stronger so that it may carry heavier pressure, or making it bigger so that it may have more heating surface is dealt with, and the conclusion drawn from this discussion, based upon data presented, is to the effect that single expansion locomotives using saturated steam are most efficient when operated under a boiler pressure of 180 lbs. When this limit of pressure has been reached, any further increase in weight which may be possible, should be directed toward securing increased boiler capacity rather than higher boiler pressures. Copies of this bulletin may be obtained gratis upon application to the Director, Engineering Experiment Station, Urbana, Illinois.

There have been hundreds of books published treating of link motion in the effort to make a puzzling subject clear, but most of them are about as transparent as a mud puddle. An eminent exception to this is the Locomotive Link Motion, by F. A Halsey. This book, which is finely illustrated, gives in plain language particulars about link motion that enables a student to grasp the subject so thoroughly that he can design the valve motion for any form of steam engine. Yet this treasure of information costs only one dollar.

Standing Alone and Quite Happy.

There have been various rumors afloat concerning the combination or consolidation of some of the car lighting and axle light companies. Whether or not such a combination has been effected, we are not prepared to state, but we are authorized by the Consolidated Railway Lighting and Equipment Company of New York to say that they are standing alone as in the past and are in no way affected by whatever combinations may be brought about among the others. The Consolidated Railway Lighting and Equipment Company have been doing a good business and the officers of the Consolidated look forward to a still more prosperous year to come, but in any case they intend to go it alone.

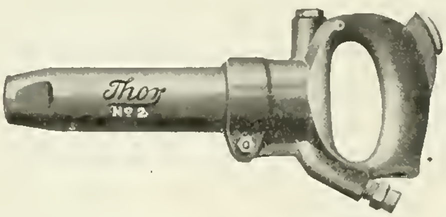
Thor Pneumatic Hammers.

The Independent Pneumatic Tool Co. with offices in New York, Chicago, Pittsburgh and San Francisco, report that they have received an unusually large number of orders for their Thor pneumatic hammers from railroads and boiler shops since the first of the year. The most apparent characteristic of the Thor pneumatic long stroke riveting hammer is its one-piece construction. Handle, barrel and valve chamber are all embodied in one solid piece of steel. The main object of this is simplicity in construction and an absolute certainty that no part will work loose during operation. The further marked departures in this hammer are the placing of the valve on one side of the barrel, allowing piston to overlap the valve in its upward stroke.

Another important feature is the auxiliary valve. This entirely overcomes the shock generally caused by the too sudden reversing of the piston at the end of the return stroke. In this case the piston on its return opens the small auxiliary valve by cushion. The piston is thus first retarded by cushion, secondly, started on its downward stroke for a short distance by a comparatively small amount of air from the auxiliary valve, later it passes the main inlet from the valve proper, and thus obtains the highest possible speed in its downward stroke.

Another feature is the inside safety trigger. When not in use this trigger will fall away from handle by its own weight. When the hammer is picked up, the workman having his fingers between the hammer handle and the trigger, the hammer cannot be discharged while carrying or while waiting for a rivet. As the trigger is short it is not necessary to release the entire grip of the handle when again getting in position to operate hammer. It is obvious that in leaving the trigger on the inside of the handle it is practically impossible to start hammer accidentally when it is laid away or accidentally dropped; because the trigger is entirely protected by the handle and the hammer itself. Another point is that the outside of the handle is perfectly smooth. The workman has, therefore, a large area of smooth surface on which to exert a pressure on the handle in riveting.

The Thor chipping, calking and beading hammers consist in the main of a barrel, valve block and handle, the barrel being screwed into the handle and clamping the valve block between the two. A special style of milled thread is used in this case which together with the locking device employed, holds the barrel securely. This hammer has two valves placed in alignment in a block transversely to the piston. Being two in number they work practically simultaneously and can be of small area and very light. This arrangement eliminates vibration from the valve. Both valves open and give a practically unobstructed central inlet for the downward stroke. One valve takes care of the exhaust of the downward stroke and the



THOR NO. 2 HAMMER.

other the exhaust of the return stroke. The valves have constant live air on their inner and smaller area and when released the live air is very close to the barrel. The outer and larger area of these valves differs in diameter, therefore one will release a trifle ahead of the other, which gives the plunger a slight impulse at first on its return stroke, which is immediately followed by the other valve opening full and giving an increasing velocity and volume of air for the power stroke.

In addition to the pneumatic hammers, the Independent Pneumatic Tool Co. manufacture a complete line of piston air drills, reaming, tapping, flue rolling, wood boring and grinding machines. They state that they will send any of their pneumatic tools on 30 days' trial at their expense.

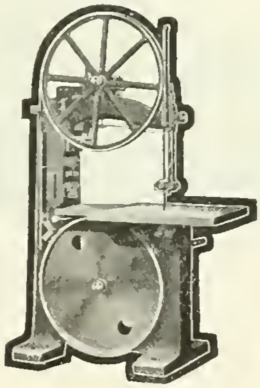
For the past five months the daily output of the tie treating plant of the Mexican Central at Aguascalientes has been about 3,500 ties. The treatment consists in using Ebano oil. With one exception in the United States, the Aguascalientes plants is the first in the history of railway operation to make a success of the oil process. It is too soon to judge of the effect of the oil, but it is expected to prolong the life of ea tie from 8 to 12 years. The ties are placed in huge cylinders, which are then filled with oil and subjected to heat and pressure for seven hours. The average tie absorbs a little more than three gallons of oil. The oil used contains a large amount of solid matter which, being forced into the wood, is expected to act as a preservative. The average penetration into pine ties is about 2 ins. In harder woods it is less, but in all cases the oil is expected to keep out moisture for years.

Good Business Record.

We are in receipt of a letter from the well-known firm of J. A. Fay & Egan Co. of Cincinnati, Ohio, stating that since their No. 50 Band Scroll Saw was put on the market six years ago, they have made and sold 2,000 of them.

Some of the points which have contributed to the success of this machine may be enumerated, and our illustration shows what the band scroll saw is like.

The square form of column gives it rigidity. The solid lower wheel and the extremely sensitive straining device indicates high speed, which is essential to fine and intricate scroll cutting. This straining device is a special feature, and consists of a knife-edge balance for the upper wheel counterbalanced by a compound lever and weights. No matter what the vibrations are, it takes up the slack in the blade instantly, thus adding to the perfect working of the machine and the life of the saw blade.



BAND SCROLL SAW.

The lower wheel is webbed or solid, instead of having spokes; this prevents the circulation of sawdust. The solid wheel increases the momentum, and, being heavier than the upper wheel, controls its movement, there being thus no possibility of overrunning. The upper wheel can be raised or lowered while the machine is in motion, and all the different adjustments, such as stopping of feed, etc., are easily and quickly made. The manufacturers claim that a skilled operator can do much more on one of these machines, especially so where fine, intricate scroll work is desired, than can be done on the usual form of band scroll saw; and this saw handles light or heavy wood with equal facility.

For detailed information you are requested to write to the manufacturers, who will be pleased to send you full particulars by return mail.

High Rate of Travel.

On most American railroads the fare charged for transporting a dead person is the same that would be charged if the person were alive. On European railways the transportation of corpses comes high.

During a snowstorm on the Highland Railway a train was held up for an hour or two. The guard, a cheery Scot, passed along the carriages trying to keep up the spirits of the passengers. An old gentleman angrily complained that if the train didn't go on he would "die of cold." "Tak' my advice an' no' dae that," replied the guard. "Min' ye, we chairge a shillin' a mile for corpses."

Report on Railway Accidents.

In the annual report of the Public Service Commission for the second district it is stated that the purpose of the investigation was to get at the causes of railroad accidents and that the chief end to be attained is the protection of the employees themselves.

The report says, "They are unquestionably the greatest sufferers from existing conditions; they encounter the greatest dangers and the commission earnestly hopes for their active co-operation in the measures which it hopes to inaugurate for their benefit."

Attention was called to the fact that in order to proceed with this investigation the working force of the commission would have to be enlarged, accident inspectors to go out upon the trains of the various railroads and ride with the men themselves and observe the conditions under which operations are carried on. Additional inspectors are also asked for in the locomotive boiler inspection department, and for the inspection of electric railroads.

Since the commission's report was issued, meetings of the legislative boards of the Brotherhood of Locomotive Engineers and of the Brotherhood of Locomotive Firemen and Engineers have been held in Albany and resolutions were adopted commending this work of the board.

We are informed by the American Specialty Company of Chicago that Schedule of Supplies No. 833, Hardware and Tools, Bureau of Construction and Repair, of the U. S. Navy (Eastern Yards) contained request for bids on 12 dozen "Use-Em-Up" Drill Sockets. These sockets are similar to the standard taper socket with the exception of a flat on the inside, and are designed to use up taper shank drills having the tangs twisted off or the shank broken. They are now in use by the United States Government in 27 different places, as well as in 6 places by the Government of Canada, and 2 places by the Government of Mexico. They are manufactured and sold by the American Specialty Co.

One of the many funny stories told by Harry Lauder during his American tour referred not to the sons of Auld Scotia but to a son of the Emerald Isle. Lauder described the meeting of a railway track-gang foreman with a man of the laboring class who had a request to make. This man applied for a job. The foreman, off his guard for the moment, referred to the melancholy fact that his force was being cut down by the railway authorities instead of being increased. "In fact," he said, "there is not work enough for the men I have, and I can't see how I can give you a job. If I took you on it would take work from someone else." "No, it wouldn't," quickly responded the applicant, "you might very well give me a job for all the work I'd do."

The Detroit Seamless Tubes Company of Detroit, Mich., have been sending to their friends a neat little card on which they say that a boiler full of lap-welded tubes carries a weld approximately a mile long. The substitute which they offer is a cold-drawn seamless open-hearth steel tube, and they say that its name fully explains what it is. If you are anxious for a little more information on the question of steel tubes for locomotives or if you want a look at the card, write to the company direct; a post card will bring a reply from them.

Automatic Cylinder Cock.

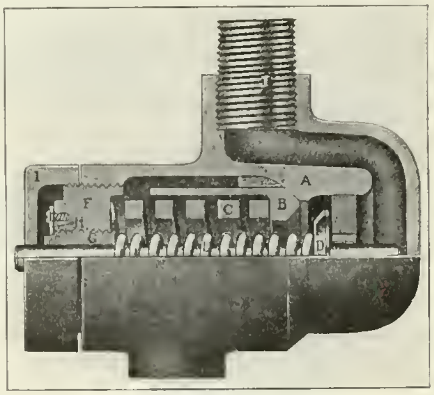
A locomotive engineer on the New York Central Lines living at Worcester, Mass., has got out an automatic cylinder cock which relieves the cylinders without any attention from the engineer, in fact there is no connection from the cylinder cocks to the cab. Mr. F. C. Miller, the inventor, calls it an automatic drainage relief and compression valve.

In our illustration we show a section of the device. The nipple J is screwed into the cylinder. The part marked B is a high-pressure valve held to its seat by the heavy coil spring C. The smaller valve D is the drainage valve, and its seat is in the larger high-pressure valve B, but the drainage valve is normally held open by the light coil spring E. The two coil springs are adjusted by the nuts contained inside of the cap I. The heavy coil spring C is set above boiler pressure. The smaller spring E is adjusted so as to hold the valve open against exhaust pressure but permits it to close at once under the pressure of live steam.

When steam enters the cylinder, as at starting the engine, this valve closes. As soon as the exhaust takes place the drainage valve D opens and allows the water of condensation to escape. When the engine is running the compression taking place in the cylinder holds the valve so that there is practically no leakage. When there is an excessive quantity of water in the cylinder the drainage valve is forced down on its seat on valve B. Then both these valves act as one and open together, giving a wide aperture for the rapid escape of the water.

With this valve opening automatically, as it does when steam is shut off, the water is drained as fast as it condenses, therefore no water is worked through the valves and cylinders and the lubricant is not washed out.

While the engine is drifting the drainage valve remains open, which permits the entrance and exit of air. It is in fact a small relief valve and any excessive pressure of air, water or steam is capable of unseating the valve B and so relieving the strain.



AUTOMATIC CYLINDER COCK.

Trespassers on Railways.

From reports compiled at the general offices of the Pennsylvania Railroad, it appears that the number of trespassers killed on the system east and west of Pittsburgh in 1908 amounted to 657, while the number of those injured were 701. In 1907, no less than 822 trespassers were killed, so that in two years nearly 1,500 persons lost their lives in this way.

While it is gratifying to observe that the gross number of casualties is diminishing, it is a deplorable fact that the large death rate on American railways which is so constantly and severely commented upon by the European press arises largely from what may rightly be called the criminal negligence of the unfortunate persons themselves. Several causes lead to this which might be more strictly guarded against if proper legislation was enacted, making it punishable by severe penalties for other than railway employes to be found on the right of way of railways. In European countries the people are so accustomed to the strictness of the enforcement of all laws against trespass that no one thinks of venturing on a railway track any more than one would think of venturing uninvited into a private garden. The result is that trespassers on railways are extremely rare and promptly and severely punished when arrested.

Something also might be said in regard to the better fencing of American railways, but even where the fences are of the best, as in many portions of the Pennsylvania railroad, the fences do not diminish the number of trespassers. The subject is one which should engage the attention of the Railway Commissions, and it would surely be quite fitting that these bodies should consider reasonable and legal means calculated to safeguard human life.

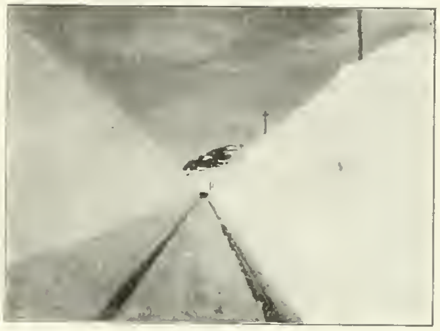
The recent completion of the thousandth locomotive constructed in the locomotive works at Milan, Italy, was the subject of an enthusiastic celebration among the employees as well as workmen, from the neighboring manufactories. Four of the company's officials were honored by the Italian government by having the Order of the Crown of Italy conferred on them. Commemorative medals were given to the workmen recording their merits and years of service. The locomotive was of the 2-6-2 compound type, with four cylinders, and was ordered by the State Railways of Italy.

The Cleveland Twist Drill Company of Cleveland, Ohio, in a recently issued folder approach the mechanically-minded public by saying: "You believe in high-speed drilling, and very likely in high-speed milling, why not high-speed reaming?" The catalogue No. 36, which they have recently issued, gives particulars of the "Peerless" high-speed reamers, which they have put on the market. The blades in these reamers are kept in place by what they call the Brazo-Hardening process. The blades are made of high-speed steel. They are, by this process, made one with the soft steel body of the reamer and cannot work loose. In fact, the company feels so sure of their ability to make a good job of thus permanently placing of the reamer blades that they are willing to replace any "Peerless" reamers when the blades show any sign of coming loose. Get the company to send you their catalogue and folders, read them over, and try a reamer.

"PEERLESS" SHELL REAMER.

Pennsylvania Railroad Statistics.

Statistics recently compiled by the Pennsylvania Railroad show that the average of the 4,802 engineers of this company's lines is 44 years, and the average length of service is 21 years. This class of employees began service as young men and have gone through a course of training preparatory to becoming engineers. This is shown by the average age at which they were appointed engineers, viz., 31 years, while the average age at which they entered the service was 23 years.



SCENE ON THE BERGEN RAILWAY, NORWAY, LAST MAY.

Included in these figures are 134 locomotive engineers who have been retired from active service and are now receiving pensions. Their average age is 72 years. Up to the time they were retired these men had served an average of 43 years, 36 of which had been spent as engineers. Their present retired pay amounts to 43 per cent. of the average wages for 10 years preceding retirement.

A Cautious Scot.

A long-headed Scotsman had won a six-to-one bet on the horses. The sporting man begrudgingly handed him seven sovereigns. The Scot looked at each one very carefully before placing it in his pocket.

"Well," said the bookie, with a snarl, "are you afraid they're bad?"

"Oh, no," said the Scotsman; "but I was just lookin' to mak' sure the bad 'un I gie'd ye wisna amang them."

A new catalogue entitled "Pipe and Boiler Insulation" has just been issued by the H. W. Johns-Manville Co., of New York. This book is devoted to a thorough presentation of the problems of insulating all kinds of heated and cooled surfaces, such as pipes, boilers, furnaces, flues, ducts, etc., as well as insulation for refrigerating and cold storage work. The book is the most complete one of its kind ever issued to the trade and bears out the company's idea, "a covering for every condition." It is very handsomely illustrated and printed throughout. A copy of the catalogue can be secured by addressing the company's nearest branch and asking for Catalogue No. 100.

Arad-Csanad Line.

By A. S. Martin.

On one of the railroad lines in Hungary there is a train made up of petrol-electric motor cars and trailers, and the system has proved to be quite satisfactory after several years' regular running. The line in question is known as the Arad-Csanad Railroad, and it takes in a number of branches which connect some of the leading cities such as Szegedin, Arad and Brad, the total length of the railroad lines being about 340 miles. Since the first use of the petrol-electric trains six years ago, these have now covered over 2,000,000 train miles, and there was found a considerable increase in the traffic of the road after the new trains came into use. While other light railway companies realized an increase of but 6 per cent. during the period, the Arad-Csanad company had an annual increase of 25 per cent. and over, showing the good results obtained by the petrol-electric trains. We illustrate one of the locomotives, or motor cars, and the train.

Two sizes of outfit are used for the motor cars, there being a heavier outfit for 80 h. p., and a lighter one which gives 30 h. p. In both cases the petrol-electric equipment is installed on the same lines. This includes a gasoline motor group mounted on the same foundation, with a generator of the railway type. Current is supplied by the generator to the electric motors, mounted on the car axles. Single-reduction gearing is employed between motor and axle. On the roof is installed the radiator for the water cooling. The motor car is also provided with a controller for operating the motors, also with a gasoline tank for the petrol motor, and other appliances.

As concerns the 80 h. p. locomotive, which is illustrated here, the net weight of the locomotive in service is 17 tons. It has the space not occupied by the stationary motor cabin and the motorman's cabin fitted out for passengers, using a first-class compartment, which holds 15 passengers, and a second-class compartment for 25, making 40 in all, seated. Such a train has a radius of operation equal to 200 miles. At the present time there are in regular service on the Arad-Csanad lines 14 locomotives of the 80-h. p. type. With the motor car running alone for high-speed service, the standard speed is 40 miles an hour. Using one trailer it can also make the same speed, the load in this case being 35 tons. When four trailers make up the train a slower speed of 20 miles an hour is used. The total weight of the latter train is divided as follows: Weight of the locomotive, 17 tons; four trailers, weighing 7 tons each, 28 tons; 222 passengers, 18 tons; baggage, 3 tons, making the total weight 66 tons for the train. A lighter locomotive is also employed, using a 30-h. p. outfit. It has a net weight of 14 tons and a radius of action of 120 miles. There are now 22 locomotives of this type in service. More recently there has been put in service a lighter unit of 22 h. p.; also on the petrol-electric system. The Westinghouse petrol motor is used in these cases. M. Sarmezey, president of the company, was efficient in promoting the present enterprise.

MOTOR CAR AND TRAILERS, ARAD-CSANAD RAILWAY, HUNGARY.

Thermit Repairs is the name of a paper-covered booklet which fits the pocket and gives information about how Thermit welding is done, and the illustrations carry conviction to the mind of the reader. Locomotive driving wheels, cylinders, frames, and a lot of other things are susceptible to treatment by this process after they have been broken, and more often than not the broken parts need not be removed from their place in the engine. A lot of tool parts or appliances used about a shop can be repaired in this way, and a glance at the booklet shows the extent and variety of the broken things which Thermit brings back to useful and efficient service. In fact Thermit "makes good." Write to the Goldschmidt Thermit Company, 90 West street, New York, and ask for a copy of this booklet.

Cure for Fits of Weakness.

"Alas!" confessed the penitent man, "in a moment of weakness I stole a carload of brass fittings."

"In a moment of weakness?" exclaimed the Judge. "Goodness, man! what would you have taken if you had yielded in a moment when you felt strong? To guard you against more fits you will do hard work in the penitentiary for five years!"

Self-Propelling Breakdown Cranes.

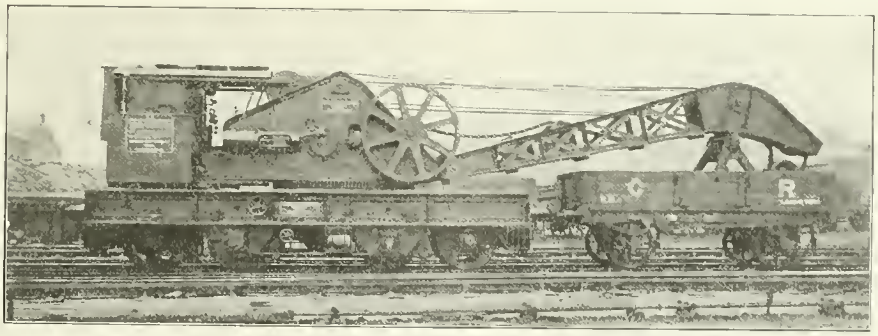
The breakdown equipment of the Caledonian Railway has just been supplemented by a novel feature in the form of two twenty-ton self-propelling steam cranes built by Messrs. Craven Bros. Ltd., Manchester, on the order of Mr. J. F. McIntosh, the company's locomotive carriage and wagon superintendent.

The under-carriage is built of steel plates and girders, braced by cross-beams and carries a massive foundation casting, fitted with a forged steel center post of large diameter. The foundation is fitted with a steel roller path, and a circular steel spur rack in halves for slewing. The under-carriage is mounted on four pairs of wheels, two pairs of which are carried in a swivelling bogie, fitted with axial slide, the bogie center being carried by a heavy steel beam, rivetted between the side frames of the carriage. The other two pairs of wheels are carried by horn plates rivetted to frame sides. This arrangement enables the crane to take curves smoothly and without grinding. To the four traveling wheels, brakes are fitted, operated by a hand-wheel from the side of the carriage, and a relieving gear is also fitted so that the weight of the boiler and balance weight may be taken off the center post when the crane is not working. The revolving superstructure is placed on two heavy steel beams, carrying a heavy steel center, fitted with rollers which revolve on the steel path on the under-carriage, and horizontal rollers, which revolve round the center post.

There is a platform placed between the boiler and the crane, from which the operator can control all the movements of the crane, and conveniently attend to the boiler. All the motions for hoisting, slewing derricking and propelling, are worked by a pair of high pressure reversing engines 8 ins. diameter, by 14 ins. stroke carried on the crab sides, one cylinder on each side of the crane, and driving on the crankshaft from which all the motions are worked. The hoisting gear has two speeds, and the lowering is controlled by a powerful brake on the second motion shaft. The load is carried on two strands of 1¼ ins. diameter, made of best quality crane chain, one end of which is securely attached to the grooved chain barrel, then passes over pulley at point of jib, under pulley in lifting block, and is fastened to shackle at point of jib by a hook, which may also be used for two speeds of lifting by single strand of chain for lighter loads. The derricking is worked by worm gear, the angle of the thread which is self-locking, so that it is impossible for the jib to run down. The slewing is worked by bevel and spur gear, driving a pinion gearing into the slewing rack. This motion is fitted with a brake to control the slewing. The self-propelling is worked from the second motion shaft, by bevel gear driving a pinion gearing into an intermediate wheel concentric with the center post. All the gears, axles and shafts are of steel, and the bearings are made of gunmetal.

The leading dimensions of this machine are as follows:

Maximum radius with full load, 21 ft.; height to centre of jib head pulley at 21 ft.; gauge of rails, 4 ft. 8½ ins.; extreme wheel base, 18 ft. 6 ins.; cylinders, 8 ins. diam. x 14 ins. stroke; boiler, 4 ft. 9 ins. diam. x 6 ft. 9 ins. high; speed of self-propelling, about 2 miles per hour; working load, 20 tons; officially tested to 25 tons.



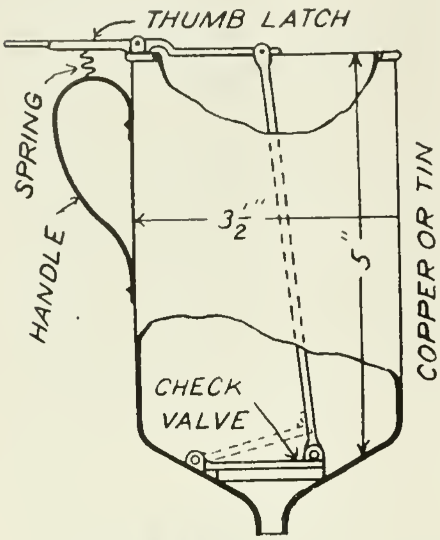
BREAKDOWN OR WRECKING CRANE ON THE CALEDONIAN.

The American Specialty Company of Chicago have closed a contract with the high Speed Drill Company of Dubuque, Iowa, whereby they take the entire output of the Drill Company and become the exclusive sales agents for the complete line of the celebrated flat and flat-twisted high speed drills. This line comprises machine shop, structural, blacksmith, ratchet, track drills, etc. These drills are radically different from the majority of high speed flat and flat-twisted drills now in use, as they have the common standard taper shank, and will therefore fit any standard drill press, air drill, electric drill, ratchet, etc., without the use of special chucks of any kind. The entire line is also made with the common straight shank.

Above all things, don't condescend! Don't assume the attitude of saying, see how clever I am, and what fun everybody else is!—*Charles Dickens.*

Home-Made Oil Can.

The drawing shows a home-made oil can, described by a contributor to the *Practical Engineer.* The barrel and neck of the can are made of sheet copper. For the seat of the valve in the neck, a piece of brass pipe is used, and the valve itself is a leather disk fastened to a brass hinge. The latch, which



HOME-MADE OIL CAN.

runs up to the top of the can, is made of ¼-in. wire. The writer says: "After an engineer has once used this can for filling glass oil cups and bearings, he will never go back to the ordinary kind." It is a useful sort of can for filling sight feed lubricators, as by using it one can readily see what one is doing.

One Decade on the Lackawanna.

During the last ten years the Delaware, Lackawanna & Western Railroad have been steadily making progress and improving things generally. In that period there have been used 736,288 cubic yards of stone ballast on the roadbed. Such figures take on a new meaning when they are translated into terms we all understand. This amount of material, if spread evenly over the ground, would cover the surface of Central Park in New York to a depth of 6 ins. The park has an area of 843 acres.

The wooden ties used in the road if placed end for end would equal the polar diameter of the earth and stand out north and south some 1,500 miles, thus making a very respectable pair of handles for Old Sol to catch hold of if he wished to do so. The number of ties was 7,502,488 in all. The polar diameter of the earth is about 7,918 miles.

The amount of concrete masonry used on this road for bridges, culverts, foundations, etc., is 904,534 cubic yards. This amount would make a concrete sidewalk of the usual thickness, 6 ft. wide and long enough to reach from New York to San Francisco. The total tractive effort of all their locomotives used in the ten-year period have an aggregate equal to about 400,000 horses. That is more than the combined cavalry of several first class nations.

Extra Work Welcome.

Mr. W. C. Brown, just made president of the great New York Central Railway, was once a train despatcher on the Chicago, Burlington & Quincy; and this is the way he attracted the favorable notice of the authorities of the road:

It was in the late seventies. A great snow storm fell on East Burlington and swamped it. Three or four hundred carloads of stock lay in the yards, and Jerry Hosford, the superintendent, was at his wits' end to know how to get them into safety before the cattle were frozen to death.

At midnight Brown, having finished his trick, came over and offered his services. Hosford fairly fell upon him with joy, and they worked through the early morning hours saving the stock.

When day came "Tom" Potter, then the head of the Burlington, arrived, badly worried and expecting to find the stock a loss.

He was overjoyed when he found that it had been saved, and congratulated Hosford.

"I couldn't have done it," said Hosford, bluntly, "if it hadn't been for a young train despatcher named Brown, who came over to help me when his trick was done. That fellow is such a hustler that he could have saved double the amount if we had 'em to save."

The news that there was a train despatcher who, instead of going home when his work was done, actually volunteered to work outside of his particular line for a night, made an impression on Mr. Potter.

"I made a note of Brown then and there,' he said afterward. "But he never needed pushing. He furnished the motive power himself."—*C. E. World.*

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Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

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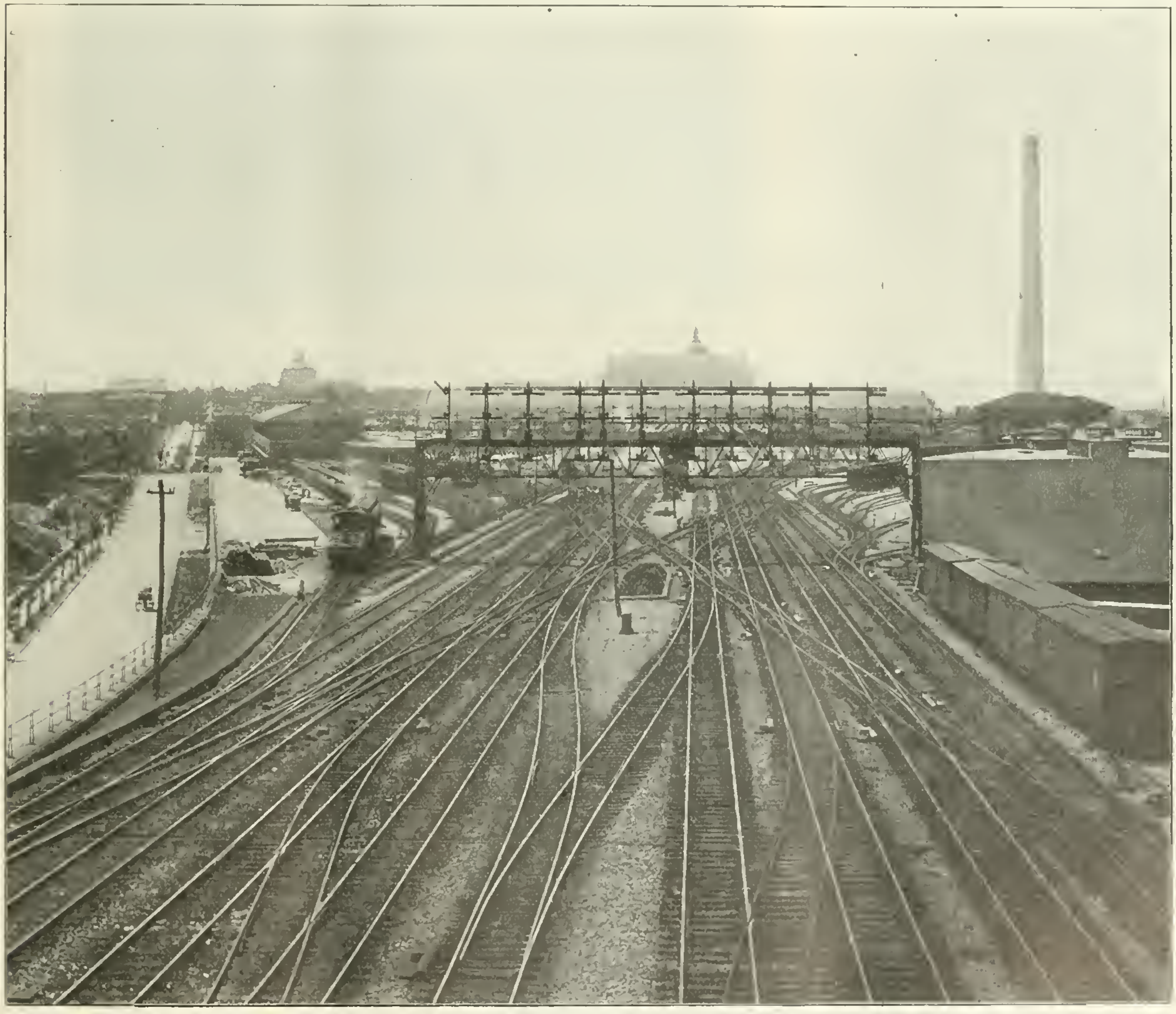
Washington Station Signal System.

The new Union Station at Washington, D. C., which is the joint terminal of the Southern Railroads, has been equipped with a very complete and elaborate signal system.



WASHINGTON, D. C.—LOOKING SOUTH TOWARD NEW UNION STATION. SIGNAL BRIDGE II IN THE FOREGROUND. DOME OF NATIONAL CAPITOL SEEN OVER ROOF OF STATION. CONGRESSIONAL LIBRARY TO THE LEFT.

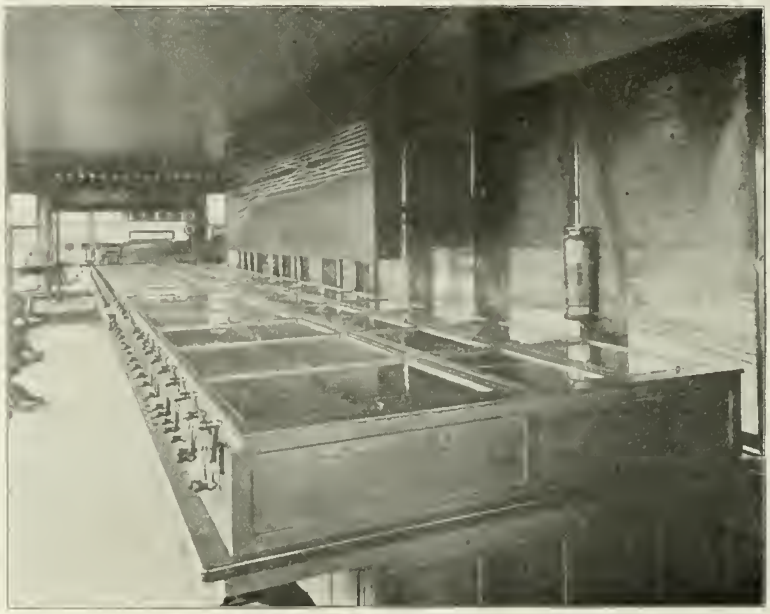
Pennsylvania, the Baltimore & Ohio, the Seaboard Air Line, the Atlantic Coast Line, the Richmond, Fredericksburg & Potomac, the Chesapeake & Ohio and the

The method used is what is known as the upper quadrant or three-position signal system. In this arrangement the semaphore blade is horizontal in the stop position, and at night this position displays a red light. The caution position is assumed when the blade is at an angle of 45 degs. with end of blade above the horizontal, and the yellow caution light is then visible at night. In the all clear position the semaphore blade is vertical, that is, parallel with the post, and a green light is displayed at night. In the all clear position the uppermost blade extends some distance above the post which supports the signal.

Some of the advantages claimed for the three-position or upper quadrant signal system is that in severe weather the signal blade is not easily frozen in the all-clear position, and the weights of the spectacle frame and that of the blade itself are so proportioned that in the event of breakage or failure of any kind the signal will assume the stop position. The three-position system, when used in connection with the automatic principle along the road, does away with the distant signal on the same post as the home for each block.

Under this system, a train entering a block at full speed passes the home signal in the vertical position, the blade literally standing on end, and as soon as the train has passed through the block and has entered the block next ahead, this signal rises to the caution or 45-deg. position, and in this way acts as a distant signal for the block next ahead. Consequently the signal is at one time the home signal for its own block and later becomes the distant signal for the home signal next ahead. In its capacity of home signal for its own block it may either indicate all clear in that particular block when in the 45-deg. or vertical position, or it may indicate stop when in the horizontal position. In its capacity as distant signal for the block next ahead it may indicate all clear for the block next ahead, when vertical, or it may indicate caution by its 45-deg. position.

The vertical position of the signal blade therefore gives an indication for two blocks, the one which the train is about to enter and the one next ahead. In the caution position the blade permits reduced speed entrance of the first block, but indicates the stop position of the home signal next ahead. The horizontal position indicates the immediate and absolute stop before the first block is entered. The disadvantage of this system is that at night all indications are dependent upon one light, and in case of failure of the light, no indication of the whereabouts of the signal is given by the signal itself. The absence of a signal light where one ought to be displayed constitutes an occasion for stopping the train, no matter what signal system be employed, but it is held by some that in foggy or snowy weather the absence of the one and only light capable of giving a signal indication might make it difficult for the men on the engine to locate the signal. In case of an engine proceeding under orders, with headlight extinguished, the absence of the one signal light might prove a serious disadvantage.



ILLUMINATED TRACK MODEL IN K STREET TOWER.

LOOKING NORTH, FOOT OF K STREET, INTERLOCKING SIGNALS.

Our frontispiece illustration this month is a magnificent view taken so that the observer is above the tracks leading to the Washington Union Station, and is looking south toward the terminal. Signal bridge H, is in the foreground, and the dome of the National Capitol is seen above the roof of the station almost in line with the center of the signal bridge. The dome of the Congressional Library is seen clear of the bridge to the left of the picture. Our other illustrations show the K signal bridge in the foreground; the interlocking bridge with tower near K street; signal bridge H looking north; an interior view of the K street tower, and a part of the K street plant and tower.

The station itself, together with three signal towers, a powerhouse, an express building, a locomotive and car repair shop, coach yard, with the necessary tracks, etc., stand on a ground area of over eighteen acres, and within this area there is a total of 60 miles of tracks. The signal system installed is as already stated the latest form of three-position speed signaling, employing the upper quadrant priciple of operation with semi-automatic control of all interlocked signals. Electric detector circuits are used at the Washington terminal instead of the ordinary detector bars. The K street tower has 162 working levers. The New York avenue tower has 58 working levers, and the Massachusetts avenue tower contains 20 working levers. This makes a total of 240 working levers in the three towers. There are 108 working switch levers in all, operating 73 single switches, 5 derails, 86 ends of double slips and switches, and 43 pairs of movable point frogs. There are 106 working signal levers operating 251 three-position signals, and 157 two-position signals, making a total of 408 working signals, besides which there are 164 fixed blades to carry out the speed signaling principle. Thirty of the working signals are light signals in the Massachusetts avenue plant for tunnel operation.

In the K street tower there is a most ingenious arrangement for indicating to the towerman the routes as set and signalled. Instead of the ordinary track model, in which slender brass bars represent the tracks, this model is an illuminated track diagram, and is, in fact, a miniature reproduction of the entire yard with all the tracks, switches, turnouts, crossover tracks, etc., faithfully represented. The front of the diagram is glass painted black, except where lines of clear glass represent the tracks. Behind these clear lines 1-candle-power lamps are placed in metal slots, so that when a route is set up the appropriate lamps glow, and a continuous band of light shows the track ready for the passage of a train. The lighting of the lamps being dependent upon the integrity of the route. The model is 19 ft. 6 ins. long, 5 ft. 4¾ ins. high, and is 9 ins. deep. It is set in a convenient position, and is easily in view of the towermen. There are 750 lamps used in the model, supplied by alternating current. There are 130 track sections shown on the model. At all times the routes set are shown in the model; all others are blotted out by the extinguishing of the lamps behind the miniature tracks which may not be used.

LOOKING NORTH TOWARD NEW YORK AVENUE, SIGNAL BRIDGE K IN THE FOREGROUND.

According to the Union Switch and Signal Company's bulletin No. 36, "the three-position speed signaling system, upper quadrant aspect is used throughout, the upper arm of all signals controlling the highest speed routes only; the second arm or medium speed blade controls other route or routes where considerable speed, but not the maximum, may be maintained. The low speed arms, in all cases, lead to routes whose condition prevents them being used at any but low rate of speed. In addition to this function of the low speed arms, they may be cleared for high, medium or low speed routes, which may be occupied (for example, drilling movements). The operation of all signals from the horizontal to the 45-deg. position is controlled by the interlocking machine, and they automatically assume the clear 90-deg. position from the next high speed signal ahead over the route set up, providing the signal in advance is in the caution 45-deg. or clear 90-deg. position, and the signal in question has been moved to the 45-deg. position.

"The compressed air, at a pressure of 80 to 90 lbs. for the operation of all switches and signals throughout the entire system, is supplied from a duplicate set of steam-driven air compressors in the power house, and is conveyed through a duplicate system of 2-in. galvanized iron pipes. Both mains are used except when repairs are necessary. All current for charging storage batteries and lighting signals is also supplied from the power house.

"The entire terminal improvement was carried out under the direction of Mr. D. D. Carothers, chief engineer of the Baltimore & Ohio Railroad, and Mr. A. C. Shand, chief engineer of the P. R. R., Mr. W. F. Strouse being the engineer in direct charge of general construction. The actual work of installation was done under the direct supervision of the signal department of the Baltimore & Ohio Railroad, representing the Washington Terminal Company. The methods of construction followed were under the immediate direction of Messrs. Rudd and Patenall. All the labor and material customarily provided by signal companies in contracts of this nature was furnished by the Union Switch and Signal Company of Swissvale, Pa., the work being carried out by the signal company through its staff in the eastern district office at New York. The operation of this signaling comes under the jurisdiction of Mr. G. W. Martin, superintendent. Its maintenance is directly in charge of Mr. Charles McCauley, who was foreman in charge for the Union company when the work was installed."

Safety Valve Capacity.

By Philip G. Darling.

Mechanical Engineer for Messrs. Manning, Maxwell & Moore, Inc.

(Extracts from paper, A. S. M. E., Feb.)

The functions of a safety valve are to prevent the pressure in the boiler to which it is applied from rising above a definite point, and to do this automatically and under the more severe conditions which can arise in service. For this, the valve must have a relieving capacity at least equal to the boiler evaporation under these conditions. If it has not this capacity, the boiler pressure will continue to rise, although the valve may be blowing. Thus with the exception of a requisite mechanical reliability, the factor in safety-valve construction which bears the most vital relation to its real safety, is its capacity.

Two factors in a safety valve geometrically determine the area of discharge, and hence the relieving capacity. These are the diameter of the opening at the seat, and the valve-lift. The former is the nominal valve size, the latter is the amount the valve disc lifts vertically from the seat when in action. In calculating the size of valves to be placed on boilers, rules which do not include a term for this valve-lift, or an equivalent, such as a term

K STREET SIGNAL TOWER AND ELECTRIC PLANT.

for the effective area of discharge, assume, in their derivation, a lift for each size of valve. Nearly all existing rules and formulas are of this kind which rate all valves of a given nominal size as of the same capacity.

To find what amount of lift standard makes of valves actually have in practice and thus test the truth or error of this assumption that they are approximately the same for the same size of valve, an apparatus has been devised and careful tests have been made upon different makes of valves by the writer.

The locomotive valve tests were made upon locomotives No. 900 of the Illinois Central, the valve being mounted directly upon the top of the main steam dome. This locomotive is a consolidation type, having 50 sq. ft. of grate area, and 2,953 sq. ft. of heating surface. The lift records show, with the exception of a small preliminary simmer, which some of the valves have, an abrupt opening to full lift and an almost equally abrupt closing when a certain lower lift is reached. Both the opening and closing lifts are significant of the action of the valves.

Of the six 3½-in. muffler locomotive valves, the summarized lifts, are as follows: Average of the six valves, .07 in. at opening and .043 in. at closing. Average excluding the highest, 061 in. at opening and .031 in. at closing. The lowest lift valve had .04 in. opening and 0.23 in. closing; the highest .140 in. opening and .102 in. closing. As per cents. of the highest and lowest lift valve was 36.4 per cent., the next larger 39.8 per cent., and the next 46.6 per cent. The great variation, 300 per cent. in the lifts of these standard valves of the same size, is startling, and its real significance is apparent when it is realized that under existing official safety valve rules, these valves, some of them with less than one-third the lift and capacity of others, receive the same rating and are listed as of equal relieving value. Three of these existing rules are given as an illustration of their nature; the U. S. Supervising Inspectors' Rule, the Boiler Inspection of Philadelphia Rule, and the Board of Boiler Rules of Massachusetts.

RULE OF THE UNITED STATES BOARD OF SUPERVISING INSPECTORS.

$$A = .2074 \times \frac{W}{P}$$

A. = area of safety valve in sq. in. per sq. ft. of grate face.
W. = lbs. of water evaporation per sq. ft. of grate per hour.
P. = boiler pressure (absolute).

In 1875 a special committee was appointed by this board to conduct experiments upon safety valves at the Washington Navy Yard. Although the pressures used in these experiments (30 x 70 lbs. per sq. inch) were too low to make the results of much value to-day, one of the conclusions reported is significant.

"First—That the diameter of a safety valve is not an infallible test of its efficiency.

"Second—That the lift which can be obtained in a safety valve, other conditions being equal, is a test of its efficiency."

The present rule of the board, as given above, formulated by Mr. L. D. Lovekin, chief engineer of the New York Shipbuilding Co., was adopted in 1904. Its derivation assumes practically a 45 deg. seat and a valve lift of 1/32-in. of the nominal valve diameter. The discharge area in this rule is obtained by multiplying the valve lift by the valve circumference and taking but 75 per cent. of the result to allow for the added restriction of a 45 deg. seat over that of a flat seat. The 75 per cent. equals approximately the sine of 45 deg. or .707.

MASSACHUSETTS RULE OF 1909.

$$A = \frac{W \times 70}{P} \times 11$$

A = area of safety valve in sq. ins. per sq. ft. of grate surface.
W = lbs. of water evaporation per sq. ft. of grate surface per second.
P = boiler pressure (obsolute).

One of the most recently issued rules is that contained in the pamphlet of the new Massachusetts Board of Boiler Rules, dated March 24, 1908. This rule is merely the United States rule given above with a 3.2 per cent. larger constant and hence requiring that amount larger valve. The evaporation term is expressed in pounds per second instead of per hour and two constants are given instead of one, but when reduced to the form of the United States rule it gives

$$A = .214 \times \frac{W}{P}$$

Test number.	Duration of test, hours.	Size and type of valve.	Adjustment remarks.	Valve lift, inches.	Pressure, lbs. per sq. in.	Superheat, Deg. F.	Disc'hge per hour, lbs of steam.	Discharge area, sq. ins.	Remarks.
10	2½	3½" locomotive Form B.	Regular adj., Without muffler.	.140	146.7	39.0	8,685	1.109	Tests 10-12 inclusive with an open locomotive valve.
11	3	"	"	.070	152.5	38.0	4,670	.5493	
12	3	"	"	.105	150.3	41.2	6,780	.8280	
13	3	"	With muffler.	.1395	146.3	38.1	8,400	1.106	Muffler valve in this following locomotive test.
14	2	"	"	.140	52.2	51.3	3,620	1.109	Test at low steam pressure.
15	2½	Same except with lipped feather	"	.140	146.4	39.0	8,600	1.109	Different type of valve disc.
18	2	1½" locomotive Form B.	Regular adj., With muffler.	.107	140.8	23.0	2,515	.4272	Tests 18-21 inclusive unsatisfactory as the valve was too small for the boiler used.
19	1	"	"	.060	151.2	none	1,550	.2038	
20	2½	"	"	.075	146.3	none	2,025	.2560	
21	2½	"	"	.075	147.7	none	1,975	.2560	
28	3	2" locomotive Form B.	Regular adj. With muffler.	.130	138.4	48.7	7,060	.8846	
29	3	"	"	.090	139.3	43.9	4,950	.6034	

Working this out as was done with the United States rule and taking the 75 per cent. of the flat seat area shows that this rule assumes a valve life of 1/33 of the valve diameter instead of 1/32 of the U. S. rule. This changing of the assumed lift from 1/32 to 1/33 of the valve diameter being the only difference between the two rules, the inadequacy of the U. S. rule just referred to applies to this more recent rule of the Massachusetts board.

PHILADELPHIA RULE.

$$A = \frac{22.5\ G}{p \times 8.62}$$

A = total area of safety valve or valves in sq. ins.
G = grate area in sq. ft.
P = Boiler pressure (gauge).

The Philadelphia rule now in use came from France in 1868, being the official rule there at that time and having been adopted and recommended to the City of Philadelphia by a specially appointed committee of the Franklin Institute, although this committee frankly acknowledged in its report that it "had not found the reasoning upon which the rule had been based." The area A, of this rule is the effective valve opening or as stated in the Philadelphia ordinance of July 13, 1868, "the least sectional area for the discharge of steam." Hence if this rule were to be applied as its derivation by the French requires, the lift of the valve must be known and considered whenever it is used. However, the example of its application given in the ordinance as well as that given in the original report of the Franklin Institute Committee, which recommended it, shows the area A applied to the nominal valve opening. In the light of its derivation, this method of using it takes as the effective discharge area, the valve opening itself, the error of which is very great. Such use, as specifically stated in the report of the committee above referred to, assumes a valve-lift of at least one quarter of the valve diameter; that is, the practically impossible lift of 1 in. in a 4-in. valve.

The principal defect of these rules in the light of the tests recently made is that they assume that valves of the same nominal size have the same capacity and they rate them as the same, without distinction, in spite of the fact that in actual practice some have but one-third of the capacity of the others. There are other defects, such as varying the assumed lift as the valve diameter, while in reality with a given design the lifts are more nearly the same in the different sizes, not varying nearly as rapidly as the diameters. And further than this the actual lifts assumed for the larger valves are nearly double the actual average obtained in practice.

The direct conclusion is this: That existing rules and statutes are not safe to follow. Some of these rules in use were formulated before, and have not been modified since, spring safety valves were invented, and at a time when 120 lbs. was considered high pressure. None of these rules takes account of the different lifts which exist in the different makes of valves of the same nominal size, and they thus rate valves exactly alike which actually vary in lift and relieving capacity over 300 per cent. It would therefore seem to be the duty of all who are responsible for steam installation and operation, no longer to leave the determination of safety valve size and selection to such statutes as may happen to exist in their territory, but to investigate for themselves.

The elements of a better rule for determining safety valve size exist in Napier's formula for the flow of steam, combined with the actual discharge area of the valve as determined by its lift.

To determine for this formula what the constant or co-efficient of flow is and how it is affected by variations in valve design and adjustment, an extended series of tests have recently been conducted at the Stirling Department of the Babcock & Wilcox Co., at Barberton, O., by the writer.

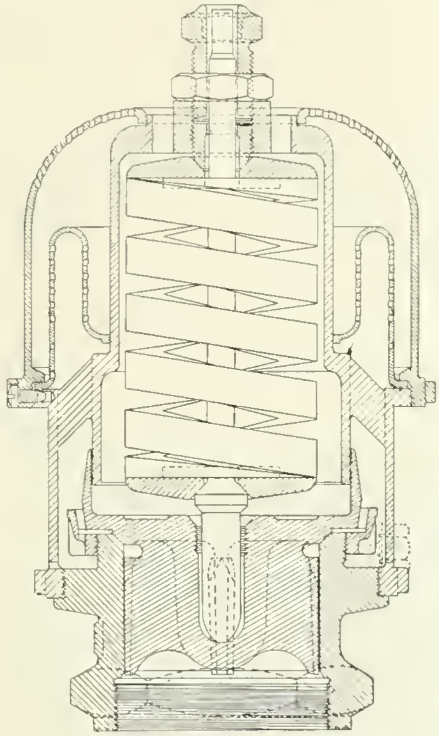
As previously stated, the application of the results obtained is in fixing a constant for the flow, in Napier's formula as applied to safety valves.

The formula is $W = A \frac{P}{70}$

where W equals pounds discharged per second, P equals the absolute steam pressure under the valve, and A equals the effective discharge opening in sq. in. This may be stated as $E = C \times A \times P$; in which E equals the pounds of steam discharged per hour, C equals a constant, E, A and P being given for the above tests, C is directly obtainable.

Figuring and plotting the values of this constant indicates the following conclusions: (1) Increasing or altering the steam pressure from approximately 50 to 150 lbs. per sq. in. does not affect the constant, this merely checking the applicability of Napier's formula in that respect. (2) Radically changing the shape of the valve disc outside of the seat at the huddling or throttling chamber, so-called, does not affect the constant or discharge. In test No. 15 the valve had a downward projecting lip, deflecting the steam flow through nearly 90 degs., yet the discharge was practically the same as in tests Nos. 10 and 14, where the lip was cut entirely away, giving a comparatively unobstructed flow to the discharging steam. (3) Moving the valve adjusting ring through much more than its complete adjustment range does not affect the constant or discharge. (4) The addition of the muffler to a locomotive valve does not materially alter the constant or discharge. (5) Disregarding the rather unsatisfactory 1½ in. and 3 in. locomotive valve tests, the different sizes of valves tested show a variation in the constant when plotted to given lifts of about 4 per cent. (6) There is a slight uniform decrease of the constant when increasing the valve lifts.

The fact that these tests were run with some superheat (an average of 37.2 degs. F.) while the majority of valves in use are used with saturated steam, would, if any material difference exists, place the



MUFFLED POP SAFETY VALVE.

above constants on the safe side. The capacities of the stationary and locomotive valves, the lift test results of which have been figured from this formula, taking the valve lifts at opening and in pounds of steam per hour, are as follows:

Of the seven 4-in. iron body stationary valves, the average capacity at 200 lbs. pressure is 7,370 lbs. per hour, the smallest capacity valve (figured for a flat seat) has a capacity of 3,960 lbs., the largest 12,400 lbs., and of the six 3½-in. muffler locomotive valves at 200 lbs. pressure, the average capacity is 6,060 lbs. per hour, the smallest 4,020 lbs., the largest 11,050 lbs.

To make the use of the rule more direct where the evaporation of the boiler is only indirectly known it may be expressed in terms of the boiler heating surface or grate area. This modification consists merely in substituting for the term E (lbs. of total evaporation) a term H (sq. ft. of total heating surface) multiplied by the pounds of water per sq. ft. of heating surface which the boiler will evaporate. Evidently the value of these modified forms of the formula depends upon the proper selection of average boiler evaporation figures for different types of boilers and also upon the possibility of so grouping these boiler types that average figures can be thus selected. This modified form of the formula is

$$D = C \times \frac{H}{L \times P}$$

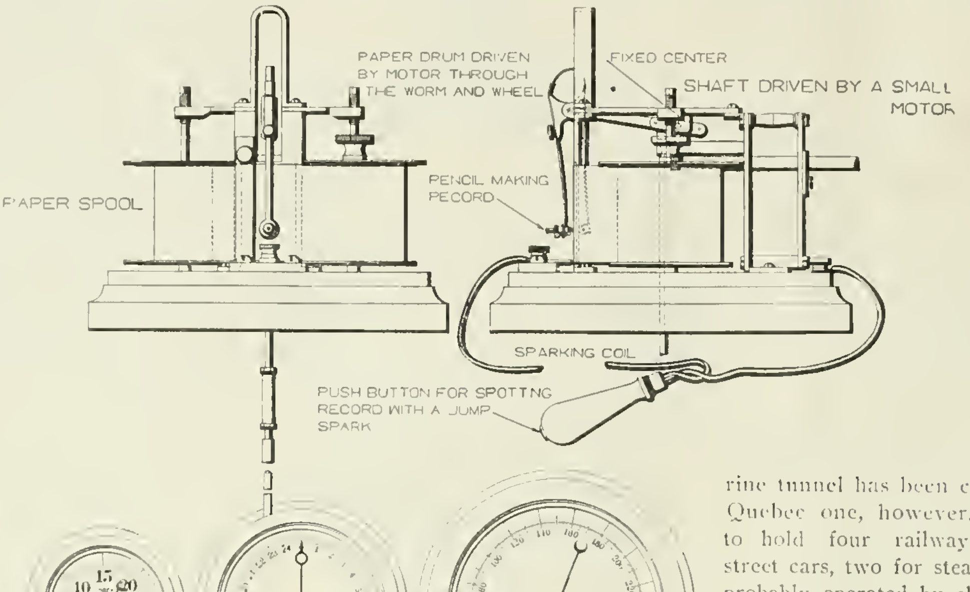
where H equals the total boiler heating surface in sq. ft. and C equals a constant.

Values of the constant, for different types of boilers and service have been selected. These constants are susceptible of course to endless discussion among manufacturers, and it is undoubtedly more satisfactory where any question arises, to use the formula containing the term E itself. Nevertheless the form containing the term H is more direct in its application, and it is believed that the values given below for the constant will prove serviceable. In applying the formula in this form rather than the original one, containing the evaporation term E, it should be remembered that these constants are based upon average proportions and hence should not be used for boilers in which any abnormal proportions or relations between grate area, heating surface, etc., exists.

For locomotives .055 as the constant was determined experimentally. In locomotive practice there are special conditions to be considered which separate it from regular stationary and marine work. In the first place the maximum evaporation of a locomotive is only possible with the maximum draft obtained when the cylinders are exhausting up the stack, at which time the throttle is necessarily open. The throttle being open is drawing some of the steam and therefore the safety valves on a locomotive can never receive the maximum evaporation of the boiler. Just what per cent. of this maximum evaporation the valve must be able to relieve under the most severe conditions can only be determined experimentally. Evidently the severest conditions obtain when an engineman, after a long, hard, up-hill haul with a full glass of water and full pressure reaching the top of the hill, suddenly shuts the throttle and injectors. The work on the hill has made the engine steam to its maximum, and the sudden closing of throttle and injectors forces all the steam through the safety valves. Of course, the minute the throttle is closed the steaming quickly falls off, but it is at just that moment that the severest test upon the valves comes.

A large number of service tests have been conducted to determine this constant. The size of valves upon a locomotive have been increased or decreased until one valve would just handle the maximum steam generation, and the locomotive heating surface being known, the formula was figured back to obtain the constant. Other special conditions were considered, such as the liability in locomotive practice to a not infrequent occurrence of the most severe conditions; the exceptionally severe service which locomotive safety valves receive, and the advisability of providing a substantial excess valve capacity.

As to the method of applying the proposed safety valve capacity rule in practice, manufacturers could be asked to specify the capacity of their valves, stamping it upon them as the opening and closing pressures are now done. This would necessitate no extra work further than the time required in the stamping, because for valves of the same size and design giving practically the same lift, this would have to be determined but once, which of itself is but a moment's work with a small portable lift gauge which is now manufactured. The specifying of safety valves by a designing engineer could then be as definite a problem as is that of other pieces of apparatus. Whatever views are held, as to the advantages of high or low lifts, there can be no question, it would seem, as to the advantage of knowing what this lift actually is. Further, as to the feasibility of adopting such a rule, which incorporates the valve lift, in statutes governing valve sizes: this would involve the granting and obtaining by manufacturers of a legal rating for their valve designs based upon their demonstrated lifts.



APPARATUS USED IN TESTING THE LIFT OF SAFETY VALVES.

Valve Gear and Breakdowns.

A committee of the Traveling Engineers' Association, of which Mr. O. H. Rehmeyer, 559 Elm street, Blue Island, Ill., is chairman, is calling for information on: Functions of the parts of Walschaerts valve gear, a method of procedure in failure or breakdowns on simple and compound engines, including Mallet type. That covers subjects that are highly important to enginemen and to railroad companies. There have been so many changes in construction and weight of locomotives during the last few years that rules concerning methods of dealing with breakdowns have been greatly changed. Giving details of latest practice is spreading popular information that will be welcomed by many people. Anything that will be said about the Walschaerts valve gear is sure to receive sincere welcome, for to many enginemen that form of valve gear possesses many mysteries.

Any of our readers who have information to impart on the subject named ought to send it along to Mr. Rehmeyer. To members of the Traveling Engineers' Association we would say: "Perform your duty by answering the queries of this circular at once."

Proposed Submarine Viaduct.

A proposal to substitute what would practically be a submarine viaduct instead of the bridge over the St. Lawrence at Quebec, was made in an address by Mr. J. S. Armstrong, C.E., before the Board of Trade in Montreal. The speaker said that if such a viaduct was built and lowered to a depth of about 40 ft. below the surface, it would allow large ocean-going vessels to reach Montreal. The bridge he said would have to be 190 ft. above high water to permit this.

The underwater tubes, such as Mr. Armstrong proposed, would be laid very much in the same way that the Detroit submarine tunnel has been constructed. The Quebec one, however, could be made to hold four railway tracks, two for street cars, two for steam railroad trains, probably operated by electricity, and two footways could be provided for pedestrians. The viaduct, or rather the tubes, could be made strong enough to withstand the action of the current, and could be anchored securely. Being so far below the surface the tubes would be entirely free from ice in the winter and the interior could be brilliantly lighted. If the scheme got as far as providing for foot passengers, provision could no doubt be made for vehicular traffic.

Aluminum.

Aluminum is coming into such general use that a brief description of the metal may be of interest to many of our readers. As is well known it is white and very ductile and malleable, and about the same degree of hardness as zinc. It melts at 1,125 degs. Fahrenheit. Its specific gravity is 2.6, or a little more than two and a half times heavier than pure water at the maximum density. As a conductor of heat, placing silver at 100, its conductivity is 31.33. Its comparative strength is about 10,000 lbs. per square inch. It is almost entirely non-corrodible. When it is deemed desirable to be hardened it is mixed with other metals, particularly with copper, nickel and zinc. It is very easily mixed with other metals. The best carbon crucibles should be used in fusing the metal, as it very readily absorbs the silica in the lining of crucibles. Six per cent. of copper greatly hardens and strengthens aluminum without adding much to its weight.

General Correspondence

General Foremen's Association.

Editor:

In your March issue I note that Mr. Llewelyn Morgan, of the Boston & Maine refers to a controversy between the writer and Mr. Glover, of the Pere Marquette. In this connection I want to say that this discussion has not yet attained the dignity of a controversy, Mr. Glover having very evidently been misinformed as to the aim of the International Railway General Foremen's Association, the writer endeavored to put him straight in the matter by assuring him that roundhouse management and operation receives more consideration in the deliberations of the Association mentioned than those of any other department. This necessarily follows from the fact that the roundhouse is the "backbone" and principal feature of the locomotive end of railway operation. Of course, in convention, methods of handling back shop work, of obtaining maximum results from each department, of harmonizing interests and of obtaining necessary supplies promptly are also discussed, but these matters all bear an intimate relation to the roundhouse.

As stated in other letters which I have recently had the pleasure of reading in your columns and those of other mechanical journals, the roundhouse foreman, if ambitious, expects to be a general foreman, a district foreman or a master mechanic at some future time. Therefore, we contend that it is and will be our aim to promote, through our association, the interests of the roundhouse foreman and any other official engaged in the construction and repair of locomotives. Our association is open to all such and we would certainly welcome as members the officers and members of the New England Locomotive Foremen's Association.

At our next convention we will discuss the following subjects:

1. Air brake equipment, including pumps for all classes of service. C. H. Voges, chairman.

2. Coaling of engines with coaling machines, vs. coaling stations. W. H. Clough, chairman.

3. How to obtain quickest and best routine of handling engines at roundhouse. Figures as to time and cost to be submitted with each paper. T. H. Ogden, chairman.

4. Advisability of installing hot water washout and filling systems. E. A. Murry, chairman.

5. Best method of getting work through the shop with economy and dispatch. W. C. Stears, chairman.

6. The superheater. D. E. Barton, chairman.

There will also be a topical discussion on the following. There will probably be no papers, but every member will be expected to come prepared to voice his views:

1. Best method of arriving at cost of repairs and utility of cost department.

2. What class of repairs should be made at outside points where facilities are lacking?

3. The use of commercial gas for heating purposes in modern shop plants in place of gasoline or crude oil, particularly in tin shops, handling of fires and straightening of frames in place, lighting of fires in roundhouse engines, in boiler shop rivet forges, and other similar places.

4. The use of oxy-acetylene process of welding fireboxes and boiler sheets, frames and other similar work.

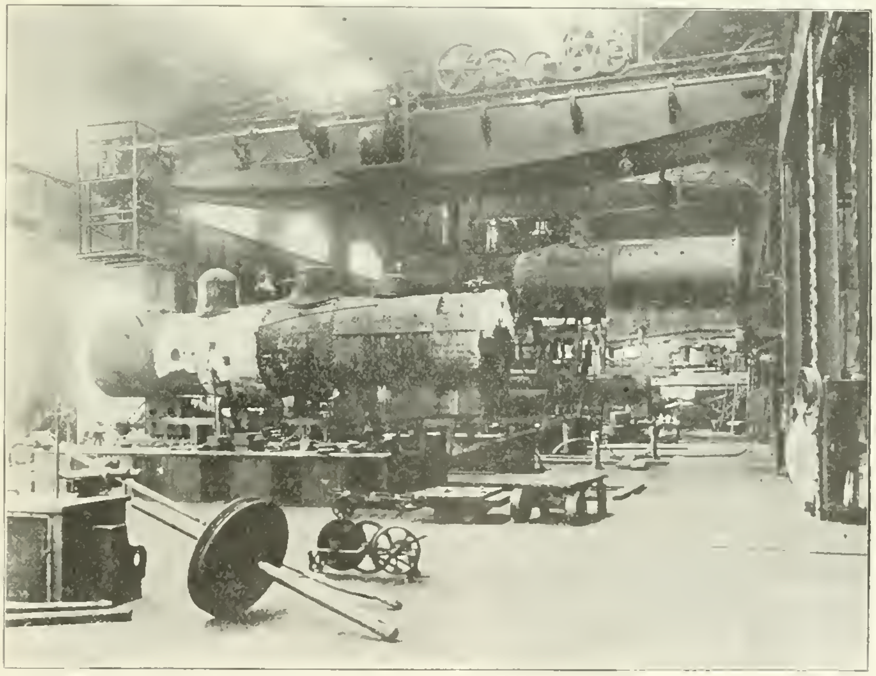
5. The advantage, if any, which is derived from the use of the wide firebox over its predecessor, the narrow firebox. Whether the wide firebox should be designed with a wide or narrow water leg and what should be done to overcome the present tendency to crack sheets under short periods of service.

6. The superheater and whether or not the same efficiency is obtained from superheated steam at a pressure of 175 lbs. or less, that is obtained from saturated steam at pressure of 200 to 215 lbs. Whether there is sufficient saving of firebox sheets effected by the lower pressure carried to offset the increased difficulty of lubricating cylinders to obviate excessive abrasions.

7. The location of the point of water delivery in the boiler, whether it would not be an advantage to deliver water at a point of six to eight inches above the mud ring just in the rear of the throat sheet than to deliver in the front end of the boiler near flues.

I think a little consideration of this list will convince the most skeptical of the value of membership with us. I would be very glad to hear further from any others interested in locomotive work and will endeavor to reply as intelligently as may be, to any questions, criticisms or comments. E. F. Fay, President.

Cheyenne, Wyo.



120-TON CRANE IN SOUTHERN PACIFIC SHOP, MADE BY THE WHITING FOUNDRY EQUIPMENT CO. OF HARVEY, ILL.

Stationary and Locomotive Engines.

Editor:

I think our friend, Mr. Wiley, on page 107—Railway and Locomotive Engineering—will find some other things besides those mentioned in his article on stationary and locomotive practice. The stationary engine and boiler have usually plenty of room to install feed water heaters and condensers, which same room is very limited in the modern locomotive. The modern injector makes a very good live steam heater, as compared with the old style pump, as all the steam required to use injector is returned to boiler.

The locomotive has to develop one h. p. on about two square feet of heating surface, as compared with thirteen to fifteen square feet per h. p. in the stationary boiler. A locomotive would not have much power left to pull cars with if it had to drag around six or seven boilers for the sake of fuel economy—due to a slower rate of combustion and evaporation, and it would probably lose the amount of fuel saved by so doing. If there was enough in it, the builders could as easily install a feed water heater in the front end, as they have done with the superheater. The main thing in the modern locomotive is to keep the fire and the boiler hot, and experience has shown the simplest way is by turning the exhaust into the stack.

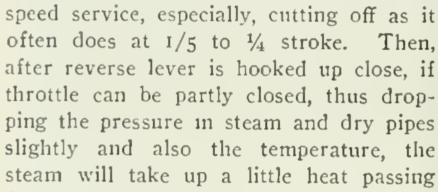
I think he will also find that the locomotive uses more expansion of steam than the average stationary engine in high-speed service, especially, cutting off as it often does at 1/5 to ¼ stroke. Then, after reverse lever is hooked up close, if throttle can be partly closed, thus dropping the pressure in steam and dry pipes slightly and also the temperature, the steam will take up a little heat passing from dome to cylinders, which it cannot do in the stationary engine, owing to steam piping being all outside boiler. The whole problem resolves itself into making the locomotive as efficient at the draw bar as possible per pound of coal burned.

WALTER C. HILL,
Buffalo, N. Y. Loco. Engr.

Rule for Determining Wheel Fit.

Editor:

A variety of opinions exist as to the proper method of predetermining the ton fit as indicated by the gauge on a wheel press for the mounting of wheels and



PIN WITH LINES SCRIBED.

axles. It is highly important to know that a satisfactory fit has been made when wheels and axles have been assembled. The varied kinds of tools used on axle lathes, from a micrometer down to a rigid gauge, including the use of paper, chalk, etc., by men in certain localities in making an effort to provide the proper fit, prompts the writer to suggest the following rule, known as the "Caliper Drag" system, for car wheel and axle assembly.

If the length of the wheel seat is 6 ins. and the diameter of the wheel seat 5 ins., equaling 11 ins., for each inch thus obtained use 1-16 in. if the wheel center is cast iron, or 11-16 in. By referring to the sketch herewith attached you will find two parallel lines, and in the case mentioned the same are drawn 11-16 in. apart by a pair of dividers, the same being parallel with the axle. If the wheel center is cast steel, rolled or pressed steel, 1-32 in. instead of 1-16 in. is used, and the distance between these two lines would be 11-32 in.

In making the fit one leg of the calipers is held upon one of the lines while the other leg, as in ordinary calipering, is directly opposite. The leg that is opposite to the one line is held in that fixed position. The other leg of the calipers is moved across the wheel seat, and the proper diameter of the same is when the leg of the calipers will just intersect the other line.

It cannot be expected that a proper assembly of wheels and axles can be made when axles are stored up in a warm room and the wheels brought from the wheel yard during extremely cold weather, bored out and immediately applied. A much better method is to bring the wheels from the wheel yard and leave them in the same room where the axles are, and at the same time know that the frost is entirely expelled from the wheels before machining. It has been positively proved that a correct and safe system of wheel assembly can be inaugurated by this method.

J. E. OSMER.
Chicago, Ill.

The Personnel of Commissions.

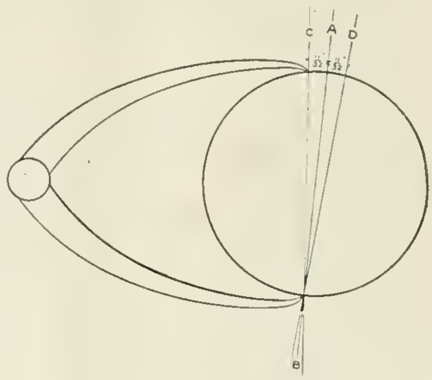
Editor:

At the present time, both the federal and State authorities are "regulating" the railroads by means of commissions. Perhaps this method is the right one, although it is open to many objections. However, if the commissions are to stay, it is imperative that fundamental changes be made in their organization. Under present conditions, incompetent persons secure positions on the various commissions through political influence, and the railroads suffer as a consequence.

Politicians who seek to "ride into office" on a wave of supposedly popular indignation against railroads have long since become familiar figures in the annals of this country. These time-servers should be forced out of office and their places given to men who, by experience and temperament, are fitted to occupy them. It is the height of absurdity to entrust the regulation of railroads to persons who do not possess even an elementary knowledge of railroad operation and management.

Therefore, commissions having the power to regulate railroads should be composed of practical railroad men and business men of integrity who have had experience as shippers.

The politicians, faddists, theorists and professional office-seekers who occupy places on such commissions at the present time should be summarily removed,



CALIPER DRAG METHOD.

for, in addition to their incompetence and unfitness, their egotism, ignorance and intolerable arrogance are odious both to the railroads and to all the intelligent citizens of this country.

ARTHUR CURRAN.
New York, N. Y.

Voluntary Retirement.

Editor:

After reading your extended notice of me in your March issue, I have concluded that in a brief article on the retiring business, I may interest some who are contemplating a voluntary dropping of tools, and getting out.

I suppose it is universally known to railroad men that the Delaware, Lackawanna and Western Railroad has a pension system. Between 60 and 69 years of age, if a man becomes unable to perform his duties, he may make application to be placed on the pension roll, providing he has been in the employ for 25 years. I think I can say without fear of contradiction that I have always had robust health until last August. A local physician diagnosed my ailment as "a derangement of the alimentary canal." I never knew I harbored a canal in my internal parts until he told me. Three other disciples of Esculapius said the same, and I knew as much about what they meant as a dog does about the man in the moon. One thing I did know—that I was a very sick man, and unless they could do something to improve the canal, my name would soon be Dennis.

I hung onto the job, while the disciples were dosing me, with very poor results. Coming close to the end of October, I decided to get out, and onto the pension roll. I came to my home, where I have been ever since to the time of this writing, March 4, 1909, and no great change for the better is in my physical condition.

I would not impress my personality on your readers but that I want to give a pointer to any person contemplating voluntary retirement. When a man serves 32 years in a one-man shop, as roundhouse foreman, subject to being called any hour of the night to look after the alimentary canals of old plugs of engines, and other defects too numerous to mention, when he finds he isn't called any more and that he is like Othello "with his occupation gone," he'll devote his whole mind dwelling on the cause that knocked him out, and if he does not get his mind away from brooding over it he'll soon be a subject for the funeral director. The first two months I was off, I kept myself on dress parade on the carpets around my house until I had them nearly threadbare, and I kept wishing I was taking the lockstep with some of the involuntary servants of the State. When the 6 o'clock whistles would blow in the morning I'd often jump out on the floor and begin dressing myself, like of yore, ere I'd think that I was retired. When in active service, 6 was my invariable time for getting up, and oh! how longingly I'd look back at the bed, wishing I could stretch out the nap. Now, when I could sleep till noon every day, I am wakeful as a hungry sparrow at the time of "crusty old six in the morning." Another thing that helped me along to the contemplation of what undertaker would rush me graveward, was reading my obituary in some of the papers which told their readers of my being beyond my usefulness and that I could take a much-needed rest, and I did not know whether the rest was to be this side of the grave or in it.

Well, time makes all things even. Although I cannot enjoy the embraces of Morpheus after six, I can enjoy the fact that my ears are not being filled up with the ailments of "my engine" by the throttle-bar manipulators or knights of the scoop.

Just think of it—thirty-two years a round-house foreman, and clergymen coming to prepare me for a regimen of sackcloth and ashes, to purge the ills of the flesh. Why, it is canonization I deserve, as a saint of the round-house. It is a tough job to drop the tools after the habits of a lifetime. We have read of people being incarcerated in dungeons for years, and when offered their freedom implored to be let remain in their living tombs.

When at Columbus last May, at the B. of L. E. Convention, I attended a smoker of the Knights of Columbus. When my time came to make a few remarks I told a story of my early boyhood days, when a clergyman asked me, "What is hell?" I failed to reply, "but," said I to a clergyman sitting in the audience, "ask me what is hell now, father, and note how quickly I'll reply." "Well, what is it?" said he. "Serving a railroad company in the position of round-house foreman."

You state in my latest obituary in your columns that "the leisure I now enjoy will give my pen a greater scope than formerly." I don't think it will. I hope so. I am getting skeptical about the ability of doctors, and you're a first-class one to doctor old and new engines, but I doubt your skill to fix up the "canal."

As you say, I intend to take a sea voyage on the *Caledonia* of the Anchor Line the first of May next. I shall go direct to "the land of cakes and brither Scots." I shall go to Edinburgh and Stirling from Glasgow. I want to see the places made famous by Sir Walter Scott and Burns. I shall try and reanimate with life King James and Lady Heron in Holy Rood. I'll fancy I hear the king importuning her to sing, and her declination, and I'll imagine I see her—

WASHINGTON, D. C. LOOKING NORTH TOWARD NEW YORK AVENUE.

"When first she pitched her voice to sing,
And turned her dark eye on the king,
And then around the silent ring;
And laughed, and blushed, and oft did say
Her pretty oath by yea and nay,
She could not, would not, durst not play—"

and after her brief prelude, rolled the liquid numbers of "Young Lochnivar" out of her musical throat.

I'll go through the Trossachs with James Fitz James. I'll pay the tribute of my admiration to that most beautiful creation of peerless womanhood on the shores of Loch Katrine, Ellen Douglas. And ere I leave such classic scenes I'll go through Stirling Park to do some measurement there, so I can absolve Sir Walter from a suspicion I hold that he is the Mont Blanc of accomplished prevaricators, fit to be a Past Grand in ex-President Roosevelt's Ananias Club, or a wizard of stainless veracity. I have reference to where the burghers are holding their sports, where Douglas

"rent an earth fast stone
From its deep bed, then heaved it high,
And sent the fragment through the sky,
A rood beyond the farthest mark!
And still, in Stirling's royal park,
The gray-haired sires who know the past,
To strangers point the Douglas cast,
And moralize on the decay
Of Scottish strength in modern day."

I'll have one of them point me out the place, but I am afraid the "Wizard of Romance" will be yet held in suspicion by me.

From Edinburgh I'll continue my wanderings over to the shores of the Firth of Clyde, stopping off at Ayr, to pay my heart's adoration to the scenes where "Earth's proudest bard" lived—dear old Robby Burns.

I supposed when Bulwer Lytton made Richelieu say, "The pen is mightier than the sword," that he used but a figure of speech; but since I began making out my itinerary for this trip I am contemplating, I find Lytton is right; for I do not know where in any part of the world railroads run and are joined by coach roads, to visit daily places which are made immortal by the sword, what Scott and Burns have done for the pen.

After I quit Dumfries I shall go direct to Leeds, in England, where I am to foregather with the Associated Society of Engineers and Firemen of Great Britain, whose convention will open May 18th at that place.

From England I'll sail for "Ould Dunleary," which Daniel O'Connell and other toady hunters permitted to be changed to Kingstown to commemorate the visit to the place by King George IV in 1824, and which toadying was used as a scourge by Lord Byron in his Irish Avatar to castigate them.

Should Providence permit me to carry out this programme, it will be to see the humble cot where I was born, and the places "where my young footsteps in infancy wandered," now sixty years ago, to come to God's country, the United States of America. I was born in the town of Carlow, on the river Barrow, in the Province of Leinster; and I also wish to see a country which is noted for the modesty of her sons, their unselfish and retiring nature, their self-sacrificing manner of letting others get the start of them racing for a prize, in all the greatness of a glorious self-denial. Amen.

SHANDY MAGUIRE.

Oswego, N. Y.

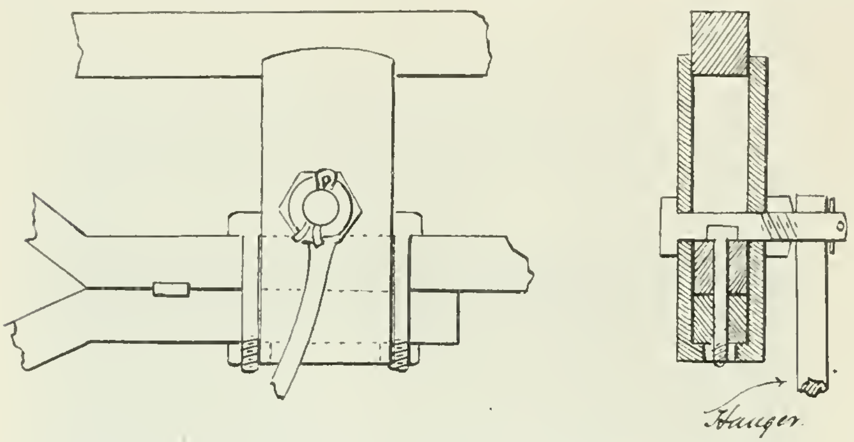
Driver Brake Hanger.

Editor:

Enclosed you will find a sketch of driver brake hanger support as made in the shops of the Kentwood & Eastern Railway, at Kentwood, La. Usually the front brake hanger is held in place by a cast iron block, as a rule fastened to lower frame by the splice bolts; those bolts frequently get loose and break off by the down pull on hanger going ahead, necessitating putting in new bolts, resulting in delay and expense. The hanger as made here is working successfully and entirely independent of the splice bolts. The holes are drilled so that hanger pin will rest on the frame, and the hanger support is extended to the upper rail. If the distance between the back cylinder head and casing do not permit the hanger to go on the pin from the outside we put on a nut on inside instead of the head.

C. WILHELMSEN,
M. M., K. & E. R. R.

Kentwood, La.



DRIVER BRAKE HANGER SUPPORT.

Guides and Crossheads.

Editor:

Mr. J. W. Moorhead, engineer on the P. S. & C. R. R., has asked certain questions about guides of engines on that road. Trying to keep up repair work without tools or equipment is a hard proposition and requires ingenuity. Guides that are worn ¼ in. in the centre are in bad shape. We do not think his guides are worn this much, but we believe they are sprung so that he cannot properly line them. We hesitate to give advice without being able to judge of the conditions personally, however, if the case is as we think it is, he could straighten guides with a heavy screw jack, fastening the ends of guides and jacking against centre of guide, until he has forced it back into a straight line on wearing surface. He should force guide a little more than is required in order to allow for its springing back a little. This can be done without heating, if the guide is not too heavy. A straight-edge should be used in this operation.

His trouble in keeping the soft metal lining on crosshead shoes can be easily overcome. First, melt the old metal off shoe and heat the shoe thoroughly in order to get rid of grease. While shoe is hot, apply soldering acid with a small brush. Then put a thin coat of solder over the face of shoe, distributing it evenly with soldering iron. As quickly as possible, pour the soft metal and make the lining the thickness desired. As he has no way of machining crosshead shoes, he should be careful in making the mould for the lining so as to have an even surface. It is not necessary to use block tin as good babbitt metal is cheaper.

SHOP FOREMAN.

Jersey Shore, Pa.

Babbiting Crossheads.

Editor:

In reply to Mr. Jay W. Moorhead of Clarion, Pa., in your March issue, relative to lining and rebabbiting crossheads, if he will use half and half the metal will last longer and stick better, that is, half babbitt and half block tin. It is useless to put this or anything else in unless it is put in right, and there are few machinists who understand this class of work, saying nothing to a locomotive engineer.

I am aware just at the present time railroads are in a somewhat bad condition financially and can't see their way clear to employing as many machinists as are really needed to keep up repairs; but to the road that can't put on any, and the engineers often making twelve hours on the road having to put in their twelve hours that are intended for refreshment and sleep in keeping up running repairs of their engines, certainly must be in a bad condition, and it is to be hoped that our beloved President Taft will soon be able to bring such changes that will help such roads as this, especially for the benefit of the engineer.

It is coming on springtime and the lawns will need attention, and that it may give some poor machinist who has been out of work for ten or twelve months a job, that he may take the guides down, straighten them, pull the piston, put them up in centre line of cylinder, see that oil hole is not stopped up to keep oil off the guides. I have no doubt but those engineers who are now working twenty-four hours a day will find relief. I hope I am not intruding, but I have the acquaintance of some engineers and shop foremen who, if they were to lose their jobs, it would be a case of back to the farm. I sincerely hope that business will soon mend up, that we may have more men employed, that it may give to those who have to put in such long and toilsome hours more time to rub their heads against the peg of knowledge, that they may be better fit to fill the duties of life in their business circles and keep the grass clipped close that it may not dew-poison the baby's toes.

G. C. BRICKHOUSE.

Covington, Ky.

Designing Link Motion.

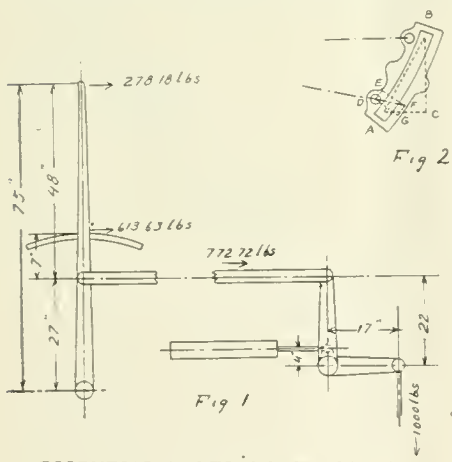
Editor:

This article deals with the parts of the link motion from the hanger to the reverse lever, also taking up the effect of the weight on handling the lever. The link hanger supports the weight of the link and half the weight of the two eccentric rods. It is also subjected to the strain due to moving the valve with the reverse lever, and to the lifting action of the link, which will be considered later. The lifting shaft is a good illustration of a shaft in torsion. The reach rod arm holds one end of the shaft stationary while the weight on the end of the hanger arms tends to twist the other end, turning it through an angle called the angle of twist. The greater the length of the rod the greater the twisting force and the diameter should be large enough to insure sufficient stiffness.

The reach rod is usually straight, and the principal strain is tension, but sometimes the end is curved, which introduces a bending strain. The load equals the weight of the two links, half the weight of the four eccentric rods, and the weight of the two link hangers, modified by the leverage of the lifting shaft. There is also the strain due to moving the valve with the engine using steam. The rod should be calculated to take both these strains, for, though the weight of the parts is counterbalanced by the spring, this may be broken.

Taking the reversing gear shown in Fig. 1, we will first consider the effect of the weight alone on the reverse lever. Assume the weight to be lifted by the two lifting arms at 1,000 lbs. total. With the dimensions shown in the figure there will be 772.72 lbs. acting as tension on the reach rod, and at the end of the reverse lever there will be 278 lbs. With a broken counterbalance spring this weight pulls the lever forward the instant the latch is released. Now consider the lever locked in position. The latch on the sector acts as a fulcrum, and the reaction on the pivot of the reverse lever is 159 lbs., while the reaction on the latch is 613.69 lbs. Again, consider the lever as being pulled back. Now the reach rod is a fulcrum, and, with 278 lbs. on the end, the reaction on the pivot is 494¼ lbs. In practice these forces are supposed to be taken up by the counterbalance spring, but they should be considered in the design to allow for emergencies.

There is another force acting on the reverse lever when it is operated with the engine under steam. Assume the link in Fig. 2 to move from full gear forwards to full gear back. The link block will move in the slot from B to A, or a horizontal distance equal to C A. At the same time the point of suspension will move a vertical distance equal to C B. This is equivalent to moving the weight on the valve up an inclined plane, B A. By the usual rule



ESSENTIAL PARTS OF VALVE GEAR.

the power required equals the load on the valve multiplied by the distance A C, and divided by C B. This, of course, is a very rough calculation, as the link is constantly changing its position, and the power changes with the angle, but it serves to show the effect of moving the valve on handling the reverse lever when the engine is using steam.

The small rectangle at the bottom of the link will illustrate another force acting through the link on the reverse lever. The figure is not drawn to scale, but it may be constructed for any given case as follows: From the eccentric rod pin, D, continue the line of motion of the rod to F, making D F equal to the force acting at D. Complete the parallelogram so that the sides D E and F G are parallel to the link arc, and the sides E F and D G are parallel to the motion of the end of the link. Now the force D F is broken into two forces, one equal to D G, tending to rotate the end of the link, and the other equal to D E, and tending to lift the link bodily. With a given length of eccentric rod this lifting force increases as the radius of the link decreases, and if the radius is too short, it is transmitted to the reverse lever and makes it hard to manage.

To find the force acting on the spring, due to the weight of the parts, we have, in Fig. 1, $1{,}000 \times 17/4 = 4{,}250$ lbs. By using two coils, a lighter spring can be used, with a smaller load on each spring.

SIDNEY C. CARPENTER.

Plainville, Conn.

How About Wootten Firebox Engine?

Editor:

I have been a reader of RAILWAY AND LOCOMOTIVE ENGINEERING for a number of years and am always anxious for the next number to come. It certainly seems like old times to see these pictures of locomotives with diamond stacks, and I have been greatly interested in them.

A number of years ago some of the Western roads bought some engines with the Wootten firebox. The Burlington, Union Pacific and others bought a few of these engines for experimental purposes. I would like to see pictures of these engines in your columns if they are still in service, and I don't think you will have any trouble in getting these pictures from the way in which the Western men have responded with pictures of diamond stack engines. Wishing you and your paper success.

A READER.

Rock Island, Ill.

Wheel Economy.

Editor:

I am enclosing a copy of a tabulation I have on the subject of wheel economy. The minimum thickness of a steel tire of steel-rolled M. C. B. wheel flange is ¾-in. The correct thickness is 1⅜ in., both measurements being made 17/64-in. above the tread. You will note that when the wheel flange is allowed to become worn down to the minimum, ¾-in., the cut at the lathe is 20/32-in., or a total reduction in diameter of 1¼-in. You will also observe that when a wheel flange is allowed to wear down to 1 in., the cut in the wheel lathe is 12/32 in., or a total reduction in diameter of the wheel is ¾-in. From the point of economy the writer is of the opinion that it is more profitable for a railroad company to remove steel-tired wheels from coaches when the flange is worn down to 1 3/16 or 1¼ in. flange thickness. This requires a reduction in diameter of ⅜ in. and ¼ in., and is enough to restore the fillet sufficiently to arrest thrust. It is wasteful of material and also dangerous to permit wheels to run when the flanges have become 1 in. down to ¾ in. in thickness. It is considered that 1/16 in. of steel, after it has been applied to a 34-in. wheel is worth approximately $1.70. You will therefore observe that it costs less in labor to remove, re-turn and re-apply a pair of wheels than it does to permit them to remain in service and allow the vertical flange wear to continue

CLEARING THE SNOW, BERGEN RAILWAY, NORWAY, LAST MARCH.

until the wheel flange becomes worn down to the thickness mentioned.

MEASUREMENTS FOR M.C.B. STEEL TIRES AND WHEELS.

Thickness of Wheel Flanges Inches.	Depth of Cut At Wheel Lathe. Inches.	Reduction in Diameter of Wheel. Inches.
¾	20/32	1¼
13/16	18/32	1⅛
⅞	16/32	1
15/16	14/32	⅞
1	12/32	¾
1 1/16	10/32	⅝
1⅛	8/32	½
1 3/16	6/32	⅜
1¼	4/32	¼
1 5/16	2/32	⅛
1⅜	.....	...

NOTE.—Measurements to be taken through flange 17/64 in. above the tread.

J. E. OSMER.

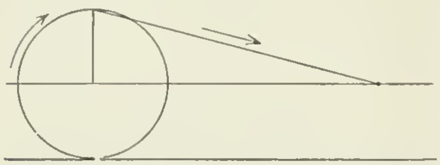
Chicago, Ill.

Views on Mechanical Principles.

Editor:

A few years ago at a time when the writer was connected with the American Order of Stationary Engineers as an honorary member, the discussion one evening dealt with the question: In which position, top or bottom quarter, will the driver crank deliver the greatest effect to the rail? It being understood that the locomotive was to actually move a small distance so as to include the element of friction.

The question as presented did not consider the reduction of piston head area which is present in locomotives when the piston rod is in extension. This particular feature was introduced almost as soon as the discussion started and as there was no difficulty in pointing out its effect and calculating its magnitude, pro-

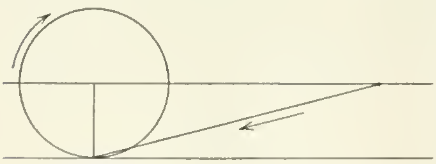


CRANK PIN ON TOP QUARTER.

vided steam pressure, cylinder diameters, etc., were given a certain value, the top quarter advocates conceded this point without any dispute, and the bottom quarter members felt that victory was theirs. Such, however, was not the case, considerations of leverage were the same with both sides, but as far as there being more driver axle friction with power applied at top quarter than at bottom quarter there was no such thing as agreement.

After discussing the matter for about two hours the order was divided about half and half as to the advantage of one quarter over the other. About a month after this the same question was asked and answered in the columns of *Science and Industry*. The mechanical editor informed the enquirer that there was no difference at all, it was an even thing.

The writer of this article took exception to the editor's answer, and the matter was treated both graphically and mathematically, horizontal and vertical components as well as the resultant force was shown up by using the parallelogram of forces. The editor's parallelogram, square roots, etc., showed an exceedingly small amount of mechanical advantage in favor of the lower quarter. This was all that the writer wanted, the small amount that was shown up by "cold hard figures," but the mechanical editor quit figuring at this point, he dropped his mathematical



CRANK PIN ON BOTTOM QUARTER.

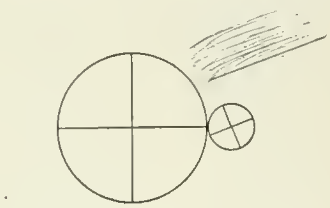
accuracy, so to speak, and proceeded to relate offhand what he thought would happen in actual practice.

He was up against the reduced area of piston head with the rod in extension, not having considered the effect of that when he answered his correspondent. He was willing to allow the calculated value for such reduction, but partly for his own benefit and furthermore for the information of his adversary he did state that in a great many locomotive cylinders there were piston tailrods that went through the front ends of the cylinders and in such cases piston heads did not have the advantage or the disadvantage of the usual reduction.

The personal correspondence pertaining to the matter was referred to a high-grade scientific journal for an opinion and the decision was that the mechanical editor was right, there being no advantage in one quarter over the other. The matter was taken up with a leading magazine devoted to steam and mechanics, three or four letters were exchanged with the associate editor, using the "graphics" and the methematics previously employed and the result was, he decided there was no difference between the top and bottom quarters.

About this time the writer visited the scenes of his boyhood, and he did not forget to stop and see the man who owned the old grist mill run by the immense old-fashioned water wheel. A walk into and through the old mill, that had not been seen for twenty-five years, followed and we stood right at the old water wheel.

"Mr. Judd," the writer remarked, "what would be the effect if your small gear was



WATER WHEEL AND PINION.

meshed in with the water wheel at a point diametrically opposite the point where it is now?

The old man of three score and ten who spent his whole life as a millwright in that mill, replied, "It would set up terrible strains in the wheel and would cause so much pressure in the main bearings that they would cut to pieces in no time."

The matter is now submitted for the consideration of the readers of Railway and Locomotive Engineering, and while the author pins his faith to the lower quarter, he wishes to say that if he has any pet theory that does not deserve to live, the individual who assassinates it will become his best friend. For the purpose of elucidation and for the further purpose of greatly exaggerating effects, the crank pins are shown in the periphery of the wheel instead of being in the intermediate position in which they are found in practice. T. H. Reardon.

North Adams, Mass.

[Our readers are welcome to discuss this matter if they so desire. We may say that our correspondent's view is correct when the engine is running forward. A piston without tailrod must have the area of the front side exposed to steam pressure, greater than the area where the section of the rod has to be deducted. When the engine is running forward the greater front area is effective when the pin is on the lower half of its course and when the engine is running backward the larger piston area is effective when the crank pin is on the upper half of its course. Perhaps some of our correspondents can tell us if the old millwright was correct, and if he was, why is it so.—Editor.]

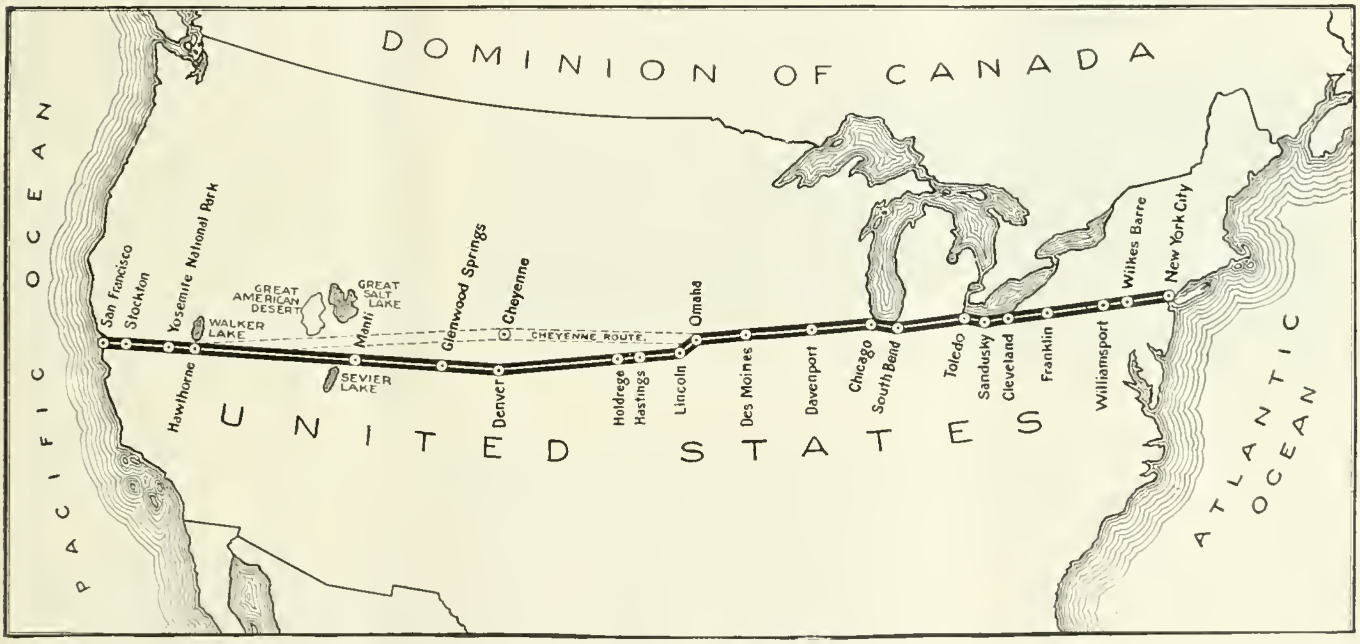
A Dream of the Future.

Editor:

The time now required in traveling by rail from New York City to San Francisco is about four days. While this is a great improvement over former years, especially when our forefathers occupied as many months in making the journey, yet there is still much room for improvement, especially in the matter of insuring prompt arrival of trains, greater speed and greater safety insured to passengers. By the use of electricity as a motive power in place of steam, improved signals and rolling stock, together with more direct routes, accomplished by means of cuts, fills and tunnels, it is thought that the present surface roads will be able eventually to travel at a rate of about eighty miles per hour, including stops; but not faster than this on account of the curves and crossroads. Thus the traveling time by rail between New York City and San Francisco would eventually be reduced to about thirty-seven hours. This would be accomplished only by means of many miles of absolutely straight track, which would mean the filling up of many valleys, innumerable bridges and cuts, together with countless tunnels; and all this to reduce the number of curves and windings in the route. For, as is well known, where many curves exist fast time is impossible on account of the friction of the wheels against the rails and the centrifugal force tending to throw the cars from the track.

As a future solution of the problem of extremely rapid travel by railroad between the Atlantic and Pacific coasts, it would seem that a properly constructed and operated tunnel route would offer many advantages over the transcontinental lines as now constructed and operated. The road would consist preferably of but a single tunnel, provided with a west-bound and east-bound track, thus insuring against head-on collisions, as the trains would run in but one direction on each track. The tunnel, from an engineering point of view, might be in section as shown in the accompanying drawing, being provided with niches at frequent intervals as means of retreat for workmen and others so that they might instantly step out of the way of passing trains. The roof portion of the tunnel might thus be continued downward to form a complete circle for the subaqueous portions of the route, as shown by dotted lines on the tunnel section on the accompanying map, the circle being the preferable section for the tunnel in passing under the rivers. Louvered skylights and vent shafts would be provided at frequent intervals extending from the tunnel to well above the surface of the ground, and properly capped to keep out the snow and rain and to provide against trespassing; certain of these shafts being provided with rotary fans for purposes of ventilation. The extremely rapid movement of the trains would tend to force the foul air ahead and out through the skylights and vent shafts, and the suction at the rear of the trains would draw fresh air in behind the trains. At frequent intervals, especially at all towns and villages, doors would be provided as a means of exit or entrance for workmen or for use in case the accompanying map might be made, yet from New York City to Omaha it could not well be improved, the cities indicated being practically in a straight line. Were the route to be via Cheyenne, as indicated by the dotted lines, the total distance from New York City to San Francisco would be about twenty-five miles less. The following table gives the approximate distances between the various points along the route as indicated on the accompanying map, given in statute miles and measured in straight lines.

The great feature of the road would be the vastly improved schedule that could be made, owing to the straight and clear track. The ordinary rate of speed, including stops, should average one hundred miles per hour, thus traversing the entire approximate distance of twenty-six hun-



MAP SHOWING PROBABLY SHORTEST LINE ACROSS THE UNITED STATES.

of accident. In certain localities where special conditions prevail, some special construction would be necessary, but the road for its entire length would embody the concealed or underground principle, the tracks being always enclosed.

One great advantage of building a long distance railroad underground would, of course, be that the track would be substantially straight for very long runs, the tunnel passing under all the rivers and through mountains in substantially straight lines. The necessity for winding and curving being thus almost entirely eliminated, the trains would not need to slow down on account of curves, and hence very fast time could be made. Electricity, of course, being the motive power employed for moving the trains..

The route would need to be, as nearly as possible, a straight line between New York City and San Francisco. While some variation in the route as shown on the accompanying map might be made, … dred and fifty miles from New York City to San Francisco in about twenty-six and one-half hours. It is believed that this rate of speed would not be unattainable under such favorable conditions. Traveling at the rate of one hundred miles per hour would be in effect:

Miles.		Minutes.
108	New York City to Wilkes-Barre	65
60	Wilkes-Barre to Williamsport	36
149	Williamsport to Franklin	89
96	Franklin to Cleveland	57
51	Cleveland to Sandusky	31
45	Sandusky to Toledo	27
144	Toledo to South Bend	86
74	South Bend to Chicago	44
151	Chicago to Davenport	91
159	Davenport to Des Moines	95
128	Des Moines to Omaha	77
53	Omaha to Lincoln	32
93	Lincoln to Hastings	56
53	Hastings to Holdrege	32
310	Holdrege to Denver	186
130	Denver to Glenwood Springs	78
238	Glenwood Springs to Manti	143
385	Manti to Hawthorne	231
66	Hawthorne to Yosemite Park	40
92	Yosemite Park to Stockton	55
65	Stockton to San Francisco	39
2,650 total miles.		Total time, 26½ hours.

The schedule time between New York City and Chicago by the tunnel route would thus be about seven hours and sixteen minutes, as compared with the present eighteen-hour "flyers," the distance by the tunnel route being about seven hundred and twenty-seven miles.

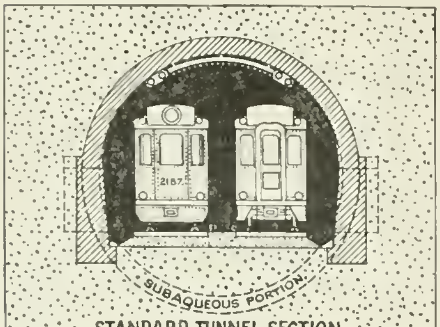
One immense advantage of a tunnel route would be that the track would always be free from snow, thus insuring a clear track in this particular at all times, and hence the schedule would be much more reliable than at present, for with the trains as now operated it is frequently a question of transporting the passengers at all, the matter of schedule being entirely out of the question on account of the snow, and it must ever be so with surface roads.

The tunnel would afford shelter for the power rails and the electric light, telegraph and telephone wires, thus doing away with all telegraph poles, as the said wires would all be within the tunnel.

Among the advantages of such a railroad would be the greater safety with which a person could travel, for the railroad being underground there would be no cross-roads, and hence no accidents, such as colliding of the trains with carriages, wagons, automobiles, or pedestrians. This would mean that the trains could move with greater safety at a very high rate of speed, and mean also a great saving of money, as the question of damage suits would be reduced to a minimum. Should the cars leave the track they would be in no danger of rolling down dangerous embankments as is so frequently the case with surface roads, but would simply slide along in the tunnel. The cars would, of course, be constructed entirely of metal, hence they could not catch fire, and would offer greater resistance in case of a collision or derailment.

The surface land immediately above the tunnel could be used as fields for the pursuit of agriculture or for buildings or other purposes, which would mean immense revenues and saving in cost of construction and operation of the road.

One of the greatest features and advantages of a tunnel route would be that it would carry the mails, thus not only saving an immense amount of time in their delivery, but would insure their being carried promptly, the trains being never snow-bound, and this feature of the road alone would go far to warrant its construction.



STANDARD TUNNEL SECTION.

By the use of specially constructed machinery and appliances for executing the work, the cost of constructing such a road, exclusive of the rolling stock, stations and power plants, would average about one million dollars per mile, this estimate including the tunnel, tracks, signals, telegraph, telephone, electric light and power installation complete and ready for operation. Through that portion of the United States where there is but little rock, and the surface of the earth is substantially level, the cost of construction per mile would be less, but in the Rocky Mountain and other mountainous regions the cost would, of course, be greater. But the tunnel once cut through these mountains would insure a direct means of communication and travel from the Atlantic to the Pacific coast, and would remain for centuries a blessing to mankind.

The road, of course, would not need to be undertaken for its entire length all at once, but could be built in sections. The section from New York City to Chicago, a distance of about seven hundred and twenty-seven miles, would be the first to be constructed and operated, and the Western portion, evidently the most difficult and costly to construct, would not be needed until that section of the country is more fully developed.

In view of the certainty of the trains arriving on time, the greatly improved schedule and the greater safety of travel, it is believed that the revenue derived from the road would be sufficient to warrant the undertaking from a financial standpoint. The construction of the road might be undertaken by the government, or each State through which it passed might assume the construction and maintenance of its respective section. That an undertaking of such magnitude could be successfully brought to completion there can be no doubt, in the light of the many great undertakings of a similar character, among which are to be mentioned the Simplon tunnel passing through the Alps of Switzerland for a distance of about twelve miles, the Saint Clair Tunnel, under the Saint Clair River, between Michigan and Canada, the Baltimore Belt Tunnel at Baltimore, Md., the Blackwall Tunnel under the River Thames, the Busk Tunnel on the Colorado Midland Railway in Colorado, and the Hoosac Tunnel in Massachusetts. The successful piercing of the Alps by the great Simplon Tunnel insures the road passing through the Rocky Mountain and other mountainous regions along the route.

To many persons such a project will no doubt seem chimerical, outlandish and not to be thought of. But our answer to such is that though we are living in an age of great things, yet greater shall be on the morrow. In view of the immense improvement in the art of railroading within the past fifty years, short-sighted, indeed, would be the person who would limit the achievements of the art within the next century. When we consider the marvelous development and improvement in the construction and schedule of ships traversing the high seas, and that each decade shortens the time between America and Europe, why should it be thought impossible or incredible that there should be as marked improvement in travel upon the land as upon the sea? In view of the wonderful development of the United States within the past century it would seem that should this development continue at the same rate, at least the first main section of the tunnel route between the Atlantic and Pacific coasts, that is to say, the section between New York City and Chicago, will be a necessity at a time not far distant.

ALBERT E. LONG.

Brooklyn, N. Y.

As Others See Us.

Editor:

I have often felt inclined to take a hand in some of the discussions in your paper, but either business, indifference or distance has prevented me, but the November number, just to hand, has upset my balance entirely.

In the first place might I ask further information from Mr. Lee, "Bank vs. Level Firing," page 475? What kind of fireboxes have the engines he runs? I figure out his statement this way: Seventh trip, eight cars at 40 tons each, 320 tons; engine and tender, 130 tons; total, 450 tons. With a consumption of 20 lbs. of coal per 100 tons per mile; 90 lbs. per mile for 79 miles, 7,110 lbs. coal in firebox at last firing; as I presume from his description of the road, that steaming all the way is required. I should not wish to have charge of an engine with such a fire if anything occurred which would entail dumping the fire, or what would become of the water if layed up in a siding for an hour or so? As I understand his letter, he arrives at the end of section with a big fire, covers this with 15 scoops of coal, say 180 lbs. at outside; what means are adopted to prevent blowing off at safety valves during the two hours in shed? I know that this could not be done with either a British or Colonial engine, much less an American, and there is no comparison between the ashpans and dampers of the two, the British being almost airtight, while there are so many open spaces in the American pans and dampers that it makes very little difference whether they are open or shut.

Also, what becomes of all the heat gen-


EXHIBIT IN EIGHT-HOUR PROCESSION AT SYDNEY, N. S. W.

erated by fuel during the two hours spent preparing fire at beginning of trip, and is it a usual practice for firemen to get in shed two hours before starting time? It seems to me to be a long time indeed! On these railways we are allowed 45 and 60 minutes for driver and fireman to prepare for trip, no matter whether long or short, but in no case must we be over twelve hours on duty from start to finish. As I take a deep interest in these matters, I hope he will be good enough to explain fully in an early issue.

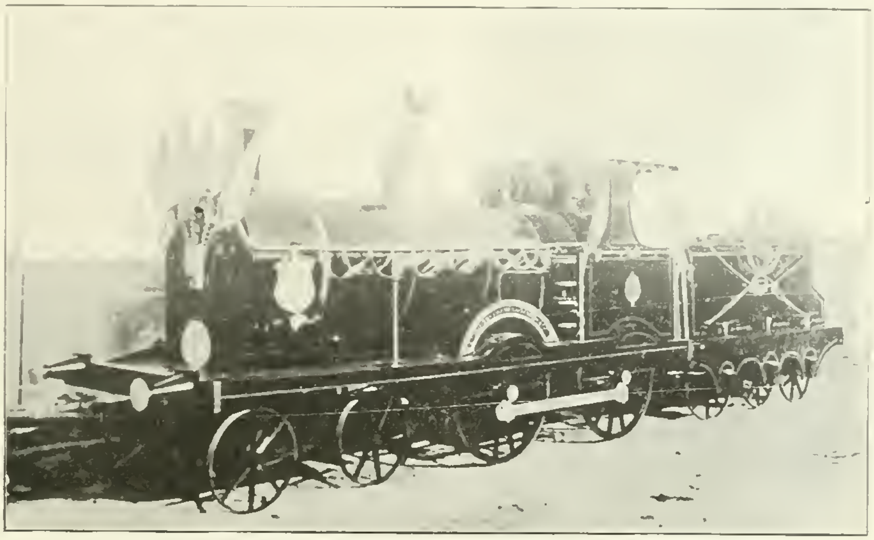
But it is Jim Skeevers I am after, and as I have been one of his most ardent admirers ever since he wrote to "Ours," I regret to see him run up against his fourth vice-president, whether that worthy married the president's daughter or not. So far as Verry Newe was concerned he was all right; it was the other fellow, he who designed the machine, that Jim should have tackled. Our worthy senior philosopher can no doubt inform Jim that with a properly designed locomotive boiler and firebox and even indifferent fuel, the fire door need never be shut close, and no doubt he can also inform him that in all his journeys in Great Britain, and even in Australia, he never saw engines running with door closed. Among us here such a thing is practically unknown, and as our standard type is Webb's marine door, working on a hinge with a V-shaped latch, we could not keep door closed if we wished to, as the blast will pull it open when engine is working. We have a few sliding doors, but these are at least 3 ins. open at all times.

By this means comparatively little smoke is made and only for about ten seconds after each scoop of coal is thrown on fire is any perceptible while engine is working; and it is easily avoided altogether at stations by the judicious use of dampers, door and blower. Our blowers are very quiet and powerful, being all rings cast on blast nozzle, bored with 1-16 in. holes close all around.

Our loading is fully up to the capacity of at least one 9 m/m or 10 m/m injector and fairly good speed, from 30 to 50 miles per hour on passenger service and 15 to 25 miles per hour in freight service. Grades very heavy, nearly 40 per cent. of our main line being 2½ per cent. grades, with some miles of 3 per cent., but most branch lines now made are much easier in grade.

What puzzles me most in reading all the correspondence on "No more bad coal," "Bank vs. level firing," etc., is this—what can the engineers who design your locomotives be thinking about to have engines built that will not consume the smoke and yet expect the crew to take the loads over the road on time, smokeless?

Another thing is, what advantage is gained by using steel fireboxes? It seems to me that most of the locomotive failures are caused by leaking tubes and fireboxes, and I can well understand this, as I worked a Baldwin consolidation over two years, having the engine to myself, with every possible opportunity of looking well after the machine, and having a fair knowledge of how to do so, according to general report; in fact, the engine was allotted to me for that very reason; yet with all the care I could take of it, leaking tubes were a continual source of annoyance, and at the end of two years there were various small cracks at the base of the corrugations in the firebox.


MODEL OF ENGINE IN EIGHT-HOUR PROCESSION IN AUSTRALIA.

Now with copper boxes and short stays, brass tubes with iron ferrules, such a thing as a leak is practically unknown, and we have engines which have never been known to leak under any kind of treatment and some boxes have been taken out of condemned boilers that were to all appearance as good as new, after 20 years service. It cannot be, surely, the difference in the cost of material, as one serious failure when in service would cost any company more than this. Then what is it?

Your design of valve and travel seems to me to be faulty, for otherwise why should your engines be so heavy on fuel?

Our Australian consolidion has 21 x 26 in. cylinders, valve travel 5 ins., lap 1⅛ in., lead ⅛ in. Baldwin consolidions 21 x 26 ins. cylinders, 5⅜ ins. travel, ⅞-in. lap, 2/32 in. lead. Consumption of fuel average all over system. Australian consolidation 87 lbs. per mile; Baldwin consolidation 121 lbs. per mile. Baldwin consolidation tonnage rating is about 10 per cent. less than Australian consolidation, so that on a tonnage basis the difference is even greater. Your system of isolating engineman and fireman on different parts of the engine seems to me a serious mistake and I pity Jim shut up in his own side of cab. Personally I like to see my mate, and I cannot well understand how Jim's mate can pass signals along to him when seen, if he is placed in a different part of the engine. I feel quite certain on this point, that if the fireman was in close touch with the engineman fewer serious accidents would take place.

Now with us, working all single lines on electric staff or tablet system the fireman takes staff or tablet, examines it, and hands to engineman, who places it in rack set apart for it, where it remains under their eyes right through section, where fireman again exchanges it. The fireman also calls out all fixed signals as seen, the engineman acknowledging this sometimes by hand, nod or word of mouth. With your system of isolation this would be a difficult matter and you thereby lose an additional safeguard, in fast or even slow heavy trains.

On the whole, I think Jim should stir up your engineers who design these faulty engines, to copy some of the best points in other peoples' work, and I feel quite certain that given the machines to do the work the crews will respond and there will be neither smoke nor lost time to growl about. Our locomotive failures are in some classes of engines less than one failure in 40,000 miles per engine, a record I think all can be proud of when we consider that any delay charged to locomotives is classed a failure. Can you procure and publish in "Ours," a return of some of your principal lines, showing mileage per locomotive failure. A failure to be any charge of 5 minutes or over delay to any train through any locomotive failure to make schedule time?

I enclose you photos of our last exhibit in Eight-Hour procession and which was awarded third prize, the leading exhibit being the work of one of our members who served his time on same road as our senior philosopher, and the other exhibit was the work of a few members of this branch in their spare time.

CORNSTALK.

Sydney, N. S. W.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

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Railroad Men, Defend Your Interests.

The statement has been made so often that there is community of interest between all railroad employes high and low, from the president down to the track laborer, that the sentiment is undisputed; but unfortunately it has continued to be merely a sentiment without practical application, a sort of faith without works. For years a conflict has been carried on by politicians against railroad companies' interests, in which the lower grades of the railroad service are the greatest sufferers, yet those most afflicted have done little or nothing to repel the assaults of the enemy; but have left the officials to bear the burden of the fray, and at times even have given aid and comfort to the enemy. This condition of affairs has been due to misunderstanding the interests at stake. When high and low in railroad employment come to realize that all suffer injury from legislation that tends to reduce the earnings of railroads, they will co-operate cordially to oppose those who pose in legislatures as enemies of railroads.

That more cordial relations between the rank and file of railroads has been so little in evidence of late years, has been due in a great measure to the upper ranks holding themselves in contemptuous aloofness from the men who perform the actual work of operating the railroads. There was a time when every railroad manager and superintendent was personally acquainted with every person on the pay roll and was ever ready to exchange a word of greeting or sympathy. When any adverse legislation was threatened in those days, the management could count on every man belonging to the road using his full political influence on the side of the company and of justice. The consolidation and enlargement of railroad properties has created a widened breach between the managers and their men, but it might not be so wide as it is if the officers followed the policy of keeping in as close touch as possible with their fellow employes no matter how humble their station.

We believe that Mr. Daniel Willard, second vice-president and really general manager of the Burlington line, has inaugurated a movement which is destined not only to bind the management and employes generally into closer union than they have been before, but to rear up a barrier between railroads and the destructive assaults of politicians.

Mr. Willard has been lecturing to the employes of the Burlington Railroad Company and others, on the inside workings of the company and on the effects of legislation calculated to reduce its income. It is a most interesting story and contains statements that would appear incredible coming from less reliable authority. During the month of October, 1907, the company did the largest business in its entire history. There were 53,000 names upon the pay roll, and every car and locomotive that could be forced into service was busy. Four months later business had fallen off so that the Car Efficiency Bureau reported 325,000 freight cars idle and the Burlington had reduced its force by nearly 18,000 men. At the beginning of 1907 the budget, or estimated expenses for operating and carrying on improvements on the property, was $16,000,000; a year later, when the wave of anti-railroad legislation that overran the country had done its work, the budget was reduced to $8,000,000, and to-day the calculated expense for the year is little more than $1,000,000.

There is some conflict of opinion about what was the immediate cause of the panic of 1907, but it is certain that the legislation hostile to railroad interests alarmed capital so that there was a general movement to sell all kinds of railroad securities. Other forms of property suffered in sympathy.

The greatest sufferers from the collapse of business were railroad employes. Thousands were thrown out of employment altogether, and many more were put on reduced time, which meant curtailment of their incomes. Now suppose the railroad employes generally had taken an active part at the polls in opposing the demagogues who fattened on proclaiming anti-railroad sentiments? There are about 1,800,000 railroad employes in the United States and Canada, a voting army that could exercise immense influence in self-defense if properly applied. Yet the active enemies of these people have carried out their nefarious projects without any consideration for the railroad vote. This has come about because the railroad men were apathetic in defending their own interests. The lesson of the panic calls upon all railroad men to be up and doing. There ought to be clubs in every town where railroad men reside, to hold all interested in combination for the protection of the business that supports their hearths and homes. Were this done systematically, a very different sentiment concerning railroads would prevail in the halls of legislation. To encourage a movement of this character railroad managers generally would do well to follow the example set by Mr. Daniel Willard, and take their employes into their confidence to explain the pernicious effect of hostile legislation.

Extracts from Mr. Willard's admirable lecture will be found in another column of this paper.

Improved Headlights.

At the International Convention of the Brotherhood of Locomotive Engineers, held at Columbus, O., in May, 1908, the following resolution was proposed and adopted:

"Resolved, That it is the sense of this Convention that our Legislative Boards be instructed to use their best endeavors in the future to have laws passed in their respective States requiring railroad companies to equip all road engines with the best power headlight."

The sentiment of this resolution has been used by persons interested to have laws passed requiring the use of headlights of not less than 1,500 candle power, which is equivalent to prescribing electric headlights as no other form meets that requirement. Assertions have been published that the Brotherhood of Locomotive Engineers are using their influence in favor of electric headlight, but that is not true, for those authorized to speak for the brotherhood say that all they demand is an improved form of headlight, and a positive denial is made of the statement that the Brotherhood has raised a large sum of money to promote legislation in favor of electric headlights. The State of Texas has passed a law requiring railroad companies to use on their road engines headlights of not less than 1,500 candle power measured without the aid of a reflector. We consider that a very short-sighted law as it debars other forms of improved headlights which may be equally efficient for practical purposes although less powerful than the electric headlight.

Railroad companies have displayed so much discrimination in providing safety appliances that they ought to be left to their own volition in the kind of details required in headlights and similar equipment. It requires a considerable volume of steam to keep a 1,500 candle electric arc in operation and many small boiler engines are not equal to the drain without interference with their train-hauling capacity. Companies having such engines ought certainly to enjoy the privilege of using headlights that put no drain upon the train-motive power. There are in use acetylene and gas headlights that are perfectly satisfactory in illuminating the track and it seems very unwise that legislators should pass laws debarring these from use.

It would be well for the advocates of improved locomotive headlights and other safety appliances to follow the lead of the Master Car Builders' Association in this line of requirement. That association specified a form of coupler and form of continuous brake that would be considered satisfactory, and left inventors and railway supply people to work out the details. That prevented the forming of rich compaines to control the manufacture of necessary appliances and provided an open field to invention and to enterprise.

Abuses of the Compensation Act.

The fact that democracy is a political state of affairs and not a free-and-easy mingling of men in social intercourse, is very clearly brought out by the trend of legislation in Great Britain, in recent years. The Workmen's Compensation Act is a very good example. This law, which has been in operation for a number of years, has recently been enlarged in scope, so that the British workman is practically assured of compensation when an accident befalls him, without reference to where the responsibility for his injury lies.

The act now provides that the employer must pay an employee injured on his premises, even though the injury is the result of the workman's own carelessness or that of a fellow employee. The "fellow servant" iniquity as we know it here has long ceased to exist in the United Kingdom. As a result of this there have been a number of more or less barefaced attempts to take advantage of the situation, and some abuses of the law have arisen which are perhaps inevitable, and these have been taken into court, and even there the workman has not fared very badly in some cases.

The courts heretofore have held that an injured employee could not be compelled to undergo an operation intended to effect a cure, if the operation was attended with risk. Hardly any surgical operation is entirely free from risk, and men have been known to prolong their inability to work by refusing to submit to an operation otherwise justifiable, on the ground of risk. The courts have, however, held that if an operation not fraught with danger is refused, continued compensation need not be given by the employer.

Cases have come up where an injured man has refused to render even light and easy service while in a state of convalescence, the right to say when he is thoroughly well and able to work being claimed by the injured man. The courts have, however, exercised what may be called common sense in the determination of such cases. The law itself works in the interest of the employee, and judges and juries almost invariably lean to an interpretation of the law which is favorable to the workingman. It will be a great pity if public sympathy is alienated from the great body of toilers in what is held to be an equitable construction of the act by reason of the behavior of a few unscrupulous persons. Organized labor is sometimes less vulnerable to attacks from without than it is from the effects of overreaching by those within its pale.

Reboring Cylinders.

In the case of general repairs to a locomotive, which may occur at any time within one or two years hard service, it is good practice to carefully caliper the cylinders. This can be readily accomplished by cutting a pencil-shaped piece of wood into which a common pin may be inserted with the head projecting outwards, and adjusting the pin carefully to the widest part of the cylinder, which will generally be found to be at the front end, the wear being usually greatest at the bottom. In some well equipped shops a metal gauge with an adjustable screw in one end, which is sharpened to a point, is used. If the wear shows over one thirty-second, the boring of the cylinder should be proceeded with, as it will be found that there are more irregularities than are at first sight apparent. If time is allowed it is well to stretch a line through the cylinder extending the entire length of the frame, as it does not always follow that the cylinders are exactly in line with the frames. The usual rapidity with which the frames are originally set up in some shops precludes the possibility of an exact adjustment of the cylinders to the frames. Even with a careful setting of the frames there are a number of causes that tend to create slight variations in the perfect parallel that should exist in the relation of the frames to the cylinder. Among these it may be readily noted that the succession of blows on the pedestal jaws are not exactly alike on both sides of the locomotive. This arises from the two cranks being set ninety degrees apart, while the intervening part of the circle having no equivalent attachment, the effect has a more or less distorting effect on the frames. Again, the fatigue of metal, so-called, caused by the irregular heating and cooling of certain portions more than others, or by vibration, tend to increase these growing variations, with the result that it will be found by stretching lines through the cylinders that neither the frames nor cylinders are perfectly parallel to each other.

This variation can be largely rectified by allowing a remedial variation in the setting of the boring bar, which is usually exactly equal from the unworn counterbore. The cutting tools should be carefully set, following each other as closely as possible, the finishing cutter being of a broader face than the others. In addition to the usual attachments for holding the bar securely in place, hanging a heavy weight on the back end of the bar has the effect of steadying the bar and avoiding the vibrations incident to the variation in the metal, especially when the cylinders are much worn.

It will generally be found that there are variations near the center of the cylinder, sometimes of considerable depth, owing to the varying degrees of softness in the metal arising from the variation in the thickness of the cylinder walls, the thick ribs between the steam ports being much softer than the thinner portions of the walls near the intercostal spaces. These depressions sometimes exceed the amount of wear at the extreme ends of the cylinders, and as may readily be imagined are the cause of some of the blowing of steam past the piston rings while working.

If the first cut is not sufficient a second cut should be taken which, of course, may be much lighter, as care should be taken not to cut out more metal than is necessary to perfectly clean the cylinder. It should be noted that the counterbore is sufficiently deep to avoid the possibility of a shoulder forming at the end of the piston stroke. It should also be of sufficient width so that the outer edge of the packing ring will travel slightly over the inner edge of the counterbore. In reboring the counterbore, a portion of the original metal should be left as a partial support to the back cylinder head, the back counterbore thus forming when rebored a kind of recess sufficiently wide for piston clearance purposes.

Feed Water Heaters.

Some of our correspondents have taken up for discussion the subject of heating feed water from the waste heat that passes away to the atmosphere through the exhaust steam. That has long been an attractive subject for discussion among enginemen or in the columns of the engineering press; but there are difficulties in the way of locomotive feed water heating that must be experienced to be properly realized. Among the first inventions devised to utilize steam wasted in the operating of locomotives were feed water heaters, and their number since that time have been legion. There have been two distinct forms of feed water heaters introduced, one taking part of the exhaust steam, the other kind utilizing the steam wasted through the safety valve. There are few railroads in the country that have not had experience with one or other of these heat-saving devices, and there are few old engineers who are not ready to give emphatic testimony against their use.

The supreme difficulty in using locomotive feed water heaters to advantage is, that the heat imparted to the feed water was never properly regulated, and failures of the engine were constantly happening through the feed water getting so hot that it could not be fed through the injector. A single failure from this cause would sometimes be so costly that it would overbalance the saving of months. Another objection to the heaters was that the saving of coal was so small, that the benefit could not be seen in the amount of coal consumption, which tended to throw the heater into disrepute.

A form of feed water heater used considerably on foreign railways is the Metcalf exhaust injector. That form of injector is operated by the exhaust steam, and, of course, all the heat added to the feed water goes into the boiler and is so much gain. Injectors of that kind have been tried on the American continent, but they have never reached popularity which would indicate that they did not work so satisfactorily as the direct steam injectors.

On the whole, the prospects for a man trying to push a locomotive feed water heating device into use are not encouraging. The sentiment among railroad men in favor of coal saving is too apathetic to promote the use of fuel saving devices. If a feed water heater would operate without any attention and never would give trouble from overheating the feed water, it might be tolerated; but a device that needs watching adds new responsibility to the enginemen, and they are already so much burdened with responsibilities that material benefit would be needed to overbalance the trouble incurred.

Self Dumping Ash Pans.

The United States Congress has passed a law which says that, "on and after the first day of January, nineteen hundred and ten, it shall be unlawful for any common carrier engaged in interstate or foreign commerce by railroad to use any locomotive in moving interstate or foreign traffic, not equiped with an ash pan, which can be dumped or emptied and cleaned without the necessity of any employee going under such locomotive.

"That any such common carrier using any locomotive in violation of any of the provisions of this Act, shall be liable to a penalty of two hundred dollars for each and every such violation, to be recovered in a suit or suits to be brought by the United States district attorney in the district court of the United States having jurisdiction in the locality where such violation shall have been committed; and it shall be the duty of such district attorney to bring such suits upon duly verified information being lodged with him of such violations having occurred; and it shall also be the duty of the Interstate Commerce Commission to lodge with the proper district attorneys information of any such violations as may have come to its knowledge."

Now, it might be in order for Congress or the Interstate Commerce Commission to invent a self-dumping ash pan that will not entail evils worse than that of emptying by manual effort. The Interstate Commerce Commission seems very ready to put the noose of patent cranks around the necks of railroad companies.

Too Much Zeal.

In the parable of the tares, the servants of the householder desired to go out into the fields and gather them up as soon as they had been discovered, but in this well-intentioned purpose the man who owned the field at once apprehended the danger of over-zeal, and said to his servants, "Nay, lest while ye gather up the tares ye root up also the wheat with them." There is no denying that the conduct of some railways and some large concerns was such as to cause a very widespread feeling that the various State governments should apply corrective legislation. This has been done, and like the love of Hamlet's mother, "as if increase of appetite had grown by what it fed on."

At the present moment we are confronted with the effects of over-zeal, and in rooting out some railway tares by the legislative servants of the people much good wheat has been destroyed. The object of the Railway Business Association is to save what remains of the wheat and leave the process of separating the tares until the harvest, which happens to be the sensible way the owner of the wheat field in the parable advised his servants to do.

The fact that the railways of this country have been very seriously hampered by the long drawn out campaign of hostile legislation is very clearly exemplified by the effect of the rate war among steel producers. The lowering of prices did not produce a rush of business as it would over a bargain counter. Railways are not insisting upon cheaper goods; they desire a fair chance to make the money necessary to buy goods at fair market prices and to carry out improvements and betterments along their lines, all of which means good wages for the army of workers in the land, part of which is now on short time or out of employment altogether.

In a recent editorial, the New York *Times* points out that the steadily reduced budgets of our railways is largely, if not entirely, due to hostile legislation. This is true only in the United Sattes, for in Canada and Mexico the reverse condition prevails. Not long ago the government of the province of Alberta guaranteed bonds at the rate of $20,000 per mile for railway construction by Kansas City capitalists. It also guaranteed 850 miles of Canadian Northern branch lines, and 500 miles of Canadian Pacific branches. The aggregate of the day's business was $27,500,000. Almost at the same time the Manitoba Legislature began the favorable consideration of a railway projected by Mr. James J. Hill. The Canadian Pacific Railway was stated to be expending $6,000,000 on extensions and important electrical improvements. The Southern Pacific successfully financed the remainder of 1,500 miles in Mexico, of which about one-third has been built. The *Times* adds: "The distinction is not along lines of principle, it will be seen. The very men whom we denounce as malefactors are regarded as benefactors north and south of us."

Speaking on the same subject, *The World's Work* remarks:

"Under the circumstances, is it not time that we woke up to the fact that traffic is international? And should our railroads not have a fair show in our own borders? It may be true that heaven ordained Japan and Greater Britain to control the trade of the Pacific; but surely our own laws might at least give our own railroads whatever little chance heaven may leave to them."

The Missouri Rate Decision.

The numerous State legislators who have acted on the policy that railroad companies have no rights worthy of consideration have received something like a shock from a strong galvanic battery in a decision by Federal Judge MacPherson against the State of Missouri in cases growing out of the two-cent-a-mile passenger fares and the maximum freight rates measures enacted in 1907. The court holds that the only question or issue involved is whether the rates fixed by law can be made to yield a reasonable profit to the carrier companies or intrastate or local traffic; and the conclusion from the testimony is that the rates fixed by both statutes are unremunerative and in some instances would ultimately be confiscatory of the carriers' property.

The importance of the decision lies in the fact that State legislators are prohibited from confiscating railroad property. The people at large are making no demands on railroads to do business at unremunerative rates and the Missouri decision is likely to exert a salutory effect upon the zeal of the politicians.

Book Notices

The Railway Locomotive. Why it is and Why it is What it is. By Vaughan Pendred, M. E. Published by D. Van Nostrand Co., New York. 310 pages. 5½ ins. by 8¼ ins.; numerous illustrations; ornamental cloth. Price $2.00.

This excellent work forms one of a series of what is known as the "Westminster," the idea of publishing which originated with a well-known publishing firm of world-wide reputation. The series is intended to bridge over the gaps left by specialization. The author in this work handles his subject from a physiological standpoint, so to speak, and an important new place in engineering books is introduced by giving reasons why the various parts of the locomotive have assumed the particular shapes in which they are to be found. The work is not in any sense a historical work. It is rather a descriptive work explanatory of the forms and uses in which the locomotive is what it is. The contrast between the American and British locomotives are very clearly pointed out and the work is altogether a valuable addition to railway locomotive literature.

Social Engineering. A Record of Things Done by American Industrialists Employing Upwards of One and One-Half Million of People. By William H. Tolman, Ph.D. Published by McGraw Publishing Co., New York. 384 pages. 6 ins. by 9¼ ins. New York. Cloth. Price $2.00.

Dr. Tolman, the accomplished director of the American Museum of Safety Devices, has performed a notable work in collecting in one volume and presenting in the best possible form a record of the vast and growing improvements tending toward the amelioration of the condition of the industrial classes. The illustrations are drawn from hundreds of the leading industrial centres, and it is gratifying to observe that there is a growing spirit of emulation among individual firms as to who will treat their employees in the best way calculated to develop that mutual good will which ought to exist among all human kind. A perusal of Dr. Tolman's work cannot fail to convince the most casual reader that the world is really better than some think it is, and while it is still far from right, especially in the matter of properly recompensing the real workers, "Social Engineering" will help along the coming of the golden age. It is a handbook of suggestion. It is a guide to others. Dr. Andrew Carnegie speaks a good word for the book by way of introduction. The wealthy ironmaster ought to take a leaf from the book himself and learn that there are other things besides libraries that the industrial classes need. The need of good books is great, but the need of fresh air, and shorter hours of excessive toil, and better wages, and healthful recreation and intelligent companionship and fair treatment, and opportunities for developing the brightest and best attributes and aspirations of overburdened humanity is much greater. Dr. Tolman's book should be in the hands of all employers of labor, and it is to be hoped that those into whose hands it does come will have eyes to see and ears to hear the humanizing gospel that Dr. Tolman preaches.

The Acetylene Headlight.

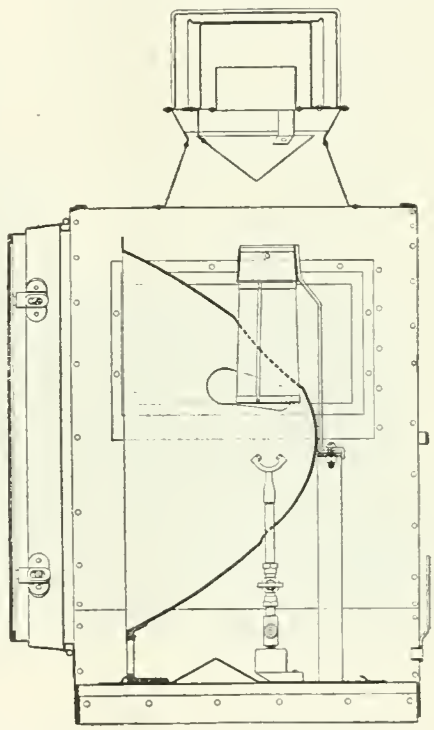
The use of acetylene gas for lighting railway cars, yachts, steamships and isolated private houses is now well known. This form of illuminating gas is adapted for use where the source of supply has to be portable, or in the case of private houses where there is no gas-making or electric plant in the vicinity. Where acetylene is used the supply and the light are together, because the storage of acetylene, and, in fact, its generation, are both comparatively simple matters.

Acetylene is a carburetted hydrogen gas having the chemical formula C_2H_2 and is usually generated for commercial purposes by adding water to calcium carbide, when acetylene gas is given off, leaving slaked lime behind. This gas burns with a bright luminous flame and produces a white light. For a description of, and some remarks on, the kind of light obtained from acetylene, the reader is referred to an article on the "Quality of Headlamp Light," which appeared in Railway and Locomotive Engineering for October, 1908, page 448.

The storage of acetylene is an important matter, for it is explosive when mixed with air just as ordinary house illuminating gas is explosive when allowed to collect with air in the oven of a cooking range. The method of storage as adopted by the Commercial Acetylene Company, of New York, and called by them the Safety Storage System, consists first of all in generating, purifying, drying and compressing the gas. These processes were described in our June, 1906, issue, page 278, where a glance was taken at the Delaware, Lackawanna & Western acetylene plant at Hoboken, N. J. The Safety Storage System proper consists of introducing acetylene gas at about 150 lbs. pressure into tanks of various sizes depending on the supply necessary where tank is to be used. These tanks are cylindrical and are full of silicated discs of asbestos, packed close together. The tank seems to be full of asbestos, and so it is, as far as one can see, but the asbestos is 80 per cent. porous, so that in the minute spaces between the particles of the closely packed asbestos discs there is a large aggregate volume for the introduction of a gas or a liquid.

The asbestos is used to absorb acetone, a colorless liquid prepared by passing the vapor of acetic acid through a red hot tube. Dilute acetic acid is vinegar. Here we have the tank packed with asbestos and the pores of the asbestos saturated with acetone, yet acetylene gas is not excluded. Acetone has the property of dissolving about 25 times its own volume of acetylene at a temperature of about 62 degs. F. Asbestos distributes the acetone throughout the tank and when acetone dissolves the gas the resultant liquid is non-explosive. Acetylene at 150 lbs. pressure is thus safely stored in the tanks.

The liquid acetone in which the acetylene is dissolved boils at 56 degs. F. and under the pressure of 150 lbs. in the tank, readily comes over laden with acetylene in the form of vapor. Acetone, C_3H_6O contains carbon, hydrogen and oxygen in the proportions indicated in the formula and thus aids, rather than retards, the combustion of the acetylene gas, a very small quantity passing off with the gas. This supply is replenished as the tanks are charged at the plant so that there is always the proper amount in the tank. The resultant flame gives a soft, white, bright powerful light.

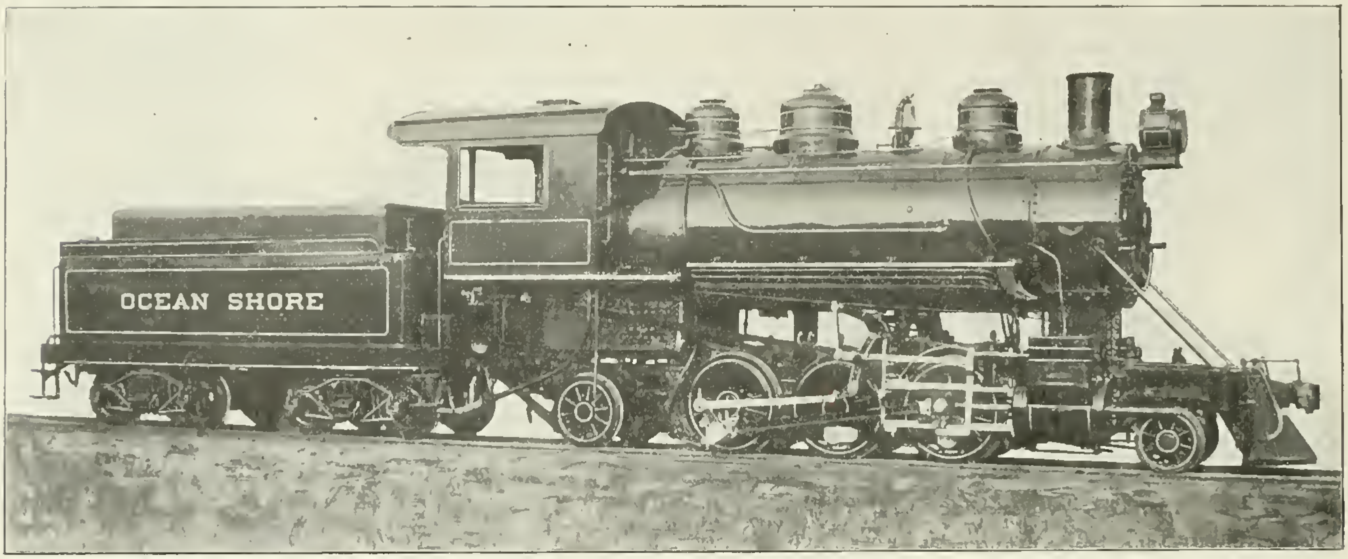


HEADLIGHT BURNING ACETYLENE.

Where a headlight burns acetylene a tank 12 x 36 ins. is secured on the engine in any convenient place, and a pipe, provided with suitable pressure gauge and regulating valve and stopcocks, leads to the headlight. If cab lights are desired, such can be supplied from the same tank. On switch engines, where a headlight is used on the tender, a second pipe leads from the storage tank and has a flexible connection between engine and tender. The tank now made for this purpose is 12 ins. in diameter and 36 ins.

long, and contains 225 cubic feet of acetylene at 150 lbs. pressure. When this is consumed at a burner using ¾ of a cubic foot an hour, the supply lasts for 300 hours. A headlight burned steadily for 10 hours a night would last about one month.

The burner is a very simple affair. It is practically an upright pipe surmounted by a U-shaped terminal and at the end of each curved arm a small circular hole permits the gas to escape. These holes are inclined to each other so that the two streams of gas meet in the centre of the U-shaped piece, and when ignited, the gas takes the form of a small fish-tail flame which burns brightly in the focus of the reflector. Any oil headlamp may be arranged for burning acetylene by removing the oil burner, fount and chimney, and applying the acetylene burner. There is nothing to get out of order in the acetylene equipment. When light is wanted the gas is turned on and ignited with a match, as it would be in a dwelling house. Where acetylene headlights are used, a road owning its own generating and charging plant fills the locomotive tanks as they do those under the cars. Where no charging plant exists, an empty tank may be readily exchanged for a full one, a supply of which is usually kept on hand by the stores department of the railway.



F. A. Stevens, Master Mechanic. 2-6-2 ENGINE FOR THE OCEAN SHORE RAILWAY. Baldwin Locomotive Works, Builders.

Prairie Type for the Ocean Shore.

The Ocean Shore Railway of California have recently placed in service two locomotives which were built by the Baldwin Locomotive Works. The line has curves of 35 degs. and 4 per cent. grades; and is laid with 70-lb. rails. The new engines are designed for general road service; they are of the Prairie or 2-6-2 type, with short, flexible wheel bases, and are thus well adapted for work on a line of this character. They exert a tractive force of 27,200 lbs. and as the weight on the driving wheels is 111,800 lbs., the factor of adhesion is 4.11. The cylinders are 20 x 24 ins., and the valves are of the ordinary slide valve type, balanced.

Owing to the compact wheel spacing on these locomotives, the main rods are connected to the third pair of drivers. This design gives room for a convenient arrangement of Walschaerts valve gear, in which both the link and reverse shaft bearings are bolted to the guide yoke. The valve rods are supported by brackets, which are mounted on the top guide bars. Balanced slide valves are used, and they are set with a maximum travel of 5½ ins. and a constant lead of 3/16 in. The frames are of cast steel, 4½ ins. wide, with double front rails of wrought iron. The rear frame sections are separate pieces, strongly spliced to the main frames back of the rear driving pedestals. The rear truck is of the Rushton design, with inside journals. It is equalized with the second and third pairs of driving wheels, while the front truck is equalized with the leading drivers in the usual manner. The middle driving-wheels have plain tires without flanges.

The boiler is straight topped with a wide firebox and short smoke box, and is equipped for oil burning. Its center line is placed 9 ft. above the rail, thus giving room for ample depth of furnace. The mud ring approximates a square in plan, and the grate area, if a grate were used, would be 33 sq. ft. The engine, however, is equipped for burning oil as fuel, a supply of 4,000 gallons being carried on the tender. The firebox is supported by sliding shoes in front, and a buckle plate at the rear. Radial staying is employed, and the water legs are vertical. Those at the sides and back have 3½ ins. water space, and the front space is 4 ins.

The engine and tender-truck wheels are steel tired, with cast iron centers, and were supplied by the Standard Steel Works Company. The main driving-wheel centers are of cast steel, and the driving boxes are of steeled cast iron. Automatic air brakes are applied to the driving and tender wheels, and the LeChatelier water brake, which is a most useful device when descending heavy grades, is applied to the cylinders.

The tender frame is built of 10-in. steel channels, and the trucks are of the arch bar type, with cast steel bolsters. The water tank is U-shaped, with a straight top, and the oil tank is placed in the fuel space. The tank capacity for water is 2,800 gallons. This locomotive is chiefly interesting as a special design, prepared to meet conditions on an exceptionally crooked and hilly road. The photograph shows the general features, while the principal dimensions are given in the table which follows:

Boiler—Material, steel; diameter, 72 ins.; thickness of sheets, 11/16 ins.; working pressure, 160 lbs.

Firebox—Material, steel; length, 72 ins.; width, 66 ins.; depth, front, 73¼ ins.; back, 70¼ ins.; thickness of sheets, sides, ⅜ ins.; back, ⅜ ins.; crown, ⅜ ins.; tube, ½ in.

Tubes—Material, steel; wire gauge, No. 12; number, 310; diameter, 2 ins.; length, 14 ft.

Heating Surface—Fire box, 145 sq. ft.; tubes, 2,259 sq. ft.; total, 2,404 sq. ft.

Driving Wheels—Outside diameter, 48 ins.; journals, 8½ x 10 ins.

Engine Truck Wheels—Front, diameter, 28 ins.; journals, 5 x 12 ins.; back, diameter, 36 ins.; journals, 6½ x 12 ins.

Wheel Base—Driving, 9 ft.; total engine, 23 ft. 6 ins.; total engine and tender, 48 ft. 9 ins.

Weight—On driving wheels, 111,800 lbs.; on truck, front, 18,250 lbs; on truck, back, 23,050 lbs.; total engine, 153,100 lbs.; total engine and tender, about 233,000 lbs.

Tender—Wheels, diameter, 33 ins.; journals, 4¼ x 8 ins.; service, passenger and freight.

We are informed that the Westinghouse-Church-Kerr Company, engineers in charge of the equipment of the New York terminal of the Pennsylvania Railroad tunnel, have recommended the use of Sturtevant Multivane fans for ventilation. They have placed an order with the B. F. Sturtevant Company, of Hyde Park, Mass., for thirty-six of these fans.

Applied Science Department

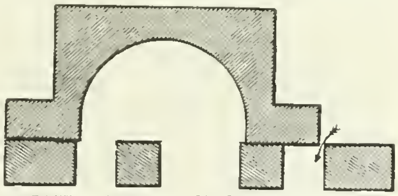
Elements of Physical Science.

VII. The Slide Valve.

Having described in the last issue of Railway and Locomotive Engineering the construction of the slide valve and its relation to the steam ports, and pointed out the advantage derived from the face of the valve being made more than sufficient to cover the steam ports, it remains to be stated that the opening and shutting of the steam ports by the movement of the valves is of the utmost importance in the running of the steam engine. It will be readily understood that when the piston is at one or other of the extreme ends of the cylinder and it is intended that it should be moved in the other direction, the steam port should be rapidly opened so that the steam may exert its full pressure on the face of the piston. Many eminent engineers held the opinion that the opening of the port should occur in advance of the arrival of the piston at the end of the stroke. This is what is known as the *lead* of the valve. It has been the subject of much discussion and is still an open question. At first sight it would apear to be a hindrance to the piston to meet with a pressure of steam working adversely to the direction in which the piston was moving, but when it is borne in mind that even steam at a high pressure, moving at a high velocity, requires some small instant of time to move through the intervening space between the steam chest and cylinder, and also that the piston itself may be moving at a high speed, it is easy to understand that it may be an advantage to begin to open the valve slightly in advance of the reversing of the movement of the piston.

This is more readily apparent in the case of engines running at high speeds than otherwise, because the velocity with which the steam moves through a certain space at a certain pressure may be safely called a constant velocity, while the rate of speed at which the valve or the piston travels varies according to the kind of work accomplished. This fact has led to the claim that the increase in the amount of lead in the valve which is caused by the shortening of the travel of the valve in the case of engines equipped with the Stephenson valve gear is an advantage to locomotives running at high speeds when the reverse lever is "hooked up." The action of the steam in striking with sudden force at the beginning of the piston stroke may be likened to what is known as "advancing the spark" in gasoline engines, which has the effect of increasing the velocity of the engine partly from the more complete compression of the inflammable gases, and partly from the fact that the gasoline engine piston receives the full shock of the explosion before it has moved any considerable distance from the end of the cylinder.

The parallel between the action of steam pressure and gasoline explosion, however, is not an exact one. The variation is very great, steam being a constant pressure and gasoline explosion an intermittent shock. Increasing the amount of lead in the valve of a steam engine does not by any means increase the speed of the engine. It has the contrary effect, and it is a growing fact that the idea which obtained in many quarters that a locomotive could not run freely unless the valves were set with considerable lead is rapidly losing its adherents. This fallacy may readily be dispelled by marking the degree of smoothness with which a well-balanced locomotive will run when an opportunity occurs to shut off steam altogether. The alleged shock which a certain amount of lead of the valve is said to overcome is not apparent, and there is undoubtedly a growing opinion that the older methods of having a valve opening of one-eighth of an inch is gradually losing ground, and this amount after being cut down to one-sixteenth is now reaching the thirty-second mark, and if the present trend of thought continues the so-called lead of the valve will have become a minus quantity.



SLIDE VALVE SHOWING LEAD.

It may be added that the idea that the increase in the amount of lead of the valve caused by the shortening of the valve travel, in the case of the Stephenson valve gearing, was an advantage, has lost credence largely from the fact that since the rapid introduction of the Walschaerts valve gearing, with which many of the new and larger locomotives are equipped, it has been clearly demonstrated that the constant lead maintained by the latter valve gearing at varying amounts of valve travel and speed, is a decided advantage in its favor. Indeed, many experienced engineers do not hesitate to assert that the excessive amount of lead formerly allowed in locomotive practice, and the large increase in that amount occasioned by the shortening of the valve travel, was the chief cause of much of the troubles incident to the involved mechanism of the Stephenson valve gearing. Be this as it may, the opinion is rapidly taking firm root that the amount of valve opening at the end of the piston stroke should be kept at the lowest possible amount, and that better results in locomotive and engine running generally could be obtained by having the valve closed at the end of the piston stroke than by having an opening wide enough to admit sufficient steam that cannot do other than counteract the motion of the piston as it approaches the dead centre.

Celebrated Steam Engineers.

XVII. John E. Wootten.

John E. Wootten, whose name will always be associated with the large anthracite-burning locomotive firebox which bears his name, has the right to be classed among the pioneers of locomotive development to whom this country owes more than is likely ever to be repaid or even acknowledged.

John E. Wootten was born at Philadelphia in 1822 of highly respectable parents, his father, Captain John Wootten having been one of the enterprising mariners who helped to build up the magnificent clipper ship trade that Philadelphia enjoyed with China, Japan and other oriental countries before steam pushed sailing vessels off the sea, and before the United States had inaugurated the policy of neglecting its marine interests. Young Wootten would have naturally followed his father's business, but being reared in Philadelphia, the principal seat of railroad extension enterprises and of locomotive building industry, living in an atmosphere permeated with railroad aspirations, he became attracted towards the popular profession of railroad and mechanical engineering. Accordingly in 1837, when fifteen years old, he was apprenticed to Matthias W. Baldwin, then working into a successful business as a locomotive builder, in a small shop located on Broad and Hamilton streets, now part of the great works. The choice of that career was voluntary, and it was lovingly pursued, the chief aim of the youth being to become known as a first-class mechanic, competent to perform a creditable job on any line of work a machinist might be called upon to do.

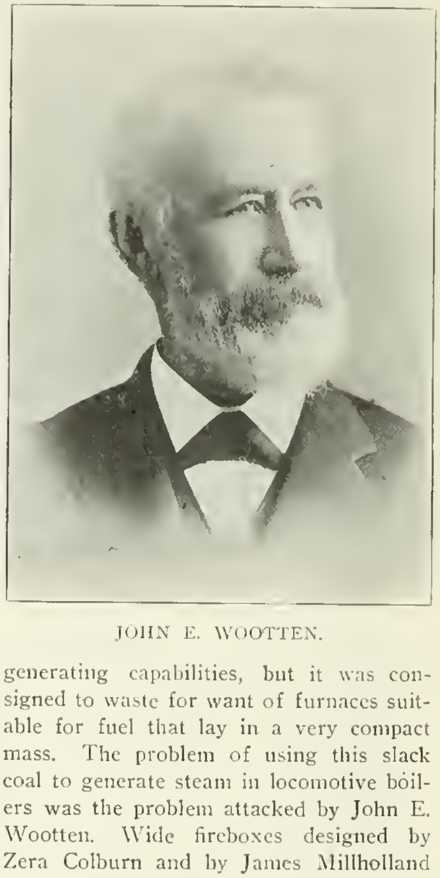
Mr. Wootten may be said to have joined the locomotive building industry at the time it was promising to become a permanent business and when the engine was assuming an established form. During the first year of his apprenticeship Mr. Baldwin built forty locomotives, most of them having been of the Miller type, with four-wheel truck and a single pair of driving wheels located behind the firebox, which was of the hemispherical or haystack form. The number of hands employed in building the forty engines was about three hundred, a much larger proportion of labor than what is necessary to turn out the same volume of work nowadays, but it represented almost exclusive hand work.

The first year of Mr. Wootten's apprenticeship witnessed one of the first panics that have been periodically produced by irregularity in the demand for railroad equipment. The year opened auspiciously, but about midsummer many of the railroad companies stopped ordering locomotives, and panic times intervened. Much of the work was then done by the older hands and the apprentices, which was really a benefit to the latter. It may have been owing to that temporary interruption in business at this time that induced Mr. Baldwin to direct his attention to introducing interchangeable parts, but whatever may have been the cause, this policy was begun then and was never abandoned. This was an advanced line of production that young Wootten took part in carrying out, and maintained in after years on a great railroad.

The first notable honor bestowed upon Mr. Wootten by the Baldwin Locomotive Works was sending him with a locomotive to the Western Railway of Massachusetts, a duty he performed to the entire satisfaction of his employers. That was in 1843. Two years later, in 1845, on the completion of the Beverly Railroad to Pottstown, Mr. Baldwin was asked to recommend a man to take charge of the mechanical department, and he named John E. Wootten, then in the twenty-third year of his age. The Beverly Railroad afterwards became part of the Philadelphia & Reading Railroad system, which subsequently became the sphere of Mr. Wootten's life labors. For about twenty years Mr. Wootten filled positions as foreman or master mechanic at various points on the Reading system, passing through the valuable experience that such useful men go through, but always acquitting himself to the satisfaction of his superior officers.

Like all men who have risen above obscurity, Mr. Wooten was ambitious to better his condition in life, and railroad service falling short of his expectations, in 1864 he left the Reading to be a member of the Pottstown Rolling Mill and Iron Company. He was one of the principal active men in the concern, but it did not prove exactly to his liking, for after one year's experience in that line of work he was induced to return to the Reading as superintendent and master mechanic of the Mine Hill & Schuylkill Haven Railroad, a proprietary line. In 1866 he succeeded James Millholland as the head of the mechanical department of the Philadelphia & Reading Railroad, with headquarters at Reading. While holding that position he proceeded to remodel the famous Winans locomotives in order to better adapt them for burning inferior grades of anthracite coal, a line of improvement which ended in his designing the wide firebox that has proved so successful for the combustion of slack coal.

The Philadelphia & Reading Railroad Company had labored assiduously to extend the consumption of anthracite coal for domestic and industrial purposes, but it was only the more superior grades of coal that attained popularity, and there were immense quantities of slack coal for which there was no market, piled up in immense heaps. The greater part of this coal was pure carbon with immense heat-



JOHN E. WOOTTEN.

generating capabilities, but it was consigned to waste for want of furnaces suitable for fuel that lay in a very compact mass. The problem of using this slack coal to generate steam in locomotive boilers was the problem attacked by John E. Wootten. Wide fireboxes designed by Zera Colburn and by James Millholland were improvements upon the older forms. Upon them Mr. Wootten effected other improvements which produced the most successful slack burning boiler ever produced.

Mr. Wootten possessed the inventive faculty in a high degree. Among his early inventions was the locomotive steam gauge granted in the early fifties, supplanting safety levers with adjustable weights and spring balance. Hydraulic brake for passenger cars, hydraulic pinch bars, car heaters outside or underneath the car, so familiar to the older patrons of the Philadelphia & Reading Co.; as well as other appliances and tools. Mr. Wootten, so closely connected with an army of workmen who were bound to meet with accident in spite of precautions, built and partly equipped at a cost of $25,000 a wing of the Reading Hospital, and likewise cancelled a large mortgage on a home for the aged, as well as other gifts to the unfortunate.

A member of the American Philosophical Society for a number of years, received at home and abroad medals in recognition of merit. From Paris Exhibition of 1879 and National Exhibition of Railroad Appliances of 1883 he received gold medals for economy and advancement in railroad practice as well as the John Scott medal for his mechanical achievements.

Mr. E. J. Rauch, of New York, a veteran engineer who was long associated with Mr. Wootten, has written us a long letter concerning the subject of this sketch, from which we condense the following notes:

"Mr. Wootten was a fine practical mechanic. He was of an inventive mind and was the author of many inventions, some of them in present use, not the least of them being the wide firebox for steam boilers.

* * *

"Mr. Wootten was quick to detect a 'fallacy' in an invention. R. D. Cullen, president of the Philadelphia & Reading, invariably referred patent people to Mr. Wootten to investigate their ideas. An inventor conceived the idea that by building a locomotive engine with three cylinders, each taking steam in the back end only, and of course pulling always on the upward throw of the crank, he would save one cylinder measure of steam—25 per cent.—and always have two strokes pulling at strongest point. He would have about 50 per cent. of power gain. This man took his model and idea to Norris Bros., of Philadelphia, and they approved of it at once and referred him to Grant & Stone, their financial backers, and advised the building of an engine on the idea, and securing an interest in the patent.

"The inventor then called on Mr. Cullen, who sent him to Mr. Wootten at Richmond. Mr. Wootten looked the model over and made an appointment to meet the party in a day or two. That night at his home Mr. Wootten made a model and with it convinced the inventor of his error. There was no engine built, and I doubt if many persons ever heard of the idea.

"Another party invented a perpetual motion and exhibited it at Reading. I knew the inventor very well, and Mr. Wootten asked me to get him a private look at it, that is, not during exhibition hours, but in the presence of the inventor. We went to it and found it running all right. The inventor began to explain his machine, but Mr. W. cut him off by saying he only wanted to see it. Then he was asked for his opinion. Wootten's reply was, 'Nothing can come from nothing; there is a nicely concealed power that drives your machine'—and we left.

"Some fifteen years after, I met a man who used to work under me, who had been a partner with the 'perpetual motion' man, and he not only explained the trick of the thing and that Mr. W. was correct, but more marvelous than all showed me a certificate signed by a committee of six experts (?) from the Franklin Institute of Philadelphia, who had, in couples, kept watches of four hours each from Monday noon day and night, until 12 o'clock on Saturday night, and certified that the machine, though practically of no use, was really what was claimed for it, and would and did of its own volition run as claimed.

"Another case was that of a method of assisting the horses in street cars to start the car. The inventor was a good mechanic known to both Mr. W. and the writer. He had about 20 feet of a model track made on which to exhibit his device. He showed it to street railway officials, who all approved of it; to them it was just what was wanted, and a company was formed to put the device in use. The patentee wanted Mr. Wootten, then master mechanic of the Philadelphia & Reading, to see it. I got him an interview and he brought his model and exhibited it. Mr. W. looked on, and in less than ten minutes convinced the patentee his machine would not work in practice.

"In Mr. Wootten's treatment of committees of his men who waited on him with claims or grievances he was always kind and courteous to the limit. A committee had to have their case well in hand and know just what they wanted or they would sometimes wonder what they came for. There have been instances where a committee had their case torn all to pieces and told just what they meant to ask for, and then it was given to them."

Questions Answered

E. T. EQUIPMENT.

21. G. C. M., Pueblo, Colo., writes: With the E. T. equipment when the brake cylinder leakage causes air to pass from application chamber to brake cylinders, does equalizing piston 26 move to permit air from pressure chamber to flow to application chamber?—A. The application chamber pressure cannot enter the brake cylinders except by leakage past the packing leather and ring on the application piston. The brake cylinders are filled with pressure from the main reservoir and the pressure in the application cylinder determines the pressure that will build up in the brake cylinders. The action of the equalizing valve of the distributing valve is similar to that of a triple valve piston and slide valve, in release position the pressure chamber is charged, and in application position air is admitted from the pressure chamber to the application chamber and cylinder forcing the application piston and valve to application position, which admits pressure from the main reservoir to the brake cylinders, until it is equal to that in the application cylinder, when a spring forces the piston to lap position. If brake cylinder leakage reduces the brake cylinder pressure below that in the application cylinder, the application piston and valve will be forced to application position again and the leakage will be supplied. The equalizing valve is moved by reducing or increasing brake pipe or train line pressure. Brake pipe leakage has the same effect on the distributing valve as it has on a triple valve applying the brake in full after a light reduction, and when brake pipe pressure is somewhat lower than that in the pressure chamber the valve will be moved to the extreme end of its stroke or emergency position.

With the H5 equipment this movement results in flow of air from the main reservoir to the pressure chamber, thence to the application chamber and cylinder, as they are connected in this position. With the H6 equipment this does not occur, but there is a flow of air from the brake valve to the application cylinder when the brake valve handle is in emergency position. The independent application does not disturb the equalizing valve in either equipment.

SQUARING DRIVERS WITH FRAMES.

22. G. D. L., Ashtabula, Ohio, asks: What is the best method of squaring the drivers with the frames when they are in place?—A. If you are certain that the cylinders are faced off exactly to standard dimensions so that face of back flange is the same distance from centre cross line of cylinders, and frames are true, tram from back cylinder face to straight edge laid across horn blocks, being careful to see that each end of tram is the same distance from outside of frame. If you are not sure about back face of cylinder flange, find centre of valve seat and tram from that point with tram exactly parallel to frame. If the cylinders are fitted up accurately, and frames parallel as they should be, either of these methods will give you the desired result.

WESTINGHOUSE K TRIPLE VALVE.

23. J. H. M., Osceola Mills, Pa., asks: Kindly explain through the columns of your valuable paper what change there has been made in the latest type "K" freight triple valve? I understand that there is some change in the retarded release feature.—A. The operation of the type "K" triple valve has not been changed, but there have been several minor changes in the mechanical construction. The small elongated retarded release port in the first type of valve was found in service to become partially stopped up with foreign matter. With the later design of valve, the main exhaust cavity in the slide valve is separated from the retarded release port by a bridge. And the opening that regulates the time of the exhaust is a small drilled hole that connects the two cavities. The port "Y" no longer acts as a recharging port in retarded release position, the small port in the slide valve that formerly registered with this port in retarded release position is removed and the slide valve now blanks port "Y," and the charging of the auxiliary is now made through a groove cut in the seat of the piston.

BLOWS OF PISTON AND VALVES.

24. Young Runner, Perth Amboy, N. J., asks for some pointers on cylinder packing and main valves, also if that is broken how do you place the engine to find the blow?—A. If the piston packing is broken or cylinder worn, place engine with piston near front end of cylinder, open cylinder cocks and slightly open throttle. If steam blows through back cylinder cock and up exhaust the cylinder is probably worn at front end; same test may be made with piston near back end when front cylinder cock will blow. If rings are thought to be broken, place piston in centre of cylinder and move reverse lever so that valve will move sufficiently to give steam first on one side of the piston and then on the other, and if there is a blow in each case the rings are probably defective. If the valve yoke is broken clean off the valve will be pushed forward and will stay there, allowing steam to enter back end of cylinder only. If the yoke is broken on one side the valve will lag on its back travel and will probably not open sufficiently to give any lead. In testing for these defects place reverse lever so as to give proper lead openings at both ends of travel and note results.

OLD AND NEW PUMP GOVERNORS.

25. G. C. M., Pueblo, Colo., writes: Please explain fully why air pressure above the governor and a spring is any improvement over the old method of a spring alone.—A. The use of the excess pressure governor top avoids the necessity of changing the adjustment or cutting out a governor top when a change of brake pipe pressure is desired. In order for this governor top to operate and close the steam passage to the pump, the main reservoir pressure, which is under the diaphragms, must exceed the brake pipe or feed valve pipe pressure above the diaphragms and the tension of the spring. There should be a tension of about 20 lbs. on the spring and when the brake pipe pressure is 70 lbs., about 90 lbs. main re-

servoir pressure will be required to lift the diaphragm valve from its seat and stop the pump. If the brake pipe pressure is changed to 90 lbs. the governor will stop the pump at 110 lbs. reservoir pressure.

In order to change from a 70-lb. brake pipe pressure to the high speed brake 110 lbs., it is only necessary to turn the hand wheel on the adjusting screw of the feed valve. By always maintaining a main reservoir pressure at a certain figure in excess of that carried in the brake pipe, regardless of what that brake pipe pressure may be, the excess pressure top may be said to provide the governor with an automatic adjustment. When the brake valve handle is on lap, service or in emergency positions, the excess pressure top is imperative and the high-pressure top, which is usually adjusted for 130 or 140 lbs., will stop the pump.

METHOD OF BENDING PIPE.

26. G. D. L., Ashtabula, Ohio, writes: Please show an easy method of bending pipes, of sizes from ½ to 1¼ ins.—A. There was published in RAILWAY AND LOCOMOTIVE ENGINEERING, January, 1908, page 41, a description of a very neat and expeditious machine for bending pipe, made by H. B. Underwood & Co., of Philadelphia, Pa. You could not do better than to read this description or write to the firm and ask for their descriptive circular.

EFFECTS OF ROUGH HANDLING.

27. E. N. M., Brockville, Ont., asks: Does rough handling of the air brake have an effect on the staybolts of the boiler? If it has, what is the effect?—A.—Rough handling of the air brakes has no direct effect on the boiler staybolts, though the powerful application of brakes and a quick stop has the effect of throwing all the water in the boiler to the front, and it tends to slide the boiler ahead out between the frames; or a quick stop may tend to turn the boiler up at the back and throw it over. As a matter of fact, a quick stop puts extra strain on the boiler fastenings, but it does not injure the staybolts individually.

BRAKE HANDLING ON GRADES.

28. D. A. B., Camina, Cal., asks: Is it good practice to kick off 5 or 10 lbs. of air on a grade where the train is pinched down too slow, or is it better to recharge? If so, why?—A. By kicking off 5 or 10 lbs. of air you no doubt mean moving the brake valve handle to release or running position for a second or two and then back to lap or service position, which is poor practice at any time and a dangerous one on grades. On descending grades the brake pipe and auxiliaries should be recharged at every opportunity, the object being to maintain as high a brake pipe and auxiliary reservoir pressure as it is possible to do, not only to insure keeping the train under control but to enable the brakes to stop the train if an emergency should arise.

PRESSURE IN BRAKE CYLINDERS.

29. W. P. W., Hoisington, Kans., writes: Will you please explain how to figure the pressure in brake cylinders with different piston travels and during different brake pipe reductions?—A. The brake cylinder pressure that results from different reductions of brake pipe pressure and for different lengths of piston travel is determined by attaching an air gauge to the brake cylinder.

In most air brake instruction cars you will find brake equipments with gauges attached to the brake cylinder, brake pipe and auxiliary reservoir and an arrangement for blocking the brake piston to different lengths of piston travel. Any mathematical calculations, to determine the resultant pressure, are likely to be inaccurate or only approximate at the best for reasons that will be explained later.

As an example, suppose we wish to find the brake cylinder pressure that will be developed in a 10-in. passenger car cylinder when the piston travel is 8 ins., and the brake pipe reduction is 10 lbs.

The 12 x 33-in. reservoir has a capacity of 3,030 cu. ins.; this is determined by squaring the diameter and multiplying by .7854 and by the length, in inches, allowing, of course, for the thickness of the metal and 1½ ins. on each end for the flange.

The capacity of the brake cylinder in cubic inches is found in the same manner, the diameter, $10 \times 10 = 100 \times .7854 = 78.54$. $78.54 \times 8 = 628$ cu. ins., at 8 ins. piston travel. With a 10-lb. reduction, 10 lbs. of compressed air will leave from each inch of the reservoir's capacity, whether the pressure is 70, 90 or 110 lbs., and $3{,}030 \times 10 = 30{,}300$ cu. in. lbs., which leaves the reservoir to enter the brake cylinder.

Now the space between the piston follower and the cylinder head, and the space in the port through the head and in the triple valve that must be filled with compressed air when the brake is applied, must also be taken into consideration, and assuming the space to be 100 cu. ins. at atmospheric pressure we have 14.7×100, or an additional 1,500 cu. in. lbs., or $30{,}300 + 1{,}500 = 31{,}800$ cu. in. lbs. in all, and a space of 100 cu. ins. + 628, brake cylinder capacity or 728 cu. ins. space to be filled. $31{,}800 \div 728 = 42$ lbs. brake cylinder pressure.

Now the brake cylinder capacity is not at atmospheric pressure before the application, and must be filled to that pressure, 14.7 lbs. before an air gauge will register, or if the piston were drawn out by some other force without admitting any atmospheric pressure to the cylinder it would result in a vacuum which would require 15 lbs. to relieve. Therefore $42 - 15 = 27$ lbs. brake cylinder pressure, and 27 lbs. less, say 4 lbs., for the losses mentioned would leave a final brake cylinder pressure of 23 lbs. resulting from a 10-lb. reduction at 8 ins. piston travel.

The losses from the auxiliary reservoir which make the calculations so uncertain are slight and are due to the fact that some of the auxiliary reservoir pressure escapes through the triple piston feed groove at the time the piston starts, and as the piston is moved to application position the reservoir volume is expanded and consequently reduced slightly by this movement alone. There is also a loss through the cylinder leakage groove as the brake piston is displaced, and there is also a natural loss due to the expansion of air during the application which lowers the temperature and consequently the pressure.

SHIFTING DRIVERS AFFECTS VALVE GEAR.

30. G. D. L., Ashtabula, Ohio asks: What effect does it have on the Walschaerts valve gear to shift the main drivers ahead from ⅛ to ¼ in.?—A. Shifting the drivers ahead under these circumstances makes the eccentric rod too long by the amount that the wheels have been moved. This effect would be produced in the Stephenson link motion by moving the driving wheels.

ORIGIN OF NAME OF MALLET COMPOUND.

31. G. D. L., Ashtabula, Ohio, asks: Why is the Mallet articulated compound so named?—A. The name is derived from that of a French engineer, Anatole Mallet, who brought out the first successful locomotive of this type. It was tried on the Bayonne & Barritz Railway in France.

CENTRE OF FRAME JAWS.

32. G. D. L., Ashtabula, Ohio, writes: Please show method of finding centre of frame jaws with wedge on back jaw.—A. With wedge securely in place divide the distance between the face of the wedge and the forward frame jaw and allow for the thickness of the horn or forward frame shoe.

CONTENTS OF EQUALIZING CHAMBER.

33. A. H., Wheeling, W. Va., asks: About what is the cubical contents of equalizing chamber "D" between piston and reservoir pipe connection?—A. It is 6½ cubic inches.

The steel barge *Blackwood* has been delivered by the builders to the Lehigh Valley Railroad Company. This is the third barge of this type already delivered on an order for several to be used in the coal trade between Perth Amboy and New York and other coast points.

Air Brake Department

Conducted by G. W. Kiehm

Broken Air Pipes, H6 Brake

Part III.

If the brake pipe was broken or the brake valves disabled in fast passenger service while out on the road and no connection of brake cylinder pipes and brake pipe could be made between the engine and tender on account of special couplings, a connection between the main reservoir and the brake pipe could be made through the quick-action cylinder cap of the distributing valve.

It would not be a very practical method and the service application would be about as difficult as with the old style three-way cock, but the brake pipe could be kept charged and it would be an emergency brake. If the brake pipe was broken at the brake valve the brake valve would be placed on lap and the stop cock under the brake valve closed; after closing the stop cock in the supply pipe and releasing the brake, the quick-action valve and cylinder check valve can be removed, the upper cap nut removed and the application piston blocked in application position. When the adjusting nut of the safety valve is screwed down and the three caps are again screwed in place the stop cocks in the brake cylinder pipes would be closed and the stop cock in the distributing valve supply pipe opened. Main reservoir pressure will then flow through the distributing valve past the quick action and cylinder check valve seats into the brake pipe releasing the brake and recharging the train.

To apply the brake the stop cock under the brake valve would be opened and the pressure would reduce in both the brake pipe and main reservoir, unless the reservoir cut-out cock or the distributing valve cut-out cock were located within reach of the engineer or fireman; closing either cock would separate the main reservoir and brake-pipe pressures; the pump governor would regulate the pressure.

Still another connection could be made, in case of this kind, through the independent brake valve, by removing the equalizing valve from the distributing valve, closing the stop cocks in the supply and brake cylinder pipes and screwing down the adjusting nut of the reducing valve. By placing the independent brake valve in application position and adjusting the reducing valve, reservoir pressure would flow through the independent brake valve and distributing valve into the brake pipe. This could scarcely be recommended on a train of any length on account of the comparatively small ports in the distributing valve and on account of the length of time it would take to remove the equalizing valve, but if the train pipe could be charged, and it can on a short train, the brake valve stop cock can be used to assist the independent brake valve in exhausting brake-pipe pressure in cases of emergency.

If the brake pipe of H6, H5 or the standard quick-action brake is broken between the brake valve branch and the hose couplings between the engine and tender, the broken off pipe and hose can be removed and the brake pipe leak plugged, the signal and brake hose on the pilot can be coupled and the stop cock opened and the signal hose at the rear of the engine coupled with the brake-pipe hose on the front of the tender. When the brake valve is placed in release position the pressure will flow from the brake valve to the pilot, then through the signal pipe on the engine to the brake pipe on the tender and train; the brake on the engine and train can be applied in the usual manner.

This crossing over from the brake pipe to the signal pipe by hammering together the hose couplings has avoided many engine failures on account of broken brake pipes on tenders, there being but a few minutes' detention in coupling the hose.

The equalizing discharge feature of the G6 brake valve remains the same in the H5 and H6 valves; leaks about the equalizing reservoir and its connections have the same effect, and breaks in the pipe connections or reservoir itself will be handled in the same manner. Several years ago it was considered in some quarters to be desirable for the second engineer of a train double-heading to be able to note the brake-pipe pressure as maintained by the first engine, to observe the brake manipulation to a certain extent, and to apply the brake in case of emergency by a movement of the brake-valve handle alone. This was accomplished by placing the brake-valve cut-out cock in the reservoir pipe, as the brake valve was then subject to brake-pipe pressure as controlled by the first engine the black hand of the gauge would show this pressure. To prevent the equalizing piston of the brake valves from wasting brake-pipe pressure if forced from its seat during train brake release, the exhaust port was piped to a port in the cut-out cock and when the cock was closed for double-heading purposes this port would be blanked and at the same time a port at the large end of the cock would be opened, which would admit brake pipe pressure to that portion of the reservoir pipe above the brake-valve cut-out cock.

When this style of cut-out cock is used with the H6 brake the connection to the feed valve is made at a point above the cock in the reservoir pipe.

This cock is sometimes found to be leaking and the leakage is similar to that of a leakage rotary valve, leaking main reservoir pressure into the brake pipe.

The leakage if in any considerable volume sometimes lifts the equalizing piston of the brake valve.

Sometimes the cock leaks at the small end through the port through which the equalizing piston discharges the brake-pipe pressure; when it does it is a difficult matter to discover whether the leaks from the cut-out cock or from the seat of the equalizing discharge valve.

The pipes connecting the cock to the brake pipe and brake valve should be tested as well as other piping; the pipe connecting the brake pipe and the cock has pressure at all times the brake pipe is charged, the pipe connecting the brake valve and cut-out cock can be tested by closing the cock and making a service reduction with the automatic brake valve.

Should the pipe connecting the small end of the cock be broken, it would have no effect except that the air discharged by the brake valve will escape at the break instead of the port in the cock. Should the pipe connection at the large end of the cock be broken it would be necessary to stop the brake pipe leak and drive a wedge between the handle and the body of the cock to hold the plug valve to its seat.

If broken on the second engine when double-heading the brake pipe leak would be stopped and the cock handle turned to a position half way between open and closed, at which time the three ports through the cock would be closed; a wedge between the handle and the body would also be used to hold the plug valve in this position.

If at this time the brake valve rotary was forced off its seat on account of this broken pipe it would only result in a slight escape of air, or a pop at the emergency exhaust port, as the air pressure surrounding the valve would equalize instantly and seat the rotary valve before any volume could escape at the brake valve. If the pipe connecting the smaller end of the cock was broken on the second engine when double-heading, the pipe would be plugged to prevent the escape of brake-pipe pressure when the equalizing piston was forced off its seat at the time of train brake release.

The dead engine equipment when used should include the stop cock and it should be kept closed at all times except when the equipment is to be used; this cock is often found open and with some dirt or foreign matter on the check-valve seat; the leak is similar to a leaky brake valve rotary, or a leaky brake-valve cut-out cock, all of which will leak main reservoir pressure into the brake pipe.

THE SIGNAL SYSTEM.

Judging from the letters that have appeared in the general correspondence columns recently, the signal system used with the E. T. brake equipment is not receiving the attention it should. There has been no change made in the signal valve and whistle and the disorders which result from neglect of the signal valve in either brake equipment are the same. The improvement noted in the E. T. brake is that a slide valve reducing valve supplies the signal system.

The reducing valve is intended to supply air for the operation of the independent brake and the signal system, to promptly open and supply any leakage that may exist in the signal pipes and to prevent the signal-pipe pressure from increasing beyond the adjustment of the reducing valve.

The check valve that is combined with the strainer is intended to prevent a back leakage from the signal pipes when the independent brake is used, and if all parts perform their duties there will be no unusual action of the signal whistle.

It should be known by test that the supply and regulating valves of the reducing valve are absolutely tight and that the valve is sufficiently sensitive to supply leakage promptly, that the check valve does prevent a backward flow of signal line pressure, and that the signal pipes are free from leakage. When the independent brake is applied pressure on the brake valve side of the check valve reduces slightly, and during the brief time of application signal pipe leakage will not be maintained; leakage past the check valve will also make a signal pipe leak, either of which is likely to result in a blast from the signal whistle, depending upon the condition of the signal valve.

Should leakage past the supply or regulating valves of the reducing valve slowly increase the pressure in the signal pipes beyond that for which the valve is adjusted, say to 50, 55 or 60 lbs. there will be no possible way of supplying slight leakage in the signal sysem, after an application of the independent brake until the necessary pressure to raise the check valve and enter the signal pipe is accumulated from this leakage. The choked port through the strainer and check valve should not be enlarged; the port has been made the proper size by the manufacturer, and in the event of the signal pipe pressure accumulating slowly the reducing valve should be reported and the pipes tested first; it may be unnecessary to disturb the check valve. Some railroad officials consider an inoperative signal whistle sufficient cause for a change of engines, which appears unfair to the motive power department, an engine failure being charged when the engine is in condition to handle the train.

The combined strainer and check valve of the signal equipment is similar in appearance to the strainer and check valve of the dead engine fixture and about the only difference is in the springs that hold the check valves to their seats. The spring in the signal line check is very light so that a very slight increase in pressure below the valve will cause it to be lifted from its seat and supply the signal pipe while the spring used in the dead engine fixture is rather heavy, the object being to create a considerable difference between reservoir and brake pipe pressures when the fixture is in use, or with 70 lbs. pressure in the brake pipe, but about 45 or 50 lbs. will enter the main reservoir.

When this strong spring happens to be used in the signal line strainer by mistake or the wrong check valve is used, the proper signal pipe pressure cannot be attained, or if it is, the reducing valve will be found set at 65 or 70 lbs. The stop cock used in connection with this dead engine fixture should always be closed except when the engine is dead and being hauled in the train; if it is not, an accumulation of dirt or gum is liable to hold the check valve off its seat and with the stop cock open it will result in leakage from the main reservoir into the brake pipe similar to a leaky rotary valve.

Leakage from the main reservoir into the brake pipe might also occur through the brake valve cut-out cock when located in the reservoir pipe, or there is a possibility of leakage from the reservoir pressure into the brake pipe through the excess pressure top of the pump governor, if the spring box is not drawn down tightly on the diaphragm body or if the diaphragms should be broken for when the H6 or H5 brake valve is in release, running or driver brake holding position there is main reservoir pressure underneath the diaphragms and feed valve pipe or brake pipe pressure above them.

It will be noted that any leakage into the brake pipe coming from the main reservoir results in the excess pressure top gradually losing control of the pump, because the brake pipe pressure rises and the object of the governor top is to maintain an excess pressure regardless of the figure and both pressures increase until the high-pressure top stops the pump.

Just what can be done in each attempt to overcome an engine failure in case of a broken air pipe depends entirely upon how the equipment is arranged, upon the time it will take, and in some cases upon the number of stops before the terminal is reached.

In the foregoing articles some of the methods would not be practical in every sense and under all circumstances and are cited with the intention of creating an interest and study of the equipments. If the construction and operation of the brake in use is not thoroughly understood some of the methods for overcoming breaks in air pipes, mentioned herein, had better not be attempted.

However, simple methods of overcoming the breaks should be understood and the way of using the signal to convey brake pipe pressure from the engine to the first car on the train in case of a burst brake pipe under the tender, which is done by hammering the brake pipe and signal hose couplings together is simple and should not result in much of a delay, and the way of using the signal pipes on the engines to connect the brake valve with the brake pipe on the tender and train in case of a broken or burst brake pipe between the brake valve branch and the rear of the engine, which is done by connecting the signal and brake pipe hose on the pilot and at the rear of the engine, is also simple and can be done whether the engine is equipped with the H6, H5 or G6 brakes.

It might occur on a freight engine equipped with the old G6 brake valve and with no signal pipes whatever, then if the engine and tender is also equipped with the straight air brake quite likely the ordinary signal hose are used to connect the straight air pipes between the engine and tender, if so the straight air hose at the rear of the engine can be connected with the brake pipe hose on the front of the tender and the straight air pipe leading to the driver brake cylinders blanked, then by placing the straight air brake valve handle in application position, reservoir pressure can enter brake pipe and be governed by the reducing valve, placing the valve handle in release position will then exhaust brake pipe pressure and apply the brake.

It should, however, be remembered in all cases that the law of the Interstate Commerce Commission forbids running an engine without a driver brake.

Electrical Department

Oil Used in Electric Transformers.

By W. B. Kouwenhoven.

Oil finds a very important field for usefulness in electric transformers and oil switches, and its consumption for these purposes amounts to hundreds of thousands of gallons annually. The use of oil is now considered absolutely essential for high voltage transformers, besides being employed to a very large extent in small house transformers. The oil not only cools the transformers, but serves as an insulator as well. Oil also plays an important part in the manufacture of oil switches and oil circuit-breakers, acting, as was explained in the March number, to smother the arc and to insulate the parts. Thus it is clear that oil, besides possessing properties that make it useful for the lubrication of all kinds of machinery, possesses certain other qualities that make it valuable as a cooling and insulating agent for some forms of electrical apparatus. It is very important that the men who have charge of oil cooled and insulated transformers and of oil switches should not only understand the operation and care of the apparatus, but also the purpose for which the oil is used, and not leave out the care of the oil itself, in order that they may be able to successfully remedy any adverse conditions that may arise, which if permitted would destroy the good properties of the oil, thereby causing the failure of the aparatus itself.

Any oil that is light enough to flow easily and which does not thicken when cold, is satisfactory for cooling purposes. All oils, whether animal, vegetable or mineral, when pure, are good insulators. Animal and vegetable oils eventually decompose and gum. For this and other reasons mineral oils are preferred for use as insulators, and at the present time are used almost exclusively. Transformer oil, as it is known to the trade, is obtained by the fractional distillation of petroleum unmixed with any other substance. The product is not chemically treated during any part of the process.

The windings and the core of the transformers are mounted in a case made usually of cast iron or of sheet iron. The terminals of the coils are brought out at the top of the case and the case is then filled with oil until the coils are covered to a depth of about one inch. When the current is turned on, heat is developed in the windings due to their resistance, and in the iron core. This heat is communicated to the oil immediately surrounding the heated parts. The warm oil rises and cool oil takes its place. The warm oil gives up its heat to the case from which the heat is radiated to the surrounding air. Thus a circulation is set up which continues as long as the transformer is in operation. The cooling effect is greatly increased by making the case with vertical corrugations, thereby increasing the radiating surface.

The temperature of the transformer depends largely upon the surface exposed to the oil, and also upon the ability of the oil to circulate freely. In order that the oil may have access to all parts of the transformer, passages are left between the coils and through the iron core. Usually the core is subdivided by oil passages, or ducts, as they are called, so that no part of the iron is more than one inch from the oil. These ducts are usually quarter-inch openings in the core with larger ones between the coils. They are most efficient when they run in a vertical direction. Care must be taken that they do not become clogged and so lose their effectiveness.

In transformers of 500 kw. and over, oil alone is not sufficient for cooling, because the exposed surface of the case cannot radiate the heat fast enough (500 kw. are equivalent to about 660 h. p.) Two methods are employed to overcome this difficulty. In the first, a coil of copper pipe is placed in the oil at the top of the case and cold water is pumped through the coil to absorb the excess of heat. In the second the warm oil is withdrawn from the top of the transformer case and cooled, and is forced in again at the bottom by a pump.

Pure oil is a very high grade insulator. It takes approximately 10,000 volts to puncture 0.075 of an in. of pure oil. Ten thousand volts will puncture or break down 0.75 of an in. of air gap under the same conditions. This comparison illustrates the value of oil as an insulator. Transformers are not built to operate on circuits where the voltage is 33,000 or higher, unless oil is employed to increase the strength of their insulation.

A transformer usually fails because of its insulation burning out. The insulation is destroyed, a hole being formed, through which the current passes, producing a short circuit. The insulation of a transformer resists the voltage in the same way that a boiler shell resists the steam pressure. In a transformer, the insulation is under strain because of the pressure of the voltage in its effort to get from one wire to another. The pressure of the steam strains the boiler shell. When the boiler or the insulator become weak and over-strained they fail; in the case of the boiler it is called an explosion; in the case of the transformer it is called a breakdown. The addition of oil to a transformer increases the strength of the insulation because it soaks in between the wires and through the insulation. The oil thus increases the factor of safety of the transformer against breakdown in much the same way that increasing the thickness of the boiler shell increases its factor of safety. Instances are known where lightning has punctured the insulation of

MOUNT SHASTA, 14,000 FEET HIGH. SOUTHERN PACIFIC RAILWAY.

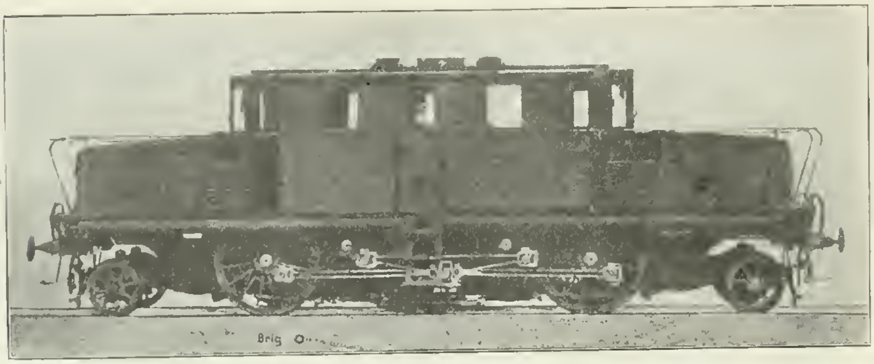
a transformer, forming only a small hole into which the oil has flowed repairing, a break that was too small to cause serious damage.

The quality, upon which the insulation value of the oil depends most is its dryness. The presence of water in the oil to the extent of four parts in 10,000 will reduce its breakdown voltage to approximately one-half of its former value. If the presence of water is suspected in a transformer it may be easily found by inserting a thin glass tube to the bottom of the case, the upper end of the tube being held closed by the finger until the tube strikes the bottom. The finger is then removed and the oil allowed to flow into the tube from its lower end. The finger is replaced, the tube withdrawn and its contents discharged into a glass. If water is present it will at once make itself apparent to the eye. There is a difference between water and moisture in oil. When we say that water exists in oil it is that part that actually settles out, and its presence may be determined by the eye when a sample is placed in a glass. Moisture is that portion that is intimately mixed with the oil, and its presence cannot be determined by this test. If water is found, moisture is also present, but the converse is not true. The simplest and at the same time a very good test is to remove a sample of oil in a cup. Heat an iron nail to a dull red heat and thrust it into the cup. If a crackling sound like that of flying grease is heard moisture is present. It does not make very much difference as to the amount of moisture, as even a very small amount will ruin the value of the oil.

There is nothing for which an operator must be more on his guard than to prevent moisture getting into high tension transformers. The writer has known two 22,000-volt transformers to fail from no apparent cause. Upon investigation the nail test disclosed the presence of moisture in the transformer oil. A failure of a low-voltage 2,200-volt transformer has been attributed to the same cause. The variety of ways that moisture can get into transformers is very great. Cases have been known where the water coils have leaked; in other cases moisture has collected during transportation, and again by carelessness in leaving the cover off during installation. When installing transformers first make sure that there is no water in the bottom of the case and test the water coils for leaks. It is a very good plan to dry out the transformer thoroughly before filling the case with oil. One method of doing this is to apply a low voltage to the windings for several hours, taking care that their temperature does not rise above the boiling point of water. If, however, either water or moisture is found to be present in the transformer oil, the best plan is to draw off the oil, dry out the case and refill the case with pure, dry oil.

The necessity for having perfectly dry oil is shown by the fact that even such a small amount of moisture as four parts in 10,000 lowers the insulating value of the oil one half, and as there are innumerable ways in which the oil may collect moisture, its treatment for the removal of water is of prime importance. There are a number of methods for the separation of water from oil. Probably the most satisfactory method is that employed and developed by the Westinghouse Company. This method is known as dehydrating the oil. It consists of passing the oil to be treated over a disc, which, allows the excess water to pass through, and retains the oil. From the disc the oil is pumped into a treating tank in which the dehydrating agent is placed. Lime is generally employed, although there are a number of other agents that give satisfaction. The oil is kept in motion by a pump while in the treating tank, and the lime absorbs the moisture that remains in the oil. From the tank the oil is passed through a dry sand filter to remove any particles of lime or other foreign matter that may be present. Tests are made from time to time to see that the dehydrating agent has not depreciated in strength. This method of treatment does not injure the quality of the oil, is cheap and rapid, and is very satisfactory.

The following lists of specifications give the necessary qualities for transformer oil:



ELECTRIC LOCOMOTIVE FOR THE SIMPLON TUNNEL.

1. The oil shall be pure mineral oil obtained by fractional distillation of petroleum unmixed with any other substance and without subsequent chemical treatment.

2. The flash point of the oil shall not be less than 180 deg. C. (356 deg. F.), and the burning point shall not be less than 200 deg. C. (392 deg. F.).

3. The oil must not contain moisture, acid, alkali or sulphur compounds.

4. The oil must stand a breakdown insulation test of at least 40,000 volts, with a spark gap of one-quarter of an inch between one-half-inch balls.

5. The oil must not show an evaporation of more than 0.2 per cent. when heated at 100 deg. C. (212 deg. F.) for a period of eight hours.

6. It is desirable that the oil be as fluid as possible and the color as light as can be obtained in an untreated oil.

7. The oil shall be free from dirt or deposit.

The flash point of an oil is the temperature to which is must be raised in order that it may give off gases which burn when ignited. The burning point is the temperature at which the oil itself takes fire. The breakdown test or insulation test is determined by immersing the spark gap in the oil at a standard depth and raising the voltage until a breakdown of the oil occurs. A very convenient and simple method of making the evaporation test is to take a small sample oil, weigh it carefully and place it over a water bath for eight hours. Then weigh again and determine the loss by evaporation. For convenience transformer oil should be water white in color, but as water white oil usually means chemical treatment, it is better to use a dark oil than to run the risk of having traces of chemicals remain in the oil. In actual service a brownish or black deposit is formed in the oil. This deposit is in itself a good insulator, and the only harm it can do is to clog up the ducts and thus impede the circulation of the oil. New oil, however, should be free from deposit.

Practically the only difference between oil which is to be used for transformers and that to be used for oil switches is in the fluidity of the oil and a cold test is added to the list of specifications. Switch oil should be less fluid than transformer oil, to prevent it being thrown about by the switch when opening or closing. Oil switches are occasionally used for outdoor purposes, and are then exposed to cold. The cold test is made by placing a test tube containing a sample of oil in a freezing mixture and noting the temperature at which the oil ceases to flow when the tube is turned on its side.

Go in and win—an admirable thing to recommend if you only knew how to do it.—*Pickwick.*

AMONG THE WESTERN RAILROAD MEN

By James Kennedy

ON THE CHICAGO GREAT WESTERN RAILWAY.

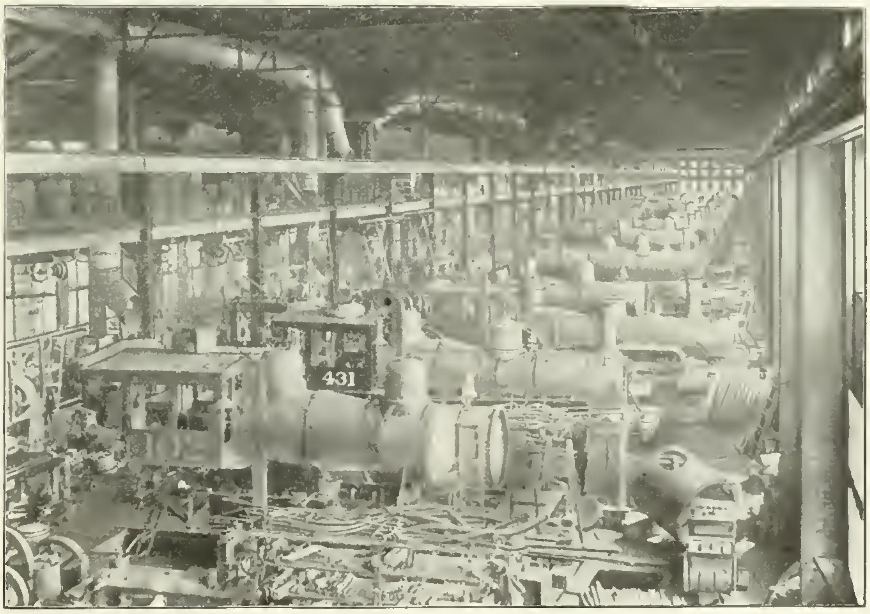
The original promoters of the Chicago Great Western Railway showed some sense in selecting Oelwein, Iowa, as the location of the general repair shops of the railway. Oelwein is the proper geographical center of the railway, taking Chicago as the eastern point, Minneapolis as the northern, Omaha as the western, and Kansas City as the southern point of the vast system. This district is rich in natural resources and is thickly populated. It is among the most fertile regions on the Continent of America. The railway should have been a success from the beginning, but it had its dark days.

To-day the management and the equipment are unsurpassed by any railroad in America. The flat lands of Iowa and other States give fine opportunities for long level reaches of track and the speed with which the 100-ton passenger locomotives swallow up mile after mile takes away one's breath. The slacking up as town after town comes into the flying panorama affects the time record between distant points, but even with that over 60 miles an hour is accomplished every day in the year. The service between Kansas City and Oelwein, on what is called the Southwestern Division, has recently been brought up to the very highest standard of excellence, so that the elegance and rapidity of transportation between Kansas City and Chicago is almost without a parallel. In point of safety it should be a model to many others, and it would be well if all of our American railways would take lessons from the operating department of the Chicago Great Western.

In the great shops at Oelwein which extend 1,100 feet under one roof, and include the machine shop and boiler shop, the equipment is entirely of the most modern kind. The machinery is electrically driven, all of the larger machines being fitted with separate motors, some of the smaller machines being grouped in sections, the direct current system being used. There are thirty-three transverse pits in the machine shop with ample spaces between the pits. The pits are of concrete and fitted with electric lighting, compressed air, steam and water attachments. In front of the pits there is a transfer table extending the entire length of the building. Two traveling cranes traverse the whole length of the machine shops and boiler shops, one fifteen-ton crane, of rapid movement, adapted for the lighter work, while the other crane of sixty-five tons' capacity is used in placing locomotives on their wheels and other heavy work.

In addition to the general repair work of the entire system which is done in the Oelwein shops there have been a number of very successful changes made in certain classes of the locomotives which have added much to the motive power and some of which are of particular interest. Among these there were recently six heavy ten-wheel freight engines, of the class of what is known as 200-A, re-designed with a view to passenger service, the diameter of the driving wheels being changed from sixty-three inches to sixty-eight inches. This organic change involved considerable reconstruction in many of the working parts of the locomotive. The engines so changed are doing excellent service, and are meeting the rapidly increasing traffic with a degree of efficiency that is unexcelled.

These and other important changes and marked improvements incident to the introduction of new men and new methods are a notable feature of the mechanical department. Mr. Walter P. Chrysler, Superintendent of Motive Power, has amply demonstrated the fact that he is the right man in the right place. He belongs to the younger class of skilled mechanicians who combine a thorough technical training to which is superadded a large experience in actual work. He is keenly alive to the advantages of engineering literature, and his example is felt throughout the mechanical department. Some of his operations show an originality that is attracting considerable attention. An interesting illustration came to our observation in the case of a compound locomotive with a piston stroke of thirty inches, having been changed to a simple locomotive of twenty-eight inches stroke. The change of stroke was made to maintain the standard of general equipment. In order to do this, and save the wheel centers, the crank pins were removed and the crank pin holes filled with thermit and re-bored. The engine is now running in the hardest kind of freight services and is in every way equal to the best. This is the first instance that has come to our attention of the use of thermit in such an operation and is a fine illustration of the widening field of uses to which this new method of fusing metal can be applied.



INTERIOR OF ERECTING SHOP, OELWEIN, IA., CHICAGO GREAT WESTERN.

The fine roundhouse consisting of forty stalls is well equipped for the making of such repairs as do not call for an extended period in the machine shops. A number of portable machines are readily at hand and every modern appliance is in use. The pits are of concrete and the convenience and comfort of working in the roundhouse under such conditions are of the most agreeable kind.

The general storehouses for all supplies for the whole system are also located at Oelwein, and as will be seen in the accompanying illustration the main galleries in the machine shop are utilized to store much of the lighter material. The repairs of freight cars are made at various points on the system, but all the mill and wood work is handled at the Oelwein shops. The passenger coach reconstruction and repair work is entirely carried on at the central shops. Mr. J. E. Thompson, mechanical engineer, has demonstrated his engineering skill in much of the recent changes made in the shop equipment.

Mr. G. T. Neubert, master mechanic, and Mr. A. L. Thomas, general foreman, very ably supplement Mr. Chrysler's important improvements in the locomotive department, while Mr. A. Aiken, foreman boiler maker, is a thorough expert in boiler construction and repairs. Mr. S. Coris, in charge of the car shops, is also a fine example of the skilled mechanic familiar with every detail and of rare executive ability, while Mr. H. W. Flanagan, foreman painter, ably demonstrates the fact that this important and artistic branch of the work is in the right hands. The relations between the hundreds of mechanics and the heads of the various departments is of the most cordial kind, and we cannot close this brief sketch of the Oelwein shops without referring to Mr. T. F. Johnstone, the locomotive inspector and traveling engineer. He is another example of the thoroughly trained mechanic who in addition to his multiplex duties finds time to keep abreast of the times, and we congratulate Mr. Chrysler on his excellent staff, without which it would be impossible to maintain the fine euqipment at its present high degree of efficiency.

The 200-A class of passenger engines to which we have already referred seem likely to hold their place for a long time. The following are some of their principal features and dimensions:

Weight in working order; 160,000 lbs.; weight on drivers, 120,000 lbs.; weight on engine truck, 40,000 lbs.; wheel base driving, 15 ft.; total wheel base, 27 ft. 2 in.; traction power, 28,000 lbs.; cylinders, simple, 20 ins. by 28 ins. Richardson balanced valves.

Diameter of wheels over tires, 68 ins.; diameter of truck wheels, 30 ins.

Boiler—Radial stayed; pressure, 200 lbs.; diameter of first ring, 64 ins.; flues, 275, 2 ins. in diameter; length of flues, 15 ft. 1¼ ins.; grate area, 32 ft. 6 ins.; total heating surface, 2,600 ft. Tender—Weight, light, 51,400 lbs. Capacity, 6,125 gallons; coal capacity, 10 tons.

Daniel Willard's Address.

As the subject of Railroad Legislation is a very important one in this country just now we give below a number of extracts from a most admirable address by Mr. Daniel Willard, second vice-president of the Chicago, Burlington & Quincy Railroad. Mr. Willard is in direct charge of the operation of the line, and the address from which the extracts have been taken was delivered by him a short time ago at Galesburg, Ill., before an audience composed of Burlington Railroad employees. Among other things he said:

REDUCTION OF THE BUDGET.

"The effect of this adverse legislation is best shown by the size of the Budget on January 1, 1908—it was then a little over $8,000,000, or about one-half of what it was twelve months before. In the meantime the November panic of 1907 had come upon us, and it seemed not only best, but necessary, to continue the policy decided upon in January of that year, and on the 1st of January, 1909, the Budget, as it then stood, and as it now stands, amounts to a little less than $1,000,000; and this brings us up to the present time."

REDUCTION OF STAFF.

"The Burlington Company has on its pay-rolls to-day about 38,000 men, 15,000 less than in October, 1907, and 7,000 less than in February, 1907. We are doing all the things that we consider necessary for the safe operation of trains, and for the proper maintenance of the property, but conditions so far have not seemed

SISKIYOU MOUNTAINS. SOUTHERN PACIFIC RAILWAY.

to us to justify a resumption of the policy of betterments and extension followed during 1906, and the preceding years. I do not know absolutely that it is so, but I imagine that the other railroad companies have been pursuing much the same course as we have here. The latest reports indicate that the total railroad mileage of the United States is about 230,000, so that the Burlington's mileage is about one-twenty-fifth of the whole, and if you multiply what has happened on this road by twenty-five, you will get a result for the whole country which will probably not be far from the truth. In fact the Eastern roads suffered much more from the actual business depression than we did in the West."

EQUIPMENT AND BONDED DEBT.

"The Burlington System to-day, as I have said, is over 9,000 miles in length. It has large terminals in Chicago, St. Louis, Kansas City, and the other great cities it reaches. It owns 1,600 locomotives, 1,200 passenger cars, and 52,000 freight cars. The last annual report shows that its bonded debt, or the size of its mortgage, amounts in round numbers to $165,000,000, equal to about $18,000 a mile. This mortgage is legally entitled to interest at the average rate of 4.185 per cent. per annum, because it is so specified in the bond, and that interest must be paid, or the mortgage would be foreclosed just as would happen if you failed to pay the interest on a mortgage, in case you happened to have one on your home. In addition to the bonded debt above referred to, there is outstanding $110,000,000 of stock in round figures, or about $12,000 a mile, making a total capitalization of $30,000 per mile."

TIME AND OPPORTUNITY TO RECUPERATE.

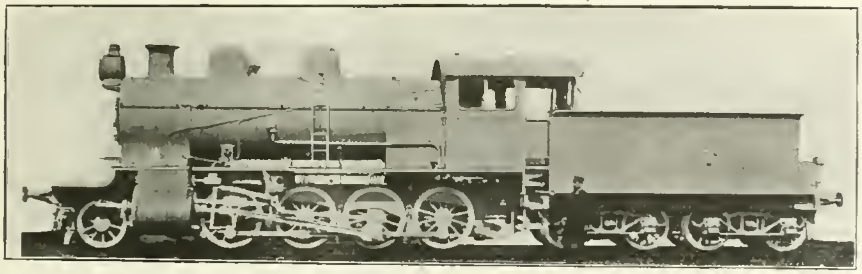
"In my opinion, railroad business, which really means all business, will recover its former proportions when the influences and forces at work during the last two or three years shall have ceased doing the things that have contributed so largely toward bringing about the depression which we all deplore. Perhaps that is not quite clear. I do not mean that laws already made must necessarily be unmade, that wages raised must be reduced, but we must have a rest. We must be given time and opportunity to work out the new problems that have been forced upon us during the last two years. We must be given a chance to find out what it is going to cost to meet the new requirements, and also how much our revenues are going to be reduced by reduction of rates. Perhaps it will be found that by new methods growing out of the exigencies of the case we will still be able to earn a surplus sufficient to justify the resumption of extraordinary expenditures as formerly. If not, then, either rates must be advanced, or wages be reduced, or improvements must wait or be carried on with borrowed money and railroads will be slow to increase their interest-bearing debt under such circumstances."

PUBLIC NOT A GENERAL MANAGER.

"No one to-day questions the right of the properly constituted authorities to supervise the railroads. No one defends the rebate, or discrimination of any kind, but, as the Supreme Court of the United States has recently well said, 'It must be remembered that railroads are the private property of their owners; that, while from the public character of the work in which they are engaged, the public has the power to prescribe rules for securing faithful and efficient service and equality between shippers and communities, yet in no proper sense is the public a general manager.'"

AMERICAN AND FOREIGN WAGES.

"No doubt there may be much in connection with railway management in the past, and for that matter at the present time as well, to criticise; but please tell me what line of human undertaking since the world began, be it industrial, educational or religious, has been free from criticism; and, granting all that is said against the railroads, then what? This is what we find: That the railroad rates in this country are the lowest in the world, with few minor exceptions not worth considering; that the wages paid railroad employees in the United States are higher than anywhere else in the world, and that the capitalization of American railroads per mile, as reported by the Interstate Commerce Commission, is but one-fourth as much as that of English railroads, and one-half that of the railroads of Germany and France, and one-third that of Belgium; and this has all been accomplished in a country where a high protective tariff obtains, and where everything the railroad uses costs more on that account. It is claimed that our manufacturers must have the protection of a high tariff in order to enable them to meet the prices of their foreign competitors and pay American wages; but the American railroad sells its product, that is, transportation, for less than any other nation and still pays higher wages. A locomotive engineer, for instance, receives $4.01 per day here as against $1.62 per day in England, and $1.01 per day in Belgium."



2-8-0 ON THE CHRISTIANIA-BERGEN RAILWAY.

LAND GRANTS TO RAILROADS.

"It is sometimes said that the railroads have received great help from the people in the shape of land grants, and on that account should give much in return. Let me give an instance of how this has worked with the Burlington Company. In order to induce the original projectors of this line to extend the road through Iowa, this company was given 359,000 acres of government land in that State, selling at that time $1.25 per acre, amounting to less than $450,000 cash value. By an act of Congress, passed over thirty-two years ago, a reduction is made of 20 per cent. from the mail pay on all land grant roads. At the present time the amount so deducted from the Burlington, because of the Iowa grant, amounts to over $65,000 a year, and since the law was passed has amounted in the aggregate to over $1,500,000, or more than three times the original value of the entire grant. Not only that, but it goes on without end. Do you think that is fair?"

FORTY-TWO PER CENT FOR WAGES.

"We do not ask for favors. We wish to be treated fairly, that is all. No one can possibly be more interested in the prosperity of the railroads than the railroad employees. From every dollar earned by the railroad forty-two cents go directly to pay wages of railway employees, while only twenty-one cents, or one-half that amount, goes to pay interest and dividends. In no other country in the world does the railroad employee get so large a share and the security holder so little. Why should not the man who invests his money in railroad stock receive as much return in shape of dividends as the man who invests his in a farm or factory?"

FAIR TREATMENT WANTED.

"It is estimated that the number of railroad stockholders to-day is over 400,000. We know that in 1907 over 1,600,000 men were employed on American railroads. Do you know of any good reason why this army of railroad men, together with the 400,000 stockholders, should not receive as fair consideration from government and people at large as the farmer and manufacturer receive? And yet the government in effect lets the one have money without interest to buy his land, and by means of a tariff makes you pay more for much that you buy, so that the other can pay his employees good wages. Personally I make no complaint because of either of these things; but so far as I can learn no one in Congress has suggested that railroads should raise their rates so that you might receive higher wages, and yet the two things, rates and wages, are very closely related."

Longest Railway in the World.

When finished the Cape to Cairo Railway, in Africa, will be the longest railway in the world. The main line from Cape Town to Buluwayo is 1,360 miles long, and has been in operation since the year 1897. The location line north of Buluwayo has been altered from the original plan proposed by the late Cecil Rhodes, owing to the now fuller knowledge of that region. The building of branch lines has also played a part in the alteration of the route selected. The opening of great Victoria Falls bridge in 1895 marked an important advance in the work.

The present terminus of the line is at Broken Hill in Rhodesia. The recent formation of the Cape to Cairo Syndicate means that the stretch of line 2,500 miles long, between Broken Hill and Khartum, in the British Egyptian Soudan will be pushed forward with vigor. The complete line from Cairo to the Cape will be about 6,000 miles long, and its estimated cost will be about a billion of dollars. Some of the best railway engineers of the world, British, German and American, are employed, the chief engineer himself, Mr. Gildemeester, recently paid a visit to the United States to study railroad construction here.

Speaking at a banquet of the Liverpool Engineering Society, the Bishop of Liverpool said that the engineers had done much to bring together four remarkable peoples, namely, the Englishman, who loves the Bible and beer; the Scotsman, who keeps the Sabbath and everything else he lays his hands on; the Welshman, who prays on his knees on Sundays and on his neighbors on week days, and the Irishman, who never knows what he wants and is never satisfied until he gets it.

ONE OF THE GREAT WESTERN FOUR-CYLINDER SIMPLES.

Questions *and* Answers *on our* Educational Chart No. 10

At the request of a large number of our readers we republish the series of questions appearing on our new chart, and the answers to the questions, which appeared serially in the January, February and March issues of RAILWAY AND LOCOMOTIVE ENGINEERING. We now have a new edition of our chart No. 10 and all orders will be promptly filled. The chart is not on sale but is sent free by mail to all new or renewed subscribers.

1. What is clearance?

A. The distance between the piston and the cylinder head when cross-head is at the end of the stroke, a position known as the dead center.

2. What is lead?

A. The distance the valve has uncovered the steam port at the beginning of the piston stroke.

3. Show position of valve and piston when cutting off at half stroke.

A. This is shown by the use of movable parts on the chart. The piston is set in the middle of the stroke by the indication below the cross-head. Then the valve is placed at the position in which it would cut off admission to the steam port.

4. How does this make steam work expansively?

A. The admission of steam from the boiler being cut off, the steam in the cylinder pushes the piston by expanding.

5. Has this valve inside lap?

A. No.

6. What is lap? What does it mean?

A. Lap is the distance the valve edge extends over the steam ports when set on the middle of the valve seat.

7. Why is lap given to a valve?

A. Lap is put on the valve to make the engine work steam expansively, by cutting off steam before the piston reaches the end of its stroke.

8. Where would you place the valve if you had to disconnect for a broken eccentric?

A. On the middle of the seat.

9. Where would you place it if you broke the steam chest?

A. In the same position, but it would be necessary to prevent the passing of steam into the steam chest.

10. Where would the valve be when compression commenced on forward stroke?

A. At the point of closing the forward steam port when moving backward.

11. What is pre-admission?

A. The steam admitted by the lead opening before the piston had reached the beginning of its stroke.

12. Show point of release.

A. The point of release would depend upon how far the motion was linked up. In the motion of this chart release and compression would begin at the same time.

13. What is changed about the valve when the reverse lever is hooked up?

A. The travel of the valve is reduced.

14. How would you place piston and valve if disconnecting a mogul or ten-wheeler where side rod pin would strike crosshead key if it was blocked in the center of guides?

A. Block the piston at the front of cylinder and valve at front end of its travel.

15. How would you block valve if one of the bridges was broken?

A. On the middle of the seat.

16. How if a rocker broke?

A. In the same position.

17. What is the reason that the cross-head is not in the center of the guides when the crank pin is on the top quarter?

A. The difference is due to the angularity of the main rod.

18. Why does the piston travel unevenly?

A. Because the crank pin with which the piston is connected does not move in a horizontal line. Towards the beginning and end of the stroke the crank pin motion is nearly perpendicular, while in its journey between the eighths it is nearly horizontal.

19. Does this cause the valve to travel unevenly? If so, why?

A. The valve travels unevenly because it is operated by an eccentric which has the same motion as a crank of small throw.

20. What effect has the length of the main rod upon the piston travel?

A. None.

21. Suppose you were running ahead shut off, with the reverse lever hooked close to the center, what would the valve do?

A. The valve would be forced off the seat at certain parts of the stroke, while at other parts it would aid the piston to suck in dust and hot gases through the exhaust port.

22. Why is the valve placed over the center of ports when engine is disconnected?

A. To prevent the admission of steam into the cylinders.

23. What could happen that would cause you to disconnect without covering the ports?

A. Any failure in the supply of steam, such as a safety valve blowing out or the dry pipe collapsing.

24. When an engine is running at what part of the travel does the piston move the fastest?

A. When the crank pin is passing the quarters. At those points the pin movement is nearly horizontal.

25. Does the piston stop at each stroke, and when?

A. The piston stops at the end of each stroke, the point where it changes direction of movement.

26. At what part of the piston travel is the greatest pressure exerted on the crank pins?

A. At the beginning of each stroke.

27. In running ahead, why does the top guide wear most?

A. Because the main rod pushes the crosshead upwards.

28. What is back pressure?

A. The pressure that obstructs the piston on the return stroke, due to steam, moisture or air left in the cylinder after the exhaust port has opened.

29. What is the difference between back pressure and compression?

A. Back pressure has just been explained. Compression occurs when the valve closes toward the end of the return stroke, permitting the piston to squeeze the gases in the cylinder into a diminishing space.

30. What is the cavity under the valve for?

A. It provides a passage for the exhaust steam to escape from the cylinder into the exhaust pipe.

31. What is meant by the expression, "cutting off at six inches?"

A. It means that when the steam has pushed the piston six inches of its stroke, the valve cuts off further admission of steam.

32. Could you change the lap of the valve by changing the eccentrics?

A. No.

33. When a valve blows, where does the steam go to?

A. Into the exhaust passage, thence to the atmosphere.

34. What is inside clearance?

A. The cutting away of the inside edges of the valve cavity, so that there is an opening to the cavity from both ends of the cylinder when the valve is on the middle of the seat.

35. Could steam be worked expansively with a valve without lap?

A. No, because release of the steam would happen at the same time as cut off.

36. Suppose this piston was on the forward dead center and the reverse lever was put in full forward gear, where would the valve be? Where would the valve be if the lever was put in full back gear?

A. In both cases the valve would be in the position to begin admitting steam at the forward end of the cylinder.

They that will not be counselled, cannot be helped. If you do not hear Reason she will rap you on the knuckles.—*Franklin.*

Items of Personal Interest

Mr. Malcolm Baxter, master mechanic of the Western Ohio Railway, has resigned.

Mr. W. H. Foster has been appointed master mechanic on the New York Central at High Bridge, vice Mr. H. L. Raymond, resigned.

Mr. J. D. Skeen has been appointed road foreman of engines of the New York Central Lines, with headquarters at Mt. Carmel, Ill.

Mr. George W. Robb has been appointed assistant master mechanic of the Grand Trunk Pacific Railway at Rivers, Manitoba.

Mr. H. B. Whipple has been appointed master mechanic at North White Plains on the N. Y. C., vice Mr. W. H. Foster, transferred.

Mr. Carl Holt Smith has been appointed assistant purchasing agent of the National of Mexico Railway, with headquarters at Mexico.

Mr. C. Geldart has been appointed foreman of machine shop on the Grand Trunk Railway at Stratford, Ont., vice Mr. James Duguid, promoted.

Mr. James Blair has been appointed mechanical foreman on the Intercolonial Railway at Stellarton, N. S., vice Mr. H. D. Mackenzie, promoted.

Mr. S. S. Riegel has been appointed mechanical engineer of the Delaware, Lackawanna & Western at Scranton, Pa., vice Mr. J. A. Mellon, resigned.

Mr. W. A. Deems has been appointed master mechanic of the Mohawk and Malone and the St. Lawrence & Adirondack divisions of the N. Y. C. lines at Tupper Lake.

Mr. W. H. Fenley has been appointed signal engineer of the Chicago Great Western Railway at St. Paul, Minn., vice Mr. C. A. Christofferson, resigned.

Mr. C. C. Wallace has been appointed road foreman of engines of the Peoria & Eastern division of the New York Central Lines, with headquarters at Kansas City, Mo.

Mr. W. H. Peters has been appointed assistant master mechanic of the Iowa division of the Chicago & North-Western Railway at Boone, Iowa, vice Mr. C. Coleman, promoted.

Mr. T. A. Lawes has been appointed master mechanic of the Southern Indiana and of the Chicago Southern Railway, with headquarters at Bedford, Ind., vice Mr. G. A. Gallagher, resigned.

Mr. G. E. Johnson has been appointed master mechanic of the Wymore division of the Chicago, Burlington & Quincy Railway at Wymore, Neb., vice Mr. A. B. Pirie, assigned to other duties.

Mr. E. V. Williams has been appointed general foreman of locomotive department of the New York Central & Hudson River Railroad, with office at Avis, Pa., vice Mr. H. B. Whipple, promoted.

Mr. James Duguid, formerly foreman of the machine shop of the Grand Trunk Railway at Stratford, has been appointed general foreman on that road at Toronto, Ont., vice Mr. J. C. Garden, promoted.

Mr. H. W. Peters has been appointed assistant master mechanic of the Iowa division of the Chicago & North-Western Railway, with headquarters at Boone, Iowa, vice Mr. C. Coleman, promoted.

Mr. P. J. Ryan, formerly with the Lake Shore, has been promoted to be traveling engineer of the Lake Erie & Western Railway at Lima, Ohio. He will have charge of the Sandusky-Tipton division.

Mr. A. J. Edmonds, general foreman for the Sioux City and Dakota divisions of the Minneapolis, St. Paul & Sault Ste. Marie Railway, has been transferred to a similar position on the same road at Madison, Wis.

Mr. W. B. Embury has been appointed master mechanic of the Oklahoma & Pan Handle divisions of the Chicago, Rock Island & Pacific Railway, with headquarters at Chickasha, Okla., vice Mr. W. J. Monroe, resigned.

Mr. Charles Coleman, formerly assistant master mechanic, has been appointed master mechanic of the Northern Iowa and Sioux City divisions of the Chicago & North-Western Railway, with headquarters at Eagle Grove, Iowa.

Mr. J. R. Laizure, general foreman on the Erie Railroad, has been transferred from the Hornell shops to those at Susquehanna, Pa., and Mr. Harry Chamberlain, who has been in the Cleveland shops, goes to Hornel.

Mr. Charles Coleman has been appointed master mechanic of the Northern Iowa and also of the Sioux City division of the Chicago & North-Western Railway, with headquarters at Eagle Grove, Iowa, vice Mr. A. B. Quimby, resigned.

Mr. W. R. Beauprie, formerly superintendent of the Montgomery District of the Atlantic Coast Line Railroad at Montgomery, Ala., has been appointed general manager of the Atlanta & St. Andrews Bay Railroad, with headquarters at Dothan, Ala.

The annual meeting of the stockholders of The Union Switch & Signal Company recently took place in the office of the company. Owing to the absence of George Westinghouse in Europe, Colonel H. G. Prout, vice-president of the company, acted as chairman. The financial statement was read to the stockholders, and an election of directors was held with the following results: Messrs. George Westinghouse, Robert Pitcairn, William McConway, George C. Smith, Thomas Rodd, H. C. Prout and James J. Donnell, directors. Mr. George Westinghouse was elected president.

After the meeting, a representative of the company stated that they have at the present time on hand at Swissvale, Pa., orders for unfilled business amounting to $1,357,000. New contracts for block signaling and other railroad safety devices are now coming in more freely than at any time during the last twelve months. Inquiries for quotations on new business are increasing right along, and are spread pretty widely over the entire country.

A selling company has been organized under the name of J. Rogers Flannery & Company, with headquarters at Pittsburgh, Pa., to take over the sale of the Tate Flexible Staybolt, owned and manufactured by the Flannery Bolt Company. This selling organization will also exploit the Keystone Nut-Lock, which has found great favor, and which is also manufactured by the Flannery Bolt Company. The representatives of the new company will be Messrs. H. A. Pike, New York; W. M. Wilson, Chicago; Grundy & Leahey, Richmond, Va., and Tom R. Davis, mechanical expert, Pittsburgh, Pa.

Mr. Joel S. Coffin recently received a touching tribute from his friends and former associates in the Galena Oil Company, expressing their regard for him upon his recent retirement to become vice-president of the American Brake Shoe & Foundry Company. Galena men from all parts of the country assembled in the office of Mr. Coffin and presented him with a handsome loving cup, engraved with the fac simile signatures of the donors. A magnificent mahogany office desk and handsome specially designed inkstand formed part of the presentation. Gifts from friends are not unusual upon the withdrawal of a highly esteemed officer and associate, but it is given to few men to inspire the staunch affection of strong, successful men such as was revealed on this occasion. The gifts themselves, handsome as they are, were only an incident in this demonstration of affectionate regard.

Mr. Geo. F. Risteen and Mr. John E. Griffith, of the Canadian Pacific Railway, who have had many years experience in railroad operation in the Rocky Mountains, have been lent to the Transandine Railway of Argentine for the winter to report to the directors of that road on the class of equipment suitable for severe mountain service.

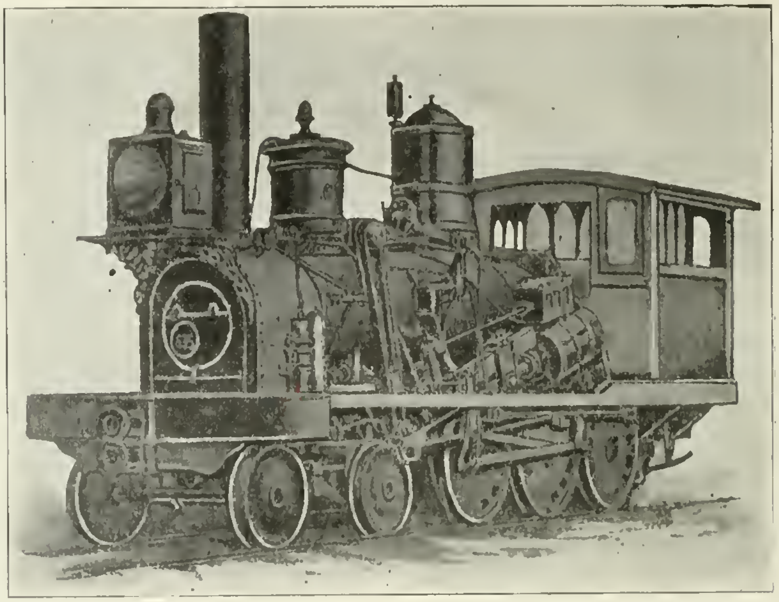
Mr. Philip Pickering, the oldest engineer in point of service on the Iowa Division, after 40 years continuous service with the Chicago & North Western Railway, has been retired on a pension, effective March 1, 1909. Few engeneers who devote their lives to the railroad service achieve the success attained by Mr. Pickering. He was recognized as the highest type of the successful engineer of the present day, and the feeling existed among his friends that when Phil Pickering was at the throttle, under ordinary conditions, it was sufficient evidence to believe that the train would go to the next terminal on time. In recent years quite a number of notable fast trains, or one may say trains for notable people, have been run on the C. & N.-W., and often Mr. Pickering was found at the throttle when the train came on his division. The sensation of 1876 was the Jarret & Palmer special, which was hauled over the line between Boone and Dunlap, a distance of 100 miles, by Mr. Pickering at a speed of 42.8 miles an hour, including stops. He was in charge of the engine on the Jay Gould train in 1891, and gave a good account of himself on that trip, going from Council Bluffs to Boone, a distance of 141 miles in 2 hours and 59 minutes.

Obituary.

The death of William P. Henszey, senior partner of the firm of Burnam, Williams & Co. (the Baldwin Locomotive Works), occurred on March 23 last, at his home in Philadelphia. Mr. Henszey was born in Philadelphia on September 24, 1832, and was in his seventy-seventh year. He became connected with the Baldwin Locomotive Works on March 7, 1859, and has therefore been connected with the firm for half a century. Mr. Henszey in earlier years had charge of the drawing office, and it was through his instrumentality that many improvements in locomotive construction appeared in the Baldwin engines. He was wonderfully well informed upon the history of the locomotive, and Dr. Sinclair learned many valuable facts from the distinguished locomotive builder, when preparing the manuscript for "Development of the Locomotive Engine." Mr. Henszey married Anne R. Hitchcock, of Abington, Mass., and is survived by his widow and one daughter. He was a member of the Union League, the Art Club, the Merion Cricket Club and the Historical Society of Pennsylvania. He was a prominent and highly respected citizen, esteemed and loved by all who knew him.

It is with deep sorrow that we have to announce the death of Ervin Saunders, vice-president of the firm of D. Saunders' Sons, Incorporated, at Yonkers, N. Y. Mr. Saunders died at his brother's home in Yonkers in February last, in his sixty-first year. He was respected and highly esteemed by all who knew him.

As the melancholy result of an accident, Winfield Scott Templeton, superintendent of motive power and equipment of the Guatemala Central Railroad, died at Guatemala City last February. Mr. Templeton was a valued contributor to the pages of RAILWAY AND LOCOMOTIVE ENGINEERING, and had acted as our agent in the various places of the United States which were his headquarters in railroad work. He evinced a warm interest in our paper, and strongly believed in the dissemination of useful knowledge among those who worked under him. He was universally beloved by all who knew him, and his untimely death is deeply regretted by his hosts of friends, both in the United States and Guatemala.



THE "MONSTER" REBUILT, USED ON THE PENNSYLVANIA AS LATE AS 1875.

Mt. Union Tie-Treating Plant.

The Pennsylvania Railroad Company, in awarding a contract for the erection at Mt. Union, Pa., of a "one-cylinder" plant for the treatment of timber by any standard process, has taken the initial step toward the preservative treatment of its cross-ties and other timbers. In connection with this plant, two creosote storage tanks of 500,000 gallons' capacity each are to be erected at Greenwich Point, Philadelphia. These tanks will have a combined capacity sufficient to receive a tank steamer cargo of oil, that will be shipped to Mt. Union in tank cars as needed. The treating plant will have a capacity of from 1,500 to 2,000 ties a day, if day and night shifts of hands are worked. This will give an annual output of about 500,000 ties.

Mt. Union was selected as the site for the first plant because it is near the center of a tie-producing region, and, in addition, is a convenient receiving and shipping point.

During 1907, 840,000 hardwood ties were obtained along the Middle Division of the Pennsylvania Railroad, while the Eastern Pennsylvania Division, of which the Middle Division is a part, produced 1,250,000 ties. Eliminating the white oak and chestnut, which do not take treatment readily, and including the miscellaneous hardwoods, such as beech, maple and birch, which, if treated, make excellent ties, the territory tributary to Mt. Union should produce enough ties to supply a one-cylinder plant for many years to come.

The Mt. Union tie yard will occupy an area of about 17 acres. There will be six tracks about 1,500 ft. long, and 73 ft. apart. There will be ample space for adding other tracks as they are needed. The capacity of the yard will be from 450,000 to 600,000 ties, depending on the height to which they are piled. All timber treated will be given not less than six months of summer seasoning in this yard.

While the plant will be equipped for any process of recognized value, it will operate mainly with creosote. The agitating pipes and rotary pumps are for the use of an emulsion of zinc-chloride and creosote.

Mogul Engine for China.

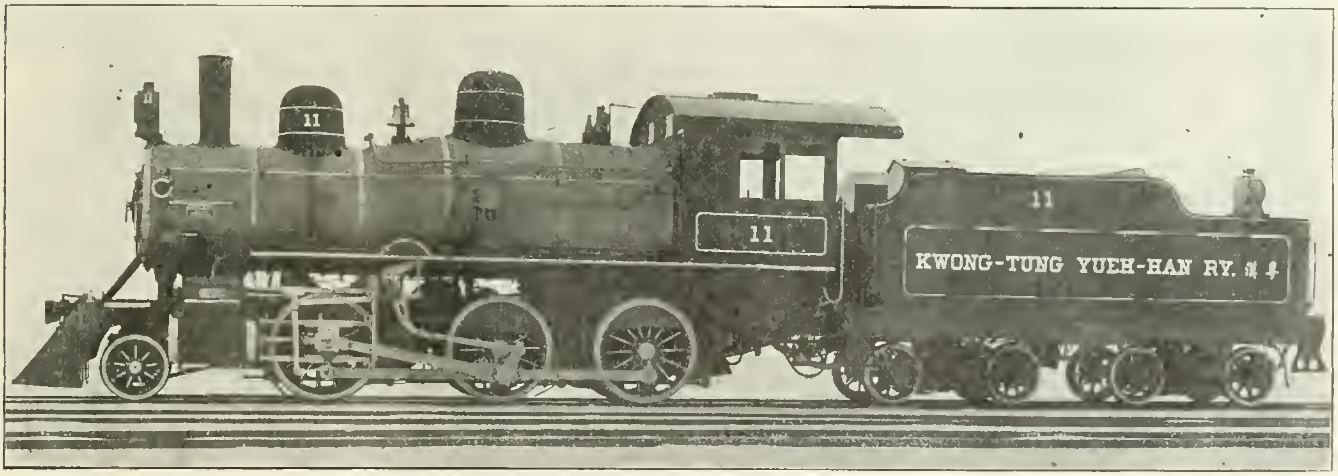
On the illustration which accompanies this article the reader will notice that Mogul engine No. 11 is owned by the Kwong-Tung, Yueh-Han Railway. This line will be, when completed, part of the Canton-Hankow line. The engine, which is a simple one, was built at the Dunkirk shops of the American Locomotive Company.

The cylinders of this engine are simple, 19 x 26 ins., and the valve is of the ordinary Richardson balanced D-slide type. The driving wheels are 56 ins. in diameter and with a steam pressure of 180 lbs., the tractive effort developed amounts to 24,100 lbs. The weight on the drivers is 120,000 lbs. and this gives a factor of adhesion of 4.97. The valve motion used is the Walschaerts. The valves are set with 3/16 in. lead which, with this form of gearing, is constant. The travel of the valve is 6 ins. and it has 1 in. lap. It will be observed that the motion of this engine is supplied with what are called castelated nuts. The main driving wheels are not flanged.

The boiler is an extended wagon-top one, the first ring of which is 62 ins. in diameter. The firebox is narrow, that is, it is set upon the frames, but does not extend outside them. In the matter of heating surface the firebox provides 165 sq. ft. The tubes, of which there are 290, each 12 ft. 2 ins. long, provide 1,833 sq. ft. and with the brick arch tubes which provide 20 sq. ft. the total heating surface amounts to 2,020 sq. ft. The grate area is 30.3 sq. ft. and this gives a ratio as 1 to 66 for grate to heating surface.

The tender is made with steel frame, the channel bars being 12 ins. deep. The tank is the ordinary U-shape with gravity slides for the soft coal which is to be used. There are 9 tons of coal carried and the cistern has a water capacity of 5,000 gallons. The tender trucks are of the ordinary arch bar type. Some of the principal dimensions are here appended for reference.

Wheel Base—Driving, 14 ft.; total, 21 ft. 10 ins.; total, engine and tender, 51 ft. 3 ins.
Weight—In working order, 141,000 lbs.; engine and tender, 245,000 lbs.
Axles—Driving journals, main, 9 ins. x 12 ins.; others, 8½ ins. x 12 ins.; engine truck journals, diameter, 5½ ins.; length, 10 ins.; tender truck journals, diameter, 5 ins.; length, 9 ins.
Firebox—Length, 108 3/16 ins.; width, 40¼ ins.; thickness of crown, ⅜ ins.; tube, ½ in.; sides, ⅜ ins.; back, 5/16 ins.; water space, front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Crown Staying—Radial.
Tubes—Gauge, No. 12 I. W. G.; 2 ins. outside diameter.
Boxes, Driving—Main, cast iron; others, cast iron.
Pump—9½ ins. L. H.; reservoir, 2 27 5/16 x 36½ ins.
Engine Truck—Swing Radial Center Bearing.
Piston—Rod diameter, 3¼ ins.; piston packing, cast iron rings.
Smokestack—Diameter, 15 ins.; top above rail, 14 ft. 9½ ins.
Driving Wheel—Material, cast steel; engine truck, diameter, 33 ins.; kind, spoke center; tender truck, diameter, 33 ins.; kind, spoke center.



MOGUL ENGINE FOR THE CANTON-HANKOW RAILWAY.
American Locomotive Company, Builders.

A very interesting catalogue has just come from H. B. Underwood and Company of Philadelphia. This well-known concern are the makers of all sorts of portable tools for railway repair shops. The catalogue is printed on tinted paper and is well illustrated. It is the standard size, the same as the Railway Club Proceedings. In its 72 pages, it contains descriptions and pictures of a great variety of portable tools for doing all kinds of work about a locomotive. The use of these portable tools greatly facilitate the various repair operations in the back shop. Nearly everyone in the railroad field has a sort of general idea that the Underwood Company make a good many handy tools, but it is not until one has carefully perused the pages of this catalogue that the number and variety of these tools is fully realized. The company is prepared to send this catalogue free, upon request, to anyone who is interested enough in the matter to write for one. The catalogue is a good one to have on your desk for reference.

The new edition of "Twentieth Century Locomotives" is the best two-dollar-bargain to be found in the book-selling trade.

Signal Lamp Shows Fish Tail.

A new departure in the form of signal lights is being used in England. The object of the new form of light is to clearly and emphatically differentiate the home from the distant signal light. In day time mistakes are practically impossible, but at night there may be confusion of the one with the other. The form of lamp used on the distant signal on the Great Eastern, the London and Southwestern, and on the London, Brighton and South Coast Railways, consists in the addition of a luminous fish tail, corresponding to the notch in the distant semaphore arm. The fish tail notch is used both in England and America as the distinguishing mark of the distant signal blade.

It is said that the luminous fish tail can be plainly seen at a distance of between 700 and 800 feet. The same flame which gives light to the signal lense also supplies light to the fish tail by means of a reflector. In this way no change is made in the lamp or the burner or even in the intensity of the flame. Under the Coligny-Welch patent the lamp case only is modified for use on distant signals, and it is believed that this change will be a source of satisfaction to the men on the engine. A form of train order signal used on the Canadian Pacific Railway utilizes the principle of reflection in order to provide what was called a back sight for use of enginemen who had, in making the proper station stop, been compelled to pass the train order signal.

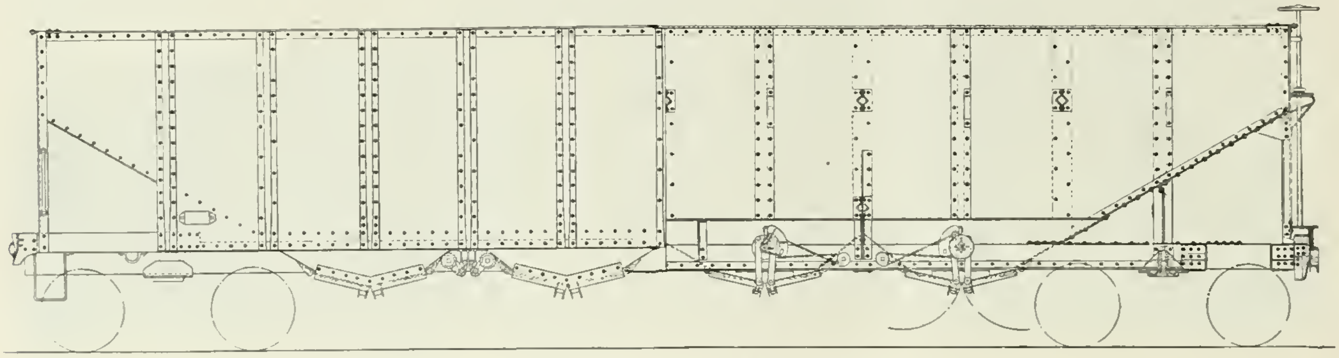
There is a great deal of waste light in any signal lamp, and by waste we mean the light which falls upon the interior surface of the case, other than the lense. It is this otherwise unused light which is reflected in the new form of distant signal into a tube or projection or extension of the case, the outer face of which has a glass placed over a fish tail shaped opening. The lamp shows the ordinary lense light with the addition of the luminous fish tail alongside of it.

Steel Coke Car on the P. R. R.

In an effort to provide shippers of coke with an improved car, which can be loaded and unloaded in the shortest possible time, the Pennsylvania Lines west of Pittsburgh have specified that of the recent order for 2,200 new cars, 1,000 should be all-steel cars of new design and of greater capacity than any coke cars hitherto built for regular service.

The main novelty in these cars will consist of four hoppers, with eight openings in the bottom of the car, making the car practically self-clearing. With the doors all open, there will be an open area of 84 sq. ft. This will greatly facilitate unloading. It has been found that three somewhat smaller cars could be unloaded by three men in fifteen minutes from the time they were placed on the trestle until the engine moved them away. From the time the drop doors were opened until the coke ran out of the car required one minute and forty-five seconds. The four-hopper car is expected to do even better.

To facilitate loading, it is planned that the old-fashioned coke racks shall be left off these cars, and the sides of the cars will not be as high as in previous designs. This loss is made up by the greater length of the new cars, which are 42 ft. long. The drop doors are to be provided with operating gear of special design. The total capacity of each of the new cars is 2,794 cu. ft., providing for a load of 100,000 lbs. The top of the car stands 10 ft. 6 ins. from the rail and the hopper is 9 ft. 6 ins. wide inside. The truck wheels have a spread of 5 ft. 6 ins., and the truck centres are 32 ft. apart. Our illustration shows the general design of the car, which is seen to be of very substantial construction.



PENNSYLVANIA RAILROAD SELF-CLEANING STEEL HOPPER CAR.

Adjustable Boiler Flues.

A form of boiler tube adapted to locomotive use has been put on the market by the Adjustable Boiler Flue Company, of Minneapolis, Minn. This tube is made up by mounting standard gauge tubing with reinforced ends of crucible steel, butt-welded onto the tube proper by the Thompson process of electric welding. Having the ends thus reinforced by material heavier, harder and stronger than ordinary tubing. The makers claim that it offers great strength where required, and that this protects and strengthens the tube sheets, this reinforcement of flue ends, set so as to form wedged, tapered joints by reaming of tube sheets to conform to taper of tubes, every flue acting as a stay tube from the fact of its having same taper joints at both ends, secured by stay burrs at front end sheet.

The tapered crucible steel end of flue is used in firebox end of boiler, the flue sheet is reamed in the same direction as the taper on the flue, and just large enough to allow the reinforced end of the flue to pass through the flue hole. A copper ferrule is inserted between taper end of flue and the flue hole. This end is then driven in or seated, forming a steam-tight joint without the process of expanding or beading. The bushing or sleeve end goes into smokebox end of boiler, the flue sheet having been reamed exactly as for the taper end of the flue in the firebox, and a solid copper ferrule having been seated in the flue hole with a swedging iron, before flue was seated in firebox end. The tapered crucible steel sleeve is then placed on the flue, which is then wedged or seated between the flue and the copper ring in flue hole completes exactly the same taper joint in both ends of the boiler. The flue is threaded at the sleeve end for the bronze burr. The use ot this burr is not necessary to secure steam-tight joints, nor does the thread on the flue extend into the boiler so as to come in contact with water to cause rust or corrosion, but it has been adopted and is used for the purpose of staying the flue and thus avoiding any possibility of the sleeve joint working loose, as might possibly be the case in high pressure and locomotive boilers.

Removal of these tubes does not destroy them or necessitate re-tipping as with ordinary tubes. The adjustable tubes can be removed and put back as often as may be necessary, the process being comparatively simple. The work can usually be done by boiler makers' helpers in less time than is required to reset ordinary tubes.

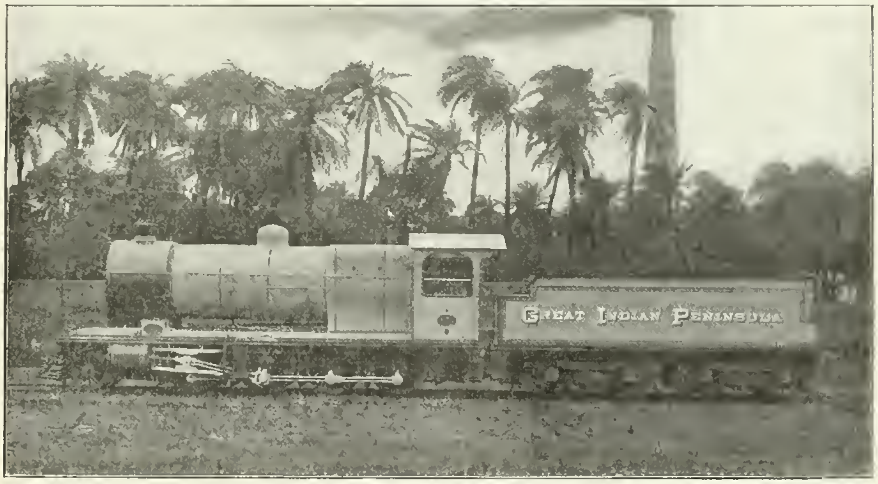
Recent Freight Locomotives Abroad.

The Ottoman Railway has recently had delivered a powerful 0-8-0 freight locomotive for service between Smyrna and Aidin. It has been built by Messrs Robt. Stephenson & Co. of Darlington and has the following leading dimensions: Cylinders 19½ in. in diameter by 20-in. stroke; diameter of driving-wheels 4ft. 6½ in.; total wheel base of engine 17 ft. 10.; heating surface: firebox 152.4 sq. ft., tubes 1,634 sq. ft., total 1,786.4 sq. ft.; grate area 25.35 sq. ft.; working pressure 180 lbs. per sq. in.; tender: diameter of wheels 3 ft. 6½ in.; wheel base 12 ft.; capacity 3,000 gallons of water and 7 tons of fuel; weight of engine in working order 57 tons 18 cwt., and of tender 37 tons 2 cwt.; total wheel base of engine and tender 41 ft. 0½ in. The boiler is fitted with steel tubes and a copper firebox. Richardson balanced slide valves are fitted, and to give flexibility to the long wheel base ¾ in. slide play is allowed to the trailing wheels, the trailing coupling rods being fitted with ball joints. Other features of interest include the use of the steam brake, with a vacuum ejector for working the train brake.

For the heavy freight traffic over the Ghat Mountains on the Great Indian Peninsula Railway some large 2-8-0 engines have recently been sent out to replace the smaller six-coupled engines previously used on the main line. The average load drawn by these engines exceeds 1,000 tons. These new engines are fine specimens of modern British locomotive design, and should give a good account of themselves in a country where rough treatment is more likely to be accorded them than smooth. They have been built at Glasgow by The North British Locomotive Co. (Atlas Works) and re-erected at Parel shops; they are known as H1 type. The chief dimensions are, cylinders 21x26 ins., drivers 4 ft. 7 in. diameter.

The boiler has a total heating surface of 2,079 sq. ft. The working pressure is 180 lbs. per sq. in. and grate area 32 sq. ft. The equipment for the automatic vacuum brake comprises one of the new "C" type combination ejectors and two brake cylinders. Steam sanding gear is fitted. The boiler is covered with asbestos, as also is the inner roof of the cab. The weight of the engine in working order is 70 tons, and of engine and tender full 125 tons. The large tender has bogie wheels that are 3 ft. 7 in. diameter, and carries 10 tons of coal and 4,500 imperial gallons of water; there is a "Monarch" water gauge fitted to indicate the height of the water in the tank.

OTTOMAN RAILWAY 0-8-0 ENGINE.



GREAT INDIAN PENINSULA 2-8-0.

To further complete the remodeling of the locomotive stock of the G. I. P. R. new type of suburban tank engine has recently been constructed by Messrs. Kitson of Leeds. These engines have cylinders 18x26 in., and six-coupled drivers 5 ft. diameter, the trailing wheels are 3 ft. 7 in. diameter. The boiler has a total heating surface of 1,169 sq. ft., 1,063 sq. ft. of which is contributed by 214 tubes 1¾ ins. diameter. The firebox has a grate area of 23 sq. ft. The tanks carry 1,500 Imperial gallons of water, and the bunker 2½ tons of coal. These engines (Nos. 79-94) are employed on the Bombay suburban service, and handle trains of seven large bogie cars weighing about 35 tons each. They replace a smaller type of six-coupled tank engine, and have many improvements, which bring them into the front rank of Indian tank locomotives.

SUBURBAN TANK ENGINE ON THE G. I. P.

The engine shown in our illustration No. 86 has an electric headlight which has been tried prior to being fitted on one of the large tank engines operating over the Ghat inclines. The arc lamp receives current from a small dynamo actuated by a miniature turbine placed on the left side of the footplate.

Locomotive Boiler Explosion

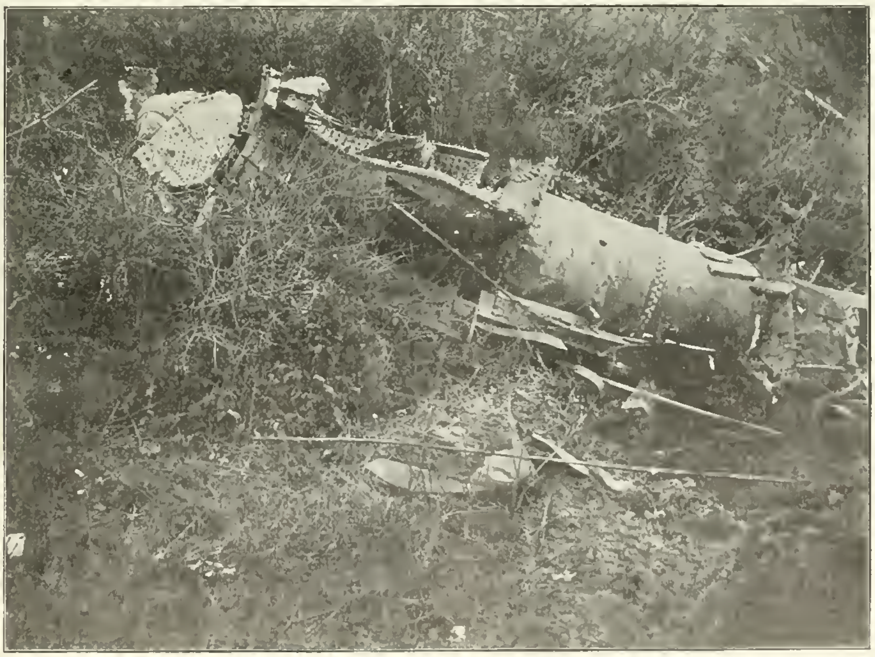
A correspondent on the Pacific coast has sent us photographs, which we reproduce, of a recent locomotive boiler explosion which occurred in his vicinity, resulting in the death of the engineer and fireman and the complete destruction of the locomotive. It appears that the locomotive was proceeding at a rate of about ten miles an hour, traversing a portion of a shore line where many treacherous slides have occurred. The engineer and fireman were both men of the highest ability and had had much experience in the passenger service. The effect of the explosion was of the most amazing kind, not a particle of the locomotive being left on the track. The rupture had evidently begun in the right leg of the boiler near the mud ring. The locomotive frames had been rent apart, the driving axles snapping as if they had been sawn asunder. Portions of the wreckage were blown over a height of two hundred feet on the top of an adjoining cliff; other portions were blown into the bay and the bodies of the engineer and fireman were also precipitated into the water. The engineer was most gallantly rescued from drowning by the conductor and a colored passenger, who risked their own lives in the icy waters at a time when a fierce gale was blowing and while it was still dark, so that they could barely see the distant body of the engineer. Bell ropes were bound together by the assisting passengers and the heroic men and dying engineer were dragged ashore. The engineer never regained consciousness and shortly afterwards expired. The dead body of the fireman was washed ashore some hours later.

ROAD BLOCKED WITH DEBRIS FROM EXPLOSION.

As usual, the coroner's inquest developed a variety of opinions as to the cause of the disaster, the low water theory being advanced by one set of witnesses against the corrosion theory of the opposing set. The discovery of a number of fractured stay-bolts rendered the question more than usually difficult of solution. It would be idle for anyone other than an expert witness of the condition of the boiler immediately after the disaster to speculate at length on the causes that led to that particular disaster. It is for the thoughtful railway man, rather, to exercise a renewed determination in a resolute effort to exercise every precaution possible looking toward the prevention of such disasters. That such explosions are less frequent is a proof that they are preventable. That they occur sometimes in the case of new boilers is proof that other causes besides corrosion lead to explosions. That the majority of these disasters occur in the case of boilers that have been many years in service is also proof that thorough and repeated inspections of boilers should be made at regular intervals, such intervals being shortened as the life of the boiler becomes lengthened.

It is a noteworthy fact that in the report of the British Board of Trade, recently published, in the case of one hundred boiler explosions, no less than seventy-six were clearly demonstrated as being caused by organic weakness due to corrosion as shown in the weakening of the sheets of the fire box, in some instances portions of the sheets having been reduced from three-eighths of an inch in thickness to less than one-sixteenth. In this regard it is also worthy of note that while locomotive boiler explosions are extremely rare on the British railways, the occurrence of boiler explosions in the agricultural and other industrial works are of much more frequent occurrence, and particularly more so than they are in America. This leads to the logical conclusion that the inspection and consequent high state of efficiency of British locomotive boilers is more marked than is the case with boilers in other branches of service. In the United States the opposite seems to be the case. The laws in regard to boiler inspection are particularly effective in American industrial service generally, and the rarity of boiler explosions, especially in thickly populated districts, is remarkable.

It may be added that the important advance recently made in the laws of the State of New York in regard to inspection of locomotive boilers has undoubtedly had a most beneficial effect, and it would be well if other States followed the example set by the Empire State in this regard. Meanwhile, as we have already said, it becomes those in authority in railroad repair shops to keep ever before them the appalling possibilities incident to careless methods of inspection and repair of boilers. At the same time it need hardly be reiterated that engineers themselves, having not only their own lives at stake, but also the lives of hundreds of their fellow beings, should exercise the greatest degree of vigilance and unceasing watchfulness in dealing with the titanic forces with which they are entrusted; an illustration of which we find in the amazing destruction caused in the incident to which we have referred.


EXPLODED BOILER HURLED FROM THE TRACK.

The Dodge Manufacturing Company, of Mishawaka, Ind., are correctly described as transmisison engineers, and from their list of catalogues it appears that they practically make everything used in the mechanical transmission of power. Among the material already published by this enterprising firm may be mentioned their No. 7 catalogue, in both library and pocket editions, also their No. 18, a remarkable test of an iron centre wood rim pulley; No. 99, condensed price list of the Dodge line; No. 56, Dodge calculator; No. 101, Dodge keyless compression couplings; No. 20, Dodge pulleys; No. 116, friction clutches; No. 77, from log to line shaft; No. 115, hanger bulletin; No. 92, hanger price list; No. 3, hardwood lagging; No. 98, harnessing water power; No. 108, roadbed for power; No. 123, safe construction and speeds for flying wheels; No. 62, something about friction clutches; No. 86, standard iron split pulley price list; No. 57, the construction of a modern cement mill; No. 107, the conversion of Mr. Pennywise; No. 76, twenty-five years of rope driving; and No. 104a, wood split pulley price list.

The C 7 or library edition of power transmission is a very handsome volume of 407 pages, in which everything for the transmission of power in and about a shop is illustrated and described. The Dodge wooden split pulleys are known far and wide and these are made in a variety of sizes, which is truly marvelous. Countershafts, shaft hangers, bearings, clutches, shaft couplings, belt tighteners, binder frames, etc., etc., are only a very few of the many devices and appliances turned out of this company's works. Look over the list of catalogues and write to the company for a copy of the one you want, and they will be happy to send it to you and to give you any further information which you may require on the subject.

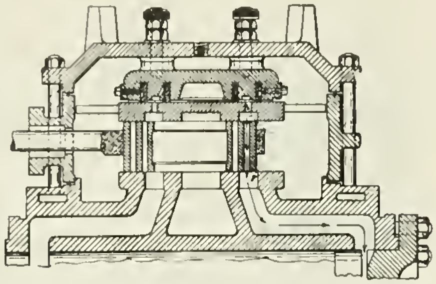
Balancing of Piston and Slide Valves.

Many people believe that the piston valve is the most perfect form of balanced valve in locomotive practice, this belief being based upon the fact that the steam surrounds the valve if it is internal admission, and if it is external admission steam is at each end of the valve. In the piston valve while the steam is expanding the snap rings against the valve chamber, and furnishing thereby an unbalanced surface equal to the area of the frictional contact of the snap rings against the cage. It is interesting, therefore, to find a slide valve which is more perfectly balanced than a so-called balanced piston valve, and that this kind of slide valve is working under the highest locomotive steam pressure.

In comparing the balanced area of piston and slide valves, it is instructive to observe a high-pressure slide valve, such as the Jack Wilson high pressure slide valve, made by the American Balance Valve Company of Jersey Shore, N. J. It has a balanced area of 184.62 sq. ins., the face of the valve being 11½ x 22 ins., or 253 sq. ins. in all. The unbalanced area is, therefore, 68.37 sq. ins. The 14-in. piston valve, which is used on the same engines with piston valves instead of slide valves, has each four rings ⅝ in. wide, which equals 2½ ins. by the circumference of 14 ins., or a total frictional contact surface of 109.95 sq. ins., which is 40.58 sq. ins. greater than the frictional surface of the slide valve, or more unbalanced surface than the slide valve.

From these figures it appears that the piston valve as commonly used is not so well balanced a valve as is commonly supposed. In addition to this, this modern balance slide valve has other valuable features, such as double-exhaust opening in addition to the double admission of steam, the double exhaust being a feature long sought, for locomotive valves, and many valves have been designed to secure this result. We are informed by the makers that this valve has made a mileage on the Central Railroad of New Jersey of 168,000 miles without requiring the facing of the seats, the greatest wear of the seat being 46/1000 of an inch. The severe service of nearly three years under the highest steam pressure would seem to indicate that this design of valve is able to meet the requirements of locomotive valve service under present conditions. This is of considerable importance, when it is remembered that the common belief that the slide valve would not meet these conditions is largely responsible for the use of piston valves on locomotives to-day.

The balancing feature of this valve remains stationary; the valve is of the gridiron type, and being the only reciprocating part, and this is reduced to a minimum in weight. The valve in full stroke overtravels the seat, but the proportions of valve travel and seat are such that the valve, even when the reverse lever is notched up, still moves to the edge of the seat. In fact, the valve travels across the seat, thus "wiping" it at every revolution of the wheels, no matter at what cut-off the engine may be worked. This insures an even wear of the face, and long continued steam-tightness of the valve. The company has been developing this valve for six years, and has during this time



JACK WILSON BALANCED VALVE.

perfected the valve in all details, so that it is giving the highest satisfaction on a large number of roads on which it is now in use. The valve can be applied to old power without material changes. The double admission and double exhaust features make a free-working engine, these features being equivalent in a way to doubling the speed of the valve, and the double exhaust relieving the back pressure quickly is a very desirable feature, especially in high-speed passenger engines.

No Boiler for 325 Lbs. Pressure.

An item has been going the rounds of the railroad mechanical press to the effect that Mr. H. D. Taylor, superintendent of motive power and rolling equipment, on the Philadelphia & Reading is engaged in the building of a new locomotive boiler capable of carrying 325 lbs. steam pressure and that an engine with such a boiler would soon be in service. In regard to that rumor Mr. Taylor writes us:

"I am surprised that you would give any credence whatever to comments you may find in newspapers. We have passenger engines carrying as high as 240 lbs. pressure, but we do not intend, in the future, to build anything carrying over 180 lbs., as we have found, from practical experience, that the cost of maintaining such boilers is beyond any gain to be derived from the high pressure."

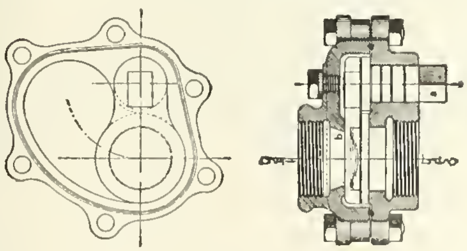
Block Signal Report.

In the report of the block signal and train control board, to the Interstate Commerce Commission, there is much interesting matter. In the investigation made by the board, particularly of the British system, it appears that where safety appliances are concerned there is not much to be learned, but the undoubted merit of their system lies in the personnel. The English signalman is better trained than the American signalman. The British officials maintain a stricter personal supervision over the employee than obtains here. A feeling of admiration is aroused for the men, the methods, the system of training and the discipline which makes possible the high degree of safety and celerity which enables railways in the British Isles to move the great volume of dense traffic as successfully as they do.

In this country the board has examined plans and specifications of 371 devices; 248 of these are block signals, cab signals or automatic train stopping devices. As many as 184 have been reported on, 168 of which are signal and train stopping devices. Only twelve of these have been considered to possess sufficient merit to warrant the board in authorizing the proprietors to make a working installation with a view to conducting tests at the Government's expense. Of these twelve devices four are now being installed. One is ready for test and the board is advised that the installation of four other devices will begin in the near future.

Everlasting Blow-Off Valve.

There has lately been put on the market a form of blow-off cock, designed for locomotive use made of solid brass. It is called the Everlasting Blow-Off Valve. It consists of two "bonnets" which when bolted together form the valve case. An orifice through the case is opened or closed by a movable partition which in a kind of way resembles an ordinary gate valve. The "gate," however, turns upon a pivot and when moved up opens the passage and when moved down closes it. In fact the action is like the movement of a semaphore signal arm of the upper quadrant system. When the disc or gate is horizontal the valve is closed, but when the disc is swung up to an angle of about 45 degs. it opens the orifices below it, by moving into a suitable space in the bonnets.



EVERLASTING BLOW-OFF COCK.

To operate the valve a wrench is placed upon the square head at *a* and pushed down, opening the valve, and reversed to close it; the effort to open it being in the 2-in. size, about 25 lbs. on an 8-in. lever against 200 lbs. steam pressure. The two bonnets are set together upon an approved high pressure gasket with machine bolts, giving quick access to the inside. The valve face, being raised, can readily be refaced by a few strokes of draw filing and the face of the disc can be refaced in the same manner, practically renewing the valve. The operating post is set tight upon a ground joint and held there by a stiff bronze spring, thus doing away with a stuffing-box. The inlet orifice is tapered just above the seat at *b;* this increases the velocity of the flow without producing much wear to the seat. It also has the effect of "syphoning" the valve clean at each operation. The clearance spaces within the valve have been made so as to avoid clogging, the valve works well discharging mud or muddy water as well as pure water. This valve is handled by the Scully Steel and Iron Company of Chicago. They will be happy to give information concerning the valve or will mail a circular to anyone who is interested enough to apply to them for one.

Museums.

It is a matter of regret that the various types of locomotives that have been built in America are not in a complete collection available to the engineering student. The best is at Purdue University, Ind. The accommodations there are already crowded, and it would be well if some public-spirited millionaire philanthropist strengthened the hands of the faculty in remodeling and enlarging the buildings and completing the collection. Doubtless the right man will come along some day and the thing will be done.

As an illustration of what can be done in another direction, the example of Mr. Francis Bannerman, of this city, might be quoted. As a collector of inplements of war he has erected a museum of colossal proportions on an extensive island in the Hudson River. The collection of military weapons and other warlike equipments rivals that of the older collection in the tower of London. Those who have not time to visit the island museum should look in at 501 Broadway. Other realms of human endeavor are crowded with rivals. In ancient and modern military goods Bannerman stands alone.

Thickness Not Determined.

There had been rather a tedious trial in which the delivery of coal to a railway was the paramount issue. A rather bumptious lawyer had badgered an old locomotive engineer grown grey in the service of the company. The old engineer had several times endeavored to explain what he understood by the expression "run of mine" coal, but had failed to satisfy the fountain of legal knowledge who was cross-examining him. "Come now," said the lawyer at length, "can't you give the court some sort of an idea what the lumps of coal were like? Were they as big as my head?" "Yes, they were," replied the engineer, "but they were not quite as thick."

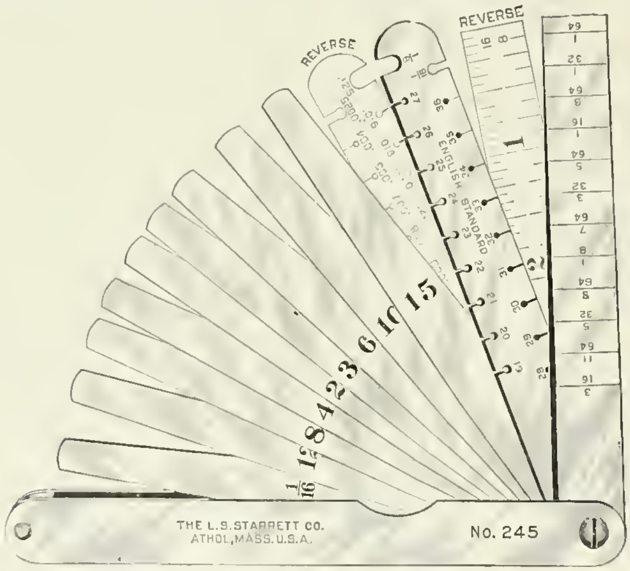
Some New Small Tools.

The well-known makers of fine machine tools, the L. S. Starrett Company, of Athol, Mass., have recently added some new tools to their already extensive list. One of these is what they call their fillet or radius gauge No. 178. This gauge is also referred to as a concave and convex gauge, and is adapted for use in laying out special forming tools, dies, etc., as well as for measuring fillets. The illustrations show a few of the ways in which the gauge can be used.

Size A has 26 leaves stamped to indicate radii by 64ths, from 1/16 in, to ¼ in., that is, of course, one-half diametric size. Diameters are from ⅛ to ½ in., varying by 32nds. Size B is made with 32 leaves, stamped to indicate radii by 64ths, from 17/64 in. to ½ in.

Another of the new hand tools is what the makers call the engineer's taper, wire and thickness gauge. It is designed for marine engineers, machinists and, indeed, all others who require such a tool in compact form. This is No. 245. The taper gauge shows the thickness in 64ths to 3/16ths of an inch on one side, and on the reverse side is graduated as a rule three inches of its length, reading in 8ths and 16ths of an inch. The wire gage, English standard, shows on one side sizes numbered from 19 to 36, with two extra slots, one 1/16, the other ⅛ of an inch, and on the reverse side shows the decimal equivalents expressed in thousandths. This gauge has also 9 thickness or feeler gauge leaves, approximately 4 ins. long of the following thicknesses: .002, .003, .004, .006, .008, .010, .012, .015 and 1/16 of an inch, all folded within the case, which is 4¾ ins. long, convenient to handle or to carry in the pocket.

The new electricians' pocket screw driver is made with a handle of hard rubber which forms an insulation for electrical workers when in the neighborhood of live wires. It is, however, useful to anyone who needs a handy pocket screw driver. It is No. 560 and is similar to their No. 557 screw driver, except in the insulating handle, which in this case is nicely ribbed so as to insure a firm grip when the tool is being used. It has four blades of different widths, any one of which may quickly be taken from the telescope handle and inserted in the end, where it is automatically locked and firmly held for use. Any or all of the blades are carried in the handle, where by a spring pressure they are held from rattling when carried in the pocket, or from being lost when the cap is off. While the cap may be readily pulled off or put on it is rigidly held from turning and frictionally held from coming off without screws. The widths of the blades are 3/32-in., 5/32-in., ¼-in. and ⅜-in.



TAPER, WIRE AND THICKNESS GAUGE.

B.T.U. Basis for Fuel Cost.

Some of the electrical traction companies throughout the country and many industrial concerns are purchasing their coal according to the calorific value of the fuel as determined by samples. What is known as the British thermal unit is the quantity of heat required to raise one pound of pure water from 39 deg. to 40 deg. F. The water works department of Cleveland has adopted this method of purchase, and Mr. W. H. Woodward, discussing a paper read by Mr. L. P. Crecelius, superintendent of power of the Municipal Traction Company, of Cleveland, said that the basis was fixed at 13,625 B. T. U., and that all coal showing a value of less than 11,500 B. T. U. was put in a class to itself. Coal showing a value of 13,500 B. T. U. was paid for at the rate of $1.79 per ton, and the price varied from that to $1.50, as the value decreased to 11,500. The analyses of the various consignments received during each month are averaged and the coal paid for according to the average thus found. Mr. Woodward further stated that his office made tests for thirteen manufacturing concerns in Cleveland during the year 1904, upon which they afterward based their contracts. These tests showed the values to be all the way from 13,500 B. T. U. to 11,500 B. T. U., with ash varying from 11 per cent. to 20 per cent.

Discipline on Railways.

Speaking of discipline at a recent meeting of the New York Railroad Club, Mr. W. J. Harahan, assistant to the vice-president of the Erie Railroad, said:

"Proper discipline is as much of an essential in railway work as it is in army work. Most railroad officers occupy the dual position of superior and subordinate. If a man carries out carefully the principles of discipline in his capacity of subordinate it cannot but be far-reaching in influencing the conduct of his subordinates, and cannot but make easier his path so far as the proper application of discipline is concerned, as example is the most effective teacher. . . . When a man has made a mistake and it is necessary to apply discipline he should always be told to avoid such mistakes in the future; to simply assert to him that a mistake has been made without showing him in detail in what his fault consists, and how to avoid it, is not taking advantage of such experience as a guide for the future either for the employee involved or for the other employees. When possible to avoid it, men should not be reprimanded within the hearing of other men as it seems only to inflame and wound them, and such reprimand thus loses a large part of its efficiency. It would seem that no one would be purposely unjust or purposely prejudiced, so that much of it must be attributed to bad judgment, or the inability to distinguish as between right and wrong on this particular proposition. I believe it can be unquestionably stated that the more contented a body of men are the more satisfactory will be their service, and proper discipline by which the men always know where they stand and what they may expect goes a long way toward making for contentment."

A remarkably fine catalogue has come from the Harbison-Walker Refractories Company, of Pittsburgh, Pa. The catalogue which has just come from the press is a standard publication on refractories and is probably the most complete and reliable catalogue ever issued on this subject, as practically all of the illustrations, cuts, etc., have been supplied by the owners of patentees of the furnaces illustrated. It is needless to say that the presswork, the paper, the illustrations and the binding of this catalogue are excellent in every particular, but the usefulness of the catalogue to those who use firebrick or other similar material is that they can find an assortment and variety of brick illustrated which practically covers the entire field. There is no form of brick arch which cannot be made by this company, and they are prepared to make brick to suit special orders if necessary. The catalogue, in addition to information about the various refractories handled by this concern, has a number of tables and other useful engineering matter which makes the book valuable in the office and the shop. Write to the company for a copy if you are in any way interested.

ELECTRICIANS' POCKET SCREW DRIVER.

FILLET OR RADIUS GAUGE.

Training Apprentices.

There is a great deal of talk among certain public men about the desirability of establishing industrial schools where young people could learn trades. The idea is very catching with many men who have had no opportunity of observing how manual skill is acquired combined with the practical experience that enables a graduate to go among other workers and earn a living. The kindergarten kind of experience gained in a trade school falls far short of real shop or factory experience and we doubt its utility as training for life work.

To us, many railroad companies are doing ideal work in preparing young men to enter the battle of life with the training that will enable them to take part as efficient leaders in railroad mechanical establishments. About sixty railroad companies in the United States and Canada have established instruction classes for the technical education of apprentices and ambitious workmen. That constitutes the most practical form of useful education and is destined to confer substantial benefits upon the railroads which have been enterprising enough to establish the schools. They are not moving blindly in the course pursued, for the Pennsylvania Railroad Company have for many years provided special education for certain apprentices and they have been substantial gainers from the practice.

Quite a notable presentation of the product of a large industrial concern has recently come to this office. "Bettendorf Bears" is the name of a very artistic booklet which the Bettendorf Axle Company of Davenport, Ia., are sending to their friends. The story is told in rhyme, and one can spend a few moments very pleasantly in reading it. The particular point brought out and which bears on the subject of car repairs is that there is no trouble with these one-piece trucks. The S. M. P. in the story found that his car troubles had grown to be practically unbearable, hence his trip to the shops of the Animal Line, and the visit was profitable and now bears fruit in his own shop methods. Some of the pictures show the removal and complete dismantling of a Bettendorf truck in barely ten minutes, which includes the removal of the journal bearings and the freeing of the wheels. Other illustrations are printed in three colors and altogether the book is unique. There is no elaborate argument introduced, just the bare facts are stated and the figures stand out clearly on each page. The two lively little truck frame bearers on the cover are artistically drawn. Raising their caps respectfully to you, they show quite a gentlemanly bearing. Write the company if you would like a copy and they will send you one. They can't bear to keep them.

Phonographic Announcements.

The fact that a man possess a powerful voice is no guarantee that what he says will be understood in a big building. This fact is often painfully brought home to the traveling public in the waiting room of almost any large railway station. There is a great difference between mere loudness and distinctness. This fact has led Mr. G. J. Bury, general manager of lines West, on the Canadian Pacific, to introduce what is probably a most welcome innovation in the matter of announcing the arrival or departure of passenger trains.

Ordinarily a man with a loud voice calls out something and the public is made aware of the fact that something is happening, but what it is nobody seems to know. Mr. Bury has substituted a phonograph for the loud man in the Winnipeg station of the C. P. R., and records have been prepared where distinct enunciation has been substituted for the usual jumble

U. P. SIGNALS DOUBLE LOCATION NEAR SHERMAN, WYO. BANJO SIGNAL INDICATES DIVERGING ROUTE.

of sounds and where a clear, steady voice supercedes a roar. The new arrangement, if satisfactory, will be repeated in the Montreal station. Mr. Bury believes that to make the traveler understand what is said is the main thing, and if this is not done, Stentorius himself would be a useless railroad employee in the matter of train announcement.

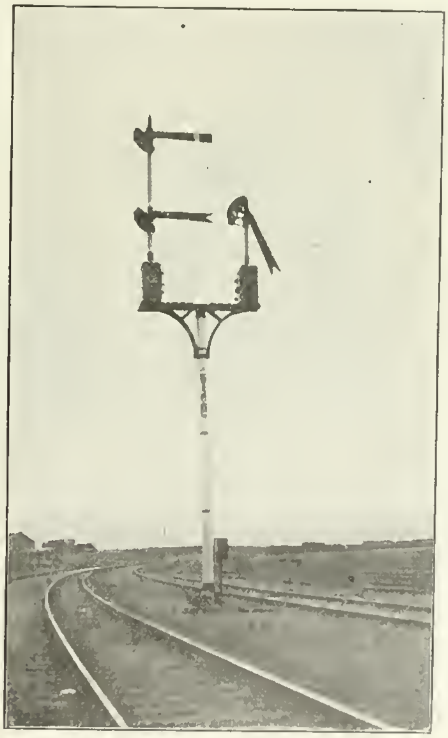
After prolonged and earnestly contested litigation between the rival claimants for the patent for the "impositive lock" which forms part of the well-known Gold Hose Coupler, a decision has just been rendered by the commissioner of patents on appeal in favor of Mr. Edward E. Gold, president of Gold Car Heating and Lighting Company, of New York. The Gold Coupler is provided with a lock which locks automatically and prevents accidental uncoupling, but yields when the cars pull apart and permits the coupler to uncouple automatically. The contest for the patent for this important invention has been a vigorous one for four years past and much testimony has been taken, resulting in the recent decision of the commissioner of patents on appeal in favor of Mr. Edward E. Gold.

The Goldschmidt Thermit Company have issued a very useful pamphlet, called "Instructions for the Use of Thermit in Railroad Shops." The pamphlet is what its name implies, and is illustrated so that anyone about to make a thermit weld may see at a glance how he should dispose his apparatus in order to expeditiously accomplish the work he may have in hand. No railroad foreman or blacksmith should be without it. The Goldschmidt-Thermit Co. of 90 West street, New York, will be happy to send a copy of this pamphlet on receipt of a request. Even if you do not have occasion to use thermit at present, it is satisfactory to know how the work is done, and this little brochure will give you the information.

Might Happen on a Railroad.

The following anecdote taken from the columns of *Success*, is instructive, and is worth considering. It exemplifies the old adage, "Like master like man":

A man was considered a general ignoramus by the concern for which he formerly worked. He came into our employ when we were obliged to take him on account of the scarcity of labor.



"DOLL" POLE, UNION PACIFIC RAILWAY HALL GAS SIGNALS.

It was not long, however, before he discovered that the firm appreciated suggestions. He proved a genius in his line and his ideas were worth a good many dollars to us. I asked him one day why he did not present some of these ideas to his former employers, and his reply makes the point:

"They treated me like a fool," said he, "so I acted like one."

Air and Steam Mixed.

Tests have recently been made on an express engine of the North British Railway. The apparatus applied to this locomotive comprises a pair of air compressors and a superheater, and by means of these an economy of fuel is said to have been obtained. The air pumps are attached to the framing in front of the usual steam cylinders, and driven through tail rods by the main pistons. Air is compressed by these pumps to a pressure equal to that of the steam in the boiler, and is delivered into a superheater in the smokebox. The steam generated by the boiler is also led into the superheater, and is consequently intimately mixed with the compressed air which is raised to a high temperature. This mixture of air and steam is used in the cylinders in the usual manner. It might seem as if the power used in compressing the air would about equal that returned by its expansion in the main cylinders, and that no economy would result. The reverse, however, was found to be the case. It has been suggested that the air thus introduced tends to form an envelope around the steam particles which checks the tendency to condensation and consequent loss during expansion. It may be, however, that this mixture of air with steam produces a superheating action which is greater than that on the steam alone.

The working of the various oppressive laws that the Interstate Commerce Commission delights to use as castigating weapons has worked havoc upon the Harriman properties, but the head of these lines does not blame the law makers. Speaking upon the subject, Mr. E. H. Harriman said lately: "The Interstate Commerce Commission was just as much at fault as the rebate payers, and the rebate takers. They failed to enforce the original act. To that extent they were at fault. Their agitation for increased power has not been, as they claim, through a desire to enforce that act, as all the action which has been taken since the Elkins act and the Hepburn act went no further than the authority given in the original."

Washing and Refilling Boilers.

The fact that the more nearly uniform the temperature of boilers is kept the less expansion and contraction there will be, especially in the firebox, is inducing the use of heated water in washing and refilling boilers. The effects so far as the reports are received are of the most gratifying kind. The effect is especially marked in the matter of much less complaint in regard to flues leaking, and the number of staybolt breakages. A very important item in saving is effected by the rapidity with which the work can be done. Locomotives are made ready for service in nearly two hours less time.

Any waste of heat means a waste of coal or other fuel, and the saving in this way more than compensates the keeping of a plentiful supply of water at the boiling point. It is claimed in some quarters that the use of heated water in washing and refilling boilers has caused a considerable reduction in the number of boilermakers employed in the repair department. Several ingenious methods are now in operation to utilize the hot water from engines and other sources that formerly were allowed to run to waste.

Automobilists are lamenting a court decision that an automobile owner who permits his machine to be hit by a railroad locomotive is liable to pay for any damage done to the railroad property. There are so many reckless idiots running about the country steering automobiles that any decision likely to increase their sense of responsibility will be welcomed by the road-using public.

The Gold Car Heating and Lighting Company of New York have recently issued a supplement to their 1905 catalogue. The supplement deals in concise and convenient form with Gold's combination Pressure and Vapor Car Heating System. This most ingenious method of dealing with the problem of heating railway cars is strictly in accord with the law of supply and demand, if we may so say. The system was very fully described in the January, 1909, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 36. In the supplement the various parts are clearly illustrated and numbered for ordering. Write to the company if you would like to have a copy of this new addition to Gould's catalogue.

Conditions of Employment Improving.

Making arrangements for preserving the health of workers and taking precautions against accidents are responded to very reluctantly by many employers of labor, but matters have been greatly improved in that respect during one century.

In the beginning of the nineteenth century children were sold like slaves to the mills in England, Merry England, and worked sixteen hours a day, including Sundays. Tea was $5 a pound and whisky 20 cents a quart. Bread was a luxury, and turnips were served as dessert. These were the good old times which some people profess to regret, when there were no health officers and none of those precautions to stamp out disease which municipal governments take to-day.

Railways in Siam.

The railways in Siam are to be reconstructed; that is, the lines south of Bangkok, and the sum of about $20,000,000 of British capital will be expended in the work. This comes about owing to a treaty lately signed by Great Britain and Siam whereby the latter country voluntarily ceded the States of Kolantan, Tringano and Kedah to the British Government. These States will be administered with the Malay Federated States. This treaty adds about 15,000 square miles of territory to the British Empire and is practically the outcome of a desire on the part of the people of those States for better government. Railways nowadays play a leading part in many international negotiations. The railways which are to be reorganized and put in good shape are to be controlled by a new department quite distinct from the present railway administration of Siam, which is administered by Germany.

Phosphoro Bronze is the trade name which has been given to a special brand of bronze, intended to meet the conditions of extremely hard service to which locomotive and car journal bearings are subjected. The New Era Manufacturing Company, of Kalamazoo, Mich., are prepared to furnish castings of this metal, in regular sizes, of the M. C. B. type of bearing; or upon request they will furnish, free of charge, their formula for making the Phosphoro Bronze. Red or yellow bronze mixtures deteriorate somewhat during the process of remelting, and while melting does not injure Phosphoro Bronze as badly as it does phosphor bronze, the best results can only be obtained by pouring the castings from the original mixture. For this reason the New Era people do not sell Phosphoro Bronze in the form of pig metal, but prefer to furnish the formula to those who do not desire to purchase castings. A neat little circular on the subject can be had by writing to the New Era Company.

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ailway AND Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

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Electricity on the N. Y., N. H. & H.

The New York, New Haven & Hartford Railroad, which connects New York with many of the towns and cities of the New England States, does not possess a terminal in New York City, but shares with the New York Central Railroad the latter's terminal at Forty-second street and Madison avenue, known as the Grand Central Station. The New Haven road also uses the Central's tracks as far as Woodlawn, N. Y., where its own tracks begin.

During the early part of 1905, the engineers of the New Haven, began the formation of plans for the electrification of a portion of the road nearest New York City with a view of extending it later over the entire road. Prior to this, however, the New York Central had installed a 600-volt direct current electric service on its lines to a point some distance beyond Woodlawn, and was already operating its local and express trains by electricity. This fact made the problem that confronted the engineers of the New Haven road doubly difficult because the electrical equipment that they adopted for their road would also have to be operated over the Central's tracks from Woodlawn to the Grand Central.

In consideration of this condition and in view of the future operation of the entire road by electricity, the engineers adopted the single phase alternating current system as being the one best suited to their purpose. Briefly, the electric system adopted consists of supplying a trolley wire direct from the generators

NEW YORK, NEW HAVEN & HARTFORD RAILROAD TRAIN PULLED BY TWO ELECTRIC LOCOMOTIVES.

with single phase alternating current at a frequency of 25 cycles and a potential of 11,000 volts. The trains are drawn by electric locomotives which are capable of operating on either direct or alternating current. Each locomotive is equipped with four single-phase alternating current compensated series motors. The locomotives collect the current from the overhead trolley wire at 11,000 volts; step down the voltage by means of transformers carried on the locomotives, and then apply the power to the motors. The track is used as the return circuit.

In the January, 1909, issue of RAILWAY AND LOCOMOTIVE ENGINEERING the difference between direct and alternating current was described, and also the term frequency was explained. A direct current generator supplies current from one terminal and it flows back to the generator through the other. A direct current machine only supplies one circuit. If an alternating current generator has only two terminals and supplies current to a single circuit it is called a single phase alternator, and its two terminals tap the armature winding at points that are 180 degs. apart. A two-phase alternator has four terminals and can supply two entirely separate circuits. It is in reality a machine having two single phases, and its four terminals tap the armature winding at angles of 90 degs. A three-phase alternator has theoretically six terminals, but practically only three because each terminal supplies current to one circuit and acts as the return for another circuit, thus doing double duty. The three terminals tap the armature winding at angles of 120 degs. and the alternator is capable of supplying three entirely separate circuits with power. If only one phase of a two or three-phase alternator is used at a time a single phase current flows in the circuit.

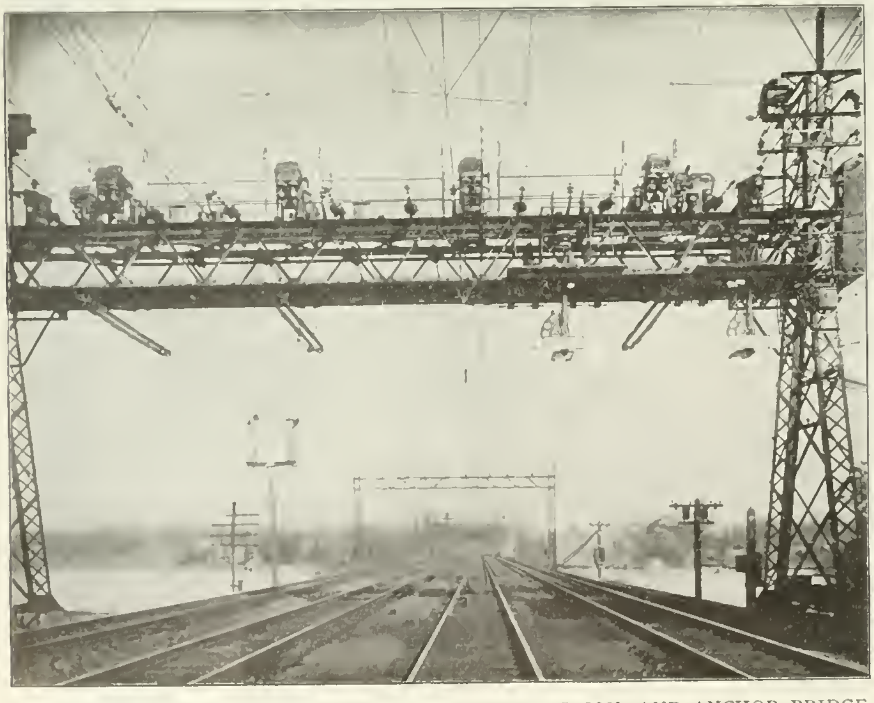
The plan for the electrification of the New Haven road was the work of Mr. W. S. Murray, chief electrical engineer; Mr. E. H. McHenry, vice-president, and Mr. C. Townley, who acted as consulting engineer. These three gentlemen and those who were associated with them, deserve great credit for the skill and faithfulness with which they carried out the work. The New Haven is the pioneer in trunk line operation by single phase alternating current. They have met and solved many difficult problems and have blazed a trail for others to follow.

The New Haven road hauls the trains by means of electric locomotives from the Grand Central Station to Stamford, Conn., a distance of 33.48 miles. At Stamford the electric locomotives are uncoupled and steam locomotives draw the trains to their destination. The electric locomotives operate from New York to Woodlawn, N. Y., a distance of 12.03 miles, on the tracks of the New York Central and are supplied with direct current at 600 volts from the third rail. From Woodlawn to Stamford, a distance of 21.45 miles, the electric locomotives of the New Haven road operate on their own right of way, and are supplied with single phase alternating current at 25 cycles frequency and a potential of 11,000 volts.

THE POWER STATION.

The power station is situated between Woodlawn and Stamford, Conn., at Cos Cob, a distance of about three miles from Stamford. This location was chosen with a view to the future extension of the electric service. The power house is equipped with four generators of the three-phase type. Only a single phase, however, of these generators is employed for the railway work. The reason for installing three-phase generators, and then utilizing only a single phase was the fact that the New Haven road has other fields for three-phase power.

The single-phase rating of each generator is 3,750 kilo-volt amperes (1,000 volt-amperes). They are two-pole machines and run at 1,500 revolutions per minute, giving 25 cycles per second. The voltage generated is 11,000 volts. The generators are driven by Westinghouse-Parson's steam turbines. These generators feed current directly to the trolley line, and as the track is used as the return circuit, one of the terminals of the 11,000-volt generator is permanently grounded. The insulation is made very heavy because of this fact. The machines are protected by oil circuit breakers and impedance coils (impedance coils were described on page 351 of the August issue in the 1908 Volume of RAILWAY AND LOCOMOTIVE ENGINEERING). On any railway short circuits are liable to occur and are more or less frequent. A "short" on an 11,000-volt line produces an enormous rush of current. There are no transformers or converters such as are usually found on electric roads to prevent and dampen these current surges. The circuit breaker that was at first supposed to protect the generators proved inadequate to stop the current surges. With the addition of the impedance coils which lessen the value of short circuit current surge, the breakers have successfully performed their functions.



OVERHEAD TROLLEY DOUBLE CATENARY CONSTRUCTION, AND ANCHOR BRIDGE.

OVERHEAD LINE CONSTRUCTION.

As was stated, the trolley wire is supplied with 11,000 volts. The road is from four to six tracks in width and as many as twelve tracks are spanned at certain points; therefore the overhead construction is of a very substantial character. Supporting bridges are placed at intervals of about 300 feet and from these the wires are suspended. There are two types of supporting bridges, the intermediate and the anchor bridges. Every two miles the anchor bridges, as they are called, are placed. These are heavy structures at which the trolley lines are dead-ended. They also carry circuit breakers, and a footpath across them is provided. The intermediate bridges are of much lighter construction and serve simply to support the cables. All the bridges are built of steel and are set in concrete foundations.

The trolley or contact wire is suspended 22 ft. above the ground and is heavy enough to carry the entire current. Two extra feeders, however, are provided which run from Woodlawn to Stamford. The trolley or contact wire is held practically horizontal and is suspended by what is known as the double catenary construction. Two steel wires which support the trolley wire proper are suspended from the bridges by heavy insulators. These steel wires are connected together and to the trolley wire proper by means of triangular supports or hangers which are placed about ten feet apart and vary in length with the amount of sag. The result of this type of suspension is that although the steel wires which support the contact wire sag about six feet, the contact wire itself is maintained in an almost horizontal plane. This type of construction also greatly increases the strength and stiffness of the line. The trolley or contact wire originally adopted was a number oooo hard drawn copper wire. After a period of only a few months operation it became clear that this wire was rapidly wearing out. Breaks were occurring in many places and where the wire was not actually broken it was so badly kinked that it was almost impossible to operate the electric locomotives. It was then decided to suspend from the copper contact wire a new contact wire of steel, of the same size as the copper wire.

(Continued on page 213.)

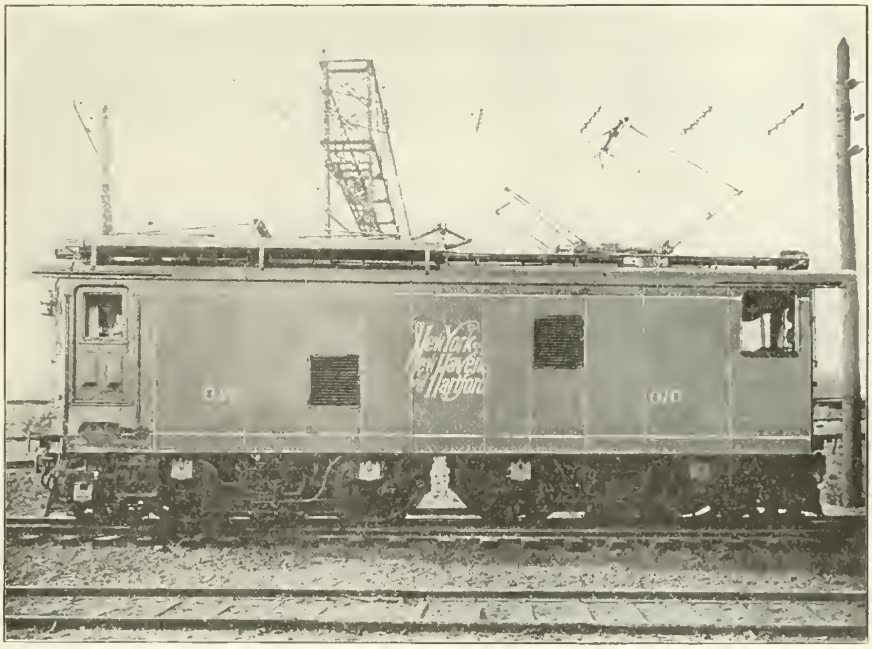
Safety Valves.

The general practice in deciding upon any particular size of safety valve for a given locomotive boiler has been rather "off hand," in the opinion of Mr. F. M. Whyte, general mechanical engineer of the New York Central Lines. An interesting discussion of the whole safety valve question recently took place at a meeting of the American Society of Mechanical Engineers, in which Mr. Whyte's paper was the first one presented. In our April issue, page 143, we gave a synopsis of the paper presented by Mr. P. G. Darling.

Mr. Whyte pointed out that size, that is, the diameter of the valve, had been taken solely as an indication of the capacity of the valve, while the lift of the valve had been practically ignored, and the lift was a very important factor in determining the capacity of the valve. Capacity really means the quantity of steam at a given pressure which can be discharged by the valve in a given time. The determination of the capacity of a valve, Mr. Whyte believed, was not a difficult matter, but he said it was important to know how much steam in a boiler is to be released and in what time it must be got rid of. In other words it is necessary to know, in the case of any boiler, what work it is going to give the valve to do.

From this it is evident that some method should be adopted for expressing the capacity of a valve in pounds of steam at certain pressures. With any kind of steam generating plant it ought to be quite sufficient if those immediately responsible for the quantity produced, and for its use, know what is available. In stationary and marine work this is generally true, and steam gauges can be placed in view of those who should know what the pressure is at any time. In locomotive practice it is otherwise, and the usual way for a fireman to let the train crew know that there is plenty of steam to get up a grade with is to have the engine blowing off.

Two devices at least are available to give the indication at a less cost to the company than the full open roaring pop. One is the simmering valve, which opens slightly for two or three pounds about the normal maximum and then opens full. The other is the use of a small pilot valve which opens at two or three pounds below the pressure for which the working valve is set. In the first method the material and shape of the valve have to be considered, and the second means the added expense of providing the small valve. In locomotive practice the total valve capacity has not been as great as the maximum steam generating capacity, for the reason that using exhaust steam for the forced draft it happens that when the throttle is shut the forced draft ceases and the steam generating power of the boiler is reduced. It therefore appears that a valve equal to the full steam generating capacity of the locomotive boiler is not necessary, but the relation of valve capacity to steam generating capacity is a most important relation to determine accurately.



LATEST TYPE OF N. Y., N. H. & H. ELECTRIC WITH PONY TRUCKS.

Mr. F. J. Cole, consulting engineer of the American Locomotive Company, referred to English practice concerning locomotive safety valves. Not much advance had been made in the United Kingdom in determining the relation of valve capacity to steam generating capacity. In that country a safety valve is looked upon to a great extent as an instrument for indicating that more water should be put into the boiler or that less fuel should be thrown on the fire, and locomotive runners are severely censured for allowing steam to blow off.

Referring to the general question Mr. Cole said: "Usually in urging a locomtive to its utmost capacity up a steep grade, the boiler is taxed to its utmost capacity, and the water is frequently lowered so as to just show in the lower gauge cocks when the summit is reached, so that when steam is shut off the water is still further lowered, and it is usually necessary to put on the injector and fill up the boiler, and this same practice has often to be resorted to when an engine is shut off suddenly on account of a signal unexpectedly displayed, or from other causes. Furthermore, locomotive boilers are so carefully constructed with a large factor of safety, ranging from 4 to 5, that they have ample margin of strength, and there is no cause for alarm even if the pressure goes temporarily 20 to 25 lbs. above the normal blowing-off point.

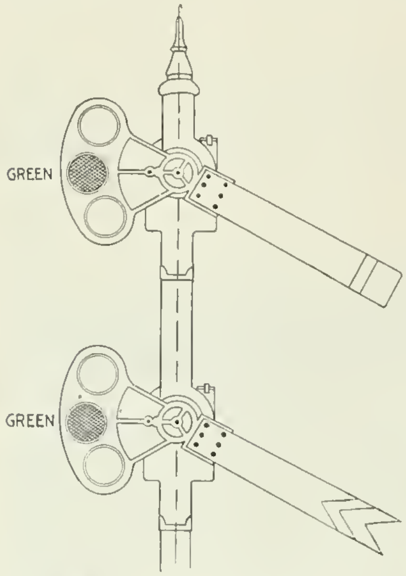
Mr. Cole advocated a thorough investigation of the subject looking to the formulation of definite and authoritative rules for the application of safety valves to locomotives. He also called attention to what we may call the effective heating surface of boilers. Firebox heating surface is much more efficient than tube heating surface, and water tubes for supporting a brick arch are more efficient than ordinary boiler tubes. Also the firebox ends of ordinary tubes are more efficient than the smokebox ends of the same tubes. The evaporation per square foot of heating surface in locomotives is a variable quantity, ranging from 6 lbs. or even less, to 15 or 16 lbs. per square foot of heating surface per hour.

Jamie Bryan has a small farm near the entrance to a railroad tunnel with a single track where trains are rushing in and out day and night. On being asked what attracted his eye so much to the entrance to the tunnel he replied: "I'm expecting to see a train miss the hole some day."

THE APPEAL OF THE RAILWAY SIGNAL

The Absolute or the Modified Red?

There were three systems of signaling discussed at the recent Chicago meeting of the Railway Signal Association. Two of them, however, appear to have certain reciprocal relations, which may be briefly summarized as follows. The first system

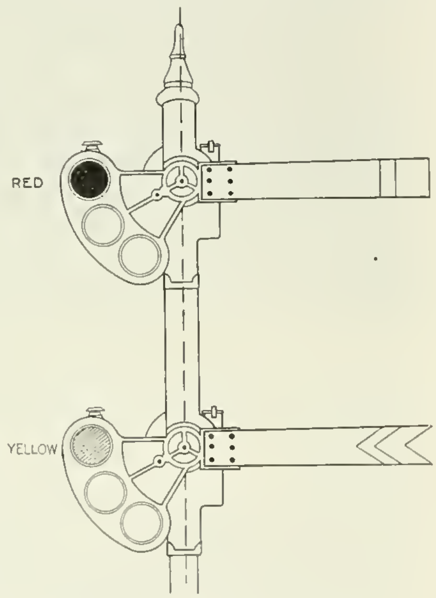


AUTOMATIC. TWO BLOCKS CLEAR, PROCEED. NO RED LIGHTS.

extends the principle of interlocked signals to the automatic type, and the other system seeks to introduce the automatic principle into the interlocking type. The idea of both these systems is to produce a greater degree of uniformity in railroad signals and to enable the uniform system to be developed as occasion demands, but to maintain as far as possible consistency of aspect at all times.

Before describing the systems discussed by the signal engineers one may glance at a typical example of the ordinary automatic signal, and then at one of the interlocking system. The usually installed automatic signal shows two arms on one post. The upper, the home, and the lower, with fish-tail end, the distant. When two blocks ahead are unoccupied, both these signals stand at clear. As the train enters the first block both assume the horizontal position, showing a red home light above and a yellow caution light below. When the advancing train enters the block next ahead the home arm on the first post, drops to clear and displays a green light, and when the train has passed out of the second block the caution arm drops to clear, showing a green light. The night indications may be one of three. Two green lights in a vertical line indicate two blocks ahead are clear. A green above and a yellow light below indicate only one block clear. A red above with yellow below indicate stop before entering the block. The principle here involved is that in any combination of lights permitting the advance of the train, no red light is shown. When a red light is displayed it indicates stop.

The principle used in the interlocking system may be exemplified by considering a post bearing two signals similar to the automatic, but without the fish-tail end on the lower arm. These signals stand normally in the stop position and each displays a red light. When one of them is lowered to the clear position, showing green at night, a route is indicated. The upper signal governs the main line or high-speed route—the lower governs the diverging route. If the route set up by the towerman is for the main line, the upper arm drops to clear and displays



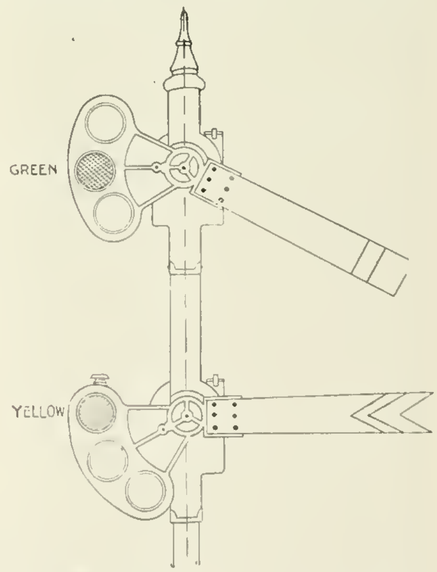
AUTOMATIC. ONE RED LIGHT, STOP.

green, while the lower or diverging route signal remains horizontal and shows a red light. The simplest interlocking indications at night are these: two red lights in a vertical line bars both routes and enforces a stop. One green light above and a red below indicate the main line route is set. A red light above and a green below shows that the diverging route is the one which the train must take.

From these two examples it is plain that the fundamental difference between the interlocking and the automatic signal arrangements as at present used on railways, consists in the fact that in the automatic signal family no red light is ever passed without being preceeded by a halt. One might almost say that is the religion of the automatic system. In the interlocking system, however, two reds are required for a halt, and always one or other of them is passed when the main line or the diverging route is used. The red light, which is then passed or disregarded, stands for the track upon which the advancing train will not go. It, therefore, bars, not the movement of the train, but the right to enter one of the two tracks ahead. An interlocking red may therefore be passed when its complimentary light has given the permission.

These two systems, the automatic and the interlocking, used on the same railroad have, nevertheless, an element of inconsistency about them which the Railway Signal Association seem to be desirous of eliminating. One may imagine the automatic family of signals insisting that a red light can only be obeyed by a stop, and the interlocked system contending that with more than one route at its disposal, a partnership of red lights is desirable where the permission to proceed is given by a change of one of them and the forbidden route is barred by the other light remaining red.

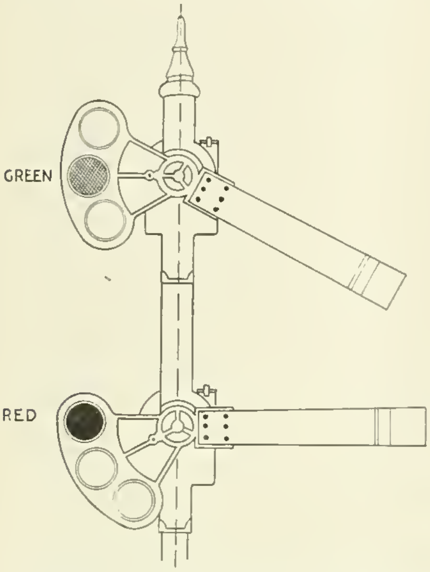
One of the systems discussed at the Chicago meeting seeks to produce a uniform system by applying the interlocking principle to automatic signals. This system makes use of the three-position, upper quadrant signal, and with this arrangement an interlocking home signal post has three arms on it, the upper one for the high-speed route, the second for the limited speed or diverging route, and the dwarf signal below for slow speed, or



AUTOMATIC. PROCEED. ONE BLOCK AHEAD CLEAR. NO RED LIGHTS.

drilling movements. At night three red lights show in a vertical line when all the routes are blocked. When one of the routes is set up the light for that route changes from red to green or yellow according to whether two or one block ahead is unoccupied. The lights of the other routes not to be taken by the train show red.

In the application of this principle to the automatic system, one upper quadrant three-position signal is used. According as green, yellow or red appears the enginemen know that they have in front of

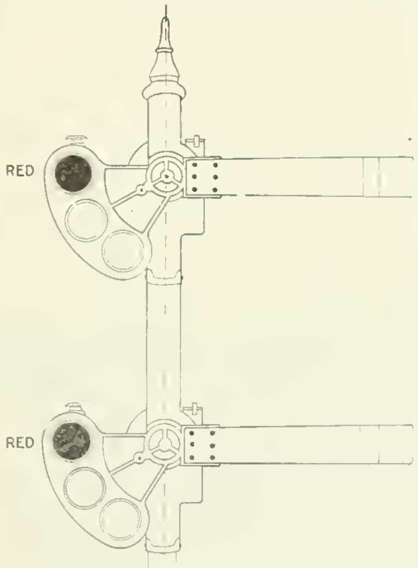


INTERLOCKING, PROCEED, HIGH SPEED ROUTE CLEAR. ONE GREEN AND ONE RED.

them, two, one, or no blocks clear. There is, however, a permanent red light displayed lower down on this post. This light is not set exactly below the upper light, but slightly to one side, thus giving a diagonal line for the centers of the lights. This indicates that the signal so equipped is an automatic one. The presence of the permanent red light is for the purpose of recognizing the signal if the upper light had gone out. With green light above and permanent red below, the signal would indicate two blocks ahead clear. With yellow above and permanent red below, one block ahead would be clear. Two reds would call for a stop, as in the interlocking system, and where proceed is indicated the permanent red modified by the presence of a green or yellow light above it would still maintain the interlocking principle where the permission to proceed is given on the high-speed route by the change of the upper light. If the upper light was out the unmodified permanent red would compel a halt. And if the permanent red light was out a stop is also imperative.

The other system introduces to a certain extent the automatic system upon the interlocking. This arrangement also uses the upper-quadrant three-position signal, with three arms on one post. The upper one indicating one route by the vertical, and the other by the upper 45 degree position, the horizontal position indicating stop. The lower signal with three positions faithfully reproduces the condition of the upper signal next ahead on the route set up. The dwarf signal below stands for slow-speed movements. This system in the automatic form has two signals on one post, the upper giving three home indications, viz.: normal speed, limited speed and stop, the lower or distant reproducing the indications of the home signal on the block ahead. This system, however, while introducing the distant indications on the interlocking signal, yet permits the passing of a red signal, modified by other lights on the automatic post, as in the other system.

We have here endeavored to briefly put before our readers the efforts so far made to produce a uniform automatic and interlocking system, and we invite engineers and firemen, traveling engineers and others interested in the subject to give us the benefit of their experience and their views on the question of the red



INTERLOCKING, BOTH ROUTES BLOCKED. TWO RED LIGHTS. STOP.

signal. We may call it the question of the absolute or the modified red signal. What do you think about it?

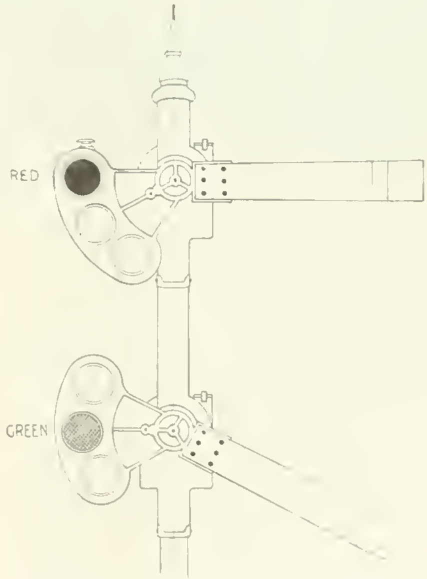
Statistics of the P. R. R.

Some idea of the Pennsylvania Railroad system, and its vital relationship to the territory which its lines traverse, may be gathered from figures in the annual Record of Transportation Lines, issued by the Maintenance of Way Department of that system. It shows that on December 31, 1908, the Pennsylvania Railroad controlled a total of 11,235.81 miles of line and 23,077.41 miles of tracks. The total population of the Union January 1, 1909, according to the estimates of the Governors of the respective States, was 89,770,126, and that of the States through which lines of the Pennsylvania Railroad run 44,936,522, or almost exactly half the total. Reports compiled by the company show that during 1908 the Pennsylvania Railroad carried 142,676,779 passengers, an average of over three trips for every inhabitant of the States through which its lines run. Likewise, during the year the company handled 334,429,541 tons of freight over its 23,977.41 miles of track, an average of nearly eight tons to every person living in the States it serves.

During the year the various companies also carried 3,551,361,095 passengers one mile, which means that the company carried an average of 316,098 passengers over every mile of its line. The total freight conveyed one mile aggregated 29,353,934,199 tons, or an average of 26,216,319 tons passing over every mile of the company's line. Of the total trackage of the system, 14,089.76 miles are east of Pittsburgh and Erie, while 9,887.65 run west of those points. During 1908 the total trackage was increased 405 miles, while 155 miles were added to the total mileage. The system's lines now have 3,326 miles of double track, 784 miles of triple track, while for 564 miles four tracks have been laid. There are also 8,065 miles of sidings owned by the various companies.

American Cars in China.

A trial run was recently made on the South Manchurian Railway with some new American first-class cars, says the *Railway Magazine*, which are to be used for its express trains connecting with the Chinese Eastern at Changchun. The train, consisting of a first-class day coach, two sleepers, one dining car and one baggage car, took a party of invited guests, leading Japanese officials, foreign consuls, foreign and Japanese merchants and press men, to the station of Chinchou, a run of about



INTERLOCKING, PROCEED, DIVERGING ROUTE CLEAR. ONE RED AND ONE GREEN.

one and a quarter hours from Dalny. After an hour's stay the return trip was made at a speed at which the express trains are to be run, an average of about 30 miles an hour, reaching a maximum of about 45 miles per hour, so that the guests were able to observe the behavior of the cars under actual service conditions.

AN EXCURSION TRAIN ON THE GLASGOW AND SOUTHWESTERN.

A Scots Excursion Train.

The train shown is an excursion on the Glasgow & Southwestern Railway on its way from Glasgow to the Ayr races. Note how this Scots locomotive adheres to the smoke preventing ordinances.

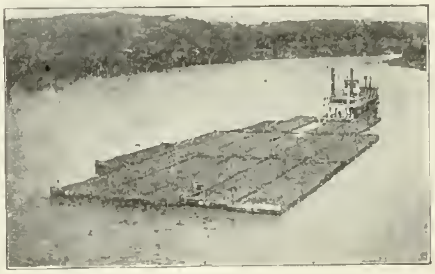
Reprimanding on the Sly.

A most sensible remark was made by Mr. W. J. Harahan in his paper on "Discipline on Railways," when he said: "When possible to avoid it, men should not be reprimanded within the hearing of other men, as it sems to inflame and wound them, and such reprimand loses a large part of its efficiency." This reminds us of the ways of a Western general manager who was one of the most popular men in his day and generation. He was familiar with every detail of railroad work and never hesitated to express himself with vigorous fluency when he found anything going in the way he considered wrong. When an individual was at fault, however, or was guilty of any serious blunder, this general manager would pour the vials of his wrath into the delinquent's ear, but always did the reprimanding on what the men called the sly. He would go behind a box car or call the man into a private room or car and roast him to his heart's content. But never a word of reprimand was uttered where others could hear what was said. The consequence was that the worst abused man would depart from the tongue lashing, feeling that he deserved much more than he had received and ready to swear that the general manager was the finest gentleman in Illinois.

Not only does the man not lose self-respect, but the fact that no one else has heard the rebuke, entirely eliminates any exhibition of bravado or resistance to authority. In fact, on one occasion, a boy with a sense of humor, who had been rather severely dealt with quietly and alone by his superior, went out into the roundhouse after he had been "called down" and gave it out that he had been brought in for consultation and his advice on certain matters had been asked for by the boss. His altered behavior in the thing complained of was noticed.

Red in the Face.

A correspondent who sends us the photograph of a tow of coal barges on the Ohio River calls the picture "Our esteemed competitor," meaning the flat bottomed stern-wheel river steamboat always seen in pictures of Uncle Tom's Cabin. The picture is near Wheeling, W. Va., and our friend remarks: "He has enough fuel in this tow to make a few 'battleships' look red in the face up a hill."



OUR ESTEEMED COMPETITOR.

Righteous Indignation.

Jacob DeCou, of Chanute, claim agent for the Santa Fe Railroad on the Southern Kansas division, recently received a letter from a friend in New Mexico, who is the Santa Fe claim agent there. Inclosed was a copy of a complaint recently turned over to him. It follows:

"Dear Sir—Did your injineear tell you he has kiled too couse belongin' to me, he said he would tel you and the konduckter too thay kiled them tonite as they cam acros the road at my plais where I have got a crosin and when I put my crosin in you sed you was puttin' up a fense on eche side of the rode that wud keap criterz from gettin' kiled you put up a hel of a fense too cafs broak it to kindelin' wood a ouar after your fense gang went down the road—youre injinear ott to be fired he knos there is a graid thare and he comes down thare hel bent every nite—the couse he kiled was yerelin heffers—brand bar J bar swallow fork on rite ear and left ear underhacked—I want the money for the couse my criterz is all I have on urth to live on and if your injinear can kil one every time he gets drunk all I say is this United States has gon to the devvil the couse will be 50 dolers hoping you are wel."—*Kansas City Journal.*

Glasgow & Southwestern Railway.

SHOPS NEAR TROON.

The railway company were compelled to build these works in an out-of-the-way locality, instead of enlarging them at Kilmarnock, owing to the rapacity of the feudal landlord, Lord Howard de Walden, on whose ground the Kilmarnock works are built.

The land was originally given to the ancestors of the present landlord by a King of Scots, who was establishing the feudal system brought to Great Britain by the Normans.

Note the heather covered moor in front of the works.

GLASGOW AND SOUTHWESTERN RAILWAY SHOPS AT TROON.

General Correspondence

General Foremen's Association.

Editor:

I notice in the February issue of Railway and Locomotive Engineering an article written by Mr. A. B. Glover, roundhouse foreman, Pere Marquette, at Toledo, Ohio, replying to an article by Mr. E. F. Fay, president International Railway General Foremen's Association, published in your November issue and also some remarks in your March issue by Mr. Llewellyn Morgan, engine house foreman, Boston & Maine, at Fitchburg, Mass. If you will allow me a short space in your paper for a few remarks on this subject I will be very thankful to you for the courtesy.

I, being a charter member and an officer of the General Foremen's Association, do feel that these men are giving Mr. Fay unjust criticism where they state that he is just now extending them the glad hand of membership into our association and also that they had never heard of such an association before. For the benefit of these gentlemen I will state a few facts that will be of interest to them as well as to a lot of other foremen. When we were organizing this association the general master mechanic of the Pere Marquette wrote to our secretary requesting him to send him a lot of application blanks for charter membership so that he could give them out to his foremen on his road. We appreciated this very much. These blanks were sent him and we know that he distributed them, for we received a number of members from them, and if some new foremen have come into the service since that time they may have been overlooked. Is it not a fact that all the railroad papers or most of the leading railway journals have given publicity to the fact that there was such an association and announced our meetings from the very start? The railway associations are not invitation affairs, but are open to all foremen that are eligible. It seems to me that if these gentlemen were reading the leading railway papers they would have known something of it long ago and would have written for information the same as others have done.

Furthermore, we had three charter members from the Pere Marquette and I am free to say that there are many of the foremen in the New England States who knew of it, for we had one charter member from Eastern Maine and several in New Brunswick, Montreal and all through New York State. The charter members of the Pere Marquette were from this country and from Canada. A number of our charter members and new members coming in are roundhouse foremen. It is a fact that Mr. Wm. E. Ferrell, roundhouse foreman on the Big Four, at Delaware, Ohio, was a charter member and was elected fourth vice-president. Is this not clear enough to these roundhouse foremen that we solicit their support?

I have been a roundhouse foreman for a number of years and think one association should do for both. There the roundhouse foremen can stand up and tell the general foremen their troubles and they will have to listen to them. Furthermore, there are but few general foremen who have not been roundhouse foremen, and as stated by Mr. Fay, I cannot see where anything would be gained by the formation of a roundhouse foremen's association. I am quite sure the foremen on the Pere Marquette and in the New England States who are members of our association do not approve of this move.

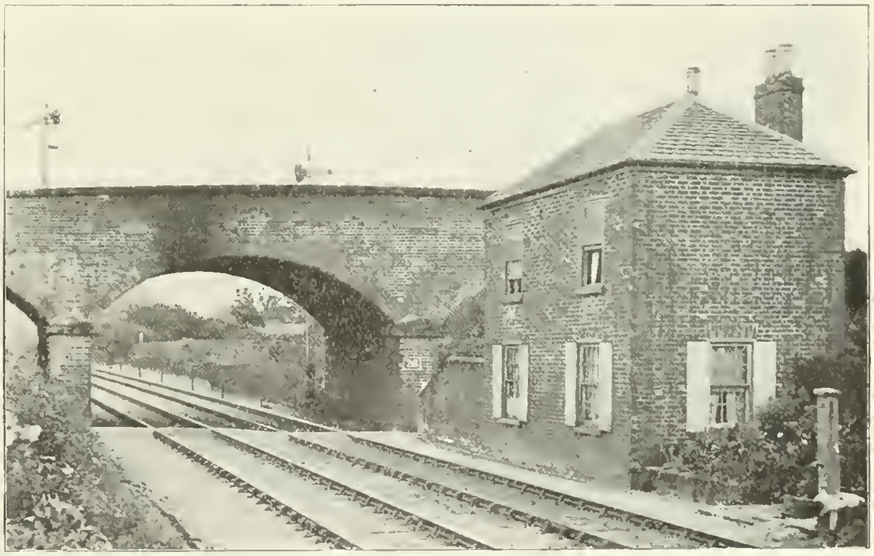
In my opinion there are enough railroad organizations throughout the country that are taking the foremen from their duties, and if there are to be many more organized I am very much afraid that the managements of these corporations will put their foot down on them and then we have harmed ourselves. Mr. Morgan suggests that it might be well for the International General Foremen's Association and the New England Locomotive Foremen's Association to get together and discuss the question with the view of the formation of a national association open to all locomotive foremen. Our association is more than a national association; it is international and its scope is far wider than his or the kind he suggests.

Now I hope that I have made this clear enough that the roundhouse foremen can see that President Fay is not just now hanging out the sign of welcome to them to become members of our association, but this sign has always hung up and we solicit their support at all times. If Mr. Glover doubts these remarks I trust that he will communicate with the general master mechanic on his road who will set him straight on this question. I certainly think that it is not the foremen mentioned in this letter who are agitating this move, but that it is some railroad paper. Now I would like to see Mr. Glover and Mr. Morgan in our convention hall at the Lexington Hotel, Chicago, Ill., on June 1st, where our convention will be held, and they will not only get the glad hand of President Fay, but will get the glad hand of all of the members of our association. Now, as before stated, I hope I have made this clear enough to all foremen throughout this country and Canada who are eligible to our association that we solicit their support.

G. W. Keller.

General Foreman Norfolk & Western.

Portsmouth, Ohio.



MERRYLEES PASSENGER STATION ON THE LEICESTER AND SWANINGTON RAILWAY. OPENED 1832. NOW USED AS A PLATELAYER'S HOUSE.

[Would it not be a good move for the General Foremen's Association to appoint a committee to confer with a similar committee from the New England Locomotive Foremen's Association and talk over the whole question.—Editor].

Good Spring Persuader.

Editor:

Putting in driving springs is a task not desired by many, and as moral persuasion is not available, physical or main strength and awkwardness is more frequently used. I enclose herewith a "spring persuader" of known merits, which will induce a spring to go in place when other devices fail.

It consists of a square yoke, with a slotted top bar to fit ends of yoke. Sizes A and B made according to requirements of job or bottom rail of frame. Yoke is made from 1¼ x 3-in. iron. Top bar from 2 x 2-in. iron. B. O. HOGHEAD.

Wheeling, W. Va.

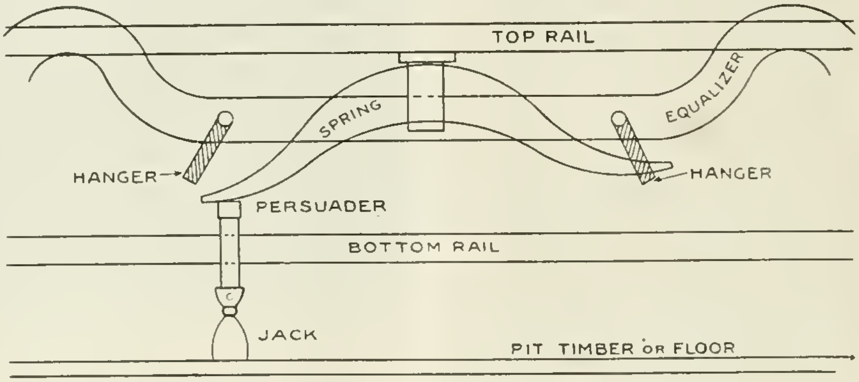
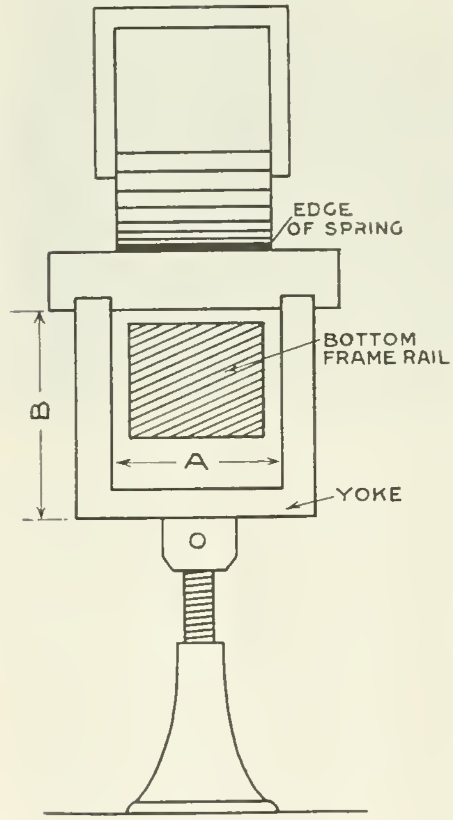


FIG 2

GENERAL VIEW OF SPRING PERSUADER AT WORK.



SPRING PERSUADER.

Ancient Train Resistance.

Editor:

The Journal of the Franklin Institute, Vol. 1, 1826, contains a description of a new "locomotive carriage," from which the following is taken: "The medium speed of the engines and carriages upon the level parts of the new line is about six miles per hour, while the speed upon the level of the Hetton line seldom exceeds three miles and a half per hour. This improvement is to be attributed to the increased size of the boiler, and to the employment of larger running wheels.

"The weight of the locomotive engine is about seven tons. Having a cylindrical boiler, ten feet long and four feet diameter, coated with wood to prevent the radiation of heat, and placed in a horizontal position with the fire inside the cylinder and the flue two feet diameter leading straight through the boiler to the chmney. There are two working pistons moving perpendicularly, in cylinders of nine and a half inches diameter, which cylinders are principally immersed in the boiler and the pistons are packed with hemp.

"The steam acts at a pressure of thirty pounds upon every square inch of the boiler; and the safety valve is loaded to the extent of fifty pounds. The induction and eduction valves of both cylinders are worked by rods connected to eccentrics below and the alternating power of the pistons is communicated by parallel motions and sweep rods on each side to cranks upon the spokes of the running wheels; the range of the cranks is two feet, the running wheels being four feet diameter with flanges on their edges.

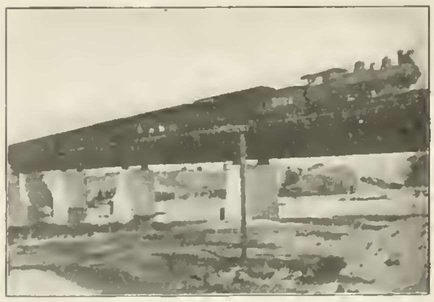
"The water is supplied to the boiler by pipes leading from a cistern carried in a cart, and attached behind the engine; the same cart also carries the coals for feeding the furnace, which consumes about three-quarters of a ton in going a distance of fifty miles. Certain parts of the line of road rise half an inch in a yard; this the power of the engine overcomes readily, with twenty carriages attached to it, each containing about two tons weight, and proceeds, as above said, upon an average at the rate of six miles per hour. On the first day of opening the railway a train of thirty loaded wagons and a carriage with passengers was drawn along some part of the line at the rate of fifteen miles per hour; but this was doubtless a mere experiment. The ordinary speed is not likely to exceed six miles as above stated; but this speed and the employment of a plain rail is certainly a considerable improvement upon the locomotive carriages near Leeds, which travel upon a rack or cogged rail, and not faster than two and a half or three miles per hour."

The grade mentioned is about 1.4 per cent. At 20 lbs. per ton for each one per cent. grade, the resistance would be 28 lbs. per ton account grade only. Taking the gross weight of the carriages at 2½ tons each, the 20 carriages, exclusive of the engine, would require 1,400 lbs. draw-bar pull to overcome grade, without friction. Assuming the engines to have been double acting the usual tractive power formula indicates a tractive power of about 1,340 lbs. (This is allowing the usual 15 per cent. for drop in pressure, wire drawing, etc., and in this case, engine friction). Evidently the cars had ball bearings or other frictionless devices since the grade resistance overcome, without counting anything else, such as car journal or flange friction, was already greater than the power of the engine.

Or, assuming that the two tons weight of carriages was gross, the grade resistance was 1,080 lbs., which, subtracted from the tractive power of the engine, leaves 260 lbs. available to overcome friction, etc., or in this case 6½ lbs. per ton, which is about as low as any one dares put it even nowadays.

From all of which it appears that our ancestral yardmasters put just as much "behind" an engine in proportion to its power as the best of them do nowadays. Or maybe this bit of history considered in the light of heredity explains what we have all wondered at, in which case we mustn't blame the yardmaster, as he was born that way.

Urbana, Ill. E. W. FISKE.



BRIDGE AT FORT STEEL, WYOMING.

Tonnage Rating and Efficiency.

Editor:

It has long been recognized that any machine will show a maximum efficiency only when working to its full capacity, no more, no less. If it is overloaded it is wasteful of the energy supplied to it; soon shows distress in some of its parts and frequently fails altogether. On the other hand, if it is not loaded to full capacity, its internal losses are large in proportion to the work it is called upon to do.

In rating the capacity of a machine for maximum efficiency, it is also necessary to take into account its physical condition and the elements of deterioration. It would be manifestly unfair to give a machine a rating when new and in good condition, and expect it to work at its rated capacity and do it efficiently after it had become half worn out. This principle applies to all machines, but more especially to machines which do not receive their energy by mechanical means.

To determine the hauling capacity or tonnage rating of a locomotive at any given time is not a difficult proposition, but to determine the most efficient rating for an engine or class of engines to cover an extended period of time is not so easy and involves many uncertain conditions.

There are many questions of operation which will influence the rating of engines operating over a given division, as, for example, is it more economical, from an operating standpoint, to rate an engine on its ability to take a train over the steepest grade on the division unaided and without danger of stalling, or is it more economical to base the rating on a level haul with a helper engine over the heaviest grades?

The time consumed in getting over the division is also an important item, more especially in the case of "Q-D" or "Red Ball" freight, most roads scheduling such trains almost as fast of their passenger trains. Engines assigned to these runs are given less than full rating in order to reduce failures and delays to a minimum. It is generally agreed that in hauling dead freight trains a speed of eighteen to twenty miles per hour on the level will give the best results and a minimum speed of six miles per hour on the heaviest grades, with an average speed of ten miles per hour for all grades should be maintained.

Since the greatest effort to move a given tonnage will be on the heaviest grade, tonnage rating should be figured on a speed of six miles per hour as a basis.

Tonnage rating may be obtained theoretically by calculation or proved from the dynamometer car record, the weight of the train being known, or it may be obtained from a combination of both.

In calculating tonnage rating it is necessary first of all to have an accurate profile of the division which will show the ruling grade, the maximum curvature, if any, on the ruling grade and also the grade and curvation of any portion of the road on which the engine may be called upon to start the train from rest. We must also know the tractive power of the engine and its total weight in working order; also weight of tank loaded.

The formula for tractive power is usually stated as $T = \frac{d^2PL}{D}$

where T=tractive power in pounds at drivers.

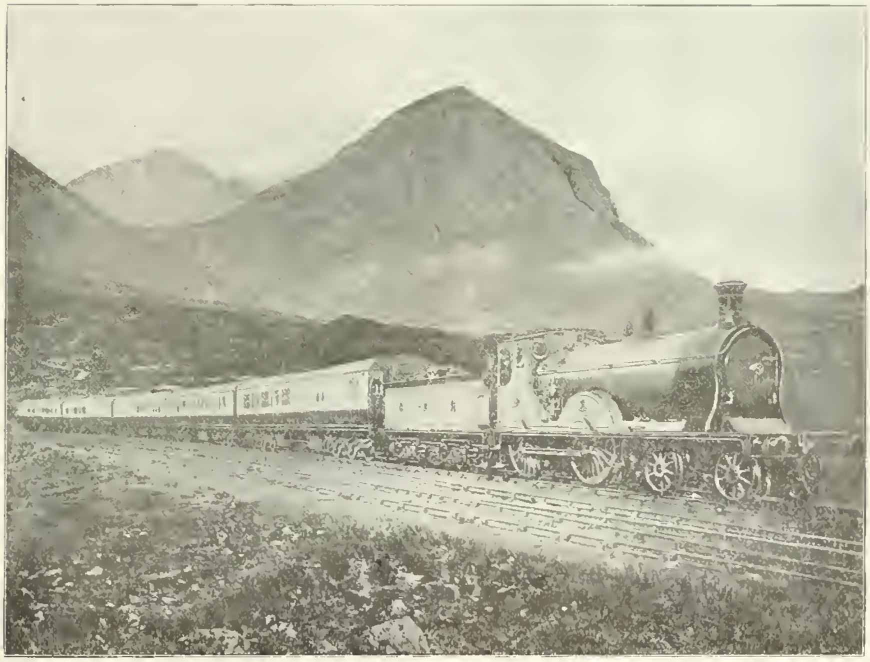
d = diameter of cylinder in inches.

P = mean effective pressure in cylinders.

L = length of stroke in inches.

D=diameter of driving wheels in inches outside tires.

The value of P may be taken as 85 per



CALEDONIAN RAILWAY EXPRESS.

cent. of the boiler pressure at slow speeds and long cut-off.

The available drawbar pull at back of tank is equal to the tractive effort T, less E, the total resistance of the engine and tank which consist of the machine friction and rolling resistance of the engine, the rolling resistance of the tank and the grade and curve resistance of the engine and tank. Resistances are all figured in pounds per ton moved and the values are known very accurately from tests with the dynamometer car under all sorts of conditions.

The total train resistance R is made up of the grade, curve and rolling resistances and may be regarded as a form which must be balanced, or rather over-balanced, in order to keep the train in motion.

The rating of the engine will be equal, then, to the drawbar pull S in pounds, divided by R, the total train resistance expressed in pounds per ton of train, or to state it another way,

Tonnage rating =

$$\frac{S}{R} = \frac{T-E}{R} = \frac{\frac{d^2PL}{D} - E}{R}$$

In this equation it is evident that tonnage rating is a function of both T and R, since they are both variable quantities. R varies as the grade and curvature, while T depends for its value on $\frac{d^2PL}{D}$, or tractive effort. Now d, L and D are constant for any given engine, while P is a variable depending upon the steaming capacity of the boiler and the distribution of the steam to the cylinders.

It is evident that if an engine is rated correctly and it stalls on the ruling grade when R becomes maximum, it is deficient in power, while, on the other hand, if P has a value which will make T equal to the adhesion and the engine fails on the ruling grade then the rating is too high or else some unusual conditions exist.

The value of E is constant as far as the drawbar pull is concerned and remains practically the same whether the engine is working to capacity or running light. The same is true of the resistance of the tank, the radiation losses, wages of the crew, etc., which explains why an engine cannot be operated with maximum efficiency when handling light tonnage.

It is the practice on most American roads to sacrifice engine efficiency in order to handle a larger volume of business per unit of power. Owing to conditions of construction and operation peculiar to itself the locomotive is exceedingly wasteful when compared with units of the same capacity in stationary practice. These losses invariably increase with the drawbar pull whether it is increased by maintaining high speed or in moving heavy tonnage.

Twelve pounds of coal burned per square foot of grate surface per hour is considered fairly good in stationary practice, while with the locomotive 120 lbs. is about the average and 200 lbs. is not unusual in case of overloading. Results of many tests have shown that only about one-half the power developed in the cylinders is available at the drawbar. This loss undoubtedly increases with both the speed and load.

In the investigation of unusual conditions of train service, as well as in the solution of tonnage problems, the dynamometer car is almost indispensable on any well-equipped road. By its use and by methods of comparison and elimination the effects of high winds, open car doors, dragging brakes, bad weather, etc., on train handling may be ascertained very accurately. As to failures in train service directly chargeable to the locomotive itself a great many can be avoided while some cannot. Accidents to an engine's machinery or the bursting of a flue cannot be foreseen or prevented, although they may indicate poor workmanship, inspection or careless handling.

Long hours on the road tend to cause failures, and whether the overtime is the result of overloading or a slow steaming engine it demoralizes train movement and is a costly proposition.

In the engine proper the valves may be "out" so badly that they cannot control the distribution of the steam to the cylinders and a great deal of steam goes out of the stack without contributing to the power of the engine. Leaky piston rings and rod packing have the same effect.

Perhaps the greater proportion of engine failures are chargeable to the boiler, and if we consider the rocking, the jarring, the almost constant forced draft and the thousand and one things which the locomotive has to contend with, it is small wonder that there are failures. Add to all this the fact that it is very often neglected in the matter of repairs, we can hardly blame it for "laying down" once in a while.

Many master mechanics work on the theory that so long as an engine is kept in condition to handle her tonnage, they have done enough without bothering about the possibility of failure or the question of efficiency. A locomotive leaving the roundhouse for a trip with valves and packing blowing, mud ring leaking and a dozen plugged flues is just about as efficient as a man going to work on crutches and one arm in a sling.

It certainly would not be out of place for the "old man" to apologize to an engine crew when called upon to take an engine out in this condition.

About ninety per cent. of the heating surface in a locomotive boiler is in the flues and about 3 per cent. of the total is represented in one flue. Ten flues plugged and as many more choked with cinders makes a loss in heating surface of 6 per cent. into a probable loss of 6 per cent. in boiler efficiency, for while it is true that restricting the flue area will intensify the heat in the flues remaining, still it interferes with the proper distribution of the draft through the grates and causes improper circulation of water around the flues, with possible overheating.

It has been demonstrated by experiment that a coating of scale 1/16 in. thick will cause a loss in fuel of 13 per cent. It would be interesting to know how many master mechanics could claim this saving or any part of it.

UNION PACIFIC SIGNALS AT DALE CREEK, WYO. EXAMPLE OF DOUBLE LOCATION.

It is well to remember that engine efficiency alone does not constitute the whole saving, but it greatly lessens the probability of failure in service. Engine failures in service are rather expensive and often exceedingly dangerous, especially when a large volume of business is handled over a single track.

An engine crew may be struggling desperately to get a heavy train out of the way of the Limited, only to have the engine fail at the last moment, and if their train is not well protected there is likely to be a mix-up.

In keeping motive power in a high state of efficiency some sort of systematic record is of first importance. For example, the ton-mile is often used as a basis for comparing the performance of engines of the same class or one class with another. Coal burned, oil used, maintaining cost, etc., per ton mile of any engine may be compared with any number of others, and conclusions drawn accordingly.

A. W. VESTAL,
Danville, Ill. C. & E. I. Ry.

How About the Belpaire Box?

Editor:

The boiler is the most important part of a steam locomotive. Numerous attempts have been made to increase its efficiency or prolong its life. The result of these endeavors has frequently been the introduction of some new type of firebox. At the present time, it would appear that the radial stay type, which can be built with either wide or narrow grate, is the most popular in this country. The crown bar type is also used to some extent. A consideration of the Wootten type is unnecessary in this letter, as the latter is merely suitable for burning anthracite and certain other kinds of coal. The various forms of "freak" fireboxes may also be eliminated, as they are of no importance.

There only remains, then, the Belpaire type to be considered. Those who are acquainted with locomotive development in England are aware of the favor with which this style of firebox is regarded on several of the prominent railways in that country. Upon the Great Western Railway, for instance, the Belpaire firebox, in conjunction with what is known in England as a "coned" boiler, has become standard practice. The handsome ten-wheel type passenger engines, which haul the fast trains operated by this line between Plymouth and London, are worthy of careful study. When one considers the excellent service rendered by these locomotives, it becomes difficult to understand why the Belpaire firebox has not attained greater popularity in the United States. For it must be remembered that, with the exception of the Great Northern Railway and the Pennsylvania Railroad, practically no system of any consequence in the United States has used this form of firebox extensively.

The fact that the Great Northern Railway has used the Belpaire firebox for at least sixteen years in a section of this country where operating conditions, particularly in winter, are very severe, furnishes ample testimony to the efficiency of this style of firebox. The writer does not mean to imply that the radial stay firebox should be abruptly abandoned, but begs to submit the suggestion that, in view of the frequency of firebox troubles on some roads in this country, it would be advisable to give the Belpaire type a fair opportunity to prove its value. Also, that in designing a firebox for burning bituminous coal, it is well to remember that a narrow grate often gives more satisfactory service than a wide grate. While it is true that large grates are necessary on the enormous Mallet compounds and other huge freight engines, it is equally true that very wide grates are neither necessary nor desirable on many classes of locomotives The troublesome consequences of ignoring this fact are too well known to require mention here.

Another English railway upon which the Belpaire firebox has been conspicuously successful is the Great Central. The character of the passenger service maintained by this line between Sheffield and London is sufficient recommendation for the locomotives which make it possible.

In view of the facts presented, it would be interesting to know by what process of reasoning the indifference displayed by the majority of American railroads toward the Belpaire firebox may be explained or justified. It is possible that some motive power official can be induced to give a little information on this point. If so, now is his chance to come forward.

ARTHUR CURRAN.

New York, N. Y.

Railroad Service in the Argentine.

Editor:

I am a driver on the Buenos Aires Great Southern Railway and am stationed at Ingeniero White, better known as Pueblo Bahia Blanca, "the Liverpool of the South." Formerly, I was an employee of the Caledonian Railway at Perth and peruse with interest the various views you publish of that system from time to time.

Perhaps a few details of our conditions of service may interest you. The locomotive men are promoted by time service; by that I mean that after one year's satisfactory service in one class he is raised to the next highest. There are 6 classes, and a driver can reach first class in seven years. A sixth class driver gets $165, or pesos paper each month (about equal to $60 gold U. S. A.) and a first class driver $240 paper.

The hours of labor are: Main line passenger trains, 8 hours per day; freight trains, 12 hours per day, with 12 hours rest when away from home shed and 18 hours rest when at home shed, with an additional 36 hours once a month, and when outside home shed on trains which are away for more than 12 hours the men are paid 12 cents Argentina as expenses for every hour until they return to home shed. On pilots the hours are 8 per day in most cases, 6 days' work and one day rest.

C. B. & Q. FREIGHT. ENGINEER E. B. THRALL AT THE FRONT.

I do not at present have any photographs of the various classes of engines, but shall endeavor to obtain you some if you should desire them.

When reading your leader, "Labor and Capital Reasoning Together," the sentence "One of the worst iniquities that workmen of all classes, railroad men included, suffer is the difficulty of collecting damages for injuries caused by the fault of the employers" recalled to my mind (but in a different sense) the remark of a driver who had been punished for causing a collision between two trains, and of course running the company into considerable expense.

SOUTHERN PACIFIC ROUNDHOUSE AT DUNSMUIR, CAL.

Now this driver's opinion was that the company want cheap labor, and the way to secure it good, yet cheap, is to reduce the pay of the men wherever they can get the pretext, and that, in a way, they welcome the mistakes the men make, and indeed want men to make mistakes so that they may be reduced a class or two. I do not take this view of it at all, but believe that it pays a company to give good wages to competent men, who by their skill and attention to duty often avert serious loss to their employers, both in hard cash and prestige, and that drivers who by carelessness, want of skill or willful disobedience of orders or rules cause loss have lost the confidence of their employers, are punished by reduction in wages in preference to dismissal and that this reduction represents their value to their employers at the time.

JAS. A. ROBERTSON.

Bahia Blanca, F. C. S.

Locating Gauge Cocks.

Editor:

That water seeks its level is a fact well known by everyone. This is a law of physical science that has several practical applications. In locomotive contract and repair shops this principle is used to advantage in determining the proper location of the gauge cocks and water glass in relation to the crown sheet. Of course these attachments may be located by other means; but where accuracy is essential, and time an important factor the scientific method should be used.

The necessary apparatus simply consists of a rubber hose, the inside diameter of which is about one-half inch, with ordinary glass tubes fastened on the ends. (Water gauge glasses serve the purpose admirably). The glass tube should fit firmly in the hose for several inches. The hose and glass tubes are filled with water when ready for use.

In locating the top line of crown sheet on the back-head of boiler the top of one glass tube is held at the highest point of the crown sheet, while the one at the other end is held at about the point where it is evident the top line of the crown sheet will come, as shown in Fig. 1. Now by slowly moving the glass tube up and down, the water level will come to rest at the exact point, horizontally. It is needless to say that the boiler must be plumb before the operation is begun; the reason is self-evident.

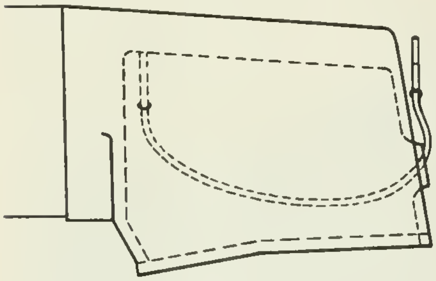


FIG. 1. WATER LEVEL METHOD.

A chalk mark is put on the back-heads at the point so obtained. Since the crown sheet is usually about three-eighths of an inch thick, it is necessary to locate the true level at that distance above the chalk line. It is advisable to place a horizontal row of center punch marks along the level last obtained. Some roads have adopted the practice of placing crown sheet markers on this line. This marker is made of cast iron, with the inscription, "top line of crown sheet" cast on it. It is held in place by two half-inch studs. Fig. 2 shows a marker of this sort.

Opinions differ as to the height that the bottom gauge cock should be located above the top line of crown sheet, but three or four inches is considered good practice. The middle gauge cock is usually placed at a point where the normal water level should come. Most crown sheets have a slope from front to back of about 3/8 inch per foot. Hence the highest point is at the back flue sheet.

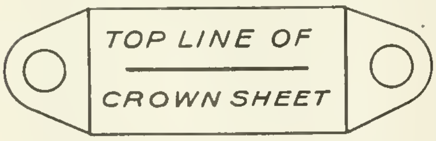


FIG. 2. DESIGNATION OF HIGHEST POINT.

Ordinarily the plumb-bob level or spirit level is used to level the frame and cylinders of new engines or engines undergoing repairs. With the advent of the Mallet articulated compounds these tools could not be used for such work, due to the fact that the frames of the high and low pressure engines are not rigidly connected. Before the furnace and waste bearers can be laid off it is necessary to have the high and low pressure engine frames on an exact level in relation to each other. In this case the simple contrivance of hose and gauge glasses can again be used to advantage. The top rail of frames make a convenient point to level from. Thus what, on the face of it, seems a difficult problem is made easy.

W. SMITH.

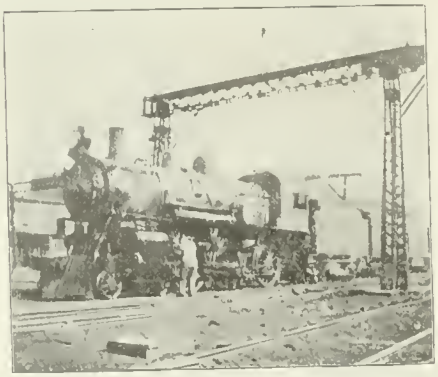
Newark, Ohio.

The Middle West Heard From.

Editor:

In reading the pages not only of your valuable magazine, but of railroad literature in general, the scarcity of articles on the railroads of several sections of our country, notably the great Middle West, has greatly impressed me. The papers now appearing in RAILWAY AND LOCOMOTIVE ENGINEERING prepared by Mr. James Kennedy fill a long felt want with me, and I am sure many others in this section are more than ordinarily interested.

In your March paper Mr. Kennedy mentions the high grade of work performed by the Missouri Pacific at Atchison, Kan., although the shop space is very limited and the roundhouse is over forty years old. He hopes there will be a new roundhouse and a new machine shop when he again visits the West. It may interest you to know the Missouri Pacific has prepared plans for the enlarging of the Atchison shops, work to begin early in the spring, and estimated to cost $100,000.



FRISCO 4-6-0, OIL BURNER.

I am enclosing several snapshots of engines hauling trains in and out of Kansas City. The Frisco 4-6-0 is a good type, hauling fast express trains. It burns oil, has Walschaerts valve gear, wide firebox, and was built in 1908. The other 4-6-0 is a "Katy" engine, used on the Texas Mail and the Katy Flyer. The 2-8-0 engine is pulling a northbound Rock Island "drag" on a track just east of the Union Depot train sheds. The depot is shown in the background. Hoping to hear from other friends of the Middle West and wishing your valuable magazine continued success.

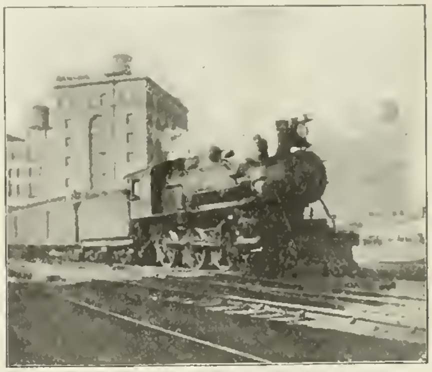
CLAUDE V. MCMILLAN.

Kansas City, Mo.

Boring Rocker Boxes in a Lathe.

Editor:

I enclose herewith sketch of tools as made on the Kentwood & Eastern, at Kentwood, La., for boring out rocker boxes in the lathe, instead of doing the work in a boring machine. The tools consist of one piece of cast or wrought iron A, thickness over K to be 1/16 in. less than the thinnest locomotive frame, so that rocker boxes of larger engines can be bored on same tool; they should be some 3 or 4 ins. wide and 10 ins. long. Two sleeves or bushings, D, of same length, to be placed between A and the faceplate as at L, with 4¾ ins. or 47/8-in. bolts, for fastening both A and rocker box.



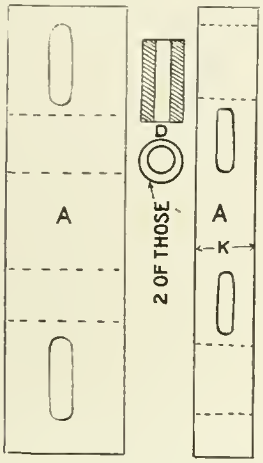
ENGINE OF THE KATY FLIER.

The rocker box after being bolted together is placed on A, and end B is set for boring; no attention is paid to end C, as it will follow in line. The box must, however, be forced against A at E; this will insure box to be square when placed on frame after boring. When boring two boxes from one engine A is placed only once, as it will be in line for the other box; in this way both boxes will be bored with center line the same on both sides of engine, which is important if link hangers are the same length.

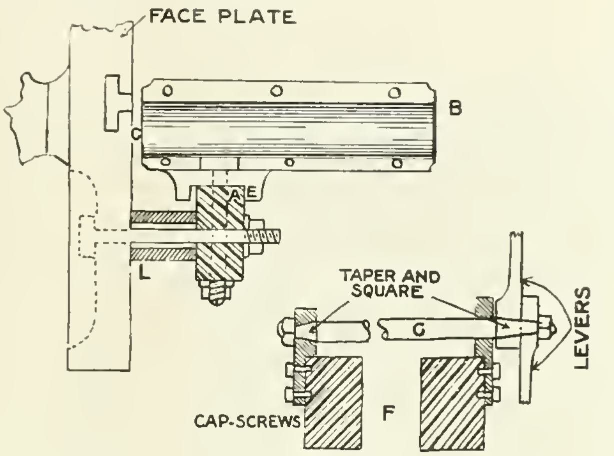
2-8-0 ROCK ISLAND "DRAG."

Sketch F shows arrangement for

cylinder cock rigging, which may seem to be rather crude, but it is working all right. One of our 75-ton mogul engines turned over some time ago, and among other repairs needed was the cylinder cock rigging. To get the old rigging out, it was found necessary to cut rod G in three pieces with a hack-



BORING ROCKER BOXES.



CYLINDER COCK RIGGING.

saw. Those rods and levers are usually put together with taper pins, which are hardly ever tight, caused lost motions and are hard to get at. Holes in old levers were plugged up, and made with taper and square holes, and ends of rods same way. They are easy to put together and take apart, and have no lost motion. The construction is practically the same as a brake staff on a car.

C. Wilhelmsen.

Kentwood, La.

They say that a need has nowadays only to be known to be supplied, but some urgent needs seem to escape attention. What is the most urgent need that waits unsupplied for locomotive service is a question we present to our readers. Let us hear from you. Please do not guess on automatic stokers.

Official's Act Appreciated.

Editor:

Please find enclosed item from a Janesville paper of April 3 in regard to one of your old subscribers, an old English general foreman and an employe of the Chicago, Milwaukee & St. Paul Railway since Oct. 16, 1851. I understand he has been a subscriber to your paper for the last twenty years, consequently I thought you would like to publish the enclosed item in consideration of it being something unusual for a president of a corporation like the Chicago, Milwaukee & St. Paul Railway to give it a thought to make one of his old employes a visit in case of sickness, but this is in accordance with the many kind acts President H. J. Earling has done to his men. Hoping you can find space for it.

"A. J. Earling, president of the Chicago, Milwaukee & St. Paul, came up on 131 this morning in his private car on his way to attend the funeral of J. B. Stickney, former agent at Mazomanie, the oldest agent of the road. While here he gave orders to hold the train and took a carriage to the home of J. C. Fox, who has been unable to leave his house for some time, and who is also one of the oldest active employes of the road. The visit delayed 131 for over twelve minutes."

Thos. F. Fox,
Loco. Engineer, C. M. & St. P.

Janesville, Wis.

Old Hinkley Engine.

Editor:

Enclosed I send a picture of the old *Stoneham,* which will be recognized by many who remember the old B. L. & N. engines. Her engineer, Edward Haggins, who is not now living, is seen standing in the cab, and her fireman Jim Dudley, is on his seat at the window. The *Stoneham* was a good specimen of the Hinkley of her day, early in the 70's. She ran on passenger trains between Boston and Woburn, Mass., for many years. Woburn at that time was the terminus of a two mile branch from Winchester. She was a handsome and efficient engine, weighing in the neighborhood of 30 tons.

B. L. & N. ENGINE "STONEHAM," BUILT AT THE HINCKLEY LOCOMOTIVE WORKS.

I remember when a school-boy I went several times to South Boston and watched with eager curiosity the work in the erecting shops at the Hinkley works, which could be seen from the street. When, as sometimes happened, I was given a short ride in the Woburn yard on the *Stoneham* or on the "Lawrence" by engineer Pettingill I was about as happy as a boy could be.

J. M. Kimball.

Hingham, Mass.

Proper Lubrication Pays.

Editor:

Much has been said about economical supplies of oil issued to locomotives. I have given this matter much consideration in the past five years not only to find out the real results, but to satisfy my own mind which was best in the long run. After a careful series of tests I am now fully satisfied which is the best, and I believe I can demonstrate the fact. I realize this proposition is one of long standing, and will come before some of our best mechanical men of this period. I wish to say in the beginning, the price of valve oil is 48 cents per gallon, and coal is $1.50 per ton.

We take one of our large engines, new, out of the shop, 22 x 30 ins., and put this engine on a tonnage drag approximately 1,200 tons. Of course, the tonnage is regulated by the grades, and if you give all your engines are capable of drawing on different divisions is equivalent to same should it be 1,000 or 2,000 tons. We start this engine out on a division of 145 miles. We probably have 45 or 50 cars in the train. We will give this engine a very small amount of valve oil, just barely enough to get in with by using it very sparingly, taking considerable of the small allowance to keep up train line pressure by a fast running pump. The engineer on this engine starts out figuring on his oil. He knows how close it will be and probably he sets his lubricator so sparingly the first thing he knows he has struck a hill with dry valves.

He goes up this hill, just barely making it, and before half way up his reverse lever has found its way near the corner, and as we all know each notch calls for more coal and before the hard pull is reached, down in the corner she goes. With 200 lbs. of steam pressure licking every particle of lubrication from the valves and cylinders at each stroke which has full boiler pressure he just manages to get over this hill, but there are many more staring him in the face yet. The cream is in his engine yet. Clean fire, lots of sand and plenty of steam. He opens up on his lubricator feeds slightly to be ready for the next hill and goes up all right, but says "I can't feed this way on account of shortage of oil." He very soon finds himself in the same old rut, on the next hill, and so on.

On arrival at the terminals he gives the engine the last drop of oil, and comes in with very dry cylinders and valves, knowing he has to start out with the same allowance again. I say this engine, under these conditions, burns four more tons of coal than it should have burned, which will cost the company $6, or if you think I am too high I will cut it in two and call it $3. This first cost does not include the damage that would happen to this engine in a short time working under these conditions. We will presume this engine makes one single trip over the division each day and will burn in excess two tons, which amounts to $21 per week, as against one gallon of valve oil, which is worth 48 cents. This does not include the worry and figuring which is required of the man in charge.

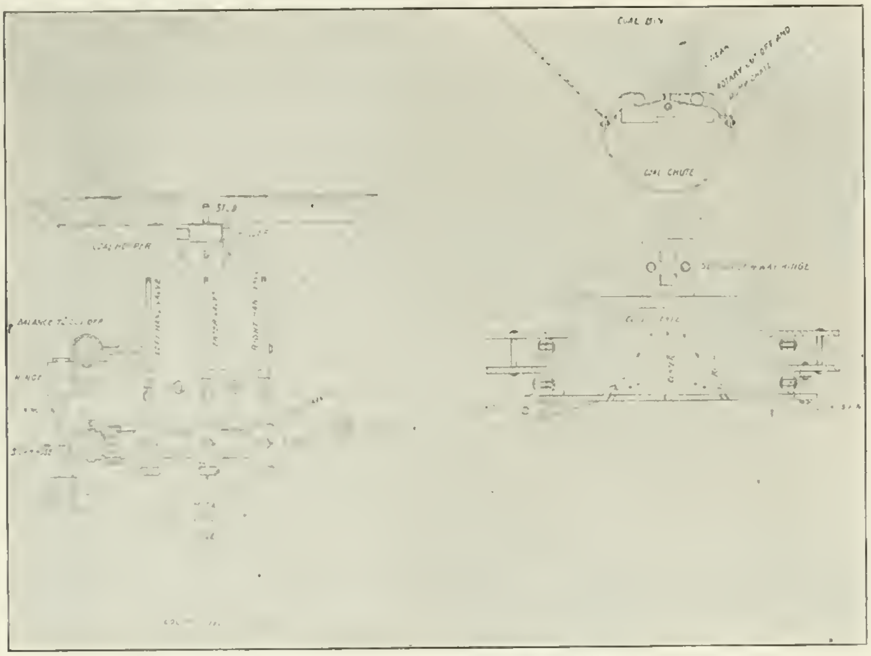
Take these figures which I base on actual experiments and figure them up for a month on one engine and then a year, and then count all the engines on your division, and you will have quite a sum of money involved. Sixty days later we see this engine in the back shop, cylinders bored and probably bushed, valves faced, etc. This is not the only one, but there are numbers of her kind running along by her waiting for the same pit. Now, according to my notion this is where money goes, time and loss of power.

I fully realize the fact that it is quite a nice thing to look at the monthly oil reports and see where engines run so many miles on a pint of valve oil. This division beat that one, etc., but look at the engines and back shops. I venture to say the division giving the proper allowance of oil can show you a nice lot of cylinders and valve seats, good engines, good work, no overtime. Look at the coal reports, look at the shop work on your scantily supplied division. It will tell its own tale. I make this plea for saving dollars and cents for the company. I will start the same engine and crew out under same conditions; engine perfectly lubricated and go up against these hills and do her work perfectly, responding to every notch given, using steam expansively, saving money every mile. I treat the locomotive as a human being. It takes so much air, so much sleep, so much rest, so much food, etc., for the human body to exist; without either we feel it, and in time it tells on us, and in the long run overcome us.

I say with the locomotives it takes so much water, so much steam, so much attention, so much lubrication, so much work to keep the machine going. The absence of any of these necessarily results in something expensive. The old adage which I know is quite familiar to all, "a stitch in time saves nine," applies here. When your engines are in good condition keep them so. Give them a reasonable amount of oil necessary to do their work, watch the little things before they become big things. Your men will take more interest, your engines will do better work, stay out of the shop longer, make more mileage and make more money for the company.

ROAD FOREMAN OF ENGINES.

Louisville, Ky.



END VIEW AND PLAN OF MARSHALL MECHANICAL STOKER.

Marshall Mechanical Stoker.

A mechanical stoker for use on locomotives has recently been designed by Mr. J. J. Marshall of Shelburne, Ont., Canada, a brief description of which we are able to give through the courtesy of Mr. Marshall himself. The fuel space in the tender is fitted with steel doors, so as to close off the fuel entirely from what might be called the shoveling plate. At the bottom of the fuel space there is what the inventor calls a cut-off and dump grate. Normally coal of small size passes through this grating by gravity and falls into a chute below. The grate can be turned by the movement of a lever so as to entirely shut off the flow of coal, or in case large lumps block the grate it may be turned so as to pass them through by dumping.

The coal chute below this grate introduces the coal into the base of a spiral conveyor which is pivoted to the floor of the tender by a four-way hinge. The conveyor stands at about an angle of 45 degs., the upper end resting upon a coal hopper placed against the back head of the boiler. The conveyor being hinged below and resting on a friction roller on the edge of the hopper secured by a link is free to adjust itself to the oscilations of the engine and tender. At the upper end of the spiral conveyor, and secured by a suitable bracket, a small engine is placed. This engine drives the conveyor, and is fed with steam from the boiler through a wire-wound hose.

The hopper and the stoking mechanism is attached to the firebox door, and a vertically sliding gate, operated by a lever, opens, restricts or closes the flow of coal to the fuel-plate, which lies in about the centre of the fire door and extends a few inches into the firebox. The passage of coal from the tender to the fuel-plate is as follows: It drops through the cut-off and dump grating in the tender into the chute below; from there it slides into the conveyor and is carried up past the upper edge of the hopper. From the hopper it flows by gravity under the coal gate in large or small quantity, according to the amount of opening provided by the gate. It thus reaches the fuel-plate, and is ready for distribution in the fire box. The fuel space doors in the tender and the upper side of the conveyor are provided with poke holes which enables the fireman to get at lumps with a bar or pick when necessary.

When the coal is on the fuel-plate it is blown into the firebox by jets of steam, three in number, the right-hand one blowing coal to the left of the box, the left-hand jet blowing coal to the right of the firebox and the centre jet blowing coal toward the centre of the firebox, the direction of each jet being governed by a nozzle or orifice set permanently in these directions. Steam for these jets is supplied by an articulated steam pipe, the joint of which is in line with the hinge bolts of the door frame, carrying hopper, fuel-plate and operating valves. In case it is necessary to open the fire door for any cause, the conveyor can be secured by a chain from the fuel space doors in the tender, so that it does not then bear on the edge of the hopper. The door can then be opened and swung back without breaking the steam joint of the supply pipe.

The steam from the boiler required to blow the fuel into the firebox enters a valve chamber back of the fuel-plate and on a level with it. The three valves are normally held closed by steam pressure aided by a coil spring. The valve chamber is normally full of steam. The opening of any one of the valves is controlled each by a lever, which is pulled back by the fireman and allowed to close either automatically or gradually by hand. A mica peep hole below the valve chamber enables the fireman to see the interior of the firebox from time to time.

The operation of the Marshall mechanical stoker requires the constant attention of the fireman, though he is relieved of all heavy mechanical labor. He can, at will, stop or start conveyor engine. He can close the cutoff and dump grating in the tender as required. He can regulate the hopper gate opening and so regulate the supply which reaches the fuel-plate. He has, however, to constantly operate one of the three valves which govern the blast of steam which distributes the coal to the firebox. This hand-operated device enables the fireman to distribute the coal as he desires. Thus he may cause several right-hand jets to blow in succession for the purpose of covering the left side of the firebox, or he may resort to any sequence of blasts which he may deem requisite. The fireman is also able to regulate the intensity of any blast by the degree of opening he may give to it. The object of the hand-operated valve mechanism is to enable a fireman to so distribute the coal as to cover a thin spot or cover a hole in the fire produced by the slipping of the engine or other cause.

The whole apparatus has been designed with a view of providing means for resorting to hand firing when desired. The hopper and stoking mechanism can be removed by disconnecting the steam pipe at the union nut and taking out the hinge bolts and locking bolt and lifting the whole mechanism out of the way. An ordinary fire-door must then be applied. The conveyor can be taken down altogether by disconnecting the steam hose supplying the small engine and the conveyor disconnected at the four-way hinge on the floor of the tender and the whole lifted out of the way.

The disconnecting of the hopper and the conveyor and the lifting of these comparatively heavy parts out of the way must consume some time, and the necessity of carrying a spare fire door on the engine, in case hand firing had to be resorted to, are certainly valid objections to the mechanism as now designed. The peep hole through the fire door is rather too low to be convenient for the fireman to constantly use, and although the distribution of coal over the grate may be performed easily and intelligently by the fireman, the constant hand operation of the valves is not a feature which is likely to commend it to the men on the engine. This stoker, however, is an effort to solve the problem of lightening the work of the fireman in modern heavy freight traffic.

Trying to Abolish the Fireman.

Many attempts have been made to provide a substitute for the locomotive boiler to do away with firing on the road, and at the same time provide steam or a substitute for short runs. The most successful of these attempts was a compressed air reservoir designed by Robert Hardie, a locomotive engineer. It ran for some time on the New York elevated railroad. The plan was abandoned because it cost more than direct steam power without giving any decided advantage.

Another substitute for the fired boiler was hot water carried in a strong vessel. The water was put in at a high temperature representing about 200 pounds steam pressure. On being drawn off through a suitable reducing valve the water became steam and operated the pistons in the usual way.

Soda and other chemicals capable of storing heat were also tried to eliminate the fireman, but they all failed.

The Fatal Water Crane.

The swinging water crane that is so easily blown foul of the track has been responsible for the death of many persons. One of the latest victims was William C. Nagel, one of the oldest engineers on the Big Four System, who had been an engineer over forty years and was considered one of the most reliable express engine men belonging to the road. In the line of his duty he looked out of the side window at a point where the fatal water crane was protruding upon the track; it struck his head and ended his career. Can some invention be perfected to hold that murderous crane in place?

Automatic Fog Signalling.

One of the greatest dangers which have attended the working of railways in England has always been that of signalling trains in the exceedingly dense fogs in the British Isles. The Great Western Railway have been testing on one of their branch lines an automatic system to overcome this trouble. By the new system, whenever a train runs into a danger zone, a whistle sounds in the cab of the engine, and thus warns the driver of his position. The experiments have been so successful that the Board of Trade have approved of the permanent adoption of the system. It is expected that the usefulness of the apparatus may be further increased by a device to apply the brake automatically.

CROSS SECTION OF MECHANICAL STOKER.

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What Do You Think of Signals?

On another page we publish an article entitled "The Appeal of the Railway Signal," which deserves close study from every person connected with the movement of trains on lines protected by stationary signals. The appeal is really to the judgment and good sense of the people who have to act under direction of the signals displayed, and their opinion of the method most conducive to safety is earnestly requested by the editor of RAILWAY AND LOCOMOTIVE ENGINEERING. The officials who decide upon the installment of signals select the system which they consider the most efficient; but their judgment may be guided to a great extent by theoretical considerations; the engineer, on the other hand, who has to obey the signal and be guided by its indication, is the better judge of what system is most conducive to the safe operating of trains.

In the article referred to (page 190), there are three systems of signalling mentioned, each one of which no doubt has merits of its own. The railway world and the traveling public needs the use of the very best system, the system with the fewest weak points. The men who run locomotives or have had experience in the cab are best able to judge the merits or defects of a signal system, and we trust that many of them will favor us with their views for the benefit of those whose safety depends upon the prevention of train accidents.

We believe that there is a growing desire to make the signal system used in this country the most efficient in the world. We believe the signal engineers are putting forth conscientious efforts in that direction, and that they and other railroad officials would welcome a fair and frank discussion of the whole subject. A signal engineer said to RAILWAY AND LOCOMOTIVE ENGINEERING a short time ago: "In devising our signal systems we, so to speak, put the viands on the table and we see that they are swallowed, but we don't know whether they are palatable or not. Get the men who obey the signals to say what they think of them, through your columns." Gentlemen, there is the invitation. Now you have the floor.

The Price of Safety.

Many railroad men hate the word discipline and regard it as a species of revenge against the lower orders, meted out by the higher orders of railroad employees on the principle that some religious sects believe that God sends one to heaven and ten to hell for his own glory. Yet the man who looks upon the working of the human mechanism forming a railroad organization is thankful that unsleeping discipline keeps the forces in that condition of alertness that enables intricate train operation to be conducted without mishap. A mishap or accident of any kind nearly always results from a lapse in vigilance.

When an express train runs into a train standing on the main line, it may safely be concluded that it is a common thing for stray trains to be on the track when an express train is due. A railroad company that permits this dangerous method of train operating to be practiced, has no right to run trains at a greater speed than twenty miles an hour. The practice does not, however, always indicate that the railroad through crowded business is unable to keep a clear line for fast passenger trains, but rather that the discipline regulating train movement is lax. No excuse ought to be accepted for any train or engine intruding upon the line on which a fast through train is due. The violation of this rule is generally done by the chance-taker who insanely imagines that he can save time by following dangerous practices. Strict discipline in every day operating is necessary to make all understand that taking chances will be considered as serious an offense when nothing happens, as when an accident results. Unfortunately this sentiment is far from being universally regarded as sound operating doctrine, on the contrary, on not a few roads the conductor or train dispatcher who saves a few minutes by taking dangerous chances is regarded as a smart railroader.

The numerous fatal railroad accidents that continue to hold up American railroad operation to the scorn of humanity, calls loudly for reform and the first action toward reform ought to be the making of all concerned understand that fast trains must be given a clear track. The next reform ought to be the general introduction of block signals that will keep trains apart. Much has been done in the last few years in the installment of block signals, but in many quarters there is a tendency to neutralize that provision for safety by loose discipline. The practice of making block signals permissive—that is giving the engineer permission to pass a danger signal when he thinks that the passing may be done safely, paves the way to the practice of ignoring signals, and putting personal judgment in their place. During excavations that uncovered parts of Pompeii that had been covered by ashes thrown up by Mount Vesuvius, they found Roman soldier guards who stuck to their posts during the death dealing storm, through sense of duty. That was the spirit that made Roman soldiers conquer the world. Stern discipline of the same kind is necessary with American railroad men if they ever hope to lead the world in efficiency, which means safe operating.

Pounding.

The marked improvement in locomotive construction and the increase in the weight of the working parts has caused a diminution in the chronic defect known as pounding, and which has ever been one of the leading troubles in locomotive running and management. As a constant cause of annoyance to engineers it is alarming, because if unheeded, it is almost always sure of leading to disaster, and the beginning of a pound is wisely looked upon as a note of warning and should be immediately heeded. The location of the cause of the trouble, generally a matter of some difficulty even to the most experienced engineer, should be looked for with extreme carefulness.

It is a noteworthy fact that there are some kinds of locomotives that always pound when running in full gear. Such engines should not be blindly experimented with. It will be readily noted that setting up the wedges and tightening the main rods instead of correcting the trouble, leads to new troubles. It should be carefully observed whether the pounding is of a constant or of a growing kind. If the volume of sound is of a constant kind when running in full gear, the trouble might be in the lack of compression at the end of the piston stroke, as something of a shock at the end of the piston stroke is inevitable in many locomotives when pulling hard with a full travel of the valves. If the valves are of the proper dimensions and finely adjusted this should not occur as the properly graduated compression period should relieve all sudden sound of lost motion in the reciprocating parts; but it is a well known fact that in locomotives equipped with the shifting link the valves do not retain their exact position for any considerable length of time, and hence some disturbing element is to be expected.

Some of the more unusual causes of pounding are the loosening of cylinders on the frames. Loose driving boxes are also a fruitful cause of pounding and difficult to locate. The most common cause of pounding, however, is in the main rod connections and in the driving boxes working loose in the wedges. Loose side-rod connections will also cause pounding when passing the centres. Care should be taken in noting the striking point when the piston and cylinder heads touch each other. The tendency of the main rod to increase in length until the piston strikes the front cylinder is more rapid than might be expected, and special care should be taken in refitting the rod brasses to see that a slight excess of clearance should always be maintained at the front end of the piston stroke. In the event of the piston striking either of the cylinder heads the noise is much louder and harder than that caused by lost motion in the rods or driving boxes.

Among the methods of locating a pound, after determining on which side of the engine the pounds occurs, perhaps the best method is to place the main crank pin on the top quarter on the side of the engine on which the pound occurs, and after blocking the driving wheels, admit steam to the cylinder, and by reversing the lever so that the steam will have an opportunity of alternately striking each side of the piston, a close observer will readily detect the location of the trouble. If there is no visible movement of the parts the trouble may be looked for in the cylinder itself, but it may be added that broken piston rings or loose follower-bolts produce a metallic clicking sound which can be readily distinguishable from the duller sound of a pounding on account of a loosening of the wearing parts.

Responsible for Short Working Hours.

When the panic of 1907 assailed the business interests of the country, the railroad companies were the greatest sufferers, the reductions in revenue having been so great that many of them experienced the greatest difficulty in keeping out of the hands of receivers. To escape bankruptcy, nearly all railroad companies were compelled to cut down operating expenses in every possible manner, an unavoidable policy which brought much hardship and suffering upon people thrown out of employment. According to the Bureau of Railway News and Statistics, whose reports are generally reliable, the first year after the depression began brought to the railroads of the United States the loss of $330,000,000 in gross earnings and $129,300,400 net earnings, the income which in ordinary years is devoted to paying dividends, wages and for the expense of desired improvements. Among the outrageous losses imposed upon railroad companies was $25,000,000 due to certain legislatures compelling railroads to carry passengers for two cents a mile, a form of vicious legislation that the courts have decided to be illegal, but nevertheless the damage was inflicted.

As a highly important portion of the current expenses of railroads consists of repairing rolling stock and the keeping up of the track; reduction in these departments threw many men out of employment who were poorly prepared to endure reduction of income, and much suffering resulted. Railroad managers were put to their wits' ends to find a policy that would be least hurtful to their employes. Some railroad companies reduced their force to the limit, keeping only enough men to do the necessary work, while others kept all the men they could, putting them upon short working hours. It is difficult to say which policy was the more satisfactory, for we have found a very hostile spirit existing among workmen who have been put upon short time, not a few of them blaming their immediate superiors, such as master mechanics and road masters for the short hours worked. Feelings of that short are very unreasonable, for there is not a master mechanic or road master in the country who would restrict the hours of the men under them if they could avoid it.

Whatever influences were responsible for the panic were the real culprits whose acts put the workmen upon short time, together with the political tyrants who forced unprofitable rates upon the railroad companies. These are the people that ought to be abused by the workmen, not the officials who merely obeyed orders from the general office. The lesson of the short hours ought to result in every effort being made to send to private life the politicians who make capital by abusing and injuring railroads.

Superstition of Railroad People.

Reporters of daily newspapers are not technically educated men. When they attempt to describe accidents that happen to cars and locomotives they sometimes make fearful blunders, but we ought not to blame them severely. They are like the artists in a Western resort where a notice was displayed reading: "Please do not shoot the musicians; they are doing their best."

A reporter gifted with imagination is fond of lingering about the resorts of stove committees, where he gathers strange items of information that are sometimes curious if not edifying. Lately he discovered many superstitions and amazing beliefs cherished exclusively by railroad people. Engineers and firemen are said to hold a monopoly of certain superstitions. They never have confidence in a locomotive that has been in an accident. No matter in what condition the engine may be in, or to what run she may be assigned, they would rather go out on the worst scrap heap belonging to the road or the hardest run so long as the engine used had escaped any accident. Another superstition this reporter found to be prevalent among enginemen was the direction in which the engine was turned on the turn-table. Some of the men prefer turning to the right, others to the left, and they are as particular about this as the Musselman is about facing the East when howling his evening prayers. Many enginemen, he says, make a point of being present whenever their engines are turned in order to assure themselves that it is done the right way, or if in their absence it has been wrongly done they will have it set right before consenting to climb into the cab. Numerous accidents are attributed to engines being turned from east to west with the front buffers toward the north.

One should never step onto the engine with the right foot first. Equally serious would be the consequences of climbing out of the cab on the right side in order to oil the engine. Such a mistake would certainly result in an accident sooner or later. There seems also to be a superstitious prejudice against locomotives whose numbers contain the figure 9 or can be equally divided by that number. There is no apparent reason for this, and nothing to explain why the generally acknowledged ominiousness of 13 is disregarded. But 9 is disliked emphatically by many workers in locomotive cabs.

One will sometimes see a track layer who has stumbled in crossing a rail retrace his steps and cross the rail again with sure feet. To stumble over a rail is productive of misfortune, and the only way to ward off disaster is to take the step again. Cross-eyed men are unpopular. Some support to this superstition is discoverable in the story of a gang of track layers who, during the ten months' presence among them of a cross-eyed man, lost nine of their number by accidents on the line, so it is said, and the cross-eyed man himself was killed as the tenth victim.

All persons engaged in dangerous occupations are naturally superstitious, and railroad men may be classed with sailors, fishermen and miners in this respect. It is not difficult to work up signs that would arouse the apprehension of enginemen or others liable to meet with serious accidents. We never heard of the superstitions mentioned by the imaginative reporter, but we have known enginemen in the old country who would be thrown into tremors of apprehension if a hare crossed the track when they were starting on a trip, and who would be frightened all day on hearing the scream of a lapwing. Belief in some form, of the supernatural afflicts most members of the human race and the reputed doings of the Witch of Endor, the encouragers of Macbeth and the antics of the gang in Alloway's Auld Haunted Kirk keep all superstitious people in good company.

New Organization.

A new kind of organization on the roads which are generally called the Harriman system has recently been put into operation. In the new plan the titles of master mechanic, resident engineer, train master and traveling engineer are all changed to that of assistant superintendent. The duties performed by these men remain as they were, with perhaps some added activities.

The object is to facilitate business and to train and develop the men in the various departments in a wider view of their responsibilities, and to develop resourcefulness. An assistant superintendent is always on duty at divisional headquarters to handle special classes or correspondence and telegrams. Correspondence on the company's business is addressed "superintendent" or "assistant superintendent," the name of an individual is not used unless the letter or telegram is intended to be more personal than official.

The tendency of the existing forms of railroad organization has been to develop three departments whose interests seemed frequently to be opposed to each other, and led to action that was not conducive to the good of the service at large. The transportation department often assumed authority that rightly belonged to the mechanical or to the engineering department and vise versa, with the result that the individuals concerned appeared more interested in fighting the other department members than in working for the best interests of the company. It has been notorious that members of the transportation department having direct communication with the cars of the management, had the strongest pull in obtaining promotion, a condition which spread a spirit of jealousy and discontent among members of the other departments. The new organization of the Harriman lines will put each department upon an equal footing, and will give the managers a much larger field from which to select officials of marked ability.

Unexpected Orders from the Orient.

Business in all lines of railroad supply work has been deplorably depressed during the last year, but foreign orders have come in unexpectedly and have helped to keep mills and factories going that otherwise might have been idle. Newspaper philosophers and certain politicians preach that the home market is enough for American manufacturers, but we fail to see why foreign orders should not be welcome as long as they can be executed at a profit.

Railroad building in China has been very active during the past year and the greater part of the new equipment required for the South Manchuria Railway was placed in the United States. That equipment included rails, locomotives, cars, bridge material and minor accessories to a total value of over ten million dollars. The quantities and approximate values of the equipment ordered were 205 locomotives, worth $3,888,000; 2,190 freight cars and cabooses, $3.020,000; 51,145 tons rails and accessories, $2,118,000; 95 passenger, baggage, and mail cars, including 3 sleepers and 3 dining cars, $793,000; and 486 sets steel bridge material, $590,000, making a total of $10,409,000. Of the cars 980 were ordered in Japan, but as the trucks, brakes and accessories were bought in the United States, it is necessary to subtract only about $300,000 to secure the value of the equipment contracted for in the United States.

Of other material for the railway the track ties were ordered in Japan. Several locomotive cranes worth $104,522, a turbine engine for $43,798 and cement to the value of $230,000, or $378,320 in all, were ordered from the United Kingdom. A shop building with traveling cranes, complete even to the wired glass windows, and to cost about $175,000, was ordered from the United States, as well as two steam shovels costing $21,000. About $50,000 worth of machine tools were ordered, and the greater part of these also were of American make.

In the trade returns for the whole year these supplies are divided under three heads, each including a certain quantity of other articles also, namely, iron goods, machinery, and other building materials, so that it is impossible to classify all the railway equipment. According to American returns for 1907, shipments of engines, cars, rails and bridgework sent from the United States amounted to $4,023,151, while the exports of track ties from Japan to this territory during the eleven months were valued at $446,967. Foreign cement imported amounted to a value of $347,839, almost all being from the United Kingdom. The exports of American metal-working machinery for the ten months ended October 31, amounting to $29,631, were practically all destined for the shops of the South Manchuria railway.

Book Notices

Twenty-Second Annual Report of the Interstate Commerce Commission. 377 pages, cloth. Published by the Commission at the Government Printing Office, Washington, D. C.

This report is particularly interesting in view of the fact that it is largely composed of matter affecting the railways. Of recent years little is heard of the Interstate Commerce Commission, except in regard to the railways, and, as is well known, much of the work has not been of a beneficient kind. It is to be regretted that these reports make very dull reading, but much of the matter is of vital interest to railway men. Copies of the report may be had on application to the Commission, of which Hon. M. A. Knapp, of New York, is chairman, and Hon. Edward A. Moseley, Washington, D. C., is secretary.

Washing and Coking Tests of Coal, at the testing plant, Denver, Colo. By A. W. Belden, G. R. Delamater and J. W. Groves. Published by the Government Printing Office, Washington, D. C. 54 pages. May be obtained by applying to the Director, Geological Survey, Washington, D. C.

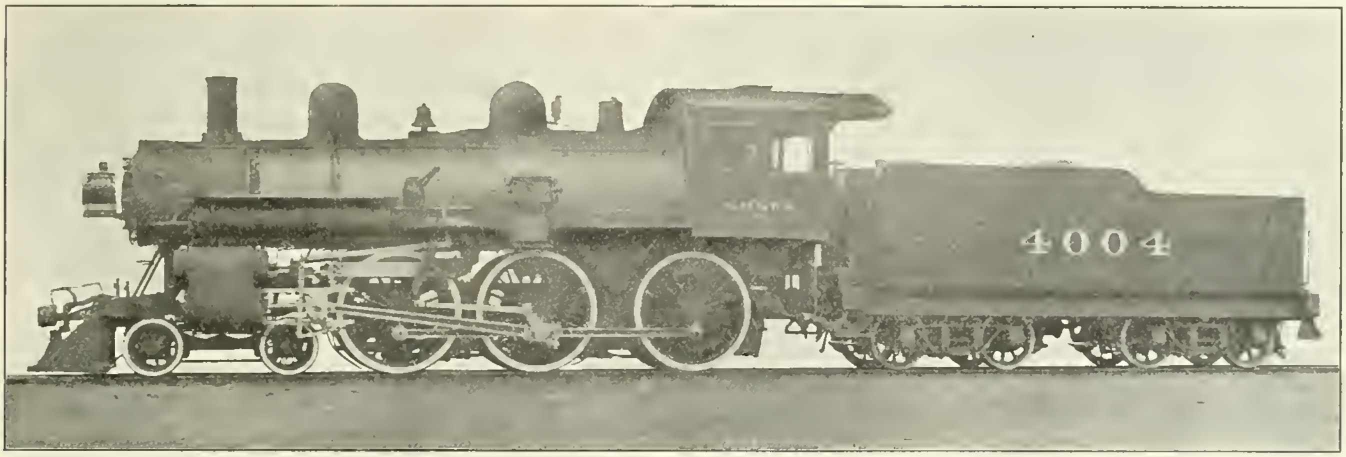
The output of printed matter by the U. S. Government is so great that the matter that is of real value is very often lost sight of as grains of corn may be in a wilderness of straw, but it would be well for all who are interested in the increasing efficiency in the utilization of the fuel supply by devising improvements in washing and coking coals to note carefully the various reports issued from time to time on this important subject. The authors of the report before us have the happy faculty, which is rare in government work, of condensing their report to a reasonable bulk. These tests demonstrate the fact that many coals that are too high in ash and sulphur for economical use under the steam boiler may be rendered of some commercial value by proper treatment in the washery. As an illustration we note that among 37 coals tested from the Rocky Mountains, all but 3 produced good coke, though a large number had been considered of a non-coking kind.

Plenty of Rain Somewhere.

On a line running round the world from four to eight or nine degrees there are patches over which rain seldom ceases to fall. This is called the "zone of constant precipitation," but at the same time there are several localities along it with very little rainfall.

4-6-0, for the Chicago, Milwaukee & Puget Sound Railway

Our half-tone illustration represents a ten-wheel engine, thirteen of which were recently built at the Brooks Works of the American Locomotive Company for the Chicago, Milwaukee & Puget Sound Railway. These engines, known in the road's classification as the G-6, are used in fast passenger service and handle the heaviest and fastest passenger trains on the Superior, La Crosse, Kansas City and H. & D. Divisions of the above-mentioned road. One of the hardest schedules which they have to maintain is that between Kansas



4-6-0 FOR THE CHICAGO, MILWAUKEE & PUGET SOUND RAILWAY.

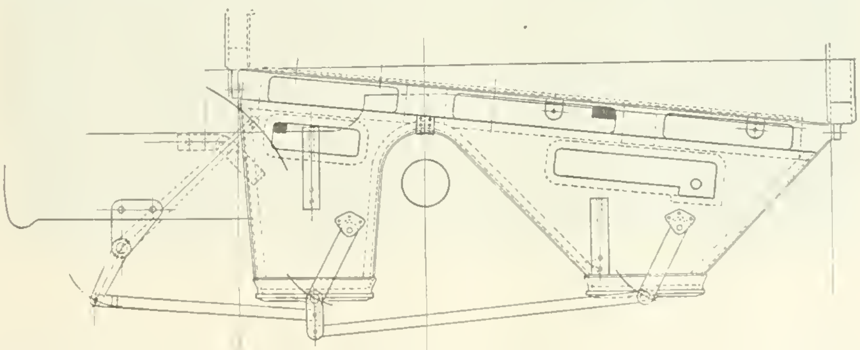
A. E. Manchester, Superintendent of Motive Power. American Locomotive Company, Builders.

City and Ottumwa Junction. Train No. 12, made up of nine cars, weighing 416 tons, hauled by one of these engines, makes the run between these cities, a distance of 206 miles, in 6 hours and 4 minutes, or at an average speed of 34 miles an hour. This includes 11 regular stops, as well as stops at railway crossings and reduced speed within the limits of Kansas City.

On this division there are numerous grades of 5 per cent. and 3½ miles long, while the heaviest grade is 6 per cent. and 7 miles long. Going in the other direction, or between Ottumwa and Kansas City, on train No. 5, composed of the same number of cars, they make the run in 36 minutes longer time or at an average speed of 30.9 miles an hour over 5 and 6 per cent. grades, several of which are 3 miles in length and two are 4½ and 5½ miles long respectively. Between Milwaukee and Green Bay on the Superior Division, a distance of 112.1 miles, train No. 3, comprised of 7 cars and weighing 300 tons, covers the distance in 3 hours and 17 minutes, or at an average running speed of 34.1 miles an hour. Several 1 per cent. grades, the shortest of which is one-half mile in length and the longest about three miles in length, are encountered on this division. This performance would seem to justify the opinion of the officials of the road that in this design they have obtained an engine which is particularly satisfactory for the service conditions.

In working order, the engines have a total weight of 177,000 lbs., of which 125,500 lbs. is carried on the driving wheels. The cylinders are 20½ ins. in diameter and 26 in. stroke, which, with driving wheels 73 ins. in diameter and a boiler pressure of 200 lbs., gives a theoretical maximum tractive power of 24,200 lbs. The cylinders are equipped with 12 in. piston valves actuated by the Walschaerts valve gear. These have a maximum travel of 5⅞ ins. and a steam lap of one inch and ⅛-inch exhaust clearance and are set with ¼-in. lead.

The design of the valve gear which, as far as the reversing mechanism is concerned, differs from previous applications to engines of this type. As will be seen from our illustration, the back end of the radius bar is suspended by means of a long link from the backward extending arm of a bell crank bolted to the side of the boiler, 7¾ ins. ahead of the centre of the link. The reverse shaft is carried in bearings bolted to the back of a yoke extending across the frames and out beyond the driving wheels, between the first and second pair of drivers, and the reverse shaft arm is connected to the downward extending arm of bell crank by means of a short rod. This construction was employed in order to use the link type of radius bar suspension, as, owing to the large diameter of drivers, it was impossible to place the reserve shaft over the driving wheels ahead of the link. The frames, which are of wrought iron with double front rails are 4 ins. wide. They are very strongly braced together, there being a cast steel filling piece just ahead of the cylinders, a cast steel cross tie at the guide yoke to which the latter is bolted, another between the first and second pair of drivers, to which the yoke previously mentioned supporting the link brackets and reverse shaft bearings, is bolted. A steel casting has been introduced between the frames under the front end of the firebox and a cast steel footplate.



ASH PAN EMPTIED FROM THE CAB.

The boiler is of the radial stayed wagon top type and is 62 ins. in diameter outside at the front ring. It is fitted with 304 two-inch tubes, fifteen feet long, having a heating surface of 2,374 sq. ft. The firebox which is between the driving wheels is 41⅛ ins. in width and 107⅛ ins. long, and provides a heating surface of 182 sq. ft. It is equipped with a fire brick arch, supported on three water tubes 3 ins. in diameter. These provide 23 sq. ft. of heating surface. The total heating surface is therefore 2,579 sq. ft.

The design of the ashpan, which is one of the builder's types of self-clearing pans, is also worthy of notice, and is shown in the accompanying engraving. It has two hoppers, each of which is equipped with a cast iron drop floor. As will be seen from the illustration, the door is suspended between two links, one on each side of the hopper in such a manner that when the lever is raised the back end of the door drops down and the door swings forward, thus opening the hopper. The two doors are equalized together and operated by the same lever from the cab. This ash pan conforms to the law which will shortly go into operation which requires the cleaning of ash pans to be accomplished without the necessity of men going under the engine.

Some of the principal ratios and dimensions of the design are given below:

Weight on drivers ÷ tractive effort = 5.18.
Total weight ÷ tractive effort = 7.31.
Tractive effort x diameter drivers ÷ heating surface = 685.
Total heating surface ÷ grate area = 84.5.
Firebox heating surface ÷ total heating surface per cent. = 7.9.
Weight on drivers ÷ total heating surface = 48.6.
Total weight ÷ total heating surface = 68.6.
Total heating surface ÷ volume of cylinders = 259.7.
Grate area ÷ volume of cylinders = 3.07.
Grate area to heating surface as 1 is to 84.5.
Wheel Base Driving, 14 ft. 10 ins.; total, 26 ft. 5½ ins.; total, engine and tender, 57 ft. 8¾ ins.
Weight—In working order, 177,000 lbs.; on drivers, 125,500 lbs.; engine and tender, 313,700 lbs.
Grate Area—30.5 sq. ft.
Journals—Driving, 9 x 12 ins.; engine truck, diameter, 6 ins.; length, 10 ins.; tender, 5½ ins.; length, 10 ins.
Boiler—Working pressure, 200 lbs.; fuel, Bitum. coal.
Firebox—Type, wide; length, 107⅞ ins.; width 41⅛ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, 5/16 in.; back, ⅜ in.; water space, front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Crown Staying—Radial.
Tubes—Material, iron; gauge, .125 in.
Boxes—Driving, C. S.
Brake—Driver, N. Y. Auto & St. Air; tender, New York air signal; New York pump, Duplex No. 5; reservoir 2 ft. 18½ ins. x 108 ins.
Engine truck—4 wheel swing, center bearing.
Exhaust Pipe—Double.
Piston—Rod diameter, 3¾ ins.; piston packing, cast iron rings.
Smokestack—Diameter, 18 ins.; top above rail, 14 ft. 8 ins.
Tender Frame—13-in. channels.
Tank—Style, U. Shape; capacity, 7,000 gallons; capacity fuel, 10 tons.
Valve—Type, piston; travel, 5⅞ ins.; steam lap, 1 in.; exhaust clearance, ⅛ in.
Setting—Constant lead, ¼ in.
Wheels—Driving; material, cast steel; engine truck, diameter, 33 ins.; kind, cast steel; tender truck, diameter, 38 ins.; kind, cast steel.

Ancient Highways.

The history of civilization has demonstrated that there are three things which are essential to making a nation great and prosperous, viz.: A fertile soil, busy workshops, and easy conveyance of people and goods from place to place. Railways have proved the most expeditious means of inter-communication the world has seen, and much of the extraordinary development of civilization during the last eighty years with its spread of comfort, refinement and luxury, has been due to the introduction of railroads.

But many centuries before the railroad era, enlightened nations had developed various methods of transportation, the most important of them being on roads that were good or bad according to the ingenuity and enterprise of the makers. It took civilized people ages to acquire the art of road making, and many nations of antiquity that attained great proficiency in certain arts, met disaster that led to ultimate decay, for want of good roads on which defenders could be concentrated against the attack of powerful despoilers.

ROMAN STONE-WAYS ON WATLING STREET, NEAR WEEDON.

The first great nation to acquire in a high degree the art of road making was the Romans. The protracted life of that nation and the great power it attained in the world, was largely due to the magnificent roads built by its people to every region where the Roman power was extended. The Roman stoneway now seen on Watling street near Weedon, England, shown in our illustration, for which we are indebted to Mr. C. E. Stratton of Leicester, was one of the roads constructed by the Romans in England about seventeen hundred years ago, and it was built so solidly and substantially that it is still used as the finest highway in the district. The longitudinal runway is five feet between centres and provides a smooth level path for all kinds of wheeled vehicles. There were originally two lines of this stone track, but one line has been converted into the ordinary macadam road shown in the picture.

The systematic construction of good roads was begun by the Emperor Appino Claudius, B. C. 312, under whose direction the Appian Way was built which was originally extended to Capia, 125 miles, but ultimately extended 350 miles. The highway was not finished before 30 B. C. That became the model of all Roman roads of which 29 radiated out of Rome alone. The pavement, which rested on several prepared substrata, was formed by large blocks of hard stone fitted to each other with great exactness. Its breadth varied from 14 to 18 feet including the side walks, which the Romans were always careful to provide.

Many remnants of the old Roman roads are still to be seen in various parts of Europe, and in some cities they have been imitated in laying stone tramways used in the absence of iron rails. When the development of modern freight carrying business began, and it was found that the soft roads of Great Britain were unequal to the task of carrying heavy loads of coal and other minerals, the conditions led to the construction of crude imitations of the Roman roads with wooden ways in place of stone. In the line of progress stone and wood paved the way for iron tracks and eventually to the modern railway. While rejoicing over the comforts given to the world by the modern arteries of street, we ought not to forget the debt we owe to ancient civilization for pointing the way toward improved lines of travel.

Glass water pipes, which have a covering of asphalt to prevent fracture, are in use in some parts of Germany. They give thorough protection against moisture in the ground, against the action of acids and alkalies, and they cannot be permeated by gases.

Read the article on the "Appeal of the Railway Signal" on page 190 of this issue and write us a letter, giving your views on the subject.

Applied Science Department

Elements of Physical Science.

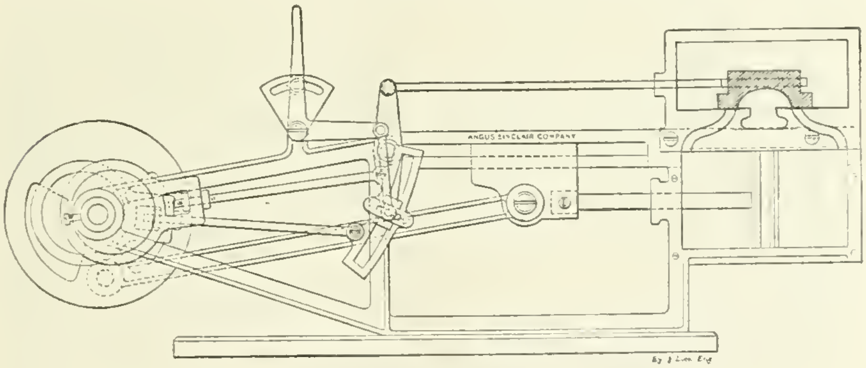
VIII.—The Link Motion.

A peculiarly important quality of the steam engine is the fact that it lends itself with ease to perfect control. That motion of such amazing force can be suddenly stopped and reversed within a brief period of time is one of the most wonderful results of applied science. Both results were not the discovery of a day. Much time and ingenuity have been spent in perfecting the appliances whereby the mysterious force of steam has been so completely harnessed that the simple movement of a short lever backward or forward will stop the engine or project its force in either direction.

The most common form of reversing gear is what is known as the link motion. This clever invention was produced in the works of Robert Stephenson, the eminent English engineer, by a young draughtsman named Williams. It is commonly known as the Stephenson link motion, on account of its first appearance on Stephenson's locomotives. The combination of levers and rods and eccentrics and radial link have an involved air of mystery to the young engineer, but a little attention will show that the movements are simple enough, and if taken into consideration one by one can be readily understood by the average student in a short time.

In the excellent model before us, a duplicate of which can be procured from the publishers of Railway and Locomotive Engineering, and a drawing of which is reproduced for illustration, it will be noted that the piston is in the middle of the cylinder. Both steam ports are closed, and if it is desired that the engine should be moved forward it will be necessary that the steam be admitted at the front so that the piston should be pressed backwards and so move the wheels forward on the rails. In order to admit the steam to the front end of the cylinder the valve must be moved backward. It will be readily noted that by moving the lever forward on the quadrant the radial link is dropped downward until the upper eccentric rod is in line with the lower end of the rocker. To accommodate itself to this movement the lower end of the rocker has been pushed some distance forward, the upper end of the rocker consequently moving an equal distance backward and carrying with it the slide valve. This has the effect of opening the steam port leading to the front end of the cylinder and the pressure of the steam is admitted to the front face of the piston.

If, on the other hand, it is desired to move the engine backwards, it will be found that by moving the lever to the back of the quadrant, the link is raised until the lower eccentric is in line with the lower end of the rocker. To admit of this movement the lower end of the rocker is drawn back with the consequent result that the upper end of the rocker has been moved a corresponding distance forward, thereby opening the steam port leading to the back of the cylinder and so admitting the steam to the back of the movable piston, which moving forward has the effect of moving the wheels backward upon the rails.



REPESENTATION OF THE ANGUS SINCLAIR CO. VALVE MODEL WITH D-SLIDE VALVE.

There are several important factors rendering these simple movements possible and which, if carefully observed, will readily impress themselves upon the memory of the attentive student. The first is that with the rocker in perpendicular position, the valve rod should be of the exact length so that the valve should be in the central position in regard to the steam ports. Presuming that the piston has moved forward in the cylinder until it has reached the extreme end of the stroke, it is necessary that the valve should be beginning to open the front port in order that the steam may be admitted to the front face of the piston for the purpose of moving the piston backward. At this particular point it is well to turn our attention to the position of the eccentrics and their relation to the driving crank. It will be understood that with the piston at the front end of the cylinder the main crank pin is at the forward centre. If the valve was so constructed as to cover the steam ports exactly, the two eccentrics should be standing with their extreme points at right angles to the main crank pin, the forward eccentric with its extreme point being on the top or above the crank, and the eccentric controlling the backward motion on the bottom or below the crank.

As previously described, however, the valve in modern use is so constructed that the extreme ends of the valve when in a central position overlap the steam ports. In the modern locomotives this amount of lap extends to three-quarters of an inch, and if to this is added some amount of valve opening it will be readily understood that the eccentrics must be moved sufficiently from the position at right angles to the crank to a position nearer to the crank by an amount equal to the lap and lead combined. The effect of this movement toward the crank on the part of the eccentric has the effect of pushing the lower end of the rocker toward the cylinder and consequently drawing the upper end of the rocker with the valve rod backward a sufficient distance to overcome the lap of the valve.

It will be observed that the radial link is simply a contrivance for the purpose of detaching one eccentric and placing the other in operation, besides which it has the advantage of varying the amount of travel of the valve, thereby allowing a supply of steam to be admitted for a long or short space of the piston stroke. This is accomplished by moving the lever toward the centre of the quadrant and it will be easily understood that as the eccentric rod in operation is moved some distance from the end of the rocker it has the effect of shortening the movement of the rocker arm and consequently shortening the stroke of the valve. Such are the chief features of the link motion and with these clearly in mind, other less important details may be readily mastered by the thoughtful student.

Next month we will take up the consideration of the Walschaerts valve motion and endeavor to explain as briefly and simply as possible the salient features of this valve gearing. As is well known, it has come into prominent notice recently and bids fair to outrival the shifting link motion whose operations we have briefly described.

Celebrated Steam Engineers.

XVIII.—George H. Corliss.

The importance of the steam engine in the performance of the world's work is such that any man who has shown sufficient mechanical ability to improve any particular part of the machine is sure of worldwide recognition, and if also possessed of business capacity rarely fails to achieve fortune. A notable illustration is that of George H. Corliss, whose improved valve gearing, which is admirably adapted for certain classes of engines, brought him prominently into notice as one of the foremost engineers of the nineteenth century. His career is also interesting from the fact that the inventive faculty rarely finds its life work at the beginning of the career of the inventor. In the case of James Watt, as we have seen, it was in an effort to provide for the condensation of the steam used in Newcomen's atmospheric engine in a vessel outside of the cylinder, that he stumbled, as it were, on the elimination of the comparatively feeble atmospheric engine, and produced the crowning invention of the ages—the steam engine.

In the case of Mr. Corliss, he began his mechanical career in an effort to construct the sewing machine. He was partially successful in this, and although his invention had not the merit of later inventors in the same field, his invention attracted wide attention and led to his introduction to a firm of engine builders who were not slow to recognize the talent of the young engineer. It was while employed by this firm, the Messrs, Fairbanks, Bancroft & Co., of Providence, R. I., as a draftsman on the designing of steam engines, that he produced his first improvement on steam engine valves. As is well known, the steam engine governor was one of Watt's contrivances for regulating the admission of steam. The device consisted of two globular weights revolving in a horizontal plane, their position on each side of a central shaft being secured by movable arms. The weights spread apart from each other when their velocity was increased, and they approached each other as the speed was diminished. Taking advantage of this simple centrifugal motion means for working the throttle valve was devised, and as the speed of the engine increased the attachments were so adjusted that the throttle valve closed in a corresponding degree, or as the speed of the engine was diminished the valve opened to admit a larger supply of steam to the engine.

This contrivance was eminently successful, and in the case of stationary engines where the amount of work was a variable quantity, the governor was a necessity. Mr. Corliss, however, went a step further, and instead of following Watt's contrivance for throttling the quantity of steam or increasing the valve opening as the case required, he devised a means for varying the point of cut-off, the supply of steam being continuous at boiler pressure. The valves on the Corliss engine are four in number, a steam and an exhaust valve being placed at each end of the steam cylinder. Short steam passages are thus secured, and this diminution of clearance is a source of some economy. A disk or wrist plate is rocked by an eccentric, and rods connecting with the disk operate both sets of valves. The movement is such that the valves are opened and shut with great rapidity and moved slowly when the port is fully opened or shut. This effect is produced by placing the pins on the wrist plate that their line of motion becomes nearly transverse to the direction of the valve links when the limit of movement is approached. The links connecting the wrist plate with the arms moving the steam valves have catches at their extremities which are disengaged by coming in contact with a cam as the arm swings around with the valve stem. This cam is adjusted by the governor.

At first thought it would not appear to be a matter of much consequence whether the supply of steam was reduced or augmented by the throttle valve or by the variations in the point of cut-off, but the Corliss engine immediately demonstrated the great saving of fuel in the latter case. In this regard many of the original Corliss engines were disposed of on the same terms as the original Watt engines, the manufacturers contenting themselves with the amount saved in fuel in a specified time.

Perhaps the most notable steam engine manufactured under the supervision of Mr. Corliss was that built for the Centennial Exhibition at Philadelphia in 1876. This engine weighed over 600 tons, and moved the entire machinery exhibited in the machinery hall. It was the theme of universal admiration among engineers, and established the reputation of Mr. Corliss as being in the front rank of the world's engineers. It may be added in justice to other inventors that devices nearly similar had been tried on marine engines, but the devices as adapted and perfected by Mr. Corliss were the first that completely embodied a principle whereby the full, direct and expansive force of steam was measured out at each stroke with a degree of exactness that met the requirements of the moment with a precision that could not be surpassed.

The application of the contrivance to the valves of locomotives was repeatedly experimented upon, but it can be readily conceived that no kind of contrivance could dispense with the continued intelligent supervision and manipulation of a skilled engineer in conducting an engine rapidly moving from place to place. Mr. Corliss was among the first to admit this truth, and confined his experiments to stationary and pumping engines.

He received many honors from foreign governments. He had the respect of all who had the honor of his acquaintance. He was a broad-minded gentleman, a typical American, and an accomplished engineer.

Questions Answered

WEIGHT OF COAL.

34. E. B. E., Newark, Ohio, asks: How much coal would there be in a block of coal 4 ft. square; that is, how much would it weigh?—A. We suppose you mean the block to be a cube with a side 4 ft. long. Such a cube would contain 64 cu. ft., and taking coal of the Pittsburgh variety, as quoted by Haswell at 46.81 lbs. to the cubic foot, your four-foot cube would weigh 2,995.84 lbs. Other coals weigh more to the cubic foot, but the Pittsburgh burns with a small percentage of clinker.

CAR HEATING BY EXHAUST STEAM.

35. M. E. W., Massillon, writes: With the so-called Economy heater where exhaust steam from the air pump is used, we will assume that it takes a 20 lbs. pressure on the steam line to keep the cars warm. In this case the air pump is working against 20 lbs. back pressure. What is the saving in this over using 20 lbs. direct from the boiler, and exhausting the air pump direct to the atmosphere? —A. In order to have your question answered as fairly and explicitly as possible we submitted it to the Economy Car Heating people and their reply to the question is as follows: "With an air pump compressing air to a main reservoir pressure of say 130 lbs. (high speed brake) it is safe to say that the exhaust steam pressure at the moment of exhaust is at a still higher pressure and with the use of the Economy system, all of this steam is available for car heating, and while it is true that with the back pressure carried on the exhaust side of the steam piston, a higher steam pressure will be required to operate the pump, careful tests made by air-brakemen and by different technical institutions as well, show that with a back pressure of 30 lbs. carried for car-heating, there was required an increased evaporation of 8.2% more water to operate the pump, leaving 91.8% of the total exhaust steam leaving the pump absolute gain and as this 8.2% of the total would go but a little way toward heating a train and on the other hand the total amount of steam passing through an air pump does in many cases furnish the whole amount of steam required for heating purposes, the economy is apparent."

SIDE RODS.

36. D. A. B., Camino, Cal., writes: Is it safe in disconnecting for broken eccentric straps or rods to leave the side rods up? This question arose after reading a paragraph in Dr. Sinclair's "Locomotive Engine Running and Management." It is on page 138 of the book and it only mentions taking down the main rod.—A. Yes it is quite safe to leave up both side rods after disconnecting as described in the book. In fact, to leave them up is the proper course. The only question about leaving side rods up or taking them down is when it is a choice between a side rod on one side or none at all, and then none at all is the safer course.

FIRST STEEL LOCOMOTIVE BOILER.

37. R. M. B., Scranton, Pa., writes: I am preparing a paper on boilers which will not affect various lines of development and I wish to know when and where the first locomotive boiler of steel was made. Any information on the subject would be thankfully received.—A. The first locomotive boiler in America to be made entirely of steel was constructed in the Grand Trunk Railway repair shops at Stratford, Ont., in 1861. The engine for which the boiler was made was illustrated by a colored insert in LOCOMOTIVE ENGINEERING, February, 1892.

GRAVITY OF OIL.

38. B. S., Buffalo, N. Y., writes: In magazine and papers I often find oil described as being of certain "gravity." I understand that word to mean a tendency to fall, but I cannot see how it applies to oil. Could you give an explanation that a common man can understand?—A. The gravity of oil means its lightness or weight as compared with water. It is recokned on what is known as the Baumé scale. In this water stands as 1 and as all oils are lighter than water, their specific gravity is a decimal part of 1. Oil of 32° gravity has a specific gravity of .8641 as compared with water, and one gallon weighs 7.20 pounds. A gallon of water weighs 8.33 pounds.

BLOCKING A VALVE.

39. D. A. B., Camino, Cal., asks: How do you block a valve that is operated by a transmission bar, like on Atlantic type.—A. The method of blocking a valve if done properly has no connection with the type of motion. The valve rod should be taken off, and a socket put on the end of the valve stem and secured by the key. This socket being provided with an arm or bracket of the proper form to fit on one end of the metallic packing studs, under the lock nut, and of suitable length, so that when in place the valve is exactly central. Every engine should be provided with one kept in the tool box.

DISTRIBUTING VALVE TEST.

40. F. E. A., Spencer, N. C., asks: If a brake pipe reduction results in less brake cylinder pressure than it should on an engine equipped with the E. T. brake, where would you look for the trouble?—A. At the safety valve of the distributing valve to see that there is no leak past the valve seat where the equalizing valve is in service application position, at the equalizing valve packing ring to see that it is not stuck in the groove and leaking badly, which would allow pressure chamber air to escape into the brake pipe during the reduction, and to see that the equalizing valve moves freely in the bushings. If a light application from the Independent brake valve applies the driver brake promptly and a light application from the automatic brake will not, the safety valve being known to be in good condition, it indicates that the equalizing valve of the distributing valve is not working properly.

Circulation in Locomotive Boilers.

By ROGER ATKINSON.

Water circulation in steam boilers is the result of the absorption of heat by the water. Water is a very poor conductor of heat, by which we mean that heat does not pass readily from one particle which is hot to another cooler one which is in contact with the hot one; and therefore heat is not easily distributed from one part of the body of water to another by conduction or transmission between particles. Each part of the water must be brought in contact with the source of heat. This takes place by natural laws if the heat is applied in a proper manner. Water, like almost all bodies, expands on heating, and therefore when hot becomes lighter than the cooler water which may surround it, and rises from the heated surface, thus giving place to the colder water to flow in and become heated. The more rapidly this movement, which is called convection, takes place, the sooner does the whole body of water become hot. The heated water, which leaves the source of heat, rises to the surface, losing some of its heat on the way by conduction and dispersion amongst the colder water and is soon pushed aside by other particles of hot water following until it reaches the cool side of the vessel and then sinks down to take the place of cold water which has gone toward the source of heat. It does not readily go below the level of the heated portion for the reason that the water below the source of heat remains practically cold until it is warmed by conduction, and little by little expands and comes up to the hot zone, and is then heated rapidly and sent up. Consequently the movement called convection, or circulation is not soon set up, nor does it exist to any extent below the source of heat, and it is never produced as in other parts unless arrangements are made to compel it to "join the procession." The expansion of water per degree of increase in temperature is not nearly a constant quantity. At 60 deg. F. it expands about 1-12,500th (one twelve-thousand five-hundredth) part per degree Fahrenheit. At 140 deg. F. it expands about 1-3,000th (one three-thousandth) part of its bulk, while at 211 deg. F. the expansion is about 1-2,000th (one two-thousandth) part, or six times the rate of expansion that it had at 60 deg. F.

The hotter the water is, the more efficient the additional heat absorbed becomes in expanding it and causing it to rise and circulate. This accounts for the length of time required for a locomotive boiler to begin to feel warm after lighting up, and its rapid heating afterwards, and also for the legs of the firebox remaining cold for a long time. Thus the more rapid the circulation is, the oftener can each particle of the water come round and "take a lick" at the hot surface. The generation of steam bubbles materially aids the rise of the hot currents of water to the surface by their more rapid rise, while on the other hand, anything that impedes the descent of the circulation current militates against the circulation and the steaming capacity, and also against the economy. It is therefore important that the descending column of water shall have unimpeded flow, and in tubular boilers where the evaporation is high as compared with the total volume of water in the boiler, it is of the greatest importance. Probably nothing has such a bad effect as the application of heat to the water in the "down-take" part of the boiler, whether this downtake is in the form of pipes or only a certain section of the boiler which the water naturally gravitates toward. Thus for instance, as an example of good practice, we see the Babcock and Wilcox downtake is located out of the draft, but where the surroundings are sufficiently hotter than the water to prevent cooling by radiation; other instances can easily be found by the observer, and such boilers as have the downtake heated much above the temperature of the water descending are to that extent deficient in design.

In locomotive boilers there is no downtake constructed. The greatest evaporation takes place about the firebox, and the maximum of that about the front of the crown sheet. Thus there will be a current rising all round the firebox, but most rapidly near the front, and also up through the flues throughout their entire length in the centre, most rapidly near the back flue sheet, but whether the side flues are in an upward flow or a downward one is not easy to ascertain. It is, however, reasonably certain that it is not good practice to splay the flues out to fill this down space, and that it is good practice to leave plenty of space between the flues and the shell at the sides. This was the conclusion arrived at by the S. M. P. of a prominent road, after finding that of duplicate en-

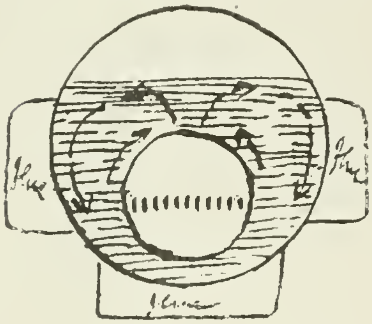


FIG. 1.

gines those with more side space and fewer flues were the best steamers.

In some designs the body of the water is filled with flues apparently with a view to take the heat to where the cold water is, and compel it to heat by conduction, which is both unwise and unnecessary, as the water will readily come to the hot surface if the formation is such as to permit its ready displacement by other water, which has been heated, and internal circulation ducts are rather a hindrance than a benefit.

There have been several attempts made to improve the downtake at the sides of the firebox and against the outside sheet by putting a diaphragm down the centre of the water space. This was tried by the late Mr. Charles Blackwell about 1884 in a class of consolidation engines, but no gain was observed. It is doubtful, indeed, if there is any down current inside the firebox shell that would be of much account, as it is much more probable that the hot water from the sides of the firebox goes forward toward the comparatively cool front end where the water is heavier, and is carried down the sides of the flues as it cools by admixture with colder water.

There will, therefore, be a gradual progression of the greater part of the water from the front where the supply enters, to the firebox end where most is evaporated and leaves the boiler as steam. It is evident that little of the water over the crown sheet ever goes far down the sides again, as it is very hot, and as the layer of water against the sides of the firebox is also hot and probably filled with steam bubbles rising and being evaporated rapidly, the downward current against firebox shell will be comparatively small and slow; and on the average the whole body of water around the firebox is rising at a fair rate of speed and must be supplied from some other part of the boiler.

If we now consider the entering water, it will be evident that from the inlet the current will be forced down by three causes: (1) The entering water is colder and denser than that already in; (2) the down flow around the sides of the flues; (3) the demand for water to take the place of that rising by heating at the firebox end, causing supply to flow back along the bottom of the boiler and fall into the legs of the firebox to replace the rising column.

If we take a fair-sized locomotive working hard, say developing 1,000 h. p., and assume that we can get 1 h. p. from 25 lbs. of steam or water evaporated, then the total evaporation per hour is 25,000 lbs., or 50 gals. per minute, which is well within the capacity of a Sellers 10½ injector. The boiler of such a locomotive would have probably about 70 sq. ft. of evaporating surface on the water, when the water is 6 in. above the firebox crown, and much less if the water level is higher, as it is commonly carried. That is, under these conditions the level free surface of the water from which steam can rise would be about 70 sq. ft. The evaporation then would be not less than 6 lbs. of water

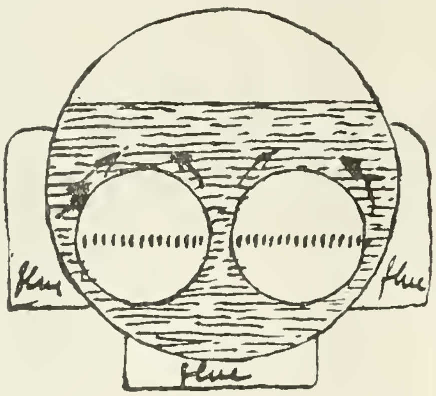


FIG. 2.

per square foot of surface per minute, or the water level would go down at the rate of 1⅛ in. per minute, over the total surface. It must be disappearing much faster than this rate at the places where the evaporation is at its maximum. Now the water area on a horizontal plane through the centre of the boiler is much less than the surface we have considered, as the firebox and flues from such a large portion, and therefore the area on this central plane is only about 40 sq. ft. as the feed is 50 gals., or 11,550 cubic inches per minute, and the area of the boiler on the centre line is 40 sq. ft., or 5,760 sq. ins., then $11550 \div 5760 = 2$ ins. Consequently the average rise of the water to supply the evaporation will be about 2 ins. per minute, for the whole area of the boiler at the centre line. This, of course, does not refer to the speed of circulation in any way, but only to the rise due to evaporation, and it would have to be added to, or deducted from, the speed of circulation for any given point. If it were not for the longitudinal circulation the cold water would lie still under the flues in the Scotch marine boiler, where a hydrokineter has to be used to draw away the cold water and put it in at another point, and thus force a circulation to take place below the fires to prevent destruction of the plates due to unequal expansion.

In the old Cornish boiler with one internal flue, which is also the firebox, the gases of combustion return along the bottom and then pass along the sides, the heat on both sides of the furnace is balanced and the circulation takes place as shown in Fig. 1, being reduced by the heating effect of the side flues, and but little movement takes place in the water at the bottom, under the flue. Longitudinally, however, as the furnace is at one end, there will be a rising current at that end and a descending current at the other end.

In the Lancashire, or two-flued boiler, Fig. 2, the water between the two furnaces will be the quickest in movement and is partly balanced by the water from the opposite side of each flue. The longitudinal circulation backward along the top and return forward along the bottom is the only means by which the water below the furnaces can be brought into the hot region.

In the Galloway type of Lancashire boiler, the two fire-flues join behind the brick bridges at the end of the grates, and form an oval flue, Fig. 3, which is stayed by taper pipes. These pipes being in the direct flame, act as ducts to cause the water at the bottom of the boiler to come up through the centre, and it then flows down the sides, thus equalizing the temperature of the boiler to some extent. In these boilers the side flues militate against circulation.

The Babcock and Wilcox type of boilers give the best illustration of good circulation, but it is absolutely necessary that the pipes have great inclination in order

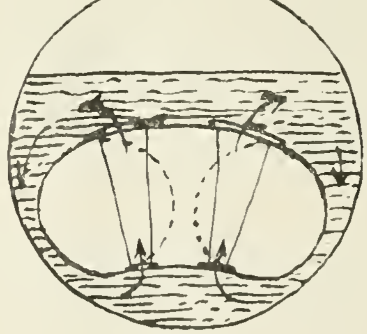


FIG. 3.

to carry away the steam as formed. Those boilers of this general type which have a comparatively small inclination of the water tubes, will give most trouble by burst tubes. The marked incline of the Babcock and Wilcox tubes promotes rapid circulation.

Air Brake Department

Conducted by G. W. Kiehm

Leak at H6 Brake Valve.

From the time the automatic air brake was invented up to the present time, air brake men have been busy attempting to impress upon the minds of everybody connected with the operation and maintenance of the air brake, the importance of the knowledge of construction, operation and care of the equipment, and the instruction has in the meantime extended to the form of lectures, demonstrations, books, technical magazines, correspondence, and private conversations, and instead of the work being near completion it has only begun, not through the failure of any air brake instructors, but due to the varying conditions and requirements of air brake service and to the fact that as a man severs his connection with air brake matters, some one must be trained to fill his place. Misconceptions and wrong impressions of the functions of the various parts of the air brake equipment are natural, and intelligent men profit by their mistakes, and questions are often asked which cannot be answered directly or fully in the question and answer columns, as a brief explanation is usually unsatisfactory, and profuse explanation tends to confusion of the subject, and at the present time it is intended to consider an air brake leak coming from one of three different points of the H6 Westinghouse brake equipment.

On a locomotive with this brake equipment, having proper brake pipe and main reservoir pressures and the handles of both brake valves in running position, there may be a leak or blow of air at the emergency exhaust port of the automatic brake valve, which may be from the rotary valve seat of either the automatic or the independent brake valve, or from the equalizing slide valve of the distributing valve, and to locate the source of the leak without an examination of the parts or without removing any, is a simple operation scarcely worthy of serious consideration; nevertheless, three different tests to locate the part at fault will be submitted:

(1) "With the brake pipe pressure at 70 lbs., if 110 lbs. reduce to 70 by turning the handwheel of the adjusting screw of the brake pipe feed valve to the 70-lb. stop, and with both brake valve handles in their running positions reduce brake pipe pressure 10 lbs. by a service application of the automatic brake and return handle to lap position. The red, or brake cylinder, hand of the small duplex air gauge should then show about 25 lbs. pressure, and if it increases to 45 lbs., it indicates a leak past the rotary valve seat of the independent brake valve; if the pressure increases to a figure somewhere between 50 and 60 lbs., it indicates a leak from the equalizing slide valve seat of the distributing valve, and if the pressure increases to the adjustment of the safety valve (68 lbs.), it indicates a leak from the rotary valve seat of the automatic brake valve into the application cylinder of the distributing valve."

(2) "With brake pipe pressure at any figure, place the automatic brake valve handle on lap position and note whether the blow has stopped; then return to running position and place the independent brake valve handle on lap position and note the effect. If the blow at the emergency exhaust port of the automatic brake valve continues when its handle is placed on lap position, its rotary valve is at fault, and if the blow stops, it indicates that it does not leak, return the handle to running position and place the handle of the independent brake valve on lap position; if the blow then stops, it indicates a leak from the equalizing slide valve of the distributing valve; if it continues, it indicates a leak from the independent brake valve."

SINGLE POST WITH AUTOMATIC AND INTERLOCKING SIGNALS.

(3) If any doubt exists as to where the blow is from, after the first two tests, the third should locate it positively.

"With both brake valves in running position, unscrew the adjusting nut of the reducing valve and open the signal line stop cock; this will relieve the independent brake valve of air pressure, and if the independent brake valve is leaking the blow will stop. If it continues, close the stop cock under the automatic brake valve and open an angle cock, place the independent brake valve handle in release position for a few seconds to exhaust the pressure from the application cylinder and allow it to return to running position; if the blow stops, it indicates that the distributing valve is at fault; if it continues, close the stop cock in the distributing valve supply pipe, and after a few seconds the automatic brake valve alone will be under air pressure, and a leak at its exhaust port at this time must be from the brake valve itself."

In reviewing the foregoing tests it will be observed that the conservative word "indicates" is used, for the reason that a leak at the exhaust port of the brake valve might possibly be due to a cracked gasket in the brake valve, or to a cracked or corroded tube or cored passage in the distributing valve reservoir, as well as from the three points mentioned, while not likely to occur, yet the possibility of the unexpected is always present, and furthermore, the valve that leaks when in one position may be practically free from leakage in another.

It might be well to dwell for a moment on the flow of air during the time any of the leaks mentioned exist; it is well known that when both brake valve handles are in their running positions and the equalizing valve of the distributing valve is in release position, the application cylinder and application chamber are open to the atmosphere through the independent brake valve and the exhaust cavity of the automatic brake valve, and any leak into the application portion of the distributing valve or into the application cylinder pipe or into the release pipe, will at this time cause a blow or leak of air at the emergency exhaust port of the automatic brake valve. A leaky rotary valve in the automatic brake valve would allow air to pass directly into the exhaust cavity and to the exhaust port, but in order to build up a pressure in the application cylinder of the distributing valve, and apply the brake when the handle is moved to lap position, there must also be a leak into the ports in the valve seat to which the application cylinder and release pipes are connected.

A crack in the body gasket between the chamber and the equalizing discharge valve and the ports just referred to, would allow air to pass through the release pipe to the exhaust cavity of the brake valve in one case; in the other case, through the application cylinder pipe to the application portion of the distributing valve, thence to the release pipe to the atmosphere, and if the valve handle is moved to release, lap, or holding positions, the escape would be cut off and the brake would be applied by the building up of pressure in the application cylinder.

The leak from the rotary valve seat of the independent valve would pass into the release pipe and into the exhaust port of the automatic brake valve in one case, and into the application cylinder pipe, application cylinder, release pipe, and to the brake valve exhaust port in the other case.

The leak from the equalizing slide valve would travel the same route and would be free to pass from the pressure chamber into the application, and the supply would be maintained from the brake pipe through the feed groove, and should a leak start from any of the tubes or cored passages in the reservoir, brake pipe, pressure chamber, or supply pipe, that leakage would also escape at the automatic brake valve exhaust port and have the same effect of applying the brake when the brake valve handle is moved away from running position. Considering the leaks from the brake valve rotaries and from the equalizing slide valve as ordinary, that from the slide valve being the one usually encountered, and the possibility of leaks from the brake valve gaskets and from the reservoir passages as extraordinary, and applying the three tests, the first two of which are merely observations requiring but a moment's time, the three could be properly conducted in a very short time, admitting the possibility of the unusual being present and to avoid a complication or misunderstanding of the simple tests given, the effect of an unusual action would be considered in a measure separately from the test, but at the same time.

Suppose the blow at the brake valve exhaust port was due to a cracked brake valve body gasket which leaked, equalizing reservoir pressure into the application cylinder pipe or into the release pipe, it would be noticed during the second test when the brake valve handle was moved to lap position, by the equalizing discharge valve becoming unbalanced, due to the reduction of equalizing reservoir pressure, and the result would be a discharge of air at the brake pipe exhaust port, and an automatic application of the brake. Should the supply pipe passage of the distributing valve reservoir start a leak into the application chamber, it would upset the theory advanced in the first observation or test, and indicate a leaky automatic brake valve rotary, but during the second test when the independent brake valve is placed on lap position to separate the automatic brake valve and the distributing valve, it would be observed that the application cylinder pressure was built up to the adjustment of the safety valve by this leak of main reservoir pressure, which we know could not occur from an equalizing slide valve leak under a 70-lb. brake pipe pressure.

The effect of a leaky brake pipe passage and a leak in the pressure chamber tube where they pass through the application chamber, would be similar to a leaky equalizing slide valve, and in the first test, just to what pressure the brake cylinder hand on the gauge would rise to, depends upon the amount of leakage and the length and size of the brake pipe, for if the volume of leakage from the equalizing slide valve is about equal to the capacity of the feed groove the pressure chamber could not be charged, and a 10-lb. reduction would not move the equalizing valve, but the brake would of course be applied by the leakage, and in a short time the brake pipe, pressure chamber, and application cylinder pressures would equalize.

If a leak in the tube or cored passage should exist, according to the test, it would indicate a leaky equalizing slide valve, and if the distributing valve were removed and replaced by one tested and known to be in good condition and the same disorder continued and under the same conditions, a test for the tube and passage would be necessary to locate the defective one, or a test would be necessary to locate a leak or crack that would allow pressure from an unusual source to enter the application chamber. The reservoir can be thoroughly tested without removing it from the engine by whittling a few wooden plugs to fit the different sized ports exposed after the distributing valve has been removed from the reservoir, and before removing it the brake would be applied in full by exhausing the brake pipe pressure; then the stop cocks in the reservoir supply pipe and brake cylinder pipe can be closed and the distributing valve removed, driving plugs in each port successively or bolting a circular board with an opening in the center, and a blind gasket to cover the various ports, to the distributing valve reservoir and opening first the stop cock in the brake cylinder pipe will allow brake cylinder pressure to flow back to the cored passage in the reservoir, the reservoir or supply passage can then be tested by opening the cock in that pipe, placing the brake valve handle in running position would charge the brake pipe passage.

After those parts are known to be free from cracks or flaws, the pressure chamber tube and the wall dividing the application and pressure chambers can be tesed by making a connection from the signal line to the pressure chamber drain passage, by means of a hose, a piece of pipe, and a few fittings.

Of course, it is understood that a leak of this kind might never occur in the entire experience of an individual, but is liable to occur at any time, and to thoroughly understand the effects of any leaks that are liable to occur will lead to a pretty fair knowledge of the construction and operation of the air brake, and when that is once understood the so-called mysterious actions of the brake will disappear.

The leak through the brake valve gasket is not so unusual, and is liable to be met with at any time, and the leaks from the rotary valve seats of the brake valves are the natural results of wear, while the leak from the equalizing slide valve of the distributing valve is of the most common occurrence, being similar to a triple valve, will leak from the same causes that triple slide valves will, and if the action is always compared with that of a triple valve on a car, and the brake valves with that of a retaining valve, and the application piston with the brake cylinder piston, there will be no difficulty encountered in locating the cause of an unusual action. Unfortunately for those who do not follow air brake matters closely, the H6 and the H5 brake equipments are in use at the same time, and often both are found on the same class of locomotives, however the different parts of the equipments are not interchangeable, and the differences are not so marked but that a knowledge of one will quickly lead to an understanding of the other, it being remembered that in the H5 brake the application cylinder and the application chamber are always in communication and open to the atmosphere when the brake valve handles are in their running positions, while in the H6 brake those chambers are open to the atmosphere through the exhaust port of the equalizing valve when it is in release position, both valve handles being in running position, and the application cylinder and pressure chamber are divided when the equalizing valve is in emergency position. In the H6 distributing valve there is no port opening in its emergency position to regulate application cylinder pressure, but instead a "blow down timing port" is added in the brake valve, it and the warning port receiving their supply of air from the feed valve pipe. The number 6 distributing valve reservoir has a 1-in. brake pipe connection to provide a large brake pipe opening for emergency applications when the quick-action cap is used, in double heading the stop cock under brake valve is closed, but the valve handle remains in running position.

Electrical Department

(*Continued from page* 189.)

This auxiliary contact wire is suspended by clips attached midway between the hangers and has shown very little wear and gives a smooth, sparkless contact for the current collecting device of the locomotives.

At the anchor bridges all the steel cables are dead-ended as was stated, and each contact wire is separated from the next section by a section insulator. A circuit breaker is mounted on each anchor bridge for every contact wire and, in addition, a single circuit breaker is arranged so that the entire section may be cut out. These circuit breakers connect the feeders with the contact wires. This arrangement of circuit breakers makes it possible to disconnect and cut out any single trolley wire that may be giving trouble, or if necessary an entire section can be cut out without disturbing the section beyond. This plan makes each section entirely independent. The sections are equal in length to the spacing of the anchor bridges, which are about two miles apart. The insulation provided is very substantial, and the bridges and cables are built with a high factor of safety. The return track circuit is bonded together.

THE ELECTRIC LOCOMOTIVES.

The electric locomotives are designed to handle a 200-ton train at a schedule speed of 26 miles an hour with stop every 2.2 miles. On long runs they can haul a 250-ton train at a speed of 60 miles an hour or higher. For trains that are heavier than these, two locomotives are coupled together and operated as a unit. The electric locomotives are equipped with four motors, each of 250 h. p. capacity, nominal rating; their continuous capacity is over 200 h. p. each, making a total of over 800 h. p. The motors are of the gearless type and are connected permanently in pairs. They operate on either direct or single phase alternating current.

The frame, trucks and cab of these locomotives were built by the Baldwin Locomotive Works. The frame is of the rigid type and is 36 ft. 4 ins. in length. The side frames are of forged steel and to them the pressed steel bolster carrying the pressed steel centre plate is riveted and bolted. The weight is carried by semi-elliptic springs with coiled springs at the ends of the equalizer bars to produce equilibrium. The construction is very strong, but without excess weight.

The runing gear as originally designed consisted of two trucks, each mounted on four 62-in. driving wheels. It has since been found advantageous to install two pony trucks. The trucks are spaced 14 ft. 6 in. between centres. The cab is built of structural steel, on a framework of Z-bars; all apparatus inside the cab is carried on structural steel supports. Large trap doors in the floor permit easy access to the motors.

THE MOTORS.

The motors are of the alternating current single phase series wound compensated type. In the early stage of electric railway development very little was known about alternating currents, and a direct current circuit of 500 volts was as high as was considered safe. As a result the 500-volt direct current system became standard railway practice. When alternating current with its ease of transformation came into more extended use and was better understood the engineers turned to it for a motor suitable for railway work. Now it is a well-known fact that if you reverse the direction of the current flow in a direct current series motor, that the motor will continue to rotate in the same direction as formerly. This is due to the fact that the current in both the field coils and the armature has been reversed. In order to reverse the direction of rotation of a motor either the field current or the armature current only must be reversed. Therefore, if a current that is periodically reversing in direction, or in other words, if an alternating current is supplied to the terminals of an ordinary, direct current series motor, it will rotate in one direction only because the reversals of current in the armature and in the field will take place simultaneously. The motor, however, will spark badly at the brushes and will have a very low efficiency.

Only a few changes are necessary to alter the ordinary direct current series motor into a satisfactory alternating current series motor. On a motor, when a brush touches two commutator segments, it short circuits the armature coil connected to those segments. If the motor is supplied with alternating current this short circuiting of a coil in the varying magnetic field produced by the alternating current causes severe sparking. This is due to the fact that the varying magnetism induces a high current in the short circuited coil. Now, during direct current operation the coils are also short circuited by the brushes, but the varying magnetic field is absent. The direct current field is stationary, therefore there is no sparking produced. To remedy this state of affairs with alternating current, two things are done. The wires or leads that connect the armature coils to the commutator bars are made of metal that has an appreciable resistance. This increase in resistance reduces the current in the short circuited coil. Extra field coils, called auxiliary or compensating coils, are provided which provide a steady magnetic field at the brushes. These two additions remedy the severe sparking of the direct current motor when supplied with alternating current.

The cause of the low efficiency of the motor when operated on alternating current is the fact that the field poles of direct current motors are usually made of either cast iron or cast steel. When the iron of the field poles is subjected to varying magnetism, it has induced in it currents that flow back and forth. These currents are known as eddy currents and they produce heating. In order to reduce them, the poles and field frame of an alternating current motor are made from thin plates such as are used in transformer construction. If these three changes are made in an ordinary direct current motor, the result is a motor that will run satisfactorily on a single phase alternating current circuit. Not only will the motor run well on alternating currents, but it will work even better on direct current.

The motors employed on the electric locomotives of the New Haven road are of this type. The armature is made in two sections and is mounted on a hollow shaft. The armature winding is connected to the commutator segments by resistance leads called preventive leads, which reduce the current when the coil is short circuited by the brushes as was explained. There are twelve field poles and the field circuit consists of two parts, the main field for driving the motor and the compensating field for producing sparkless running. The field frame is split horizontally so as to permit easy removal and give access to the armature. The armature is not mounted directly upon the car axle, but on a hollow shaft or quill, through which the car axle passes with about half an inch clearance. At each end of this quill are bearings which carry the field frame. On each end of the quill a flange is forced. From this projects seven pins. These pins engage corresponding pockets in the hub of the driving wheels. Around each pin there fits a coiled spring which turns progressively eccentric. These springs serve to transmit the torque from the motors to the driving wheels. This type of motor suspension is very flexible and is a new feature of motor suspension which was inaugurated by the New Haven road.

One of the novel features of these locomotives is the cooling arrangement. A blower was needed to furnish air for the cooling of the transformers, and it was decided to extend this to the motor. A flexible conduit supplies a liberal quantity of air to all the motors. The success of this method of cooling is shown by the fact that the continuous rating of the motors is almost equal to the nominal rating. It also possesses the advantage of keeping the motors clean, there being no chance for dust or dirt to enter, because the flow of air is always outward. A special electric thermometer is placed in the cab in view of the engineer and indicates the temperature of the motors.

THE CONTROL.

As the motors are required to operate on both alternating and direct current there must of necessity be two systems of control. This does not mean that there are two complete separate sets of control apparatus on the locomotive, because many of the parts are common to both systems. In almost all railway equipment the resistance grids and other pieces of apparatus are placed underneath the floor of the car where they are out of the way. On the New Haven electric locomotive, however, none of the auxiliary apparatus are placed beneath the floor; everything is inside the cab, where it is protected from the weather, and can be readily inspected. As was stated before, the motors are permanently connected together in pairs and operate as a unit.

The direct current control is very similar to the other systems of direct current control such as are described on pages 21, 119 and 163 of the 1908 volume of Railway and Locomotive Engineering. The New Haven control, however, possesses several new features. The control apparatus for each motor consists of four resistance grids and a set of eleven contactors for making the different connections for applying the power to the motor. On the first notch the two motors are connected in series with all of the resistance grids in circuit. The resistance grids are cut out of circuit step by step until the full voltage is applied to the motor in series. Here a new feature of motor speed control is introduced. Ordinarily the next notch would connect the motors in parallel with all resistance in circuit. On the New Haven locomotives, however, the next notch puts a resistance across the fields, thereby taking or shunting, as it is called, some of the current away from the fields. This reduction of the field current lowers the strength of the magnetic field. The motor increased its speed in its effort to maintain its counter or back voltage constant, as was explained on page 209 of our 1908 volume. If the field magnetism of an ordinary railway motor was reduced, sparking at the brushes would result. Here is where the compensating fields are useful because they provide a magnetic field at the brushes which is constant and thus prevents sparking.

Making this operation possible, the motors are next put in parallel with all the resistance in circuit and the resistances are cut out step by step until both motor units are receiving full power. The controller has several more running positions than the ordinary controller which has only two positions, because it is possible to weaken the fields without producing sparking. This system of control can be favorably compared to a steam locomotive where the engineer not only opens his throttle step by step but at the same time notches up his reverse lever. The gradual opening of the throttle may be compared to the cutting out of the resistance grids step by step. The act of notching up the reverse lever and shortening the cut-off is something like the shunting of the fields by resistance.

The alternating current for operation of the motors is collected at 11,000 volts from the trolley wire, and is fed to the primary of a transformer. The secondary of the transformer delivers the current at a pressure of 450 volts. The secondary is provided with a number of taps which are connected to successive turns of the winding. By means of these taps the voltage supplied to the motor units is varied without the use of resistance grids, and therefore in the alternating current control no power is lost in resistances. There are two transformers, one for each motor, and the two sets of eleven unit switches, which have been already mentioned, serve to make the connections.

Both motors are operated separately on the alternating current control, each being supplied with power from its particular transformer. On the first notch one terminal of the motor is connected permanently to the terminal of the transformer, the other motor terminal is connected to the first tap on the transformer, and power at a low voltage is supplied to the motors for starting. The next notch shifts the terminal to the second tap, from which power is supplied at increased pressure. The third notch shifts the connection to the third tap and this advance is continued until the full 450 volts is supplied to the motors. There are six running points on the alternating current control.

The direct and alternating current controls may be compared to a system of control that could be applied to a water wheel. Suppose a tank 100 ft. in height is provided with a succession of pipes which tap it at intervals of 20 ft. each, and that an extra tap is provided at the bottom that is fitted with a throttle valve.

If we start the water wheel, using the throttle valve and opening it notch by notch, thereby increasing the pressure supplied to the wheel until the valve is wide open, we have a system of control that can be compared to the direct current control described above. Suppose that instead of using the throttle, we first feed the water wheel with water from the pipe that taps the tank 20 ft. from the top. Then increase the head to 40 ft. by turning on the next tap and continue until the wheel is connected to the tap at the bottom of the tank. If this method of supplying water power is employed, the system is similar in principle to the alternating current control. It is in fact the varying of what hydraulic engineers would call the "head." To start the water wheel only a low head is used and the flow of water is small. As the wheel gains speed the "head" is increased and the flow of water is more powerful. Each increase in "head" supplies more power as the water wheel gains speed.

The wires that work the control circuits for both the direct and alternating systems are bunched into what is called a train line, which is brought out at either end of the locomotives. When the train lines of two locomotives are connected together, the locomotives can be operated as a single unit by one engineer in the cab of the front locomotive. For very heavy trains two locomotives are used and if necessary more can be added, all being under the complete control of a single engineer.

THE MASTER CONTROLLER.

A master controller for operating the unit switches is placed in each end of the cab, the same controller operating both the direct and alternating current systems. The controller has two handles, one for reversing and the other for operating. The operating handle is provided with notches similar to a steam locomotive throttle. On the controller there is mounted a row of eight knobs or buttons, one for pushing the direct current trolley up, one for pulling the alternating current trolleys down, one for pushing the third rail shoes down, one for pulling the third rail shoes up, and the remaining three operate the bell and the front and rear track sanders.

THE CURRENT COLLECTING DEVICES.

The New York Central 600-volt direct current service is supplied by third rail except where the tracks intersect or at road crossings, where short section of overhead conductors are placed. The New Haven supplies its alternating current entirely by overhead wires. There are four third rail shoes, two to each truck for collecting direct current, and these are controlled by buttons on the motor controller, as was stated. When not in use they are raised and are out of the way. There is also a small direct current pantagraph trolley mounted at the centre of the locomotive, which collects current from the overhead conductors on the New York Central's tracks. There are two alternating current pantagraph trolleys for collecting the electric power on the New Haven system. These trolleys are built of steel tubing, and the collector is a strip of soft copper. The collecting devices are under control of the engineer.

AMONG THE WESTERN RAILROAD MEN

By James Kennedy

In drawing some conclusions from a brief tour among the Western railway men it may be said that there are two prominent features that strike a visitor from the East whose previous experience or opportunities may have been of the most casual kind. The first is the prevailing degree of thoroughness of equipment which marked almost every section visited. The passenger locomotives have everywhere the massive elegance and perfection of detail that one sees in the large marine engines of British manufacture. This fine feature is enhanced by the standardization of the equipment. When one recalls the infinite variety of designs that marked the locomotives of thirty or forty years ago, and contrast their mechanical absurdities with the finished and settled forms of our own day, we cannot but think that we are not only living in an age of progress, but we are also living in an age when things mechanical are taking shape as perfect as the architecture of the ancient Greeks did in the days of Pericles.

JAMES KENNEDY.

The other striking feature is equally important. It manifests itself in the convenience and elegance of the repair shops. Crystal palaces many of them are, with walls white as polished marble and floors smooth as burnished jasper. The symmetrical beauty of these buildings, vocal with the melodious murmur of multitudinous machines, glittering like silver, and rich in color as cathedral windows, are often in strange contrast with the uncultured wilderness without, where the impenetrable jungle spreads its leafy labyrinth, or the stunted sage bush sparsely covers the parched plain. The opportunities for doing fine work under the best conditions are great. The mechanics seem to be well-cared for and contented.

THE ROUNDHOUSE FOREMAN.

Nobody seemed to be in a particular hurry except the roundhouse foreman. Whether his lot is cast in a ramshackle wigwam, frail as a circus tent, or in a brilliant amphitheatre, his burden is everywhere a heavy one. While the master mechanic may be said, in his luxurious elegance, to resemble on English squire or a Scottish laird, the roundhouse foreman might be likened to an Irish "spálpeen," whatever that is. Everybody from the poorest paid mechanic in the shop to the latest arrival among the firemen or engineers can come at any hour of the day or night and, figuratively speaking, wipe their feet upon him. An overworked mule in a Pennsylvania coal mine has some brief glimpses of green fields in its darkened life. The roundhouse foreman has no such sunny spasms. With him it is the everlasting grind of dull mechanical drudgery. His life is harder than that of a Dutch grocery store boy who has to eat what nobody else will buy, and sleep under the bench all night. He is a walking encyclopedia. He has to furnish brains to overgrown boys, and eyes and ears to old men. He has to have the suppleness of an acrobat and the attributes of a quadruped. When you enter a roundhouse and behold a pair of muddy feet looking out of the dome top that is the roundhouse foreman standing on his head examining an old-fashioned throttle valve of the vintage of 1860. If you should see a four-footed creature crawling in the slimy pit with one eye on the forward eccentric and the other dimly scanning through the murky haze the crafty mechanics warming themselves at the fire box doors in the comfortable cabs, that's him. He is not there from choice. He is doing things that nobody else can do. He is rectifying the involved valve gearing that some meddling engineer has distorted. He is the only man in the place whose fine ear is tuned to the rhythmic and passionate exhaust of an overworked freight engine. And what thanks has he?

Thanks indeed! He is paid by the month. At night when other men are paid time-and-a-half he gets nothing but abuse. It matters little what time of day it is or what day of the week it is, he is on the job. And such jobs! Ranging as they do from 3,000° Fahrenheit to 40° below zero, he must be at once a salamander and a polar bear. Civil magistrates are paid $7,500 a year for deciding cases of much less consequence than he does. He must have the calm, judicial mind in the most agonizing situations. The man he decides in favor of never thinks of thanking him, while the man he decides against does not rise up and call him blessed.

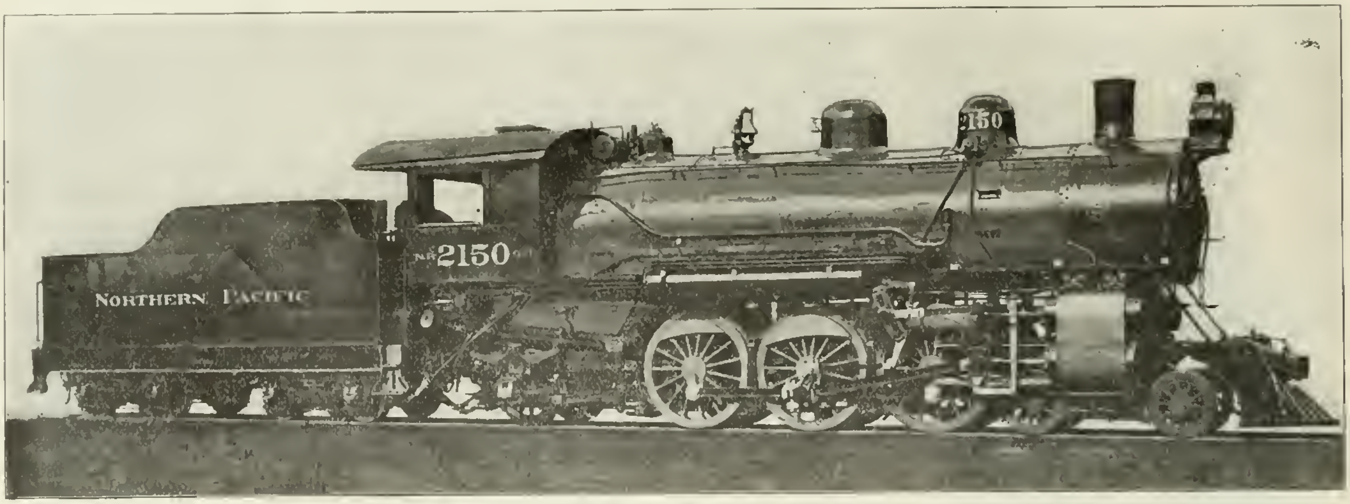
On winter nights when the other officials are at the Railway club wreathed in tobacco smoke and social joy, the roundhouse foreman is roasting in sulphur or freezing in glacial caves under dilapidated tanks, the winter wind singing a melancholy monotone through his petrified whiskers. Sometimes he has ten locomotives in organic and elemental ruin on his hands. And only four men and a boy to place them in perfection again. How he manages is one of the mechanical mysteries. He is a real genius. Inspirations come to him. From the sacred precincts of the back shop he removes the finished work from its well-fitted place, and with a few blows of a soft hammer that is soft only in name, he refits the parts to the lame locomotive and it is ready for the road again and away to seek its fortune.

When there is a strike on the company mistrusts him. He is too familiar with the men. When the stern-faced strikers are purchasing second-hand revolvers at cheap pawnshops and casting lots among themselves to find out whose duty it is to attend to the roundhouse foreman, he is attending to his work with the desperate energy of a commander in the main bastion of a doomed fortification. When the strikers send a captured locomotive under a full head of steam crashing through the roundhouse doors into the turntable pit, the roundhouse foreman must sit up all night writing a report.

PATRICK FENNELL
(Shandy Maguire).

Of course this does not last forever. What the single-barrelled revolver does not accomplish, double pneumonia will do at short notice, and the roundhouse foreman has few mourners. In an unknown grave, or with a tombstone perhaps the size of an ash-pan lid, the worn-out sheath of the high, heroic soul is at rest. The blue-birds are prophesying spring there, and in summer the blue forget-me-nots will be opening their starry eyes and looking heavenward with a promise of a joyous immortality where the wicked cease from troubling and the weary are at rest. If he should survive a long time, it is certain that the better he suits the job, the longer he will be kept there. If he wants promotion he must fight for it with all the cunning of a ward politician. If he tarries long, a day comes when a young assistant to the vice-president comes along. He may be a consumptive dude with a chest as flat as a coffin lid and bleary eyes with spectacles that resemble storm windows, but he quickly sees the gray hairs showing here and there in the devoted head of the roundhouse foreman. His days are numbered. An excuse is found for his removal, or he may have his choice of facing nuts in the bolt room in the back shop, or he may have an appointment offered to him as night watchman of the boiler room and vicinity with a treadmill round of time clocks to visit and mark their tell-tale disks relentlessly revolving like the wheel of Ixion.

There are exceptions. Some there are like "Shandy Maguire," who has just finished forty years' service as roundhouse foreman at the Lackawanna shops at Oswego, N. Y., and retires on a well-earned pension. He is one among a thousand. A great, stalwart man with a soul of fire and a body of iron. Gifted by nature with colossal strength, he has led the simple life. Like the Hebrew children of old he has come unscathed through the fiery furnace. Like Daniel he has been in the den of lions and the fine spirit of the man shining through his radiant eyes softened the hearts of the savages. He is one of the very few railroad men out of whose life work among the grosser elements of the earth, the rare blossoms of poetry have sprung, sanctifying, adumbrating and ennobling the common dish of evedy-day experience. All things move onward and upward, and let us hope that there are better things in store for the future of the roundhouse foreman.



4-6-2 PASSENGER ENGINE FOR THE NORTHERN PACIFIC.

W. Moir, Mechanical Superintendent. Baldwin Locomotive Works, Builders.

WESTERN RAILROAD SCENERY.

New Locomotives for the N. P. Ry.

The Baldwin Locomotive Works have recently completed thirteen passenger locomotives for the Northern Pacific Railway. Ten of these engines are of the Pacific type, while the remaining three are of the Atlantic type. Two of the latter are equipped with Schmidt superheaters. The designs for both classes are based on drawings and specifications furnished by the railway company. Our illustrations give a good idea of these fine passenger machines.

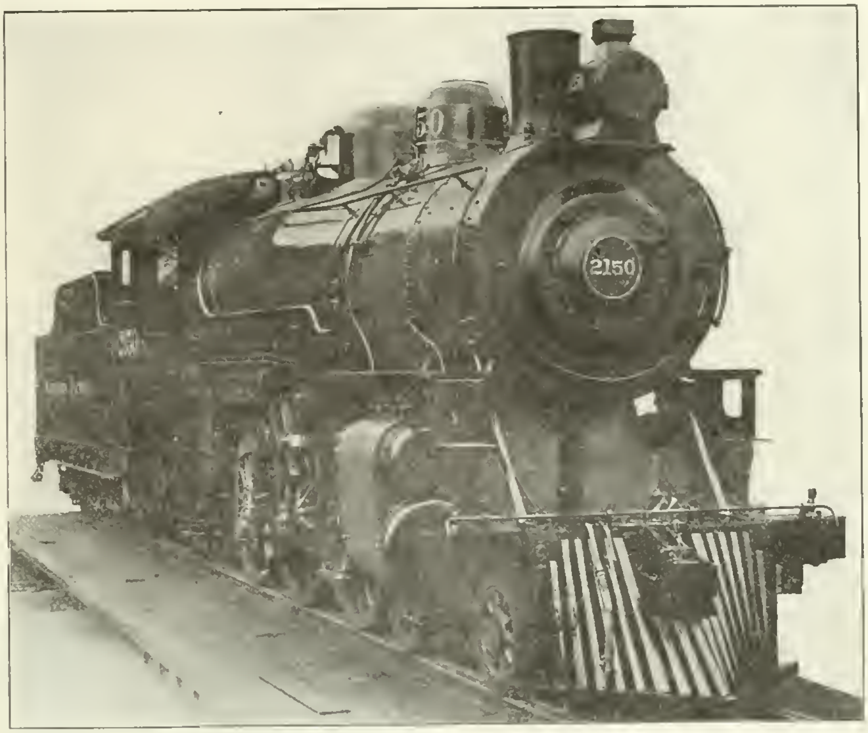
PACIFIC TYPE ENGINES.

The Pacific or 4-6-2 type of locomtives, with cylinders 22 x 26 ins., and driving wheels 69 ins. in diameter, exert a tractive force of 31,000 lbs., thus giving a ratio of 4.65 with 144,350 lbs. on driving wheels. The engines are thus well adapted to handling the heaviest class of passenger traffic, and should be able to start trains promptly regardless of rail conditions. The steam distribution is controlled by inside admission piston valves, 12 ins. in diameter. The cylinders are arranged for single front frame rails 4½ ins. wide by 9 ins. deep. They are built with heavy walls, and the castings are double bolted to the smokebox and to each other. The steam chest centre lines are set out far enough to enable the valve gear, which is of the Walschaerts type, to be in one plane. The link and reverse shaft bearings are supported by a cast steel bearer, which spans the frames between the first and second pairs of driving wheels. The frames are also braced by broad steel castings placed above the front driving pedestals, and between the second and third pairs of driving wheels.

The rear truck is equalized with the driving wheels, and is of the radial type with outside journals. The equalizing beams, fulcrums and driving spring saddles are of cast steel. The driving boxes are of the same material, and the wheel centres are fitted with cast iron hub-liners. The total weight of the engine is 233,250 lbs., and of this the front truck carries 47,000 lbs., and the rear truck sustains 41,900 lbs. The driving wheels, as already stated, have an adhesive weight of 144,350 lbs. The weight of the tender when added to that of the engine, gives a total of about 375,000 lbs.

The boiler is of the wagon type, with a wide firebox and combustion chamber. The combined heating surface of the fire-box and combustion chamber is 212 sq. ft., which is nearly 8 per cent. of the tube heating surface, which is 2,665 sq. ft., while the ratio of grate area to total heating surface is as 1 to 66. The total heating surface is 2,885 sq. ft. In order to provide an unobstructed entry to the throat, the second ring of the barrel is made conical, all three rings having the same centre line. The dome is placed on the conical ring, which has a welded longitudinal seam on top. The combustion chamber is made in one piece with crown and sides of the inside firebox. The under side of the chamber is stayed to the boiler shell by flanged plates, which have suitable circulating openings cut in them. Two T-irons, hung on sling stays, support the forward end of the crown; otherwise, it is stayed by radial bolts. The fire door opening is formed by flanging both sheets outward, and uniting them with a sleeve. A brick arch is provided, and it is supported by a single water tube placed on the centre line of the firebox. The diameter of the boiler at the smokebox end is 72½ ins. The working pressure is 200 lbs. to the square inch.

The tender trucks are of the equalized type, with wrought iron frames and equalizers of cast steel bolsters. The tender frame is composed of 13-in. channels. The tank capacity for water is 7,000 gallons and the amount of fuel carried is 12 tons of soft coal.



NORTHERN PACIFIC 4-6-2 LOCOMOTIVE.

ATLANTIC TYPE ENGINES.

The Atlantic or 4-4-2 type locomotives are generally similar in design and construction to the engines above described, with cylinders 21 x 26 ins., driving wheels 73 ins. in diameter and working pressure of 180 lbs., they exert a tractive force of 24,760 lbs., and with 100,800 lbs. on drivers the ratio of adhesion is 4.07. The same cylinder and cylinder head patterns are used for both classes of engines. On the Atlantic type locomotives, the cylinders are bored to a diameter of 22¼ ins., and are lined with cast iron bushings ⅝ ins. thick. The valve motion details are closely similar throughout, being interchangeable wherever possible. The Atlantic type is equipped with a radial trailing truck having inside journals. The rear frames are of slab section; they are spliced to the main frames back of the rear driving pedestals and are supported on inverted leaf springs between the drivers and trailers. The main frames are braced by steel castings placed over both pairs of driving pedestals. The distribution of weight is 100,800 lbs. on the drivers, 51,950 lbs. on the front truck and 44,300 lbs. on the trailing truck. This gives a total weight of 197,050 lbs. for the engine itself, and with the tender the weight amounts to about 320,000 lbs.

The boiler is straight topped, with three rings in the barrel, the front one having a diameter of 72⅛ ins. The grate is of

ATLANTIC TYPE ENGINE FOR THE NORTHERN PACIFIC.

W. Moir, Mechanical Superintendent. Baldwin Locomotive Works, Builders.

the same size as that used on the Pacific type locomotives, and a large number of fittings are thus common to both classes. The arrangement of the brick arch is similar to that used on the Pacific type. The boilers of the three Atlantic type engines are practically identical, except for the changes necessary to accommodate the superheaters with which two of the locomotives are equipped. The superheater pipes are placed in 22 tubes, 5⅜ ins. in diameter. The heating surface provided, exclusive of that contained in the superheater, is 2,287 sq. ft. as compared with 2,718 sq. ft. in the engine designed for saturated steam. The ratios of grate area to heating surface are thus 1 to 53 and 1 to 63 respectively. A total superheating surface of 430 sq. ft. is provided. The heating surface for the saturated steam engines are firebox, 168 sq. ft.; tubes, 2,543 sq. ft.; firebrick tube, 7 sq. ft.; total, 2,718. Similar dimensions in the engines with superheater are: Firebox, 168 sq. ft.; tubes, 2,112 sq. ft.; firebrick tube, 7 sq. ft.; total, 2,287 sq. ft. The tubes in the superheater engine are 196 in all, 2 in. in diameter, and 22 tubes 5⅜ ins. in diameter; superheating surface, 430 sq. ft. The saturated steam engines have 306 tubes 2 ins. diameter, 16 ft. long.

The tenders of these locomotives are generally similar to those used on the Pacific type, except that they have a smaller capacity for coal and water. As indicated by the tables of dimensions, these are all high-powered locomotives. The details have been carefully worked out and both designs present a symmetrical and pleasing appearance.

DIMENSIONS OF 4-6-2 TYPE.

Boiler.—Material, steel; thickness of sheets, ¾ in., 13/16 in., ⅞ in.; staying, radial.
Firebox.—Material, steel; length, 96 ins.; width, 65¼ ins.; depth, front, 82⅝ ins.; back, 68½ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ⅝ in.
Water Space.—Front, 4½ ins.; sides, 4 ins.; back, 4 ins.
Tubes.—Material, iron; wire gauge, No. 11.
Heating Surface.—Firebox, 166 sq. ft.; combustion chamber, 46 sq. ft.; firebrick tube, 8 sq. ft.; grate area, 43.5 sq. ft.
Driving Wheels.—Outside diameter, 69 ins.; journals, main, 9½ x 12 ins.; others, 9 x 12 ins.
Engine Truck Wheels.—Front, diameter, 33½ ins.; journals, 6 x 11 ins.; back, diameter, 45 ins.; journals, 8 x 14 ins.
Wheel Base.—Driving, 12 ft.; total engine, 32 ft. 6 ins.; total engine and tender, 61 ft. 11 ins.
Tender.—Wheels, diameter, 33½ ins.; journals, 5½ x 10 ins.; tank capacity, water, 7,000 gals.; coal, 12 tons; service, passenger.

DIMENSIONS OF 4-4-2 TYPE.

Boiler.—Type, straight; material, steel; thickness of sheets, ¾ in.; fuel, soft coal; staying, radial.
Firebox.—Material, steel; length, 96 ins.; width, 65¼ ins.; depth, front, 76 7/16 ins.; back, 63 ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ⅝ in.
Water Space.—Front, 4½ ins.; sides, 4 ins.; back, 4 ins.
Tubes.—Material, iron; wire gauge, No. 11.
Heating Surface.—Grate area, 43.5 sq. ft.
Driving Wheels.—Outside diameter, 73 ins.; journals, 9½ x 12 ins.
Engine Truck Wheels.—Front, diameter, 33½ ins.; journals, 6½ x 12 ins.; back, diameter, 45 ins.; journals, 8 x 14 ins.
Wheel Base.—Driving, 6 ft. 10 ins.
Tender.—Wheels, diameter, 33½ ins.; journals, 5½ x 10 ins.; tank capacity, water, 6,000 gals.; coal, 9 tons; service, passenger.

Wireless for Trains.

The successful transmission of wireless messages to a moving train on the Lake Shore & Michigan Southern Railway, which was accomplished Feb. 27 of this year, recalls a similarly successful experiment made on the Grand Trunk Railway on Oct. 13, 1902, a brief notice of which appeared in RAILWAY AND LOCOMOTIVE ENGINEERING on page 504, December, 1902.

Before the close of the twentieth century wireless telegraph in some form may probably be adopted for train service, and fast trains of the future may have their regular equipment making possible the exchange of messages while the train is in motion. If this is ever brought about it will greatly increase the safety of railroad travel because of the possibility of recalling an incorrect train order after a train has left a station or of halting a train following one that had stopped, thus preventing a serious accident.

Wireless transmission depends for its operation upon the sending and receiv-

TRACK LAYING IN SOUTH AFRICA.

ing of electro-magnetic waves through the atmosphere. Several wires known as the antennae or aerial line are placed at a considerable height above the ground and are connected to one side of a spark gap. The other side of the spark gap is connected to a pipe or iron rod driven several feet into the ground, and known as a ground connection.

The spark gap is simply the space left between the ends of the wires. The terminals are metallic balls placed a few inches apart. A series of sparks from an induction coil is made to pass across the spark gap. The induction coil is supplied with electricity from a battery or dynamo. The passage of these sparks across the gap set up currents in the aerial line that surge or vibrate back and forth a great many times a second. These oscillatory currents, as they are called, send out electro-magnetic waves from the aerial line into the air in all directions. The electro-magnetic waves, known as Hertzean radiations, fly off from the wire in very much the same way that waves in a pool of water go out from a common centre when a stone is dropped into the pool. Any other aerial line that is in the path of these waves will have oscillatory currents induced in it that are similar to those at the sending station. If a suitable device for detecting these currents is connected in series with the second aerial line and the ground, the combination serves as the receiving station of the wireless system.

The receiving or "aerial" wire on the Lake Shore train was carried outside the cars and extended the whole length of the train, which was made up of eleven coaches. In the Grand Trunk experiment, made six years ago, the receiving wire was strung along inside the cars and was carried in the bell cord hangers.

On the Lake Shore train a telephone receiver and a battery were connected across the wave detecting device which is known as a coherer. This important little piece of mechanism is a small glass tube which is set where the spark gap is in the receiving wire. There are a number of different styles of coherers, but their principle of operation is much the same. The simplest coherer is a glass tube about the diameter of a crow-quill. This is filled with loose silver filings. When the oscillatory current strikes the filings they cohere or stick together and so form a connection for the receiving circuit and a click is heard in the telephone. When the current ceases the coherer is tapped and the filings fall apart, breaking the local circuit and the sound ceases in the telephone receiver. In other words, the coherer is simply a link in a local battery circuit and the wireless waves make and break this local circuit by making the filings cohere and fall apart.

The code of signals is very similar to that of the Morse telegraph alphabet, a large number of sparks representing a dash and a small number a dot. The number of sparks that pass across the air gap is controlled by a key which is used to operate the induction coil and which is similar to the ordinary telegraph key. This is on the local sending circuit. On a complete wireless station a single aerial and a single ground connection are sufficient. Switches are arranged to change either the sending or receiving apparatus so that the same aerial wire may be used as one or the other as required.

The Lake Shore train on which wireless was used was section No. 2 of train No. 35. Mr. W. J. Daley, general passenger agent of that road, said that the success of the experiment meant help in eliminating train accidents. The Grand Trunk trial of 1902 was conducted by Prof. Barnes, of McGill University. This train was kept in communication with a central station of St. Dominique while running between Montreal and Brockville.

Items of Personal Interest

Mr. S. E. Kildoyle, master mechanic of the Vera Cruz & Isthmus Railroad, has resigned and his position has been abolished.

Mr. D. J. McCuaig has been appointed general foreman, motive power department, on the Grand Trunk Railway at Ottawa, Ont.

Mr. W. F. Hays has been appointed foreman on the Atchison, Topeka & Santa Fe Railroad, with headquarters at San Bernardino, Cal.

Mr. C. B. Keiser has been appointed the master mechanic of the Pennsylvania tunnel and terminal, with headquarters at New York, N. Y.

Mr. C. R. Craig has been appointed purchasing agent of the Mobile & Ohio, with offices at Mobile, Ala., vice Mr. R. H. Duesberry, resigned.

Mr. R. N. Millice, master mechanic for the Mexican Central at Aguascalientes, has resigned, and his position has been abolished.

Mr. J. B. Emery has been appointed night roundhouse foreman on the Baltimore & Ohio Railroad with headquarters at Fairmount, W. Va.

Mr. J. Scott has been appointed road foreman of locomotives on the Canadian Pacific Railway at Saskatoon, Sask., vice Mr. L. Fisher, transferred.

Mr. F. T. Seaverns has been appointed road foreman of engines on the Wisconsin division of the Chicago & North Western Ry., with headquarters at Chicago, Ill.

Mr. Roy S. Parker has been appointed general storekeeper of the Kansas City, Mexico & Orient Railway, with headquarters at Fairview, Okla.

Mr. F. A. Hedengren, master carpenter on the Chicago, Burlington & Quincy at Lincoln, Neb., has been appointed the master carpenter on the same road at Omaha, Neb.

Mr. W. P. Chrysler will remain in the service of the Chicago Great Western Railway as superintendent of motive Railway at Ottawa, has been appointed as- at Oelwein, Iowa.

Mr. W. B. Blue, formerly engine inspector, has been appointed mechanical foreman on the Louisville & Nashville shops at Lexington, Ky., vice Mr. A. B. Vaughan, resigned.

Mr. S. B. Morris has been appointed assistant road foreman of engines on the Elmira & Canadaigua divisions of the Pennsylvania Railroad, with headquarters at Elmira, N. Y.

Mr. E. D. Andrews, master mechanic on the Chicago, Burlington & Quincy Railroad at Sterling, Colo., has been appointed master mechanic of the Omaha division on that road, with headquarters at Omaha, Neb.

Mr. Carl Woodworth, roundhouse foreman of the Baltimore & Ohio Railroad at Sandusky, Ohio, has been transferred to a similar position on the same road at South Chicago.

Mr. A. B. Bayless has been appointed superintendent of the Atlanta Division of the Louisville & Nashville Railroad, with headquarters at Atlanta, Ga., vice Mr. C. W. Bradshaw, transferred.

Mr. C. B. Smyth, assistant mechanican engineer of the Union Pacific Railway, has resigned, and has been appointed superintendent of the McKeen Motor Car Co., at Omaha, Neb.

Mr. G. W. Robb, formerly general foreman motive power on the Grand Trunk Railway at Ottawa, has been appointed assistant master mechanic on the Grand Trunk Pacific road with headquarters at Rivers, Man.

Mr. A. B. Vaughan, mechanical foreman of the Louisville & Nashville shops at Lexington, Ky., has retired after fifty years of continuous service with the company. He is the second oldest employee connected with the system.

Mr. C. W. Bradshaw has been appointed superintendent of the Louisville, Cincinnati & Lexington divisions of the Louisville & Nashville Railroad, with headquarters at Louisville, Ky., vice Mr. C. A. Davies, deceased.

The Whiting Foundry Equipment Company announce that they have appointed Mr. L. G. Henes, San Francisco, Cal., as their representative for cranes and foundry equipment. His territory is California, Nevada and Arizona.

Mr. G. Fred Collins has been appointed to take charge of the railroad business for the firm of John A. Crowley & Co., 120 Liberty street, New York, who are the United States representatives of the Arrow High Speed Tool Steel.

Mr. L. Fisher, formerly road foreman of locomotives on the Canadian Pacific Railway at Saskatoon, Sask., has been apponted road foreman of locomotives on the same road at Souris, Man., vice Mr. J. Scott, transferred.

Mr. E. V. Dexter, purchasing agent of the Mexican Central has resigned, and all purchasing and sales of the National Railways of Mexico will in future be done by Mr. J. H. Guess, purchasing and fuel agent with offices at Mexico City.

Mr. Theodore N. Ely, chief of motive power of the Pennsylvania Railroad, is at present traveling in Egypt. We do not expect that Mr. Ely will find much on the railroads operated in the land of the Nile which he can bring back to the standard railroad of America.

Mr. John J. Brady has been appointed general foreman of the Harlem Division of the New York Central & Hudson River Railroad at North White Plains. Mr. Brady has had charge of large engine houses on this road at Corning, West Albany and Minoa, and is well equipped for the work.

Mr. Robert French, formerly general foreman of the Southern Pacific Company at Oakland, Cal., and later master mechanic at Bakersfield, has been appointed to the position of Superintendent of Motive Power and Equipment on the Guatemala Central Railroad at Guatemala City, vice Mr. W. S. Templeton, deceased.

Mr. W. H. Foster, master mechanic of the New York Central and Hudson River Railroad, in charge of the Harlem division, with offices at North White Plains, N. Y., has been transferred as master mechanic on that road at High Bridge, and put in charge of the Hudson and the New York & Putnam division, vice Mr. L. H. Raymond, resigned.

Fred McArdle and Henry Helmholtz have established a firm in Chicago for publishing books and charts for the instruction of railroad men. The members of the firm are both old railroad men, Mr. McArdle having been a traveling engineer. The publishers have produced a most comprehensive book containing thirty-two colored charts, illustrating the working of the Westinghouse airbrake. It is an extension of the colored chart we have been selling for several years. The plan of instruction is so comprehensive that it deserves success.

Mr. C. T. Malcolmson, briquette engineering expert for the Roberts & Schaefer Co., will read a paper for the first annual meeting of the International Railway Fuel Association, which convenes in the Auditorium Hotel, Chicago, June 21 to 23, inclusive, on the subject, "Briquetted Coal as a Railroad Fuel." Mr. Malcolmson is in charge of the work of briquetting coal at the United States Government fuel testing plants at St. Louis and Norfolk. He constructed the briquetting plant at Hartshorn, Okla., for the Rock Island Mining Co. He is probably the best-informed man in this country on the question of briquetting coal.

Announcement has just been made of the election of the following officers of the Museum of Safety and Sanitation: Acting President, Philip T. Dodge; vice-presidents, Charles Kirchhoff, T. C. Martin, Prof. F. R. Hutton and R. W. Gilder; treasurer, Robert A. Franks; plan and scope committee, Prof. F. R. Hutton, William J. Moran, Dr. Thomas Darlington, H. D. Whitfield and P. T. Dodge; director, Wm. H. Tolman. Among the charter members are C. H. Dodge, Elbert H. Gary, Richard Watson Gilder, Dr. Thomas Darlington, Charles Kirchhoff, T. Commerford Martin, Philip T. Dodge, Prof. E. R. A. Seligman, Irving Fisher, Wm. J. Moran, Henry D. Whitfield, A. R. Shattuck and Prof. F. R. Hutton. The Museum of Safety and Sanitation has its office at the Engineering Societies' Building, 29 West Thirty-ninth street, New York. The object of the Museum organization is to study and promote means and methods for safety and sanitation and the application of them to any and all public or private occupations whatsoever. The authorities of the Museum desire to advance knowledge of kindred subjects; and to that end to establish and maintain expositions, libraries and laboratories wherein all matters, means and methods for improving the general condition of the people as to safety and health may be studied, tested and promoted, with a view to lessening the number of casualties and avoiding the causes of physical suffering and premature death, and to disseminate the results of such study, researches and tests, by lectures, exhibitions and other publications.

Mr. Wilson E. Symons has been appointed superintendent of motive power and machinery of the Chicago Great Western Railway. Mr. Symons was born at Farmland, Ind., on December 18, 1858. He received his education at Dublin Academy in Eastern Indiana. He began railway work in 1880 as a machinist on the Chicago, Rock Island & Pacific Railway at Chicago. In 1881 he was made chief engineer of the merchant marine service on the Great Lakes. From 1885 to 1887 he was a locomotive fireman and engineer and did some special expert work on the Wisconsin Central. From 1887 to 1889 he was a locomotive engineer on the Atlantic & Pacific, now a part of the Atchison, Topeka & Santa Fe, and also did some special engineering work in California and Arizona. During 1889 he was engaged in special and electrical engineering work in Chicago. In 1890 he was appointed general foreman of the Atchison, Topeka & Santa Fe at Chanute, Kan., and in 1892 he became master mechanic at Raton, N. Mex. In 1896 he was made master mechanic of the Mexican Central at San Luis Potosi, Mex., and later in the same year was appointed mechanical expert and salesman of the Galena Signal Oil Co., in the United States, England and France. In July, 1898, he was appointed superintendent of motive power and equipment of the Plant System of Railways at Savannah, Ga. In May, 1902, he was made mechanical superintendent of the Gulf, Colorado & Santa Fe, and in August, 1904, superintendent of machinery of the Kansas City Southern. From 1905 to 1909 he has been engaged in special expert and consulting railway work in Chicago. Mr. Symons is a member of the Western Society of Engineers, the American Society of Mechanical Engineers, the American Railway Master Mechanics' Association, the Master Car Builders' Association, and the Franklin Institute. His headquarters will be at St. Paul, Minn.

Obituary.

Charles J. Chapman, general foreman of the Southern Pacific Shops at Dunsmuir, Cal., died a few weeks ago in the S. P. Hospital at Sacramento, Cal. Mr. Chapman began working for the Chicago & Northwestern Railway as a wiper in the Dunlap shops on the West Iowa Division in the year 1872. He was employed as wiper and machinist helper for two or three years when he was put firing the switch engine at that place, and

CHARLES J. CHAPMAN.

in time he was promoted to be switch engineer. After a time he was given a freight engine and ran between Dunlap and Council Bluffs for some time. Later he was transferred to Carroll to run a freight train between Carroll and Mapleton, after which he was promoted to a passenger train between Missouri Valley and Council Bluffs. He was after this promoted to the position of foreman at Norfolk, Neb., on the F. E. & M. V. Railway, which road was leased to the C. & N. W. Railway. He stayed there, and at Chadron, until 1901, when he was offered the position of master-mechanic of the Oregon & Eureka Railway at Samoa, Cal. He was with this company for more than five years, when he resigned to accept a position with the Southern Pacific Company at Dunsmuir, Cal., on the Portland line. He was general foreman of these shops for nearly a year and a half, until ill health compelled him to give up work. His loss is deeply mourned by a wide circle of railway men and friends.

The death of James Seiveright removes one of the veterans of railroad life in Canada. He was connected with the Quebec Central Railway. Mr. Seiveright was 73 years of age and was a native of Dundee, Scotland. He came to Canada in 1861. For some time he remained in Montreal and then coming to Sherbrooke was employed by the Smith-Elkins Company. Later he entered the service of the Quebec Central as master mechanic at the shops at Newington, where he remained without a break for 33 years, retiring from active work in December last. His death was due to no special disease, but to the gradual failure of the forces of life. He was respected and highly esteemed alike by the officials of the railway and the men who worked under him. He was a prominent member of the Victoria Lodge A. F. & A. M.

Snowbound in April.

The Poet Goldsmith sang about "winter lingering chills the lap of May." This season is a case in point. For instance, on April 14 seventy-five passengers were rescued from a snow-bound train on the Rocky mountains in Colorado, after being confined four days and four nights. Fortunately the locomotive had coal enough to keep the cars warm, while the express car and a stalled freight train supplied raw material for meals. A matter of universal regret was the entire absence of a single euchre deck. A magnificent opportunity for the cultivation of skill in poker was thus missed.

Certain pious ladies in the train tried to start a prayer meeting which promised success at first, when all joined enthusiastically in singing "From Greenland's Icy Mountains," but just as the hymn was finished an unregenerate brakeman announced that there was plenty of coal on the locomotive, and inquiries for cards at once became active.

Purely Mechanical.

Every employee of the Bank of England is required to sign his name in a book on his arrival in the morning, and, if late, must give the reason therefor. The chief cause of tardiness is usually fog, and the first man to arrive writes "fog" opposite his name, and those who follow write "ditto." The other day, however, the first man late gave as the reason, "wife had twins," and twenty other late men mechanically signed "ditto" underneath.—*Everybody's Magazine.*

The Hedjaz Railway.

By A. R. Bell.

The Hedjaz Railway from Damascus to Medina was opened on the anniversary of the Accession of the Sultan of Turkey. It will ultimately unite the Pilgrim's City of Mecca with Constantinople. The route of the railway follows the old pilgrim road to Mecca, a distance of 1,100 miles from Damascus. It was commenced in 1901 and nearly 900 miles have been completed in seven years, the remaining distance to be covered being that between Medina and Mecca. The cost has been only £3,100,000 or less than £3,000 per mile, the land included. The labor has been supplied by the Turkish Army. There are numerous cuttings, tunnels and other engineering works involved. The workshops at Damascus are equipped with up-to-date machinery from America and Germany.

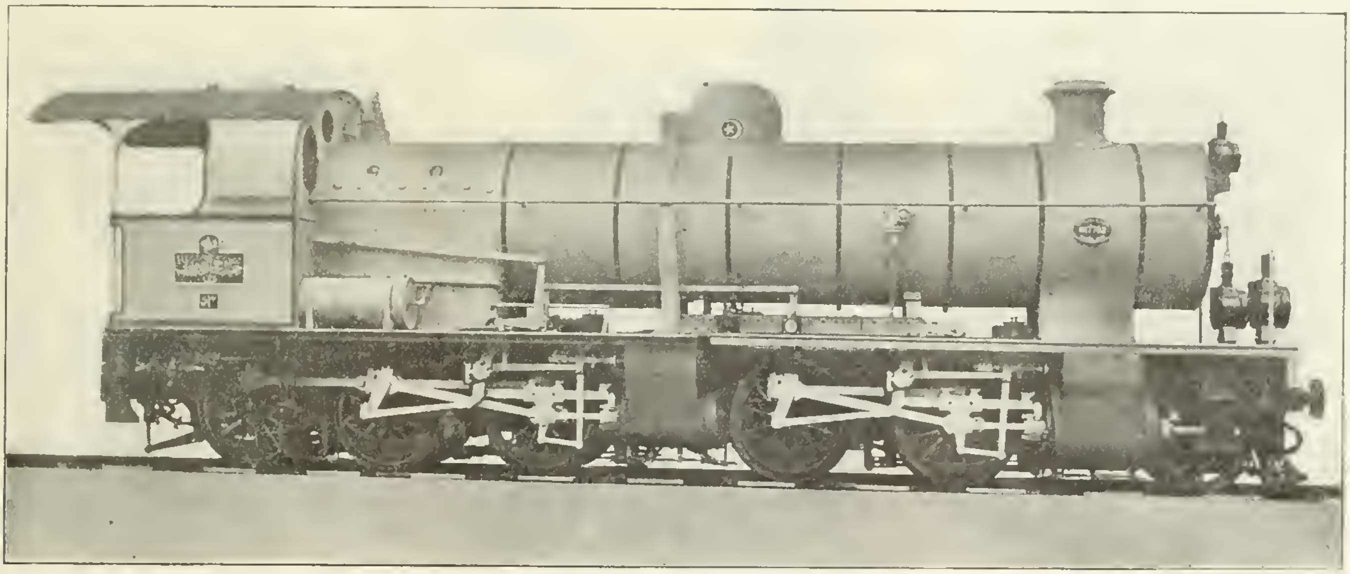
The locomotives have been supplied by Henschel & Sohn, of Cassel, Germany. Our illustration shows one of them. It is an articulated Mallet Compound intended for working heavy goods trains over long gradients and around sharp curves, of which there are many on the Hedjaz Railway. The trains to be pulled have a weight of 250 tons. The permanent way being laid with rails of small weight, and the gauge of the track being 3 ft. 6 ins. only, it was necessary to have the heavy boiler carried by six axles. The wheels of these axles are arranged in two groups of three pairs each. The wheels of the hind group are six-coupled and placed in the main frame, to which the boiler is rigidly connected. They are driven from the two high-pressure cylinders. The wheels of the front group are in a bogie frame and the second and third pair are also coupled and driven from the low-pressure cylinders, while the leading pair of wheels have further lateral play provided in addition to that permitted by the bogie. The arrangement of the wheels allows the engine, though the total wheel base amounts to 28 ft., to travel round curves of 450 ft. radius with perfect ease. The slide valves are actuated simultaneously by Heusinger's gear by means of screw and wheel.

The coupling of the bogie with the main frame differs from that hitherto provided in Mallet engines, being effected by means of a double joint, which requires less lateral play in the truck. This coupling is arranged in the same manner as that between engine and tender. The oscillating movement of the front group of wheels is controlled by springs and buffers. The engine is fitted with the automatic vacuum brake to all coupled wheels and tender wheels.

The following are the principal dimensions—Engine: Diameter of h. p. cylinders, 12⅝ ins.; diameter of l. p. cylinders, 20 ins.; piston stroke, 22 ins.; diameter of coupled wheels, 42⅜ ins.; diameter of truck wheels, 28⅜ ins.; working pressure, 170 lbs. per sq. in.; heating surface, 1,780 sq. ft.; grate area, 27 sq. ft.; wheel base, 28 ft.; number of boiler tubes, 200; weight of engine in working order, 51 tons 12 cwt.; weight on drivers, 45 tons; tender: tank capacity, 4,000 gals.; bunker capacity, 5 tons; weight in working order, 37 tons 16 cwt.

The Hedjaz Railway when completed will be a remarkable work, traversing a desert country peopled by religious fanatics. The leading stopping places en route are Ma'ân, which was reached in May, 1905, about 250 miles south of Damascus; Tebuk, 145 miles further; El'Ala, 185 miles beyond Tebuk; Medain Saleh, 600 miles south of Damascus, and Medina. Water is scarce along the route. South of Ma'ân the railway has to descend from a tableland about 3,700 ft. above sea level down a steep escarpment into a valley 500 ft. below, by means of a long looped curve with a minimum radius of 336 ft. and with gradients ranging from 1 in 55½ to 1 in 62½, followed by a series of less severe curves and gradients, and beyond Tebuk a similar rise has to be encountered.

There are engine sheds and repairing shops at Ma'ân and Tebuk, which will no doubt be added to after the completion of the line, and a feature consists of the establishment of blockhouses for the defense of the railway officials from fanatic tribesmen. At present, the Ottoman Government forbid any European, except the railway officials, from going south of Ma'ân. Moslem engine drivers and mechanics are almost exclusively employed, mostly drawn from the Turkish navy.



MALLET COMPOUND ENGINE FOR THE HEDJAZ RAILWAY.

Telephone Train Despatching.

At our request a very interesting communication has been received from Mr. Thomas Williams, superintendent of the Montreal-Newport, Vt., section of the Canadian Pacific Railway. Mr. Williams has had experience with both the telegraph and telephone systems as used on the C. P. R. In earlier years of railroad work he was an expert operator and train dispatcher and his opinion will be of interest to our readers. He writes as follows:

"In regard to dispatching trains by telephone, the first circuit of 43 miles between Montreal and Farnham was put into service on June 23, 1908, and the circuit was extended to Newport, Vermont, on November 1 of the same year, making 108 miles in all. This, I may say, is the busiest dispatching circuit I have come across in my experience, and I am of the opinion that the telephone is safer than the telegraph, for the reason that there is no guesswork on the part of operators in receiving orders from dispatchers. The system is more rapid, it is less laborious to the dispatcher, and the system of calling operators by bells or "selectors" is more effective than a call by the ordinary telegraph sounder is.

"The bell or selector is operated by the dispatcher by one movement, and it rings in the required operator's office until he stops it by breaking the circuit. Operators cannot signal to the dispatcher, or to another operator. The dispatcher being always on the circuit the operator simply says 'Dispatcher' and goes on with his report or request.

"In sending orders the dispatcher writes each one in his book with pen and ink. As he dictates to all offices concerned in that way he does not send faster than he can write, which is an advantage over the telegraph system, as a dispatcher when pushed for time will sometimes crowd an operator, and the operator will get behind in copying and possibly repeat from memory. A great deal of time is saved in repeating, as it is done as rapidly as the operator speaks. As a precaution against possible errors all numbers are spelled out in this way, 'Order 79 seven nine' or 'Engine 1187 one one eight seven'; also station names are spelled.

"There are no conversations over the wire that in any way affect the movement of trains; the only authority for train movement is an order in the prescribed form, duly signed and made complete by the dispatcher. The system commends itself in every way and will ultimately supersede the telegraph generally, I think. The dispatcher should be secure from noise or interruptions from any cause, and to this end he should have his office kept strictly private, and be free from the sound of telegraph instruments."

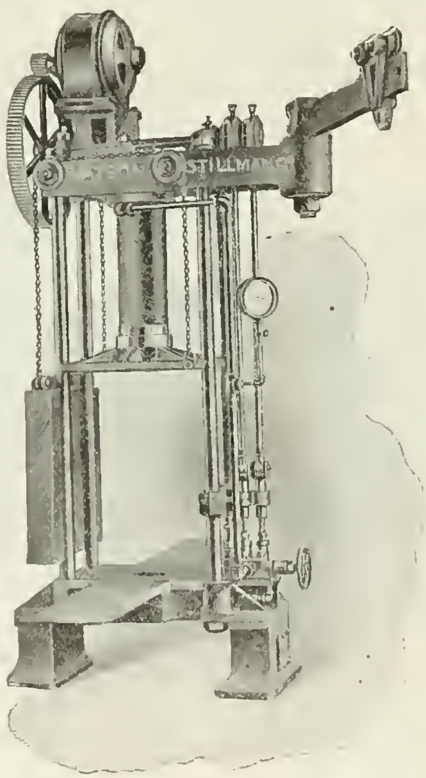
The telephone system of train dispatching as outlined above appears to have one very clearly marked advantage over the telegraph system, and that is, in an emergency the dispatcher is, if one may say so, instantly within ear shot of the operator, and also the call of the dispatcher for an operator, when once made on the selector, is maintained by the instrument with peremptory insistence until answered by the operator, or by some one in the office called up. The integrity of the form and method of delivery of orders to train crews is, of course, carried out as faithfully under the telephone system as under the older telegraph system. We will be pleased to hear the opinion of any of our readers who have had any experience with the telephone system.

Reversed Cylinder Press.

The Watson-Stillman Company, of New York, have just introduced a new reversed cylinder forcing press, which should prove a handy tool for pressing bearings and for miscellaneous work. As will be seen from our illustration a crane bracket and beam extending from one end enables the operator to swing a heavy piece of work onto bracket shelves extending out from each side of the bottom platen. These shelves, 30 ins. long by 12 ins. wide, are detachable, can be lifted off on jobs where they would be in the way, and are sufficiently strong to support any work that will go into the machine. This arrangement will be appreciated by those who have had to push castings or parts into place on the ordinary small platen.

The motor, mounted upon pedestals on top of the press, drives the pump shaft through single reduction gearing. A hand or belted drive is furnished if desired instead of the motor. On the other end of the pump shaft are two eccentrics, each driving one of the pistons of a ¾-in. by 2-in. twin pump, for which the pedestal legs act as reservoirs.

The operating valve is of the single screw stem type, and connected to release the pressure from the work when opened, and start the ram down when closed. It



REVERSED CYLINDER PRESS.

will not retain the pressure unless the motor is stopped or the liquid driven through the safety valve. Other types of valves may be substituted to meet special conditions. A gauge is furnished to read in tons or pounds per square inch, as desired.

Literature descriptive of this and many other assembling presses may be obtained by addressing the manufacturers, The Watson-Stillman Company, 50 Church street, New York.

Air Brake Cylinder Cup Packing.

Leather packing for general hydraulic and pneumatic use has been made in what is known as the cup shape, but up to the present this method of manufacture has not been applied to the leather packing used in the air-brake cylinders under cars. Several of our leading railroads have been making tests of the cup packing recently placed on the market by E. F. Houghton & Co., of Philadelphia. Their packing is known by the name "Vim."

The ordinary procedure is to submit what are called oak and hemlock leathers to the action of tannic acid in a bath which contains oak or hemlock bark. The process is practically one of slow digestion and seven months is the time required to tan a hide suitable for use in an air-brake leather. The trouble with the ordinary process is that before the interior of the hide is reached by the tannic acid, the surface has overtanned. When a hide so treated has to be "cupped" for air brake or other similar use, it is necessary to soften it to a pulp by soaking in water, and when in the soft condition it is drawn into the required shape by rings and allowed to dry while in the forming rings. All leather is porous, and it therefore becomes necessary to fill the pores with some air-proof compound, which is generally a mixture of oil and grease. Leather rendered air tight by this process is also waterproof, and the necessary softening with water cannot be effected.

FIG. 1.

Oak and hemlock leather so treated when formed into cups are found to be not only hard and brittle, but are liable to leak air, and the effort to impregnate them with air-proofing material only causes the cups to swell and thus lose their shape and the uniformity of size is destroyed. These are some of the difficulties which have stood in the way of the manufacturer in his endeavor to produce air-brake packing which will stand the exacting service required in air-brake work.

The process by which Vim air-brake cups are made is not only interesting, as it surmounts these several obstacles to the production of a good packing, but the process is scientific throughout. The tanning of Vim leather is really a misnomer. The word tan refers to the action of tannic acid on the hide. In the preparation of Vim leather no tannic acid is used. The Vim process is one of rapid oxidation, in which the natural fibers of the hide are retained while all foreign matter is got rid of. This permits of the fibers of the hide being brought into close contact. As the durability of leather may be said to be in direct proportion to the length of the fibers, other things being equal, long fiber leather will give the better results. A comparative idea of the length of the oak tanned and of the Vim leather fibers may be had by a glance at our illustration, Fig. 1.

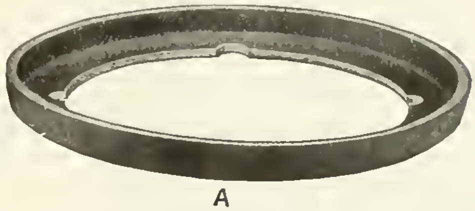


FIG. 2.

In the tannic acid process the hide absorbs in its pores minute particles of oak bark pigment, and although every effor is made in the finishing process to remove this pigment, it cannot be thoroughly or completely done. The finished leather is often incorrectly spoken of as having the natural color of leather, but its appearance is really due to the presence of tan-bark dye. The natural color of all hides is grayish green. The pores of oak or hemlock tanned leather are clogged with dye, and it is therefore impossible to fill them with air-proofing material. In the Vim process tan-bark dye is absent, and the pores of the hide are free to take up the required quantity of air-proofing material. As an evidence of this, Vim leather comes from the vats with its natural, green color.

Oak or hemlock leather will not safely withstand a temperature above 130 degs. F. Vim leather is several times during the process of cupping subjected to 300 degs. F. This high temperature is employed for the purpose of opening the pores, and while in this condition Vim leather is dipped into a bath of air-proofing compound, also at 300 degs. F. The leather is then cooled and in shrinking retains the required amount of compound in the tightened pores. The leather is then placed in moulds heated to 300 degs. F., where it is squeezed into shape under a hydraulic pressure of 50 tons. It is then permitted to cool gradually while locked in the moulds, where a pressure of 50 tons prevents its swell-

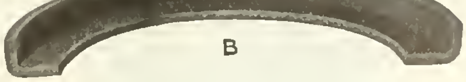


FIG. 3

ing or shrinking. This produces a permanently cup-shaped packing of uniform thickness.

Another advantage here becomes apparent in this process; not only is the

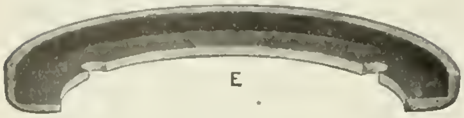


FIG. 4.

leather itself uniform in thickness, but as the air-proofing compound had been introduced as a liquid at 300 degs. F., the severe hydraulic pressure now applied forces the compound to enter every open portion of the leather, and as the liquid solidifies under this pressure its particles are also compressed. The manufacturers lay great stress upon the fact that in forming these cups for air-brake use they are moulded and not drawn. The moulding process has the effect of producing a cup, in which at the bend or shoulder of the packing there is as much leather as there is in the flat portions. The process of drawing would have reduced the thickness

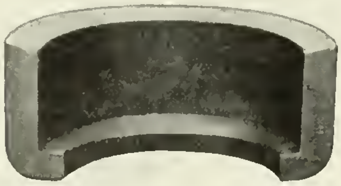


FIG. 5.

of the leather at the bend, which is the portion that in service would experience the greatest strain and the greatest wear. Fig. 2 shows the formed cup. Each one is labeled with the inspector's number, so that complaints can be readily traced. Fig. 3 shows a section of a Vim cup, illustrating the uniformity of the material in the bend. Fig. 4 shows an oak tanned packing leather after two weeks' service. It was formed up, and the bend shows a loss of about 40 per cent. of material.

In order to more clearly illustrate the condition of the shoulder, two other illustrations are here introduced.

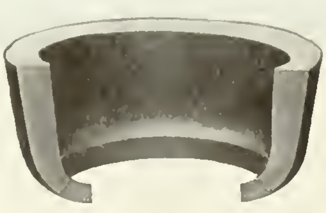


FIG. 6.

They are full size half-tones of 1¾-in. deep-well cup packings. Fig. 5 is made of Vim leather, and Fig. 6 represents one of oak tanned leather. The full round of the Vim shoulder and the drawn appearance of the oak leather bend can readily be seen. In Fig. 7, which is one of the best of fifty oak tanned cups removed after use, the irregular formation of the cup is revealed. An interesting experiment is shown in Fig. 8. The round piece marked D was cut from the bend of the cup. It was flattened out and subjected to an air pressure of 80 lbs. to the square inch without showing the least sign of a leak. One might have expected that although the shoulder was air tight in the formed shape, that the flattening of the shoulder would

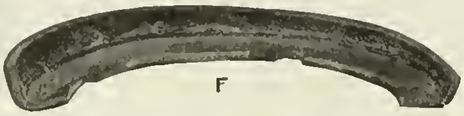


FIG. 7.

have expanded or opened the pores along the line of the bend, but such was not the case. The experiment proves that in the process of manufacture the pores are so tightly closed and the fibers are in such intimate contact, that they can fully meet the exacting conditions imposed in air brake service. The manufacturers believe that in producing the Vim leather cup air-brake packing leather they are able to supply a most durable and thoroughly satisfactory article, and they will be pleased to give any further information which anyone interested in this subject may require.

If you want to get a good idea of what style and variety of steam hammers are used in railroad shops at the present time,

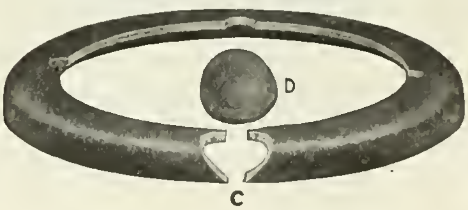


FIG. 8.

take a look at some Bement hammers or get the recently-issued catalogue from the Niles-Bement-Pond Company, of New York. They will be happy to send a copy to those interested. These Bement hammers take steam above and below the piston and are fitted with adjustable guides for taking up wear of the ram. They are rated according to the actual weight of the falling parts, these parts consisting of piston, ram and ram die. For instance, an 1,100-lb. steam hammer would have a piston, ram and ram-die weighing 1,100 lbs. The rating takes no account of the top steam, which enormously adds to the blow. The actual force of the blow cannot be stated in pounds for the reason that energy must be expressed in foot pounds. The effect of a steam hammer blow depends upon the steam pressure, stroke and the resistance offered by the material which is being hammered. There are about thirty different styles of steam hammers illustrated and described, each style being made in a number of sizes. A number of board drop hammers are also shown. These hammers are designed to meet the requirements of plants where steam or compressed air is not available. They combine simplicity of construction, strength and reliability of action. The frames are fitted to grooves in the anvil, to which they are securely bolted. The head fits over the frames and two large bolts bind the head and frames securely in position. This arrangement effectually prevents the parts from working lose under the continued jar to which they are subjected.

Training Signal Engineers.

The Pennsylvania Railroad Company, which may be depended on to take the lead in technical educational matters, have lately established several schools for the training of men for the signal service of the road. The block signal and interlocking systems have been extended so much lately that the officials of the road decided that special training concerning signals was necessary, and the establishing of instruction schools has resulted.

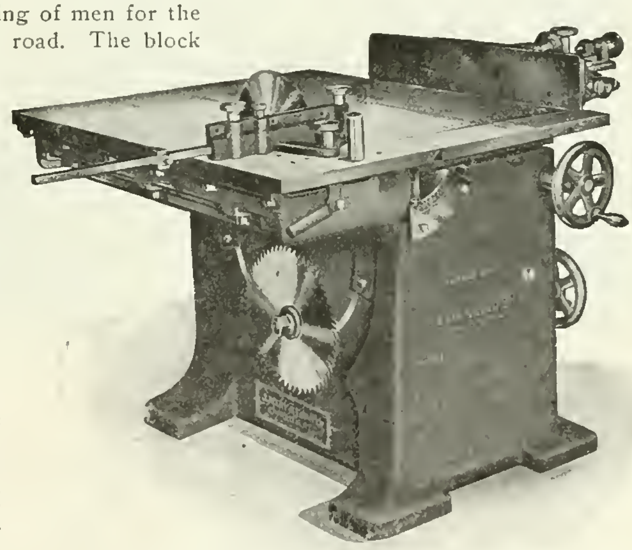
The company have appointed six signal apprentices, to be trained as engineers capable of directing and planning signal installations. Apprentices will serve a three years' course. The first year will be spent on the mechanical end of the work with the repair and construction gangs, the second year in the office of the Supervisor of Signals, and the third year on outside work on electric and electro-pneumatic appliances. They will report to the supervisors of signals while taking this course.

Double Circular Saw.

A very useful tool, especially good in the pattern shop of the car department on railways, is made by the J. A. Fay & Egan Company, of Cincinnati, Ohio. It is a combined ripping and cross-cutting machine, constructed on lines distinctly different from other machines of the same kind.

Both saw arbors are carried on a revolving frame, and it is easy to take off or put on saws without disarranging the table. Two saws up to 16 ins. diameter, one on each arbor, can be carried at the same time and the frame revolved, or if only one saw is used, it may be as large as 20 ins. in diameter. The table is made in two sections, a moving section 44 x 16 ins., moving easily on frictionless rollers, and a stationary section 44 x 20½ ins., the latter having an extension so that material up to 20 ins. in width can be ripped. The moving section of the table has sufficient motion to edge or cut-off material up to 35 ins. and will open to permit the use of a 2-in. grooving head. The whole table can be tilted by a hand-wheel to an angle of 45 degs. from the saw.

A gauge registers the angle to which the table is tilted. The ripping fence may be set to take stock up to 20 ins. wide and used on either right or left section of table; a micrometer adjustment is provided on this fence, which is used when certain adjustments are too fine to be made by hand. The miter cut-off fence is used on the sliding table and covers a range from 45 degs. back of the fence to 60 degs. in front, as shown in our illustration. This fence is furnished with a stop-rod, to be used for stock of various lengths. This saw is one of the latest productions of the shops of the above named firm, who will be pleased to send you a descriptive circular, showing a large half-tone reproduction of the machine and of its mechanism. In the tool itself the mechanism is completely enclosed.



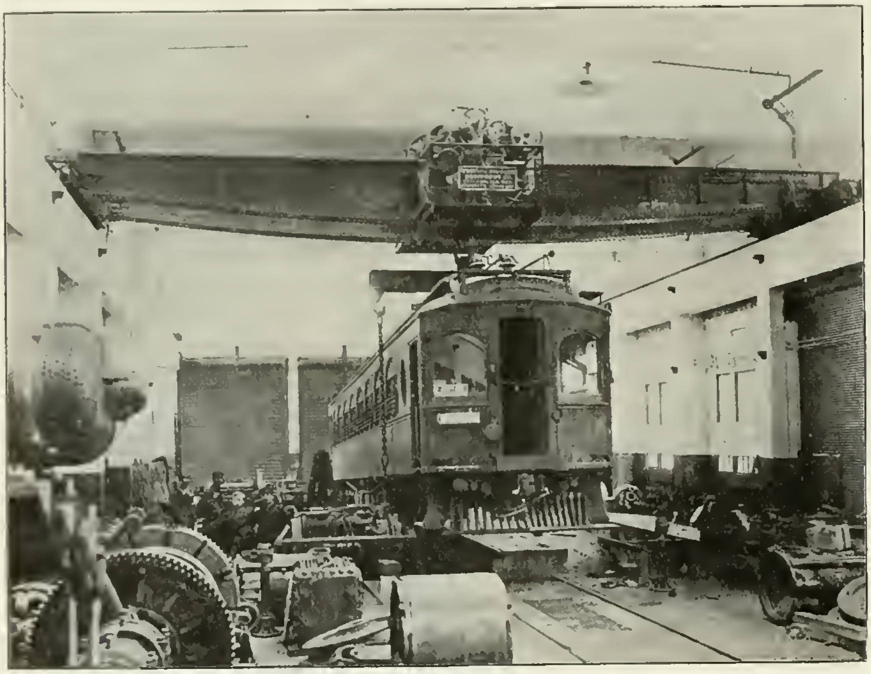
NO. 205 DOUBLE CIRCULAR SAW.

The 1826 Farina Cologne Co., 744 Broadway, New York, are sending out free, small specimen bottles of their celebrated perfumery. Nothing better was ever made for rubbing on face and hands for preserving the skin, especially after exposure from a long journey. No lady's dressing table is complete without a bottle.

Modern Shop Equipment.

In the earlier days of electric railway operation many managers believed that all the equipment required to maintain rolling stock in good condition was a barn-like structure rightfully called a car barn, a plank-lined pit between the rails, and a couple of screw jacks. At the present time many managers believe that there is undoubtedly economy in properly equiping car repair shops so as to quickly and adequately do the work.

In 1909 when designing the car repair shops of the Washington, Baltimore & Annapolis Electric Railway at Academy Junction, Md., the designing engineers provided in their plans for the installation of an electric traveling crane to be used first in setting the new shop machinery in place and later to handle car bodies and heavy running-gear parts.



CRANE BUILT BY THE WHITING FOUNDRY EQUIPMENT COMPANY OF HARVEY, ILL.

Our illustration shows the crane supporting one end of a car body by means of a yoke, the car having previously been placed with one truck standing on a small transfer table so that on raising the car body the truck can be readily run out. The crane used in this case has a capacity of 15 tons from the main hook and 6 tons from the auxiliary hook. The span of the crane is 42 ft. and the hoisting speeds are: Main hook, 13 ft. per minute; auxiliary hook, 50 ft. per minute. The bridge travel is 260 ft. per minute and the trolley travel is 120 ft. per minute. The main hoist is 20 h. p. The auxiliary motor develops 15 h. p., and the trolley traveler develops 3½ h. p. The motors are Westinghouse type "K," working at 550 volts, D. C. The controllers are types C-3 and V, of the Electric Controller & Mfg. Company.

As ordinarily constructed the operator's cage is placed below the crane at one side of the girder near the runway. On this crane such an arrangement would interfere with the wall cranes. The cage has therefore been placed at the centre of the span and at a height sufficient to clear cars when lifted to the maximum height. The transfer table, while of strength sufficient to sustain a completely equipped car when rolled across it, is required to move only heavy trucks. The table is operated by hand power, the necessary travel being short. Both crane and transfer table were designed, manufactured and erected by the Whiting Foundry Equipment Co., of Chicago.

On the pilaster on both sides of the shop are to be seen brackets or pin bearings for the support of small capacity wall cranes. By using the electric cranes to place a wall crane on any pilaster where needed a small number of wall cranes will render very good service over the entire shop.

The building is of reinforced concrete with brick curtain walls. Size of building is 256 ft. 8 in. x 83 ft. 7 in., and the design is such that the lighting is exceptionally good. The heating is by fan system with ducts under the floors, and automatic sprinklers provide fire protection.

"Safety Valve Capacity" is the title of a neat little pamphlet issued by the Consolidated Safety Valve Company of New York. This is one of the subsidiary companies of Manning, Maxwell & Moore, Inc. The pamphlet contains the paper read before the American Society of Mechanical Engineers by Mr. Philip G. Darling, mechanical engineer of the company. The tests of safety valves on stationary and locomotive boilers which were conducted by Mr. Darling, at

Bridgeport, Conn., are all fully reported in this paper and numerous illustrations show how the tests were made. In addition to the paper, there are tables giving the capacities, in pounds of steam per hour, of Consolidated safety valves, and also similar tables for locomotive safety valves based upon heating surface, and other data of interest to steam engineers. A copy of this interesting and valuable treatise will be sent to anyone who applies to the company for one.

A recent press dispatch from Ithaca, N. Y., states that in co-operation with the New York State College of Agriculture, the New York Central Railroad will operate a farm train over its lines in the near future. The N. Y. C. have been considering this departure for some time and sent a representative to the college during the recent farmers' week. The train, which will be similar to that run over the Erie lines several months ago, will consist of a locomotive and several coaches. Lecture platforms and exhiibts will be taken along. The train will be in charge of a corps of trained experts from the college. Stops will be made at towns and cities where lectures will be given from the train, while at night mass meetings will be held in cities. The Lehigh Valley and the Delaware & Hudson are also considering running such trains.

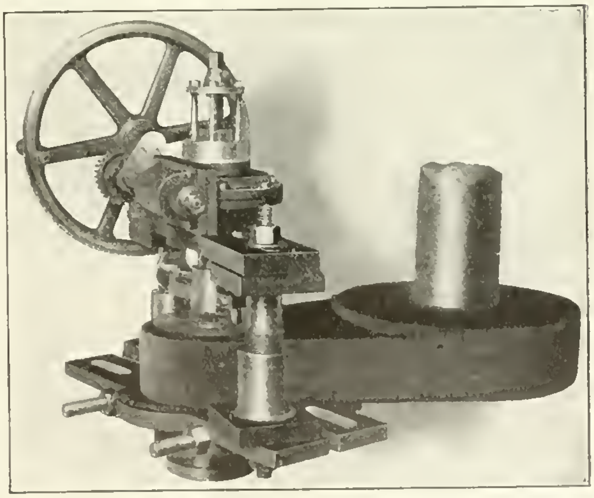
Boring, Turning and Facing Machine.

This new tool shown in our half-tone illustration is designed principally for facing off the rivet head on crank pins when it is necessary to remove the latter, but it is also adapted to a wide range of other work. When crank pins are riveted in a counter-sunk hole, it is a laborious and time-taking operation to cut away all this metal with a hammer and chisel, which is necessary before the pin can be forced out.

This machine is easily set up and will cut out the metal in a neat manner in one-quarter of the time required by the other method. It is readily clamped to almost any piece of work and is then in a position to bore, turn or face. It consists principally of a slotted crosshead which forms the base of the machine, and a casing which contains a worm-wheel having large integral hubs for resisting wear. Through the worm-wheel the cutting spindle slides with a range of 4 ins. This feed is adjusted by hand. In the end of the spindle is a steel slide for the cutting tool and this is adjustable for different diameters by means of a feed screw, the maximum diameter being about 12 ins. Two slotted crossheads, which in the centre are cut V-shape, clamp the work (the V's take practically all sizes) and are pulled together by one-inch through bolts. There are two adjustable spacing blocks threaded to receive each other and bored out, which will straddle cranks of different diameter, locomotive wheels or other work. Bolts pass through these blocks and clamp the machine proper to the crossheads.

The entire arrangement is very firm and solid and each piece being light in weight is easily handled by one man. The machine is quickly centered and has three changes of speed for heavy, medium or light work. These speeds are obtained by interchanging the gears shown on the driving shaft or by driving direct without them. The spindle is at right angles to the base or cross-head and by means of an extra facing attachment can be used for facing off pump or engine valve seats, it being immaterial whether or not the steam chest is solid or the valve seat several inches below the face of the chest. The machine may be driven by hand or any other suitable power.

In turning off a rivet on a crank pin, the machine will save at least 70 per cent. of the time required to do it with hammer and chisel. Such a saving in time and labor is worth attention, and besides the many other uses of the machine, makes it indispensable in a locomotive or other repair shop. New uses will be found daily for it and the makers inform us that they have found it extremely satisfactory and efficient in their own work. H. B. Underwood and Company of 1023 Hamilton street, Philadelphia, are the makers of this tool and they will be happy to give any further information which may be required. Write to them direct if you are interested. They have a very interesting catalogue of handy shop tools.



UNIVERSAL BORING, TURNING AND FACING MACHINE.

We happened to see a lot of freight cars getting hauled across a passenger train track in a New York yard last week and expected to witness much delay in getting the line clear. A switchman hurried to the engine and brought back two specimens of the Z locomotive replacer, the article that we used to call a wrecking frog. They were placed in front of the first pair of derailed wheels, the engineer putted along slowly and the track was clear in five minutes. These very efficient frogs are made by the Johnson Wrecking Frog Company, Cleveland, O., of which our old friend John Mackenzie is general agent. John was one of the most popular presidents that ever guided the proceedings of a Master Mechanics' Convention and he is not likely to lose popularity by his connection with the Wrecking Frog Co.

Spark Arresters Needed in Britain.

British railway companies have always been noted for the small attention they devoted to the spark throwing from locomotives. Early in railway days it was decided that the prevention of sparks from the smoke stacks of hard working locomotives was impracticable, and any one receiving damage from fires caused by locomotive sparks was left for remedy to the tender mercies of the common law, which has been noted for its failure to do justice to the unjust conditions arising from the industrial progress of the last century. Under the common law a railway company was not liable for damages from sparks unless negligence could be proved. As no railway company employed spark-arresting appliances, negligence could not be proved by their absence.

The British Parliament has lately passed a law under which proof of damage caused by sparks from locomotives carries with it the right to compensation. This change is likely to lead to the introduction of spark arresters and may open a new market for some of the numerous American inventions designed to prevent spark throwing. The most efficient spark arrester is the extension front with diaphragm and netting, a combination which we may expect to see becoming the fashion for British locomotives in the near future.

A recent press dispatch which appeared in one of our daily newspapers stated that "just to see how it worked, an Italian employed in a railroad car shop, picked up an air hammer used in driving rivets and looked into the end of it. His handling of the device started it going, and the plunger dealt him a terrific blow in the mouth, knocking out his front teeth." We sympathize with the man in his perfectly natural curiosity, but we could not help thinking that possibly if the latest form of "Thor" hammers, made by the Independent Tool Company, had been investigated by the laborer, he might have found out all he wanted to know without losing his teeth. In the March issue of Railway and Locomotive Engineering, page 134, we gave a description of the Thor hammers, with the inside safety trigger designed not to go off while being carried about the shop or while the workman is waiting for a hot rivet.

Pneumatic Dispatch Tube.

The pneumatic dispatch tubes used on the Pennsylvania railroad between the inspection pits and the roundhouse foreman's office, for the purpose of quickly forwarding inspection reports, were thus described by Mr. William Elmer, master mechanic on that road at Pittsburgh.

The dispatch tube is made of 2-in. pipe layed in a box underground or carried on the ends of ties; corners are turned with easy curves. The fins are smoothed off the inside of the pipe and a simple carrier can be made of an old air brake hose. When the inspection reports are ready they are slipped into the carrier and the latter pushed into the open end of the tube. A hinged flap valve is then held against the tube and the air pressure turned on, a distance of several hundred feet can be traversed in a few seconds. As almost all our large engine houses are provided with air compressors, it is easy to secure the air pressure needed by using a reducing valve set to a few pounds. The carriers as they come out of the tube strike against a spring buffer a foot or so away and drop into a basket. The man at the receiving end then signals to the other end by means of a bell or incandescent lamp and the air is shut off and the flap valve allowed to fall.

The Scully Steel and Iron Company of Chicago, Ill., are placing on the market what is known as the Ruggles' Perfection Flue Cleaner. The design of the cutters is such that they are always in direct contact with the metal of the flue and will override any imperfections of the tubes, such as blisters, welds, or kinks. The knives are so made that they are always sharp and they have a tendency to work in deeper. The heads or ends are made of drop forged steel. When used in a welded flue the cleaner easily passes over the projection of the safe end because of the long shearing cut of the knives. It has neither screws nor rivets to work loose, and it is strong and durable. Write to the company direct if you would like to have a descriptive circular and they will be happy to send you one.

Arrow High-speed Steel.

In a test recently completed at one of the large railroad systems in the East, unusual results were produced by some of the high-speed steels. The test covered a period of almost one year, and was very thorough, and the results should form a reliable standard by which to judge the merit of the respective steels tested. We are informed by John A. Crowley & Co., of New York, that Arrow High-speed Steel was among the few that made a remarkable showing. This steel is said to possess advantages quite distinct from other brands of high-speed steel, in that it is not necessary to heat the cutting edge to a white or sweating heat. This avoids the danger of crumbling, or producing a shell-hardness characteristic of some high-speed steels, which require a sweating heat to harden which, after a few grindings must be rehardened, frequently causing deterioration. The low temperature at which Arrow High-speed Steel hardens has been found particularly desirable in the manufacture of milling cutters, twist drills and other forming tools that require keen cutting edge. This steel may also be used for finishing, as it affords a cutting edge that will permit the making of a finishing tool for boring journal bearings composed of composite metal. It works equally as well on cast iron and steel castings. Any further information concerning the Arrow High-speed Steel can be obtained from John A. Crowley & Co., 120 Liberty street, New York.

There is a new kind of track wrench recently got out by the Jeffrey Manufacturing Company, of Columbus, Ohio. The idea of the wrench is to prevent the jaws spreading. They do spread in time when in constant service. This wrench has the ordinary fork opening to take the flats of the track bolt nut. At one side of this fork opening, and uniting the jaws, a web of metal extends across. In this web, which is about one-third the thickness of the jaws is cut an opening which takes the nut exactly like a box wrench. In fact, this tool is the practical combination of the open jaw spanner and the box wrench. The makers call it the Jeffrey lock-jaw wrench. The spanner opening and the box wrench opening are not the same size, and thus the wrench is made to serve the purpose of two wrenches. The web keeps the spanner jaws from spreading and the whole thing is strong and handy.

A distribution of cash prizes on the Pennsylvania has recently taken place. These prizes are awarded for the best track maintenance of the various sections and divisions. The prizes vary from $800 to $25, and are awarded by the general manager after an official inspection trip. The object of awarding such prizes is to promote a spirit of friendly rivalry among those whose duty it is to keep the tracks in a safe and smooth condition. About $10,000 in all has been thus distributed. The Pennsylvania maintains a high standard all through, and those who succeed do not gain distinction as prize winners without some patient and conscientious work.

Results of Contentment.

The people comprising the most powerful and enlightened nations of the earth belong to what is known as the Aryan race, which originated in India, where it grew and multiplied till great masses of humanity were forced away in search of food or to perform their mission of populating the earth. The migration began many centuries before the Christian era, the Greeks, the Celts and all the people who established civilized communities having sprung from Aryan stock. The people who remained in their native villages seem to have made no progress in four thousand years. A consular report about the condition of textile workers in India says:

"The wages paid to men in the mills range from $2 to $3 per month, women from $1.50 to $2, and boys and girls from $1 to $1.75. These people subsist principally on rice and vegetables made up in the form of curry, which is a peppery and sweetish mixture of rice and vegetables, with now and then chicken, duck or goat meat.

"The people of a mill, or several mills if the mills are nearly located together, occupy a village, which is made up of huts made of mud, bricks and palm leaves woven into sheets and tacked onto bamboo poles. All are thatched with a long tough grass used throughout India for covering huts and bungalows, and which makes a tight, cool and durable roof. The floor is made of clay tamped down hard, which makes a very good floor. On this floor is spread in places matting made of bamboo grass. On this matting many of the natives throw down a cotton blanket, or possibly a thin mattress, for beds. Some have a rude bed made of four posts 16 inches high with crosshead and side pieces, pinned together and then criss-crossed with bed cords. There may be a few rude benches, but little or no other furniture is to be seen in the huts. The natives eat on the floor, squatted around a pot or pan containing the food. The men and boys eat first and the women and girls afterwards, taking what is left. The mode of life is thoroughly primitive. No knives, spoons or forks are used in eating, the fingers answering all purposes."

This case illustrates one phase of the human forces that have made the United States in little more than one century the most prosperous country in the world. The immigrants who came to our shores year after year were the people who were not contented to stay in their native countries. It takes courage, energy and perseverance to induce a person to leave the land of his birth and venture into the unknown. When he decides to do this the attributes that induced him to leave home are the most valuable kind of assets to the land of his adoption.

We have lately received from the manufacturers an account of the performance of what is known as Jessop's "Ark" high speed steel. One of the tests was upon 80 point carbon, hammered steel shear blades, 8½ ft. long and 6 ins. wide. These blades were as hard as they could be made and were planed by an "Ark" steel tool and the entire cut was taken without the tool having to be re-ground. The cut was 1/16 in. deep, ⅛ feed, and the cut was maintained at 16 ft. per minute. A test made at one of our leading railway repair shops consisted in turning a pair of 63-in. driving tires. These were very hard and the speed was 12½ ft. a minute. The cut was 7/16 in. deep and 5/16 in. feed, work was done in 23 minutes and the tool was good at the finish. If you desire any further information concerning this brand of high speed tool steel, write to William Jessop & Sons, Limited, 91 John street, New York.

We are informed by the Consolidated Railway Electric Lighting and Equipment Company of New York that they have no connection of any kind with other electric car lighting companies. There have been rumors that the Consolidated had gone in with others to form a big concern. This is not the case. The Consolidated Railway Electric Lighting and Equipment Company are standing alone, and intend to stand alone. They feel confidence in the future and their business is growing all the time. They claim to be able to offer very attractive terms to customers and to deliver the goods. Write to them for any information on this subject which you may want. They are in the Hanover Bank Building, corner Nassau and Pine streets, New York, and they are standing alone.

Young mechanics with the slightest ambition to make a success in life by means of their trade, stand in their own light when they fail to read popular shop books and papers. After Railway and Locomotive Engineering we think *Popular Shop Talks*, by Fred H. Colvin, ought to be prominent in every mechanic's library. It costs only fifty cents, about one-tenth cent for each good pointer, and no sense for being without it.

In another column of this issue we refer to a good air brake cylinder packing leather. The J-M air brake expander ring, that is made by the H. W. Johns-Manville Company, of New York, is worthy of a trial. This ring is made of the best spring steel, and with ordinary care in handling will last a long time. The advantages claimed for it are that it will prevent brake failures due to packing leather leakage and will increase the life of the leather by pressing a larger surface of leather against the walls of the cylinder than the round ring will do, thus distributing the wear over a larger area. It is also claimed that packing leathers now considered unfit for service, on account of very small bearing surface against the walls of the cylinder, can be placed in service again by means of this ring, and will give as good service as new leather. Write to the company if you would like to get their clearly illustrated little folder on the subject.

President Tuttle, of the Boston & Maine Railroad, declares the many railroad accidents are not due to overworking the railroad men nor to lack of safeguards, but to "brain fag" and men guaranteed not to suffer from this psychological disease cannot be obtained. He thinks this mysterious disease which, he says, makes the most competent trainmen temporarily irresponsible at intervals, is one of the greatest problems confronting railroads.

There will not be any souvenirs at the Railroad conventions at Atlantic City this year, but that does not say that you cannot get a souvenir now. The Fort Pitt Spring & Manufacturing Company, of Pittsburgh, Pa., are giving to their friends a little ashtray for home or office use. The centre of the tray is stamped so as to show a coil and an eliptic spring, and the whole thing is very artistic. The souvenir will be sent to any railroad official who has not already got one. Write to the company if you have been left out and spring the request on them.

The Westinghouse Air Brake Company, of Pittsburgh, have recently issued an illustrated and descriptive instruction pamphlet No. 5030. It deals with the type K freight triple valve, and the booklet supercedes the issue of May, 1907, on the same subject. Those who desire to acquaint themselves with the details and operation of this excellent piece of air brake mechanism should write to the company for a copy.

The summer months bring grand opportunities for using up leisure hours pleasantly, but they also bring along the periods of the examinations that obtrude themselves in front of promotion. The Railroad Men's Catechism supplies the best kind of help in climbing over that stile and makes a helpful suggestion on a fireman's bedroom table.

The ash pan law which goes into effect next January, has stimulated the designing of new forms of ash pans, which can be emptied without the necessity of a man going under the engine. If there is a good ash pan on your road, which fulfills the conditions of the law, send us a blue print or sketch and we will be glad to publish it in our columns.

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Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXII. 114 Liberty Street, New York, June, 1909 No. 6

Railway Up Mount Pilatus.

The Alpine railway up Mount Pilatus in Switzerland was opened for traffic in June, 1889. It has become very popular and its business has steadily grown since then. The road is substantially built and there are many safeguards provided which give a feeling of security to the traveler who thus makes the ascent of one of the famous mountains which overlook the beautiful Lake Lucerne.

The lower level of the road is at Brunig, whence it winds up to Alpnachstad, the station situated near the highest point of the mountain. Mount Pilatus rises 2,070 meters or 6,791 ft. above the level of the sea, and the road rises 441 meters or about 1,447 ft. above the level of the lake. The grades vary from 0.192 to 0.48. Deep ravines in which dashing torrents gush are traversed by the pathway of steel, carried on great stone arches, the road often clinging to the bare shoulder of some huge slope overhanging a sheer abyss. Short, steep tunnels are driven through overhanging masses of solid rock. The longest of these tunnels measures about 318 feet.

A continuous and smooth granite floor serves as foundation for the metallic substructure of the track. The steel ties are held solidly to the masonry by deep anchor bolts. The gauge of the road is 80 centimeters, or about 31 ins., and many of the curves are about 80 meters, or nearly 263 ft. radius. On the curves the accurate gauge is maintained and the outer rail has no elevation. The rails are made in lengths of about 19½ ft. and are nearly 4¾ ins. high. The rail is held to the ties by two angles the horizontal portion of which lies on each side and on the flange of the rails; the whole is bolted to the metal ties. The top edge of the vertical portion of the angle extends up

INCLINED STEAM RAILWAY UP MOUNT PILATUS, SWITZERLAND.

the web of the rail, about half way, and thus leaves the underside of the rail-head clear, and on the underside of the rail-head, a shoe, which is attached to the frame of the car, slides along when the car is in motion. The function of this shoe is to prevent the car from being raised off the rail. In this way the wheels and gears of car and rails are constantly kept in contact, and derailment is practically impossible.

BRIDGE AND TUNNEL ON THE HEAVY CLIMB.

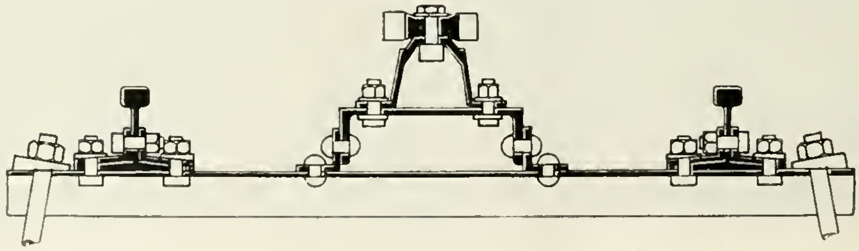
The rack rail in the centre of the road is double, that is, there is a set of teeth standing vertically on both sides of the centre construction. This centre construction consists of a pair of angles riveted to the metal ties, the vertical portions of the angles are riveted to a channel placed flanges downward, and on the back of this channel a special member shaped like an inverted letter U, carries the rack. The rack itself is made of soft steel in sections 3 meters long or nearly 10 feet. The teeth have a pitch of a little more than 1½ inches. These rack-rail sections are curved where necessary in accordance with the curvature of the track.

Steam is used as the motive power and the engine and boiler have been made as light as is consistent with the work to be done. The driving being done by gear and rack-rail, the engine does not depend entirely on the tractive effort which could be developed on the smooth rail. The locomotive is placed at the lower end of the passenger car, which holds 32 persons. The car is carried on four wheels, having a wheel base of about 20 ft. The front of the car is carried on swing hangers, while the rear axle has side play in its boxes. The driving mechanism consists of two gear wheels engaging with the rack. These are driven by a train of wheels capable of multiplying the power, and are at the locomotive end of the car. The cylinders are horizontal and drive on a crank shaft carrying bevel wheels. A differential gear is arranged so that the driving motion may be uniform when rounding curves. At the front are also two similar gear wheels engaging with the rack. These assist in guiding the car and have also a brake action when the car is descending the grade.

The boiler is practically a vertical tubular one, inclined so that there will be as far as possible little alteration in water level on the different grades of the steep climb. The boiler is about 6 ft. 6 ins. high and has 245 sq. ft. of heating surface. A steam pressure of about 176 lbs. is carried. The cylinders are 7.9 ins. in diameter and have a stroke of 11.8 inches. About 80 h. p. is developed by the engine.

The brake arrangements for this car are very complete, as upon this feature depends the safety of the passengers and the reputation of the road. There is the ordinary air brake applied to the wheels of the car. There is also a friction brake on the crank axle, the engine never being thrown out of gear with the driving mechanism. There is also a friction brake which acts on the front gear wheels which engage with the rack rail. This brake can be applied by the engineer, fireman or conductor in case of emergency. A governor is applied to the front gear wheels which stops the rotation of the gear and holds the cars when the speed exceeds 1.3 meters per second, the normal speed being 1 meter, or 3.281 ft., per second. During the ascent, the front gear wheels turn easily along the rack rail, but during the descent they somewhat drag by reason of the fact that a worm gear is thrown into mesh with them. In this way the descent is automatically retarded, the governor locks the gear wheels if the speed rises above the pre-determined amount. The crew can also at any moment lock the gear with the rack rail and the engineer can lock the driving gear wheels with the friction brake on the crank axle.

The whole scheme has been carefully worked out and the Mount Pilatus Railway is very popular with tourists. A curious legend is connected with this mountain and accounts for its name. Some time after the crucifixion, Pontius Pilate, the Roman procurator of Judea, was deposed and banished. It is said he was oppressed with the deepest melancholy, and in this unhappy state wandered among the deep ravines and upon the solitary heights of this majestic mountain, near the shores of that beautiful sheet of water amid the mountains, called Lake Lucerne, until death released him from his mental anguish.



ANCHORED TIE, RAILS AND CENTRAL RACK RAIL, MOUNT PILATUS RAILWAY.

Main Reservoirs.

The main reservoir, the duty of which is to store the air compressed by the air pump, and to cool it to the temperature of the surrounding atmosphere and collect the dirt and moisture therefrom, is the recipient of very little attention outside of an occasional draining or tightening up.

The design, capacity, and location of the main reservoir is usually taken care of by the locomotive designer or builder, and the air brake men are not always consulted concerning it, and the location and capacity of the reservoir are very often governed by the type of the locomotive.

The obnoxious practice of locating one of the reservoirs on the tender is being rapidly abandoned and more attention is being paid to piping arrangement and capacity. There is, however, a possibility of overdoing the matter of capacity in freight service.

For freight service a capacity of not less than 50,000 cubic ins. is recommended and 100,000 cubic ins. would not be too much if the air pump is in good condition and a release in grade service results in almost a full brake pipe pressure shortly after equalization. But if the main reservoir and brake pipe pressures equalize at a considerably lower figure than feed valve is adjusted to maintain, the pump will be compelled to compress a considerable quantity of air before the brake system is ready for the following application.

If it is at any time necessary to wait for the pump to compress air in the brake pipe for the following application, the larger the main reservoir is the more free air that must be compressed and the longer the wait.

Of course, if the pump is in good condition, as it always should be in grade service, a volume of air will be compressed for the following release and recharge.

Less main reservoir volume is required to operate the brake when the type "K" triple valve is used, because but about one-half of the brake pipe pressure that was formerly wasted at the brake valve now enters the brake cylinders and results in a saving of air, and as this action gives much more braking power for the same pounds in reduction, air is used less expansively and the less reservoir volume is required.

ANGUS SINCLAIR ON THE ROAD AGAIN.—COMPLIMENT BY THE ERIE RAILROAD TO THE EDITOR OF "RAILWAY AND LOCOMOTIVE ENGINEERING."

The volume of course must be sufficient to allow the compressed air to cool, and to then keep it cool depends to a great extent upon the piping arrangement and this can be looked after by air brake men if the location and capacity cannot. The reservoir should have but two connections, the inlet and the outlet, and they should be separated as far as possible.

Connecting small pipes for the governor or sanders direct to the reservoir is decidedly objectionable.

Wireless Lighting.

Not long ago an exhibition of electrical apparatus, held at Omaha, Neb., was lighted entirely without metallic connection with any power house. The 4,000 incandescent lamps used in lighting the buildings were made to glow by the transmission of current carried through the air by what we are now in the habit of describing as "wireless."

The lamps themselves were connected by wires in the building in the usual way, but a mast with an aerial wire suitably placed received current from the government wireless station at Fort Omaha, five miles away, and the lamps in the auditorium were kept burning in this way for four hours.

The system by which this interesting experiment was made was devised by Dr. Frederick Milleuer, the electrical expert of the Union Pacific Railroad at Omaha. In our June, 1908, issue, page 233, we gave an account of the operation of a truck which was made to move about over the tracks in the Omaha yard of the U. P. by means of wireless control from the office.

Mr. W. J. Harahan, of the Erie, speaking before the New York Railroad Club recently, gave this piece of sound common sense advice: If one is not in full possession of knowledge of any particular detail, it is the greatest mistake not to ask questions so as to become so. It is not a lowering of dignity, nor an indication of incompetency to have to ask for information, in fact, much can often be learned from even the men of the lowest grade by intelligent questioning. Any other principle of conduct usually results in an ostrich act on the part of the one who attempts it, his ignorance being easily apparent.

MACHINE FOR TESTING RAILWAY RAILS

A very notable rail testing machine has recently been designed by the Pennsylvania Steel Company and the results so far secured are of the highest scientific value not only to the railmaker, but to railroad companies as well. Our first illustration shows the rail testing machine in its original form, Fig. 1. It consists of a heavy circular cast iron girder about 20 ft. in diameter. Upon this frame three rails, bent to the required curve, are secured.

In the original machine the revolving arm is driven by an electric motor. The ends of the revolving arm are carried on two 33-in. M. C. B. car wheels, and the whole is made to sweep round and round and round. The wheels have independent axles and carry the load of the revolving arm and the centre steady pin. This pin is also used to transmit the rotary motion to the revolving arm through bevel gearing, directly connected to the axle shaft of a 50 h.p. motor. The pressure upon the wheels can be regulated by the tension of a strong spring mounted on the revolving arm. To eliminate as far as possible the friction between the stationary spring and revolving arm, ball bearings are placed between them.

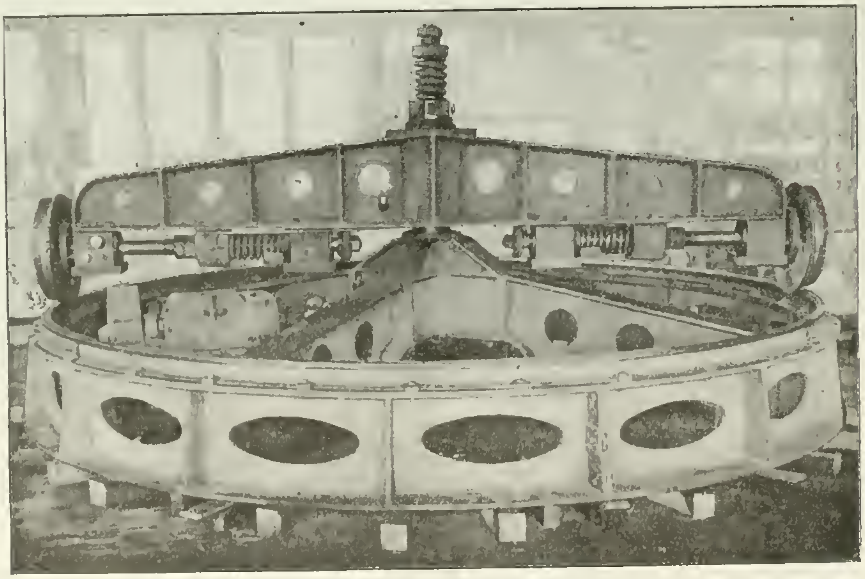


FIG. 1. ORIGINAL FORM OF RAIL TESTING MACHINE, SHOWING DRIVING GEAR BELOW CENTRE-PIN.

It is evident that not only can the pressure of the wheels on the rails be altered as desired, but the speed of rotation of the revolving arm causes variation of the flange pressure against the rails according as the centrifugal force becomes greater or lesser. This can be increased by the pressure of springs at the end of the axles. Sufficient end play is allowed on each axle for this purpose. The conditions of heavy railroad traffic on a curve are thus easily reproduced by the machine. Three rails of different grades of steel are here tested and standard angle bars or fish plates are used to fasten them together. The comparative wear of three different kinds of steel rails under absolutely identical conditions readily becomes apparent.

The later form of testing machine. Fig. 2, contains some interesting improvements. The feature just described, that of rotating the revolving arm by power applied to the centre pin, is retained for reproducing conditions similar to those encountered by a loaded car when being hauled over the road by a locomotive. The principal feature of the second machine, however, is that the wheels can be made to revolve by motors, through shaft and gear wheels, so as to act as driving wheels. The load on these drivers can be varied as before and the end play of the axles allows for the reproduction of flange friction due to the centrifugal force of the wheels, and this can be augmented or diminished by the action of a spring at the inner end of each axle. Short wooden ties are used in the improved machine and these carry the rails. The three rails of different grades of steel are painted red, yellow and white, for easy distinction. If desired, the rails can be fastened directly to the iron frame, which is so designed that even under these conditions a slight wave motion in the rails, due to the advance of the heavily loaded wheels is perceptible. The maximum speed at which the machine is designed to run is 85 revolutions a minute, which gives a train speed to the car wheels of 60.94 miles an hour. Intermediate speeds can be used to produce the conditions of freight or passenger traffic.

The vertical pressure exerted by each car wheel on the rail due to the dead load is 11,500 lbs., and by the adjustment of the springs mounted above the revolving arm this can be increased by any amount up to 30,000 lbs., making the maximum vertical pressure 41,500 lbs. There is, of course, lateral pressure on the head of the rail due to the centrifugal force of the moving wheel and axle. This varies from 450 lbs. at 10 revolutions up to 32,800 lbs. at 85 revolutions. By adjusting the spring on each axle this can be increased by any amount up to 15,000 lbs. The maximum lateral pressure which can be exerted by each wheel varies from 15,450 lbs., at 10 revolutions. to 47,800 lbs. at 85 revolutions a minute.

With this machine it is possible to not only equal but to surpass the traffic borne by any rail or set of rails used on even the busiest of our steam roads to-day. As an example of maximum traffic conditions: The tables of car movement over the horseshoe curve of the Pennsylvania Railroad, one of the points of greatest main line traffic congestion in the United States, show that an average of 2,600 cars per day pass over each freight track at this point. This means that each rail in the track is subject to the daily wear from 10,400 wheels. A corresponding wear is given the rails in this machine, when the revolving arm and the wheels are running at 30 revolutions a minute, in less than three hours, and a week's wear can be had in less than a day. With the arm of this machine making 30 revolutions a minute, the wheels are traveling at a train speed of 21½ miles an hour, which is above the average speed of a freight train on the horseshoe curve.

Other possibilities of test open up as the scientific value of this unique machine is developed. The wheels are even now equipped with air brakes, and the value of various kinds of brake shoes, the effect of skidded wheels, the damage done by flat spots can be reproduced and studied. It will also be possible to see the effect of drivers constantly slipping at a given point, as on a grade, and this may be made apparent not only on the rail, but on the wheel itself. In fact all sorts of wheel tests can be made on this machine. By altering the speed at which each wheel is driven the so-called mysterious dragging action produced by drivers "slipping shut off" can be brought about. Bad counterbalancing can be made to show its hammer blow effects on the tracks. It may be said that practically all the relations of wheel and rail in service conditions can be viewed at close range and with the time required to produce the effects reduced as never before. In fact the power of observation is here concentrated with almost the accuracy and intensity of a close examination made with the aid of a searchlight.

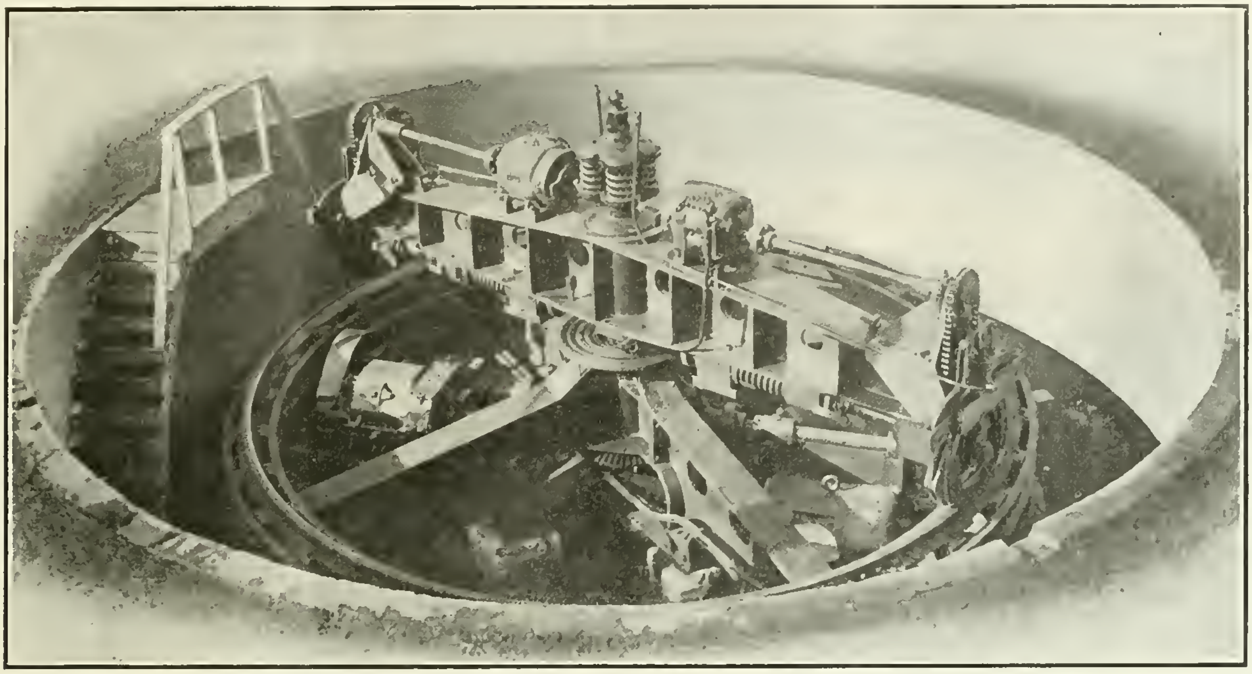


FIG. 2. LATEST FORM OF RAIL TESTING MACHINE. WHEELS DRIVEN BY MOTORS.

One of the objects which the designers of this testing machine had in view was to ascertain the relative wearing quality of their new Manard rails as compared with the ordinary Bessemer rails or high carbon open hearth steel rails. The name Manard is made up of the three first letters of the word manganese, and the termination "ard" is the last part of the word "hard." Manard steel is therefore hard manganese steel and it has been used extensively during the last eight years or more in the form of castings for frogs. switches and street railway special work, dredger parts, crusher jaws, coal breaker rolls, and, in fact, wherever severe wear and shock conditions had to be met. Manard steel possessed all the essential qualities demanded of rails subjected to exacting traffic conditions, but the difficulties in the way of rolling so peculiar a material were assumed to be insurmountable. After years of experimenting and investigation, a rolling process has been devised.

The Boston Elevated Railroad some years ago found that cast Manard rails had more than fifty times the life of ordinary Bessemer steel rails. On a particular curve of 82 ft. radius where a Bessemer rail showed a wear of about ¾ inch in 44 days, the cast Manard rail gave about ½ inch wear after a period of over six years. The rolled Manard rail which has now been produced bids fair to greatly outlast the Bessemer or the carbon rails. The Manard rail, however, costs about four times as much as the Bessemer, but even on the basis of the life of each as 50 to 1, the ultimate economy easily rests with the Manard rail.

The testing of the various kinds of steel rails which may be placed on the machine we have described, will give for all practical purposes the actual value of each as far as wear resisting qualities are concerned, and with such data before them, railways will be able to so distribute the kind of rails used on tangent, on easy curves and on sharp curves with heavy or light traffic so as to obtain greater uniformity of track life, if one may so say, although the rails at different points may vary greatly in composition and in price.

Rise of the Engineer.

There was a time, not so very remote either, when it was popular for engineers and other train men to boast that they had never learned anything concerning their business from books. People of that kind never learned anything more about their business than what could be acquired by repeating the operations they had seen others perform. The engineers of this class acquired the title of the starter and stopper and their standing among their fellow workmen accorded with their ignorance. That class of person had a tendency to lower the popular estimate of our engineer's ability.

A railroad general manager, who is a credit to his exalted office, which he reached by the way of both sides of the cab, the master mechanic's office, superintendent and so on, is very ready to publicly express the great help he received from engineering books and publications of our own kind. In the course of conversation with that gentleman some years ago he said:

"There is no mistake but the engineer is every day becoming a more important person. When I was on the road the engineer received no consideration compared to that extended to the conductor. If there was a very important train to be run, where the making of time was of unusual consequence, the best conductor on the road was selected and upon him devolved the responsibility of getting the train along. Even in snow-fighting expeditions, the conductor was looked upon as a great help in getting a division cleared. You remember having Conductor McConway sent out to help you in clearing the Pacific division? You also remember that he made himself comfortable all the time hugging the way car stove, but carried away full honors for the good bucking of snow drifts done by the plow in front of your engine."

The year after year addition to the mechanism carried by the locomotive has been fatal to the supremacy of the conductor, and put the engineer into the position of credit to which his skill and knowledge entitles him. When railroad management progresses to the point where ability, merit or value of services performed by men in the motive power department pushes them into the higher positions, enginemen will be made more conspicuous in high places than they have been in the past.

Flexure of Staybolts.

A new form of flexible staybolt has recently been designed by Mr. H. V. Willie, assistant to the superintendent of the Baldwin Locomotive Works. In speaking of his form of staybolt before the members of the American Society of Mechanical Engineers, he said among other things that iron is universally employed in the manufacture of these bolts but that it was not good practice to exceed a fiber stress of 12,000 lbs. to the square inch.

ORDINARY STAYBOLT MADE OF GOOD IRON.

Staybolts in the zone which meets the expansion of sheets are stressed above the elastic limit and must fail at the point where the bending moment is greatest. These fractures are in detail, that is, they begin in a minute surface crack at the base of a thread and gradually extend inward. Manufacturers of staybolt materials have endeavored to meet the conditions by specially piled iron arranged with a view of arresting the extension of the initial fracture.

FIG. 1. SECTION OF WILLIE'S STAYBOLT.

The form of fagot from which this kind of iron is made consists of central section of small bars and an envelope of flat plate, has met with much success in this class of service.

Mr. Willie's contention is that the remedy for staybolt failure is not to be found in the use of slow-breaking material, but lies in the employment of material of sufficiently high elastic limit to meet the conditions of service. Stay-bolt material, however, must possess sufficient ductility to enable the ends to be really hammered over to make a steam-tight joint and to afford additional security against pulling through the sheets. To meet these conditions the bolt illustrated in Fig. 1 has been designed by Mr. Willie, and he says the stem is of the same grade of steel as that used in manufacture of springs. It is oil-tempered and will safely stand a fiber stress of 100,000 lbs. per square inch. Its high elastic limit makes it possible to reduce the diameter to 3/8 or 7/16 in. or even less. The ends are of soft steel, and it is thus possible to apply and head up the bolt in the usual manner. The employment of a stem of the diameter indicated reduces the fiber stress in flexure to less than one-half that in the ordinary type of bolt and it is of material capable of being stressed to a high degree. It has hitherto been impossible to employ in staybolts any of the steels containing chromium, nickel, vanadium or other metaloid possessing properties especially adapted to this class of work, but these steels can readily be used in the stem of the bolt here described.

The stem of the bolt is flexibly secured to the end in one of the customary ways, but the flexibility of the bolt does not depend upon a flexible connection. This bolt is flexible as a spring is flexible, in that it can be deflected to meet the requirements of service without exceeding the elastic limit. In fact the stem may be of a number of pieces, either of plates or small rods, thus increasing its flexibility.

Mr. Willie gives a table of the actual breaking strength of staybolts in which a 1-in. iron staybolt with a tensile strength of 32,500 lbs. broke after 6,000 vibrations; another 7/8-in. iron bolt with 24,500 lbs. tensile strength, broke at 5,200 vibrations; while the Willie spring steel staybolt, with 1-in. ends and 7/16-in. stem, had a tensile strength of 32,000 lbs. and successfully withstood 500,000 vibrations. These bolts have been used in locomotive boilers on a number of roads, and have been in service on one of the worst divisions of the Santa Fe for some time and have given every satisfaction.

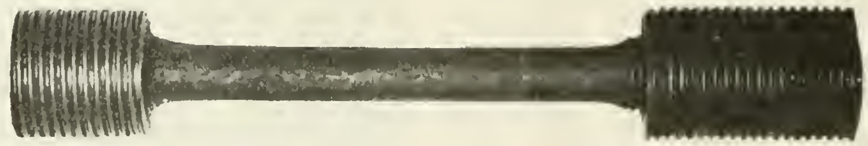
Technical Education in Canada.

Now that the importance of technical education is everywhere acknowledged, it is hard to believe that the movement to establish technical schools was once not only thought to be unnecessary, but was actually opposed. Dr. W. H. Ellis, professor of Applied Chemistry in the University of Toronto, Canada, writing in the February issue of *Applied Science*, has pointed out that up to the middle of the nineteenth century no attention was paid in England and very little in America to the organized teaching of science, and in particular to science in its application to industry.

Up to that time chemistry had been looked upon as part of the medical curriculum, and outside of military engineering, the science of engineering as we know it was taught only by apprenticeship. The first international exhibition in the world, held in London in 1851, directed public attention in England to the possibilities of scientific invention and scientifically directed industry. The interest so awakened took the form in the first instance of an attempt to teach elementary science to the artisan.

In the United States, scientific education followed the German model more closely than that in England. When the need for technical education began to make itself felt in Ontario a commission was appointed to study the problem as it was being solved in the United States. The commissioners were Dr. J. Geo. Hodgins, then deputy superintendent of education, and Dr. McHattie. As a result of their report a bill was introduced into the legislature of the province of Ontario in 1871, establishing a College of Technology for the teaching of mathematics, chemistry, modern languages, civil and mechanical engineering and drawing. In 1877 the College of Technology was transformed into the School of Practical Science and a suitable building was erected on the university grounds. In 1892 the school of Practical Science was definitely made part of the university, and became the faculty of Applied Science and Engineering of the University of Toronto.

One of the commissioners already refered to, Dr. J. Geo. Hodgins, is still in active service in the Education Department of Ontario. He is the oldest man in the civil service of Canada, having become connected with the department in 1844. He is the father of Mr. Geo. S. Hodgins, managing editor of Railway and Locomotive Engineering. Dr. Hodgins of Toronto was several years ago made a member of Imperial Service Order by King Edward VII in recognition of his long and efficient service in the cause of popular education.



WILLIE'S SPRING FLEXIBLE STAYBOLT.

One of the road foremen of engines of a leading trunk line writes us concerning The Railroad Men's Catechism: "It is a very nice, neat compact little volume, and there is a good deal of valuable information in it. I have a good many different kinds of question books, but I find this is so compact and easily carried in the pocket that it makes it more valuable. Every fireman should have one of these books, as it would certainly help him to answer his examination questions."

General Correspondence

Valve Motion.

Editor:

There is no subject in connection with locomotive designing or repair work that is more interesting than the details of the valve motion. It is a subject that carried with it a certain amount of mystery years ago, but which is understood to a great extent to-day. The object the writer has in view is to bring out some of the features of the subject which are of most interest to locomotive engineers.

Many engineers have a hobby on some particular part of the valve motion, such as believing in a large amount of lead; wanting exhaust clearance, or long lap, etc. As a matter of fact, what might be beneficial with one design might not be at all satisfactory with another. If we were to select the most important feature of the valve operation, we would say it was "travel," because a change in the travel of the valve brings with it changes in all the functions of the valve. The character of the service is another matter which should receive consideration. When the engineer asks for more lead, he refers to full stroke. If he would ask for more lead at a certain cut-off, it would be a more reasonable request. We all know that lead is the distance the valve opens the steam port when the piston is at the end of its travel, either front or back, which means that the steam is admitted into the cylinder before the piston has finished the stroke. In starting, and at slow speeds, we can readily understand that this is undesirable, and, instead of making the engine quick to start, has a tendency to retard the movement of the piston at the completion of its stroke.

If we should disconnect one side of a locomotive and place the other side on one of its dead centers, we could not start the light engine—not because we could not get sufficient steam pressure against the piston head, but because we could not get the use of the pressure due to lack of leverage. It is the same as applying an equal pressure on both of the main driving axles, which we know would not give any result. If we uncovered the entire port on that end of the cylinder, the result would be the same. What is lead good for, then? It is good for use as the engine increases in speed when the time is limited in which to get the steam into the cylinder; the faster the speed, the greater requirement in this respect. And as the speed increases, the results of greater lead are also beneficial, such as earlier cut-off, earlier exhaust and greater compression. The question then arises, how are we to get sufficient lead when running at short cut-off if we must not have lead in full gear? With the Walschaerts motion our lead is always the same, and its motion is not as good for starting a heavy train as the shifting link motion. With the latter the easiest way to get the results mentioned—that is, no lead in full gear and sufficient lead at short cut-off—is to give the back motion eccentric 1/8 to 1/4 in. lead, depending on radius of link, travel, etc., which will increase the lead in forward motion as the reverse lever is brought towards the center notch. In considering this matter, the conditions affecting different styles of valve motions should not be overlooked, as what would be a proper arrangement for one class would not do for another. For instance, some roads give forward motion as high as 1/8 in. negative lead and set the back motion line and line. The comparative results are similar.

All engineers have handled engines that would tell them if the lever was hooked up too high, indicating excessive compression, causing engine to ride hard and pound if there were lost motion in rods and boxes. With such an engine, instead of increased lead in back motion, the results would be better to go into negative lead in the forward motion.

After an association with engineers of experience covering a period of fifteen years, we are convinced that the most successful engineers and those who have their valve motion in the best condition are the men who bring the reverse lever back to the running notch gradually. By handling an engine in that manner, less strain is placed on the valve motion, which means a freer action of the engine and less wear and tear on the motion work parts.

For the same reason, we believe firmly in a "light" throttle policy. There is another good reason which is connected with the valve motion question, however.

ON THE SHOULDER OF THE MOUNTAIN, PILATUS RAILWAY.

It is one which affects the economical operation of the engine. If we admit steam to cylinders at a lower pressure than boiler pressure and by using it a little

ON THE "SHASTA ROUTE" AT SISSONE, CAL.

longer get the same or better results, the steam will be exhausted at a lower pressure, making it easier to get rid of it and representing less of a loss than is the case with wide-open throttle. The engine will steam better, will use less water and coal.

The questions of lap and inside or exhaust clearance are questions which must be decided after considering the nature of the roadbed and the service requirements. A long lap is economical, but not always advisable, the service often requiring a sacrifice in economy to get the desired results. The same is true of inside or exhaust clearance. It is only engines which have long, fast runs which require exhaust clearance. It is also a sacrifice in economy because it allows the exhaust to take place earlier in the stroke, or, in other words, we do not use the steam as long.

We often hear engineers inquiring about the merits of the outside valve motion. It seems to be a favorite with them because it is handy to get at to oil or inspect, and it runs along without much repair. These are the features from an engineer's standpoint. It also does away with large eccentrics and straps under engine, which are a source of continual trouble; the adjustments of the motion are easier to make, one adjustment taking care of both motions; the repairs in engine houses are cut out almost entirely, and the repairs in the shop are brought down to a low figure. If the Walschaerts motion is repaired in good shape and put u carefully with trams of the proper length, it is not necessary to even run the valves over. The various forms of this outside motion do not complicate it to any extent, the position of the eccentric arm being dependent upon whether the valve is outside or inside admission and whether the motion is direct or indirect in the forward motion. At all points except the engine centers, forward and back motion are directly opposite, which is the reason that one eccentric rod serves both motions, the link being "stationary" and acting as a rocker arm. The crosshead lever and combination lever regulate the position of valve at the beginning of the stroke, which position is the same whether forward or back motion. The quickest way to understand this motion is to get the above idea and study the balance of the relationship of the various levers gradually.

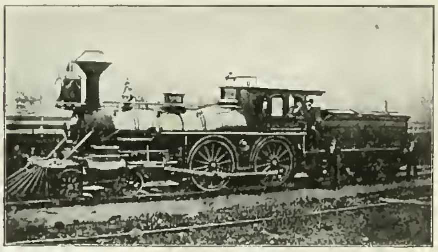
Columbus, Ohio. SHOP FOREMAN.

Old-Time Engines.

Editor:

I enclose some prints of some old engines which I have photographed at various times. Knowing that many of your readers like to see pictures of the old wood burners, I thought perhaps you might want to use one or more of them. I have numbered the prints on the backs and such information as I can give is as follows:

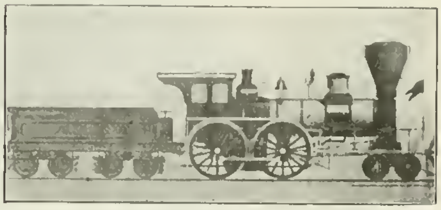
No. 1. These engines drew a train on the "Shasta Route" in July, 1897, and this snapshot I took as the train was stopping



B. L. & N. "STONEHAM."

at "Sissone," Cal. These are good samples of the diamond stack. They burned wood.

No. 2. This is a picture of one of the last woodburners that I have seen in the Northeast. It is a narrow gauge locomo-



OLD TIME "ARIEL," 1855.

tive at Brattleboro, Vt., August, 1899. The road extended from Brattleboro to South Londonderry, but has since been changed to standard gauge.

No. 3. The old "Stoneham," which ran between Boston and Woburn, Mass., on the old B., L. & N., when Woburn was on a branch from Winchester.

No. 4 is a copy from an old and rare lithograph of an old timer, "The Ariel," made in 1855 by the Lowell Machine Shop. Doubtless some of your readers could tell her history.

Hingham, Mass. JAS. M. KIMBALL,

Choked Nozzles.

Editor:

Your question on page 199 of May number: "What is the most urgent need that waits unsupplied for locomotive service?"

The last information I have on the subject estimated the consumption of fuel of U. S. locomotives at $400,000,000 per year, an acknowledged waste of 35 to 50 per cent. One railroad running out of Denver has paid $390,000 for fires set by locomotive sparks in the last five years.

The efficiency of most locomotives has been reduced by about 60 per cent. by choked nozzles creating excessive "back pressure," and consequent high compression.

The most urgent need is: A complete "front end" that will create more perfect combustion in the fire-box without the use of brick arch automatic stoker, or other superfluities, and do so without choking the nozzle beyond what is necessary back pressure for a cushion in the cylinders.

J. A. ESON,
Engineer C. & S. Ry.

Denver, Colo.

General Foremen's Convention.

Editor:

The International Railway General Foremen's Association meets in Chicago, Lexington Hotel, June 1 to 5 inclusive. The headquarters of the association will be in the Red Parlor, immediately off the parlor rotunda on first floor above the office. The headquarters and general arrangements of the convention are in charge of the Executive Committee of the Railway Supplymen. This committee consists of Messrs. Frank Raymond Spear, chairman; Frank Baskerfield, Charles P. Storrs, Clifford A. Nathan, J. Will Johnson, secretary-treasurer. Mr. James C. Younglove is chairman of entertainments. The meetings begin each day at 9 a. m. and 2 p. m. Topical discussions to be made special order of business the last forty-five minutes of the morning session each day. The meeting will adjourn at 2:30 o'clock p. m. on the second day of the convention, and the members will visit the Railway Appliance Exhibition that will be on the Parlor Rotunda floor of the hotel.

Committees will report on the following: Air brake equipment—all classes of service. Coaling of engines with mechanical devices. How to obtain the

NARROW GAUGE WOOD BURNER, BRATTLEBORO, VT., 1899.

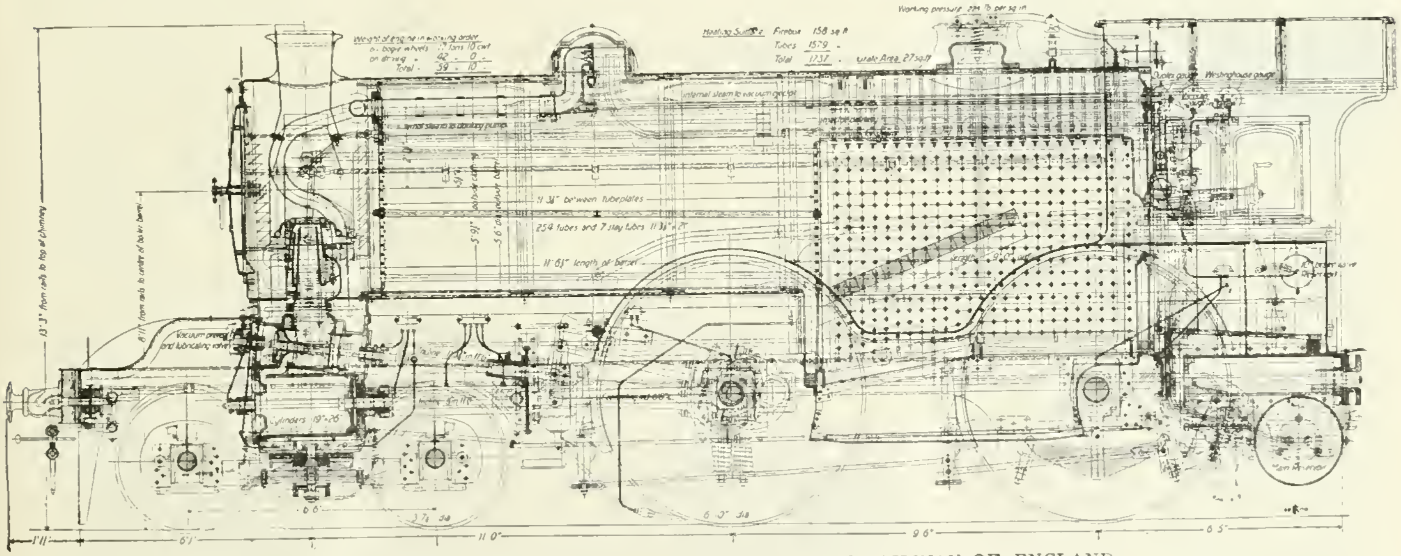
greatest despatch in handling engines through terminals. Installation of hot water washout and filling system. Best method of getting work through shop with economy and dispatch. Most approved type of ash pan, conforming to requirements of Inter-State Commerce Commission.

The topical discussions are on the following subjects: Best method of arriving at cost of repairs, to be introduced by W. S. Cozad, Erie R. R., Meadville, Pa., followed by Mr. H. D. Kelly, C. & N. W., Chicago, Ill. What class of repairs should be made at outside points where facilities are limited, to be introduced by F. W. Rhuark, B. & O., Halloway, Ohio, followed by Mr. S. B. Clay, 'Frisco Ry., Fort Smith, Ark. The use of commercial gas for heating purposes in modern shop plants in place of gasoline or crude oil, to be introduced by J. N. Davis, C. & S., Denver, Col., followed by T. L. Drew, B. & O., Connellsville, Pa. The use of oxy-acetylene process of welding fireboxes, boiler sheets, frames and other locomotive work.

The advantage, if any, which is derived from the use of the wide firebox over its predecessor, the narrow firebox, whether the wide firebox should be designed with a wide or narrow water leg, and what should be done to overcome the present tendency to crack sheets under short periods of service, to be introduced by Lee R. Laizure, Erie, Hornell, N. Y., followed by P. F. Flavin, vice-president International Railway Boilermakers' Association, St. Louis, Mo. The location of the point of water delivery in the boiler, whether it would be an advantage to deliver water at a point of six to eight inches above the mud ring just in the rear of the throat sheet than to deliver in the front end of the boiler near the flues; to be introduced by W. H. Kidneigh, Santa Fe, La Junta, Col., followed by H. J. Carrier, Erie R. R., Huntington, Ind. A successful meeting is assured.

E. E. Fay, President.

Cheyenne, Wyo.



NEW EXPRESS 4-4-0 ENGINE ON THE NORTH EASTERN RAILWAY OF ENGLAND.

New Express Locomotive, N. E. R.

Editor:

The accompanying dimensioned drawing shows one of the latest express locomotives of the type known as the class R 1, designed by Mr. Wilson Worsdell for the North Eastern Railway of England.

The engines were built at the Darlington Works of the company for working the heavy East Coast Scotch expresses between York and Edinburgh. The trains equal twenty carriages loaded and run 124½ miles without intermediate stops at an average speed of 53 miles an hour. The weight behind the tender varies from 350 to 400 tons. Gradients of 1 in 96 for about five miles and others 1 in 150, 1 in 170, and 1 in 200 are frequently met with. It will be observed, therefore, that the work these engines are required to do is of the heaviest description.

There are ten engines of the class running, all of which are fitted with a patent variable blast pipe and ash ejector. The blast pipe is designed to relieve the back pressure on the pistons and to eject the ashes from the smokebox. The driver can regulate the blast on the fire by means of a valve rod and handle in the cab, thus preventing waste of steam. A valve at the bottom of the blast pipe is fully open when the engine is starting and when taking heavy gradients. This increases the blast pipe orifice from 4¾ ins. to 7½ ins. and consequently reduces the amount of ash drawn through the tubes into the smokebox.

Any accumulation of ash or cinders in the smokebox is prevented by vertical passages cast on to the outside of the blast pipe, as by means of these passages the ash is ejected after being broken up in passing through them to such smallness that the possibility of causing roadside fires is reduced to a minimum.

A. R. Bell.

Chesham Bois, England.

Too Much Territory Covered.

Editor:

On page 109 of your March, 1909, number I note the following: "It may be mentioned that the highest commercial railway in the world is at a point 490 miles from Mombasa on the Uganda Railway, in South Africa, where a height of 8,320 ft. above sea level is reached." That statement takes in a lot of territory, and unless the roads of which I am about to speak are in some way disqualified, we have them beaten by a country block.

The Peruvian Central Railway from Lima to Oroya reaches an altitude of 15,665 ft. at Galera Tunnel, the highest point on the road, and there are a number of stations at an altitude of 12,000 ft. and over. From Galera the Central drops to Oroya (on the Eastern watershed of the Andes) at an altitude of 12,272 ft.

The Cerro de Pasco Railway connects Oroya with Cerro de Pasco. The latter place is 132 kilometers distant from Oroya and the station is at an altitude of 14,208 ft. above the level of the sea, and as a matter of fact, not one inch of the Cerro de Pasco's line lies below an altitude of 12,272 ft. and on the branch to the coal mines at Goyllarisquisga, an elevation even higher than that of Cerro de Pasco is reached, at Alcacocha, where the road is 14,386 ft above the sea.

There are also some great altitudes met with on the Peruvian Southern Railway, which runs from Molliendo on the coast to Puno, on Lake Titicaca, which is at an altitude of 12,000 ft. or over. However, the altitudes on the Southern do not approach those on the Peruvian Central nor those of the Cerro de Pasco.

I will not even say that the instances cited are the highest elevations reached by any railroad in the world—that's taking in too much territory. As a matter of fact, I have heard of a narrow-guage road somewhere in the Himalayas that is said to have even the Central's elevation beaten, although the same informant told me that the Central was the highest standard-gauge road. OTTO HOLSTEIN.

Cerro de Pasco, Peru.

Co-operative Work in a Railroad Town.

Editor:

Milo Junction, Maine, is a new modern town built by the Bangor & Aroostook Railroad for their employees. It is situated on the main line and is thirty-eight miles north of Bangor and one mile and a half from the town of Milo.

The large car and machine shops situated at that point are modern and up to

MILO JCT. ON THE B. & A. RAILWAY.

date in every way, and the neat little houses built by the company are as modern as can be found. Two years ago, when Mr. Hugh Montgomery, formerly of the C. R. R. of N. J., was appointed Superintendent of Motive Power and Equipment, the town had not semed to have found itself. Mr. Montgomery believes thoroughly in co-operation, so a society called the Ladies' Improvement League, with the men as honorary members, was organized. In one year, with the assistance of the Bangor & Aroostook, which loaned the League several unused office rooms. A circulating library of two hundred and one books on the shelves, a reading room well supplied with the current magazines, and a hall where the employees could hold their social gatherings have been installed. A piano and many other things, including a large flag for the band stand, have been purchased with money made by the Improvement League.

Every two weeks during the summer band concerts are given by the Milo Military Band in the large new band stand that has been erected in the park by the honorary members, also a mechanical drawing class with an enrollment of forty members, and gymnasium classes for boys and girls hold their well attended weekly sessions.

A course of lectures by professors of the University of Maine have been very interesting and well attended. The large park that lies in front of the town will be beautified by flowers, trees and shrubs through the kindness of the railroad company and the efforts of the Improvement League. Stopping to consider that all of these improvements have taken place in less than two years, Milo Junction and the Bangor & Aroostook can safely boast of the success of the co-operative plan as carried on there. ARTHUR GANNETT.

Milo, Me.

B. & O. Engine With Wootten Boiler.

Editor:

In compliance with a request in your April number relative to the Wooten Type Locomotive, I take pleasure in sending you a photograph of locomotive No. 763, of the Baltimore & Ohio Railroad, which I trust may be of interest to your readers. This locomotive was built by the Baldwin Locomotive Works in 1886 and ran on the Washington branch for a number of years, making a record for high speed that was difficult to equal. The most authentic record that the writer has been able to obtain is that this locomotive made a run in 1892, from Baltimore to Washington, with nine coaches in 50 minutes, which included the time lost from backing into and from the Metropolitan "Y." The locomotive when originally built had a steam pressure of 120 lbs., 69-in. wheels, weighed 67,350 lbs. on the drivers and had a tractive power of 13,411 lbs. In 1906, this locomotive was reconstructed in the Mount Clare shops, the steam pressure being the same as the original, but the driving wheels were cut down to 54 ins., the weight increased to 83,900 lbs. and the tractive power increased to 17,136 lbs. The writer is indebted to the kindness of Mr. A. G. Bowie, chief clerk to the superintendent of motive power, for the above figures, and to Mr. J. B. Adams, assistant station master, for the photograph.

L. J. SAPLEY,
B. & O. Gen. Office.

Baltimore, Md.

OLD TIME B. & O. ENGINE WITH WOOTTEN FIREBOX.

Position of the Cut-Out Cock.

Editor:

In reading the Air Brake Department of the April number under the heading, "Broken Air Pipes, H. 6 Brake," Part III, I notice a description of the Pennsylvania Standard cut-out cock for double heading, why it was put in the main reservoir pipe instead of the brake pipe, and what should be done if either of the pipe connections should break off. The paragraph, on page 165, reading, "This cock is sometimes found to be leaking and the leakage is similar to that of a leaky rotary valve, leaking main reservoir pressure into the brake pipe." This is true and is a dangerous condition if the leakage is of any considerable volume. The writer states in another paragraph, "Should the pipe connection at the large end of the cock be broken, it would be necessary to stop the brake pipe leak and drive a wedge between the handle and the body of the cock to hold the plug valve to its seat." This is also true. But it should not be necessary to wedge the plug valve to its seat; if it is, it is not safe to run, for when the brake pipe is emptied the pressure leaves this pipe and the large end of the plug valve. It is just as apt to be blown off its seat by main reservoir air as when the pipe is broken. When the brake pipe is again charged with pressure the plug is driven back to its seat, providing it does not trap any dirt to prevent its going to its seat. If it does trap dirt there will be a permanent leak from main reservoir to brake pipe, causing a raise in the brake pipe pressure sufficient to cause triples to go to the release in making an ordinary service stop while the brake valve is on lap. I have known enginers to report the rotary valve leaking so badly they could not handle their brakes properly. Invariably I have found the cut-out cock plug had been off its seat, and had trapped dirt, causing a bad leak.

There is a small spring, the same as in every angle cock, for holding this plug to its seat, under which I put a washer of sufficient thickness so that when the cap is screwed on, the spring will be solid, or nearly so. If this is done and the pipe connection at the larger end of the cock should become broken, it would not have to be wedged to its seat. For safety, and the smooth handling of trains and for those of your readers who might be interested, I have attempted this article for your valuable paper.

Mr. J. D. Van Atta, of Orville, Ohio, an engineer on the C. A. C. Division, has made a very simple and efficient improvement to this cut-out cock by simply milling a groove in the side of the plug, so that when the cock is shut the groove is at the top and connects the brake pipe exhaust with the main reservoir pipe above the cock, performing the same function as the pipe, namely, getting brake pipe air on top of the rotary, to prevent its being lifted off its seat during train brake release. Six of these improved valves were tried on the Cincinnati Division and gave perfect satisfaction. I think all air brake men and engineers will agree with me that there should be no possible conection between the main reservoir and brake pipe except through the brake valve, and that the proper place for the double-heading cut-out cock is in the main reservoir pipe. In my opinion the Standard Pennsylvania cut-out cock with the Van Atta improvement is perfection and should be made a universal standard. It is impossible for the second engineer to make a mistake and get his brake valve handle in the wrong position or in any way interfere with the handling of the brakes, and there should be no stop cock in the brake pipe to become accidentally closed and cause trouble, as is the case with the Westinghouse standard. I don't think that any engineer would want to ride on the second engine and not be able to note the brake pipe pressure and the handling of the brakes at all times. It is safer for both to be able to watch the brake pipe pressure.

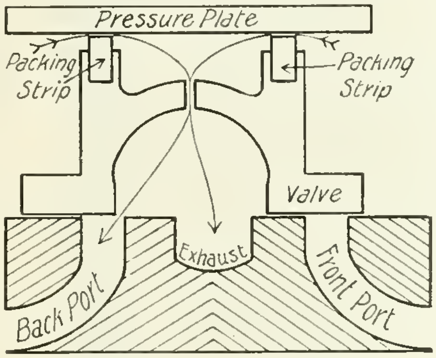
James E. Ganson,
A. B. Instructor, P. C. C. & St. L.
Columbus, Ohio.

Test for Leaky Balance Strips.

Editor:

A number of us, like Mr. Sam Hutchins at the club meeting, would like to know the infallible method of testing a Richardson balanced valve for strip leakage. If you have room in the June number of Railway and Locomotive Engineering, wil you be kind enough to put in a communication covering the subject? We have discovered that by placing engine with right main pin near upper forward eighth that both sides can be tested and leakage determined with reasonable certainty.

As the front port has not opened, no live steam can get to the front side of the piston, the rear port being open to the exhaust, it follows that any leakage past the balance strips will manifest itself at the rear cylinder cock. By putting the reverse lever in full gear back, the left side



POSITION OF VALVE IN TEST.

may be tested also if the engine is exactly spotted or placed. I think by being careful in spotting the engine that this test is reasonably certain to show packing strip leakage, more so than with valve covering ports; especially if the valve has considerable exhaust lap and is tight on its seat.

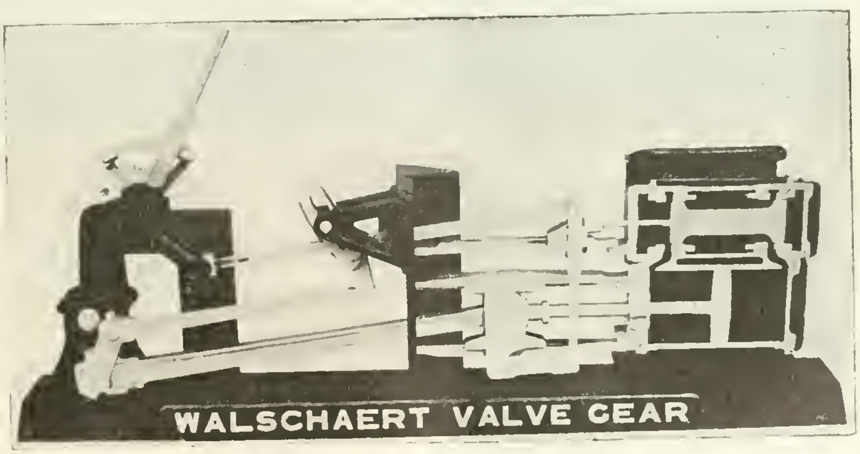
Augustine Holtzkopf.
Wheeling, W. Va.

Walschaerts Valve Gear Model.

Editor:

I am sending you by same mail photograph of a model of Walschaerts Valve Gear. This may be of some interest to the readers of your paper. The original design was taken from a Consolation freight engine on the L. S. & M. S., and was laid out and made to 1½ ins. to 1 ft. scale. This has proved to be a very interesting model among railway men here as it shows the various valve events as well as the motion. The valve and piston appear to be flat but they are not, as the cylinder, valve and piston were bored and turned and then split. The model occupies a space 36 x 12 ins. Cylinder diameter is 3¼ ins., by 4½ ins. stroke. Valve diameter is 1⅝ ins.; travel, ¾ ins.

A. J. Koon.
Grand Rapids, Mich.



MODEL OF WALSCHAERTS VALVE GEAR USED ON THE L. S. & M. S.

Splendid Explanation.

Jim Bragg ran a locomotive on the Prairie Central and was worthy of his name, but altogether a good, though reckless, engineer. One morning Bragg, while breakfasting at Junction, the end of his run, foregathered with a stranger and as usual began boasting about the speed made on the way down.

"You say that you whirled that train of freight cars at the rate of thirty miles an hour," remarked the stranger, "and the company's rules make eighteen miles the limit?"

"The company's rules be blanked," returned Bragg. "Rules are like pie crust; made to be broken."

"Just so," said the stranger. "Mr. Engineer, permit me to introduce myself as Robert Grim, your new general manager!"

"Glad to meet you, Mr. Grim. Hope you did not take my talk as serious. I am known as Jim Bragg, the worst liar on the Central."

Buenos Aires Exhibition.

It is gratifying to observe that the International Exhibition of Railways and Land Transport to be held in Buenos Aires, Argentine, from May to November, 1910, is creating much interest among railway supply men generally. The scope and plan of the exhibition embraces every kind of mechanical device used in transportation. The municipality of Buenos Aires is making preparations on a scale of magnitude and liberality hitherto unapproached in South America. Copies of the official programme may be had from Mr. E. Schlatter, C. E. Secretary, Executive Committee, Buenos Aires, Argentine Republic. Intending exhibitors shoud send applications not later than June 30, 1909.

Posters took their name from the fact that in former times the pavements of London streets were separated from the roadways by lines of post, on which advertisements were displayed.

Heavy Consolidation for Wabash-Pittsburgh Terminal

Wabash-Pittsburgh Terminal 2-8-0.

The Brooks Works of the American Locomotive Company have recently completed a heavy consolidation type freight locomotive for the Wabash-Pittsburgh Terminal Railway Company. This engine is of interest as it is equipped with the builder's latest design of fire-tube superheater. It is one of an order of ten of the same type, the others were designed for the use of saturated steam. One of these is shown in our half tone illustration.

This locomotive is of the same general design as the other engines except for such modifications as were necessary because of the superheater. In order to obtain the full advantage from the superheated steam, larger cylinders were used and the working pressure was correspondingly reduced. The diameter of the cylinders was increased from 22 ins. in the sister engines to 25 ins. in this one, the stroke in both cases being 32 ins., and the boiler pressure was reduced from 200 to 160 lbs. The cylinders of both classes of engines are bored to the same diameter and a bushing 1½ ins. thick was inserted in those of the engines using saturated steam. This arrangement will permit of their being subsequently equipped with a superheater. Except for these changes and the necessary modifications in the boiler design for the introduction of the superheater apparatus, the two classes of engines are practically identical in design.

In working order the engine under consideration has a total weight of 236,000 lbs., of which 207,000 is carried on the driving wheels. Superheated steam is distributed to the cylinders by means of 14-inch piston valves, actuated by the Walschaerts valve gear. The valves are designed with 1-inch steam lap and no exhaust lap or clearance and are set for 3/16-inch lead.

The driving wheels are 58 ins. in diameter, which with the boiler pressure and size of cylinders above mentioned, gives a tractive power of 46,900 lbs. This is 1,500 pounds greater than that of the engines using saturated steam. The frames are of cast steel with double front rails and are very rigidly braced together.

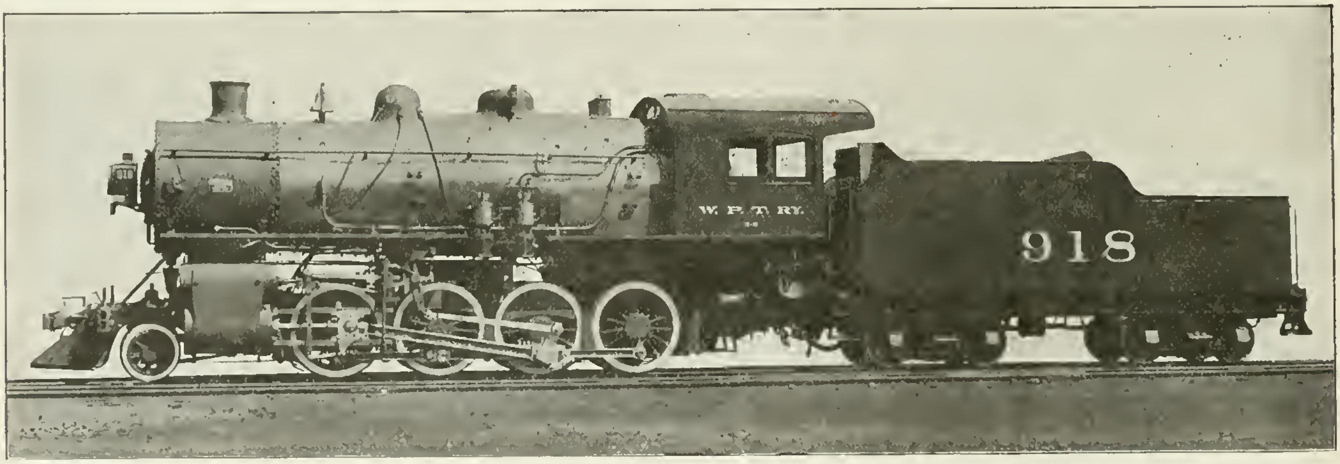
The boiler is of the radial stayed extended wagon top type with wide firebox and is 80 ins. in diameter outside at the front end. It is equipped with 358 tubes 2 ins. in diameter, each 14 ft. 6 ins. long and twenty 5¼-in. tubes of the same length which contain the superheating pipes. The total heating surface of the boiler is 3,283 sq. ft., of which the tubes contribute 3,093 sq. ft. and the firebox the remainder. The superheating surface is 374 sq. ft. The firebox is 109 ins. long by 68 ins. wide, with sloping back head and throat sheet, and provides a grate area of 50.5 sq. ft.

The design of the superheater which is shown in the smaller of our illustrations represents a distinct departure from previous designs of firetube superheaters as applied to locomotives in this country and Canada, and is arranged for giving a superheat of from 100 to 125 degs. F. In this design, instead of a number of vertical steam headers secured to the tee-head, as used in the builder's former designs, there are two steam headers, one on either side of the smokebox. Each header is separated into saturated and superheated steam compartments, the arrangement of the partitioning wall being clearly shown in the illustration of the header. A short curved pipe connects the saturated steam compartment with the tee-head, while the superheated steam compartment is connected to the steam pipe leading to the steam passage in the cylinder. All the connections are made in the usual manner by cast iron ball joints.

The header is secured to a box casting bolted to the side of the smokebox, thus holding it stationary and taking any strain due to the weight of the header off of the steam-pipe-joint bolts. Each of the 5¼-ins. tubes contains four 1½-in. O. D. seamless steel superheating pipes arranged in pairs, the two pipes in each pair being connected at the back ends by cast steel return bends. The ends of the superheating pipes are bent around horizontally to meet the steam headers, one end of each pair being connected to the saturated and the other to the superheated steam compartment.

These bends, besides serving to eliminate the use of vertical subheaders, which were required in former designs, also allow complete freedom for the expansion and contraction of the superheater pipes due to variations in temperature. The ball principle of ground joints has been used for the connections between the superheater pipes and the side headers and all soft joints of copper or composition have been eliminated, and the danger of deterioration of brass or copper with high temperatures is thus avoided. The ends of the superheater pipes are upset and machined to form a ball, and ground to a steam-tight joint with the socket in the steam headers.

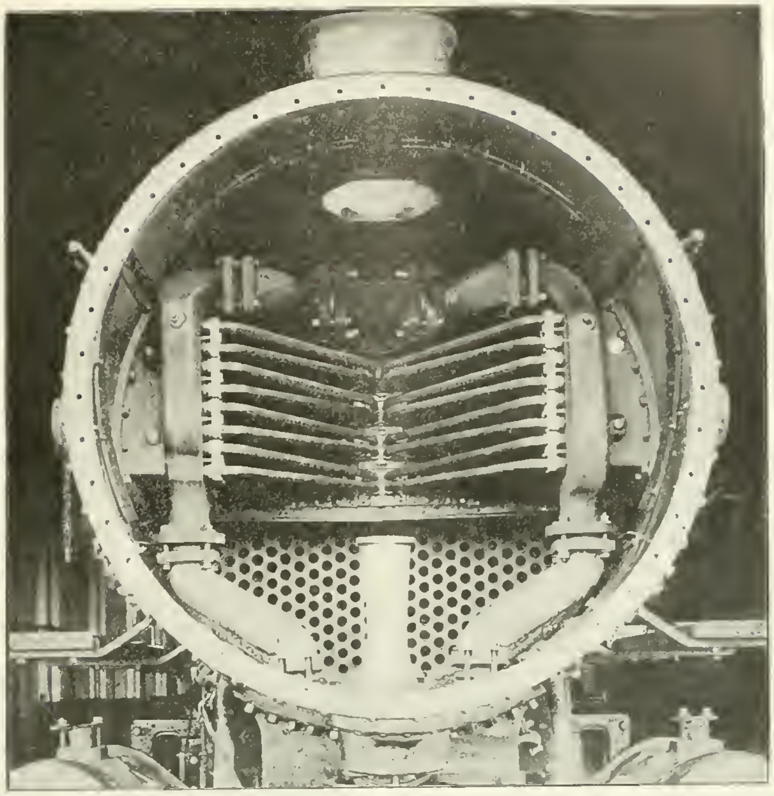
The inlet and outlet pipes of each superheater unit are connected together by a gland and secured to the header by means of a single bolt which passes through the header and box casting with the nut and screw thread inside of the box casting. Covered openings are provided in the smokebox sheet to give access to these bolts from the exterior of the smokebox. The passage of gases through the 5¼-in. tubes and around the superheating pipes is controlled in the usual manner by a damper which is automatically operated by a piston working in a



HEAVY 2-8-0 FOR THE WABASH-PITTSBURGH TERMINAL RAILWAY.
E. F. Needham, Superintendent Locomotive and Car Department. American Locomotive Company, Builders

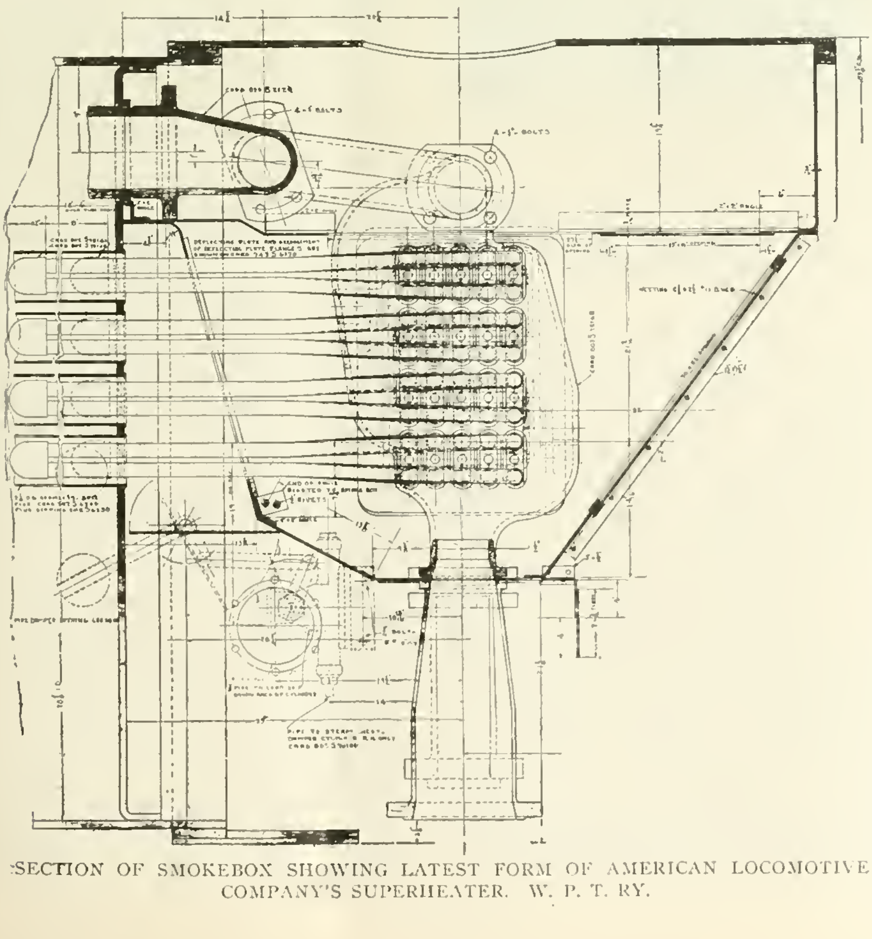
vertical cylinder, having a pipe connection with the steam chest. When the throttle is open, the pressure in the steam chest forces the piston upwards and opens the damper which is closed again by a counterweight as soon as the throttle is closed.

Several important advantages are claimed for this design of superheater. It reduces the number of steam joints for inspection and maintenance; gives complete freedom for the expansion and contraction of the superheater tubes; renders the joints between the superheater tubes and the steam headers more accessible; protects the nuts and screw threads of the bolts securing the superheater pipes to the steam header from corrosion by the hot gases and leaves the boiler tubes easily accessible for cleaning and caulking.



SUPERHEATER IN SMOKEBOX OF W. P. T. RY. ENGINE.

Cylinder—Type, Simple; diameter, 25 ins.; stroke, 32 ins.
Wheel Base—Driving, 15 ft. 9 ins.; total, 25 ft.; total, engine and tender, 59 ft. 11 ins., estimated.
Weight—In working order, 236,000 lbs.; on drivers, 207,000 lbs.; engine and tender, 390,000 lbs.
Heating Surface—Tubes, 3,093 sq. ft.; firebox, 190 sq. ft.; (superheating, 374); total, 3,283 sq. ft.
Grate—Area, 50.5 sq. ft.
Axles, driving journals, 10 x 12 ins.; engine truck journals, diameter, 6½ ins.; length, 12 ins.; tender, 5½ ins.; length, 10 ins.
Boiler—Type, extended wagon type, with superheater; O. D. first ring, 80 ins.; working pressure, 160 lbs.; fuel, bitum. coal.
Firebox—Type, wide; length, 109 ins.; width, 68 ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 5 ins.; back, 5 ins.
Crown—Staying, radial.
Tubes—Number, 358, there being 20 superheater tubes 5¼ ins. diameter, 5/32 thick; length, 14 ft. 6 ins.; gauge, No. 11 B. W. G.
Boxes—Driving, cast steel.
2 W A B pumps, 9½ ins. L. H.; reservoir, 30¼ x 60 ins. and 22½ x 84 ins.
Engine Truck—Two wheel swing motion.
Piston—Rod diameter, 4¼ ins.; piston packing, bronze rings.
Smokestack—Diameter, 19 ins.; top above rail, 15 ft. 4 ins.
Tender Frame—13 ins. center channel and 10 ins. outside.
Tank—Style, water bottom; capacity, 8,000 gallons; fuel, 14 tons.
Valves—Type, piston; travel, 6 ins.; steam lap, 1 in.; exhaust, line and line.
Setting—3/16 in. lead.
Wheels—Driving diameter, outside tire, 58 ins.; material, cast steel; engine truck, diameter, 33½ ins.; kind, A. L. Co. Std.; tender, 33 ins.; kind, double plate.



SECTION OF SMOKEBOX SHOWING LATEST FORM OF AMERICAN LOCOMOTIVE COMPANY'S SUPERHEATER. W. P. T. RY.

Moving Platform.

The popularity of the escalator or moving stairway would seem to have made the moving platform a logical necessity. A project is on foot to install a moving platform on an underground passageway between the Central London Railway and the Great Northern, Piccadilly and Brampton Railway. These two are respectively the "Twopenny Tube" and the "Piccadilly"; both are underground electric railways in London. The stations which it is proposed to connect are separated by a distance of about 400 feet, and a rather steep grade or stairways would have to be features of any passage between them.

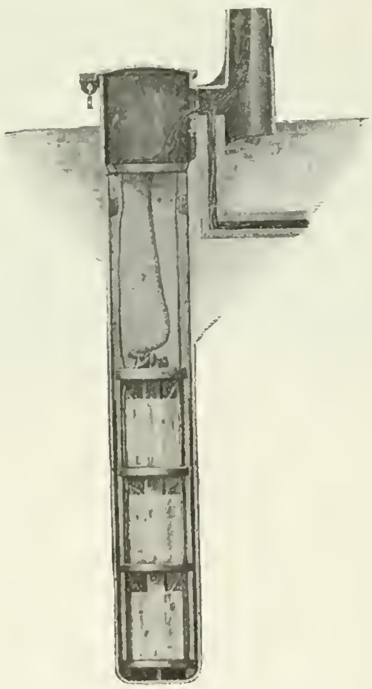
The two companies are considering plans for connecting the British Museum station on the Twopenny Tube with the Holborn station on the Piccadilly, by means of a moving platform. Passengers desiring to go from one station to the other would simply have to get on the moving platform and be carried from one to the other without any exertion on their part. Hand rails will move with the platforms, and will travel at exactly the same rate of speed as the platforms. Attendants will be stationed at either end to assist passengers to get on and off the conveyor.

Track Circuits and Batteries.

By Geo. S. Hodgins.

The ordinary track circuit used in automatic signaling is usually a battery current of low voltage, derived from 2 to 6 or 8 cells placed in a cast iron case or battery-chute sunk in the ground and protected by a substantial cast iron cap. The cast iron chute is set in the ground and there is a wooden frost cover on top. The cells of the battery are placed in an elevator which is simply an iron frame with several shelves one above the other. The cells stand one on each shelf, connected in multiple, and are raised or lowered by a rope. As the chute is 6 or 8 ft. deep, and as the battery elevator is only about half as high as the chute, the battery is well below the frost line when lowered into place.

The battery used is, as we have said, composed of three cells. The cups containing the liquid are made of glass and at the bottom of each cup a quantity of blue vitriol is placed. Embedded in this are a couple of pieces of clean sheet copper riveted together at the centre, with ends spread something like the letter X. From the copper an insulated wire is brought to the surface of the cup. In the upper part of the cup a piece of cast zinc is suitably suspended from the edge of the cup and a



BATTERY CHUTE IN THE GROUND.

wire leading from the zinc, when joined with that from the copper, forms a closed circuit.

The battery is completed by the addition of some water which is poured in until both metals are submerged. We have therefore in the glass cup copper, zinc, blue vitriol and dilute sulphuric acid. Chemical action manifests itself after a short time by the flow of an electric current if the wires are connected. Blue vitriol is a salt of copper, and is produced by dissolving copper oxide in sulphuric acid. Blue vitriol, or bluestone, as it is often called, is sulphate of copper, and is represented by the chemical formula $Cu\ SO_4$. Being crystalline it also contains what is known as the water of crystallization, and the full chemical formula may be written $Cu\ SO_4 + 5H_2O$.

The action of the battery begins after the dilute sulphuric acid has acted upon the zinc and the copper. A solution of zinc sulphate is formed in the upper part of the liquid in the cell and copper sulphate is formed in the lower part, with the liberation of hydrogen. The solution of zinc sulphate being lighter than that of copper sulphate, remains in the upper part of the cell surrounding the zinc, while the copper sulphate surrounds the sheet copper at the bottom. The separation of these two liquids takes place automatically, and with the heavier one below, and the lighter one above, the cell becomes what is called a gravity battery.

There is no absolute line of demarcation between the two fluids, but the amount of copper sulphate rising, although comparatively insignificant, nevertheless produces small copper pendants from the zinc which have to be broken off from time to time before they become long enough to reach down into the solution of copper sulphate. The chemical action taking place in the battery, when current flows may be represented by the chemical formula, as follows:

$$Zn + H_2SO_4 = ZnSO_4 + H_2.$$

This translated into English means zinc and sulphuric acid produce sulphate of zinc and hydrogen. The hydrogen, however, does not pass off in bubbles, but is seized upon for further chemical transformation where the copper is concerned. This may be represented as

$$H_2 + CuSO_4 = H_2SO_4 + Cu.$$

Translated, this formula reads: hydrogen and sulphate of copper produces sulphuric acid and copper. The reactions are apparent by the gradual wasting away of the zinc as it is dissolved and the deposition of metallic copper in the sheet copper. The copper grows while the zinc is diminished. The blue vitriol at the bottom of the cell maintains the requisite supply of dilute copper sulphate as it slowly dissolves in the liquid surrounding it. The original dilute sulphuric acid gradually changes into a solution of sulphate of zinc and the solution of sulphate of copper changes into dilute sulphuric acid. The battery operates continuously with a closed circuit until interrupted for the purpose of signaling.

The wires which come from the zinc and from the copper terminals of the battery are connected, as we have already said, in multiple, and with the three cells arranged as described a current of a little more than one volt flows. This is suitably connected to the rails and forms what is called the track circuit. The method of connection is such that for example let us say the zinc pole of the battery reaches the fireman's rail, and the copper pole is attached to the engineer's rail. The signals, operated by a separate, though

TRACK RELAY BOX.

similar battery circuit, stand at the entrance of the block and the battery for the track circuit is placed at the far end of the block. The rails are connected together at the signal end of the block, and thus form a closed circuit, from the copper down one rail, across the connection and up the other rail to the zinc.

This arrangement of track circuit provides that the entrance of a train into the block at the signal end, short circuits the battery and leaves the rails between the end of the train and the signal without any current, and the connection between the rails near the signals is also dead, while current flows from the battery along the rails toward the advancing train across wheels and axles and back to the battery. The connecting wire between the rails at the signal end is now dead, and this fact is made use of to operate the signals. The connecting wire does not stretch directly from rail to rail, but forms a circuit on which a track relay is placed, contained in a suitable iron case. The movement of this relay is dependent on the flow or absence of current. As soon as the connecting wire becomes dead by reason of the train having short circuited the battery the armature of the relay drops. The movement of the armature breaks the signal circuit which is a separate but similar battery circuit, and the home signal rises to the stop position. In doing so this home signal opens a circuit breaker on the distant signal circuit and the lower signal arm rises to the caution position.

As soon as the train passes out of the block, current again flows through the full length of track circuit and energizes the relay, its armature picks up and thus closes the signal circuit, and this signal circuit, operating a valve on the pneumatic system, fills the cylinder under the home signal with air and pulls it down to clear. The circuit-breaker on the distant signal circuit is closed by the action of the home signal clearing and the distant would also clear but for the special arrangement of its circuit so that it may repeat the indication of the home signal next ahead. A wire from the distant signal circuit at block A runs to the circuit-breaker on home signal at block B, and as this long wire circuit has been broken by the rise of the home at B, the distant at A remains in the caution position until the home at B is cleared. It thus appears that the home at A is operated by its signal circuit controlled by the relay in the track circuit, but the distant at A has its circuit opened first by home signal circuit-breaker at A and when that is closed the distant signal circuit is still kept open by the operation of the circuit-breaker on the home at B.

The arrangement just described requires a wire which is part of the distant signal circuit to be strung along the telegraph poles the length of each block. This is the older form of installation, the more modern being what is called the polarized or wireless track circuit system. In this arrangement the short-circuiting of the track battery acts upon a neutral relay in the home signal circuit and upon a polarized relay in the distant circuit in block A and opens both circuits, and these signals rise to the horizontal position. A circuit-breaker in the distant signal circuit operated by the home makes sure of the opening of the distant circuit in case the polarized relay stuck.

As the train moves into block B, the short circuiting of the track battery for block B causes the signals at B to assume the stop position, but it also operates a pole-changing switch in the track circuit of block A. This means that if the zinc end of the battery was formerly connected with the fireman's rail, it now becomes connected to the engineer's rail and vice versa for the copper terminal of the battery. The track circuit in block A is restored by the departure of the train, but the direction of flow has been reversed by the pole-changer operated by the short-circuiting of the track battery in block B.

The result of this revival of current but of altered polarity in the track circuit of block A acts differently on the neutral and on the polarized relay which govern the home and distant signals at A. The neutral relay at A governing the home picks up with current of either polarity and makes contact by which the home signal circuit operates and pulls down to home at A to clear. The current of changed polarity is powerless to move the polarized relay governing its distant signal at A, and it remains in the horizontal position until the passage of the train into block C restores the track current in block B and moves the pole-changer at B and thus sends current through track circuit A with the polarity necessary to actuate the polarized relay at A. The closing of the polarized relay at A closes the distant signal circuit at A, and as the circuit-breaker on this circuit has been previously closed by the clearing of the home signal at A, the integrity of the distant signal circuit at A is assured and the caution arm at A clears.

UPPER QUADRANT, THREE POSITION SIGNAL.

The wireless track circuit is also applied to the one-arm three-position signal. Instead of the signal motor pushing up or pulling down two rods attached to the signal arms, one signal rod is pushed up its full stroke for the stop position and is pushed up half its stroke for the caution position. This adjustment is made for the distant signal by a compensating gear at the base of rod which moves the signal arm.

The "Ash Pan Law."

AN ACT TO PROMOTE THE SAFETY OF EMPLOYEES ON RAILROADS. [PUBLIC—NO. 165.] [H. R. 19795.]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That on and after the first day of January, nineteen hundred and ten, it shall be unlawful for any common carrier to engage in interstate or foreign commerce by railroad to use any locomotive in moving interstate or foreign traffic, not equipped with an ash pan, which can be dumped or emptied and cleaned without the necessity of any employee going under such locomotive.

Sec. 2. That on and after the first day of January, nineteen hundred and ten, it shall be unlawful for any common carrier by railroad in any Territory of the United States or the District of Columbia to use any locomotive not equipped with an ash pan, which can be dumped or emptied and cleaned without the necessity of any employee going under such locomotive.

Sec. 3. That any such common carrier using any locomotive in violation of any of the provisions of this act shall be liable to a penalty of two hundred dollars for each and every such violation, to be recovered in a suit or suits to be brought by the United States district attorney in the district court of the United States having jurisdiction in the locality where such violation shall have been committed; and it shall be the duty of such district attorney to bring such suits upon duly verified information being lodged with him of such violation having occurred; and it shall also be the duty of the Interstate Commerce Commission to lodge with the proper district attorneys information of such violations as may come to its knowledge.

Sec. 4. That it shall be the duty of the Interstate Commerce Commission to enforce the provisions of this act, and all powers heretofore granted to said commission are hereby extended to it for the purpose of the enforcement of this act.

Sec. 5. That the term "common carrier" as used in this act shall include the receiver or receivers or other persons or corporations charged with the duty of the management and operation of the business of a common carrier.

Sec. 6. That nothing in this act contained shall apply to any locomotive upon which, by reason of the use of oil, electricity, or other such agency, an ash pan is not necessary.

Approved, May 30, 1908.

A man has confidence in untried friends; he remembers the many offers of service so freely made by his boon companions when he wanted them not.—*Pickwick Papers.*

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Tempering Steel.

The changing of the physical condition of metals is an art that is more elusive than is generally imagined. A good tool-dresser is one of the most reliable mechanics in a large engineering establishment. He is rarely a young man. He must be a graduate of the school of experience. Hints may be had from books, but if to these are not added the fine faculty of observation, fortified by a patience that wearies not, the tool-dressed will never become the perfect master of his calling. The standard of excellence is easily set. The tool that, while at work, will neither bend nor break is the one that is wanted.

It may be noted at the outset that the amount of carbon in a piece of steel is the chief determining factor as to the temper of the metal. What is spoken of as point one carbon is a quantity in common use in the construction of chisels and other hand tools. Point one-and-a-half carbon in steel gives a composition that is capable of the very highest temper such as is required in lathe tools used in cutting hardened material. Slight variations in the amount of carbon produce nearly all of the varieties of steel used in lathe tools, cutters, reamers, drills and taps. It should be remembered that such an expression as "point two carbon," although it is often written 0.2 does not accurately express the amount of carbon in the steel. Each such figure means the fraction of one per cent. Point 2 carbon is really 0.002 carbon or equal in proportion as two mills are to one dollar. The figure is two hundredths of one per cent. As the quantity of carbon increases, the tendency to burn the steel becomes greater, and more care is required in heating and working the metal. The steel should be worked and tempered at the lowest degree of heat at which it is possible to bring the desired results, both in regard to ductility in hammering and hardness in tempering. The kind of work on which the tool is to be used should be the determining factor in regard to the degree of hardness and also to the extent of the hardening process in the body of the tool.

The common method is to harden the tool to a degree considerably beyond that required, and then reduce the hardness to the necessary degree. The relation between the colors that come over the hardened surface of the chilled metal on being slowly reheated, and the degrees of temperature which correspond with the colors should be known. As the heat approaches 450 degs. F., a light straw color appears. This is the temper at which tools are usually quenched in cold water, if they are to be used in lathe or planer work. A dark yellow will succeed the lighter yellow indicating a temperature of about 500 degs. Taps, dies, cutters and reamers are generally taken at this color and cooled. Light purple, indicating about 525 degs. is used for thin edged tools such as are employed for wood cutting machines. Dark purple succeeded by blue, indicating a temperature of from 550 to 575 degs of heat are generally the shades of color at which wood saws, cold chisels and other smaller tools are cooled.

Some tool dressers cleverly perform the forging and tempering work at one heat. In such cases the chisel or other tool is heated for several inches and after being drawn or bent into shape, only a short space at the cutting edge of the tool is quenched, leaving a sufficiently heated portion in the body of the tool to reheat the cutting edge of the tool when withdrawn for the cooling liquid. When the required color has reached the cutting edge, the entire tool is suddenly cooled in the water. The skilled mechanic carefully observes that the hammering on the metal is not continued until the metal has cooled too much, in which case the degree of brittleness in the steel is greatly increased, and on the other hand that there is not too much heat left in the body of the tool so that when cooled, the necessary degree of toughness will be affected.

In the case of tempering tools of considerable length such as reamers and taps, many devices are in vogue for the equable heating of the tool, a popular plan being the heating of the tool is fused lead. It must be borne in mind that it is easy heating lead to a greater degree than would be essential to good practice in tempering. A careful management of the fire can readily secure the desired temperature of the lead into which the tools to be hardened are immersed, insuring in a short time a perfect uniformity of heat. Cooling solutions of oil are considered superior to water by many persons.

Several kinds of self-hardening steel have recently come into use and bid fair, in certain classes of work, to outrival the tempered tools. A metal known as tungsten is added to carbon steel, the exact percentage varying in the hands of the different manufacturers, with the result that steel of great hardness and durability is produced. This metal is usually made in bars suitable for lathe tools, and pieces of the bar are ground into cutting edges, no forging being necessary.

Lining Guides Text for Sermon.

We sometimes hear friendly critics remark: "The trouble with mechanical papers is that much of the stuff they publish is not new." There are many new things happening in shops, new tools are perfected and new processes devised, but the young mechanic or engineer of observing habit finds plenty of old things that make excellent material for loading the memory.

The apprentice in a machine shop with a blissful taste for reading trade literature finds in the simplest every-day matter subjects of novelty to himself, and in the course of time his mind becomes stocked with material gathered item by item, each one as old as the hills to the veteran, but fresh as the daisies of the field to the youth.

Here is a pen picture drawn by See, the author of "Chordal's Letters," a book that every ambitious mechanic ought to read: "An apprentice boy sits on a block at noon reading a mechanical paper and is thoroughly interested in an illustrated article on lining up guides. Some old gray-haired fellow looks over his shoulder, gets a general idea of the illustrations and sneeringly remarks to the boy: 'Pshaw, that thing's a thousand years old. Is that what you fellows read about in those papers?' If the boy is smart he will reply: 'I am 16 years old and this is the first I ever knew about this guide business. How old were you when you found it out?'

"When this same boy gets to be, say, fifty years old, he may possible get disgusted with this kind of shop literature and begin to think that the editor ought to be kicked for putting old things in the paper, thinking that they can be passed off as novelties. He may forget his own experience. The literature of the artisan to be of any real value must contain repetitions that describe processes that are ever new to the learner and old to the master of the art."

We have among our readers the apprentice boy and the old workman, also the new fireman and the old engineer, all of them helped by reading the literature of that calling by either men old or young or the reading matter new or venerable with age. It is news to most youths to read that one cubic inch of water converted into steam occupies seventeen hundred times the space it needed as water; the same statement may be like a tale many times told to the gray veteran, but it may refresh his memory concerning a fact that all intelligent engineering people are expected to know. Men forget things so quickly that old memories will stand touching up on the knowledge that is new to the younger generations.

Sharp or Loose Practices.

At a meeting of the Western Railway Club a paper was read by Mr. J. J. Hennessey, master car builder of the Chicago, Milwaukee & St. Paul Railway, on "The Abuse of the Master Car Builders' Association Repair Cars," which was well deserving of attention from every person in the country interested in honest dealing in the interchange of cars. Mr. Hennessey voiced a complaint heard in every part of this continent, that a great amount of unfairness, not to say dishonesty, exists in failure to adhere to the Rule 4 Section 16 of the Master Car Builders' Rules of Interchange of Cars, which says: "When repairs of any kind are made to foreign cars, a repair card shall be securely attached to outside face of intermediate sill between crosstie timbers."

Mr. Hennessey emphasizes the regret that the rules concerning the making repairs are not complied with and continues: "The road I am connected with has cases coming in every day where our cars are sent home with wrong repairs to sills, trucks, draft gear and other very expensive parts and the expense of correcting the same is enormous. The repair card is invariably missing and we are then forced to the only other method of ascertaining by whom the repairs were made, and this leads us to that same old story of tracing with its attendant voluminous correspondence, loss of time, and expense, to say nothing of the burden placed upon the office forces of our Motive Power and Car Accounting departments. This difficulty has been growing worse from year to year, until now it presents to us a very serious condition with no apparent relief in sight. It is to be deplored that this particular rule is so flagrantly violated."

There is no doubt that the principal part of this trouble comes from carelessness on the part of men executing the repairs. They are busy and have many things to attend to that seem more important than making out repair cards; but all the failures to apply cards cannot be attributed to carelessness. It has been found in car interchange and in other lines of mutual business dealing that men who are strictly honest in their own personal affairs will act dishonestly in the interest of employers. The remedy proposed to secure fairness and honest dealing between railroad and railroad in the interchange of cars is to employ inspectors who will watch that cards will be applied when repairs have been done to foreign cars. That plan might effect some improvement, but we doubt it.

It appears that history is repeating itself in the difficulties concerning repairs of foreign cars. When loaded cars first began to be sent over foreign lines, there was for a time a sentiment of honor that demanded the return of the cars in the same condition as they were received and most of the railroad companies acted fairly with each other. But as business increased and the volume of car interchange became large, certain railroad companies began to take advantage of connecting roads by returning cars in very bad condition or by effecting repairs with inferior material. Furious disputes arose over these practices and the management of some railroads gravely discussed the propriety of refusing to permit their cars to be sent upon certain railroads. At this juncture the master car builders of the leading lines got together and agreed upon equitable rules concerning the repair of foreign cars. This led to the organization of the Master Car Builders' Association which has labored incessantly during the forty-three years of its existence to have justice done between railroad and railroad in the repairing of interchanged cars. It seems now that the spirit of dishonesty has become so rampant that moral suasion has lost its power.

Instead of employing more inspectors to check carelessness in applying cards to repaired cars, we suggest that systematic reports be published of the cars received with repair cards missing. All railroads would have some charges against them, but the companies that encouraged carelessness would receive prominent mention that would be certain to go home to the parties responsible.

Locomotive Inspection.

Rapid and accurate locomotive inspection is a matter of the greatest importance, especially at busy terminals, and the way it is done on the Pennsylvania railroad was recently described by Mr. William Elmer, Jr., master mechanic at Pittsburgh to the members of the Pittsburgh Railroad Club. Inspection pits are used where a small force of men is stationed and as soon as an engine comes in, it is placed on this pit and the inspectors go to work.

The head inspector examines the outside of the engine and tender, and looks at trucks, wheels, draw gear, brake rigging, couplers, grab irons, footboards, pilot steps, and all safety appliances. He gauges the couplers for height, wear of knuckles and heads, examines the knuckle-lock pins, etc. He examines driving wheels, flanges and tires, main and side rods, brasses, knuckle joint pins, crosshead pins, crossheads and guides. He looks for loose pipes and clamps, oil cups and lids, cracks or breaks in frame, working of cylinders, missing or defective safety pins and examines the valve gear, springs and spring rigging. He reports hot bearings, leaky washout plates or plugs or any other defects that may come under his notice. He has charge of the other inspectors and sees that each inspector makes out a report for each engine inspected.

Another engine inspector starts in under the pilot and examines the truck, wheels, frame, braces, axles, boxes, king bolt, main frames, stiffening pieces, driving boxes, shoes, wedges pedestal caps, valve gear, eccentrics and straps, and oil pipes, cups, lids, draw gear between engine and tender, spring chambers, buffer castings, ash pans, dampers, grates and grate rigging and underneath the tender he examines trucks, center castings, wheels, frame and side bearings.

The head air brake inspector examines the brake valve, air pump, gauges and governors, noting dates on tags. He reports them for attention after 30 days from the date on the tag. He examines air pipes and reservoirs above the running board to see that they are tight and properly secured, the sanding devices, gauge glass and gauge cocks. He is required to try them and blow them out. He notes the condition of the fire door, latch and chain, the apron and hearth plate, wash out plugs, sprinkling hose, etc. He examines the throttle gland to see if the packing will last until the engine is due for boiler washing. When an engine is due for boiler to be washed he calls attention to the need of throttle packing, if such be the case and also if any valves in the cab need packing. His most important duty is to examine the crown and side sheets for leaks and to note the condition of the flues. This examination is made in the presence of the engineer and before he goes off duty. This practice is of great advantage in protecting the round house staff in the event of subsequent discovery of damage due to low water. This inspector also examines the staybolt and boiler wash out tags, notes when the engine is due for staybolt test or boiler washing, and keeps a book record of the same. When an engine is due for staybolt test or boiler washing, he chalks the steam chest so that the hostlers know that the fire has to be knocked out.

One duty of the head air brake inspector on roads equipped with track troughs, is to lower the water scoop while the man underneath gauges it, to see that it is neither too high nor too low. This underneath man is also an air brake inspector, and he examines all air pipes, hose and connections below the running board, brake rigging of engine and tender, notes the piston travel and locates leaks of every description. For this purpose what we call a wickless torch has been found of considerable service, and the men who use them prefer them to those of other patterns. They burn less oil than other torches, require no wicks and almost no repairs.

The steam heat inspector examines all valves in the cab and at the rear of tender, all joints and pipes between engine and tender and on front and rear. He tests the governor to operate at 100 lbs. and reports any leaks or defects in the portion of the equipment for which he is responsible.

When these examinations have been completed from four to five minutes being sufficient, each man writes his report on the proper form and sends it by pneumatic dispatch tube to the engine house office. By this means the reports covering the condition of the engine reach the work distributor's desk almost as soon as the engine reaches the ash pit. The pneumatic dispatch tube can easily be installed by any competent pipe fitter and is usually made of two-inch pipe laid in a box underground or carried on the ends of the ties. The usefulness and value of this simple and inexpensive tube system can hardly be appreciated by those who have never used it. The condition of an engine is known to the round house force within a few minutes after it reaches the inspection pit, and they know at once whether the engine can be marked up for a run and a crew called or whether it will require shop attention which may take several hours.

Speaking of the method of keeping track of the dates for stay bolt inspection and boiler washing for each engine, Mr. Elmer outlined a very simple and most effective system. He said: The division with which I am connected has about 700 locomotives and a dozen or more engine houses. A locomotive may be at one terminal on Monday, another on Tuesday, a third on Wednesday, and so on, and the method of keeping a book record in the master mechanic's office and sending out letters to all points giving a list of engines due to have stay bolts inspected or boilers washed out, was found to be cumbersome and unsatisfactory and was giving very poor results and it required the interchange of so many messages between engine house foremen in order to prevent giving the same attention to an engine at different points on the same day, that it was decided to have each engine carry its own record. For this purpose small tin tags $1\frac{1}{8}$ by $2\frac{1}{2}$ ins. for the staybolt test and 2 by $1\frac{1}{2}$ ins. for the boiler washing are fastened by wire to the water bottle connection. These are marked with steel stamps to show the point and the date when the engine was last given attention, and as soon as the proper time comes, there are the reminders that the engine is again due. An engine coming to any terminal without these tags is taken in hand at once and new tags applied. A book record is kept, simply as a check, but the list of overdue engines is surprisingly small.

Superheaters.

Experiments are being continued on the Prussian and Belgian State railways, and the fullest kind of reports are being constantly issued by these companies in regard to the comparative merits of simple and compound engines when using superheated or saturated steam. There is a close similarity in the reports, both pointing to the superiority of the simple superheated type of engine. The result is that superheaters are more universally fitted to the Belgian locomotives, while the Prussian new locomotives are nearly all being equipped with similar apparatus. On the British railways the companies seem to make haste toward adapting the use of the superheater much more slowly than on the Continent. We hear of a locomotive here and there being tried with a superheating device, and while a certain saving of fuel and water is claimed, it is evident that there is a desire to extend the experimental period over a number of years with a view of testing whether the extra cost of maintenance does not counterbalance the saving.

Doubtless for the same reason the superheater does not make rapid progress toward universal adoption in America. In districts where coal is cheap and skilled labor high-priced, it can be readily imagined that it would take a considerable quantity of coal to offset an extra amount of skilled labor, not to speak of the material used in superheater construction and repair. A notable feature among recent experiments in America is a step in the direction of lower steam pressures with an increase in the size of cylinders. The lowering of steam pressure may lead to a more general use of superheating. It is a generally admitted fact that the superheater temperature of the steam, if it is to be economical at all, must exceed 600 deg. F., and in order to reach this temperature there must be a constant velocity in the steam passing through the pipes in the drying process. The Schmidt superheater has this advantage, that the steam having to travel a considerable distance passes through the superheated area at a high speed while the engine is in motion, thus having the temperature of the steam raised to the economical point.

It is difficult to gather much satisfaction from the reports. It appears as if there is some real gain in the use of superheated steam under certain conditions, the best reports showing that the tests have been made in locomotives engaged in the lightest, steadiest kind of service. Whether its universal adoption in locomotive service is practically advisable is still an unsolved problem.

Railroad Mechanical Associations.

It might naturally be supposed that an organization such as the American Railway Master Mechanics' Association, which holds its forty-second convention this month, would display a disposition to rest and be thankful for past achievements, but instead of that, age seems to whet the inclination of the association for more labor. In its sturdy youth the organization used to be contented to report upon five or six subjects and devote much time to discussing the reports, but of late years the number of subjects reported upon have been double what was for years considered sufficient, and this year the number is greater than it has ever been before. We do not consider this a desirable manifestation of progress, for the most valuable information concerning a subject has generally been brought out during the discussion, which must be curtailed when the reports are numerous. Two reports a day with discussions upon them ought to be sufficient with the noon hour topical discussions. The latter discussions have proved wonderfully interesting, bringing out most valuable information sometimes, but the desire to devote time to the regular reports have of late years seriously curtailed the discussions of the noon hour, a thing that many of the members regret.

There has been a tendency in the Railway Master Mechanics' Association of late years to reach up into reporting on and discussion of more scientific engineering phases connected with railroad motive power, but this year the purely practical subjects have come again into hand, as, for instance, mechanical stokers, castle nuts, safety valves, steel tires and tender trucks. Of mechanical engineering subjects are: Motor cars, superheaters, widening gauge on curves, fuel economies, lubricating material economies. Among the general subjects to be discussed are: Revision of standards and revision of constitution and by-laws. This latter movement indicates a tendency long apparent in the association to draw into closer relations with the American Railway Association, which is composed of railroad managers and other officials of the managing class. In both the Railway

Master Mechanics' Association and in the Master Car Builders' Association actions have been taken and decisions arrived at of stupendous legal importance, the members acting as if they had the authority of railroad presidents. Such action has caused conflict of authority at times, and now the Master Mechanics' Association are going to take the higher officials into their confidence. A proposed change in the constitution reads: "Subjects involving legal, transportation, permanent way or traffic questions, or for any other reason requiring such action, may be submitted on recommendations to the American Railway Association."

Referring in another part to the powers of the Executive Committee, the proposed change reads: "It shall also determine which, if any, of the subjects presented at the convention or by the members shall be referred to the American Railway Association."

This tendency of the American Railway Master Mechanics' Association to move into closer relations with the American Railway Association might profitably be imitated by other mechanical associations. We have noticed that members of the two leading mechanical associations have been considerably annoyed by resolutions passed by subordinate associations, which assumed that such associations were authorized to speak for railroad companies. There are now so many associations of railroad men that can speak with authority concerning the construction merits of any device that it is highly desirable that conflict of expressed opinion should be avoided because the expressed opinion of a minor association is liable to be used to the prejudice of railroad interests. It is not practicable to put, for instance, the Traveling Engineers' Association, the Air Brake Association, the General Foremen's Association, or others under control of the American Railway Master Mechanics' Association, but there ought to be co-ordination between the various associations without subordination of any one. The time has come for some understanding of this character being arrived at. It requires no great stretch of imagination to find that one of the minor associations passes a resolution putting itself on public record as favoring practices which may have been publicly condemned by the Railway Master Mechanics' Association; or it is not beyond the bounds of probability for another minor association to endorse a practice or a device that has been condemned by the Master Car Builders' Association. Contentions of that character might have very serious consequences, when the conflicting views were submitted to a jury in a court of law. It is a good thing to reason together, and it is a joyful sight to witness various grades of railroad mechanical men forming organizations for helpful exchange of information; but it is time that some sort of co-operation should be established. Let an understanding of co-ordination prevent the different organizations from injuring instead of promoting the common welfare, and by promoting the general welfare promote their own individual interests.

Book Notices

Proceedings of the International Railway General Foremen's Association, 1908. Distributed by the Association. E. C. Cooke, Secretary, 506 Royal Insurance Building, Chicago, Ill. 110 pages.

The educational possibilities in organizations of skilled artisans who have risen to positions of responsibility is finely exemplified in the work of this young organization. Although this is only the fourth meeting of the association that is reported in the pages of the work before us, it is agreeably surprising to note the breadth and importance of the field of thought and action in railroad work which the discussions presented cover. If an excuse was necessary for the existence of such an association, it can be found in a few pages of this report. The discussions have the particular merit of being entirely personal experiences of trained minds in close contact with subjects of real importance in railroad work. Among these the question of the cause of pounding on the left side of the locomotive is exhaustively treated, as is also the general question of shop construction, embracing the questions of cross or longitudinal pits, care of material, the dispatching of engines at terminals, and the apprentice question. Among the more abstruse questions were that of the frequency of staybolt fractures on the left side of the engine, the methods of determining when an engine should be sent to the repair shop, the comparative cost of piston and slide valves, and the prevention of the breaking of valve rings. These and other questions are fully discussed, and much information of real value obtained. A copy of the Constitution and By-laws are appended, and the officers and members are to be congratulated on the interesting and valuable contribution to the railroad literature of our time, which this printed report of their proceedings presents.

Audel's Gas Engine Manual. Published by Theo. Audell & Co., Publishers, New York. 470 pages, profusely illustrated, ornamental cloth. Price $2.00.

This handsome book treats of the theory and management of gas, gasoline and oil engines, including chapters on producer gas plants, marine motors and automobile engines, and extends to twenty-eight chapters, covering the entire subject or subjects from the historical development and laws of permanent gases through the various theoretical principles and actual working cycles of the different types of gas engines. It treats fully of fuels and explosive mixtures, and the different designs and constructions are fully discussed. The important subject of lubrication is clearly set forth with valuable hints on management and suggestions for emergencies. There is a special chapter on automobiles and another on marine engines, and it may be said briefly that there is no part of the gas engine in modern use but what is fully and ably discussed in this work. The illustrations are of the best, while the style of the work is simple and direct and peculiarly valuable to the student in being free from technical jargon. We heartily commend this work to all who are interested in the theory and practice of gas engines.

Railway Working and Appliances. By Edward S. Hadley. Published by Longmans, Green & Co., London and New York. 120 pages, flexible cloth. Price 50 cents.

The Great Western Railway of England has established a number of "Signalling Schools," with miniature models and appointed lectures in connection with the schools. Mr. Edward Hadley has been very successful in this department of railroad work, and the volume before us consists of fifteen chapters presenting his lectures in a handy form. The writer has the excellent faculty of clear description and in a non-technical way which is especially agreeable to beginners in this important department of railroad work. The book has met with much favor in Great Britain and should be of interest to all railway men throughout the world. The numerous photographs and drawings are excellent and finely illustrate the text.

First Aid on Indiana Trains.

A recent press dispatch says: "Following a conference between the railway surgeons and superintendents of the State and the railroad commission of Indiana concerning the enforcement of the law requiring railway trains to be equipped with surgical cases, the commission gave the order that all passenger and freight trains be equipped with such cases, containing material for first aid to the injured, within 90 days from the entry of the order. The commission declared that the statute provided specifically that every such case shall contain a pound of absorbent cotton.

Flexible Fireboxes.

The New York Central have had a Consolidation engine equipped with the Wood flexible firebox, and it is reported to be giving entire satisfaction, after five months of very severe service.

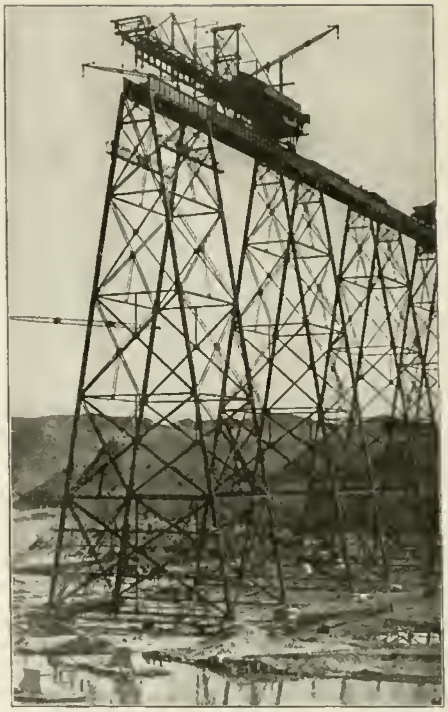
The Lethbridge Viaduct.

The Canadian Pacific Railway is changing the route of the Crows' Nest Pass branch in the Rocky Mountains between Lethbridge and Macleod. The cost of the work is estimated at about two million dollars. Wooden trestles are being replaced by steel structures and the line is being straightened and grades reduced on account of the increase of traffic. One of the most notable steel structures is that being built over the valley of the Belly river at Lethbridge, Alta. The Lethbridge *Herald* gives some interesting facts concerning the new bridge, and two of our readers in Northwestern Canada have kindly sent us photographs of this interesting viaduct.

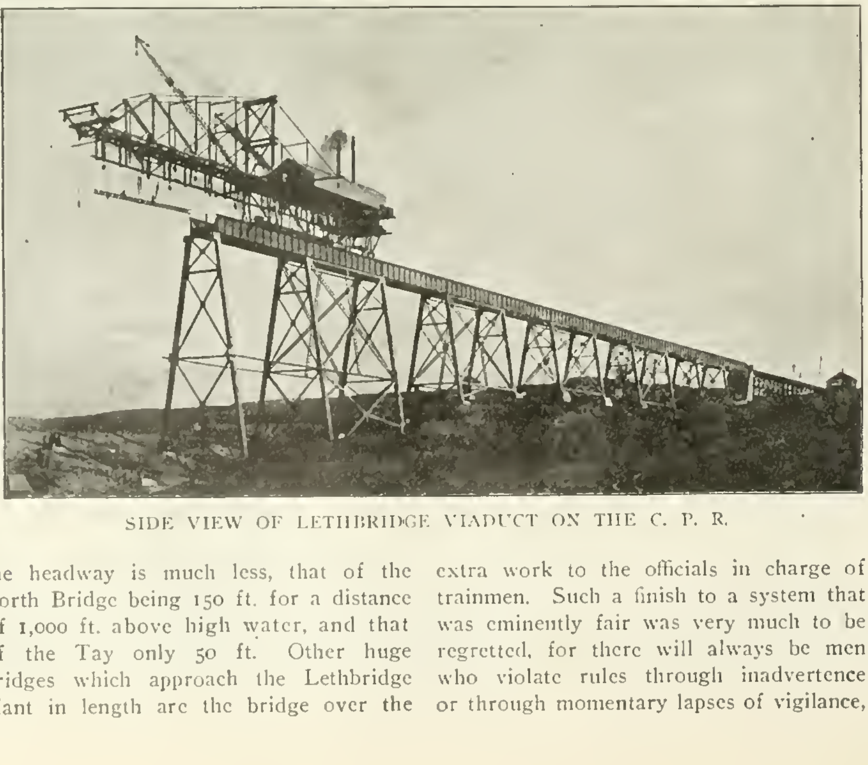
Among other things the *Herald* says: "The height of the bridge will be 307 ft. above the water, the length is 5,327 ft., or some 12 yards over a mile, and the cost of the structure will amount to $1,500,000. The bridge spans the deep cutting which the waters of the river have worn in the prairie by their age-long course. The banks of the river are dissimilar in that in one case there is a high cliff, while on the other side the bank slopes gradually to the usual prairie level. It is this irregularity in the banks of the river that has forced the designer to build so lengthy a bridge.

"The Lethbridge structure will be, taking both height and length into consideration, the largest in the world. This superiority over other railway bridges it owes to its enormous height above the water. It is not so long as the famous Forth Bridge, which is 8,296 ft. in length, or as the Tay Bridge, which has a span of over two miles, but in each of these cases the headway is much less, that of the Forth Bridge being 150 ft. for a distance of 1,000 ft. above high water, and that of the Tay only 50 ft. Other huge bridges which approach the Lethbridge giant in length are the bridge over the Dneiper at Jekaterinoslaw, which is 4,557 ft. in length; the Alexandrowski bridge over the Volga near Syzran, 4,871 ft.; the Severn bridge, 4,162 ft., and the Empress bridge over the River Sutlej, on the Indus Valley Railway, four-fifths of a mile. Of the bridges which approach the bridge at Lethbridge in height the Kentucky Railway bridge is important, having a height of 275 ft. 6 ins. above low water, while the C. P. R. bridge over the Fraser River is 125 ft. high. The structure which spans the Victoria Falls of the Zambesi River has the advantage of the new C. P. R. bridge in height, but fails in comparison in length.

All the steel used in the bridge is run out on a traveler, which lets the steel girders down into place by means of a cable. The concrete foundation goes down to 24 ft. below low water, standing on hard shale. The land towers are built on concrete piles, the three main towers in the centre of the bridge are also built on piles. The total weight of the bridge is estimated at 12,000 tons. If there had been no allowance made for contraction at 40 degs. below zero the bridge would be too short by three and a half feet, but a system of sliding plates allow for expansion and contraction. At the present rate of progress the bridge will probably be finished by October of this year."



UNDER THE TRAVELER, LETHBRIDGE VIADUCT.



SIDE VIEW OF LETHBRIDGE VIADUCT ON THE C. P. R.

Discipline Without Suspension.

The system which was introduced upon the Fall Brook Railroad many years ago by Superintendent George W. Brown, known as the system of "Discipline without suspension," was extended in a changed form to many railroads, but was gradually abandoned for no particular cause except that its operation gave some extra work to the officials in charge of trainmen. Such a finish to a system that was eminently fair was very much to be regretted, for there will always be men who violate rules through inadvertence or through momentary lapses of vigilance, and inflicting upon them punishment of suspension has a pernicious effect. Many railroad men who have conducted themselves for years without giving the least cause for censure, will fall into a blunder for which punishment will be inflicted as strenuously as if the person was a habitual violator of rules.

We are pleased to learn that Mr. Daniel Willard, second vice-president of the Burlington system, in charge of the operating department, has introduced upon the road a system of fair discipline which resembles the Brown system, if it is not exactly the same thing. Mr. Willard, who has always been noted for fairness in dealing with men under his charge, talking about the new system of discipline, said:

"The practice of suspending a man cannot make him better, and it deprives him of the opportunity of earning money with which, perhaps, to support his family, and not infrequently when a man has been so deprived of the opportunity to work, the punishment has borne most heavily upon those who are dependent upon him. It does not seem that a proper system of discipline should cause such results.

"It should be possible to keep such a fair and, at the same time, accurate record of men, that it can be made a sufficient basis for a system of discipline which will satisfy the requirements of existing conditions. Such a system will call for greater care and personal attention on the part of all officers than has been given in the past, but it is believed that its importance justifies the additional effort."

This record system, as adopted on the "Q," is fair and equitable, and good results are expected of it by the management.

Applied Science Department

The Walschaerts Valve Gear as Applied to Locomotives.

I.—General Principles.

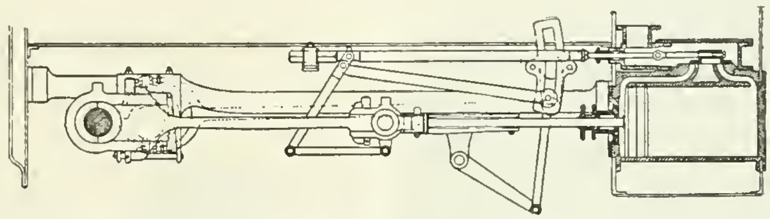
In treating of valve gearing as applied to steam engines generally, it is presumed that it is scarcely necessary to dwell at any great length on the fact that all such gearing is designed with a view to admit steam readily to the reciprocating piston at a time when the steam pressure will be most effectual in moving the piston in the cylinder, which movement is readily conveyed through a connecting rod attached to the piston at one end, and to a crank at the other end, thereby inducing a turning or revolving motion to a wheel and axle. In the economic use of steam, and incidentally of fuel, it is advisable to shut off the supply of steam as early as possible during the piston stroke, so that the steam admitted to the cylinder at a high degree of pressure may have an opportunity to spend its force before being permitted to pass into the outer air. It will be readily understood that in a cylinder two feet in length, if the supply of steam is cut off at a point when the piston has only traveled six inches on its course toward the other end of the cylinder, the steam pressure will only amount to one-half of the original pressure when the piston has traveled twelve inches, because the steam will then occupy twice the space, and so on until the piston has reached the end of the stroke, when the pressure will be four times less than when admitted. Other causes, which need not now be dwelt upon, will have reduced the pressure even more than this, so that steam admitted at 180 lbs. of pressure per square inch at the beginning of the piston stroke will be less than 40 lbs. per square inch by the time the piston stroke is completed.

In the early days of the steam engine the necessity for this economical or expansive use of steam, as it is called, was not so great as it is now, for the reason that steam was used at a much lower pressure at that time, and the loss of steam at the end of the piston stroke was small in comparison with what it is now, when steam is admitted during the entire length of the stroke. Other causes soon arose calling for a variable supply of steam. With the locomotive the difference in grades to be climbed and in loads to be hauled necessitated an increase and a diminution of the steam pressure, and the brightest minds among steam engineers were early at work on this important problem. As boiler construction improved and higher steam pressures became possible, the necessity for a variable valve motion increased. Egide Walschaerts, a young Belgian engineer, was among the first, and perhaps the most successful, in solving this intricate mechanical problem. Eccentrics were already in use for the simple purpose of reversing the movement of the engine. This was accomplished by having two eccentrics set in such positions that when their rods were in operation on a rocker that moved the valve rod, one rod was adjusted so that it would act in advance of the main crank, while the other, when in operation, would follow the crank. One rod could be lifted off the rocker pin and the other one attached by a simple appliance similar to the lifting shaft now in use on locomotives, the rods being furnished with hooks adapted to catch the rocker pin.

This reversing contrivance attached to the early locomotives is alluded to in order that the condition of the valve gearing at the time that Walschaerts brought his keen intellect and engineering skill to bear upon the problem may be understood.

The valve then in use, known as the D-slide valve, the steam ports leading to the cylinder and the method of exhausting the steam through the inner cavity of the valve were not in any way affected by the work of the young Belgian engineer. The perfect adjustment of an eccentric or crank set at right angles to the main crank is the primal necessity in the construction of the Walschaerts gearing. It can readily be understood that a connecting rod attached to an eccentric or crank so fixed and so adjusted in point of length that it would reach exactly to the movable valve while the valve was in the central position would, by continuing the movement of the engine, continue to place the valve in the middle of the valve seat when the piston was at the end of the stroke, and also move the valve to the extreme end of its stroke at the moment that the piston was in the middle of the cylinder.

With the piston at either of the extreme ends of the cylinder and the valve in the central position, it would be found that a certain portion of the valve face overlapped the steam ports and it would be necessary to move the valve a distance equal to the amount of lap in order that the steam might be readily admitted to act on the piston in the early part of its movement towards the other end of the cylinder. The mechanism invented by Walschaerts in moving the valve the required distance from the center at either end of the piston is one of the cleverest devices in use in steam engineering, and is generally looked upon as the crowning feature of Walschaerts' masterly invention. It should be noted that the overlapping of the valve is an essential requisite in the economic use of steam. If the valve exactly covered the ports any movement of the valve would cause an immediate opening of one port at the instant of the closing of the other port. The amount of lap makes a period of closure of the ports possible, and consequently renders the expansive use of steam already alluded to a mechanical possibility.



WALSCHAERTS VARIABLE EXPANSION VALVE MOTION APPLIED TO LOCOMOTIVE 98 AT BRUSSELS, BELGIUM, SEPTEMBER 2, 1848.

This moving of the slide valve toward the desired point is effected by the engaging of the valve rod by an intervening combination lever which is connected to the crosshead by a union link, and which will be fully described hereafter. The co-relation between the combination lever and a radius bar driven by an oscillating radial link, which is driven by the eccentric rod, becomes the determining factor in moving the valve from the central position to the point desired.

The shortening of the valve stroke, making it possible to close the supply of steam at any desired point of the piston stroke is effected by the oscillating radial link into which the radial bar attached to the valve rod and cross-head is movable by the lifting shaft, and it will be readily seen that as the radial link suspended centrally oscillates furthest at the extreme ends the radial bar will travel further when near the extreme ends of the link, and as it is made to approach the center the motion of the bar will be shortened. At the center of the link it will cease moving altogether, and after passing the center it will move in the opposite direction, thus reversing the movement of the engine. The moving of the valve towards the opening point by the use of the cross-head connection, as well as the intervention of the oscillating radial link, together with the use of the single eccentric or crank, are three distinct and separate features of this valve gearing, and these, together with their connections and relation to each other, will be treated in detail in the forthcoming chapters describing the construction and adjustment of this steam-engine attachment, as applied to the locomotive.

Celebrated Steam Engineers.

XIX.—Egide Walschaerts.

Egide Walschaerts, the inventor of the valve gear that bears his name, was a native of Belgium where he was born in 1820. At the age of eighteen he was a student of the Municipal College in Brussels, and at an exhibition of products there he furnished several remarkable models, among which was a complete locomotive made of copper on a scale of one-twentieth of the railway locomotives in use in Belgium at that time. The Minister of Public Works was so interested in the young man's work that he assisted him in entering the classes in the University of Liege, where he made rapid progress. During this period he constructed several other models, and in 1841 he was awarded a silver medal by the commissioners of the Brussels Exhibition.

At the age of twenty-two he entered the shops of the Belgium State Railways at Malines as a machinist. At twenty-four he was shop foreman, and in the same year he perfected the valve mechanism that bears his name. It may be remarked that at the time that Walschaerts' valve gear appeared, the Sharp valve gear, having two eccentric rods with forked ends, was the only kind in use. The shifting link, the invention of a young English draughtsman, named Williams, who was employed by the Stephensons in their locomotive works at Newcastle, and which came into use about the same time, had not been seen by Walschaerts. It will be readily understood, however, that there is little resemblance between the two kinds of mechanism. Both are evidently the work of clever inventors on different lines, and while the results are necessarily largely similar, there are several marked features in Walschaert's masterly invention, especially in its application to locomotives, that mark its superiority almost beyond controversy.

It is to be regretted that little or nothing came to the ingenious mechanic from his fine invention. Under the absurd laws in vogue in the Belgian State Railways he was not even permitted to obtain a patent in his own name. Other inventions of less note came from his hand from time to time. He was awarded a gold medal and diploma for his valve gear at the Paris Exposition in 1878, and another at the Exhibition in Antwerp in 1883. The first locomotive equipped with Walschaerts' valve gear was No. 98, of the Belgian State Railways, and ran from the shops at Malines to Brussels on Sept. 2, 1848. It attracted wide attention, but as the English locomotives had almost complete control of the market at that time, the new and beautiful valve motion did not come into general use outside of Belgium for many years. It slowly worked its way into the Continental service of Europe, and where it was given a fair trial, almost always superseded the shifting link motion used by the Stephensons.

UNION STATION AT FREMONT, NEB., C. & N. W. AND U. P. TRACKS.

One of the first American engineers to appreciate its superiority in locomotive service was William Mason. He began building locomotives at Taunton, Mass., in 1852. He was a fine artist in mechanism and his locomotives had an elegance of design and a beauty in finished workmanship hitherto unapproached. He made repeated efforts to introduce the valve motion as perfected by Walschaerts, but without success. At the Centennial Exhibition at Philadelphia in 1876 a beautiful locomotive ran on a narrow gauge track around the exhibition grounds. It was equipped with Walschaerts' valve gear, but was looked upon more as a fantastic curiosity than as an enduring and serviceable piece of mechanism. It seems as if this masterly invention appeared before its time, and it was not until the increased size of the locomotive had rendered the use of an outside valve gear an absolute necessity that the merits of this cleverly designed motion became fully apparent.

Meanwhile Walschaerts remained at his humble post as shop foreman. He designed the locomotives in use on the Belgian railways. His life was an example of patient industry and unpretentious merit, overshadowed somewhat by State officials who came and went with the political weathercocks of the little principality in which he lived. He was easily the foremost mechanic of Continental Europe. He could not but have known that those under whom he worked were utterly unworthy of being called his superiors, but he never complained. It was not his good fortune to live to see the general adoption of his beautiful invention to the twentieth century locomotive. He died in 1901 at Saint Giles, near Brussels, at the ripe age of eighty-one.

The merits of his chief work seemed to have almost lain hidden during his life time, like the corner-stone that the builders despised. In America his work has risen into splendor, like the fabled fountain of Arethusa that disappeared in the grosser elements of the earth and rose again beyond the seas with fresher brightness of beauty and perennial newness of life.

Questions Answered

ACTION OF THE GRADUATING SPRING.

41. P. J. K., Hornsly, N. S. W., Australia, writes: What is the highest reduction of train pipe pressure that could be made on 8 cars that would send the brake into the emergency? What I want to know about particularly is the tension of the graduating spring.—A. The volume of air and the number of pounds pressure that must be exhausted at the brake valve to throw the triple valves on a train of cars into quick action or emergency position, depends upon the length and arrangement of the piping between the brake valve and the first quick-action triple valve. Under ordinary conditions a rapid reduction of 10 or 12 lbs. is required and it depends upon the rapidity of the reduction rather than upon the

amount, as instances are known where crooked brake pipes containing numerous elbows have created sufficient resistance to the flow of air to prevent quick action even if the brake valve handle was placed in the emergency position.

The number of pounds difference in brake pipe and auxiliary reservoir pressures that the graduating spring is able to resist depends upon whether the triple-valve piston is moved against the graduating stem gently or with considerable force; if drawn against the stem gently, as in the case of a broken graduating pin, the spring used in the P1 or P2 (F 27 or F 29) triple valves will resist a difference of approximately 8 lbs., or if the reduction is more than 8 or 9 lbs. the spring will be compressed enough to allow the triple valve to assume quick action position. In the case of a "sticky" equalizing piston in the brake valve where the triple valves are "jerked" into application position quick action will occur with 4 or 5 lbs. reduction or almost the same instant that the equalizing piston is unseated.

DYNAMOMETER CARS.

42. A. B., St. Dominique, Que., asks: Where was the first dynamometer car built? I mean by that what road first used this kind of car? A.—The Pennsylvania Railroad was the pioneer railroad in the use of dynamometer cars. The Chicago, Burlington & Quincy followed; but their car was more or less copied from the original Pennsylvania car.

STARTING INJECTOR WHEN WATER IS LOW.

43. A. V. W., Gallitzen, Pa., writes: An engine was pushing a freight train on a 2 per cent. grade, and was stopped at a home signal. Injector was shut off and fireman discovered there was no water in the gauge and none in the water bottle. The fireman did not draw the fire, but started the injector, then went to the cabin and reported the fact to the engineer. There has been discussion among the boys of the wisdom of the fireman's act, and we wish to have your opinion. —A. The fireman did perfectly right. The difference of opinion would arise through some people holding the erroneous belief that it is dangerous to inject water upon hot sheets. The fallacy of this opinion is forcibly explained by Angus Sinclair on page 168 of "Twentieth Century Locomotives" in an article that ought to be furnished to every person connected with the operating of locomotives.

BROKEN E. T. BRAKE PIPE.

44. Subscriber, Covington, Ky., writes: When the brake pipe breaks off at the brake valve, out on the road, could not temporary repairs be made by connecting the application chamber pipe, which is copper, into the strainer where the distributing valve pipe connects, close the double cut-out cock and increase the pressure to the independent brake valve by adjusting the reducing valve and apply and release the brakes with the independent brake valve, the distributing valve being cut out?—A. The form of your question explains the method, and it is only necessary to state that you refer to the H-5 equipment, and assuming that the application chamber pipe is of sufficient length and standard or that interchangeable fittings are used. Mostly any length of train can be charged and the brake applied in this manner, and in a case of emergency, quick action could be obtained by opening the double cut-out cock and allowing the brake pipe air to escape through the broken off pipe. You will remember, of course that the H-6 equipment uses 1 in. iron pipe to convey brake pipe pressure to the distributing valve.

WHO OR WHICH?

45. Car Man, Minneapolis, writes: In several reports and circulars concerning car matters that have reached me a common expression used is, "the railroad who did the repairs." In the little grammar I studied the pronoun who was applied exclusively to persons. Inferior animals or things without life take that or which. We have been having a little dispute about the expression and decided to leave it to you. Which is correct, who or which?—A. The correct form of such a sentence as you give should use the pronoun "which."

CROSS COMPOUND PUMP CAPACITY.

46. Subscriber, Covington, Ky., writes: How would you figure the capacity of a cross compound air compressor?—A. By ascertaining the amount of free air drawn in on each stroke of the low pressure air piston. The low pressure air cylinder is 14½ ins. in diameter, the stroke is 12 ins. $14\frac{1}{2} \times 14\frac{1}{2} = 210.25$, then $210.25 \times .7854 = 165.13$, and $165.13 \times 12 = 1981.5$, and $1981.5 \times 2 = 3963$, and lastly, $3963 \div 1728 = 2.3$ cu. ft. In this, the diameter of the cylinder is squared, multiplying it by the decimal fraction .7854, which then multiplied by the length of stroke in inches gives the cubic inch capacity of the cylinder, or the amount of air in cubic inches drawn in on each stroke. The result of two strokes or one cycle, as it is called, divided by 1728, the cubic inches contained in one cubic foot, we find the pump should compres 2.3 cu. ft. of free air per cycle. The pump will actually compress 2 cu. ft. per cycle in service, which is 13 per cent. less than the theoretical value. In a future number this matter, together with some simple calculations to determine air pressures, will be referred to in a more extended manner.

BRAKE PIPE REDUCTION.

47. F. E. A., Spencer, N. C., asks: How much brake cylinder pressure should a 10-lb. brake pipe reduction put in the driver brake cylinders if the engine is equipped with the E. T. Brake?—A. 25 lbs. Every brake pipe reduction of 1 lb. should result in a brake cylinder pressure of 2½ lbs. As the application chamber is filled with atmospheric pressure before the reduction is made, there is very little additional space created by the movement of the application piston, while with a triple valve and a brake cylinder the first 10-lb. reduction is not so effective on account of the volume of air required to fill the space vacated by the movement of the brake cylinder piston.

TYPE K TRIPLE VALVE.

48. F. M., Chicago, Ill., writes: It is generally understood that brake pipe leaks have a tendency to cause undesired quick

FRAME WELDING ON THE ERIE.

action, does not the type K triple valve in taking air from the brake pipe during service applications have a tendency to assist brake pipe leaks to throw other triples in the train into quick action?—A. No. The type K triple valve has a tendency to prevent undesired quick action by running the service application promptly through the entire train and moving all the triple valves to application position at the first reduction of brake pipe pressure. If there are enough K triple valves in the train all brakes will be applied perfectly and if brake pipe leakage reduces brake pipe pressure much faster than auxiliary reservoir pressure can expand into the brake cylinder the increasing auxiliary reservoir pressure will force the triple valve to full service position, in which the brake pipe flow to the brake cylinder is cut off and the service ports left open. This action insures the triple valves being forced to lap position when the reduction at the brake valve ceases, unless excessive brake pipe leakage will not allow them to be returned to lap position.

Air Brake Department

Conducted by G. W. Kiehm

16TH ANNUAL CONVENTION.

The sixteenth annual convention of the Air Brake Association was called to order at the Hotel Jefferson, Richmond, Va., Tuesday, May 11, at 9.30 a. m., by the President, P. J. Langan.

Addresses of welcome were delivered by Mr. D. C. Richardson, mayor of the city of Richmond, and by Mr. Duke, assistant general manager of the R. F. & P. Railroad, which were responded to by the president of the association.

After the customary routine of business a letter from Mr. F. A. Moseley, secretary of the Interstate Commerce Commission, was read. Mr. Moseley expressed his regret at not being able to be present and designated Mr. W. P. Borland of that commission to represent him. Mr. Borland made some significant statements in his brief address.

Mr. Borland said in part that the laws of the Interstate Commerce Commission, concerning safety appliances, were based to a great extent upon the recommendations of the Air Brake Association. He reminded the association of the decision of the Supreme Court, which holds the law of the Interstate Commerce Commission as absolute and stated that the control of trains on mountains had resolved itself into a matter of brake efficiency.

The usual number of questions and explanations followed, during which the meaning of the words "equipped," "operative" and "efficiency," although somewhat misunderstood, were explained. It was brought out that the law required that 75 per cent. of a train be equipped with air brakes before the train could leave the terminal, however, with 100 per cent. of the train equipped with air brakes, the law could be construed to mean that 100 per cent. of the brakes must be operative and that at a meeting of the commission, to be held soon, the advisability of increasing the percentage of cars that must be equipped with brakes that are operative will be considered.

Mr. Borland intimated that the commission was inclined toward 100 per cent. equipment, 100 per cent. operative and 100 per cent. efficiency, and from the figures he presented it was indicated that the number of efficient brakes in the average train was now about 85 per cent., and he thought that no valid reason existed for not increasing to 100 per cent.

It also developed that the commission could and would permit a train to proceed a reasonable distance to a terminal point controlled by hand brakes in cases of emergency, such as a failure in the air supply or an accident, which can be taken to mean that the commission will use discretion in cases that could be dealt with by law.

Altogether, the construction of the law as cited by Mr. Borland does not appear unreasonable, and he gives the assurance that more attention will be given to the matter of air brakes in the future, the protection of the individual being one of the chief considerations.

The reading and discussion of the technical papers was then taken up. The first paper was "Pipe and Pipe Fittings for Locomotives and Cars," by Mr. J. R. Alexander of the P. R. R. This was quite a lengthy paper dealing with pipe, pipe-fittings, dies, threading, bending machines, pipe friction, material, specifications and tests, including illustrations and tables, and deals with cast iron, wrought iron, steel pipes and pipe fittings, from the selection of the material, through the welding, threading and bending to the finished work on the locomotive.

This paper is one of value, and the author received a vote of thanks from the convention. This paper alone is well worth the price of the proceedings of the 1909 convention.

In the discussion which followed the relative merits of the metal joint and the ordinary gasket joint union pipe connection were considered, some members being skeptical as to whether the increased cost of metal of ball joint union was a sufficient improvement upon the ordinary gasket union to justify the expenditure, while others viewing the matter from an "on-the-road" point of view, would not consider expense in the matter of providing a union connection that could be tightened anywhere and on short notice without renewing the gasket, in the event of vibration loosening the connection.

"Ordinary," "extra heavy" and "double extra heavy" pipe was also referred to, Mr. Best of the N. C. & St. L. R. R stating that the use of "extra heavy" pipe had entirely overcome air pipe failures on that road.

"Lap" and "butt" welds were discussed at length, and Mr. W. V. Turner, mechanical engineer of the W. A. B. Co., made some statements and furnished figures that showed the effect of using union connections with restricted openings.

There were no objections raised to the eleven conclusions set forth in the paper, the final one of which was, "Last, but by no means the least important is the necessity for the railroad companies which we represent adopting a proper and rigid specification for pipe and pipe fittings."

The second paper presented was "Yard Air Brake Test Plants and Air Brake Repairs," by Mr. F. Von Bergen of the N. C. & St. L. R. R. This paper dealt with test plants and repairs, it illustrated tools, apparatus, and showed a number of photographs. The hour of adjournment having arrived, the discussion was postponed.

At 3:30 p. m. the members assembled to discuss any matters suggested and to have a general talk on air brake subjects, and it is indeed to be regretted that no record of the meeting was obtained. This feature, which was suggested and adopted at the St. Paul convention in 1908, is one of the most valuable features of the convention.

After a discussion upon M. C. B. rules and "wrong repairs" the time-honored subject of "Undesired Quick Action" was brought up, and after a number of causes and remedies were spoken of in an intelligent manner, Mr. W. V. Turner was called upon and gave a short talk in which he handled the subject in a really wonderful manner. Some of his statements were almost beyond belief at the first suggestion.

He said in part that among the 42 causes of undesired quick action the dirty triple valve was the least likely and the recently cleaned and well lubricated one the most likely to cause the disorder, and that it was absolutely impossible to lay down any fixed rule to locate the disorder under all circumstances.

In explaining his statement he called attention to the fact that the dirty triple valve usually permitted air to get under the slide valve and have a tendency to reduce frictional resistance due to pressure on top of the slide valve, while the lubrication on the recently cleaned slide valve acted as a packing, excluding slide valve leakage and permitting the slide valve and piston to travel faster toward the graduating spring. Another statement was that too slow a reduction was as sure to cause quick action as one that is too rapid for a service reduction, and he cited instances where, due to a defective feed valve, quick action occurred on a standing train with no one near the locomotive or cars.

He recommended that in attempting to locate the defective triple valve on a short train, time permitting, instead of closing one stop cock as is the usual practice, close all but one, and he explained that by this method one defective valve could not cause another to "dynamite."

On long trains he suggested that train crews note the direction the quick action is running and be guided to a certain extent thereby, and that in the event of the disorder being finally traced to a few cars, when it is almost impossible to determine which one starts first, in quick action, to apply all brakes lightly and close the stop cocks in the branch pipe leading to the suspected triple valves, then after recharging open the stop cocks merely enough to release the brakes, recharge and follow this with another application to locate the defective valve.

When the quick action then occurs but one triple valve, the defective one, can apply in quick action owing to the partially closed cocks preventing the heavy reduction in brake pipe pressure on the rest of the cars in the train.

He then stated that the 42 causes of undesired quick action resolved themselves into one condition, or practically into one cause, namely, too much differential between brake pipe and auxiliary reservoir pressure, even if too short a piston travel was responsible for the unequal pressure resulting suddenly.

Mr. Turner attempted to close his remarks upon several different occasions, but the members insisted that he continue, but finally darkness and the noise made by the removal of chairs and tables preparatory to the ball broke up the meeting. In concluding his remarks he took occasion to compliment those who spoke before him and congratulated them upon the views expressed, namely, that the disorder is seldom caused by defective triple valves and often by other conditions that a reasonable amount of care would avoid.

SECOND DAY'S PROCEEDINGS.

In opening the discussion upon yard testing plants the president called attention to the remarks of Mr. Borland on the previous day and stated that all railroad men present knew what was expected of them by the Interstate Commerce Commission and that in order to obtain the efficiency that would be expected, a great deal of attention must be given to yard testing plants, they being second to none in importance. The discussion which followed brought out very plainly the conditions existing on most railroads of today.

Mr. Coutts, of the Interstate Commerce Commission, spoke very briefly on the subject and was asked a number of questions during which he made it clear that in decisions by the courts that the engine was considered one brake and one unit, and the tender as another, or that engine and tender were two brakes when considered among the percentage of operative brakes in a train; also that inoperative brakes must not be associated with the brakes in the train, or rather that such brakes must be shifted to the rear of the train in order to comply with the law. It is, of course, understood that this matter of Interstate Commerce law is in all cases decided as in any other civil suits by a judge or jury and that it is not impossible for decisions to be reversed.

Near the close of the discussion Mr. Alexander, from an economical point of view, called attention to the many recommendations concerning air brakes, and asked that some attention be given hand brakes, and stated that more cars were broken up because of inoperative and defective hand brakes than from any other cause, the gravity or "hump" yards, of course, making this possible.

The paper on "Slid Flat Wheels," by Mr. J. P. Kelly, was then read; the paper contained many valuable references to the forces acting upon a revolving car wheel in a train of cars, and the speaker used a blackboard to more clearly bring out and illustrate by drawings the information which he had collected. Slid flat wheels is at present a very live topic, and the subject was so ably and thoroughly handled that it left very little room for discussion; however, Mr. Burton was called upon, and stated that the paper alone repaid him in full for the time spent at this convention. His remarks agreed with those of Mr. Kelly, and he said that in order to get to the bottom of the slid flat wheel trouble it was his practice to shop the car upon the discovery of flat spots and to test the triple valve on the standard test rack, to test the retaining valve and piping, to examine the foundation brake gear, to calculate the leverage, and, in fact, to leave no stone unturned in the effort to locate the cause of the trouble; and in not one case in ten was there any disorder found on the car with slid flat wheels which could be directly shown as the cause of the trouble. This statement coming from a practical railroad man is significant and will, no doubt, be given more serious consideration than it would be if made by a representative of an air brake company.

Mr. Turner was then called upon, and in his usual optimistic manner professed to find consolation in the fact that when a slid flat wheel was found it indicated that there was at least one good brake in the train and that if all the brakes leaked off in a few seconds after being applied the annoyance of slid flat wheels would cease. He, however, suggested another method of overcoming the flat wheel problem, which consisted principally of compelling all cars in a train to contribute to some extent to the retarding force. A few facts that were brought out during the discussion showed that the principal causes of wheel sliding were due to unequal braking power, starting a train with brakes applied, re-application after release has been accomplished, and at times too large main reservoir capacity, together with incorrect manipulation of the brake valve.

It was, of course, admitted that defective triple valves would also cause this, and it is interesting to note that during this time it was agreed the 70-lb. brake pipe pressure for freight trains was a thing of the past, or should be.

The term unequal braking power does not necessarily mean defective or cut-out brakes, but the calculated braking power on freight equipment now ranges from 70 to 90 per cent of the light weight of the car. Condition of rail, relative braking power of light and loaded cars, and defective driver brakes, were not neglected during slid flat wheel troubles.

It might be of interest to state that Mr. Turner was later on called upon to read a portion of his paper presented before the meeting of the New York Railroad Club, the portion relating to the subject discussed, and his technical points of view will be incorporated in the printed proceedings of the convention.

After the concluding remarks by Mr. Kelly it was voted to hold an afternoon session, and at 3 p. m. the New York Air Brake Co.'s B3 equipment was taken up in a general way and proved interesting; the good features were pointed out and numerous question were asked, and they were answered in an able and satisfactory manner by Mr. Lovell of the N. Y. A. B. C. Co., and Mr. Lyons of the L. S. & M. S. Ry.

While space will not permit a very comprehensive account of the discussion, there is one feature of the B3 and B2 equipments, viz., the duplex pressure controller, that is a cause of difference of opinion. It led to a discussion of pipe friction, volume of air and head or excess pressure required to maintain the flow of air to the brake pipe with which to release and recharge the brakes on a train.

Remarks on the floor of the convention are guided by a desire to avoid any comparison or controversy concerning apparatus manufactured by different companies, but a personal view from a disinterested standpoint may be of interest.

The pressure controller is in both equipments located in the reservoir pipe near the brake valve, and as the controller separates main reservoir and brake pipe pressures, and main reservoir pressure cannot enter the brake pipe in any position of the brake valve handle, however, it can be admitted by a hand wheel on the controller body provided for that purpose, the brake valve being in release or running position. The question which arises is, can the release and prompt recharge of brakes be effected without admitting main reservoir pressure into a long brake pipe. The importance of recharging the auxiliary reservior on heavy grade service cannot be disputed, and the higher the pressure in the brake pipe, the quicker it can be accomplished. On the other hand, under ordinary conditions, a few seconds difference in the time of recharge is unimportant so long as the release is accomplished, while on heavy grades, where the most rapid recharge possible is necessary, the hand wheel on the controller can be used with no more inconvenience than opening a lubricator feed valve.

Air brake demonstrations on the Southern Pacific Railroad by Mr. C. C. Farmer was the next paper presented, and after the reading Mr. Farmer was called upon to answer numerous questions, and at the close of the session was generously applauded.

A description of those tests has been prepared and the most important results will be published in a future number for the benefit of those interested and that have been unable to procure a copy of the limited edition of "Air Brake Demonstrations" of July and August, 1908.

THIRD DAY'S PROCEEDINGS.

The Air Brake Association's recommended practice was reviewed and suggestions as to changes and additions were considered. As the association numbers over 1,000 members from points all over the United States, who are connected with almost every branch of railway service, and as the recommended practice is practically the opinion of the entire body, and not fitted particularly to any local conditions alone, it has been suggested and approved that the recommendations be printed in separate form. The association is no longer regarded as a body of men who assemble to exchange ideas for their own benefit alone, but as men who are interested in the operation and maintenance of air brakes on every railroad, consequently other associations, manufacturers and locomotive builders look to them for information and practical recommendations such as only air brake men are able to obtain.

As an illustration there is a recommendation "that the discharge pipe between the air pump and first main reservoir be not less than 45 ft. in length, and that the equalizing pipe be not less than 1¼ ins. in diameter and not less than 45 ft. in length," which is the result of experiments of which the practical and technical information, diagrams and tables would alone fill a volume larger than the printed proceedings.

The discussion of the "recommended practice" was followed by Mr. Talty's paper, "How can the road foreman of engines be of most assistance to the air brake service." Those who know Mr. Talty, of the D. L. & W. R. R., can surmise the character and quality of the paper, and the discussion following in which Messrs. Turner, Lyons, Alexander, Garabrant, Langan and others participated, brought out so many valuable points that space will not permit us to mention them here.

A paper by Mr. W. D. Seeley, N. Y. C. R. R., on "Engine House Inspection, Repairs and Maintenance of Air Brakes," followed. This paper dealt with systematic inspection, the character of repairs that should be made in an engine house, and the force of men required to properly maintain air brakes in a high state of efficiency. The paper was a timely and instructive one, especially as the heavier service and increased requirements of modern times has changed roundhouse conditions very materially in the past few years. During the discussion the matter of testing the train signal apparatus and the best method was spoken of; some members were of the opinion that a line of pipe in the engine house, its length corresponding with that of a long passenger train, should be used, some thinking that the convenient way of attaching a test gauge was proper.

Mr. Turner was finally called upon, and he stated that the gauge test with a 3/32 opening was a practical and convenient way, but to get an absolutely reliable test, various main reservoir pressures taken into consideration, was to attach the apparatus to sufficient piping to represent train conditions, as practiced by the W. A. B. Company.

The final paper and the one bringing out the longest discussion was "Handling Passenger and Freight Trains With E. T. Equipment," by H. A. Flynn. The valuable points brought out cannot be enumerated here as the paper was an excellent and lengthy one covering a wide range of experience.

The discussion was participated in by almost every member whose duties associate him with train handling, and many time-honored theories and traditions were upset and shown to be worthless. In fact, to anyone who is familiar only with the brake equipments of four years ago, it must appear that whatever was right is wrong, when the later equipments are being used. Large capacity air pumps, large main reservoirs, new engine equipments, type K and L triple valves, and 100-car trains have made the subject of train handling a matter that requires skill, intelligence and an air brake knowledge, even if anyone can step into the cab of an engine and "put them on" and "let them off."

The subject was gone over thoroughly, and the most valuable air brake information that can be inserted in these columns is, that no one interested in air brake matters or no one whose duties bring him in contact with the air brake, can afford to be without a copy of the 1909 Proceedings of the Air Brake Association.

It will include the address, "Recent Developments in Air Brake Apparatus," by W. V. Turner, M. E., Westinghouse Air Brake Co.

Mr. Turner is the inventor of the new E. T. Equipments, and he is considered by air brake experts to be the foremost and undoubtedly the most thoroughly well informed air brake man to-day.

This is shown by the fact that he is invariably called upon in the event of differences of opinion and his statements are accepted as authority. He is endowed with that rare ability to make clear, complicated and technical air brake problems, and he does it in a gentlemanly and unassuming manner. He is always willing to enlighten the humblest learner in air brake service.

At the beginning the lecture is somewhat technical and deals with retarding effect and work of the brake shoe rather than the operation of valve mechanism. It would be unfair to Mr. Turner and the Westinghouse Air Brake Co. to quote the majority of his statements here, as they might not be understood as they were intended. By means of diagrams shown on a screen, Mr. Turner was able to demonstrate beyond doubt the soundness and accuracy of his statements. It may be of more than ordinary interest to give two expressions as examples only.

Having had occasion to use the expression "percentage of braking power," he immediately stated that the expression meant nothing, represented nothing and was but a convenient term; also that "a determined effort was being made to create a brake as efficient as that of the year of 1872, but that it might not be accomplished for years," he succeeded in proving both statements to the entire satisfaction of every air brake man present.

One that needs no explanation is, "The time has come when we cannot longer confine ourselves to tracing the flow of air through ports and passages, and call ourselves air brake men; we must study and teach each other the underlying principles of the air brake."

"Theory has made possible the practical development of air brake equipment."

Mr. Turner created the impression that the developments of improved air brake apparatus was not exactly the result of great inventions, but rather of conditions that high speeds, powerful locomotives and 100-car freight trains imposed upon air brake manufacturers.

Electrical Department

The Wireless Telegraph.

By W. B. Kouwenhoven.

In 1865 Clerk Maxwell published a mathematical paper on wave motion. He was ahead of his time and his paper was not understood, although it actually gave the theory of wireless telegraphy as it is known to-day. It was not until twenty-three years later that Hertz put to use Maxwell's theory and discovered that electric signals could be transmitted through the air without the use of wires. He transmitted signals across a room and for very short distances only. No one understood how these signals were carried through the air, and they were called Hertzian waves, after their discoverer. They are now generally spoken of as electro-magnetic waves. In London in 1894 Sir Oliver Lodge delivered a memorial lecture on "The Work of Hertz." At this lecture he showed a number of interesting experiments with Hertzian waves and proved that they would pass through the brick walls of the building. His lecture did not give even the slightest hint of the possibilities of the future. Meanwhile Marconi, a young Italian who had become a British subject, was busy with their adaptation to commercial purposes, and in 1896 he took out a British patent on his apparatus.

Before taking up a description of the apparatus itself, let us consider for a few moments what these so-called Hertzian waves are, and through what media they are transmitted. If a stone is dropped into a pool of water, a series of crests and troughs called waves radiate out in all directions from the stone as a centre. The water itself does not progress but moves but up and down. Pieces of paper on the surface move or vibrate up and down but not ahead, nevertheless the crests and troughs move ahead. It is really a propagation of form and not of matter. An invisible something which permeates everything and fills all empty space not only carries the light waves, but also transmits the Hertzian electric radiation. These electric waves consist of a series of crests and troughs that pass out in all directions through the ether.

Sound travels through the air at the slow rate of about 1,090 ft. a second, or about 750 miles an hour. Light and electricity travel through the ether at the enormous rate of 186,000 miles a second. The fact that both light and electricity have the same velocity indicates the existence of some relation between them which has not as yet been discovered.

The transmission of messages by wireless telegraphy consists of sending out these electro-magnetic or Hertzian waves into the ether from one station and receiving them at another. These waves are sent out by electric currents that oscillate or vibrate back and forth at a frequency of from five hundred thousand to a million times a second. The necessary elements for producing these currents and sending out the waves are an aerial wire or the atennæ of the apparatus, strung high in air and connected to a plate sunk in the ground called a ground connection, an apparatus for producing the oscillatory currents, including a spark-gap, a condenser and a high frequency auto-transformer, a battery or source of power, and a key for starting and stopping the flow of the waves. At the receiving station is found the atennæe with its ground connection similar to the one at the sending end, a wave detecting device called a coherer, and a recording or signal-producing instrument. Each wireless station is equipped with both sending and receiving apparatus, a single aerial being common to both.

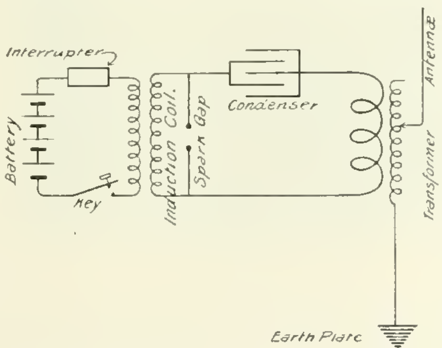


DIAGRAM OF WIRELESS STATION.

The atennæ, so named because of its resemblance to the feelers or atennæ of an insect, consists in its simplest form of a single wire suspended vertically from an insulator held high in air. It may consist of several wires, running either vertically or on a slant, or even in a horizontal position, at a considerable height above the ground and conected by wires to the ground. On shore these aerial lines are usually supported by masts rising several hundred feet in the air. On ship-board they are strung horizontally on yards between two masts. It is of prime importance that the insulators used to support the aerial wires be of good quality and of sufficient size to prevent the current leaking away. The aerial line is made of either copper or aluminum, iron being out of the question because of its magnetic properties. Copper wire is most always used, and it may be either bare or insulated. One end of the aerial wire is, as we have said, high in the air and the other is connected to a metal plate buried in the ground sufficiently deep to secure contact with moist earth.

The apparatus for producing the oscillating currents exists in several forms, the most common one being the induction coil. An induction coil may be compared to a transformer. It receives current in its primary coil at a low voltage or pressure and delivers it from its secondary coil at a very high voltage. The coil itself consists of a primary having a small number of turns, wound on a bundle of soft iron wires, and a secondary, with a large number of turns wound on top of the primary. The current that is fed to the primary is governed by an interrupter which makes and breaks the circuit. This alternate making and breaking of the primary current sets up or induces in the secondary a high voltage or pressure that will cause a spark to jump between the terminals of the secondary coil.

For wireless work on ship-board an induction coil is employed that is capable of giving a 10-in. spark. The primary of one of these 10-in. coils consists of 360 turns of No. 12 cotton-covered copper wire wound on a bundle of soft iron wires 2 ins. in diameter. The whole is incased in a stout tube of ebonite. The secondary consists of 17 miles of No. 34 double silk-covered copper wire, making about 50,000 turns. The secondary is not wound directly on top of the primary, but is made up of 700 separate sections. These sections are each flat like a disc, and are connected together and slipped over the ebonite tube of the primary, and the whole is cemented together with parafine wax.

The spark gap is the space between two brass balls that are mounted on brass rods on which a screw thread is usually cut; so that the air gap or distance between the balls may be easily changed. The terminals of the spark gap are connected to the ends of the secondary of the induction coil, which sends a stream of sparks across the gap when the current is on.

The third and fourth elements of the apparatus for producing the oscillatory currents are a condenser and a high frequency or auto-transformer. The transformer is employed to raise the high-frequency oscillatory currents to a still higher voltage and deliver them to the atennæ. The secondary of this transformer is connected in series between the aerial wire and the earth-plate. The number of turns of the secondary that are in use can be varied, from which fact it takes its name of auto-transformer. A condenser consists of sheets of tin foil that are separated by a non-conductor of electicity, like glass or mica. Alternate sheets of tinfoil are connected together and form one terminal of the condenser; the remaining sheets are connected and form the other terminal. One terminal of the condensers is connected to one side of the spark-gap, the other terminal of the condenser to one end of the primary of the high-frequency auto-transformer, and the far end of primary terminal of the transformer is connected to the opposite side of the spark-gap.

The action of these four pieces of apparatus, the induction coil, the spark-gap, the condenser, and the high-frequency transformer, in setting up oscillatory currents will be better understood if we consider the action of the condenser first. When the current is turned on, one set of tin foil sheets is charged with a current at a high pressure, and the other sheets that lie in between have a very low negative pressure. The state of affairs can best be compared to two air receivers that are connected by a valve, one receiver at a high pressure, and in the other a vacuum. Suppose the valve to be suddenly opened, air rushes into the vacuum receiver, but due to its inertia, it overshoots the mark and rebounds, and the pressure is only equalized after several to and fro movements of the air. The spark gap in the condenser circuit is the valve that connects the high and low pressure sides of the condenser together. The current flows into the condenser until it can hold no more, and then the spark jumps between the terminals of the spark-gap. The valve is open, and the current that is stored at high pressure in the condenser rushes across to the low-pressure side as in the air receivers just described. It overshoots its mark and rebounds. Thus the current that was in the condenser oscillates to and fro across the spark-gap until the pressure on the two sides is equalized. This current oscillates back and forth across the gap at a frequency of from 500,000 to 1,000,000 times a second, or even higher.

The other two elements necessary to complete the sending station are the battery or dynamo for supplying current to the coil and the key for starting or stopping the waves. This key is similar to the ordinary telegraph key in operation, and construction, but is made very much heavier and more substantial.

In sending a wireless message, the operator presses his key and feeds current from the battery through the interrupter to the primary of the induction coil. This sets up high voltage in the secondary of the coil, which serves to charge the condenser with current at a high pressure. When the condenser can hold no more, a spark jumps across the gap and immediately an oscillatory current of an enormous frequency is set up. This oscillatory current rushing back and forth across the spark-gap and through the primary of the high-frequency auto transformer, sets up in the secondary coil of the transformer which is connected to the atennæ oscillatory currents that are at a still higher voltage. These currents vibrating up and down the atennæ send out in all directions electro-magnetic waves that travel through the ether to the receiving station. The reader must not for one moment consider that only a single discharge of the condenser takes place when the key is closed, because such is not the case. The condenser is charged and discharged thousands of times in one second, if the key were to remain closed for only that brief space of time.

At the receiving station we have atennæ with its ground plate, being an exact counterpart of the one at the sending station. An auto-transformer and a condenser are also there, but in the place of the spark-gap we find the electric eye, if we may call it so, for seeing or detecting the wireless signals. The connections are similar to those at the sending station, the only difference being that the spark-gap is replaced by the electric eye, which is usually called a coherer.

In 1856, Varley, who had previously noticed that a mass of loose metal filings possessed a very high resistance, discovered that during a thunderstorm there was a remarkable fall in resistance, and that the powdered metal became an excellent conductor of electricity. This is the elementary principle of the coherer. In its simplest form it consists of a tube with metal caps at both ends, containing a quantity of metal filings. These metal filings offer a very high resistance to the passage of the electric current, but when electro magnetic waves strike the coherer, the filings cohere or stick together and become a very good conductor of electricity, and if a telegraph sounder and a battery are connected across the coherer a click will be produced when current passes. It was found that when the wave has passed the filings still cohered, and it became necessary to tap the tube to restore them to their former state. An ordinary electric bell with the gong removed, if placed so that the hammer will gently tap the tube, forms a very convenient and simple method of doing this. Years before Marconi brought out his wireless apparatus a Russian professor used a simple coherer to detect the approach of thunder storms, but never thought of its application for practical purposes. The Marconi coherer consists of a glass tube one or two inches in length and about a quarter of an inch in diameter. In the tube are placed two silver plugs that fit quite tightly. They are separated by about 1/8 in., and their faces are slightly beveled, so that the intervening space between them is wedge shaped. This intervening space is partially filled with a mixture of very fine nickel and silver filings. Platinum wires are attached to the silver plugs and lead out at either end of the tube. The air is pumped out and the tube sealed. Marconi employed an ordinary electric bell for tapping the tube and returning the filings to their original condition. He thus made the filings de-cohere.

The greatest difficulty with all coherers using metal filings is due to the fact that it becomes necessary to tap the tube in order that the filings may de-cohere or separate and be ready to receive the next signal. The coherer invented by Fessenden is free from this criticism. It is called the "liquid barretter," and is very sensitive, and not at all affected by vibrations or shocks. The instrument consists of a platinum wire one one-thousandth of an inch in diameter, which dips into a solution of nitre and sulphuric acids. The platinum wire forms one terminal of the coherer. The acid is contained in a platinum or gold cup, which forms the other terminal. The acids only become conducting when the electro-magnetic waves strike the apparatus. This coherer, as was stated, is self-restoring, and needs no tapping device.

The remaining element of the receiving station is the recording or receiving instruments. Across the terminals of the coherer is connected a battery and a sensitive telegraph relay which operates a Morse sounder. The changing of the resistance of the coherer as the waves strike it permits the battery to send a current through the relay which operates the sounder. Another type of receiving apparatus that is very common does away with the sounder and the relay. It consists simply of a telephone receiver which is substituted for the relay.

When the sending operator presses his key a series of sparks pass across the spark-gap and oscillatory currents are set up in the atennæ or aerial wire. These oscillating currents send out the electro-magnetic waves. A short series of sparks represent a dot and a longer series a dash on the Morse system. The short series of sparks produces a short set of electro-magnetic waves and the larger series a longer set of waves. The alphabet employed is similar to the familiar Morse code. The waves that are sent out travel through the ether at the rate of 186,000 miles a second. Whenever they encounter a vertical wire or the receiving atennæ, they induce in that wire an oscillatory current that is similar to the one that sends them out. These oscillating currents travel up and down the atennæ, pass through the transformer, and strike the coherer, which immediately becomes conducting, and the telephone or sounder makes the signal heard by the listening operator. The dot of the Morse code, either made by the sounder or heard by the operator with his telephone attachment, is produced by a comparatively short duration of the flow of current across the spark gap and consequent oscillatory current in the aerial wire. The dash of the Morse alphabet is produced by a longer duration of current flow.

One of the greatest difficulties encountered by wireless telegraphy in its operation is where a single receiving station is within the range of two other stations both of which are sending at the same time. As the electro-magnetic waves set up corresponding waves in any wire they encounter oscillatory currents, the receiving operator receives both messages simultaneously, and has great difficulty in distinguishing them. This difficulty can be almost entirely overcome by what is called tuning. The rate at which the oscillatory currents vibrate back and forth in the atennæ depends upon three things—the resistance of the circuit, the number and size of the condensers, and the inductance. If the relations between these three factors be changed, the frequency at which the oscillatory currents are set up will also be changed, and because of this fact the sending and receiving stations may both be tuned, as it is called, up to exactly the same frequency, just as two musical instruments may be brought to exactly the same pitch.

Usually only two of these factors, the condensers, or capacity, as it is called, and the inductance, are changed when it is desired to alter the frequency. The operator at the sending station adjusts the number of condenser plates to the amount of capacity which he wishes to use, and he shifts the contact on its auto-transformer, cutting in or out of circuit more or less turns, as the case may be, thus changing the inductance. He then begins to call the receiving station. The receiving operator catches his call rather faintly and immediately begins to adjust the inductance or number of effective turns in the transformer, and to regulate the condenser in his circuit. He continues adjusting until he obtains a maximum of sound in the telephone receiver at his ear. When he reaches this correct relation his instruments respond to the wireless message, just as when notes struck on one piano call forth in another instrument similar notes. Thus the receiving operator can catch the message intended for him, and need not be seriously affected by any foreign message. The ether is like an open book, and any wireless station can intercept a message and read it, and neither the sending nor the receiving operators be cognizant of the fact.

Electric Shock Accidents.

Accidents due to touching a live wire or coming in contact with the third rail or other electric conductors, are not necessarily fatal. Many such accidents result in death because the victim is not properly attended to. In the majority of cases the shock does not kill, as only a portion of the current passes through the body of the victim and it is often only a case of suspended animation. The following rules are printed in the Maintenance of Way book of rules of the New York Central and are from the pen of Dr. A. H. Goelet. They originally appeared in the *Electrical World and Engineer.* The treatment resembles that for apparent drowning and efforts to restore should be made promptly and the treatment persevered in with resolution until medical aid can be had.

When an accident occurs, the following rules should be promptly executed with care and deliberation:

1. Remove the body at once from the circuit by breaking the contact with the conductors. This may be accomplished by using a dry stick of wood, which is a non-conductor, to roll the body over to one side or to brush aside a wire, if that is conveying the current. When a stick is not at hand, any dry piece of clothing may be utilized to protect the hand in seizing the body of the victim, unless rubber gloves are convenient. If the body is in contact with the earth, the coat-tails of the victim, or any loose or de-

BRIDGE GIRDER DOWN.

tached piece of clothing, may be seized with impunity to draw it away from the conductor. When this has been accomplished observe Rule 2. The object to be attained is to make the subject breathe, and if this can be accomplished and continued he can be saved.

2. Turn the body upon the back, loosen the collar and clothing about the neck, roll up a coat and place it under the shoulders, so as to throw the head back, and then make efforts to establish respiration (in other words, make him breathe), just as would be done in case of drowning. To accomplish this, kneel at the subject's head, facing him lean forward, and seizing both arms draw them forcibly to their full length over the head, so as to bring them almost together above it, and hold them there for two or three seconds only. (This is to expand the chest and favor the entrance of air into the lungs.) Then carry the arms down to the sides and front of the chest, firmly compressing the chest walls, and expel the air from the lungs as far as possible. Repeat this manoeuvre at least sixteen times per minute. These efforts should be continued unremittingly for at least an hour, or until natural respiration is established.

3. At the same time that this is being done, someone should grasp the tongue of the subject with a handkerchief or piece of cloth to prevent it slipping, and draw it forcibly out when the arms are extended above the head, and allow it to recede when the chest is compressed. This manoeuvre should likewise be repeated at least sixteen times per minute. This serves the double purpose of freeing the throat so as to permit air to enter the lungs, and also, by exciting a reflex irritation from forcible contact of the under part of the tongue against the lower teeth, frequently stimulates an involuntary effort at respiration. To secure the tongue if the teeth are clenched, force the jaws apart with a stick, a piece of wood, or the handle of a pocket knife.

4. The dashing of cold water into the face will soemtimes produce a gasp and start breathing, which should then be continued as directed above. If this is not successful the spine may be rubbed vigorously with a piece of ice. Alternate applications of heat and cold over the region of the heart will accomplish the same object in some instances. It is both useless and unwise to attempt to administer stimulants to the victim in the usual manner by pouring it down his throat.

While the above directions are being carried out, a physician should be summoned, who, upon his arrival, can best put into practice Rules 5, 6 and 7, in addition to the foregoing, should it be necessary.

RULES FOR THE PHYSICIAN.

5. Forcible stretching of the sphincter muscle controlling the lower bowel excites powerful reflex irritation and stimulates a gasp (inspiration) frequently when other measures have failed. For this purpose, the subject should be turned on the side, the middle and index fingers inserted into the rectum, and the muscle suddenly and forcibly drawn backwards toward the spine. Or, if it is desirable to continue efforts at artificial respiration at the same time, the knees should be drawn up and the thumb inserted for the same purpose, the subject retaining the position on the back.

6. Rhythmical traction of the tongue is sometimes effectual in establishing respiration when other measures have failed. The tongue is seized and drawn out quickly and forcibly to the limit, then it is permitted to recede. This is to be repeated 16 times per minute.

7. Oxygen gas, which may be readily obtained at a drug store in cities or large towns, is a powerful stimulant to the heart if it can be made to enter the lungs. A cone may be improvised from a piece of stiff paper and attached to the tube leading from the tank, and placed over the mouth and nose while the gas is turned on during the efforts at artificial respiration.

AMONG The RAILROAD MEN And In The SHOPS

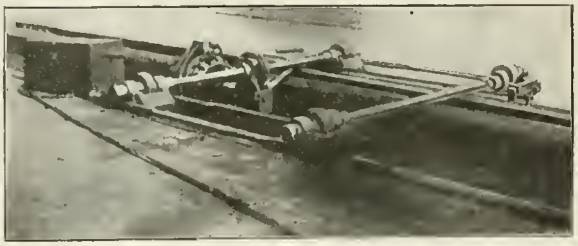
By James Kennedy

READVILLE, MASS., ON THE N. Y., N. H. & H.

Since the consolidation of the New York, New Haven & Hartford Railroad with various other smaller roads in the New England States, it was to be expected that suitable central repair shops would be erected to meet the great and growing demand for thorough equipment repair incidental to the increasing traffic of the system. As all branches of the road lead to Boston, it was natural and proper that the location of the shops should be as near the Hub as possible. Hence Readville, a pleasant suburb of the capital of New England, was selected. The great shops, now in perfect equipment and full operation, are a city in themselves, occupying, as they do, nearly a dozen separate squares of buildings, of which the machine shop, 950 ft. in length by 250 ft. in breadth, is the largest. In this hive of industry there are nearly one thousand skilled mechanics at work. The equipment is entirely modern, embracing the latest improvements in electrically driven machinery, to which is added a number of devices, chiefly of the jig variety, that are not only labor-saving, but labor-perfecting in the rapidity and excellence with which the work is performed.

The utilization of electricity as a motive power is a marked feature of the establishment. Flat motor cars are running in every direction carrying the lighter material from place to place. The heavier service is performed by traveling cranes capable of lifting locomotives from pit to pit. There is also an extensive arrangement of jib cranes run by compressed air that serve a series of machines arranged in groups. The construction of these cranes is such that the floor space is not interfered with, the supporting column having its base in the centre of a worn-out car wheel embedded under the cement floor.

A noticeable feature in the later stages in the repairing of locomotives was the fact that as soon as they were placed on their wheels, which operation was performed in about ten minutes, they found themselves transferred to the outer of the several tracks that ran along the entire length of the machine shop. They were moved by easy stages from section to section, receiving a portion of their finished attachments here and a portion there, until with their coupled rods, valve gearing and burnished brass work applied, they found themselves emerging one after the other into the outer world at the appointed hour with a regularity only equalled by their varying careers in road service, when trains of cars were attached and they moved on their foreordained courses with all the punctuality of well-wound Waterbury clocks.



VALVE-SETTING MACHINE RUN BY MOTOR.

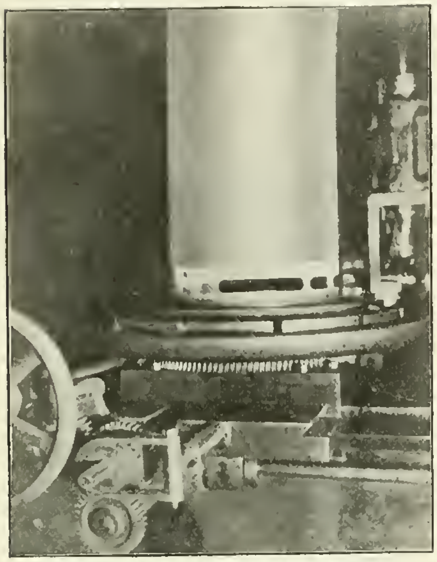
We noticed a few finished Moguls lingering in their varnished splendor near the door. They waited for ash-pans. The double gang on the new ash-pans could hardly keep pace with the high speed of general repairs, which usually occupied a space of eleven or twelve days. The larger number of locomotives, with their back drivers located about the middle of the firebox, lend themselves readily to the form of ash-pan now being placed on all the engines. The bottoms of the two sections of the ash-pans are being fitted with a strong hopper-shaped casting, which, sloping at an angle of about 30 degs. towards the center, is fitted with two sliding pieces suspended in grooves on the casting. These slides are easily drawn outwards and upwards by a hook in the hands of the fireman, the ashes quickly fall out, the slides readily closing as soon as the hook is withdrawn from the projecting orifice in the outer edge of the slide. It will require some period of service with its attendant climatic changes to test fully the perfect adaptability of this device to meet not only the requirements of the new federal law in regard to ash-pans, but what is of equal importance, the severe strain on ash-pans in locomotive service generally.

The reboring and rebushing of cylinders take place while you wait, and it is time well spent to observe the high speed with which the electrically-driven boring bar works its way through the cylinder. Meanwhile, the bushing is being got ready. It is ⅝ in. thick, and there is no time wasted in drilling a series of holes and chipping and filing the spaces for the steam ports. The turned bushing is set on a machine resembling a small drill-press, on which a horizontally attached revolving cutter gets its fine work in for a few minutes and the steam ports open before us. It rivals a machine that we lately saw boring a square hole. It cuts an oblong hole with great swiftness and precision. Meanwhile, a flaring torch formed of a metallic cylinder along the center of which is a perforated pipe fed with crude oil and blown by compressed air, is placed in the cylinder, and the heating and consequent expanding of the cylinder proceeds rapidly. A few minutes of white flame and the bushing slides easily into place. The ports in the bushing are adjusted exactly to the steam ports in the cylinder, and the cooling contraction sets in and the job is done. There is no useless grinding of cylinder heads. The ends of the bushing become

VIEW OF THE READVILLE SHOPS OF THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

the cylinder head joints. They never move, and they could not if they would, because both cylinder heads would keep them in place.

The moving of the locomotive wheels during the adjustment of the valve gear



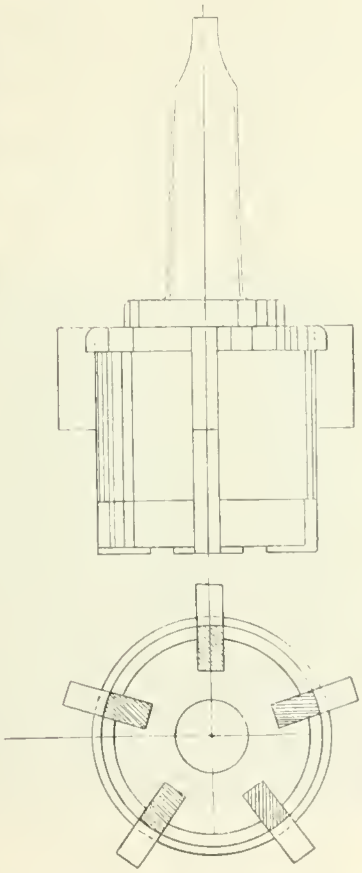
CUTTING STEAM PORTS IN CYLINDER BUSHING.

is performed by a 3-h.p. electric motor. The apparatus necessary in conveying the moving force to the main axle can be adjusted in less than twenty minutes, and by the time the valve-setter has his openings marked on the valve rod, the wheels are ready for moving. The wheels are slightly raised on rollers in the usual way from the track, and a touch of the electric switch lever, and the wheels make four revolutions a minute. The moving wheel was stopped at the tram mark with perfect precision, and one had barely time to cross the pit and get the tram ready when the chalk mark was around again. Except in cases where there are new link saddles to adjust, the setting of the valves is accomplished in about the same time as it formerly took to get ready, that is between one and two hours.

The chipping of saddles is a matter of ancient history at Readville. When a saddle is marked off it is lifted by the traveling crane to an adjacent planing machine, where a special attachment cuts off the superfluous metal. A slight raising of the casting at the end not being operated upon produces a finished fit slightly hollow towards the center of the saddle. So careful is the marking and so correct the planing that the saddle is never touched the second time. It is usually bolted into place the day after it has been marked off.

The planing machines seem to have invaded the boiler shop, and the edges of all sheets are planed with that bevel usual to overlapping sheets, and with a straightness that the chisel could not give. A square punching machine of ample dimensions was being put to a variety of uses, especially in ash-pan work, that was a revelation in itself. By its use angle iron could be cut at any angle, and the perfect formation of angle iron joints could be effected without any heating or chipping or filing.

We can hardly enumerate the variety of new methods and new machines at work all over this establishment. Especially interesting was the clever process of boring, drilling, tapping and literally completing the fitting up of eccentric straps without removal from an adjustable jig plate to which they were attached. By the simple movement of a lever they

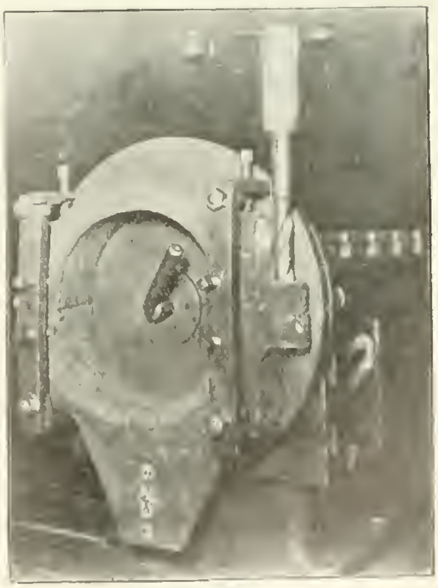


EXHAUST PIPE BORER.

were placed in any position necessary for the twenty or more operations to which they were subjected. Piston-heads and cylinder heads were turned and bored and made ready for service without change or removal from the apparatus holding them. The methods and tools used insure a standardization and interchangeability of parts not common in heavy machine work.

Proceeding to the galleries where the lighter work is done, one is struck by the space at the disposal of the various sections. These galleries extend the entire length of the machine shop, and are over 50 ft. in width. They embrace the brass finishing as well as others of the lighter machine work. Several devices were in operation in valve grinding, the most notable being revolving metallic hemispheres upon which concave packing rings could be ground to a perfect joint by simply holding the ring in the hand over the polar extremity and resting upon the circular face of the sphere. The tool room had many novelties, some perfected and some in progress. Among the latter was a drill arbor so constructed that a series of spiral grooves on its lower rim were adapted to slide readily into the grooves of the spiral drills. The combination of socket and drill became such that the drill shank was a factor of little or no importance in the running of the drill. The anticipated result is that the drill shanks will last till doomsday. This is a consummation devoutly to be wished. Among the smaller drill presses we observed one compact little machine noiselessly piercing holes longitudinally through six staybolts at once. The tool room is great on cutters. Some had almost the magnitude of boring bars. We saw a five-toothed specimen working its way quietly into the heart of a locomotive exhaust pipe, leaving a finished surface on the inner face of the pipe 5 ins. wide, the casting being held meanwhile in one of the jig contrivances that insured a perfect similarity of finish in that class of exhaust pipes. The interchangeability of cutters in a variety of stocks or holders gave a range of sizes at once complete and easy of adjustment.

The spray painting apparatus that came into vogue at the building of the white palaces at the Chicago Exposition is being utilized in the painting of trucks and other of the less elegantly finished work, and the spray is so finely handled that there is scarcely any indication of loss of paint on the floor.



ECCENTRIC STRAP JIG.

In the air-brake department a complete instruction apparatus painted in colors corresponding with charts and descriptive matter is within reach of all. A number of excellent devices are in use in this section of the works. The portable tables, adapted for the holding of pumps, allowing one to turn the pump in any required position, admirably suit the necessities of the work. A test gauge apparatus presented a new feature, consisting of a double-feed screw, the larger screw giving one inch each revolution, while the smaller screw required twelve turns per inch, the result being that one or two turns of the larger screw would furnish almost the required pressure, the finishing turns being accomplished by the smaller screw. The releasing of the entire pressure is almost instantaneous, the result being that gauges can be tested by the gross instead of by the dozen, as formerly.

CAR SHOPS.

The spirit of ingenuity in labor-saving devices used in the car shops keep pace with the work of the clever inventions in the machine shops. The largest kinds of timber can be seen moving on adjustable rollers through the various machines, and after being projected through openings in the walls, were returned on another system of rollers and reduced and shaped to the requirements of the work in view. All this was accomplished with a minimum of handling that seemed incredible and in strong contrast to methods in vogue in many of the older establishments. The stock room, containing trimming and other material, was arranged with a perfect system of recording quantities and sizes in large lettering, so that the required material can be had and accounted for easily and correctly. We observed a novel system of adjustable scaffolding used in connection with the cleaning and painting of cars. In place of the usual cumbrous affair, an adjustable platform is arranged at the sides of each car whereby the workmen can raise or lower themselves at will. A portable machine of the staybolt cutting kind was at work on the rivets of car framing. It resembled a swivel gun, and can be readily adjusted to any angle. In a 6-in. pipe with 100 lbs. air pressure single blows of 2,700 lbs. were being delivered with a rapidity resembling a Gatling gun in action, but with this difference, that each forceful repercussion effected the desired purpose in removing a rivet head. This operation is usually the work of ten or twelve minutes by hand labor. In this shop the inner decoration of the passenger cars are undergoing a standardizing process which in point of elegance in finish is a dream of oriental splendor that would make a Young Turk feel that he was in the Sultan's palace.

THE STORE ROOM.

The store room almost rivalled the machine shop in extent. It is completely traversed by the electric traveling cars already alluded to, with turning tables at the crossings. The system of labeling the various compartments is worthy of imitation. Held in an attached tin sheath, the labels can be readily withdrawn when required with the full description and the numbers of parts readily changeable to suit the varying supply or demand on the articles.

OTHER DEPARTMENTS.

The lack of space prevents us from describing even briefly the blacksmith shop with its double row of power hammers, ranging from light compressed air hammers and forging machines to great steam hammers whose strength and capacity seemed unlimited. A brief glimpse at the upholstery department revealed a large number of young women at work in an atmosphere of elegant comfort that seemed to be appreciated by them. The gilding and bronzing of the finer castings is also a particularly interesting section.

THE LEADING MEN.

As may be readily imagined, the men in charge of this mechanical center are all men of wide experience and thorough training. Mr. George Donahue, superintendent of shops, had a long experience as a master mechanic on the Erie Railroad. He is a fine specimen of the stalwart, masterful mechanic who is ready to put his hand and heart into any railroad problem that arises. He is manly and outspoken. Keenly alive to the advantages of new means and new methods, he has no regard for things that have been weighed in the balance and found wanting. His comments on compound locomotives and piston valves and other recent changes, that are still the subject of controversy, would make interesting reading, but need not be reproduced at this time. He is loud in praise of the Walshaerts valve gear.

Mr. John Reid, the general foreman, is a mechanic of the all-round type, now becoming a rarity. He was among the most skilled of the mechanics employed on the elevated railroad in New York for many years. Later he was foreman at New Haven, and was selected from among many able mechanics to take charge of the new shops at Readville. His head is clear and his heart is warm. He is particularly encouraging to the younger mechanics who exhibit any inventive faculty. Hence, many of the clever devices in operation in the shops.

The brothers, Mr. A. L. Roberts and Mr. G. H. Roberts, are a pair of scholarly, cultured mechanics, versed in theory and ripe in practice. The former constructed the valve-setting machine that we have alluded to, while the latter has made, or, rather, invented, a variety of jigs of much practical value, among which is the apparatus used in machining the eccentric straps.

Mr. Eustace Stock, of the air-brake department, has a stock of knowledge that would be difficult to add to. The intricacies of the air brake are like the alphabet to him, and he has the rare faculty of imparting his varied information to others in a way that is at once interesting and engaging.

Mr. Frank Casperson, the foreman toolmaker, has the fine eye of a jeweler. His manipulation of the drill press socket to fit the grooves of the twist drill is the work of a master. We will keep our eye on him.

Of the foreman painter, Mr. G. W. Gahman, it may be briefly said that he is putting the finishing touches on a class of work that we have not seen surpassed. He is an artist, and if the old days were here when they painted buffalos on engine tanks, the Readville painter would show us something at which we might open our mouths in dumb wonderment. As it is, his car interiors would place in the shade the garnished glories of an Asiatic kiosk.

Safety Record of the Pennsylvania.

Reports just compiled of all accidents on the Pennsylvania Railroad for the past year, show that during 1908 the various lines carried 141,659,543 passengers, and that not one passenger was killed as the result of an accident to a train. During the year this road carried fewer passengers than in 1907 by about 7.4 per cent., but the total number of passengers injured in train accidents was only 102. This is a reduction of 452, or 81.6 per cent. from 1907. These figures include every case requiring surgical or medical attention. It will thus appear that, counting every personal injury due to train wrecks, only one person out of every 1,388,819 passengers carried was injured. The passenger trains of the Pennsylvania traveled 58,440,449 miles during 1908. The fact that the millions of passengers carried were handled with such safety is made more significant by the fact that alongside the passenger trains, freight trains were operated for a total of 60,293,996 miles. Statistics for the Pennsylvania lines east of Pittsburgh, directly operated, show a total of 88,328,604 passengers carried in 1908, and but 51 injured in train accidents.

On the lines west of Pittsburgh, directly operated, 22,314,209 passengers were carried during the year, and there were 17 injured as the result of train accidents. Thus the chances were 1,312,600 to one that every passenger who started upon a journey during the year would reach his destination in safety. Of the subsidiary lines, independently operated, the record of the Long Island Railroad shows that line to have carried during the year, 23,242,838 passengers and only 17 were injured in train accidents. Passengers carried one mile numbered 352,228,060. This line has now been operated for some 15 years without a fatality to a passenger, due to a train wreck.

Items of Personal Interest

Mr. F. E. Fox, master mechanic on the Denver & Rio Grande at Denver, Colo., has resigned.

Mr. L. L. Dawson has been appointed the superintendent of motive power of

C. E. FULLER,
Vice-President M. M. Association.

the Ft. Worth & Denver City with office at Childress, Texas.

Mr. J. Lowell White has been appointed the purchasing and supply agent of the St. Louis, Brownsville & Mexico, with offices at Kingsville, Texas.

ANGUS SINCLAIR,
Treasurer M. M. Association.

Mr. Frank Hamilton has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe, at Newton, Kans., vice Mr. J. B. Hasty, resigned.

Mr. A. Shields, master mechanic of the Canadian Northern, has been appointed also master mechanic of the Duluth, Rainy Lake & Winnipeg.

Mr. J. O. Harrison has been appointed master mechanic of the Ft. Dodge, Des Moines & Southern Railway at Boone, Ia., vice Mr. H. B. Sutton, resigned.

Mr. John Kent has been appointed inspector of the newly installed automatic electric signal system of the New York Central on the Buffalo division.

The office of Mr. W. H. Elliott, signal engineer of the New York Central & Hudson River Railroad, has been moved from New York to Albany, N. Y.

Mr. Willard R. Collins has been appointed the purchasing agent of the Erie, with offices at New York, vice Mr. E. T. Campbell, assigned to other duties.

H. H. VAUGHAN,
President M. M. Association.

Mr. John Kirby, Jr., of Dayton, Ohio, son of Mr. John Kirby, the veteran master car builder, has been elected president of the National Manufacturers' Association.

Mr. N. W. Pringle has been appointed New England Passenger Agent on the Lehigh Valley Railroad with headquarters at No. 39 Church street, New Haven, Conn.

Mr. Robert A. Primrose has been appointed road foreman of engines on the Iowa division of the Chicago & Northwestern Railroad, with headquarters at Clinton, Ia.

Mr. C. A. Wight, foreman painter of the Chicago & Northwestern Railway in the motive power and car department at Boone, Ia., has resigned to engage in business for himself.

Mr. H. Carrick, formerly assistant division master mechanic on the Oregon Short Line, has been appointed master mechanic of the Montana division with office at Pocatello, Ia.

Mr. A. H. Gairns, division master mechanic of the Oregon Short Line, at Po-

GEORGE W. WILDIN,
Vice-President M. M. Association.

catello, Ia., has been appointed master mechanic of the Idaho division only, with office at Pocatello, Ia.

Mr. Geo. Ross, formerly district foreman on the Oregon Short Line at Salt Lake City, Utah, has been appointed

J. E. MUHLFELD,
Vice-President M. M. Association.

master mechanic of the Utah division, with office at Salt Lake City.

Mr. P. H. Wilhelm has been appointed special railroad representative for the Asbestos Protected Metal Company of

Canton, Mass. He has been with the American Steel & Wire Co. since 1904.

Mr. Harry Giegoldt, formerly division foreman of the Atchison, Topeka & Santa Fe at Woodward, has been appointed division foreman on the same road at the new division terminal at Waynowa, Okla.

Mr. S. D. Wager, formerly master mechanic of the Toledo, Port Clinton & Lakeside Railway, has been appointed general shop foreman of the Northern Ohio Traction & Light Co., of Canton, Ohio.

Mr. T. J. Raycroft, general foreman of the Chicago, Burlington & Quincy, has been appointed master mechanic of the Sterling division, with offices at Sterling, Colo., vice Mr. E. D. Andrews, transferred.

Mr. J. H. Davis, formerly assistant electrical engineer on the Baltimore & Ohio Railroad, has been appointed electrical engineer on that road with headquarters at

LE GRANDE PARISH,
Vice-President M. C. B. Association.

Baltimore, Md., vice Mr. L. T. Gibbs, deceased.

Mr. W. J. Hill, general foreman of the Atchison, Topeka & Santa Fe, has been appointed the master mechanic of the Oklahoma division of that road with offices at Arkansas City, Kans., vice Mr. J. T. Lendrum, transferred.

Mr. J. Snowden Bell, the well-known mechanical engineer and patent attorney, announces the removal of his offices from 31 Nassau street to 165 Broadway, New York. Mr. Bell has had great experience in securing patents on railway appliances.

Mr. Edward C. Sawyer, who was formerly the representative of the H. W. Johns-Manville Co., is now associated with Mr. H. G. Hammett, Troy, N. Y., manufacturer of Trojan Metallic Packing, locomotive specialties and machinery.

Mr. Willis C. Squire has been appointed general sales agent for "Rogers' Improved Journal Packing and Receptacles" for the Rogers Journal Packing Company, of Chicago, Ill.

Mr. J. J. Barry, who was appointed general foreman at the West End Shops on

R. F. McKENNA,
President M. C. B. Association.

the Norfolk & Western, at Roanoke, Va., has again received promotion as master mechanic of the Pocahontas division on the same road, vice Mr. L. D. Gillett, resigned.

Mr. G. Robinson, formerly acting locomotive foreman on the Grand Trunk Pacific Railway at Portage la Prairie, Man., has been appointed locomotive foreman on the same road at Watrous, Sask., vice Mr. C. E. Brooks, assigned to other duties.

JOHN KIRBY,
Treasurer M. C. B. Association.

Mr. John J. Brady has been appointed general foreman of the Harlem Division of the N. Y. C. & H. R. R. R. at North White Plains. Mr. Brady has had charge of large engine houses on that road at Corning, West Albany and Minoa and is well equipped for the work.

Mr. E. D. Gibersen and Mr. Frank E. Olin, formerly connected with the New York Sales Agency of the National Tube Company, have been appointed Eastern sales agents of the Ohio Seamless Tube Company of Shelby, Ohio, with offices at No. 2 Rector street, New York.

Mr. A. Stewart, general superintendent of motive power and equipment of the Southern Railway, with offices at Washington, D. C., has been appointed also the general superintendent of motive power and equipment of the St. Louis-Louisville lines of the Southern Railway, with office at Washington, D. C.

Mr. E. A. James has been appointed general manager of the Alberta & Great Waterways Railway, the building of which begins this summer. The road will connect Edmonton with immense territory tapped by natural waterways of the Arctic Ocean and will be the most northerly railroad in Canada.

F. H. CLARK,
Vice-President M. C. B. Association.

Mr. F. W. Fultz has been appointed locomotive fuel expert on the Missouri Pacific Railway, with headquarters at St. Louis, Mo. His duties are to ride on locomotives and instruct firemen and enginemen on proper methods of firing and the handling of draft appliances; also in all matters pertaining to the efficient and economical use of fuel.

Mr. Jas. R. Paterson, manager of the advertising department of RAILWAY AND LOCOMOTIVE ENGINEERING, has been compelled to give up work for a month or two, owing to a severe cold, contracted last winter, having settled on his lungs. Mr. Paterson is recuperating among the pines on the higher levels of the Catskills, and is making progress toward recovery. He will, however, not be able to attend the railroad conventions at Atlantic City this year. His many friends from whom we have received inquiries will understand the cause of his temporary absence from his accustomed place in the office and on the board walk and among the exhibitors at the convention city by the sea.

AMONG THE ERIE RAILROAD APPRENTICES.

By Angus Sinclair.

The development of complex mechanism in railroad operating has raised a demand for mechanics familiar with the scientific principles of mechanical engineering. It is not now sufficient that a first-class mechanic should know how to push a file straight and possess the skill necessary to fit up a set of links in a workmanlike manner; he must know why certain dimensions are used, how to regulate the speed of machines, what size of pulleys will produce certain speeds, the strains that any article can safely endure, the weight of parts used in construction and repairs of machinery, besides many other things that in the good old times were known only to the mechanical engineer and master mechanic.

It has not yet become the custom, except in rare cases, for graduates of scientific schools to enter machine shops as apprentices. The practice is, as of old, to select boys of good character who have received a fair grammar school education and permit them to acquire whatever skill and knowledge they are capable of grasping while passing three or four years in a machine shop, boiler shop, blacksmith shop, or any other shops where apprentices are admitted. Of late years railroad companies have been experiencing difficulty in securing scientifically trained mechanics fit to take charge of work, a condition that has moved many of them to institute schools for the education of their apprentices. One of the latest railroad companies to make this benevolent educational move is the Erie Railroad Company.

The principal mechanical repair establishment of the Erie is at Meadville, Pa., and naturally the first apprentice school was opened there. About a year ago a school was started in a passenger car at Meadville, which was soon abandoned for a most commodious room in the office building of the works. Since that time schools have been instituted in connection with the repair shops at Hornell, Susquehanna and Dunmore. The scheme of the schools, which are taught during the company's time, is to have every apprentice in the works share the benefits of this practical education, and to employ no apprentices who fail to attend the schools and to keep up to a certain standard of educational excellence. It speaks well for the material employed as apprentices by the Erie, to find that out of a total of nearly 300 pupils, only ten have been dropped for inefficiency.

Attending the technical instruction classes is a high privilege to the apprentices, but of even greater potential benefit is the attention bestowed upon the young men in according them variety of work to do in the shops.

The writer, who holds the position of Inspector of Technical Education on the Erie Railroad, recently received from General Manager J. C. Stuart, a request to visit the apprentice schools at Meadville, Hornell and Susquehanna and report. This duty was duly performed, and it gave me an excellent opportunity to observe the working of the classes and the treatment given to the apprentices in the various shops. There are educational classes connected only with the four shops named, but there are apprentices in the shops at Huntington, Ind.; Galion, O.; Cleveland, O.; Buffalo, N. Y.; Port Jervis, N. Y.; Stroudsburg, Pa., and Jersey City, N. J., who will receive direct benefit from the new policy of supervising the shop work done by the various apprentices, even if they receive no school instruction.

An elaborate organization has been formed to deal with the education and training of apprentices, which may thus be summarized:

First. A supervisor of apprentices.

Second. An assistant supervisor of apprentices.

Third. A technical instructor in shops having fifty or more apprentices.

Fourth. A practical instructor in shops having fifty or more apprentices.

GROUP OF APPRENTICES ON THE ERIE RAILROAD HORNELL SHOPS.

Fifth. A man having the necessary ability to teach both technical and practical mechanics to have charge of the work in shops having less than fifty apprentices.

My intercourse during the visit was principally with Mr. W. S. Cozad, supervisor, and his assistant, Mr. E. V. Lea, who accompanied me to the different shops. Both of these gentlemen displayed keen interest in the work they are doing, and certainly have the confidence of the young men whose ideas they are cultivating to shoot into the realms of scientific knowledge.

The classes work two hours a day twice a week, which is rather short time for drawing and technical studies, but the pupils are making remarkably rapid progress. The company supplies all instruments, drawing boards and other requirements. While I was visiting the classes Mr. J. C. Hassett, the technical instructor at Meadville, gave various arithmetical problems to be worked out on the blackboard, which was done very readily by different scholars. Some of the problems involved knowledge of the weight per cubic inch of metals, a subject on which most of the young men displayed a commendable degree of knowledge.

The drawing was begun with simple projection and worked along by degrees to prospective work. In the latter exercise the scholar is given a part such as a gland or bushing, of which he is instructed to make two views and then find a third for himself. A remarkably useful form of exercise is instruction concerning the standards of the company. I have seen so many blunders made by foremen in applying parts that were not the standard size or form that the utility of this line of study struck me as likely to prove highly profitable to the railroad company.

At Meadville the practical instructor, Mr. C. K. Lockie, went around the shops with me and pointed out the work the apprentices were engaged upon. The plan is to begin the youth upon an easily learned tool or simple operation and advance him by degrees to the most intricate work to be learned in the trade. This is a very different condition of things from what they were in my youth. Then a shop boy was regarded as a necessary nuisance, and giving him instruction was the last thing thought of. If he learned the trade it was by his own persistence in getting work to do that involved skill. The lazy or indifferent boy passed four or five years in the shop without credit to himself or to his employer.

When the knowledge pervades a shop that the apprentices are there to be instructed, it is wonderful how readily all concerned are ready to lend a helping hand. I have known cases, however, where an educational system was introduced by the company or management and was brought to nought by subordinates.

Having been a mechanic who acquired some scientific knowledge through the ordeal of self help, I was always interested when I heard that some company or firm had provided facilities for the scientific instruction of apprentices and ambitious workmen. I was interested enough to visit such places and to envy the easy road to knowledge that some fortunate youths enjoyed. The unexpected was also frequently met at such places, in the shape of covert opposition from foremen and others in minor authority. This secret opposition was frequently potent enough to render the educational scheme a failure. Prejudiced opposition to education is the weak resort of ignorance and envy that are gradually losing their sting. For a mechanic to obtain the reputation of being a student was in old times likely to subject him to constant derision from the oxmen who filled many shops.

ERIE RAILROAD APPRENTICES AT THE SUSQUEHANNA SHOPS.

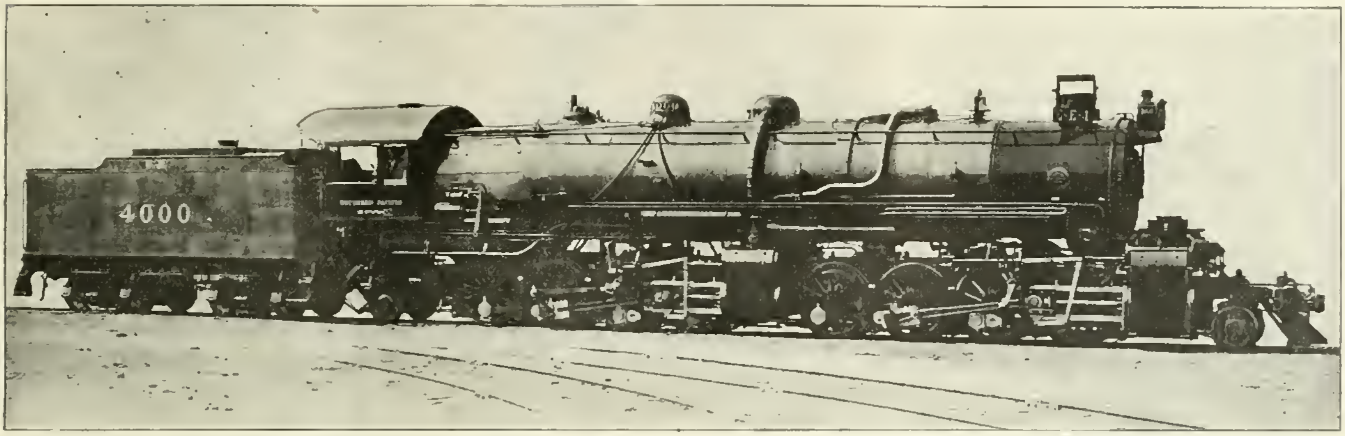
During this trip I employed the newspaper man's privilege of finding out how sentiment stood on the apprentice-school system, and was pleased to find it generally sound. The beneficent purpose of the Erie management is cordially supported on every hand. The master mechanics in charge of the shops I visited, Mr. T. J. Cole, Meadville; Mr. E. S. Fitzsimmons, Cornell, and Mr. H. H. Harrington, of Susquehanna, are enthusiastic supporters of the apprentice schools, and all their foremen that I was able to reach quietly were also friendly. They all will enjoy the satisfaction in the future of having helped an excellent cause, that opens fine opportunities for advancement to young mechanics.

BALDWIN MALLET ARTICULATED COMPOUND

The Baldwin Locomotive Works have recently completed for the Southern Pacific Company, two Mallet articulated compound locomotives, which are probably the heaviest engines thus far built for any railway. The weight of the engine itself being 425,900 lbs. These locomotives have eight coupled wheels in each group, and in accordance with the placed right and left immediately back of the front tube sheet. A superheater, placed in the piping system between the high and low pressure cylinders, is located in the smokebox. The combustion chamber is provided with a manhole, so that the tube ends are readily accessible.

In order to facilitate repairs, the boiler is provided with a separable joint, which ber and the low-pressure cylinders with the front group of wheels.

The waist-bearer under the combustion chamber is bolted into place, while the front waist-bearer and the high-pressure cylinder saddle, are riveted to the shell. The longitudinal seams in the barrel are placed on the top center line, and have "diamond" welt-strips inside. Flexible

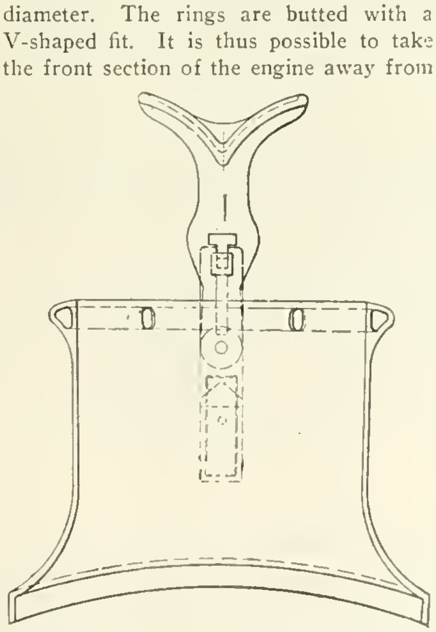


HEAVY ARTICULATED MALLET COMPOUND FOR THE SOUTHERN PACIFIC COMPANY.

H. J. Small, General Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

previous practice of the builders, are equipped with two-wheeled leading and trailing trucks. The constructive details embody various features of special interest. These engines will be used on the Sacramento division of the Southern Pacific, between Roseville and Truckee, where the maximum grade is 116 ft. to the mile. The rating of the engine, exclusive of the tender is 1,212 tons. The calculated tractive effort of this machine is 94,640 lbs. The design is that of a boiler which extends beyond the dome and terminates where the band is shown in our illustration, about over the center of the rear driver of the front group. From that point forward there is a combustion chamber and beyond that is a compartment for feed water heating, and the smokebox proper, containing a superheater.

The boiler is straight topped, 84 ins. in diameter, and is equipped for oil burning. The fire tubes are 21 ft. long and there are 401 of them, each 2¼ ins. in diameter. They terminate in a combustion chamber, 54 ins. long, in front of which is a feed water heater 63 ins. in length. The tubes in the feed water heater are set in alignment with the fire tubes, and are equal to them in number and diameter. Two non-lifting injectors are provided, and they discharge, right and left, into the feed water heater chamber, which is kept constantly filled with water. The feed passes out through the top of the chamber, and is then delivered into the main barrel through two checks, is placed at the rear end of the combustion chamber. The joint is effected by riveting a ring to each boiler section, and uniting the rings by 42 bolts, 1¼ ins. in diameter. The rings are butted with a V-shaped fit. It is thus possible to take the front section of the engine away from the back, by removing the pivot pin in the frame casting between the high pressure cylinders. The back section therefore consists of the cab, firebox, boiler, high pressure cylinders and rear group of wheels. The front section consists of the smokebox containing superheater, the feed water heater, the combustion chamber



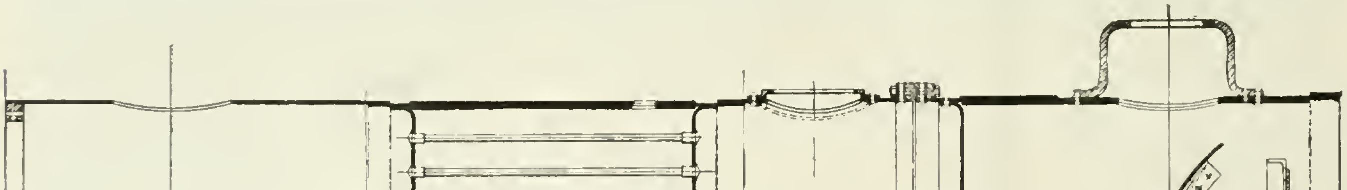
SOUTHERN PACIFIC ENGINE STACK, WITH SMOKE DEFLECTOR.

staybolts are liberally used in the sides, back and throat sheets of the fire box, while the crown sheet is stayed with T-irons hung on expansion links, in accordance with the practice of the Associated Lines.

The dome, which is of cast steel, is placed immediately above the high-pressure cylinders, and the arrangement of the throttle and live steam pipes is similar to that used on heavy articulated locomotives previously built at the Baldwin works. The form of throttle valve was illustrated in our 1906 volume, page 472. The exhaust from the high-pressure cylinders passes into two pipes which lead to the superheater. These pipes are of steel, and each is fitted, at the back end, with a slip joint made tight with a packed gland. The steam enters the superheater at the front end of the device, and passes successively through six groups of tubes. It then enters a T-connection, from which it is conveyed to the low-pressure cylinders through a single pipe having a ball joint at each end and a slip joint in the middle. Each low-pressure cylinder is cast separately, and is bolted to a large steel box casting, which is suitably cored out to convey the steam from the receiver pipe to a pair of short elbow pipes, making final connection with the low-pressure steam chests. The steam distribution is here controlled by 15-inch piston valves which are duplicates of those used on the high-pressure cylinders. The final exhaust passes out through the front of each casting, into a T-connection, which communicates with a flexible pipe leading to the smokebox. The slip joint in this pipe is made tight by means of snap rings and leakage grooves. At the smokebox end, the ball joint is fitted with a coiled spring, which holds the pipe against its seat.

The valves for both the high and low-pressure engines are set with a travel of 5½ ins. and a lead of 5-16 ins. The steam lap is 1 inch, and the exhaust clearance 1-16 inch. Reversing is effected by the Raggonet power gear, which is operated by compressed air and is self-locking. The gear is directly connected to the high-pressure reverse shaft. The reach rod connection to the low-pressure reversing shaft, is placed on the center line of the engine, and is fitted with a universal joint, placed immediately above the articulated frame connection. The joint is guided between the inner walls of the high-pressure cylinder saddle. In this way the reversing connections are simplified, and when the engine is on a curve the angular position of the reach rod has practically no effect on the forward valve motion. This arrangement had been made the subject of a patent.

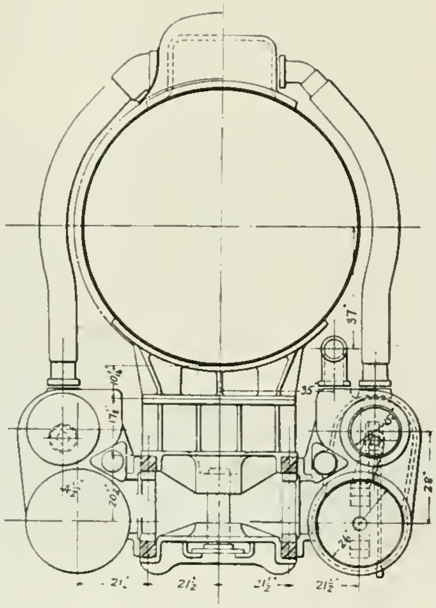
One of the locomotives is equipped with Vanadium steel frames, and the other with frames of carbon steel. The connection between the frames is single, and is effected by a cast steel radius-bar which also constitutes a most substantial tie for the rear end of the front frames. The fulcrum pin is 7 ins. in diameter; it is inserted from below, and held in place by a plate supported on a cast steel crosstie, which spans the bottom rails of the rear



SMOKEBOX, FEED-WATER HEATER AND COMBUSTION CHAMBER OF MALLET COMPOUND.

frames between the high-pressure cylinders. The weights on the two groups of wheels are equalized by contact between the front and rear frames, no equalizing bolts being used in this design.

The front frames are stopped immediately ahead of the leading driving pedestals, where they are securely bolted to a large steel box casting, previously mentioned, which supports the low-pressure cylinders. The cylinders are keyed at the front only. The bumper beam is of cast steel, 10 ft. long, while the maximum width over the low-pressure cylinders is



SECTION THROUGH H. P. CYLINDERS.

approximately 11 ft. The boiler is supported on the front frames by two bearings, both of which have their sliding surfaces normally in contact. The front bearing carries the centering springs, and the wear is taken, in each case, by a cast iron shoe 2 ins. thick. Both bearings are fitted with clamps to keep the frames from falling away when the boiler is lifted.

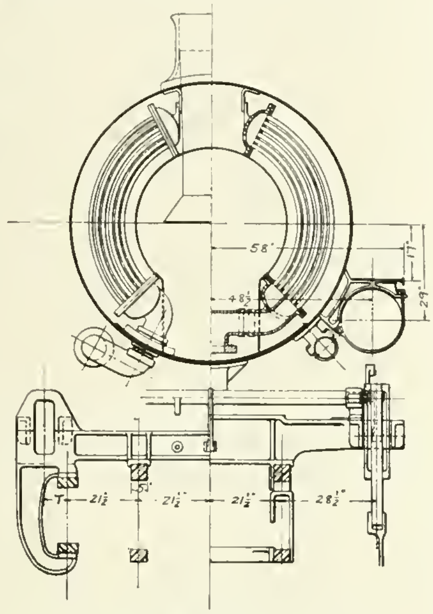
This locomotive naturally embodies in its design, many smaller details of interest. The cylinder and steam chest heads are of cast steel, the low-pressure heads being dished and strongly ribbed. The low-pressure pistons are also dished; they have cast steel bodies, and the snap rings are carried by a cast iron ring which is bolted to the body, and widened on the bottom. The links for the low-pressure valve gear are placed outside the second pair of driving wheels, and are supported by cast steel bearers which span the distance between the guide yoke and the front waist bearer. The low-pressure valve stems are connected to long crossheads, which slide in brackets bolted to the top guide bars. The locomotive is readily separable, as the joint in the boiler is but a short distance ahead of the articulated frame connection and all pipes which pass the joint are provided with unions. The separable feature was tested by the builders, and proved entirely feasible. Sand is delivered to the rear group of driving wheels from a box placed on top of the boiler, and to the front group from two boxes placed right and left ahead of the leading drivers.

The tender is designed in accordance with Associated Lines standards, and is fitted with a 9,000-gallon water-bottom tank. The capacity for oil is 2,850 gallons. The detail parts of this locomotive have, where possible, been designed in accordance with existing standards of the Associated Lines. The engine is practically equivalent, in weight and capacity, to two large consolidation type locomotives, and in spite of its great size, presents a pleasing and symmetrical appearance. In this connection we would call attention to the fact that the engine and tender trucks of these locomotives are equipped with "Standard" solid forged and rolled steel wheels. The high-pressure cylinders are lubricated from the cab in the usual manner, while the low-pressure cylinders are lubricated by means of a force feed-pump driven from the forward valve motion. This arrangement avoids the use of flexible oil piping.

The smoke stack is provided with a deflecting plate. This device is used when the engine is passing through snow sheds with the intention of preventing the smoke from striking the roof and also to discharge it through ventilating openings placed on either side. The deflector can be so placed that the exhaust will drive the smoke and gases directly to these openings as the engine proceeds.

Some of the principal dimensions and measurements of these interesting engines are here appended for reference:

Cylinders—26 ins. and 40 x 30 ins.
Valves—Balanced piston.
Boiler—Type, straight; material, steel; diameter,



SECTION OF SMOKEBOX SHOWING SUPERHEATER PIPES.

84 ins.; thickness of sheets, 13/16 ins. and 27/32 ins.; working pressure, 200 lbs.; fuel, oil.
Firebox—Material, steel; length, 126 ins.; width, 78¼ ins.; depth, front, 75½ ins.; depth, back, 70½ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.
Water Space—Front, 5 ins.; sides, 5 ins.; back, 5 ins.
Fire Tubes—Material, steel; thickness, .125 in.
Heating Surface—Firebox, 232 sq. ft.; fire tubes, 4,941 sq. ft.; feed water heater tubes, 1,220 sq. ft.; total, 6,393 sq. ft.; grate area, 68.4 sq. ft.
Driving Wheels—Outside diameter, 57 ins.; journals, main, 11 x 12 ins.; others, 10 x 12 ins.
Engine Truck Wheels—Front, diameter, 30½ ins.; journals, 6 x 10 ins.; back, diameter, 30½ ins.; journals, 6 x 10 ins.
Wheel Base—Driving, 39 ft. 4 ins.; rigid, 15 ft. 0 in.; total engine, 56 ft. 7 ins.; total engine and tender, 83 ft. 6 ins.
Weight—On driving wheels, 394,150 lbs.; on truck, front, 14,500 lbs.; back, 17,250 lbs.; total engine, 425,900 lbs.; total engine and tender, about 596,000 lbs.
Tender—Wheels, diameter, 33½ ins.; journals, 6 x 11 ins.; tank capacity, water, 9,000 gals.; oil, 2,850 gals.; service, freight.
Feed-Water Heater Tubes—Number, 401; diameter, 2¼ ins.; length, 5 ft. 3 ins.
Smokebox Superheater—Heating surface, 655 sq. ft.

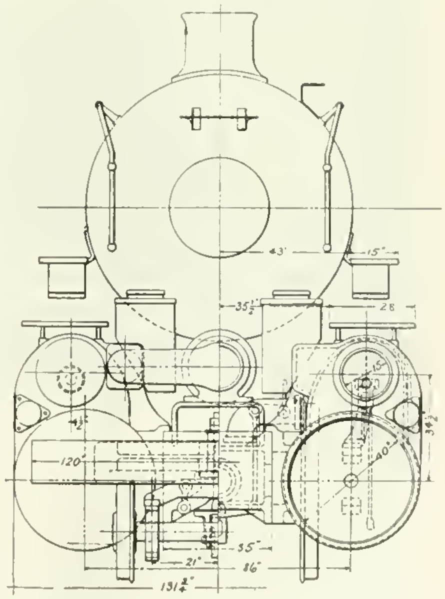
Organization on the Harriman Lines.

One of the most valuable papers ever read at a railroad club meeting was presented to the New York Railroad Club by Mr. J. Kruttschnitt, director of maintenance and operation of the Harriman Lines. The title of this interesting paper was "The Operating and Organization of the Union Pacific and Southern Pacific Systems." Upon assuming the presidency of all the corporations comprising the Union Pacific and Southern Pacific systems, Mr. E. H. Harriman was confronted with the problem of designing an organization that would economically and efficiently supervise lines comprising 22,880 miles of track, employing about 80,000 persons. Mr. Kruttschnitt's paper gave comprehensive outlines of the splendid organization devised by Mr. Harriman.

The theory of the organization is that the different properties must be brought into close relationship with each other, yet preserve a full measure of autonomy. The director of maintenance and operation really represents the president, and exercises similar power, but all the officials have duties that are not interfered with by others. Each superintendent is general manager of his division, and the general manager is responsible operating head of the property, and has under his direction an army of other officials, such as the chief engineer, the superintendent of motive power, the signal engineer, the purchasing agent, and others, who in turn have subordinate officials subject to their supervision.

An Arab proverb says: "He that knows and knows that he knows is a wise man—follow him." The philosophy embraced in that wise saying dominates the policy of the Harriman organization, which searches for men of ability and advances them to responsible positions, where merit will assert itself for the general good.

A conspicuous feature of the organization is, the careful compilation of statistics showing the cost of all details of operation, and having the information promptly placed before the responsible of-



FRONT ELEVATION SHOWING L. P. CYLINDERS AND L. P. VALVES.

ficials, so that the lessons conveyed may influence the current operations. Their statistics are live stimulants to producing better results, promptly administered.

Much attention is bestowed upon establishing and maintaining standards that are applicable to the entire system; but care is taken to guard against permitting devotion to standards to paralyze progress.

The heads of various operating departments meet twice a year and discuss details and standards, among many other important questions. The minutes of these meetings go to the director of maintenance and operation, who confirms the decisions arrived at, modifies them, or refers them back for further consideration.

Nothing in the policy of the system forbids experimenting with new devices, but it forbids their adoption and use on a large scale until their merit has been demonstrated to the satisfaction of the general officers interested. The ability to order in large quantities standard articles, free from a capricious variety of details, makes possible a reduction ranging from 10 to 30 per cent. in the price for staple articles.

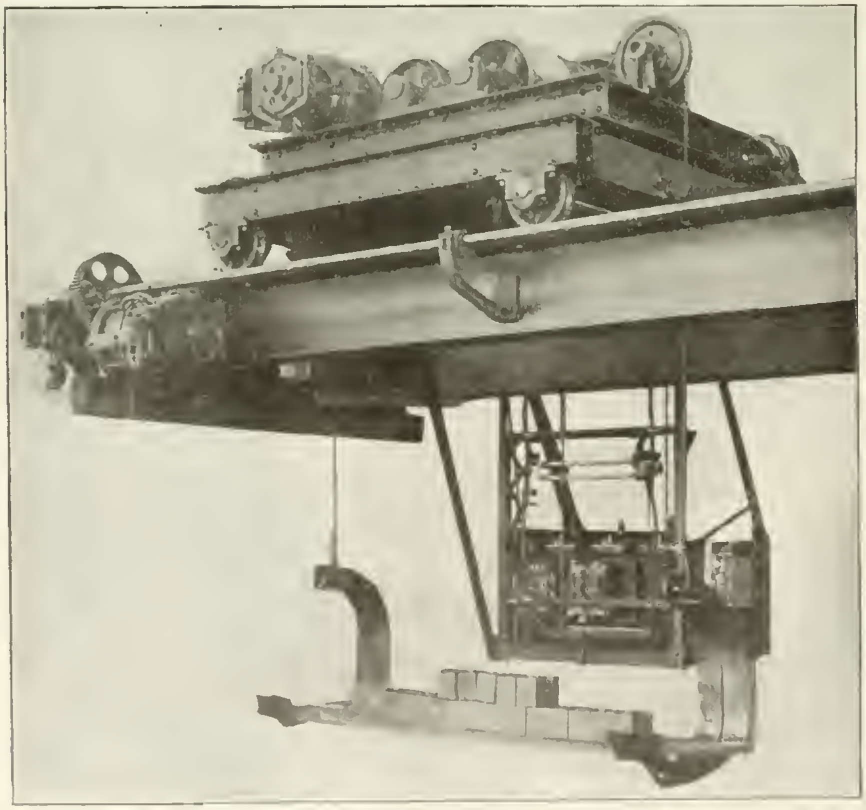
Want of space prevents us from giving full particulars of this new form of railroad organization. When generally adopted by the leading railroad companies of this continent, it will mark a revolution that abandons antiquated, expensive methods for practices adapted to modern requirements. Devising this organization will hold an important place among the great achievements of Mr. E. H. Harriman.

Electric Weighing Crane.

Our half-tone illustration shows a new type of scale crane, designed and manufactured by the Whiting Foundry Equipment Company, of Harvey, Ill. All the movements made with the crane are by electric power. The novel feature of the crane consists in the application of scales for weighing material, which are supported on the trolley truck frame and carry the hoisting mechanism mounted on an independent steel frame work. The scale beams are in the cage suspended from the trolley and readings can be quickly taken and recorded by operator. There are three beams: two scale beams with self-recording poises and one tare beam, enabling scale weights to be determined of several different items of material with ease and accuracy. A simple movement of hand lever transfers, when desired, all load from the knife edges of the scale to the trolley truck frame, and then the operation of the crane is the same as with an ordinary trolley.

The former method of crane weighing consisted of hanging a scale device on the hook. This required an extra man to read, enter and calculate the weights and deduct the tare, a process much more laborious than with the new arrangement, which also eliminates the liability of personal error. A scale device on a hook occupies considerable head room. This scale is economical of head room.

An open side platform is furnished, as shown, for carrying long pieces such as rods, bars, etc. The design of this platform is made to suit the material to be handled. A crane of this type is useful in loading material, checking invoiced weights, and in loading for shipment, for inventory, etc. An application has been made for patent covering essential features of this design.



ELECTRIC WEIGHING CRANE FOR SHOP USE.

Vanadium Steel.

It is almost a universal custom to estimate the value of iron and steel by what may be called the static test. That is, giving the tensile strength of the metal, its percentage of elongation and the reduction of area of the test sample when it is finally pulled apart. The data secured by such a test is valuable, but it is by no means the final or most cogent piece of evidence which can be placed before the court on which to rest the verdict.

The reason why the static test, although in many ways most valuable, cannot be considered as the "last word" in the argument is that it gives little or no hint of the performance of a piece of steel in actual railway service, such as an axle under a heavily loaded car, making thousands of miles per month and always subjected to the irregular vibration and to the alternating stresses of service, while carrying a load. Such an axle may even be subjected to a series of repeated shocks, such as those produced by a flat spot on the wheel pounding along on the track. In other words, high static strength does not measure the endurance of steel.

What is sometimes called the fatigue of steel, or what some people refer to as the fibrous structure of steel crystallizing, is a more or less accurate attempt to describe what takes place in an axle which is subjected to the shocks, alternating stresses or vibrations of service. Metallurgical chemists prefer to describe the condition produced in the structure of the steel, not as crystallization, but as "molecular disintegration," because the effect produced more nearly resembles the cracking of a stone wall, where the foundation has settled unevenly, and where the fracture runs along an irregular line. The failure of steel in such cases generally begins with a minute surface crack, which gradually extends deeper and deeper until the break is complete. The slow, minute extension of the initial crack is known by the term fracture in detail, or progressive fracture.

The chemical compound formed by the union of iron and carbon is carbide of iron, a molecule of which contains 3 atoms of iron and 1 of carbon. This chemical compound alloys itself with the carbonless iron or ferrite, each molecule taking up 21 atoms of ferrite to form what is known as pearlite.

It is difficult to accurately picture in the mind the actual structure of steel. A section exposed for examination reveals the structure of a surface only and it must be remembered that the close grained appearance of good steel not only exists along this surface, but the steel being a solid mass the structure is the same in every direction. In the mass of steel, the crystals of ferrite are joined together and form what may be called a ductile mesh, in which and through which the granules of pearlite are closely interwoven. There is thus an intimate association of minute particles all the way through the steel, and the ability to resist initial fracture is due partly to the way the crystals of ferrite are interlocked with each other, partly to the indestructibility of these ferrite crystals, in themselves, and partly to their firm adhesion to the pearlite granules. Furthermore, the pearlite granules, owing to their large component of "carbonlen iron," are in themselves more or less tough. The rare metal vanadium now plays an important part in the production of steel of high quality. Vanadium is named after the fabled Scandinavian goddess Vanadis, and stands for what we would call "mother earth." Its introduction into steel produces several very important results. In the first place it gets rid of impurities, notably nitrogen, which has been described as a most virulent poison in steel. It also has the power of increasing the static value of steel, that is, it gives the steel in which it finds a place a much higher tensile strength and greater ductility. Its most remarkable property, however, is its ability to strengthen steel against the action of repeated stresses. It enables steel to resist fatigue in a remarkable degree, for in it we have the intimate association of particles which tends to resist fracture and also the important quality of inherent toughness, coupled with close interlocking of those particles upon which the ability to resist fatigue so largely depends. Their "potential" brittleness is thus to a very large extent reduced.

Many steel castings fail in service, not because they are not remarkably strong as far as tensile strength is concerned, but because they are not able to endure the effect of rapidly changing stresses. The ordinary stone wall may fall because it is possible to break it up piecemeal along the cement lines. The vanadium wall resists such breakage, and must be thrown down as a whole or not at all. Steel castings have before now failed from what seems to be no reason at all, when judgment of quality has been based on chemical analysis and the static test. Mr. J. K. Smith, a noted metallurgist, is authority for the statement that the addition of vanadium increases the elastic limit of steel castings 25 per cent., and the ultimate tensile strength 10 to 15 per cent., the same static ductility being retained. In a table embodying the results of some tests made to determine the fatigue-resisting properties of various grades of iron and steel, the figures show that the presence of vanadium reveals itself most markedly in the "dynamic" column.

A piece of old steel boiler plate with even a higher elastic limit than mild vanadium steel stood 612 alternations of stress, while the mild vanadium steel stood 1,111 alternations. A carbon steel casting and a vanadium steel casting endured respectively 269 and 850 alternations. The vanadium steel here had a somewhat higher elastic limit. Nickel forging steel remained intact up to 664 on the test machine, while a specimen annealed of chrome-vanadium steel stood 1,608 alternations.

In the table of tests there is what has been called the "quality figure." This represents an idea of comparative usefulness gained from the combined static and dynamic tests of each specimen. The quality figure is got at by multiplying together the elastic limit, which represents useful strength; the per cent. of reduction of area, representing static ductility; and the alternating impact figure, representing the resistance to fatigue; and dividing the product by 1,000,000 in order to bring the figure within limits which facilitate easy comparison.

The relative value of the steels as far as real usefulness is concerned, is strikingly brought out in the case of two specimens compared above, the carbon and the vanadium steel castings. The carbon steel endured as stated 269 alternations and the vanadium 850, but when the quality figure of each was calculated the carbon steel showed a value of 419 as against 1,671 for vanadium. Both of these were acid open-hearth steels with the same area reduction, but the vanadium exceeded the carbon steel not only in useful static strength as well as in fatigue resistance.

These and other examples demonstrate the large dynamic improvement which the presence of vanadium in steel brings about. In fact, as Mr. J. Kent Smith puts it, vanadium can be used for either strengthening the steel statically or dynamically. "If we want the preponderating influence to be static, with some dynamic improvement, we can get it; if we want the preponderating influence to be dynamic with some static improvement, we can get it." The whole question of the fatigue-resisting quality of steel is most important, and nowhere more so than on railways. Vanadium steel can be used for wheels, springs, rails, rods, pistons, piston-rods, axles, crank-pins, drawbars, locomotive frames, piston valves, and all sorts of working parts. It can be easily machined, and flows readily under the drop-forging hammer. There is certainly increased first cost in the use of vanadium steel, but it possesses a quality that is beyond price. It pushes back the chances of failure and enhances the endurance of the metal, and increases safety of all that are dependent upon it.

People who have enough to do to hold their own way had better be content with their own obligations and difficulties, and not increase them by engaging for other men.—*Dombey & Son.*

Galena-Signal Oil.

The standard oil case in the courts brought out a good deal of evidence on both sides, and while we have no wish to remark upon the legal aspect of the trial, we may be permitted to quote a few words spoken of our friend, General Miller, of the Galena-Signal Oil Company of Franklin, Pa. Mr. J. G. Milburn, counsel for the defendants, said: "I now have a word to say about the Galena-Signal. It was one of the subject of the attack upon us in this bill. The Galena-Signal runs itself—that is, General Charles Miller is its president, and has been since in the '70s. He runs that business. It is his business. It is his achievement. The record in this case bearing upon Galena-Signal is one of the most beautiful demonstrations we have ever seen accomplished by evidence. General Miller has built up the business until he lubricates almost all of the railroads in the United States, including (I don't know whether it is in the United States or not; if it is not, it will be) the Panama Railroad. And we have here—they got in on some Government vouchers—the certificate of military engineers that only Galena oil will serve their purpose. Seventy-five per cent. of the railroads of South America, 29 per cent. of the street railways of the United States, and substantial portions of the railroads in England, France, Germany, Italy and other countries of Europe use the oil. That is what General Miller has accomplished. And he has done it by having the best article—by an invention—by a discovery—by a secret process with the use of oxide of lead which produces that article—something which nobody else can do—by having a corps of experts who go to trains and instruct the men in its use and who watch its application. He sells lubrication—not oil by the gallon. By merit, by industry, by persistence, he has built up a magnificent business which is an honor to American integrity, American resources and American capacity. He carries that wherever his company goes. No basis exists for any charge against Standard Oil in the achievements of General Miller with his Galena-Signal Company. He is entitled to the credit. The Standard is not entitled to that credit, because he has worked out and accomplished that result.

An Example for Boys.

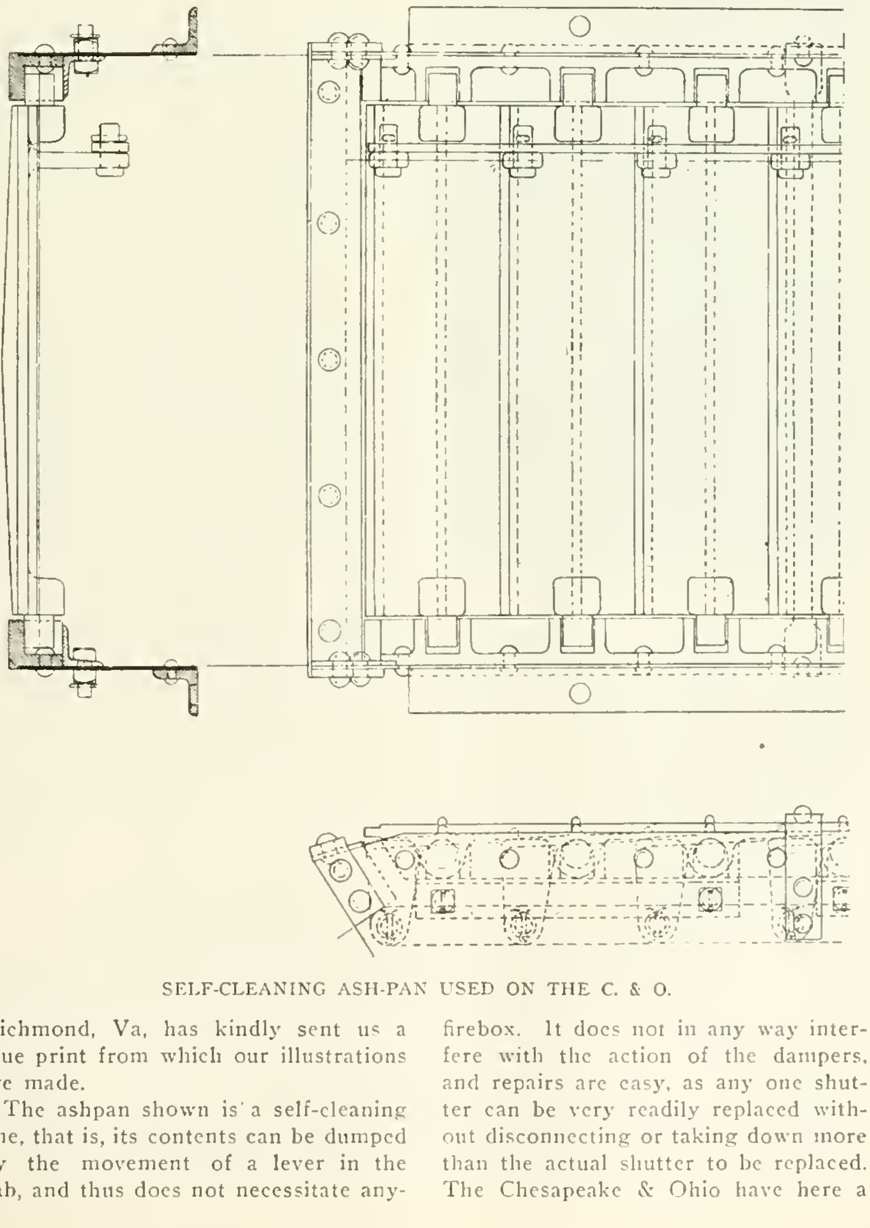
Fifty years ago, Mr. William Mahl, comptroller of the Southern Pacific Company, began work as an apprentice in a repair shop of a railroad at Bowling Green, Ky., long ago absorbed by the Louisville & Nashville Railroad Company. His pay was seventy-five cents a day. Overtime was paid one and a half rates after regular hours on week days, and double on Sundays. The ambition and industry of William Mahl may be judged from the fact that notwithstanding the small regular pay, he never drew less than forty-five dollars a month. Mr. Mahl is a fine example of what intelligence and industry can do to elevate one from a lowly to a high position in railroad life. He possessed an artistic taste and was fond of drawing. There were few draftsmen in those days attached to division shops, and Mr. Mahl used to make drawings of parts that were required from headquarters at Louisville. This brought the young man under the notice of the officials and led to rapid advancement. His skill as a draftsman and clear-headed ability in explaining mechanical problems first commended Mr. Mahl to the attention of the late C. P. Huntington, who raised him to a high confidential position.

C. & O. Self-Cleaning Ashpan.

In response to our invitation to send drawings of any ashpan which conforms to the ashpan law that goes into effect next January, Mr. J. F. Walsh, superintendent of motive power of the Chesapeake & Ohio Railroad at Richmond, Va, has kindly sent us a blue print from which our illustrations are made.

The ashpan shown is a self-cleaning one, that is, its contents can be dumped by the movement of a lever in the cab, and thus does not necessitate any-one going under the engine to clean it. It is particularly suitable to engines which are equipped with the old flat-bottomed ashpan like the standard 4-4-0 engines. It can in a modified form be applied to other types of engines.

Mr. Walsh writes us that this form of ashpan is not patented, and that he himself ran an engine with a similar ashpan more than twenty years ago. The ashpan consists of twelve horizontal shutters, each of which has a lug on the underside to which an operating rod is attached. This rod is moved by a lever in the cab. When shut, the ashpan has a tightly closed bottom, but when open each shutter is tilted so that the contents of the pan drop out. It opens and shuts something like a Venetian blind, and there is no place where ashes or cinders can lodge. When open the bottom of the pan is literally gone and only the edges of the shutter are turned up toward the firebox. It does not in any way interfere with the action of the dampers, and repairs are easy, as any one shutter can be very readily replaced without disconnecting or taking down more than the actual shutter to be replaced. The Chesapeake & Ohio have here a

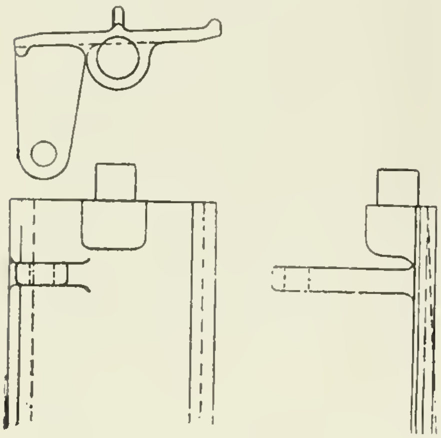


SELF-CLEANING ASH-PAN USED ON THE C. & O.

very satisfactory self-cleaning ashpan, and we are informed that they have already equipped a large number of their engines with it.

Railway Fuel Association.

The International Railway Fuel Association will meet in Chicago on June 21, 22 and 23, 1909. The headquarters of the association are to be in the



DETAIL OF SHUTTER, C. & O. ASH-PAN.

Auditorium Hotel. The subjects on which papers will be read are as follows: (1) Proper method of purchasing fuel with regard to operating and traffic conditions, considering also the permanent interests of the producer when located on the consumers' rails. (2) Standard type or types of coaling stations. Best design and most economical coal chute for handling coal from cars to locomotives. (3) Best method of accounting for railway fuel, including movement from mine through coaling station to engines, up to monthly balance sheet. (4) Difference in mine and destination weights. Legitimate shrinkage allowable on car-lots. Correct weighing of coal at mines and on railroad track scales. Importance of tare weights being correct. (5) Difficulties encountered in producing clean coal for locomotive use. (6) Briquetted coal as a railway fuel. By C. T. Malcolmson, briquetting engineer, Roberts & Schaefer Co. On the second day of the meeting, June 22, the Association will be guests of the United States Steel Company at Gary, Ind., making the round trip from Chicago by water on specially chartered new steel steamship. Opportunity for a business meeting will be afforded en route and refreshments and music will be provided.

Steam Heat Hose Coupling.

The Gold Car Heating and Lighting Company have recently put upon the market a very cleverly devised steam coupler. It is called Gold's universal straight-port, two-piece steam coupler, with interchangeable gaskets and nipples. The coupler is made with the idea of using different sizes of hose, and this is arranged for by the fact that the body of coupler will take three different sizes of nipples, viz.: one for 1¼-in. inside diameter hose, one for 1⅜ in., and one for 1⅝-in. hose. These three sizes of nipples all have the same diameter and thread where they screw into the body of the coupler. Any one is easily removed and another applied.

Gaskets are used which, having the same external diameter, are pierced by holes corresponding to the sizes of the nipples. In this way the three sizes of gaskets are interchangeable and any desired size can easily be used. In fact, it is possible to unite a coupler using one size of nipple and gasket to a coupler using another size of nipple and gasket. Or it is possible to maintain a given size of apperture in the couplings all through the train without the substitution of new couplings. It is also designed to couple with Gold's No. 105 and No. 400 couplers and with the medium size couplers of other makes. It is fitted with Gold's latest improved gravity relief trap, and may be used with or without Gold's lever lock. The coupler arrangement, as made in the design before us, has been very cleverly worked out, and is fully protected by patents. The company will be happy to send an illustrated and descriptive folder to anyone interested enough to apply to them for one. Their office is at 17 Battery Place, New York.

Accident Bulletin No. 30.

The number of persons killed in train accidents during the months of October, November and December, 1908, as shown by the Inter-State Commerce Commission was 184 and injured 2,924. The number of accidents of other kinds, including those accidents to employes while at work and to passengers in getting on or off cars, etc., was 798 killed and 16,846 injured. This shows a decrease of 2,814 in the total number as compared with the figures reported for the same period in the previous year.

The total number of collisions and derailments for this quarter were 1,375 collisions and 1,311 derailments, of which 206 collisions and 130 derailments affected passenger trains. This is a decrease of 721 collisions and 559 derailments for the same period the year before. The damage to cars, engines and roadways by these accidents amounted to $1,940,133.

For many kinds of work where planers have in the past been used, the milling machine has proved itself more efficient, as there is no class of machine tool of corresponding size and weight capable of removing metal as rapidly as the milling machine. A very handsome and beautifully illustrated catalogue of heavy milling machines has recently been received from the Niles-Bement-Pond Company, of New

York. So great is the variety of sizes and combinations of horizontal milling machines that complete illustration of each one would be impossible in the limits of an ordinary catalogue. In this book the aim of the makers is to present the more regular types and sizes made for the trade. These machines are built for different kinds of work, in some cases having but the single slabbing spindle or are combined with vertical or horizontal facing spindles for operations of a special character. For locomotive connecting rod, or side-rod milling, the heavier types of these machines have been designed and are very efficient. They are also extensively used for other kinds of heavy steel work. Since the use of milling cutters of low carbon bodies with inserted high speed blades as supplied by this company, there is not the same maintenance cost involved in keeping cutters in good condition or attendant loss by breaking as with solid cutters. Write to the company for a copy of the catalogue. It is well worth careful study.

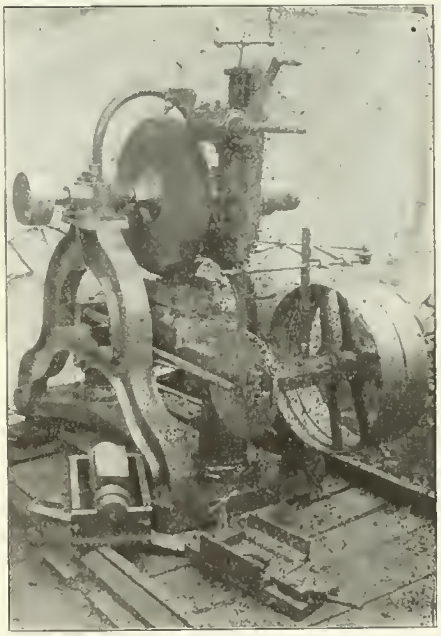
A great deal of interest is being taken by railroad companies in the perfected Pintsch mantle lamp using the large inverted mantle. The Safety Car Heating and Lighting Company, of New York, inform us that this car light gives 100 candle power per lamp with a consumption of about 2 cu. ft. of gas, costing 1c. per hour. while it furnishes a beautiful white light. The Delaware, Lackawanna & Western have recently remodeled their entire flat-flame lamp equipment, the Philadelphia & Reading are now engaged in the same work and over 600 cars on the Pennsylvania have been changed in the same manner. This lamp has, indeed, an extraordinary illuminating capacity and its economy in gas consumption and cost of operation commends it to the careful consideration of railways which are endeavoring to solve the problem of car lighting with the greatest satisfaction to their patrons and with the minimum of expense to themselves. A copy of the catalogue recently issued by the company is well worth careful study. Copies can be had on application to the company, whose New York office is at No. 2 Rector street.

C., M. & P. S. Finished.

A recent press dispatch from the West says: "The last rail to connect Chicago with Seattle and Tacoma, on the Chicago, Milwaukee & Puget Sound Railway, was laid May 10 just east of Hellgate station, about 100 miles east of Butte. No ceremony marked the practical completion of the coast extension of the St. Paul system. With the laying of the last rail it is expected that the road will shortly inaugurate a transcontinental freight service, soon to be followed by the operation of through passenger trains.

Car Brass Grinder.

Our illustrations show a very useful tool in railway repair shop work called the car brass grinder. It is made by The Tanite Company of Stroudsburg, Pa. The absence of the word abrasive from the 1874 edition of Webster indicates the newness of that general industry in which The Tanite Company was a pioneer. The Tanite people believe in the dry use of solid emery wheels, with high speed, light touch and soft wheels. The claims made



TANITE CAR BRASS GRINDER.

by the makers for Tanite Wheels is safety and high productive capacity. In the machine shown in our engraving the brass is held in a chuck, which is shown in position. A separate view of the chuck is also given. The brass is clamped between the jaws of the chuck by a cam motion actuated by a handle. The chuck fits into planed guides and thus travels exactly square with the motion of the wheel. The table is moved horizontally by the crank and connecting rod, and also rises and falls on planed ways, being pressed up by springs. The hand wheel gives vertical adjustment to the bed by means of a chain beneath the base of the machine. There is a pulley by which a suction fan, to remove dust, etc., may be driven. The machine is said to be able to finish from 150 to 600 car brasses a day. Write to the Tanite Company and ask for a descriptive circular of this very useful machine.

Three Savers.

A very artistic folder issued by the Cleveland Twist Drill Company of Cleveland, Ohio, has recently come to this office. It is headed, "Three Tools That Save," and the trio referred to are the Peerless high-speed reamers, the Perfect double tang sockets, and the Paradox adjustable reamers.

The soft steel Peerless body is tougher than high speed steel; it is tougher than the stock of carbon steel tools. Any one who constantly uses reamers knows what this quality means in prolonging the life of a tool after the cutting edges begin to wear down. The soft core lends itself readily to this. All Perless styles can be furnished as expanding reamers.

The Perfect double tang socket has no plugs to lose; no set of parts to get out of order. It is made in one piece and is compact and strong. It requires no new standard of shank. If the ordinary shank, whether the new or with old tang be broken off it can be quickly got ready for service by grinding a second tang on the old shank. The double tang gives a stronger hold than the single tang, either large or small.

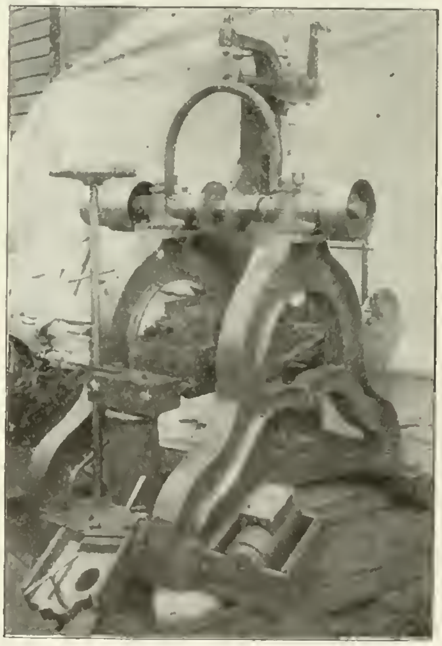
The Paradox Reamers have blades which are changed evenly their whole length, and so remain parallel, insuring straight, true holes. The use of tin foil in adjusting gives very accurate results. The blades fit firmly in their grooves and are held secure by special taper-headed screws. The cutting ends are flush with the end of the reamer body. They will cut to the bottom of a blind hole. Write to the company for catalogues of these three most useful tools.

We have received from the American Specialty Company of Chicago their new catalogue, "Drills and Sockets That Are Different." It is true that the reader when going over this booklet will see that the drills and sockets described therein are radically different from those in common use for the last few years. For example, the "Use-'Em-Up" drill socket has come into popularity as quickly as any tool of a like nature which was ever placed on the market. The flat twisted high speed drill has a great many advantages, but heretofore has had the disadvantage of requiring a special chuck to drive it. As supplied by this company, it is fitted with a common standard Morse taper shank and therefore does not require any special chucks to drive it accurately. To cap the climax, as it were, the American Specialty Company flats the shank of this drill to fit the "Use-'Em-Up" drill socket, and have thereby done away with the trouble from twisted tangs or broken shanks, and they still retain the advantages of the taper shank drive. The booklet is illustrated in a clear and striking manner, and the letter-press puts the matter in shape to be easily studied. One does not have to grope round in the dark to see the advantages presented; they are placed so that "he who runs may read." Write to the company; even send them a post card and ask for the booklet and you will get some good ideas on drills and sockets.

The Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio, announce that they have just established an agency in Canada for the sale of their product in the territory west of Lake Superior. Their Western representatives are the Brydges Engineering and Supply Company, 249 Notre Dame avenue, Winnipeg, Can., and with Messrs. Mussens, Limited, 299 St. James street, Montreal, Can., for the sale of staybolt iron in the territory east of Lake Superior.

The Falls Hollow Staybolt Company have also appointed Messrs. H. J. Skelton & Company, Royal London House, Finsbury Square, London, E. C., England, as their sole representatives for the British Isles and India.

A very neat little booklet of pocket size has come to us from the Detroit Seamless Steel Tubes Company of Detroit, Mich. It will be sent on application to any address, and is well worthy of perusal. It



GRINDING MACHINE WITH WHEEL REMOVED.

deals with the "Detroit" seamless hollow staybolt. These staybolts are made from basic open-hearth steel, and are formed by the seamless process the bolts being rolled over various mandrels, the object being to compress the metal both inside and outside, and so give a dense and close grained structure to the metal.

What might be called a pocket edition general catalogue has just been brought out by the Joseph Dixon Crucible Company of Jersey City, N. J. It lists their principal products, such as crucibles, facings, lubricating graphite, greases, pencils, protective paint, etc., giving brief descriptions and prices. It is of value to the purchasing agent, engineer, contractor, superintendent, and, indeed, anyone who uses or specifies graphite in any form. The booklet is of commercial envelope size, and will conveniently go in the pocket or desk pigeonhole. It is substantially bound in tough cover stock, and attractively printed. If you want a copy address the Dixon Company at their home office and at the same time you might mention this publication. A post card sent them will bring a response.

Portable Wheel Press.

The 60-ton portable hydraulic wheel press manufactured by the Walter A. Zelnicker Supply Co., St. Louis, and which has been on the market for nine years, has been further improved lately by lengthening and squaring the arms and by placing the pump on top of a reservoir which is located on top of the cylinder instead of having it draw the liquid from a separate vessel beneath the pump. The press will work satisfactorily on either street car or steam car wheels; it will also handle small locomotive driving wheels where the bars can be placed between the spokes of the wheels. The press, being on wheels, can be easily moved from place to place. It is a very efficient tool for small railroad shops. The press is extremely simple in its construction and operation. Full explanatory circulars wil be furnished by the manufacturers, Walter A. Zelnicker Supply Co.

Locomotive Running Repairs.

One of the most useful little books on our list is "Locomotive Running Repairs," by L. C. Hitchcock. It is the production of a railroad shop foreman telling how to perform certain shop operations properly. The subjects treated are grinding in brass valves, cocks, etc., tramming rods, setting up wedges, springs, setting slide valves, flange wear, shoes and wedges, driving boxes, washing boilers, moving eccentrics, back cylinder head, guides, tire wear, etc. All this useful information can be had for 50 cents. The chapter on valve setting is well worth the price of the book.

Record of Recent Construction No. 66, issued by the Baldwin Locomotive Works, deals with the subjects of smoke-box superheaters and feed-water heaters. A number of illustrations are given of both these devices and pictures of the locomotives to which they are applied. The letter press in connection with the superheaters is supplied by Mr. John W. Converse and that on the feed-water heaters by Mr. Lawford H. Fry. Both these gentlemen are connected with the Baldwin Locomotive Works.

Circular 1,502, issued by the Westinghouse Electric & Manufacturing Company, contains much valuable information on alternating current distribution covering transformers, lightning arresters, insulators, cross arms, etc. Considerable space is devoted to underground and overhead construction applicable to congested and scattered districts. There is also some useful information on potential regulating systems. The circular contains 52 pages, and the contents are of value to any central station man or other person connected in any way with the distribution of power by alternating current lines.

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Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXII. 114 Liberty Street, New York, July, 1909 No. 7

Grade Reduction on the Big Hill.

On the western end of the Canadian Pacific Railway, that part of the line which passes down the Pacific slope of the Rocky Mountains, is called by the railway employees the "Big Hill." This part of the road lies between Hector and Field, B. C., and traverses the valley of the Kicking Horse River, passing the majestic towering masses of stone known as Mount Stephen and Cathedral Mountain. Since we published some details of the work of grade reduction in our February, 1909, issue, we have been able to obtain photographs taken along the new line, through the courtesy of Mr. James A. Macdonell, of the contracting firm of Macdonnell, Gzowski & Co., of Vancouver, B. C., who are doing the work.

The railway line between Hector and Field is 4.1 miles long and the grade is 4½ per cent. for a distance of 3 1-5 miles. The grade reduction is effected by doubling the length of the road and making the grade a little less than half as steep. The new line is therefore 8.2 miles long and the new grade becomes 2.2 per cent. A train of cars moving east over the old line experienced a vertical rise of 4½ ft. in the distance of 100 ft. On the new alignment the same train will practically have a similar vertical rise after passing over 200 ft.

GRADE REDUCTION IN THE ROCKIES. PORTALS OF SPIRAL TUNNEL IN MOUNT STEPHEN, C. P. R.

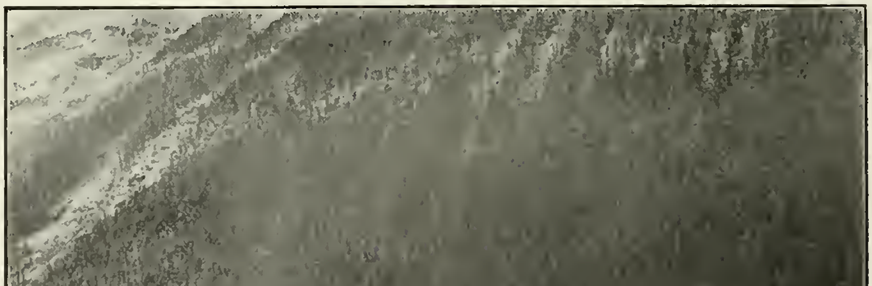
The old location of track crossed the Kicking Horse valley once, while the new road crosses the river three times on magnificent steel bridges. The feature of greatest interest on the new line is two loops in the track which makes a train reverse its actual direction of motion twice in the ascent or descent. A train leaving Hector for the west crosses the river and proceeds along the left bank. It continues what may be called its westerly course for about 3½ miles, when it

LOOKING UP THE YOHO VALLEY NEAR FIELD, B. C., ON THE C. P. R.

passes round a loop having a radius of 573 ft. This loop is 3,200 ft. long, and has a vertical fall of 48 ft. This loop is a spiral tunnel driven through solid rock, and in our frontispiece picture both portals are visible. The one on the higher level is, if we may so say, the eastern entrance, though as a matter of fact it is geographically west of the western or lower mouth of the spiral.

From this point the westbound train, descending the grade, moves in a generally northerly direction for about two miles. It again crosses the river and travels along the right bank. A curve in the line takes the train in the direction of the flow of the river, and it enters the second spiral tunnel after traveling 2,890 ft through solid rock, in which it makes a descent of 45 ft.; it comes out close to the river and at right angles to the flow of water, crosses the canyon for the third time on a steel bridge, and again continues its course in a generally westerly direction toward Field. The actual grade in the spiral tunnels is not as steep as the rest of the new alignment. The tunnel grades are only about 1.6 per cent.

The work of building the new line has been carried out with vigor. The tunnel, shown in our frontispiece, which pierces into Mount Stephen over 1,000 ft., was broken through on May 3, and the other tunnel on May 6. Trains are now in operation over the new alignment. The whole of this costly piece of grade reduction on the C. P. R. is in charge of Mr. J. E. Switzer, assistant chief engineer of the road at Winnipeg, Man., and Mr. John Callaghan, divisional engineer. The men actually on the ground are Mr. H. N. Merriam, assistant engineer, and Mr. J. W. Shepperd, resident engineer. The cost of the work is about one and a quarter millions. Great credit is due to the management of the Canadian Pacific, the engineers and the contractors, for the splendid piece of engineering work which they have put through. It will lessen the cost of train operation and add to the safety of a portion of the line upon which, with the 4½ per cent. grade, climbing down the canyon almost like a stairway, there has never been an accident, and on which not a single life has been lost.



PORTAL OF SPIRAL TUNNEL NEAR THE KICKING HORSE RIVER.

Railway Operating in China.

There has always been annoying interference by the nations to the people operating Chinese railways and protests to the government brings no perceptible relief or protection. Of late complaints have been rife as to the failure of the authorities to afford proper protection to passengers on the Shanghai-Nanking line. It appears that when some irresponsible Chinaman meets with an accident through trespassing on the line, or not exercising proper caution at a level crossing, it is customary for his fellow-villagers to stop the next train, bombard it with stones, and extort compensation from the unlucky travelers, who are fortunate if they reach their journey's end with their heads unbroken. Such attempts at repression as have been made have proved entirely inadequate, and these outrages are said to be of frequent occurrence. Near Chinkiang recently a mob hurled through the windows of a train heavy jagged pieces of granite, any one of which might have caused serious injury to passengers. The wily Celestial who worships his ancestors is not above making a pecuniary profit out of his dead, and it is stated that in more than one case a corpse has been placed upon the railway line so that it might be run over and compensation claimed from the railway authorities for the alleged fatality.

Smith—"Do you think that traveling on the Continent is pleasanter than travelling at home?" Brown—"I should think it is. I travelled thousands of miles on the Continent without meeting a single man I was owing money to."

Recent C. & A. Equipment.

The Chicago & Alton Railroad have recently received 10 heavy consolidation freight locomotives and 5 large Pacific type locomotives, which were built at the Brooks Works of the American Locomotive Company. One feature of interest, common to both classes of engines, is the Baker-Pilliod Valve Gear. This type of gear, which is one of the latest developments in locomotive valve gears, has been applied on several roads during the past year with very satisfactory results. A detailed description of this gear was given in the February, 1909, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 85.

On the Chicago & Alton it was tried on a Pacific type locomotive, with the result that it was specified for the engines under consideration. Like the Walschaerts valve gear it gives a constant lead, the motion of the valve being derived from a return crank opposed at right angles to the crank pin and from the motion of the crosshead. In this gear, however, there are no links and sliding blocks as in the Walschaerts, but it consists of a system of levers, cranks and rods, having pin connections and bearings. Reversing, the engine requires no change in the reciprocating parts, but is effected by merely changing the angle of the reverse yoke from which the radius bar is suspended.

As will be seen from our illustrations the method of application is the same in both classes of engines. All the motion parts proper are carried in a cast steel cradle supported at the front end by the guide yoke and at the back end by a special crosstie extending over the frames, which in the case of the Pacific type engine is between the first and main driving wheels and in the Consolidation type it is just back of the intermediate driving wheels.

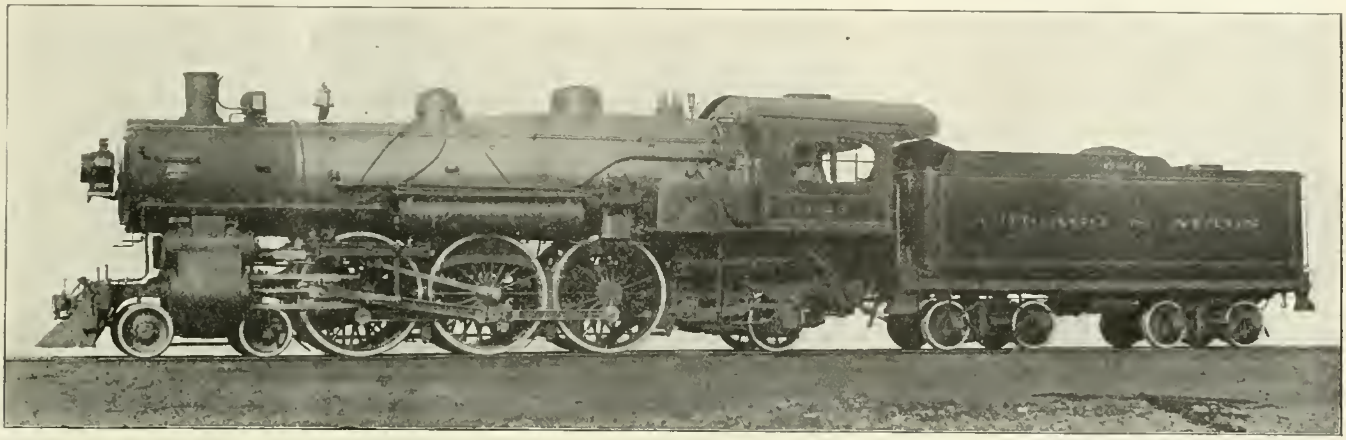
In working order the Consolidation engines have a total weight of 228,000 lbs., of which 203,500 lbs., or 89.2 per cent., is carried on the driving wheels. The cylinders are 22 x 30 ins., which with driving wheels 62 ins. in diameter and a boiler pressure of 200 lbs., gives a maximum tractive power of 39,800 lbs. Steam is distributed to the cylinders by means of 14-in. piston valves having a maximum travel of 5½ ins. The valves have inside admission and are designed with 1-in. steam lap and no exhaust clearance and are set for ¼-in. lead, which with the Baker-Pilliod valve gear, is constant.

The frames, which are of wrought iron, with single front rail forged integral with the main frame, are 5 ins. wide. The valve gear being outside of the frames, ample opportunity is given for rigid frame bracing. In addition to the foot plate at the rear and the filling casting ahead of the cylinders, which extends back underneath the cylinders to their center, there is a heavy crosstie just back of the front pedestal and one between the intermediate and main driving wheels, all being of cast steel.

The boiler is of the straight top radial stayed type and is 80 ins. in diameter outside at the front ring. It contains 381 tubes 2 ins. in diameter, and each 16 ft. long. This provides a total heating surface of 3,372 sq. ft., of which the tubes contribute 3,175 sq. ft. and the firebox the remainder.

The firebox is narrow, with sloping back head and straight throat sheet. It is 120⅛ ins. long and 40¼ ins. wide and has a grate area of 33.6 sq. ft. With the large boiler and narrow firebox, the ratio between grate area and heating surface is much greater than usual in this class of engine, there being only 1 sq. ft. of grate area for every 103 sq. ft. of heating surface. There is a liberal use of flexible staybolts in the sides, back and throat sheet of the firebox, 575 in all being used. The water spaces are 4 ins. wide at the mud ring on the front and sides, increasing in width at the crown sheet, and 4½ ins. wide at the throat sheet. The dimensions, weights and principal ratios of this Consolidation engine are given below.

The Pacific type locomotives are among the heaviest and most powerful of this class of power built by the American Locomotive Company, the only ones exceeding them in weight being those built for the New York Central lines and the one for the Pennsylvania Railroad. In working order these C. & A. engines have a total weight of 248,000 lbs., of which 149,500 lbs. is carried on the driving wheels. The cylinders are 23x28 ins. so that with a boiler pressure of 200 lbs. and driving wheels of 80 ins. in diameter, the engines can develop a maximum tractive power of 31,475 lbs. The piston valves are 14 ins. in diameter and have a maximum travel of 5 ins. They have inside admission and are designed with 1 in. steam lap and no exhaust lap or clearance and are set with ¼-in. lead. The frames, which are of wrought iron, consist of a main frame with single front rail integral with it and a slab form of trailing frame spliced to the main frame just back of the rear pedestal. The main frame is 5 ins. wide while the slab frame is 2¼ ins. wide.



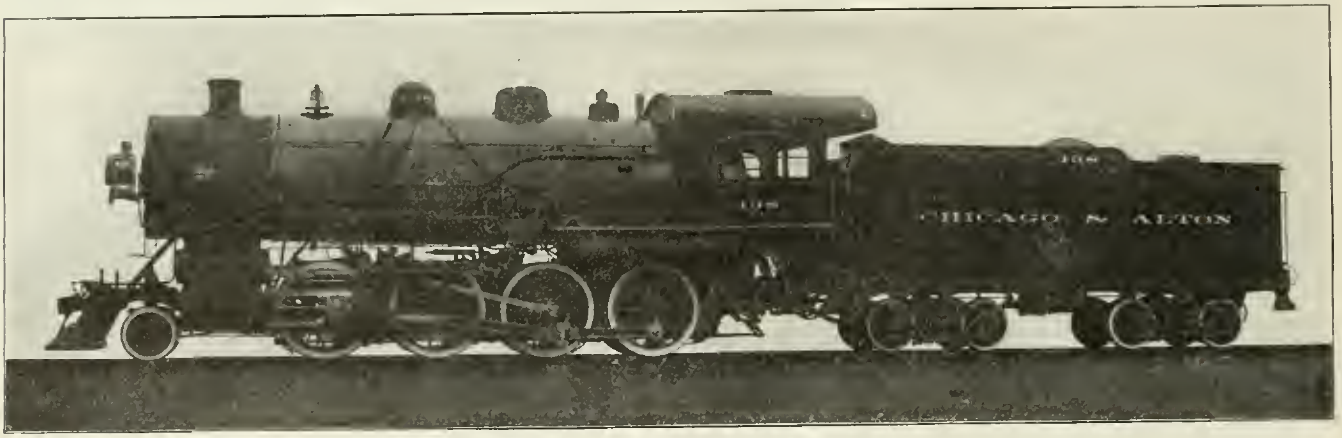
CHICAGO & ALTON 4-6-2 TYPE FOR FAST PASSENGER SERVICE.

Peter Maher, Superintendent Motive Power and Equipment. American Locomotive Company, Builders.

One of the most interesting features of the design is the trailing truck, which is the builder's latest arrangement of outside bearing radial trailing truck. As will be seen from our illustration, this arrangement eliminates the use of the supplementary frames and heavy spreader castings required in former designs, thereby effecting a considerable reduction in weight. The truck frame is of wrought iron and has a pivot connection at the forward end to a cast steel crosstie between the frames underneath the front end of the firebox, which in this case also furnishes support for the firebox. The load is transmitted to the journal box in the usual manner by means of a semi-elliptic spring, connected at one end to an equalizing beam between it and the rear driving spring, and at the other end to a cast steel bracket secured to the frame. The spring rests on a spring seat, having a flat sliding bearing on top of the box. This spring seat is carried on trunnions in a yoke-shaped steel casting of I-section, which is hinged at either end to brackets secured to the frame. This construction permits the spring seat to adjust itself to the alignment of the box as the latter rises and falls relatively to the frame.

A spring centering device, the same as that used in former designs, is provided to bring the truck back to its normal central position when the locomotive passes on to a tangent after a curve. This consists of a spring housing bolted to the foot plate in the center of the engine, fitted with transverse coil springs, having followers and fitted with horizontal thrust rods which have a ball and socket connection with the truck frame and also with the spring followers.

The boiler is of the extended wagon top type with wide firebox. The wide firebox is worthy of notice inasmuch as most recent practice on this road has been in favor of the narrow firebox for all classes of engines, and the last engines of this same type were equipped with that form. The boiler has an outside diameter at the first ring of 72 ins. It is equipped with 371 2-in. tubes, 20 ft. long. The total heating surface is 4,071 sq. ft., of which the tubes contribute 3,869 sq. ft. The firebox is 108 ins. long and 66 ins. wide and provides a grate area of 49.5 sq. ft. The ratio of heating surface to grate area is thus 82, whereas in the engines of this type with similar design of boiler, but with narrow firebox previously built, the ratio was as high as 119. As in the Consolidation engines, a large number of flexible staybolts are used, there being 376 in the sides, and 115 in the back-head, while all the throat stays are of the flexible type. The crown and side sheets of the firebox are in one piece, as are also the outside side sheets and roof. Other principal dimensions and ratios of these two designs are given below.



HEAVY FREIGHT 2-8-0 FOR THE CHICAGO & ALTON.

Peter Maher, Superintendent Motive Power and Equipment. American Locomotive Company, Builders.

RATIOS AND DIMENSIONS OF 2-8-0 ENGINES.

Weight on drivers ÷ tractive effort... = 5.11
Total weight ÷ tractive effort........ = 5.72
Tractive effort x diameter drivers ÷ heating surface .... = 731.00
Total heating surface ÷ grate area.... = 100.30
Firebox heating surface ÷ total heating surface, per cent............ = 5.84
Weight on drivers ÷ total heating surface .... = 60.30
Volume both cylinders, cubic feet..... = 13.20
Total heating surface ÷ volume cylinders .... = 255.00
Grate area ÷ volume cylinders........ = 2.55
Cylinders—Simple; diameter, 22 ins.; stroke, 30 ins.
Wheel Base—driving, 17 ft. 9½ ins.; total, 26 ft. 9½ ins.; total, engine and tender, 64 ft. 1 11/16 ins.
Weight—In working order, 228,000 lbs.; on drivers, 203,500 lbs.; engine and tender, 393,100 lbs.
Heating Surface—Tubes, 3,175 sq. ft.; firebox, 197 sq. ft; total, 3,372 sq. ft.
Grate Area, 33.6 sq. ft.
Axles—Driving journals, main, 10½ ins. x 12 ins.; others, 9½ ins. x 12 ins.; engine truck journals, diameter, 6½ ins.; length, 12¼ ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.
Boiler—Working pressure, 200 lbs. fuel, bituminous coal.
Firebox—Type, narrow; length, 120⅛ ins.; widtb, 40¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4½ ins.; sides, 4 ins.; back, 4 ins.
Crown Staying—Radial.
Boxes—Driving, cast steel.
Brake—Driver, New York; pump, No. 5,duplex.
Engine Truck—2-wheel swiveling.
Piston rod diameter, 4 3/16 ins.; piston packing, cast iron rings.
Smokestack—Diameter, 18½ ins.; top above rail, 15 ft. ½ in.
Tender Frame, 13-in. steel channels.
Tank—Style, rectangular; capacity, 8,500 gals.; fuel, 14 tons.
Wheels—Driving diameter outside tire, 62 ins.; material, cast steel; engine truck, diameter, 33 ins.; kind, standard steel car; tender truck, diameter, 36 ins.; kind, standard steel car.

RATIOS AND DIMENSIONS OF 4-6-2 ENGINES.

Weight on drivers ÷ tractive effort.. = 4.75
Total weight ÷ tractive effort........ = 7.87
Tractive effort x diameter drivers ÷ heating surface .... = 618.00
Total heating surface ÷ grate area.... = 82.00
Firebox heating surface ÷ total heating surface, per cent............ = 4.96
Total weight ÷ total heating surface.. = 60.90
Weight on drivers ÷ total heating surface .... = 36.70
Volume both cylinders, cubic feet..... = 13.28
Total heating surface ÷ volume cylinders .... = 306.50
Grate area ÷ volume cylinders........ = 3.72
Wheel Base—Driving, 13 ft. 9 ins.; total, 34 ft. 8½ ins.; total, engine and tender, 66 ft. 4 ins.
Weight—In working order, 248,000 lbs.; on drivers, 149,500 lbs.; engine and tender, 413,120 lbs.
Heating Surface—Tubes, 3,869 sq. ft.; firebox, 202 sq. ft.; total, 4,071 sq. ft.
Grate—Area, 49.5 sq. ft.
Axles—Driving journals, main, 10½ ins. x 12 ins.; others, 9 ins. x 12 ins.; engine truck journals, diameter, 6½ ins.; length, 12¼ ins.; trailing, truck journals, diameter, 8 ins.; length, 14 ins.; tender, truck journals, diameter, 5½ ins.; length, 10 ins.
Boiler—Type, extended wagon top.; O. D. first ring, 72; working pressure, 200 lbs.; fuel, soft coal.
Firebox—Type, wide; length, 108 ins.; width, 66 ins.; thickness of crown, tube, ½ in.; sides, ⅜ ins.; back, ⅜ ins. water space, front, 5 ins.; sides, 5 ins.; back, 5 ins.
Crown Staying—Radial.
Boxes—Driving, cast steel.
Brake—Driver, N. Y. high speed; pump, No. 5, duplex; 2 reservoirs, 120 x 20¼.
Engine Truck—4-wheel swiveling.
Trailing Truck—With outside journals.
Piston rod diameter, 4 3/16 ins.; piston packing, cast iron rings.
Smokestack—Diameter, 18½ ins.; top above rail, 15 ft. ½ in.
Tender—Frame, 13-in channels.
Tank, Style, rectangualr water bottom; capacity, 8,500 gals.; fuel, 14 tons.
Wheels—Driving diameter outside tire, 80 ins.; material, cast steel; engine truck, diameter. 33 ins.; kind, standard steel car; trailing, 42 ins.; tender, 36 ins.; kind, standard steel car.

A New Mechanical Principle.

Nickola Tesla, who has invented numerous electrical appliances, has announced that he has discovered a new mechanical principle of great economic value. In connection with this discovery, a company has been formed with a capital of one million dollars. Mr. Joseph Hoadley, of New York, is one of the directors.

Neither the discoverer nor the directors of the company are prepared to explain the new mechanical principle, but Mr. Tesla says that it is appliable to air, steam, gas or water power, and may be used for locomotives, automobiles or any form of power production. With it a locomotive, as powerful as any now used, would need to be less than half the size.

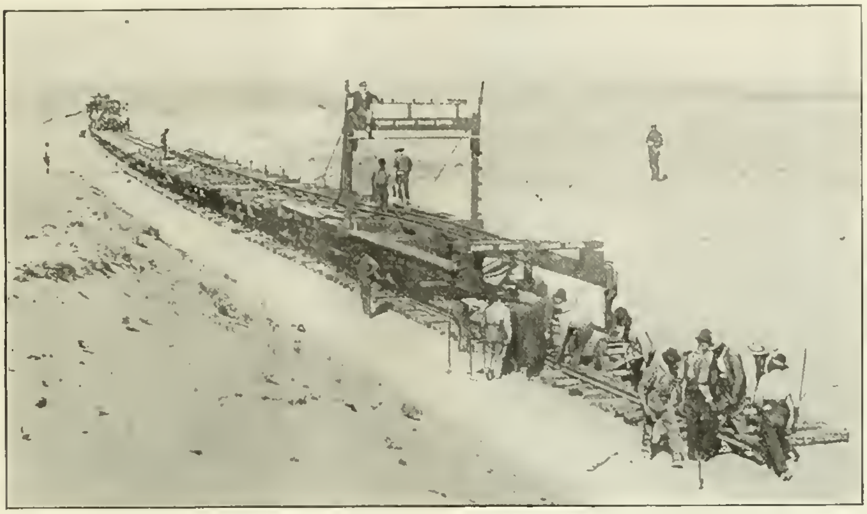
Mr. Tesla stated that machines of several types had been built and that successful demonstrations had been given with them to his associates in the new company.

The inventor of new and useful appliances is too common nowadays to excite comment, but the discovery of a new mechanical principle is something that makes us wait for particulars with painful expectancy.

Tracklaying Apparatus.

By J. F. Springer.

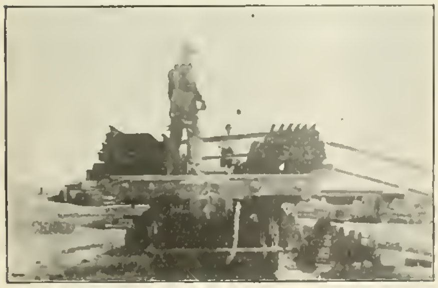
The laying of the track for railways has come, in the United States, to be a problem of such magnitude that every economy of time and money is eagerly sought out. It frequently happens that track is to be laid at points almost inaccessible to teams hauling ties. Under almost any conditions such teams are expensive. The expense is not merely due to cost of actual operation, but to the inevitable idleness and delay occasioned. The use of tie teams is objectionable on account of the injury to the roadbed. In respect to the rails, it can scarcely be doubted that the ordinary methods are unequal to delivery of them where and when wanted, at a sufficiently low figure.



TRACKLAYING MACHINE IN OPERATION.

At any rate, tracklaying apparatus has, during recent years, been coming into favor with the railroads. There are now five or six styles of apparatus in use.

The fundamental idea underlying the design of tracklaying machines is that of getting ties and rails from the supply cars to the precise point where the new track is being laid, and to accomplish this economically and at the rate of delivery suited to the work.



POSITION OF RAILS ON FLAT CAR.

However perfectly or imperfectly others may have had this idea before them, there can be no question but that it has been very thoroughly appreciated by the practical men who have developed the Harris Tracklaying Machine.

The apparatus is installed, and the regular railroad foremen are instructed in operation in this device which is simple enough for the ordinary force to handle.

The supply train consists of ordinary flat cars. These are loaded with ties and rails, the cars containing the rails being forward. The locomotive is at the rear. At the front of the train is the pioneer car. From this car the rails and ties are delivered to the men working on the track. It will readily be understood that the problem is to get ties and rails to the front.

The rail cars have, each, laid upon them and secured in position transversely, five long timbers. These are placed about 7 ft. apart. At the center of each, for a distance of something over 2 ft., a portion is cut away. The purpose of this is to furnish a place for a train track, sunk below the general surface of the timbers. Such a track is constructed. Between the train rails at intervals are placed transverse rollers. In loading these cars, the rails are piled alongside the little track on either side. When it is desired to take rails to the front, they are slid or rolled onto the rollers. This is easy of accomplishment because of the sunken position of the track, it being unnecessary to lift the loose rails over the train rails. The rails to be transported, when once on the rollers, are readily pushed along.

The tie cars have laid upon them a number of ordinary 8-ft. ties. These are placed transversely in such manner that every other one projects over one side of the car, while the remainder project over the other side. A train track is laid, likewise, along the central portion. But these ties are not cut away to receive the track. Nor are rollers set in the space between the train rails. A foot board is laid alongside the track to right and left for the accommodation of the men operating the train car.

All the cars, both rail and tie cars, have thus a train track or tramway of 2-ft. gauge laid along their centers. The object of it is to furnish accommodation to train cars for the transport of ties along the length of the train. The track, as already described, however, is interrupted between cars. Flexibility in this connection is especially necessary on account of rounding curves with the train. The method adopted is to bolt angle-bars to each side of the rail-ends at the extremities of the car. The projecting parts of these plates form a kind of slot. Short lengths of rails are prepared by cutting away the flanges at each end. It is then possible to drop the ends of these short lengths into the slots. In this way the train track is made continuous throughout its entire length. At the same time, the pieces of rail are easily removed and again inserted, when required, and make a very flexible connection.

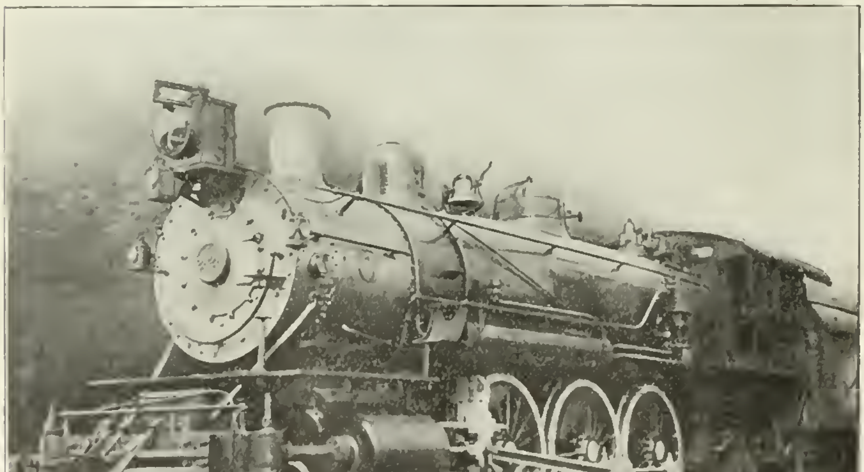
The tram-car which carries the ties is run along this track. The ties are loaded on the main cars crosswise. A special device is used at the point where loading onto the tram-car takes place. This is the tie loader. Upon it the ties to be loaded upon the tram-car have already been put into place, so that when the tram-car is brought beneath the loader, they are automatically dumped onto it. The tram-car thus begins its trip to the front, being loaded with enough ties for a portion of track corresponding to a single rail length, say thirty feet.

The car is pushed along by three or four men. Arrived at the forward end, the car runs out on what is termed the pioneer car. This has an extension arrangement whereby the track is continued for about 20 ft. beyond the car itself. This extension is sufficiently high to avoid interference with the men on the ground. There is a stop-block at the front end of the track. The impact of the tie-car against it accomplishes an automatic de-

CENTRAL TRACK AND ROLLERS ON TOP OF FLAT CARS.

livery of the ties upon the roadbed for about a rail-length ahead of the newly laid track. There are two frames to the tie-car. To one of these the wheels are secured. The other, which is in immediate contact with the load, is arranged on roller bearings, and is thus capable of a back and forth movement. While the ties are being transported from the rear, it is held in position by a latch. But just before the car strikes the stop-block, this latch is disengaged. Consequently, when the car itself is brought to a stop, the movable frame with its load of ties continues forward for an instant. The result of this is to overbalance the car at the forward end, resulting in a dumping of the ties onto the roadbed ahead. The ties, it should be observed, are loaded crosswise. When dumped they are scattered into approximately their final positions.

It will be noticed that a clear track is always maintained from the tie-supply to the front, although it passes over the cars carrying the rails. This is secured by the manner of loading the rails on each side of the track. Each rail-car carries from 80 to 120 lengths of rail. These rails are easily handled, practically no lifting being necessary, on account of the arrangement of the sunken track. When the rails arrive at the front they are separated with the assistance of a nose-piece into right and left rails. They pass finally over a double roller, one roller for the right, the other for the left, which is arranged at a lower level. The rails thus drop down an inch. A "dolly," that is, a portable frame upon which is arranged a roller, receives the rail as it is finally delivered to the men engaged in the actual laying of the track.



HEAVY 4-6-2 ENGINE ON THE C., B. & Q.

These men perform the double duty of placing the ties and laying the track in proper position. They do not spike the rails to the ties. This is done by a separate gang of men after the track laying train has passed. The rails are maintained temporarily in position by bridle-rods. These secure the two rails firmly at gauge, and are left in place until the final spiking is done. These bridle-rods are simply rods provided with a kind of hook at each end. The outer flange of each rail is held in position. The inner flanges are locked in place. This device is of great service from an economic point of view. For, with its use, it is not necessary to hold up the operation of the train until the final spiking is done. Of course, it would be possible to do but a part of the spiking and then allow the train to move on. But this device, by the simplicity and accuracy of its operation, permits the train to move ahead with scarcely any delay.

The tie-loader, which is used to economize time at the point where the supply of ties is loaded onto the tram-car, consists of a combination of a trestle and a small car about a foot high. The car is at one end and rests on the track. The trestles proper, at the other end, are fitted with runners which slide on the ties outside the train-track. Between the little car and the trestles the tie-loading device is supported. This consists of a framework supported by four steel links attached to it and the trestle-work. These links permit a raising and lowering of the framework. There are latches to hold it in place when elevated. When it is desired to give the tie-loader its complement of cross-ties preparatory to loading the tram-car, it is shoved car-end first up to the supply of ties. By means of an incline, these may readily be placed in position on the framework mentioned before. When all is ready, the tram-car is held by movable clamps, capable of being run in under the framework upon which the cross-ties are. There is an automatic arrangement which operates to displace the latches. The result is the framework falls with its load. But the framework falls a couple of inches further than the load of ties, which land upon the top of the tram-car. The latter is thus loaded for its return trip to the front. While it is gone, the tie-loader is being got ready with another load of ties. It should be noticed that at no stage are the ties turned about; they are crosswise on the supply car or cars, and remain crosswise to the end.

There are two methods of operating this machine. First, a single rail-length is the amount added to the track at each advance. For this mode of operation, but few men are required. The second method takes a step of two rail-lengths at a time; that is to say, 60 or 66 ft. at each advance. Four rails are thus necessary, two for each side of the track. The practice is to bolt these rails together into pairs, each pair consisting of two rails bolted together end to end. In this way two 60-ft. lengths are made ready before delivery to the men at the front. Of course, a greater force of men is required for this mode of operation. But greater speed is thus attainable. The fact that a small gang may operate the apparatus when laying single-lengths or a large force when laying double-lengths, is considered an advantage of the method.

An improved method of handling the rails after they have come to the pioneer car is also in use in connection with the ordinary apparatus. This is the Hicks mechanical rail layer. Two booms are arranged to project from the forward end of the pioneer car. One of these is about the length of a rail, the other about half a length. If the style of tracklaying being used at the time is the broken-joint method, then the full length of the long boom is used. Rail carriers operate along these booms. The rails are carried by these to about their final place, when they are let down. At the time the rails are gripped by the tongs suspended from the carrier they are in motion forward. The momentum causes them to swing ahead and get clear of the rollers upon which it is running. As the pendulum swings back, the rear end, being heavier, drops down, and the rail is heeled into position. If the track is being laid with even joints, but one-half the length of the long boom is used.

This tracklaying apparatus has been used on the Chicago, Rock Island & Pacific; the Pennsylvania; the Chicago, Burlington & Quincy, and numerous other roads. Three railroads have laid, on an average, 1,200 miles each with this machine. One machine has laid an average of 54 miles per month for a period of 5⅓ months. This would appear to be about 2 miles per day. However, one machine has made a record of more than 3 miles for a single day. A mile has been laid in less than 2 hours with one of the machines.

Ambition makes the same mistake concerning power that avarice makes concerning wealth. She begins by accumulating power as a means to happiness, and she finishes by continuing to accumulate it as an end.—*Colton.*

General Correspondence

Opinions on the Railway Signal Question

Seeing the Signal Arm at Night.

Editor:

Encouraged by the article and editorial in your May issue I send you the following on railroad signaling. Your invitation to contribute was principally to railroad men, and while I am not at the present time a railroad employee, I have yet spent many years in that capacity, I have been present at the scene of many wrecks and have been intimate with the train order and signal system of many roads.

Of all the discussions that I have heard and read in the last five years regarding the dangers attendant upon the use of colored lights in railroad signaling, and the fallibility of the men who have to in-

FIG. 3. CLEAR POSITION WITHOUT BACKGROUND.

terpret them, by far the most significant have been those in which a large number of locomotive enginemen have expressed their ability to distinguish the position of the semaphore arm at night regardless of the color indication. These remarks have led the writer to believe that except on very dark nights it is the practice among the majority of enginemen to try to discern the position of the blade of all signal lights while passing the semaphore. This is possible when there is a moon, when there is a gray sky, and when there is a bright and wide angle reflector in the head light. The presence of one or other of these conditions occurs in a large number of cases. Still there are

FIG. 1. STOP SIGNAL HARD TO DISCERN.

probably a larger number of cases when it is impossible for the engineman, even by the closest scrutiny, to detect the position of the semaphore blade.

The important point then appears to be the fact that the enginemen are so deeply impressed with the reliability of the system of indication by day and the fallibility of the system of indication by night, that at the expenditure of consid-

FIG. 2. STOP SIGNAL EASILY SEEN.

erable effort they endeavor to take the above-mentioned precaution. It would seem logical then to try to help these men in the way, that by their actions they indicate would be acceptable and helpful. This has been attempted and carried out in the following manner, and while everybody seems to be in a quandry as to the means of solving this great problem, it might be well to look into and examine what has actually been done to accomplish the very object for which they are working.

A semaphore of ordinary design, automatic or interlocked, is used. Behind this at an appropriate distance is placed a large white background in a vertical position. Upon the semaphore pole, a little below the blade, is fastened an oil lamp with a specially designed reflector.

FIG. 4. CLEAR POSITION WITH ILLUMINATED BACKGROUND.

The formation of this reflector is very interesting, but it will suffice to say that a very uniform illumination of the background is secured. One lantern only for each blade on the pole is used. Against this square patch of light, which can be confused with nothing else on the horizon, the outline of the semaphore and blade can be as distinctly seen as the ordinary semaphore on the brightest day. It would seem that the likelihood of overlooking this signal at night would be, if anything, more remote than the chance of overlooking the present semaphore as it appears in the day time. The light reflected from this white surface is so great that a man on a dark night, standing many feet away, can plainly see his watch by holding the face toward the signal. The background is so large and so bright as to attract the attention of an engineman even though he be in a very tired or absent-minded condition.

This system of signaling is known as the "World System." It is no new, untried or visionary scheme, proposed by a body appointed to investigate the sub-

FIG. 5, SIGNAL SET FOR STOP.

ject of signaling, who feel that they are called upon to make some sort of suggestion for improvement. It is actually on the market at the present time, offered to any railroad which will take the trouble to investigate it.

An installation of this principle of signaling on one road would correspond with an installation upon another as the present system of day signaling is so universal. The danger of an engineman who had become accustomed to the use of certain color indications on one road, becoming confused with the color indications when employed upon another, the danger of a colored glass becoming broken or displaced, the danger of an engineman becoming color blind between his yearly examination or when very tired, would be dangers no longer. The danger of steam, dirt or snow obscuring the signal would be very much reduced, and almost done away with. And the danger of an engineman sleeping past a signal, it seems to the writer, would also be reduced. All these advantages being realized, a great deal of discussion would be at an end, a good many committees would have to go into permanent adjournment and much confidence would be inspired. Accompanying are a few photographs of the "World Signal" on the Center & Clearfield R. R. The views show the same scene in one case without the signal backboard, and in the other with it.

J. H. Wisner, Jr.
Phillipsburgh, Pa.

In Favor of White and Against Yellow.

Editor:

Relative to block signal lights my experience running into Chicago and over many roads using different kind of lights, will, I believe, help me to give you the information you are after, from a locomotive engineer's as well as a road foreman's viewpoint; and let me say that in expressing my opinion here I am also expressing the opinion of many engineers.

The best lights to be used at an interlocking or a block signal are red for stop or danger, green and white for clear route have an equal number of friends. Many engineers favor white, while others favor green, personally I favor white. Yellow should never be used for this particular reason—if none other—it is a hard signal to distinguish between red and yellow, especially if the red lamp is not in perfect line and burning bright.

Of course, I can see where the man who favors yellow can hit me, and hit me hard, but let me explain the stand taken. You ran an engine and know the strain put on an engineer's eyes in a snow or rain storm, also in foggy weather. Now in these times where fast and high speed is required—time very sharp, trains heavy, very congested territory and traffic, we know an engineer cannot and must not be shutting engine throttle off or making an application of the brakes, being in doubt as to the position or color of signal ahead. It is a very easy matter for a person to ride on an engine and make tests or stand back on the ground a certain distance and watch the changing of the lights and say to himself, yellow is just as easy to distinguish as any other color, and the engineer who cannot distinguish between red and yellow easily, there must certainly be something the matter with his eyes: but I want to say such is not the case. The lights, red and yellow, are too near one shade in foggy or misty weather and will put an undue strain on the engineer's eyes, and naturlly make him register a kick, and a right one, too, from my point of view.

With explanation as made, I recommend for one arm or light on post: Red to stop, white for clear route. A block signal post same purpose as above, with two arms on it, one for caution should be white for clear, green for caution to warn engineers that train is in block ahead and that he will find absolute block ahead set to danger, or red.

For a two-arm post, controlling main and diverging track movements for main track or high-speed route, red and white. For diverging track route, red to stop and green for clear route.

Personally, I do not like the dwarf signal controlling the movement from main to side track, located near a home post, and usually stands about 7 feet high with a very short arm on it. This is very hard to locate correct position, and with our long freight trains, where the young engineer applies brakes to slow speed down to about 6 or 8 miles an hour, then discovers arm all right for him to proceed in on siding. Then releases brakes, in some cases, the slow speed of train and releasing brakes just at that moment will mean a break-in-two; while, on the other hand, the old veteran would come to a full stop rather than take any chances of breaking in two. The arm should be placed near, and just below the top arm or light on the high or home post.

W. H. Corbett,
Road Foreman of Engineers,
Jackson, Mich. M. C. R. R.

Red Should Be Absolute.

Editor:

On the subject of railroad signals I have asked for an expression of sentiment regarding signal systems from our engineers in passenger service, and all are unanimous in saying "red should be absolute," to which I also voice the same opinion. Yours truly,

J. F. Jennings,
Road Foreman Engineers,
Jackson, Mich. M. C. R. R.

Signals on the Alton.

Editor:

On the railroad signal question, let me say that on the road I am connected with, the Chicago & Alton, use the standard form of signals operated by the electric

FIG. 6, STOP POSITION, WITH BOARD BACKGROUND.

current which is generated by a system of batteries located near each signal and connected with each other by bond wire at rail joints. We have the semaphore blade, which is operated the same as the arm of a switch signal, horizontal, danger; vertical, clear. Red and green lights at night to indicate position.

We have these signals set in various

places along the line, especially on territory on which we have good many curves, that is to say, there are more in this kind of territory than where the track is straight. Between each right and left-hand signal, which are numbered east and west, the territory is called a block and at stations where there are side tracks, we have what is called a lap block and the position of the signals in the lap block indicate whether or not there is anything wrong with switches or if a train is standing in this territory.

In addition to the regular stop and preceed signal as indicated above, we also have the standard yellow signal operated the same as the electric block signal. These are only used in places where it is entirely safe to proceed under control.

While we consider this system of signals a very safe one, and as it is handled on our railroad, it has proved very good. Yet the rules covering the operation of the electric or any other system of signals play a very important part towards safety in operation. They must be rigid and strictly adhered to, in order to make the signal system perfect, and so long as the rules are not violated, covering the use of the system we have in use, we feel that we have a very safe method of signal operation. I have not been connected with another road using anything different, I am unable to say whether the system we use is any better than any other.

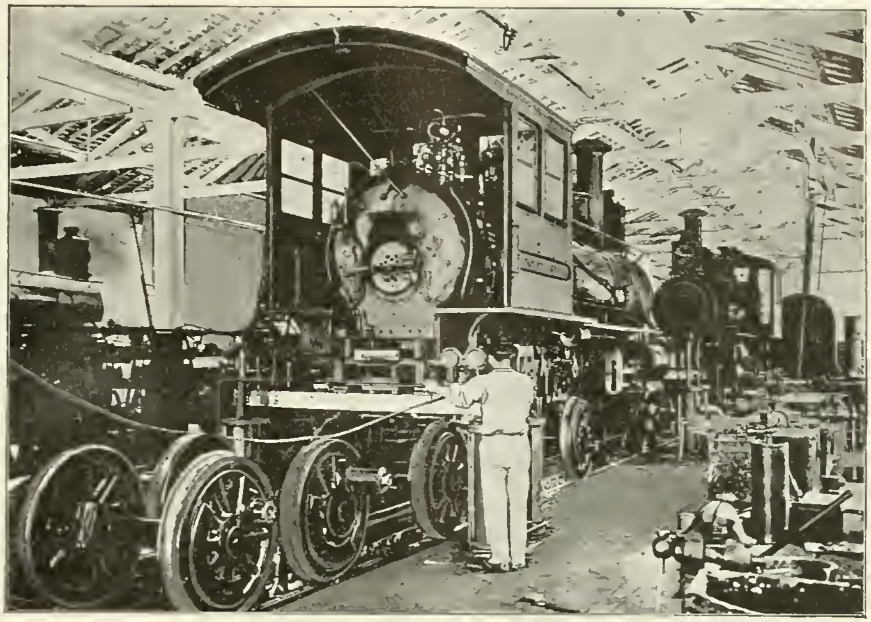
J. P. Griffin,
Road Foreman Engineers.
Slater, Mo.

News from Brazil.

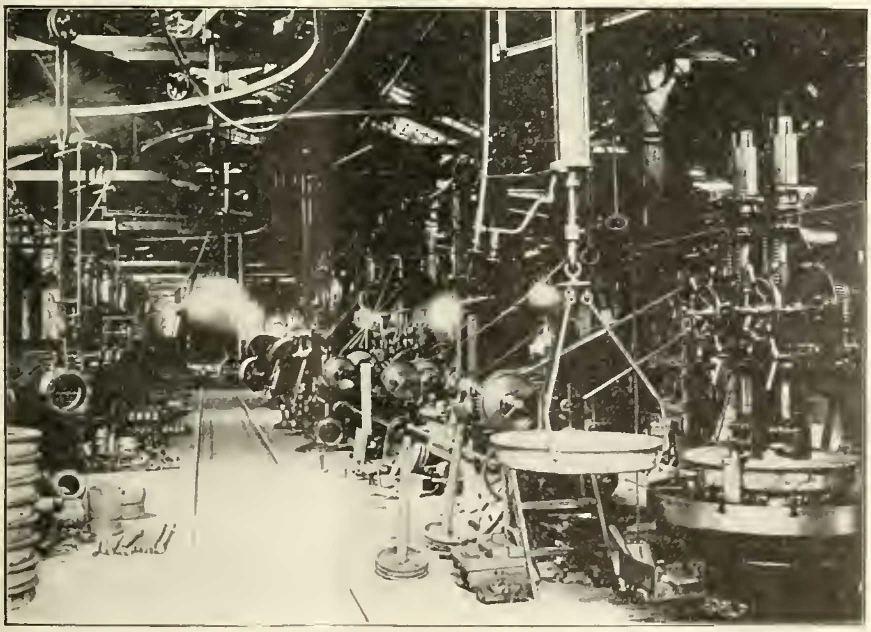
Editor:

I am enclosing some photos of our shops in Rio Claro. It is the metre gauge. We have 800 km. of line and 300 of broad gauge. I am sending them for you to see how we lift our engines by compressed air. We lift also our carriages, wagons and tenders by air. If you can find room for them in your journal, I shall be very pleased.

Alfred Williams,
Companhia Paulista, Estado de San Paulo.
Jundiahy, Brazil.



RAISING ENGINE BY AIR, RIO CLARO SHOP, BRAZIL.



MACHINE SHOP, RIO CLARO, BRAZIL.

Wide Firebox Engines.

Editor:

In reading the April number of your magazine I would like to write you in regard to article 5 in your general correspondence. The advantage of the wide firebox over its predecessor, in my opinion, is as follows: The wide firebox gives more equal expansion, is easier kept clean and has less leaky and broken staybolts.

As to the widening of the water leg to prevent side sheets from cracking, in my opinion, this would result in a failure, as the water would bubble away from side sheets with an eight-inch water leg, the same as from a four-inch leg, when the engine is in service and if it did not, there would be no circulation, and in comparison on this item a three-and-one-half or four-inch water leg would be sufficient.

To overcome the cracking of side sheets, my advice is to keep the boiler washed clean and the only way to do this is to make the roundhouse boilermaker responsible for the boiler washing, and when he sees the good results that follow, and the manner in which it lightens his work on fireboxes, he will not allow a boiler to go out half washed, but will take time to see that each is washed thoroughly, and the result will be that the cracking of side sheets is reduced about forty per cent. This I know from experience.

J. R. Cushing.
Bellefontaine, Ohio.

Circulation of Water in Boilers.

Editor:

I was very much interested in Mr. Atkinson's able article in your May number, under the above heading, and, as the circulation of water in any locomotive boiler has apparently a very definite relationship to the life of the firebox sheets, and to some extent, to the amount of tube leakage also, it is particularly appropriate at the present time, in view of the rapid decrease in the average life of firebox sheets due to the constantly increasing proportion of large engines with shallow fireboxes in service.

I believe it is correct to say that throughout the entire country, but perhaps to a greater extent in territory where bad water is prevalent, the amount of work necessary to maintain fireboxes and tubes on large modern engines is out of all proportion to the increase in size, and pounds of water evaporated per square foot, and this naturally suggests the question: "Has some vital principle affecting the circulation been overlooked in the later designs, and is it not possible by modifying details to avoid to some extent at least, the very serious trouble experienced through staybolt leakage, and the bulging and cracking of firebox sheets?"

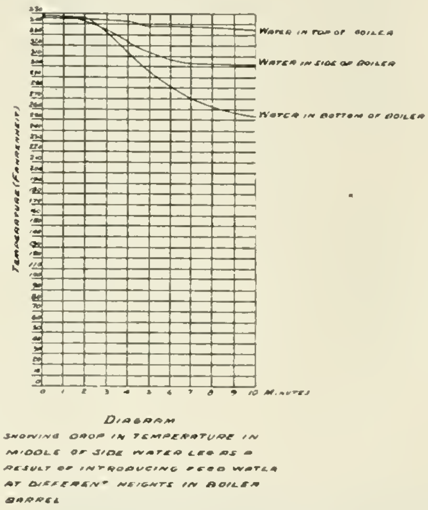
With good water almost any design of locomotive boiler will give fairly good service, but the bad water generally found all over the great Western prairies immediately displays the relative excellence of different types and designs, in no uncertain manner, and it is common practice on some roads to assign power to different districts on the basis of boiler suitability.

There appears to be little doubt but that the older forms of locomotive boilers, with narrow and deep fireboxes, give much less trouble in service and their fireboxes last very much longer than those of later design with shallow and wide fireboxes when using any quality of water, and it is equally true that they will work with fair results on districts where the water is so extremely bad that the shallow fireboxes positively cannot be used at all. It is also a fact that firebox sheets that lean in toward the fire are more subject to bulging and cracking than those that stand vertical, or that, having an outward sweep at some point, may be said to incline away from the fire. All these facts taken together indicate that here is something lacking in connection with the design of modern types, and, as the question is one of tremendous magnitude and the greatest importance it demands the most careful study and experiments in order to devise if possible, some alteration that, without being revolutionary or impracticable, will minimize the trouble.

The technical papers have printed a great many communications consisting largely of recitations of well known facts about the prevalence of the trouble and speculations about the causes, but very little has been suggested toward actually overcoming the evil. The writer begs to propose one or two slight alterations, which can be made without difficulty on most designs, that will, he feels sure, mitigate to some extent in all cases, and possibly entirely overcome it in others.

It has occasionally been considered advisable to raise grates so that the top surface, instead of being nearly even with the top of the mud ring, would be from six to ten inches higher, where side sheets have developed numerous short cracks and other defects immediately oposite the fire bed, and very beneficial results have uniformerly been obtained, but this has usually been ascribed to the formation of a mud drum below the fire level, where there were no strong currents, and where the suspended matter in the water might find a quiet resting place, thus automatically improving the quality of the water coming in actual contact with the heated portion of sheets.

Recent investigations and experiments apparently show that this supposition is only partially correct, and that the most benefit is derived from the fact that when the fire is raised above the mud ring any considerable distance, the space below the fire level serves as a distributing header or channel through which the relatively cooler water from the barrel of the boiler flows without interference from the violent currents produced by the ascending steam bubbles, and from which it rises easily to displace the heated water above in proportion to the varying rates of evaporation at different points along the sheet. Instead of being quiet water for the mud to settle in, there is really a powerful current running from the throat sheet water space toward the rear. Undoubtedly if the distance between the top of mud ring and fire was great enough,

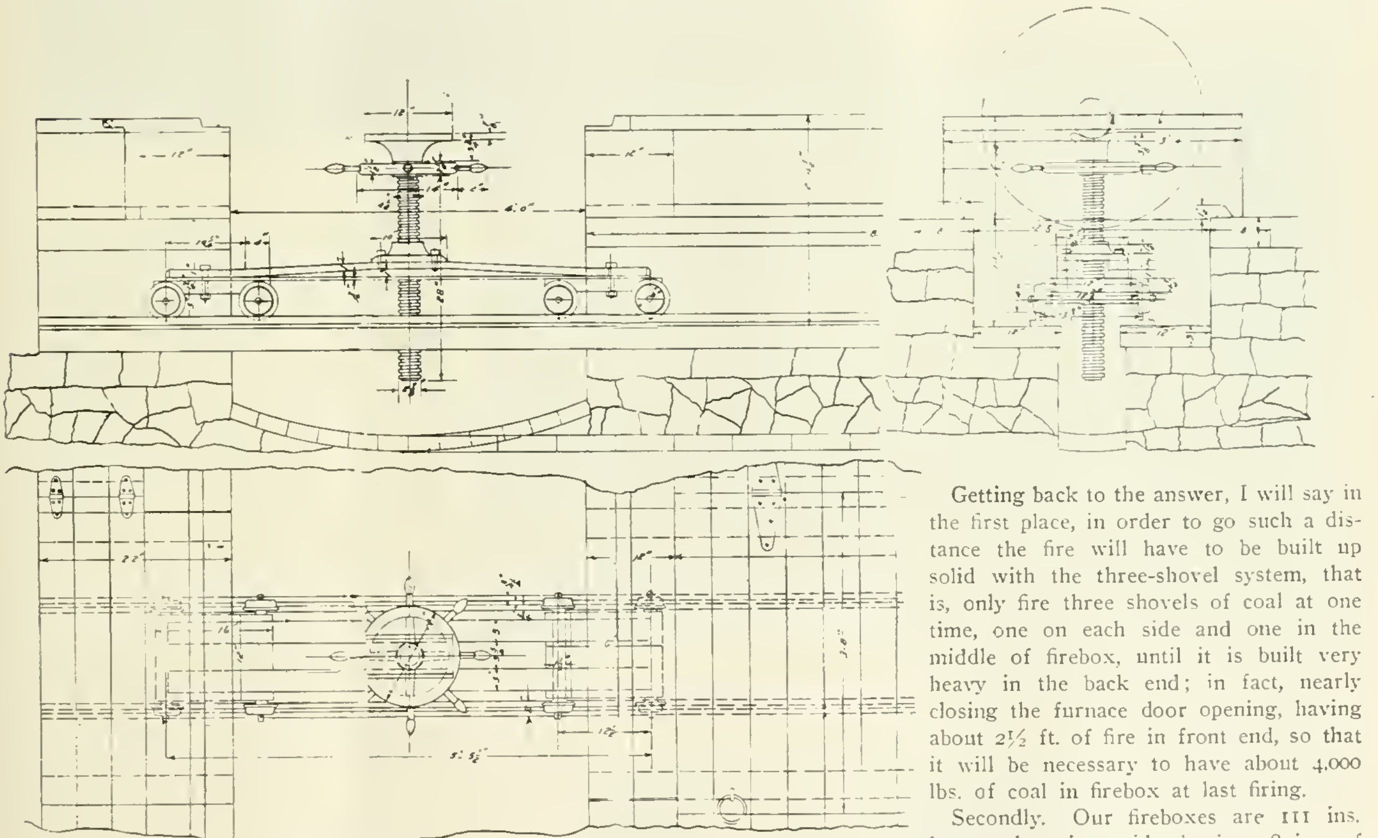


TEMPERATURE DIAGRAM.

there would be a body of quiet water near the bottom, but within the limits possible on an ordinary modern locomotive this does not occur, and the water below the fire is forced to rise by the greater weight of the comparatively quiet water toward the front of the boiler, as compared with the weight of the water ascending in the water legs, which, owing to its being largely composed of steam bubbles, is consequently much lighter. The action, in fact, is somewhat similar to that which causes the displacement of the comparatively cold water in the return cross-over pipes, which are considerably below the fire level in a coach heated with hot water. There really does not appear to be any other channel through which the returning water can reach the heated portion of side sheets easily, as it does not appear probable that there is any considerable downward current about the firebox, and any horizontal movement above the grate level is likely interfered with by the rapidly ascending currents of water and steam bubbles. The rapid and uninterrupted flow of water from the front, it is obvious that this supply channel supplies the water space above in such a way as to prevent local overheating in places due to partial blowing away of the water caused by rapid evaporation and insufficient supply of water to replace it as steam is formed. As practically all of the water supply flows in from the front, it is obvious that this supply channel may be decreased in capacity toward the rear end, and, in fact, its cross sectional area should decrease in direct proportion to the distance from the throat sheet, so that only enough water will be furnished at the rear to meet the requirements of the door sheet, and the logical arrangement is to slope the mud ring toward the front to the necessary or possible extent, and then place the grates in a nearly horizontal plane.

In order to ascertain how the water actually flows about the water legs, a number of hollow plugs containing "bulls-eye" lubricator glasses were screwed into the inside and outside sheets of an engine at points directly opposite each other, and as the grates were raised above them the observer could, with the assistance of an electric light held on the other side, watch the flow of water perfectly, a little sawdust having been put into the boiler previously to furnish distinguishable objects. When no steam was being used there was no pronounced current, but as soon as the injector was started there was a strong backward flow in the water space below the grate level, the speed of which appeared to become greater proportionately as the amount of steam consumed, or the quantity of feed water introduced was increased, thus proving the usefulness of this space as an aid to circulation. At the same time an effort was made to ascertain the change in temperature in the water leg caused by the introduction of feed water at different heights on the boiler barrel. To this end thermometers were inserted through the outside sheet into the water space, and then equal quantities of feed water of the same temperature were injected during uniform periods, while the steam pressure was kept at the same point. The results are the strongest possible argument in favor of introducing feed water through the top of the boiler, instead of the side or bottom, as thermometer readings taken at a point about four inches above the top of grates and four feet from the front of firebox, where side sheets fail most frequently, showed only a drop of twelve degrees Fahr., when the water was put in at the top, as against forty-six degrees drop when introduced through the side of boiler about half way up, and ninety-five degrees drop when injected through the bottom of barrel. As it is universally conceded that, other things being equal, the firebox sheet that is subjected to the least change in temperature will remain in service the longest, and as it evidently secures this desirable condition in a large degree, it appears safe to say that the feed water should always be introduced through the top of the boiler barrel, and where possible the top grates should be from six to eight inches above the top of foundation ring. The latter feature is impracticable on some designs with very short water legs, but as already explained, considerable benefit will be derived from the change where it is possible, and in getting out designs for new engines special provision should be made.

J. S. Hungerford,
Winnipeg, Man. Supt. of Shops.



THOMAS' ORIGINAL DROP PIT.

Original of the Drop Pit.

Editor:

I beg to enclose a blue-print of what, perhaps, was the first drop pit ever invented for removing and replacing engine trucks or driving wheels of a locomotive without jacking up. The print was made in 1877, from a tracing, and the tracing was made at the time the device was constructed by me in the roundhouse of the Pennsylvania Railroad Company at Renovo, Pa. At the time I happened to be foreman. It was designed to use a hydraulic jack for raising and lowering the wheels, but as hydraulic jacks in those days were luxuries, the officers of the company thought they would be too expensive for use in that connection. I was, therefore, compelled to use a screw, as is shown in the print.

The first trial device showed a wonderful saving of time over the old method. Two helpers or laborers removed a pair of defective wheels and replaced them with a pair of good wheels in less than half an hour from the time the screw jacks were placed under the locomotive to release the weight, and again removed. The late Mr. Howard Fry was then superintendent of Motive Power of the Philadelphia & Erie Division of the Pennsylvania Railroad. (He afterward became superintendent of Motive Power of the West Shore Railway Company, now part of the New York Central). He was very much interested in the device and took occasion to bring several of his friends to see it in operation. He made the claim for it that it was one of the greatest labor-saving devices he knew of. In the course of a few years the device was put into use by many of the leading railroads. When compressed air, however, came into general use, the screw was discarded and an air hoist used in place thereof in the pits afterward constructed.

When on a visit to the Renovo shops, a few months ago, I found the old device, this original design, still "doing business at the old stand." I have since learned that it has been removed to a smaller shop at another point on the line, where compressed air is not available. The device was never patented by me, although some other person did get a patent on the very same device many years after I had constructed the original one and put it into use.

W. H. Thomas,
Late Supt. of Motive Power,
Philadelphia, Pa. Southern Ry.

Bank Vs. Level Firing.

Editor:

In answer to our cousin from Sidney, N. S. W., on page 154, and also Mr. Brothers, on page 56, in reference to Bank vs. Level Fires, I may say that I am not altogether in favor of this practice, yet I am very sorry to see that none of our good readers have tried this long-distance firing and let us know through the columns of your valuable magazine what they can do, and, in fact, see if they can better our distance or record.

Getting back to the answer, I will say in the first place, in order to go such a distance the fire will have to be built up solid with the three-shovel system, that is, only fire three shovels of coal at one time, one on each side and one in the middle of firebox, until it is built very heavy in the back end; in fact, nearly closing the furnace door opening, having about 2½ ft. of fire in front end, so that it will be necessary to have about 4,000 lbs. of coal in firebox at last firing.

Secondly. Our fireboxes are 111 ins. long and 72 ins. wide, having 38 ins. of front end of firebox bricked off with fire brick, leaving firebox 73 ins. long. Now to convince themselves that this can be done, have their fireman build up his fire running along the road to about the amount above named, have the engineman use a light throttle, or just enough steam to make the schedule, and see how far they can go with this fire without looking at it, much less adding coal to same, and see if they are not surprised with the result. Try it, one and all, and let us know your answer.

Thirdly. In order to keep the engine from blowing off at safety valves in the engine house, we wet the coal before putting it on the fire, close both dampers, and put a piece of sheet iron over the top of stack, sheet iron pad with 5-in. hole in it is to retard the draft, and let gases out; doing this, the engine would stand for hours without blowing off.

Fourthly. There is not so much heat lost if the fireman is careful in preparing or building up his fire.

Fifthly. All enginemen and firemen know to report to engine house two hours before train leaving time, on short as well as long runs, as they all have to be out of engine house one hour before train leaving time, as engine houses are from one to six miles away from station or terminals.

This article has given me great pleasure, as I have had letters from Richmond, Va., Washington, D. C.; Boston, Mass.; Pittsburgh, Pa.; Chicago, Ill.; Spooner and Madison, Wis.; San Francisco, Cal.; San Pueblo, Canal Zone, and Lagos, West Africa, from Southern Nigerian R. R. in reference to coal used (kind), size of locomotives and fireboxes, and existing conditions of road as to time, grades, etc.

M. H. Lee.

Philadelphia, Pa.

Appreciation from Australia.

Editor:

Being a constant reader of your valuable magazine for the past twelve years, I thought perhaps that it would not be out of place on my part, sending you under separate cover the evolution of the locomotive in Queensland. Wishing your paper every success for its future from one of the Queensland, Australia, drivers.

James Sanderson,
Woolloongabba Loco. Dept.

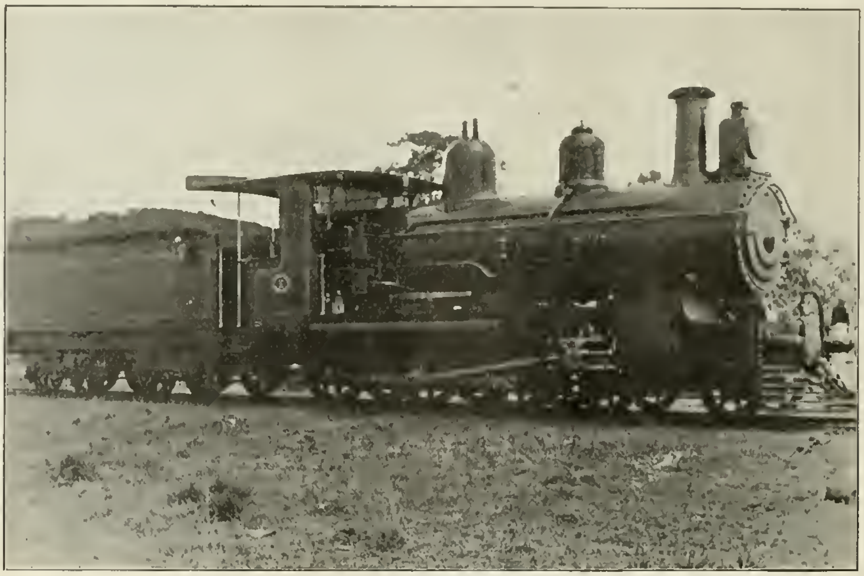
Brisbane, Australia.

Should Not Pass a Red.

Editor:

Referring to the preventation of accidents on account of imperfect signal being displayed or passing signals on account of imperfect aspect. This subject has resulted in a great deal of difference of opinion; so far as I am concerned I do not believe that we should pass a red singal at high speed.

G. C. Grantin,
Road Foreman of Engines,
Hornell, N. Y. Erie R. R.



PRESENT DAY ENGINE, QUEENSLAND, AUSTRALIA.

OLD-TIMER IN QUEENSLAND, AUSTRALIA.

Boiler and Cylinder Design.

Editor:

In the design of the modern locomotive the two most important considerations are the boilers and cylinders—everything is made subordinate to these. Of the two, the boiler is the most important, because on it depends the successful working of the engine; if it is unable to supply the necessary quantity of steam the engine is sure to lose time on a hard schedule. Again the boiler may be able to supply the steam, but it may do this at a sacrifice of economy in the use of fuel and water—probably due to insufficient grate area and heating surface, which are the two most important elements in the boiler.

For these reasons, the boiler should be made as large as the weight of the locomotive will permit.

The size of the locomotive boiler should be proportioned to the amount of adhesive weight, and to the speed at which the engine is intended to work. Cylinder capacity must be considered in connection with this, because an engine with considerable weight on the driving wheels is capable of pulling a heavier load—that is, exerting a greater tractive power—than one with little adhesive weight. It is unnecessary to state that the tractive power is limited, independently of the cylinder power, by the weight on the driving wheels, and friction between the driving wheels and the rails. In order that the full tractive power may be utilized, on starting, the cylinder capacity should be proportioned to the adhesive weight. Under these conditions the cylinders will not limit the power at any speed.

The cylinders of both freight and passenger engines consume large quantities of steam; in the freight engine the steam generated in the boiler is used to supply the very large cylinders—large because of the long piston stroke—and in the passenger engine it is used to fill smaller cylinders which are using the steam and exhausting it at a much faster rate. It is evident that the size of the driving wheels have a decided influence on the speed of the piston, because small wheels make more revolutions, in running a given distance, than large ones, and hence with the latter. more strokes of the piston are made. Driving wheels of large diameter are always used for fast passenger engines, in order to keep down the piston speeds; the large wheels, however, require larger cylinders—large in diameter, with a short piston stroke, and hence the steam consumption is not materially reduced. Economy will increase with increasing diameter of drivers, provided the work at average speed does not necessitate a cut-off longer than one-fourth the stroke.

From what has been stated above, it is evident that a passenger locomotive must have greater boiler capacity than a freight engine. By means of the B. D. factor, or factor of steam consumption, the boiler capacities of engines of the same type, or of different types, can easily be compared. This factor expressed as a ratio is:

$$\frac{\textit{Tractive Effort} \times \textit{Driver Diameter}}{\textit{Heating Surface.}}$$

It is evident that a low ratio gives the largest boiler capacity. The Atlantic, Pacific and Prairie type engines have the lowest B. D. factor—a ratio of about 600 is considered very good practice for these engines.

In order to keep our modern Pullman trains, weighing from 500 to 600 tons, running on a schedule of 40 or 50 miles an hour, exceptional power is required. A few years ago the ten-wheel type engine was used for heavy and fast passenger service; but at the present time the Pacific type has, largely, superseded the 4-6-0 type, and the ten-wheel engine has been relegated to less strenuous service. As a rule the ten-wheel type engines have more weight on their drivers and a greater hauling capacity in proportion to the total weight than the 4-6-2 type. Hence, in starting and accelerating heavy passenger trains the 4-6-0 type is equal to the 4-6-2 type; for, the maximum tractive power of the engine is not a measure of what may be required of the boiler. The full tractive power is only used in starting, but the larger portion of the work and the greatest power is developed while cutting off at less than half stroke. It is possible for a small boiler to supply all the steam necessary at slow speed, but it is the exacting service of pulling heavy trains at high sustained speeds that requires large boiler capacity. The drain on the boiler under such conditions is enormous, and when we consider that, in addition, the train must be heated and lighted, the performance of the 4-6-2 type is commendable.

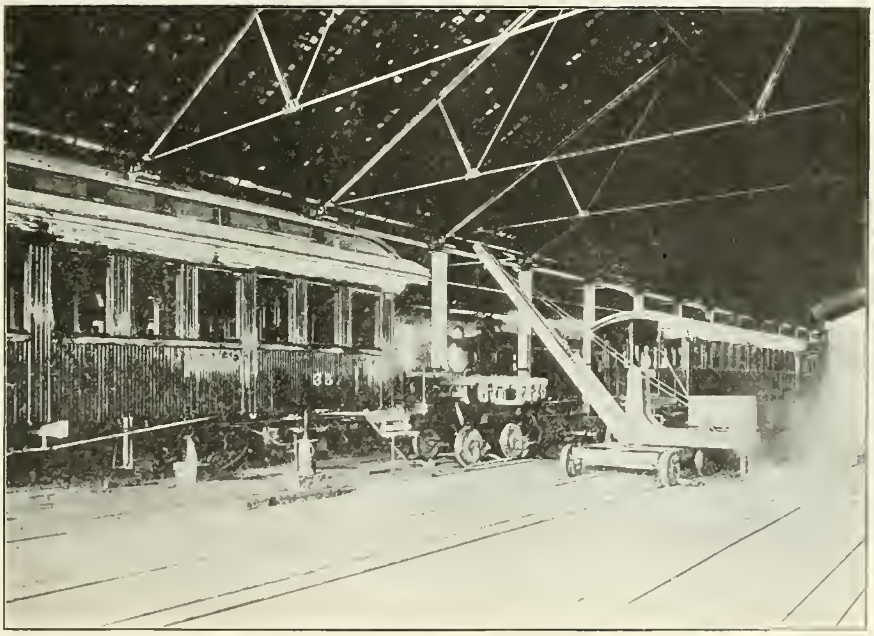
The Pacific type engines, put in service on the New York Central last year, are the best example of a locomotive with plenty of reserve boiler capacity. They have a B. D. factor of 550, which is considerably below the average figure for Pacific type locomotives. Their steam generating capacity is unequaled, as is shown by the results obtained in service.

Although the 4-4-2 type has not the total heating surface for a given total weight that is provided in the 4-6-2 type, it has made an enviable record with moderately heavy trains. A few years ago, before the introduction of the large Pacific type engines, Atlantic type engines handled the heavy limited trains (on the N. Y. C.), made up of from ten to fifteen cars. These engines had difficulty in starting the heavy trains, due to the deficient tractive weight, but they made a remarkable record of power and speed, when once the train was well under way. Yard engines were often on hand to aid these locomotives in making the start—that is, they gave a push at the back end of the train.

The Consolidation engine being designed for heavy trains, and slow speeds, has a large maximum tractive effort which is available up to a speed of about eight miles an hour, from which point the boiler capacity reduces the draw bar pull as the speed increases. The small diameter of driving wheels limits the speed to some extent, but nevertheless, on some roads this type of engine is assigned to the Q. D. and "High Ball" runs, which run on schedules nearly as fast as those of the passenger trains. The 2-8-0 type may be able to make bursts of speed, but it has no reserve boiler capacity for high sustained speeds. It has another field of usefulness—that of hauling heavy tonnage trains at comparatively low speeds.

The power of any locomotive is dependent on three coefficients: the total heating surface, the rate of steam production, and the efficiency of the utilization of the steam. As far as getting trains over the road on schedule time is concerned, the first two coefficients are the most important, but where possible efficiency of steam utilization is required. High steam pressures, compounding and superheated steam have been introduced to effect this efficiency, and have met with a fair degree of success.

W. SMITH,
B. & O. R. R.
Newark, Ohio.



CAR SHOP, RIO CLARO, BRAZIL.

Injector Troubles.

Editor:

The injector is the ideal locomotive boiler feeder and is now used for this purpose almost to the exclusion of all other methods. Low maintenance, cost, high thermal efficiency, ease of operation and compactness of form in proportion to capacity give it an immense advantage over mechanically-operated pumps for use on the locomotive.

The thermal efficiency of the injector is practically 100 per cent., since all the heat energy required to operate it is returned to the boiler and the only loss is that due to radiation.

The first requisite for the successful working of an injector is, of course, the proper size for operating under and against a given steam pressure and the capacity corresponding to the requirements of the boiler. Most injectors are capable of working under a wide range of pressures and capacities, but results of tests will show that they are neither economical nor reliable when worked at other than normal rating.

Great care should be taken that the size of piping recommended by the manufacturer be used and its sectional area should never be less than that of the injector connections. Injectors used on locomotives are usually of the lifting type, so they may be placed in the cab for convenience in operating.

In this type the water must first be lifted a height equal to the difference in level between the injector and the water in the tank and then forced into the boiler.

In lifting the water, a vacuum must be created in the suction pipe. This is accomplished by means of an auxiliary or primary valve, which, on being opened, allows steam to flow through the body of the injector and by induction the air is carried along with it and out through the overflow. Atmospheric pressure, acting on the water in the tank, then forces the water from the tank, through the suction hose and into the injector.

There are many things which may cause the water to fail to rise and flow into the injector, and by starting at the tank and following along the path the water must take, these reasons will become apparent. First, the tank may be empty or, if in the winter time, the water may become coated with a sheet of ice which will prevent the admission of air and no water can enter the suction hose. Tank hose strainer clogged with rubbish, loose hose lining, leaks in suction hose and pipe, stuck overflow valve or clogged overflow, all have a tendency to prevent the proper flow of water to the injector, and of these, dirty strainer and leaks in the suction pipe are by far the most common.

As the water begins to flow into the injector, the main steam valve is opened, the overflow closed and the injector should go to work.

In some injectors the overflow is closed mechanically in the operation of opening the steam valve or ram, while others have simply a floating valve, which closes by gravity.

The Metropolitan is a well-known example of the former and the Sellers of the latter. It is readily seen that the overflow serves a two-fold purpose: (1) It allows the air to escape from the injector when the vacuum is formed and (2) it provides for the escape of the surplus water which accumulates in the injector before the mingled steam and water has attained a sufficient velocity to overcome the opposing boiler pressure.

It is rather a remarkable fact that although the injector has been in use for over fifty years, the theory of its operation is in dispute. The "velocity" theory is the one now generally accepted as correct, although the "pressure" theory has its followers.

A significant fact in this connection is the ability of an injector to work with an open overflow. It certainly indicates that there is no pressure in the space over the tubes which would be present if the injector worked on the principle of the steam pump. After starting an injector of this type the overflow valve may be removed entirely without interrupting its working.

If an injector lifts the water and fails to force it into the boiler, its general behavior will often indicate where the trouble is. If it blows back through the suction pipe into the tank it may be due to a check valve stuck to its seat or the overflow valve may have closed or partly closed before the steam has accelerated the water sufficiently to overcome the pressure in the boiler. This seldom occurs with the open overflow, but is often very troublesome with the closed overflow; in fact, all injectors of this type in which the overflow valve and starting lever move simultaneously are objectionable for this very reason. The two valves being rigidly connected together, it is very difficult to keep a perfect adjustment and the overflow valve will sometimes seat before the main steam valve has fully opened, and then again in shutting the injector off the overflow valve may come up against its guide before the steam valve seats; result, a hot injector and a hot, sticky cab.

If part or all the water goes out of the overflow, it indicates a stuck boiler or line check, worn or obstructed tubes, leaky suction pipe, incorrect proportions of water and steam or dirt under the overflow valve. Badly worn, obstructed or loose nozzles and tubes in an open overflow injector will invariably cause a dribbling and waste of water at the overflow. The use of muddy, gritty water soon means nozzles and tubes too large or out of round, and in hard water districts they soon become limed up. This trouble increases very rapidly as the steam pressure increases.

CONTRACTOR'S CAMP IN THE ROCKIES. CAN. PAC. RY.

It is important that a distinction be recognized between a faulty injector and faulty auxiliary attachments in case of failure. If the fault lies in front or behind the injector, it certainly would be a waste of time to replace it with another.

It may be said in general that if an injector stops suddenly or fails to start, the water supply has been cut off by dirt or loose hose lining. Blowing steam back through the suction pipe will generally bring relief by cleaning out the pipe and straightening out the loose lining, but it is likely to be only temporary, because the dirt will settle back again and the lining will roll up again as soon as the water begins to flow from the tank.

An injector that works intermittently and sluggishly or wastes water at the overflow generally needs repairs, although if it is getting air the same results will occur.

Injectors and accessories receive far less care and attention than they should in view of their importance. There is certainly nothing about a locomotive that could put it out of business more effectually than an interruption to its water supply. Yet there are very few injectors that are operated under ideal conditions or that do not show marks of rough usage. It would be hard to find any one thing more trying to an engineer's peace of mind than a balky injector, whether it is the fault of the injector or not. In such cases it is better policy to use the spare injector altogether before a run has to be made for water.

Right here it may be said, in passing, that the spare injector is not put on an engine as an ornament, but it should be tested frequently so that it can be relied upon to an absolute certainty in case of emergency.

The writer can recall an instance where an engineer, pulling a passenger train, had to dump his fire out in the country "miles from nowhere," for the simple reason that both injectors failed at an unexpected moment. Upon investigation he admitted that he had not tried the spare injector since receiving the engine from the shop two weeks before. When the injector was taken apart the tubes were found to be nicely coated, on the inside, with black paint which had been drawn up from the tank when the engine was tested.

In repairing injectors it is of the utmost importance to keep everything to as near standard sizes as it is possible to make it. It is an excellent policy to work from a drawing or from a standard model. Care should also be taken to use the right size of nozzles and tubes. Some injectors are made to receive nozzles and tubes of different sizes, the size determining the feeding capacity. To work economically an injector must admit of close regulation so that it may be operated continuously, which cannot be done if the feeding capacity of the tubes is very much in excess of the evaporative capacity of the boiler.

It is of doubtful economy to use "home-made" repair parts in injectors, as the quality of material is generally much inferior to that of the manufacturer and there is likely to be more or less variation in size and shape from standard. In reaming or forcing seats and joints care should be taken that the parts when brought up to position again will bear the same relationship to each other as regards spacing, alignment, etc., as called for by the standard. All dirt and scale should be removed from the body and parts and the former carefully inspected for holes and cracks. All valves should have snug fits in their seats and guides, so that when moved they will stay in line and come up square on their seats.

As an illustration of this point a certain road not long ago were having a great deal of trouble with a number of Metropolitan "1898" injectors. They were very hard to prime and would break and blow back in the tanks as soon as started. Every imaginable remedy was tried without success until it was noticed that the end of the main steam valve which passes through a hole in the body just back of the steam nozzle was worn to a very loose fit. Another valve was turned up, the end of which made a snug-sliding fit in the hole and the priming problem was solved. Then some one observed that the nut holding the overflow valve disc on its stem should be large enough to completely fill the hole underneath the seat when the valve was drawn. This was done and all trouble disappeared. A little reflection will show why these changes produced the right results.

In the first case when the priming valve was opened, the steam, instead of passing through the litfing steam nozzle and lifting the water, part of it passed around the end of the worn steam valve through the forcing steam nozzle, forcing tube and overflow to the atmosphere. In the second case, a small nut on the overflow valve spindle permitted a full opening of the valve until it was nearly to its seat and then would close very suddenly, more water would be in the injector than the steam could handle and the injector would break. By using a nut large enough to nearly fill the hole a very gradual closure of the overflow was obtained.

It is needless to say that the repairing of injectors requires not only mechanical skill of the highest order, but a thorough knowledge of the principle by which it operates, together with a clear understanding of its construction are absolutely necessary. A careless or inexperienced workman can easily ruin an injector, to say nothing of putting it in working condition.

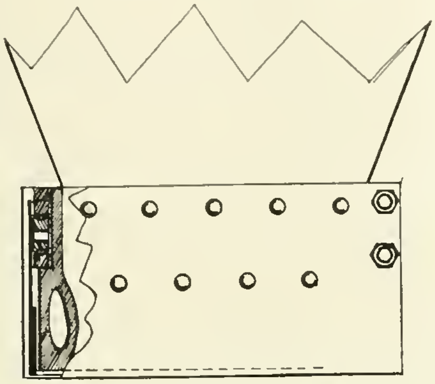
While it is true that the highly improved injectors of the present are, by reason of their simplicity, very easy to operate, still it is not every one that can get good results from them under any and all conditions of locomotive service.

A. W. Vestal,
Donville, Ill. C. & E. I. Ry.

Self-Cleaning Ash Pan.

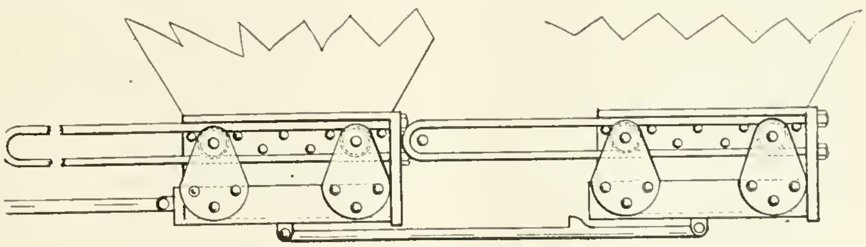
Editor:

I am sending you a sketch of an ashpan that is to be tried on the St. Louis & San Francisco Railroad. The pan was designed by Wm. Cheney, road foreman of



END VIEW, SHOWING STEAM PASSAGE IN SIDE OF PAN TO PREVENT FREEZING.

equipment, and myself. By referring to sketch you will see that dumping feature of the pan is all attached to the cast bottom, so that should the pan warp in such a manner that the cast iron bottom sets on an angle it will in no way affect the operation of the pan. The bottom or slide is set away from casting, and should the casting get out of shape, which is not likely, the dumping feature will not be affected.



SIDE VIEW OF SELF-DUMPING ASH PAN ON THE 'FRISCO.

The track arrangement feature of the pan makes it a very easy working dump.

I would like to have your opinion of the pan and also that of any of your readers who care to give us the benefit of their views through the columns of Railway and Locomotive Engineering. The pan, I think, may be of interest to readers of your paper. I do not know anything that is of more interest to the railroad world at this time than dump pans.

John J. Loud,
General Foreman Frisco.
Chaffee, Mo.

Drop Testing Machine.

The Department of Railway Engineering of the University of Illinois has recently erected a drop testing machine which is identical in design with the standard machine of the Master Car Builders' Association. This apparatus will be used in making impact tests of such materials as car couplers, wheels, axles, etc. It consists essentially of a spring supported anvil weighing 20,000 lbs. upon which is placed the specimen to be tested, and a hammer weighing 1,640 lbs., which runs in vertical guides rising at either side of the anvil. This hammer may be dropped in these guides from any height up to 50 ft. The addition of this machine to the existing equipment of the College of Engineering of this institution, renders it possible to make there tension, compression, bending, and impact tests of all materials of construction, on specimens of the full size ordinarily met with in practice.

Through the courtesy of Mr. A. W. Gibbs, the Pennsylvania Railroad Company furnished the drawings, and loaned its patterns for the construction of this machine. The Cleveland, Cincinnati, Chicago & St. Louis Railroad Company, through its superintendent of motive power, Mr. William Garstang, has donated to the University its services in connection with the work of construction and assembling the machine, which was done at the Urbana shops of this company.

Block Signal Installations.

The Chicago, Rock Island & Pacific Railway will eventually have automatic block signals on 270 miles in Missouri and Iowa. This road has now about 350 miles equipped, that is, from Chicago to the Mississippi River. The Frisco system intends to carry on similar work on practically all of their main line. Altogether, 500 miles of the Rock Island and about 800 miles of the Frisco are included in this project. It is understood that extensive experiments in the use of telephones for train dispatching will be made later.

We should be perfect in all we do, to help in the formation of a good character. We should not be like the soapstone, that crumbles as it is rubbed, but like gold, that shines the brighter the more it is used.—*Mary Lyon.*

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The Annual Meeting of the Mechanical Railway Men.

It was a happy thought that grew and blossomed into action—the calling together of the leading men in the mechanical departments of the railway world. The interchange of thought on the rapidly multiplying problems that confronted those who were engaged in the construction and repair of the appliances used on railways became a necessity, and it would be difficult, indeed, to estimate properly the value of the enduring work that has grown out of these annual meetings of the best and brightest minds in the expanding mechanical departments of railway work in America.

That the need of such meetings was great was readily proved by the response which at the first call was spontaneous and enthusiastic, and has grown in importance year by year until to-day the work of these meetings, as shown in the able reports and eloquent debates is looked upon as standard text-books in their separate realms of matured thought and practical endeavor. The questions that have been discussed at these meetings have not only been of the utmost importance in their various departments, but they have been met and mastered in a manner that would have been impossible in the case of minds working separately and at remote distances. The results have been of the most beneficial kind, especially in regard to the standardization of many of the involved mechanical appliances used on railways. We need not now enumerate the names of these separate parts that have passed through the crucible of intellectual analysis and by systematic and careful experiment have been brought to universally accepted conclusions. It is rather our province to encourage the continuance of the good work and to point out the fact that much still remains to be done in the growing field of work which these associations have marked out for themselves, and which they have so far nobly advanced.

In this regard the report of the committee on automatic stokers which was presented at the Master Mechanics' Convention this year is of particular interest, and while many are of opinion that this important problem is not yet completely solved, it is generally admitted that much progress has been made. It is well known that the severe mechanical toil experienced in firing the largest locomotives has reached a point that approaches the limit of human endurance, and while the younger class of railway men are unquestionably among the most active and robust of all who are engaged in mechanical occupations, their superb vitality being almost equal to any emergency, it must be remembered that their work is not altogether of a merely mechanical kind, but also involves much thoughtful concern in the ceaseless watchfulness of the intricate features of the mechanical appliances with which they are entrusted. Many of the best minds in the railway world are of opinion that the general introduction of mechanical stokers is a mere question of a few years, and in this belief we largely partake with the added hope that the triumph of mechanical skill in this particular will be complete.

Apart from mere mechanical progress it is peculiarly gratifying to observe that questions involving the better education of the younger railway men are receiving that attention which they deserve. The better and proper education of apprentices is engaging the minds of the leading railway men and through the concerted action of the members of these railway associations much has been already accomplished, and it is of particular interest to note how generously many of the railroad corporations have received the suggestions that have come from the united thought arising from the meetings of the railway associations. That the most advanced scientific course of training in applied science would be placed within the reach of the humblest apprentice, in the company's time, and at the company's expense, was something hardly to be dreamed of among mechanical workers of the last century, but which to-day can be observed in nearly all of the chief railroad mechanical centres as an accomplished fact, owing its beneficient existence largely to the insistent demands of the associations to which we have alluded.

Apart from these facts to which we can only briefly refer, there is a growing social element arising from such meetings, the real value of which would also be difficult to overestimate, and which is apparent to all who have had the pleasure of attending these conventions.

We no longer hear of that senseless rivalry between the employees of different corporations. There are no more mechanical mysteries in workshops. Every new device is openly proclaimed and the fullest information in regard to new methods widely and freely circulated. Invention is encouraged. Ability meets with more ready recognition. A wider and higher companionship exists between the most active and intelligent of the men engaged in a common industry. In a word, nothing but good has come of the meetings of these associations of railway men, and the future cannot be other than stepping-stones to higher and better things.

We need hardly state that the aim and object of RAILWAY AND LOCOMOTIVE ENGINEERING has always been in the direction in which these associations are moving. It is very gratifying to us to know that our work has been warmly appreciated. Many of the leading members of these associations acknowledge that they owe more to the regular perusal of our pages in the thorough acquisition of a mastery of their calling than to any other source whatever. We are hopeful of continuing to be able to be worthy of the grateful recognition of thousands yet untried in railroad work. We are proud of the part that we have taken in the organization of these associations. It has been our aim and object to reflect in a condensed form the best and brightest of their work. We are not forgetful of the great numbers of railway men whose opportunities to attend such meetings are limited, but whose interests in the matter discussed are as keen as those who are able to be present. Their interests are our interests, and anything that may add to the knowledge essential to a mastery of their calling, anything that may tend to lighten the burden of labor or to increase their comfort, will continue to be our aim and object.

The Appeal of the Railway Signal.

In our general correspondence columns for this month will be found a number of letters from practical men, engineers, road foremen of engines and others, called out by our article on signals in the May issue. The men who write are the ones who have to observe and obey the signals, no matter what system is adopted by the railway, they serve, and no matter what the color scheme of the right signals may be. These men are the ones who make the record of signal observance which railways are proud of. It is on the conscientious work of such men as it appears in the signal records of the road, sometimes called the surprise checking system, that the officials rely when they give out statements to the public and to the press that 98 per cent. signal observance is normal on their line.

The remarks made by this class of railroad men is well worthy of attention by all, because it is the honest opinion of practical men, alert and diligent concerning the matter in hand. We invite our friends, the engineers, firemen, road foremen of engines and others who are properly and rightly interested in this important subject and who we believe are competent to give some very valuable information, to keep up the good work and send us in their views. Write us what you think and feel. Our columns are open for the intelligent discussion of the subject.

One writer believes that enginemen try to observe the position of the semaphore blade at night just as they do in daytime. For this, he says, they rely on a good headlight or on moonlight in clear weather. We want you to tell us your own practice. Do you try to see the semaphore arm at night or do you look only at the colored lights? A little real information on this point will be valuable. Write us just what you do and give us your name and address. If you want to use a nom de plume or pen name we will respect your wish. It is the fact that you do or do not look at the blade at night that we want to hear about. Do you prefer to see the blade when you can, or do you like the colored light best?

Another writer says engineers would prefer the absolute red. That is the red light at night always and everywhere to mean a stop. How do you feel on this point? Present practice is to regard a red as absolute and to be obeyed by a stop when on an automatic signal post. At the same time and on the same railway you pass a red light on an interlocking home signal. By this we mean that when you come to a junction, you get a green for the route you are to run on, and a red light is displayed for the route upon which you do not go. Does this system meet with your approval or does it not?

In answering this question you must remember that the argument in favor of the practice is that, say you come to a junction and that your train and your run is over the main line. You get the green light for proceed in the upper signal, and the red of the lower signal blocks only the diverging route upon which you are not to travel. You and your main line are signalled clear and you have no concern with the diverging route except to know that it is closed against you. You pass a red light, but it is not for your route.

The argument against this practice is that you pass a red light when it is on the post carrying the signal you must obey, and that you must look at it in order to know that the diverging route and the rails ahead are set as they should be for your train. The lower red means something important to you, yet you pass it. You would not pass the automatic red signal, where there was no choice of routes, but you pass it when there is the main line and the diverging route before you.

These are the arguments for and against the practice, briefly stated. Do you agree with one and against the other, or are you satisfied with the different functions of the red light on the automatic and on the interlocking home signal? We want you to tell us your candid opinion.

The whole signal problem is an intensely important one in railway operation. Railway men in Great Britain have made a reputation of which they are justly proud for signal observance, and in that country practically every line is signalled. We are installing signal systems in America every day, and before it is too late we want to get the best system, and follow the best practice. On this question the engineers and the firemen, who will be engineers later, should speak out plainly and clearly.

The columns of Railway and Locomotive Engineering are open to you. The signal engineers of this country are doing noble work and are conscientious and painstaking men who think before they act. You are also practical men with a practical problem before you, and now is the time, and here is the means to speak. We have put before you three straight questions. What have you to say?

Brine from Refrigerator Cars.

It may sound somewhat strange to say that salt is thrown in among the blocks of ice in a refrigerator car for the purpose of making the ice melt more quickly, but such is the case. It is only by the melting of the ice that the interior of the car can be kept cold, and the faster the ice melts the colder will be the air in the car. The ice does not give out cold, it takes up heat from air and the perishable contents of the car. If the ice did not melt the car would not be particularly cold.

The melting of the ice and the flow of salt water down through the ice box to the drip pipes while very desirable from a refrigerating point of view, is very harmful to rails, spikes, angle bars and steel bridges. Some figures compiled by the Michigan Central Railroad for a year make it evident that on 545 miles of track the deterioration ascribed to this cause amounted to $25,000 on bridges alone, and the damage to rails, angle bars, spikes, etc., brought the total loss up to $145,000.

It is said that one refrigerator car will produce about 200 gallons of brine in the 24 hours. Coating bridges with waterproof material is expensive, and may not always be effective. A type of car having a centrally placed drip pipe is good on the principle that half a loaf is better than no bread, as the central drip keeps the brine away from rails and spikes except where the rails of cross-over tracks occur. Bridges, however, get the drip from the center pipe as well as from the old form.

Originally the evil effects from the salt water drip was not confined to track and bridges. It extended to the refrigerator cars themselves, and the axles of the cars were gradually rusted away until they became too small for the capacity of the car. Some private lines did not stencil any capacity on their rolling stock, and even went so far as to expect the using roads to make good each axle as it became too small for safe use. The alternation of the car interchange rules obviated this trouble. So far the drip, even when centrally placed and when the brine falls clear of wheels and axles, has not yet been eliminated. The American Railway Association is to take the subject into consideration.

Centre of Gravity and Rail Wear.

History is repeating itself in the matter of the old problem that has arisen in the rapid wear of rails and wheel tires on electric railways. The early steam locomotives, with their boilers placed by the designers as low as possible, had the same effect on rails, wheels and permanent way generally as the electric motor-trucks are now having. In the case of the early locomotives the work was experimental, and therefore excusable. Constructing engineers soon discovered that a high center of gravity, not only produced an easy riding machine, but was far less destructive to rails and wheel-flanges, than an engine with low center of gravity.

Even with the greatly increased weight of the modern steam locomotive, the wear is still comparatively light, because the pressure is placed almost entirely on the tread of the rail. The carrying of the weight on springs in the case of the steam locomotive also adds to the saving of the rail, and renders it possible to raise the center of gravity to a much higher point than would be possible if the bulk of the weight was on a level with the axles.

It would be natural to suppose that the constructors of the electric locomotives would have benefited by the experience of the steam locomotive builders, but this does not seem to have been the case. Lessons learned by hard experience are likely to be more deeply impressed on the minds of the learners than instruction gathered from a mere echo, but engineers do not usually wander in the woods while a beaten track is near by, or grope in the dark while a light is burning brightly near at hand.

The rapid wear of rails by electric motors is undoubtedly, in a general way, owing to the low center of gravity of motor trucks. Special rails have been introduced on some British railways to meet this rapid deterioration, but we believe that the real remedy will be applied as rapidly as possible, as the tendency to deflect rails and spread them apart from each other is very great, especially at curves, and this is a constant menace to safety in electric transportation. The General Electric Company have recently designed an electric locomotive where the motors are above the frames, and drive the wheels by connecting and side rods. This is following European practice, and it enables the whole machine to have a higher center of gravity than could otherwise be attained, and it is quite probable that rail wear under such a locomotive will very closely approximate to that obtained in ordinary steam practice.

Harmony in the Cab Saves Coal.

Mr. Frank Tuma, master mechanic of the Erie Railroad, recently presented a paper on the subject of Fuel Economy at a meeting of the Central Railroad Club. He said that aside from faulty design, increased fuel consumption is due to three causes, improper or insufficient draft, heat of the fire not being fully utilized and poor management on the part of the engineer. He also remarked that the firing and pumping the boiler have much to do with fuel economy and in order to obtain the best results they must be performed in harmony.

"The fireman may be a capable man and may do his best to make a good record, but if the engineer does not perform his duty in the matter of economy, the fireman's efforts do not produce very satisfactory results. The fireman may save coal by the pound and the engineer may waste it by the shovelful, if they work independently of each other.

"In only one way can a standard rule governing the front end draft arrangement be established, and that would be to furnish locomotives with a standard quality of coal at all times; but where the quality of coal changes, a standard arrangement cannot be maintained. When the quality of coal and mixed coals are used the drafting of the engine must be made to suit the coal."

Mr. Tuma specially urged the thorough instruction of men to prevent waste of fuel. "Economy in the use of coal is of great importance, but in railroad service where running time is about as fast as can be made, or when an engine is loaded to its maximum capacity, the chief aim under these conditions should be to generate steam as it is required and without the emission of black smoke. There is only one economical system to use for firing locomotives, and that is the spreading system, which is generally used, as it has a tendency to make steam rapidly."

The Master Mechanics' Convention.

When we first considered the volume of work cut out for the Master Mechanics' Convention of 1909, we feared that superabundance of subjects would result in the sort of rush that has sometimes prevented any part of the work being properly performed. With the 1909 convention a thing of the past, we are gratified to report that our fears concerning the effect of too many subjects have been groundless. The convention proved to be one of the most interesting and profitable meetings ever held, and the various reports and papers were read and discussed without undesirable haste.

The inaugural address of President Vaughan contained many suggestions concerning the future policy of the association and the widened range of business which ought to come within its grasps. The masterly resume of the work performed and the influence which the work of the association has had upon the development of the locomotive engine, conveys deserved credit that has generally been ignored or overlooked by the powers that received the benefits from the work of the association. The recommendation that the American Railway Master Mechanics' Association should assume more intimate relations with the American Railway Association on questions arising in connection with locomotive construction and operation voices a desire and a necessity that has been growing yearly more urgent. The American Railway Association will exert powerful influence in the future with the people to prevent legislators from creating laws tending to inflict injury upon railroad interests. Many of the most pernicious measures threatened are for senseless elaboration of mechanical appliances that the men composing the American Railway Master Mechanics' Association are best able to show up as being useless, and in many cases the means of increasing the danger attending railway operations.

The reports and papers presented to the convention were unusually free from the perfunctory tone assumed when a committee is performing a disagreeable duty, or one considered of small importance. They were mostly rigorous, pushing into the heart of the subject, thereby bringing out the natural response of increased information in the discussions. The increasing sense of responsibility felt by the members of an association of mature years was seen in the tendency to attend to essentials and leave minor details to others. Subjects which would have held the attention of earlier conventions for sessions, are now profitably relegated to the care of the minor associations which have time and inclination to make the necessary investigations. This detail work is better performed by the Traveling Engineers' Association, the Air Brake Association, the General Foreman's Association and by others such as the Blacksmiths, the Boilermakers, all of which give mutual help to the railroads and to the men performing the voluntary duties.

Mr. Vaughan again raised the question of combining the Master Car Builders' and the Master Mechanics' Associations into one organization and the proposal appeared to excite cordial endorsement. There are some cogent reasons for effecting this combination, but from our past experience when similar propositions were brought up for action, we conclude that the time is far distant when the two shall be made one. The older race of master car builders are firmly opposed to the change and their sentiments on the question were fairly expressed in the opening address of President McKenna, of the M. C. B. Association. The incorporate standing of the Master Mechanics' Association with its property interests present difficulties not easily overcome. The time occupied by the two conventions could be shortened if one body performed the functions now done by the two, but the benefits derived would not be so great as they appear to the superficial observer.

The people who have the time and inclination to read the proceedings of the Forty-second Convention of the American Railway Master Mechanics' Association will find the reports, papers and discussions make interesting and profitable matter for study and reflection.

Saturated and Superheated Steam.

The use of steam or heated water as a medium for transforming the tremendous potential energy of fuel into mechanical work, has performed the modern miracles that have done so much to accelerate human progress since the day only two hundred years ago, when the blacksmith, Thomas Newcomen, first used the vapor of water to operate a piston enclosed within an oblong cylinder. The world has learned much concerning steam in the period that has elapsed since the inventor named first performed his epoch-making operation; but knowledge has accumulated very slowly since that time, and so many blunders and mistaken notions have been disseminated concerning the action of steam that many well informed engineers of this twentieth century have difficulty in distinguishing truth from fiction in popular explanations of steam phenomena. The whole question of superheated steam is a live one at the present time, and some of the brightest minds in the mechanical departments of our railways are engaged on it.

The disturbing action of cold on steam was so indifferently understood in Newcomen's time, that he used the power generating cylinder both as a vessel for applying the force of expanding steam and also for condensing the steam to create a vacuum. The inability of the industrial world to construct a boiler capable of resisting a pressure a few pounds greater than that of the atmosphere, compelled the first engine builders to use machines in which the vacuum created when the steam was condensed in the cylinder formed the principal medium of power. Ingenious Americans had devised methods of boiler making that rendered the high pressure, high speed engine possible. That was the kind of engine given by Oliver Evans to Americans at the time James Watt, of Glasgow, was working on the improvements of Newcomen's condensing engine. Had Watt devoted himself to the designing of a high pressure instead of striving to perfect the slow moving, ponderous low pressure engine, the world would have been provided with an engine adapted to modern conditions long before it was received.

The readiness of steam to condense under the action of cold and to create a vacuum under proper control that produced power, was first taken advantage of to devise a practical steam engine. The engine had not, however, been in use many years when it was discovered that the tendency of the steam to part with its heat seriously reduced the economy of the steam engine as a prime mover. All sorts of inventions and schemes were tried to restrain this tendency, but no effectual remedy had been discovered. James Watt was probably the first engineer to discover that steam condensed in the cylinder to an extent that materially reduced its economical operation. The producer that he considered most efficient in preventing cylinder condensation was steam jacketing of the cylinders. Watt and other early engineers recognized that the condensation of steam in the cylinders of slow moving engines had been so serious that it was a profitable move to pass steam from the boiler into a cylinder casing in order to keep the metal of the cylinder at a temperature approaching that of the boiler steam.

Steam jacketing having proved unsatisfactory, other remedies were resorted to. One of these that has been sufficiently successful to have imposed itself permanently upon some forms of the steam engine, is compounding. Advocates of this remedy reasoned that if steam was used successively in two or more cylinders, extremes of steam temperature would be avoided and condensation prevented. This theory has brought into use most of the compound engines now at work.

Compounding did not prove satisfactory with some form of steam engines, and the practice was resorted to of superheating the steam, so that it might enter the cylinders at a temperature which would stand some degree of cooling before the chilling effects of the cylinder metal would reduce it to the point of condensation. The indications are that superheating will be largely used with locomotives to prevent or reduce the losses due to cylinder condensation.

For a few years after locomotives were introduced, there was a belief that the high piston speed at which this form of engine was worked prevented the cooling of the cylinders to any injurious extent; but the famous engineer, David Kennear Clark, in a series of most elaborate experiments demonstrated that the locomotive with its exposed cylinders was peculiarly susceptible to refrigerating influences. The losses due to cylinder condensation were found to be most serious when the steam was used expansively and gave rise to Clark's expression, "expansive working is expensive working."

A paper by Professor Goss on "Saturated and Superheated Steam" was presented to the last Master Mechanics Convention, which described two elaborate series of experiments made on the Purdue University plant for the purpose of determining, first, the performance of a locomotive using saturated steam, and second, that of a locomotive using superheated steam. The paper is too elaborate for publication in these columns but we cordially recommend students of steam engineering to study it thoroughly. The results shown by the tests indicated that with superheated steam there was a saving of 21 per cent. in water consumption and a reduction of coal consumption of about 19 per cent. If that proportion of saving should be maintained with all superheaters that invention will be the most valuable money saving improvement ever applied to the locomotive.

The probabilities are that the saving from the use of superheated steam will be greater in road service than that shown on the testing plant. On the road the cylinders of a locomotive are more exposed to the cooling influence of weather conditions than they are in the protected house occupied by the testing plant and consequently there are greater opportunities for saving. Again, the surging of the water in a boiler rolling over a rough track or around sharp curves frequently finds its way into the dry pipe conveying wet steam that would make the superheated supply more efficient.

The discussion that followed the reading of the paper prepared by Professor Goss indicated that the practice of superheating the steam of locomotives has gained numerous friends during the last year. What was for a time regarded as a passing fad appears to have forced its way upon the favor of the railroad mechanical officials of this continent.

Book Notices

THE WESTINGHOUSE E-T AIR BRAKE INSTRUCTION POCKET BOOK. By W. W. Wood. Published by the N. W. Henley Publishing Co., New York. 250 pages. with 20 colored plates and numerous other illustrations. Ornamental cloth. Price $2.00.

The importance of a thorough knowledge of the details of air brake equipment to all who are engaged in locomotive service is such that every means of instruction calculated to attain that knowledge is eagerly sought after by the interested railroad man. In the perfecting of the Westinghouse air brake, what are known as the No. 5 and No. 6 E-T equipment, are of special importance as it is generally conceded that these clever devices will remain the standard engine and tender brake equipment for the future. In the work before us this new and important equipment is ably and elaborately treated. The author is well known as one of the leading air brake instructors in America. His style is lucid and well adapted to the limited knowledge of the beginner as well as to the more advanced in the study of air brake equipment. The colored plates accompanying the work leave nothing to be desired in point of illustration of the text, while the typography and presswork fully sustain the high character of the work of the enterprising publishers. We bespeak for the book a ready popular reception.

ENGINE LATHE WORK, by Fred H. Colvin. Published by the Hill Publishing Co., New York. 180 pages, with numerous illustrations, cloth. Price, $1.00.

The neat volume before us presents in a clear, practical manner what may properly be called good shop practice and should be welcomed as an aid to young men in acquiring a thorough knowledge of this most important machine. The work is divided into fourteen chapters and the style is such that is easily understood by the apprentice. The illustrations have all the characteristics that have long been a leading feature of the Hill publications. It may be added that even the most experienced mechanic will find something new, especially in the growing use of test indicators. We bespeak for the book an immediate and encouraging reception.

On the Trail.

"I'm gunning for railroads," announced the trust-buster.

"Then come with me," whispered the near-humorist. "I can show you some of the tracks."—*Southwestern's Book.*

No man can answer for his own valor or courage till he has been in danger.—*Rochefoucauld.*

Duluth and Iron Range.

The Duluth & Iron Range Railroad have recently placed in service four Consolidation type locomotives, which were built by the Baldwin Locomotive Works. These engines are intended for heavy freight service; they exert a tractive force of 42,670 lbs. and as the weight on the driving wheels is 176,600 lbs, the ratio of adhesion is 4.14. The adhesive weight is thus utilized to the full.

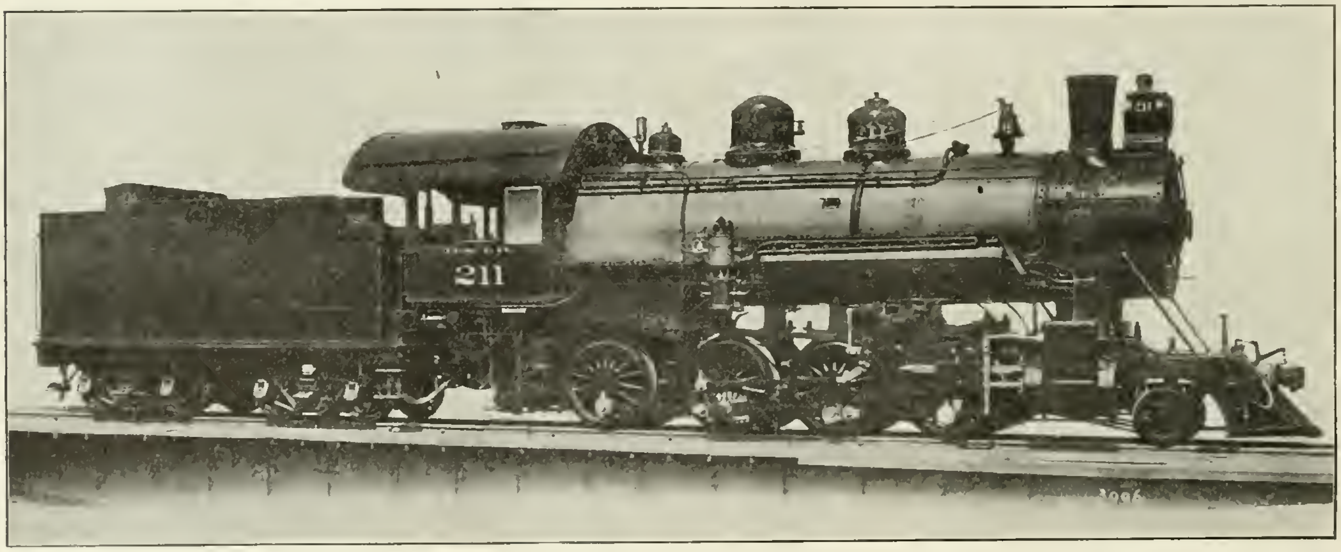
The cylinders are single expansion, and the steam distribution is controlled by balanced slide valves, which are driven by Walschaerts valve gear. The steam-chest center lines are placed 3½ ins. outside the cylinder center lines; with this arrangement all parts of the gear are in practically one vertical plane, and the combining levers are connected directly to the valve rods. The link bearings are supported on the guide yoke. All driving tires are flanged on these locomotives, and the main wheels have cast steel centers. The driving boxes are of steeled cast iron. The guides are forged steel, of the well-known Laird type, and the crossheads are of cast steel with bronze gibs.

The first and second pairs of driving wheels are equalized with the engine truck, while the two rear pairs are separately equalized on each side. Inverted leaf springs support the frames at the rear. The frames are of cast steel, 4½ ins. wide, with wrought iron front rails.

The boiler is straight-topped and has a wide firebox. It is radially stayed, with two T-bars supporting the front end of the crown. A brick arch, supported on water tubes, is provided. The firebox is built with a vertical throat and sloping backhead, and is supported on sliding shoes in front and a buckle plate at the rear. The barrel is composed of three rings, and in accordance with the practice of the builders, has a welded longitudinal seam under the dome, with a liner inside.

The tender is equipped with a water bottom tank and the frame is composed of 10-in. channels. The trucks are of the arch-bar type, with steel bolsters and chilled cast-iron wheels. Both trucks have side bearings. These engines are good examples of conservative designing, and should give satisfactory results in service. The principal dimensions are presented in the table.

Cylinder—22 ins. x 28 ins.; valve, balanced.
Boiler—Type, straight; material, steel; diameter, 74 ins.; thickness of sheets, 13/16 ins.; working pressure, 200 lbs.; fuel, soft coal; staying radial.
Firebox—Material, steel, length, 108 ins.; width, 66 ins.; depth front, 73 ins.; depth back, 61¾ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back ⅜ in.; thickness of sheets, crown, 7/16 in.; thickness of sheets, tube, ½ in.
Water Space—Front, sides, back, 4 ins.
Tubes—Material, steel; wire gauge, No. 11; number, 321; diameter, 2 ins.; length, 16 ft.
Heating Surface—Firebox, 168 sq. ft.; tubes, 2675 sq. ft.; firebrick tubes, 21 sq. ft.; total, 2864 sq. ft.; grate area, 49.5 sq. ft.
Driving Wheels—Diameter, outside, 54 ins.; journals, 9 ins. x 12 ins.
Engine Truck Wheels—Diameter, front 28 ins.; journals, 6 ins. x 10 ins.
Wheel Base—Driving, 16 ft. 2 ins.; total engine, 25 ft. 1 in.; total engine and tender, 54 ft. 8½ ins.
Weight—On driving wheels, 176,600 lbs.; on truck, front, 22,250 lbs.; total engine, 198,850 lbs.; total engine and tender about, 338,000 lbs.
Tender—wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7,000 gals.; fuel capacity, 11 tons; service, freight.



HEAVY FREIGHT 2-8-0 FOR THE DULUTH & IRON RANGE.
H. S. Bryan, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Origin of Nickname.

J. A. Fitzpatrick, Southwestern freight agent of the Clover Leaf-Alton, is responsible for the statement that when the trade mark of the Clover Leaf was first placed upon the equipment it was intended to represent a shamrock. Some Teutonic individuals, not being familiar with the difference, persisted in calling it a clover leaf, as a result of which they nicknamed the road accordingly.—*N. Y. Commercial.*

Bank and Level Firing.

At the last Master Mechanics' Convention Mr. E. D. Nelson, of the Pennsylvania Railroad, read a most valuable paper on Bank vs. Level Firing which excited keen discussion. The question of which method was preferable was brought up by certain engineers and firemen and the company decided to settle the matter by trials on the testing plant. The paper described the experiments and recounted the result which was in favor of level firing. On page 321 of this issue we give a brief synopsis of the report.

Distribution of Time.

Not long ago Mr. A. T. Dice, general superintendent of the Philadelphia & Reading Railway, issued instructions to the superintendents on the system to make a very careful analysis of the time-table schedules on their several divisions. The object of this was to make, where required, slight adjustments of time to accommodate actual operating conditions. It sometimes happens that what may be called the distribution of time over a portion of a road is hard to exactly live up to by the men on the road, though the total time between two given points may be all right.

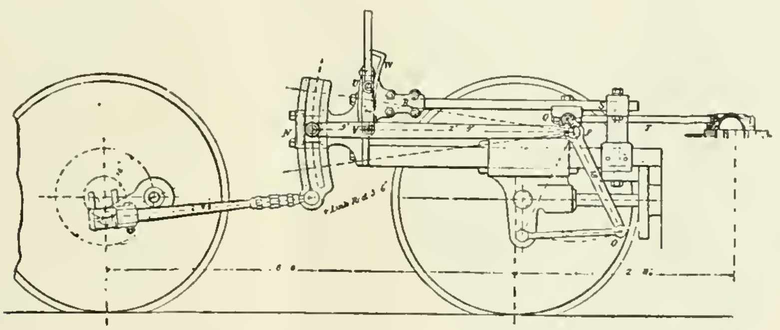
In making the analysis, the superintendents took up the matter with their subordinates, and in some instances the subordinates addressed letters to the enginemen and conductors and asked them for criticisms and suggestions. There was no general form of letter issued, as suggested in the daily press, but the desired information was obtained by each supervising officer in any manner that he deemed the best. This was either by writing or by personal interview. The method followed, however, was good, and the results thus attained were eminently practical.

Applied Science Department

The Walschaerts Valve Gear as Applied to Locomotives.

II.—Variations in Form.

It will be noted that the construction of the Walschaerts valve gearing as originally applied by the inventor to the locomotives of the Belgian State railways differs somewhat in detail from the forms in which it is now made applicable to twentieth century locomotives. These changes do not in any way affect the organic principles of the device, but are merely matters of convenience made to suit the increased size of the engines. Among the changes in form it will be observed that the original method of causing the radial link to oscillate on its central suspension stud was by an eccentric attached to the main axle to which a rod was attached, one end of the rod being fastened to the eccentric strap, and the other end attached to the lower end of the radial link. This eccentric was set at right angles to the main driving crank, that is while the piston would be at the extreme back end of the cylinder and the main crank pin consequently on the back center, the extreme point of the eccentric would be on the top center, or 90 degrees ahead of the main crank while the engine was running forward. It must be borne in mind that the original invention was applied to an outside admission D-slide valve. In the case of a modern locomotive equipped with an inside admission piston valve the eccentric would be set 90 degrees behind the main crank, that is on the bottom center. This change of position is made necessary from the fact that an inside admission piston valve must necessarily move in the opposite direction from that of the ordinary outside admission slide valve.



WALSCHAERTS VALVE GEAR, AS APPLIED TO LOCOMOTIVES BY WILLIAM MASON.

In addition to the change of position in the eccentric there is also a change necessary in the relative positions of the radius bar and valve rod, the outside admission valve requiring that the valve rod should be attached to the combination lever above the radius bar as in Walschaerts' original design, whereas with an inside admission valve, the valve rod attachment is made beneath that of the radius bar. The cause and effect of this change of position will be fully explained hereafter, the present reference being merely the need of calling attention in a general way to some apparent changes in the construction of the valve gearing, which in reality are not changes at all, but simply varying modifications of the same general principles.

With this idea in mind it will be readily understood that the eccentric fulfilled the same purpose in the original design as the return crank does that in the larger locomotives with the advantage that the crank being attached to the outer end of the main crank pin its motion can readily be imparted to the oscillating link by a rod moving in the same plane, thereby avoiding the necessity for extended attachments which would be necessary if the eccentric was attached to the main axle inside of the engine frames while the oscillating link would necessarily be at some distance outside of the frames.

Other changes of less importance have occurred, among which is the placing of the lifting shaft above the frames so that the radius bar is hung by a short hanger or suspended by an adjustable sleeve, instead of being sustained by a bar from beneath which in the case of the modern locomotive would be of considerable length and add to the degree of unwieldiness of the mechanism.

Among the first to adopt the Walschaerts valve gearing to the expanding form of the modern locomotive was William Mason, an American engineer. The changes in the position of some of the parts of the mechanism made by him have been closely followed by subsequent engineers. In his application of the device he not only made the valve rod adjustable by the use of threaded ends on the valve rods on which nuts were movable to equalize the position of the valve, but he also applied turn buckles to the eccentric rods so that the inevitable wear of the return crank bearing could be readily rectified in case of the lengthening or shortening of the rod occasioned by the refitting of the brasses.

It will be noted that in the modern use of the radial link there is an attachment extending beyond and underneath the bottom of the link. This attachment is variable in extent, and is adapted to form a suitable connection for the eccentric rod. The exact location of the connecting point must be carefully considered by the constructor on account of the relation of the amount of throw of the crank to the travel of the valve. In ordinary practice a locomotive with a piston stroke of 28 ins., would have a valve stroke of 5½ ins., while the path of the return crank would describe a circle 12 ins. in diameter. The center of the eccentric rod attachment to the link would thus be describing an arc 12 ins. in length while the radius bar being considerably nearer the centre of the link would move through a smaller arc which continues to grow smaller if the radius bar is moved towards the centre of the link.

In the construction of some kinds of locomotives there are two lifting shafts connected by a transmission bar. It will be readily found that variations of this kind are made necessary in order to accommodate the location of other parts of the engine, the additional lifting shaft not in any way affecting the action of the valve gearing.

Such briefly are the principal changes in form which have occurred in Walschaerts valve gearing since its original introduction. These changes illustrate its ready adaptability to changing conditions and stamp it as one of those few mechanical contrivances that have come to us as nearly perfect as any kind of mechanism involving the changing of circular motion in some parts to linear motion in other parts can be expected to be, and not surpassed in the fine quality of reliability.

Celebrated Steam Engineers.

WILLIAM MASON.

The question of utility was of such paramount importance among the early builders of the locomotive that the question of beauty or elegance in design did not seem to occur to them. The first attempts at softening the terrifying spectacles took the form of lurid paintings evidently intended to gladden the hearts of the amazed beholders, as the bedizened paraphernalia of a traveling circus delights the eager urchins of our own day. The glitter of burnished brass ran riot around the boilers and up the lofty smokestacks. The blows of circumstance showed heavy upon them like the spear thrusts on the battered shields of ancient warriors. At the best their gaudy gorgeousness was in poor taste. When the teeth of time began to leave cruel marks upon them they were a sorry sight. The walls of the cabs and the sides of the tanks were the canvasses for the magic brushes of embryotic scenic artists, and although the picture galleries of art museums contain much work that is no better, it must be admitted that the winter wind made quick and sad havoc on the glowing faces of these gay landscapes.

William Mason, a manufacturer of cotton machinery at Taunton, Mass., changed all this. He began building locomotives in 1852, and it was immediately recognized that a genuine artist had arisen in locomotive construction. In his skilled hands the locomotive took new and beautiful form. In the proportion and symmetry of the parts he was an ideal architect. His American type of locomotive has not been improved upon. His painting ran into dark green and gold and defied the elements. Not only in form and color, but in organic principles he wrought many enduring changes. He placed the cylinders on the same plane with the centers of the driving wheels. He made the front ends of the frames separate, greatly facilitating frame repairs. His engine wheels were made with hollow spokes and rims and he instituted the counterbalancing of driving wheels with lead. He introduced spokes into the truck wheels and set them symmetrically apart from the cylinders. He placed the lifting shaft over the frames suspending the links from above, and by his fine adjustment of the link hanger to correspond in length with the rocker arm he prevented much of the irregular slip of the link block. He introduced conical ended staybolts for the crown sheets. He designed the arrangement of wedges in the pedestal jaws for driving wheel boxes. He placed a straight shoe on the front of the driving box and a movable wedge on the back of the box. He changed the awful smokestack into an elegant diamond pointed structure. His wagon top boiler was the most popular form for half a century. Even his failures have the element of perennial vitality in them, his short lived double-ended locomotives appearing at intervals until it now assumes what is spoken of as the Mallet type.

In this latter regard Mr. Mason's introduction of the Walschaerts valve gear into American practice is of real interest as showing his fine appreciation of that masterly invention. At the Centennial Exhibition, held in Philadelphia in 1876, he exhibited a locomotive equipped with this gearing. It was a narrow gauge locomotive and ran around the grounds, conveying passengers in a train of cars. It largely resembled the fine locomotives now in use on the Boston, Revere Beach and Lynn Railroad. The mechanism was faultless, and although the locomotive attracted great attention, Mr. Mason seemed to be the only American mechanic of prominence who recognized the real value and importance of the clever work of the Belgian inventor. He applied it to other locomotives, and urged its adoption. Strange as it may seem, it was said to be strongly opposed by locomotive engineers who seemed to take some mysterious delight in constantly and needlessly experimenting with the lead of the locomotive valve gear, the Stephenson shifting link lending itself readily to such unnecessary changes, when the eccentrics were simply held in position by set screws, and the eccentric rods slidably engaged by bolts in slotted holes.

WILLIAM MASON.

Mr. Mason's repeated attempts to introduce the Walschaerts valve gear were not successful to any appreciable extent, but the recent rapid and general adoption of the gearing justifies the excellent judgment displayed by him in regard to it, and adds greatly to his good name in showing that he was not only a beautifier and improver of the locomotive, but he had the fine faculty of discerning merit in the work of others. He had the true prophetic vision in regard to the essential ultimate forms in locomotion construction. He was a man of great intellectual strength. He had rare artistic sense. He was among the most accomplished American engineers of the nineteenth century, and there is not a locomotive in America to-day that does not bear the marks of the master mind of William Mason.

Mason and the Walschaerts Gear.

Editor:

For the June number, the article on "Celebrated Steam Engineers" speaks of Egide Walschaerts. I was for some time quite positive that this valve motion was first introduced into this country by the late William Mason, of this city, but I find that previous to about 1873 this valve motion was used on two locomotives on the Lehigh Valley R. R. As Mr. Mason built a great many engines for this road, it is probable that he saw them then, and finding it difficult to put the ordinary link motion on his bogies he adopted it. He first tried it on an engine named after himself, for the New Bedford & Boston R. R., which was leased to the Boston, Clinton & Fitchburg before the engine was finished. The engine left his shops as belonging to and built for the B., C. & F. R. R. She was a bogie 4 ft. 8½ ins. gauge. Owing to construction of this and other bogies he placed the tumbler shaft on top of his boilers. I doubt if he approved of it, but it was the easiest way out of the difficulty. His idea was so intense for grace and beauty of design that the placing of the tumbler shaft on top of the boiler must have been distasteful to him. As the writer well says in the June number, "it was looked upon more as a fantastic curiosity," and it may have been ahead of its time. I can't help but feel that the use of the Walschaerts valve motion is a fad to-day, like many other things in use on railroads and elsewhere.

If this valve motion was ahead of the times, certainly Mr. Mason's bogies were, and it was after the Mason people decided to give up locomotive building, that many inquiries were made for them. The patterns were loaned to other builders. An amusing incident in the construction of some bogies by a company to whom the patterns were loaned was that when the engines were delivered and put together they went backward when they wanted to go forward. The head of this company was one of those consummate know-it-alls who thought anyone could set a Walschaerts valve gear.

HERBERT FISHER.

[Our esteemed correspondent will note that in our reference to Mr. William Mason in the May number of RAILWAY AND LOCOMOTIVE ENGINEERING we spoke of him as being among the first to introduce the Walschaerts valve gear in America. The application of the gearing to the Lehigh Valley locomotives referred to is fully described in "Development of the Locomotive," by Dr. Sinclair, on page 317. —EDITOR.]

Questions Answered

FOREMAN OF MACHINES.

49. Subscriber, Covington, Ky., asks What number of machines in a railroad machine shop would justify a machine foreman being placed over same?—A. This question cannot be answered as it stands, because it is not the number of machines that determines the presence or absence of a foreman. In any shop organization, large or small, there must be a responsible head. In the army, the smallest party is composed of a corporal and two men, the corporal being in charge when sent to execute any command, but he is in the ranks himself. If you mean whether or not the foreman or chargeman or whatever you call him shall work or not, that is a matter which has to be decided by a knowledge of the kind of shop, the sort of work to be done and the character of the men employed.

WESTINGHOUSE AIR BRAKE CO.

50. S. A. C., Scarborough, asks: How does the Westinghouse Air Brake Company get the benefit of their enterprise? Is it by selling their apparatus or collecting a royalty?—A. By selling the apparatus.

EVAPORATION OF WATER.

51. J. B. M., Youngstown, Ohio writes: What is the average amount of water evaporated by the burning of one pound of coal in a locomotive?—A. Much depends on the kind and quality of the coal used. With ordinary anthracite coal, nearly 7 pounds of water will be evaporated in the burning of each pound of coal. With fairly clean bituminous coal nearly 8 pounds of water will be used for each pound of coal. The condition of the locomotive also has considerable effect on the combustion of coal and consequent evaporation of the water.

TRACTIVE EFFORT.

52. Apprentice, Susquehanna, N.Y., asks: How is it that a locomotive with small driving wheels can start and pull a heavier train than one with larger drivers? A.—In the case of two locomotives with the same steam pressure, diameter of cylinders and length of stroke, the locomotive with the smaller driving wheels would pull the greater load because greater leverage would be had in turning the wheels. It will be readily seen that the distance from the center of the crank pin to the center of the axle is greater in comparison to the distance from the center of the axle to the rail in the case of the small wheel than it is in the large one. It must be remembered that what the smaller drivers appear to gain in strength they lose in velocity.

STATIC TEST FOR TENSILE STRENGTH.

53. J. B., Altoona, Pa., writes: In your issue of June I observed an interesting advertisement in regard to Vanadium steel, and reference was made to what is called a static test. How is this test made?—A. Ordinary tests of the strength of metals are made by submitting the piece of direct pull, direct compression, bending or torsion. Testing machines are arranged so that they may apply any of these four modes of stress. When the load is increased to a value exceeding the elastic limit of the piece of metal tested, the metal will be seen to draw, if the stress be one of pulling apart, at first rapidly and then more slowly until rupture occurs. The ultimate strength of metals are well known, but the constant improvements in metals, especially in the manufacture of steel, render these figures liable to change. Ordinary steel resists a strain of 30 tons per square inch. The data recorded in such tests is, of course, the ultimate strength or breaking load of the specimen, the percentage of elongation and the percentage reduction of area.

Brick Arches and Water Tubes.

There is great diversity of opinion among the railroad mechanical men of this country concerning the value of brick arches in locomotive fire boxes. Mr. J. F. Walsh, of the Chesapeake & Ohio, holds very pronounced views in favor of the brick arches which were thus expressed in a paper submitted to last master mechanics' convention.

Not considering for the moment the many desirable features in the use of the brick arch in locomotive fire boxes, we will consider only water tubes which are applied primarily for the purpose of carrying the arch bricks. In the four three-inch water tubes which are used in the fire boxes of our locomotives we have a total heating surface of about 26 sq. ft., which aids materially the steaming qualities of the engine, if considered alone.

Again, in the wide fire box locomotives with a grate surface of practically 50 sq. ft., the rapid deterioration of side sheets has been the cause of complaint, due to the buckling and cracking of those sheets at a point close to the flue sheet and crown sheet. With a total of 250 of that type of engine in service, some of them in service for the past six years, we have had little cause for complaint concerning defects in our side sheets as noted above, which we believe is due to the fact that our arch tubes assist very materially in the circulation of the water, and by that means avoids the overheating of the side sheets. Therefore, I believe that the arch tube itself independent of any other feature connected with it is a desirable addition. We provide ample means for keeping the tubes clean by placing hand hole plates in the boiler head and in the throat sheet in front of the water tube openings. These are taken off each time the boiler is washed and the tubes are thoroughly cleaned.

In a test recently made on one of our divisions we proved that by the use of the brick arch we can save 20 lbs. of coal per mile as compared with the operation of the engines without the brick arch. Where the brick arch is used the locomotives steam much more freely than without the brick arch, and we are enabled to keep up full boiler pressure regularly. The use of the brick arch enables the fireman to maintain the maximum boiler pressure regularly. Without the brick arch this cannot be done when the engines are worked to full capacity. Therefore, without the brick arch we cannot haul full tonnage, consequently by the use of the brick arch we increase the earning capacity of the locomotives and of the railroad. Our brick arches cost us on an average of 30 cents per brick; using ten bricks in each engine means a total cost per engine for arch brick of about $3. A saving of 20 lbs. of coal per mile will mean a saving of 2,000 lbs. of coal per hundred miles, and with coal costing us approximately $1.50 per ton we can save the price of the brick arch in a round trip by the saving in coal, and not considering the increased efficiency of the engine.

It would seem quite superfluous to add that by the use of the brick arch we obtain very much better combustion of fire-box gases and reduce the quantity of smoke emitted. The same is quite true of the quantity of sparks emitted, as the brick arch serves as a baffle to the escape of the cinders, retaining them in the fire-box until consumed, resulting again in better fire-box efficiency and reducing as well the danger from fires along the right of way. Our transportation officials and our enginemen and firemen complain if our supply of arch brick becomes exhausted, or if for other reasons we have to operate our engines without arch brick. Dependent on the quality of the brick and the frequency that it has to be removed for flue or other repairs, a set of brick in our heavy locomotives will last from two to six weeks. Where the quality of the brick is good it may be removed to permit of work being done and used over several times.

Air Brake Department

Conducted by G. W. Kiehm

Leaky Graduating Valve.

In view of some of the theories that are advanced, and from some of the questions that are asked on air brake subjects, it is plainly evident that many men whose duties bring them in contact with the air brake, are inclined to memorize that which they hear and read rather than to apply it practically and use their own observation and reasoning powers. Too often expressions such as "leaks in the train line pipe set the brake," and "leaks in the auxiliary reservoir release the brake," are taken for granted and given no further thought, and while they have a tendency to result in those effects there is no assurance that they will do so under all conditions. Very often the effects of a disorder in one part of the brake system depends so much upon the condition of some other part that its action is very uncertain, as in the case of a leaky graduating valve in the distributing valve.

This valve leaking should not be associated with "brake leaking off," "brake releasing," "brake applying in full," or "blow at the brake valve exhaust port," for a leaky graduating valve alone in the H6 distributing valve can have no noticeable effect whatever whether the engine is handling the train brakes or being hauled in the train, and a leaky graduating valve could seldom be detected, except by an examination. To reason out how a leaky graduating valve effects the movement of the equalizing piston and slide valve and the result, it is well to compare the action of the application portion of the equalizing valve with the action of a triple valve, and assuming that a brake equipment on a locomotive is in good condition, there being no rotary valve, brake pipe, equalizing slide valve, or pressure chamber leakage and that the equalizing valve is properly lubricated and working freely in its bushings, consider the movement of the equalizing piston and slide valve when the brake pipe pressure is reduced 5 or 10 lbs. by placing the brake valve handle in service application position and returning to lap position. The equalizing valve and piston will be promptly moved to service position being held there by the graduating spring, and during the movement the equalizing valve piston, to which the graduating valve is attached, will at the same time close the feed groove and open the graduating port in the slide valve by drawing the graduating valve away and the port will fill with pressure chamber air, and as the port is opened the shoulder of the piston stem engages the equalizing slide valve, drawing it to service position, and its first movement draws the exhaust cavity of the slide valve away from the port leading to the application cylinder and brings the service port to register with it, expanding pressure chamber air into the application cylinder until pressure chamber air has reduced slightly below brake pipe pressure, when the equalizing valve will be moved to service lap position. When the brake pipe pressure is restored the valve will be moved from service lap to release position, the first effect of the movement being to sever communication between the graduating port and the application cylinder port, and it is here that the effect of a leaky graduating valve is overcome, not by design but by a necessity of construction to insure a correct operation. The final effect of the movement toward release position is to open the feed groove and to bring the application cylinder port in communication with the exhaust cavity of the slide valve, and there is of necessity sufficient space between the graduating port and the exhaust cavity in the equalizing slide valve seat to permit of the graduating port being lapped before the exhaust cavity is opened to the application cylinder, if it were not a slight movement of the equalizing valve from release toward application position would admit air from the pressure chamber to the application cylinder, thence through the exhaust cavity to the release pipe, which might be very undesirable if the engine was being hauled among a train of cars.

From the foregoing it will be observed that if the graduating valve of the distributing valve is leaking, the flow of pressure from the pressure chamber to the application cylinder will not be cut off perfectly after a light reduction when the equalizing valve assumes service lap position and the remaining pressure chamber air will be reduced by expanding into the application cylinder, the brake pipe pressure remaining constant will force the equalizing valve toward release position until the graduating port no longer registers with the application cylinder port and the slide valve will then prevent any further expansion of pressure chamber air, and the valve will remain in this position until again moved to application position by a further reduction of brake pipe pressure or to release position by an increase of brake pipe pressure. Thus its leakage has no noticeable effect so long as it is influenced by no other disorder, and at a first glance it would appear that the valve is superfluous, but it is necessary to render the equalizing valve sensitive to the second or subsequent service reductions of brake pipe pressure, for by the use of it only the frictional resistance incident to the movement of the piston and graduating valve is encountered during brake pipe reductions following the first movement, and the slide valve on one side and the graduating spring on the other act as a stop to limit the travel of the piston instead of encountering the additional friction that would result from a movement of the slide valve during every graduated reduction of brake pipe pressure.

This action of the leaky graduating valve in allowing the slide valve to be forced to a position between service lap and release would occur only after reductions of less than 20 lbs., assuming that the brake pipe pressure is at 70 lbs., or at any brake pipe pressure, it would occur only up to the time the pressure chamber, application chamber, and application cylinder pressures have equalized, and if the equalizing slide valve did not move freely, or was inclined to start with a jerky or jumping movement, due to an improperly lubricated wearing surface, the valve would undoubtedly jump to release position instead of stopping in the half-way position, and in jumping to release position could not release the brake as the release pipe is closed by the automatic brake valve rotary when the handle is on lap position, and about the only noticeable effect it would have would be to render the distributing valve less sensitive to service reductions.

Again if the slide valve and its seat were properly lubricated and the piston worked freely in the bushing and the valve assumed this half-way position, due to graduating valve leakage, the valve could not stay in this position if there was a slight leak from the pressure chamber to the atmosphere or from the equalizing slide valve seat into the release pipe which is practically the same thing, as the valve would then be moved to release position by the leakage from the pressure chamber. Suppose again that the graduating valve leaked slightly and the equalizing valve packing ring leaked a like amount, after the equalizing valve assumed service lap position after a light brake pipe reduction the graduating valve leaking into the application cylinder and the pressure chamber being supplied from the brake pipe past the leaky packing ring would result in an equalization of application cylinder, pressure chamber and brake pipe pressures.

This effect should not be confounded with brake pipe leakage or with a leak from another source, such as from the equalizing slide valve seat or from the rotary valves of either brake valve, which would cause a blow at the automatic brake valve exhaust port when the handles of the brake valves are in running position, and before a leaky graduating valve is tested for, all other leaks or blows must be corrected first, and it will be remembered that with all other parts in good condition a leaky graduating valve will scarcely have any noticeable effect, and it might appear therefore that it did not matter whether the valve leaked or not, but such is not the case for as soon as the equalizing valve does not work perfectly free, or any slight disorder would assist the leaky valve to reduce pressure chamber air in service lap position after a slight reduction, and the valve would move to release position, and while not resulting in the release of the driver brake on the engine handling the train brakes, it would release the engine and tender brake if the engine were elsewhere in the train with the brake valve cut out and the handles in their proper positions. Therefore, as the leaky graduating valve that results in the equalizing valve being forced to release position has no particularly bad effect on the engine from which brakes are being operated but does effect a release of the brake on an engine that is the second one in double heading or that is being hauled in a train, it is evident that the disorder should be tested for occasionally during the regular trip inspections so that it can be corrected before the engine is assisted by another in double heading a train, and the following test is submitted to determine whether the equalizing valve will be forced to release position, due to a leaky graduating valve after a light reduction.

"With proper brake pipe and main reservoir pressures and no noticeable leakage from the automatic brake valve exhaust port, from the pressure chamber of the distributing valve, from the brake pipe, or through the brake pipe feed valve, with the independent brake valve in running position place the the automatic brake valve in release position until the brake pipe and pressure chamber are charged to main reservoir pressure, then place the brake valve in service application position until the brake applies, and return handle to running position. If the brake releases shortly afterward, the application cylinder pressure escaping at the automatic brake valve, it indicates a leaky graduating valve that will result in the release of the brake when the engine is the second one in double heading or being hauled in a train."

In this test of overcharging the brake pipe and placing the brake valve handle in running position in which position air can enter the brake pipe only by the way of the feed valve pipe, which is controlled by the feed valve, but no pressure could enter the brake pipe by this route as the pressure is higher than the adjustment of the feed valve, and none could enter until brake pipe pressure fell below the adjustment and in the meantime the brake valve, being in running position, would have the release pipe open to the atmosphere. A light brake pipe reduction from the automatic brake valve would apply the brake, and with brake pipe pressure constant and the valve handle returned to running position, a leak from the pressure chamber would release it, application cylinder pressure escaping at the automatic brake valve, then knowing that there is no leak from the pressure chamber to the atmosphere or from the equalizing valve into the release pipe, it would be safe to assume that the pressure chamber leak which released the brake was through the graduating valve.

However, if the indications of the test are not entirely satisfactory, or if for any reason proper pressures could not be obtained, a second test would be advisable.

"With any brake pipe and reservoir pressure above 50 lbs. and with no perceptible leakage out of, or into, the brake pipe and no leaks from the pressure chamber to the atmosphere, or from the exhaust port of the automatic brake valve, make a light service reduction returning the valve handle to lap position, remove the safety valve from the distributing valve, and with the equalizing valve in service lap position there should be no leaks into the cavity from which the safety valve was removed. If there is, it is from the graduating valve, assuming that the equalizing slide valve is tight."

Although the construction and operation of the H6 and H5 brake equipments are necessarily somewhat different, all that has been said concerning the effect and tests for a leaky graduating valve in the H6 equipment applies to the H5, with the exception of the first test mentioned, the second test applies to either, and for a test similar to the first that can be applied to the H5 brake the following could be used:

"With any brake pipe and main reservoir pressure above 50 lbs. no leaks from the pressure chamber or equalizing slide valve, and the brake pipe reasonably free from leakage, place the automatic brake valve handle on lap position and close the stop cock in the brake pipe under the brake valve, and by means of an angle cock make a light application of the brake, closing the angle cock as the brake applies. If the brake pipe pressure remains constant and the brake remains applied there is no leak of pressure chamber air to the atmosphere or from the pressure chamber to the application chamber, assuming that the equalizing valve packing ring divides brake pipe and pressure chamber air.

"If the brake releases shortly after the application, the application chamber pressure escaping at the automatic brake valve exhaust port, it indicates that pressure chamber air has leaked past the graduating valve into the application chamber causing the equalizing valve to be moved to release position."

By placing the automatic brake valve handle on lap position and closing the stop cock in their brake valve branch pipe no air could enter the brake pipe from the brake valve, and the exhaust cavity of the equalizing slide valve would be open to the atmosphere through the double heading cock and the emergency exhaust port of the automatic brake valve.

Let it not be inferred that in the second test that the safety valve could be removed and the brake applied with a graduated reduction of brake pipe pressure, but the brake can be applied with a light reduction and the safety valve can be removed afterward without disturbing the application chamber pressure. The duty of the graduating valve, when the equalizing valve is in service lap position, is to cut off the flow of air to the safety valve with the same movement that it cuts it off from the application chamber, and failure to do so would allow the leak into the safety valve passage.

The equalizing slide valve could also leak into this passage, but as stated previously, before testing for a leaky graduating valve the equalizing slide valve must show by test or observation to be free from leakage.

Anger effects nothing it goes about, and hurts the man who is possessed by it more than any other against whom it is directed.

Be happy in the good you have won, and in the good you do.—*Haunted Man.*

Electrical Department

Automatic Block Signals.

By W. B. Kouwenhoven.

On any road on which large earnings are to be derived and over which there is plenty of traffic, the problem that presents itself is how to move the maximum number of trains with the greatest degree of economy and safety. In this country the traffic has increased at a rate that is far in advance of the trackage, and one of the most efficient methods of handling the heavy traffic is a good block system.

The early block systems of this country were all manually operated. In the days when the station agent was ticket agent, baggage man, freight handler, telegraph operator and man of all work, it was thought good to let him handle the block signals while he was resting. But as traffic increased the station agents became too busy to handle the signals, and as the stations were not close enough together to serve as block stations, it was found necessary to install towers for handling the signals. The cost of these towers was about $1,000 apiece, and the wage cost ranges from $1,000 to $1,500 per year.

The next step was to equip the roads with block signals which were automatic in their action, and which depended for their operation upon either the presence or absence of a train in the section. These automatic signals were so constructed that in case of the breaking of a rail or any damage to the signal mechanism, the semaphore would immediately assume the stop position. Automatic block signals are of necessity of the premissive type, because if a signal is out of order and assumes the stop position, traffic must not be suspended for several hours. This is not a serious objection on double track roads where a train after waiting at a stop signal the prescribed time, usually one minute, may proceed cautiously, expecting to find either a broken rail or a train in the block. On single-track roads, however, a flagman must be sent ahead before the train can proceed, in order to protect it from a train approaching in the opposite direction.

Automatic block signals have not met with much favor on single-track roads, because of this fact, and are not used to any great extent by them. Nevertheless the Harriman lines have installed several thousand miles of block signals on their single-track roads, and believe they have been warranted in doing so because of the number of broken rails that have been reported by the automatic signals. This article will consider only the operation of block signals on double-track roads.

Length of Block.

The minimum length of a block is the greatest distance in which any train on the road can be stopped. This distance varies with the contour of the road and the weight of the trains that are handled. In practice the length of the block is usually from 4,000 to 12,000 ft. These are shortened as the terminals with their congestion of traffic are approached. The control of the automatic block signals is such that it not only warns the engineer that the block ahead is occupied, but warns him in time to stop his train before reaching the entrance of the occupied block. In order to accomplish this every

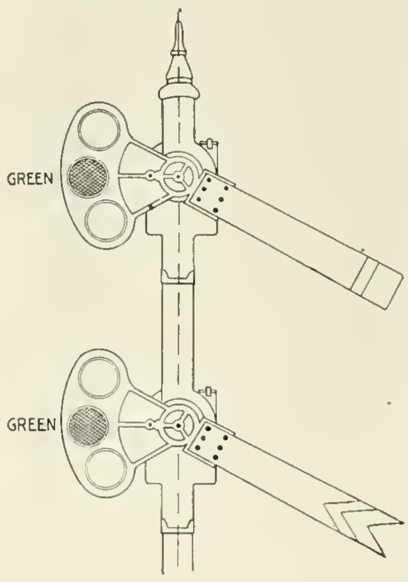


FIG. 1.

block is provided with two signals, one at the entrance of the block, called a home signal, and the other at a considerable distance to the rear, called a distance signal. The home signal is in the stop position when a train occupies the block, and the distance signal is in a caution position, serving to warn the following train that the block ahead is occupied. By means of this arrangement of signals two trains starting two blocks apart and both running at the same speed, will reach their destination two blocks apart. The second train will have clear signals all the way unless the first train stops, and then the distant signal will warn the engineer of the second train, thus giving him ample room to stop before reaching the occupied block.

Arrangement of Semaphores.

On roads where the blocks are very long, home and distance semaphores are sometimes mounted on separate posts. This, however, is not customary, and usually both home and distance signals are on the same post.

Both Signals on One Post.

Fig. 1 illustrates a block system with the semaphores mounted on the same post. The ends of the home semaphore arms are square, while those of the distance semaphore are notched. They are usually painted differently, and different colored lights are used at night. A train is in block A, and is proceeding across the page to the right. The home semaphore, A, at the entrance of the block, is in the stop position, and the distance semaphore, A, at the entrance of the preceding block, is in the caution position. The home signal, B, and the distance signal, B, are both in the proceed position, Fig. 1.

Some types of block signals use only a single semaphore arm for both home and distance signals. The semaphore is then known as a three-position signal. When the semaphore is in its horizontal position it indicates stop, the block is occupied, in its 45 degree inclined position it serves as a distance caution indication, and in its vertical position it indicates proceed.

The semaphore arms are so arranged with counterweights that the signal tends to return to the stop position, even when covered with ice or snow.

The Track Circuit.

The track circuit is the principal element of any automatic block signal system, and it is also the weakest. It is extremely simple to form the blocks or sections. All that is necessary is to remove the fishplates from the rails at both ends of the section, replacing them with one of the many forms of insulating joints that are on the market, and bond the intermediate rails together with No. 8 galvanized iron wire. Then connect a battery across one end of the section and an electro magnet or relay across the other end, where the signals are. When there is no train in the section the current from the batteries will flow down one rail through the electro magnet and back to the battery through the other rail. The relay is provided with a pivoted armature, which is attracted by the relay, against the pull of gravity. This armature carries contacts which serve to actuate the semaphore arms. When a train enters the section or block its wheels on the rails offer so little resistance that practically all the current flows through the short circuit formed by the wheels and axles of the train, and the relay does not get enough current to hold up its armature. The armature drops, causing the semaphore to go to the stop position. In case of the breaking of a rail, the track circuit will be opened and the semaphore assume the danger position, because the armature of the relay will fall.

Although the track circuit is so very simple, it is extremely difficult to make it work under all conditions. There is no insulation between the rails, but the ties, and these become conductors in wet weather, allowing a large part of the current to leak from one rail to the other. It does not take much current to operate the relay, but it is a very difficult matter to hold onto that small current throughout 5,000 ft. of track. The relays must also be inclosed and sealed so that no one can tamper with the adjustments, and so that moisture cannot get in and short circuit the contacts. They must also be protected by high grade insulation, and a first-class lightning arrester must be provided.

CLASSIFICATION.

Automatic block signals may be classified in two ways, the one depending upon the railroad system, and the other upon whether direct or alternating current is used to operate the signals. We will consider the automatic block signal systems in the following order:

(1) Signals operated by direct current on steam roads.

(2) Signals operated by alternating current on roads where direct current is used for the propulsion of trains. (a) the single rail system, (b) the double rail system.

(3) Signals operated by alternating current on roads where alternating current is used for the propulsion of trains.

DIRECT CURRENT CIRCUIT.

Automatic block signals on steam roads are usually operated by direct current, and either the track circuit is employed throughout or else live wires are used to operate the distant signals.

The use of the track circuit for operating all the signals by direct current, is what is known as the polarized system. Block A represents the last block of the system. The home signal A is controlled by a relay and battery. When a train enters section A it short circuits the track relay causing the armature to drop, and the home semaphore A immediately goes to the stop position. The home semaphore in going to the stop position shifts the pole changing switch or pole changer to the new position. This pole changer reverses the direction of the current supplied to the section B. The relay is a combined neutral and polarised relay which is provided with two armatures.

One armature depends for its operation upon whether there is a train in the block or not, and is similar in action to the neutral relay at A. The armature is magnetized, and will respond to current in one direction only. One armature controls the home signal B and the other the distance signal A. Now when the home signal A goes to the stop position it reverses the polarity of the current supplied to the rails, as was stated, and the relay R will attract the magnetized armature and the distant semaphore A rises to the caution position. When a train leaves section A the relay R will attract its armature, and cause the signal arm to fall to the proceed position, and shifts the battery connections to their original position, thus releasing the armature and returning the distant semaphore A also to its proceed position. It will be noticed that when the polarity of the track battery is

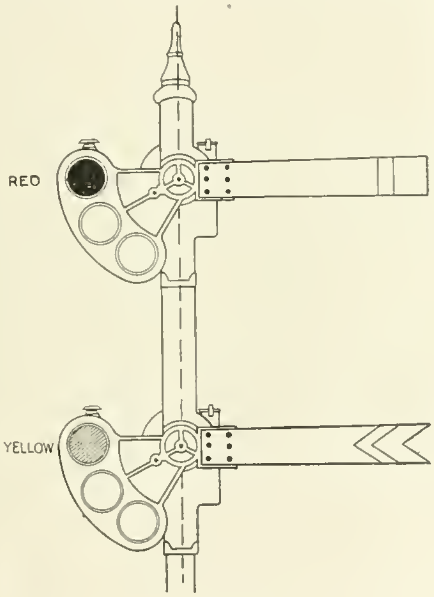


FIG. 2.

changing, the circuit will be opened for an instant, and the home signal at B would go to the stop position, because there would be no current for the relay R. This is prevented by applying an additional coil to the relay R, which will momentarily hold the signal B in the proceed position.

The method of using line wires does away with the pole changing switch, and the polarized relay at B. An additional contact is placed on the relay R which is connected by line wires, which are strung on the telegraph poles to a relay at B. This relay in turn actuates the distant signal. Two relays are required at B by this method, one for operating the home signal and the other for the distance signal. The line wires are protected by the lightning arresters, but even then the distant semaphores are sometimes out of commission. For this reason the control of home signals by line wires has not met with approval.

Switch and sidings are made a part of the main track circuit up to the fouling point in order to protect trains on the main track from cars which they may not clear. Miniature semaphore signals are located at the switching points, which indicate when a train on the main track is approaching two blocks or sections away. When a switch is thrown to permit a train to leave a siding and enter the main line it short circuits the two rails, takes the current from the relay and sets the signals to the stop position.

When the block is too long to be operated by a single battery, the section is broken in two and a relay which is similar to the ordinary telegraph relay is employed to repeat the signal from one part of the section to the other. Usually from 3,000 to 5,000 ft. can be operated in a single section.

The batteries which operate the signal mechanism consist of 16 cells of caustic potash primary batteries connected in series and carefully housed. The track batteries consist of two or three gravity cells, such as used in telegraph work. The cells are connected in parallel. Storage batteries are sometimes used, but they require regular charging and a good deal of attention. It costs about $750 to $1,200 to install a block section, and from $75 to $100 a year to maintain a two-arm signal per year.

How It Really Happened.

A brakeman from Missouri with "mitts' on him that resembled two canvassed hams, and a swagger that would have tempted a sailor to keel over and pass up his proud spirit out of sheer envy, was recently called before Superintendent Given of the Des Moines Valley Division for his version of an accident that happened to his train while pounding over the iron near Eldon some time ago.

"It wuz this way, Mr. Given," he began, taking an extra reef in his trousers. "We wuz mopin' 'round the curve at about a sixty-five per when I spied a stack of reds on the main. I give the grand hailin' sign of distress and notified the skillet head on the head end. He trowed her in de breechin' on two pipes of seashore. He give her de secret works and commenced to sound de bugle call. Then I makes a high dive and disappeared in de atmosphere."

Mr. Given remarked that if it all happened as the Missouri brakeman had stated, he presumed it was an act of Providence and not the slightest chance of neglect attached to the highly intellectual crew.—*The Railroad Trainman.*

The other-people's-business man persisted in trying to extract information from a prosperous looking elderly man next him in the Pullman smoker. "How many people work in your office?" he asked. "Oh," said the elderly man, getting up and throwing away his cigar, "I should say, at a rough guess, about two-thirds of them."—*London Opinion.*

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION

Address of Mr. H. H. Vaughan, President

In 1868 six master mechanics attending the Master Car Builders' convention at Dayton decided to call a general meeting at Cleveland to organize an association of the master mechanics of the United States and Canada. At that meeting, which was held later on in the same year, fifty were present, representing many of the most important lines of railways in the country and a constitution was adopted with the following preamble:

"We, the undersigned railway master mechanics, believe that the interests of the companies by whom we are employed may be advanced by the organization of an association which shall enable us to exchange information upon the many important questions connected with our business."

These words outlined the object with which the new society began its career, adopting as its purpose the discussion of the best methods of construction and operation of the locomotive at a time when it had just emerged from the experimental stage and was assuming a permanent and fairly uniform design. It had already taken its place in the world as the most powerful and economical engine of transportation, but few even who were connected with it in those days could have foreseen the development it was to undergo, or the extent to which it would render possible the cheapening and extension of the transportation facilities of the world, the chief factor in the wonderful change that has taken place in the relations of nations, the distribution of food supplies and the growth of manufactures, cities and continents.

The association so quietly started was well founded. It had chosen for its aim a work that was needed, and as the railways of the country grew, it grew with them, until now, forty-one years later, we have a membership of nine hundred and sixty-one (961), representing every railway in the United States and Canada, and a large number of those in foreign countries. It has been unique in its devotion to the locomotive and its problems alone, but its object has proved worthy of its attention, and we are to-day confronted with problems just as important as those which our predecessors considered, none the less vital to us because they are broader in scope and because financial considerations are now more closely connected with those which are purely technical.

I have always been deeply interested in the history of this association; I have been a great admirer of the work that it has done, and I am going to take this opportunity to speak to you of the success it has obtained, the methods it has used, and the opportunities that lie before it for the future.

It is impossible to review in detail the work which has been accomplished; the mass of information contained in our proceedings is too great for individual reference. To even touch on the more important subjects would necessarily result in a mere catalogue. Figures are but a poor way of illustrating results, but in the forty-one years of our proceedings three hundred and fifty-one (351) reports of committees, sixty (60) individual papers and one hundred and fifteen (115) topical subjects have been presented and discussed. Of these reports and discussions it may be stated that one hundred and twenty-six (126) contain information of special interest at the present time, while two hundred and eighty-three (283) are of specific value, either in whole or in part. While this classification is to a certain extent a matter of opinion, it shows most decidedly the general excellence of the work which this association has done. It has investigated almost every conceivable subject connected with the locomotive, its construction, operation and maintenance, developing, criticising and discussing it as it progressed from the little sixteen-inch (16-in.) eight-wheeler of the sixties to the magnificent freight and passenger equipment of the present day. To say that the wonderful development that has taken place is entirely owing to the work of our associations would be an exaggeration. Apart, however, from the facts determined in our reports, the improvements they have suggested, and the practice they have introduced, our meetings have year by year been attended by the men engaged in carrying on and advancing this work. They have presented their own views in our discussions, they have heard the views of others, and, whether speakers or listeners, have returned home from our conventions with their opinions modified, new ideas conceived and their experience broadened. With that renewed energy and interest in their work which invariably results from communication with other workers in the same field, they have put into practice suggestions which have been advanced and by their daily work have together built up that mass of knowledge and experience that has resulted in the production of the American locomotive of to-day. In such ways, as well as by the exchange of information, our association has succeeded in its object in being of benefit to the railways by whom our members are employed.

Our work has not been limited, however, to the exchange of information, but from the very beginning our committees have done far more than obtain and report existing facts or give the opinion they have formed as a result of their inquiries. This has been an important and valuable portion of their work, and our history shows that in the large majority of cases it has been done well. The answers received to the letters of inquiry have frequently indicated a great divergence of opinion or a lack of proper knowledge, while our later experience has justified the committee's decision. Their reports have presented carefully thought out and correct conclusions, which have, through investigation and the standing of the members of the committees, been widely accepted and of valuable assistance in establishing advanced practice. A development of their work to which I wish to call your attention has not, I believe, been generally awarded the credit it deserved, yet it has been the source of the greatest influence exerted by our association, and of the importance of its service to the railways. I refer to the investigation of the scientific principles underlying the questions assigned to our committees, the tests and experiments they have carried out when necessary to determine additional data, and the correct and practical conclusions they have deduced. As a result their work stands to-day as the basis of most of our scientific knowledge of the locomotive, the engineering principles on which it is designed, and the reasons for the methods by which it is operated.

I do not mean that we have to look to our committee for all the knowledge that is available on the theoretical mechanics of the locomotive, or for such researches as those on the properties of steam, the strength of materials, or the chemistry of combustion. That has been the work of the mathematician or physicist, and its value in solving the practical problems of engineering is limited by the vast number of factors which enter into actual working conditions. Our work on the other hand, has been the observation and interpretation of results in a scientific manner, and through being carried on by practical men, who have established the relation between the facts they ascertained, and the theoretical principles underlying them, has been sound in its basis, and rendered general in its application.

Probably the best example is the series of experiments on exhaust nozzles, stacks and steam passages. This began with the road tests which were carefully carried out in 1879, the experiments carried out in 1890, which were independent of road conditions, the first record of that kind in our proceedings, and in 1891 tests of a high degree of scientific excellence which indicated the benefits obtained by lowering the nozzle. It was then intended to continue the experiments at Purdue, but when that laboratory was destroyed by fire a locomotive testing plant was constructed by the chairman of the committee which was, with the exception of that at Purdue, the first in existence. The experiments made upon it were the first careful and thorough investigations of the action of the blast and the result of variations in design of nozzles and stacks that had been carried out on an actual locomotive on a testing plant on which uniform working conditions could be maintained. The results were given in the report of 1894 and the great report of 1896, which will be remembered as the best report up to that time presented to this or any other society on a subject connected with locomotive engineering. Supplemented by the more recent work, this subject stands as one of the most scientifically and carefully investigated details of the locomotive, and its history is one of which our association should be proud.

The test of compound locomotives presented in 1892 marked an important advance through recording the first complete and properly conducted road test, using the dynamometer car, indicators, accurate measurement of coal and feed water, the quality of the steam, and the measurement of various losses. These methods, although previously applied along similar lines on stationary plants, yet marked a decided advance in locomotive work, and supplemented by the report on the standard method of conducting locomotive tests have assisted materially in defining conditions that should be observed if accurate results are desired.

The subject of locomotive capacity has always been well handled and our recommendations in this respect have exerted a considerable influence and have been widely used. One report is of special interest, that of 1897, in which was presented the first comprehensive study of the characteristics of the locomotive, since made familiar to us by the work at Purdue University and the St. Louis Testing Plant. Then, however, the subject was broadly new and such a method of treatment almost unknown, but it marked the important discovery of the locomotive as a machine with definable properties, although of wide variations, as opposed to the indefinite views on its capacity and economy which were previously held.

Other notable reports of a general character were those on high steam pressures in 1898, the loss of power from friction in the machinery of a locomotive in 1906, and the results obtained from briquetted coal in 1908. There have been many others of more detailed nature, but which indicate the valuable character of our experimental work. Among the more important are those on driving wheel tire wear, in which the forces acting were carefully analyzed and compared with the wear actually found, showing distinctly the cause of the trouble; the report on engine truck swing hangers in which indicating apparatus was used to determine the action of an engine with different types of suspension; the report on slide valves, in which the dynamometer was used in the valve stem, and the forces shown compared with those determined by elaborate calculations of the various stresses; the reports on counterbalancing which have established the allowable disturbing weight, and the specifications for materials in which laboratory tests have been compared with an enormous number of service results. Add to these reports others, which by their high degree of merit have had a far-reaching effect on our railway work, such as those on ton-mile statistics, repair shops, and the education of apprentices, and the whole forms a series of progressive and leading contributions to the science of locomotive design and operation which has produced a permanent effect and has demonstrated correct principles to the entire locomotive world. For years past locomotive practice in America has been based on scientific knowledge, and such questions as the proportions of heating surface and cylinder capacity, and the designs of front ends have been decided by the analyzed experience of the entire country, or carefully conducted experiments. In foreign countries where no such association as ours has existed, these matters have been left to the judgment of the individual or what are practically rule of thumb methods. Few realize what this work has done for the railroads of the country, but the result is seen in the general success of our locomotive practice.

That our association has done its self-assigned work energetically and efficiently, there is no question. Its history is practically that of the modern locomotive in America, and from the years when lengthy discussions on iron versus steel for firebox plates, the cause of boiler explosions, and the proper thickness for the shell of a boiler were the live issues at our meetings, through the periods of air brakes, injectors, high-pressure boilers, compound locomotives, and testing plants, to our present times with Mallet engines and superheated steam, the association has been untiring in its interest in each new subject that has been introduced and its members individually have shown their interest by their attendance and the large amount of time they have devoted to the work. In no other country has there been any similar society organized to consider the problems of locomotive construction and maintenance exclusively, and we may justly feel that the predominating excellence of American practice is in no small degree due to our efforts. Our work has been well done. We have formed an immense machine for the interchange of information and have added to that our expressed intention, by having also carried out a large amount of experimental investigation.

What further can we do to increase our usefulness and develop into still more important fields of work? I feel that in making suggestions I am recording my own sins of omission, and yet when a man endeavors to seriously consider such a question, ideas occur to him that previously lay dormant or unthought of, and this must be my excuse for recommending now what I have not done. Our opportunities are somewhat different from those of our great sister society, the Master Car Builders' Association. We have no such business relationships to regulate between one road and another as those involved in the interchange of equipment. The possibilities of establishing additional standards that would be extensively used are few, and indeed it is very doubtful whether standards are of much value for the locomotives of an entire country. We must consequently ask ourselves whether we are obtaining all classes of information that are of possible value, and whether our committee reports, individual papers and topical discussions could be advantageously supplemented by any other activities.

We are face to face with several changes in the development of our motive power and the department having charge of it. The steam locomotive, that has been supreme for so many years, is finding its superiority questioned by a new invention, the electric locomotive. The small railway with its individual methods is being absorbed into large systems, and superintending and recording the work under the charge of our members is becoming more difficult. The growth of the large mechanical departments has made it impossible and in fact undesirable for their heads to retain the same touch with minor mechanical and operating details that they formerly had to, and has increased the importance of the financial and business questions they should control as compared to those of a mere technical nature. Unless this association and its members concern themselves seriously with these new and larger problems, there is danger of their work being undertaken by others in place of by ourselves.

The articulated locomotive has increased the field of the steam locomotive and enabled it to compete on more favorable terms with its younger and more powerful rival. We should be informed of every development in this line, the results and the experiences that are being obtained and the reduction in the cost of transportation that is being realized. We should also, I feel, know more of electric operation, so that as motive power officers we may be better informed as to its advantages and disadvantages, and may be in position to assist in deciding on the proper system to employ.

The advice of men experienced in motive power matters is needed by the railways in making decisions on this question. To be of value it must be based on a thorough understanding of the subject and a familiarity with its difficulties. I would urge your giving earnest attention to this important subject, which thus far has received too little consideration by the men who best understand railway motive power conditions.

Systems of organization are changing with the changes in our railways and new methods are being introduced for watching results. We should compare experience as to the efficiency of various types of organization, obtain more information as to the best forms of records, statements that are actually found useful and successful in practical service; comparisons that can be made on a reasonable basis and are interchangeable.

I believe we should endeavor to pay more attention to the commercial side of our work than we have done in the past. Excellent as our work has been, it has with few exceptions investigated the technical rather than the business problems of the locomotive.

We certainly do not want to decrease our attention to technical matters, but could we not with advantage to our members and to the railways take more interest in, and exchange information with each other more fully on factors connected with the cost of operation?

It is true that some years ago a standard postcard performance sheet was adopted and for a time was extensively exchanged, but it fell into disuse, and yet a properly prepared performance sheet, giving figures useful and possible of comparison, would, I feel sure, be of considerable value and interest to us all. The benefits of a membership in this association would be increased by information as to each other's cost of engine house expenses and supplies, of repairs and fuel consumption, the percentage of power in shops and out of service, and a number of other figures that have to be continually watched. Knowledge of the results obtained by others would assist us all in gauging our own performance, in more easily locating the branches in which we are deficient, and in encouraging all to a higher uniformity of accomplishment.

In short, without in any way reducing the interest we have in locomotive engineering, we must take up in a far more business like and serious way the financial problems connected with the operation of the locomotive department, the form of organization that will give the best results, the commercial aspects of the work of a motive power official in conducting his department as though he were manager of a large business enterprise.

Take as an instance of comparing costs the operation of our repair shops. We manage the largest collection of factories in the world devoted to one substantially uniform product, the repairing of locomotives, and our total expenditure for this item alone amounts to about eighty million dollars per year. Each and all have the keenest interest in knowing whether our methods are the best and our costs among the lowest. A few years ago comparisons would have elicited little, but some statements of performances which were exceptionally worthy of imitation; to-day, with the progress that has been made in shop engineering, there is no reason why properly trained observers should not record time studies containing the necessary data to prepare intelligent and valuable statements about one operation after another that is performed on substantially the same parts in hundreds of shops from the Atlantic to the Pacific. Such work is possible and it has already been performed in several shops by experienced engineers. If carried on by a properly organized bureau under our auspices, it should be of the greatest value not only to the railways of this country as a whole, but to our members individually. By comparing operation by operation their results with those of other roads, and by analyzing their methods and available machinery, they would be enabled to improve the one or justify their expenditure for additions to the other. This is but one of many questions connected with the operation of our mechanical department which will occur to you, on which some systematic interchange of information would be of material assistance.

What I wish most strongly to impress on you is that while still carrying on the technical work that has been so splendidly successful, we should pay more attention to the business problems under our control in which we can be of such mutual service.

Our methods of obtaining information might also, I consider, be supplemented to advantage by effecting closer relations with the various railway clubs. The circular letter has been a practical failure in obtaining general information, and I feel sure that the railway clubs would welcome reference to them of certain subjects for their opinion, especially those on which the experience of the men actually in touch with the work is required. They have a large membership, representing every section of the country and every class of men engaged in locomotive work. On many subjects their views would be of far greater value than those obtained in answer to circular letters, especially on questions similar to those suggested for topical discussion.

A valuable practice which obtained in the past, but which has been discontinued in recent years, was the appointment of a committee to report on the advancement in locomotive practice during the year. There are numerous small improvements devised in railway shops which would be collected by a committee gaining its information from the railway clubs. These improvements, while not of sufficient importance in themselves to justify a report or paper, are of considerable value in our successful operation, and presented by a committee would have sufficient indorsement to insure their being carefully considered.

Co-operation with the railway clubs would also relieve the association of the discussion of details of minor importance which have occupied so much time in the past. Such discussion is necessary, and, in fact, of the greatest value, but it more properly belongs to local societies where local conditions are understood and where it can be carried on just as efficiently and satisfactorily as when occupying the time of a national association.

Our association could, I believe, also be of considerable value with reference to the various legal questions that are arising in connection with locomotive construction and operation, by co-operation with the American Railway Association. We could provide a systematized organization for obtaining the opinions of the railways with the proper representation for each section of the country and a meeting at which important questions could be discussed.

Any development in this direction must, however, come at their request, and we can simply indicate our willingness to undertake any work in which we can be of use.

The present system of holding the conventions of the Master Mechanics' and Master Car Builders' associations in two separate weeks prevents many from attending one or the other. The consequence is, the attendance is largely divided, and unfortunately so, as the majority of the members of either association are equally interested in the other. There are two remedies: the first, to hold the two conventions in one week; the second, to unite the two associations. When this was last proposed by the late Mr. Pulaski Leed in 1898, our executive committee was instructed to confer with that of the Master Car Builders' Association, but, although a report was made to the succeeding convention, suggesting that both conventions should be held during the same week, nothing was done.

It is a reflection on the business ability of our mechanical departments to continue an arrangement that necessitates a man being away from his work for practically two weeks at the meetings of important associations, which he should, for his own sake, and that of the railway employing him, attend and take part in.

There is to-day no valid reason for maintaining two separate mechanical railway associations. All the officers and members of the executive committee of the Master Car Builders' Association, with the exception of two, seventy-five (75) per cent. of the members of the standing committees, and seventy (70) per

(*Continued on page* 315.)

Mechanical Stokers.

The American Railway Master Mechanics' Association considered the subject of automatic stokers of so much importance that a standing committee was appointed to report annually on the progress of that boom of invention. The report submitted this year by the committee, of which Mr. T. Rumney, of the Erie, was chairman, did not present a very hopeful view of the progress made during the past year, but the discussion that followed the reading of the report indicated that the stoker is finding decided favor on some railroads. Mr. P. Maher, Chicago & Alton gave particulars concerning the Strouse stoker which is now applied to twenty locomotives on his road that are working very satisfactorily. Four or five other members testified favorably concerning the operation of the same stoker and it appears to have passed beyond the experimental stage.

From what was said on the subject of mechanical stokers we are inclined to think that the experience of another year will enable the standing committee to submit a final report.

In discussing the report of the committee on mechanical stokers, Mr. G. R. Henderson referred to the increase in tractive power of large locomotives and in the increased fuel consumed per mile to maintain this tractive force, he said:

When this subject was discussed last year, we called attention to the fact that a great many of the large modern locomotives were not giving returns in hauling capacity commensurate with the size and cost of the locomotive, apparently on account of the impossibility of one fireman getting sufficient coal into the firebox, and we advanced the argument that an automatic stoker would be necessary in order to realize the full benefit of such large locomotives. Since the last meeting we have had occasion to estimate the probable advantages on a large Mallet locomotive of an automatic stoker, and we thought that the figures might be interesting to the members of this association.

The division to be covered by this locomotive was 100 miles in length, against the traffic, of which there is a 0.5 per cent. compensated up-grade 40 miles long, and the remaining 60 miles are practically all down grade. The locomotive upon which our figures were based was of the Mallet type, having a tractive force of 65,000 lbs., which would enable it to haul at slow speed 4,200 tons up the 0.5 per cent. grade, on which our figures were made, ascending the grade at 6, 10 and 15 miles per hour. It was assumed that one fireman could handle 3,000 to 4,000 lbs. per hour throughout the 40 miles up grade, or that two men, by working in relays, would be needed to supply 6,000 to 8,000 lbs. an hour, but for quantities over this a mechanical stoker would be necessary. As the grate area of this locomotive is 78 sq. ft., it will be seen at once that it would be possible to burn from 12,000 to 15,000 lbs. of coal per hour if found desirable or necessary. In making these figures, the following units were assumed: The actual time between terminals would be 20 per cent. greater than the running time, this allowing for lay-overs, etc.; the down hill speed would be 30 miles an hour; the cost of the coal was taken at $1 per ton and of water at 5 cents per thousand gallons. Allowances were also made for repairs, renewals, pay of enginemen, handling at terminals and interest on investment. It was considered that there would be 5 hours consumed in turning the engine at the terminals of the division, and the cost of train supplies, car repairs, pay of trainmen, etc., were included, so that the figures show the actual cost of operating the train, but, of course, do not cover the general expenses of superintendence, maintenance of track, buildings, bridges and other data except the usual train operation, which figures really comprise only about 40 per cent. of the total cost due to all

ARANAL STATION ON THE CARTAGENA-COLUMBIA RY.

expenditures of the road. The cost was figured out for the total movement on one trip, also for 1,000 ton-miles of train back of engine, including the weight of the cars and ton miles per hour performed by the engine, with the allowance of five hours for turning, as above mentioned. These figures, therefore, enable one to see at a glance the variation in cost and capacity due to one or two firemen, or to a mechanical stoker. The figures are given below.

It is seen, therefore, that by far the greatest amount of work done by the engine is with the use of a stoker and running up hill at a speed of 15 miles per hour, the assumption being in this case that there would be 15,000 lbs. of coal burned per hour while running up the grade. The cost per 1,000 ton-miles is less than if we attempted to run with half the load at the same speed up hill with only one fireman, and it is only 3 cents greater than if we went up the hill at six miles an hour with a single fireman. At ten miles an hour two firemen would give nearly the same capacity of the locomotive and at somewhat lower cost, but it is rather uncertain whether two firemen can be managed satisfactorily on a locomotive, and where a large amount of traffic is to be gotten over the road, the advantage of being able to push the engine to its full capacity and at a fairly high speed is shown without any uncertainty.

At 15 miles an hour, considered economical speed for general operation, one fireman could handle 19,000-ton miles at a cost of 25 cents, two firemen 28,000-ton miles at a cost of 22 cents, and the stoker 38,000-ton miles per hour at a cost of 22 cents. You will see, with a slight additional increase of cost of stoker over one man at slow speeds, a much larger amount of ton miles can be attended to, and at speeds of 15 miles an hour the cost of the stoker is considerably less than that of one fireman, and double the amount of ton mileage can be made with the engine.

Continuing the discussion, Mr. C. E. Gossett, of the Iowa Central, said:

I witnessed the action of the stoker of the Chicago & Alton, and wish to state frankly that I consider it beyond the experimental stage so far as the principle is concerned. On the trip that I made out of Bloomington the Consolidation engine was rated at 2,800 tons. The engine on this day had 3,300 tons, or 500 tons more than the rating, using mine-run Illinois coal. The fireman experienced no trouble whatever in keeping the engine hot, in fact he was at no time hurried about his work. The engine made an average speed of 17 miles an hour for a distance of 88 miles. In that 88 miles the fireman moved his grate slightly three times. On arriving at the terminus the fire was apparently as good as it was when we started, and the variation of the steam pressure throughout the trip was not to exceed 4 lbs. at any place. Another important factor to be considered in using the stoker is when the engineer started to shut off for drifting or station stop, on account of the fire being in such perfect condition there was very little blowing off, and, as stated before, when we arrived at Joliet, after being on the road about seven hours, the fire appeared to be in such condition that it could go on several times that distance without cleaning. I consider the stoker a complete success.

The discussion showed the topic to be a live one and though some believed that it was difficult to eliminate smoke with the mechanical stoker, yet the use of the brick arch on the Chesapeake & Ohio in conjunction with the Strouse stoker was proof that the matter was being followed up very closely.

Speed up hill, m. p. h.	6	10	10	15	15	15
Cost, movement, per trip	$79.93	$82.35	$62.18	$87.05	$67.00	$50.38
Cost per 1,000 ton-miles	.19	.20	.21	.22	.22	.25
Ton-miles, per hour	27,300	34,400	24,600	38,000	28,300	19,000
Weight of train, tons, behind tender	4,200	4,200	3,000	4,000	3,000	2,000
Method of firing	1 fireman.	2 firemen.	1 fireman.	Stoker.	2 firemen.	1 fireman.

Motor Cars.

The report on motor cars, of which Mr. C E. Fuller was chairman, practically contained a description of the Union Pacific motor car. Descriptions of the various types have appeared in the columns of RAILWAY AND LOCOMOTIVE ENGINEERING.

In the discussion which followed, Mr. H. H. Vaughan, of the Canadian Pacific Railway, said:

The whole matter of the combining of a steam engine in a passenger coach is, to my mind, radically wrong. The proper place to put a passenger coach at night is in the passenger car yard. The proper place to put a steam engine at night is in the roundhouse. If you put a passenger car in the roundhouse, which is full of smoke, the car becomes dirty and grimy and you have got to send your car cleaners from the car yard to the roundhouse to clean the motor car. If you put the car in the passenger car yard, that means that you must send your men from the roundhouse to the passenger car yard to repair the engine. There is nothing radical about a motor car. It is simply a small steam engine; it takes about as much coal per mile as any other engine, possibly a little more; it is easier to fire, because it is small; and its capacity is limited.

We have had cases where our people thought the motor car should pull two or three trailers with ease, and the car will not do it. It is simply applicable for a light service, and, in most of our conditions, which are, of course, rather different from those further south, can be handled by mixed trains better than they can be by motor car service. You must, in the majority of cases, run three men, an engineer, a fireman and a conductor, and it seems to me that a very much better solution of the question is to build a little tank engine with a baggage compartment on it, in which you can get a fireman to attend to the baggage and let the conductor look after the tickets. We have prepared designs for such a car, and now await the passenger department to find a place where they want to run it.

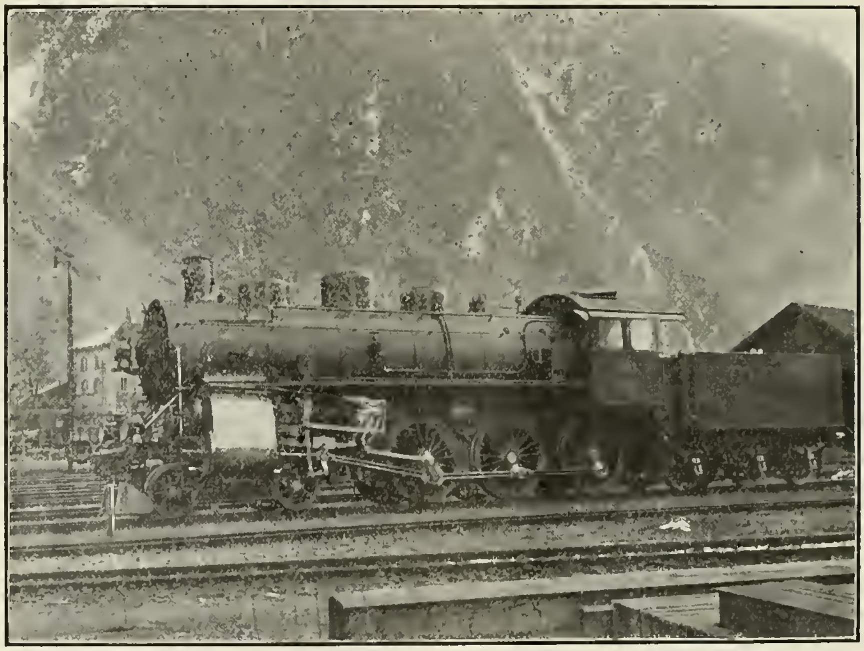
Continuing the discussion, Dr. Angus Sinclair said:

I have just returned from a trip I made to Omaha, where I examined the motor car which the McKeen Company is building for the Erie. I have had considerable experience with the running of automobiles, which is a good way of working up toward gasolene railway motors. I have found gasolene automobiles as nearly perfect as anything you could expect in the mechanical line. One peculiarity about the gasolene motors was that the designers seemed to think that they would never need any repairs. They designed them so it would take you half a day to get a screw out—one of the kind of screws that is always getting loose. But I find in the later cars that they have learned a good deal of what the locomotive men did in the early days, namely, that it was good to make a machine which was easily repaired.

What struck me about the machine I examined at Omaha, the latest development of the McKeen Company, was the great care that had been taken in having each part so that it could be readily taken apart and was easily get-at-able. That will prove a very important help in working up the popularity of that sort of a motor. The power seems to be ample for the kind of service for which it is designed.

Another thing about it was the arrange- of the engines. What made the marine engine a real success was the vertical position and putting the cylinders and mechanism above the crank-shaft so that everything was within reach and so that the power was applied directly where it was wanted. The same thing has been adopted in the mechanical motor. They have put the cylinders up above and have all the working parts precisely the same as the vertical inverted marine engine. Another thing—they have a very good air starting arrangement. The ordinary automobile causes difficulty in starting, especially in cold weather when the combustible is cold. This arrangement with the air pressure gives a few turns and I do not think there will be any difficulty at all with that machine in starting it in any weather or under any conditions. I think, gentlemen, so far as the branch lines are concerned, that are operated at a great expense with locomotives at the present time, that the gasolene engine will give very satisfactory results in the near future.

Mr. E. I. Dodds, of the Erie Railroad, spoke hopefully of the future of the motor car, and contrasting it with the steam engine, said we have been working for eighty years on the steam engine and we are just beginning to do it about right. Motor cars of the gasolene type, particularly, are rapidly reaching a point where the difficulties of operation are being solved more rapidly in the case of the gasolene than the steam car.



PASSENGER LOCOMOTIVE, ST. GOTHARD RAILWAY, SWITZERLAND.

Hardwood for California.

The Pacific Coast will soon be the scene of an interesting tree growing experiment. The United States Forest Service is planning to introduce a number of the more important Eastern hardwoods into California, and will this year experiment with chestnut, hickory, basswood, red oak, and yellow poplar or tulip trees. Small patches of these trees will be planted near the forest rangers' cabins on the national forests, and if these do well larger plantations on a commercial scale will soon be established on wider areas.

There are over 125 different species of trees in California, a number of which produce some of the most valuable varieties of lumber in the country. Although considerably over one-half of the species are hardwood or broad-leaved trees, yet, with the exception of the exotic eucalyptus, there is not a single species of hardwood in California ranking in commercial importance.

A farmer writing to the late Mr. Cassatt asking for the settlement of a claim against the Pennsylvania Railroad Company, concluded: "Strange as it may seem, I feel as easy writing to you as to an ordinary mortal, but this is perhaps because I know that this will hardly escape the waste basket of that good-looking gentleman, your secretary."

Items of Personal Interest

At the recent meeting of the American Railway Master Mechanics' Association at Atlantic City, N. J., Mr. George W. Wildin, mechanical superintendent of the New York, New Haven & Hartford, was elected president of the association for the year 1909-10. Mr. C. E. Fuller, assistant superintendent of motive power of the Union Pacific Railway, was elected 1st vice-president, Mr. H. T. Bentley, assistant superintendent of motive power of the Chicago & Northwestern, was elected 2d vice-president, Mr. D. F. Crawford, general superintendent of motive power, Pennsylvania Railroad, was elected 3d vice-president, Mr. Jos. W. Taylor was elected secretary and Dr. Angus Sinclair, of New York, was elected treasurer of the association. Members of the Executive Committee are: Messrs. C. E. Seley, Chicago, Rock Island & Pacific, D. R. MacBain, New York Central & Hudson River R. R., and F. M. Whyte, New York Central & Hudson River R. R.

Mr. H. L. Roth, formerly engineer on the Cincinnati, New Orleans & Texas Pacific Railway at Ludlow, Ky., has been appointed master mechanic of the Ocean Shore Railroad, with headquarters at San Francisco, Cal.

Mr. M. S. Monroe, formerly master mechanic on the Chicago, Lake Shore & Eastern Railway at Gary, Ind., has been appointed master mechanic on the Elgin, Joliet & Eastern Railway at Gary, Ind.

Mr. J. P. Callahan, formerly master car builder on the Chicago, Lake Shore & Eastern Railway at Gary, Ind., has been appointed master car builder on the Elgin, Joliet & Eastern Railway at Gary, Ind.

Mr. J. R. Mullen, formerly with the Chicago, Lake Shore & Eastern Railway, has been appointed chief clerk on the Elgin, Joliet & Eastern Railway at Gary, Ind.

Mr. R. Preston has been appointed master mechanic of the Central division of the Canadian Pacific Railway, with headquarters at Winnipeg, Man.

Mr. A. H. Powell has been appointed master mechanic of the Salt Lake and Humboldt divisions of the Western Pacific, in charge of motive power and car department, with headquarters at Salt Lake City, Utah.

Mr. P. O. Sechrist, formerly general foreman of the Queen & Crescent shops at Somerset, Ky., has been appointed general master mechanic on the same road.

GEO. W. WILDIN,
President American Railway Master Mechanics' Association.

Mr. W. G. Seibert has been appointed master mechanic of the Missouri Pacific Railway at Fort Scott, Kan., vice Mr. T. E. Carberry, assigned to other duties.

Mr. C. E. Chambers has been appointed general master mechanic on the Central Railroad of New Jersey, and will have charge of the assignment of motive power over the entire system and perform such other duties as may be assigned to him from time to time by the superintendent of motive power, with headquarters at Jersey City, N. J.

Mr. R. G. Turnbull has been appointed master mechanic of the Missouri, Pacific Railway Company, with headquarters at Ossawatomie, Kan., vice Mr. M. M. Myers, resigned.

The officers of the Museum of Safety and Sanitation announce the election of Mr. Arthur Williams to the Board of Trustees. Mr. Williams is the general inspctor of the New York Edison Company and a member of the American Institute of Electrical Engineers. In 1907 he was decorated by the French Government. He is a member of the American section of the International Housing Congress and was a member of the 8th International Congress of Social Insurances at Rome, 1908. Mr. Williams will serve on the Lecture Committee of the Museum.

Mr. W. H. Barrows, for a number of years master mechanic of the Kansas City Southern Railway, and formerly of the Rio Grande, has become connected with the Texas Oil Co. as their expert on lubrication and fuel oils, with headquarters at Houston, Texas.

Mr. W. M. Law has been appointed traveling fireman of the Iowa Central Railway, with headquarters at Oskaloosa, Ia.

Mr. Henry J. Bellman, of "Hair Felt" fame, who is now located in New York, wishes to advise his many railroad friends that he is now ready to "receive callers" at his new headquarters, and anyone who "sneaks" into New York without letting Mr. Bellman know, really misses one of the best times which the big city affords. Both the H. W. Johns-Manville Co. and Mr. Bellman are to be congratulated by the recent change by which Mr. Bellman becomes manager of the Hair Felt Department of the company.

Mr. R. A. Pyne has been appointed district master mechanic on the Canadian Pacific Railway, with headquarters at Nelson, B. C.

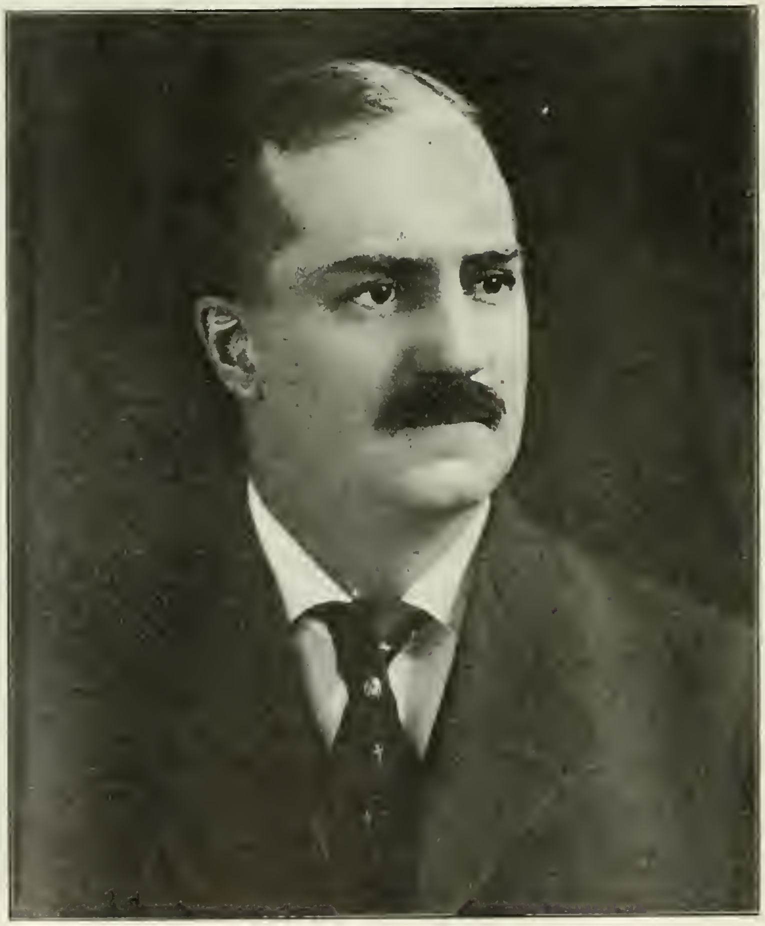
At the recent meeting of the Master Car Builders' Association held at Atlantic City last June, Mr. F. H. Clark, general superintendent of motive power, Chicago, Burlington & Quincy, was elected president of the association; Mr. T. H. Curtis, superintendent of machinery of the Louisville & Nashville, was elected 1st vice-president; Mr. Le G. Parish, superintendent of motive power of the Lake Shore & Michigan Southern, was elected 2d vice-president, and Mr. Alex. Stewart, general superintendent of motive power of the Southern Railway, was elected 3d vice-president. Mr. John Kirby, of the Lake Shore & Michigan Southern, has been elected treasurer, and Mr. Jos. Taylor is secretary of the Master Car Builders' Association as well as that of the Master Mechanics'. The Executive Committee consists of Messrs. D. F. Crawford, of the Pennsylvania; F. W. Brazier, of the New York Central; C. A. Shroyer, of the Chicago & Northwestern; J. D. Harris, of the Baltimore & Ohio; C. E. Fuller, of the Union Pacific, and H. D. Taylor, of the Philadelphia & Reading.

Mr. F. W. Sadler, formerly locomotive foreman on the Canadian Pacific Railway at Field, B. C., has been appointed district master mechanic on the same road, with headquarters at Moose Jaw, Sask.

Mr. R. E. French has been appointed superintendent of motive power and machinery of the Guatemala Central Railroad, with offices at Guatemala, Central America. Mr. French served his apprenticeship on the Baltimore & Ohio at Cumberland, Md., with the class of 1878. Previous to this he was in the telegraph department, and was secretary to his father, who was superintendent on that road for many years. In 1880 he worked as machinist at Newark, Ohio, with Mr. J. F. Deems, now general superintendent of motive power on the N. Y. C. lines, and with Mr. J. B. Kilpatrick, now superintendent of motive power of the Chicago, Rock Island & Pacific, and many others who have risen from the ranks. He was with the Southern Pacific for twenty-six years as machinist, foreman of shops, general foreman, assistant master mechanic, and master mechanic. The latter position he held for eleven years on the hardest division of that road through the famed San Joaquin Valley, and over the Techashapi Mountains. Mr. French has many friends and acquaintances throughout the railroad world who wish him well in his new position.

Mr. R. W. Burnett, formerly assistant master car builder of the East Lines on the Canadian Pacific Railway, has been appointed master car builder on that road with headquarters at Montreal, Que., vice Mr. W. E. Fowler, resigned.

Mr. F. W. Schultz, master mechanic of the Iron Mountain, has resigned his position at McGee, Ark., to accept a similar one with the same company at Atchison, Kans. On April 22nd in the Railroad Y. M. C. A. at McGee, a reception was given by the railroad men of the Valley Division in honor of Mr. Schultz. The men had gathered there to show their high appreciation for the good and meritorious work that Mr. Schultz had done as master mechanic for the past sixteen months. After songs, speeches and merry-making Mr. Davis, manager of the Y. M. C. A. at McGee, Ark., on behalf of the engineers, firemen and other employees of the mechanical department, presented Mr. Schultz with a diamond stud as a token of the high esteem in which he was held by all the men under his jurisdiction, and to Mrs. Schultz was given an elegant silver dinner set. Mr. Schultz then responded in a few well-chosen words, thanking the men for their remembrance as well as for their loyalty, which in a large measure he said had helped him attain the good results which all acknowledged, on this part of the Iron Mountain system. Mr. Schultz carries with him to his new position the best wishes of a large number of friends.



F. H. CLARK,
President Master Car Builders' Association.

Mr. M. E. Hamilton has been appointed the general air brake inspector of the Atchison, Topeka & Santa Fe system, with office at Topeka, Kan.

Mr. G. W. Robb, assistant master mechanic on the Grand Trunk Pacific Railway at Rivers, Man., has been appointed master mechanic in charge of motive power, cars and shops, vice Mr. Wm. Gell, resigned on account of ill health.

In our description of the 2-8-0 Wabash-Pittsburgh Terminal engine in the June issue we gave the name of Mr. E. F. Needham, superintendent of motive power of the Wabash. We are, however, informed that Mr. J. E. O'Hearne, master mechanic of the Wabash-Pittsburgh Terminal, in conjunction with the builders is responsible for the design of that engine.

Mr. J. J. Ellis, superintendent of motive power of the Chicago, St. Paul, Minneapolis & Omaha Railway, recently retired from the position on a pension given by the railroad. He has been thirty-three years in railroad service. On the occasion several hundred employees gathered in Minnehaha Hall, St. Paul, to do honor to their retiring chief. Speeches were made eulogizing Mr. Ellis and his work and as a token of esteem he was presented with a handsome silver loving-cup, valued at $500. The whole affair was a complete surprise to Mr. Ellis. In fact, it was only with great difficulty that he was persuaded to attend the meeting. Invitations had been sent out quietly and a large number of employees, particularly those of the mechanical department, came in to attend the affair. A special train was run to accommodate those from Spooner, Wis. The meeting opened at 2 o'clock with an address by J. H. Hall, an engineer on the road, who acted as chairman. The presentation speech was made by W. S. Doolittle, another engineer, and also the mayor of Sioux Falls, S. D. Mr. Ellis was much affected, but made a very appropriate reply.

The loving cup presented Mr. Ellis

is of solid silver and is one of the largest seen in St. Paul. It stands fully two feet high and has three handles. It is inscribed: "Presented to

JOHN J. ELLIS.

John J. Ellis by the employes of the motive and mechanical department of the Chicago, St. Paul, Minneapolis & Omaha Railway as a token of our love and respect." Accompanying the cup was a set of framed resolutions appropriately expressed.

Obituary.

Mr. Lloyd Clarke, another veteran locomotive engineer, and one of the oldest in the service of the Central Railroad of New Jersey, died in the Memorial Hospital, Long Branch, N. J., on May 7th, 1909, of kidney disease. He was nearly 60 years of age, having been born on May 12, 1849.

Mr. Clarke entered railroad work when very young, and after two or three years spent in and about Meadville, Pa., on the Atlantic & Great Western Railway, he decided to go West in response to the call for railroad men to push the work of construction of the Central Pacific Railroad then building. He worked as a fireman for a short time on the Central Pacific between San Francisco and the Humboldt River, with headquarters at Winnemucca, Nevada. A few months before the Eastern construction of the road met the Western end, he was promoted to the position of engineer as a result of having done some clever work in preventing a serious wreck on a runaway train in the mountains near Truckee, Nevada. About a year before reaching his majority he was made a passenger engineer and continued in service on the Central Pacific for several years, running between Wadsworth and Winnemucca, Nevada, on the first through train ever run across the United States. He was also on the second engine of the first train (a double-header) that ever passed over the Rocky Mountains, and on the occasion of the trans-continental trip of the Boston Board of Trade to San Francisco, a year or so after the opening of the road, was the only engineer to handle that train on the mountain divisions with a single engine.

After leaving the Central Pacific, he was for one or two years in the employ of what is now the Illinois Central System, running betwen Macomb, Miss., and New Orleans; then coming North in 1875 Mr. Clarke entered the service of the Central Railroad of New Jersey as a passenger engineer, on the personal recommmndation of Mr. John Taylor Johnson, then president of the road, to whom he had letters from prominent railroad men. During 1876 he ran a Centennial train between Bound Brook, N. J., and Philadelphia, but previous to this, on June 25, 1875, he ran the first train, a special, carrying passengers over and opening the N. Y. & Long Branch R. R. from Long Branch, N. J., to Jersey City. General U. S. Grant was the guest of honor on that occasion, and the superintendent's order outlining the running time of that train is still in existence. He also ran the first train from Asbury Park, when the Long Branch Division was extended to that point, and later, when it was extended to Point Pleasant, N. J., he made his home there and continued in service on that division up to within a few months of his death. In the summer of 1881, when President Garfield was assassinated, and in hopes of saving his life was removed from Washington, D. C., to the seashore at Elberon, N. J., Mr. Clarke was assigned to haul, over the temporary track laid for the purpose, the car carrying the President from the Elberon station to the Francklyn Cottage on the ocean front.

Had Mr. Clarke lived, the fourth of August, 1909, would have marked the completion of forty years continuous passenger service. He had, by process of survival, become the only engineer in the employ of the Central R. R. of New Jersey who had never served as a fireman on that road.

As an engineer, he felt that his chief efficiency lay in the use of the air-brake and in judgment as to where speed was necessary and safe and where it was not, but perhaps the most striking feature of his entire service was that he had run a passenger locomotive for a period of nearly forty years, making an aggregate mileage of almost two millions of miles, and had never even injured a passenger on his own or any other train.

Walter G. Coleman, for the past twenty-four years storekeeper on the Chicago & Northwestern Railway at Boone, Ia., and for many years timekeeper at Boone shops, died in April at Cold Water, Mich., where he had gone for his health. He was held in very high esteem by officers and men of the C. & N. W. Ry. The large procession which followed the remains to their last resting place in Glenwood Cemetery showed the high regard in which he was held by his fellow men.

Mr. Vaughan's Address.

(*Continued from page* 310.)

cent. of the members of the special committees, hold joint department titles.

These figures demonstrate most clearly the amalgamation that has taken place between the car and locomotive departments on our railways. They justify the statement that the time has arrived not for the absorption of one of our associations by the other, but for their uniting into one society, call it, if you please, the American Railway Mechanical Association, which would consider both car and locomotive matters. Such a step is demanded by the spirit of the times, to conserve the forces of our railway officers and economize their time. It is one of the most important questions we have to deal with, and I would impress on you the necessity for action being taken to remedy the present conditions.

The help of our association has been requested by the National Conservation Commission, and it has been informed that our resources would be at their command either for purposes of investigation or to ascertain the recommendations of our members in any respects in which we could be of service to them. A committee was also appointed which could co-operate with them if required, or with any of their committees, but so far this has proven unnecessary, and our position has simply been that of exhibiting our willingness to perform any work that might assist this important movement. We have, however, our own share to carry of the duty of the nation to posterity. The railways are one of the largest consumers of coal, and in most cases peculiarly indifferent to the economy with which it is used. About two hundred millions of tons are annually burned in locomotives alone, and we do not therefore need to ask in what direction we can be of service in assisting this commission. Our work is before us. We should individually, and as an association, use every means in our power to impress on our railways the importance of this expenditure, one of the largest we are responsible for. The reduction in the present rate of consumption that it is our duty to make will not only lead to an immense saving in expense, but will assist materially in the conservation of the natural resources of the country.

At our last convention several of our members were asked by members of the American Railway Association to introduce an alteration in our constitution whereby subjects involving legal, transportation, permanent way or traffic questions or for any other reason requiring such action may be submitted as recommendations to the American Railway Association. In response to this suggestion, a committee was appointed who have recommended the change which they consider advisable, which will be submitted to you at this convention. Your executive committee has carefully considered the amendment and indorse it as a progressive step in the orderly grouping of the important associations which are all working toward the development and advancement cf American railway work, associations of which our own is one of the largest and oldest. An innovation, however, this amendment certainly is, and it has led me tc speak to you of the work this association has done for the railways, its history, its achievements and its problems.

Fuel Economies.

The report of the committee on Fuel Economies, of which Mr. W. C. Hayes, of the Erie Railroad, was chairman, was the result of a number of inquiries intended to bring out if possible the average practice on the various railroads of this country. Among the methods for effecting fuel economy the committee enumerated twenty-six, any one of which is supposed to reduce the fuel bill when properly carried out. These methods consist of 1, compounding; 2, steam distribution; 3, superheat; 4, relative diameter of wheels to diameter of cylinders; 5 loss of pressure between boiler and cylinder; 6, loss by radiation; 7, economic boiler design, in relation to horse-power; 8, feed-water heating; 9, loss by air pump and waste; 10, quality of feed water; 11, exhaust stand, nozzle, stack and front end arrangement; 12, brick arches and water tubes; 13, grate design and relative area of bar and air space for different kinds of coal; 14, air inlet to ashpans—a subject much neglected; 15, fire-door design; 16, auxiliary air inlets and smoke consumers; 17, preparation of coal for use; 18, storage of coal to avoid loss in heat value per pound; 19, purchase of coal on the basis of heat value; 20, automatic stoker; 21, hot-water service in engine house; 22, banking or dumping fires; 23, methods and time for firing up engines; 24, time lost on road at meeting points; 25, instructions and control of engineers and firemen; 26, the influence upon fuel economy of progressive examinations of engineers and firemen.

In brief the report may be taken as an indication that the general belief is well founded that fuel economy is best effected by the intelligent performance of duty by the men in the cab and that this intelligent performance can be brought about by a campaign of instruction on the whole subject carried on by the railroad officials.

The discussion brought out quite a number of interesting points. Dr. Angus Sinclair pointed out the necessity for cooperation by the purchasing department in the matter of obtaining fuel of good or of even uniform quality. The practice of buying coal on the B. T. U. basis is growing and if a division be supplied with coal of uniform heat-giving qualities, the engines on that division could be drafted to suit and so effect a very satisfactory saving in coal.

Mr. G. W. Wildin, of the N. Y., N. H. & H., said that a good deal of waste took place by not having the roundhouse staff fully interested in the matter and that it was a matter of importance to the railways to inculcate the right feeling both in the shop and on the foot plate in the matter of fuel economy. Repairs could be made, not merely to get steam, but to get steam economically.

Mr. A. M. Waitt, continuing the discussion, said: It has been said that there have been for the past 20 years committees on the subject of fuel economy, which is true. There have been presented by the present committee some six proper essentials of fuel economy. This is a broad subject. On every one of these six essentials there is a great deal of difference of opinion. Would it not be wise for the committee to be continued, with instructions to take for next year one of those six essentials and thresh it out to a finish and present a report that the members

LETHBRIDGE VIADUCT.

could go home and put in practice—definite, well worked-out ideas? If they have done their work well, then another year take another of the subjects, and at the end of a certain reasonable length of time each one of those essentials that the committee have very properly mentioned would be well worked out and the members would have something very definite to work upon and put in force as the result of the best practice in the country.

The six essentials to which Mr. Waitt referred were embodied in the report, as follows: 1, a clean boiler whose shell tubes, sheets, and stays (and in addition the crown bars, in the crown bar type of boiler), are kept free from mud and scale; 2, properly drafted and good steaming engines; 3, a good quality of fuel properly prepared for use; 4, efficient operation of the locomotive; 5, individual fuel records; 6, a full and fair accounting.

Derailments of Tenders.

The report on Tender Trucks, presented to the Master Mechanics' Association by the committee of which Mr. H. T. Bentley, of the C. & N.-W., was chairman. The committee states that the members believe the arch-bar, cast-steel side frame, and pedestal trucks, will if correctly designed be thoroughly reliable for high and low speeds.

In the matter of tender derailments, the replies to a number of inquiries, sent out by the committee, assign the cause or causes to a number of reasons. These are bad track conditions, high center of gravity of tank, rolling action of water on account of splash plates being out of place, coil springs, short wheel base, shallow center plates, center plates not fitting, too much rigidity, improper location and clearance of side bearings, lack of clearance between drawbar and end sill; on Prairie type engines by excessive lateral swing of engine, depression of track by rear engine driver ahead of front tender truck causing more front trucks to be derailed than rear ones; the steadying effect of cars helping to keep rear trucks on track.

The conclusions presented by the committee were briefly and in part as follows: Tender derailments can be practically overcome by the use of properly designed trucks having rigid or swing motion bolsters supported by suitable bolster springs, either elliptical or half elliptical, double or triple, and when side bearings are properly located, having a spacing of 36 ins. front where possible, and 48 to 50 ins. at rear end. The types of truck may be of the arch-bar or steel side-frame pattern, with journal boxes rigid with the arch-bars or side frames; or of the pedestal type having arch-bars of solid frames with springs over the journal boxes; or of the pedestal type having side equalizers with half elliptical springs between the equalizers. The tender should be as long and low as possible. Spring buffers between engine and tender give flexibility and reduce liability of derailment due to solid chafe irons binding or sticking, on account of wear. The buffer face and bearing on engine should be amply large and well rounded to prevent locking. The committee does not believe that splash plates in tank help to overcome derailments.

Advantage of Superheated Steam.

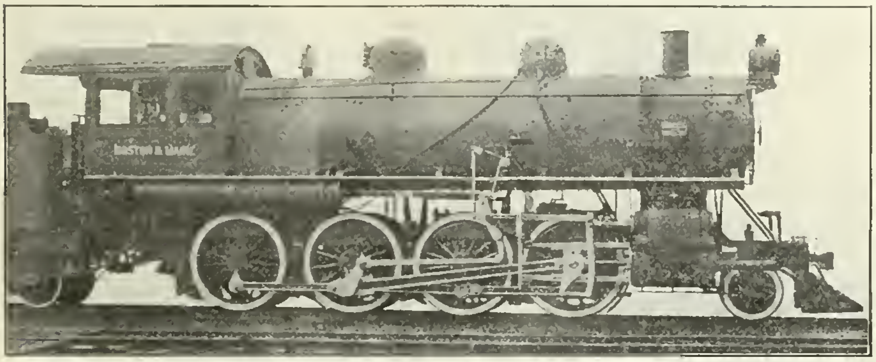
Superheating of steam was very interestingly discussed by Mr. S. M. Vauclain at the last Master Mechanics' convention. He remarked that highly superheated steam was not wanted in this country, but rather steam superheated sufficiently to overcome all the loss of the single expansion locomotive, and at the same time enable us to go back to a normal boiler pressure of 160 lbs. If we could do this we would overcome the necessity of the compound locomotion and the necessity for any special appliance or special metal in the construction of our locomotives for the highly heated steam, and we would be able to produce a locomotive that would require even less attention than is now accorded to the single expansion locomotive.

AMONG THE RAILROAD MEN IN THE EAST

By James Kennedy

ON THE BOSTON AND MAINE RAILROAD.

If the expanding activity manifested everywhere on the Boston and Maine Railroad is to be taken as an indication of the coming of improved business conditions, the improvement is here already. Several millions of dollars will be spent in erecting new shops at East Somerville. This has been in contemplation for several years and is now taking definite form. An equipment order of 28 passenger locomotives, 20 freight locomotives, and 10 switching engines, said to be the largest equipment order ever made by the company, is beginning to be filled this month. The American Locomotive Company are repairing and rebuilding 25 of the large passenger engines, and the various shops at Concord, Keene and Lyndonville are working to their full capacity. The order for cars looks as if a complete renewal of rolling stock was being projected, and before the end of the summer the equipment will far surpass anything hitherto seen in the northeast corner of the United States.



BOSTON & MAINE HEAVY FREIGHT, WITH WALSCHAERTS GEAR.

Nearly 200 men are busy installing the new system of block signalling, and there is now completed about one-half of the 2,500 miles of road. About a dozen new stations are being built, and about as many grade crossings are being abolished so that everybody is busy all along the line. The latest experiment in operating, that of despatching by telephone, is being tried between Boston and Fitchburg and other points and the reports are of the most gratifying kind, and the rapid adoption of the use of the telephone in the despatching service is inevitable.

AT SPRINGFIELD, MASS.

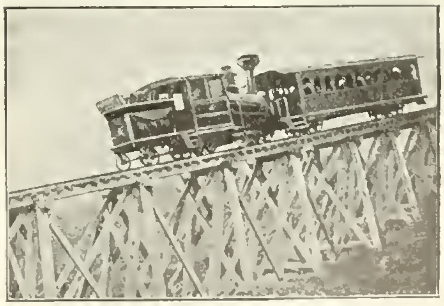
At Springfield, the southern extremity of the road, we had the pleasure of meeting Mr. C. S. Hall, a typical Eastern master mechanic. He was among the first air brake instructors and over 10,000 men have listened to his eloquent discourses on the air brake, and became experts themselves. He was busy equipping the fine passenger locomotives with new ashpans. With one of the driving wheels under the firebox, the ashpans are constructed in three sections. It is necessary to drop the back driving wheels a certain distance in order to place the central section of the ashpan in position. The other two sections are strongly secured to the central section, and on the hopper-shaped bottoms of the front and back sections there is a strong casting attached, into which well-fitted flat cast steel plates are slidably engaged. These plates, forming the bottoms of the ashpan, are moved by a shaft to which arms are attached, the arms being coupled to the sliding bottoms of the ashpan. A fixed lever on the shaft located under the cab flooring readily moves the sliding plates backward or forward. The apparatus seemed admirably suited to meet the requirements of the new Federal law in regard to ashpans, but it will be interesting to note with what degree of facility the bottom plates will slide after several months' service. Experiments are being carried on with a view to apply a blower to clean the ashpan, and while the problem of adopting the mechanism to the new law is a hard one, there is no doubt but that the skill of the leading railway mechanics will speedily overcome the difficulties of the situation.

AT EAST CAMBRIDGE, MASS.

The extensive network of railways in and around Boston brings the smoke preventing question into sharp prominence now and then. Like the tariff question in Washington or the licensing question in New York, the politicians must have something to exercise their State craft upon. The Massachusetts legislator begins and ends in smoke. Sometimes it is a special commission resembling a certain aldermanic committee who were entrusted with the matter of paving a thoroughfare when a wise man suggested that they get their heads together and the job would be done. Meanwhile the locomotives come thundering from every point of the compass and whether the accompanying pillar of cloud by day and pillar of fire by night is less than formerly is not owing in the remotest degree to legislative enactments, but is owing largely to the careful training of the fireman on the various roads.

Among the most active and intelligent educators of the young railway men the Boston and Maine Railroad Company have been conspicuously prominent. Mr. E. T. Sumner, master mechanic at East Cambridge, is one of the leading experts in America on locomotive firing. He has been nearly fifty years in the service. He is a great believer in brick arches in fireboxes, and when you enter the big roundhouse the fifty-three pits seem separated from each other by walls of fire brick. One could hardly tell whether some of the busy mechanics are masons or machinists. The brick arches are no ramshackle structures that tumble to pieces at the first touch of a slicing bar. With crowning pediments and transverse openings they are stronger and kept in better repair than the arch of Constantine.

In the seemingly unimportant matter of starting a fire something new was in evidence in the shape of sheet iron receptacles filled with sawdust and shavings. The fireman took a pailful and from an adjacent tank mixed the sawdust with crude oil. A moment later the firebox was like Vesuvius in eruption. The passenger locomotives were in perfect condition, nearly all of them being equipped with the Walschaerts valve gearing, which is highly spoken of among the railroad men.



MT. WASHINGTON RAILROAD.

Mr. Summer's educational work is ably supplemented by Mr. T. J. White, the scholarly chief clerk. It was gratifying to see the kindly spirit existing between the workmen and the officials. The office door is open at all hours. There is no ante-chamber where sad-faced employees nursing some real or imaginary grievances are waiting their turn to see the master mechanic or the chief clerk. They walk right in, and are welcomed like men. They are taught self-reliance and self-respect, and a manly feeling of working toward a common end pervades the entire establishment.

ON JACOB'S LADDER.

The earliest and many of the cleverest engineering works were done on what is now part of the Boston and Maine Railroad. The Hoosac Tunnel, nearly five miles in length, was for many years the longest in the world. The railroad running to the summit of Mount Washington was the pioneer in that department of engineering, and it is a strange sight in the dawn of a summer's morning to see the miniature train coming out of the white clouds that envelop the dark valleys beneath and slowly but surely rising into the upper regions already glittering in the golden glow of sunshine, while here and there out of the spectral whiteness mountain peaks are rising like emerald islands in a sea of amethyst. The little train comes like a messenger from the nether world and out of the weird wonderland we feel that we are in touch with the earth again.

AT NEW LONDON, CONN.

The Central Vermont Railroad begins or ends at New London, according to which way you are going. There is a finely equipped roundhouse and machine shop there. Mr. T. Hinchey, the general foreman, is a good sample of the ingenious Eastern mechanic. He thinks nothing of taking the wheel tires off one of the great freight engines and putting a new set on in the same day. In the twelve pits there are almost as many varieties of locomotives. Conspicuous among them were samples of the Richmond Compound built in Montreal, with a high pressure cylinder, 18 ins. in diameter on the left side and a low pressure cylinder of 36 ins. diameter in the right side. They carried 200 lbs. pressure and ran 121 miles every day, consuming about 4½ tons of coal each trip. Mr. Hinchey was very eloquent in praise of their reliability. We observed a new feature on the coal-box doors attached to the coal compartment on the tank. The door was constructed in three divisions, so that when the full complement of 12 tons of coal was on the tank, the upper division of the door was enough to have opened and so on as the supply of coal diminished, the other divisions were readily opened. In the handling of coal there is a special portable engine with crane and clam shell attachment that moves along an elevated road and from an extended coal bin a dozen of locomotives can be supplied with coal without moving from their places. With a gang of clever mechanics, and fine equipment, the southern end of the Central Vermont Railroad receives proper attention, and the little roundhouse is an ideal one in neatness and efficiency.

The Baker-Pilliod Valve Gear.

At the annual convention of Railway Shop Foremen held at Chicago, and at the Master Mechanics' and the Master Car Builders' conventions held at Atlantic City, a working model of the Baker-Pilliod locomotive valve gear was exhibited which attracted very great attention. Several superintendents of motive power who have engines equipped with this valve gear were reluctant to give figures about the performance of the gear because the steam distribution was so good that they wanted to have more experience with it before giving their testimony.

The difficulty of reaching valve mechanism located between the frames of modern locomotives has brought the Walschaerts valve gear into popular favor. The Baker-pilliod gear is a very compact piece of mechanism, the parts can be readily renewed, it produces an excellent distribution of steam and altogether possesses the qualities that recommend it for use on locomotives.

Wood's Corrugated Fire-box.

A section of the corrugated fire-box invented by Mr. W. H. Wood, of Media, Pa., was one of the novelties which attracted much attention in the exhibits at the railroad mechanical conventions at Atlantic City. This form of fire-box has been applied to locomotives belonging to a few of our leading railroads, and very satisfactory reports of its performance have been made. The great strength of the corrugated plates is beyond question. Material increase of heating surface is claimed and the free steaming for which the engines having the Wood fire-box are noted would indicate that the fire-box will prove a valuable fuel saver.

The locomotives belonging to the Illinois Central running out of McComb City, Miss., make an average of 227 miles daily. During the last year they have made 29,800 miles for each engine failure. Mr. Thos. M. Young, the engine house foreman there, is an enthusiast on engine inspection, which may account for the extraordinary long mileage between engine failures.

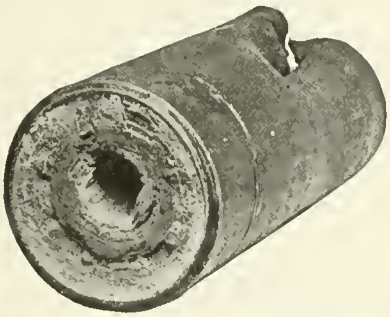
THE ST. GOTHARD EXPRESS, SWITZERLAND.

Dispatching Trains by Telephone.

The Canadian Pacific Railway Company is experimenting on train despatching by telephone. The system between Montreal and Farnham has been in successful operation for some time and has given very satisfactory results. A description of this appeared in RAILWAY AND LOCOMOTIVE ENGINEERING for May. The system is now being installed between Winnipeg and Branden, and other important sections will shortly be dealt with. The distance between the latter points is 135 miles, embracing 28 stations and 3 junction points. The Burlington and other roads in the United States have been using the system under test for some time, and as it has passed beyond the experimental stage there is likelihood of its still further growth in popular favor and its wide and extended use.

Water Softening for Locomotives.

At the recent exhibition of the Railway Appliance Association in the Coliseum at Chicago the Dodge Manufacturing Company of Mishawaka, Ind., was the only concern showing a machine in full operation. This company manufactures what is known as the "Eureka." The machine was put through its paces there and produced 1,500 gallons of treated water per hour. The main portions of the tank were removed, but there was enough of the mechanism on display to show how the system worked.



HOW UNTREATED WATER TREATS A PIPE.

The pitting of tubes and sheets in a locomotive boiler is a matter of most serious moment to mechanical men. Many raw waters contain acids, salts or other impurities that render them actively corrosive. Again in picking up a variety of waters at different points there not infrequently results a mixture, which, through chemical reactions in the boiler, produces corrosion. Properly purified in a water softener one may say that practically all waters can be rendered non-corrosive and non-incrusting. The use of good feed water facilitates the use of brick arches, by rendering it unnecessary to remove them so often for repairs to boilers and flues, because the amount of such repair is reduced.

The Dodge water softening system is a very simple arrangement. Only fifteen or twenty minutes a day are necessary for attention, and any intelligent man can do the work. The "Eureka" as shown by the Dodge people at Chicago consists of two main parts, a large decanting chamber in which, through chemical reaction, purification takes place, and a lime saturating tank for the production of clear lime water. The water to be softened and purified, enters the distributing tank through an inlet valve, connected by rod and lever to a float in the decanting tank. This device automatically starts and stops the machine. The inlet valve maintains a constant head of water in the distributing tank, the weight of this water when falling over a water wheel furnishing power to run the entire mechanism.

From the distributing tank part of the raw water is fed through a hollow shaft into a lime tank wherein is produced a powerful saturated lime water solution. All impurities in the raw lime settle during the saturating process and pass out through a valve to the sewer or a catch device. In a compartment at the top of the lime tank lump lime is placed and slaked. Proceeding downward in a regulated flow through a large central tube, this slaked lime is thoroughly mixed by a stirring arrangement, the raw water re-

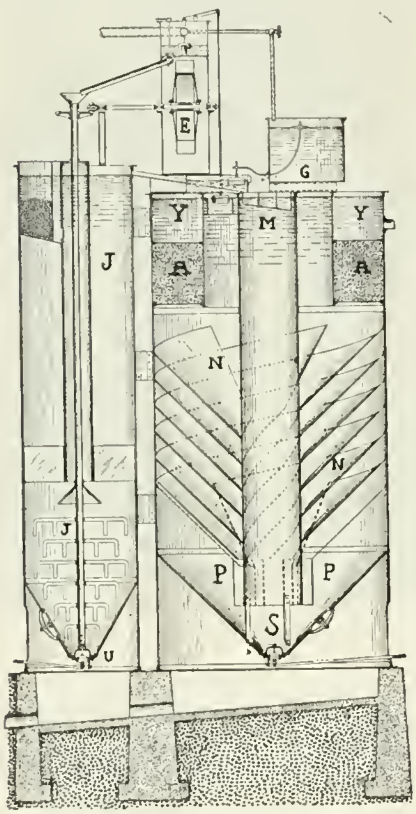
EUREKA WATER SOFTENER.

turning upwards from the bottom of a hollow shaft displaces a like quantity of the saturated solution, which flows through a trough into a down-take tube. Here it meets the raw water that has passed over the water wheel and also a predetermined amount of soda solution from the soda ash tank and is thoroughly mixed in a mixing pan in the top of the down-take pipe.

The treating process, it may be said, has now begun. After passing downward through the down-take tube the water turns upward through spiral accelerator plates upon which, as well as in the cone, all solid matter is deposited in the form of thin putty or sludge. Gravitating down the sharply inclined plates, this sludge drops into slime-catchers and is conducted into the cone to be flushed away. After leaving the accelerator plates the now softened and purified water passes through a wood-fibre filtering bed which clarifies it completely. The filtering material requires renewal only at long intervals.

Emerging from the filter bed the soft, clear water enters the top reservoir and is drawn off for use through an outlet pipe, flowing by gravity.

The Dodge Manufacturing Company have given us some figures in connection with the operation of their plant. We print the figures as received from them, without verification, as a statement likely to interest or be useful to our readers. The Dodge Company say, in connection with the following table: "The Master Mechanics Association reports that the average cost of boiler repairs on roads in the United States and Canada is $720 per year. In the present statement this figure has been cut 38 per cent. in order to cover only such repairs as are due to impure water.



SECTION OF THE APPARATUS.

A repair charge of $225 per locomotive has been allowed when treated water is used. The cost of pumping water for washing and filling purposes has not been included in the figures owing to the difficulties of arriving at a satisfactory and equitable basis."

Estimate of the cost of operating one hundred locomotives on a 200-mile division before and after installation of water softeners at ten pumping stations:

USING UNTREATED WATER.

Loss of time of three locomotives out of service for washing, eight hours each, equal to one locomotive continuously, at $100 per day, 365 days	$36,500.00
Washing, at $5.25 daily, wages of three men, for three locomotives daily, 365 days	1,916.25
Boiler repairs per year, at $450 per locomotive, one hundred locomotives	45,000.00
Coal required to heat cold boilers to steam after cleaning	2,000.00
Cost on yearly basis	$85,416.25

USING TREATED WATER.

Cost of ten water softeners, 8,000 gallons per hour, each (est.)	$40,000.00
Cost of foundations for plants, ten cubic yards each at $6 per cubic yard	600.00
Housing for plants at $175 each	1,750.00
Investment	$42,350.00
Interest on investment at 6 per cent., one year	$2,541.00
Treating 1,900,000 gallons, estimated daily consumption at two cents per one thousand gallons, 365 days	13,870.00
Washing one hundred locomotives each three months, four hundred locomotives per year, at $1.75 each	700.00
Loss of time of one locomotive, out of service for washing, eight hours equal to one locomotive a day, every three days, at $100 per day, 365 days	12,166.00
Boiler repairs, $225 per locomotive, per year, one hundred locomotives	22,500.00
Cost on yearly basis	$51,177.00

THE COST AND THE SAVINGS.

Costs as above without water softener installed	$85,416.25
Costs as above with water softener installed	51,777.50
Total saving per year resulting from the use of treated water	33,637.00
Time required for softener to repay investment cost	15 months
Per cent. of saving	39½

Courting a Southern Embrace.

The indications are that the Harriman lines will in the near future embrace the Central Railroad of Georgia. The coming event has cast golden colors over Savannah and other regions of the South. Rumor has it that immense shops are about to be erected near Macon, Augusta, or some other point that will be convenient for collecting dilapidated cars and paralytic locomotives needing the regeneration that the skill of good mechanics alone can impart. Every big transaction in landed property in Georgia and in South Carolina is examined with feverish minuteness in the expectation that the location of the coming new industrial city may be identified. The fortunate exploiter will rank himself among the blessed.

Railroader Has Kind Heart.

It was at a railroad junction in the South that the Northern traveller found himself hungry, but with only two minutes to spare before his train left. "I'll take a cup of coffee," he said to the young woman in charge of the restaurant. "I've no time for anything else."

"You can take all the time you want, sir," said the young woman, cordially. "You look at that bill of fare, and I'll telephone to the superintendent to delay the train a little while."

"Why, can that be done?" asked the traveller, in amazement.

"Certainly," said the young woman. "Of course it can. It's a branch road, and no other train coming or going over it to-day—and the superintendent would want you to have a good meal. He owns this restaurant."—*Youth's Companion.*

Bank vs. Level Firing.

The paper on this subject was not in the form of a committee report but was, in fact, an individual paper by Mr. E. D. Nelson, engineer of tests on the Pennsylvania. The paper consisted of a record and analysis of a series of tests in which both methods of firing had each not only its advocates but its practiced and expert manipulators. The work was done on the testing plant at Altoona.

In the discussion which followed Mr. De Voy, of the Chicago, Milwaukee & St. Paul, thought that it was a matter which entirely depended on the design of the firebox. Mr. Bentley, of the Chicago & Northwestern, did not consider the shape of the firebox as of much importance. He regarded the quality of coal as the main factor. He had known engines fired by the bank method, which was the only way they could be fired 30 years ago. In Great Britain, with the South Wales coal, the only way to feed an engine was to fill the firebox and have the coal taper off toward the front, while Northwest Wales coal used this way would kill the same design of engine.

Continuing the discussion Dr. Angus Sinclair said: "When they first started to use coal in place of coke in Great Britain much attention was paid to smoke prevention, and one locomotive superintendent advocated a grate with a slope of 25 per cent. and introduced bank firing. It was well adapted to the qualities of Welsh coal, but a practice suitable for one coal is sometimes entirely unsuited to another. A great many of the locomotive superintendents in Great Britain followed this lead and slope fire grates were introduced to a great extent, but they did not give satisfaction unless with special coal, and the consequence is that level firing became the firing of the British Isles."

In closing the discussion Mr. Johnson explained that in these tests the Pennsylvania did not obtain the amount of clinker and ash separately. This subject was not entered into for the purpose of trying sloping and level grates, or to determine questions as to large or small ratios between heating surfaces and grate areas.

How the tests affect other modifications of grate area and heating surface the committee did not say positively, but from general observation, with this test, and the conditions there, and with the type of locomotive used, as well as the Atlantic locomotive, and over 60 different kinds of coal, tried at different times, it seems to be the general conclusion that each square foot of firebox should give a definite proportion of work. The coal per square foot of grate is larger in front than in the back, and we think that with these forms of grate which we have used, with uniform burning over the surface of the grate, and, therefore, approximately, level firing, they produce the most desirable results.

New Hydraulic Jack.

Anyone who has much heavy lifting to do appreciates that there are pleasanter tasks than carrying around a jack from one place to another, especially when it weighs more than a hundred pounds. It means rather a heavy load if carried by hand, and if the jack is loaded and reloaded onto a truck with each using, this involves considerable work too.

The new Watson-Stillman shop jack, which we show in our illustration, renders unnecessary much of this labor. This jack, made in eleven sizes, of from 20 to 50 tons capacity, and lifts of 12 and 18 inches, fills all the ordinary requirements of lifting heavy machinery and for general shop work. The wheels on the base and the handle on the cylinder facilitate moving the jack quickly from one place to another without the exertion of a great deal of energy. The wheels touch the floor only when the jack is tilted, so they are never in the way during the lifting operation. If it is desired to use the jack at an angle, it can be tilted in the

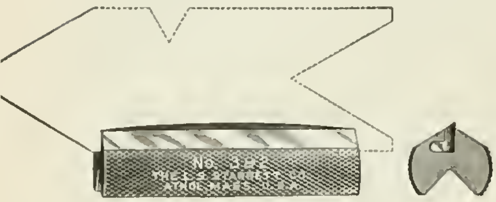
NEW HYDRAULIC JACK.

opposite direction to the wheels, and when it is laid flat upon the side, the ram will push out to its entire lifting length. The head is enlarged sufficiently that the jack will not stop working for lack of filling, even if there has been slight leakage. An independent steel claw (not shown in the illustration) can be used when desired for lifting from near the ground. This is more convenient than a permanently attached claw, as the independent part is easily applied when a low lift is required, and its removal at other times allows the jack to be made of considerably lighter weight.

The Independent Pneumatic Tool Company of Chicago, makers of the well-known "Thor" hammers, have moved their general offices from the First National Bank building to their own new Thor building, 1307 Michigan avenue, Chicago. In their new location they have larger space and greater facilities for taking care of their increased business.

Some Handy Small Tools.

Among the many useful and very cleverly devised tools which are made by the L. S. Starrett Company of Athol, Mass., we would like to mention their Center Gauge Attachment No. 392. This attachment is a V-block with a slot above the V, containing a flat spring to frictionally hold the center gauge parallel with the block. Placing the V-block against a lathe spindle or face-plate, a threading tool can be adjusted to line perfectly to cut both sides of a thread to the proper angle, eliminating uncertainty for both external and internal work. The attachment is adapted to hold the gauges either by the side or by the end for testing work.

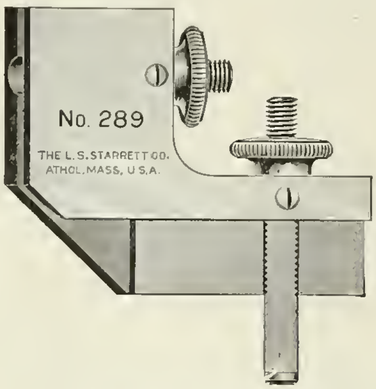


V-BLOCK WITH SLOT.

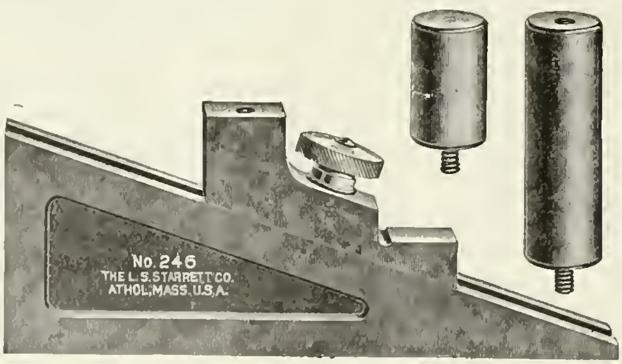
Another "good thing," if we may so say, is their Planer and Shaper Gauge No. 246. This gauge is made of steel, drop forged, and is designed with a view to getting different heights on a planer. It will measure from ½ to 5½ ins. It will also be found convenient on other tools such as milling machines where slots are being milled. This tool can be inserted in the slot, and by sliding the block on the wedge a perfect fit is given. Then the tool may be taken out and exact measurements obtained by the use of a micrometer. When a certain close measurement is desired the tool can be first set by the micrometer and then used as a standard gauge.

Another useful device is the Starrett Attachment for Combination Squares No. 289. The use of this attachment is very clearly shown by our illustrations. It is made to fit the 12, 18 and 24-in. blades of the Starrett Nos. 11, 23 and 33 squares, and can be used in connection with any of their regular rules as wide as one inch, or with flat steel square No. 21 for laying out key seats, etc. Altogether it is a very handy little adjunct for combination squares.

Leaving the shop, we may say a word which may interest the designer. There is the Draftsmen's Protractor No. 361. This protractor is made of sheet steel, nickel plated, graduated in degs. and figured to read from either right or left, with vernier to read in five minutes. The three straight edges of the protractor are graduated in inches and 16ths, the longer part 6 ins. It is made so that it lies flat on the paper. The knurled locking nut is convenient for picking up the instrument. By loosening the binding nut, friction is taken off, making it easy to adjust to degrees, when the tool may be again firmly locked. The Starrett Company are willing to send descriptive circulars concerning any or all of these handy little devices and quote prices, which are very reasonable, to anyone who will drop them a post card asking for the information.



ATTACHMENT FOR COMBINATION SQUARES.

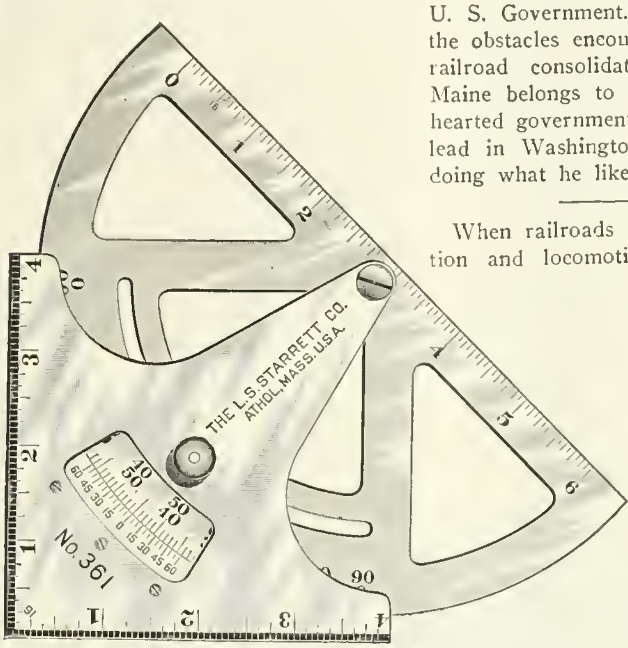


PLANER AND SHAPER GAUGE.

Steam-heat Regulator and Stop Valve.

A very ingenious contrivance is Gold's new stop valve temperature regulator. A circular describing and illustrating it has recently been issued by the Gold Car Heating and Lighting Company of New York. This regulating valve can be applied to any car heating system and regulates from 0 to 20 lbs. steam pressure. The valve is applied to each car and when set for the desired pressure it does not require further attention. The device may be used as a stop valve, and when closed steam is entirely shut off from the car.

The regulator is used in place of the ordinary inlet valve and is adjusted by means of a wheel handle which has an indicator in which a spring is inserted to hold it in whatever position it may be set. No steam gauge is necessary, as one turn of the wheel gives 20 lbs., half turn 10 lbs., or any intermediate position gives a corresponding pressure. Each notch is marked with the pressure which results from setting it at a particular notch.



STARRETT'S DRAUGHTMAN'S PROTRACTOR.

With this device the train line pressure may be reduced—in fact, where the entire train has been equipped with this regulator we are informed that the train line pressure has been reduced by half the amount formerly carried. In consequence there is a saving of steam and steam hose, and it relieves the various parts of the steam-heating equipment from excessive strain. The regulator is made in both straightway and angle type. The angle type is used for passenger car coils, and the straightway valve for baggage and express car coils. All parts of these regulators are interchangeable. Write to the Gold Co. for their circular on this subject.

We are informed that the Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio, have recently received a large order for their staybolt iron from one of the largest railway systems in England. This railway company wishes to give Falls Hollow staybolt iron a preliminary test, with a view of its adoption on their entire system.

Cold Weather for Consolidation.

People who have been trying to effect a consolidation of the New York, New Haven & Hartford Railroad and of the Boston & Maine Railroad are said to have promoted the passage through the Massachusetts Legislature a holding company bill, the purpose of which was to make the consolidation legal. The latest developments now are a checkmate in the form of the Sherman Act moved by the U. S. Government. The case illustrates the obstacles encountered by the modern railroad consolidator. The Boston & Maine belongs to one man, yet a cold-hearted government hiding its diminished lead in Washington prevents him from doing what he likes with his own.

When railroads first came into operation and locomotives manifested speed capabilities that were new even to sporting people, a sentiment of brief duration arose in favor of racing the engines, and a few races of that kind took place. But the practical people who managed railroads soon perceived that there was no merit of one engine outstripping another in a race, as it merely involved the combining of power and leverage.

That being the case, it is curious to observe the persistency of the sentiment in favor of racing with automobiles. That taste has largely abated in Europe, but it continues active among American automobilists. The condition is, no doubt, due to the fact that America contains a larger proportion of fools with money to squander than other countries.

The Detroit Lubricator Company's catalogue for 1909 is something elegant. There are 64 pages of cream-tinted superfine paper and over 200 superb illustrations showing the various products of the company. These embrace lubricators in various forms, multiple oilers, oil cups, oil pumps, throttle valves, water indicators, oil injectors, crank pin oiling devices, pop safety valves, gauge cocks, self-cleaning water gauges, radiator valves and a variety of attachments. The details of the company's improved standard lubricator is shown in various sizes. Among the new devices a clever adjustable crosshead oiling device is sure to meet with favor. Copies of the catalogue may be had on application addressed to the company's secretary at Detroit, Mich.

Under a law passed at the last session of the Minnesota Legislature and becoming effective Jan. 1, 1911, railroads operating in the State will have to buy new and large cabooses for their freight trains. They must be 24 ft. long, exclusive of platforms, and have two four-wheel trucks.—*N. Y. Commercial.*

Whoso Hesitates.

Make up your mind to act decidedly and take the consequences. No good is ever done in this world by hesitation. The old saying: "He that hesitates is lost" is as good to-day as it ever was and is finding apt illustrations in daily life. Sam Myers is an engineer on the X. Q. Z. road and a fairly good man with an engine, but he related an incident that illustrates the danger of hesitating. His fireman directed his attention to a sudden knock on the left hand crosshead as it appeared to be and he decided to make an examination at the first stopping point. But before that place was reached the piston went out through the cylinder head. The pound was caused by the piston key working out.

Proper Care of Belts.

This is a new booklet of 24 pages, recently issued by the Joseph Dixon Crucible Company, Jersey City, N. J. It is divided into three sections, headed respectively:—Belts; Belt Dressings, and Hints, Kinks, Tables. The first section deals with the running condition of belts; the second takes up treatment with various preparations; and the third, as the title indicates, has some general points upon belting and its use.

This last section contains a considerable amount of interesting and valuable matter collected from many authoritative sources. It tells what results were secured in a plant where records were kept over a period of years; gives the economical speeds at which leather belts should be run; has some matter telling of the different styles of joints, illustrating three methods of leather lacing; contains rules for calculating speed of pulleys; gives horse power transmitted by various sizes of single and double belts, etc.

Any one who has any amount of belting under his care should have a copy of this booklet. Those desiring a copy of this booklet may secure same by writing direct to the home office of the Joseph Dixon Crucible Company, at Jersey City, and mentioning this publication.

The catalogue recently issued by the Safety Car Heating & Lighting Company of New York is a most complete and comprehensive publication. It is got up in loose-leaf form in a special post binder and the contents make clear the manner in which the company is meeting the demands in the car lighting and heating fields. Among the devices which have been given special attention are the Axle Dynamo Lighting System and the Thermo-Jet System of heating. The Axle Dynamo Electric Lighting System has been brought to a state of high efficiency after sixteen years experience with this form of car lighting and possesses the qualities that make for efficiency, reliability and economy. The heating system illustrated in this catalogue is designed to give exactly the heat required, irrespective of the outside temperature. This means there must be no lack of heat in cold weather and no over-heating in mild weather. The new Thermo-Jet System of the Safety Company was designed to meet these requirements and the makers say that the service given by this equipment during the past season has amply demonstrated its efficiency in this respect. The system, which is a form of heating by direct steam, provides for a regulation of the temperature of the radiating pipes both above and below 212 degs. F. and at all times just enough steam is used to heat the car comfortably. The operation of the valves is most simple, for the words "Mild" and "Cold" on the indicator quickly suggest to any trainman the direction in which the operating handle must be turned. In very cold weather the valves can be opened wide, admitting steam up to 25 lbs. pressure, and as soon as the car is warm the pressure can be reduced to give any desired temperature of the radiator pipes. The Safety Company find that for about nine-tenths of the ordinary heating season as experienced in this climate, a temperature of the radiator pipes 110 degs. above the normal temperature of the car is ample and the ability to effect this regulation means an economy in steam which, when converted into coal consumption, is equivalent to 5 lbs. per car per hour. A copy of this catalogue can be had on application to the company.

Enemies of Railroads Turned Friends.

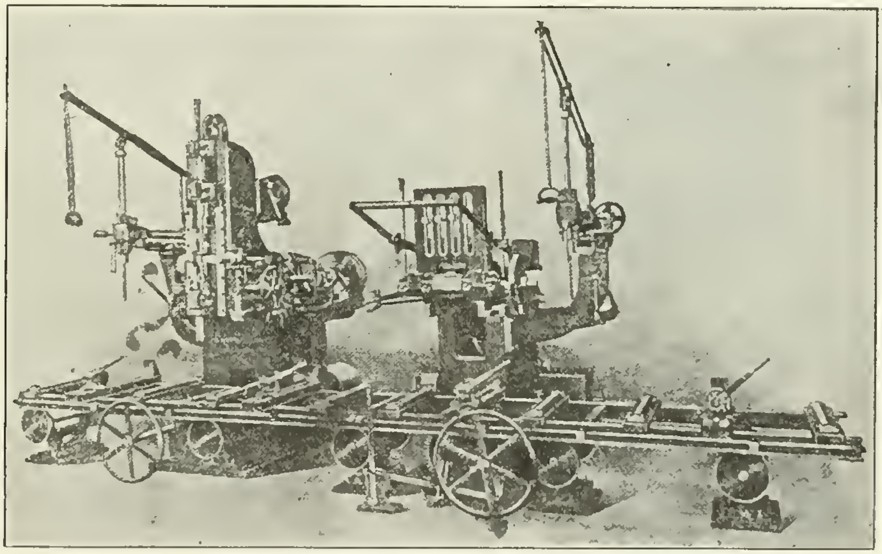
A year ago the statesmen and other men constituting the Congress of the United States seldom failed to hit a railroad head that was exposed to the insurgents' bludgeon. The most popular blow was knocking railroad management into the hands of the Interstate Commerce Commission. One of the most annoying of these blows gave that commission supervision over the hours of labor performed by railroad employees. Railroad companies contend that they are willing to curtail the hours worked by employees, but they do not agree to be managed by the Interstate Commerce Commission.

The Baltimore & Ohio Railroad has appealed to the Supreme Court to test the validity of the law seeking to enjoin the Interstate Commerce Commission from putting into effect its order requiring railroads to make reports of the hours of service of their employees, taking the ground that the order by the expense entailed in making the reports deprived them of property without due process of law and was violative of the rights of the railroad not to be compelled to give evidence against itself or be subjected to unreasonable search or seizure. The Federal court in Maryland dismissed the bill and the railroad appealed.

Similar suits brought in other jurisdictions by the Pennsylvania, Philadelphia & Reading, Lehigh Valley, Central of New Jersey, New York Central, Lackawanna, Erie, New York, Ontario & Western, and New York, New Haven & Hartford roads are dependent upon the outcome of the case docketed.

Successful Combination.

Many carshop foremen have felt the need of a wood working machine that would mortice and gain heavy material without the labor of moving it from one machine to another, to say nothing of the loss of time involved. The J. A. Fay & Egan Company of Cincinnati, Ohio, are the makers of a machine which does away with this extra labor and loss of time.



COMBINATION NO. 214 VERTICAL HOLLOW CHISEL MORTISER AND NO. 150 AUTOMATIC CAR GAINER.

The manufacturers have constructed this machine by placing their No. 214 vertical hollow chisel mortiser and their No. 150 automatic car gainer side by side with a single traveling table. This combination machine has a capacity for timbers up to 20 ins. thick and 24 ins. wide. The company have just issued a circular showing a large half-tone photograph of this machine with detailed description, a small reproduction of which we give in our illustration. A copy of this circular may be had by applying to the makers at 445 West Front street, Cincinnati.

Robbers and Wreckers.

Train robbers are always heartless ruffians that ought to be handled without scruple when caught. A band of these miscreants that held up a Great Northern train in Washington last month were unusually brutal in their actions. After moving engine and mail car two miles away from the train so that the robbery could be carried out leisurely, they ran engine and car back into the train, causing a violent collision. That was an act of reckless cruelty that will no doubt bring condign punishment when the thieves are caught.

American Locomotive Building.

The American Locomotive Company is preparing to erect extensive works at Gary, Indiana. The site comprises 130 acres and is fully twice as large as that occupied by any other of the company's extensive plants. It is estimated that 15,000 men will be employed when the works are in full operation. The works will occupy a site near the United States Steel Corporation's works, and will thus have the advantage of quick and cheap delivery of the principal material, besides being in the center of a district where several of the leading railroads converge. At present the company has no large locomotive plant west of Pittsburgh.

Hour-Glass Section.

A very interesting, useful and novel form of drill has lately made its appearance and was on exhibition at the railroad conventions at Atlantic City this year. The drill is made from steel of a specially rolled shape. The end view makes the section something like a circle in which two V-shaped notches have been cut or roughly speaking like an hour glass with, of course the connecting central portion of substantial thickness.

When this steel shape is twisted it becomes a twist drill, the V-shaped recesses become the spiral grooves of the drill.

The cutting edges are sharpened in the usual way and the point is ground at the proper angle. The whole then makes a strong, good drill and as it has no metal cut out of the grooves the entire surface of the steel has the skin strength of the original piece.

The shape of the section lends itself readily to the driving socket. This is the ordinary Morse taper socket as far as the drill press is concerned, but the socket is formed internally, so as to easily slip over the hour-glass section of the drill and the advantages of this is that there can be no possibility of slip and the socket can take several sizes of drill. One socket does for all drills from the smallest up to its full capacity. The makers also supply chucks to hold these drills, which have the same wide range as the socket.

Mr. W. J. Press represented the makers, Messrs. Mussens, Ltd., of Montreal, Canada.

The Detroit Seamless Steel Tubes Company have issued an interesting pamphlet on the subject of locomotive flues. The chief feature is a concise extract from a paper submitted by Mr. B. F. Sarver, of the Pennsylvania Lines to the International Master Boiler Makers' Association held in Louisville, Ky., last April. The argument in favor of the cold-drawn seamless, open-hearth steel flue is very convincing, and copies of the pamphlet should be in the hands of all interested in locomotive boiler construction and repair. We may add that as we write this we have received a post card from one of the locomotive engineers of the Egyptian State railways dated Cairo, May 15, in which he says: "In the valley of the Nile the Detroit locomotive flue is considered the best," and signs his name Mohamed Sayed. We have no doubt it is as the aforesaid Sayed says.

The Safety Car Heating and Lighting Company of New York have recently sent us the following for publication. They say: "Until recently certain statements made in the papers about the wreck on the Union Pacific at Castle Rock, Utah, in March last, have gone uncontradicted and we are taking the liberty of referring to the matter at this time. At first the cause of fire was attributed to Pintsch gas, but it has since been definitely established that the baggage car, on which the fire occurred, was lighted with oil lamps. It surely is a matter of great interest to all railroad officials to know that on the other cars equipped with Pintsch gas none of the tanks were ruptured, a fact, we think, which adds another strong testimonial to the safety and reliability of the Pintsch equipment under the most trying conditions, and again verifies our most thorough tests and the claims we have made in the past."

Canadian Divisions B. of L. E.

The city of Hamilton, Ontario, has been selected for the Union Meeting of the Canadian Divisions of the Brotherhood of Locomotive Engineers. The meeting will be held there on the 27th, 28th and 29th of July, 1909. A better spot for such a meeting could not have been selected. Locomotive engineers who visit the City of Hamilton during this meeting will have a golden opportunity to inspect the Canadian Branch of the Westinghouse Air Brake Company. This plant is equipped with 80 car lengths, E T. and K 2 equipments, as well as the older forms of the brake. This company manufactures all descriptions of electric motors. There are in Hamilton blast furnaces, steel plant, rolling mills, agricultural implement factories and about 150 other industrial establishments. For those seeking instruction, and for those looking for pleasure, this beautiful city of Hamilton is hard to beat.

The Progress Reporter, showing the products of the Niles-Bement-Pond Co., New York, appears in fine form. No. 19 is particularly interesting as showing the extraordinary amount of work accomplished by their best machines in tire turning. The strength and simplicity of these machines are finely illustrated in the pages of the Reporter, there being over twenty half-tone illustrations besides descriptive text containing authentic statements of work done at some of the chief railroad centers in America.

Going Up Against the Big Hill.

One of the boasts of James J. Hill, the railroad magnate, has been that he has no telephone in his house. "My office is the place to do business," he has declared, "and my office hours the time in which to do business. When I am behind the door of my home I am safe from the world."

He has been, too, as can be proven by many a reporter who tried to interview him there at night. The best the reporter ever got was a sarcastic grin from the butler, who buttled the reporter out to the cold world and a hot city editor. But the other day, according to Mr. Hill's own statement, his butler approached him. "The man is here to put in the telephone," said the butler.

Mr. Hill promptly wilburwrighted. He wanted no telephone, he said. He would have no telephone. He regarded it as a piece of gross impertinence on the part of the telephone company to assume that he wanted a telephone. "Why didn't you tell him so?" he demanded of the butler. Now you would think that this menial, convicted of error, would have wilted beneath the magnate's frown. He did not. "Hi told 'im, sir," said the butler, calmly, "that this telephone was wanted by the servants, sir. Hi told 'im you didn't desire hit, sir, but that we 'ad to 'ave it."

James J. Hill, magnate, looked at Mr. Hill's butler's impassive face. He twiddled his fingers for a moment on the mahogany desk. Then, confronted with the certainty of a servants' strike, he weakened. "Put it in, then," he said, and, with a return of courage, he growled at the butler: "But if I'm ever bothered by it I'll fire every one of you."

And the butler bowed in meekness and said: "Very good, sir."—*Cincinnati Times-Star.*

A multitude of weak, imitative natures are always lying by, ready to go mad upon the next wrong idea that may be broached. —*Our Mutual Friend.*

When the Baltimore & Ohio Railroad was chartered in 1828, there was so much public enthusiasm concerning the enterprise that the charter was framed in the offices of the company, and the stock was subscribed for three times over, and parties of engineers were put into the field before it was clearly known what they were required to do. Then a committee was appointed to go to Quincy, Mass., to examine the quarries railroad, but that not proving satisfactory, another committee was appointed to go to England to find out what a railroad looked like and how it was built.

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Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXII. 114 Liberty Street, New York, August, 1909 No. 8

Golden State Limited.

The Golden State Limited is the name given to two trains, No. 3 westbound and No. 4 eastbound, on the Rock Island lines. These lines are composed of the Chicago, Rock Island & Pacific Railway the train from Chicago to Los Angeles. Our frontispiece illustration this month gives a view of the Golden State Limited taken while that train was crossing the bridge over the Rio Grande River at El Paso, Tex. Our other illustration shows Millan, of Kansas City, shows a C. R. I. & P. 4-6-2 starting out with the Golden State Limited. Another of our illustrations shows a train crossing the bridge over Canadian River.

The C., R. I. & P., commonly spoken

THE GOLDEN STATE LIMITED CROSSING THE RIO GRANDE RIVER IN TEXAS. ROCK ISLAND LINES.

and several other roads. These trains run between Chicago and Los Angeles; connection is also made by sleeper without change for San Francisco. Atlantic and Pacific types of engines haul these trains. Ten relays of engines are required to take another of the fast trains on the C., R. I. & P. The photograph was taken for us by Mr. Stanley C. Brown, of Grinnell, Ia., when the train was running about 60 miles an hour near that city. Another photograph taken by Mr. Claude V. Mc- of as the Rock Island, derives this name from the town of that name on the Mississippi. On the island itself, which is a ridge of limestone rock about three miles long, there is the U. S. Government arsenal. The charter of the town dates from 1849, and it now has a population of something over 23,000 inhabitants.

The Canadian River rises among the Spanish peaks in New Mexico and flows in an easterly direction. The junction of this river in the Indian Territory with

ROCK ISLAND 4-6-2 ON THE GOLDEN STATE.

Beaver Creek forms the Arkansas River. The name of this river has no connection with the Dominion of Canada; the word has two meanings. The one from which the river probably takes its name is Canadian, a Spanish word, being a diminutive of canyon, meaning steep-sided gorge. The word Canada is of disputed origin. One of the derivations given is that the word is of Iroquois origin, and is fram Kanta or Kanada, meaning a collection of huts or a village or town. This word the early explorers are said to have mistaken for the name of the country.

The route of the Golden State Limited is via El Paso Short Line, which is the logical winter way. With evening departure from both Chicago and St. Louis,

FAST C., R. I. & P. TRAIN NEAR GRINNELL, IA.

the train arrives at Los Angeles shortly after noon of third day out; at San Francisco the following morning. The equipment includes mission style Rock Island dining car, electric-lighted stateroom and drawing-room Pullman between Chicago and Los Angeles; electric-lighted drawing-room Pullman, Chicago to San Francisco; electric-lighted double drawing-room Pullman, St. Louis to Santa Barbara, and buffet-smoking-observation car, also finished in mission style, Chicago to Los Angeles.

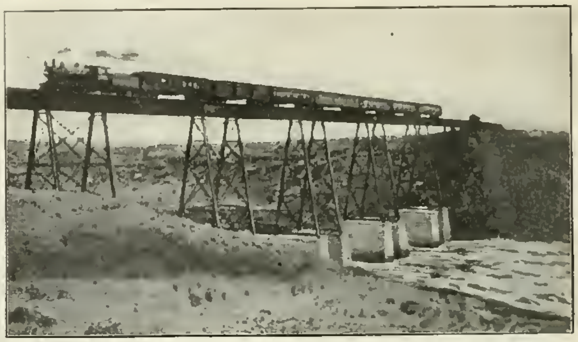
Our frontispiece shows the arid land through which this portion of the road runs, and how scarce water becomes at certain seasons. On this subject the Kansas City *Star* of recent date says: Water is a precious article in the upper Rio Grande region of Texas. The Rio Grande itself contains an ample supply for the Mexicans and the few Americans who live in this remote region, but it sometimes is a difficult matter to transport and distribute a supply. In the villages and goat ranches situated back from the river the water problem is one of the most difficult that the people have to contend with. Many months may pass without rain. The country becomes dry and parched. The hardy desert plants are the only species of vegetation that are able to go through the long droughts. Water frequently has to be transported long distances from the Rio Grande. Where the country is mountainous and rough water carts cannot be used, the water is carried in water bags which fit over the back of a horse. These bags are evenly balanced upon the back of the horse, and carry from ten to twelve gallons when filled. The bags are made of stout canvas and are fitted with tin funnels. It is not uncommon to see a dozen or more of these water pack horses in a single train wending their way to or from the river, all in charge of a Mexican driver. But the traveler in the luxurious Rock Island trains cares not for these things.

If the American people were not wonderfully deficient in sense of gratitude, many of them would be singing hymns of praise to Mr. E. H. Harriman for the extraordinary help he is giving in providing means of railroad transportation over regions that from time immemorial had to depend upon the ox team as the sole supplement to human legs. The railless territories west of the Rocky Mountains that have lately been provided with railroad benefits have Mr. Harriman to thank for their good fortune. He has conferred incalculable benefit upon the southern portions of California, and now he is engaged in pushing a line south 350 miles from Nogales, to connect with the Mexican Central, with its far-reaching lines.

Where the Deadhead Flourishes.

There once was a time when the American railroad deadhead flourished and multiplied without limit, but misfortune has overtaken this class of parasite, so now he remains at home or disgorges reluctantly the greenbacks that helped to grace the festive board in the happy days gone by.

Americans seldom cast longing eyes in the direction of Russia for aid or comfort of any kind, but our deadheads have been casting longing eyes to that country of late, for there the free ride habit has taken root, and there it has found a fertile soil. Its growth has been so rapid that the Russian Minister of Ways and

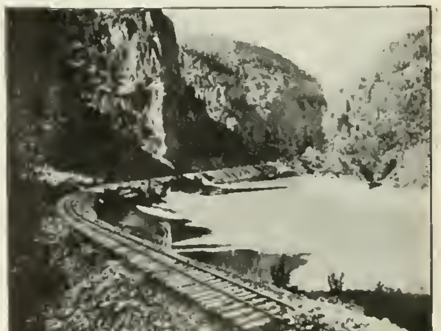


BRIDGE OVER THE CANADIAN RIVER.

Communications recently requested the management of the Nikolai Railway (St. Petersburg-Moscow) to furnish him with a list of passengers traveling without tickets over the line during 1908.

The return is now published. From this it appears that 32,834 so-called "deadheads" used the line during the twelve months, some without tickets, but the larger number with passes irregularly obtained. Of these passes 716 were confiscated and the bearers compelled to pay their fares, and $9,245 was recovered by legal process.

We are informed that the Barre Railroad Company have purchased from the Baldwin Locomotive Works one 70-ton saddle-back switching engine. The Baldwin Works have also received an order



ON THE ROCK ISLAND LINES.

at the same time from the Montpelier & Wells River Railroad for one 65-ton mogul engine. Mr. F. W. Stanyan is general manager and treasurer of these roads.

Time Speed Control Signals.

By Geo. S. Hodgins.

A bullet fired from a rifle into a heap of sand or earth enters the breastwork at a certain velocity, but as it penetrates the yielding substance of the mound, it gradually loses its force, and after having burrowed inward some distance comes to rest. The entrance at high speed and the gradual loss of velocity is, in a certain sense, analagous to a very cleverly devised arrangement used in the New York Subway for advancing a train with decreased velocity through a long block up to the point of ultimate stop.

The Ninety-sixth street and Broadway station on the Interborough line is really a junction point where the trains for the northern part of New York on the West Side and those for the Borough of the Bronx, deviate from the trunk line running up from Brooklyn and the lower part of the city. This junction has a regularly interlocked system of signals and power operated switches, but it has formed what may be called the "neck of the bottle" as far as operating the road is concerned, where expresses and locals converge in the south-bound train movement and where the up-town locals and expresses are switched to their tracks. The arrangement of which we write is designed to remove the "choaking" at the bottle neck during the rush hours, morning and evening.

Under the direction of Mr. Frank Hedley, vice-president and general manager of the Interborough, the signal engineer, Mr. J. M. Waldron, has perfected a very ingenious plan for governing the approach of trains to the Ninety-sixth street station. Mr. Waldron recently patented this arrangement and all the claims made by him have been allowed by the Patent Office in Washington. On account of the formation of the tunnel north of this station, under Broadway, both south-bound local and express trains are compelled to traverse a single track for a distance of something over one-eighth of a mile. At the entrance to the station the expresses are turned onto the south-bound express track and the locals reach the south-bound local track. Similar conditions exist for the up-town express and local traffic. All four tracks are equipped with these time control signals, but for sake of clearness we may consider one of them here.

The former arrangement of signals at this portion of the line for down-town Broadway trains was such that a stop signal was placed practically out of sight of the interlocking signal at the crossing point of the tracks, and when the station was occupied by a train; the train following was compelled to halt the full distance of this block away from the station. This arrangement provided a braking distance of over 600 ft. to the cross-over tracks for a speed of 40 miles an hour, so that if this stop-signal was overrun for any cause, the disobedient train would be automatically brought to rest by the action of the stop signal before it could strike a train using the cross-over.

This arrangement was pre-eminently safe, but there was nevertheless a loss of time, after the departure of the train in the station, before the following train could take up its position at the platform. This was owing to the second train, stopped at the far signal, requiring a certain time to pass through the block up to the interlocked signal and so into the station.

The problem to which the Subway officials applied themselves was to devise ways and means by which this delay could be avoided, and which would enable the following train to creep up to

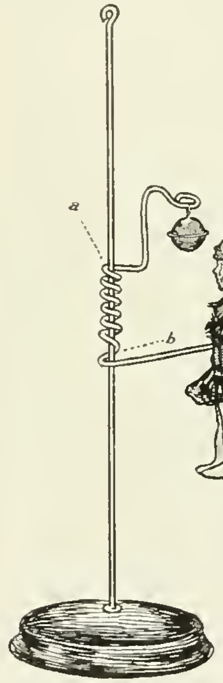


FIG. 1. DANCING DOLL.

the threshold of the station while the platform was already occupied. This had to be accomplished without the sacrifice of safety in any way, and the provision of the full braking distance ahead of the oncoming train which was required for its speed.

Briefly stated, the problem was solved by the combination of the signal, the automatic stop and the time-lock principle which is used at various interlocking signal plants in many parts of the country. The far away and the interlocking signals were moved further from the station and four new signals were installed. A word may be said about this time-lock, which will perhaps make clear its operation in the New York Subway. The reader must, however, bear in mind that while the principle here described is made use of at the Ninety-sixth street junction, the mechanism is necessarily modified to suit the particular requirements of the case.

The principle of the mechanical time-lock, as made by the Union Switch and Signal Company, is very simple and in a sense it embodies the principle ingeniously adopted by toy-makers to the little dancing doll which is commonly sold on the streets. The dancing doll is a little china figure, shown in our illustration, about 2 ins. high and is supported by a small steel wire standing out at right angles to the body, the other end wound in a loose coil around a straight piece of wire. When at rest, the top of the coil remote from the doll touches the upright wire at *a* Fig. 1, and the bottom of the coil at the junction of the supporting wire *b* also closely hugs the upright stem. To make the doll "dance" the loose coil is easily slid up the vertical wire and the doll released so that a vibratory motion is imparted to it. The springiness of the supporting wire and the alternate slip and jamb of the loose coil on the stem are sufficient to prevent any continuous slide of the little figure. Its center of gravity is so far away from the line of support that the up-and-down vibrations of the doll continue during its entire course down the rod. As much as ten seconds may thus be occupied by the doll in traversing the distance, up which it can be drawn in a fraction of a second.

The mechanical time-lock used in the Subway is within the signal case, and though it has no external or entertaining feature like the doll, it nevertheless depends upon the time a vertical bar takes to descend when hampered in its fall by oscillating mechanism, and the bar, like the dancing doll, can be raised to the desired height in the fraction of a second. In Fig. 2, A is a vertical rack-bar engages with the teeth of the small centre ratchet wheel. The long teeth of the ratchet wheel engage with a pawl attached to the gear wheel C. The teeth of this wheel mesh with a pinion, D, which has a small clock-work escapement wheel keyed on the same shaft. The escapement and pendulum are discernible in the figure, the pendulum being marked F. In the back of the upright bar, A, near the centre, is a notch in which lies a small roller at the end of a locking-bar, E. As A rises the locking-bar is moved to the left and remains in that position until notch and roller again coincide, after A has run down to its original position. When once the bar, A, has been raised, the pawl has carried the wheel, C, around, and causes the pendulum to vibrate, and this compels the escapement to step off a long series of consecutive short drops and halts, for the vertical bar, A. As much as a minute, if necessary, may be occupied in letting A sink down to its lowest position, from which it may have been raised in something less than a second. In the Subway adaptation of this time-lock, the raising of the bar, A up to the desired height is done electrically and this movement causes the signal next ahead to remain in the danger position. It is not possible to clear this signal until the bar, A, has dropped its full predetermined travel, and this is governed during the time occupied by the bar, A, in descending the required distance.

The description which has just been given refers to the time-locking mechanism designed to prevent a towerman, having once set up a route, from suddenly altering it. By the time-lock arrangement he is compelled to wait a specified time before his levers will unlock. Now comes the adaptation of the time-lock principle to the Subway operation. Here the object is not to lock the signal levers in a tower, but to provide a pre-determined time interval between a series of automatic stop signals, placed comparatively close together.

For example, an express in the Subway approaches the first signal which normally shows clear in the upper light, no matter whether the station is occupied or not. The lower light shows clear if the station is empty, but displays the caution light if the station is occupied. The express train has therefore, in any case, the right to proceed past this signal This signal, by reason of its lower light showing "caution," indicates that the station is occupied, and all the intermediate signals in the system we are considering. show red in the upper light and yellow in the lower. If, however, the station is not occupied by a train, both lights of the first signal, and those of all the signals between it and the interlocking signal, show clear. If the express train of which we speak approaches the first signal, and finds that it shows green in the upper light, and yellow in the lower the motorman knows that the station track for which the route is set, or the cross-over track is occupied by a train.

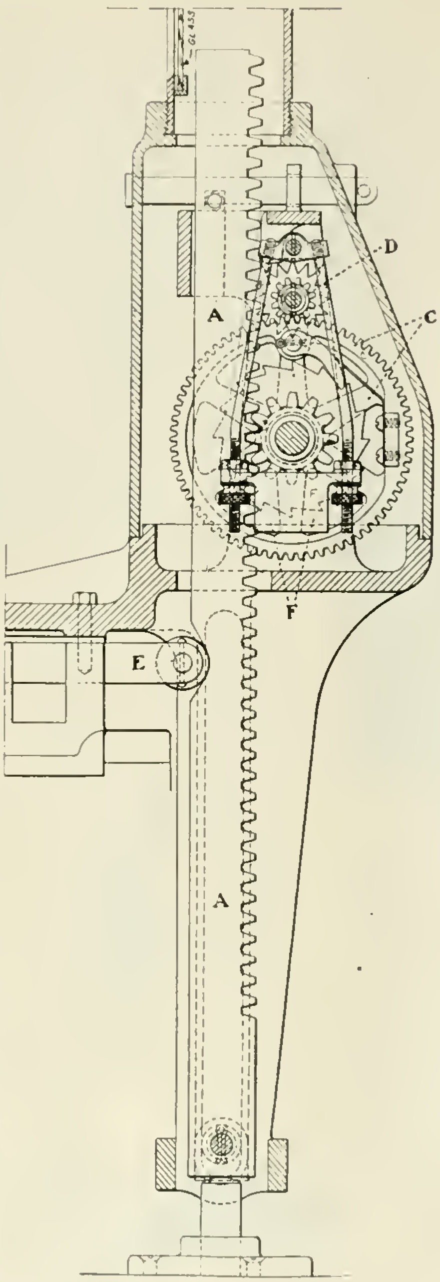


FIG. 2. TIME LOCK MECHANISM.

The arrangement of these signals is such that whether a train is standing on the express or local tracks at the station, the outlying string of approach signals will show red in the upper light and yellow in the lower, or they will all show clear, according as the cross-over switches are set for the express or the local tracks. If a train is occupying the local track at the station, and the towerman has thrown the cross-over switches for the empty express station track, the system of signals will show clear, as an oncoming train cannot then collide with the standing train on the local track. Similarly if the express track at the station is occupied, and the local track is empty, this signal system will show clear as soon as the crossover switches are set for the local track.

The towerman is always able to set up either the express or the local route, as soon as a train passes the signals at the end of the station platform, placed one on the express, and one on the local track. The interlocking signal for the unoccupied track is cleared when a train has drawn in past the signals at the end of the station platform. The passing of a train over the cross-over tracks causes the whole of this system of signals to indicate "danger," and put the time-governing mechanism into operation. It is thus possible to move a south-bound local train from the Lenox ave. track over the cross-over tracks, if the local station track is empty, and at the same time, to advance a south-bound Broadway express through the short outlying blocks, at reduced speed, up to the interlocking signal. The location of this interlocking signal is such as to maintain the required braking distance, for the reduced train speed between the interlocking signal and the fouling-point of the cross-over tracks.

The green upper light in the first signal gives the motorman the right to proceed, and the passing of this signal causes the time-lock mechanism to operate, and if the route is set for the station track which is already occupied, this mechanism will prevent the second signal from clearing for 5 seconds after the moving train has passed the first signal, and the second signal trip will remain in the stop position for that time. The second signal, which would otherwise remain red with automatic stop raised, will actually clear and lower the trip after the time limit of 5 seconds. The lower light of the second signal still showing yellow indicates that there is a train in the station on the track for which the route is set, or that the cross-over tracks are occupied. The moving train must therefore so regulate its speed that the second signal will clear before it is reached.

The distance between the first and the second signal is 150 ft. and this insures that a reduction of speed necessarily must take place in passing through this first short block. In fact, if the first signal is passed at 35 miles per hour, the train will require to reduce speed with an average loss of velocity of about 22 ft. per second for the 5 seconds in which the automatic trip of the second signal is held up while the signal light indicates "stop." The speed of the train through this first block must therefore be reduced to an average of 20 miles an hour.

The successful passing of the second

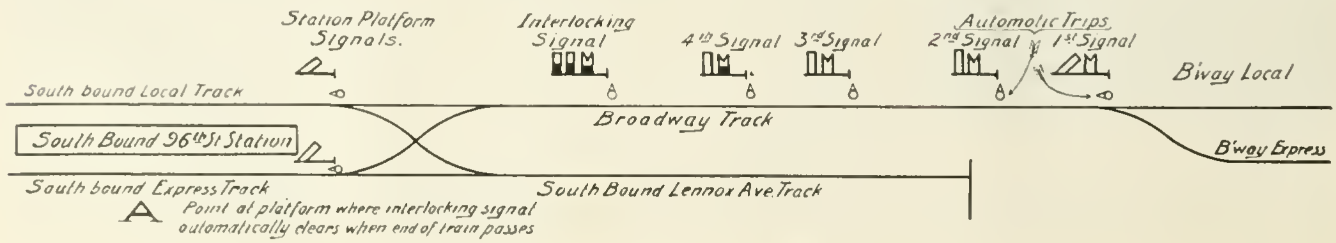


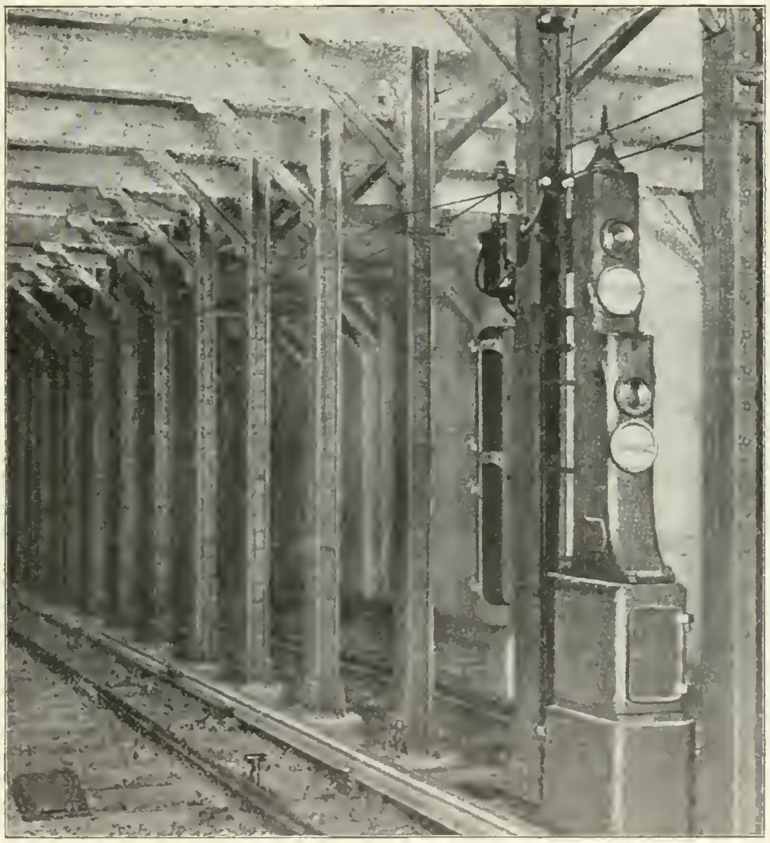
FIG. 3. PLAN OF ROAD WITH OUTLYING SERIES OF TIME CONTROL AND STOP SIGNALS.

signal operates the timing mechanism and the third signal remains at danger with its trip in the stop position for a period of 10 secs. after the second signal has been passed. The initial speed, reduced as it was at the entrance of this block, is again necessarily further reduced in passing over the 215 ft. which separates the second and the third signals, and this brings the speed down to an average of 13½ miles per hours. The same operation is repeated between the third and fourth signals, which latter requires 9 secs. before it will clear. This brings the average speed down to 6½ miles per hour. The distance between the third and fourth signals is 120 ft. After passing the fourth signal the train has 125 ft. ahead of it before the interlocking signal is reached. The result of this is that the train is compelled to approach the interlocking signal at about 6½ miles per hour, at which speed, if the interlocking signal with its upraised trip was overrun, the moving train would be stopped before it could reach the fouling-point of the cross-over tracks. The clear distance ahead of the train at each signal in this system is more than the required braking distance for the speed demanded by the signal.

The arrival of the moving train at the interlocking signal when halted, brings it up to the very threshold of the station, and when it gets this signal clear, authorizing its entrance to the station, it is but a short distance from the platform, and the lost time hitherto required to bring it from the first signal in the series is now eliminated, and a gain of 25 secs. in each train movement is thus secured. The time speed-control arrangement operates to provide what may be called a "conditional advance" for a following train when either track in the station is occupied by a train at the platform or when a train is passing over the crossover track. The "condition" imposed by these comparatively closely spaced stop signals is that the distance separating them shall be traversed by a moving train in a specified period of time, which necesssarily implies the required reduction of speed in each short block. Disregard of any one of the time-governed signals brings about an automatic stop with an emergency application of the brake. In this way a safe advance of the train is secured up to what we have called the threshold of the station, which is the interlocking signal, and the automatic signals stand like silent but watchful sentinels imperiously demanding the sign-manual of reduced speed before permitting friend or foe, express or local, fast or slow train to pass.

There is, however, another condition which is met by this cleverly devised arrangement of stop and time-requiring signal operation. In case there is no train occupying the express or local track in the station, the entire series of "sentinel" signals, if one may so call them, shows clear, and the passing of the first, or any of them, does not operate the time-governed mechanism, and the moving train may proceed into the station without consuming the longer time required when the speed-controlling mechanism is operative. Further than this, if after an approaching train has slowed down in obedience to the speed-control indication, owing to a train being at the station platform, and had correctly proceeded past one or more of the "sentinels," the departure of the train occupying the station would clear all the "sentinels" subsequently encountered, and the moving train could steadily proceed.

is so arranged that the outgoing train has only to traverse about half the length of the station platform, A in Fig. 3, when the interlocking and the "sentinel" signals clear and thus while a safe interval between the trains is automatically preserved, the time taken up in handling trains is reduced. The record of the Subway shows that during the rush hours and before this mechanism was put in, 60 trains an hour on the south-bound tracks were operated with more or less detention to most of them. The present arrangement of speed control enables 66 trains to be moved within the hour and all on schedule time. A total south-bound train movement of 78 trains has been secured in the hour with the new system. In fact this approach signal



SIGNAL SHOWING TRIP UPRAISED NEAR OUTSIDE OF RAIL.

The operation of the speed-control or time-governed mechanism of these "sentinel" signals is dependent upon the presence of a standing train at the station platform, or on the cross-over, and when the station track is empty, and the cross-overs free, the speed control does not operate. In this way the presence or absence of a train in the station track or on the cross-overs is the determining factor in the problem. The presence of such a train calls into play the protective mechanism, and the absence of such a train, by removing the necessity for station or cross-over track protection, automatically governs the "sentinel" signals and they indicate the line clear. The limiting point in the station express track

system has increased the capacity of the station tracks at Ninety-sixth street above that of the road above and below that point. In other words it is possible to pass trains through the Ninety-sixth station faster than they can be handled in and out of other important points on the line. This system has now been applied to all the tracks at the Ninety-sixth street junction.

The station and cross-over tracks are, as it were, the nerve centers of the whole scheme, and the presence or absence of a train upon them determines whether the outlying "sentinel" signals shall give free entrance to the station or automatically hold down the speed of an approaching train and permit only what we have called its gradually slowing "conditional advance."

The successful working of this system has entirely removed the "choking" at the Ninety-sixth street station as now applied to the various train movements. The new system removes the choking or congestion of traffic at this point, while securing safe and adequate train service. The officials of the Interborough Rapid Transit Company must be credited with a noteworthy achievement in the arts of signaling and of train operation.

The Lesson of the Sharp Corner.

Some time ago an accident occurred on one of the British railways in which, fortunately, no one was hurt. It was on a train called the 8:13 P. M. express ex Carlile. On this train the crank-axle of the engine broke inside the boss of the left-hand driving wheel, causing the coupling rod to break between that wheel and the intermediate wheel, the engine being of the 4-6-0 type. The left-hand driving wheel broke away from the engine. When this happened the coupling between engine and tender parted and the tender and the train were derailed. The engine kept the rails and traveled some distance along the track minus one driving wheel.

The matter was investigated by the Board of Trade. Col. H. A. Yorke conducted the inquiry. In the report prepared by Col. Yorke he tells us that the steel axle had not been manufactured with sufficient care and was originally of a somewhat brittle nature. It became "fatigued" during use. He moreover says "Without going further into the question of the quality of the steel, the axle had a radical defect in the sharp step or angle at the place where the diameter of the axle changes from 9½ to 8½ ins., this defect being accentuated by the fact that the step was entirely concealed by the boss of the wheel, so that there was no chance of detecting any incipient fracture. It is a well established principle that any such alteration of diameter should be made gradual by means of a curve or 'fillet.'"

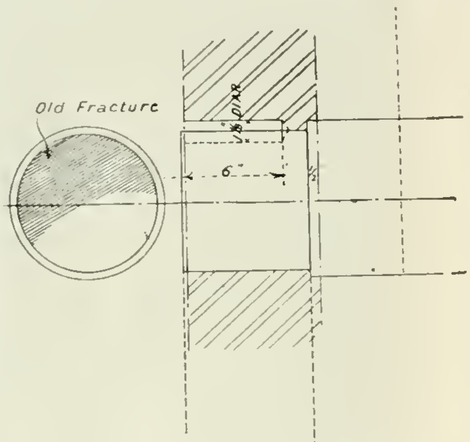
This axle failure was one in which what is called fracture in detail or progressive fracture was clearly to be seen. At the time of the accident, the axle had broken about half way through and the severed surfaces had been rubbed smooth. The remaining half of the axle had the characteristic appearance of sudden fracture. There were no imperfections in the axle as far as could be seen, and it is impossible to tell how long the slow extension of the growing crack had been in progress. The Board of Trade report recommends that all axles now in service on this road which have the sharp-cornered step should be withdrawn from service as soon as possible.

The lesson from this accident for all designing engineers is that the "fillet" is a safety device of the highest value and that the fracture in detail is one of the most insidious and dangerous forms of deterioration, that it is produced by what is called "fatigue" and this comes from the constant reversal of internal stresses in the steel, and they may all the time be well within the elastic limit of the steel. The best form of design and the highest quality of material are practically all the engineering world can do to prevent such an accident as we have here described.

Subjects for 1910, M. M. Association.

1. To act jointly with similar committees from other railway associations to formulate recommendations as to lumber grading suitable for railway use, as an official description of the different qualities or grades of lumber to be used for all railroad work.

2. To consider the proposed government regulations for the construction and inspection of boilers, having in mind



SHARP SHOULDER ON AXLE.

Senate Bill 236 and the resolutions adopted at the last convention.

3. To report at the next convention on the heavy articulated locomotive, considering its advantages, disadvantages, possibilities and limitations from the operating standpoint.

4. To report at the next convention on the electric locomotive, considering its advantages, disadvantages, possibilities and limitations from the operating standpoint.

5. To report next year a plan whereby the work of the railway clubs and that of the association may be co-ordinated for the assistance of our committees, by the discussion of subjects in detail in their relations to local conditions, for the educational advantage of minor officials and for the conservation of time in the conventions of our associations.

6. A committee of three to confer with a similar committee from the Master Car Builders' Association, and present for discussion next year, a constitution and by-laws of a new association to combine the Master Mechanics' and Master Car Builders' Associations into one association; to report on the advantages and disadvantages of such consolidation, considering the question from every standpoint.

7. To consider a systematic plan for stating operating costs controlled or influenced by the motive power department in order to facilitate recommendations as to motive power policy and render it possible to make intelligent and fair comparisons.

SAFETY APPLIANCES FOR LOCOMOTIVES.

8. To include grab irons, steps, handholds, uncoupling levers for engine and tender in both yard and road service.

9. To revise the present instructions relating to air brake and train air signal equipment to meet the requirements of the recent improved developments in air brake construction and practice for both locomotives and trains.

10. Take up with the Executive Committee of the Master Car Builders' Association the question of the vertical clearance between the side lugs of the journal bearing and the journal bearing wedge for 4¼ x 8 and 5 x 9 journals, increasing it to ⅛ in. instead of 1/16 in.

11. To appoint a committee to confer with the Association of American Steel Manufacturers regarding the adoption of decimal gauges.

12. Motor cars.

13. Revision of standards.

14. Mechanical stokers (standing).

15. Safety valves.

16. Superheaters.

17. Widening of gauge on curves.

18. Steel tires.

19. Fuel economies.

20. Lubricating economies.

21. The importance of shop and operating costs and the best methods of grouping in concise or graphic form for information of officials to whom this information is of vital importance.

22. What are the causes of the reduction in the life of locomotive fireboxes at present as compared with designs of former years.

23. Investigation of design of driving boxes, brasses, shoes, wedges, binders and frames that will give increased mileage to locomotives between shoppings.

24. The operation and maintenance of electric locomotives.

25. How can locomotives be handled by the departments responsible for their movement so as to increase their efficiency; for example, so that four will do the work now requiring five locomotives.

26. Feed-water heaters in locomotive practice.

27. Management and discipline of employes.

28. Frame construction for engines with outside valve gear.

INDIVIDUAL PAPERS.

1. Engineering experiment stations. Prof. L. P. Breckenridge.

General Correspondence

Opinions on the Railway Signal Question

Plea for the Absolute Red.

Editor:

The subject of stationary signals is of great importance to the safe operation of modern roads today. I have read with great interest the editorials printed in your magazine and cannot help but concur with one writer who states that a majority of engineers prefer absolute red, that is, red light at night, always and everywhere to mean stop.

It has been my experience while a locomotive engineer, as well as road foreman of engines, to observe a red light as danger whether it is in line with the track that is being used, or whether it is elevated on a signal pole, or even it may be to one side of right-of-way. The natural tendency for locomotive engineers is to regard it as danger and should mean stop.

On the other hand it is my opinion that if red is used for diverging route and the enginemen are constantly passing red signals, they are not apt to treat red as seriously as the case oftentimes requires to avoid serious accidents. The signal problem of up-to-date roads governing high-speed trains is a very important one. Signals should be so located that their view would not be obstructed from the enginemen seeing them plainly, which is very often the case.

I would prefer red for danger at all times, green for safety, and yellow for caution, I also think it possible that when two lights are shown on one pole governing two different movements, that they should be placed on the pole at least 25 ft. apart, so that the engineman could tell as to whether the signal was displayed against him or giving him right-of-way. If placed far enough apart on poles, it would seem to me that the light giving him the right-of-way could be displayed only, and the other signal governing the diverging route could be covered by blind lens, therefore, there would be only one signal displayed and he would not have to run against other lights.

JOHN R. TALTY,
Road Foreman of Engines, D. L. & W.
Buffalo, N. Y.

Prefer Position Day and Night.

Editor:

I have noticed your article "The Appeal of the Railway Signal" in the May number of the RAILWAY AND LOCOMOTIVE ENGINEERING, page 190; also your editorial "What do you think of Signals," inviting expression of men who have to obey the signals. Having run a locomotive for over 13 years, and been a road foreman of engines over double that time, I, in accordance with your kind invitation, will endeavor to give my impression of the systems of railway signals.

The systems discussed, as presented on page 190, have many points of merit that are common to all; many of each system having the same and meaning the same to the man in the cab. Signals should be as few in number and kind as possible. For on 2, 4 and soon there will be 6 track railroads, there must, of necessity, be many automatic and interlocking signals, therefore the signals should be of the kind most easily seen and read; as few as possible in number and the indications for similar movements to be the same at all points. Of the 3 systems discussed I think that interlocking home signals should only indicate the route through the interlocking, and the condition of the track be indicated by an advanced signal.

On all railroads there are many lights, both on the track and along the road, exposed to view from the cab: many of these could, and should be kept from view of approaching trains, as they tend to confusion in locating and correctly interpreting signals, and to overcome the mistaking of white lights for white signals. The colors of lights for signals have been changed on many railroads, and probably will be changed on many more. The colors likely to be used are: green for clear, yellow for caution, red for danger or stop. These changes do not give clear indications to the man in the cab, for the following reasons:

Any colored light is more or less indistinct compared with a white light and cannot be seen as far. If the yellow signal is light enough to be distinguished from the red it may be mistaken for a white light or some light not in use as a signal, and be passed unnoticed as a caution signal. If the yellow light is of a shade so dark that it cannot be mistaken for white, it may be mistaken for a red light and an unnecessary slow up or stop be made, or time lost in properly reducing speed approaching such colored signals by night until their color or indication can be positively determined. A light through the 8⅜-ins. circles in the semaphore arm cannot be seen distinctly at any great distance or angle as it should, particularly when it is a colored light or your train is approaching it on a curve. The man in the cab could not see a light through an open keyhole as soon nor as well as he could through an open window.

EXPRESS ON THE ST. GOTHARD RAILWAY IN THE ALPS.

Enginemen and firemen try to observe the position of semaphore blades at night just as they do in daytime, to have it confirm the indication given by the light, and it is also a practice of many road foremen of engines and many others who are interested in this subject, and it is also my own habit to do so, but often it cannot be done on account of the speed of the train and poor light.

The stop position or color should always be observed and be absolute when there are 2 or more semaphore signals on a post governing a track on which a train is approaching, and also signals on other tracks running in the same direction, I regard as a help to the engineer to locate the signal he is to get; and such signals being in the stop position, or red by night, is no objection because they are not his signals. Getting a clear signal for proceed by its position or color, and the signals he should not get being in the stop position, shows him that he is getting the proper signal for the route he desires to use.

If we could do away with colored signs altogether and have larger signals than we obtain by colored lights at night, as seen through the 8⅜-in. circle, and the signals protected so they could not be confused with other lights the relief to the man in the cab would be very great indeed. This, none of the signal systems noted in your May issue contemplate: however, the World Signal Company's system overcomes the above objection more fully than any system I have noted. It does away with colored lights altogether. The signals are read by day and night by position, using lamps for lighting up the white back ground at night, making the signal position to be more clearly seen by night than by day. The whole of the semaphore signal arm (over 6 ft. in length) can be seen in its full length in any of its various positions at any distance the eye will enable you to see objects of such size. The location of the signal can be seen farther by the reflection from the white back ground, as it is still larger than the semaphore arm. It eliminates the confusing of other lights with signals. It gives a perfect background to all the signal indications, which is a great benefit as they can be seen at a greater distance and more distinctly. It does not require any change of semaphore signals now in use, but eliminates colored lights by night. It can be used wherever semaphore blades are in service by adding the proper background, and it is a much better and safer signal.

Pittsburgh, Pa. H. A. W. P.

Front End Arrangement.

Editor,

The object of the front end herein described as an improvement over those in use at present is to reduce the waste of fuel, and the nuisance of fire, smoke and cinders. The figures on the consumption and waste of fuel by American locomotives is too well known to need consideration here.

The commonly accepted theory of forced draft in a locomotive, the piston action of the exhaust steam, has been discarded as a fallacy, and the theory of the entraining movement is a questionable one. That is, while it is known that the exhaust steam does not fill the stack, the question is, should it not? It is known that with the stack in use at present there is a downward column of air at the side which has a tendency to destroy the vacuum, and that in order to make an entraining movement create draft, the nozzle must be choked to give the exhaust steam sufficient velocity, and that choking the nozzle is seriously detrimental to the free working of the engine, causing back pressure and consequent high compression.

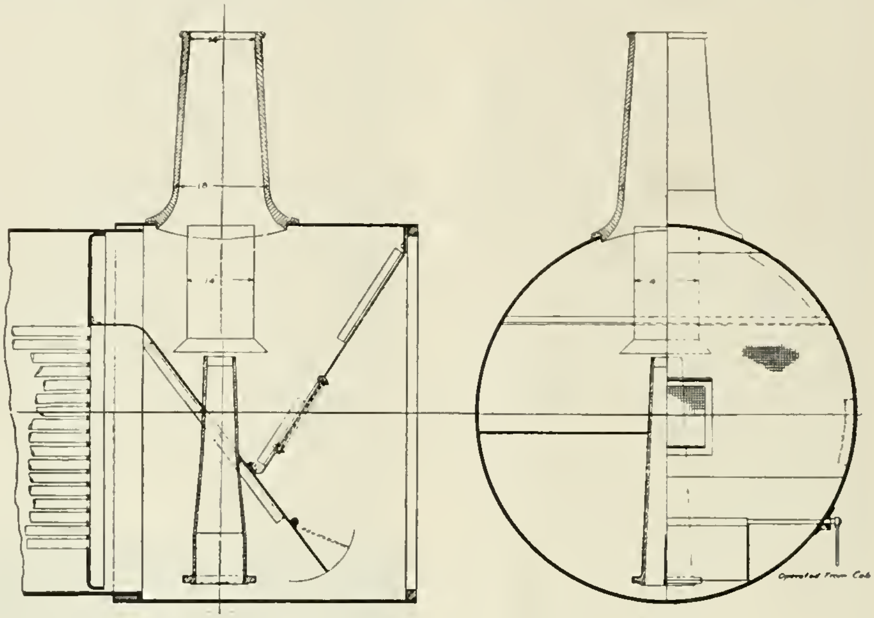
Supporting the theory that the exhaust should fill the stack at or near the top instead of at the base, I recommend a stack 18 ins. in diameter at the base and tapered to a point about 6 ins. from the top and then straight. The exact proportion of the stack at the choke has not been sufficiently demonstrated to give absolute figures, but about ⅔ the diameter of the cylinder has given the best results. The nozzle should have the same area as the steam port, but authorities differ on this. It is, however, intended that the nozzle shall be sufficiently large to relieve the engine of back pressure.

I advise a high nozzle for three reasons: first, to line the exhaust more nearly central to the stack; second, that the diaphragm plate can be extended from the connection at the flue sheet across the steam pipes and nozzle and not obstruct the draft through the top flues as the present method of turning the plate down, back of the steam pipes, certainly does; third, to give a superheating effect to the steam pipes, which is beneficial. After the necessary amount of draft has been created, it having an intermittent action, must be equalized to give it a steady pull on the fire. To do this, an extension front end is used as an equalizing pressure drum, the points of equalization being the openings of the draft pipe and the lower edge of the plate. The draft pipe should be set high enough above the nozzle to clean the table plate. If it is too low it will give the plate a polished appearance. At the top the draft pipe should be level with the base of the stack.

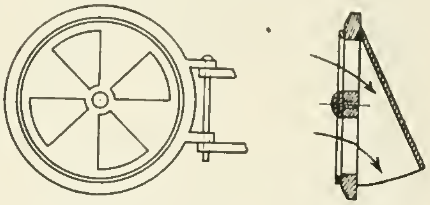
The diaphragm plate should extend nearly straight from the connection at the flue sheet across the steam pipes, then turned down to a point about half way between the nozzle stand and front end with extended wings giving an opening of about 15 ins. vertical and 30 ins. across for the adjustable plate. This plate should be made adjustable from the cab where the fireman can regulate it to different qualities of coal and conditions of service. To arrange this so it will not fire-burn or corrode, a rod crossing the front end resting on lugs outside of the smoke box with a lever and connecting rod to a rachet in the cab and the plate to be fastened in such a way that it can be raised or lowered in a circle, will work free. It should be proportioned so as to give 15 ins. opening when wide open and 5 ins. when closed and fireman should use it as low as possible, lowering it to stop any tear of the fire at front end of the firebox or any filling up of smokebox with cinders, etc.

A great many master mechanics object to an outside operated diaphragm plate, and by putting cleats on the wings of the solid plate with a single hole at each side and a number of holes in the adjustable plate for key bolts will do very well as a slide where one grade of coal is used. Authorities agree that while the main draft should pass through the grates, an auxiliary draft should be given above the fire. The firebox door shown in drawings was patented in 1854, is very simple and easily applied. The Denver North-Western and Pacific are using this front end arrangement. J. A. Eson.

Denver, Col.



FRONT END ARRANGEMENT USED ON THE D., N.-W. & P.



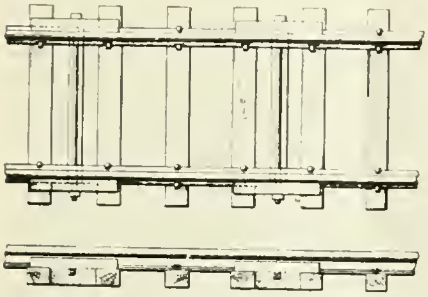
FIRE DOOR WITH AIR OPENINGS.

Anti-Rail Spreader.

Editor:

I herewith send you a print of a patent issued to the tenant on my farm, Mr. C. H. Magruder, of Shelbina, Mo. I would be much pleased to see this published in RAILWAY AND LOCOMOTIVE ENGINEERING. I have not missed an issue of "R. & L. E." since its publication commenced and could not do without it.

Moberly, Mo. M. W. BURKE.



RAILS TIED TO PREVENT SPREADING.

The method of preventing rail spreading to which Mr. Burke refers in his letter, consists of a rail clamping device, as shown in the illustration. The rails are spiked to the ties in the usual way along the inner edge of the rail-flange. On the outside of the rail, however, there is a specially made angle brace which is applied so that it rests on the top of the rail-flange and fills the space between a pair of adjacent ties. Between these angle braces and from rail to rail a tie-bar is placed which when the end nut is tightened, holds the rails together at the proper gauge and closely against the spikes on the inner side. This clamping arrangment is repeated every second tie, and where the angle brace is used there are no spikes on the outside of the rails. A block hollowed to receive the tie-bar is placed between the ties. Patent No. 922928 has been issued covering this device.—Editor.]

Efforts for Economy of Fuel.

Editor:

With reference to President Vaughan's remarks in the Master Mechanics' convention in regard to the enormous consumption of fuel for the locomotives of the United States, amounting in round numbers to about 200,000,000 tons annually, and at a cost of about $80,000,000, and his recommendation that superintendents of motive power should give their attention to decreasing the consumption of fuel on locomotives. This is surely timely and good advice. It is a well-known fact that the duties of a superintendent of motive power are so numerous that it is next to impossible for him to take time to look into what might be of great assistance in accomplishing the purpose recommended by Mr. Vaughan in his address.

It is a well-known fact that a great amount of labor, time and ingenuity has been spent on improving the engine part of the locomotive for economical working; but it would appear to me, that we shall have to look more to the boiler than to the engine in the future. The fireboxes of locomotive boilers have been extended, as well as the grate surface, in order to get results, at the expense of fuel. What is requisite for economy is not to increase the size of the firebox and the grate surface, but to increase the direct heating surface in the regular size fireboxes and tube plates. It has been conclusively proved that this can be done by flanging, to an extent of from 20 to 30 per cent., and in flanging, as is shown on the fireboxes which I have designed, the natural effort of the steel to expand and to contract is fully taken care of, and by its formation the box is made over 50 per cent. stronger than if made in the regular form with flat plates, to be bound up with stays, so that the natural behavior of steel cannot exert itself.

We have here an example that is in accord with President Vaughan's remarks, in regard to the saving of fuel, for undoubtedly we shall have to look, as before stated, to the boiler for economy in fuel in the future. It must not be lost sight of that we shall have to devote our attention to eliminate all horizontal and vertical riveted seams in fireboxes, that can be dispensed with, in order to allow the strains set up by contraction and expansion, to be neutralized; and the reduction of stays is an important factor, consistent with taking care of the heavy pressures at which boilers are worked. It will be noted that such firms as Worth Brothers' Company, and the Otis Steel Company, especially, are increasing the size of their rolls, so as to roll firebox sheets 146 ins. wide. This fact it shows that there is to be a demand for fireboxes made from one sheet. In conclusion I may state, with what I have done in regard to my studies to get this increased surface in the firebox and tube plates, reducing the number of stays and economizing on fuel to an extent of at least 15 to 20 per cent. is a great satisfaction to

WM. H. WOOD,

Media, Pa. Engineer.

Four-Cylinder Simples.

Editor:

Some important changes have been taking place in British railway practice during the last two or three years. Not the least interesting of these is the introduction by the English Great Western Railway of a design of locomotive which until recently cannot be said to have passed out of the experimental stage.

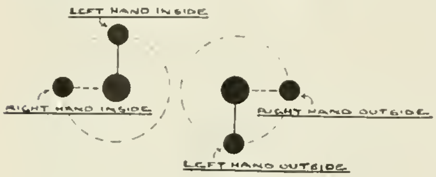
In thus characterizing the 4-cylinder simple express engine we may say that several such engines have been employed on the fast and heavy non-stop express traffic between London and Bristol at an average speed of slightly under 60 m.p.h. This type of locomotive was introduced experimentally in 1892 by three companies, the Glasgow & Southwestern Railway, the L. N. & W. Railway, and the L. & S. W. Railway, within a few months of one another. Since then multiple cylindered simples, though few in number, have been experimented with by several lines, one of the latest in the field being the Lancashire & Yorkshire Railway. The most numerous and successful form yet produced is to be found on the G. W. R., probably the most go-ahead line in the country, from a locomotive point of view.

In the case of this company the interregnum of the "Atlantic" between the older 4-4-0 and the newer 4-6-0 type was very short, for after a few had been built it was decided to discard that type

FRONT STREET, COLON—IN THE CANAL ZONE.

in favcr of the 4-6-0 design, existing examples being converted to the newer form in view of its superior adhesion.

The first 4-cylinder simple appeared in 1906 in the shape of an "Atlantic," named "North Star," similar to the others, except that it had 4 h.p. cylinders instead of two, the dimensions being 14¼ x 26



POSITION OF CRANKS ON ENGLISH 4-CYLINDER SIMPLE ENGINE.

ins. stroke. This experiment was so satisfactory that during 1907 ten 4-6-0 express engines known as the "Star" class appeared; they have four cylinders with piston valves, 14¼ x 26 ins., driving wheels 6 ft. 8½ ins. in diameter, a working pressure of 225 lbs., a total heating surface of 2,143 sq. ft. and a total adhesive weight of 58.75 tons.

Divided driving is adopted, the inside cylinders driving the leading, and the outside cylinders driving the middle coupled axle. The year 1908 saw ten more, known as the "Knight" class, with Swindon type superheaters, a kind of modified Schmidt and early in the same year an engine appeared which is still the last word in English locomotive construction; it is of the "Pacific" type 4-6-2, a new wheel arrangement for Great Britain.

The "Great Bear" is easily the largest locomotive in the country, with 4 cylinders 15 x 26 ins., piston valves, and driving wheels of 6 ft. 8½ ins. in diameter. The total heating surface including superheater and four brick arch tubes amounting to just over 3,400 sq. ft., with a grate area of 41.8 sq. ft. The boiler is of the Belpaire wide fire-box type, as is usual on this line. The working pressure is 225 lbs. and with a total adhesive weight of 60 tons, practically the limit load of some 20 tons per axle has been reached, the weight, exclusive of tender, being 96 tons. The valve gear between the frames is of the Walschaerts type, seldom used in Great Britain, especially in this position; as in all the G. W. R. 4-cylinder engines there are only two sets of valve gear, since the outside valves are driven by levers from tail rods on the inside ones.

In 1908 there were upward of 20 4-cylinder simples in constant use and we believe there are more on order or about to appear, so the type may fairly be considered as adopted. The outstanding features of the design must now be considered; the cranks are all at 90 degs. to one another, the diagram here presented shows the actual arrangement in the "Great Bear." The right hand crank leads, cranks on the same side of the engine are at 80 degs. to one another, and the shaft for the inside cylinders is of the built-up type.

For the sake of comparison we may consider one of the G. W. R. "Star" class and an engine of exactly the same dimensions, but having only two cylinders which would be about 20¼ ins. in diameter to give equal power and, of course, would drive one axle only. One of the first objections to the 4-cylinder design is complication of machinery, but it by no means follows that a 4-cylinder engine requires twice as many parts as one with only two cylinders, for it may well be questioned whether a locomotive designer would use 20¼ ins. pistons without tail rods, these being unnecessary with pistons 14¼ ins. in diameter. The number of cylinder glands, stuffing boxes, etc., would be the same in each case, and only two sets of valve gears are required.

The question of steam and fuel economy comes up for consideration, two departments in which the locomotive is conspicuously deficient at the best of times. These two questions, however, can best be disposed of by asking whether the improvement in mechanical and general efficiency by the adoption of 4 cylinders compensates for any diminution in those or any other respects, such as increased cost of construction and rebuilding. The answer is to be found chiefly in one consideration, namely that of balancing, it is in this direction that the 4 cylinder design vindicates its superiority over the 2 cylinders.

Balancing is a rather complex subject, especially secondary balancing, due to obliquity of connecting rod, etc., but viewed from a practical standpoint the main facts are sufficient. In our 2 cylinder engine the balancing of the revolving masses presents little difficulty. It is in dealing with the reciprocating masses that the difficulty lies. If we could have our two cranks at 180 degs. to one another excellent balance might be obtained; but other evils such as swaying couples would appear in an exaggerated degree. In practice, however, the cranks must be set at 90 degs. to one another in order to avoid dead centres so the reciprocating masses (piston, piston-rod, crosshead, etc.) cannot balance themselves. The revolving masses are balanced by adding weights to the wheel rim, leaving it in equilibrium. The same thing is done to balance the reciprocating masses, but unfortunately this destroys the equilibrium of the wheel. If weights are added to the rim in such a position that when the reciprocating masses are moving in one direction, the weights are moving in the opposite direction, then balancing will be effected when the weights, though necessarily moving in a circle, have a mean direction of motion in a line fore and aft of the locomotive. i. e. in the top and bottom portions of their circumferential path, which is the path of the wheel rim.

C. S. STOCK.

Finsbury Park, London, Eng.

Railways in the Philippines.

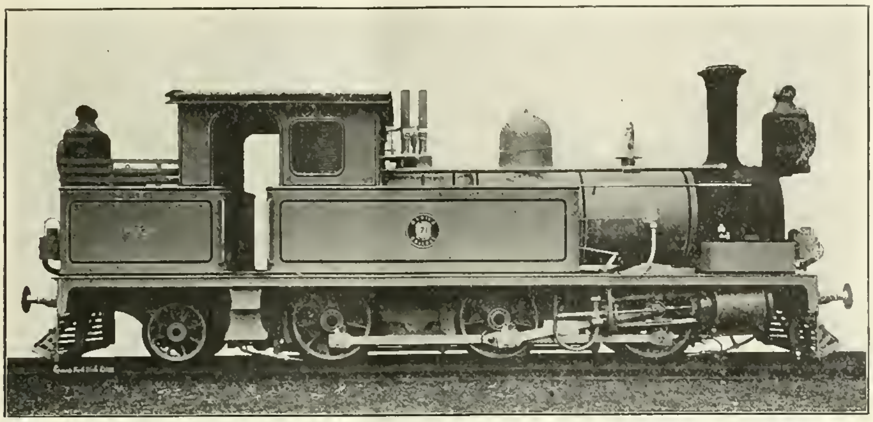
Editor:

Manila is 30 days from San Francisco, and a railroad man coming this way has an opportunity of seeing Hawaii, Japan, and China. At Hawaii he will find several small American roads with Baldwin engines, but jobs are scarce except to skilled mechanics, as their engineers are mostly made. In Japan the entire motive power officials are Japanese from A to Z, and I have not seen a foreigner on a Japanese railroad. The wages paid for mechanics range from 30 cents to $1.50 in gold per day. Their system is entirely English; still they have quite a number of Baldwin engines, and all re-

DUTCH LOCOMOTIVE REBUILT BY THE PHILIPPINE RAILWAY.

ports to the contrary, these engines seem to be doing the best work.

In China the roads are fast becoming Chinese; it is the rare exception to find



ENGLISH ENGINE USED ON THE MANILA RAILWAY.

an American master mechanic or civil engineer. The wages range from 10 cents to $1.25 in gold per day for mechanics and engineers, and by the way, it costs any kind of an American $2.50, gold, to live, unless he wishes to live like the Chinese; so do not go to China unless you have enough to bring you back safe home again.

In Manila, Island of Luzon, where the American flag flies, the railroad man finds 300 miles of road, and about 75 locomotives. This is an English company, and their trains are run under the Spanish system. Mr. C. W. Broxup is their able locomotive superintendent. The main shops are at Caloocan, where about 300 men are employed, all natives, doing the mechanical work, with but two or three Englishmen as various superintendents.

Here you will find an up-to-date English shop, locomotives and cars; all seem to be in first-class condition and neatly painted and polished. While I was there they were putting in two 150-h.p. stationary engines to run their car and locomotive shops, also a new transfer table. Mr. Broxup has something to be proud of with this plant and his fine machinery.

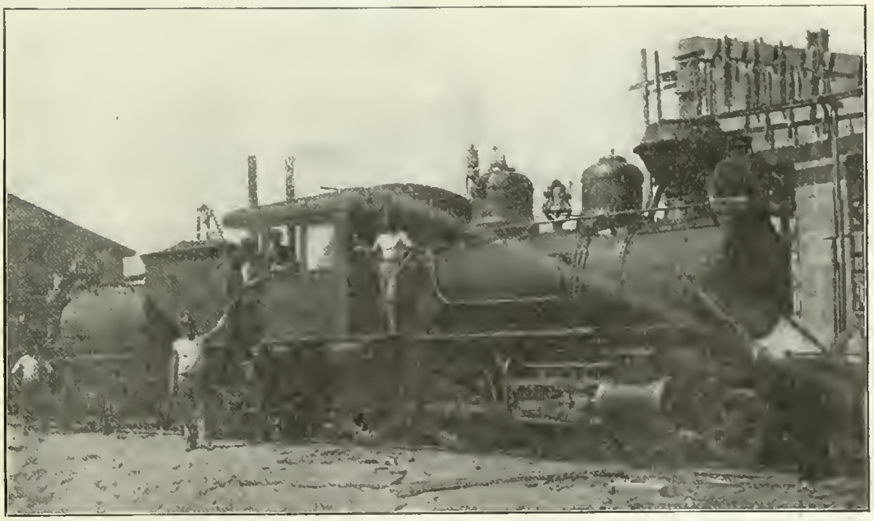
A BALDWIN MOGUL ON THE PHILIPPINE RAILWAY.

This work is, as I said before, entirely done by native mechanics, and their locomotive engineers are natives, with but one or two English locomotive inspectors. The wages range for mechanics up to 3.00 pesos, and engineers 75 pesos per month. This company has concessions to build about one thousand miles of road.

In Manila you will also find an up-to-date electric street car system with about 40 miles of track; ice plants, saw mills and various other plants, where a good American machinist can always get a job.

Leaving Manila for the Southern Islands, you find the two second cities in the archipelago, Iloilo and Cebu. The former city is the headquarters of the Philippine Railway Company, and no doubt you will find the most up-to-date plant and general offices of any railway in the East. This company is building railroads on the islands of Cebu, Negros and Panay, which will be over 350 miles in all, when complete. The lines on the island of Cebu are completed, and 40 miles are in operation. On the island of Panay are the main shops for the three islands, which are under the superintendence of Mr. W. D. Holland. While I was there he was practically rebuilding three Dutch locomotives, which at one time belonged to the Spanish Government. These engines had been in the islands for over 18 years. They were entirely stripped by the Insurrectos during the late war. These engines were purchased by the Philippine Railway and they are now being used as switching and construction engines.

The buildings here are magnificent, being constructed of iron and concrete, with the most beautiful native hardwood finish. The plant is complete and modern and a locomotive can be built in these shops as easily as in any of our modern American



17 x 24 IN. BALDWIN MOGUL. PHILIPPINE RAILWAY.

shops. There are 17 locomotives at present in service, and when the roads are completed there will probably be double this number. The mechanics are mostly native, and the wage scale conforms to that of the Manila Railroad. There are quite a few American and English locomotive engineers, the wage schedule running from $3.75 in gold to $4.00. Twelve hours constitute a day for engine men and ten hours for shop men. Mr. Holland informed me that there will be, for a few years to come, an opportunity here for locomotive machinists, boiler makers and enginemen, and I believe that hard working, industrious young mechanics would make no mistake in coming here. This applies only to first-class men, as there are plenty of native mechanics and engineers.

I was agreeably surprised to see that Railway and Locomotive Engineering was in the hands of all the engineers and firemen on the various divisions of the Philippine Railway, and upon making further inquiry learned that the chief clerk of the mechanical department represented your company in the capacity of agent, and had interested himself to the extent of disposing of quite a large number of your mechanical books, as well. These books have been of great assistance to the engineers and mechanics, as men who had fired from four to eight months were able with hard study to pass the examination on air and machinery, and in riding behind some of these men they handled their trains as well as it can be done anywhere. To mechanics and engineers I would like to say that the climatic conditions here are as healthful as anywhere else and the expense of living is about the same as in our Western States. I enclose some photographs, which will probably be of interest.

EASTERN CORRESPONDENT.
Manila, Isla de Luzon.

Old-Timers on the U. P.

Editor:

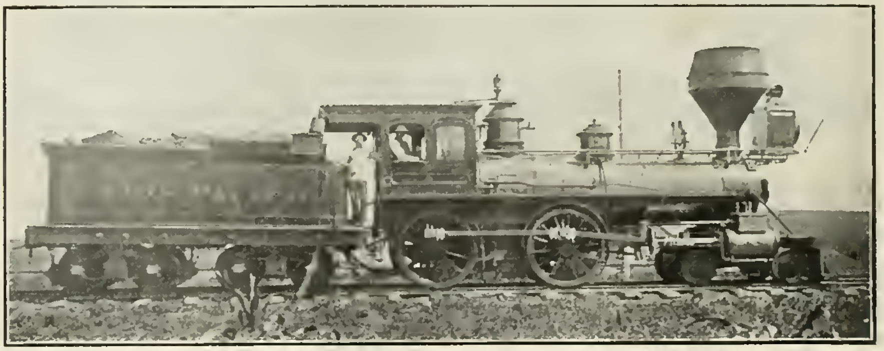
As you have been publishing pictures of some old diamond stack engines I send you one, and also two pictures of Congdon stack engines that were in use only about 20 years ago on the Union Pacific.

These engines are a great contrast to our modern power on Mr. Harriman's up-to-date railroad. These little engines carried 130 to 135 lbs. of steam, and it is a wonder how much work they could do and how fast they could run, having only a 51-in. wheel center, yet they made a mile in sixty minutes with light train many a time.

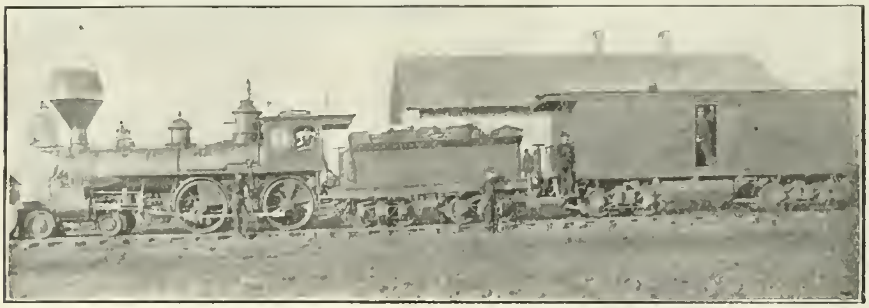
We put in many hours between runs working on these engines. You may see some evidences of "homesteading" on engine 338. The Congdon stack was patented by the superintendent of motive power at that time to prevent fires in this thinly settled pioneer country. At that time we were burning very light coal. These engines were not free steamers, but I assure you they were about as nearly fire-proof as it was possible to make them. In fact, very few cinders ever left the right of way unless on some patron or in an employees' eye or down his back.

I have often wondered how much money I had lost by not getting out some sort of an apron to attach around the stack to catch the cinders which could be used in the manufacture of briquettes for fuel. I hope that these pictures will be of some interest to your readers, especially the older enginemen on the Union Pacific.

HARRY A. RILEY.
Spalding, Neb.



OLD TAUNTON ENGINE ON THE UNION PACIFIC.



OLD TIME 4-4-0 ON THE UNION PACIFIC.

Method of Indexing Subjects.

Editor:

Next to knowing a thing is knowing where to find it. This applies with special force to an engineering library, the value of which is in direct proportion to the readiness with which information may be obtained at short notice. The mechanical publications and trade catalogues are mines of valuable facts, but the facts that a man wants are buried among those that he has no use for at the moment. When he wants them he wants them quick, and unless he can pick them out easily and surely, they are practically useless.

There are many ways of indexing data and each has its advantages and disadvantages. The following is a method which has been used by the writer for some time, and he has found it very convenient. The fact that it is the standard method used in most of the libraries in the country speaks well for its efficiency.

When you ask for a library book you ask for it by number. With the possible exception of the symbol denoting the author, you would use the same number from Maine to California and this number alone tells just what the book is about. This system is called the Dewey Decimal System, and is of universal application, as there is literally a place for every subject in the universe. This sounds complicated, but it is really extremely simple. By this system all human knowledge is divided into 10 main divisions, numbered from 0 to 9. 0 is general and contains matter which cannot be grouped under the other heads. Each of these groups is further divided into 10 divisions, the 0 of which is general, and the division may be carried out indefinitely, placing a decimal point every three figures. This point has no value, and simply divides the figure into convenient groups. To illustrate more clearly, I will follow out the complete number for locomotive wheels in the accompanying table.

Everything on the subject of wheels, boxes, cellars, tires, etc., would be grouped under the number 621.135.2, and all this matter would be kept together instead of being scattered through the index from A to Z. If necessary, the subject could be further subdivided into nine more divisions, as tires, wheel centers, journals, etc.

The table gives the complete headings for the line leading up to locomotive running gear and gives a very good idea of the system, showing how any particular subject can be carried out to as fine a detail as necessary. The numbers are not hard to remember. It is second nature to think of mechanical engineering as 621, and the smaller subdivisions are memorized very soon. If you wish to index an article on injectors you very likely know without thinking that 621.133 is locomotive boilers, and it is but a step more to 621.133.8, "miscellaneous fittings." If you are in doubt where to place a given subject the system places it for you almost automatically. An article on spark arresters goes under 621.13 without an instant's hesitation; boilers is the only reasonable sub-heading, and it is quickly located under 621.133.4, smoke-box and stack.

Often a subject may be considered from a number of standpoints, and may have several numbers in the system. In this case the proper number to use would depend upon the general heading under which the subject was usually considered. Thus, electric signals, considered simply as an application of electricity, would be filed under 537.88, but from the railroad man's standpoint they would take some subdivision under 656.25.

It was stated in the first part of this article that the number gave an accurate description of the book to which it was applied. The number 656.25 will serve as an illustration. 65 is the Communication and Commerce Division of Useful Arts; 656 is Transportation; 656.2 is Transportation by Railways, and the final 5 refers to Safety Appliances. This subject is further subdivided into the main types of signals, etc. Whether the title is known or not, it is evident that any book bearing this number deals with railway signals.

The author uses a card index, and each article in the magazines is indexed under the proper number. All data, tables and formulas in the catalogues are indexed in the same way. When reference is made to any given subject the cards show at a glance all the data available on that subject, and these cards are together instead of being scattered through the files.

SIDNEY C. CARPENTER.

Plainville, Conn.

ILLUSTRATING DEWEY DECIMAL SYSTEM.

0 General works.
1 Philosophy.
2 Religion.
3 Sociology.
4 Philology.
5 Natural science.
•6 Useful arts.
7 Fine arts.
8 Literature.
9 History.
60 Useful arts.
61 Medicine.
•62 Engineering.
63 Agriculture.
64 Domestic economy.
65 Communication and commerce.
66 Chemical technology.
67 Manufactures.
68 Mechanic trades.
69 Building.
620 Engineering.
•621 Mechanical.
622 Mining.
623 Military.
624 Bridge and roof.
625 Road and railroad.
626 Canal.
627 River and harbor.
628 Sanitary.
629 Other branches.
•621.0 Mechanical engineering.
.1 Steam engineering.
.2 Water engines and motors.
.3 Electrical engineering.
.4 Air, gas and other engines.
.5 Air compression; refrigerators.
.6 Blowing and pumping engines.
.7 Manufactories; engineering works.
.8 Transmission machinery; machine design
.9 Machine tools.
621.10 Power plants.
1 Steam engine design.
2 Marine engines.
• 3 Locomotives.
4 Traction engines.
5 Portable engines.
6 Stationary engines.
7 Steam economy.
8 Steam generation; boilers.
9 Steam heating.
621.130 Locomotives.
1 Theory.
2 Types.
3 Boilers.
4 Engine.
• 5 Running gear.
6 Tenders.
7 Management.
8 Maintenance and repair.
9 Supplies.
621.135.0 Running gear.
.1 Frames.
• .2 Wheels, boxes, axles.
.3 Springs, equalizers, saddles.
.4 Trucks
.5 Brakes.

Railway Fatalities.

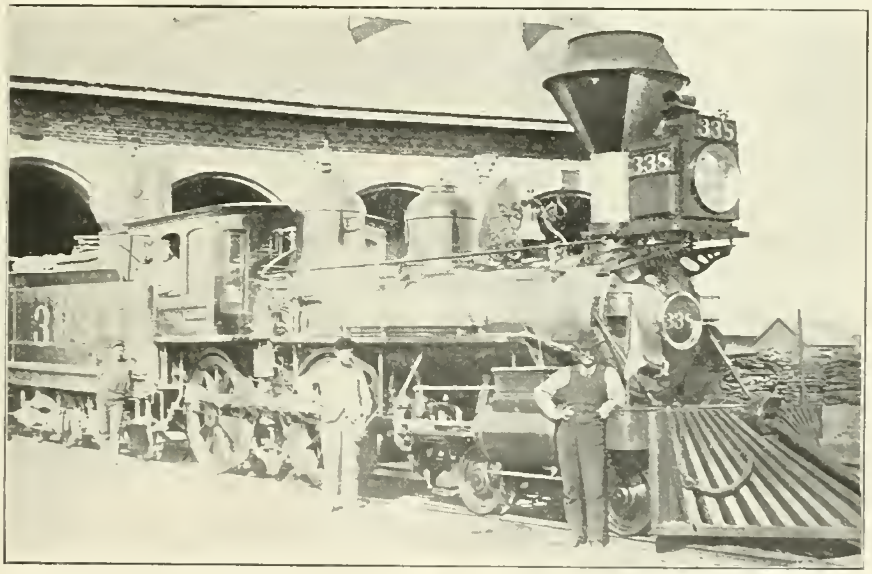
It is very gratifying to observe from the advance reports just published that the fatalities to railway passengers and employes in the United States during 1908 shows a remarkable decrease over that of 1907, a decrease amounting to nearly 50 per cent. It may be thought at first glance that this is owing to the decline in passenger traffic, but this is not the case as the passenger mileage traffic for the year ending June 30, 1907, amounted to 28,000,000,000, whereas in the year ending June 30, 1908, the passenger mileage was over 29,000,000,000 and the report for the year ending June 30, 1909, the traffic again amounts to about 28,000,000,000. It will be generally conceded that the decrease in the number of accidents is owing largely to the greater deliberation and more careful observance of regulations on the part of all connected with transportation.

In regard to similar statistics in Great Britain it is a well-known fact that the British railways have long held a most enviable reputation in regard to the safety of a passenger on railways. A close comparison will show that American railways approach very nearly, in point of safety to passengers, the record of the British railways. In 1908 the total fatal accidents to railway passengers in Great Britain, from all causes, was 107, while during the same period in the United States, the number of passengers killed on railways was 125. In comparing these figures the difference in mileage should be noted; the railway mileage of Great Britain amounts to 23,108 miles, while that of the United States amounts to more than 230,000 miles. Another fact must also be remembered in making comparisons between the two countries. Although railway track mileage here is greater than in the United Kingdom the volume of passenger traffic there is much greater than it is here.

Effect of Grade Reduction.

A record achievement in the movement of a heavy freight train has been accomplished on the Pennsylvania Railroad between Altoona and Enola, near Harrisburg, Pa. To determine what could be done in actual road service 85 steel gondola cars loaded with a total of 4,451 tons of coal were attached to locomotive No. 1113, a freight engine of the most improved type.

The total weight of the train was 6,151 tons, and its length from the pilot of the locomotive to the rear platform of the caboose was 3,000 ft., or nearly three-fifths of a mile. The run of approximately 124 miles, and was made in 7 hrs. and 15 mins., the average speed of the train being 17 miles per hour. The heaviest trains moved between Altoona and Enola, prior to this record run, were six freight trains, the lightest being 4,922 tons, total weight, and the heaviest 5,307 tons. These runs had been made possible by the fact that all grades had been reduced and compensated curves put in on the middle division on the main line between New York and Pittsburgh, so that the ruling grade there is only .2 of one per cent., or less than 12 ft. to the mile. Formerly it was necessary to have a pusher engine to help long freight trains over heavy grades.



OLD ROGERS ENGINE ON THE UNION PACIFIC.

Lighting the Pennsylvania Tunnels.

The Pennsylvania Tunnel & Terminal Company, operating the Pennsylvania railroad tunnels under New York City and the rivers, are installing in the Long Island City power house two Westinghouse turbine-alternator sets of 2,500 kilowatts capacity each, for lighting the tunnels and terminals. This service demands that every precaution be taken to insure absolute continuity of operation in the generating and distributing systems. The alternators will supply three-phase, 60-cycle current at 440 volts.

NEW OPERATING SYSTEM ON THE HARRIMAN LINES

Correspondence between Dr. Angus Sinclair and Mr. Julius Kruttschnitt, Director of Maintenance.

The new system of management of the Harriman Lines has occupied the earnest attention of the editorial staff of Railway and Locomotive Engineering because it appeared to be calculated to reward merit and efficiency wherever found. For reasons explained in the letter, Angus Sinclair addressed the following letter to Mr. Kruttschnitt, director of maintenance and operation of the lines named, which brought out a courteous reply:

LETTER FROM DR. SINCLAIR.

As the greater proportion of the readers of Railway and Locomotive Engineering are connected with the mechanical department of railways, and as most of my experience has been on that side, I naturally cherish changes or improvements in railway management calculated to confer benefits or advantages upon shopmen, enginemen, trainmen and others. Major Hine was kind enough to escort me about the Union Pacific offices at Omaha a few weeks ago, when he took occasion to explain, as far as the short time would permit, the practical working of the new system of management. The information then obtained and your admirable paper read at the New York Railroad Club, have supplied me with material for earnest study that I am pursuing to the best of my ability. But there are some things that I am anxious to obtain more light upon, and I am writing to you in hopes that you will help me.

Considering the number of people employed upon it, the mechanical department ought to supply half of the operating officials, but it has always fallen far short of that proportion, although those chosen from the mechanical department have proved themselves particularly efficient, as might be expected from the character of their training. I expected that a new system of railroad management would provide means of identifying the men of ability in the mechanical department, who have been overlooked under the old system, which gives undue favor to the office class, because such men come constantly within the observation of the officials. In your paper you say:

"The consulting engineer, among his many advisory activities, takes young civil engineers from the lines for service in his office, and with this supplementary training returns them to their properties better qualified for official positions. A student course of practical training for division officials and sub-officials is being worked out on the various properties."

That is fine for the engineering department and the student course would naturally favor the office class blessed with regular hours and the opportunity to attend classes; but where does the ambitious engineer or conductor of ability come in, the men whose daily duties constitute the best kind of training for filling official positions in the operating department? A student course ought to take in the shopmen of ability, many of whom would become excellent officials, but the tendency would be to leave my trainmen in the cold.

The new scheme, as I understand it, aims to place all railway employees on an equal footing, so far as their future is concerned, which is really a revolutionary movement; but what puzzles me is your method of identifying the man likely to be of the greatest service to the company. If the facts bear me out, I am anxious to tell the mechanical men of the Harriman Lines, that they have the finest prospects of any railway men in the world belonging to their class, and I am bothering you for more particulars of how the mill grinds out its work of fate.

MR. KRUTTSCHNITT'S REPLY.

The answer returned by Mr. Kruttschmitt is very encouraging to all young railway men ambitious to rise in the service by the forces of industry, ability and attention to business. It reads:

"I have your letter of July 1, and am glad to see the interest that you take in these matters, and hope you will point out to the many readers of Railway and Locomotive Engineering that what we have done on the Harriman Lines is to throw the doors of promotion open to all employees.

"The 'Outline of Work and Reading for Students in Railroad Operation,' a copy of which I enclose, supplemented by what is properly known as the Hine system of organization, it seems to me, should prove to the young man entering railroad service, whether a graduate of a technical school, or one who enters the ranks with very little more than a common school education, that he may aspire to and eventually reach any position in the railroad service.

"We have for some years been offering inducements to graduates of universities and technical schools in our territory to enter our service and fit themselves for positions of petty officers. These young men reach us with a certain amount of theoretical training, but are deficient in practical knowledge of the operations of the railroad. It is our purpose to train them while paying them fair living salaries. The pamphlet shows a practical work, as well as the reading expected of them.

"In making this effort to recruit our ranks from college graduates we do not wish to check the ambition of or discourage employees who have started in the shops, motive power, maintenance of way, or train service. We wish the intelligent and capable locomotive engineer, firemen, shopmen, conductor, brakeman, agent, or transportation clerk that if he fits himself for promotion he can get it, but, in such cases, we would expect him by some study to equip himself to understand the elements of railroad acounting, use of statistics, analysis of operating results, etc., etc.

"In the case of the man from the ranks untrained in office work the practical work prescribed in the pamphlet would be cut out because he would be familiar with it, but he would be expected to follow the course of reading as outlined. All of the works named are of a nature that can be understood by anyone of fair intelligence with a common school education.

"I think the above answers your questions as to the opportunity afforded practical men for advancement.

"Under Major Hine's system, which we are now using on a number of our divisions, we practically say to the superintendent's staff of assistants, to-wit: his trainmaster, master mechanic and division civil engineer, that at the date we inaugurate the system we propose to start them all together as assistant superintendents, each one of them clothed with authority co-extensive with that of a division superintendent, i. e., over all division employees. Each is given to understand that he is to take steps to educate himself in those branches of the service in which he is weak or deficient. The master mechanic must familiarize himself with track work, train dispatching, handling of cars and study of statistics. The division civil engineer must post himself on locomotive and equipment construction and design, and with track work. The trainmaster must make good his shortcomings in the mechanical and maintenance line. We shall be patient with these gentlemen and give them ample time to fit themselves to broader duties, but we expect, and on this point we shall insist, that after reasonable delay each one that fails to grasp the opportunity and prove himself fitted for promotion must expect to drop out and make way for better material.

"Allow me to suggest that your paper, reaching, as it does, so many engineers, firemen, conductors and brakemen, could render them and the management the greatest service by clearly pointing out that our system is affording them an opportunity which I do not think any other system has heretofore offered; that it is, therefore, incumbent on them to justify the management in the course it has taken by the manner in which they receive and profit by it, at the same time facing them with the fact that if they fail they must expect some one else to step into their places.

"I write as I do because I understand some of the gentlemen recently promoted to the position of assistant superintendents have spoken rather flippantly of the system and of their new titles, and have indicated by remarks, and even acts, that it was too much to expect a master mechanic while looking out for the motive power and equipment, to burden himself with questions pertaining to maintenance of track and train service; and, in some cases, even, officers as high as superintendents of motive power have commented in the same flippant and disapproving spirit forgetting that, eventually, under the logical development of the system they must expect to appear on the payrolls first as assistant general managers, then as general managers, vice-presidents and presidents.

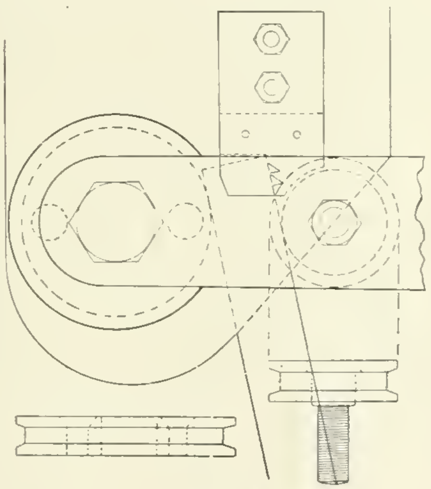
"Under rate and industrial conditions of fifteen or twenty years ago railroads could be run successfully by almost anyone, but the small roads have disappeared to such an extent and merged into larger systems, and the margin between revenue and expenses has shrunk to such small proportions that much more is demanded of the railroad manager of the present day. New methods of operation are necessary, and if they are to be successful men must be trained to fully meet the larger responsibilities thrown upon them.

"If the system we have devised, and on which we are now working, fails it will fail because of the incapacity or unfitness of the individuals, and not because of the system, so that whatever you can do to bring this point out clearly, will, as I have said, be of inestimable value both to the rank and file and the management."

Centre-Casting Liners.

The forging of iron or steel liners for locomotive or car truck centre-castings involves considerable work when forged in the usual way (by bending over the horn of the anvil). It is also difficult to make a half circle anything nearly perfect unless more time is taken with the operation than the job is worth. A clever device has been brought into operation by Mr. William Low, foreman blacksmith of the shops of the Interborough Railroad, New York, which not only produces an exact semi-circle, but in the way of output performs many times more work than by the old process of hammering.

As will be seen in the accompanying illustration, the device consists of a wheel the diameter of which corresponds to the inner diameter of the liner that may be desired. This wheel is firmly attached to a strong iron plate which may be attached to a portable table or other heavy object. A movable lever three or four feet in length is attached to the center of the wheel and attached to this lever is another smaller lever. Both wheels are grooved in their outer rims, and are adjusted sufficiently apart from each other to admit the iron or steel bar of which the liners are to be made. The pieces of which the liners are made are cut the length necessary and heated, and on being inserted in the opening between the two wheels the lever is moved a half revolution and the liner is quickly and perfectly bent into shape. It will be noted in the illustration that there is an attachment fastened to the iron plate at the point where the heated bar is inserted between the two wheels. This attachment is provided with several notches or teeth so set that they hold the heated bar in place when the lever is moved. It may be added that for different sizes of liners there are different levers with wheels adjusted to suit the particular size required. In the case of thinner liners the



MACHINE FOR BINDING THE LINER.

grooves in the edges of the wheels are slightly bevelled and two or three thin bars may be admitted at once. When the liners are cooled the projecting points are readily cut off in a jig which presents the superfluous metal to the shears. It is a noteworthy fact that the crushing of the heated metal on the outer edge by the small wheel has the effect of thickening the outer edge almost as much as is shown by the contraction of the inner edge. As a labor-saving device it is a great success.

Care of Lubricators.

Among the many thoughtful members of the Traveling Engineers' Association, Mr. W. H. Corbett of the Michigan Central has gained prominence as an advocate of good, sensible methods in locomotive management. Talking on that troublesome matter, care of lubricators, he said: From my past experience and watching the feeds of the lubricators, I feel quite confident that it is absolutely necessary to start the lubricator feeding from twelve to fifteen minutes before leaving time. It is for this reason: The drops of oil as they leave the lubricator pass along down through the pipe and adhere to the inside of the pipe, and if you have a glass at the steam chest you will discover that a drop of oil does not appear at the glass until nearly fifteen minutes from the time that you start to lubricate. Therefore I say that it is absolutely necessary to educate the men that they should start the feeds at least fifteen minutes before leaving time. It is not necessary to open them wide, but it is essential to get the oil pipe lubricated on the inside so that the oil will pass into the steam chest when you are ready to start up, and get the cylinders lubricated and valves oiled also. After doing so, do not blame the lubricator or the oil if the cylinders groan. On the road with which I am connected we received some new engines with 12-in. water glasses, and the cylinders would groan at times and the valves get dry. Mr. McBain, the superintendent of motive power, had a 10-in. glass put on every one of those engines, and I want to assure you that the engines are going up and down the road, and there is very little trouble unless some young engineer is in charge who happens to fill the boiler to the top of the glass and works water. It is not only water that you work out of the stack, but it is the saturated steam that you have to avoid. Educate your men, and also help them by fixing up their engines so that this will not occur.

I know from experience that it is necessary to start the lubricator feeding early. The hand oiler is also a very good feature on the engines. It is not absolutely necessary, but in case the valves and cylinders are dry, you have a chance to get the oil into the cylinders and valves immediately without increasing or disturbing the feeds of the lubricator, and you have overcome that difficulty immediately.

In order to simplify details in connection with correspondence, telephoning, etc., the Quincy, Manchester, Sargent Company, of Plainfield, N. J., have deemed it advisable to change their name and hereafter will operate under the corporate name of the "The Q. M. S. Co." This change has been under consideration for some time, many friends and customers having practically demanded it.

The Wabash Railroad people are said to be considering the adoption of the Baker-Pilliod valve gear for all multi-coupled locomotives in which outside valve motion is highly desirable. Mr. F. A. Dolan, president of the Wabash Railroad, himself an old superintendent of motive power, examined very carefully the model of the Baker-Pilliod valve gear shown at Atlantic City during the railroad convention.

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Even Chance for All on the Harriman Lines.

We have noticed lately that oftentimes when a few railroad men happen together with leisure for social conversation, that the new system of management introduced upon the Union Pacific and other Harriman lines frequently comes up for talk and discussion. Railroad men, more especially those engaged in the operating department, are the most conservative class of people we have ever met outside of hard shell Baptists and naturally they do not regard with favor new rules and regulations formulated to replace the rules of practice that have controlled the destinies of thousands of earnest workers for over fifty years. The fact that a system or practices have the reputation of being old, does not by any means imply that they cannot be improved. Not only has the original system of selecting men for promotion on most railways become obsolete and unfair, it never was just to the great mass of men who displayed zeal and developed commanding ability in the performance of duties that naturally recommended them for promotion to official positions.

These discriminating conditions have always been actively at work against the able men in the mechanical and those engaged in the train operating departments. The duties performed by these classes of railroad people are of the character that tend to develop the most valuable human faculties, the qualities that render the holders peculiarly useful railroad officials. It might naturally be supposed that men belonging to these classes would be noted for the cordial support which they extended to the officials introducing a reform calculated to extend justice to people who have long labored under grevious disabilities; but the letter from Mr. Kruttschmitt, published in another column of this paper, indicates that appreciation of favors received, has not been manifested with the readiness that might have been expected.

We would like to believe that the opposition shown on the Union Pacific against the new system of management, arises from ignorance of the benefits in store for deserving employes, and through misunderstanding the purposes of those instituting the change. The new scheme aims to put every person who has entered railway service with the view of making it the field of his career, on the same footing so that advancement shall depend upon the ability and zeal displayed. The department of work they are engaged on will naturally make employes expert on certain lines of responsibility and deficient on others. The beneficial plan of the management proposes to provide all ambitious employes with opportunities for acquiring knowledge in the lines their duties did not reach. No part of the new arrangement will be permitted to check the ambition or discourage employes who have started in the shops, motive power, maintenance of way or train service. The intelligent and capable locomotive engineer, fireman, shopman, conductor, station agent or transportation clerk may feel with assurance, that if he fits himself for promotion he can get it; but in such cases the management would expect the candidate by study to equip himself with the knowledge that their daily work brings to those engaged in clerical duties On the other hand, the station agent and transportation men would be required to familiarize themselves with work now belonging to the mechanical and to the maintenance of way departments.

At first thought, the ordinary railroad man is inclined to believe such training or study as preparation for promotion to be impracticable; but that is because he has encountered something out of the beaten path. There are numerous lines of business wherein efficient workers have to master many more details than an all-round railroad superintendent must do to become familiar with the new organization of the Harriman Lines. Those who face the new problems with confidence that they can be easily solved, have fought more than half the battle. Skulking or holding back will place the conservative or kicking element at a disadvantage alongside of those who display willingness to give the new order of things their hearty support.

Those who swim ahead on the new wave of progress will encounter novel conditions that ought to be met in a fair and manly spirit. Each Superintendent has a staff of assistants holding the title of Assistant Superintendents who perform the duties previously done by Train Masters, Road Foremen of Engines, Master Mechanics and Division Civil Engineers, each of them having authority over all division employes. It has been necessary in consolidating the office business to take away stenographers and secretaries from some of the officials, which has caused some soreness, but there was no intention to infringe upon the dignity of the individual and the wounds will no doubt heal leaving no disfiguring scars, for their duties are widened sufficiently to bring consolation to healthy minded men. Consolidating the office work has greatly reduced the volume of correspondence with decided benefits to the interests of the company.

The company's officials are actuatel with charity to all and malice towards none, which makes it the bounden duty of the officials bearing the new names to give their management hearty and cordial support. They are in the position of Sydney Smith, the famous humorist, when he was under examination for entering the ministry. The question was asked, Can you subscribe to the thirty-nine articles? Certainly, was the reply, to forty if that will give you greater satisfaction. Try to give satisfaction and all will be well.

The Signal Question.

Our readers will see in the correspondence columns of this issue two letters from men well qualified to give an opinion in the signal question. One of these men, a road foreman of engines, habitually viewing signals from the engine cab, is of the opinion that good practice would be to make the red light absolute. That is that red should always and under all circumstances be the railway color for an absolute stop.

This idea would involve the changing of many signal lights and also modifying the interlocking principle. He suggests the obscuring of the red light at a junction point when the red light does not indicate the route for the oncoming train. He also would like to see advance signals used at interlocking plants.

While we do not wish to express an opinion just now on the pros and cons of this proposal, it is nevertheless a frank and valuable expression of opinion and we invite others to discuss the whole question in the same practical way. Tell us what you think of existing systems. They are not perfect and what you tell us of how you regard the whole matter may lead some signal engineer or other railroad man to devise a valuable improvement.

Another correspondent. also a traveling engineer on a prominent railway, believes that engineers and firemen prefer to see the semaphore arm when they can at night just as they do in day time. We want a full expression of opinion from engineers and firemen, for the latter will be engineers a little later on. Tell us if the sight of the semaphore arm at night is more satisfactory to you than the colored light.

The signal system on American railways, while it is the product of expert minds and is altogether a wonderfully efficient and practical safety feature in modern railroading, yet it is not so perfect that it is beyond improvement and we believe that the men who look out for these signals from the windows of the cab are the men who can tell some things that the signal engineers and the managers of railways would like to know. Read what has been written on the subject and let us hear from you without delay.

French Railway Men.

The improvement in the condition of railway men in France is one of the marked features of the advance of the industrial classes under the republic. Apart from the simple question of increase of wages, which, when contrasted with a larger increase in the cost of necessities, is often no increase at all, there has been much real gain in the shortening of the hours of labor. In regard to engineers and firemen having charge of direct passenger service it is rarely that over 5 hours is spent in actual traction service each day, and the entire day's work never exceeds 8½ hours. Regular intervals of rest on each eighth or ninth day is established on all roads, the rest extending to more than 30 hours. There are also 12 consecutive days' holiday a year, during which time their wages are paid.

Quite a number of small concessions are made to the railway men and their families, such as cheap rates at restaurants, coal at cost price, reduced railway fares for the families of railway men, annual allowances for large families, scholarships and other gratuitous aids which in the aggregate give railway men quite an advantage over the employes of other corporations. The most important matter, however, is the national pension fund, all railway employes paying 4 per cent. of their wages into this fund, the company paying 15 per cent. on the fixed wages. Every man has a right to a pension on reaching his fifty-fifth year, after having served the company for twenty-five years. After that period of service the pension is equal to the half of the average pay of the six years during which the pay was the highest. If the railway man prefers to continue longer in the service his pension is correspondingly increased. It is a noteworthy fact that many of the superannuated railway men have a larger pension than many of the petty State officials, who had to undergo heavy outlays in order to qualify for their positions. It may be added that while the actual wages in France do not exceed one-half what are paid in America, many of the French railway men are in receipt of pensions amounting to 3,300 francs or nearly $700 a year, a sum which is in every way a very comfortable competence to a retired working man resident anywhere in Europe.

Machine Shop Management.

Those of us who have been railroading a long time cannot fail to be struck with the marked improvement observable in machine shop management that characterizes the method in vogue at our chief railroad centers nowadays in comparison with the method, or rather the want of method, in use thirty or forty years ago. A peculiarity of these earlier times was the incessant meddling by men in higher authority over those in subordinate positions. It seemed that after some capable mechanic had been selected from among the others to take charge of a certain section of the work he was not to be altogether trusted. It would have been a lowering of the dignity of the higher official if his assistant had been allowed a full opportunity to superintend the part of the work that was allotted to him. The individuality of the subordinate was not to be permitted to blossom and ripen into fruition. The result was that the promise of hope, as far as the capabilities of the subordinate was concerned, was unfulfilled. The highest value of the man was never realized. Like a recruit forever at drill he was simply marking time when he should have been marching bravely onward.

We recall in memory several master mechanics and shop foremen of this kind. Their periodical visitations were a terror not only to evildoers who knew of their coming and got busy when they came, but it was a source of irritation to the gang foremen whose nerves were on edge and whose plans were so systematically and completely upset that the more astute among them usually set some trifling operations awry in order to engage the attention of the supercilious supervisor and so permit the chief operations to proceed unhampered. Usually when the "old man" came on his unwelcome rounds the day's disasters could be seen in his morning's face. A word of encouragement never fell from such a man. Importance sat upon his dark brows. He was the fountain of all knowledge. He and he alone was infallible, or seemed to think he was, and in this delusion such men lived and moved and had their narrow being.

Higher education has done away with this class of railroad men. A few fossilized barnacles may remain here and there, but they belong to a defunct period and are really no part of the broad, kindly, systematic management of the twentieth century railroad machine shop. The new system is manifesting itself everywhere, and is begetting a feeling of self-respect and self reliance among this important class of railway men. Men know better than before what their duties are. Officials realize more fully than they ever realized before that there is a limit to their authority. Improvement in system is keeping pace with improvements in mechanism, and if moral lessons may be learned from inanimate things it must be admitted that there are fine illustrations in mechanism where each part has its defined work and its limitations.

Any system that leads toward harmonious action and at the same time leaves opportunities for the development of the latent qualities of the earnest, conscientious mechanic is the system that should be encouraged. The spirit engendered by the adoption of such systems is one of the most cheering signs of the time in which we live.

The Valve Rod.

In the hurry and bustle incident to the completion of the repairs of locomotives, machinists are apt to overlook the correct adjustment of the valve rod. It should never be taken for granted that the valve rod is of the correct length. It should rather be borne in mind that, in the case of general repairs to the engine, the valve rod must necessarily require to be re-adjusted. Several causes lead to this. In the first place the refitting of the rocker boxes have the effect of throwing the bolt holes out of line with those in the frame. This requires that one or other of the bolt holes in the rocker must be slotted to admit the bolting of the rocker box in position. It is immaterial which of the holes is changed; the position of the rocker box is no longer exactly as before, the centre having changed its location backward or forward along the frame. Then the refitting of the valve yoke, or the attachment of new ends on the valve rod or other organic changes all tend to affect in a greater or less degree the required length of the valve rod.

The best method of accomplishing its exact adjustment is, after attaching the valve rod to the valve stem and rocker, to mark the valve openings on the valve rod with a tram. It should then be noticed whether the engine is exactly level or not. It will be generally found that the locomotive has a tendency to be lower in front. This tendency is generally rectified when the boiler is filled with water. In any event the locomotive should be carefully leveled, and a double plumb may be hung over the rocker arm, and the center of the rocker moved to the central point between the two lines of the plumb. A mark on the valve rod by the tram while the rocker is in this position will readily show whether the valve is in the central position or not. The lengthening or shortening of the valve rod should be carefully marked by the machinist for the guidance of the blacksmith, and the entire experiment should be repeated in order to prove beyond a doubt that the valve rod is correct It should also be observed that there is no twist on the valve yoke, and it is well that the valve rod should be tried on the rocker end, and note that the rod points centrally to the valve stem.

These directions in regard to the valve rod are made with special reference to locomotives equipped with the Stephenson shifting link and D-slide valve, but in a general way the method of ascertaining the exact length of the valve rod may be applied to any kind of valve gearing, and no kind of valve gearing can be properly adjusted unless the valve rod is exactly fitted to its place.

Real Inventor of the Steam Engine.

Our national tendency towards hero worship has moved our people to bow many times in heart-felt adoration to supposed deities that were really images of clay. The American people have been peculiarly unfortunate in their choice of industrial heroes and have given devotion to many persons for services to the world which they never performed. A movement is in action at present to make people overexert themselves directly in shouting for Fulton, while Watt, Stephenson and others have been applauded in the past for achievements which others executed.

With all that miscarriage of sentimental justice, the silent pleadings of a real hero of invention, a genuine benefactor of the human race are ignored because others, who were mere laborers helping in completing the work originated by Thomas Newcomen, the real inventor of the practical steam engine, have stepped in and claimed credit for the invention. The problem of making the immense potential power of heat through steam carry the burdens of mankind, occupied the minds of men for at least twenty centuries and was at last solved by an ingenious English blacksmith named Thomas Newcomen, whose name is almost to become unknown.

There have been periods of great mental awakenings in the world's history, times when men's minds were excited by spasms of powerful emotion that produced various fruits of righteousness, utility or iniquity, that exerted mighty influences upon human affairs. These periods of intense heart inspiration generally brought forth new ideas and startling revelations concerning religion; but sometimes they brought increasing light upon such mundane matters as science, mathematics, mechanics and other departments of learning. A time of this kind which twentieth century people would call a "revival" and the earnest thinkers of three centuries earlier would have called "a rustling of the dry bones," happened about twenty centuries ago and brought to the world particulars of an apparatus through which the inventor supposed that the force of expanding steam might be converted into work.

For a period of several centuries that began about three hundred years before the Christian era, the city of Alexandria in Egypt was the principal seat of learning in the world. Tremendous intellectual vigor prevailed and all sorts of soul-stirring enterprises were promoted. Philosophical speculations became fashionable among the leaders of society and pretensions of imposing knowledge moved the people into unheard of field of inquiry. Here a philosopher named Hero compiled a treatise in which numerous useful and curious machines were illustrated and described, among them a form of engine that was operated by compressed air or expanding steam. The apparatus was a mere toy incapable of application to useful purposes, but it demonstrated the fact that steam could be used to produce motion.

In the ages that have elapsed since the glory of Egypt departed, intellectual awakenings came at irregular intervals, and scientific speculations concerning the potential possibilities of steam have been ventilated, but not until the eighteenth century was anything done that paved the way for real progress.

When the art of war had ceased to form popular occupation and mental diversion for the English speaking people many of them turned their attention to science and invention which brought into consideration the possibility of making steam lighten the burdens of mankind. It is useless to detail even the names of the workers whose devotion and labor cleared the rough road that gave the world the blessings brought by the steam engine.

Probably the world discovered long before Hero's time that terrible force was generated when boiling water was corked up without means of escape. The thrifty housewife who tried to hold in the fumes of the boiling broth by putting a stone upon the lid of the kale pot, occasionally had an explosion which spread consternation and mystery. The wise men of the world proceeded to find means of harnessing this mysterious force of steam. Thomas Newcomen was the first to accomplish the feat.

For generations inventors had tried to make steam perform the work of raising water by putting pressure directly upon the surface of the body to be raised, the way that compressed air is now used to raise water in a sleeping car. That plan caused immense loss of steam in connection with many other very perplexing operations. Newcomen applied a piston inside of a cylinder and used the steam to move the piston. That was the combination which produced the first successful steam engine. It was a crude apparatus, but it was the pattern on which Watt, Evans and other improvers worked to develop the modern steam engine.

Thomas Newcomen patented his so-called "fire engine" in 1705, but there were so many delays in construction and so many changes and experiments to be made in working out details of the novel machine, that it was not ready for doing the work of pumping water until 1709, so this is the second anniversary of the most important invention of modern times.

This invention of Newcomen was no fruitless attempt to provide the means for making steam do useful work; it was a practical steam engine that became extensively used for pumping water out of mines and for supplying power to city water stations. When James Watt, the Scotch instrument maker, had his attention first directed to the Newcomen engine in 1763, through being requested to repair a model of that engine belonging to the University of Glasgow, there were, at a conservative estimate, seventy Newcomen engines running into hundreds of horse power, at work in different parts of Europe. Watt performed important services to the cause of human progress by the improvements he effected upon the Newcomen engine, but Watt's work was nothing as compared to that of the original inventor who devised the mechanism that brought the force of steam within man's dominion, the force that the inventors of twenty previous centuries has failed to subdue.

Surely Thomas Newcomen deserves to have the second centenary of his success as the inventor of the steam engine proclaimed to the world.

Book Notice

How to Use Slide Rules. By D. Petri-Palmedo. Published by Kolesch & Company, New York. Second edition. 72 pages, flexible covers. Price 50 cents.

The slide rule has kept pace with the spirit of the age, and it has been greatly improved since the days of the original Gunter Scale. It is one of the most practical and time-saving mechanical contrivances, not only to the engineer and surveyor, but also to the machinist and electrician as well as to the bookkeeper and salesman. The work before us has already met with popular favor, and de servedly so, because it contains almost all that can be learned in regard to the use of the slide rule in a clear, compact and handy form.

Simple 4-4-0 for the Idaho Northern.

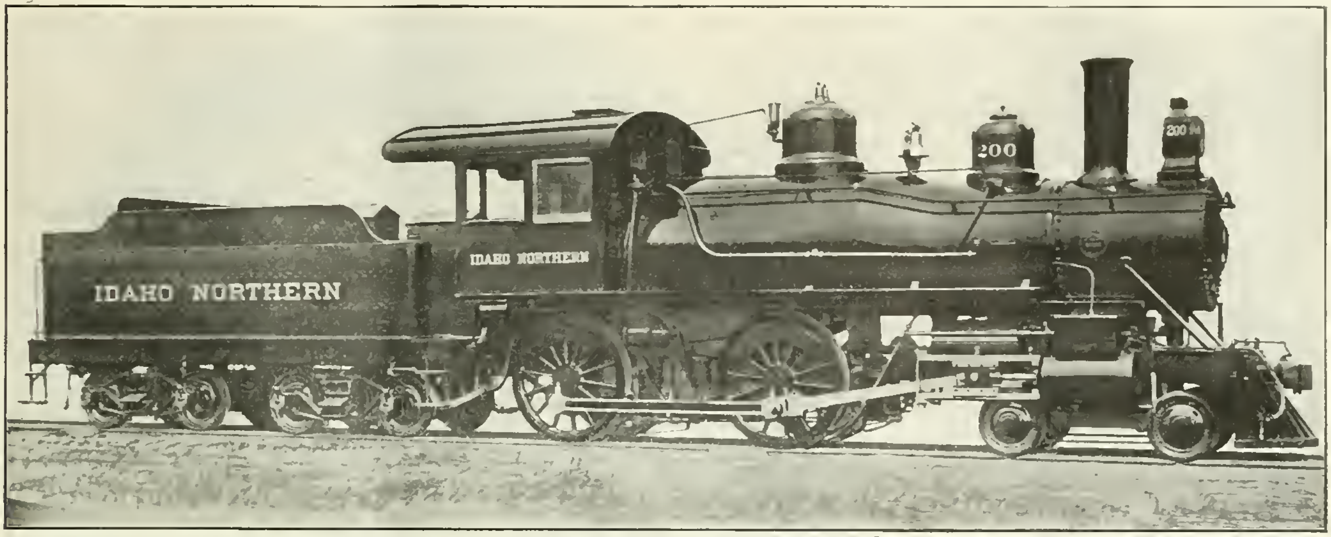
The Baldwin Locomotive Works have recently completed for the Idaho Northern Railway Company a 4-4-0 type locomotive which is of interest chiefly because it is equipped with a smoke-box superheater. This engine exerts a tractive force of 17,050 lbs., and is employed in passenger service.

In its general features, the locomotive follows established practice for engines of its type. The boiler is arranged for burning bituminous coal, and has a deep fire-box placed between the driving axles. The barrel is built with three rings, and is of the extended wagon-top form. In accordance with approved practice in locomotives using superheated steam, a moderate pressure is carried. The superheater contains a total of 200 tubes, so arranged that the steam in flowing from the dry pipe to the cylinders, passes successively through five groups.

Our illustrations of the superheater show the general arrangements of tubes, drums and deflecting plates. The exhaust nozzles are double, they are of moderate height, and they are placed under a petticoat pipe which is extended into the stack. Using previous experience as a guide, the smoke-box fittings of these locomotives are now so arranged that they are practically self-cleaning. This engine is equipped with balanced slide valves, driven by the Stephenson link motion. As a moderate degree of superheat is attained, no special lubricating devices are necessary. The tender is provided with a U-shaped tank, and the frame is built of steel channels, with wood bumpers. The trucks are of the arch-bar type, with steel bolsters and chilled cast iron wheels.

The cylinders are 18x24 ins. and the driving wheels are 62 ins. in diameter. The working pressure of steam is 160 lbs. per sq. in. The boiler measures 56 ins. outside diameter at the smoke box end, and the dome course is 64¾ ins. in diameter. The heating surface amounts to 1,639 sq. ft., the firebox providing 147, and the tubes contributing 1,492 sq. ft.; the grate area is 18.6 sq. ft., and this gives a ratio of grate to heating surface as 1 is to 88. The weight of the engine itself is 114,500 lbs., of which 71,800 is on the drivers. With the tractive effort as stated above, the ratio of adhesion is as 1 is to 4.21, which shows a very satisfactory proportion. The length of the engine is 23 ft. 11 ins. The driving wheel base is 9 ft. 1 in., and when the length of the tender is added, the total length over all becomes 48 ft. 0½ in. The tender carries 4,000 gallons of water and 9 tons of coal. Some of the principal dimensions are appended for reference:

Boiler.—Type .... Wagon Top
Material .... Steel
Thickness of sheets .... 9/16" & ⅝"



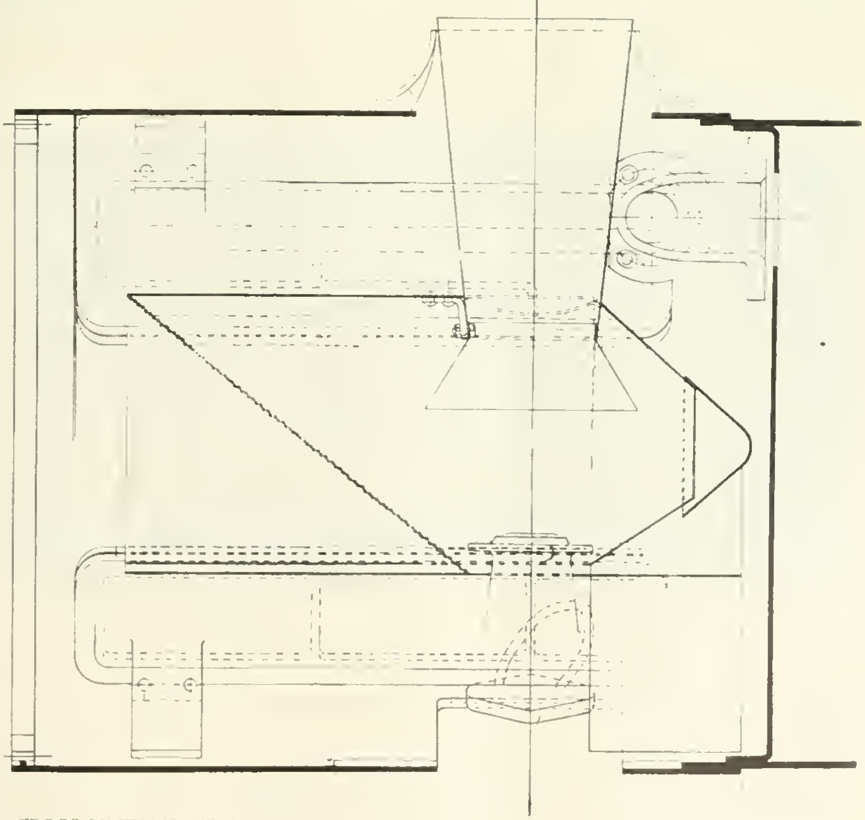
SIMPLE 4-4-0 WITH SUPERHEATER FOR THE IDAHO NORTHERN

J. S. Hickey, Superintendent of Motive Power. Baldwin Locomotive Works, Inc., Builders.

Fuel .... Soft coal
Staying .... Radial

Fire Box.—Material .... Steel
Length .... 78"
Width .... 34⅜"
Depth front, 81⅝" .... back, 80⅛"
Thickness of sheets: Sides, 5/16"; back, 5/16"; crown, ⅜"; tube, ½".

Water Space.—Front .... 4"
Sides and back .... 3"



CROSS-SECTION OF SMOKEBOX SHOWING DEFLECTOR PLATE, NETTING AND SUPERHEATER.

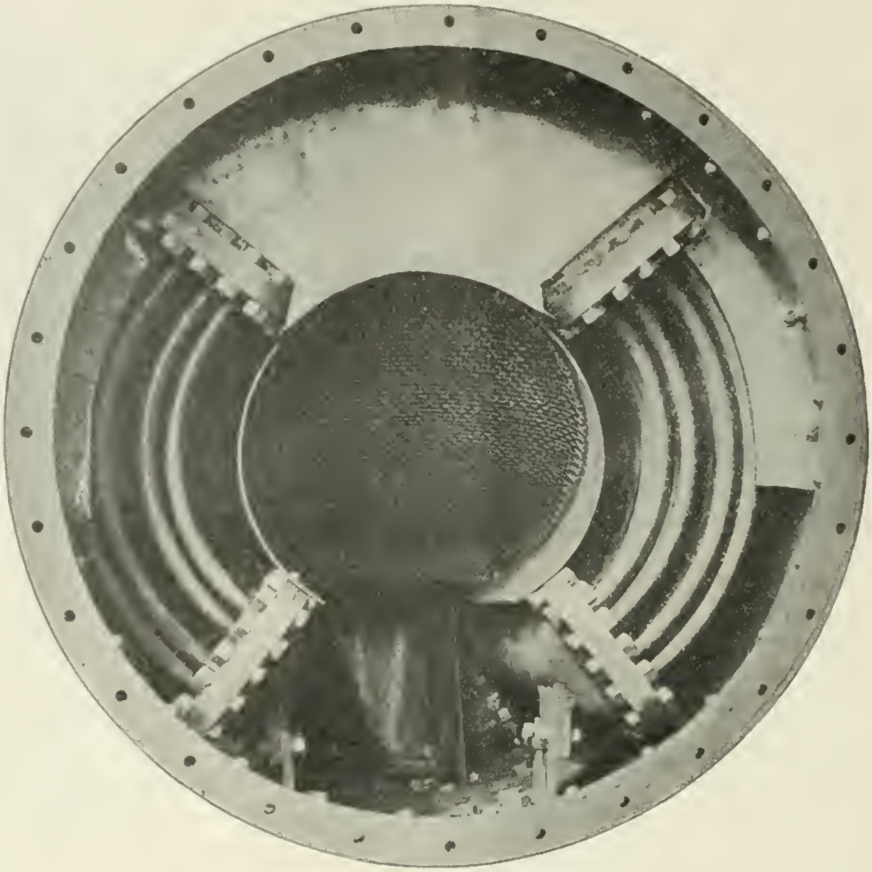
Tubes.—Material	Steel
Wire gauge	No. 12
Number	246
Diameter	2"
Length	11' 8"
Driving journals	7½x × 8½"
Engine Truck Wheels.—Diameter	28"
Journals	5" × 10"
Weight.—On driving wheels	71,800 lbs.
On truck, front	42,700 "
Total engine	114,500 "
Total engine and tender, about	194,000 "
Tender.—Wheels, diameter	33"
Journals	4¼ × 8"

Creditable Record on the D. L. & W.

The advent of the sixteen hour law regulating the length of train crew service has awakened operating officials to the importance of conserving every minute of the permitted period of duty and has emphasized in their minds not only the desirability, but the great importance of getting trains started on time at initial terminals. The Delaware, Lackawanna & Western officials have gone into this matter with the serious intention of utilizing the time at their disposal to the very utmost.

Prior to 1908 one of the greatest causes for terminal delays was the late delivery of engines from the roundhouse to the yard, this being particularly the case in freight service, where, when business was heavy and shortage of power prevailed, it was the common practice to permit engine and train crews to remain on duty several hours waiting for an engine to be made ready to begin their run. Aside from the expensive features of this plan it was found that too often a delay at the initial terminal meant the shortening of the run and the cutting of engine milage before the completion of the trip. To eliminate such delays, and to provide that most of the 16 hours go in on train movement, caused many changes in dispatching methods to be made and much improvement has been effected along that line.

Our attention has been called to the very favorable showing made in this direction by the Lackawanna, especially on the Scranton division of which Mr. H. H. Shepard is superintendent, and Mr. Harvey Shoemaker is master mechanic. On that division the commodity handled is the coal mined in the territory contiguous to Scranton, Wilkes-Barre and other points in North-Eastern Pennsylvania. The maximum business prevails in cold weather and it is a frequent occurrence to move 1,500 cars of coal daily out of Scranton. The system in vogue on this road is that the power needed for a day's business is ordered at one time, 24 hours in advance of its departure, the movement being distributed more or less evenly over the daylight and dark hours.



VIEW OF SMOKEBOX WITH SUPERHEATER IN PLACE.

There is a fixed hour of departure set for each train. This system works out very well, but occasionally when wrecks, etc., tie up the incoming power the mechanical department finds itself badly handicapped in adhearing to the order given, as in busy times all available power is engaged and passes in and out steadily, there being no appreciable margin left to take up any interruptions in traffic movements.

Notwithstanding this handicap Mr. Shoemaker and his assistants, Mr. M. A. Quinn, chief engine dispatcher, and Mr. F. Hart, general roundhouse foreman, have every reason to be pleased with the record they have established, a copy of which we give below. It should be understood that in the Lackawanna system of records, an engine counts as once dispatched for every complete day's service performed by it. No credit is taken for extra coaling, cleaning or fire, sanding and turning or other attention given to an engine during the performance of a day's service. In the table of delays there are two very significant lines; these are number of engines delayed in 1908 and in 1909, and the number of engines dispatched to one delayed.

SUMMARY OF ENGINES DELAYED AT TERMINALS—SCRANTON DIVISION.

Year ending	Scranton Rd. House		Hailstead Rd. House		Kingston R. House		Gravel Place Rd. House		Scranton Division Total	
March 31st, 1909	'08	'09	'08	'09	'08	'09	'08	'09	'08	'09
No. of engines dispatched	59,658	54,790	9,686	9,073	8,700	10,748	5,346	4,292	83,396	78,903
No of engines delayed....	1,325	499	24	9	28	15	35	12	1,412	535
Engines dispatched to one delayed	45	110	404	1,008	311	717	153	358	59	147
No. of hours delayed...	858 hrs. 29 min.	305 hrs. 12 min.	11 hrs. 30 min.	5 hrs. 50 min.	14 hrs. 0 min.	4 hrs. 0 min.	18 hrs. 1 min.	7 hrs. 4 min.	902 hrs. 0 min.	322 hrs. 6 min.
Aver. length of delays...	39 min.	37 min.	29 min.	39 min.	30 min.	1 min.	31 min.	35 min.	38 min.	36 min.
Aver. detention on every engine dispatched	51 sec.	20 sec.	4 sec.	2 sec.	6 sec.	1½ sec.	12 sec.	6 sec.	39 sec.	15 sec.
An engine dispatched every	8 min. 50 min.	9 min. 36 sec.	54 min. 25 sec.	57 min. 56 sec.	60 min. 32 sec.	48 min 54 sec.	98 min. 18 sec.	122 min. 28 sec.	6 min. 19 sec.	6 min. 40 sec.

Applied Science Department

The Walschaerts Valve Gear.

III.—Construction.

In view of the fact that the Walschaerts valve gearing does not possess that flexibility of adjustment common to shifting link valve gearings, there is greater need for perfect accuracy in construction. Not only must the design be carefully laid out, but in fitting up the gearing a degree of exactness must be attained that approaches as nearly as possible to perfection. As a general rule it is very safe to presume that the design, as far as the draftsman's work is concerned, is correct, but the same cannot always be said of the machinists' work. Shopmen are well aware that in the process of hardening the wearing parts of machines there is a tendency to irregularities, owing to the variations in the sizes of the parts. This is particularly true in regard to the parts where the greatest degree of exactness is required, and it should be carefully observed that the radial link attachment, extending as it does some distance beyond the link proper, has not moved in one direction or the other during the hardening process. The application of a turnbuckle or other device to the eccentric rod, although not now used, was a ready corrective to variations of this kind, but it was not a complete remedy, as it will be readily understood that any variation in the paths described by the moving parts have some disturbing effect on the constructor's design.

Errors of this kind are more easily detected than remedied, and it may be accepted as a rule that organic defects in the construction of the Walschaerts valve gearing can rarely be altogether remedied. It is a well-known fact among shop men that in the construction of locomotives there is a tendency to what may properly be called dramatic flourishes in the beginning of the building of a locomotive. The frames and saddle and cylinders are bolted together with a degree of rapidity that fills the eye that is pleased with superficial appearances. The exact alignment of the parts, however, is never correct by chance. Whatever is correct in mechanism is always difficult of accomplishment, and it is time well spent to note that the pedestal jaws of the frames are not only exactly square to each other, but that the shoes are also perfectly parallel. It should not be supposed that the simple matter of adding or subtracting a certain quantity of metal to or from the shoes will restore or maintain a just relation of the parts to each other. The least variation in the setting of the frames has the pernicious effect of throwing the bolt holes in the frames out of position, and braces and guide yokes and rocker boxes are more or less strangers to the truth from the first day of their industrial existence, and no amount of temporary tinkering can ever bring them back to where they properly belong. This is especially true of the relation of the center of the main driving axles to the various parts of the Walschaerts valve gearing, and it cannot be too strongly instilled into the minds of those who are engaged in this important work that every precaution should be taken to maintain the exact mathematical relation of the parts to which the valve gearing is attached and from which it derives its accuracy of movement. This is the highest kind of constructive work, and to which the work of the draughtsman is merely preliminary. It is a singular circumstance that error multiplies as it proceeds from point to point, and that which is only a small fraction at the main axle becomes a considerable quantity by the time that it has reached the valve opening.

In the designing of the Walschaerts valve gearing the length of the piston stroke being given, together with the amount of valve travel and the extent to which the valve overlaps the steam ports, and also the amount of opening or lead which may be deemed necessary, the combination lever is designed in such proportion as to move the valve the exact amount of lap and lead away from the central position at the time that the piston is at the extreme end of the stroke. The union link and crosshead arm are so constructed that the combination lever will be in the perpendicular position when the piston is in the center of the cylinder. The radial link is so constructed that its arc or curve corresponds to the circle described by the length of the radius bar; that is, measuring from the point to where the radius bar is attached to the combination lever along to the center of the link block. The radius bar should be at least eight times the length of the space in which the link block is designed to travel. The longer the radius bar is the more direct its thrust will be on the valve rod, and consequently less subject to the disturbing and distorting effect of a short angular movement. The length of the link is such as when oscillated by the eccentric rod the radius bar will move the slide valve the desired amount of travel; that is, when the link block which is attached to the radius bar and moves freely in the link is at either end of the link.

As we have already stated in the case of engines equipped with the ordinary slide valve or with outside admission piston valves, the radius bar is connected to the combination lever below the valve stem, and in the case of piston valves where the steam is admitted from the inner edge of the valve, called inside admission, the connection of the radius bar is above the valve stem. It should be noted that in order to maintain the perfect equality of the valve travel both in the forward and backward motions the suspension point of the link should be in line with a point between the combination lever's connection with the radius bar and valve rod, the line being drawn parallel with the valve rod The same

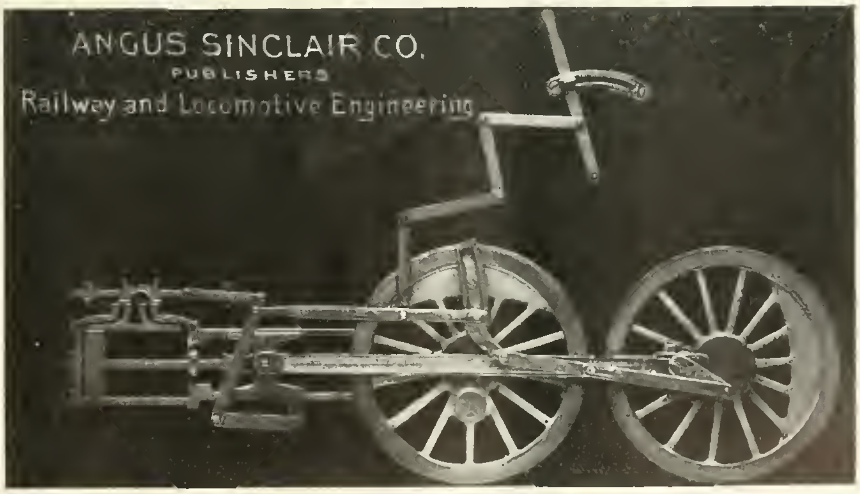


FIG. 1. FORWARD GEAR, LINK-BLOCK AT BOTTOM OF LINK.

alignment should be maintained as nearly as possible in regard to the eccentric rod and the center of the driving axle. The point of connection of the eccentric rod with the link should be parallel with the axle centers. In the construction of some classes of locomotives, especially with the largest kind of cylinders, the perfect alignment of these points would necessitate an extra extension of the link arm, which in turn would require an excessive amount of eccentric throw, and hence the point of eccentric rod connection with the link arm is often at some distance above the centre line. The distorting influence of these variations is reduced to a minimum by the action of the combination lever, which being attached to the crosshead, maintains the position of the valve with a degree of accuracy rarely equalled by any kind of mechanism where circular motion is changed to linear or reciprocating motion.

A working model of the Walschaerts valve gearing is a good aid to a clear understanding of the mechanism, and readily reveals not only its essential features and advantages, but shows at a glance some of the seeming contradictions to other valve gearings that its actions exhibit. Thus, in Fig. 1 an illustration of the model before us, it will be noted that in the forward motion the link block is in the bottom of the link. This is opposite to what occurs in the Stephenson shifting link, but it will be observed at once that it is the link block and attached radius rod that moves, and the action is direct and simple in comparison with a floating link passing through a variable arc, disturbing the exact position of the valve as it passes from point to point. It may be stated here that in Walschaerts' valve gear in the position shown in Fig. 1 the reverse lever may be moved from one end of the sector or quadrant to the other end without disturbing the position of the valve. If the eccentric rod is of the proper length it will be readily proved at either end of the piston stroke by moving the reverse lever and thereby moving the link block in the link. If the valve remains stationary the rod referred to is of the correct length. If the piston is at the extreme front end of the cylinder and the valve moves forward as the link block rises in the link the eccentric rod is too short. If on the other hand the valve moves backward the eccentric rod is too long. The eccentric rod controls the position and motion of the link, and should be so adjusted in point of length that the link block and accompanying radius bar should not disturb the valve when the piston is at the extreme ends of the stroke.

A peculiarity of the gearing may be noted at this point which affects the movement of the valve advantageously. As shown in Fig. 1, the eccentric rod is on the bottom center, and when in motion moves the link at a comparatively high rate of speed, the motion of the link being reduced to a minimum as the eccentric rod passes around what are properly called the dead centers in its circular path. It will thus be seen that at the moment when the eccentric or return crank is at the lowest or highest point of its path the valve, having its motion conveyed to it by the oscillating link, is traveling at its highest velocity. This is at the exact point where the opening of the valve occurs, and coincident with the rapid movement induced by the location of the eccentric or return crank the velocity of the valve travel is further induced by the action of the combination lever, which, acting on the radius bar connection as a fulcrum, has moved the valve in its path the increased distance required to overcome the space occupied by the lap and lead. The opening of the valve, therefore, occurs more rapidly on account of the movement of the combination lever, and if we follow the movement until the middle of the piston stroke has been reached it will be found that there is a diminution of speed not only on account of the return crank passing the dead center, but this pause in the valve's motion is further accentuated by the combination lever passing the vertical dead center of its connection to the radius bar and valve rod. This double eccentricity, as has been stated, emphasizes the rapid opening and closing of the steam ports and prolongs the period of full opening. These features are of decided advantage in any kind of valve gearing used in steam engines.

In overcoming defects in construction the eccentric rod is usually the part in which any change is made. This rod may be lengthened or shortened to correct errors in the location of the main axle center or link center. The central position of the valve or the exact amount of opening of the steam port at each end of the piston stroke can readily be adjusted by lengthening or shortening the valve rod, which is usually fitted with adjustable threaded nuts. It may be added that the slightest variation of the return crank from its proper position at right angles to the main crank will be readily discovered by comparing the action of the valve as shown in the forward movement of the engine with the action and position of the valve in the backward movement. Referring again to Fig. 1, it will be readily recognized that in the event of the valve showing a greater amount of opening in the forward motion than in the backward motion the variation may be divided by moving the return crank connection the required amount nearer to the main crank, or by moving the point of suspension of the link nearer to the valve; both of these organic changes having the same effect, neither of these changes should be made except under very pressing conditions, and after repeated experiment and identical results.

Celebrated Steam Engineers.

XXI. James Nasmyth.

The adaptability of the steam engine to almost every kind of mechanical undertaking was such that it soon brought about an industrial revolution in manufacturing and transportation. In the hands of clever engineers the locomotive and steamboat soon took practical form and it is a noteworthy fact that the call for large shafting, suitable for the increasing size of steamships called into being the steam hammer. James Nasmyth, the inventor of the steam hammer, came of a Scottish family of artists, and at an early age displayed a strong bent towards engineering. He made models of engines and in 1834 he engaged in machine construction and was eminently successful as a builder of engines, boilers and machine shop tools. He was particularly successful in the manufacture of special machine tools, and was among the first to bring the turning lathe and planing machine near to that degree of perfection which these machine shop tools have subsequently attained.

It was, as we have stated, on the occasion of the necessity arising for the forging of a shaft which was to be used in a steamboat that Nasmyth's inventive mind produced the steam hammer. It immediately came into general use, and the original design is still closely adhered to. The success which attended the introduction of the steam hammer, seemed to act as an incentive to Nasmyth's constructive ability. In rapid succession he produced the steam pile-driver, thereby effecting an incalculable saving in the construction of building foundations, docks and wharves and other work, and also the flexible shaft, steam and torpedo rams, and finally the hydraulic press.

In addition to his skill as an engineer he gave much attention to the science of astronomy, and although his discoveries in connection with that science were not remarkable, he was among the first to create an interest in the phenomena known as sun spots. He was much engrossed in these speculations and many admiring friends regretted that he did not keep his fine intellect at work nearer the surface of the earth. He retired from active engineering at an early age, and devoted the latter half of his life to what may be called the pleasures of artistic and scientific speculation. It must be admitted that he did enough real work of the most enduring quality to entitle him to whatever pleasure he could find in wandering among the stars. He was born at Edinburgh in 1808, and died in 1890. He was a fine gentleman, a delightful companion, and his high intellectual qualities were enhanced by a purity of life that kept his heart young and sweet.

Questions Answered

LEAK AT THE H-5 BRAKE VALVE.

54. F. E. A. Spencer, N. C., asks: What disorders can cause a blow at the emergency exhaust port of the H-5 brake valve?—A. We may say in answer to this that a leaky slide valve in the distributing valve or a leaky rotary valve in the automatic or independent brake valve are the most common causes It can also be caused by a leaky plug valve in the double cut-out cock under the brake valve, a leaky body gasket in the automatic brake valve and it might be caused by a leak from port to port through the pipe bracket gaskets in either brake valve or in the gasket between the distributing valve and reservoir or by any crack or defect of the distributing valve reservoir that would allow a leak into the application chamber.

ACCIDENT TO WALSCHAERTS GEAR.

55. G. C. C., Plainville, Conn., asks: What course should be taken in the care of a broken eccentric crank or eccentric rod with a locomotive equipped with the Walschaerts valve gear?—A. Disconnect the eccentric rod from the link and crank, and also disconnect the suspension bar from the radius bar, and the radius bar from the combination lever. The forward end of the radius bar should then be raised beyond possible interference. The valve should then be placed centrally and the valve rod clamped to prevent the value from moving. The link block may be blocked in any position preferably at the bottom of the link. In moving the engine it is well to watch the action of the combination lever, as its action is not the same as when attached to the radius bar. The lubrication of the cylinder should be continued. The cylinder cocks on the disabled side should be blocked open.

CALCULATING HEATING SERVICE.

56. Constant Reader, Philadelphia, Pa., writes: Please explain in arithmetic how to calculate the heating surface of a firebox and flues of a boiler.—A. The calculation of the heating surface of a locomotive boiler is a comparatively easy matter when you have the data concerning the boiler. The flue heating surface is found by taking the outside diameter of the tube, finding its circumference in inches, multiplying that by the length of the tube in inches and bringing the result to square feet, then multiplying by the number of tubes. Some authorities take the distance between the flue sheets as the length of the tube, but others include the part of the tube in the tube sheets, as a sort of offset to the fact that no account is taken of the front flue sheet. For example, in our description of the C. & A. 4-6-2 engine on page 283, July issue, the back tube sheet is ½ in. and the front ⅝ in.; that leaves a flue length of 15 ft. 11⅞ ins. This makes a difference of about 18 sq. ft. The firebox heating surface is found by ascertaining the area in square feet of inside side sheets, the inside back head, minus the area of the fire door, and the area of the tube sheet, minus the combined area of all the flue holes. The sheets are usually measured to the grate level, though some authorities measure from the top of the mud-ring.

MID-GEAR VALVE TRAVEL.

57. J. C. S., Clovis, N. M., asks: When an engine is running, and the reverse lever is in the centre, what causes the valve to move, and why?—A. The valve moves because the link is, even when the link-block is in the centre, under the influence of two eccentrics. Both the eccentrics are on the same side of a line drawn through the centre of the axle. Each one has an angular advance sufficient to move the valve a distance equal to the lap and lead of the valve, so that in the position you speak of the valve moves over a distance equal to twice the lap and twice the mid-gear lead. The mid-gear lead is greater in the Stephenson motion than the full gear lead by reason of the fact that the curve of the Stephenson link is of a radius which cannot be made to coincide with any fixed point which is an element of the valve motion.

BROKEN RESERVOIR PIPE.

58. M. E. L., Chicago, Ill., writes: Can a passenger train be handled over the road with the air brake if the reservoir pipe is broken off at the brake valve and cannot be connected again, engine equipped with the standard high speed brake?—A. It might be done on a very short train, but from the conditions under which a connection must be made between the main reservoir and the brake pipe it will be seen that it is impracticable and would be only an emergency brake at the best. Both ends of the break could be plugged and the signal and brake pipe hose on the pilot connected, main reservoir pressure could then flow through the signal reducing valve into the brake pipe and if there is no brake pipe leakage a few cars could be charged up. The brake valve handle would remain in running position and the feed through the reducing valve is not likely to unseat the equalizing discharge valve, but by comparing the opening through the reducing valve with the feed groove of the P-2 (F-29) triple valve you will appreciate how difficult the release of a brake would be 3 or 4 cars back in a train. Sometimes locomotives are equipped with a "double heading pipe," running from the main reservoir to the pilot and to the rear of the tender. In a case of this kind the connection to the brake pipe could be made at the pilot and the brake valve exhaust fitting plugged and the application made by going slowly to emergency position.

Should the engine and tender be equipped with the combined automatic and straight air brake a connection from the main reservoir to the brake pipe could be made by coupling the hose on the brake cylinder pipe on the rear of the engine with the brake pipe hose on the tender, the brake could be applied and released on the tender and train with the straight air brake valve, but there would be no driver brake.

MAIN RESERVOIR VOLUME IN INCHES.

59. Constant Reader, Philadelphia, Pa., asks: Why are the dimensions of the main reservoir and air equipment given in cubic inches?—A. Because it is the most convenient way to state the capacity or contents of an air brake reservoir or cylinder and avoids the use of fractions and decimals. Reservoirs, cylinders and air pumps are always of a cylindrical form, and their dimensions are usually given in inches. To determine the capacity it is necessary to square their diameter, multiply by .7854 and again multiply by the length in ins. and the result is in cubic inches. To state this result in cubic feet requires an additional calculation. If a reservoir or storage tank was of a rectangular form exactly so many feet long, so many feet high and so many feet wide on the inside, it would be simpler to state the capacity in cubic feet, but in air brake practice such is not the case and it is more intelligible to say that the 8-in. freight auxiliary reservoir contains 1620 cu. ins. than to say that it contains 0.973 of a cubic foot. There are 1728 cu. ins. in 1 cu. ft.

SIZE OF DRIVING WHEELS.

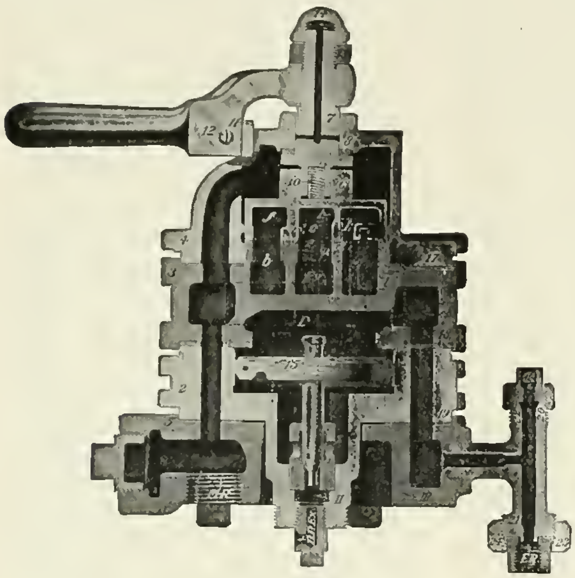
60. Fireman, Oakland, Cal., writes: I would like a question over which there has been quite a dispute out here on the Southern Pacific. Has the New York Central Railroad a locomotive with an 18-ft. driving wheel or has such a locomotive ever been built by any other railroad in the United States either for experiment or otherwise?—A. The New York Central has no such driving wheels on any of their engines; 79 ins. is a good sized wheel for passenger engines, sometimes 80 and 84-in. wheels are used. We do not know of any 18-ft. driving wheel on a locomotive here or elsewhere. Some engines in England were built with 9 ft. single drivers, but very large wheels are not popular. An 18-ft. wheel would be higher than the top of the smoke stack of many large and powerful engines now built. See sizes given in our July paper.

Air Brake Department

Conducted by G. W. Kiehm

H6 Equalizing Discharge Valve.

The equalizing discharge valves of all Westinghouse brake valves are constructed and operated upon the same principle, and when subjected to a variation in the pressures surrounding them their action is always the same.



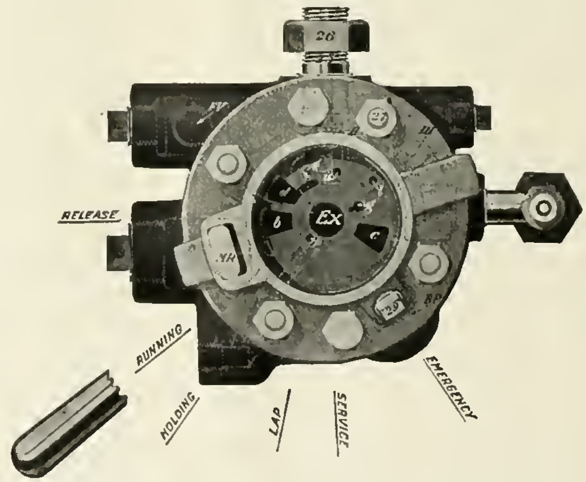
H.6. AUTOMATIC BRAKE VALVE.

It is merely a repetition to state that the object of the equalizing reservoir used in conjunction with the equalizing discharge valve is simply to enlarge the space and increase the volume of compressed air above the equalizing discharge valve, we use the equalizing reservoir pressure to operate the equalizing valve or equalizing piston, which in turn uses the brake pipe pressure to operate the distributing valve on the locomotive and the triple valve pistons throughout the train. As the Westinghouse brake valve handle is placed in train brake release position, the equalizing reservoir is supplied with compressed air through a suitable port directly from the main reservoir, and in an indirect way from the main reservoir through the brake pipe, as the handle is moved to running position direct communication is cut off by the movement of the brake valve rotary, and air can only enter the equalizing reservoir by the way of the brake pipe, the pressure at this time being controlled by the brake pipe feed valve.

As the handle is turned to lap position, the movement of the rotary valve separates main reservoir, brake pipe, and equalizing reservoir pressures, and the dividing line between brake pipe and equalizing reservoir pressures is the equalizing piston packing ring. The pressures remain separated, as the handle reaches service application position. When equalizing reservoir pressure is reduced the escape of air weakens the pressure and the pressure under the equalizing piston becomes predominant and the brake pipe pressure, which has not been distributed, lifts the equalizing piston and reduces brake pipe pressure, a like amount, the air escaping to the atmosphere. Closing off the escape of the equalizing reservoir pressure allows this pressure to remain stationary, and by acting on the piston and packing ring it forces down the piston, and closes the brake pipe exhaust when the brake pipe pressure has reduced to a point slightly below the remaining equalizing reservoir pressure.

When the handle is placed in emergency position the flow of equalizing reservoir pressure depends upon the pattern of the brake valve in use, with the D8 valve the equalizing reservoir pressure cannot escape, and at a certain point, shortly after the direct application port is opened, main reservoir pressure can reach the equalizing reservoir, while in the D5, E6, F6 and G6, valves, equalizing reservoir pressure was permitted to escape, and the groove in the seat of the rotary valve through which it escaped overlapped both the emergency exhaust port and the feed port, and it is safe to assume that a considerable amount of equalizing reservoir pressure at this time escaped by the way of the feed valve into the brake pipe, then to the emergency exhaust port, as the feed valve would open promptly upon a reduction of brake pipe pressure, and the exhaust port would naturally be filled with escaping brake pipe pressure. In the H5 brake valve equalizing reservoir pressure is expanded into the application chamber of the distributing valve when the brake valve is in emergency position, and in the H6 valve, it is allowed to escape directly to the atmosphere by a port especially provided for the purpose, and used for no other.

The disposition of this pressure during emergency applications is of very little consequence, and about the only particularly noticeable effect is the release of the driver brake, or sometimes both driver and tender brakes if the brake valve handle of the D8, D5, E6 F6 or G6 valves are moved to emergency position for an instant and then promptly back to lap. This movement, while leaving brake pipe and auxiliary reservoir pressures equal, does not give sufficient time for equalizing reservoir pressure to reduce, and it is free to equalize with the brake pipe pressure by flowing past the equalizing piston packing ring, and with a short brake pipe it sometimes equalizes at a pressure high enough to kick off or release the driver brake. With the H5 and H6 brake valves the flow of air is the same, but an increase of brake pipe pressure cannot release the locomotive brake while the automatic brake valve is on lap position, even if the equalizing reservoir pressure flowing into the brake pipe after a quick emergency application and a rapid return to lap position, does move the equalizing valve of the distributing valve to its release position.



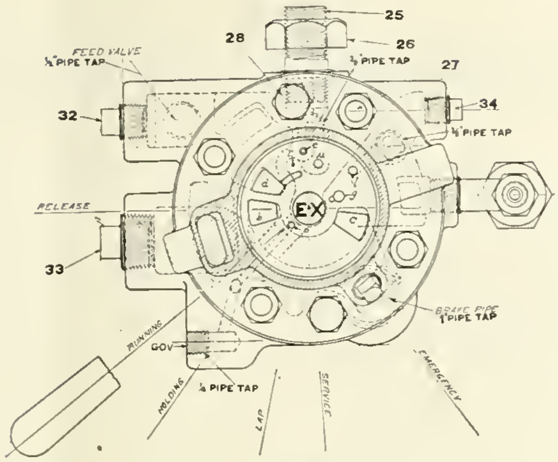
PLAN OF ROTARY VALVE H.6. EQUIPMENT.

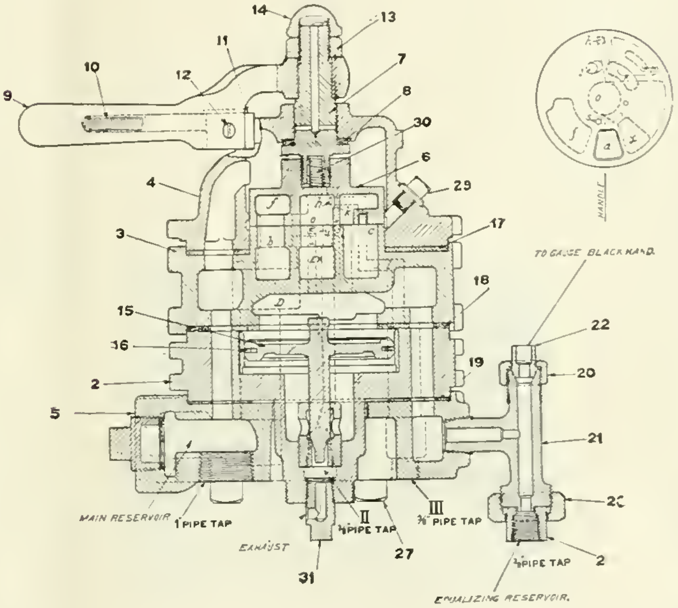
It will be remembered that such manipulation of the brake valve is wrong, regardless of the results, as it conflicts with the Westinghouse Air Brake Company's instructions. These instructions read: "In case of emergency, place the brake valve handle in emergency position, and allow it to remain there until the train stops or until the danger is past."

Having traced the flow of air to and from the equalizing reservoir during the different positions of the brake valve, we will return to and consider the H6 and G6 brake valves only, but before doing so it might be well to consider the work of the equalizing piston or the amount of air that must be expanded from the brake pipe on a long train when a service reduction is desired. The equalizing reservoir pressure escapes through an opening 5/64 of an inch in diameter, when the brake valve is in service position, and it is essential to a correct operation that this preliminary exhaust port is neither enlarged nor restricted in the opening, it should reduce equalizing reservoir pressure from 110 to 90 lbs. in from 5 to 6 seconds, and from 70 to 50 lbs. in from 6 to 7 seconds.

If the pressure is reduced in less time, or if the black hand on the air gauge falls faster than the time given it indicates an enlarged preliminary exhaust port, leakage from the equalizing reservoir volume, or a reduced volume if the hand falls at a more rapid rate, with a tendency to build up again on the gauge, it indicates a restriction in the pipe connections to the equalizing reservoir.

If the fall of the hand on the gauge is slower than the time given, it indicates a restricted opening through the preliminary exhaust or leakage into the equalizing reservoir from some other source; the leakage may be from the brake pipe past the equalizing piston packing ring or through the brake valve body gasket, or from the main reservoir port through the brake valve body gasket.





SECTION OF THE H6 BRAKE VALVE.

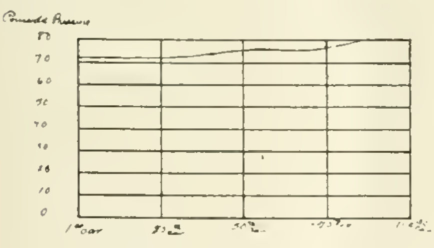


FIG. 1. VARIATION OF BRAKE PIPE PRESSURE IN LONG TRAIN.

The maximum opening through the brake pipe exhaust of the G6 brake valve is 9/32 of an inch; in the H6 valve it is ¼ of an inch. In view of the fact that the G6 valve was designed to operate the brakes on trains of from 30 to 50 cars, while the H6 equipment is designed for all classes of service, and especially for locomotives that can handle from 80 to 120 cars; this looks very inconsistent at the first glance; however, the rate of discharge from both brake valves is the same, in spite of the difference of 1/32 of an inch in the opening, as the air in escaping from the angle-fitting of the G6 valve makes two right angle turns, while in escaping from the H6 valve it makes but one turn at a right angle. When we realize that the resistance to the flow of air by adding an elbow is increased, even in this short distance, by an amount equal to reducing the original opening 1/32 of an inch when that opening is but 9/32 in., every elbow used is about equal to an additional 15 ft. of pipe in frictional resistance, we can readily appreciate the difficulties encountered in conducting compressed air to and from the 80th or 100th car in a train. The difficulty is not because there are any elbows used in the brake pipe on the modern car, although they may be used in the branch pipes, but because of the extreme length of pipe between the last car and the brake valve, and on account of the resistance offered by the hose couplings. The best designed couplings used on freight cars compel the flow of air to turn approximately at right angles twice between each car in the train.

In fact, if the triple valves do not assist in the reduction of brake pipe pressure it can be withdrawn from the entire train of 80 or 100 cars as rapidly with the service reduction as it can with the emergency. If all the triple valves in a train were cut out, the brake pipe pressure can be exhausted in practically the same time whether the brake valve is placed in service application position to do so, or whether the angle cock on the pilot is opened. The whole question is simply a matter of expanding the compressed air in the brake pipe and getting it out through the various crooks and turns in the pipe, and it requires just so much time.

While the size of the brake pipe exhaust port is proportioned, to a certain extent, to the size of the service port in the triple valve, the desire to obtain a uniform reduction has not been lost sight of. A 3/32 in. opening in the brake pipe exhaust port will result in a more uniform reduction throughout the long train than from a ¼ in. opening; however, this is too small when the size of the feed grooves are taken in consideration.

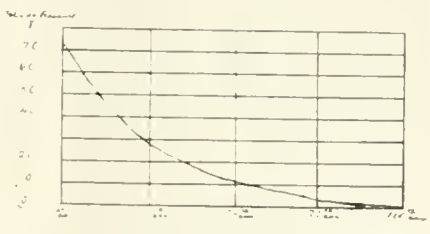


FIG. 2. PRESSURE IN LONG TRAIN 20 SEC. AFTER RELEASE.

A larger exhaust port than ¼ will not run the reduction through the train any faster and would only tend to increase the liability to undesired quick action. Deciding upon the present size of exhaust port takes into consideration uniformity of reduction, and a reduction rapid enough to operate the triple valves and not rapid enough to throw them into quick action whether the brake pipe to which the brake valve is connected is one of 2 cars or one of 100 cars.

Particular reference to the rise and fall of brake pipe pressure is unintentional, but the work of the equalizing discharge valve is to reduce the pressure, and reference to the subject cannot be entirely avoided. It is well known that the most difficult place to reduce brake pipe pressure on a long train is at a point just back of the middle of the train, which is due to the forward rush of air having a tendency to build up at this point. The difficulties encountered in forcing compressed air into the long brake pipe have been mentioned and if the engineer wishes to operate the brakes successfully on long modern trains it is absolutely necessary that he should realize and bear in mind that with a large capacity air pump and a large main reservoir volume, at 140 lbs. pressure it requires about 20 seconds time from the movement of the brake valve handle to release position until compressed air can flow out of the open angle cock on the rear of a 100-car train, and when the train of cars is charged and a 10-lb. reduction in brake pipe pressure is made it will require over 50 seconds time for the auxiliary reservoir and brake pipe pressure to equalize on the 100th car. When the brake is to be released after the 10-lb. reduction the brakes on the 80th car in the train will not start to release until about 40 seconds after the brake valve handle is moved to release position. This is not to be construed to mean that the brake valve handle should be allowed to remain in release position for such a length of time, but merely to show the time required for air to flow back into a long train.

The variation of air pressure in the brake pipe on a long train can best be illustrated by a diagram, or a rough sketch, Fig. 1. The lines may be slightly exaggerated, but they will serve to convey the idea and leave a more lasting impression on the minds of those who may not have given the subject any serious consideration. The irregular line is intended to represent brake pipe pressure throughout the train, original brake pipe pressure of 80 lbs. This diagram is intended to show approximately the manner in which the brake pipe pressure is inclined to fall about 25 seconds after a 10-lb. brake pipe reduction has been made.

The second diagram, Fig. 2, is intended to convey an idea of the distribution of pressure throughout a long train about 20 seconds after the brake valve handle is placed in release position and allowed to remain there. Large capacity air pump, main reservoir capacity of about 60,000 cu. ins., at a high pressure, and no pressure in brake pipe before movement of valve handle. This has no reference whatever to type K triple valves, as conditions of this kind made necessary the designing of type K valves, and if the diagrams convey the idea they are intended to convey the necessity for quick service and uniform recharge will not be questioned. If the diagrams are regarded in the manner in which they should be, they practically constitute a complete air brake lesson in themselves, and are a clear answer to some of the so-called mysterious actions of the air brake.

The diagram, Fig. 2, answers in a language plainer than words, problems such as the following: "After an application of the brake, the brake valve handle was placed in release position to release the brakes on the train and after about 25 or 30 seconds' time the handle was returned to running position and a few seconds afterward brake went on in the emergency, am unable to locate the disorder," or again stating it another way: "While running at a moderate rate of speed, brake valve handle in running position, brake applied in quick action am unable to assign the cause." The diagram practically explains the why in both these cases.

To return to the subject, when the brake valve handle is placed on lap position, thereby dividing main reservoir, equalizing reservoir and brake pipe pressures, it naturally follows that if any leakage from the equalizing reservoir creates a difference of pressure between it and the brake pipe the equalizing piston will be unseated and discharge brake pipe air to the atmosphere and this leakage is bound to create a difference if the packing ring is a proper fit.

CARTAGENA-COLUMBIA SHOPS, SOUTH AMERICA.

The leakage could occur in the equalizing reservoir itself, in the pipe leading to it, in the branch pipe leading to the air gauge, from a burst tube in the gauge, from the brake valve body gasket, or from the gasket, past the bolt heads at the bottom of the brake valve, or from a cut on the face of the rotary valve or its seat. In the G6 valve the leak may be from the stud with which the brake valve is fastened to the bracket, but with the H6 valve the stud is differently placed.

The effect of any of the leaks mentioned depend upon the amount of leakage, condition of packing ring, and volume of air in the brake pipe. By placing the brake valve handle on lap position and opening an angle cock in the brake pipe the fall of the black hand of the large gauge will show the amount of equalizing piston packing ring leakage, assuming that there is no leakage from the equalizing reservoir to the atmosphere.

An increase of a few pounds in equalizing reservoir pressure during the time the brake pipe exhaust port is open, indicates leakage past both the packing ring and lower body gasket, which would permit the higher brake pipe pressure to enter the equalizing reservoir. The equalizing piston packing ring in the H6 valve is usually fitted neatly and is as nearly an air tight fit as it is possible to make it. Leakage past the ring enables the black hand of the large gauge to show brake pipe pressure when the valve handle is on lap position, but the black hand tube of the small duplex gauge is connected directly with the brake pipe and shows this pressure at all times.

In a two-application stop, with a passenger train, a slightly leaky packing ring may really be of some small advantage, as it will allow the equalizing reservoir pressure to equalize with the brake pipe during the short space of time that elapses between the first and second application, or as the first application is released, equalizing reservoir and brake pipe charge together and high enough to release the brakes, the handle is then quickly returned to lap position and the auxiliary reservoirs absorb the surplus of brake pipe pressures, while the increased equalizing reservoir pressure cannot escape except through ring leakage, and it follows that if it does not escape the much desired prompt response of brakes on the second application cannot be obtained as the surplus must first be drawn from the equalizing reservoir.

Exchanging Locomotives.

The London and North Western and the Great Northern of England, says the *Railway Engineer*, have loaned to each other a locomotive. The G. N. R. is trying the "Marquis," one of the 4-4-0, or "Precursor" type, while the L. and North Western R. is working a 4-4-2, or "Atlantic" engine. Both companies will profit by the experience gained, and the arrangement is such a wise one that it seems strange that it was not tried long ago instead of resorting to the costly one of building types of engines for more or less experimental purposes.

This interchanging and loaning between railway companies might be carried on to a much greater extent, *e. g.*, there is no reason why patterns should not be loaned, as they are most expensive to make, and very often patterns which, if not exactly alike, would be, or ought to be, quite near enough to be borrowed.

Electrical Department

Automatic Signals for Direct and Alternating Current Railroads.

By W. B. Kouwenhoven.

On electric railroads where trains are propelled by direct current the rails of the track form the return circuit for the electric power. Now as the basis of all automatic block signal systems is the track circuit, some form of electric current must be chosen to operate the signal mechanism which will not be affected by the presence of the direct current flowing along the rails, on its return to the power house. The signals must respond to the signal current only. Under these conditions, alternating current has been chosen as the best current for operating automatic signals. There are two methods, the single rail system and the double rail system, of employing alternating current for signal purposes on roads where the trains are propelled by direct current.

SINGLE RAIL SYSTEM.

In the single rail system one rail is used as the return circuit for the propulsion current, and is called the return rail. The other rail is divided into block sections that are insulated from each other, and this rail is known as the block rail. The trains receive direct current power either from a third rail or trolley, and only the return rail serves to carry the electricity back to the power stations, the other rail being depended upon to operate the signals. The alternating current for operating the signals is supplied at a comparatively high voltage, usually about 500 volts, by live wires, which are ordinarily strung on the telegraph poles. Fig. 1 illustrates the typical arrangement of a single rail signal circuit system. The full arrows indicate the direction in which the direct current or propulsion current flows, and the dotted arrows show the path of the signal current. The high voltage signal current is taken from the alternating current signal mains and is sent through a transformer which lowers the voltage to a few volts. This transformer is called a track transformer. The current at a few volts is fed from the secondary of the transformer through a non-inductive resistance coil and a fuse to the rails at one end of the block. At the other end of the block is placed the alternating current track relay. A non-inductive resistance and a fuse are connected in series with this relay, and an impedance coil of very low resistance is connected or shunted across the terminals of the relay. At this end of the block there is placed another transformer, known as a signal transformer, which steps down the voltage to a value which is suitable for operating the semaphore mechanism and lighting the signal lights. The current from the signal transformer is controlled by the movement of the armature of the track relay. The track transformers in this system takes the place of the two or three gravity cells that supply the signal current in the direct current signal system described in last month's paper, and the signal transformer takes the place of 16 caustic potash batteries that operate the signal mechanism in that system.

When there is no train in the block the armature of the relay is held up by the signal current flowing through the rails and the semaphore indicates proceed. When a train enters the block it short circuits the two rails, and because of the low resistance offered by the wheels and axles, practically all of the alternating signal current will flow through them. The small remaining current which passes through the track relay is not strong enough to hold up its armature. The armature drops and the semaphore arm immediately goes to the stop position, indicating that the block is occupied. In case of the breaking of any rail in the section, the track circuit would be interrupted, and in consequence the signal current would be cut off from the relay, allowing its armature to drop and the signal to assume the stop position. It will thus be seen that the operation of the alternating and the direct current signal systems are very much alike.

Almost all of the direct current used in the propulsion of trains flows through the return rail and very little through the block rail. The result is that there is a drop in voltage in the return rail, caused by the propulsion current flowing through the resistance offered by the rail. This drop in voltage produces a difference in voltage between the points A and B. Some of the propulsion current will flow at B, through the secondary of the track transformer to the block rail, along the block rail to A, where it will pass through the track relay and back to the return rail because of this difference in voltage between the points A and B. If this current is powerful enough it will operate the track relay and the relay will then retain its armature whether there is a train in the block or not, and the signal will at all times indicate a clear track ahead. To prevent this and to reduce as far as possible the propulsion current that may flow through the block rail, non-inductive resistances are placed in service with the track transformer and the track relay, as stated above. In addition to these, an impedance coil of low resistance is connected across the terminals of the track relay. The track relay is of a much higher resistance than the impedance coil. This impedance coil or choke coil, as it is usually called, offers a very high resistance to only the alternating signal current and forces it to pass through the relay. This impedance coil, however, permits any direct propulsion current that may get through the two non-inductive resistances to pass easily through it. The path of the propulsion current that manages to pass the non-inductive resistance is shown by the broken or dotted arrows in Fig. 1. Thus it will be seen that the propulsion current does not pass through the relay, but leaves the relay free to perform its proper function.

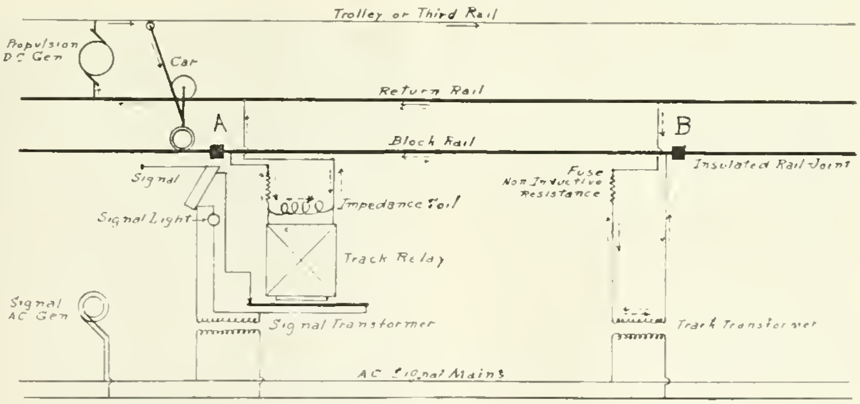


FIG. 1. SINGLE RAIL ALTERNATING TRACK CIRCUIT.

The action of this impedance coil may be compared to a by-pass valve that will permit the flow of only one given fluid. The impedance coil, like the valve, will not permit the alternating current to go through it, and the only path remaining is the relay, through which the current must pass. The impedance coil, like the valve, will permit the flow of any propulsion current that may leak past the two barriers in the form of the non-inductive resistances. The fuses serve to protect the signal apparatus from very heavy currents.

One of the best examples of the application of single rail automatic block system is to be found in the Interborough subway system in New York City. In the New York subway, in addition to the system just described there is provided an automatic stop. When the signal indicates stop, an automatic trip is raised, and if a train attempts to pass the stop, it will strike against a projection from an air brake dummy coupling, and apply the brake in the emergency on the car, and will cut off the power.. We are informed that the record of signal performance in the New York subway is one failure in every 400,000 signal operations, and during some months it is even better than this.

Alternating current is growing in favor for the operation of signals on steam roads, because it does away with the necessity of batteries. The main objection to the use of alternating current is to the placing of the high tension mains for the carrying the current on the telegraph poles. In case of the breakage of a wire a large number of signals may be put out of commission. A separate pole line is sometimes provided for carrying the signal mains. However, if the voltage is not higher than 500 volts, and if the mains are placed above the telegraph wires so that in case of breakage of the latter, they will not come in contact with the live wires. When the electric current is used it is customary to replace the oil signal lamps with small incandescent lamps of from two to four candle power. These small lamps have a very long life, do not smoke the glass or blow out, and, generally speaking, give far better illumination than the average oil lamp.

DOUBLE RAIL SYSTEM.

On railroads where both rails are used to return the propulsion current to the power house, the single rail system is not applicable, and what is known as the double rail system is employed. In this system the track is divided into sections by what are called inductive bonds, and which are simply large impedance or choke coils. Choke coils are described on page 351 of the August, 1908, issue of RAILWAY AND LOCOMOTIVE ENGINEERING. These inductive bonds consist of two separate coils which are connected together at their centres by heavy copper conductors. Each coil consists of a number of turns of heavy copper wire wound on an iron core. One coil is connected between the rails on one side of the insulated rail joints, and the other coil on the other side. The two coils are connected together at their centres, as was explained, thus completing the bond. These bonds offer but very little resistance to the flow of the direct current, but they offer a very high impedance, as it is called, to the alternating signal current, and impedes its flow. Impedance is a form of resistance that is offered to alternating currents only, and which does not effect direct current in the least. Its value depends upon the number of turns of wire that there are in a circuit, and upon the amount of iron upon which those turns are wound.

A typical double rail system is illustrated in Fig. 2. The full arrows indicate the direction of the propulsion current, and the dotted arrows show the signal current. The inductive bonds permit the passage of the direct current from one section to the other, but effectually insulate the sections from each other, as far as the alternating signal current is concerned. The alternating current is taken from the mains and reduced to a low voltage by the track transformer, which feeds it to the rails at one end of the block. At the other end of the block the track relay is placed with its armature for operating the signals. The operation of this system is similar to that of the single rail system.

In this system, as both the rails carry practically equal currents, there is almost no difference of voltage between them, and therefore very little tendency for the propulsion current to flow from one rail to the other through the signal apparatus. For this reason, the resistances in series with the transformer and relay are omitted, as is also the impedance coil which shunts the relay in the single rail system.

This system works best where the rails serve as the sole return conductors for the propulsion current to the power house, and where the blocks are long. Under the opposite condition the single rail system is preferable. The frequency of the alternating signal current is usually 25 cycles per second; that is, it changes its direction 50 times a second.

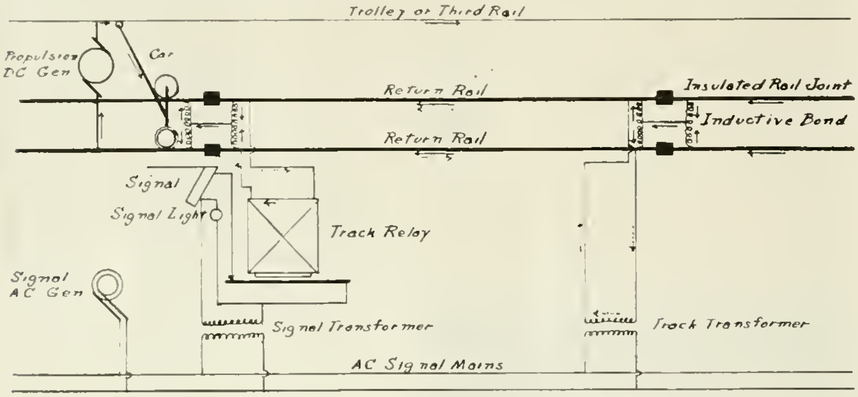


FIG. 2. DOUBLE RAIL ALTERNATING TRACK CIRCUIT.

DOUBLE RAIL SYSTEM WITH ALTERNATING CURRENT PROPULSION.

On railroads where alternating current is used to propel trains the double rail system in a slightly modified form is generally employed to operate the automatic block signals. The New York, New Haven & Hartford Railroad uses this system for operating their automatic signals. The system is almost identical with the double rail system, described above, except in three particulars. The relays and bonds are of slightly different construction, and a high frequency current is employed as the signal current. The method of using alternating current for the propulsion of trains and alternating current for the operation of signals, both currents in the same rails at the same time calls for two different frequencies, and that of the signal current must be the higher of the two. The operation of the system depends upon the fact that the impedance offered by an inductive bond to alternating current increases directly as the frequency. That is a bond that will offer but little impedance to a current at a frequency of 25 cycles, but will form an almost absolute barrier to a current at 60 cycles.

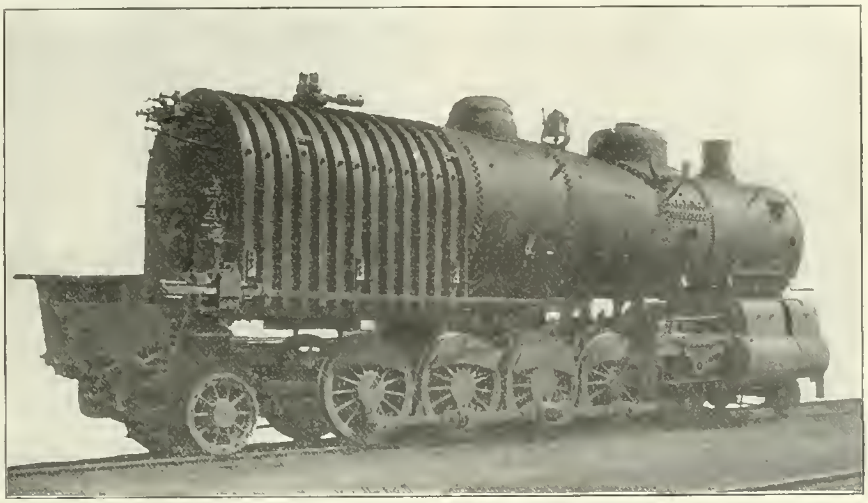
The frequency of the propulsion current is usually 15 or 25 cycles, and that of the signal current 60 cycles. The inductive bonds are smaller than those used on direct current roads, and they will permit the passage of the 25 cycles propulsion current on its return to the power station, but will block the signal current at its higher frequency of 60 cycles per second. The relays are constructed so that they will work on the 60 cycle current. Fig. 2 illustrates also this system. The only changes necessary are the substitution of a 15 or 25 cycle alternating current generator for the direct current generator, and a 60 cycle alternater for the present signal machine. The bonds would be similar only slightly lighter in construction. The operation would be the same.

THE JACOBS-SHUPERT SECTIONAL FIREBOX

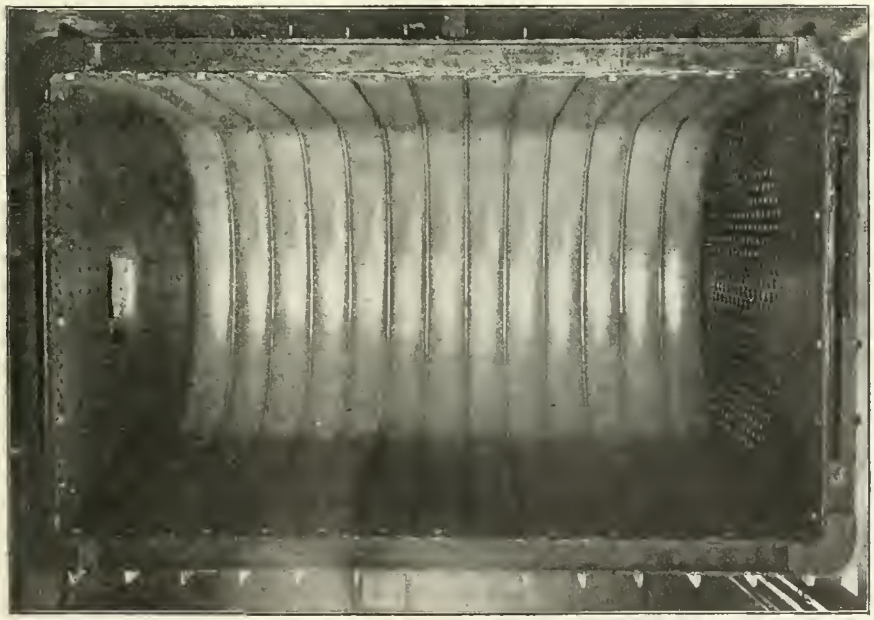
A decidedly interesting experiment in firebox construction has recently been carried out on the Atchison, Topeka & Santa Fe Railway. The firebox is usually called the Jacobs-Shupert box, Mr. H. W. Jacobs, assistant superintendent of the road at Topeka, Kan., being one of the designers, and Mr. Shupert, the other, is a practical foreman of boilermakers. The firebox produced by these men is a radical departure from the ordinary form used in locomotive boilers. The usual flat firebox sheets and outer shell are replaced by sets of channel sections securely riveted together, and the common form of staybolt is replaced by staysheets, except at the front and door sheets.

Our illustrations show each section to be composed of an inner and an outer channel tied together by two radial staysheets. Each radial sheet serves two adjacent sections and large rectangular openings are cut through the staysheets to permit circulation of water. The edges of the staysheets form caulking strips for making tight joints between adjacent sections. The channel sections are applied with their flanges away from the fire, thus submerging the seams and facilitating the work of riveting. The rivet heads are all submerged and there are no bolt heads exposed to the heat of the fire or hot gases.

At the lower ends of the sections, the flanges of the channels are so modified as to form a continuous smooth surface for the application of the mudring. The flanges are partially straightened and reverse lapped in such a manner that the lap of one flange fits snugly into the lap of the adjacent flange. The joint is secured by three patch bolts through the lapped flanges, and still further insured by welding the parts together by the autogenous process. This form of construction changes the corrugated surface into a continuous smooth surface to which a mud ring of ordinary type is applied. We are informed that this joint at the mud ring has proved very effective in service and has given no evidence of leaking.



SANTA FE ENGINE WITH SECTIONAL FIREBOX.



INTERIOR OF THE JACOBS-SHUPERT FIREBOX.

The channel sections forming the outer shell and the firebox proper were made at the Topeka shops from long, narrow strips of steel. Each channel section is formed from the straight strip by pressing hot in formers under the hydraulic flanging press. The straight channel is then bent by formers, also operated by the hydraulic flanging press to conform to the contour of the outer shell or of the firebox.

The radial staysheets are cut from rectangular sheets of steel 98½ ins. long by 59 ins. wide. For simplicity in construction and economy of material, each radial sheet is made in three pieces, and the pieces forming the water leg stays are cut from the waste material within the arch of the crown stay. The contour of each radial staysheet is made to conform to the contour of the inner and outer channels. The throat sheet is made from a single piece, and the throat sheet and back head are formed by special formers under the hydraulic flanging press. All of the parts are formed by standard dies and formers, so that all similar parts are exactly alike. All rivet holes through the channel flanges and the corresponding holes through the edges of the staysheets are drilled. No preliminary laying out is necessary, as the holes are all drilled according to standard jigs or templets, Holes through the templets are bushed with case hardened bushings made from soft steel. The sections of the firebox are riveted together by a special hydraulic riveter designed for operating in close quarters. This riveter was designed and built at the Topeka shops of the Santa Fe. The riveter is hung from a point immediately above its center of gravity, and is therefore readily manipulated by the operator.

The Jacobs-Shupert firebox has been devised for the purpose of introducing certain definite improvements in locomotive boilers, and while the boiler, with this firebox has been in service only a comparatively short time, its behavior so far makes the indications most favorable. The firebox represents years of careful investigation and study on the part of men in position to very closely observe locomotive boiler operation and maintenance.

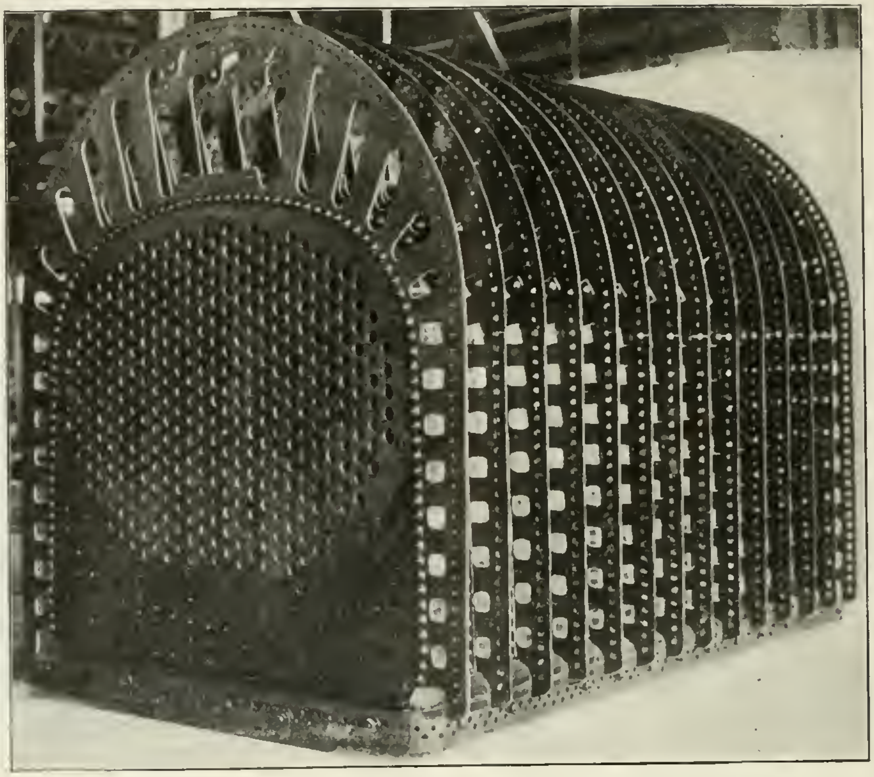
Among the several advantages claimed for the sectional form of construction, the principal are: An unusual element of safety; provision for expansion and contraction due to variations in temperature; improved vertical circulation of water; acceleration of scrubbing action of water against the hot metal surface; increased heat transmission; greater evaporation per unit of heating surface and increased area of heating surface.

In the sectional firebox a possible rupture is confined to a single section, and the destructive effects of an explosion would be confined to the simple escape of the contents of the boiler. It is the sudden tearing away of a large area in case of failure of the ordinary crown sheet, that causes a violent explosion with disastrous results. In the sectional firebox the tearing away of a large area is impossible, as the rupture cannot extend from one section to the next.

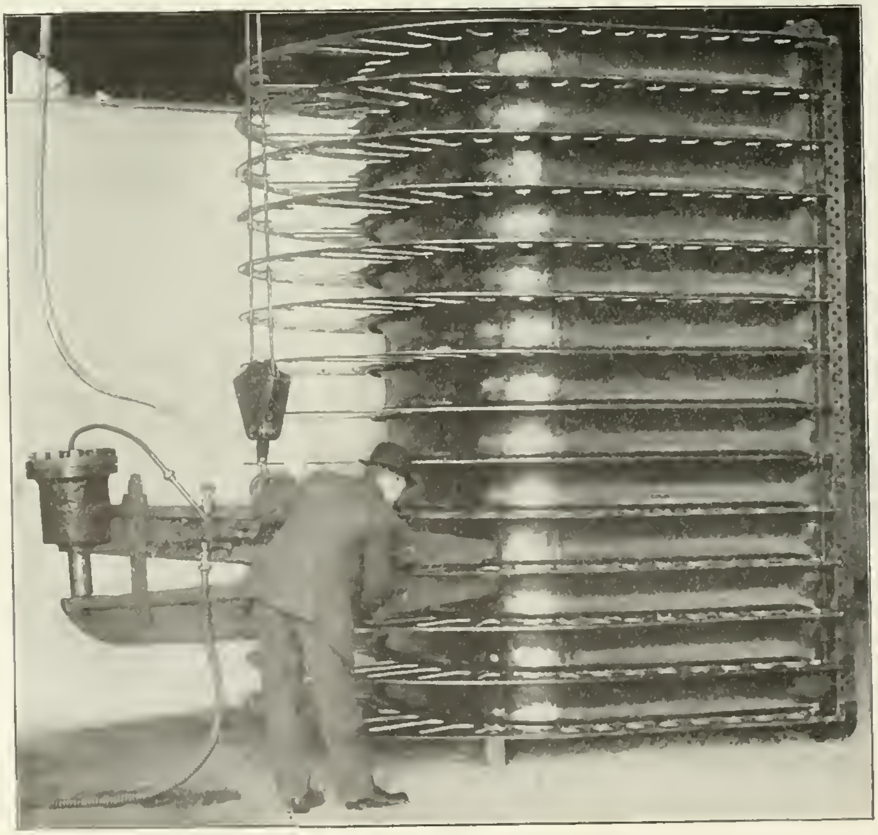
The arched sectional form of construction provides for expansion and contraction due to variations in temperature. Each section is free to expand or contract without producing excessive local stresses or transmitting undue stress to adjacent sections. The entire structure is more or less flexible, and while expansion and contraction occur, the form of each section allows it to expand without straining the next one, thus relieving any stresses induced by temperature variations.

The holes for horizontal circulation through the radial staysheets are of sufficient area to allow the free inflow of water over what we may call the crown sheet as fast as it is evaporated. The enlarged space within the individual sections encourages rapid vertical circulation and the more rapid this circulation is the greater the scouring action of the water against the hot metal.

The corrugated surface of the firebox tends to cause a turbulent motion of the hot gases, and the whirling motion thus set up brings successive volumes of hot gases in contact with the metal. This motion of the gases produces high efficiency in transmitting heat as well as in breaking through the film of inert gas, which tends to collect along the surface of the metal. The performance of the engine with this boiler will be watched with great interest.



JACOBS-SHUPERT SECTIONAL FIREBOX.



RIVETING THE SECTIONS TOGETHER. JACOBS-SHUPERT FIREBOX.

The Quebec Bridge.

The reconstruction of the Quebec Bridge over the St. Lawrence is to go on, this time with greater care than was taken with the former structure. On the vote of $150,000 to provide for the preparation of plans for the reconstruction of the Quebec Bridge, the Canadian Minister of Railways made the statement that the three men employed to prepare the plans were probably the most prominent engineers to be found in the world.

Messrs. Vautelet, Fitzmaurice and Modjeski, the three engineers referred to, were being paid $1,000 a month for their services. The Government idea was that when the plans were finished Mr. Vautelet would be retained for this work, with Mr. Fitzmaurice and Mr. Modjeski as consulting engineers.

A very valuable series of tests of coal has been carried out by Mr. W. B. Landon, chemist of the Erie Railroad. The test demonstrates the heat producing properties of the various coals used by the Erie Railroad, and is likely to result in arrangements whereby the purchase price will be based upon the quality of the coal, a very important reform.

The Susquehanna Shops of the Erie Railroad

By Angus Sinclair

The length of the journey from New York to Chicago over the Erie Railroad is exactly one thousand miles, as near as it can be figured, and there is not a stretch of five miles on the whole route that a traveler could regard as tame or lacking in scenic attractions. The first two hundred miles, however, which traverse the scenes watered by the Passaic, the Ramapo, the Delaware and the Susquehanna rivers, are so rich in natural attractions that I doubt if scenery equal in grandeur can be found on the same distance in any country. Some parts on the Delaware division may be fitly described in Scott's eulogy of Scotland's most famous scenes when the poet exclaims:

"O, Caledonia! stern and wild,
Meet nurse for a poetic child!
Land of brown heath and shaggy wood,
Land of the mountain and the flood."

The pleasure of witnessing the magnificent scenes that greet the eye on every turn through this most romantic region must excuse flights away from the more prosaic thoughts of a man whose mind is running not upon fancies of the imagination, but upon the details of an establishment reared in a mountain pass on the side of a mighty river for the purpose of regenerating worn-out locomotives and dilapidated cars.

Susquehanna has always been a particularly alluring spot to me, partly on account of its romantic location and partly on account of the repair shops there having been the pioneer railroad repair shops of any magnitude in this country, which made them the models on which nearly all other railroad repair shops were built for forty years.

Most of our readers may be aware that the Erie was one of the first railroads put under construction, and that when it was completed from New York to Dunkirk, in 1852, the distance of 460 miles made it the longest railroad in the world.

The Erie Railroad Company was incorporated by the Legislature of New York in 1832, but work was not begun until 1836. The original eastern terminus was Piermont, on the Hudson River, that inconvenient spot having been decided upon through the force of political and proprietory pulls. The same influence located large shops at Piermont for the repairing of rolling stock, and some bargain was made but broken after a few years, that these should always be the principal repair shops of the Erie Railroad. The people who made that arrangement insisted that the terminus of a railroad was the proper point for assembling cars and locomotives needing repairs, as dragging them along three hundred miles or so cost nothing. Some railroads still keep to that policy.

VIEW OF SUSQUEHANNA IN 1855.

The building of a railroad from the ocean to the lakes, through a region of forest, mountain and rugged defiles, with few human settlements and very limited facilities for transporting supplies, was a tremendous undertaking, whose magnitude can scarcely be conceived by the leaders of our most important modern engineering enterprises. State credit supported to some extent the project of constructing the Erie Railroad, but very severe financial embarrassment was encountered and successfully overcome not without protracted delays to the great work.

The building of the Erie Railroad attracted the services of many of the brightest and ablest business men in the country. There were many serious blunders made and not a few failures of alluring projects; but the iron road kept drawing out month after month, and twelve years after the first sod was cut, if such a useless ceremony was performed, a locomotive noted for its huge smokestack, passed over the imposing cascade bridge, long vanished, went past the handsome Starrbussa viaduct, and dropped down the long, steep grade from Summit into the station at Susquehanna. That notable event happened in 1847.

The place was originally called Harmony, but Major Brown, the chief engineer, called it Susquehanna, and the name adhered.

Susquehanna was a convenient division point, being the end of the rugged mountain stretches and a breathing spot for eastbound trains to start upon the mountain grade. The disadvantage of the location was that there was no level ground worth mentioning, but there was enough for the foundation of a roundhouse and machine shop. The most optimistic of the company's officials could not foresee

ERIE SHOPS AT SUSQUEHANNA, PA., TO DAY.

the day when the gullys and ravines branching from the river would be intruded upon to hold dwellings for the people drawn to Susquehanna by the repair shops which developed piece by piece to meet the needs of growing business.

In the course of a few years the first repair shops at Susquehanna became utterly unequal to the requirements, and the absolutely necessary work was done at high cost, poverty tying the company to the assortment of overgrown shanties that sheltered the workmen from the howling winter winds that scoured the mountain pass cut by the river. In 1862 there was a reorganization of the company's finances under President Nathaniel Marsh, and one of the much needed improvements carried out was the building of repair shops on a grand scale, calculated to meet the requirements for many years.

Up to this time no acknowledged arrangement of railroad repair shops had been agreed upon. Those familiar with the repair shops of the pioneer railroads will remember that the most important problem seemed to be the means of getting the engines in and out, and that the work of repairing had often to be done on engines standing in badly lighted corners, while the machine tools were placed without regard to the expeditious handling of material.

In designing the Susquehanna shops consideration had to be given to the space to be occupied and the nature of the ground, which greatly hampered the designer. But the work was splendidly performed, when we reflect that the plan was purely original. The buildings are all of excellent stone quarried in the vicinity. The machine and erecting shops, which constitute the main building, have a floor space 716 x 140 ft. and the other shops flank the main building in very convenient locations. A large roundhouse of 32 stalls abuts on the end of the main buildings .

The erecting shop consists of 28 cross stalls, that are served by a transfer table. Of course, time has brought great changes in the character and location of the machine tools, the present locations being selected for pushing the work along as expeditiously as possible. The tools are powerful, of the most modern patterns, many of them being driven by electric motors.

Since these shops were built warm controversies have arisen about the relative value of longitudinal and of cross pits, and able advocates have appeared on both sides. There has also been sentiment in favor of what was called radial pits of the kind used in the Frankfort shops of the West Shore Railway. The different plans have been the reaching out for the easiest way of doing work; of the system that entailed the minimum handling of material and the smallest interruption to the workmen engaged doing the repairs. After all methods have been tried and the advantages and disadvantages of each worked through the test of experience, the cross pit plan first introduced in these Susquehanna shops has more than held its own. If the roof of these shops could be raised to provide room for overhead traveling cranes the establishment would compare favorably with any railroad repair shop on this continent.


ERIE RAILROAD APPRENTICE CLASS AT MEADVILLE, PA.

The Susquehanna shops were built from plans drawn by Mr. John Derrick, who also superintended the erection of the buildings. The design of the shops was settled on largely at the advice of Horatio G. Brooks, then superintendent of the Western division.

Mr. Charles Minot was general superintendent of the road at the time these shops were built. Mr. H. B. Smith, superintendent, Mr. James B. Gregg, master mechanic. Mr. R. Richardson superintended the brick and stone work in a general way. He came from Boston, Mass. Jerry Foley was the foreman in charge of the stone work; J. Bosworth foreman of all the bricklayers and brick work.

A man by the name of Bishop, from Owego, N. Y., had charge of the carpenter work. Bishop was at that time superintendent of bridges and buildings of the entire system from New York to Buffalo and Dunkirk. I am unable to secure information showing the Christian name or initials of Mr. Bishop. Work was commenced on the shop the eighth day of April, 1864. The rod shop was the first department completed and opened for business, and was placed in charge of Foreman Griffith Williams. This occurred in the fall of 1865. Mr. Thomas Bourke put up the line shafting in the machine shop, finished the pits, floor, etc., and installed the machinery. The shop was ready for occupancy some time in the spring of 1866. The large brick chimney or stack at the boiler plant was finished in the fall of 1864, and upon completion a dinner was served on top by the contractors to the master mechanic and invited guests.

The different shops vie with each other in cleanliness and good order, a sure indication of active business. Mr. H. H. Harrington, master mechanic in charge, deserves credit for the manner in which the different departments are run. The men in charge are: L. R. Laizure, general foreman; D. J. Sullivan, assistant general foreman; J. W. Adams, assistant to general foreman; B. F. Walle, technical instructor of apprentices; R. S. Hoffman, practical instructor of apprentices; Wm. Heller, foreman machine department; A. Hadley, foreman wheel gang; Leonard Smith, foreman tank shop; Leslie Stead, foreman machinery repair gang; James Burrell, foreman fitting up department; H. Seth Smith, foreman erecting gang No. 1; Frederick D. Bates, foreman erecting gang No. 2; Thos. Dennett, foreman erecting gang No. 3; F. L. Lothrop, foreman boiler shop; J. B. Hassett, foreman blacksmith shop; Chas. Burrhus, foreman carpenter shop; C. R. Wallace, foreman paint shop; T. J. Griffin, foreman tin and copper shop; James J. Hogan, foreman stripping gang; Thos. Lannon, foreman shop laborers; J. I. Haller, general roundhouse foreman; J. O. Jones, night roundhouse foreman; Geo. Thibaut, track foreman, new roundhouse; O. J. Kelly, track foreman new roundhouse; Wm. Keeley, Jr., engine house foreman, old terminal.

Some particulars concerning the roundhouses on the road and the cinder pits originally designed by Mr. J. C. Stuart, general manager, deserve particular attention, but I shall reserve them for another article.

Items of Personal Interest

Mr. Wm. M. Saxton has been appointed the master mechanic of the North Coast Railroad with office at Spokane, Wash.

Mr. C. E. Chambers, formerly master mechanic on the Central Railroad of New Jersey, has been appointed to general master mechanic on that road.

Mr. E. R. Been has been appointed general agent on the Chicago Great Western Railway with headquarters at Omaha, Neb., vice Mr. J. A. Ellis, promoted.

Mr. G. Reid, locomotive foreman on the Canadian Pacific Railway at Fort William, Ont., has been transferred to Vancouver, B. C., as locomotive foreman.

Mr. J. H. De Salis has been appointed road foreman of engines on the Western Division of the New York Central Railroad with headquarters at East Syracuse, N. Y.

Mr. John Morton has been appointed night locomotive foreman on the Canadian Pacific Railway with offices at Kenora, Ont., vice Mr. A. J. Gibbons, resigned.

Mr. John A. Conley has been appointed master mechanic on the Atchison, Topeka & Santa Fe Railroad with headquarters at Raton, N. Mex., vice Mr. James Kiely, transferred.

Mr. G. Pratt, formerly general foreman on the Canadian Pacific Railway, has been appointed locomotive foreman on the same road with headquarters at Fort William, Ont.

Mr. H. J. Varlow, formerly erecting shop foreman on the Canadian Pacific Railway, has been appointed general foreman on that road with headquarters at Fort William, Ont.

Mr. J. T. Connor, acting superintendent of motive power and machinery of the Houston East and West Texas, has been appointed the superintendent of motive power and machinery.

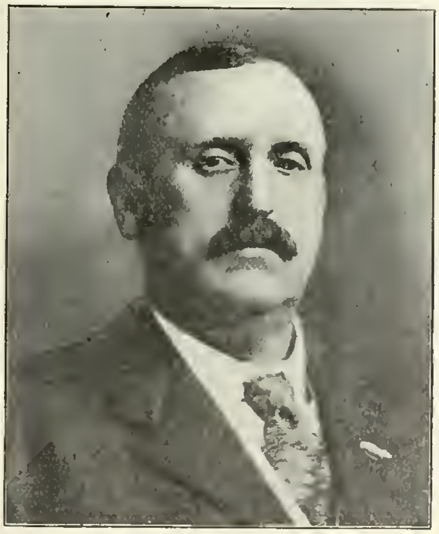
Mr. C. R. Dobson, formerly car foreman of the Chicago, Rock Island & Pacific at Dalhart, Texas, has been appointed district car inspector on the road, vice Mr. C. Stetzkorn, promoted.

Mr. J. A. Jenson, formerly car foreman on the Canadian Pacific Railway at Stettler, Alta., has been appointed car foreman on that road at Swift Current, Sask., vice Mr. D. Smyth, transferred.

Mr. L. A. Mattimore has been appointed master mechanic of the Arizona Division of the Atchison, Topeka & Santa Fe Railroad with office at Needles, Ariz., vice Mr. H. S. Wall, promoted.

Mr. C. H. Temple, formerly master mechanic of the central division of the Canadian Pacific Railway, has been appointed assistant superintendent of motive power with office at Winnipeg, Man.

The recently elected president of the International Railway General Foremen's Association, Mr. T. H. Ogden, was born in Wayne county, Ohio. He began railway service with the Pennsylvania at Crestlin, Ohio, in 1878. His first appointment on the Union Pacific was that of roundhouse foreman at Salt Lake City. After serving this company for a number of years Mr. Ogden was made general foreman of the Kansas City, Pittsburgh & Gulf at Kansas City. Later he went with the Mexican Central in Mexico, on which system he filled a similar position and later on that of master mechanic. On returning to this country a few years ago he took service with the Chicago, Peoria & St. Louis at Springfield, Ill., and from



T. H. OGDEN.
Bowman Studio, Chicago, Ill.

there he went with the A. T. & S. F. as general foreman at Dodge City, Kan., which position he now holds. His bright, practical ideas and conservative methods make him specially fit for the executive head of the association which has just chosen him president. He is a charter member of the organization and has always been a zealous worker for the good of the association.

Mr. D. J. Redding, formerly master mechanic of the Pittsburgh & Lake Erie, has been made assistant superintendent of that road. The position of master mechanic has been abolished.

Mr. M. F. McCarra has been appointed the general foreman of the Kingsville shops of the St. Louis, Brownsville & Mexico with office at Kingsville, Texas, vice Mr. A. J. Conrad, resigned.

Mr. D. Smyth, formerly car foreman on the Canadian Pacific Railroad at Swift Current, Sask., has been appointed car foreman on that road at Stettler, Alta., vice Mr. J. A. Jenson, transferred.

Mr. C. F. Richardson has been appointed the assistant to the superintendent of motive power of the Chicago, Rock Island & Pacific in charge of fuel economy with headquarters at Chicago, Ill.

Mr. J. Moore, formerly district master mechanic on the Pacific Division of the Canadian Pacific Railway at Revelstoke, B. C., has been appointed foreman of repair track on that road at Winnipeg, Man.

Mr. T. L. Roberts, formerly general fuel and locomotive inspector on the Canadian Pacific Railway, has been appointed acting master mechanic on the road during the absence of Mr. S. Phipps, on leave.

Mr. E. E. Austin, formerly district master mechanic on the Canadian Pacific Railway at Nelson, B. C., has been appointed district master mechanic at Revelstoke, B. C., vice Mr. J. Moore, transferred.

Mr. S. S. Stiffey, general superintendent of motive power of the Toledo & Ohio Central, the Hocking Valley and the Zanesville & Western, has resigned as the general superintendent of motive power of the Hocking Valley.

Mr. D. W. Fitzgerald, master mechanic of the Galveston, Harrisburg & San Antonio at El Paso, Texas, has been appointed the assistant general superintendent of motive power of the St. Louis & San Francisco with office at Springfield, Mo.

Mr. D. Smith, formerly shop foreman on the Grand Trunk Pacific Railway at Rivers, Man., has been appointed locomotive foreman at West Fort William, Ont., in charge of the locomotive and car works at that point, vice Mr. W. P. Agnew, resigned.

Mr. Chas. T. Banks having resigned as superintendent of the W. M. & P. Division of the Chicago Great Western Railway, the jurisdiction of Mr. C. E. Dafoe, superintendent of the Northwest Division, will be extended to include that division with headquarters at St. Paul, Minn.

Mr. B. D. Lockwood, formerly mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway, at Indianapolis, Ind., has resigned to accept a position as assistant chief engineer of the Pressed Steel Car Company. Mr. Lockwood has had a railway experience of many years.

Mr. James Kiely, master mechanic of the New Mexico Division of the Western lines of the Atchison, Topeka & Santa Fe with office at Raton, N. Mex., has been appointed the master mechanic of the Rio Grande Division with office at Clovis, N. Mex., vice Thos. Booth, granted an indefinite leave of absence.

Mr. H. S. Wall, the master mechanic of the Arizona Division of the Atchison, Topeka & Santa Fe Railroad with office at Needles, Ariz., has been appointed the superintendent of shops on that road at San Bernardino, Cal., with jurisdiction over all mechanical department facilities excepting the roundhouse.

Mr. Hugh M. Wilson, formerly editor and publisher of *The Railway Age*, has become associated with The Barney & Smith Car Company of Dayton, Ohio. He has been elected a director and also a vice-president. Mr. Wilson disposed of his publishing business over a year ago, and has only recently returned to the United States after nearly a year spent in foreign travel.

At the recent meeting of the International Railway General Foremen's Association, held in Chicago, the following officers were elected: President, Mr. T. H. Ogden, of the Atchison, Topeka & Santa Fe, Dodge City, Kan.; vice-presidents, Messrs. C. H. Voges, Big Four, Bellefontaine, O.; T. H. Griffin, Big Four, Indianapolis, Ind.; Wm. Hall, Chicago & North-Western, Escanaba, Mich.; J. A. Boyden, Erie, Cleveland, O.; Mr. L. H. Bryan, Two Harbors, Minn., was elected secretary-treasurer. The new members of the executive committee are Messrs. H. D. Kelly, Chicago & North-Western, Chicago, and T. J. Finerty, I. & G. N., Spring, Tex.

Mr. B. V. H. Johnson, formerly with the Scullin-Gallagher Iron & Steel Co., has been elected a vice-president of the Commonwealth Steel Co. of St. Louis, Mo. Mr. Johnson is a graduate of the Manual Training School of Washington University. He was for several years in the employ of the Pullman Co., and afterwards he was connected with the New York, New Haven & Hartford Railroad. Later he became connected with the Safety Car Heating and Lighting Co. Mr. Johnson is very happy in his connection with the Commonwealth Steel Co., as the president and two of the vice-presidents of that concern were schoolmates of his at the Manual Training School.

The firm of Burnham, Williams & Company, which consisted of Messrs. George Burnham, John H. Converse, William L. Austin, Samuel M. Vauclain and Alba B. Johnson, and which owned the Baldwin Locomotive Works of Philadelphia, recently dissolved by mutual consent. The firm have sold its entire property and interests in the locomotive business to the Baldwin Locomotive Works, Inc. This concern is now a corporation organized under the laws of the State of Pennsylvania and has assumed the assets and liabilities of the late business firm. The officers of the Baldwin Locomotive Works, Inc., are Mr. John H. Converse, president; Mr. William L. Austin, vice-president and engineer; Mr. Alba B. Johnson, vice-president and treasurer; Mr. Samuel M. Vauclain, general superintendent, and Mr. William De Krafft, secretary and assistant treasurer.

Major Hine, who is engaged as special assistant to Mr. J. Kruttschnitt, Director of Maintenance and Operation of the Harriman lines, has had a very notable career. He made his mark as an army officer by his work as a bitter and uncompromising foe of needless formality, so it need not be thought that in giving military organization to railway forces he is bringing into play what is known as "red tape." Indeed, he says that railways have far more red tape than the government. Major Hine was born at Vienna, Va., a suburb of Washington, March 15, 1867. While in the employ of a contractor he won a cadetship at the United States Military Academy, was graduated in the class of 1891, and while serving as a lieutenant of infantry he found time to study law and was admitted to the bar in 1893. He resigned his commission in 1895 and began railway work as a freight brakeman. He has also filled the positions of switchman, yardmaster, conductor, chief clerk, trainmaster, assistant superintendent, right-of-way agent, and general superintendent, besides filling various unique staff positions. The knowledge which he acquired in the subordinate grades, enables him to speak authoritatively on the subjects he has in hand. It is doubtful whether any railroad man in the country is better qualified than he to deal with railroad questions. He has investigated and made reports upon such roads as the Alton, the Rock Island, the Frisco, and Chicago & Eastern Illinois, the Burlington, the Erie, the Delaware & Hudson, the Intercolonial, the Prince Edward Island, the Union Pacific and the Southern Pacific.

Obituary.

A. Bradshaw Holmes, secretary and treasurer of the Independent Pneumatic Tool Company and Aurora Automatic Machinery Company, Chicago, Ill., died on June 30, 1909, from injuries sustained by accidentally falling from the piazza of his hotel. He was 31 years of age and was unmarried. Mr. Holmes was well known in the pneumatic tool business, having been connected with the Standard Pneumatic Tool Company and the Rand Drill Company for a number of years prior to his connection with the Independent Pneumatic Tool Company, of which corporation he was secretary and treasurer since its organization. He was a man of exceptional business ability, honorable and upright in all of his dealings, and his loss will be keenly felt by his business associates and all who knew him.

Sellers Wheel Lathe.

A very remarkable lathe for turning car wheel tires has lately been designed by William Sellers & Company, Inc., of Philadelphia. A short time ago the company gave a demonstration before some representatives of the technical press of this and other cities. Through the courtesy of Mr. H. D. Taylor, superintendent of motive power and rolling stock of the Philadelphia & Reading, the operator who manipulated the Sellers new extra high power car wheel lathe on this occasion was Mr. William Anthony, from the Reading shops of the P. & R.

The tool itself shown in our illustration is among other things intended to simplify manipulation so that the least possible time and labor would be expended in setting the wheels and in doing the work of tire turning. The capacity of the lathe is from 28 to 42-in. wheels and it provides for axles having either outside or inside journals.

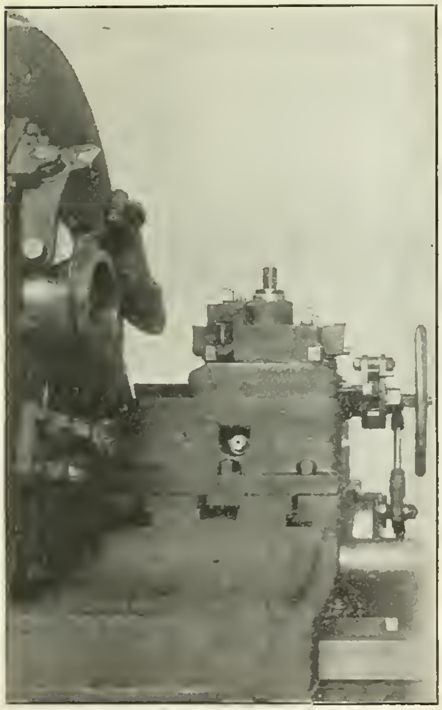
The driving mechanism is cleverly devised. It is really a short lever pivoted a little nearer one end than the other. The pivot casting being carried on the face plate, can be moved from or toward the centre of the lathe according as the diameter of the wheels to be turned, varies. The toothed cam at the lower end of the lever is brought into

ROUGH CUT, HALF-INCH FEED RECORD OF NINETEEN MINUTES.

contact with the side of the tire, by a slight turn of a small wrench. The upper end of the grip is thus also pressed against the tire. Any tendency to slide due to the first application, the tool tends to cause the cam to revolve and so more firmly imbed its teeth in the tire, and at the same time tightening the grip of the upper contact. In this way all chance of slip is eliminated and the drive is constant, powerful and well maintained. There are three drivers on each face plate, they are made of steel and as all bear equally upon the wheel, all tendency to distort the wheels or axle is eliminated.

The bed of this lathe is substantial and heavy. There is a fixed and a moveable head. Each head carries a face plate, the two are driven in unison by a large cross shaft. The main casting of each head is extended forward along the bed, this arrangement provides a support for the slide rest. The face plates are carried on large sleeves with ample bearing surfaces.

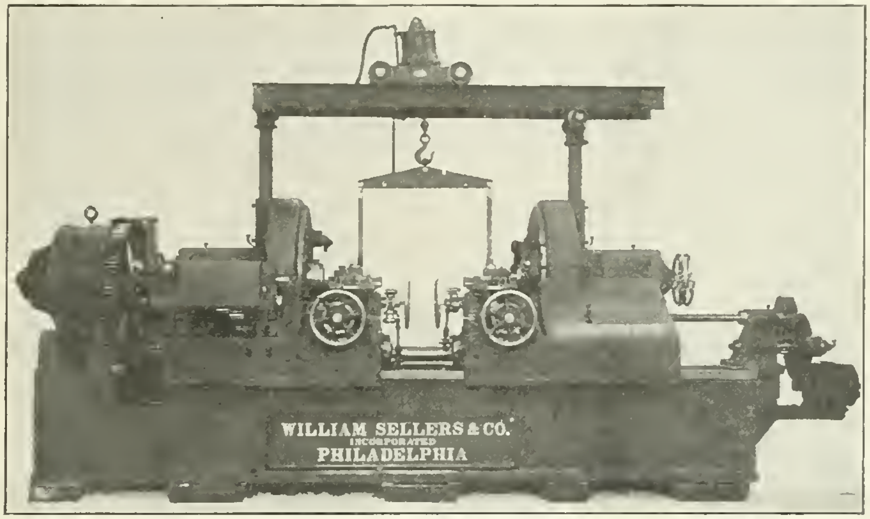
The method of centreing here employed has some advantages as, where possible, the bearing surface of the journal is



FACE PLATE, TOOL POST AND TURRET, SELLERS CAR WHEEL LATHE.

used, and not the axle centre. Within each face plate sleeve is placed a sliding spindle having a tapered hole at its front end. This is to hold clamping bushings for centreing by the journal. This method is preferable from the fact that if there should be any eccentricity of the axle, the tread of the wheel must be concentric with it. In the case of axles having inside journals, ordinary lathe centres are used.

The turret holds the four tools necessary for the operation of tire turning. The turret is of new design, and is so made that a partial turn of a wrench is all that is required to tighten or loosen the turret. When the proper tool is placed for use, a double cam stop is laid over behind the turret and this effectually prevents its rotation. This design requires the least possible projection of the tools. The finishing and forming tools are bolted directly to the turret. The roughing tool is, however, held in a

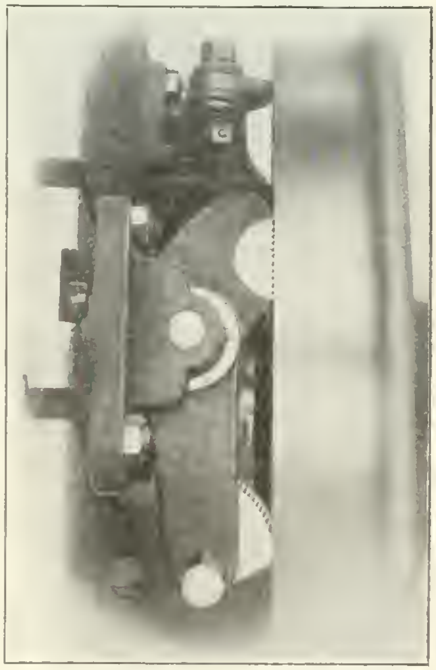


MODERN EXTRA POWERFUL CAR WHEEL LATHE.

sort of tunnel and is held in place by four clamps. If this tool should become dull or broken while in use it can be passed out backwards and replaced without stopping the lathe or moving the turret.

In the test at which Dr. Sinclair of RAILWAY AND LOCOMOTIVE ENGINEERING was present the first pair of wheels was turned in 19 minutes 28 seconds, from which should be deducted 27 seconds for replacing a burned-out tool. The second pair took 18 minutes 27 seconds. The third pair, 19 minutes 51 seconds. The fourth pair, truck wheels, with inside journals, was turned up in 15 minutes 9 seconds. This makes a total for the four pair, floor to floor, of 72 minutes 28 seconds. The change in the lathe for turning the last pair of wheels, that is, from outside to inside journals, consumed just 6 minutes. In ordinary practice in the shop an operator would not make such changes from pair to pair, but would group his wheels so as to turn all of a size or kind one after another, and then change for a different size or kind. An expert operator doing this kind of work every day in a railroad shop on this high-grade lathe would be able to give a very good account of himself and of the machine.

The Falls Hollow Staybolt Company, of Cuyahoga Falls have secured an order from the Great Southern of Spain Railway Company, Ltd., for a carload of hollow staybolt iron bars, making the second carload order received from this company within the year. The Great Northern Railway, we are informed by the manufacturer, recently specified hollow staybolt iron in five locomotives; the American Railroad of Porto Rico is using it in three locomotives, being built by the Baldwin Locomotive Works. The Ann Arbor Railroad have specified this iron for four engines, and the Detroit, Toledo & Ironton Railroad intend to use it in eight locomotives recently ordered from the American Locomotive Company. We are informed that during the past six months, this company have secured about fifty new railway customers for Falls Hollow Iron, in the United States, Canada and Mexico. An order has also been received by this company for a large quantity of Falls Hollow Staybolt Iron bars for ship-



SELLERS WHEEL GRIP AND DRIVE FOR CAR WHEEL LATHE.

ment to the Northern Railway of Costa Rica, at Limon, Costa Rica.

There is a wonderful power in honest labor to develop latent energies and to reveal to a man his latent capacities.

Heavy Switcher for the Lackawanna.

The Delaware, Lackawanna & Western Railroad have recently received a heavy eight-wheel switching locomotive from the Schenectady works of the American Locomotive Company. The design was prepared by the builders from specifications drawn up by the railroad officials, and while presenting no unusual feature of construction, it represents a well-proportioned and satisfactory engine for the service required.

In working order it has a total weight of 199,000 lbs., which places it among the heaviest engine of its type.

It is intended to have a maximum tractive effort of 40,400 lbs. which gives a large factor of adhesion, viz.: 4.9, a very desirable feature in an engine of this class where a large starting capacity is required. The cylinders are 22 by 28 ins. They are equipped with piston valves having inside admission, and these are operated by Walschaerts valve gear. The valves have a maximum travel of 5½ ins. and have 15/16-in. steam lap and no exhaust lap or clearance. They are set to give a 3/16-in. lead, which with the Walschaerts valve gear is of course constant. A very simple arrangement of this form of valve gear has been employed in which the reversing shaft arm is directly connected to the back end of the radius bar by means of a slip block.

The frames which are of cast steel with double front rails of soft steel, are 5 ins. wide. Advantage has been taken of the opportunity afforded by the Walschaerts valve gear to provide a substantial system of frame bracing. In addition to the cast steel foot plate at the back end and the heavy cast steel cross tie spanning the upper rails of the frame directly beneath the front end of the firebox upon which the firebox is supported; there is a cross-tie spanning the upper rails just back of the main pedestals; another of cast steel between the second and third pair of driving wheels, which also serves to support the reverse shaft; directly beneath this a heavy casting of the same material placed between the frames and bolted to both the top and bottom rails; and the heavy guide yoke between the first and second pair of driving wheels. Wrought iron crossties spanning the upper front rails are also provided directly in front and back of the cylinders.

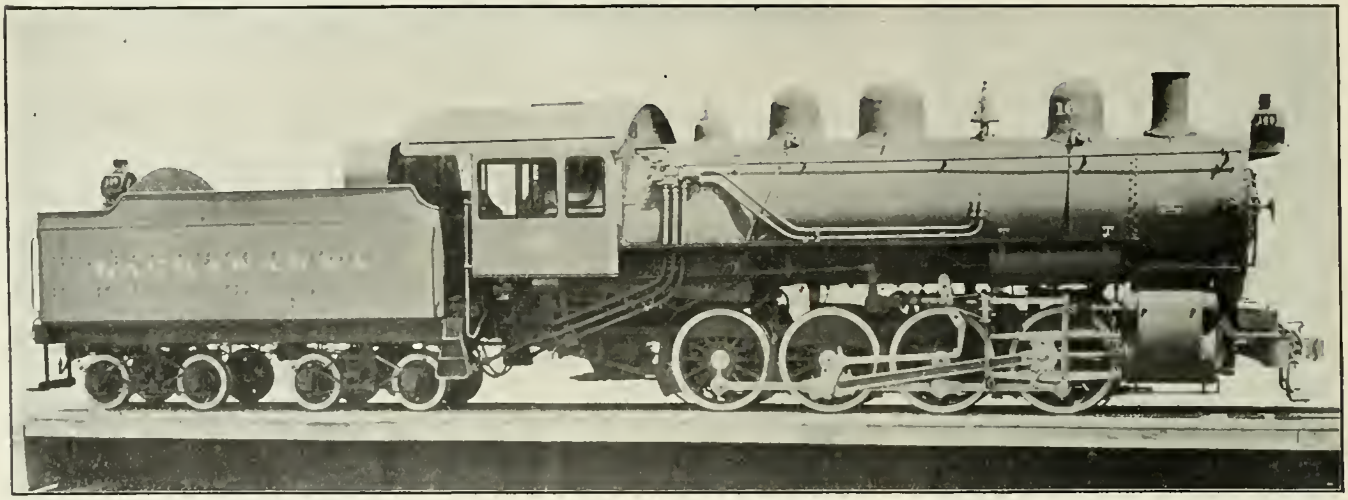
The boiler is of the radial stayed type. The barrel, which measures 74 ½ ins. in diameter at the front end, is built in two courses, the first course being slightly conical. It contains 379 tubes, 2 ins. in diameter and 14 ft. 3½ ins. long arranged so as to allow water spaces of ¾ in. between the tubes. The total heating surface of the boiler is 2,996 sq. ft., of which the tubes contribute 2,816.5 sq. ft.. and the firebox the remainder. With this amount of heating surface the B. D. factor is 769 or about the normal figure for an engine of this class. This factor is obtained by multiplying the tractive power of the engine by the diameter of the driving wheels and dividing by the total heating surface. It represents the ability of the boiler to deliver steam to the cylinders.

The firebox is 111⅜ ins. long and 75 ins. wide and provides a grate area of 58.2 sq. ft. This gives a ratio of one sq. ft. of grate area to every 51.47 sq. ft. of heating surface, which is unusually large for an engine of this size. Ample water spaces are provided around the firebox, these being 5 ins. wide at the mud ring on all sides and increasing to about 5½ ins. at the crown sheet on the back and sides. The sides and crown of the firebox are made in one sheet as are also the sides and roof of the boiler. A departure from the usual practice will be noticed in the use of Tate flexible stays for the three front rows of crown stays instead of the ordinary expansion stays. Tate flexible staybolts are also liberally used in what is called the breakage zone in the back, sides and throat of the firebox. The firebox is provided with a shallow combustion chamber 6 ins. deep which serves to increase the volume of the firebox and also to remove the bottom rows of flues from the hottest part of the fire.

The tender is of the railroad company's standard design. It is equipped with a U-shape tank having a capacity of 6,000 gallons of water and a coal capacity of 10 tons. The tender frame is of steel; 13-in. channels being used for the center sills and 10-in. channels for the side sills. The tender is carried on two four-wheel centre-bearing arch-bar frame trucks equipped with cast steel bolsters.

Some of the principal dimensions and ratios of the design are as follows:

Weight on drivers ÷ tractive effort.. = 4.92
Tractive effort × dia. drivers ÷ heating surface.......................... = 769.
Total heating surface ÷ grate area.. = 51.47
Firebox heating surface ÷ total heating surface per cent............... = 5.99
Weight on drivers ÷ total heating surface .... = 66.4
Volume both cylinders, cu. ft........ = 12.32
Total heating surface ÷ vol. cylinders. = 243.
Grate area ÷ vol. cylinders......... = 4.72
Wheel base, 15 ft. 6 ins.; total engine and tender, 47 ft. 8½ ins.



HEAVY 0-8-0 SWITCHER FOR THE LACKAWANNA RAILROAD.
T. S. Lloyd, Superintendent of Motive Power. American Locomotive Works, Builders.

Weight, in working order and on drivers, 199,000 lbs.; engine and tender, 323,700 lbs.
Driving journals, main, 10 ins. x 13 ins.; others, 9½ ins. x 13 ins.; tender truck journals, diameter, 5 ins., length 9 ins.
Boiler—Type, straight working pressure, 200 lbs.; fuel, bituminous coal.
Firebox—Thickness of crown, ⅜ in.; tube, 9/16 ins.; sides, ⅜ ins.; back, ⅜ in.
Tubes—No. 12 B. W. G.
Air Pump—One No. 11 ins.; reservoirs, 22½ x 66 and 22½ x 72.
Piston rod diameter, 4 ins; piston packing, cast iron rings.
Smokestack—Diameter, 18 ins.; top above rail, 15 ft. 0¾ ins.
Wheels—Driving diameter outside tire, 57 ins.; material, main annealed cast steel; others, steeled cast iron.

"Graphite," July, 1909, issued by the Joseph Dixon Crucible Co., Jersey City, for the purpose of establishing a better understanding in regard to the different forms of graphite and their respective uses, ably sustains its character as a breezy, interesting periodical. The continuation of the articles on preventing corrosion of steam machinery is particularly noteworthy and is well worth the attention of all interested in the maintenance of machines.

Among the Railroad Men in the East

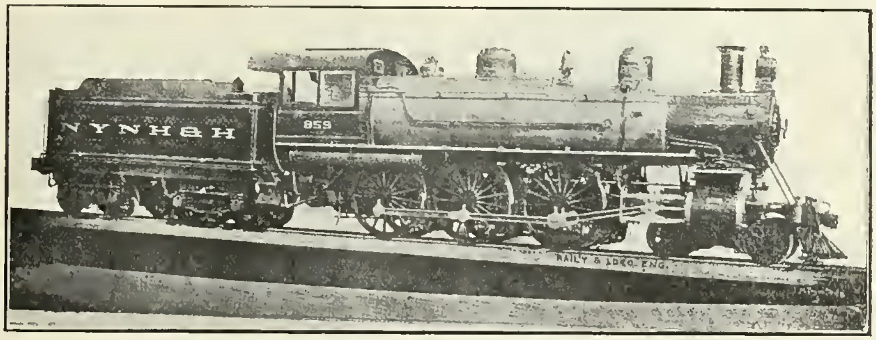
By James Kennedy

AT HARTFORD, CONN.

The early engineers of the railroad between Springfield and Hartford must have known the high water mark of the occasional floods of the Connecticut river. As we came along the beautiful valley in one of the finely equipped passenger trains, the recent rains had raised the river twenty-five feet. Scores of buildings showed only the roofs above the wilderness of waters. Tree tops green in the glow and glory of summer looked out like islets of emerald in a sea of silver. Riverside Park at Hartford was fifteen feet deep and every kind of floating craft was busy. The railroad was always high and dry, although sometimes so near the brink of the far-spreading river that the flying train was reflected in the waters beneath, like the swan that swam on still St. Mary's Lake, and as the poet Wordsworth tells us, "floats double—swan and shadow."

At the extensive shops and yards of the New York, New Haven and Hartford railroad, Mr. J. W. Collins, the recently appointed master mechanic, was busy perfecting a very complete system of fire quenching apparatus. He did not seem to have any fear of the swelling flood. He seemed to be rather pleased to know that in the event of a fire there would be plenty of water at hand. Mr. Collins has a great faculty for utilizing old material. Under his skillful eye the round house which contains about 50 stalls, and which has seen many years' service, was becoming transformed into a thing of beauty. The car sheathing usually given up to the flames, when no longer serviceable, was being fitted around the base of the inner side of the roundhouse wall, and when crowned with a neat coping and freshly painted a degree of elegance and comfort was given to the structure which we have not observed in any other of the numerous old roundhouses that we have visited. There was no hurry about this job, the carpenters worked at it when they had little else to do, and which was at rare intervals.

Boilers were being washed by the use of Mack injectors that had evidently seen much service but were still being cleverly and effectively used. A double-action Worthington pump, a relic of last century, was doing excellent work in testing boilers. Mr. Collins does not believe in four or five men wasting their energies on a force pump when steam pressure is at hand. Labor saving devices were much in evidence, and the result is that the 90 locomotives that pass through the roundhouse every day are kept in a degree of efficiency that would be difficult to surpass. The thorough cleanness of the freight engines were in marked contrast with much that can be seen rattling around in a mantle of mud on other roads. It is much to the credit of the company to know that during the dull times through which we have been passing there has been no discharging or suspending of the lowest paid class of railway men, and that during a short period, while the skilled mechanics were working on reduced time, the laborers and wipers were kept in full time to enable them to earn their regular wages, which the officials properly considered were small enough already. The result has been the maintaining of the kindliest feeling between the employer and employees, while the effect of the extra work, if it may be so classified, manifests itself in the marked degree of neatness and cleanness that are such strong features of the entire establishment.



FOUR CYLINDER BALANCED COMPOUND, N. Y., N. H. & H.

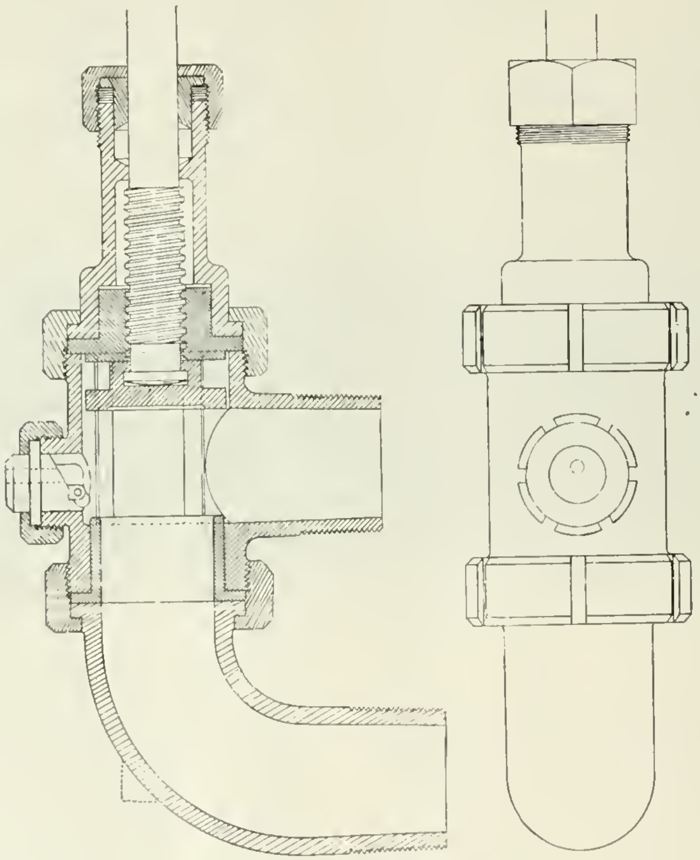
Among the devices noticed in the roundhouse was a pumping apparatus used in circulating oil through a reservoir filled with cotton waste used in packing journal boxes. The saturation of the waste was of the proper degree of consistency ready for use, and precluded the necessity of the roundhouse men wandering from place to place in search of the necessary ingredients. The material for packing journal boxes is always ready. The same remarks apply to the material used in kindling fires. Shavings soaked in crude oil are on hand at all hours.

A snow plough, formidable as a battleship, was resting on its laurels in a corner of the roundhouse. It was equipped with a long, low beak that was said to have successfully cleared its way through the heaviest snow drifts of last winter. There was no jamming of the snow into a hardened mass and running a mile or two for the purpose of acquiring new momentum and then bringing everything to a racking standstill. The Hartford snow plough cuts its way through the snow like a shearing machine in a clover field. The snow went up into the air and by reason of the angle of inclination at which it was projected skyward when the fleecy shower fell to the earth again it did not fall on the tracks of the New York, New Haven and Hartford railroad.

Among the fine locomotives that have done excellent service there are a number of the balanced compound class. The wheels are 6 feet in diameter, and the high and low-pressure cylinders drive on the leading axle, the eccentrics being attached to the second axle. The valves are immediately above the frames admitting of the valve rod reaching behind the leading driver. The balancing is arranged so that when the crank pin is on the bottom quarter as shown in the illustration, the right high-pressure crank on the axle is on the top quarter, so that when the engine is running the two pistons are moving in opposite directions. The cylinders are placed further ahead than usual to admit of the main rod being connected to the front driver.

AT STATEN ISLAND, N. Y.

The Staten Island Rapid Transit railroad blossoms into a popular institution during the summer months. Standing as the island does in the great gateway of the western world and washed by the waves of the Atlantic on one side and within easy hail of the imperial city on the other side, thousands of excursionists crowd the railroad to its fullest capacity. There are now about 50 locomotives, and Mr. J. H. Clark, master mechanic, has every one of them in the best possible condition so that when the rush to the sea shore began the motive power was ready. In this work he is ably assisted by Mr. John O'Connor, the shop foreman, and a fine body of skilled mechanics. Mr. O'Connor in addition to being one of the most skilled railway mechanics in the vicinity of New York, has earned the reputation of being an inventor of many clever and useful devices. Some time ago we had the opportunity of describing an improved piston rod of his invention that has stood the test of time by proving that piston breakages can be entirely avoided as far as their connection with the crosshead is concerned. It may be remembered that Mr. O'Connor's improvement consisted of a filleted band around the piston at the point where the piston and crosshead join each other, the projecting point of the pis-



BLOW-OFF VALVE FOR BOILERS.

ton being threaded and held in place by a slotted nut. Not a single piston breakage has occurred since the adoption of Mr. O'Connor's device some years ago. Since then other devices have come from his skillful hand. We reproduce an illustration of a boiler blow off valve which should come into general use for other purposes besides blow off cocks. As will be noted the valve is readily detachable and its chief merit lies in the fact that the valve seat and valve are also readily removable, the valve seat being of a thimble formation with projecting shoulder, while the disc is also easily removed, both being of chilled steel, no grinding is required, and no kind of sediment or scale has any effect on the hardened surfaces of the valve seat or valve disc. Ordinary copper or other metallic gaskets secure the outer ends of the valve. The simplicity and durability of the contrivance have been fully tested, and Mr. O'Connor has patented his clever invention.

New Era Products.

The New Era Manufacturing Company, of Kalamazoo, Mich., have quite a number of useful specialties for railroad work. For example, they have a metallic packing which has some interesting peculiarities. The expanded granules of metallic alloy, of which the packing is made, are pliable and may be easily formed into any desired shape by hand. When the packing is approximately shaped to suit the stuffing box, the packing is forced in by the pressure of the fingers and the gland is screwed up tight so as to increase the pressure. If the stuffing box is not filled in this way by the first application, the gland may be slacked off and more packing put in. When once properly packed, it is only necessary to close up on the gland sufficiently to secure a steam-tight joint. When refilling the stuffing box it is not necessary to remove the remnants of the metallic packing, it is good until worn out. Just put in new packing as required. This New Era packing is said to be a combination of inflated metal granules and lubricants (oils and graphite), united in such manner as to produce a self-lubricating, flexible metallic substance, which reduces friction to minimum point. This flexible anti-friction metal, as made by this concern, conforms to any size or shape of stuffing box. This company will be happy to send descriptive circular or any information required by anyone writing to them direct. From what the makers say of it, it is just the kind of packing that one would like to give a trial to.

The New Era people also issue two little booklets, one of them is called "All About Babbitt Metals." It is not merely a description of the company's own product, but it contains information useful to the shop man, master mechanic, or indeed, anyone who has to do with anti-friction metals. In this booklet all the interesting physical properties of babbit are explained and tables of quantities of ingredients of babbitts for various services are given. The book is free for the asking.

Another New Era free-for-all booklet is "Valuable Information for Superintendents and Foundry Foremen." This pamphlet, like the one just mentioned, is pocket size and deals with iron, copper, brass and bronze. The cause of porous or unsound castings is discussed and remedies set forth. A number of receipts for making many useful alloys are given. The use of metallic phosphoro for tempering bronze or improving babbitt, and as a flux for deoxidizing purposes in brass, bronze and copper castings is explained. The books, as we have said, are free, and to the enquirer so is any information the company have regarding their specialties, among which may be mentioned white brass for making metal patterns, aluminized zinc used in zinc baths for galvanizing purposes. Their soluble metallic boiler compound and their new railroad tie and rail fastening devices. Write to the New Era Manufacturing Company, of Kalamazoo, Mich., about any of their products. Some are sure to interest you.

The Consolidated Railway Lighting and Equipment Company of New York, have recently issued Bulletin No. 8. This is an illustrated pamphlet, uniform in size with their other publications and perforated for insertion in the regular catalogue series. Bulletin No. 8 contains general instructions for the maintenance and operation of this company's Type D and Type F lighting equipments, with the Kennedy regulator. The system used by the Consolidated Company is an axle light system, and what is known as the Kennedy regulator is one of the most ingenious and efficient pieces of mechanism we have seen for a long time. The axle light system has, of course, a storage battery in connection with it. The lighting of the cars is maintained constant and steady whether the train is standing still, slowing down, starting up or traveling at full speed. Under all these varying conditions the current charging the battery is kept constant, and the light is even and steady no matter whether the source of light changes from the generator under the car to the storage battery. The Kennedy regulator takes care of all the changing conditions incident to the axle system, and automatically cuts resistance coils in or out as is required to produce the desired result. The bulletin may be obtained from the company by direct application. We hope to have a more detailed description of this interesting device in a later issue of this paper.

Outing of a British Railway Club.

As railway clubs are very scarce in the British Isles we avail ourselves of the opportunity to show the appearance of the members of the Leicester Railway Club which we are enabled to do through the courtesy of Mr. Clement E. Stretton, who sent us a photograph taken when the club was visiting the Bardon Hill quarries. Mr. Stretton's familiar form is seen in the engine cab with his head uncovered.

LEICESTER RAILWAY CLUB ON AN OUTING.

The "wagons" that carried the crowd are of the form in which nearly all freight is carried on European railways.

Accepting New Responsibilities.

Railway men often blunder through timidity to undertake new or extended duties. In an address which he delivered at Purdue University, Mr. Edwin M. Herr, of the Westinghouse Electric Company, gave a good illustration of the wisdom of being ready to accept responsibilities thus:

"In the early part of my railroad work, which began some time before my technical studies at college, I had some experience as a telegraph operator. In this capacity the responsibility of equipping and opening an office, including the setting up and connecting of batteries, instruments, wires, etc., fell to my lot. With a boy's enthusiasm, everything obtainable which would give any information about the instruments and apparatus in a telegraph office, together with all I could learn about that strange and wonderful medium, electricity, was eagerly absorbed. In this way knowledge was gained which at the time was useful in meeting the responsibilities then upon me. Apparently, however, time was being spent on electrical studies, and learning about the construction, adjustment and operation of instruments for which no compensation was received, and many times I was told that it was foolish to put in time for which no pay was received in working over matters which would probably never concern me. At the time it was not apparent how this extra work and study would be of special value, as I was then endeavoring to take up studies leading to a course in mechanical engineering with the the expectation of going into the mechanical department of some railroad.

"An opportunity to take up mechanical engineering studies finally came. After gradnating, work was taken up as an apprentice in the repair shops of a railroad. From there progress through the draughting room to the test department was but natural, and in those days was far removed from any contact with electrical work. Much to my surprise, and with not a little trepidation, notice was one day received that the responsibility of the telegraph department of the road would devolve upon me as soon as I could be relieved from my work in the test department. I promptly notified the general manager, from whom this appointment came, of my entire lack of experience in handling anything more than a single office in the telegraph department. His answer was, 'You can learn, can't you?' Fortunately I could, and still more fortunately, I had already learned many things in my early telegraphic work which were of the greatest value in making the larger responsibilities bearable. The ability to learn greatly assists in making us capable of increased responsibilities."

Safety Car Heating and Lighting Co.

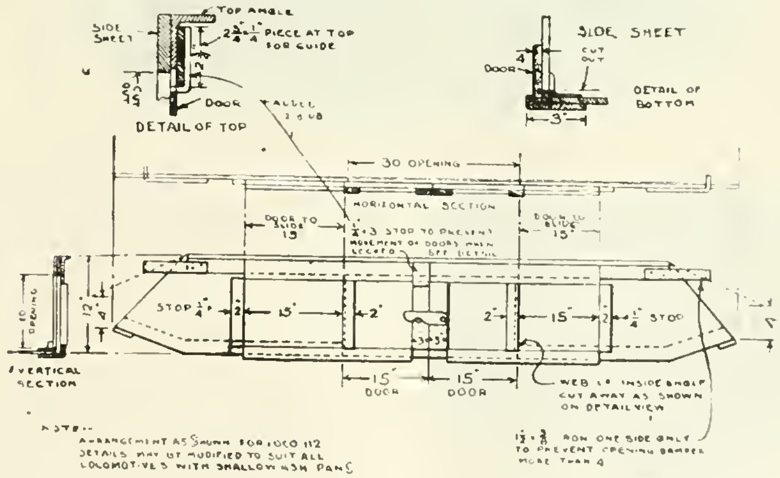
We are informed by the Safety Car Heating and Lighting Company of New York that the improvement in business during the past two months has been greater than in any similar previous period in the history of the industry. It is stated that although the demand for some lines of supplies is considerably below normal, in others it is very good, and in a few, somewhat above the level of 1907. Judging by the amount of improvement in the way of new rolling stock and other equipment projected by the railroads for the current year the outlook is as good, if not better, than at this time two years ago.

Safety Car Heating and Lighting Co. now have 70 Pintsch Light gas plants in as many different sections of the country. These are all running full time. With the exception of 1908, in which the consumption of gas by the railroads was about the same as in 1907, the average annual increase in this branch of the company's business is said to be about 10 per cent.

The Pintsch Lighting system, which the company owns, is now applied to over 33,000 cars in the United States, Canada and Mexico, and to approximately 165,000 cars throughout the world. Another system of lighting, which it has taken the company some years to develop and which is rapidly coming into favor with the railroads, embodies the axle-driven dynamo, together with the lamp voltage regulator. The company say that this system of lighting has been ordered for the Chicago, Rock Island & Pacific for 157 cars; the Southern Railway, 125; the New York Central, 25; the Lehigh Valley, 15; and the Pullman Co., 10.

B. & M. Shallow Ash Pan.

An illustration of the details of the shallow ash pans being fitted on a certain class of the locomotives on the Boston & Maine Railroad will be of interest to our readers. As will be seen there are two openings each 15 inches in length, which afford ample room for the ashes to be cleared from the ash pan. The ash pans are said to be meeting the requirements of the new Federal law. The sides and bottoms of the ash pans being strongly constructed, it is believed that the sliding doors will retain their easy movement under the most trying conditions. As we have already stated it will be interesting to note how the mechanism operates under the more severe conditions that will arise during the winter season, and we hope to have the opportunity of recording our observations of their operation later in the season.



DOORS ON SHALLOW ASH PAN ON THE B. & M.

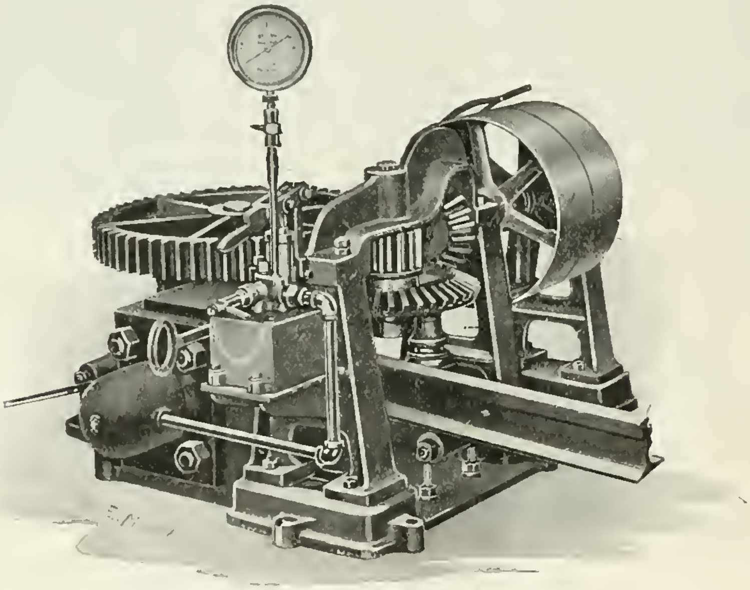
A new book, of about 104 pages, entitled "Twenty-Fve Years of Rope Driving," has been received at this office. It reviews the development of the system of rope transmission from its introduction by The Dodge Manufacturing Company of Mishawaka, Ind., in 1883 to the present time. It contains valuable information for the mechanical engineer and the power user generally. The book is profusely illustrated with views of actual installations, and has numerous line drawings showing the design and arrangement of the drives. It will be sent free on application to all who are interested in the mechanical transmission of power. We may say that The Dodge Manufacturing Company is now in the midst of plant extension work at their factory in Mishawaka, Ind. The main or south machine shop is being extended by the erection of a large addition which, when ready for occupancy, will be a complete building itself. It is 280 ft. long and 122 ft. wide, like the older portions of the shop, but the side bays will be higher so as to accomodate a second floor or gallery. The frame work of the structure is of steel, the supporting columns resting on concrete foundations. Cream brick is being used for the walls and the windows are supplied with metal sashes. This company believes in light and ventilation, and the new building will contain 158 windows and two good sized doorways. When the old shop is thrown into that now under construction, the total length will be 585 ft. on the crane runway in the center bay. Two electric traveling cranes, 25 and 10 tons, respectively, will serve the main middle bay, where all machines are placed and where all heavy work is done. In the side bays several lighter electric cranes will handle the smaller work. The traveling cranes are made by the Whiting Foundry Equipment Co. of Harvey, Ill., and by the Niles-Bement-Pond Co. of New York. They have a speed of 300 ft. per minute and much time and labor is saved by their use in moving heavy products and placing them in cars which are brought directly into the plant for this purpose. The top floor will be devoted to the production of Dodge split friction clutches, this department of the works being overcrowded by the continued growth of the business, even though at this time it covers a space of more than 12,000 sq. ft. Elevators will be used between the two floors for transportation of material, etc.

Power Rail Bender.

The use of power in bending large numbers of rails effects a considerable saving of time occupied in doing this work. With an ordinary hydraulic bender, two men will bend, say, forty 30-ft. 90-lb. rails in a day, and six with the best of screw benders cannot do the same work on more than twenty rails per day. The Watson-Stillman Tower Bender, shown in our illustration, when once adjusted, bends such rails at the rate of about one per minute and is suitable for rails of any section. It has been used a great deal on construction work, for in addition to having great capacity, the machine can be loaded onto a car and taken wherever required. A 15-h.p. motor is used for driving. Where electric power is not available, the machine is furnished with belt drive. In either instance, there is little manual labor required, and the solidity of the heavy cast steel base insures a regularity of curvature, not so easily obtained with a hand-operated bender.

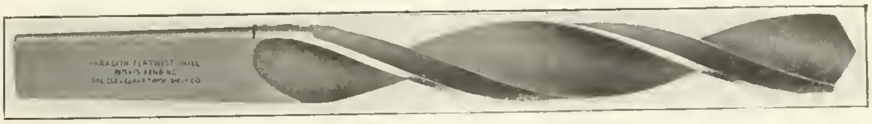
The power driven bender roll is mounted in a frame which is forced forward, by any pressure up to 50 tons, as required, to give the desired curvature. This pressure is obtained from an hydraulic cylinder receiving its power in turn from a small hand pump mounted on the frame. The two fixed roll centres are 34 ins. apart A set of bending rolls three for C. E. standard and six for other sections is required for each shape of rail to be bent. The other bending rolls are changed by loosening set screws and pulling out the pins. The ram holding the middle bending roll can be worked in and out by a lever without the aid of the pump if the release valve is open. The pump is therefore necessary only when the ram is under load. The work of bending is facilitated by providing roller runways to support the ends of the rail as it passes through the machine. For this purpose the Watson-Stillman screw jack rolls will be found convenient, as they permit adjustment to the correct height when set on uneven ground.

These machines are made by the Watson-Stillman Company, of New York, who make a large line of hydraulic tools for railroad use. Any further information may be had by applying direct to the makers.


LARGE CAPACITY RAIL BENDING MACHINE.

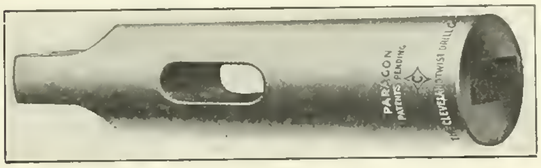
We are informed by the Hicks Locomotive and Car Works of Chicago that they have on hand several lots of flat cars, ranging in length from 34 ft. to 41 ft. and in capacity from 50,000 lbs. to 80,000 lbs. There are also a number of 34 ft. and 36 ft. gondola cars, both 60,000-lbs. and 80,000-lbs. capacity. All of these have been rebuilt and are in first-class condition, and as far as serviceability is concerned, they may be said to be as good as new. These cars are held at low prices, but business is picking up and prices are bound to advance in the near future. The Hicks Company can make quick delivery of any of these cars.

Among high speed drills quite a notable one is what the makers call the "Paragon." It is twisted from flat stock, with a shank forged and ground to size from the original bar, without weld or joint. This shank has a uniform taper on the flat sides as well as on the rounded edges. The attractive feature of the shank lies in its strength and simplicity.



THE PARAGON FLAT STOCK TWIST DRILL.

It is the natural, one may even say the logical method of driving a flat twisted drill. A regular taper shank sleeve outside, with a flat tapered hole inside to correspond with the shank, is all that is required to hold the drill. A good true fit is thus secured, resulting in a firm and accurate drive, with the strain distributed over the entire length of the shank, leaving no weak point to break or twist off. The sockets are simple and inexpensive, and are furnished in either rough, fitted,



SOCKET FOR THE PARAGON DRILL.

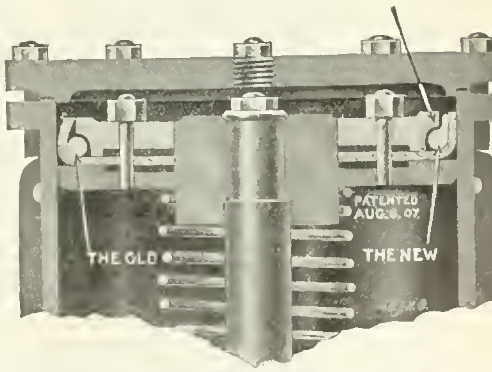
or sleeve styles. The drill and the socket are both clearly shown in our illustrations. These specialties, so useful in the railroad shop are made by the Cleveland Twist Drill Company, of Cleveland, Ohio. Further information and prices may be secured by writing direct to the makers.

We have received a copy of the little catalogue recently issued by the Storrs Mica Co., of Owego, N. Y. This company, as is well known, makes the "never break" mica head lamp chimneys, and indeed mica chimneys for all sorts of railroad lamps. The catalogue is well illustrated and shows a great variety of never break chimneys. Each kind illustrated is made in several sizes. A special chimney for the use of the acetylene headlight is on the market, as well as chimneys for Pintsch lamps. Anyone who is interested in the economy of railway lamp chimneys of all kinds ought to obtain a copy of this neat little booklet. A post card sent to the company at Owego, N. Y., will bring the desired information.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., have issued a handsomely printed little booklet describing the applications of their line of small motors to office, store and shop services. The numerous illustrations scattered through the pages suggest many time and labor saving uses for these efficient little power devices; among them are the motor-driven adding machine, mailing machine, eraser, graphophone, envelope sealer, vacuum cleaner, buffing and polishing wheel, blower, sign-flasher, box-covering machine, hand drill, hack saw, coffee grinder, etc. These instances are selected at random from the large number of uses where the electric motor provides the power. The booklet, "Westinghouse Electric Motors for the Office, Store and Shop," will be sent to anyone who applies for a copy.

J-M Air Brake Packing Ring.

A packing ring for air brake cylinder leathers is shown in our engraving. In fact, the illustration shows what is called by the makers the old and the new way. The old way is a ring of perfectly circular section which holds the packing leather out against the cylinder wall, but being circular in section it bears practically on one line all round. The new way, according to the H. W. Johns-Manville Co., of New York, consists of a ring which is flat on one side and terminates in a circular bulb. With this form of ring the leather packing is held against the cylinder wall, and makes close contact, not on a line, but with a flat surfacee. The illustration very clearly shows the difference between the old and the new way, and the advantage of the new is apparent.



PACKING RINGS SHOWING THE OLD AND NEW WAY.

The ring is made of the best spring steel, and with ordinary care in handling will probably outlast the other parts of the brake equipment. It is designed to prevent brake failures due to packing leather leakage, and it increases the life of the leather by pressing a large surface of leather against the walls of the cylinder, thus distributing the wear over a larger area of leather. Packing leathers now considered unfit for service, on account of very small bearing surface against the walls of the cylinder, may be used again with the new ring. The company will be happy to give further information on application.

Activity on the B. & O.

The Baltimore & Ohio Railroad is receiving bids on 6,000 freight cars, 70 passenger cars and 65 locomotives, involving in all, an expenditure of between $9,000,000 and $10,000,000. All of this equipment is for delivery as soon as the manufacturers can turn it out, which should be begun in about three months. The orders for freight cars includes 2,000 steel-end, self-clearing coke cars, designed for the most expedious handling of coke; 1,000 drop-end gondolas for hauling structural steel, rails and long building material, 1,000 box cars, 500 ventilated box cars for the shipment of produce in late fall and winter traffic and 500 of the latest design refrigerator cars. The passenger equipment includes 5 parlor café cars of most modern design and 45 of the latest type vestibule passenger coaches, the remainder of the order being made up of combination passenger and baggage, baggage and postal cars. In the locomotive order will be 30 Atlantic type engines for use on through express trains and designed for hauling heavy trains at high speed; also 35 consolidation freight engines.

Houghton's Vim Leather is said to be stronger than oak-tanned leather, and its merits are duly and ably set forth in their little periodical, which is now before us, as well as the other excellent products of the Houghton Company of Philadelphia. Their editor is a philosopher. Page after page of wit and wisdom from his facile pen illumines the pithy pamphlet. The great bulk of advertising publications find their way to the waste basket with a degree of rapidity that needs no accelerator, but "The Houghton Line" should be kept in camphor and bound in morocco.

New High-Speed Steel in England.

Recent tests of high-speed tool steel made in Sheffield, England, showed that in cutting forged steel with a cutting speed of 50 ft. per minute, depth of cut 3/16 in., traverse 1/16 in., the weight of metal removed, before the tool was unfit for further use, was 50 lbs. in 25 minutes. Two ordinary brands of tempered steel were used up in little over 4 minutes, and removing 9 lbs. Tests were also made with twist drills working on hard cast iron, 3 ins. thick, the drills making 435 revolutions per minute, with a feed of 6½ ins. per minute. The drills were 15/16 in. in diameter. One of the ordinary high-speed drills bored one hole 3 ins., and another drilled one-and-a-half-in. holes, while the drill made of the new steel drilled nearly 16 holes, or a total thickness of 48 ins. The tests were made before the members of the Manchester Association of Engineers.

Without Seams.

"We Want You to Know" is the title of a neat pamphlet issued by the Detroit Seamless Steel Tubes Co., makers of the Detroit locomotive flue. The bulk of the matter in the present issue is a report submitted by Mr. B. F. Sarver of the P. R. R. to the Master Boiler Makers' Association at their convention held in Louisville last April. The matter is well worthy the attention of all engaged in locomotive construction and repair. It may not be generally known that seamless cold drawn steel tubing is used almost entirely in the construction of the boilers of the modern battleship.

M. M. Subjects and Committees, 1910.

A meeting of the Executive Committee of the Master Mechanics' Association was held at Cleveland, O., July 20, 1909, attended by President Wildin, Messrs. H. T. Bentley, T. H. Curtis, D. F. Crawford, J. F. Walsh, A. Stewart, D. R. McBain, Le Grand Parish and Dr. Angus Sinclair. Considerable routine business was done, after which the selection of committees to report at next convention was proceeded with, and the appointment of members to carry out the investigations. The subject and the personnel of the committees are:

Lumber Specifications—Messrs. R. E. Smith, Wm. Moir, T. W. Demarest.

Consolidation of Associations—Messrs. F. H. Clark, D. F. Crawford, W. A. Nettleton, H. H. Vaughan, G. W. Wildin.

Design, Construction and Inspection of Boilers—Messrs. T. H. Curtis, D. R. McBain, A. E. Manchester, A. W. Gibbs, W. H. V. Rosing, W. E. Symons, G. H. Emerson.

Mechanical Stokers—Messrs. T. Rumney, E. D. Nelson, C. E. Gossett, J. A. Carney, Geo. S. Hodgins.

Safety Appliances—Messrs. C. A. Seley, T. H. Curtis, C. B. Young, L. G. Parish, H. Bartlett.

Air Brake and Signal Equipment—Messrs. A. J. Cota, F. H. Scheffer, R. K. Reading, E. W. Pratt, R. B. Kendig, T. L. Burton, R. L. Ettinger.

Revision of Standards—Messrs. W. H. V. Rosing, T. W. Demarest, F. M. Gilbert, J. D. Harris, H. T. Bentley.

Motive Power Development—Messrs. C. E. Fuller, R. N. Durborow, Angus Sinclair, J. G. Neuffer, G. W. Wildin, C. H. Quereau, R. Quayle.

Superheaters—Messrs. L. R. Johnson, F. F. Gains, R. D. Hawkins, H. W. Jacobs, W. J. Tollerton.

Widening Gauge—Messrs. F. M. Whyte, W. H. Lewis, F. C. Cleaver.

Steel Tires—Messrs. A. S. Vogt, A. Stewart, Wm. Moir, E. D. Bronner, H. D. Taylor.

Locomotive and Shop Operating Costs—Messrs. H. H. Vaughan, L. G. Parish, W. C. A. Henry, G. W. Seidel, M. J. McCarthy.

Fuel Economics—Mr. W. C. Hayes.

Design of Driving Boxes, etc.—Mr. H. T. Bentley.

Engineering Department Stations—Prof. L. P. Breckenridge.

Arrangements—Mr. G. W. Wildin.

INDEX TO ADVERTISEMENTS.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

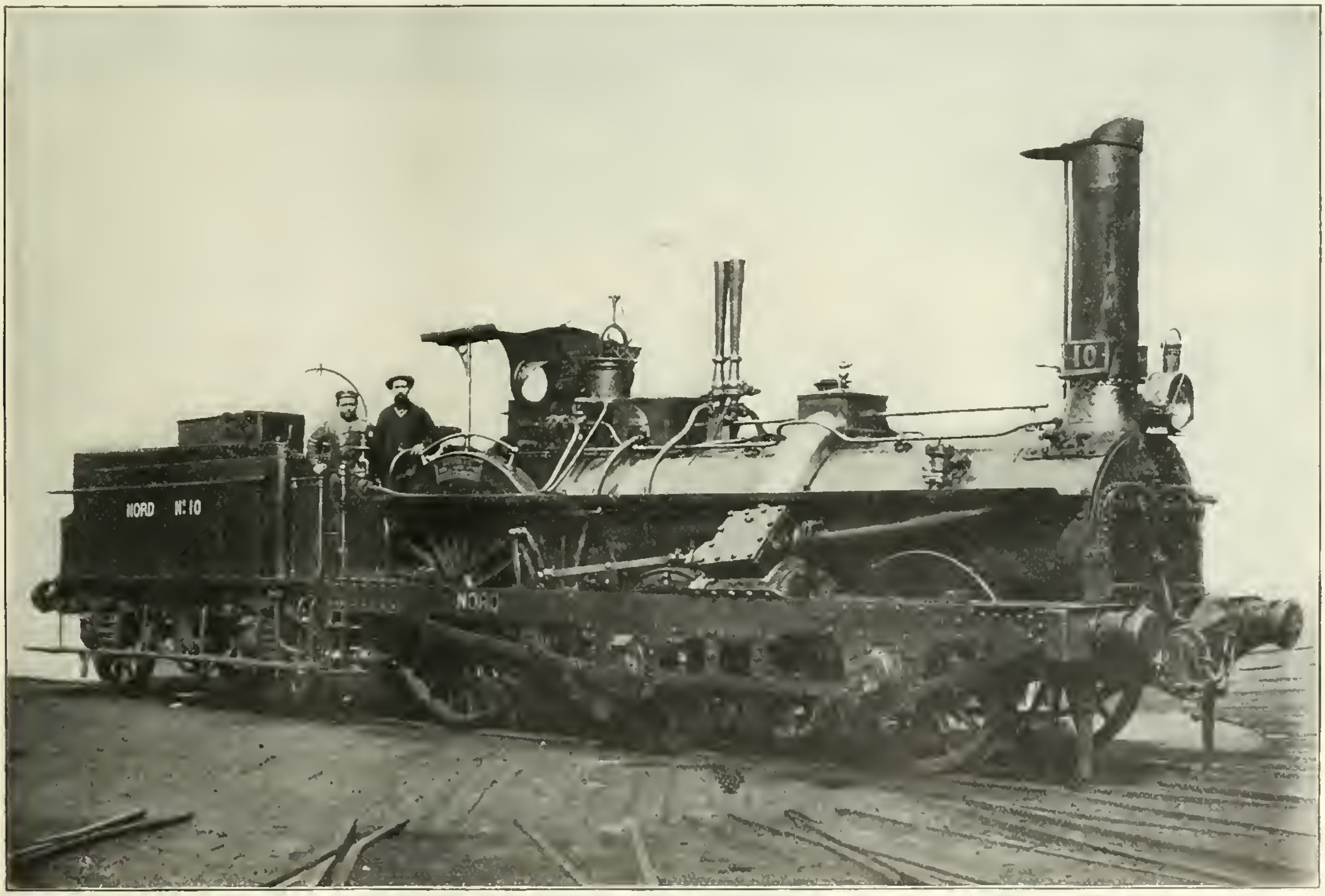
Vol. XXII. 114 Liberty Street, New York, September, 1909. No. 9

Early Engines, Northern France.

Until quite recently there were many examples of early locomotive types to be seen on the French railways. The first railway schemes being promoted by English engineers, Stephenson and others' influence is the reason for so many of the earliest locomotives being built to English designs. The first type Fig. 2, known as "Clapyron," it will be noticed, bore many characteristics common to British practice of the period, 1846. Several engines of this class were built for the Chemin de Fer du Nord, by Cave Koechlin, Hallet & Cail. Their boilers and fireboxes were clothed with brass, which gave them a very smart appearance, especially when new. Some of them were afterwards converted into four-coupled engines. In 1849 the celebrated Crampton engines made their appearance. One of these as rebuilt is shown in our frontispiece. A total of sixty were built, the last of them being put into service in 1855. They were all built by Cail, and were fitted with the Walschaerts valve gear.

In 1862 Wilhelm Engerth, an Austrian engineer, introduced a type embodying many peculiar features. The engine was built on a separate frame to the tender, the frames of the latter being prolonged to the trailing axle under the engine. They were used for express and long distance traffic. Figs. 3 and 4. The total wheelbase of these, engine and tender, was only about 25 ft.

In 1875 a number of four-wheel coupled express locomotives with 6 ft. 6 in. drivers, were built by Koechlin. These were somewhat similar to a series of engines designed by Mr. Archibald Sturrock for the Great Northern Railway of England. Some of these are still in service, modified, of course. (Figs. 5 and 6.) Very soon after they were put into service, bogies replaced the leading pair of wheels.—*A. R. Bell.*



OLD CRAMPTON TYPE, 4-2-0 ENGINE, CHEMIN-DE-FER DU NORD, FRANCE.

The Personal Equation Counts.

The remarks of Mr. H. A. Gillis on "Efficiency, System, and the Personal Element in Dealing with Labor," at a recent meeting of the Richmond Railroad Club, were well considered and timely. Mr. Gillis was formerly superintendent of the Richmond Locomotive Works, before and after the concern was absorbed by the American Locomotive Company. The paper he presented on this occasion is a plea for the establishment and maintenance of the close personal relation which ought to exist between the foreman and the shop staff. He dealt with several systems which he thinks have a tendency to kill out good feeling, and he urged those in charge of men to resist any such tendency and to get in close and sympathetic touch with those who work under them. He spoke as follows:

The modern bonus system is one of the latest developments, and consists in making time-studies of the various operations and determining accurately, or more properly inaccurately, in many instances, the length of time a man should take to perform certain work, and then give him a bonus in proportion to the amount of saving in time and money he can make. It guarantees day's wages, and a man by unusual effort can make twenty per cent. in addition to his wages. If he should make over this amount it is generally considered that the time allowance should be adjusted. This system is kept up by elaborate office records and a small army of clerks, and the foremen or assistant foremen have practically little to say about it in any way, and in some instances these men, who have been interested and satisfactory foremen, lose all interest in their work and influence on those under them. The men, themselves, as a rule, have little confidence in the system, and simply tolerate it until they can get something else to do, or if times get good and men scarce, labor trouble ensues. All sentiment and *esprit de corps* has been wiped out, the company or shop has a bad name among mechanics, and only those who cannot find employment elsewhere will work for it.

The piece-work system, with guaranteed day wages, with a careful study of prices, which the accounting officers or their subordinates work together with the foremen, and practical men who are especially skilled themselves, or have knowledge gained by years of experience, is in my opinion the simplest and most promising.

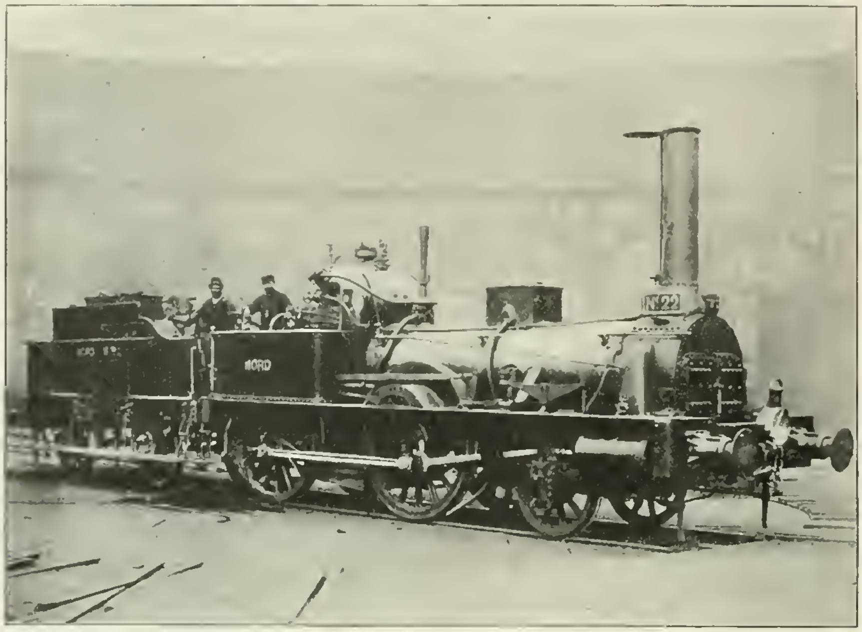


FIG. 2. THE "CLAPYRON" AS REBUILT.

I do not mean the old piece-work system such as I worked under twenty-five years ago, where prices were guessed at in a great measure, some very much too high, others equally too low, with the usual predetermined earnings which the man was going to be allowed to make and the cutting of prices every time he ran over the amount; better day work than any such system. As an example of such a system worked in regular practice, I once worked alongside of a very fair man who was running a brass lathe. This man had decided to leave the shop, and the month before leaving speeded up to the highest limit for quantity (not quality), as we afterwards discovered. The result was that he made one hundred and forty-seven dollars for the month against his usual pay of from sixty-five to seventy. He had about ruined his machine, and a large part of the work that he had turned out had afterwards to be scrapped. The master mechanic, when he scrutinized the pay-roll, arbitrarily cut the price on this work about seventy per cent., simply saying "We don't want these fellows to make over seventy-five or eighty dollars per month." Those of us who were working in the shop soon got wise to the fact that the "old man" had set a limit, and we were particular not to give him any cause to complain of our making too much. The shop afterwards was put on a day work basis, with proper supervision, and turned out more work at less cost than it had been doing piece work.

The Taylor system is another system which has its good points and bad ones. It is very elaborate, and practically consists of a "planning bureau" where every detail of operation is worked out from the ordering of materials to the shipping of the finished products. The speed and feeds of machines, the time of transporting materials from one machine to another, and the sequence of operation and assembling is all systematically worked over in advance. All of this is good, but it has a

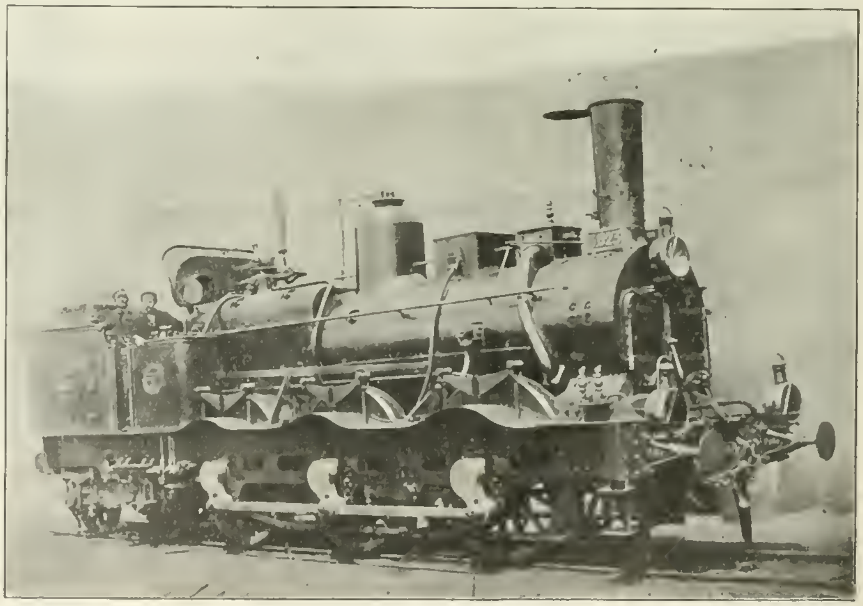


FIG. 3. ENGERTH GOODS ENGINE.

tendency, if not watched, to be carried to extremes and take away all initiative on the part of foremen and workmen. The principle seems to be that the brains are in the office or "planning bureau" and the muscle in the shop. As originally carried out by Mr. Taylor, there is no place for compromise or judgment to be used by foremen or men. The bureau is absolute. The system has certainly improved the output of a number of manufacturing establishments, has much in it of merit, but also has the serious fault of killing sympathy and mutual confidence and respect between the shop proper and the office, the employer and the employees. No system which does not take in these fundamental factors can, in the long run, stand and be successful.

The trouble with nearly all these systems is that they widen the breach between employers and employees, instead of bringing them closer and closer together in a relationship of mutual confidence and respect; yes, and in my opinion, a still closer union of brotherly love and sympathy. This is ideal, I will admit, but it is only by striving after ideals that the permanent and really good things are accomplished.

We often hear that there should be no sentiment in business, but this is not so; there is more or less sentiment in everything. If you want to lead a lot of men in a fight, you have got to have these men with you, you have got to hold them with sentiment. Why did the Japanese make such a splendid showing, and the Russians just as equally a poor showing in the Russo-Japanese War? One fought for love of the Emperor, and the other had no such sentiment, but in many instances were simply like dumb-driven cattle. Why do men lay down their lives for their flags? Because of sentiment. Why was Napoleon a great leader of men? Because of sentiment. And why do thousands to-day bend the knee and lay down their lives, if necessary, in the name of religion? Because of sentiment. What God Almighty has put in the hearts of men as a factor to be reckoned with in dealing with men, even such able men as Taylor, Gant and Emerson cannot ignore.

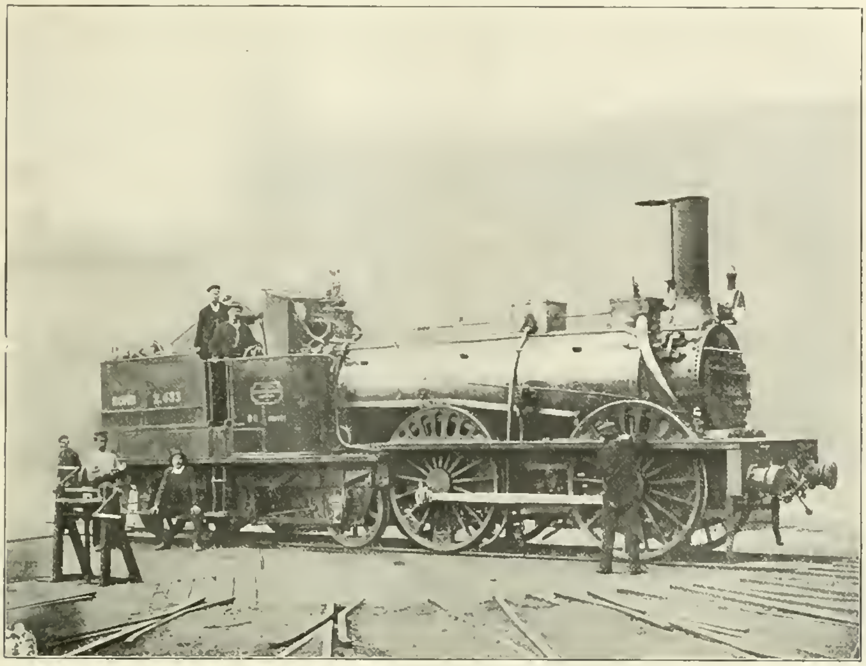


FIG. 4. ENGERTH EXPRESS ENGINE.

Now to you men who may be employing other men, I want to give a word of counsel. Know your men; get close to them; take an interest in them and encourage them. Let every man and boy feel that he has some hope of a better job; let him see that you are interested in him, and if he is a clerk or office boy, let him feel that some day he will be chief clerk. An occasional kind word or word of encouragement will often make a man who is only a fair man an excellent one. Every man likes encouragement, and needs it. I once worked for a man who for eighteen months never spoke a kind word to me. I would have to tell him every once in awhile how well I was doing, and finally he said to me one day: "You make me tired. You are all the time patting yourself on the back," and I said, "I do not know what I would do if I did not pat myself on the back. I have been here eighteen months and you have never given me any encouragement or patted me on the back, and I need it, and therefore have to encourage myself."

Now, another thing: When you see a young man going wrong or displeased with his work, don't let him continue a moment longer after you discover it, but stop him then and there, before he goes too far, and give him a chance to right himself. I don't believe there is a single man in this room who can honestly say that he ever did, day after day, a full day's work. I know that I can't say it. And even now, when I am practically working for myself, and have no one over me to find fault or to administer rebuke, I have a hard time treating myself right. My tendency is to get out doors and have a good time, and my inclination is frequently to cut my business and enjoy myself, and I do not think that I am very different from other men.

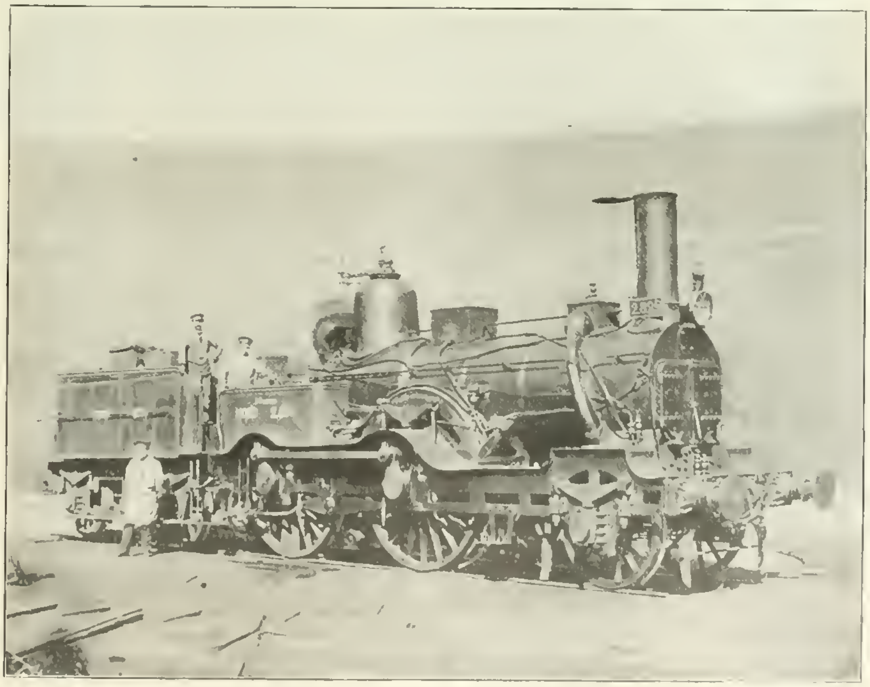


FIG. 5. EXPRESS ENGINE BUILT BY KOECHLIN.

Now let me say once more, it does not matter what kind of a system you may have for your shops and offices, you must appreciate and realize that the old fundamental principle of sentiment and consideration between man and man, and as I have said before, even brotherly love and affection at times, cannot be ignored.

Curious Basis of Firemen's Wages.

The wages received by the locomotive firemen on several British railways is, to some extent, influenced by the heating surface of the engines they work upon. Those firing locomotives with 1,500 sq. ft. or more of heating surface receive three pence per day more than the men employed firing engines with smaller heating surface. Complaints are heard that the classification is not fair. We have enjoyed the acquaintance of locomotives having 2,000 sq. ft. of heating surface that gave less labor to the firemen in keeping up steam than engines with 500 sq. ft. less heating surface.

There is no real or satisfactory basis in proportions of a locomotive to indicate the amount of work the fireman must perform in maintaining the required pressure of steam. Some engineers think that the fairest basis would be on the grate area, while others think that cylinder capacity and heating surface might be combined into a unit that would indicate fairly the work required by the firemen. For ourselves, we believe that a close record of the amount of coal consumed on different runs would establish a just basis on which to reckon the work of the fireman. That gets at positive facts. The other methods leave the way open for too many variables.

FIG. 6. PASSENGER ENGINE BUILT BY KOECHLIN.

Village With a Famous Name.

Marathon is famous in history as the place where a small body of Greek warriors hurled back an invading host of Persians, vindicating for all time Athenian valor and preserving unscathed the freedom of their country. There is another Marathon in the New World located on the Tioughnioga river with one leg, and on the Delaware, Lackawanna & Western Railroad with the other. Marathon is proud and is ambitious to enjoy the privileges and instruction of a metropolis. That ambition for instruction moved the men of Marathon to demand that certain fast trains on the Delaware, Lackawanna & Western Railroad should stop at Marathon to take up the passengers who might occasionally display a desire to visit pastures more verdant than those that grace its own borders. As the railroad company turned a deaf ear to that demand, the Public Service Commission was appealed to, when the following reply was returned:

"The road is entitled in the first instance to schedule its trains as seems to it most advantageous both as to time and stops to be made. The Commission should not interfere with this arrangement unless the change asked for will serve the convenience of a considerable number of people and will not inconvenience a greater number: also that it will not seriously interfere with the running of trains and with the general operating plans of the railroad considered as an entire system. . . . The principal petitioner has chosen to locate its business in a small village of 1100 inhabitants. It undoubtedly had its reason for doing so: in small taxes, lessened cost of living of employees, and the cheapness of manufacturing, etc. Having chosen to locate at that place it must take the disadvantages as well as the advantages of such a location.

"We think that the railroad has a right to pursue this policy, but not to the extent of seriously inconveniencing a large number of people, and that has not been shown to be the case in this instance."

New Peace Scheme.

From Lynn, Mass., comes news of a plan that has been devised to put an end once for all to labor disputes that have so often led to strikes, lockouts and other disasters. The plan calls for the organization of a fraternal body in which both the employers and the employees are to be members and the grand lodge of which is to be the supreme tribunal in settling all questions of disagreement that may arise between the workmen and the owners of the plants.

The scheme is based on good intentions but a most undesirable region is said to be paved with that form of concrete. We wait patiently for its consummation.

A Brassy Expert.

Mr. Brass, introducing himself to a well-known railroad president:

"Mr. President, I have some valuable information that you ought to be interested in. My specialty is that of a manufacturing expert, with particular knowledge of railroad shop operation. I have called to make your company an offer. If you will give me full and entire control of all your repair shops, I shall undertake to save you $1,478,520 a year."

The President: "You appear to have got your figures down fine. Have you examined our shops to ascertain the use the master mechanics and others are making of our tools and repairing facilities?"

Mr. Brass: "No. I have not visited any of your shops. My figures are based on the general incompetency of railroad mechanics in production operations."

The President: "You did not neglect to carry your cheek along with you, Mr. Brass. I happen to be an engineer familiar with manufacturing operations, and our shops and tools are as well managed as the best contract shops are. You have come to the wrong office, and the best things you can do is to get out now."

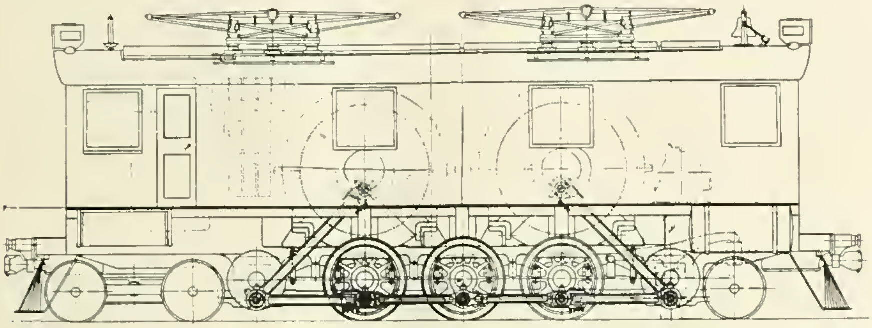
Explosives.

It should be borne in mind that any kind of solid that will burn will also explode when suspended in the air, after being reduced to powder and ignited. Explosions of this kind are frequently of great violence. Among the most common explosives are coal, chaff from grain, fine sawdust, powdered sugar, starch, flour, cork and similar substances. Vapors of inflammable liquids, if allowed to accumulate, readily explode if a spark or flame is present. This accounts for the so-called explosions of dust that have now and then taken place in factories.

A book of proverbs says: "A fool is fond of writing his name where it should not be." This reminds us of a fool apprentice who took to writing his name upon newly painted tenders. The foreman chased him from the shop on his third offence, and he checked his career by writing his name to a check used to draw money from an employee. He is now working in an institution where the means of fool writing is severely restricted. Moral—Keep your hands off wet tenders.

Electric Locomotive with Side Rods.

Our illustration shows a novel type of electric locomotive which has been designed jointly by the General Electric and by American Locomotive Companies for trying a scheme of transmitting power from the motors to the drivers through side rods instead of by the ordinary direct



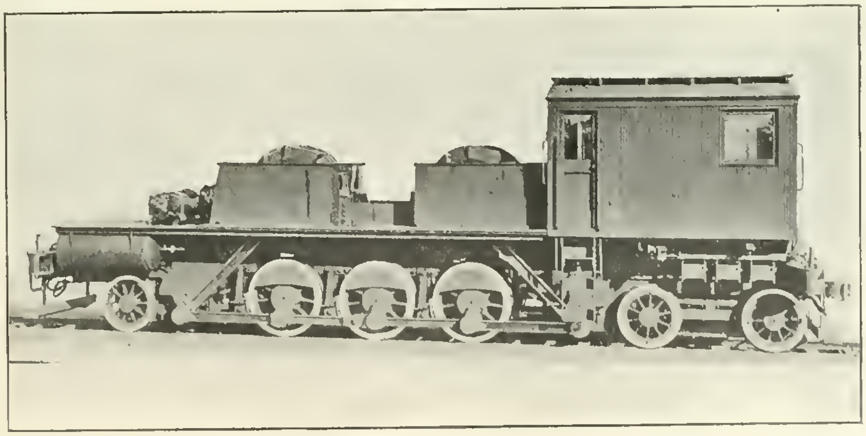
SKELETON DIAGRAM OF ELECTRIC LOCOMOTIVE.

gear methods. The locomotive is designed to produce a tractive effort of 30,000 lbs. at a speed of 18 miles an hour and with ability to attain a maximum speed of 50 miles an hour. The locomotive will operate equally well in either direction. It has been tried with temporary motors of a somewhat smaller capacity and the tests have demonstrated conclusively that the design is satisfactory in every way. It is proposed to extend the cab over the entire length of the machine when the proper motors are installed on the locomotive. The present cab and guards are only for the temporary protection of the apparatus now installed.

One of the principal advantages found in this type of construction is that a motor of large diameter and small air gap can be used in conjunction with small diameter of driving wheels, and at the same time the motor can be spring supported. The motor bearings can be very easily designed to maintain the small air gap. Such a form of construction will also secure a marked economy in the construction of the motors as the same horsepower can be obtained in two motors at a less cost and for less weight than in four smaller motors. The same motor equipment can also be used on locomotives with different diameters of driving wheels. This feature makes possible the interchange of equipment on roads where both freight and passenger locomotives of this type are employed. This type of locomotive is as well adapted for operation with direct current motors as with those of the alternating current type.

The motors in such a locomotive can be placed so as to concentrate a greater proportion of the weight near the center of the machine with the attendant advantage that the moment of inertia of the locomotive around its vertical axis will be as small as possible. This will reduce the rail pressures at the leading and trailing wheels and will tend to reduce the flange wear of the wheels and also that of the railhead. The placing of the motors in the cab facilitates inspection and repairs, and the renewal of the commutator brushes. The maintenance charges for the motors will also be greatly reduced and practically all road dust and other foreign material can be kept out. The centre of gravity of the machine can be kept high. This is a point which RAILWAY AND LOCOMOTIVE ENGINEERING has always looked on as a very desirable feature in electric locomotive construction.

The electrical control is arranged in such a manner that the motors start as repulsion motors with short circuited armatures and are changed over to series repulsion motors for the higher speeds. This arrangement eliminates running with a short-circuited armature on high voltage and at the same time gives a high torque at starting. In fact, the tractive effort is about twice as great with repulsion motor connections as with series repulsion connections for a corresponding current value.



ELECTRIC LOCOMOTIVE WITH SIDE RODS.

The armatures are similar to those of an ordinary direct current machine with equalizer rings. They have multiple drum windings with the bars soldered directly into the commutator segments. The field of stationary windings are of the distributed type and are made in two sections, viz.: the exciting and the inducing windings. The former has the same function as the field winding in an ordinary series wound motor, while the inducing winding introduces the working torque when the motor is connected as a repulsion motor. All parts of the running gear such as wheels, driving boxes, axles, springs, spring rigging, trucks, etc., follow standard steam locomotive practice.

The arrangement of the side rods is shown in the illustrations and it will be noticed that each motor is coupled to a jack shaft and thence to the drivers. The jack shaft bearings are rigid in the spring supported locomotive frame and their centres are on a level with those of the drivers. The object of this jack shaft is to permit a horizontal drive between the spring supported part of the locomotive and the driving wheels and is necessary in order to allow a vertical play of the spring-supported part with a neglig'ble variation in the distance between the crank centres. The drive is effected by a pair of connecting rods. Counterweights are used on the driving wheels to balance the side rods, and it should be noticed that as there are no reciprocating parts a more perfect balance can be had. Another interesting mechanical feature is shown in our illustrations. It is the flexible coupling inserted between the armature shaft of the motor and the motor crank. This consists of a series of leaf springs arranged radially around the motor shaft and designed of such strength as to carry the entire torque of the motor flexibly, with an amount of deflection which will reduce the effect of the pulsating torque of a single-phase alternating current motor to a minimum.

The more important data are given below:

Trolley voltage	10,000
Cycles	15
Rated tractive effort	33,000 lbs.
Speed	18 m.p.h.
Total H.P.	1,000
Number of motors	2
Type of motor	GEAZ-43
Diameter of driving wheels	49 ins.
Number of driving wheels	6
Diameter of pony wheels	36 ins.
Total wheel base	33' 6"
Rigid wheel base	10'
Height of locomotive	13' 8"
Weight on drivers	162,000 lbs.
Weight per axle (driving)	54,000 lbs.
Total weight	250,000 lbs.

To keep your secret is wisdom, but to expect others to keep it is folly.—*Holmes.*

Heavy Virginian Switcher.

For switching service in their yards at Sewell's Point, Roanoke and Princeton, the Virginian Railway have recently received three heavy eight-wheel coupled locomotives from the American Locomotive Company, one of which is shown in our illustration. In working order this engine has a total weight of 182,300 lbs. The cylinders are 22 by 28 ins. and with a boiler pressure of 200 lbs. and driving wheels 51 ins. in diameter, the theoretical maximum tractive power is 45,200 lbs. This tractive power makes them the most powerful engines of their type so far constructed by the builders.

Steam is distributed to the cylinders by means of 12-in. piston valves, having inside admission and a maximum travel of 5½ ins. The valves are designed with a 15/16-in. steam lap and with no exhaust lap or clearance. They are set to give a ¼-in. lead at 50 per cent. cut-off. They are operated by the Stephenson's shifting link gear arranged with a transmission bar. The valve chests are equipped with by-pass valves of the P. R. R. standard type. The frames, which are of cast steel, with single front rail are 4½ ins. wide. Following the ordinary practice in this type of engine, the first and second driving wheels on either side are equalized together and the first pair are cross equalized, while the third and fourth driving wheels are equalized together but the cross equalization is omitted. This equalization arrangement, thus gives a three-point suspended engine. Lubricators for oiling the driving wheel flanges are provided on the front and back driving wheels. The device consists of a 2-in. wrought iron pipe, filled with oil waste, the bottom end of the pipe being cut out to fit over the flange of the tire. This pipe is held in position by a wrought iron bracket, which is loosely pivoted on its point of support so as to allow the pipe to accommodate itself to the movement of the wheel relative to the frame.

The boiler is of the radial stayed straight-top type, with sloping back head and vertical throat sheet. The barrel, which is made in two courses, measures 74 ins. in diameter outside at the first course. It contains 354 tubes 2 ins. in diameter and 15 ft. long. The total heating surface of the boiler is 2,940 sq. ft., of which the tubes provide 2,763 sq. ft. and the firebox the remainder. The firebox is narrow and is placed between the driving wheels and over the frames. It is 108 ins. long and 42 ins. wide and provides a grate area of 31.5 sq. ft. The ratio of grate to heating surfaces is therefore as 1 is to 93.3.

The water spaces around the firebox are 4 ins. wide at the mud ring on the front and 3½ ins. wide on the back and sides, increasing in width at the crown sheet to 4½ ins. in the back and about 6½ ins. on the sides. A limited number of flexible staybolts are used in the back head and throat sheet. In the back head they are in the outside row all around and also around the firebox door, while in the throat sheet the first three rows down from the waist are flexible stays. The firebox is supported by a buckle plate at the back end and by sliding bearings on either side, ahead of the center of the firebox and just back of the rear driving wheels. Between the firebox and the cylinders the boiler is supported by two waist sheets, one just back of the main driving wheels and the other at the guide yoke. The rear one of these sheets extends down to the bottom rails of the frames and is secured to a cross tie between them, as well as to a cross tie spanning the upper rails of the frames. A similar arrangement is employed at the guide yoke, though the waist sheet is not in one continuous piece.

The tender is equipped with a sloping back tank, having a water capacity of 5,000 gallons and space for ten tons of coal. The tender frame is built of steel, with center sills of 15-in. channels and side sills of 10-in. channels. A pine floor, with spaces between the beams to provide for air circulation, has been placed between the tank and the steel frame. The tender trucks are of the arch-bar type, with cast steel bolsters. The arrangement of the draw-gear between engine and tender is similar to that employed in the Mallet articulated compound engines built by the American Locomotive Company for this road. In the arrangement the draw-bar pin is horizontal and is inserted through the side walls of the foot-plate, thus facilitating its removal.

The general dimensions, weights and ratios of these locomotives are as follows:

Weight on drivers ÷ tractive effort.... 4.03
Tractive effort × diameter drivers ÷ total heating surface .... 781.
Total heating surface ÷ grate area...... 93.3
Firebox heating surface ÷ total heating surface, per cent. .... 6.
Weight on drivers ÷ total heating surface .... 62.
Volume both cylinders, cu. ft. 12.32
Total heating surface ÷ volume cylinders 238.
Grate area ÷ volume cylinders 2.56
Wheel Base—Driving, 14 ft.; total, 14 ft.; total, engine and tender, 49 ft. 6 11/16 ins.
Weight—In working order, 182,300 lbs.; on drivers, 182,300 lbs.; engine and tender, 293,700 lbs.
Driving Journals.—Main, 9½ ins x 12 ins.; others, 9 ins. x 12 ins.
Fuel—Bituminous coal.
Firebox—Type, narrow; length, 108 ins.; width, 42 ins.; thickness of crown, ⅜ in.; tube, 9/16 in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4 ins.; sides, 3½ ins.; back, 3½ ins..
Crown Staying—Radial.
Boxes—Driving, cast steel.
Pump—9½ ins.; 2 reservoirs, 16 ins. x 120 ins.
Piston—Rod diameter, 4 ins.
Smokestack—Diameter, 17 ins.; top above rail, 14 ft. 10½ ins.

HEAVY SWITCHER FOR THE VIRGINIAN RAILWAY.

R. P. C. Sanderson, Superintendent of Motive Power. American Locomotive Co., Builders.

Real Cause of Boiler Explosions.

William Sellers, the famous machine tool maker, was not noted as a public speaker, but when he ventured to say anything at engineering meetings his words were remembered. At one time years ago Philadelphia was much excited on the subject of boiler explosions, several accidents to boilers having wakened the natives. William Sellers attended one of these meetings and was asked to explain his theory of the cause of boiler explosions. The reply came promptly: "Because the pressure inside is greater than the strength outside."

General Correspondence

The Signal Question.

Editor:

Having had about 15 years' experience running a locomotive and under many different kinds of block systems, I should like to say a few words in the prevailing discussion. In regard to the color of night indications I do not think many men of experience who have run under both a "safety white" and "safety green" indication will be found to favor the white. Those writers who wish to see the position of the arm at night must work under the "white" system. With this system any light with a broken glass is a "safety" (?) signal. Now when we see the green we know it is a real safety indication and never think of looking for the position of the arm. Perhaps the green is not visible quite as far as the white, if so the difference is small and either in good condition can be seen many miles. In regard to the caution indication, an engineer not familiar with a yellow light might mistake it for a red, but I think never mistake red for yellow. I, personally, have never known either mistake to occur.

In regard to the interlocking plant I can see some things to be said in favor of the "absolute red," but many more against it. I believe in the top arm for the main line route. Any other route where speed of 25 miles per hour or more is permitted to be represented by a lower arm, or arms if more than one diverging speed route, second arm for the route diverging to the right, etc. For all low speed routes diverging or trailing from main line the dwarf signal is very satisfactory. I would put it about half way up the home signal pole where conditions warrant, so it can be seen in daylight a sufficient distance to handle long freight trains approaching it. For night "stop" indication of dwarf signals located on main line I like the "purple" light as used on the N. Y. N. H. & H. R. R., as too many red lights, especially near the ground, are to stay at "caution" until three blocks in objectionable, while the purple light can not be seen as far as the red, the location of the home signal or signals serves to mark its location and to indicate stop unless the dwarf is at "proceed" position, when its green light is plain.

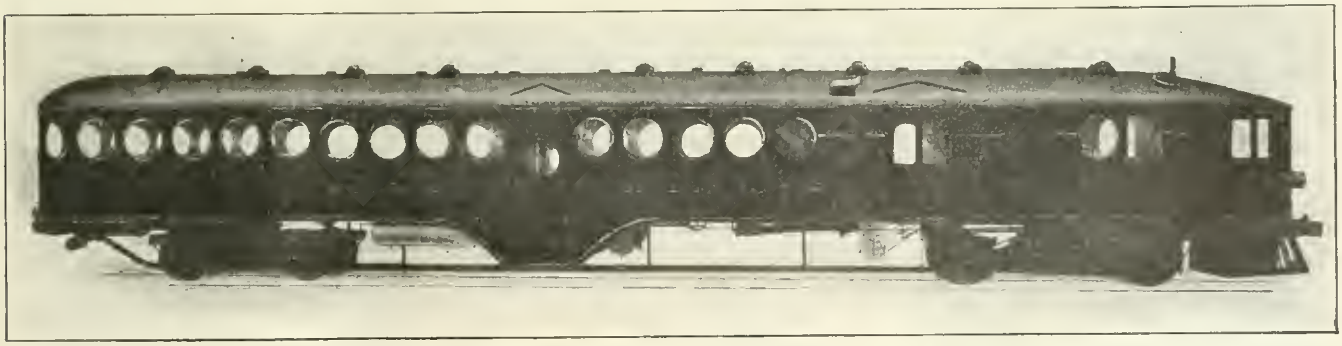
This so-called purple light does not show a very clear purple at a distance—a sort of purplish red—but it is not easily confused with a red hand lantern or other danger signal as a red light on a dwarf may be. For day indication I like the system on the N. Y. N. H. & H. 1st block and drawbridge; positive signal red, square ended blade; not to be passed without written authority, either by train order (for close in); clearance card (signal out of order); or caution card (block circuits failed); 2d, home and route signals: Arms red with round end may be passed on green hand signal from tower-man; 3d, "Permissive" signals, V-shaped or pointed end blades: Stop, then proceed under control, used for automatic block signals; 4th, Distant or caution signals: Yellow, with fish-tail or forked-ended blade. Between interlocking plants the double arm automatic semaphore block system seems to me to be ideal, especially where conditions are such that distant signal can be arranged to stay at "caution" until three blocks in advance are clear; home signal at stop until two blocks are clear. This will certainly lessen the chance for an accident, as an engineer might fail to see the first caution (and stop) indication and seeing the second still be able to prevent an accident. We are all human and anything tending to lessen the liability of an accident being serious should be adopted.

I wish to call attention to several dangerous conditions existing at many points. 1st, Derails at drawbridges and other dangerous points. In many cases they are located on trestles or approaches to drawbridges so that the consequences of going off the derail would be fully as serious as going off the open draw (unless the resulting obstruction to navigation is to be taken into account). In other words they are an additional danger, as the derail may be open when draw is closed. Place them further away and in as favorable a location for a possible derailment as possible, in many cases a spur or y-track might be used to answer in place of derail; 2nd, There are many pieces of road still protected (?) with the old style "banjo" block systems where the blocks are not overlapped. These could be overlapped breaking distance at small cost and the protection afforded largely increased; 3d, Where distant signals for interlocking plants are located on single poles and the first home signal is also a single signal, if the light is out on the distant signal the home, if at proceed, may be mistaken for the distant and following signals approached at a dangerous speed. Put the distant on same pole with last stop signal if not too far away; if so identify the distant at night by having two lights instead of one. A writer in the August issue speaks of the 6-track railroad as something of the future. We have over 10 miles in operation on the N. Y. N. H. & H. from Oak Point to New Rochelle, N. Y., and more contemplated. I hardly see how an "absolute red" system could be devised on roads of this kind. Hoping many more engineers actually in the service will have something to say on this subject, I will close

P. S. WAITE.

Locomotive Engineer, N. Y., N. H. & H.
Springfield, Mass.

[Our correspondent is right when he says anything tending to lessen the liability to accident should be adopted, and we agree with him about the "derail." A stop signal would be far better. With regard to seeing the semaphore arm at night, as we understand the "World" system, there are no lights on the signal, only the background is illuminated—Editor.]



McKEEN MOTOR CAR, 200 H. P.—70 FT. LONG, SIMILAR TO CAR FOR THE ERIE RAILROAD, RECENTLY INSPECTED BY DR. ANGUS SINCLAIR.

Reasons for Change of Color Signals.

Editor:

In response to your invitation for engineers to give their views as to what they think is the best type of signals, I herewith give you mine, which are: red, for stop; green, for caution; white, for clear. I believe these are the best for the following reasons:

Red can be seen more distinctly than any other color except white, at night. Green, for caution, because yellow shows red, pink, or yellow at different distances, mostly red until one is very close to the block, and when snow and sleet covers the glass in the semaphore arm, it completely obscures the light.

This applies even more strongly when green is used for a clear signal. I have known the glass in the semaphore arm to be completely obscured by snow so that the light appeared to be out, causing trains to stop at every block. This does not occur when using white, as the glasses in the lamp are kept warm by the heat of the flame and this prevents snow and sleet from freezing on it.

In regard to stopping at interlocking plants when there are two or more arms on same signal mast, I would say: Be sure you have the clear signal which governs your track and do not stop for signals which do not govern your track at towers or other places or you will come in late without any necessary detention to show for it.

I advocate having signals at towers connected up so when a train is given a clear distant signal, that switches and routes cannot be changed, after train has passed the clear distant, until it is past the tower. Have the distant signal indicate clear order board and home signal on next block in advance. This is my first attempt at writing for your magazine or any other, but do not forget that I am in favor of red, green and white for train signals, as explained above.

Scranton, Pa. 68-IN. WHEEL.

[Our correspondent advances practical views here, but the absolute obedience to signals according to the company's rules is more important and far beyond considerations of trains being late or on time. If you stop at an interlocking home signal for a red that does not indicate your route when the rules of the company are to pass such a red, you are simply not carrying out instructions. What we want to get at in this discussion is, What do you think of the custom of stopping at an automatic red and passing an interlocking one? Answer that. It has nothing to do with being on time or late.—EDITOR.]

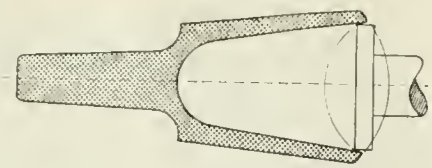
Handy Lathe Chuck.

Editor:

I am enclosing you a sketch of a friction chuck. This is a chuck I am using, being an idea of my own. I have had some of these chucks made and I find them very useful. You will no doubt see the advantage of not having to use a carrier.

You are aware that in small shops one has not always the tools for turning out work as quickly as in a large shop, therefore a foreman must keep his eyes open and on his business in order to compete with an up-to-date shop, if he wants to make a success. If he can only save a little time on each job he has it counts.

This chuck is principally used for turning bolts and pins. It can be used for hexagon head bolts, square heads or round. Considerable time is generally wasted with this class of work in stopping and changing the lathe, taking out the work, reaming the driver or carrier before you can finish the job in the lathe. With

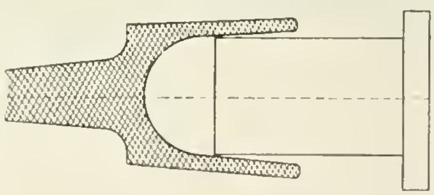


CHUCK HOLDING HEAD OF PIN.

the ordinary catch-plate and driver you will notice the catch-plate can be taken off the lathe if desired. Take out the centre of lathe spindle. Make your chuck same taper as centre and place in spindle as you would your centre.

The friction chuck is bored taper ⅝ in 3 ins. Place your work in the chuck, run up your back centre, which will press the work into the chuck. As the driving always being central, it will fit several sizes of bolts or pins. There is no need to stop the lathe to take the work out to change. As soon as you release the back centre the work stops turning and can be removed or turned end for end and work proceeded with. A man can do considerably more work with this tool and his work is not marked in any way.

At one time when I was in business I had taken a large contract for turning



CHUCK HOLDING POINT OF PIN.

bolts and pins at a low price and I could not make it pay, but I was obliged to execute the order and this is what I did, and I found it very satisfactory.

H. J. VARLOW,
General Foreman C. P. R. Shop.
Fort William, Ont., Canada.

Front End Arrangement.

Editor:

The letter from Mr. J. A. Eson of Denver, Col., that appears on page 336 of your August number, giving particulars of the form of locomotive front end used on the Denver, North-Western & Pacific Railroad, is an example of how slowly important information concerning railway appliances reaches the people who are influential in deciding upon what form of draft appliances ought to be used.

The American Railway Master Mechanics' Association devoted much attention for many years to the investigation of what form of draft appliances produced the best steaming locomotives. Reports of committees of decisions of the same constituted an important feature of the Master Mechanics' Association proceedings for many years, until three years ago when Professor Goss submitted a report that consisted largely of data obtained from experiments made in the testing plant at Purdue University. That was one of the most exhaustive engineering papers ever put before the public, and it settled the design of locomotive front end for all forms of engines. It embraced the discoveries made by several careful investigators, such as Robert Quayle, superintendent of motive power of the Chicago & North-Western Railway, and left nothing to be desired except the inclination to profit by what had been done in that time. The cultivating of the inclination to follow the lead of others has been found difficult among some railroad men.

The form of front end recommended by the Goss Committee is to be found on page 240 of the Annual Report of the Master Mechanics' Convention for 1906 and on page 428 of Sinclair's Development of the Locomotive Engine. All the leading railroad companies have adopted that form of front end as standard.

A. MACLEAY.
Philadelphia, Pa.

The La Jolla Line.

Editor:

Enclosed you will find some photographs of the Los Angeles & San Diego Beach Railway, commonly known as the La Jolla Line in San Diego, Cal. This road runs from San Diego City to La Jolla Beach and caves, passing through Old Town, where the old Mission at San Diego (the first of the old California missions) was built. It was founded by Padre Junepero Serra in 1769. The old palms, and the home of "Ramona," as described in Helen Hunt Jackson's famous book, are situated there. From here the line continues on to Pacific Beach and to La Jolla Beach, where the famous caves are. These caves and rocks are a peculiar formation of sandstone, that extend in and out, in grotesque shapes along the shore.

The La Jolla Line has two little locomotives. No. 1, as shown in the photograph, is a Baldwin 0-4-2, and if I am not mistaken, was built in 1888, as was stated on the plate in front of the engine, and is a dandy puller. The line has quite a number of flat and box cars, and five or six open passenger cars, as shown in the picture, and about a dozen little closed passenger cars. These little cars I noticed

FIG. 1, BALDWIN 0-4-2 ENGINE.

were built by Hammond & Co., San Francisco, Cal., in 1888.

The La Jolla Line also has two new gasoline motor cars of the Union Pacific type, which ply regularly between San Diego City and La Jolla Beach as does the steam dummy. They were built by the McKeen Motor Car Co., of Omaha, and they are regular wind-splitters. The depot at San Diego City is situated at the foot of C street, near the Santa Fe station, and the company's offices are located at Fourth and C streets.

I noticed that there was an electric car marked Los Angeles to San Diego Beach Ry. No. 1, and that there were two trolley lines stretched above the tracks for quite a distance from San Diego City, on line to La Jolla, and I have no doubt that in the near future the La Jolla line will become an electric inter-urban railway.

I was told that the road was built in 1888, and was first known as the San

SANDSTONE CAVES AT LA JOLLA BEACH.

Diego, Old Town & Pacific Beach R. R. The line then was built only to Pacific Beach from San Diego City. Later on, after the line was extended to La Jolla, it became known as the San Diego, Pacific Beach & La Jolla Railway; the "La Jolla Line" up to a year or two back, when it became known as the present Los Angeles & San Diego Beach Ry. It has been rumored that this railway will eventually become an electric railway, connecting Los Angeles with San Diego. I saw a picture of the old New York & Manhattan Beach Railroad train in one of your former issues, and it put me in mind, very much, of this little beach railroad.

Hoping these pictures will find a space in your valuable magazine.

L. H. de Lude.

Los Angeles, Cal.

Bees as Engineers.

Editor:

I have read with interest your articles on Celebrated Engineers and it always seemed curious to me that inventors were

ELECTRIC CAR, LA JOLLA LINE.

so tardy in introducing the piston as a mechanical device, for nature provided the pattern in the tiny engineering operations performed by bees. In order to store honey in each cell which is a cylinder set in a horizontal position, the bees fabricate an air-tight piston of wax which closes the small cylinder. When a bee arrives with a load of honey she bores a hole in the piston with her probosis and through it injects the honey, then closes the aperture with her feet. The piston is pushed forward as the honey accumulates behind it, till at last it reaches the open end of the cell, where it remains a true cylinder head hermetically sealing the vessel and excluding the air.

With such an example that carried no patent rights or restrictions against imitions the pioneer engineers seem to have been short-sighted in failing to utilize the piston.

William Arten.

Philadelphia, Pa.

Cylinder Lubrication.

Editor:

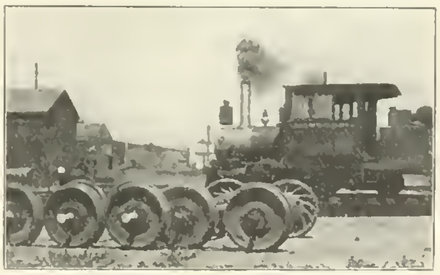
What is considered good lubrication? I answer the affinity of the iron should first be considered. If the valves and valve seats are of the same per cent. of metals it will require much more oil than if they are not. I have known of a Corliss engine of an old make to have valve seats bored and new valves put in, and it seemed as if no amount of oil had any effect, on account of the new valves not being the right proportions to correspond with the metals of the cylinder. I mean the constituents of the iron and not the size of parts.

Again an engine's valves and valve faces may be as smooth as glass and no amount of oil seems to relieve the groan, and when examined and the smoothness taken off with a fine file is all right as it opens the pores of the iron. Oil must have the viscosity for the temperature of steam. That is, oil for low pressure steam won't do for high pressure steam nor oil for high temperature steam won't do at all for low pressure steam as it won't vaporize at that temperature.

This oil question as to quality receives more consideration in general among stationary engineers than among locomotive engineers, and the results can be more closely watched in stationary than they can in locomotive service. The locomotive engineer is allowed only a small amount of oil of a grade sometimes not suited to requirements, as railroad companies furnish the same oil for engines carrying 150 lbs. of steam as for those with superheaters in the front end and at some points they use water that foams very badly.

Stationary engineers would think it strange to be allowed 5 pints of valve oil for a round trip of 130 miles each way, 260 miles in all, for two large cylinders using superheated steam and two air pumps, and it takes from 10 to 14 hours to go one way, and from 5 to 8 hours to return, and cylinder oil costs 15 to 35 cents per gallon by the barrel, and a small quantity would save a ton of coal, therefore there is no economy in saving oil to such an extent.

With some types of valves the reverse lever will rattle regardless of the amount



LA JOLLA LINE LOCOMOTIVE.

of oil, as the oil pipe leads directly above the valve and not where needed until shut off. It simply goes down the side of the valve to the port and don't get under the valve. To relieve this it should lead to side of the steam chest or cylinder saddle. It's a problem to handle a lubricator as is figured out theoretically, for the reason that after water settles and one opens up the lubricator to oil them and then closes down on the feeds, and again, chokes being more or less worn, can't regulate the drops so fine. A lubricator contains so much oil, 6,260 drops to a pint, drop at a time, but faster fed out, the larger the drops, is why one cannot handle a lubricator as per rating, take 2 drops per minute and increase it to 4, and drop in bulk or volume will contain about eight times the original drop.

Take a 3-pint lubricator containing 19,500 drops and feed each cylinder for a small engine 4 drops per minute and the air pump one, be 540 drops per hour; but, as 4 per minute drops in volume contain so much more oil than the single drops, or it would last 30 hours at this rate. Now take a large engine using superheated steam with 2 pumps, feed each cylinder 7 drops per minute as rated, and use 6 per minute, 960 drops per hour, be nearly 12,000 in 12 hours, so the lubricator would hold out about 18 hours if it could be regulated thus; but, in practical use less drops per minute as in volume contain much more oil, and it proves a problem to make it last the number of hours above stated. Doubling the diameter increases the volume eight times, which is the reason the larger drops contain so much more oil. A few cents worth of oil not only makes a large difference in the amount of coal, but a greater difference when time and expense of renewing cylinder and valve packing is considered. Take the difference in time a large stationary engine runs without reboring or renewing packing. True, the conditions are a little different and the work more constant than the locomotive.

JAMES C. STEWART.

Clovis, N. M.

Lancaster Loco. and Machine Works.

Editor:

The traveler speeding through Lancaster, Pa., probably gives but a passing thought, if he notices it at all, to the dingy iron works located a few squares east of the passenger station and on the south side of the railway; yet originally the buildings and grounds of the plant formed the home of a locomotive works which for a number of years furnished engines to many American railways.

In those days the establishment was owned by a corporation known as the Lancaster Locomotive & Machine Works. J. Brandt was its superintendent, and associated with him in the management were his two sons, John Brandt, Jr., and Abraham. The company began operations in 1853, and during the four years following built twenty-five engines for the Philadelphia & Columbia Railroad when owned by the Commonwealth of Pennsylvania; four for the Pittsburgh & Steubenville Railroad, now a part of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway; nine for the Northern Central Railway; and for a number of railways throughout the South.

Mr. Brandt was evidently progressive, as his locomotives from the first contained numerous features that were not regularly used by other builders until a later period. Chief among these was the use of the Stephenson link motion, and cylinders with practically the half-saddle used then, very probably, by no other builder except Matthias W. Baldwin.

Mr. Brandt's cylinders stood at a very

SIDE VIEW LANCASTER LOCO. WORKS.

slight pitch and were novel in having the valve seats and steam chests sloping outward laterally at quite an angle as well as coinciding with the longitudinal pitch of the cylinders. The boilers were of wagon-top pattern with two domes, one on the roof sheet and the other on the middle sheet of the three composing the barrel. The throttle valve was in the smoke-box on the end of the dry-pipe, and being of the slide type was lubricated by a tallow cup on the outside, just behind the smokestack. Cylinders, domes, steam-chests were all covered with lagging plates of polished brass, and this material was also used for the sandbox, check valve casings, boiler jacket bands, axle caps containing the name of the builder, and on many smaller parts of the engines. The tender trucks were of the Bissell type, but with inside journals like an engine truck. One peculiar ornament used

END VIEW LANCASTER LOCO. WORKS.

on all Brandt engines was a strip of round brass attached at one end to the cab just above the running board, close against the Russia iron jacket of the boiler, and carried forward about three feet, at which point it terminated in a coil about eight inches in diameter.

These engines were mostly, if not all of the 4-4-0 type, and were well made. Several of them continued in service with little change except the removal of the forward dome, for about thirty years. One of them drew the train on which King Edward VII, then Prince of Wales, was taken eastward from Pittsburgh in 1860.

During the panic of 1857, the company failed, owing to inability of some of the railway companies to pay for engines which they had ordered and which had been delivered. A few of these machines evidently were on the builder's hands at the time, but the financial depression prevented their sale to other roads for a considerable time after, and the plant was not reopened until 1865, at which time it passed into the hands of Norris Brothers, formerly of Philadelphia, Pa., who operated it for about two and one-half years and then closed it. In 1869 a Mr. Tyng reopened it, and within one year built a number of locomotives in it, after which it ceased to be a locomotive building plant, and later passed into the hands of its present owners, who converted it into a rolling mill and have operated it almost continually since taking possession.

The sons of Mr. Brandt, already mentioned, afterward went West and became interested in the construction of the Oregon Short Line Railroad and other similar enterprises on the Pacific coast. They have died within comparatively recent years. J. Brandt, Sr., was also connected at one time with the New Jersey Locomotive & Machine Works at Paterson, N. J., and at that time built two locomotives for the Philadelphia & Columbia Railroad, which were almost identical in design with the Lancaster engines, and bore his name in connection with that of the N. J. L. & M. W., on brass badge plates covering the ends of the axles.

The buildings shown in the engravings are but little changed since their erection, and conceal a number of structures which have been added for the use of the iron workers. I have never ascertained what types of machinery, if any, were built here other than locomotives; but as the word "Machine" in the firm's title would indicate other lines of construction, it is probable that these lines consisted of heavy tools, such as lathes, planers, cranes, etc., as was the practice at the shops of Seth Wilmarth in Boston, Mass., and at those of some other builders of that period.

C. H. CARUTHERS.

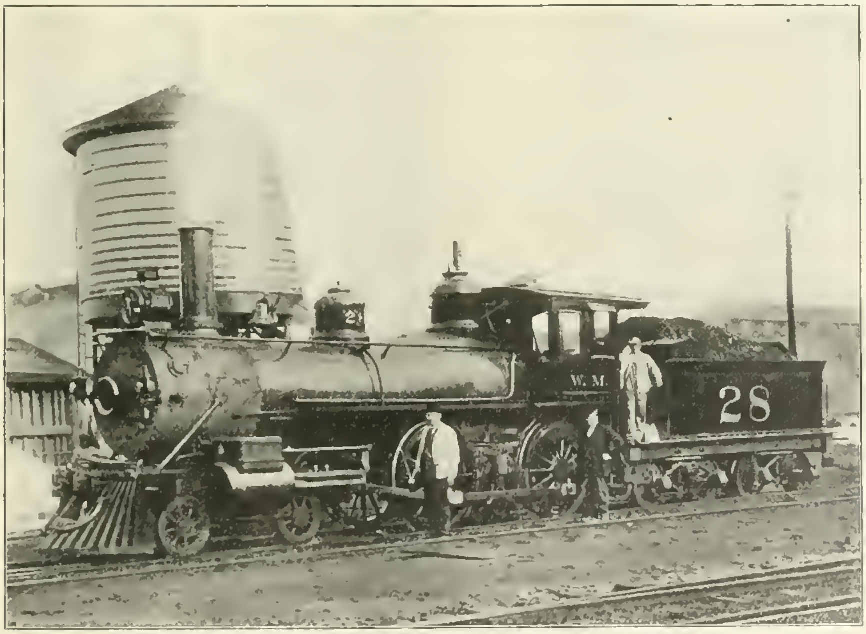
Yeadon, Pa.

Western Maryland Doing Business.

Editor:

Enclosed please find photograph of Western Maryland Railway engine No. 28. Mr. C. E. Wenrick is the engineer, and he belongs to B. of L. E., Division No. 640. This engine was built in May, 1885, and made her maiden trip in June of that year, and has been in continuous passenger service ever since. It is, as you see, a 4-4-0 type engine with cylinders 17x24 ins., drivers 60 ins., boiler pressure 140 lbs., length of tubes 11 ft. 1 in., number of tubes 215, size of firebox 34x71 ins., grate area 16.7 sq. ft., total heating surface 1289.5 sq. ft., rigid wheel base 102 ins., tractive power 12,900 lbs., total length 23 ft. 8 ins., tank capacity 2,600 gallons, fuel capacity 5 tons, total weight 80,000 lbs.

This engine was last overhauled in May, 1905, but was wrecked in a tunnel on a reverse curve caused by a cave-in of the roof on May 21, 1909. This accident necessitated an immediate overhauling, but had this not occurred the mechanical department claim that the engine would not have been overhauled until next November. The total mileage of this engine since 1905 is 154,500 miles. The reader can readily see that the engine would easily have made 172,500 miles before the motive power department contemplated overhauling it.



ENGINE NO. 28. WESTERN MARYLAND RAILWAY.

This engine is again in service, having been thoroughly overhauled under the supervision of Mr. W. H. Keplinger, general foreman of the Elkins, W. Va., shops. He has used every endeavor to do an up-to-date job that will no doubt prove a credit to himself and the company. Mr. Wenrick anticipates keeping this prize out of the back shop until 1914.

RUTHERFORD M. KITTLE.

Philippi, W. Va.

Balancing of a 4-Cylinder Simple.

Editor:

The counterweights used in the driving wheels of a four-cylinder simple locomotive, as described in my letter, on page 337 of your August issue, being situated in the rim and so moving in a circle, must also take effect in an upward and downward direction. This latter effect is not required for the purposes of balancing, and is entirely harmful, the downward action bearing the well known but sinister title of "hammer-blow." Supose the weighted wheel to be revolving, every time the weight descends it increases, and every time it ascends decreases the pressure upon the rail, so that if only the speed of revolution be fast enough and the rail load variation sufficient the wheel will be lifted actually out of contact with the rail, and upon coming down again a real blow is given, "a mistake in design," says Prof. Dalby, "not entirely unknown in practice."

In the early days of railways balancing was quite neglected and for a long time was performed in an unscientific manner, the maximum permissible speed of a locomotive often being that at which the oscillation began to approach a dangerous point. It may fairly be said that perfect balance is unattainable within the limits imposed by practice. Balancing the reciprocating masses by means of weights in the wheel rim is unfortunately the most practical and convenient way of dealing with this problem in a locomotive, but the accompanying hammer blow is such a dangerous feature of the practice that it is customary to balance only two-thirds of the reciprocating masses, leaving one-third unbalanced, but where the rim weights can be distributed over a number of wheels as in an engine with several coupled axles, more than two-thirds, perhaps even the whole, may be balanced; supposing such a course does not entail too great a variation in rail pressure per wheel or too great an oscillation of the engine vertically, for, however small the variation per wheel, it is the total variation which affects, through the medium of the springs, the vertical oscillation of the engine as a whole. The revolving and reciprocating balance weights are usually combined as a single crescent-shaped block in the wheel rim.

In a four-cylinder locomotive, if only the cranks could be set at some theoretically decided, odd angles to one another, absolutely perfect balance would be attained, one set of parts completely counteracting the effect of the other set, but these angles would entail separate valve gear for each cylinder, and the distribution of dead centres would not be good, so the method used is to put the cranks all at 90 degs. to one another, thus balancing the whole of the reciprocating masses, but leaving an unbalanced horizontal swaying couple, which, if large would cause the engine to propel itself with a side to side motion, an effect which may not infrequently be seen by interested observers; this couple, however, need not be an important factor if the general design and weight distribution of the locomotive is good; should a correction be required suitable weights must be added to the rim, thus again introducing an element of "hammer blow."

In cases like the G. W. R. "Stars," where two cylinders drive one axle and two another, these, of course, must be coupled to keep all the cranks at 90 degs., the coupling-rod being assumed to do little more than keep time and transmit the balancing couples; by splitting up the total force of the engine into two units the intensity of any one stress is much reduced and this obviously had many practical advantages. The four-cylinder design, in virtually abolishing "hammer blow" probably escapes a very prejudicial effect upon adhesion. As the weight ascending diminishes rail pressure and descending increases it, the question arises as to whether the increase due to to the downward blow, by adding to the adhesion, compensates for the upward lift decreasing the adhesion.

Without a correct knowledge of the relations existing betwen the tread of the wheel and the surface of the rail, a point upon which we are still very ignorant, this question canot be definitely answered. Prof. Perry says: "When the velocity is very great, as at the driving wheels of locomotives, secondary effects are produced, waves of compression and extension traveling in the rim of the wheel and in the rail, with very curious results." It is generally assumed as a fairly safe rule that friction is approximately proportional to the pressure between two surfaces, providing only that they remain in the same condition, and is independent of the area in contact. The contact between wheel and rail is actually a small area which varies with the diameter of the wheel, load, material, etc.; for instance, a particular experiment gave an area of ½ a sq. in. in contact under a load of 8 tons. The downward effect of the hammer blow is to increase the pressure and therefore the adhesion, but the variation in rail pressure increases rapidly with the speed, and if the contact area is always the same small amount, the pressure may easily become so great as to cause excessive abrasion of the surfaces and as a natural result that imperceptible slipping which is such an insidious and fruitful source of power waste. If the rail bends as we assume it does, then it will increase the area in contact and possibly restore the more natural state of things where abrasion is limited and adhesion normal.

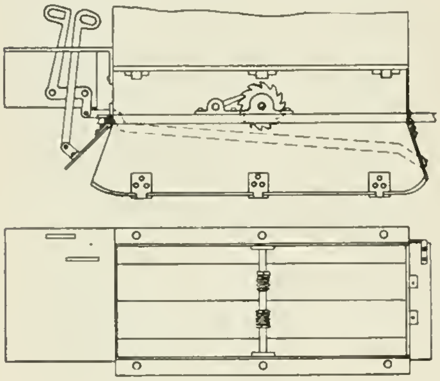


FIG. 1. FLAT ASH PAN.

Consider a fast moving wheel the displacement of whose axle is say 60 m. p. h., *i. e.*, 88 ft. per second, relative to any part of the rail, then with the usual diameter of driving wheels the "hammer blow" is quite suddenly applied and as suddenly withdrawn, the rail being like a beam suddenly loaded and unloaded, a separate portion of it being operated upon by each successive "hammer." In loading a real beam, from the instant of applying the load to the instant that the full deflection due to it occurs, occupies a measurable though certainly minute time-interval. Applying this to the case of wheel and rail it seems most probable that at high speed the required time for extra bending due to "hammer" is not reached. With the upward effect of "hammer blow" the case is different; operating always through the same point—the springs—which give, and the blow is felt as a diminution in rail pressure, and so in adhesion, also causing vertical oscillation of the whole locomotive.

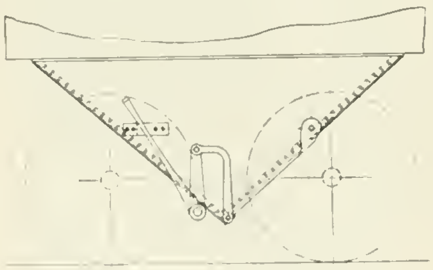
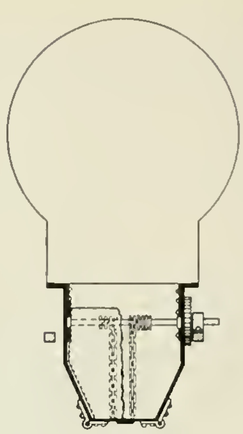


FIG. 2. DROP BOTTOM ASH PAN.

Upon this hypothesis there is strong ground for supposing that the upward lift in decreasing adhesion is more effective than the downward blow in increasing it, so that any design which escapes the reciprocating mass balance weight is to be welcomed, especially when it carries other advantages. These new departures in design are the means by which, in Great Britain, the high powered locomotive of the future will have to be produced, for failing an alteration of the loading gauge mere increase in dimensions can not go on much longer. C. S. STOCK.

Finsbury Park, London, Eng.



CROSS SECTION OF FIG. 1.

Non-Freezing Ash Pans.

Editor:

I am sending you under separate cover sketches of drop bottom ash pans that I have patented. We have a pan of Fig. 1 on some locomotives at the Duquesne Steel Works of the Carnegie Steel Company, that has been in use for seven years, and it has given good service. The idea in the designs of the different pans is to use cast iron or steel doors on hinges operated by levers or chains, as may be seen by referring to the sketches. Each pan differs in shape or style to conform with design of engine it may be applied to engine, but does not depart from being operated without a man going under the engine. We have not experienced any trouble by freezing with pan like that shown in Fig. 1, and I think that the other styles of ash pans are still better protected from freezing.

I would be pleased to have your opinion of these pans. If any one will give their views through the columns of your valuable magazine that I have been a constant reader of for 15 years, I will be very pleased. JOHN A. KREMSER,

Gen. Foreman Locomotives, Duquesne Steel Wks. & Blast Fcs.

Duquesne, Pa.

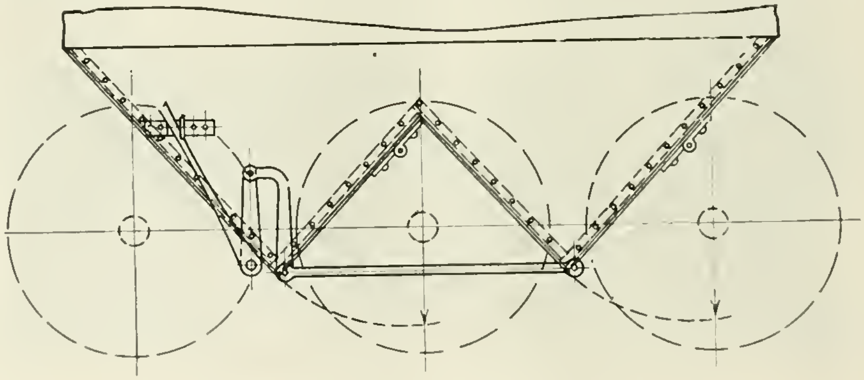
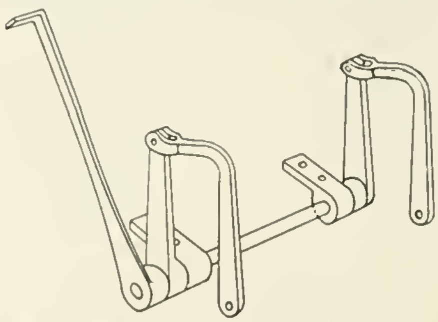


FIG. 3. DOUBLE DOOR DROP BOTTOM ASH PAN.



MECHANISM USED WITH PAN, FIG. 2.

Suppression of Whistling.

Editor:

It is said that in Switzerland the complete suppression of the use of the locomotive whistle has been the cause of increased fatalities. This applies more particularly to section men and those employed at and about stations. There are many tunnels on the Swiss railways and fog prevails at times. Those engaged in track maintenance do not have a very easy time of it in any case, and the fact that an approaching train does not give warning by whistle is said to have increased the number of accidents among this class of employees.

The prejudice against the locomotive whistle, especially in our own cities in America has to a great extent been caused by whistling which is clearly unnecessary. We remember a case where a signalman sat in his box all day governing the entrance to a large station yard by means of a distant semaphore. This man used to read the paper between trains, and although he was supplied with a time table he had frequently had to be apprised of the fact that a passenger train was standing at the signal. This was usually done by a long and powerful blast of the whistle. At length a city by-law prohibited the use of the whistle except in case of emergency, and this along with other unnecessary noises became a thing of the past. S. H. G.

New York.

Value of the Fillet.

Editor:

In an article on page 334 of your August, 1909, issue you published an account of the breaking of a locomotive axle on a British railway due to a sharp corner where the axle was reduced from 9½ ins. to 8½ ins. You point out the advantage of a fillet to make the reduction gradual. As usually done in Fig. 1, on the sketch I send you, the length of the fit is reduced to the same extent as the fillet extends. As is often, if not always the case, the fit is none too long for a secure job, and to get the benefit of the fillet on the shaft and save the length of fit or make it as large as possible, we have followed the practice, for some years, of doing the job as shown in Fig. 2. The fillet can be made in the shaft as readily one way as the other, and it saves an extra operation when boring out the wheel.

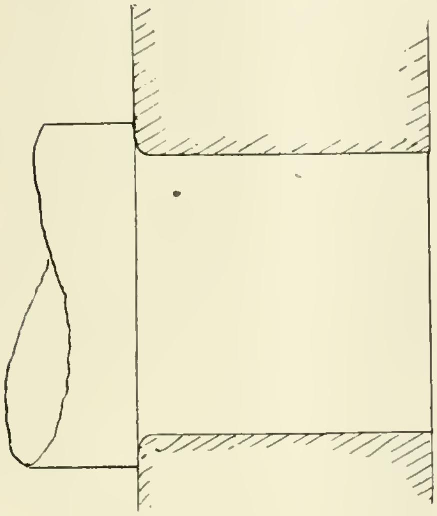


FIG. 1. FILLET AS USUALLY MADE.

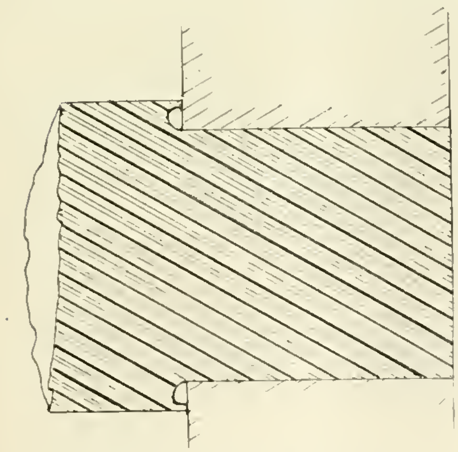


FIG. 2. FILLET AS MADE BY THE STRAIGHT LINE ENGINE CO.

JOHN E. SWEET,
Syracuse, N. Y. *President.*

Eccentric Strap Jig.

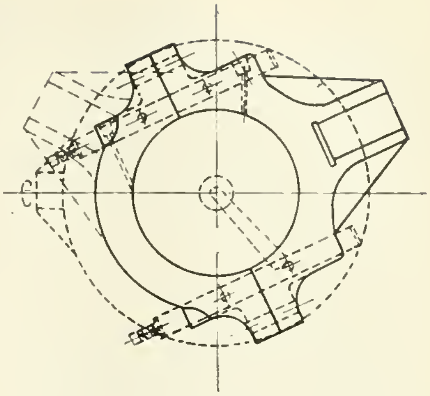
Editor:

We were all very much pleased with the description of the Readville shops of the New York, New Haven and Hartford Railroad in a recent issue of RAILWAY AND LOCOMOTIVE ENGINEERING, from the pen of your worthy associate editor, Mr. James Kennedy. One of the illustrations used in his article showing an eccentric strap jig which was recently constructed by me, and which has been found to be well adapted for the work, did not give so clear a view of the contrivance as might be wished, and I am hopeful you may find room in your valuable magazine for some drawings which will show more clearly the exact character of the device.

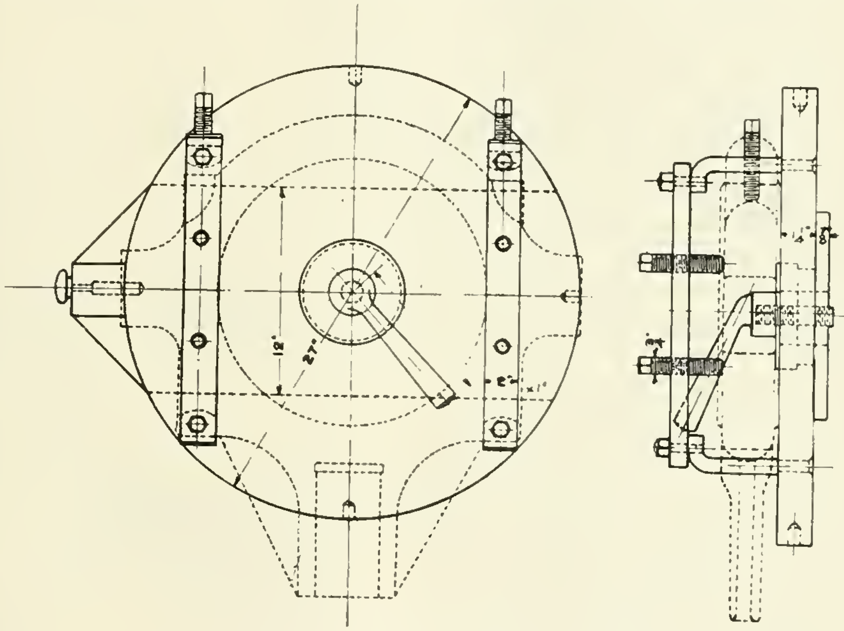
It will be noted in the enclosed drawings that the purpose of the jig is to hold the eccentric while being drilled. Formerly it required nine separate settings of the eccentric strap to perform the twenty separate operations of drilling the various holes in the strap. This occupied two hours and a quarter, whereas with this jig the separate settings of the strap take less than no time, as all there is to do is to turn the strap at right angles or upside down as may be desired. The central handle may be tightened or loosened in an instant and the strap whirled around to any desired position. The entire operations are completed in thirty-five minutes, or about four times as much work accomplished as under the old method.

We will be pleased to see some one of your staff here again at an early date. We have always something new on the way or in operation.

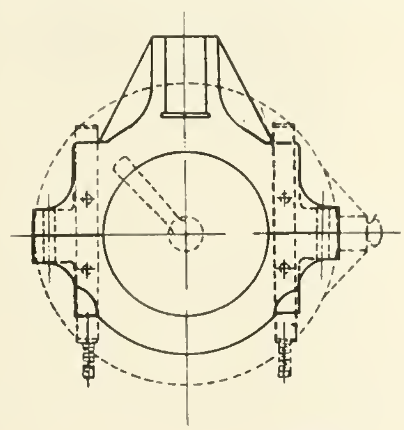
GEORGE H. ROBERTS.
Readville, Mass.



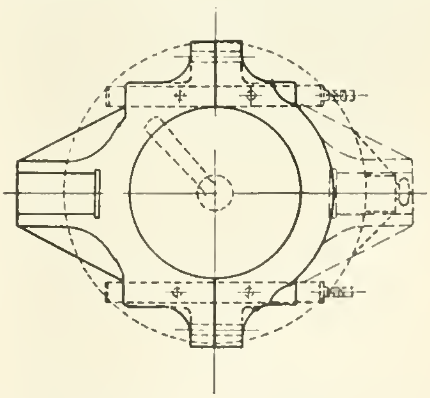
ECCENTRIC STRAP PLACED FOR BORING OIL HOLE.



JIG FOR HOLDING ECCENTRIC STRAP.



STRAP PLACED FOR BORING BOLT HOLES.



STRAP PLACED FOR BORING OIL CUP.

THE FUNCTIONS OF THE REGULATOR

Railway men who are familiar with "axle light" systems of supplying current to incandescent bulbs in coaches, know that the lamps must be kept at a steady glow without at times undue brightness, and again without becoming dull. This steadiness of light has to be maintained whether the train is running forward or backward, running fast or slow, standing still or just beginning to move or gradually slackening for a station stop.

These are the conditions, and they may in general be said to have been met by the use of a compact and carefully constructed generator and a storage battery. The generator is driven, by a belt and pulley, from the axle and the storage battery is charged as well as the car lighted by current from the generator. These are the means employed to produce the desired result. The conditions are exacting, but the means are adequate. There is, however, an essential feature in addition to the generator and battery. This is an automatic regulator to control the output of the generator and the voltage or pressure on the lamps so as to insure that quality of steadiness of light. The Consolidated Railway Electric Lighting & Equipment Company, of New York, employs what is known as the Kennedy regulator for that purpose.

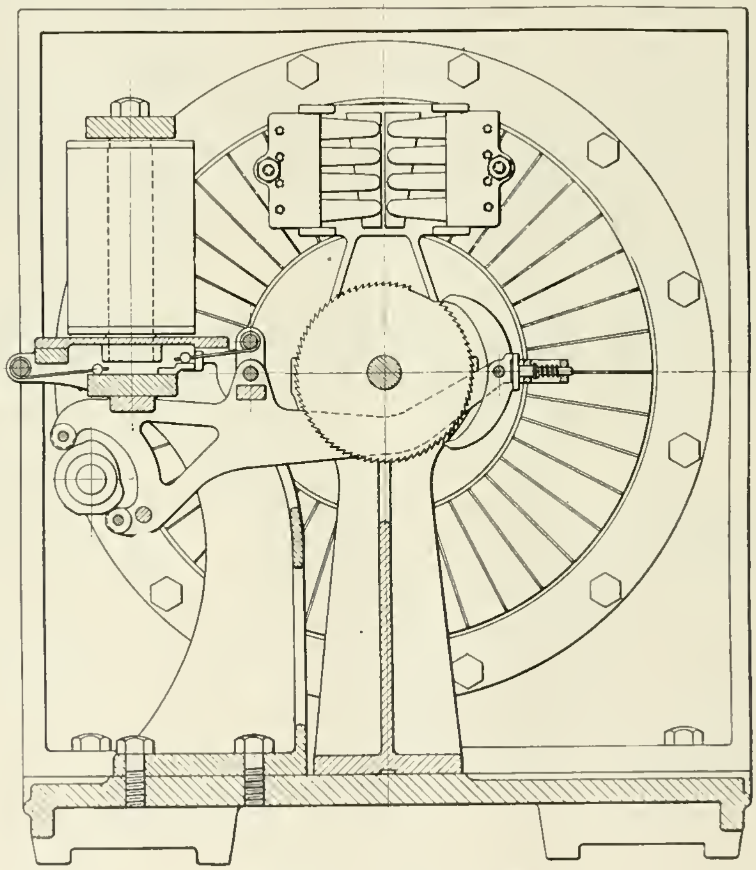
The lamps in a car require what is called a current of constant voltage to maintain a steady glow in each. The storage battery should receive a current of constant amperage in order to charge it economically. If the voltage of the lamp current increases the lamps will glow more brightly for the time, but are thereby strained and the life of the lamp shortened. If the voltage is too low the lamps become dull and red. Voltage is practically pressure. The battery, in order to be properly charged, requires that the amount of current supplied to it be steadily maintained.

The flow of electric current in a lighting system using a generator and storage battery is in a way roughly analagous to the water service maintained in some cities where the pumping station fills the mains and water flows from them to offices and dwellings, and the water which is not thus drawn off reaches a shallow reservoir of large area at the highest level of the town. We speak here of the reservoir being shallow. This is more for the purpose of illustrating the action of the storage battery than to describe the town system. When the pump stops, the reservoir supplies the city, and when the pump resumes work the reservoir again receives its supply. As a matter of fact, the level of the water in the reservoir fluctuates but slightly in a system of this kind where we have supposed the area of the reservoir to be large. If all the houses use water at the same time, very little will reach the reservoir; and when all the small faucets are shut off, the reservoir might become full to overflowing, unless the pump was stopped.

In the axle light system using the Kennedy regulator, these conditions are automatically adjusted. If a device similar in function to this regulator was applied to the water works system, we would have this result. The flow of water to the reservoir, that is the amount of water pumped into it per minute (or the amperage in the electric apparatus) would be maintained constant, there would be an unaltered flow of water of so many gallons per minute, whether the city used much water or little. So with the storage battery, the number of amperes per second or the quantity of current supplied from the generator is maintained evenly whether the train runs fast or slow and the supply is cut off entirely when the speed of the train slackens to a predetermined limit. The pressure of the erator is running at high speed, due to the velocity of the train, or whether the storage battery is supplying the bulk or all of the current for lighting.

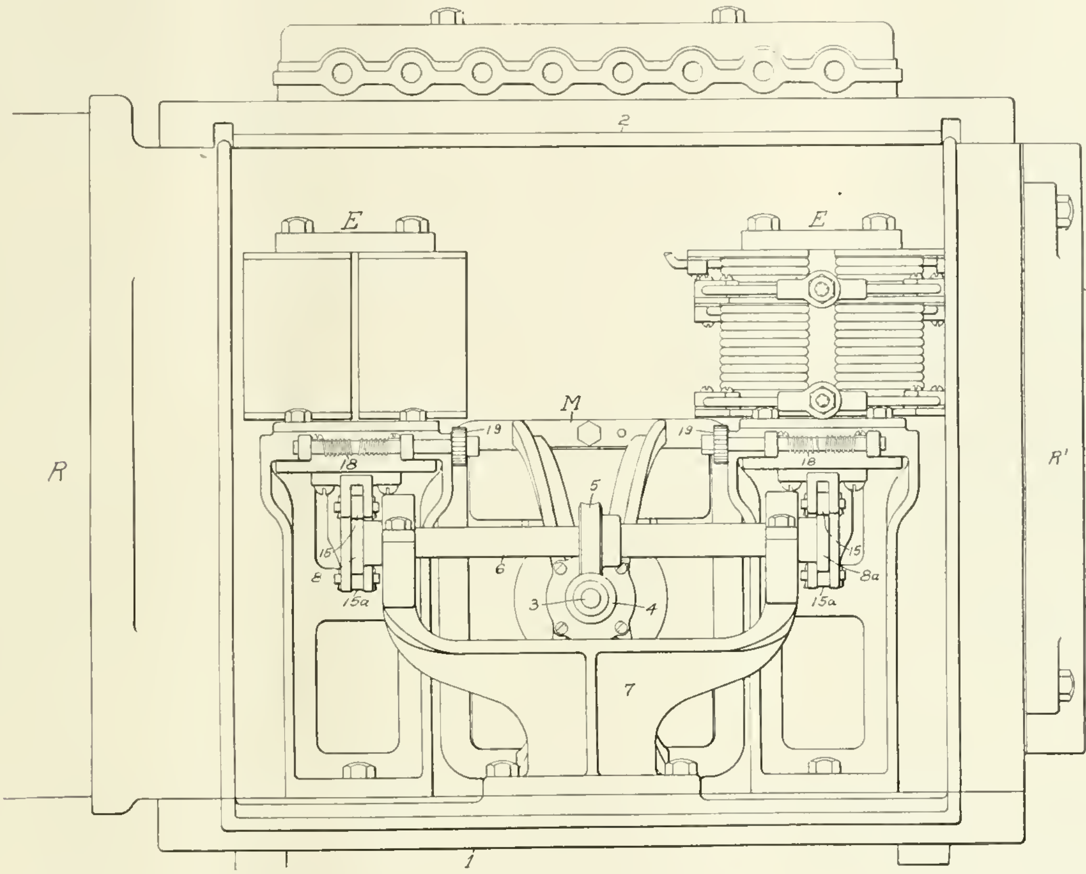
The method by which the regulator is made to respond to changed conditions is very ingenious. The Kennedy regulator is essentially a pair of electro-magnets, and a small motor, which always operates when the generator is running or when the lamps are on. One of these electro-magnets is in the circuit through which electricity from the dynamo reaches the battery and the other electro-magnet is in the lamp circuit. The armatures of the electro-magnets operate each a lever and on the end of each lever is a double pawl. Applied to suitable ratchet wheels the movement of the pawls produces right or left hand rotation according to whether the upper or lower point of a pawl engages.

Take, for example, the electro-magnet on the battery circuit. The armature is



END VIEW OF THE KENNEDY REGULATOR SHOWING METHOD OF CUTTING RESISTANCES IN OR OUT.

water at the many faucets in the houses corresponds to the voltage of the lamps in the lighting system. The supposed water regulator would here keep the pressure the same whether the pump acted or not, or whether the reservoir was full or partly empty. By means of the Kennedy regulator the voltage of the lamp circuit is kept constant whether the gen- held by light spring-pressure as nearly as possible in its neutral position, and the motor-shaft acting by means of a cam, between the jaws of the armature lever, causes a slight up and down motion of the armature, the lever and the pawls at the end of the lever. This movement is not sufficient of itself to make the pawl engage with the ratchet teeth If by reason of the high speed of the train, the generator delivers a current above the requisite charging quantity for the battery, the electro-magnet in that circuit would draw up the armature and the upper point of the double pawl would engage with the ratchet wheel, and the slight rocking motion produced by the magnet, armature, cam, pawls and ratchets, regulate the voltage on the lamp circuit. The usual condition when the train is in motion is for the generator to supply the lights and the battery is charged at the same time by whatever current there is over and above that required for the light. When the train slackens quired to a service where three hours lighting is all that is needed. This may be done without any readjustment of the regulator. The saving claimed for the Kennedy regulator is, prolonged life of the battery by preventing over-charge. The use of high efficiency lamps is possible on account of the close regulation



END VIEW OF THE KENNEDY REGULATOR USED WITH THE CONSOLIDATED AXLE LIGHT SYSTEM

cam on the motor-shaft would then cause the pawl to impart motion, tooth by tooth, to the ratchet. As the ratchet revolves it carries with it a sliding contact, set at the end of a radial arm, which as it sweeps around, cuts in step by step a series of resistances in the field of the generator, and thus reduces the quantity of current reaching the battery and so maintains it at the predetermined amperage or quantity, without reference to the speed of the train. As the train loses speed the generator delivers less current than it did at high speed, and the armature drops away from the electro-magnet, to a point below the neutral position. The lower point of the pawl then engages with the ratchet wheel and the radial arm is swept back over the circle of contacts and the resistance coils in the generator field are one by one cut out as required, thus maintaining the required amperage or quantity of charging current.

What is true of the charging current is substantially true of the lamp current. A similar arrangement of electro-speed, the generator current dies down, then the automatic opening of a switch prevents the back flow of current from the battery to the generator, and sends battery current to the lamps. The control mechanism on the lamp circuit is similar to that on the charging circuit just described, and this control mechanism maintains a current of constant voltage or pressure by throwing resistances in or out of line, no matter whether the current flows from generator to lamps or from battery to lamps. The fluctuations of current due to the various speeds of the train or the amount of charge in, or the condition of the battery, are thus taken care of.

The regulator contains an indicator which shows at any time the number of hours during which the battery can maintain light, or in other words the amount of charge the battery contains. The regulator is contained in a dust-proof box and is placed in a convenient position under the car. A car equipped with this regulator may be transferred from a run where 12 hours lighting has been re-of the voltage supplied to the lamps and longer life is assured for them. A smaller battery than that formerly used, is possible with high efficiency bulbs and this regulator. The attention required for this system is small, and the mechanism has been made as light and strong as it can be, to do the work, as it has been rendered fool-proof as far as it is possible to do it.

According to the Chinese philosopher Confucius, knowledge is holding on to a thing one knows to be true and letting go things known to be false. The philosophy of the western world consists frequently of reversing the axiom of Confucius.

Tungsten is a metal that stands 5,500 degs. Fah. of heat before melting. On that account films of tungsten are being used in incandescent lamps because it produces a much more brilliant light than a carbon film with a given electric current.

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Practicality in Unionism.

Profitable railways are indispensable to efficient transportation, and every line of production, commerce and industry in this land of magnificent distances, depends on the certainty, efficiency and cheapness of its transportation facilities. These words form what may without impropriety be called the keynote of the address of Mr. P. H. Morrissy, recently delivered before a union meeting of the Brotherhood of Locomotive Engineers. Mr. Morrissy is the president of the American Railroad Employees and Investors' Association, and he is therefore in a position to impartially estimate the merits of any argument which may be advanced from the extreme of either side of the interests which it is the object of his association to harmonize.

Speaking of labor organizations in the opening of his address he said that the most potent of all the agencies for elevating the status of working men are the labor unions. He admits that faults sometimes exist and that demands are not always just, but that in the main the labor organizations of this country have virtues which outweigh their faults. He holds that in so far or in proportion as these organizations secure conditions of life for themselves and their children that make for intelligent citizenship, so will the country be well or ill governed, because good citizenship cannot come from grinding or debasing poverty. In this good work of uplifting the working man he gives first place to the Brotherhood of Locomotive Engineers. He says the organized railway employees of the United States and Canada owe a debt of gratitude to this pioneer organization for blazing the path through the wilderness of non-unionism, of ignorance, and of opposition to labor's rights.

Public opinion is strongly against the railway strike and will not be partial in its condemnation whenever the public interests are interfered with by the stoppage of traffic from this cause. Arbitration, good as it is, he holds, should not be resorted to except in an extremity when mediation, conciliation and like methods have failed. The best results are obtained when employer and employee thresh out their differences between themselves, each side making concessions if necessary to maintain mutually friendly relations.

In this connection we may say that a leading editorial writer on the daily press of New York has described the British people as a practical people because of this very faculty or quality. In the House of Commons where the labor party as such is in an actual minority, they have been treated with great fairness because they have acted on the old adage, that half a loaf is better than no bread. They have been satisfied from time to time with concessions in which they got something they desired, if not all,. and in which the other side secured some advantages. The net result, and the practical result being that the labor party made a distinct and satisfactory advance not all at once, but by degrees, there being no actual retrograde step. It is all based on the give and take idea or that of compromise which is a sound doctrine in the affairs of every-day life. This amounts to practicality.

Mr. Morrissy beileves that "while organization of labor has done much to raise the material, moral and intellectual standing of the workman and has contributed many substantial benefits to his welfare, there is danger that the movement, having directed the workman so much toward his self-interest, may cause him to overlook essential and vital things in relation to his duties toward his employer. The labor unions should encourage on the part of their members loyalty to their employers and insist that they at all times give good, honest service. Unionism should not be a shield for the drone or the disloyal or incompetent workman. On the contrary, it should join with the employer in establishing a proper standard of efficiency and at least encourage, if not absolutely require, its members to maintain it. And it is not at all improbable that the labor union of the future will be judged by these standards."

While we can not go closely into all the statistics given in this able address we may say with the speaker that it is generally conceded that the total railway mileage of this country is largely in excess of that of Europe. In 1907, according to the Interstate Commerce Commission there were 1,672,074 men in the service of the railroads of this country. Taking the average wage at $2.20 for all these men, and multiplying by 300, the average days worked each year by all classes of railroad employees, it shows that there was something over one billion dollars required for the payrolls of the railways in that year.

The very practical application which Mr. Morrissy makes of these figures may well be quoted as showing the light in which railway men may legitimately consider the effect of hostile legislation, or as he tersely calls it, the baiting of the railways. He says, "This is the one billion which we can understand and in which we are all vitally interested, so vitally that it becomes our duty to ourselves, to our families and to our country to see to it, so far as our influence extends, that the fund from which this billion is paid shall not be impaired or depleted by the imposition of unreasonable restrictions and unremunerative conditions upon the management of the railways. It is through this particular billion that we become directly interested in every proposition that tends to reduce the revenues of the railways.

"We know, as perhaps no other class of working men in the United States knows, that profitable railways are the first essentials of prosperity, progress and contentment in this country. In saying this I do not wish to convey the impression that the prosperity of the American people depends on the payment of one billion dollars or any other sum to railway employees, greatly as the distribution of that sum into all the channels of trade regularly conduces to that result. What I mean is that profitable railways are indispensable to efficient transportation, and every line of production, commerce and industry in this land of magnificent distances depends on the certainty, efficiency and cheapness of its transportation facilities."

In closing his address Mr .Morrissy exhorts his hearers to use their privilege to protest against any tendency to deprive railways of the power to earn revenues sufficient to meet the demands of a growing country. Each railroad man has a dual interest in a square deal to the railways, one as individuals and one as citizens of the republic. It is worse than folly, he says, to believe, that the common means of communication of ninety millions of people can be hamstrung without causing the affairs of the nation to halt on limping feet.

Electric Rail Wear.

The rapid wear of rails in use for electric motor service is the subject of much comment in Europe as well as in America. The low center of gravity on which most electric motors are built, together with the small wheels used in the motor trucks, the dead weight of motors and axles themselves, and the greatly increased friction incident to the extraordinary degree of acceleration and deceleration, all tend toward rapid wear of rails. A certain amount of increase in wear was to be expected, but it was not looked for that the life of an ordinary rail which may extend to as much as twenty years under steam locomotive service would be shortened to two years in the case of electric motor service.

As may be readily imagined metallurgists have been busy experimenting with a view of securing steel of a kind calculated to resist this increased strain, and some success has been already attained. The chief toughening agent so far used has been the admixture of certain quantities of manganese and silicon. This has the effect of producing a greater degree of durability in the metal of the rail and a marked increase in the adhesive texture of the outer crust of metal.

The result so far claimed is said to be that the life of the rail in use in electric motor service is nearly doubled, and it is hoped that still further advances will be made in the direction of the increasing of the cohesive quality essential to electric railway service. At present it may be observed in electric service there is a tendency for the inner side of the rail to become corrugated. This corrugation readily lends itself to the splintering of the head of the rail. Among the remedies one may say that in addition to new mixtures of minerals for rail ingots, a new form of rail might suggest itself to the inventive minds of some of our clever engineers.

A change in the construction of the electric motors might also lead to more economical results in the wear of rails. The rails now in use may be said to have grown up under the wheels of the modern steam locomotive. They are admirably adapted to a service where the strain is directly on the top or nearly so, and where the side wear may be said to be comparatively light.

Cold Water Delusion.

We have repeatedly discussed the pernicious fallacy that injecting cold water upon overheated boiler sheets is likely to cause an explosion; but the mistaken impressions upon that subject are so difficult to eradicate from popular belief that we return to the subject from a sense of duty.

When water in a boiler is found to be low the first duty of the man in charge is to force water inside as quickly as possible. The belief that boilers with overheated sheets were likely to explode if cold water was injected upon the plates arose no doubt from the fact that hot cast iron plates often fracture when cold water is thrown upon them. It is, however, different with the mild steel that steam boilers are made of. That material softens or becomes annealed when quenched in cold water, a simple test proving the truth of that, which any mechanic or engineer can carry out for himself.

The beginning of this most unfortunate "red-hot cold water" boiler explosion theory was a philosophical experiment conducted by an English professor as follows: He first observed that water in small quantities dropped upon very hot metal did not wet the metal, nor was it evaporated in the usual way. He then took a platinum dish, heated it red hot by means of an alcohol lamp, and into this poured a small quantity of water; he found that it assumed globular form without seeminng to touch the metal, and appeared to be held away by an invisible cushion. It did not evaporate rapidly, but slowly dried away, until at a certain time the remaining drop exploded with great violence. He then deduced and proclaimed the theory of the spheroidal condition in red-hot boilers, which was to account for all mysterious boiler explosions.

This theory concerning boilers exploding by cold water being pumped upon hot plates took such a firm hold upon people intrusted with the care of boilers, that the Pennsylvania Railroad Company determined to make tests to demonstrate the fallacy of the popular delusion. A locomotive was run out on a side track near Altoona, and the plan was to fire the boiler until the steam was high, then blow it out to expose the crown sheet and allow it to become red hot, then to force cold water into the boiler from a fire engine placed at a safe distance away. The first plan miscarried, for they fired the old boiler while full of water till the steam reached 200 lbs., when it suddenly went to pieces. That proved that being full of water did not prevent a boiler from exploding.

The company then took a second old engine to repeat the tests. The boiler was fired up and steam raised considerably above the regular working pressure. Then they ran the water off until the crown sheet was bare, and allowed it to become red hot, after which they pumped in cold water. The only effect was to cause the seams to leak.

About the same time a series of experiments were made at the Harrison Boiler Works in Philadelphia, with overheated plates, under the supervision of the Franklin Institute. Several boilers were overheated and cold water pumped upon the red hot sheets. The experiments were very interesting, and very conclusive that the whole mass of the boiler, if heated red hot, does not contain heat units enough to raise the water to a dangerous steam-making pressure.

All men connected with boilers should remember not to let the water in the boiler get low. But if by accident it should become low, hurry to put water inside.

Compressed Air in Machine Shops.

A feature of the modern machine shop is the use of compressed air in the driving of motors, drills, hoists, hammers and other appliances. The ready adaptability of air pressure to tools of the kind referred to is such that its adoption has been very rapid and, apparently, very complete. In the use of compressed air, especially in the railroad repair shops, we have observed a tendency to extravagance or disregard of the quantity of air used for any operation as if its cost were a negligible quantity. The general impression seems to be that air is cheap. This is very tue so far as the common atmosphere is concerned. As a motive power the air moved in currents costs nothing. The wind bloweth where it listeth. But when it comes to forcing the atmosphere into smaller bulk in order to increase its pressure the cost is much greater than is generally imagined.

It will be recognized at a glance that the equivalent or even greater steam pressure must first be used in compressing the air. The action of complex machinery under the best conditions involves considerable loss in friction. To this must be added the loss in steam pressure caused by exhausting at a comparatively high pressure. This is increased as the compression of the air approaches the limit of capacity of the enclosing mechanism. The loss by leakage is also considerable, and much of these losses cannot very easily be avoided.

An important loss, however, often occurs in the filling of a larger portion of the air hoist cylinder that does not represent any portion of the lift. It can be readily seen that if the piston in a cylindrical hoist is raised a considerable distance before it begins to lift the desired load the space in the cylinder must necessarily be filled with air at a high pressure before any kind of work begins to be accomplished. All lifting should begin, if possible, with the piston in the lower part of the cylinder.

Many of these hoists are now placed in a horizontal position and by a clever arrangement of pulleys furnish a multiplying hoist very suitable for light work. Doubtless a closer attention will be given to the economical use of compressed air.

Its cost is much greater than steam. The same work could be done at much less expense by steam. The real advantage of the use of compressed air being that it remains cool, so that tools can be readily handled with a degree of safety impossible in the use of steam.

Cast Iron Wheels.

One of the most successful paradoxes of railroad operating has been the cast iron car wheel. How cast iron with its brittleness and general unreliability for withstanding shocks and severe stresses could be made into wheels that endured under the most trying service is something hard to understand. But that is what has been done by every American railroad these seventy long years.

The chilled cast iron car wheel has been one of the most reliable members of the railway car equipment, but the indications are that the material has more than reached its limit with eight wheels under 50-ton cars. There have been at times epidemics of broken cast iron car wheels which put the material into disrepute and raised demands for all sorts of wheels capable of enduring the most exacting service; but the real cause of these troubles has been the use of inferior cast iron wheels that would have been rejected had proper tests been made.

The question has come again into prominence, "can cast iron wheels be relied upon to carry the modern freight car?" The trend of testimony on the cast iron wheel question is that it can safely carry modern loads, but to do so the wheel must be made of well selected material and made by highly skillful foundrymen. We caution purchasing agents against buying cheap cast iron wheels, for their use is likely to prove expensive.

Cranked Axles.

At one time New England locomotive builders displayed much fondness for inside cylinders and Isaac Hinkley, one of the pioneer locomotive builders, expressed regret while on his death-bed for having abandoned inside cylinder engines. In the British Isles inside cylinders are used almost exclusively in spite of the fact that many disastrous accidents have often happened through the breakage of crank axles which is the weak link in an inside connected locomotive. When such accidents have happened the railway companies responsible have been denounced by the press and public for that reckless practice in using the dangerous cranked axle, but the storm soon blows over and the crank axle holds its own.

A locomotive crank shaft is an article which must be capable of resisting a curious array of dynamic stresses. The shaft resembles a girder supported at two points and loaded at two other points. It bends under the load, a small degree perhaps, but it bends. Moreover, in the fraction of a second the stresses and deflection are reversed in directions producing the most destructive action that can be imparted to machinery.

Inside cylinders produce a fine, steady running locomotive and the cylinders set inside the smokebox find a warm nest that reduces the loss from cylinder condensation. These are valuable features, but they are secured at high cost when a broken axle is always a probability to be dealt with. It is fortunate that fashion has not ordained that the enormously powerful locomotives becoming the motive power of American railways should be built with the uncertain element of a cranked axle.

Book Notice

Electric Railway Troubles and How to Find Them. By Paul E. Lowe, M. E. Published by F. J. Drake & Co., Chicago. 367 pages. Illustrated, ornamental cloth. Price, $1.50.

The book has been written with a view to furnish the student with a reliable guide enabling him to act intelligently and promptly, when a crisis comes in connection with electric motors. It forms at once a comprehensive treatise on the subject giving valuable information in regard to motor operation, motor repairs, car breakdowns, control systems, and repairing of control. It also describes the air brake very fully, giving instructions in case of air brake troubles, with an able dissertation on electric railway operation generally. It is one of the best books published on the subject.

The Safety of British Railways, or Railway Accidents; How Caused and Prevented. By H. Raynar Wilson. Published by P. S. King & Son, London, England. 240 pages, cloth. Price, $1.

The author of this book is an acknowledged expert on the subject of railway signaling, and has been led into the subject of the increased safety of railway operations generally and the marked safety of British railways particularly. The author believes that the mechanical appliances used on railways are now almost perfect and that the present day accidents are due to the failures of the men in charge of the perfected mechanism. The work is the result of much careful research, and from a historical point of view the information is of real value, and it is gratifying to observe the almost unvarying diminution of disasters that mark the advance in the science of railroad operation.

Locomotive Management, from Cleaning to Driving. By J. T. Hodgson and J. Williams. Published by *The Railway Engineer*. London, England. 384 pages. Many illustrations. Cloth. Price, 75 cents.

A series of lectures by two of the leading railway technical experts of England, delivered before the Locomotive Classes in Manchester, has been published in substantial book form, and has been already received with much popular favor among British railway men. The work is divided into twenty-two chapters, and leads in a clear and easy way through all the details of locomotive management. The book should be welcomed by the young engineer or fireman generally and particularly by all in any way connected with British locomotives.

Who Was to Blame? Being a digest of the Coroner's Enquiry into Sunshine Railway Disaster. By W. O. Bagley. Second edition. 205 pages. 16 full-page illustrations. Cloth. Price, 75 cents.

Mr. W. O. Bagley, the leading air brake expert in Australia, has published a very interesting book in connection with the railway tragedy at Sunshine. South Australia, which occurred on April 20, 1908. It was the greatest disaster recorded in the history of railway transport in the Commonwealth, resulting in the death of 44 persons and the injury of over 400 others. The searching enquiry conducted by the colonial authorities at Melbourne brought to light evidence of the utmost importance to railway men. Mr. Bagley presents the entire history of the case in an extremely interesting way. The book is a valuable and fitting memorial of a remarkable enquiry, dealing as it did with a calamity of world-wide interest. The lessons to be learned from a perusal of the work are of a vital interest to railway men all over the world. Copies of the work may be had by writing directly to Mr. W. O. Bagley, 533 Collins street, Melbourne, Australia.

The New Catechism of Electricity by N. Hawkins, M.E., relating to the dynamo and motor wiring, the electric railway, electric bell fitting, electric lamps, electric elevators, lighting, plating and telephoning, is being received everywhere with much favor. The book contains nearly 600 pages, is finely illustrated, beautifully printed, exquisitely bound in full morocco, and is altgether a high-class, gilt-edged publication. It should become to the electrician what Kent's book is to the mechanical engineer, an indispensable companion. Copies may be had from the Angus Sinclair Co., 114 Liberty street, New York, at bottom prices, two dollars per copy.

Catalogue No. 1, published by the American Oil and Supply Co., Newark, N. J., descriptive of fine tools, machinery, supplies and specialties, for metal workers and others, appears in the form of a handsome volume of 638 pages, profusely illustrated, printed on toned paper and bound in substantial cloth. As a first publication, we do not recall anything so elegant in form and so elaborate in detail. All interested in the endless variety of metal workers' tools, from jewelers' snips to blacksmiths' anvils, should apply for a copy of this catalogue. Address the company at 52 Lafayette street, Newark, N. J.

Aids to Engineers' Examinations, with Questions and Answers, is another of the popular books prepared by N. Hawkins, M.E. As a help to those seeking licenses as engineers, we do not know any book better calculated to prepare the candidate for an examination. The style is simple and direct. The facts are clearly and tersely stated. The book is a model of the printer's and binder's art, and in its special field leaves nothing further to be desired. Copies on hand. Price, $2. Address Angus Sinclair Co., 114 Liberty street, New York.

Air Brake Tests on the So. Pacific.

During the months of June and July 1908, representatives of the Westinghouse Air Brake Company and the Southern Pacific Company conducted a series of air brake demonstrations on that road for the purpose of obtaining an absolutely reliable record of the performance of type K triple valves and the comparative value of the quick service, uniform release and uniform recharge, features of those triple valves.

It has been found that when type H triple valves, which were designed for trains of from 30 to 50 cars, are used in trains of from 80 to 100 cars, their action becomes very unsatisfactory, for if every car of an 80 or 100-car train is equipped with these triple valves a light service reduction will apply but a small percentage of the brakes, and if all brakes are applied by a heavy reduction the brakes at the head end apply more strongly than those behind, and when released the brakes on the head end will release before those on the rear end begin to release, and by the time those on the rear end have released the auxiliary reservoirs on the head end will be recharged, which is likely to be followed by a reapplication, therefore the necessity for the additional features embodied in the type K triple valves becomes apparent.

It is generally understood how the quick service feature runs the light serial reduction promptly throughout the entire train regardless of its length, and how the uniform release is accomplished by restricting the exhaust of brake cylinder pressure where necessary, and how the uniform recharge is accomplished by restricting the feed to the auxiliary reservoirs on the head end, which allows them to absorb less brake pipe air, thus assisting materially in the prompt release of the rear brakes.

The train used to demonstrate the superiority of the type K triple valve was composed of 80 oil cars, the train being over 3,500 ft. in length, with over 3,700 ft. of brake pipe and hose connections, cars fitted with 10-in. brake equipments both H and K triple valves so that a test of H triples could be immediately followed by a test of K triples and the same condition of rail, weather, etc., could be obtained for the comparative tests, and half of each type could be used to determine the beneficial action or influence upon the type H triple valves, that is derived from the presence of type K valves in the same train. In the tests the brake pipe pressure was 80 lbs., and the average piston travel 6.78 ins.

All the electrical apparatus necessary to properly conduct the tests was used and the standing demonstrations showed that with type K valves a 5-lb. reduction acted on the brake piston on the eightieth car in 13 seconds from the time of moving the brake valve handle. With the train using half H and half K triples the time was 21.2 seconds, and with H triples alone the 5-lb. reduction would not apply any brakes back of the thirty-fifth car.

A 10-lb. reduction with H triples moved the brake piston on the eightieth car in 27.7 seconds, K and H mixed, in 15.5 seconds and with K triples, 13 seconds.

While the 10-lb. reduction with H triples went through the entire train, it does not mean that the brakes were applied uniformly, and type K triple valves in all cases cut the time of application of H valves in half.

The time required to move the piston and the time required for the brake to do work, that is, to get the piston out 6 ins., which means 10 or 12 lbs. cylinder pressure, are two different matters, but the type K valves maintained about the same ratio doing the work in about half the time required by H valves. A 10-lb. reduction with H valves got the piston on the eightieth car out 6 ins. in 49 seconds after the movement of the brake valve handle, K and H in 27 seconds, K triples alone in 21.5 seconds.

The time required to release the brake after a 15-lb. reduction, that is, to reduce the cylinder pressure to 5 lbs. at which time the shoes will be clear of the wheels can be shown best by the following. The time is measured from moment of placing the brake valve handle in the release position to the time the cylinder pressure had reduced to 5 lbs. or brakes had released.

	1st car. seconds.	25th car. seconds.	50th car. seconds.	80th car. seconds.
H triples..	4.5	6.7	17.2	40
K triples..	14.8	16.2	14.6	14.5

The numerous running demonstrations were made at various speeds with different reductions of brake pipe pressure and they proved conclusively the advantages of the type K triple valve, the train was stopped from a speed of 20 miles per hour with a 10-lb. reduction by the H triple valves in 890 ft. and by K triples in 595 ft. With a 15-lb. reduction from a speed of 20 miles per hour the train was brought to rest by H triples in 860 ft., and by K triples in 580 ft.; with K and H mixed it required 750 ft. From a speed of 30 miles per hour 15-lb. reduction halted the train equipped with H triples in 1,525 ft., while the K triples did the same thing in 1,040 ft. and H and K mixed, in 1,370 ft.

The published report of these tests is an air brake course in itself and contains much valuable information that cannot be taken in at a glance. We hope to refer to the results of those important tests in the future. The Westinghouse Air Brake Company state in the first page that the information contained is not to be regarded as a formal report, but is for the purpose of graphically illustrating in the easiest manner possible the points brought out in the different demonstrations so that those interested may readily appreciate the present state of the air brake art.

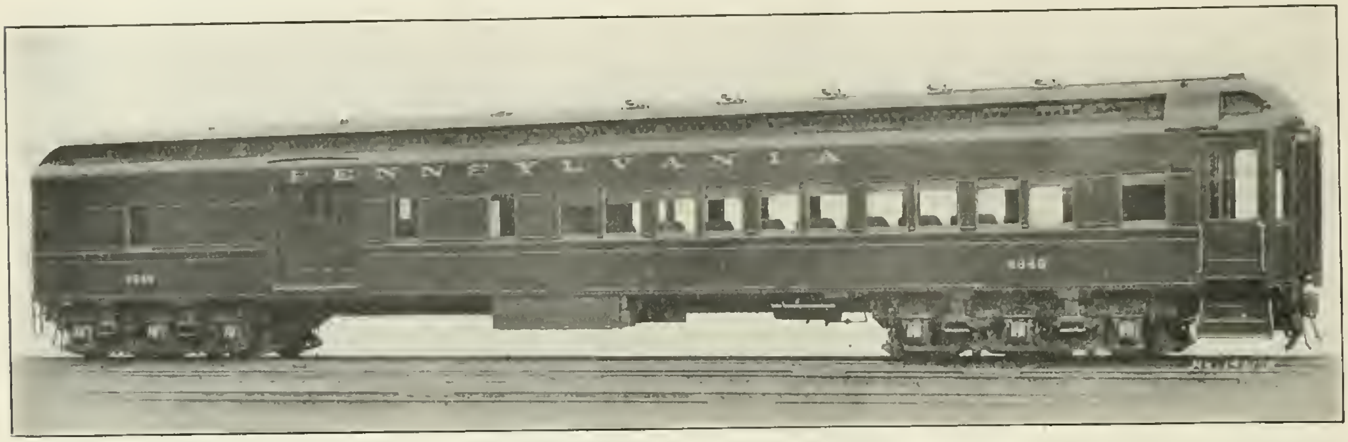
Concatination.

The Victorian Railway Magazine published at Melbourne, Australia, in one of its recent issues remarks that "The American Railway Association is endeavoring to standardize the technical terms used on railways. Some of these are still rather indefinite, although, no doubt, considerable improvement has been effected in this respect. For instance, there was a time when an extra train was known as a "wild" train, or a "wild cat" train. Thence came the verb to "wild cat" which was even printed in some of the older time tables. Thus, there appears in the time table of the Delaware, Lackawanna & Western, in the eighties, a foot-note to this effect: "Train No. ——, on arrival at S—— will 'wild cat' to Morristown!" In this connection a story is told that when the West Shore Railway was about to be opened, the superintendent was examining men who had applied for positions as conductors. One man was asked: "What would you do if you should meet a "wild cat" on a side track?" After looking curiously at his questioner for a moment, the candidate replied, "Well, if I hadn't a gun, I'd climb a tree.'"

The excessive noise from locomotive whistles causes much annoyance, and complaints about the nuisance are both loud and deep, but the people who voice such complaints should not forget that legislators are to blame for much of the whistling. In some States the law calls for the whistle being sounded at every grade crossing, which means a succession of shrieks from trains passing through certain towns and villages. Legislators and town councils ought to frame the laws and ordinances so that the crossings may be bunched for whistling requirements.

All Steel Cars.

While the all-steel coach has been a comparatively recent departure in car building development, rapid progress has been made along this line of railway construction until it has been made to apply to practically all classes of passenger-train rolling stock. The experience derived by car manufacturers from steel freight car construction and the advanced use of metal in furniture, fittings, etc., have been favorable factors in promoting this development.



ALL-STEEL COMBINATION PASSENGER AND BAGGAGE CAR FOR THE PENNSYLVANIA.

In addition to the regular all-steel passenger coaches manufactured for the Pennsylvania Railroad, there has recently been built for this road at the works of the Pressed Steel Car Co., Pittsburgh, a number of all-steel baggage cars and all-steel combination passenger and baggage cars, which are shown in our illustrations. These cars have been constructed almost exclusively of steel, including the doors. The floors and headlinings are of fireproof material, and the very small percentage of inflammable material used is not a part of the structure, but merely in the trimming. In the main structure of each combination coach there have been used 17,500 lbs. of ¼-in. plates, 4,500 lbs. of angles, and 7,100 lbs. of shapes and small plates. In addition, considerable steel material for interior finishing has been utilized. The flooring consists of monolith laid on corrugated sheets. A ¾-in. maple floor is placed upon the monolith in the baggage car and at the baggage end of the combination coach.

Six-wheel trucks were used on the combination cars and four-wheel trucks on the baggage coaches, both being equipped with 5 x 9 ins. axles and 36 ins. Carnegie-Schoen rolled steel wheels.

The general dimensions of the cars are as follows:

COMBINATION COACH:

Length over all	77′	3¾″
Length over body corner posts	71′	1 1/16″
Length inside, passenger end	39′	9 11/16″
Length inside, baggage end	35′	6″
Width over side sheets	9′	9¾″
Height from rail to top of car	14′	½″

BAGGAGE CAR:

Lenth over all	64′	3¾″
Length over body corner posts	60′	10⅜″
Length inside	60′	3″
Width over side sheets	9′	9¾″
Height from rail to top of car	14′	½″

ALL STEEL BAGGAGE CAR BUILT BY THE PRESSED STEEL CAR CO. FOR THE PENNSYLVANIA.

Japanese Oak for Railroad Ties.

The importation of timber from Japan by the Sante Fe Railroad Company for the purpose of furnishing more durable railroad ties may seem at first sight like carrying coals to Newcastle. One would think that the Ozark and Rocky Mountain foot hills would furnish all the timber required, but it is claimed that the Japanese oak is so hard that spikes cannot be driven into it, and screw holes have to be prepared in advance. The wood will remain in the ground almost as sound as when newly cut down for nearly thirty years. A recent large shipment is being prepared for use at Great Bend, Kansas. A thorough test of the timber has been made, and in the extensive improvements that are going on on the Sante Fe, there will be a large tract of the railway supplied with these ties, and thoroughly ballasted and laid with new rails.

We recently met a road foreman of engines who rose very rapidly from the position of fireman to that of road foreman of engines. He was kind enough to attribute part of his success to the help given by RAILWAY AND LOCOMOTIVE ENGINEERING. He achieved prominence in the first examination he passed through being able to tell the temperatures at which water boils and freezes. None of the other candidates for promotion could tell at what temperature water boils, which was certainly very strange.

I have seldom known of any one who deserted truth in trifles who could be trusted in matters of importance.—*Paley.*

Applied Science Department

The Walschaerts Valve Gear.

IV. Adjustment.

The operation of adjusting or setting the valves, as it is called, may be most readily begun by connecting all the levers and rods with the exception of the eccentric rod which connects the crank pin to the link arm. This admits of the valve being moved backward or forward in order to obtain the markings on the valve rod showing the exact points of the valve opening. These markings on the valve rod as well as the markings in the rims of the driving wheels showing the dead centers or points where the piston is at the extreme ends of the stroke, are made in the same manner as the markings on locomotives equipped with the Stephenson shifting link. The same trams may not suit in both cases as the guide yokes or bearings or other fixed parts upon which a tram may be steadily held vary in their positions according to the location of the parts, but the dimensions and form of a suitable tram will readily suggest itself to an intelligent mechanic. A fine centre punch mark should be made on the valve rod at the exact points where the port edges of the valve are exactly square with the admission port edges of the valve seat.

The eccentric rods may then be connected and the work of moving the driving wheels may be begun. Assuming that the reverse lever is at the extreme end of the quadrant in the forward motion, it will be readily seen whether the valve rod is of the proper length, as soon as the two valve rod markings are made when the main rod has reached the dead centres. Whatever variation there may be can readily be rectified by dividing the apparent variation by the adjustable nuts usually atached to the valve rod. When the forward motion has been corrected in this manner, suppose the markings on the valve rod should be as shown in Fig. 2, it will readily be seen, apart from the variation observable in the markings in the back motion, that the opening of the valve has to be increased in the case of the forward motion, and diminished in the back motion. Now assuming that the change is to be made on the left side of the engine and that the main rod is on the forward dead center as in Fig. 1, it will be readily observed that in order to increase the opening of the valve it must be moved backwards toward the link. To accomplish this movement the eccentric rod must be shortened, and if it were convenient to remove the pin connecting the forward end of the eccentric rod from the link arm, allowing the rod to remain in position, and moving the valve the required distance it would be seen by the variation in the edges of the hole in the link arm from that of the eccentric rod how much the eccentric rod would require to be shortened. This method, however, is not entirely to be depended upon, as there is a certain amount of lost motion both in the valve and radius rod connections, as well as on the central pivot upon which the link is suspended. These, in addition to the link block would admit of a slight motion backward or forward of the extreme point of the link arm without showing any motion of the valve. Generally speaking the eccentric will require to be moved or shortened as in the present case between two and three times more than the amount required in the opening of the valve. The exact ratio can be determined by measuring the distance from the central stud upon which the link oscillates to the center of the link block, and supposing this distance to be 8 ins., then measuring the distance from the central stud to the center of the link arm connection with the eccentric rod, and supposing that to be 20 ins., it will thus be seen that the eccentric rod must be moved two and a half times the amount that we desire to move the valve or increase the opening. So if the increase desired, as in the present instance, should be one-sixteenth, it will require a shortening of the eccentric rod amounting to five-thirty-seconds of an inch.

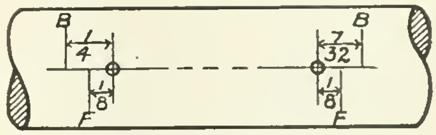


FIG. 2. FORWARD MOTION F; BACKWARD B.

It may be stated at this point that there is no need of experimenting with the union link. It might be imagined at first glance that by lengthening the union link the opening of the valve could be increased. Any change made in this lever, however, with a view to open the valve at one end of the piston stroke, would have the effect of closing the valve a corresponding amount at the other end of the stroke. After rectifying the variation as shown in Fig. 2, as nearly as possible, by shortening the eccentric rod, it may be found that there is still a slight variation between the amounts of openings. This is proof of a slight organic defect probably in the position of the eccentric or return crank, and if the defect does not exceed one thirty-second it is as well to adjust the forward motion as nearly correct as possible and allow whatever variation there may be to remain with the backward motion of the engine, which as a rule, is not so frequently in use as the forward motion.

In the case of adjusting the valve gearing of a locomotive equipped with the Stephenson shifting link, it is possible under any condition to arrange the eccentrics and eccentric rods to bring about an exact opening of the valve at the desired point of the piston stroke on either the forward or backward motion of the engine. On an engine equipped with the Walschaerts valve gear this is not always the case, but unless the organic defect in the Walschaerts valve gearing is of a serious

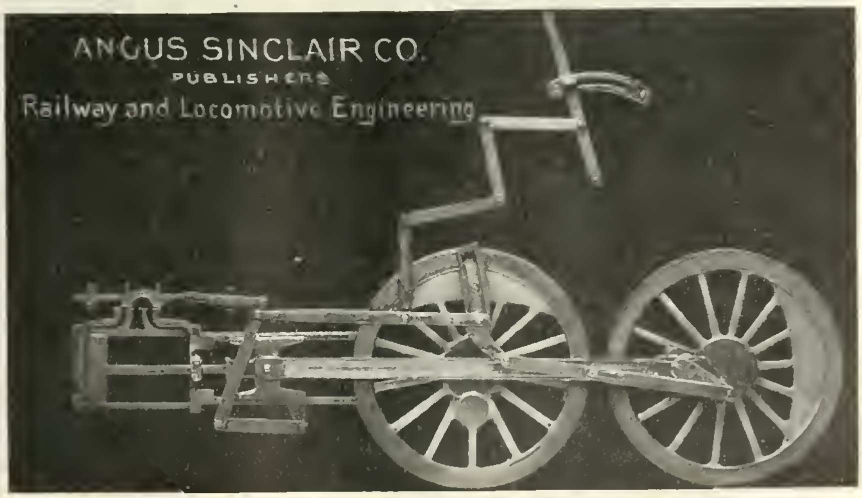


FIG. 1. FORWARD GEAR, LINK-BLOCK AT BOTTOM OF LINK.

kind, the gearing may be adjusted so nearly correct that it will likely be in much better condition during its period of service than the shifting link gearing will be after a few weeks' service. In any kind of valve gearing it is well that the point at which the engine will likely do the greatest amount of work, should be most carefully adjusted. In passenger locomotives this point is usually with the valve

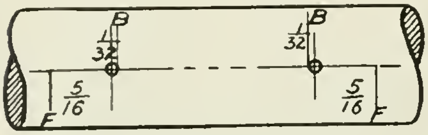


FIG. 3. B, BACK; F, FORWARD.

cutting off the supply of steam at some point considerably less than the full stroke. It will generally be found that in the case of the Walschaerts gearing the cut-off point will be nearly correct. In the event of the variation from the exact closing of the valve at each end of the piston showing a more continued opening at the front end, thereby admitting steam a longer period of time, the valve rod may be slightly changed by the adjustable nuts, as it is more desirable to have a slightly prolonged opening in the back of the piston to make up for the space occupied by the piston rod.

Turning our attention to the right side of the locomotive and proceeding by the same method to mark the valve rod when the crosshead is at the dead centers on the forward and backward motions, we shall presume that the markings are found to be as shown on Fig. 3; it will be observed that the valve shows an opening of five-sixteenths on the forward motion, while the valve is lapping one thirty-second on the backward motion. We shall assume that the central position of the valve on both motions is nearly correct. The position of the link when the main crank is on the dead centers should be carefully noted, and if the link retains its exact position when the engine is on either centres, the eccentric crank position may be assumed to he correct. If a variation of the position of the link is observed, it is safe to assume that there is an error in the position of the crank. Placing the engine on the back centre as in Fig. 4, it will be readily seen that the valve must he moved forward in order to obtain the desired amount of opening. As the eccentric rod is now acting indirectly on the valve rod, the eccentric rod must be moved in the opposite direction, and hence the crank connection must be moved a sufficient distance backward or toward the main crank to effect the required change. The exact amount may be ascertained by the same process as used in shortening the eccentric rod on the left side of the engine. As the changing of the position is a matter of some difficulty involving the fiting of a new key to hold the eccentric crank in place, it is well to secure the crank temporarily in place and move the engine from centre to centre to ascertain if the desired effect has been obtained. A change of the position of the eccentric crank may involve a slight change in the length of the eccentric rod, and even with the most careful adjustment it is rare indeed to secure the perfect coincident amount of valve opening at each of the four points of admission, and also to arrange the points of cut-off so that the steam pressure may be most advantageously used in meeting the various requirements of locomotive service.

It may be added that the amount of clearance between the link block and link at the extreme ends of the travel of the block should be carefully noted. It is usual to allow a greater amount of clearance at the bottom of the link as the tendency of the link block is to approach nearer the bottom of the link as the parts wear. Any marked deviation from an equable centre affects the travel of the valve. Slight variations in the amount of valve opening may also be remedied by lengthening or shortening the radius rod, but as the length of this rod should coincide exactly with the arc of the link it is not good practice to change the length of this rod; that is, if its length be correct. In closing it is well to remember that when locomotive boilers are filled, and all the parts of the engine more or less heated, there is a tendency to slightly distort the operations of the valve gearing and it is well that the skilled mechanic should take an opportunity to observe the changes if any, as such tendencies are very often in the direction of magnifying any slight shortcoming from the exact points to be desired, and a final skillful change may be made that may make a nearer approach to perfection.

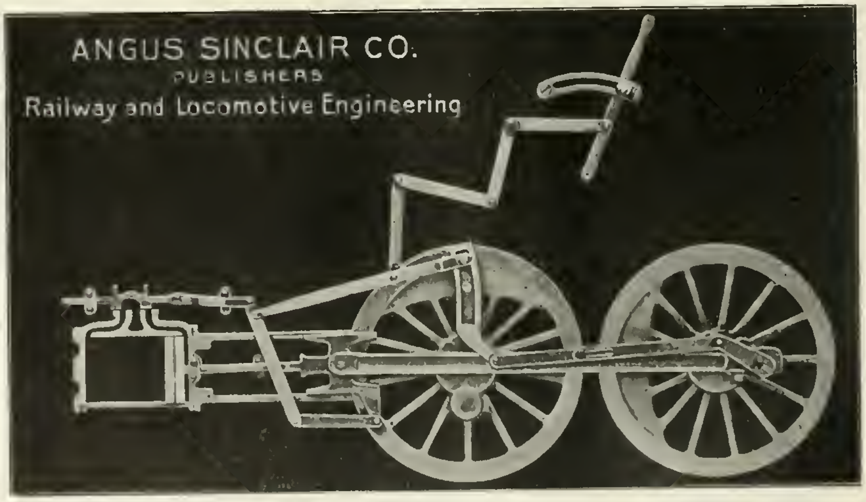


FIG. 4. WALSCHAERTS VALVE GEAR IN BACK MOTION.

Celebrated Steam Engineers.

XXII. Coleman Sellers and Sons.

Among those eminent in locomotive construction in America, Coleman Sellers of Philadelphia, and his sons took a conspicuous part, which undoubtedly had its effect in leading to the form of the American locomotive as distinct from the European locomotives. As constructors of fine machinery the firm has had an enviable reputation for nearly a century. The family is descended from an English family of mechanics that came over with William Penn. When the building of locomotives began in America, the firm of Coleman Sellers and Sons were then engaged on work for iron furnaces, rolling mills and machinery for paper making. The firm were requested by the State Commissioners of Pennsylvania to undertake the building of several locomotives. In the plans submitted by the firm the drawings called for the use of iron frames instead of wood, that up to that time was the only locomotive frame in use. Iron frames were objected to on the ground of having too much rigidity. After some discussion and delay, the iron frame was approved.

The new locomotives built by the Sellers firm appeared in 1834. They had outside cylinders with a single pair of drivers behind the fire box and a four-wheel truck with a centre bearing. Counterbalance weights were bolted to the wheels opposite the cranks. All of the new features were adopted by other builders, and from the work of the Messrs. Sellers the model of what we now call the 4-4-0 locomotive, may properly be said to have taken enduring form.

Although the chief work of the Messrs. Sellers has been largely in the improvement and construction of high class machines, every year adding some new and important development along the lines of utility and magnitude, many of their machines have been particularly useful in the construction and equipment of the modern locomotive. They were the first to introduce the injector and perfect the crude invention of Henri Giffard, the eminent French scientist, and place it at once in operation on thousands of American locomotives. Other manufacturers have met with much success in the same field, and to-day the injector ranks among the very few perfected improvements added to the steam engine, and which has had its practical utility developed in the atmosphere of American enterprise.

Of the countless variety of machines used on locomotive construction and repair, we had recently an opportunity of witnessing the operations of turning the tires of locomotive wheels by a new and improved form of Sellers lathe. The time occupied in turning the wheel tires did not exceed eighteen minutes for each pair. Indeed it may be broadly stated that each year sees some new improvement in mechanism got out by this firm, whereby the honored name of Sellers, so well known throughout the mechanical world, maintains its pre-eminence among the leading engineers of the world.

Questions Answered

BRIDGE IN NOZZLE.

61. A. E. W., Tuolumne, Cal., asks: Is it not a detriment to a locomotive, especially the boiler tubes of engines to put a ½-in. bridge in the nozzle tip? Is it not an old out-of-date idea?—A. Putting in a bridge is not good practice, there may be emergency cases where it helps temporarily, but it creates back pressure and spreads the exhaust so that it may not strike the stack evenly. It is not what may be called a scientific remedy for the disease. We do not think it is any harder on the flues than a nozzle properly contracted to have the same area of orifice.

BRAKE SHOE TEMPERATURE.

62. W. S. M., Two Harbors, Minn., writes: Which brake shoes will hold the most, hot or cold ones; or at what temperature will they hold the best?—A. There is no doubt that if the soft cast iron brake shoe could be kept cold during the time the maximum brake force is exerted the holding power or brake shoe friction would be greater; but as the work of the brake in stopping a train of cars is transformed into heat, this is, under present conditions, an impossibility.

The retarding force, the friction between the shoe and the wheel, varies, principally according to the speed of the wheel and the degree of heat generated is incidental.

As a brake shoe is forced against a rapidly revolving car wheel the heat that is instantly encountered is of sufficient intensity to burn the fine particles of metal as they are thrown from the shoe into the atmosphere, and any other methods of generating heat are comparatively slow, and under such conditions the soft cast iron shoe creates greater friction at low speeds, and lower speed means lower temperature, or at least a slower rise in temperature, while the harder or heavier chilled shoes used in high-speed passenger service will not be as effective at low speeds. They will be more effective at high speeds because of the tendency for the burning metal to flow along the face of the shoe, thereby assisting the shoe to more effectually grip the wheel under those severe conditions of service than the softer shoe would because under the same conditions the metal ground off the wearing surface of the softer shoe would tend to lubricate the surface.

From the above it will occur to you that a test to determine the relative retarding effect of cold and hot brake shoes would be attended with some difficulties, and you are no doubt aware of the fact that the only accurate and reliable method of testing brakes is by what is known as the thermal test, which consists of using a thermometer on the wheel tread after the brake has been applied for some time, the wheels, of course, having been in motion. When brakes have been doing work continuously for any length of time the shoes and wheel tread will be hot. A cold wheel tread is considered as an inoperative brake, or one that is not doing any work in stopping the train, and three warm ones are considered equivalent to one good brake.

VALVE MOTION DUE TO REVERSE LEVER.

63. J. C. S., Clovis, N. M., asks: When an engine is standing still, and reverse lever ahead, and then thrown back, how far does the valve travel and why?—A. If the piston was at the front end of the cylinder and the reverse lever was in the full forward notch, the valve would stand with port open the amount of the full gear lead. Throwing the lever into full back gear notch would move the valve, and as the lever approached the centre of the quadrant, the valve would move to its mid-gear lead position, perhaps about ¼ to ⅜ in. Then as the lever went down to full back gear notch, the valve would go back to full gear lead position again. If the engine was in any other position, the valve would be shifted from whatever position it had in forward gear, to the position it should occupy for back gear. The fact that the curvature of the Stephenson link cannot be struck from a fixed elemental point in the valve gear is the cause of the increased lead in mid-gear, but with valve motions having only one eccentric, the link radius may be struck from an essential point in the motion, and the lead therefore remains constant for any position of the reverse lever.

OLD DE WITT CLINTON.

64. G. M., Albany, N. Y., writes: We have been having a dispute about the relative historical value of the De Witt Clinton, the first engine owned by the New York Central, and of the John Bull, the first engine operated by the Pennsylvania Railroad. One member (Mr. History) of our society holds that the John Bull is the real engine first run on the Camden & Amboy division of the Pennsylvania Railroad, while the De Witt Clinton was built in the West Albany shops from designs furnished by William Buchanan a short time before the Chicago exhibition of 1893. We have decided to refer the matter to you for settlement. A.—Your historian is correct. The John Bull is the old pioneer that came to the Camden & Amboy Railroad from England in 1831. The present De Witt Clinton is almost entirely a new engine. In 1885 the writer wrote and published a short article about a pair of driving wheels which he found hanging in the blacksmith shop of the New York Central repair shops at West Albany, said by some of the old hands to belong to the De Witt Clinton. The article attracted attention to the wheels, and they were identified by the older mechanical officials and cared for. As far as we can learn, the wheels referred to formed the basis of the new De Witt Clinton and are the only original part of the old engine.

TYPES OF ENGINES.

65. L. C. B., Covington, Ky.: What is the difference between the Atlantic, Pacific and Prairie types of locomotives and where did they derive their names?—A. The Atlantic type has a wheel arrangement represented by the figures 4-4-2; the Pacific type is 4-6-2; and the Prairie type is 2-6-2. The type names were, as a rule, given by the builders or the superintendent of motive power of the road first using the type. The type names do not convey any hint of the wheel arrangement and are more or less difficult to remember, but the type when expressed in figures is definite and clear. The English technical and railroad press have adopted the figure method of designating the class of engine. This is the most convenient method yet devised, as it gives the information at a glance and is no tax on the memory.

COVENTRY BOILER.

66. Apprentice, Meadville, Pa., writes: In studying locomotive boiler practice, I have several times seen mention of the Coventry with the implication that such a boiler was well known, but I cannot find particulars in my books on boilers within my reach. Can you help me? A.—The Coventry locomotive boiler was a patented return flue boiler which was urged upon railroad companies about 1884-5. It worked for some time upon the Chicago, Rock Island & Pacific Railway and also upon the Southern Pacific. It was claimed that that boiler prevented the throwing of sparks, and was economical in the use of fuel. We have forgotten what became of the boiler. Perhaps some of our readers can supply the information.

Air Brake Department

Conducted by G. W. Kiehm

H6 Distributing Valve Test.

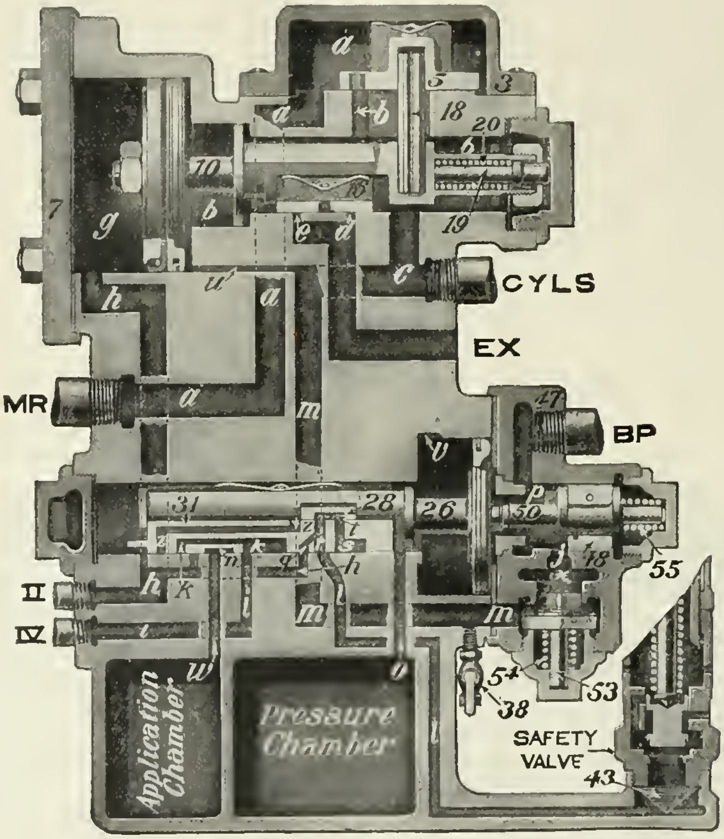
In referring to tests to determine the condition and locate defects in the distributing valve it will be observed that the work of the distributing valve depends upon the operation of the brake valves, and all three valves being connected by piping it follows that a defect in one will likely affect the operation of another. For this reason it was necessary to refer to defects of the distributing valve when brake valve defects were being considered, but they were only those that are manifest in the operation of the brake valves and those that have not been mentioned are such as "blow at distributing valve exhaust port" and "safety valve defects."

The distributing valve that will be referred to is the No. 6 quick action pattern, and it is not desired to create the impression that the E. T. equipment is liable to develop serious disorders at any time or place, but to emphasize the fact that the equipment can be abused and neglected until disorders do occur.

Suppose then that attention is called to a brake that will not apply with either a service, emergency or independent application, to determine the cause it would first be necessary to see that the stop cock in the distributing valve supply pipe and the stop cocks in the brake cylinder pipes are open, if they are, it is evident that the main piston of the distributing valve has not moved or that the port leading to the application cylinder is obstructed or that the flow of air from the main reservoir to the distributing valve is obstructed.

The latter is the least likely to occur, and in order to determine whether the application valve and piston have stuck in the bushing it is necessary to remove the cylinder cover, and if the passage leading to the application cylinder is open, air will escape from the port h, when the independent brake valve is placed in application position. In the number five distributing valve it was possible to get the application valve in wrong, that is, wrong end to on the piston, so that the port through which main reservoir pressure enters the brake cylinders could not be opened, this has been corrected in the No. 6 valve.

If the independent brake will apply and the automatic brake will not, it indicates that the application valve and piston are not at fault and that reservoir pressure can enter the brake cylinders, if the black hands on both gauges fall during the reduction it shows that the stop cock under the brake valve is open and that brake pipe pressure is being reduced, and after knowing that the pressure chamber is charged, which can be ascertained by means of the drain plug in the chamber, it is safe to conclude that the equalizing portion of the distributing valve is at fault, the valve may be "stuck," or due to the small volume of pressure on the pressure chamber side of the piston, a leaky packing ring could prevent the operation of the automatic brake. If it was found that the pressure chamber could not be charged it would be due to a stopped up feed groove or a bad leak from the pressure chamber to the atmosphere.



NO. 6. DISTRIBUTING VALVE WITH QUICK ACTION CAP.

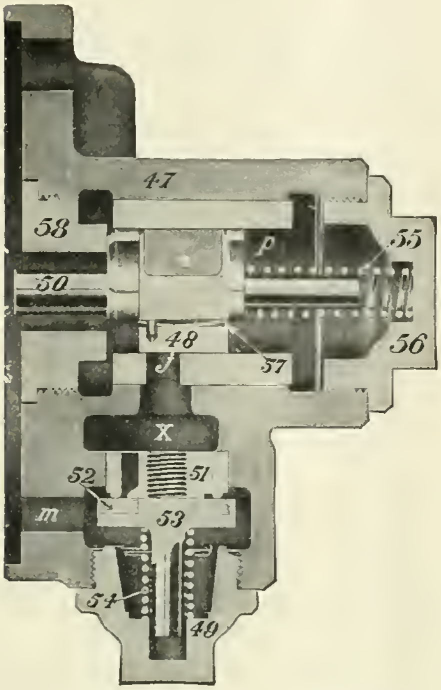
If the brake will not apply with the independent brake valve handle in slow application position or with an automatic service application, but will apply with the emergency or with the independent valve handle in quick application position, it indicates leakage past the application piston of the distributing valve, assuming that the application cylinder pipe, release pipe, and distributing valve gaskets are free from leakage.

The effects of leaks in those pipes and tests to locate them have been referred to in the past.

If the brake will apply in service, emergency, and quick application positions, but will not apply in slow application position, it indicates a stopped up slow application port in the independent brake valve.

If the brake can be applied in slow application, quick application and emergency positions, but cannot be applied in service position, it indicates equalizing valve packing ring leakage or possibly a stopped up service port in the equalizing slide valve; in the latter case the brake would apply after sufficient difference in pressure was created to move the valve to quick action position, the entire observation is based upon the assumption that all other parts except those mentioned are in good condition and free from leakage.

If the brake applies when both brake valves are in their running positions, it indicates that the distributing valve is in good condition, but that brake pipe leakage, together with failure to properly supply it, presumably due to a defective feed valve, has resulted in an application of the brake; when this happens after a release of train brakes it means an overcharge of brake pipe pressure on the head end of the train and the consequent reapplication; the same thing is encountered with the G6 or A1 type of brake, and the same remedy or method of release must



QUICK ACTION CAP FOR DISTRIBUTING VALVE.

be resorted to. If the brake is applied and cannot be released with the automatic brake valve, it indicates that brake pipe and pressure cylinder have equalized, due to a leaky equalizing valve packing ring; if the brake cannot be released with either brake valve, it means that the application piston has "stuck" or is broken, leaving the exhaust valve on lap position.

Leakage past the application piston packing leather and ring can be detected by holding a torch to the distributing valve exhaust port; if there is a leak there when the independent brake valve handle is placed in slow application position, and the brake does not apply, the leakage must be past the packing leather and ring. It is understood, of course, that the leak ceases as the handle of the brake valve is returned to running or lap position.

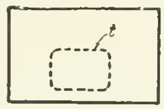
A blow at the distributing valve exhaust port when both brake valves are in running position is from the application valve or from the slide valve in the quick action cap, to determine which is at fault, close the stop cock in the distributing valve supply pipe, and if the application valve is leaking the pressure surrounding the valve will escape in a few seconds time, and the blow will stop, while if the slide valve in the quick action cap is at fault, the blow will continue. Before deciding that the slide valve in the quick action cap is at fault, it is best to close the stop cock under the brake valve and by means of an angle cock exhaust all the brake pipe pressure, then with the independent brake valve release the brake and note whether the blow at the exhaust port stops; if it does, the slide valve of the quick action cap is at fault; if it does not stop, it indicates that both the application valve and the stop cock in the supply pipe are leaking.

Leakage across the seat of the cylinder check valve in the quick action cap will have no noticeable effect until such time as pressure chamber, application cylinder and brake cylinder pressures are somewhat higher than brake pipe pressure, then with the equalizing valve at full stroke brake cylinder pressure can leak past the defective valve into the brake pipe. To test for this leakage, under a 70 lb. brake pipe pressure, reduce brake pipe pressure to 35 or 40 lbs.; if the brake valve equalizing piston operates perfectly at all other times but is unseated at this time and a continuous exhaust of brake pipe pressure occurs, it indicates that the check valve is leaking, the leakage being from the brake cylinder and being supplied from the main reservoir. Under ordinary service reductions, this leakage will have no effect upon brake cylinder pressure, as the slide valve in the quick action cap will prevent any intermingling of brake pipe and brake cylinder pressures, and there is no loss of brake cylinder pressure in either case, and this should not be confounded with any test to determine the amount of brake cylinder leakage. Brake cylinder leakage is ascertained by noting the difference in the number of strokes of the compressor when the brakes are applied and when they are released; brake cylinder leakage is accurately shown in pounds per minute by the red hand on the small air gauge when the independent brake is applied and the stop cock in the distributing valve supply pipe is closed. An application of the independent brake, accompanied by a falling of both main reservoir and brake pipe pressures and followed by a rebuilding of pressures a few seconds later, indicates an obstruction in the reservoir pipe between the reservoir and the branch pipes to the distributing valve and brake valves. The flow may be obstructed by a partially closed reservoir cut-out cock.

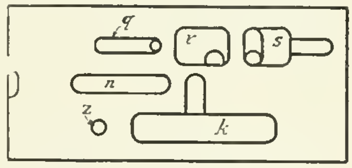
A blow at the distributing valve exhaust port, when the brake is applied indicates exhaust valve leakage, although leakage past the application valve might build brake cylinder pressure up higher than the pressure in the application cylinder and cause the piston to move and draw the exhaust valve to a position in which the exhaust valve would be partially opened in order to discharge to the atmosphere the accumulating brake cylinder pressure.

The application valve being worn unevenly might leak when in application position, yet not leak when in release position, and if such were the case it might complicate matters somewhat during a test, a valve in this condition can be detected by creating some brake cylinder leakage, and if the leak at the exhaust port stops where the brake cylinder leakage exists and begins again as soon as the leak is tightened, it indicates that the application valve is worn in the manner described, but if the blow at the exhaust port continues at all times the brake is applied, the exhaust valve is leaking. If the proper brake cylinder pressure cannot be obtained upon ordinary service reductions, that is about 2½ lbs. for every pound of brake pipe reduction, it is usually and in nearly all cases due to a leak past the valve seat of the safety valve, although it could be due to a distributing valve reservoir full of water or a dirty, gummy condition of the equalizing valve.

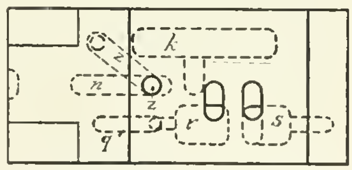
The leak at the safety valve cannot occur while the equalizing valve is in serv-



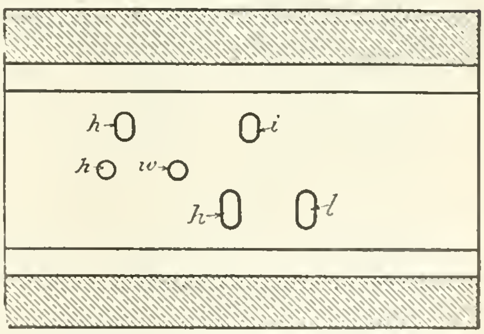
PLAN OF GRADUATING VALVE.



FACE OF SLIDE VALVE.



PLAN OF SLIDE VALVE.



PLAN OF SLIDE VALVE SEAT.

GRADUATING VALVE, SLIDE VALVE AND SLIDE VALVE SEAT.

ice lap position, the position that is assumed immediately following a light brake pipe reduction, as the graduating valve at this time cuts off communication between the application chamber and the safety valve. The leak can be discovered when the automatic brake is released and the independent brake is applied.

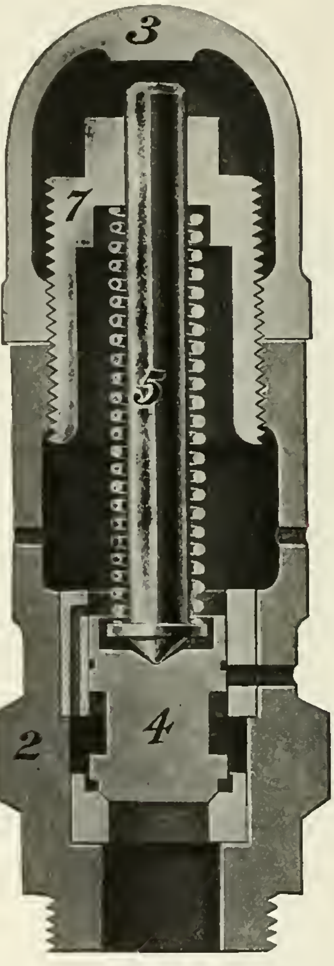
Ordinarily, this safety valve should maintain brake cylinder pressure, or rather application cylinder pressure at 68 lbs., and at 75 lbs., when the brake valve is in emergency position, the difference being due to a flow of air through the "blow down timing port" of the brake valve. The cap nut regulates the lift of the valve and must be screwed down properly, the pop action is regulated by the fit of the valve piston and by the size of the ports through the spring chamber. If the safety valve is set and opens at 68 lbs. and allows the application cylinder pressure to reduce somewhat below this figure before closing it, it indicates that the pop action or movement is too slow.

An accumulating air pressure in the spring box or spring chamber assists the spring and stem to again seat the valve piston, and the pop action depends upon the regulation of this pressure, therefore in the above case it is evident that the proper amount of pressure was not maintained in the spring chamber, due to air escaping too rapidly through enlarged ports or holes in the spring chamber or that air could not enter the chamber fast enough to insure the pop action.

The latter would be due to too neat a fit of the piston valve, which could be made so by an accumulation of dirt and oil.

If the valve opens or pops at 68 lbs. and then allows application cylinder pressure to increase to a figure somewhat above 68 lbs., it shows that pressure is accumulating too rapidly in the spring chamber, either because the ports or drilled holes leading from there to the atmosphere are partly closed with dirt or paint, or that air can enter the spring chamber too rapidly past a loose fitting valve piston. The effect is but natural, as the pressure accumulates too rapidly, and with the assistance of the spring, forces the valve to its seat before application cylinder pressure has reduced the proper amount, and it reflects no credit upon the quick repair artist if he enlarges the ports to offset the loose fitting piston instead of fitting a new piston in the bushing.

Such methods often give temporary relief, but eventually ruin all the apparatus; in the safety valve the size of the ports and the fit of the piston valve must be accurate if correct operation is desired, cleaning out the strainer and blowing out the passage into which the safety valve is screwed will result in less safety valve leakage, as it is in nearly all cases caused by a small quantity of dirt collecting on the valve seat. The object of the quick action cap of the distributing valve is to make a brake pipe opening to the brake cylinders during emergency applications, so that in double-heading there will be no difficulty in securing a brake pipe reduction that is rapid enough to throw the triple valves in the train into quick action, therefore it follows that if the equalizing valve is neglected until it becomes "sticky" enough to jump against the graduating spring with sufficient force to compress it, or if the spring is never examined until corrosion practically eats it up, quick action is liable to occur during a service reduction, occasional cleaning and examination will, however, overcome and avoid any tendency toward undesired quick action coming from the distributing valve. Lack of attention might also result in the quick action valve sticking open at some time after an emergency application, when it does, it allows brake pipe pressure to



E 6 SAFETY VALVE.

flow toward the brake cylinders, and as the locomotive brake starts to release the brake pipe will be open to the atmosphere through the exhaust port of the distributing valve, and the brakes will reapply.

For this reason there should be a stop cock located in the brake pipe branch to the distributing valve when the quick action cap is used, and in a case of this kind it can be used to cut off brake pipe pressure, and the engineer could still use the independent brake in conjunction with the train brakes.

This is one case where cutting out the distributing valve by means of the stop cock in the supply pipe will not help the matter in the least, as the flow of brake pipe air past the open valve must be stopped, and if there is no stop cock in the pipe and the valve cannot be seated by tapping the valve cap with a hammer or wrench, the pipe must be disconnected and plugged or a blind gasket must be inserted in the union connection.

A matter of this kind is in itself of sufficient importance to impress upon the mind of anyone the necessity for knowing the kind of an equipment that is being used on the locomotive and what can be done with it in a case of emergency.

The equipment may be looked after ever so carefully, yet the engine may get off the track or strike something and damage the equipment, and, furthermore, the emergency case is always unexpected.

Conserve the Timber Supply.

The Forest Service of the United States Department of Agriculture has issued a circular to railroad companies, urging them to practice forest conservation and better timber utilization. The most important section of the circular reads:

"Each railroad has its own especial timber problems which must be worked out to meet the given conditions. At the same time there are certain lines of general policy which can be profitably adopted by many roads. They are:

"1. The use of chemically treated ties wherever possible. 2. The use of so-called inferior woods, as, for example, black gum and loblolly pine, for ties, which will reduce the drain on white oak, and which is entirely practicable if the ties are treated. 3. The purchase and management of land bearing mature timber which can be used immediately, and of second-growth timber which will meet the needs of the future. Such lands, if properly managed, will insure a perpetual supply of ties and lumber at the cost of production. 4. The planting of trees upon non-agricultural land owned by the company, which does not now contain sufficient young growth to produce a timber crop. 5. Co-operation with the other roads in the adoption of standard specifications for ties and timber and for the treatment of them. Co-operation with timberland owners and the States in fire prevention, and in bringing about conditions which will make the practice of forestry profitable."

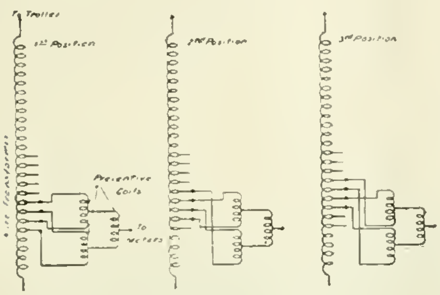
Several of the leading railway companies in Great Britain are solicitous for amalgamation in order to reduce competition and to minimize the expenses of operating. The British Board of Trade gave advice to Parliament on such matters and the majority of its members favored granting the application of the railway companies, but a recommendation has been made for the supply of more information by the companies iterested.

Electrical Department

Alternating Current Voltage Control.

WM. B. KOUWENHOVER

Power is usually applied to an electric locomotive or motor car in a series of steps by which the power is gradually increased. This corresponds to the gradual opening of the throttle on a steam locomotive. The horse power exerted by the motor in starting the train equals the product of the current in amperes and the pressure in volts multiplied by the



OPERATION OF PREVENTIVE COILS.

efficiency of the motor. The horse power developed by the motor can also be easily calculated if the torque in pound-feet and revolutions per minute, or speed, are known. It is a curious fact that the torque of an electric motor does not depend upon the electric power supplied to it, but only upon the current in amperes that is supplied to its armature, while the speed, or the revolutions per minute, depends entirely upon the voltage impressed across its armature terminals.

The effort is made by all automatic control systems in starting electric trains or locomotives to keep the current practically constant, thereby producing a steady torque which gives the smoothest acceleration. The voltage is what is increased step by step during starting, not the current as is most commonly supposed. The increased voltage multiplied by the constant current gives the increase in power, and as the voltage is increased the train gains in speed.

Both direct current and alternating current system of motor control make the attempt to maintain a constant current during acceleration. The reader is referred to pages 21 and 22 and pages 163 and 164 of the 1908 volume of RAILWAY AND LOCOMOTIVE ENGINEERING for description of two typical direct current control systems for the operation of railway motors. In these direct current systems the current is collected from a third rail or trolley and before reaching the motors it is passed through a series of resistances called grids. These grids, because of the resistance or friction offered to the passage of the electric current, consume a portion of the power. The amperes or volumes of current are not used up in these grids, but only a portion of the voltage or pressure that drives the current. The remaining portion serves to turn the motors at a slow speed. As the train gradually gains in speed, one of the series of resistance grids is cut out of circuit and the voltage that was formerly lost in that grid now serves to increase the speed of the motors. The grids are successively cut out of circuit until the full line voltage is impressed across the terminals of the motors and the train is running at speed. Just as much current as is taken from the third rail is delivered to the track; none of it is destroyed; but the voltage is used up in driving the current through the resistances and the motor.

This state of affairs might well be compared to a steam pump which delivers water to a water wheel at a considerable distance. The same volume of water that enters the pipe at the pump end must leave it at the water wheel, provided there are no leaks. The pressure at the water wheel, however, is less than the pressure at the pump because of the friction of the water in passing through the pipe. None of the water is lost in the pipe, only some of the pressure that drives it is thus transformed. In the same way none of the electric current is lost in the grid, but a part of the pressure that drives it is transformed into heat.

This loss of a portion of the voltage during acceleration results in a corresponding loss of power. If the stations are close together on a road and the stops frequent, then a considerable portion of the total energy used by the motor train is lost, because of the frequent recurring periods of acceleration. The reason that direct-current roads tolerate this waste of electric power is that there is no simple and economical method of varying the voltage of a direct currect system. Voltage changers, or direct current transformers as they might be called, are expensive, bulky, and as they are rotating machines they require considerable attention and care.

When it comes to the use of alternating current as the motive power of a railroad, the case is very different because the voltage of an alternating current circuit can be easily and economically changed. It is possible with alternating current to reduce the voltage at starting by means of transformers and to gradually increase it step by step until full line voltage is applied to the motors without the use of resistance grids. Alternating current transformers are simple in construction and possess no moving parts. They are compact, and are of the highest efficiency. With alternating current applied to the driving of electric locomotives, it is possible to omit the wasteful grid resistances and to obtain a smooth and economical acceleration without their use. The New York, New Haven & Hartford Railroad is the only trunk line that is using alternating current for train propulsion at present. The reader is referred to our May 1909 issue for a description of the equipment of this road, but in this account the control system is but briefly mentioned.

The New Haven electric locomotives are equipped with four motors of 250 horse power each. These motors are of the gearless type and are mounted directly on the axles. The motors are connected permanently together in pairs and each pair is operated as a separate motor unit, being provided with its own individual control equipment. These locomotives operate on either direct or alternating current, because they use a portion of the New York Central's tracks upon which a direct current system is employed. Their direct current control and its operation is similar to any other direct current control to which references have already been made, and it need not be described here.

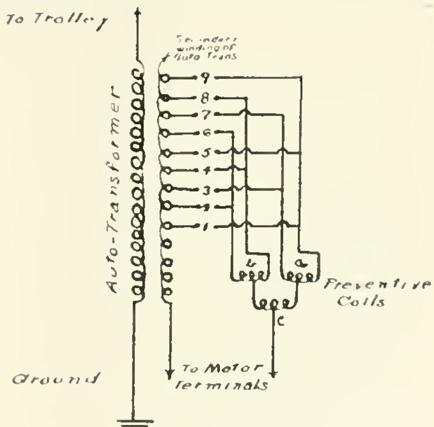


FIG. 1. ALTERNATING CURRENT CONTROL CIRCUIT.

We will now consider the alternating current system of control.

An entirely separate and independent control equipment is provided for each motor. This equipment for the alternating current control consists of one step-down auto-transformer for reducing the voltage, eleven unit switches for making the connections, and three preventive coils whose function will be discussed later. No resistance grids are used for the alternating current control. The unit switches, transformers and other control apparatus are conveniently located in the cab of the locomotive in groups. The group on one side belongs to one motor and that on the other side to the other motor. The use of two completely independent control equipments helps to distribute the weight, and greatly increases the reliability of service. The unit switches are operated by compressed air at 80 lbs. pressure, the air valves being controlled by a 20-volt storage battery.

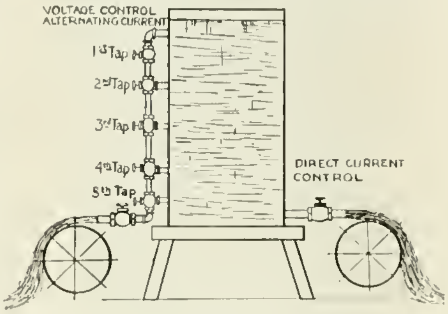
Two pantagraph trolleys collect the alternating current at a potential of 11,000 volts from the trolley wire and feed it to one terminal of the primary of the auto-transformer. The other primary terminal is grounded and the track serves as the return circuit for the current to the power house. The secondary of the transformer is provided with nine taps placed at regular intervals. From this feature it derives its name, auto-transformer.

The voltage ratio of a transformer varies as the ratio of the number of primary turns to the number of secondary turns, as was explained on pages 26 and 27 of the January, 1909, issue of this magazine in an article on the Operation and Construction of Transformers.

As the motors are entirely separate, we may consider the operation of one because there are no series or parallel connection between the two motors as in the case of direct current control systems. There are six notches or positions for the operating handle in the alternating current control and every one of them is a running position, as compared with the two running positions which the ordinary direct current control system can offer.

On the first notch one motor terminal is connected to one end of the secondary winding of the auto-transformer, and the other terminal is connected to tap No. 1 on the transformer through the preventive coils (see Fig. 1). There are three preventive coils or small transformers as they really are, and for the purpose of explanation we will call them *a*, *b* and *c*. As was stated, the other motor unit terminal does not connect directly to tap No. 1 but through the preventive coils in the following manner: The terminals of coil *a* are connected to taps Nos. 1 and 3 of the auto-transformer, and coil *b* to taps Nos. 2 and 4. The terminals of coil *c* are connected to the centers of the windings of coils *a* and *b*, and the motor terminal is connected to central point of coil *c*, thus completing the circuit, as is shown in Fig. 1. On this notch the smallest number of secondary turns are in use and the step-down ratio of the transformer is large, providing a strong current at a low voltage for starting the locomotive. In Fig. 1 the few turns of the secondary winding of the auto-transformer are represented by the three or four loops shown below the tap marked No. 1. On the second notch one terminal of coil *a* is shifted from tap No. 1 to tap No. 5, connecting coil *a* to taps No. 3 and 5. The other connections remain as before. This second notch increases the number of secondary turns and provides the increase in voltage needed for further acceleration, the current remaining about the same. On the third notch the connection of coil *b* to tap No. 2 is broken and this terminal is connected to tap No. 6, no other connections being shifted.

This is continued through notches four and five until the sixth and last notch is reached. On this notch the full 450 volts is applied to the motors, and full speed is rapidly attained. It can readily be seen that through the use of these preventive coils that at no time during acceleration is the motor circuit opened or is there any portion of the transformer winding short-circuited. Each one of the six points on the control is a running position because at no time is there any resistance in series with the motors in which energy would be lost. Thus it is clear that the alternating current system for electric roads offers a control that is very economical of power and simple in its operation.



IMAGINARY ILLUSTRATION OF A.C. AND D.C. CONTROL.

The direct and alternating current systems of control may be compared to a system of control that could be applied to a water wheel. Suppose a tank 60 ft. high, provided with a pipe feeding the water wheel and that this pipe had a throttle valve in it which opened step by step like the notches in a locomotive lever. If we start the wheel by letting water in through a very small opening and continue increasing the flow notch by notch we have a system of control that can be compared to the ordinary direct current control system. In this illustration we have nothing analagous to the resistance grids which are all cut in at the start and successively cut out.

Suppose that instead of using the throttle, we had a tank tapped with pipes every ten feet of vertical height. Now suppose we first feed the water wheel from the pipe that taps the tank 10 ft. from the top, and then shift to the next lower tap without shutting off the water and continue until the wheel is connected to the tap at the bottom of the pipe. If we use this method of starting the wheel we have a system that is similar to the alternating current system described above. It is in fact varying what the hydraulic engineer calls the "head." With alternating current it is called the system of voltage control. The illustration does not represent an exactly equivalent case; the water wheel should first be driven with 10-ft. head, then 20-ft., and so on. A rough idea of the principle of voltage control may be had by an intelligent reference to the figure. It must be remembered that a more correct illustration would have to show a series of tanks, the first 10 feet high, the second 20 feet and so on, all connected so that the water wheel would be driven by these various heads according as the valve of each was opened.

When starting the water wheel or motor only a low head or voltage is used, and this is gradually increased as the wheel or motor gains speed. Each increase in head or voltage supplies more power and means a gain in speed.

The connection for both motor units are made simultaneously by their respective groups of unit switches. The engineer in the locomotive cab controls the unit switches through a master controller. This master controller is provided with a reversing handle and an operating handle. The operating lever is fitted with notches and is similar to the ordinary locomotive throttle lever.

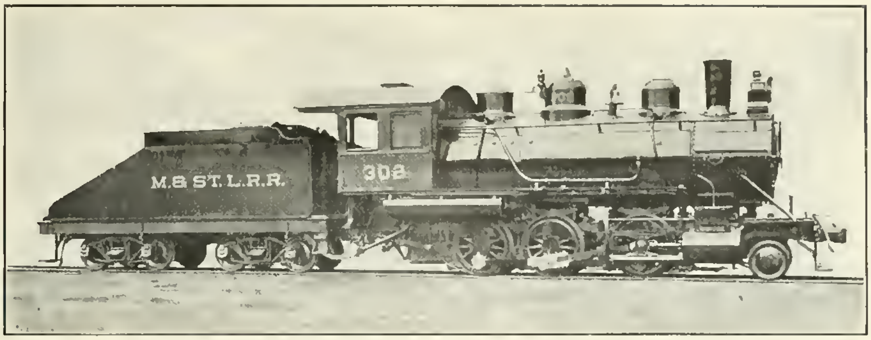
Wisdom from Burdette.

Robert Burdette, who is now The Reverend, came first into popularity through the funny sketches he wrote for the Burlington *Hawkeye*, many of them relating to railway matters. Mr. Burdette, while celebrated as a humorous writer, preached many serious sermons as advice to his son. For instance:

"Don't be afraid of killing yourself with overwork, my son. Men seldom work so hard as that on the sunny side of thirty. They die sometimes, but it is because they quit work at 6 p. m. and don't go home till 2 a. m. It's the intervals that kill, my son. The work gives you an appetite for your meals; it lends solidity to your slumbers; it gives you a perfect and grateful appreciation of a holiday. There are young men who do not work, my son—young men who make a living by sucking the end of a cane, and who can tie a necktie in eleven different knots, and never lay a wrinkle in it; who can spend more money in a day than you can earn in a month, son; and who will go to the sheriff to buy a postal card, and apply to the office of the street commissioner for a marriage license. So find out what you want to be and to do, son, and take off your coat and make success in the world. The busier you are the less evil you are likely to get into, the sweeter will be your sleep, the brighter and happier your holiday, and the better satisfied will the world be with you."

Minneapolis and St. Louis Engines.

The Baldwin Locomotive Works have recently completed 14 locomotives for the Minneapolis and St. Louis Railroad. Four of these engines are of the ten-wheel type for passenger service; seven are of the consolidation type for freight service, while the remaining three are mogul switchers. We may mention that twelve consolidation type locomotives similar in all respects to the Minneapolis and St. Louis engines, have also been constructed for the Iowa Central Railway.



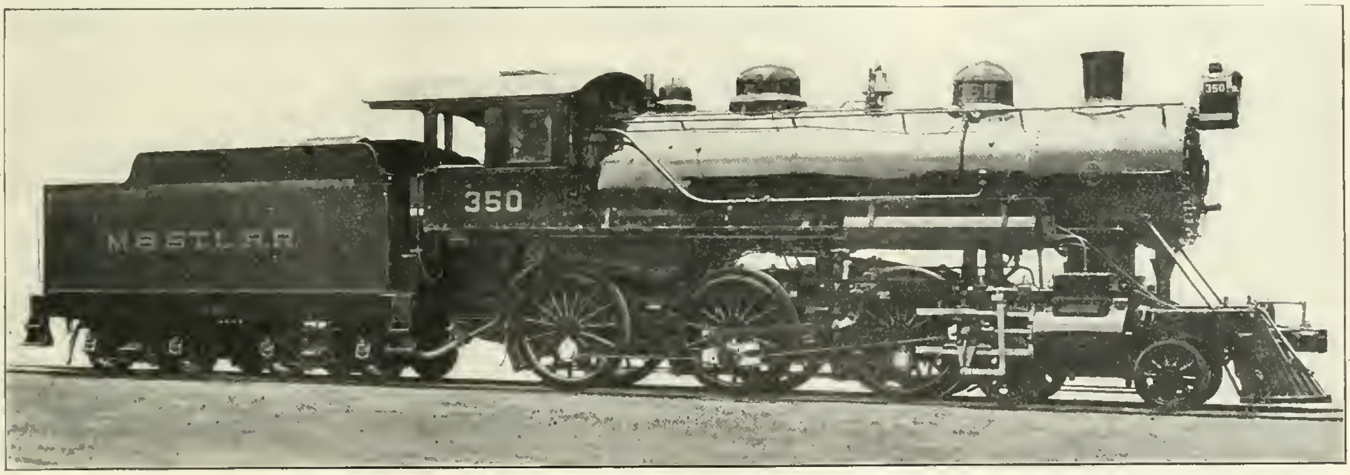
MOGUL SWITCHER FOR THE M. & ST. L. RAILROAD.

THE 4-6-0 TYPE.

The ten-wheel locomotives exert a tractive force of 28,660 lbs., and while their boiler capacity is not as great as could be provided in a pacific type locomotive with the same weight on driving wheels, they are, however, admirably adapted to the handling of heavy passenger traffic. In common with the consolidation type engines, these locomotives are fitted with balanced slide valves and Walschaerts valve gear.

The cylinders, which are 21 x 26 ins., are similar to those used with the Stephenson gear, and the steam chest center lines are placed 3 ins. inside the cylinder center lines. The upper end of each combining lever is pinned to a casting which slides in a bracket bolted to the top guide bar. The casting is rectangular in cross section, where it is supported by the bracket, and is provided, on the inside, with a lug to which the valve yoke is attached. This is a simple form of connection by which the use of rockers is avoided. The links on the ten-wheelers are supported outside the leading drivers, by longitudinal bearers, and the reverse shaft is carried on a crosstie which spans the frames ahead of the main drivers. The driving wheels are 68 ins. in diameter. The frames are of cast steel, with double front rails of wrought iron. The cross-heads, guide bearers, driving wheel centers, driving boxes, and spring saddles, are also of cast steel. The wheel centers have cast iron hub liners.

The boiler is of the wide firebox wagon-top type, with a sloping throat and straight back head. The mud ring is supported on sliding shoes in front and a buckle plate at the rear. A brick arch is used, and it is carried on four water tubes, 3 ins. in diameter. The grate is provided with a drop plate at the back, and the ash-pan is self-dumping. The tender presents no unusual features of construction. The frame is built of 13-inch steel channels, and the trucks are equipped with forged and rolled steel wheels, supplied by the Standard Steel Works Company.



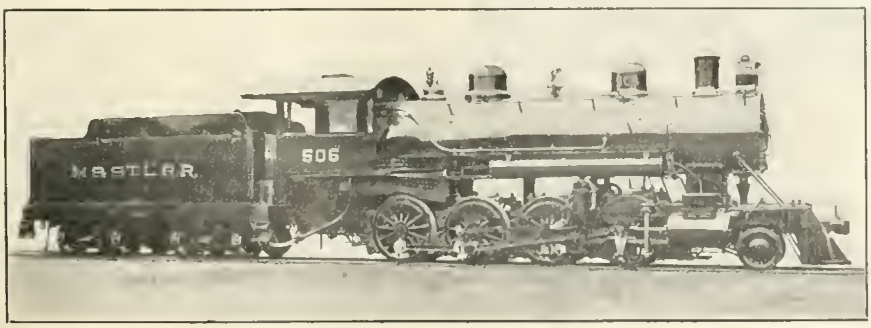
PASSENGER 4-6-0 ENGINE FOR THE MINNEAPOLIS & ST. LOUIS RAILROAD.
John Tonge, Master Mechanic and Master Car Builder. Baldwin Locomotive Works, Builders.

THE 2-8-0 TYPE.

The consolidation type locomotives exert a tractive force of 37,480 lbs., having cylinders 21 x 30 ins., driving wheels 60 ins. in diameter and a steam pressure of 200 lbs. The engines have as many details as possible in common with the ten-wheelers. A difference, however, occurs in the boilers, as these in the freight engines are straight topped with vertical throat sheets. The method of connecting the combining lever and valve rod of the Walschaerts valve gear is the same as that used on the passenger locomotives. On the consolidation engines, both the link and reverse shaft bearings are supported by the guide yoke.

THE 2-6-0 TYPE.

Although the mogul type is usually associated with road service, it is also well adapted to switching service, and the Minneapolis & St. Louis engines are



CONSOLIDATION FOR THE M. & ST. L. RAILROAD.

especially designed for this class of work. The valve gear is of the Stephenson shifting link type, and the boiler is straight topped with a long firebox placed above the rear driving axle and between the frames. The cylinders are 20½ x 26 ins.

The principal dimensions of these three classes of engines are given in the accompanying tables:

4-6-0 TYPE.

Boiler—Diameter, 66⅜ ins.; thickness of sheets, ⅝ and 11/16 ins.; working pressure, 200 lbs.
Firebox—Length, 90 ins.; width, 68 ins.; depth, front, 66¼ ins.; depth, back, 54 ins.; thickness of sheets, sides, 5/16 ins.; back, 5/16 ins.; crown, ⅜ ins.; tube, ½ ins.
Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Tubes—Material, steel; wire gauge, No. 11; number, 316; diam., 2 ins.; length, 15½ ft.
Heating Surface—Firebox, 152 sq. ft.; tubes, 2,473 sq. ft.; firebrick tubes, 24 sq. ft.; total, 2,649 sq. ft.; grate area, 42.5 sq. ft.
Driving Wheels—Diameter, outside, 68 ins.
Wheel Base—Driving, 15 ft. 10 ins.; total engine, 26 ft. 11 ins.; total engine and tender, 54 ft. 3¾ ins.
Weight—On driving wheels, 132,900 lbs.; on truck, front, 40,950 lbs.; total engine, 173,850 lbs.; total engine and tender, about 295,000 lbs.
Tender—Tank capacity, 6,500 gals.; fuel capacity, 10 tons; service, passenger.

THE 2-8-0 TYPE.

Boiler—Diameter, 66⅜ ins.; thickness of sheets, ⅝ and 21/32 ins.; working pressure, 200 lbs.
Firebox—Material, steel; length, 101 15/16 ins.; width, 60 ins.; depth, front, 65 ins.; back, 56 ins.; thickness of sheets, sides, 5/16 ins.; back, 5/16 ins.; crown, ⅜ ins.; tube, ½ ins.
Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Tubes—Material, steel; wire gauge, No. 11; number, 326; diameter, 2 ins.; length, 16ft.
Heating Surface—Firebox, 149 sq. ft.; tubes, 2,716 sq. ft. firebrick tubes, 24 sq. ft.; total, 2,889 sq. ft.; grate area, 42.5 sq. ft.
Driving Wheels—Diameter, 60 ins.
Wheel Base—Driving, 17 ft.; total engine, 25 ft. 8 ins.; total engine and tender, 55 ft. 8 ins.
Weight—On driving wheels, 161,150 lbs.; on truck, front, 20,650 lbs.; total engine, 181,800 lbs.; total engine and tender, about 312,000 lbs.
Tender—Tank capacity, 6,500 gals.; fuel capacity, 12 tons; service, freight;

THE 2-6-0 TYPE.

Boiler—Type, straight; material, steel; diameter, 72 ins.; thickness of sheets, ¾ ins.; working pressure, 195 lbs.
Firebox—Material, steel; length, 108 ins.; width, 33 ins.; depth, front, 73 ins.; back, 70 ins.; thickness of sheets, sides, ⅜ ins.; back, ⅜ ins.; crown, ⅜ ins.; tube, ½ ins.
Water Space—Front, 4 ins.; sides, 3 ins.; back, 3 ins.
Tubes—Material, steel; wire gauge, No. 11; number, 311; diameter, 2 ins.; length, 10 ft. 11¾ ins.
Heating Surface—Firebox, 178 sq. ft.; tubes, 1,775 sq. ft.; firebrick tubes, 21 sq. ft.; total, 1,974 sq. ft.; grate area, 24.7 sq. ft.
Driving Wheels—Diameter, outside, 51 ins.
Wheel Base—Driving, 11 ft 2 ins.; total engine, 10 ft. 4 ins.; total engine and tender, 51 ft. 6¼ ins.
Weight—On driving wheels, 137,000 lbs.; on truck, front, 19,800 lbs.; total engine, 156,800 lbs.; total engine and tender, about 257,000 lbs.
Tender—Tank capacity, 5,000 gals.; fuel capacity, 8 tons; service, switching.

P. R. R. Station and Tunnels.

The New Pennsylvania Railroad station in New York covers some eight acres of ground, and to enclose this area, has necessitated the building of nearly half a mile of exterior walls, and has required 490,000 cu. ft. of pink granite. The first stone of the masonry work on the building was laid June 15, 1908.

The station is built after the Roman Doric style of architecture, and covers the area bounded by Seventh and Eighth avenues and 31st and 33rd streets. In designing the exterior of the building, the architects, endeavored to embody two ideas: One, that of a great railway station, and the other, that of a monumental gateway or entrance to a great metropolis. The structure is really a bridge over the tracks, with entrances to the streets on its main axes and on all four sides. In this respect it is unique among railway stations, affording maximum entrance and exit facilities.

NEW YORK STATION OF PENNSYLVANIA RAILROAD—SEVENTH AVE. FACADE.

EIGHTH AVE. FACADE, NEW PENNSYLVANIA RD. STATION IN NEW YORK.

The main body of the building approximates in height the Bourse of Paris, reaching 76 ft. above the street level. With entrances through each of the two corners on Seventh avenue there are carriage drives each about 63 ft. wide, or the width of a New York street. One of the distinctive features of this building is the waiting-room. It is 150 ft. long and its width is 108 ft. 8 ins. The walls of the waiting-room above the main body of the building contain on each side three semicircular windows 66 ft. 8 ins. wide at the base. There is also a window of like size at each end of the waiting-room. The design of the interior of the general waiting-room, while fully adapted to modern ideas, was suggested by the great halls and basilicas of Rome, such as the baths of Caracalla, Titus and Diocletian, and the basilica of Constantine, which are perhaps the greatest examples of large roofed-in areas treated in a monumental manner.

The Pennsylvania has also completed the construction of the tunnels under Bergen Hill and the Hudson River into this station. The Hackensack portal is 6.1 miles from the junction with the main line at Harrison, just east of Newark, N. J. The first excavation for the subaqueous tunnels was begun May 12, 1905. The north tunnel was joined on September 12, 1906, and the south tunnel on October 9, 1906. The tunnels under Bergen Hill were connected on May 7, 1908, and April 11, 1908, respectively. These two tunnels, which are 23 ft. in exterior diameter, are lined with 2 ft. of concrete, and therefore are of 19 ft. interior diameter.

Locomotive History on the B. & M.

By W. A. Hazelboom.

At this time after its identity was threatened by the much discussed merger, it may not be inopportune to present a brief historical sketch of the development of the locomotive on the famous old Boston & Maine Railroad, the only survivor of the eight or nine railroads entering Boston in their own terminals twenty-five years ago. The New York & New England, Boston & Providence, Boston & Albany, Old Colony, Eastern, Boston & Lowell and the Fitchburg have one by one succumbed to the irresistible march of consolidation and are now memories only. The proposed New Haven-Boston & Maine merger had been the all-absorbing topic in political and railroad circles in Massachusetts for many months, but the consummation of this highly interesting event has been postponed to some indefinite period.

Within the memory of many living to-day, the Boston & Maine itself has grown from insignificance to the mighty proportions of a system representing over one hundred smaller corporations, the mention of many of which would recall long forgotten companies absorbed in their infancy by the larger and more powerful concern of which they were a connection or possible future competitor.

The accompanying schedule of locomotives as of record, May 31st, 1856, may be properly termed the nucleus of the Boston & Maine motive power, and furnishes an interesting and instructive study in weights, measurements and valuations of that period of the road's existence when the community was suffering from many of the inconveniences attendant upon early railroad travel. Four-wheel passenger coaches were however, a thing of the past, but Hinkley & Drury locomotives of the 2-2-0 and 2-2-2 pattern were in evidence, and in fact prominent.

The names of the locomotives were arranged alphabetically and the writer has inserted in the schedule the road numbers which, a few year later, were placed upon the engines according to their priority in the service. Those against which no numbers appear were sold or otherwise disposed of before the custom of using numbers together with the names was adopted. It is only a comparatively short time since the names were abolished, but the numbers have never been re-arranged and the present Boston & Maine locomotives from No. 1 to No. 36 descend by succession, if I may so express it, from the pioneers of the early fifties. When this road took over the Eastern, Boston & Lowell and the Fitchburg the respective equipments were assigned a group of numbers of their own and to this day may be identified.

The spirit of rivalry and emulation among the different locomotive builders in those days was most acute and it cannot be denied that any improvements upon the crude facilities of the times adopted by one road were quickly seized upon and appropriated to their own advantage by contemporaries. An early writer's account of the origin of the 10-wheel freight engine ascribes the idea to Septimus Norris of Norris Brothers, Philadelphia, but certain it is that in March 1847 the 10-wheel engine "New Hampshire" was delivered by Hinkley & Drury to the Boston & Maine, followed a little later by another exactly like it called the "Maine." The "New Hampshire" was selected to run against a coal burning engine, and the test was commented upon by Zerah Colburn in his famous book, "The Locomotive," from which I freely quote for the benefit of those who may not have read that interesting work. He says in part:

The coal burning engine built by Ross Winans, of Baltimore, and placed by him for trial on the Boston & Maine Railroad, had 17 ins. outside cylinders laid horizontally, 22 ins. stroke and eight drivers, having chilled rims 43 ins. in diameter, all the drivers being placed between the fire and the smoke boxes. The connecting rod is applied to the third pair of wheels from the smoke box. The distance between the centers of the extreme axle is 11 ft. 3 ins.; between the centers of the cylinders, 6 ft. 5 ins. The boiler shell is made of 5/16 iron, and measures, in its smallest inside diameter, 41 ins. There are a hundred and one, 2½ in. and two 2-inch wrought iron tubes, 13 ft. in length The upper row of tubes is nearly up to the top of the cylindrical part of the boiler the water level being in the dome above the waist of the boiler. The dome is formed a little forward of the middle point of the boiler, having the same diameter, and rising 51 ins. above it. There is a step on the back side of the fire box, making the length of the grate 14 ins. more than the length of the crown sheet. The firebox is of 2/3-in. copper, with the exception of the tube sheet, which is of ½-in. iron. Length of grate, 56½ ins.; at crown sheet, 42½ ins.; mean breath of grate, 42½ ins.; at center of boiler or middle row of tubes, 39½ ins.; all inside measures. The whole depth from the crown sheet to grate is 51½ ins. The grate bars are very heavy, and are cast but two together. Their ends come through the bottom of the firebox, on the back side, and have round holes through which to put a bar to stir them occasionally, in order to loosen the cinders and melted coal. The exhaust from both cylinders comes through a cast iron box or blast pipe having movable sides, so that the aperture at its mouth may be varied from 3¼ to 10 sq. ins. There is a pipe about 9 ins. in diameter, passing through the smoke box, from the bottom to the top, and entering the chimney, leaving a few inches all around it for the smoke to rise through. The exhaust enters this pipe at the bottom, and the partial vacuum created by its action supplies the blast, as in ordinary locomotives. The tube furnace of this engine is 860 sq. ft.; of heating surface in firebox, 66 sq. ft.; and area of grate is 16 2/3 sq. ft.

Messrs. Slade & Currier, civil engineers, were commissioned to make experiments with this engine, in order to institute a comparison between it and a first-class wood engine, but more particularly to test its actual value as a coal-burning engine. The results of their experiments have been published, but they neglect to state that the "New Hampshire" (the wood engine) was of a materially different pattern from the "coaler," inasmuch as it had six driving wheels and a truck frame, thereby losing a considerable per cent. of the adhesion due to its weight, as compared with the "coaler." The dimensions of the "New Hampshire" were as follows: 16-in. cylinder, 20-in. stroke; diameter of drivers, 46 ins.; length of tubes, 10 ft. 6 ins.; diameter of boiler, 45 ins. This engine was built by Hinkley & Drury.

The experimental trips were made in the later part of January and in the beginning of February, 1850. The entire distance from Boston to Great Falls is given as 74 miles. There was more or less snow on the track during the time in which the experiments were made. The highest grades were about 47 ft. per mile. One point unfavorable for the "coaler" was the fact that from there being but about 25 miles of double track, the freight trains were subject to frequent and protracted delays, in waiting for passenger trains to pass. In waiting, the fire in the wood engine could be suffered to go nearly down, the firebox being filled with wood when the train came in sight. In the coal engine, however, it was necessary to keep the furnace filled with coal, as, if suffered to get down, it would take considerable time to recover the fire.

With the "coaler," the average of ten trips showed a consumption of 4,786 lbs. of anthracite coal to evaporate 3,512 gallons in going 74 miles; this being 10.31 lbs. coal required to evaporate one cubic foot of water. With the wood engine, 3 cords and 4/10 of a foot of wood of various qualities and prices, were used to evaporate 3,734 gallons of water.

The cost of carrying 15,000 tons one mile with wood was found to be	$14.04
With coal	12.70
Balance in favor of coal	$ 1.34

The wood engine had a sand-box, and wrought iron tires; the "coaler" had a sand-box also, but had chilled wheels.

The "coaler" took 76 cars, weighing with freight, 433 tons, up Ward Hill, in Bradford, where there is a grade of 47 feet per mile, and also a very bad reverse curve. In going up the hill no sand was used, nor did the wheels slip, except, as the report states, some three or four turns where some track repairers had taken off a hand car and left a little snow on the rails.

The wood engine took 61 cars up the same hill, weighing, with freight, 391 tons. Sand was constantly running from the sand-box, except when, to ascertain whether the engine was working up to its full power, the sand was turned off, when the wheels were found to slip very much. The average cost of wood used on the through trips was $3.63 per cord. The cost of anthracite coal, per ton, of 2,240 lbs., was $5.25; ⅝ of a ton of coal was found to be equal in effect for evaporation to one cord of wood, or $3.28 worth of coal equal to $3.63 worth of wood.

The average speed of the "coaler" although having a smaller wheel and a longer stroke, was found to be 2/10 of a mile per hour greater than that of the wood engine; their average speeds being 14 3/10 and 14 1/10 miles per hour respectively. This was probably owing to a loss on the wood engine by slipping of wheels.

In conclusion the commissioners express their opinion that, for running heavy trains, which are not obliged to wait for any considerable time along the line for other trains to pass, they believe coal to be in every way more economical than wood. They also say that in their remarks they would not wish to be considered as in any way disparaging the "New Hampshire" as they considered that a first class wood engine.

A bill for the services of the "coaler" remained an unsettled claim against the Boston & Maine for a long time afterwards. In 1865 the "New Hampshire" and "Maine" were working with 4 ft. 10 in. drivers, four in number, with cylinders 15 x 24 ins., and their valuation estimated at $5,500 apiece.

The "Vermont" was an outside connected engine and was sold (about 1861) to the York & Cumberland R. R. and renamed "Alfred" No. 2. This road ran from Portland to Saco River in Buxton and was afterwards extended to Rochester. The "Cocheco" had features about it distinguishing it from the others. There were five boxes on its main axle and six eccentrics. There was a middle frame and an inside and an outside frame with cranks outside of that, and a pair of trailing wheels which were poorly equalized with the drivers and when backing would often mount the rail, causing no end of trouble. The "Dragon" was a four wheeler as was also the "Swampscott." They were engaged in shifting work at Boston and Lawrence respectively The "Portland" with her single pair of driving wheels was assigned to shifting at the old three-track passenger terminal at Haymarket Square, Boston.

Some of the early Boston & Maine engines were built at the Lowell Machine Shop. They were light weights without steam guages cabs or bells. The Essex Machine Shop, Caleb W. Marvel, superintendent, located at Lawrence, Mass., produced the "Essex" and "Pacific." With the exceptions noted on the lists all the other locomotives were mostly Hinkley's or Hinkley boilers with the principal castings.

The new Exeter (No. 34) was one of the first engines built by the Boston & Maine, followed by the "Strafford." Later they built the "Middlesex" (No. 43) and the "Gen. Sheridan" (No. 45), the latter going into service on the run from Lawrence to South Berwick in place of the old "Merrimack" which years before had taken the place of the old "Augusta."

During the regime of Mr. William Smith as M. M., some locomotives were ordered from Manchester and from Wm. Mason. A number of these were applied as renewals in place of old engines condemned and broken up. In 1863 the Boston & Maine took over the Dover & Winnepesaugee (formerly the Cocheco) Railroad, and the locomotives "Rochester" and "Alton Bay" were thus acquired, as well as 6 passenger cars and 49 freight cars. The U. S. Government called for locomotives when the civil war was at its height and relieved the B. & M. to the extent of two engines and thirteen merchandise cars. The names "Cocheco," "Dover," "Exeter," "Ogiochook" and "Yankee" disappeared from the records at about this time and were never heard of thereafter.

The "Bangor" and the "Antelope" will ever live in New England locomotive building annals as associated with the introduction of larger driving wheels than those then in existence. The "Bangor," a passenger engine, was received from the builders, Hinkley & Drury in December 1845, was inside connected, and had four coupled 5 ft.

BOSTON & MAINE RAILROAD.

SCHEDULE OF MOTIVE POWER FOR THE YEAR ENDING MAY 31ST, 1855.

Road Nos.	Names.	Weight.	Drivers.	Cylinders.	Valuation.	Year.	Remarks.
..	Andover	11 tons	5.	12¾ x 16	$1,000	....	
..	Augusta	11 "	5.	12¼ x 16	2,200	....	
7	Antelope	13 "	5.6.	11¾ x 22	3,000	....	
..	Bangor	19 "	5.6.	14¼ x 18	5,500	....	
14	Boston	19 "	5.	14¼ x 18	5,500	....	Ballardvale Machine Co.
17	Bay State	22 "	5.6.	14¾ x 20	6,500	....	
13	Ballardvale	19 "	5.	14¼ x 18	5,500	....	Ballardvale Machine Co.
..	Cocheco	12 "	5.	12 x 16	2,500	....	
1	Dragon	14 "	4.6.	12 x 20	5,500	....	
..	Dover	24 "	4.6.	15 x 20	6,000	....	
..	Exeter	24 "	4.6.	15 x 20	6,000	....	
16	Essex	24 "	5.6.	15 x 18	6,500	....	Essex Machine Shop.
18	Granite State	22 "	5.6.	14¾ x 20	6,500	....	
..	Haverhill	11 "	5.	12¼ x 16	1,600	....	
12	Hinkley	23 "	5.6.	15 x 20	6,800	....	
13	Lawrence	22 "	5.	15 x 18	5,800	....	
9	Massachusetts	19 "	5.6.	14¼ x 18	5,500	....	
11	Maine	25 "	3.10.	16¼ x 20	6,800	....	
..	Malden	13 "	5.6.	16¾ x 20	3,200	....	
10	New Hampshire	25 "	3.10.	16¼ x 20	6,800	....	
5	Norris	20 "	5.6.	14 x 22	6,000	....	Richard Norris.
..	Ogiochock	10 "	5.	14 x 18	5,300	....	
20	O. W. Bayley	23 "	5.6.	15 x 20	6,800	....	Amoskeag Mfg. Co.
2	Portland	13 "	5.3.	11¼ x 20	3,200	....	
3	Reading	13 "	5.6.	11¾ x 20	3,200	....	
21	Rockingham	24 "	4.6.	15 x 24	7,500	....	
..	Vermont	23 "	4.6.	15 x 20	6,000	....	
6	Swampscott	14 "	4.6.	13½ x 20	4,500	....	
22	United States	24 "	5.	15 x 24	7,500	....	
23	Thomas West	25 "	5.6.	16 x 20	8,000	....	
24	Merrimack	25 "	5.6.	16 x 20	8,000	....	
25	Atlantic	25 "	5.6.	15 x 22	8,000	....	
26	Pacific	25 "	5.6.	15 x 22	8,000	....	Essex Machine Shop.
	ADDITIONS TO THE ABOVE TO MAY 31ST, 1865.						
..	Yankee	23 tons	5.6.	14 x 22	$5,800	1860	
29	Newburyport	23 "	5.6.	14 x 22	5,600	1860	
30	Camilla	21 "	5.	14 x 20	4,200	1860	
28	Mystic	21 "	5.	14 x 20	3,500	1860	
31	Andover	26 "	5.6.	13 x 22	7,500	1861	
32	Ajax	27 "	5.	15 x 24	7,500	1861	
33	Hervules	27 "	5.	16 x 24	7,500	1861	
4	Medford	16 "	5.	11½ x 20	1,800	....	The Bangor re-built and re-named.
8	Memecho	22 "	5.6.	14 x 20	4,000	1863	
19	Wannalancet	20 "	5.	14 x 20	5,200	1863	
27	Haverhill	25 "	5.6.	14 x 22	6,000	1862	
34	Exeter	27 "	5.6.	15 x 22	10,000	1864	Built by Boston & Maine.
..	Rochester	24 "	5.	15 x 22	6,000	1864	From Dover & Winnepesaugee R.R.
36	Alton Bay	20 "	5.	14 x 18	5,500	1864	" " (Rebuilt by B. & M.)
35	Strafford	27 "	5.6.	15½ x 22	16,000	1865	Built by Boston & Maine.

(Continued on page 408.)

Items of Personal Interest

Mr. E. W. Wright has been appointed a roadmaster of the Interstate Railroad, with office at Stonega, Va.

Mr. Barlow has been appointed round house foreman of the Atchison, Topeka & Santa Fe at Clovis, N. M.

Mr. W. Davidson has been appointed roundhouse foreman at Halifax, N. S., on the Intercolonial Railway of Canada.

Mr. J. P. Peach has been appointed general foreman of the Clovis Shops of the Santa Fe, vice Mr. Fiddler, resigned.

Mr. L. E. W. Bailey has been appointed district master mechanic at Moose Jaw, Sask. on the Canadian Pacific, vice Mr. F. W. Sadlier, transferred.

Mr. W. E. Mann has been appointed a division engineer of the Grand Trunk Pacific, with office at Edmonton, Alb., succeeding Mr. R. W. Jones.

Mr. A. H. Biernes has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe at Belen, N. M., vice Mr. W. L. Bean, resigned.

Mr. H Buckholtz has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe at Vaugns, Nev., vice Mr. H. Bernham, transferred.

Mr. M. M. Meyers has been appointed general foreman of the Wellington, Kan., shops of the Atchison, Topeka & Santa Fe, vice Mr. J. W. McVey, resigned.

Mr. H. Williams has been appointed locomotive foreman on the Canadian Northern Railway at Kipling, Sask, vice Mr. A. W. McKenzie, transferred.

Mr. W. H. Kidneigh has been appointed roundhouse foreman on the Atchison, Topeka & Santa Fe Railway at Waynoka, Okla., vice Mr. Harry Giegoldt, resigned.

Mr. W. T. Speak has been transferred as general foreman on the Chicago & Eastern Illinois, from Villa Grove to Salem, Ill., vice Mr. H. J. Beck, deceased.

Mr. W. H. French has been appointed night foreman at Clovis, N. M., on the Atchison, Topeka & Santa Fe, vice Mr. Neil O'Connor, assigned to other duties.

Mr. C. Kyle, heretofore supervisor of engines, has been appointed general master mechanic Eastern Lines of the Canadian Pacific, with office at Montreal, Que.

Mr. C. W. Spicer, formerly chief engineer of the Tremont Lumber Co., has been appointed master mechanic on the Fernwood & Gulf Railroad, with office at Fernwood, Miss.

Mr W. McIntosh, formerly master mechanic at East St. Louis, on the Illinois Central Railway, has been appointed master mechanic on that road at Memphis, Tenn.

Mr. A. W. McKenzie, heretofore locotive foreman on the Canadian Northern at Kipling, Sask, has been appointed locomotive foreman on the same road, at Prince Albert, Sask.

Mr. H. W. Bruckheimer has been appointed the master mechanic of the New Orleans Great Northern, with office at Bogalusa, La., vice Mr. Schledorn, acting master mechanic, resigned.

Mr. Wm. Sennott has been appointed master mechanic in charge of the East Side shops of the Baltimore & Ohio Railroad at Philadelphia, Pa., where they are making extensive alterations.

Mr. W. M. Scroggins has been appointed general car foreman of the Texas & Pacific at Longview Junction, Texas, vice Mr. Thomas Welch, resigned to become postmaster at Longview.

Mr. T. J. Frier has succeeded Mr. Charles A. How as purchasing and supply agent of the Wabash Railroad in St. Louis, Mr. How having resigned to enter the service of the Missouri Pacific.

Mr. A. McGill, general inspector of motive power on the Lehigh Valley Railroad, has been appointed shop superintendent at Sayre, Pa., on the same road, vice Mr. A. W. Whiteford, promoted.

Mr. T. A. Fay, assistant general storekeeper of the Chicago, Burlington & Quincy, at Chicago, has been appointed general storekeeper of that road, with office at Chicago, vice Mr. T. J. Frier, resigned.

Mr. J. G. Stuart, inspector of stores on the Chicago, Burlington & Quincy, has been appointed assistant general storekeeper of the same road, with office at Chicago, vice Mr. T. A. Fay, promoted.

Mr. D. J. Redding, heretofore master mechanic of the Pittsburgh & Lake Erie, has been appointed assistant superintendent of motive power on that road, and his former office has been abolished.

Mr. James Kiely, formerly master mechanic at Raton, N. M., on the Atchison, Topeka & Santa Fe, has been transferred to Clovis, N. M., in the same capacity, vice Mr. Thos. Booth, granted leave.

Mr. Marian Stewart, road foreman of engines on the Santa Fe, has been transferred, with the same duties, from the Rio Grande division to the Western division, with headquarters at Dodge City, Kan.

Mr. J. M. Mack, heretofore locomotive fitter at Brandon, Man., has been appointed acting locomotive foreman at Minnedosa, Man., on the Canadian Pacific, vice Mr. W. F. Lowe, granted leave of absence.

Mr. J. J. Daily has been appointed roadmaster of the Louisiana division, Choctaw District of the Chicago, Rock Island & Pacific, with jurisdiction from Alexandria, La., to Eunice, and with office at Le Compte, La.

Mr. P. A. Crysler, heretofore car foreman, Place Viger, Montreal, has been appointed general car inspector of the Canadian Pacific Railway Eastern Lines, with office at Montreal, vice Mr. G. E. Smart, promoted.

Mr. A. W. Whiteford, shop superintendent of the Lehigh Valley at Sayre, Pa., has been appointed to the new position of assistant to the superintendent of motive power, with office at South Bethlehem, Pa.

Mr. W. B. Embury, master mechanic of the Oklahoma and Pan Handle divisions of the Chicago, Rock Island & Pacific, has had his jurisdiction extended to include Sayre Station. His office is at Chickasha, Okla.

Mr. Charles De Gress, formerly master mechanic on the Mexican Pacific at Colima, has been appointed master mechanic of the railroad department of the Oil Fields of Mexico Co., at Tuxpam, E. de Vera Cruz, Mexico.

Mr. B. L. Wooster has been appointed superintendent of the mechanical department of the corporation controlling the Magdalena River Steamboat Co. and the Cartagena (Colombia) Railway Co. in the Republic of Colombia in South America.

Mr. B. Lynch, formerly road foreman of engines on the New Mexico division of the Atchison, Topeka & Santa Fe, has been appointed to the same position on the Rio Grande division of the same road, vice Mr. Marian Stewart, transferred.

Mr. A. V. Manchester, assistant district master mechanic of the Chicago, Milwaukee & St. Paul at Minneapolis, Minn., has been appointed a master mechanic of the Chicago, Milwaukee & Puget Sound, with office at Miles City, Mont.

Mr. G. E. Smart, heretofore general car inspector, Eastern division, on the Canadian Pacific Railway, has been appointed divisional car foreman on the Eastern division, vice Mr. C. W. Van Buren, promoted. Mr. Smart's office is at Glen Yard, Montreal.

Chairman Knapp of the Interstate Commerce Commission, has been investigating the prospects of transportation business for the remainder of the year, and predicts the railroads will do the banner business in their history. They are likely to exceed the business done in 1907.

Mr. F. C. Armstead, supervising engineer of the stoker department of the Westinghouse Machine Company, who, for a number of years, has been stationed at East Pittsburgh, Pa., has moved his headquarters to the Westinghouse works, Attica, N. Y., where the stokers are manufactured.

Mr. J. G. Neuffer having resigned as superintendent of machinery of the Illinois Central, the Yazoo & Mississippi Valley and the Indianapolis Southern, Mr. J. B. Buker has been appointed superintendent of the car department, and Mr. R. W. Bell has been appointed superintendent of machinery in charge of the locomotive department, both with office at Chicago.

Mr. Oscar F. Ostby, the well-known sales manager of the Commercial Acetylene Company, of New York, was elected president of the International Acetylene Association at the convention which was recently held at the Hotel Knickerbocker in this city. Mr. Ostby is an energetic business man who has done much to popularize the use of acetylene, not only in railway work, but in many other lines as well, and his election as president of this association is a just recognition of the place he has won for himself in the business world.

Mr. J. Parker Snow, bridge engineer of the Boston & Maine at Boston, Mass., was recently appointed chief engineer of that road. In 1884, while working as bridge engineer in the office of Mr. J. W. Ellis, civil engineer, of Woonsocket, R. I., he did his first railway engineering work for the Providence & Worcester, now part of the New York, New Haven & Hartford. He went to the Boston & Maine as bridge engineer on June 5, 1888, which position he held until his recent appointment as chief engineer.

The report is current that Mr. Samuel M. Felton has been offered the position of president of the Chicago Great Western Railway, and is likely to accept. Mr. Felton is one of the best known railroad men in this country, and we consider the stockholders of the Chicago Great Western will be fortunate if they secure Mr. Felton's services. He is a trained civil engineer, the son of one of the most eminent railroad presidents of the pioneer railroad days, and there is nothing worth knowing in railroad management that he is not familiar with.

Mr. C. H. Ketcham, who was for years a popular superintendent of the Lackawanna Railroad, has accepted the position of special representative of the New York Rubber Company. Mr. Ketcham's work is handling mechanical rubber belting and electric supplies. His office is next door to that of Railway and Locomotive Engineering, and Mr. Ketcham assures us that he will be pleased to exchange railroad reminiscences with any of our visitors interested in his specialties.

Mr. Robert F. McKenna, master car builder of the Delaware, Lackawanna & Western, at Scranton, Pa., has resigned, and will retire entirely from railroad life. He intends later on to engage in some other business. His plans for the future have not been decided. Mr. McKenna has grown up in the service of the Lackawanna, advancing step by step by intelligent effort, to the responsible position which he has just left. He leaves the service of the company in the happiest relations with his superiors and subordinates, whose confidence he has always enjoyed.

Mr. Charles W. Van Buren, who was recently appointed master car builder of the eastern lines of the Canadian Pacific, with office at Montreal, Can., was born in 1867 in Rensselaer County, N. Y. He went to common school until he was 16 years old, and for a year attended night school in New York City. His first railway work was in 1889 on the New York Central & Hudson River. He was a carpenter at the West Albany shops until 1891, when he was made assistant foreman. Two years later he was put in charge of car department work on the Adirondack division at Herkimer, N. Y. In 1896 he was transferred to Utica in charge of car department work on the Adirondack and Mohawk divisions of the New York Central & Hudson River and the West Shore. In 1905 he went to the Canadian Pacific as general car inspector for the lines east of Port Arthur. He was made division car foreman of the Eastern division in 1906, where he remained until he was promoted to his present position.

Mr. Edward H. Harriman, head of the Harriman Lines, has been away at a noted European watering place in hopes that the baths might prove beneficial for a malady he is suffering from. Report says that the baths have been a disappointment. If anything should happen to take Mr. Harriman away his departure would be a misfortune scarcely second to the demise of the president of the United States. In the battle of life, his sympathies are said always to be with the under dog, as has been repeatedly proved by the settlement of labor disputes. An old rhyme fits Mr. Harriman's case, which says:

"He cares not which dog may be in the wrong,
Or which one was in the right;
But his heart will beat his whole life long
With the under dog in the fight."

Obituary.

We have regretfully to record the death of Charles C. Robinson, which occurred in Centralia, Ill., last August, as the result of a sunstroke. He was born in 1843 and in 1860 he began railroad work as a fireman on the Cleveland & Pittsburgh Railroad, now part of the Pennsylvania Lines. Four years later he was promoted and was made a locomotive engineer. He ran an engine on this road for a few years, when he resigned to enter the service of the Pittsburgh, Fort Wayne & Chicago as locomotive engineer at Alliance, Ohio. In 1872 he became an engineer on the Cleveland, Cincinnati, Chicago & St. Louis Railroad, running a passenger engine between Delaware and Cincinnati continuously for seventeen years. In 1887 he was employed by the Peoria Decatur & Evansville, now the Peoria division of the Illinois Central, first as engineer, and in 1888 he became master mechanic on that road. In 1892 he retired from railroad work. He was a member of B. of L. E., Div. 175, and served as chief of the division and committeeman for a number of years.

Locomotive History on the B. & M.

(*Continued from page 406.*)

6 ins. drivers, the largest in the state at that time. This engine fell into an open drawbridge in Charlestown, and upon being rebuilt, was known as the "Medford." The "Antelope" made by the same builders was delivered to the B. & M., September 19th, 1845, and was equipped with a single pair of 6 ft. driving wheels, a four wheel truck and a small pair of trailing wheels. The drivers were encased in hoods like paddle-boxes upon which the name appeared on the half circle like the name on English engines. In 1860 this engine was working with four 5 ft. 6 ins. driving wheels at a valuation of $500 in excess of that given in her original form. The "Antelope" remained in service for many years on the Merrimack branch.

Last but not the least in this notable list may be mentioned the "Thomas West." Named after a prominent Boston & Maine official of the early days; it remained in service well into the nineties and at the time of its retirement was the last surviving inside connected machine in this vicinity.

The writer is indebted to Mr. L. L. Fletcher, a frequent contributor of interesting reminicences in the columns of Railway and Locomotive Engineering, for much of the information in this article.

The Development of the Railroad Cinder Pit

By Augus Sinclair

When locomotives first came into use an apple of discord was at once thrown between the Mechanical and the Maintenance of Way departments in the shape of cinders discharged from the ash pans of locomotives. The locomotive men were free and easy in the way they poured hot ashes and cinders upon the road bed, while the track men became furious at the nuisance which burned up ties and imposed upon them the necessity for disposing of stuff they had no use for.

ERIE CINDER PIT SHOWING WELL FROM WHICH ASHES ARE TAKEN.

Those who can remember the appearance of motive power terminals of early days, recall tracks laden with heaps of ashes like the burrow heaps of a prairie dog settlement. The first reform was the locating of cinder pits at certain points, which for a time formed another source of discord, as the locomotive men held that it was the duty of the track men to empty these pits and the track men said they would be haggised if they would or something equivalent. A Punic war arose on this question and long years of squabbling passed before a settlement was effected.

Meanwhile cinder pits were growing and multiplying. In the British Isles a cinder pit was generally located at every water crane as convenience to the firemen and as traps for unwary trespassers who frequently descended into these pits with more tumult than dignity.

For many years the pits were mere oblong holes in the middle of the track, with wooden stringers under the rails that were always burning out and sometimes permitting part of the engine to fall into the pit.

Emptying the pits continued to be a question of unrequited labor, the overgrown piles of cinders sometimes interfering with the movement of engine and cars outside of roundhouses. The first systematic attempt at remedy was depressing a track next to the pit track, upon which cars were pushed to be loaded with the cinders thrown out of the pit. That was a labor saving arrangement, but a serious objection was that the hot cinders frequently set fire to the cars.

Some time about 1901 when Mr. John C. Stuart was general superintendent of the Chicago, St. Paul, Minneapolis & Omaha he became strongly impressed with the necessity for some sensible way of handling pit cinders. He took up the subject with Mr. John J. Ellis, then master mechanic of the road, and together they evolved the design of a pit that would carry the cinders by gravity into a side pit that could be cleaned without interference with the engines using the cinder pit.

When Mr. Stuart became general superintendent of the Erie, with headquarters at Cleveland, he developed the cinder pit idea until it had the form shown in the annexed engravings. A substantial fireproof pit receives the discharges from the ash pans and drops the material into the side pit shown which contains sufficient water to keep the cinders wet. A special form of lifting crane made by the Brown Hoisting Machinery Company, of Cleveland, O., moves along a track located close to the holding pit and scoops up the wet cinders as a dredge scoops sand from the bed of a river and loads them into an adjacent car. This is a very convenient crane, for besides handling the grab bucket that lifts the cinders, it can be made to handle other material, such as trucks, wheels and other things too heavy to lift by hand.

The pictures show the whole of this cinder pit equipment as seen at Susquehanna. Under this systematic method of working the cinders are handled at very little expense, and work that was formerly regarded as a nuisance moves as auto-

ERIE CINDER PIT SHOWING INCLINED WALL UNDER TRACK.

matically as a well regulated clock. Several other railroads have adopted the system and it is growing into popularity.

Tests of Ark Tool Steel.

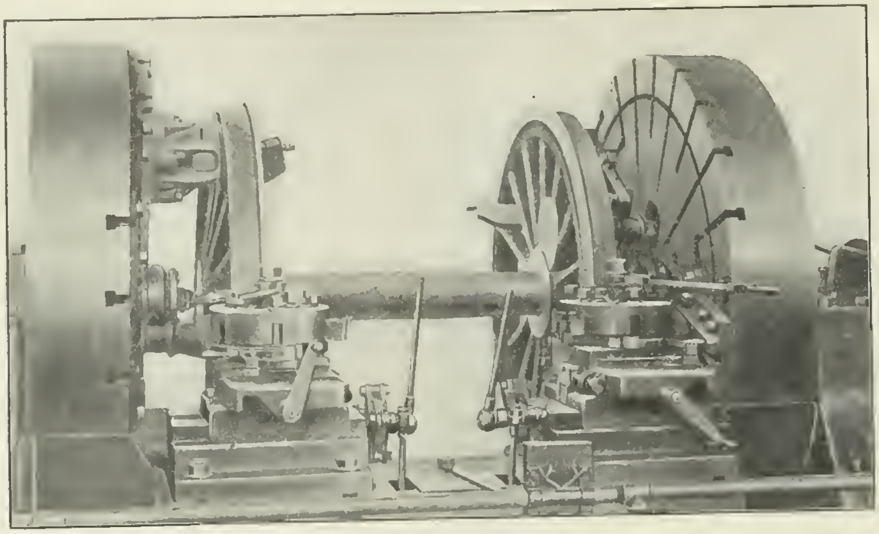
What is known as "Ark" high speed steel made by William Jessop & Sons, Ltd., of New York, was recently subjected to some severe tests, in which the steel gave a good account of itself.

In one of the tests which was conducted at the Otis Steel Company's plant a cut was taken, on a planer, from 0.8 per cent. carbon steel which was hammered into shear blades. This blade was 6 ins. wide and 8½ ft. long, and the tool took the full cut across it without having to be ground. The work was done at a travel speed of 16 ft. per minute. The cut was 1/16 in. deep and ⅛ in. feed.

The second test was in turning a 1 per cent. carbon cast-steel roll, in which the first cut was 1⅜ ins. deep, with a 1/16 in. feed while running at 10 ft. per minute. At this speed it took 4½ hours to finish a cut across the roll. The second cut was ⅞ in. deep, with a 1/16 in. feed, with the same speed per minute. It took 4½ hours to make this cut, and both cuts were made without taking the tool out of the tool post. The tool, therefore, was run 9 hours without grinding.

A third test was made by turning a cast-steel rolling mill pinion that contained 0.48 per cent. of carbon. The cut was 1¼ in deep, with a 1/16 in. feed, and a speed of 12 ft. per minute. The tool was worked 20 hours without regrinding and was in good condition at the finish. On a chill roll a tool 1½ x 2½ ins. worked 18 hours without grinding.

At another place a series of tests were conducted on locomotive tires. These tests consisted in turning up a number of tires on a Niles-Bement-Pond Company's 90-in. tire lathe, and the results of the tests are given in tabulated form in the accompanying record. No comment is necessary, as the table shows for itself what was done. In another railroad shop, satisfactory tests were made on a William Sellers & Co. 90-in. wheel lathe. This lathe with the tires in place is shown in our illustration. It indicates that the work was done in the usual way.



WILLIAM SELLERS & CO., INC., NINETY-INCH WHEEL LATHE.

Proceedings of Fuel Association.

The proceedings of the first annual convention of the International Railway Fuel Association has just been published. It is a paper-covered volume of 197 pages and is of standard size, i. e., the pages are the same size as those of the M. M. and the M. C. B. Association proceedings.

TESTS OF JESSOP'S ARK STEEL IN TURNING LOCOMOTIVE TIRES ON NILES-BEMENT-POND CO.'S 90-INCH LATHE.

Test No.	Diameter of Tire in Inches.	Make of Tire.	Speed in Feet per Minute.	Feed in Inches.	Depth of Cut in Inches.	Cutting Time in Minutes.	Condition of Tool.	Work on Tool to Put in Service.	Remarks.
1	63	Midvale	15	5/16	7/16	12	Failed	Ground.	Cut 3¾ over tread, finished with very hard tires.
2	62⅞	Midvale	15½	5/16	5/16	22	Fair	Ground at finish.	Slowed to 12½ ft.; 3¼ ins Tire very hard. Tire very hard.
3	63	Midvale	12½	5/16	7/16	23	Good	None.	
4	62⅞	Midvale	12½	5/16	5/16	24	Fair	Ground.	
5 1st cut	78⅜	No mark	10	5/16	13/32	28	Good	None.	
5 2d cut			12	5/16	¼	22	Good	None.	
6 1st cut	78¼	No mark	11½	⅜	⅜	25½	Good	None.	Tire very hard
6 2d cut			11½	⅜	5/32	25	Fair	Ground.	
7	62¼	No mark	16½	5/16	⅜	20½	Good	None.	
8	62¼	No mark	16½	5/16	11/32	20	Fair	Ground.	
9	62¼	No mark	16½	5/16	⅜	10	Good	None.	
10	62¼	No mark	17½	5/16	5/16	19½	Good	None.	

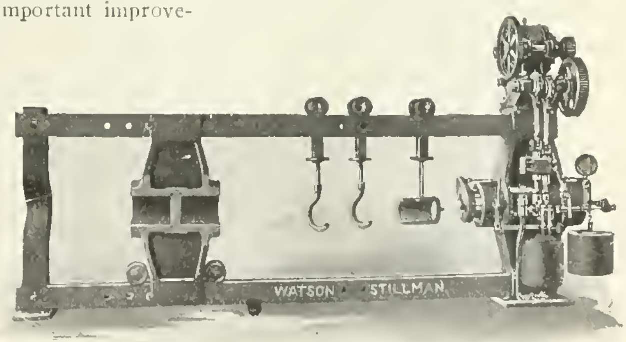
Total weight of chips removed, 1,133½ lbs. Size of tool, 1½ by 3 ins.

There are numerous illustrations and the papers read and the discussions which followed are fully reported. The papers presented were of a practical character, being (1) "Best Method of Accounting for Railway Fuel"; (2) "Briquetted Coal and Its Value as a Railroad Fuel"; (3) "Correct Weighing of Coal at Mines and on Railroad Track Scales"; (4) "Difficulties Encountered in Producing Clean Coal for Locomotive Use"; (5) "How to Successfully Burn Locomotive Fuel Coal"; (6) Standard Types of Coaling Stations." Copies of the proceedings may be obtained from Mr. D. B. Sebastian, secretary of the association, at 327 La Salle street, Chicago, Ill.

Hydro-Pneumatic.

The term "hydro-pneumatic" when applied to a wheel press, at first seems rather curious. Hydro-pneumatic, of course, means water and air, and the combination which the Watson-Stillman Company of New York have made with water and air in their new wheel press is briefly that the reservoir containing water to operate the ram is closed and when the pumps begin, air under pressure is introduced into this chamber and the water is not simply drawn into the pumps by suction, but it is forced into the pumps and the result is that the ram is pushed out faster than if the water was not forced into the pumps. There is a further advantage gained by this method, and that is that when the ram stops under air pressure both pump pistons are acting to force the ram further. The result is a very steady action is secured.

There is another feature which has nothing immediately to do with the hydro-pneumatic operation of the press but which is an important improvement. This is what the makers call their four-rod construction. They say that they have found that when the lines of pressure and resistance lie within single rods at the top and bottom there is a tendency for the press to spring sidewise when doing heavy work, as it is practically impossible to keep the strains within such narrow limits. In this press two heavy rods at both top and bottom are used, the rods being from three to six inches apart. The ram and moving abutment are centered between these, so that there is no tendency to spring out of line. The work is therefore well squared up by this four-rod construction and there is the further advantage that no heavy base plate is required.



MOTOR DRIVEN HYDRO-PNEUMATIC WHEEL PRESS.

The moving abutment is supported by four wheels, with base wide enough so that it may be moved with ease and safety. The suspension hooks and compression cap are supported by two-wheel trolleys. The machine is usually run with motor drive as shown in our illustration. It can, however, be made with suitable pulleys for belt drive. The company will be happy to answer any inquiries about this highly efficient railway shop tool.

Chinese Railways.

Extensive railroad construction work is being projected in China. The capital has been largely guaranteed by a German syndicate. The rails and most of the rolling stock is being supplied from America, but it is expected that in a few years the Chinese manufacturers of rails will be able to supply the demand at home and also look for markets abroad. The railways are of the standard gauge and are said to be designed with a view to obtain the highest standard of construction work. The chief branch will run from Canton to the boundary of the Wang-tung and Hu-nan provinces. This branch passes through a densely populated country for nearly 300 miles. The new enterprise will connect with the Imperial Chinese railways, but under entirely different management.

Articulated Compound Locomotives.

The American Locomotive Company have recently issued pamphlet No. 10,034, which consists of a very complete and instructive paper on the articulated compound type of locomotive which was read by Mr. C. J. Mellin, consulting engineer of the company, before the American Society of Mechanical engineers. The paper very fully describes the characteristic features of this type of engine, and the text is well illustrated by line cut drawings of its special details as constructed by the above mentioned company. Line cut illustrations of the side elevations of a number of different designs of articulated compound engines are also included in the pamphlet, among which are two preliminary designs for passenger service. The last ten pages of the pamphlet contain extracts from the discussion of the paper by members of the A. S. M. E. Some half-tone illustrations of a number of engines of this type built in this country are also given. The principal specifications of each design are in tabular form beneath each illustration.

Portable Jib Crane.

The portable jib crane described in this article was designed by a master mechanic on one of the largest railroads in the country, and has been for some years in successful service in the erecting shop.

The crane may be placed in any position on the floor by an overhead traveler and will handle loads without assistance from the traveler. Not only is the labor of men engaged on a given job rendered more efficient by the help of this crane, but the time of traveling crane is conserved most effectively. On account of what may be called its flexibility of location, this portable crane is destined to become popular among railroad men as an auxiliary service crane. The work handled by it in railroad shops includes among other things the removal of driving boxes, eccentric straps and eccentrics from driving axles and, after repairs have been made, of refitting these parts to the axles. Putting up collars, and the bolting of eccentrics and eccentric straps is done under the crane and driving wheels are made ready to place under engine. One of these cranes will serve a shop handling 60 engines, and the builders inform us that from actual experience its use will save the labor of one mechanic and two helpers. Besides this economy, one-third the time of the traveling crane is available for operations which could not be performed by one auxiliary crane. In this way the auxiliary crane greatly increases the commercial efficiency of the more expensive tool.

The portable jib crane can also be used advantageously in the locomotive boiler shop and for handling a pneumatic gap riveter or a staybolt breaker. In the machine shop it is useful for assembling tools and for handling heavy vise work, etc. It has a heavy base and its own weight evenly poised on the base makes it quite steady.

The crane itself consists of a heavy base plate with structural pillar attached thereto, having a swivel plate on top on which the rotating jib is pivoted. A movable trolley is provided which supports a block and hook. A weight attached to opposite end of jib balances trolley and part of load. The jib is stayed by tension rods. The strut for this crane contains eye bolts for clevis loops by which crane is lifted and transported by overhead traveler. The hoisting gear is attached to the base plate or structural pillar and is operated by pneumatic or electric motor or hand power. Swinging and trolley travel are operated by hand power. The capacity ranges from 1,000 lbs. up to 4,000 lbs., with an effective radius of about 10 ft. The special features of construc-

PORTABLE SHOP CRANE.

tion are fully covered by U. S. patents. These cranes are manufactured exclusively by the Whiting Foundry Equipment Company, of Harvey, Ill., to whom any inquiries for further particulars should be addressed.

Making Smokeless Firing Expensive.

Expensive mistakes are sometimes made by firemen who imagine that the fire must be burning just right when the stack shows absence of smoke. Absolute smokelessness and strict economy of fuel do not go together. An engineer writing about oil fuel tests of boilers supplying steam to irrigation plants, says: "In a great many plants the firemen leave the draft doors wide open and so long as no smoke appears they are satisfied, never questioning whether the amount of air is greatly in excess of that required for economical results. Under these conditions, boiler efficiencies ranging from 55 to 60 per cent. are to be expected and the results show that only such efficiencies are obtained. On the other hand when acceptance tests of plants were made under a fuel guarantee and care was taken for finding the proper draft area as especially in the manipulation of the damper to maintain as high pressure as possible in the furnace and around the heating surface of the boilers, the efficiency has ranged from 73 to 75 per cent."

In the reception hall of the Brown Hoisting Machinery Company, of Cleveland, appears a notice stating that Cleveland solicitors will not be seen after 11:30 a. m. Mr. Clapp, who originated the notice, has established the rule for the benefit of people coming from distant towns who would frequently have to stay over night by Cleveland men crowding them out of a hearing.

ORE TRAIN AT NARVIC STATION, OFOTEN RAILWAY.

Railroad Characters.

BILLY GETS TRANSFERRED.

A wave of reform swept over the railroad. Some society ladies resolved to unite and do something for the uplifting of, what they called, the lower classes. A mid-day meal was to be furnished to the railroad men for next to nothing. Frugality and Fraternity, twin goddesses, were to walk garlanded hand in hand, and lead the weary workers to a better life.

The dilapidated end of an abandoned car shed was whitewashed. Temporary tables were extended into the dim distance. A soup kitchen with burnished stoves and glorified crockery in one corner, and a raised platform in the other gave an air of sumptuousness to the place, while a few red, white and blue streamers festooned here and there, gave one the mistaken impression that a presidential election was approaching. When the opening day came the railroad banqueting hall was lit up with sweet feminine smiles graced with soft silken draperies. White aproned waiters hurried hither and thither with savory viands. The soup was so deliciously refreshing that it left nothing further to be desired. The chicken pie was a marvel of dainty luxuriousness. The strawberries and cream were past speaking about. The coffee was positively exhilarating. As for the ice cream it was a shame to eat such gems of sculpture work.

Four of the gentle ladies sang so seraphically that Billy and Jack MacFarlane and Shaw, the ex-fish dealer, agreed that they had never heard anything like it. The applause was rapturous. Then a garrulous old gentleman with a polished cranium and a pair of waving whiskers explained the direction and extent of the step that was being taken. He alluded feelingly to the fact that we were living in an age of progress. The human body was being better cared for, he said. The importance of environment was looming larger in the intellectual eye of intelligent humanity. The walls of prejudice and bigotry and ignorance and all uncharitableness were being broken down. The lamp of hope, fed by the oil of loving kindness, was every day shedding a brighter light on the dark brow of honest industry. Cultured women, the blossom and beauty of creation, were feeling the ennobling touch of the humanizing spirit of the age, and like ministering angels reached out a spiritualizing hand, and pointed the way to higher and better things in the undiscovered future. Would the railroad men take advantage of the situation? Would they grasp the hands held out to them, or would they prefer to wallow in the mire of ancient usage with its accompanying degradation? That was the burning question of the hour. He would like to hear the opinions of some of the working men themselves. The orator wiped his burnished brow, and sat down amid thunders of applause.

Jack MacFarlane suggested that Billy say something. Shaw, the haddock man, seconded the proposition. The wind was all out of Billy, but he suffered himself to be borne tumultuously to the platform. He blushed and bowed to the ladies and the aged orator and began muttering something about being too full for utterance. Billy was on the dead center, but, metaphorically, pinching himself off the center and taking steam on the left side, he claimed that it would not be seemly to allow the occasion to pass without expressing, however feebly, their deep sense of gratitude for their delightful experience, their joy at beholding such a vision of loveliness, their blessed realization of what seemed only a dream. Whatever the future might bring, Billy said, when the past came up before them this repast would also come. The bitterness of dreary hours of dull drudgery fell away from them like an old garment. Was there a man among them who had not felt at times that their lot was a hard one, and that those upon whom fortune's brighter star shone with a more refulgent radiance had never even given them a passing thought?

Billy was opening his throttle now and letting her go into a dark tunnel.

Full of emotion he expressed a strong desire that the shades of his toil-worn companions, their heroic predecessors, whose wasted bodies rested in nameless graves, could revisit them and behold the inspiring spectacle of transcendant social intercommunion. What transports of delirious joy would thrill through their disembodied spirits! It was for the living to appreciate the situation. It was for them to grasp the golden opportunity, and show themselves ready to rise upon stepping stones of their dead selves to nobler things. They were crossing the Rubicon and they were burning the bridges behind them.

Billy was throwing on chunks of mixed coal now and keeping the steam up. Giving himself sand he went on with renewed vigor.

Sometimes, Billy said, it seemed as if they were forgotten. Servants of servants, they were ground beneath the driving wheels of soulless corporations. But it was the darkness before the dawn. There was a triumph of mind over matter. There was the fair flower of hope springing from the grosser elements of the earth. Would they embrace the bright-winged opportunity? Would a duck swim? Would they ever again wander into the forbidden fields in which he was ashamed that he had ever set a wandering foot? Could they ever be lured from a splendid segregation of a physical, an artistic and an intellectual refreshment like this? Never!

Billy shut off and put on the emergency brake. He was all in. Thunders of approval greeted Billy. In the tumult the one o'clock whistle blew. The ladies clustered around Billy and refused to let him go. The party with the whiskers was the First Assistant to the Second Vice-President and something must be done for Billy. The ladies were in the uplifting business and the result was that they uplifted Billy.

Next month Billy sat clothed and in his right mind in the office of the Shop Superintendent. Visitors presenting cards had to take a back seat and wait till Billy was ready. Billy was busy dictating letters now. Sometimes his feet rested on the gilded radiator and he smoked gilt-labeled perfectos. By and by he looked at himself in the glass and brushed his hair. Then a train of thought like a train of cars seemed to rush through his mind, and he vanished into an inner room. Other visitors arrive, but they can sit there till Billy is good and ready. The reform movement has gone into quiescence. So has the soup kitchen. Clark's parlors has assumed its normal activity. Everything is just as it was except Billy. His loquacity is gone. He is a man of silence now. He is a stranger to Clark's parlors. He is holding his job down. If the reform movement never accomplishes anything else it effected Billy's translation.

This is more than can be said of many alleged reformations that come in like fire and thunder and end in a puff of smoke.

Welding Tubes by Thermit.

Butt-welding wrought iron and steel pipes is the latest triumph of the Goldschmidt Thermit Company, New York. In fact, there seems to be no limit to the possibilities of this remarkable method of welding metals. As may be generally known, the fusible material consists of a mixture of finely divided aluminum and iron oxide. This mixture when ignited produces a combustion which in a few seconds approaches a temperature of 5,000 deg. F. In the welding of pipes a cast iron mould is placed around the joint. In the upper section of the mould a narrow gate is formed to admit the Thermit, which when it is ignited is poured into the opening of the mould. Adjustable clamps are attached to the two sections of the pipe, and the joint is drawn slightly together while the metal is in a state of fusion. On cooling it is found that the weld is the strongest part of the pipe.

The catalogue, No. 58, of the Wolfe Brush Co., Pittsburgh, Pa., is an unusually attractive publication of 128 pages, printed on superfine paper and profusely illustrated. The company has been established nearly sixty years and has earned a national reputation as manufacturers of high-class brushes. An estimate may be formed of the variety of their products when it is stated that their new catalogue contains descriptive matter in regard to 4,000 kinds of brushes. The firm has evidently made a very careful study of the brush requirements of railroads, and it is generally conceded that no American brush makers are in a position to make so prompt a delivery of any kind of brushes required in railroad work. The quality of the brushes is of the highest, the prices are the lowest. All interested should send for a copy of the company's new catalogue.

The Fortieth Annual Convention of the Master Car and Locomotive Painters' Association will be held at Niagara Falls, N. Y., Sept. 14, 15, 16 and 17, 1909. Mr. George Warlick is president of the association, and Mr. A. P. Dane, of Reading, Pa., is secretary. Headquarters will be at the Cataract House. Members are requested by the hotel committee to secure reservations by addressing Mr. H. W. Isaacs, manager, Cataract House, Niagara Falls, N. Y. The list of subjects, essays, queries and special papers to be presented at this convention is of an exceptionally interesting character and will, without doubt, bring out discussions which will be valuable and instructive. Special attention is called to the paper to be presented by Mr. H. A. Gardner, chief chemist, scientific section of the Paint Manufacturers' Association of the United States, on "Excluding and Rust Inhibiting Properties of Paint Pigments for the Protection of Steel and Iron," one of the most vital problems of railroad painting. The report of the test committee of the association, of which Mr. W. O. Quest, master painter of the Pittsburgh and Lake Erie is chairman, will be one of unusual interest. All foremen and assistant foremen of railway paint shops, steam or electric, in the United States and Canada, and all others who are in any way interested in the association are invited to be present.

"Hannoversche Maschinenbau Actien-Gesellschaft."—This is the German title of a company located in Hanover-Linden, Chemnitz, Germany, and their new catalogue No. 210, illustrating their various designs of the four-cylinder balanced compound locomotive is before us. It is an elegant and artistic work. One does not require to be an advanced German scholar to learn that the company believes that the four-cylinder balanced compound locomotive is to be the express engine of the future. There are ten superb illustrations of various types of the four-cylinder compound, and it is gratifying to note that the general description of those fine locomotives is given in four languages so that engineers dwelling in the four corners of the earth may readily read and understand the chief features of these engines. Copies of the catalogue may be had on application to the company.

Articulated for the Santa Fe.

The Baldwin Locomotive Works have just finished a mallet passenger engine for the Atchison, Topeka & Santa Fe, with driving wheels 72 ins. in diameter. The engine has two pairs of coupled driving wheels in front and three pairs in the rear. There is a four-wheel carrying truck in front and a heavier one in the rear. The engine has feed water heater, steam superheater and arrangement for carrying the steam from the dome in pipes that pass through the feed water heater. The top of the steam dome is 16 ft. above the rail.

The Pennsylvania Railroad Company have decided to test on the testing plant at Altoona all the mechanical stokers for locomotives that may be offered to them during the next year. If any stoker has been developed sufficiently to fire a locomotive as well as an average fireman, it will have the opportunity of proving its merits under conditions of absolute fairness.

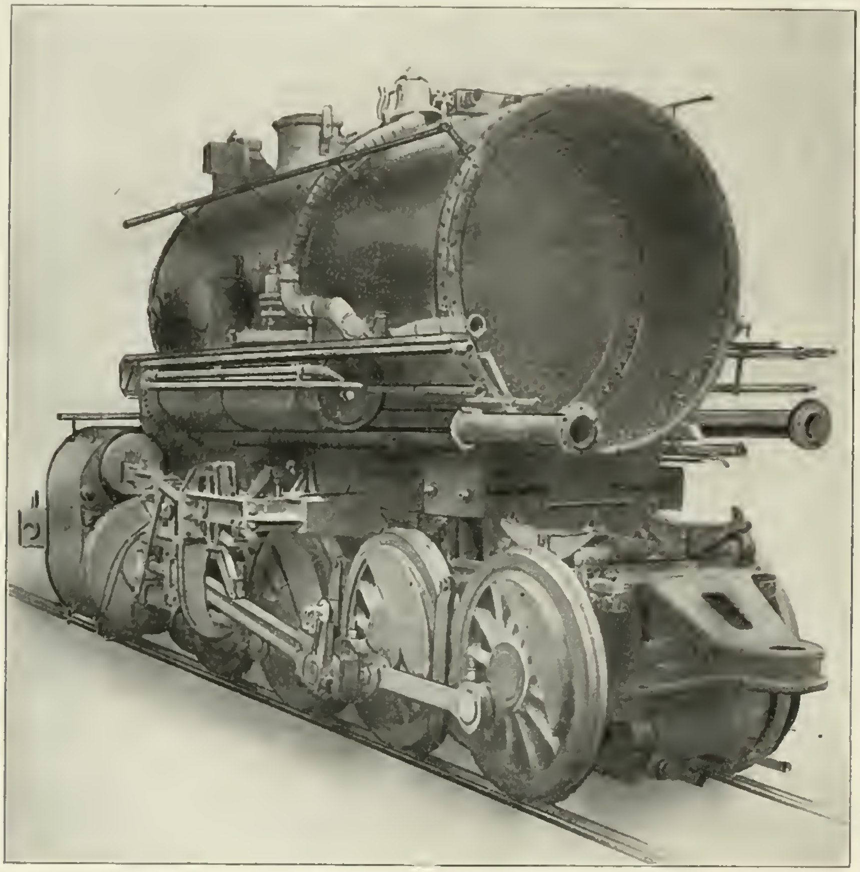
The Chicago, Hamilton & Dayton Railroad, which has been the shuttlecock of various financial interests for many years, has now fallen into the hands of the Baltimore & Ohio. Mr. Oscar G. Murray, head of the B. & O., is now president of the Cincinnati, Hamilton & Dayton.

Baldwin Mallet Articulated Compound.

In our June issue of this year, page 269, we were able to present our readers with an illustrated description of the heavy Mallet articulated compound engine, built by the Baldwin Locomotive Works for the Southern Pacific. This engine is No. 4,000 on that road. The boiler is of the straight top type and is 84 ins. in diameter. The tubes are 21 ft. long. The forward flue sheet has in front of it a combustion chamber 54 ins. long and in front of this again is a feed-water heater chamber which is 63 ins. in length. The tubes in this feed-water heater are set in alignment with the fire tubes and are equal to them in number and diameter. The combustion chamber has a man-hole which enables a workman to get at the front ends of the boiler tubes.

Two non-lifting injectors are used and they discharge into the feed-water chamber, which is always full. The feed water after having been heated, passes out of the top of the chamber and is delivered into the boiler on the right and left sides. These checks are placed immediately back of the front tube sheet. A superheater is placed in the smoke box.

The features of this engine which we here illustrate in detail is what we may call its separable quality. The boiler, and the prolonged front end can be separated one from the other for the purpose of making repairs. The boiler itself is intact in the back half of the engine and the combustion chamber, feed-water heater and superheater are all together in the front half. The frame is jointed just back of the rear pair of the front set of drivers. This joint is made with a fulcrum pin 7 ins. in diameter which is pushed up into place from below and held by a plate supported on a crosstie.



FORWARD SECTION OF SO. PAC. ARTICULATED COMPOUND.

The joint of the barrel plates is made by riveting a ring to each boiler section outside the shell and the rings are butted together with a V-shaped fit. There are 42 bolts each $1\frac{1}{4}$ ins. in diameter used to make the joint. When everything is in place the engine is as solid as any other kind of engine. The front section consists of the smoke box with superheater, feed-water heater, combustion chamber, low-pressure cylinders and the front set of driving wheels with the pony engine truck. The rear section as shown in one of our illustrations, consists of the trailing wheels, the rear set of six drivers, high-pressure cylinders, boiler, firebox and cab. The separation of the two sections can be very easily made and repairs effected. When done the engine can be put together again with very little extra work on the part of the shop staff.

If common sense has not the brilliancy of the sun, it has the fixity of the stars. —*Caballero.*

The Westinghouse Companies report a general improvement in their business. In fact, they find that if the same steady rate of advance during the previous months of the present year continues, they believe that before the close of 1909 there will be a repetition of the busy times of 1907. The Westinghouse Air Brake Company of Wilmerding, Pa., have received a large number of orders for brake apparatus and friction draft gear. As an index of the improved conditions of the Union Switch and Signal Company, Swissvale, Pa., it is stated that this plant is now employing about twice the number of men that it did a year ago. In June, the Westinghouse Electric & Manufacturing Company, of East Pittsburg, Pa., experienced an improvement of about 25 per cent. over the business of May. A large order for railway motors was secured from the Interborough Railroad Company of New York, for use on the elevated, or Manhattan, division. Switchboard and auxiliary supplies, amounting approximately to $500,000 have been ordered for the New York terminals and tunnels of the Pennsylvania Railroad.

A Wonderful Machine.

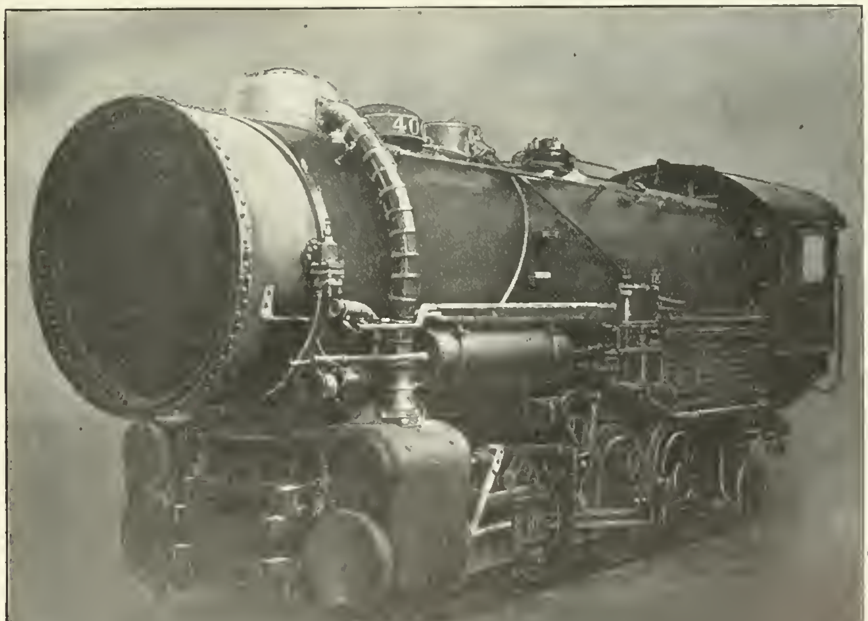
When I was laying the foundation of my mechanical fame and fortune running a bolt cutter in the Rock Island shops at Chicago, a year or two ago, I boarded in a house filled with locomotive engineers and firemen. There were a few machinists, but their voices and votes were lost among the enginemen.

A practice prevailed there of enlivening the supper table with social conversation, and the locomotive men being in the majority, the leading theme of talk was the stupendous feats performed in getting over certain hills without doubling. This was occasionally varied by the record of minor incidents, such as the exploit performed by Tom Briggs when the 96 broke her rocker arm; how narrowly Dick Norris escaped from having his checks called in when the 187 broke her side rod running down Valley Hill; how Harry Walbrandt whooped up the 492 to make a meeting point, and just got clear into the siding when the Chicago Limited rushed past.

George Dorwart, who ran a lathe in the shop, sat opposite me at the table, and he got tired of being excluded from the conversation. He became ambitious to hear himself talk in that crowd. One evening, catching on in a lull of the talk, he called out loudly to me: "Well, I went over and saw that new machine today, and it is astonishing the fine work it does."

"How does it work?" I inquired.

"Well," said George, "by means of a pedal attachment, a fulcrumed lever converts a vertical reciprocating motion into circular movement. The principal part of the machine is a huge disc which revolves in a vertical plane. Power is applied through the axis of the disc, and when the speed of the driving arbor is moderate, the periphery of the apparatus is traveling at high velocity. Work is done on this periphery. Pieces of the hardest steel are by mere impact reduced to any shape the skillful operator desires."



REAR SECTION OF BALDWIN ARTICULATED COMPOUND SO. PAC.

"What in thunder is that machine, anyway?" demanded Tom Briggs.

"Oh, it's a new grindstone," replied George, and a silence that could be cut with a butter knife fell upon the crowd.

Air Brake Proceedings.

We have received a copy of the proceedings of the sixteenth annual convention of the Air Brake Association, held in Richmond, Va., May, 1909. The book is 6 x 8 ins. and contains 411 pages, and is neatly bound in black leather.

The paper by J. R. Alexander, of the Pennsylvania, on "Pipes and Pipe Fittings for Locomotives and Cars" brings out more points on this subject than has ever been published before. The paper on "Yard Air Brake Test Plants and Air Brake Repairs," by F. Von Bergen, of the N. C. & St. L. Ry., is complete in all details and should be read by all who have to do with the very important work of maintenance of air brakes. The paper on "Slack Action vs. Undesired Quick Action as a cause of Damage in Long Freight Trains," by M. E. Hamilton, of the Santa Fe, is a somewhat startling paper which deals with train break-in-twos from a new standpoint. The paper on "Flat Wheels, Their Causes and How to Prevent Them," by John P. Kelly, is an old subject handled in a new way, and brings out many points as to the cause and prevention of slid flat wheels not hitherto touched upon. The paper on "The New York B-3 Locomotive Break Equipment," while brief, is thorough and contains much information for train operatives that will reduce trouble from break-in-twos and rough handling if carefully read, and acted on. The paper of Mr. C. C. Farmer, resident engineer, Westinghouse Air Brake Company, on "The Southern Pacific Air Brake Demonstrations," summarizes and briefly reviews the work of the large corps of air brake experts who spent several months in 1908 testing air brake trains on the heavy mountain grades of the Southern Pacific. This paper is valuable, not only for the information it gives, but for the ease of study with which Mr. Farmer presents it to the air brake fraternity. An account of these tests is to be found in another column of this issue of our paper.

The report of the Committee on Recommended Practice contains important modifications and suggestions over the standard report of 1908. An exceptionally valuable paper was that of John A. Talty, of the D. L. & W., on "How Can the Road Foreman of Engines Render the Most Effective Assistance to the Air Brake Service." Mr. Taltry shows how necessary it is for the good of the railroad company's service for the air brake inspector and the traveling engineer to work together. The paper on "Engine House Inspection and Maintenance of Air Brakes," by W. D. Seeley, of the Boston & Albany, shows how more work may be done if the work is systematically laid out and conducted. H. A. Flynn, of the Delaware & Hudson, presents an able paper on "Handling Passenger and Freight Trains with Equipment."

Much value is added to the proceedings of the sixteenth annual convention in the questions and answers on the New York B-3 locomotive equipment, the Westinghouse 8½ in. cross compound pump, and the Westinghouse K triple valve. Copies of this book may be obtained from this office. Price, postage prepaid, $2.

The Joseph Dixon Crucible Co., Jersey City, N. J., not only furnish the very best crucibles, graphite, pencils and other products, but they furnish the most valuable advice in regard to their Silica-Graphite paint, which is just the proper substance to protect all out door metal structures. Write to the paint department. The early fall is the time to paint. Now is the time to get information in regard to the best materials.

"The railroads and the farmers are natural partners" was the text of an address delivered last month before the Farmers' Union of Oklahoma by Mr. B. F. Yoakum, chief executive officer of the Chicago, Rock Island & Pacific Railway. The politicians of the land have persuaded the farmers that railroads were their natural enemies, a tale that was readily believed and caused no end of injustice. When the farmers take Mr. Yoakum's advice and join hands with railroad companies and demand fair play for producers and for carriers it will put an end to the profits of the rustic agitator.

The Detroit Bullseye Locomotive Lubricator is fully described and illustrated in a handsome new publication of 40 pages. Special instructions are given in regard to the care of lubricators, and a perusal of this publication will give a railroad man a complete knowledge of this new and important locomotive attachment. Boiler valves, air cylinders lubricator, rod and guide cups, and air pump lubricators are also fully described and illustrated. The paper and press work are of the best. The illustrations are particularly artistic. Copies may be had on application the Detroit Lubricator Co., Detroit, Mich.

Promising Positions to Graduates.

We do not believe that wickedness or that the exercise of sharp practice is increasing in this world of tears; but we know that conditions which moved us to caution certain lambs against shearers twenty-five years ago call for similar advice to-day. The article we refer to reads:

"One of the most reprehensible practices of the present time is that of the management of various institutes of "practical instruction" in promising to obtain lucrative positions for students as the reward for paying for a short course of instruction. Hundreds are induced to enter schools of this kind, generally to find themselves disappointed in the end; something, perhaps, a little short of swindling in a legal sense, but very near it. It ought to be apparent to the victims, that the teachers or managers of these schools cannot create places for their "graduates" beyond the ordinary demand, nor for the pay they will receive, but promises to do both are freely made. The demand for workers in specific directions, and the wages paid, are things over which these teachers and managers have no control."

We have no fault to find with enterprises of this kind when the business is legitimately conducted. Those of a respectable standing are doubtless of considerable utility. But when they offer as inducements to persons to become scholars, bargains, that they are not able to make good, and offer them in such a way that legal redress is impossible, their conduct is fairly open to criticism. This is done in some instances by those who would not be suspected of such practices and to such an extent as to justify a word of warning. If the authorities of a school giving technical instruction invite you or any of your friends to enter on the promise of employment at graduation, insist on having a written agreement to that effect. Such a document is not an absolute certainty of good faith but it is likely to prove useful.

Steam Engineering Advances Slowly.

In working steam engineering up towards the condition of a science, practice has for the last seventy years been constantly correcting the deduction of theory which always inclines to reach away in advance of the real mile posts of progress. Unforeseen elements are constantly met with in practice that have modified and neutralized apparent advance movements. The gain from expansion has been greatly overestimated, and the results that were reasonably expected from high pressure have not been realized. Patient practical research, with many failures, must be depended upon to further improve the steam engine.

Experience with the compound locomotive ought to supply a lesson against high expectations. The compound locomotive has held its own on some railroads and is saving at least 25 per cent. of the fuel used by simple engines doing similar work; but it has fallen into disrepute on other lines because its proper care and management was not understood. Making haste more slowly would have saved the reputation of the compound locomotive.

The high steam boiler pressures that some of our railroad companies inaugurated in connection with compound locomotives have not survived the test of time and the tendency all round is toward pressures less than 200 lbs. per sq. in. Some French railways tried boiler pressures over 200 lbs. to the square inch, but the results of service have led in the same direction as American railroad companies have gone. Repairs to boilers increased so greatly with high-pressure boilers that the practice was too expensive to be endured without protest.

The Power Specialty Company, sole agents for the sale of the Duvall Metallic Packing, have just issued a finely illustrated pamphlet describing the construction of the packing and its method of installation for any service. We earnestly recommend a perusal of the pamphlet to all interested in packing that is submitted to high temperatures and pressures, as well as to ordinary service. The proper installation of the Duvall packing is an important item, and when properly installed the packing is guaranteed to last during ten years' continuous service. The company have also introduced a corrugated bronze gasket which is specially recommended for superheated steam. The company have now twelve branch offices and agencies in America, the general office being located at 111 Broadway, New York.

The Hartford Steam Boiler Inspection & Insurance Company is one of the great institutions of New England. It will be news for most people to learn that a remark made by Professor Tyndall in a lecture delivered at Hartford led to the organization of the great boiler insurance company.

Mr. Louis W. Hill, president of the Great Northern, has announced that contracts for fifty-seven locomotives for the Hill lines have been closed with the Baldwin Locomotive Works, of Philadelphia. The order represents an expenditure of approximately $1,500,000.

Sympathy is the golden key that unlocks the hearts of others.—*Sam Smiles.*

INDEX TO ADVERTISEMENTS.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXII. 114 Liberty Street, New York, October, 1909. No. 10

Tractive Effort and Horse Power.

Our frontispiece this month is from an excellent photograph of a moving train taken by Mr. E. L. Greene, of South Paris, Me. It is a 4-4-0 engine on the Grand Trunk Railway pulling a four-car train, but it serves to illustrate a few remarks on tractive effort and horse power.

STANDARD 4-4-0 ON THE GRAND TRUNK WITH LIGHT PASSENGER TRAIN.

The expressions tractive effort, starting power and draw-bar pull are used more or less interchangeably to indicate the power developed by a locomotive standing on the rails just at the moment of starting, with reverse lever in full gear and the throttle valve fully open. If there is no slip, the engine then exerts its maximum tractive effort. Strange as it may seem, when the engine is just starting under full steam with late cut-off, it is not developing as much horse power as it will develop when running on the road as shown in our frontispiece.

The maximum starting power or tractive effort may conveniently be considered as equivalent to the weight the locomotive can sustain, if a rope were attached to the coupler at the back of the tender, carried over a frictionless pulley and let hang down a well or over a cliff, with the weight at the end. Theoretically any increase of this weight would cause the engine to be drawn backward, if its own internal friction was eliminated.

Suppose, for sake of example, that we have an ordinary 4-4-0 type of engine with cylinders 17 x 24 ins., 180 lbs. steam pressure and 56-in. driving wheels. Such an engine would have a calculated tractive effort of 18,950 lbs. That is the weight we may suppose to be hanging at the end of the rope over the cliff, and the engine can just sustain this weight against the attraction of gravity. This is, of course, on the assumption that normal adhesion exists between wheels and rails. Here then we have the tractive effort, represented by the weight hanging on the end of the rope, and without slip and under full steam, the engine just balances it.

As far as work is concerned the engine is not doing any, so long as it simply balances the weight, but when weight is moved the element of distance comes into the problem, for there is then weight or resistance acting through a given space, and that constitutes work in the mathematical sense. When the element of time is introduced in connection with work, we have the horse power which is really the rate at which work is done. The horse power is 33,000 lbs., raised one foot high in one minute.

Suppose the engine with tractive effort, as we have said, of 18,950 lbs. to make one turn of its driving wheels, it would have advanced along the track 14.66 ft. and the weight would have been pulled up a corresponding distance. To do this would require the expenditure of a little over 277,800 foot-pounds of work. That would be 18,950 lbs. moving through a space equal to the circumference of the driving wheels. If now this work was performed in one minute of time, we can easily compute the horse power developed. Taking each side of the locomotive as a separate engine the total horse power developed by the engines combined as a locomotive in the one-minute turn of the driving wheels would be 8.4 h. p.

This brings us to the consideration of how the increase of horse power is brought about at high speeds when the locomotive is running on the road. At high speeds, steam is cut off early in the stroke and less of it is used each stroke than at slow speeds, and consequently the mean effective pressure in the cylinders is less at speed than when the locomotive was in the act of starting. This appears to be an anomaly, and for the moment looks as if the reverse of this should be true.

Suppose the engine is traveling at the rate of 40 miles an hour, as shown in our illustration, and suppose the reverse lever is notched up so that the earlier cut-off brings the mean effective pressure in the cylinders down to 80 lbs., we find by calculation that the horse power developed at this speed and under this comparatively light steam pressure has gone up very considerably. As a matter of fact, when we consider both sides of the locomotive as one, we find that 1,056 h. p. is being developed, and the calculated tractive effort if such can be spoken of, under these conditions has gone down to 9,908 lbs.

4-4-0 AND LIGHT TRAIN ON THE HARRIMAN LINES NEAR FRUITVALE, CAL.

The apparent anomaly in this case disappears when we remember that although the cylinders do not receive each stroke as much steam at the higher pressure used in starting, yet they receive their scantier supply much oftener in the minute. A bucket partly filled (say only one-eighth), many times, will supply a greater total quantity of water to a tank, than two or three buckets filled to the brim and slowly lifted up and emptied.

The tractive effort in the first place we saw was 18,950 lbs., and if one may so say the lifting of the tractive effort through 14.66 ft., a distance equivalent to the driving wheel circumference, required 277,800 foot-pounds of work, and this in one minute developed 8.4 h. p. At 40 miles an hour the drawbar pull was 9,908 lbs.; the work done in exerting this pull through 3,520 ft. was 34,876,160 foot-pounds, and this being the distance passed over in one minute at 40 miles an hour, the horse power developed under the circumstances was, as we have seen, 1,056 for the whole engine. It is thus evident that a locomotive could not sustain its maximum tractive effort at anything but a speed so slow that it must practically be disregarded. In fact, the formula for finding the tractive effort of a locomotive practically does not take into consideration any motion of the machine, but as it exists it affords a necessary piece of information for the designer, and a very useful and convenient method for the comparison of engines, which may be used by anyone who takes the trouble to work it out.

Outing of Erie Officials.

One of the most admirable innovations that has lately crept into railroad managements is the practice of the general manager of inviting his principal officials to periodical meetings for consultation and the discussion of questions that are of mutual interest. In July last Mr. John C. Stuart, general manager of the Erie Railroad, effected an important improvement upon the ordinary practice by inviting his officials to go out on a special train to visit various points where alterations were going on, with Hammondsport, on Lake Keuka, as the objective point. Here the experience meeting was held, but incidentally other experiences were enjoyed that were outside the ordeal of reasoning together for the Erie Railroad Company's benefit.

The company consisted of Messrs. J. C. Stuart, general manager; A. J. Stone, general superintendent; H. C. Dunkle, general superintendent; T. Rumney, general mechanical superintendent; A. G. Trumbull, mechanical superintendent; W. Schlafge, mechanical superintendent; G. W. Kirtley, superintendent car service; A. J. Grymes, superintendent marine department; G. J. Schoeffel, superintendent police; T. C. Clifford, superintendent dining cars; G. B. Owen, engineer maintenance of way; J. Burke, superintendent maintenance of way; E. A. Wescott, superintendent car department; H. S. Burr, superintendent stores department; E. P. Griffiths, superintendent telegraphs; W. H. Willis, signal engineer; E. I. Dodds, assistant superintendent car department; C. P. Utler, general agent; J. C. Tucker, special agent; G. W. Gould, superintendent employment bureau; E. S. Parsons, superintendent; Angus Sinclair, inspector technical education.

U. P. TRAIN NEAR SANTA CLARA, CAL.

When the Erie Railroad was under construction the promoters favored the location that would touch the greatest number of towns which prevented questions of economical operating from receiving deserved consideration. An example of this is seen on the New York division, which climbs a series of low hills east of Port Jervis, seriously curtailing the weight of train loads. The company has recently made a "cut-off" 44 miles long to avoid the hill climb mentioned. The change has enabled the increasing of eastbound train loads more than three times.

The party was carried over this new cut-off and found the work remarkably well done in every respect. Rails of about 100 pounds to the yard rest on stone ballasted road bed, iron bridges resting on foundations of solid masonry are installed wherever bridges are necessary, while cuttings and fills have been made impervious to flood and storm.

Stoppages were made at Point Jervis and Susquehanna, and the buildings and machinery inspected; but the most valuable part of the journey was watching the track and listening to the valuable discussions and suggestions originated by the engineers of maintenance of way, the general superintendents, the signal engineer and others. As many of the party as could conveniently sit down there were viewing things from the observation room and the meeting frequently resolved itself into an experience seance, not altogether unlike an old-fashioned Methodist experience meeting, but more interesting to mundane people.

When two or three or even eight or ten practical people meet together to discuss questions of mutual interest useful flashes of knowledge result from the contact. I have always felt that the most valuable work done at the railroad technical men's conventions was when individual members sat quietly together and discussed methods they had followed in overcoming difficulties and in dealing with embarrassing questions. I could see evidence of the same tendency among our party in the train and I have no doubt that most of them carried away valuable suggestions that were not aired in the public meeting.

On reaching Hammondsport some fishing was done on the beautiful Lake Keuka. The fishing was of the character done by a Scots boy whom the minister found fishing on Sunday morning. "Don't you know, James," exclaimed the dominie, "that it is a sin to catch fish on the Sabbath day?" James looked round in disgust and said, "Who's catching fish?"

There was something wrong among the fish in Lake Keuka that day and our party had few fish stories to tell, but the beauty of the lake and its charming situation made up for any small disappointment at the inhospitable behavior of the fish. The lake, which is fork shaped, 22 miles long and about two miles wide, is one of the most picturesque sheets of water in the country, and its surroundings make its scenic features remarkably attractive. The country is hilly and the steep sides of the lake are covered with terraced vineyards of the character that tourists rave so much about when seen on the banks of the Rhine and in other places whose scenic fame attracts visitors.

I know that comparisons are odious, but Keuka Lake in beauty far exceeds Chautauqua or any of the smaller lakes except, perhaps, Lake George. The surprise to me is that the lake has not become a popular resort, but that is probably because it has not been made the fashionable resort of isms and faddists as Chautauqua has been.

UNION PACIFIC TRAIN NO. 2 IN PALISADE CANYON, NEV.

The business meeting of the officials was held in a hotel at Hammondsport. The proceedings were of a highly practical character, but the details would not interest our readers. One droll incident came up. General Manager Stuart drew attention to the wrong impression which appears to prevail among train men on the right to eject passengers. A case was mentioned of a conductor who had the reputation of treating passengers brusquely. On being remonstrated with, he protested that he was always very pleasant with passengers and habitually addressed them as "neybor."

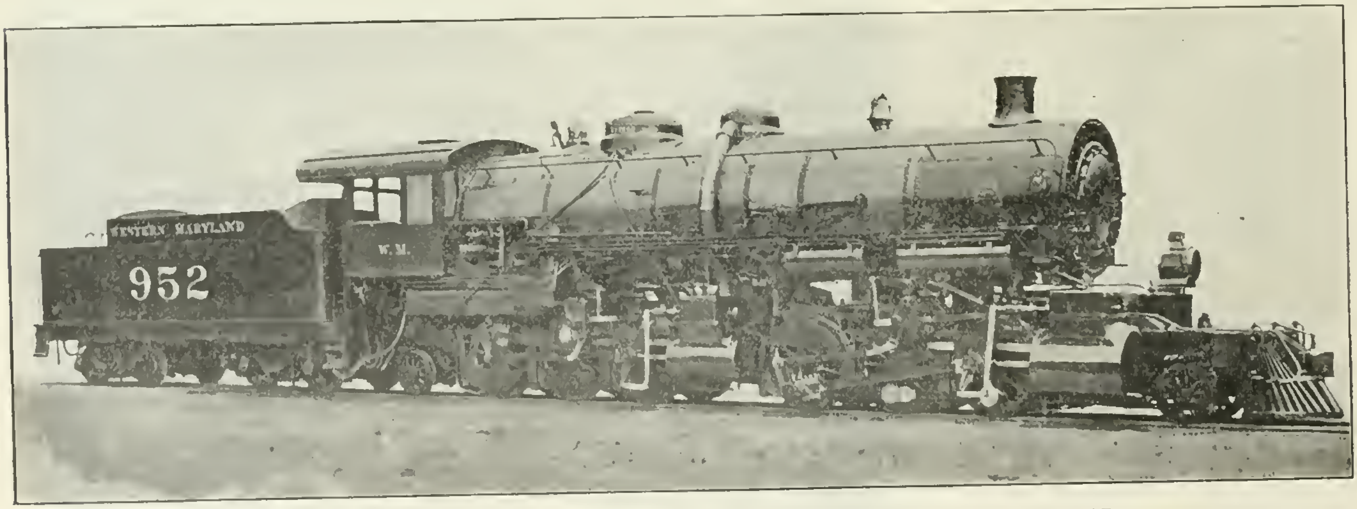
There was an interesting discussion on the prevention of accidents that would certainly convey valuable suggestions to the officials present. The outing was an unmixed success, and the prevailing sentiment was that they should be held at shorter intervals.

Western Maryland Engines.

The Baldwin Locomotive Works have recently completed five Pacific or 4-6-2 type, and two Mallet articulated locomotives for the Western Maryland Railroad. These engines are designed for passenger and freight service respectively, and are working on a line having grades of 3 per cent. and curves of 20 degs. They are the heaviest locomotives for their respective classes of service, thus far supplied to this road.

THE 4-6-2 ENGINES.

The Pacific type locomotives exert a tractive force of 31,340 lbs., and as the driving wheels carry 122,600 lbs., the adhesive weight is fully utilized. The boilers are designed for 200 lbs. pressure, while 185 lbs. is the pressure carried in



MALLET ARTICULATED COMPOUND FOR THE WESTERN MARYLAND RAILROAD.

R. C. Evans, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

service. The barrel of the boiler is straight topped and composed of four rings. The diameter at the smokebox is 66 ins. The dome is placed on the third ring, which has a welded seam on the top center line. The firebox is of the radial stay, wide type, with two T-bars supporting the front end of the crown sheet. The mud ring is carried on buckle plates at the front and back.

The cylinders are single-expansion, 22 x 28 ins., and the steam distribution is controlled by balanced slide valves driven by the Walschaerts motion. The links are carried on longitudinal bearers, placed outside the leading drivers, and bolted in front to the guide yoke, and at the back to a cross-tie; which latter also supports the reverse shaft bearings. The valve rod is extended back of its connection with the

BALDWIN PASSENGER 4-6-2 FOR THE WESTERN MARYLAND.

combining lever, and is supported in a sleeve bolted to the guide yoke. The guides and cross-heads are of the Laird type. The driving wheels are 68 ins. in diameter. The remaining details of these engines, while designed in accordance with approved practice, present no very unusual features.

Boiler—Material, steel; thickness of sheets, 11/16 in.; fuel, soft coal.

Fire Box—Material, steel; length, 102⅜ ins.; width, 66 ins.; depth, front, 68¼ ins.; depth, back, 57¼ ins.; thickness of sheets, sides, 5/16 in.; back, 5/16 in.; crown, ⅜ in.; tube, ½ in.

Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Material, steel; wire gauge, No. 11; number, 280; diameter, 2¼ ins.; length, 19 ft. 5 ins.

Heating Surface—Fire box, 164 sq. ft.; tubes, 3,185 sq. ft.; total, 3,349 sq. ft.; grate area, 46.8 sq. ft.

Driving Wheels—Journals, main; 9 ins. x 12 ins.; others, 8½ ins. x 12 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 5½ ins. x 10 ins.; diameter, back, 42 ins.; journals, 7½ ins. x 12 ins.

Wheel Base—Driving, 11 ft.; total engine, 30 ft. 4½ ins.; total engine and tender, 61 ft. 4½ ins.

Weight—On driving wheels, 122,600 lbs.; on truck, front, 36,200 lbs.; on truck, back, 30,000 lbs.; total engine, 188,800 lbs.; total engine and tender, about 310,000 lbs.

Tender—Wheels, diameter, 33 ins.; journals, 5 ins. x 9 ins.; tank capacity, 6,000 gals.; fuel capacity, 12 tons; service, passenger.

THE MALLET ARTICULATED ENGINE.

The Mallet type locomotives have three pairs of driving wheels in each group, with a two-wheel truck front and back. They are the most powerful engines with this wheel arrangement thus far constructed by the builders, the calculated tractive force being 81,870 lbs. The general design is similar to that of the Great Northern Mallet type locomotives, which have been operating most successfully for the past three years. Certain details, however, have been modified to conform to the practice of the Western Maryland Railroad. The Great Northern engine was very fully illustrated and described in RAILWAY AND LOCOMOTIVE ENGINEERING for October, 1906, page 472.

The boilers are straight topped, with radially stayed wide fireboxes. The barrel is composed of three rings with a dome centrally located above the high-pressure cylinders. The circumferential seam at the junction of the first and second rings is triple riveted. The barrel is supported on the front frames by a sliding bearing placed under the first ring. This ring is 84 ins. in diameter. The centering device is placed under the smokebox, but ordinarily it carries no weight, as ½ in. clearance is allowed between the upper and lower castings.

Balanced slide valves are used for all the cylinders which are 23 and 35 by 32 ins., and Walschaerts motion is employed throughout. Reversing is effected by the Ragonnet power gear, explained on page 456 of this issue, and the high and low pressure reverse shafts are connected through a bell crank, which is fulcrumed on the boiler shell immediately in front of the articulated connection. With this location the side swing of the lifting links, when the engine is curving, is reduced to a minimum.

The high-pressure cylinders are cast separate from their saddle and from one another, while the low-pressure cylinder castings are bolted together on the center line of the engine. The arrangement of the throttle valve and steam piping is similar to that previously used by the Baldwin Locomotive Works. The front and rear frames are connected by two radius bars, the upper being pinned to the high-pressure cylinder saddle, while the lower is fulcrumed on a cross-tie, which spans the rear frames between the low-pressure cylinders. Hanger bolts of the usual design are employed to equalize the loads on the frames.

The tender is fitted with a water bottom tank having capacity for 8,000 gals. of water and 14 tons of coal. The frame is built of 12-in. channels, and the trucks are fitted with solid forged and rolled steel wheels, supplied by the Standard Steel Works Co. The principal dimensions are given below:

Boiler—Material, steel; thickness of sheets, 7/8 in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.
Fire Box—Material, steel; length, 117 ins.; width, 96 ins.; depth, front, 78½ ins.; depth, back, 75 ins.; thickness of sheets, sides, 3/8 in.; back, 3/8 in.; crown, 3/8 in.; tube, ½ in.
Water Space—Front, 6 ins.; sides, 5 ins.; back, 5 ins.
Tubes—Material, steel; wire gauge, No. 11; number, 437; diameter, 2¼ ins.; length, 21 ft.
Heating Surface—Fire box, 223 sq. ft.; tubes, 5,384 sq. ft.; total, 5,607 sq. ft.; grate area, 78 sq. ft.
Driving Wheels—Diameter, outside, 55 ins.; journals, 10 ins. x 12 ins.
Engine Truck Wheels—Diameter, front and back, 30 ins.; journals, 6 ins. x 12 ins.
Wheel Base—Driving, 29 ft. 8 ins.; rigid, 10 ft.; total engine, 44 ft. 10 ins.; total engine and tender, 74 ft.
Weight, Estimated—On driving wheels, 323,000 lbs.; on truck, front, 17,000 lbs.; on truck, back, 23,000 lbs.; total engine, 363,000 lbs.; total engine and tender, about 520,000 lbs.
Tender—Wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 14 tons; service, freight.

Performance of Early Mallett.

In these days when there is so much talk about the performance of Mallet engines, it may not be out of place to mention the performance of a Mason bogie locomotive as long ago as 1884. The load consisted of 17 long cars and 224 short cars loaded with coke, coal and ore, making a total train load of 2,394 tons, exclusive of engine and tender. The engine weighed 36 tons on drivers, had cylinders 17 x 24 inches, driving wheels 50 inches diameter. The train was pulled on a 6-deg. curve with ease.

Significance of Speed Signaling.

By Geo. S. Hodgins.

The generally accepted method of railway signaling as used in this country is such that the automatic signals indicate the condition of the line for two blocks ahead, that is it tells if the first or second block ahead is occupied or not, and the interlocking signals indicate a route, and that the track ahead on the route indicated is clear. Speed signaling, as it is called, in no way alters the functions of the automatic signals, but is a change in the meaning of all interlocked signals.

Speed signaling as proposed on the Delaware, Lackawanna & Western Railroad, of which Mr. M. E. Smith is signal engineer, leaves the automatic signals as they are in form and function, but materially alters the significance of the interlocking signals, while bringing about what may be called a degree of uniformity, which it is the aim of many signal engineers to introduce. The uniformity on the D. L. & W. consists in the arrangement of only two arms and two lights on each post carrying interlocking signals. Thus automatic and interlocking signals all over the road will have only two arms on each post. The distinction between the automatic and the interlocking signals on the Lackawanna is, however, the presence of a dwarf signal on each interlocking post.

The ordinary interlocking signal, when at proceed indicates a route. With speed signals the route is not indicated, but the speed at which the track ahead may be run upon is definitely shown by the position of the signal arm in the day or the colored light at night. The arrangement is briefly this: The upper arm on an interlocking signal post indicates high speed, say 60 miles an hour, the lower arm indicates moderate speed, say 30 miles an hour, while the dwarf signal indicates very slow speed, say 4 or 5 miles an hour or less.

The most ordinary application of interlocking signals is at a junction where there is a main line and a diverging route. At this junction is placed the interlocking speed signal with its two semaphore arms and dwarf signal below. When both arms are horizontal, with two red lights, at night, a stop is required. The dwarf signal also shows stop. Now, if the top arm is lowered, with green light, at night, the engineer of an oncoming train is assured that the track ahead is clear and he is entitled to go forward at high speed

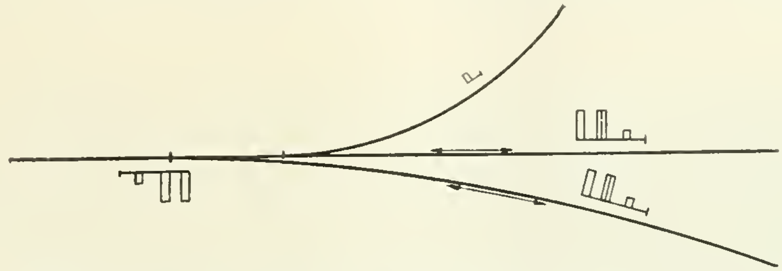


FIG. 1. JUNCTION WITH BOTH SPEEDS GOING EAST. ONLY HIGH SPEED GOING WEST. LOWER ARMS FIXED. DWARF FOR ALL MOVEMENTS.

without reference to the route, whether direct or diverging. In fact, the route for the train is not necessarily indicated with this system and the responsibility for the proper route rests entirely with the towerman. The top arm lowered says, "Sixty miles an hour, ahead." If, however, the top arm remains horizontal, with red light at night, and the second one is lowered with green light showing at night, the signal says, "Thirty miles an hour ahead" without reference to the route. If both arms are kept in the stop position and the dwarf signal lowered to proceed, the engineer is required to move forward so

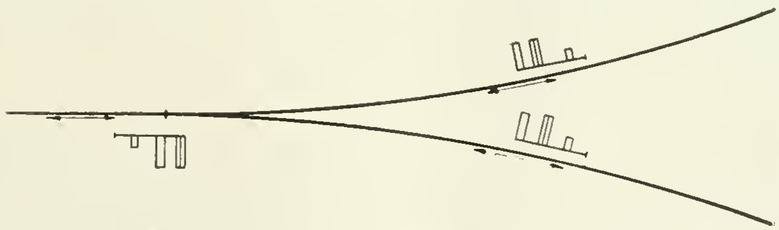


FIG. 2. JUNCTION WITH ONLY MODERATE SPEED GOING EAST AND ONLY HIGH SPEED GOING WEST. DWARF FOR ALL MOVEMENTS. ARMS WITH LINE ACROSS FACE ARE FIXED.

slowly and cautiously that a prompt stop may be made at any moment. This is briefly the broad principle involved in speed signalling. The applications, however, differ slightly with differing conditions

Such an arrangement as we have just described would be placed at a junction point where the main line and the diverging route were at such an acute angle that high speed might be made over either, Fig 1 provided the route was clear, and the fact that the route selected by the tower-man is clear is automatically guaranteed by his ability, after setting up the route, to pull down either signal to the proceed position. His ability to work the dwarf signal is not dependent on the line being clear as it is with both the high and the moderate speed signals.

Suppose the case where the main line was on a curve over which only moderate speed should be made, and that the diverging route curving away from the main line also required moderate speed. In this case, as in the former, the selection of the route lies exclusively with the towerman, but under no conditions is he to indicate high speed. The arrangement of the signals would be as before, with this difference, the top signal arm would be permanently fixed in the horizontal position with red light showing at night. It would therefore be impossible for the towerman to move the top signal arm or to alter the color of the light, and in all cases he could only give the moderate speed signal for either route, or he could block both routes or he could permit the very slow advance of a train by the use of the dwarf signal, Fig. 2.

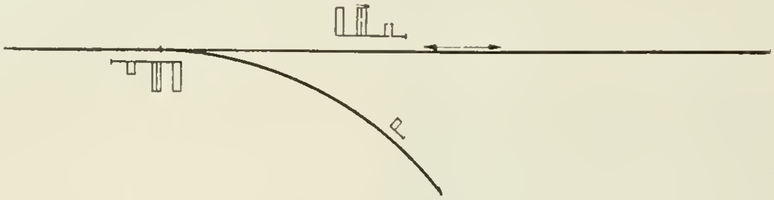


FIG. 3. JUNCTION WITH HIGH SPEED ONLY IN BOTH DIRECTIONS. LOWER ARMS FIXED. DWARF FOR ALL MOVEMENTS.

The permanently horizontal top signal arm and the permanent top red light would present an aspect similar to other interlocking signals and the habitual maintenance of the upper and lower lights would enable the engineer to locate the signal, even if one of the lights had gone out. The dwarf signal light being spaced very much farther down on the post, would not be confused with the other lights in case one of them was not burning. The absence of the mechanism for moving the permanently set signal would, of course, reduce its first cost and its maintenance charge.

Still another modification in the matter of application, though not in principle or form, would be where a diverging route left a straight main line so sharply that only very slow speed could be used upon the curve. The interlocking signal post would carry the two regular semaphore arms with the dwarf below. In this case the moderate speed arm would be set permanently in the horizontal position with red lights at night and the towerman would only be able to indicate high speed ahead or permit the slow advance of a train by the use of the dwarf signal, Fig. 3. This would mean that high speed could be regularly used on the straight main line and that the entrance to the diverging route, either by reason of its sharp curvature or the kind of traffic for which it is used, could only be approached in obedience to the dwarf signal. In this case the fouling of the main line by a car or cars on the diverging route would prevent the towerman from giving the high speed signal.

Such an arrangement as this is applicable to long sidings in which two trains might be allowed to enter the siding, the first at moderate speed. When the lower arm was raised to stop position behind the train the arm could not be lowered for moderate speed again until the first train was 2,000 ft. from the switch. Either could be let in at very slow speed, by the use of the dwarf signal, and when "in to clear," the main line could be rapidly traversed by the express after the high speed signal had been lowered to the proceed position.

The application of the speed signalling principle may be made so that, when necessary, high speed or moderate speed may be indicated in one direction, and moderate speed only in the opposite direction, or vice versa, with dwarf signal speed in both directions. The principle is broad enough to meet the various conditions which are encountered in ordinary railroad practice and the responsibility for observing the route indicated is removed from the enginemen and is put squarely and exclusively upon the shoulders of the towerman and his inability to signal high or moderate speed ahead unless the route set up is clear to the next block is guaranteed by the integrity of the interlocking mechanism. In the case we have been considering, with moderate speed barred out of consideration by the permanently fixed lower signal arm, the action of the towerman in lowering the top signal arm for the main line, means to the engineman of an oncoming train, the line ahead is clear and may be run over at high speed. The system may be modified to suit circumstances, and it may be used to block all routes, but the principle involved amounts to this: "If you can go forward at all, the signal will tell you how fast."

Relief Association's Good Record.

The Dodge Mutual Relief Association celebrated its twentieth year July 31. This organization made up of employees of the Dodge Manufacturing Company, of Mishawaka, Ind., is the oldest of its kind in Indiana. The object of the Association is the material assistance of members in cases of disability arising from sickness or accident which unfits them for daily labor. In case of death from any cause a special benefit is paid to the family or heirs of the deceased.

The Association is entirely in the hands of Dodge workers and membership is voluntary. A complete executive force is maintained to look after the membership, claims and other business. The membership is divided into two classes: First, those whose weekly earnings exceed $6, for which class the weekly dues are five cents and the benefit 80 cents per day, Sundays and holidays excepted; Second, those whose earnings are less than $6 per week, for which class dues are two and one-half cents per week and the benefit 40 cents per day. All benefits continue for a period of 13 weeks as a limit for any one term during 12 months, dating from the first day of disability. In the event of death of a member of the first class $50 is paid; and for the second class $25 is paid to the family or heirs.

Cases of disability are investigated by a committee who make a report to the board of directors, which issues the necessary order. The fee for this order is $1 for the first class, and 50 cents for the second. The weekly dues are suspended when the funds on hand amount to $500, and resumed when they get as low as $300. The Association has proved a highly satisfactory method of mutual assistance in cases of misfortune, and the employees of the company generally approve its operation and the 2,000 men on the company's payroll are all members.

PREPARING FOR THE WINTRY BLASTS. THE ROTARY.

General Correspondence

The Appeal of the Railway Signal.

Editor:

I have very much enjoyed the articles on signaling brought out by your editorial in the May number of your magazine, entitled, "The Appeal of the Railway Signal." In thus inviting discussion of this most important matter you have taken an advanced position among publications of your class, and by giving the men who have to use the signals a chance to be heard, you have struck a popular chord; for they are the persons who must read them under all conditions and who are responsible for the safe transportation of lives and property. It is unnecessary to say that the railroad companies are alive to the situation. Some of them have spent large sums of money in elaborate experiments and combinations of various colors for night indications; the majority of them have been found unsatisfactory and were not put in service.

In your editorial, page 202, May issue, you quote a signal engineer as saying, "We put the viands on the table and we see that they are swallowed, but we do not know whether they are palatable or not." Why do not the signal engineers partake of the viands themselves by riding on locomotives, not once or twice, but for one or two weeks, in all kinds of weather, to view a new set of signals or experimental changes made in any signal, placing themselves as nearly as possible in positions in the cab occupied by the engineman and fireman? They will thus be able to judge for themselves whether their ideas are practically correct. Theoretically and mechanically, their labors to put up a signal plant at a point may be good, yet when viewed from the footboard, faults may be readily located. Viewing signals from the ground is quite a different proposition to that of seeing them on a locomotive of a high-speed train, with only a second of time to read their indication and to act. The element of uncertainty should never enter into the handling of a train approaching a signal which might possibly be set at danger. A signal improperly displayed not only has its effect on the time of trains going over a railroad, but also is reflected in the cost of operation, caused by unnecessarily reducing speed and then having to pick it up again. It therefore behooves our friends of the signal department to so expend their energy as to give us the most perfect signal system possible, viewed from all points, trusting to the engineman and fireman to properly read them.

In the systems described on page 190 of the May number, many good points are mentioned, yet I do not think the use of a permanent red light on a post to indicate an automatic signal post is good, as it presents an unnecessary combination to the view of an engineman. His knowledge of the road on which he runs should be so exact that he would know where automatic or interlocking signals are located without the assistance of a marker. On page 335, August number, Mr. Talty's paper, he recommends that signals located on poles should be at least 25 ft. apart: this imposes a condition that would limit the capacity of signal poles used on four or six-track railroads and would make it impossible to install at one place a sufficient number of signals to govern all routes from any one track; neither do I think it a good practice to entirely cover any light in a combination of signals, as they all bear some relation to each other in giving indications.

The use of yellow as a color in signals is, to my mind, very objectionable. A lamp burner turned up so high as to smoke will give it the appearance of red. A clean yellow at night will often have a "dead" appearance to a rapidly moving train, making it hard and uncertain to read.

In the article of H. A. W. P., page 335, August number, he speaks of enginemen and firemen attempting to locate the position of the signal arm at night, in order to confirm the indication of the colored light. This it is possible to do at moderate speeds, but it also carries with it the possibility of looking up behind the colored red disc set at danger and seeing the white lamp behind it. Several such cases have actually occurred in times of dense fog. Another mistake that has occurred in the use of lamps was the hanging of the lamp on the post by the signal inspector, below the end of the arm hav-

UNION PACIFIC BLOCK SIGNALS NEAR OAKLAND, CAL.

ing the red-colored disc, instead of in its proper place, thus showing a permanent white light.

After reading the articles of Mr. J. H. Wisner, Jr., and H. A. W. P., who are very much in favor of the night indication displayed by the use of the illuminated background, so as to give it by position instead of by color, I am of the opinion that the system of the World Signal Co. brings the question of signals nearer a solution than any other device yet produced. I have seen this signal displayed, both daylight and night and in heavy weather accompanied by drifting fogs, and have no hesitation in saying that its performance in giving indications has justified the confidence of its friends. On one occasion I saw a test made in a fog with the World signal side by side with the standard colored lights (red, green, and white). The illuminated background and arm of the World signal could be seen after the standard lights had been entirely obscured by the prevailing fog.

In all ages the use of lights at night has been to enable persons to see objects as easily in the darkness as in daylight, and this is the underlying principle of the World signal; they so distribute the light on their backgrounds that the position of the blade is shown to approaching trains in the same manner as in daylight. Its adoption would make all systems uniform and the possibility of accidents very much reduced. An engineman who is required to run over some other company's system in addition to his own, on which signals are displayed in a different manner is seriously handicapped and put to a severe mental strain, in addition to the nerve-racking conditions incident to the service.

In the fourth paragraph of your editorial, page 344, August number, you have squarely presented the question to the engineman and fireman, and all others required to read signals, and in response to that invitation I have presented my preference as above outlined, having had nearly thirty years' experience on both sides of the locomotive cab.

B. F. C.

Too Many Lights Along the Road.

Editor:

I have noticed your editorial in the May number, "What Do You Think of Signals?" inviting men who have to obey them to express their opinion on this subject. I have run a locomotive for a number of years and will endeavor to give my views on the subject. I think signals should be as few as possible. The systems you have discussed have many points that are common to all railroad men. In my own personal judgment there are entirely too many lights along the road exposed to the man in the cab. In running through yards, town and cities it is not hard to mistake a light for a signal, as it is very common now for people to light their houses and places of business with colored lights. The colored lights used at present are not giving a clear indication to the man in the cab.

In my opinion the colored light question should be eliminated as much as possible. I would favor very much the World's signal, which is not only a good night signal, but also a good day signal, especially where you have a mountain or forest behind the signal. This signal has an illuminated background at night, as shown on pages 287 and 288 of the July number, and can be plainly seen as far as the eye can see an object the size of a semaphore arm. In daylight the white background entirely eliminates the difficulty in seeing the signal that is located against a hill or in any position below the sky line.

I saw this signal exhibited beside the standard colored lights in drifting fog. In moving away from the point at which all the signals were located the standard green, red and white disappeared in the order given. After the last of the colored lights were invisible the illuminated background and position of the signal arm on the World signal could be easily seen.

I consider this a much better and safer signal than the colored lights.

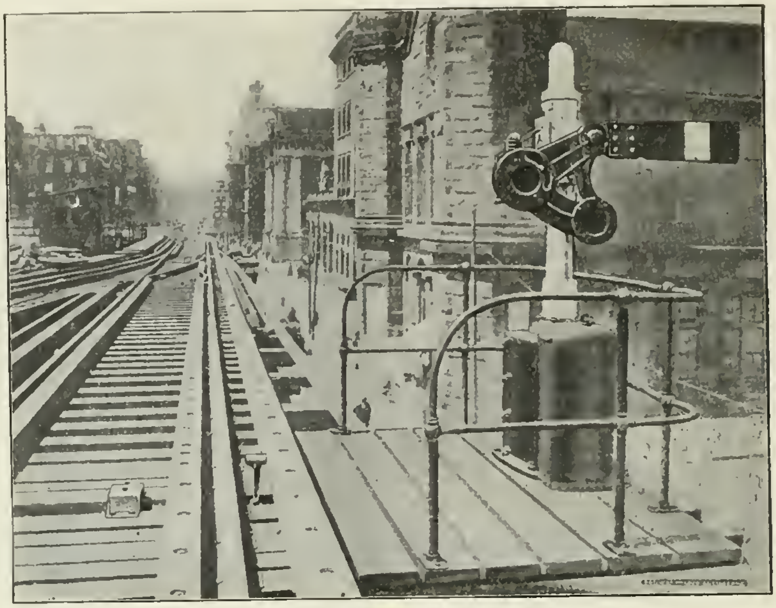
I very much fear that some of our railroad friends are so closely wedded to their own system of signaling that they cannot see much that is good in other methods.

Tyrone, Pa. J. C. S.

The Signal Question.

Editor:

In answer to the signal question invitation to write in the August number—if not too late for classification—will say that I agree with Road Foreman on red for the absolute stop signal. I would suggest red for absolute stop signal, yellow for permissive or caution signal and green for clear or proceed signal. With these colors it would not make much difference whether the signal mast has a disc or an arm. But there are a great many roads using red for stop signal, green for caution and white for proceed. In this case I would suggest the signal mast with arm—so that the position of the arm could be noticed at night in case either of the colored glasses were broken or had fallen out. The light would show proceed, but the position of the arm, if noticed at night, would save you if the red glass was gone.



STOP SIGNAL USED ON THE BOSTON ELEVATED.

When two arms are used on one mast for absolute and permissive blocking with red for stop, yellow for caution and green for proceed the top arm having the red and green glass the bottom arm the yellow and green glass, and if either of the glasses were broken or had fallen out, it would indicate a defect and would be noticed at first sight. An engineer would then be governed by the position of the arm, and it should be reported at the first opportunity.

I would prefer the arm instead of the disc, on account of the colors in the disc fading and with an electric headlight at night the reflection on the flat glass in the disc confuses a man. With the arm signal the position can be seen at a much greater distance. At a junction point I would suggest that a three-position, double-arm signal be used. If it can be operated mechanically with top arm governing main line or fast running route and the bottom arm the slow speed or diverging route. When signal is set for proceed on main line, have lower arm or diverging route set at caution and when diverging route is set for proceed, have main line signal set at caution, and in this way one would never have to pass the red, but red could be displayed when necessary by having the three positions. A single arm signal could be used on both routes for trains in opposite direction with a distant signal on each.

T. E. PATTON,
Loco. Engineer.

Jackson, Tenn.

Absolute or Permissive Red.

Editor:

In reply to your question in your editorial note on my letter in September issue of RAILWAY AND LOCOMOTIVE ENGINEERING asking what I would do in case there was an automatic signal at stop position at an interlocking plant, I would repeat the declaration in my first letter. "Be sure you have the clear signals governing your track," covers the question, as you could not have the clear signals with automatic signal at stop. But to remove any doubt on your part or others I would say that, did I meet with such conditions I would certainly stop.

I cannot conceive why there should be an automatic signal located at interlocking plants unless the signals at towers are entirely controlled by towermen, which practice, I think, is rather out of date as the signal to towers now-a-days are automatic to such an extent that towermen cannot clear them when track is occupied, switch open or a broken rail.

I would also say that I am not in favor of lights being covered at towers, as I can locate the signal governing the track on which I am running much more readily when all the lights are burning. All those red lights are saying is "I am protecting you while you are going through this plant."

I am also in favor of red glass in dwarf signals as purple gives a very poor light, and when glass is a little smoked, practically none at all. It is safer to be able to see a stop signal than a clear signal, and no matter how well you may know the location of these signals, if they cannot be seen until the headlight shows the position of the arm, you are liable to get past them before you can stop.

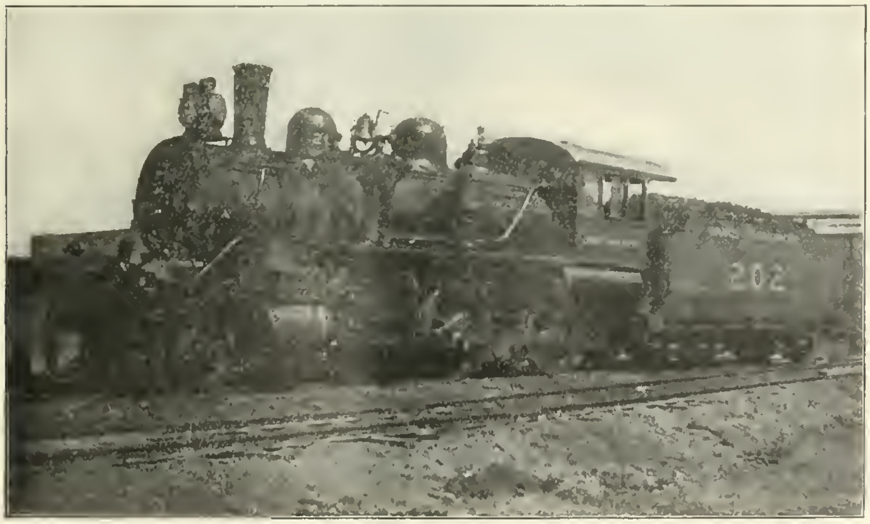
Scranton, Pa. 68-INCH WHEEL.

[Our correspondent has slightly mistaken our meaning. We do not speak of automatic signals at interlocking plants. What we desired to have each of our correspondents give us an opinion on, was the absolute or permissive red signal. 68-Inch Wheel has put his opinion very neatly in what the interlocking red lights say to him.—EDITOR.]

Boiler Explosions.

Editor:

I was much inteested in your article in this month's magazine entitled, "Cold Water Delusion." It carried my mind back to earlier days long gone by, and brought back many personal experiences. That induces me to jot some of them down in the hope they may prove interesting to some of your readers, and useful to you. Your mention of the English professor with his "red-hot cold water" recalled what I had seen Dr. Cresson, of Philadelphia, chemist for the Philadelphia & Reading, perform, and also did myself after seeing him do it. He used a metal ladle, copper or iron, I have forgotten which, and held it empty over a Bunsen burner until it showed near red hot, then he poured a small amount of water, which at once took on a spheroidal form of about ½ inch diameter. In a moment or two he would dip the bottom of ladle into ordinary cold water. The results would be different on different trials. There would be a quiet cloud of steam arise, or a sharp explosion, loud as a musket report, nothing visible, and if you were in the way you would be stung on face or hands like with sand from a blast. There was no certainty of which result would come, sometimes four or five explosions could be had in successive trials or vice versa.



GRAND TRUNK PACIFIC ENGINES BUILT BY CANADIAN LOCOMOTIVE WORKS, KINGSTON, ONTARIO.

Dr. Cresson told me he did not know just what conditions produced either result. The reason for steam boiler explosion given by Coleman Sellers "that the inside pressure was greater than the outside resistance could hold"; or the little boy's reason for a happening, viz.: "'Tis as 'tis, and can't be no tizzer," are about as near the mark as can be got.

I have seen all the conditions present in steam boilers, and no explosion followed; also have I seen locomotive boilers soon after they have been blown to fragments, and there were none of the evidences apparent that are said to be the cause of explosions.

A Ross Winans short firebox engine on the P. & R., hauling a coal train commenced to slip, and caught the rail again; just as she caught her grip the entire back end of firebox blew out killing the fireman, but engineer was not hurt and gave me the particulars.

Another engine of same class at yard work in Reading came out of the round house, hooked onto about 12 five-ton coal cars and had not run a mile when the boiler blew all to pieces. No evidence of low water. Another Ross Winans engine on coal train service was allowed by the engineer to get so low in water that she stopped. When brought to the shop, and stripped, the wooden casing on the boiler was found to be burned to black coals. The flues were, for the most part, collapsed so flat that sand would not run through them, and the cylindrical part of boiler had to be entirely reriveted, and there was no explosion. When the same engine came out of the shop, after almost rebuilding, and was turned over to service, she was thoroughly washed out and cleaned with soda. She was sent out on freight, with a first-class engineer for a few days. When he turned her in he reported her to be treacherous with her water. That same night she was sent out with a few empty coal cars in charge of a competent engineer, and she laid down about 5 miles from Reading. She was brought back to the shop and found to be in nearly as bad condition as the first time; boiler was dry and about half the flews collapsed. Enineer in statement said before he started he had boiler full of water, tried it frequently, and found water each time, finally put on pump, and in a train-length distance engine and train stopped. No explosion!

I was the first engineer on the L. & W. R. R.—it wasn't called D., L. & W. then—who took a 7½-ton Braithwaite engine that the company bought from the P. & R. Mr. Millholland used the engine a short time to run the shops during repairs to shop stationary, and would not allow over 45 lbs. pressure to be carried on her.

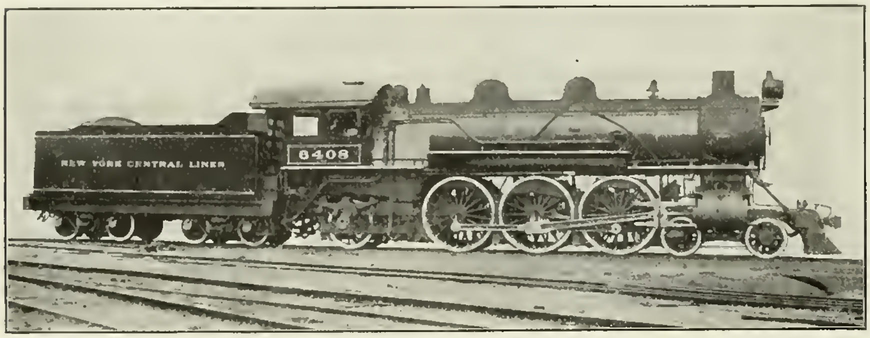
I had to hold down the safety valve until pressure would do the work. That engine was in service from 1832 until about 1873 and never blew up once.

The domes of two new R. H. & G. engines on the L. & W. split while in my care. One was too bad to get her home; the other I got home light. When second one split I figured out the safety valve—then figured out some more—and found the scale (Salter balance) held in 160 lbs. when it registered 120, our maximum.

New York, N. Y. E. J. RAUCH.

Locomotives On the Big Four.

Within the past three years the Big Four, or Cleveland, Cincinnati, Chicago & St. Louis Railway, have received some very heavy additions to their motive power. This increase was in the shape

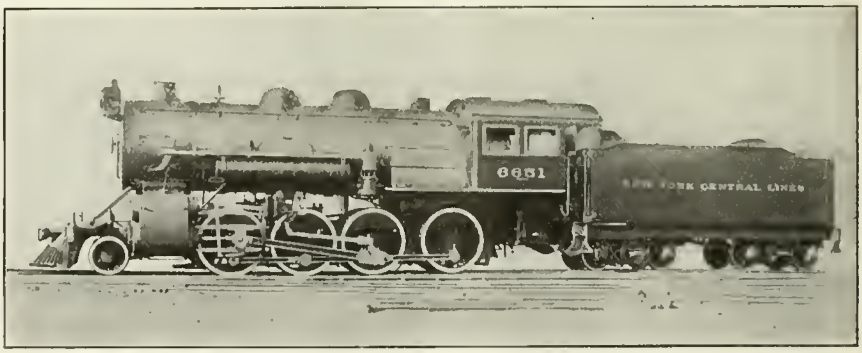


4-6-2 ON THE BIG FOUR ROAD.

of twenty Pacific-type passenger locomotives, twenty Atlantic-type passenger locomotives, 170 Consolidation-type freight locomotives, thirty six-wheel type switching locomotives, and two ten-wheel type switching locomotives for classification yard service. All of these locomotives were furnished by the American Locomotive Company, and are built according to standards of the New York Central Lines, of which the Big Four is a part.

The Pacific, or 4-6-2 type engines, one of which is shown in the photograph I send you, were built at the American Locomotive Company's Brooks Works, and are designed for heavy, fast passenger service. They are known as "class KB," in the New York Central Lines' classification. The locomotives weigh in working order 222,800 lbs., of which 142,000 lbs. is on the driving wheels, 39,000 lbs. on the trailing wheels, and 41,800 lbs. on the leading wheels. The cylinders are 22 ins. in diameter, with a 26-in. stroke, and are fitted with valves of the piston type. The boiler is of the straight top type, is 72 ins. in diameter, and carries a working pressure of 200 lbs. The tubes number 344, and are 2 ins. in diameter by 20 ft. long. They have a heating surface of 3,587.9 sq. ft., while the heating surface in the firebox is 173.4 sq. ft., making the total heating surface 3,761.3 sq. ft. The grate area amounts to 50.23 sq. ft. In diameter, the driving wheels measure 75 ins. The driving wheel base is 13 ft., the wheel base of engine, 33 ft. 7½ ins., and the total wheel base, engine and tender, 62 ft. 2 ins. These locomotives at the head of their train, can exert a maximum tractive effort of 28,526 lbs. They are giving very satisfactory service, hauling the heavy, fast passenger trains of the road, the best known of which are the Knickerbocker Special and the Southwestern Limited.

The Consolidation type freight locomotives were supplied jointly by the Brooks and Schenectady Works. There are four classes of these engines: G-5H, G-5HA, G-5T, and G-6C. About half of these locomotives (the G-5HA and G-6C types), are equipped with the Walschaerts valve gear, while the remainder have the ordinary Stephenson link motion. The one shown in the photograph has the Walschaerts gear and is one of the "G-5HA" class. The total weight of the engine in working order is 222,000 lbs., 198,000 lbs. being carried by the driving wheels and 24,000 lbs. by the truck wheels. The cylinders are 23 x 32 ins., which with



2-8-0 SIMPLE ENGINE ON THE C., C., C. & ST. L.

63-in. driving wheels and a working pressure in the boiler of 200 lbs. gives a maximum tractive effort of 45,680 lbs. The boiler is 82 ins. in diameter and is of the straight-top pattern. It contains 392 two-inches tubes, 15 ft. ½ in. long, which give a heating surface of 3,071.3 sq. ft. The firebox has a heating surface of 181.9 sq. ft. and the total heating surface aggregate 3,253.2 sq. ft. The firebox is 108 ins. long by 75 ins. wide and the grate area is 56.75 sq. ft. The wheel base of the engine is 26 ft. 5 ins., driving wheel base, 17 ft. 6 ins., total, engine and tender, 58 ft. 4 ins. The tender weighs 142,600 lbs., and carries 12 tons of soft coal and 7,500 gallons of water.

The ten-coupled or 0-10-0 type switching locomotives are practically duplicates of those built by the American Locomotive Company for the L. S. & M. S. Railway, and illustrated in RAILWAY AND LOCOMOTIVE ENGINEERING for September, 1905, page 399, with the exception that the total weight has been slightly increased in the case of the Big Four engines, making them the heaviest switching locomotives yet built. They were furnished by the Brooks Works and are classed as M-1C. Their total weight is 274,000 lbs., or 54,800 lbs. per axle.

The Atlantic or 4-4-2 type engines are known as class I J, and were built at the Schenectady Works. The letter "I" is the symbol for the Atlantic type while the suffix "J" denotes the particular design. The six-wheel (0-6-0) switching locomotives come under the B-10B class, the large letter "B" denoting the 0-6-0 type. They were built jointly by the Cooke and Schenectady Works.

ROBERT C. SCHMID.

Indianapolis, Ind.

Does Valve Gear Strain Frames?

Editor:

The close-set driving wheels with brake rigging closing up every opening, whereby a person could reach inside the frames of a locomotive, renders locating the valve mechanism inside the axle boxes a most inconvenient arrangement. This led to the introduction of the Walschaerts valve gear which came into popularity very largely through the merit of being located outside of the driving wheels.

When the Walschaerts valve gear first came into use in this country, claims were made that by removing the eccentrics and other valve mechanism from inside the wheels improved facilities would be enjoyed of strengthening the frames by cross bracing and that this strengthening would prevent the breakage of frames which is becoming very troublesome with engines having high set boilers.

I believe that experience with the Walschaerts valve gear has demonstrated that the expectations concerning the strengthening of the frames have not been realized. In fact, the impression is spreading in some quarters that the use of the Walschaerts valve gear materially increases the breakage of frames. At a recent meeting of railroad master mechanics one of the members present made the statement that his company had received a group of engines equipped with Walschaerts valve gear, and that within six months every one of the engines suffered from a broken frame. This was considered extraordinary, as the engines were of the same general design as a type of engines having link motion that had been in service for years without a single breakage of frames. This would seem to indicate that the Walschaerts valve gear puts greater stresses upon the frames of a locomotive than the link motion. The cause of the difference is not apparent, but there is no doubt that is exists. I should be glad to have the views of your readers upon this important subject.

A. Morton.

Philadelphia, Pa.

Journal Box Packing Support.

Editor:

The Pittsburg, Shawmut & Northern Railroad has had the waste supporting journal box attachment, devised by me, under test for some time past, and I may say it has given excellent service. The construction is very simple, requiring only a small quantity of sheet steel, 1-16 in. thick.

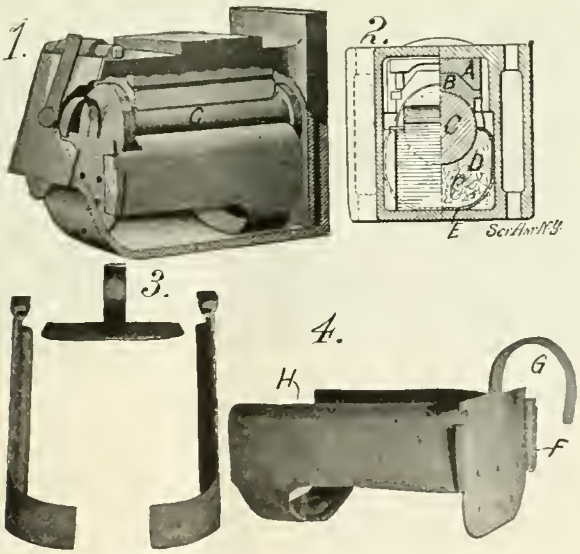
I find that the device takes care of a number of conditions that railroad people have been trying to overcome for quite a while. In the first place it saves packing. It gives practically no trouble either to the inspector or to the repair men on account of it being applied or removed without disturbing the brass or wedge. It gives the inspector a better opportunity to inspect the journals for roughness on account of the device keeping the packing from rolling up the sides of the journal or working forward.

We have given the cars and locomotives equipped with it very little attention, even with the hardest road service. We inspect them once a month to ascertain their condition. We have some of them, at the present time, under seal which we do not expect to disturb for several months, and then only for examination.

There is less danger of the packing being stolen, as it is practically concealed. The device has been patented.

R. A. Billingham, S. M. P.

St. Mary's, Pa.



WASTE CARRIER FOR JOURNAL BOXES.

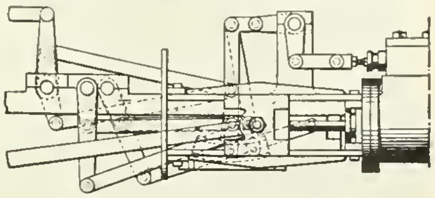
Too Much Beef.

"I have often thought," said Chordal, "that unnecessary screwing of certain bolts is a fair test of a mechanic's intelligence. I once got up the drawing for a planer to plane 5 or 6 ft. square and 25 to 30 ft. long. As a tool-holding arrangement I put in the usual two clamps with four good, big screws. The man who ran this planer broke a bolt a week. We made new ones of every kind of iron and every kind of steel, but still they broke. A planer right alongside of this one doing exactly the same kind of work, using the same tools, making the same cuts on the same pieces, but run by another man, never broke a tool bolt, notwithstanding there were only two of them and they were very much smaller. The men running the planers changed places, and immediately the old planer began to break bolts. The man with the breaking tendency had too much beef and too little judgment.

"This kind of man is found in every line of mechanical work, and he is always breaking things. These are the men who break tool-post wrenches on lathes. They break any kind of an open-ended wrench you give them. A monkey wrench volatilizes in their hands. They strip bolts and nuts, and spring face plates and angle plates and planer tables and burst pipe fittings and come down on the tops of journal boxes. If anything with a screw in it can be damaged, they will damage it. If it is so strong that they cannot damage it themselves, they will screw it up so infernaly tight that somebody will have to damage it to unscrew it. They will go home and screw the lid on the pepper box, with their beef force, and then grumble at the bruising of the bright work when the housewife has to use a fork to unscrew it."

New Valve Gear.

The subject of valve gearing is one that has engaged the attention of the brightest minds among railway men, and we observe among the devices recently patented an ingenious invention by Mr. E. L. Bowen, McComb City, Miss. Patent No. 922,250. The invention may be applied to all reversing engines. The shafts and levers are so arranged that the crosshead of one engine actuates the valve of the other engine. The movement also insures a constant lead independent of the main traveling movements of the valves. It is claimed that the combination as shown in the accompanying illustration provides a new and improved valve gear which is simple, strong and durable in construction, and easy to manipulate. The complete absence of eccentrics or cranks adds to its simplicity, and it is said to be well adapted to the present type of large locomotive.



ARRANGEMENT OF VALVE GEAR.

In all labor there is profit, said a wise man, but the talk of the lips tendeth to penury. An employer of labor on being asked to recommend a certain workman for a superior position testified: George is far from being an industrious workman with his hands, but when it comes to laboring with his mouth no person in the place can equal his performance.

KONAKASHIMA TUNNEL, JAPAN.

Traveling Engineers' Association Convention at Denver.

The Seventeenth Annual Convention of the Traveling Engineers' Association met in the Albany Hotel, Denver, on Sept. 7, with President J. A. Talty, of the Lackawanna Railroad, in the chair. After prayer being offered by a local clergymen President Talty called upon charter member Angus Sinclair for an opening address, making complimentary allusions as to the fitness of Dr. Sinclair for such a function.

DR. SINCLAIR'S ADDRESS.

Dr. Sinclair began by referring to the rapid growth of the Association into size and popularity, based on the useful work it is doing. He attributed much of the prosperity enjoyed to the fortunate choice of officers; the secretary having guided the organization in the path of safe progress during the whole of its career, in which work he was earnestly aided by remarkably efficient presidents, beginning with Messrs. Clinton B. Conger, Donald R. MacBain, and others equally as able, down to the present zealous incumbent, Mr. John A. Talty.

Dr. Sinclair then outlined the history of the locomotive which had created in eighty years a world of progress equal to five hundred years of any other period of the world's history. He concluded by highly commending the new system of individual management introduced upon the Harriman lines, which was going to give all classes of railway workers an even opportunity for promotion; the advancement to be earned by ability or industry. He anticipated that the able men for which the mechanical and engineering department were noted would profit most by the system of promotion through merit alone.

PRESIDENT TALTY'S ADDRESS.

President Talty then delivered the following address:

Sixteen years ago this Association, then in its infancy, held its second convention in this beautiful city of Denver. When we look back and consider that at that time there were only 106 members belonging to the Association and that there were as many different opinions as to the wisdom of such an association being formed, not only amongst the members themselves, but the higher mechanical officials also, I think you will agree with me that this assembly fully demonstrates that the charter members, a few of whom we are happy to have with us today, set this Association on a stronger concrete foundation than was anticipated at that time.

We start this convention with nearly 700 members, and when you think that there never has been any reduction in the membership in the 17 years of its existence further comment as to its popularity on the part of the speaker is unnecessary.

When this Association was started the position of traveling engineer was not looked up to by our higher officials as being one of great importance. In fact, he was used mostly in those days as what is known as an engine tamer. After an engine received general repairs he took charge of it and spent sufficient time with it to satisfy himself that it was in condition to perform the service required. But today the traveling engineer's position is considered one of the important positions on the American railroads. This has largely been brought about through this Association by improving the locomotive service and by investigating and discussing in common the problems peculiar to that position.

PRACTICE AND READING.

A good live traveling engineer, one who is able and willing to give his time and attention to the men under his charge as well as the locomotives, is doing a great deal toward building up an organization which assists in rendering service to both the transportation and mechanical departments. He must be fair in his dealings with the men under him as well as the company which he represents as an official. He must conduct himself in a manner which will win respect from his higher officials as well as others with whom he comes in contact daily. When the traveling engineer has convinced his superior officers that he is fair in dealing with the company and with men, they are willing, at all times, to recognize his ability and entrust him with greater authority, thus promoting him to a higher position.

WORK OF THE CONVENTION.

I wish to call your attention to the important subjects which are to be discussed at this meeting. They are of more than ordinary interest to our American up-to-date railroads. As you all have received the committees' reports and papers it is unnecessary to comment on them individually, only to say that they show hard, painstaking work and research. I want to thank the committees who have spent their

TRAVELING ENGINEERS, THEIR WIVES, DAUGHTERS AND FRIENDS GOING TO THE CONVENTION.
THEIR HEADS ARE NOT BOWED IN DEVOTION—THEY ARE FACING THE MID-DAY SUN.

time in preparing these papers as well as those who have assisted at that kind of work that requires sitting up late at night when other members of the Association are enjoying "bonnie" slumbers.

AUTOMATIC STOKERS.

I would call your particular attention to the close investigations which are being made and the continued improvements in the automatic stoker. The men who are devoting their time, energy and money toward perfecting this much-needed device are public benefactors indeed, for the time has long since passed when the number of cars or tons of freight handled per train are only measured by the tractive force of the locomotive, by the ability of the fireman with the endurance necessary to maintain the maximum steam pressure. Some of us are more fortunate in this respect than others, owing to the fact that our company buys a high grade of fuel and maintains their locomotives at a high standard.

ELECTRIC LOCOMOTIVES.

Several of my predecessors have given you a word of caution about the prominence of the electric locomotive which is manifesting itself in railroading today, but I cannot refrain from again calling your attention to the necessity of getting ourselves posted on this subject. The substitution of electricity for steam thus far has been rather slow, but the improvements that are being constantly made in electric traction show that the possibilities of electric power cannot be overestimated. Therefore, it behooves us all, holding positions which require education from us to fit others to handle the electric locomotive as successfully as they have the steam locomotive—it behooves us to give this subject some consideration. We can all remember the remarks of one of the brightest lights in the railroad world who said on the floor of our convention, a few years ago, that none of us would live to see electricity used for motive power, except on street railroads less than three miles long. The very able paper to be presented to us at this meeting should set us thinking on this subject.

FUEL ECONOMY.

An excellent paper on fuel economy has been prepared which should interest all of us. When it is considered that over 200,000,000 tons of coal are consumed annually in the locomotives in this country at an approximate cost of from 280 to 300 million dollars you can readily see that it is one of the largest, if not the largest single item of expense in railroading. Therefore, we, as members of this Association should keep everlastingly at our investigation along these lines, for it has been well said that a line of education in this direction would go a long way toward paying dividends. Many of our members, as well as our superior officials, believe that a traveling fireman without any responsibilities other than economizing on fuel would be one of the assets our railroads could have.

TRAVELING FIREMAN.

To be a successful traveling fireman a man must be fair in his dealings with the other firemen under him and should have had sufficient experience to enable him to fire successfully and economically the fuel furnished by his company. After holding such position for a short period of time he should familiarize himself with the firemen's ability so as to know the men who require instruction.

It is a question in the minds of some of our mechanical men if a man hired for this position is not more weighty for the position and better results are not obtained than when a man is picked or chosen from the forces. In many instances the traveling fireman has been so closely associated with the men under him before being appointed traveling fireman that economical results are not obtained, because he fears to offend the men by enforcing greater economy. These same remarks also apply to traveling engineers.

There is no doubt but that the traveling fireman and traveling engineer by working hand in hand can assist in reducing the amount of coal consumed. This can be done by the traveling engineer closely watching the proper draft of the locomotive to burn the fuel and also the manner in which the engineman is operating the locomotive, while the traveling fireman is keeping watch of the manner in which the fireman is handling the fuel.

DEVIL'S SLIDE, WEBSTER CANYON, UNION PACIFIC.

SUPERHEATING.

It is believed that valuable economics would result from the use of the superheated engine now being very rapidly developed and I would suggest that the members of this Association investigate the subject very thoroughly in the near future, as it has been demonstrated in many instances that the superheated engine renders more efficient service than the saturated steam engine.

As our system of organizations on the different up-to-date railroads are rapidly changing it behooves us to keep very much alive, now more than ever, to the changing times and keep up in the front row. This is advice from men experienced in the practical side of railroading and who are appreciated by our high officers, and the ones who are even partly responsible for the satisfactory operation of our railroads are looked up to as assisting the railroads which employ them as well as the public at large.

AIR-BRAKE OPERATING.

I wish to call your attention to the subject of the operation of air-brakes and trains by use of power brakes. This is a very modern subject and one which requires our most earnest thoughts, as the time has arrived when it requires experience and good judgment to control our heavy freight trains safely over the roads. We have with us several representatives from air-brake companies who will be glad to enlighten us on any point relating to air-brakes.

We also have with us supply men who represent companies which furnish the devices which are found on our locomotives today and they will be glad to impart any useful information which is requested by the members.

Just a word with reference to the entertainment committee: the chairman, Mr. James Curry, is present and will look after this end of the programme. He is an excellent entertainer and a great favorite especially with the fair sex.

MEMBERS PRESENT.

The attendance register contained the following names on the morning of the second day:

John A. Talty, Lackawanna Railroad, Buffalo, N. Y.; W. O. Thompson, New York Central, Buffalo, N. Y.; F. G. Thayer, Southern, Atlanta, Ga.; F. P. Roesch, E. P. & S. W., Douglas, Ariz.; C D. Getchell, Bangor & A., Milo, Me.; Angus Sinclair, A. S. Co., New York; J McManamy, Pere Marquette, Grand Rapids, Mich.; C. J. Evans, M. K. & T., Parsons, Kan.; Clinton B. Conger, W. Sellers & Co., Grand Rapids, Mich.; C. F. Richardson, C. R. I. & P., Chicago; Burt G. Lynch, Santa Fe, Albuquerque, N. M.; Chas. Cotter, D. & I. R., Two Harbors, Minn.; Chas. M. Boyd, Santa Fe, Winslow, Ariz.; C. B. Summers, T. S. L. & W., Charleston, Ill.; M. H. Haig, Santa Fe, Topeka, Kan.; B. J. Feeney; Ill. Cent., Paducah, Ill.; A. Arnum, Wabash, St. Thomas, Ont.; C. F. Fein, Santa Fe, Newton, Kan.; J. B. Fitzpatrick, C. R. I. & P., Chicago; Webb L. Gibbs, S. L. & F., Ft. Worth, Tex.; G. V. McGlinch, M. C., Jackson, Mich.; A. Roesch, Colo. So., Trinidad, Colo.; H. E. Exby, Ill. Cent., Carbondale, Ill.; A. L. Beardsley, Santa Fe, Chicago; M. S. O'Connor, N. G. C. & H., Avis, Pa.; John Manuell, D. & R. G., Grand Junction, Colo.; A. B. Poorman, Big Four, Mattoon, Ill.; J. R. McDonald, I. C., Chicago; G. W. Danver, I. C., Newton, Ill.; A. Geister, S. L. & S. F., Monett, Mo.; F. S. Wilcroxen, T. S. L. & W., Frankfort, Ind.; A. G. Turlay, Ill. C., Clinton, Ill.; J. P. McMurray, Col. & So., Denver, Colo.; W. R. Davis, T & O. Cent., Columbus, O.; R. L. Evans, W. & L. E., Massillon, O.; S. J. Kidder, W. A. B., New York; C. F. Schraag, C. & E. I., Ill., Danville, Ill.; W. White, Nat. Boiler Wash. Co., Chicago; D. V. Musgrove, So. R., Columbia, S. C.; W. S. Bray, Mo. P., Wichita, Kan.; T. A. Hedendahl, W. A. B. Co., Denver; James Cunneen, Erie, Port Jervis, N. Y.; T. E. Miller, B. & O., Connellsville, Pa.; Wm. Gisbar, C. R. I. & P., El Dorado, Ark.; J. S. Miller, B. R. P., E. Salamanca, N. Y.; P. K. Sullivan, Erie, Cleveland; W. M. Gaines, So. R., Greenville, S. C.; D. C. Dickert, Ga. Cent., Fort Valley, Ga.; W. G. Tawse, C & E. Ill., Dolton, Ill.; J. G. Brown, C. Ga., Macon, Ga.; Jas. Spellen, B. R. & P., DuBois, Pa.; Robt. J. Buswell, Santa Fe, Wellington, Kan.; Matt. H. Flynn, D. & R. G., Grand Junction, Colo.; J. H. Dimarin, D. & R, G., Alamoso, Colo.; F. L. Marteins, D. & R. G., Salida, Colo.; S. D. Hutchins, W. A. B. Co., Columbus, O.; Wm. Gill, Ia. Cent., Marshallstown, Ia.; J. W. Johnson, Pyle N. H. L. Co., Chicago; Frank A. Morrison, Mason Reg. Co., Boston, Mass.; W. O. Taylor, Galena Sig. Oil Co., Plainfield, N. J.; Chas. P. Storrs, S. Mica Co., Owego, N. Y.; W. L. Irkes. I. C., Freeport, Ill.; J. W. Cain, McCord Co., Chicago; L. B. Hart, B. & O., Garrit, Ind.; H. N. Spaulding, B. & O., So. Chicago; D. C. Rogers, N. Y. C., Corning, N. Y.; Geo. W. Ristine, H. W. Johns-Manville Co., Denver, Colo.; W. A. Morgan, N. C. & St. L., Nashville, Tenn.; J. A. Kerrigan, N. C. & S. L., Nashville, Tenn.; Oles Hulse, N. C. & S. L., Nashville, Tenn.; A. 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Cooper, Erie, Galion, O.; Jos. Crosthwaite, P. M., Mandan; A. C. McLaghlan, Pere Marquette, Saginaw, Mich.; Ivor W. Enos, Pere Marquette, Grand Rapids, Mich.

Increase in Shops and Rolling Stock.

The Iowa Central Railway are going in for some extensive improvements at their Marshalltown shops. They are adding a total floor space of 3,680 sq. ft. to the existing building and are erecting a new stationary boiler house 30 x 60 ft. The floor of this is laid with concrete six ins. thick and the building is well lighted and ventilated.

Mr. C. E. Gossett, the master mechanic of the road, has been purchasing some new machine tools, among which may be mentioned a 42-in. boring and turning mill with slotting attachment, one universal radial drill with 5-ft. arm, also a heavy pattern double axle lathe, all from the Miles-Bement-Pond Company, of New York. An 85-in. driving-wheel lathe, a 30-in. engine lathe, a 36 x 36 planer with 8-ft. bed, two crank shapers, two universal turret lathes, and a boring and turning mill. In the blacksmith shop there has been installed a new 116-lb. single-frame steam hammer and one Acme 2-in. heading and forging machine of the kind shown on the outside cover of this issue of Railway and Locomotive Engineering.

The Iowa Central have also received from the Pressed Steel Car Company, of Pittsburgh, fifty high-side, hopper-bottom, steel gondola cars of 100,000 lbs. capacity each, and they have also bought 250 wooden gondola cars of 80,000 lbs. capacity. Our illustration shows a string of seven new engines lately received from the Baldwin Locomotive Works of Philadelphia. These engines, twelve of which are ordered, have cylinders 21 x 30 ins., American balanced valves, operated by Walschaerts gear, 200 lb. boiler pressure straight top boiler 55 5-16 ins. diameter at the front end. Brick arches are used in these engines. The driving wheels are 52 ins. in diameter. Tractive power 37,500 lbs. The tender has a water capacity of 6,500 gallons and holds 12 tons of coal. The weight of the engine alone is 172,000 lbs. and of this 150,000 lbs. rests on the driving wheels. The leading truck therefore, has 22,000 lbs. on it. The lubricators are Nathan bulls-eye. Injectors XX Monitor, and the boilers have each two Bordo blow-off cocks.

Making a Model Locomotive.

Our advice has been asked by an apprentice who is ambitious to make a working model of a locomotive. We say, by all means, go on with the work and finish the locomotive and make sure that it runs when completed. That kind of work is excellent recreation and has considerable educational value. A youth doing such work at home is largely left to his own resources and has got to scheme and plan without the aid and counsel of a foreman or gang boss.

Such work is true education for the mechanic. It tests and develops his originality, his taste and his constructive skill. His ambition is stimulated to do a creditable piece of work, he bends all his energies to that end and succeeds if he is of the right material to force success.

Many apprentices begin making toy steam engines and model locomotives, and comparatively few make a creditable finish. We hope the young man we are spending advice upon will have perseverance to complete a good working model. His success in that may mean success in greater achievements.

Mechanical Stokers That Have Faded.

The invention, now known as a mechanical stoker, used to bear the name of a self-feeding locomotive furnace. A variety of such inventions contributed revenue to the patent office when coal burning was taking the place of cord wood in the United States. Among such inventions was a movable chain grate arrangement, which was applied to several locomotives about New York in 1850. That device was commended in the public prints as being calculated to put an end to the smoke nuisance. Smoke, that objectionable feature of locomotive operation, made itself felt before the iron horse had grown far from its foaling days. The chain grate took with it connections that could be dropped upon a push car on which cleaning and clinkering was done.

In 1884 parties in Boston made some stir in trying to introduce a self-feeding locomotive furnace, which also was guaranteed to prevent smoke. That furnace was patented by William L. Lowrey. It consisted of an apparatus for feeding the fuel by gravity from a closed magazine into a horizontal unobstructed and grateless combustion chamber, wherein the body of the coal was fed forward as required. The construction of the fixed carbons and hydro-carbons distilled from the coal was supposed to be effected at a point near where they entered the combustion chamber, controlled jets of air being introduced for the purpose.

That was one of the most elaborate forms of mechanical fireman ever offered to an unresponsive public, yet it was permitted to fade unseen and would have gone to quiet oblivion but for this searcher into unacknowledged inventions.

Many railway officials make a good start in life and remain all their days at the point where they made the good start because they refuse to employ assistants that may be abler men than their chief. Lacking confidence in subordinates has put the E. T. brake upon many a promising career.

NEW BALDWIN ENGINES FOR THE IOWA CENTRAL RAILWAY.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

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Traveling Engineer's Convention.

One of the most notable events of the year in relation to railway operating was the seventeenth annual convention of the Traveling Engineers' Association held in Denver, Colo., in early September. Some of the members had traveled nearly three thousand miles to reach Denver, and representatives were there from Canada, from Mexico, and from Cuba, but they all formed a very harmonious unit in discussing questions relating to the economical operation of the locomotive.

One feature of the Traveling Engineers' Conventions which we have always sincerely admired is the faithful way the members adhere to the motto of the organization which says: "improve the locomotive engine service on American railroads." Other organizations devote much time, ingenuity and talk to devising and advocating schemes and improvements for making a better and more efficient locomotive engine; but the traveling engineers strive their hardest to make the very best out of the locomotives which they find in service today. This tendency was very apparent during the closely attended sessions of the last convention. Denver had many attractions to allure the visitors away from technical discussions, but the members of the Traveling Engineers' Association sat persistently through two long sessions each day, and a large proportion of those present took an active part in expressing their views on the various subjects that had been brought up for investigation. It may be that railroad club meetings, lodge meetings, etc., are developing the speaking capabilities of our railroad men, for we never before saw such a large proportion of the members present take part in the proceedings as was done by the members of the Traveling Engineers' Association at Denver or heard the discussions so clear and so decidedly to the point.

Although the Traveling Engineers' Association in convention hold two protracted sessions during every day they invariably fall into the error made by all railroad mechanical meetings of undertaking to go through more work than the time available permits to be done thoroughly. Ten papers or committee reports formed the basis of the work done at the Denver convention and half the number would have been sufficient. With a body of men so well informed on all locomotive questions as the members of the Traveling Engineers' Association are and with reports susceptible to so much difference of opinion one report a day would keep the sessions busy. At this convention the formidable question of fuel economy was introduced by an excellent personal paper prepared by Mr. S. D. Wright, and it might have been profitably discussed all the three days of the convention. We expect to publish a synopsis of the paper and of the discussions thereon, so we need not comment further upon it at present, beyond saying that the subject appeals more to the members than any other, and the information brought out is calculated to save more money to railroad companies than any of the other numerous schemes for reducing operating expenses.

The inaugural address of President Talty was particularly good, practical and free from the empty platitudes so often indulged in. He commented upon the rapid growth of the association to nearly seven hundred members in seventeen years and told of the more gratifying fact that the position of traveling engineer had risen from that of a mere engine tamer to one of the highest importance and most respected among railroad officials. He credited the association with a large share of this very desirable change, and urged the members to continue the good work while earning the respect of employers and of enginemen by fair dealings and helpful supervision of locomotives and of the men handling them.

A subject which elicited curiously diverse views was a report on "The Most Economical Method of Maintaining Tool Equipment and Supplies Other Than Coal, Water and Sand on Locomotives in Service." When this long caption was boiled down it meant, "tools for locomotives," a subject that several other organizations have wrestled with not very profitably. A variety of lists of tool equipment for locomotives were published in the paper and they displayed decided diversity of practice among the different railroad companies. The trend of the discussion that followed the reading of that report favored the restricting of the supply of engine tools to the smallest number consistent with convenience and economy. In that it represented the sentiments of nearly all motive power officials responsible for their share of operating expenses.

A most valuable paper was submitted by Mr. T. H. Hedendahl, of the Westinghouse Air Brake Company, on the "Proper Method of Handling Air Brakes on Long Trains to Insure Smooth Service." The paper was profusely illustrated and elicited a long discussion that might have been profitably protracted but for the fact that too much other business deprived the members of hearing valuable comments upon a subject that all railroad men ought to know thoroughly.

Space prevents us from commenting upon the remainder of the reports, papers and discussions at present, but we hope to return to the subject again. The mountain railroads in the neighborhood of Denver enabled many of the members to enjoy the privilege of watching how railroad operating is performed under the greatest difficulties. Denver is an admirable town in which to hold conventions, its only drawback being the long journey that most people have to endure between the Rocky Mountains and their far-away homes.

The Rocker Box.

There are few parts of the modern locomotive subject to greater stresses than the rocker box. Situated as it is between the portions of the valve gearing inside the frames and the portion outside, the twisting stress is very great and even with massiveness of construction the wear is very rapid. With the introduction of the Walschaerts and Baker-Pilliod valve gears rocker boxes are less subject to the wear and tear of forces working at considerable distances apart from each other. In both of these gearings the action of the eccentric crank and combination lever are nearly directly in line with the valve rod and hence the intervening cranks or rockers that may be necessary are nearly all directly in the line of the moving forces.

The closing together of the two divisions of the rocker box and the re-boring of the same is a source of constant occupation in the larger repair shops and has called into activity much mechanical ingenuity. The results have not always been of the best. The box, on account of its peculiar construction, is not readily adjustable, either on the lathe or boring mill, and any deviation from a perfectly square boring out of the box has a very pernicious effect on the perfect fitting and adjustment of the attached link and valve rod. This trouble readily manifests itself on attaching the valve rod to the rocker and observing that the end of the valve rod which should point directly to the valve spindle may point a considerable distance outside or inside the valve spindle, thus involving slight offsets at both ends of the valve rod and greatly increasing a rapid deterioration of the parts.

We recently had the opportunity of observing a clever device in operation in the New York, New Haven & Hartford Railroad shops at Readville, Mass. A heavy bar of metal representing a section of a locomotive frame was attached to a lathe frame crosswise and suitable means were attached for raising or lowering the bar. A number of holes had been drilled in the bar and when a rocker was placed on this bar it could be readily bolted in any desired position, the holes in the bar being larger than those generally used for the rocker box bolts. The exact centering of the box was a comparatively easy matter and a rigid bar with adjustable cutter could be rapidly run through the box. It may readily be seen that the perfect adjustment of the bar representing the frame, rendered the position of the rocker box when attached, positively correct, being perfectly square to the frame. It was not left to the hand and eye of the mechanic to adjust the angle at which the cutter would operate. The bar being already carefully adjusted both longitudinally and transversely, the boring was a simple, rapid operation, and in every case absolutely correct.

It is gratifying to observe that there is a growing spirit of encouragement especially in the larger repair shops on all the leading railways, calculated to develop the latent talent of the thoughtful mechanic and call into action the inventive faculty which is so marked a characteristic of the educated American railway man, and by whose ingenuity so much that is labor saving, in point of economy, and so much that is approaching perfection in point of mechanical construction has been already accomplished.

It should be remembered that in rebolting the rocker box to the frame the general practice is to make no variation on the front holes of the box, making such alteration as may be necessary, on account of the closing together of the two divisions of the box by filing out the overlapping portion of the back holes. In any event it is the best practice to leave the holes in one section of the box intact so that some of the bolts may be a driving fit. The alteration in the exact location of the rocker box has a disturbing effect on the length of the valve rod and eccentric rods, all of which must be readjusted to suit the changed position of the refitted rocker box.

Patent Your Inventions.

We frequently hear the question asked: "Why are so many patents secured in this country for appliances that are never put upon the market?" No person well acquainted with machinery can go over the Patent Office Record week after week, without being impressed with the fact that many impracticable devices receive the protection of patents; but the greater part of patented appliances that are never pushed with public notice were not originally intended for sale. Many ingeniously planned devices are got out monthly for the purpose of facilitating work in certain lines of manufacture that give the owner some advantage over his competitor, and such inventions are often patented as a protective measure; while in other cases inventors of small devices often make a serious mistake in thinking their invention not worth patenting till they see it becoming common property. Not infrequently a man invents something to produce work easier or to save some labor, and considers it too trifling for the expense of a patent; but an invention pirate happens along, sees the device and knows its merits, patents it as his own, and finally it may be that the original inventor is called upon to pay a royalty for using the invention that his brain conceived.

That is no distorted vision of the imagination. We once knew a machinist in a Western State who turned farmer and was in the habit of applying his mechanical skill to the designing of devices that made farm operations easier. Among other improvements that his mechanical experience suggested was a peculiar form of plow clevis. He sketched the improved clevis and went to a blacksmith where he had one made after his design. Several of his neighbors perceived the merit of the device and had others made like it. Two or three years afterwards, when that clevis was extending in popularity, a man visited the district and put in a stiff claim for royalty against the people using the clevis. He had papers showing that he had obtained a patent on that identical clevis, but it was noticed that the date of the patent was about a year after the machinist-farmer had applied it to his plows.

The threat was made; pay the royalty, or stand a lawsuit. A lawyer was consulted, who said the case was clear against the invention pirate, but securing justice might involve expensive litigation. He thought upon the whole the farmers interested would save money by paying the royalty demanded, and so the inventor had the experience of paying royalty upon his own invention.

The moral of this tale is that an inventor who wishes to retain the right to his property in an invention should protect it by letters-patent. If the expense of a patent is considered too great, the inventor may file a caveat in the patent office which costs less than a patent, and acts upon the invention pirate as a hostile flag.

The Studious Season.

Now that the heat of summer is gone and the days are shortening, the minds of men turn inwardly, as it were, and other sources of contemplative meditation are being sought. Amusements suited to all seasons are plentiful in America, and we would not wish to be considered among those who sneer at rational amusement taken moderately. At the same time we have always been greatly impressed with the idea that with the falling of the leaves and the gathering in of the harvests should begin that preparation for the harvests that are to be gathered in the future. This metaphor is especially recommended to the attention of the young railroad man. If he wishes to gain a complete knowledge of his calling, if he desires to become worthy of consideration in the matter of promotion in the service in which he is engaged, if he expects to secure the confidence and esteem of his employers, and the respect of his fellow workers, he cannot do better than set his mind seriously to the mastery of his calling.

Apart from his merely mehanical experience he should devote a certain portion of his leisure hours to reading and study. General literature is easily to be had in almost every community. Technical literature is often more difficult of access. Much of technical literature is not well suited for the student whose days are spent in mechanical toil. Technical jargon is not attractive to the mind whose early training may have been limited. Correspondence school courses are excellent in their way, but it must be admitted that they cost more than many young men can well afford to pay. The limited period of the course involves a severity of application that only the most earnest and studious can keep pace with, and the result is that only a comparative few finish the course which they begun.

For the young railway men we have provided a course that has met the requirements of hundreds of thousands. The perusal of our pages from month to month brings in a leisurely and interesting way all that is necessary to be known in the field of applied mechanics in the domain of railway and locomotive engineering. A few cheap text-books might be added which can readily be selected from our catalogue of standard engineering publications. Thousands of the leading railway men in America voluntarily attest to the lasting benefit they have derived from the effective means of education that we have placed within their reach.

The revival of business is bringing to us every day the names of large numbers of young men anxious to enjoy the benefits that have been bestowed on their predecessors. We have never been so well equipped as we are at present. Our pages will retain all the old features that have made the name of RAILWAY AND LOCOMOTIVE ENGINEERING distinguished in the field of educational engineering. New features are being added. We are keeping pace with the march of events. Now is the time to join in the most economical, the most comprehensive and the most interesting opportunity of obtaining a comprehensive knowledge of railway and locomotive engineering.

Loyalty Means Something.

If the coaches or the caboose gets cold, don't put on your overcoat; that won't warm the passengers. Fix the fire. Make every traveling man a booster for the road. Be pleasant to him; it doesn't cost much but it counts big. This in effect was the way Mr. J. F. Russ, trainmaster on the Missouri Pacific at Concordia, Kan., recently addressed the employees of the central branch of that road, on the subject of loyalty.

The treatment he said that is given to the public by railroad employees is one of the largest factors in producing adverse legislation, as the persons agrieved go after the company and not the employee. Therefore, says Mr. Russ, "when you run across a knocker on our road make him smile and he may loose his hammer. Just remember that he is knocking on your employer, and anything that injures the company is a blow at your interests as well."

This is straight, sensible advice and is a presentation of the case which is very frequently lost sight of. The company is an impersonal thing to the public, the public never sees the company, but what the public does see is the employee, and the employee is for all practical purposes the company in the eye of the ordinary traveling man.

Continuing Mr. Russ said among other things, though not in exactly these words, when switching or handling cars, do not hit cars hard together. The knock that you give it today may not put a blue flag on it, but probably the next man who hits it will do so. When handling passengers, watch them carefully; they will get hurt if you give them half a chance and this is very high class of traffic to pay claims on. When you put a brass in a car, save the old brass; it is worth something. When you put an air hose on a foreign car, be sure to report it so that your company will not lose the price of it. Do not be crusty or short with a person who asks a question. He does not know as much about railroading as you do or he would not have asked it, but he does know when he gets a short answer and will be angry with the company.

Disloyalty to the company by its employees can create more adverse legislation than any other thing. By this I mean careless and improper handling of the public. Be stuck on your job. Remember that every other job in the country, as good as yours, has a man filling it right now, and that things far away are not always what they seem. You have a good company to work for, be loyal.

Theory of the Steam Engine.

Among our readers are many young engineers and mechanics who are acquiring the principles of engineering by home study, with the aid of such papers as RAILWAY AND LOCOMOTIVE ENGINEERING. Former generations of this class of youth have gradually worked their way to the front and are well advanced among the leaders who are carrying along nearly all our important engineering operations today. We receive many questions from the rising generation of students just as we have received them for the last twenty years. One question that is of perennial vitality relates to the theory of the steam engine.

The successful construction and economical operation of the steam engine were evolved by a tentative process of try and try again. Mistakes proved the paving stones to form a highway to success. Science did very little for the development of the steam engine, but modern science has worked up a theory of the steam engine from what hard-headed, practical engineers have accomplished, and self-educated engineers must be able to explain the particulars of this theory.

The late Professor Thurston gave the following explanation which is as clear as the subject can be made, when he said: "The theory of the steam engine rests upon a foundation of facts ascertained by experiments and of principles determined by the careful study of the laws relating to these facts, and controlling phenomena properly classed together by that science. Like every other element entering into the composition of a scientific system, this theory has been developed subsequently to the establishment of its fundamental facts, and the history of progress in the art to which it relates shows that the art has led the science from the first. The theory of the steam engine includes all the phenomena and all the principles involved in the production of power, by means of the steam engine, from the heat energy derived from the chemical combination of a combustible with the oxygen of the air acting as a supporter of the combustion.

"The complete theory of the steam engine includes the theory of combustion, the consideration of the methods of development and transfer and losses of heat in the steam boiler; the examination of the methods of transfer of heat energy from boiler to engine, and of waste of heat in this transfer, and finally the development of mechanical energy in the engine and its application beyond the engine to the machinery of transmission, with an investigation of the nature and method of waste in this transformation."

When that summary of the theory of the steam engine is properly comprehended it seems to say that the theory of the steam engine means a complete understanding of steam engineering.

Book Notices

THE PROTECTION OF RAILROADS FROM OVERHEAD TRANSMISSION LINE CROSSINGS. By Frank F. Fowle. Published by D. Van Nostrand Company, New York. 84 pages. Twenty-five full page illustrations and two folding plates. Cloth. Price, $1.50.

This is an important contribution on the subject of safeguarding persons and property from exposed transmission lines. Much of the work is devoted to typical cases in the general problem of protection. The question of what the dangers are is clearly pointed out, and the fine illustrations greatly aid the student of this important subject. The paper and letter press are of the best, and the style of the author is noteworthy in terseness and clearness of expression, while his almost complete avoidance of bewildering technical jargon is beyond all praise.

MACHINE SHOP DRAWINGS. By Fred. H. Colvin. Published by the McGraw-Hill Book Company, New York. 140 pages. Fully illustrated. Cloth. Price, $1.00.

The object of this handy volume is to help those who are not entirely familiar with the reading of drawings to a fuller knowledge of the subject so that a ready and correct view of the objects represented may be obtained. Numerous examples are given of drawings from some of the leading machine shops and their meanings carefully explained. The work may also justly be considered as an elementary lesson book, from which an earnest student might rapidly gain a considerable knowledge of mechanical drawing. Those of an inventive turn of mind may also, with a little attention to this work, readily become fitted to present their ideas to others in an intelligent way.

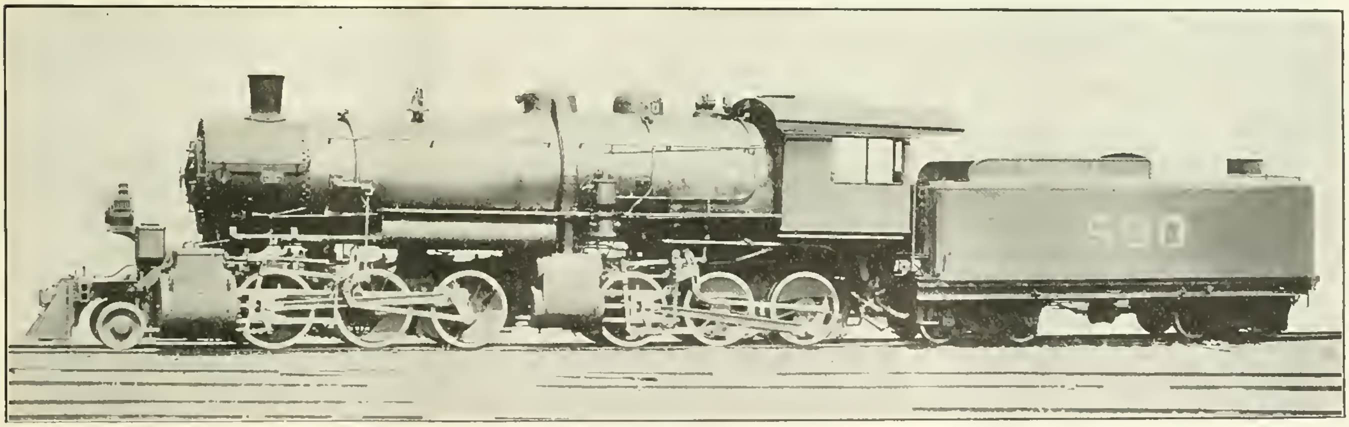
The completion of the building of seven thousand locomotives at the engineering works at Tegel, Berlin, Prussia, has been celebrated by the publication of a finely illustrated souvenir. The works were begun in 1837, and it is interesting to note that the completion of five thousand locomotives occurred in 1902. The works are the property of Mr. A. Borsig.

Mallet Articulated Compound for the Virginian Railway

Our illustration shows the general design and some of the more interesting details of a Mallet articulated compound locomotive, four of which have been built at the Richmond works of the American Locomotive Company for the Virginian Railway. These engines were completed in June and are to be used as pushers or helping engines for the heavy coal trains on the Clark's Gap grade, which is 2.07 per cent. compensated, and is 14 miles long. Later it is intended to use them in similar service on the White Thorne grade, which is 0.6 per cent. compensated and 10 miles long. They were built to designs and specifications prepared by Mr. R. P. C. Sanderson, Superintendent of Motive Power of the Virginian Railway.

The wheel arrangement includes a two-wheel leading truck, the engines being of the 2-6-6-0 type. The truck is of the radial swinging bolster type, the bolster being suspended by three-point or stable equilibrium hangers and the load is transmitted to the journal boxes by means of tains 390 tubes 2¼ ins. outside diameter, each 21 ft. long. It has a total heating surface of 5065.9 sq. ft.; of this 4842 sq. ft. are contributed by the tubes, 200 sq. ft. by the firebox and the remainder by the arch tubes. The firebox is 114 ins. long and 72 ins. wide, with sloping back head and throat sheet and provides a grate area of 57 sq. ft. The ratio of grate area to heating surface is as 1 is to 88. Large water spaces are provided around the firebox, these being 5 ins. wide at the mud ring on the back and sides and 6 ins. on the front. The fire box sides and crown sheet are in one piece, as are also the outside side sheets and roof. The dome, which is of cast steel, is on the third course, on the vertical centre line of the high pressure cylinders. The dome is similar in design to that used on other Mallet articulated compounds built by the American Locomotive Company, having an annular cavity extending around the front half of its circumference, which leads from the throttle pipe connection to the steam pipes on top of the boiler backhead. The arrangement of steam pipes to the high-pressure cylinders and the design of the cylinders follows the builders' usual practice for this type of engine. The high pressure cylinders are cast in pairs with saddles and are separated at a point to the right of the centre in order to provide room for the connection to the receiver pipe which extends along the center line of the engine. As before stated, the Mellin system of compounding is used, the intercepting valve being located as usual in the left high pressure cylinder casting.

The emergency exhaust valve is contained in a separate chamber attached to the side of the left cylinder casting and communicating with the intercepting valve. From the emergency exhaust valve, a 4½-in. pipe, with universal joints, leads to the exhaust pipe in the smokebox. Exhaust steam from the right high pressure cylinder passes back through the casting into an outside U-shaped pipe connecting with a passage in the left cylinder casting, which leads up to the



MALLET ARTICULATE COMPOUND FOR THE VIRGINIAN RAILWAY.
R. P. C. Sanderson, Superintendent of Motive Power. American Locomotive Company, Builders.

coil springs seated on top of the box and supporting the truck frame. In working order, it is estimated that the engine will have a total weight of 330,000 lbs., of which 312,000 lbs. is carried on the driving wheels. The calculated tractive effort, working compound, is 70,800 lbs. This can be increased about 20 per cent. by working the engine simple. The cylinders are 22 and 35 by 30 ins. The driving wheels are 54 ins. in diameter. The engine being fitted with the Mellin intercepting valve, which allows live steam to be admitted to the low pressure cylinders, while the exhaust from the high pressure cylinder is diverted through a separate pipe to the exhaust pipe in the smokebox.

The boiler is of the radial stayed extended wagon top type and is 76 ins. in diameter outside at the first ring. It contains

either side of the boiler, which convey steam to the high pressure cylinders. The throttle, which also acts as a steam separator, is similar in design to that applied to the engine of this type built for the Erie Railroad. This engine, which has been called the Angus Sinclair type on the Erie, was illustrated and described on page 421 of the September, 1907, issue of Railway and Locomotive Engineering. The throttle referred to here was then shown in detail.

As will be seen by reference to our illustration, the throttle valve is operated through a system of levers by a crank arm on a horizontal shaft, passing out through a stuffing box in the side of the dome and fitted with a lever arm on the outer end, which is connected by a rod, extending along the outside of the boiler, to the throttle lever which is located on

intercepting valve chamber, into which steam from the left cylinder also exhausts. From the intercepting valve, steam passes to the receiver pipe, leading to the low-pressure cylinders.

The receiver pipe has a ball joint connection with the high pressure cylinders and a slip joint at the front end where it connects to a Y-pipe, the branches of which reach the cored passages in the low pressure cylinders. The low pressure cylinders are cast in pairs. Owing to the application of the leading truck and the consequent moving forward of the boiler, it was necessary to use a different arrangement of the flexible connections between the low pressure cylinders and the exhaust nozzle, from that employed by the builders in other engines of this type without a truck.

The two exhaust passages from the

cylinders come together in the centre of the cylinder saddle, and fitted to the single opening in the top of the saddle is a cast iron flange which forms a stuffing box for the ball joint connection to a cast iron elbow. The back end of this elbow screws into the front section of the connecting pipe leading to the exhaust pipe in the smokebox. The two sections of this pipe have a slip joint connection between them and the rear section is provided with an elbow which has a ball joint connection with the exhaust pipe in the smokebox. This combination of ball and slip joints thus permits the connecting pipe to adjust itself to any lateral or vertical movement of the low pressure cylinders relative to the smokebox.

The high pressure cylinders are equipped with piston valves, having internal admission, while the low pressure valves are provided with Allen-port, slide valves, having external admission. Both valves have a maximum travel of 6 ins. and are set for 3/16-in. lead. The high pressure valves are designed with 1¼-in. steam lap and 5/16-in. exhaust clearance, while the low pressure valves have the same exhaust clearance, but 3/16-in. less steam lap. The valves in each case are actuated by the Walschaerts valve gear, and the two sets of gears are so arranged that the high pressure link-block is raised while the low pressure one is lowered, when being thrown into forward gear. Thus the two gears counterbalance each other. As the high pressure valve has inside admission, and the low pressure valve has outside admission, the eccentric crank leads the pin in each case. Reversing is effected by means of a hydropneumatic reversing device, the same as that used on the Mallet articulated compound built by this company for the Baltimore & Ohio. The construction of the frames, which are of cast steel, and the arrangement of the articulated connection between the front and rear engines are also practically the same as in the Baltimore & Ohio engine.

Because of the application of the front truck, it was necessary in this design, to use two self-adjusting sliding bearings to support the boiler on the front frames, both of which carry load under normal conditions. Each of these bearings is provided, as usual, with safety straps to prevent the frames from dropping away from the boiler in case of derailment, and the front bearing is provided with the builder's usual design of spring centreing device. The front and rear systems are equalized together by vertical bolts, connecting the upper rail of the front frame with the lower rail of the rear frame. But in this design the load on the bolt is supported by a coil spring, through which the lower end of the bolt passes and which bears up against the bottom of the rear frame rail, the spring cap having a ball joint with the frame. A flexible support at this point was necessary in order that each of the three boiler supports, namely, the two sliding bearings and the equalizing bolt, might bear each, its proportion of the load in any variation in alignment of the three. In order to obviate the necessity for flexible connections in the sand pipes, leading to the driving wheels of the front engine, sand is supplied to these wheels from a sand box supported on the front deck plate. The headlight is carried on a bracket bolted to the front of this sand box.

Another interesting detail on these engines is the arrangement of the draw gear between the engine and tender. The draw bar pin is horizontal and is inserted through the side walls of the foot plate instead of being vertical and put in through the top of the foot plate as is the usual practice.

The tender is of the railroad company's design throughout, and is provided with a water bottom tank having a water capacity of 9,500 gallons. The tender carries 14 tons of coal. The frame is of steel, the centre sills being made of 15-in. channels and the side sills of 10-in. channels. The tender trucks are of the four-wheel equalized type. Some of the principal dimensions are as follows:

Wheel base—Driving, 31 ft. 9 ins.; rigid, 11 ft.; total, 39 ft. 11 ins. Total, engine and tender, 73 ft. 2 11-16 ins.
Driving journals, 9½ ins. x 12 ins.; engine truck journals, 5½ ins. x 12 ins.; tender truck journals, 5½ ins. x 10 ins.
Boiler—Working pressure, 200 lbs.
Firebox—Type, wide; length, 114 ins.; width, 72 ins.; thickness of crown, ⅜ in.; tube, 9-16 in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 6 ins.; sides, 5 ins.; back, 5 ins.
Driving boxes, annealed cast steel.
Brake-Driver, Westinghouse-American; tender, Westinghouse; air pumps, two 11 in.; two reservoirs, 118 x 23½ ins.
Piston Rod diam., 3¾ ins.; piston packing, cast iron rings.
Smoke stack—Diam., 16 ins.; top above rail, 15 ft. 6½ ins.
Wheels—Driv. diam. outside tire, 54 ins.; material, main, open hearth annealed cast steel; engine truck, diam., 30 ins.; kind, rolled steel plate.

Energy of Coal and Corn.

The fallacy that electricity in itself possesses energy that can perform work is entertained by a great many people who have received a partially scientific education of the character that moved Alexander Pope to say that "a little learning is a dangerous thing." Electricity, which is largely employed as a means of transportating power, is generated by some source of energy, such as the coal that produces steam to operate a steam engine. Heat from coal, running water, air in motion or wind, are all forms of energy that are employed for power purposes, and there are many other sources of energy really of very great importance to mankind, although they are popularly supposed to be of small value.

The utilization of the heat energy of coal, to produce motive power, has performed such wonderfully valuable work for civilization in the last century and a half, that there is a disposition among us to overestimate the value of coal in the world's economy. Taking one pound of coal at a theoretical evaporative power of 15,000 thermal units, and each as equivalent to 778 foot-pounds, we have 11,670,000 foot-pounds for each pound of coal, but of this the best form of steam engine utilizes only about one million foot-pounds. This would appear to be wasting the earth's supply of artificial energy at a terrific rate and the dreadful vision comes to many minds of the world's wheels coming to a standstill, because nothing has been left with which to drive them.

Discoursing on this subject a noted scientist says: "It must not be forgotten that, after all, the most important source of energy is not coal, but corn and vegetable matter. The power developed in the labor of animals exceeds the power derived from all other sources, including coal, in the ratio of probably 20 or 30 to 1; so that, after all, if we could find the means of employing such power for the purposes for which it is specially employed—such as driving our ships and working our locomotives—an increase of 10 per cent. in the agricultural yield of the earth would supply the place of all the coal burned in our engines.

The energy which may be derived from the oxidation of corn has yet only been artificially developed in the form of heat, and this may be the only possible way; but physiology has not yet advanced to the point of explaining the physical process of the development of energy consequent on the oxidation of the blood; and it is at all events an open question whether the energy of corn may not be really a form of direct energy, in which case corn would yield six or eight times as much energy as coal does as at present consumed in our engines. Should we find an artificial means of developing anything like the full directable power of corn—a problem which has not yet been attempted—coal would no longer be necessary for power.

On May 24, 1830, the opening for general traffic of the first section of the Baltimore & Ohio Railway took place. This is one of the most important incidents in the history of railway development on this continent. The charter for the road was granted in 1827 by the Legislature of Maryland, and the work of construction was begun in 1828. In 1830 locomotives began to take the place of horses for drawing cars, and the Baltimore & Ohio line was rapidly extended. It is now part of the Pennsylvania system, but it had for many years a creditable record as an independent line, under the presidency of the late John W. Garrett, who was quite as noted for humanitarianism as for his administrative capacity.

Applied Science Department

The Baker-Pilliod Valve Gear.

I. Construction.

The twentieth century locomotives have grown to such colossal proportions that the arrangement of the valve gearing outside of the frames has become a primal necessity. The limited space between the frames with the increasing size of axles and eccentrics renders it particularly difficult to adjust and examine the Stephenson shifting link gear under such conditions and doubtless this was the chief cause that called the Walschaerts valve gearing into prominent use in American locomotive service. As we have endeavored to show in the preceding chapters the Walschaerts gearing has several advantages over that of the shifting link. It also has its drawbacks, which in these days of rapid construction and hard usage, are not far to seek. It is not to be wondered at therefore that in the atmosphere of American enterprise many clever mechanicians have been at work devising means of actuating and controlling the valve gear of the modern locomotive. Perhaps the most successful attempt in the present century in this direction has been the combination known as the Baker-Pilliod valve gear. The device resembles the Walschaerts gearing in several features. It has the eccentric crank attached to the main crank pin, and a combination lever deriving its motion from the crosshead. With these two factors in the motion the resemblance ceases, the chief variation being the absence of the radial link. As is well known the movement of a radial link whether shifting or fixed is a source of error in all motions. These errors are caused by the slipping of the link block and are especially marked in the case of the shifting link as it travels through a longer arc than is usual in the case of links oscillating upon a fixed center.

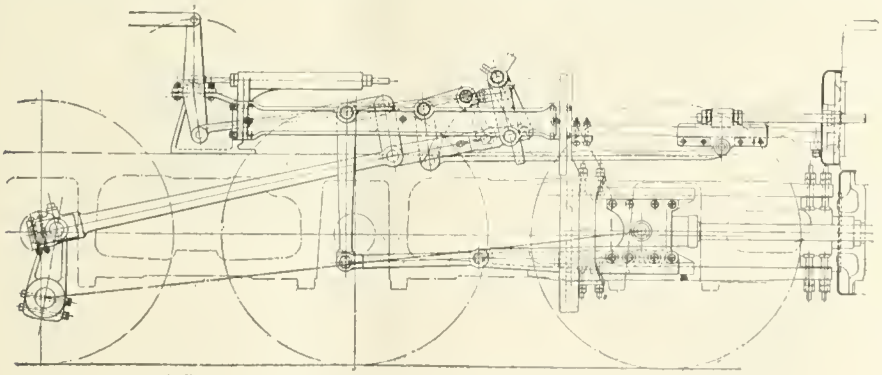
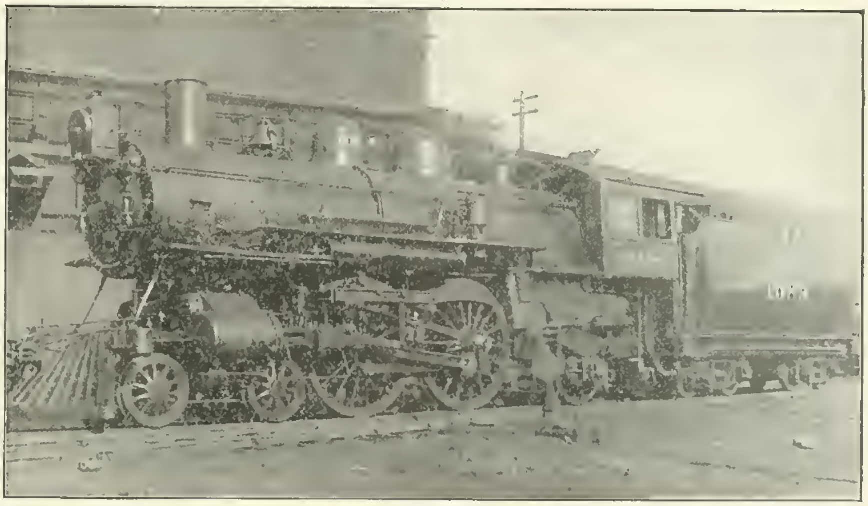


FIG. 1. OUTLINE OF BAKER-PILLIOD VALVE GEAR.

In view of this fact, it will be readily understood that if the motion of a sliding valve can be perfectly controlled and the length of stroke varied without the intervention of a radial link, a real gain in the economical use of steam will be made. The best proof of this is shown in the use of the Corliss valve on stationary engines. This kind of valve gearing with its delicate governor and complex mechanism is not suited for the incessant vibrations and distorting strains of locomotive service. The ideal valve gearing for a locomotive must have the element of rigidity in a marked degree, and at the same time possess that flexibility of adaptation essential to the various requirements of the service. The best use of steam pressure is possible only when under perfect control.



CHICAGO & NORTH-WESTERN ENGINE 1089, WITH BAKER-PILLIOD VALVE GEAR.

Coming to the valve gearing under consideration it will be observed that there are a number of rods in addition to those we have alluded to, besides levers and bell cranks and brackets which in appearance form a complex combination, but which when followed one by one lead from the circular movement of the eccentric crank and the reciprocating movement of the crosshead to the simple reciprocating motion imparted to the valve rod. It will be readily understood that neither of these primary movements are regular in their linear velocity, the crosshead travels with an increasing degree of rapidity toward the center and diminishes in velocity toward the ends of its stroke. The same irregular linear movement is made by the eccentric rod, and in Fig. 1 it will be seen that the crosshead is near the center of its stroke, the swiftest part of its motion, while the eccentric crank which is set at right angles to the main crank is experiencing its slowest movement. The union link attached to the crosshead and the eccentric rod are attached to the separate ends of a bell crank. The end of the bell crank attached to the eccentric rod describes a circle or ellipse, according to the relative proportions of the arms of the bell crank, but always at irregular velocity. This varying motion is conveyed by a coupling and hanger to another bell crank, the lower end of which is attached to the valve rod, which in turn is attached to the valve rod crosshead to which the valve stem is attached and held in place by adjustable nuts. The result of the two initial motions conveyed through this double system of bell cranks is such that the valve travels as fast as the piston at the beginning of its stroke and by the time that the piston has moved about one-twentieth of its stroke the valve is wide open and the valve then moves very slowly during the period while the piston is traveling with increasing rapidity during the first half of its stroke. As the piston approaches the release point the valve again travels with increasing rapidity and closes with a speed equal to that of the piston.

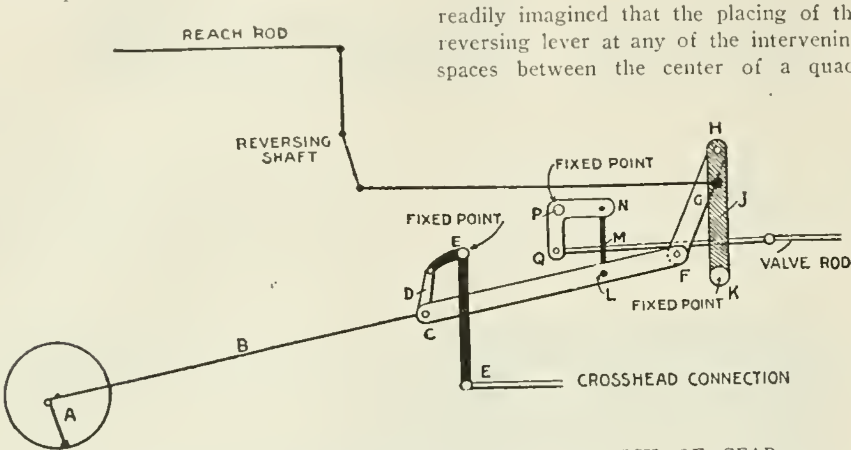


FIG. 2. PURPOSELY DISTORTED SKELETON SKETCH OF GEAR.

In regard to the reversing gear it may be shown more clearly by referring to Fig. 2, which represents a skeleton sketch of the Baker-Pilliod valve gear, shaded, and which we have purposely distorted to show more clearly the movable and fixed parts of the gearing. It will be observed that the continuance of the eccentric arm after passing the two bell cranks already described is attached to a hanger G, at the point F. This hanger is suspended from the upper end of a radius yoke J, which is attached to a fixed point at K. The point F therefore swings about the point H. This radius yoke J is suitably attached to the gear reach rod which is connected to the reversing shaft. Assuming that the piston and slide valve and reverse lever are all in the central position, it can be seen that in the event of the reach rod being moved to the front end of the quadrant, the lower arm of the reversing shaft will be drawn backward, carrying with it the radius yoke, which hangs from the top of the reverse yoke. This backward movement of the radius yoke has the effect of lowering the hanger G, so that the point F will be considerably lowered, carrying with it the point N of the second cell crank and consequently drawing the valve rod backward and opening the front steam port.

If on the other hand the reverse lever is drawn backward to the back end of the quadrant the radius yoke will be moved forward, carrying with it the hanger G, and raising the point F, the effect being to raise the bell crank at N, which moves on the fixed point P. Thus the lower part of the bell crank at Q will be moved forward, carrying with it the valve rod and opening the back steam port in the cylinder, thereby inducing a backward motion of the engine. This description presumes an outside admission valve with the main rod at the lower or bottom center.

Having thus shown the action of the radius yoke on the second bell crank and its effect on the valve rod, it can be readily imagined that the placing of the reversing lever at any of the intervening spaces between the center of a quadrant and its extreme ends, have their relative effect on the position of the bell crank and the corresponding effect on the motion of the valve rod.

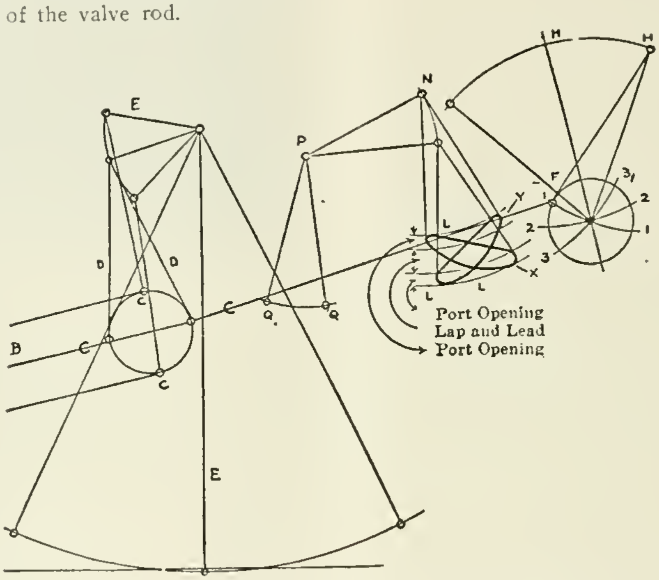
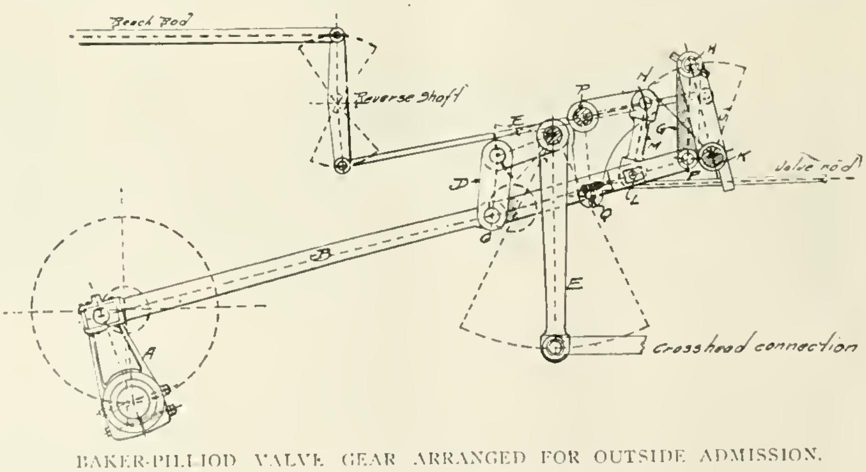


DIAGRAM OF MOVEMENTS OF PARTS OF BAKER-PILLIOD GEAR.

It will thus be seen that there are a large number of joints through which the motion must necessarily pass from the main crank pin and crosshead connection before the movement reaches the slide valve. This is one of the drawbacks in the Stephenson shifting link, and it is one of the chief merits of the Walschaerts valve gearing that the crosshead connection is immediately attached with only one joint between the combination lever and valve stem. There is this particular advantage, however, in the Baker-Pilliod gear, that the parts lend themselves readily to massiveness and rigidity of construction which is impossible in the case of the Stephenson shifting link gear and is only partially so in the case of the Walschaerts gearing.

It may be added that the lead or opening of the valve at the end of the piston stroke is an unvarying or constant quantity, so that the length of the valve stroke or point of cut-off of steam supply does not in any way affect the exact amount of opening at the beginning of each piston stroke, while the degree of rapidity with which the valve opens during the early part of the piston stroke or the rapidity with which the valve closes at the desired point of cut-off is not surpassed by any kind of valve gearing applied to locomotives.



BAKER-PILLIOD VALVE GEAR ARRANGED FOR OUTSIDE ADMISSION.

Celebrated Steam Engineers.

XXXII. Joseph Harrison.

The success attending the building of locomotives under the skillful eye of Matthias Baldwin, of Philadelphia, soon attracted the attention of other constructors of machinery. In Philadelphia the firm of Garrett & Eastwick, who were engaged in building steam engines, obtained an order to build a locomotive for the Beaver Meadow Railroad. This road was the first section of what is now a branch of the Lehigh Valley Railroad. The construction of the road was the most difficult task that had been accomplished up to that time. It had more sharp curves and steeper grades than any railroad in the world. It was formally opened in 1835, and although intended for the transportation of coal for shipment on the Lehigh Canal, the picturesque scenery through which the road passed attracted a constantly increasing throng of summer visitors. The district became known as the Switzerland of America.

Messrs. Garrett & Eastwick having no experience in locomotive building, engaged a young engineer who had been employed in the Norris Works. He proved to be an excellent designer of locomotives and invented a variety of improvements which became permanent features of the locomotive engine. His first locomotive in addition to several distinctive original features was the first that was furnished with a cab to afford protection to the engineer. This feature was speedily adopted by other builders. Mr. Harrison was also the first to introduce equalizers into locomotive construction. His first experiments were with cast iron beams placed above the frames, the ends of the beams bearing on round pins that rested on the top of the box. It was the first important improvement looking towards increasing the size of locomotives, making it possible to use any number of wheels on the roughest kind of track. Mr. Harrison secured a number of patents on equalizers, embracing almost all the kinds now in use.

As may be imagined, the marked improvements on the locomotive made by Mr. Harrison were such that the tractive power of the locomotive was greatly increased. Stephenson's early locomotives were guaranteed to pull three times their own weight. Harrison's locomotives reached the high tractive power of pulling forty times the weight of the engine. The performances were such that agents from other countries came to America to verify statements in regard to the American locomotives. The result was that Mr. Harrison and his partner Mr. Eastwick were induced to visit St. Petersburg and establish locomotive building in Russia. The loss to America was a great gain to Russia, and the work of Mr. Harrison and his worthy partner soon assumed colossal proportions in the Muscovite Empire.

Questions Answered

COMPOUND ENGINES NOT IN STEP.

67. W. H. B., Glazier, Tex., writes: (*a*) The front and rear engines of a Mallet articulated locomotive being compounded together, but not rigidly connected, what is to prevent them from getting out of step, and what would be the consequence if they did?—A. The valve gears of both engines are separate and there is nothing to prevent them from getting out of step. They are constantly out of step and no bad results follow. This fact, however, is significant; suppose the front or low pressure engines slipped they would use up the steam coming from the high-pressure engine so fast that it would amount to an easing down of the throttle and they would stop slipping for want of steam. If the high-pressure engines slipped they would fill the receiver faster than the low pressure could use it, thus increasing their own back pressure and this would tend to stop them from slipping.

EXHAUSTS FROM CROSS COMPOUND.

(*b*) Does a two-cylinder or cross compound engine have two exhausts or four?—A. Working compound the cross compound engine has two exhausts to the revolution of the driving wheels, for the reason that the high pressure steam exhausts into the receiver and cannot escape until used by the low pressure cylinder. In this way you only hear or see the low pressure exhaust at the stack, and as the low pressure or indeed each cylinder has only two exhausts for each revolution you only hear two. There are, of course, four exhausts, two from each side, but the high pressure go into the receiver and the low pressure go out of the stack working compound.

USE OF JOY VALVE GEAR.

(*c*) Is Joy's valve motion used in connection with locomotive or marine engines?—A. The Joy valve gear is used in connection with locomotives very extensively in England. We believe this motion has been recently used on a three-cylinder simple engine on the Philadelphia & Reading Railway.

CALCULATING BRAKE CYLINDER PRESSURES.

68. M. E. L., Chicago, Ill., writes: In answer to question 29 on page 164 of the April issue you state that, according to the figures given, a 10-lb. brake pipe reduction will result in a brake cylinder pressure of 27 lbs. "less, say 4 lbs. for the losses mentioned." How do you arrive at the conclusion that the loss is about 4 lbs.?—A. Using the same figures that were used in answer to the question referred to, let us attempt, by means of figures, to determine the brake cylinder pressure that will result from an equalization of auxiliary reservoir and brake cylinder pressures.

Auxiliary reservoir capacity 3030 cu. ins., brake cylinder capacity at 8 ins. piston travel 628 cu. ins., and an estimate of 100 cu. ins., space between the piston follower and cylinder head, in the port through the head and in cavity in the triple valve. In the auxiliary reservoir we have 70 lbs. gauge pressure or 85 lbs. absolute, $3{,}030 \times 85 = 257{,}550$ cu. in. pounds, in the 100 cu. ins. "dead space" there is an additional 1,500 cu. in.-pounds that is $14.7 \times 100 = 1{,}500$, $257{,}550 + 1{,}500 = 259{,}050$, the total cu. in-pounds pressure.

The total space that will be occupied by compressed air after the equalization is 628 cu. ins. brake cylinder capacity + 3,030 cu. ins. auxiliary reservoir capacity, which is $628 + 100 = 728 + 3{,}030 = 3{,}758$ cu. ins. total space.

259,050 cu. in-pounds ÷ 3,758 cu. ins. space = 69 lbs. absolute pressure or 54 lbs. gauge pressure that will result from equalization or from a full service application. We know that an air gauge attached to the brake cylinder will show that the 12×33 auxiliary reservoir at 70 lbs. per sq. in. pressure will equalize with a 10-in. brake cylinder with 7 or 8 ins. piston travel at about 50 lbs. pressure per sq. in. and the calculation shows that it should equalize at about 54 lbs. if there were no losses. The losses mentioned occur during the first movement of the triple valve and brake cylinder piston and must be taken into consideration during a calculation to determine the brake cylinder pressure that will result from a 10-lb. brake pipe reduction, hence the expression "27 lbs. less say 4 lbs."

HUMMING SOUND IN FIREBOX.

69. G. A., Appalachicola, Fla., asks: What causes the humming in locomotive fireboxes? We have a wood burner that hums something fierce when getting under way. I speak especially about coal burners.—A. The humming sound to which you refer is probably caused by a hole in the fire, especially when the blower is on. If this occurs continually there is probably a portion of the grate that is broken or defective in some way so that air is admitted in great volume in one place. Have the grates examined. A thin fire of coal in the firebox of an engine working very hard or easily slipped will tear a hole in the fire and produce the noise you speak of.

LAMP CHIMNEYS.

70. E. B., Cleveland, writes: I have noticed something in your paper about a means of toughening glass. Could you give me directions to apply it to headlight chimneys to prevent the breakage so common?—A. We are not acquainted with a process for toughening glass. We think that the Storrs Mica Co., Owego, N. Y., might help you.

BRASS POLISH.

71. Foreman, Chicago, writes: We use considerable polish for brass and other work, but the stuff used leaves some coating that promotes tarnish. Could you give me a recipe for something that would be free from this peculiarity?—A. An automobile requires a great deal of polishing, and the best thing we have found is Hoffman's metal polish. Geo. W. Hoffman, Indianapolis, Ind., manufacturer. Try that and tell him that we advised you to do so.

VARIATION OF LEAD.

72. J. H. S., Townsville, Australia, writes: (*a*) A driver here is of opinion that there is no such thing as variation of lead. Another thinks there is, and we want you to settle the question—A. With the Stephenson or shifting link motion there is variation of lead. As you notch up the reverse lever the lead increases. The mid-gear lead is the maximum. Lead is always given when variable, as that of full gear forward. With the single eccentric motions like the Walschaerts, the Joy, and the Baker-Pilliod the lead is constant, that is it does not vary when the reverse lever is notched up. There are efforts made now and then in the setting of valves to reduce the amount of mid-gear lead on the Stephenson motion, for excessive lead is not beneficial, and this is done by sacrificing the back gear perhaps the back gear may be set blind in order to reduce the variation of lead in forward gear. See the article on "Correctives in Link Motion Design," in our September, 1908, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 384. When the back-gear is sacrificed for the good of the forward with the two eccentric motion, it is done as a sort of endeavor to approximate to the constant lead of the single eccentric motions.

DIFFERENCE IN LEAD.

(*b*) If two sister engines differ a little in outside lead, say one has 3/32 in. and the other 1/16 in., which would be the more powerful of the two?—A. This is not so much a question of power as it is of which is the more satisfactory for the work each engine is required to do. It largely depends upon what kind of service each engine is expected to give. For fast passenger service the engine with the greater lead would be the more satisfactory, and for freight the second engine would be the better. Lead increases the cushion of steam which takes up the force of the reciprocating parts, and the faster they move, as in high speed service, the greater the cushion required. Lead also quickens the action of the piston by assisting in opening the port to the full more quickly, and so giving a copious supply of steam early in the stroke for high speed work.

FORCES AND VELOCITIES.

73. Student, Hornell, N. Y., asks: (*a*) What is the centrifugal of a weight of one pound revolving in a circle of two feet diameter at a velocity of 100 revolutions per minute?—A. 3.4 lbs. (*b*) Force turns a flywheel 100 revolutions per minute. Will it take twice or four times the force to double the velocity in the same time, starting in both instances from a state of rest?—A. Four times.

WRITING ON STEEL.

74. A. R., Oscaloosa, Iowa, writes: I have some steel tools that I should like to put my name upon. How can it be done?—A. Mix one ounce of nitric acid with about one-sixth ounce of muriatic acid. Clean the article and cover it with a coating of beeswax. Then with a sharp pointed scriber write on the beeswax, being careful to make the scriber cut down into the metal. With a small brush apply the acid to the writing, filling the letters. Let it remain about five or six minutes, then wash off with water.

WOODS THAT SINK.

75. R. O. S., Atlanta, Ga.: I have been told that some kinds of wood are so solid even when dried that they sink in water. Will you kindly tell me if that is true and what kinds of wood fail to float in water? A.—Among the woods that sink in water are lignum-vitae, mahogany, pomegranate, Dutch box, Indian cedar, heart of oak and a variety of others.

Rationale of Coal Economy.

It makes no difference what the commodity may be which we handle in the different branches of our business, the economy always depends upon the quantity used and the manner in which we use it. This sentence occurs in a very interesting address to the members of the Iowa Railway Club, by Mr. H. T. Bentley, assistant superintendent of motive power of the Chicago & North-Western Railway. Mr. Bentley applied these remarks particularly to the use of steam in a locomotive and showed very clearly wherein the economy of steam lay. In fact, he very cleverly explained the rationale of the subject.

The example given first by the speaker was of an 18 x 24-in. cylinder engine carrying 160 lbs. steam pressure. The driving wheels were 63 ins., and when at work the throttle was wide open. Under these circumstances the pressure in the cylinder was 145 lbs. or 90 per cent. of the boiler pressure. A 6-in. cut-off of the slide valve gave very nearly 1 cu. ft. of steam in the cylinder and the mean effective pressure was 78 lbs. The cubic foot of steam weighed about 3/10 of a pound. The engine, therefore, used double that amount for one revolution of the driving wheels, or four times for both cylinders; $4 \times .3 = 1.2$ lbs. of steam each revolution of the drivers. This size of wheel makes 320 revolutions to the mile so that, $1.2 \times 320 = 384$. The engine pulling the train one mile at a speed of 30 miles an hour used 384 lbs. of steam by weight. A pound of steam by weight means a pound of water turned into steam, so that this engine used in one mile, at that speed, 384 lbs. of water, cutting off at 6 ins. The steam in the cylinder had been expanded four times and was exhausted at a pressure of 34 lbs. per sq. in., which was comparatively light on the fire.

The second example taken was that of the same engine doing the same work at the same speed, but with more restricted throttle and slide valve cut-off at 8 ins. The steam now entered the cylinders at 118 lbs. pressure, and following the piston 8 ins. before cut-off, the amount of steam in each cylinder each stroke was .375 of one pound. For two cylinders and two strokes, $4 \times .375 = 1.5$ lbs. This amount of steam by weight in 320 revolutions amounted to $1.5 \times 320 = 480$ lbs. The steam exhaust left the stack at a pressure of 45 lbs. This had a sharper action on the fire. More water, viz.: 96 lbs. had been used to do the same work.

In the third example the same engine under the same conditions was again considered, but with still more restricted throttle and 10-in. slide valve cut-off. The initial pressure in the cylinders was now 105 lbs. The amount of steam by weight in each cylinder in this case was .526 of one pound, this becomes $4 \times .526 = 2.1$ lbs. for both cylinders and one revolution. In the mile the 320 driving wheel revolutions require $320 \times 2.1 = 672$ lbs. of steam by weight, used in one mile, and this greater amount of steam having to be got rid of a still sharper exhaust action on the fire was to be expected.

We have, therefore, three one-mile trips run by the same engine at same speed. In the first 384 lbs. of water were used, in the second 480 lbs., which means a waste of 96 lbs. of water, and in the third trip 672 lbs. of water was used, which means an excess over the second trip of 192 lbs., and over the first, 288 lbs. Taking the evaporation of water at 6 lbs. to one pound of coal the useless evaporation of 96 lbs. of water involved the unnecessary burning of 16 lbs. of coal to the mile. In 100 miles this waste would amount to 1,600 lbs., and in the second example 32 lbs. of coal per mile would have been uselessly burned to evaporate 192 lbs. of water. In 100 miles this 32 lbs. becomes more than 1½ tons. Comparing the first with the last example it appears that the fireman would have laboriously shoveled nearly 2½ tons of coal to evaporate 288 lbs. of water per mile which was not required.

Air Brake Department

Conducted by G. W. Kiehm

Inspecting the H6 Brake.

The air brake equipment on a locomotive, whether in passenger or freight service, should be thoroughly inspected after each trip by a competent man, and this is done on nearly every railroad in the country.

Sometimes the brake is inspected by the repairman, sometimes by an inspector who has other duties or who does no repair work and simply reports the disorders found. The latter is the better method where there are enough engines handled daily to keep an inspector busy. Sometimes the inspectors' report is given the same attention that the engineers' report is given, in some cases very little attention is paid to it, especially when the engineer has not noticed or failed to report the defect.

It is needless to say that the inspectors' report should be given the same attention as is given to the engineers' report instead of considering that the inspector is there simply because the management insists upon inspection. The inspector should have a good general knowledge of the air brake, and should use good judgment in reporting work, always avoiding a rash guess, but reporting defects as he sees them.

He should in all cases attempt to adjust the pump governor and feed valve, if the pressures carried are incorrect, while there is sufficient steam on the boiler to do the work, as the fire may be drawn or banked later. The banked or drawn fire may cause the repairman an unnecessary amount of work and result in a waste of fuel.

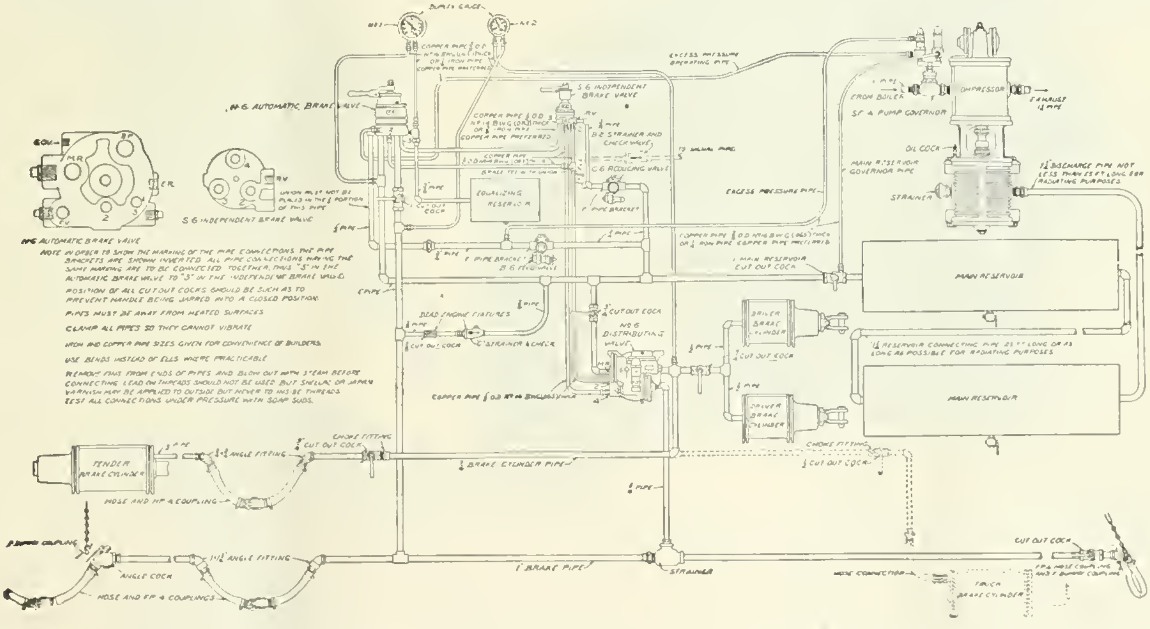
If unable to adjust the pressures, the defective part should be reported.

The brake should be inspected immediately upon the arrival of the locomotive and before the fire is cleaned or drawn, but it is not necessary for the inspector to be positive as to what causes a leak or blow of air at any part of the equipment, nor should he have to say exactly why a brake applies in full or releases, when it is not desired. His duty is to state where the leak or blow is and that the brake applies or releases when not desired. The repairman should be able to find the cause of the disorder and make the proper repairs. The following suggestions concerning inspection have reference in particular to the Westinghouse H 6 equipment, which, in spite of its good features, should have the same attention as the older equipment. If it is inspected thoroughly at the end of each trip in a systematic manner it will not take up so much time as it would appear to.

The inspector's gauge should be tested frequently, and known to be accurate at all times, and before being attached to the hose at the rear of the tender, the angle-cock and signal stop-cock should be opened slowly once or twice to blow out any cinders or loose scale that may be in the couplings or inside the pipes. This will prevent any cinders or scale from being blown into the test gauge or into the triple valves in the train.

Any unusually long blast from the signal whistle at this time should be reported, the gauge should show 45 lbs. and the whistle should not respond to slight leakage and the pressure should not vary over 2 lbs., the reducing valve should supply the signal system promptly. The action of the signal valve is the same as with the older equipment. The independent brake can next be applied in full and if the brake cylinder gauge is correct it will show the same pressure that is in the signal system, as the reducing valve will have control of the signal system and application cylinder pressure, and the brake cylinder pressure must equal it.

With the reducing valve in perfect condition and the signal pipes free from leakage, a blast from the signal whistle, when the independent brake is applied, indicates a leaky signal-line check valve. The gauge should then be connected to the brake-pipe hose, and with the automatic brake valve handle in train brake release position, the test gauge, both hands on the large air gauge, and the black hand on the cylinder gauge should register the same pressure, the brake-pipe pressure should then be drawn down a few pounds and the handle placed in running position, the brake should remain applied, the pressure should then be drawn down to the adjustment of the feed valve, the brake valve-handle placed in running position and the cock in the test gauge opened, and the brake-pipe pressure should fluctuate from about 108 to 110 lbs. If the high-speed



PIPING DIAGRAM OF THE NO. 6 ET BRAKE EQUIPMENT.

brake is used, the feed valve should not allow a variation of over 2 lbs. It should then be noticed that the governor allows the pump to start promptly when the independent brake is applied lightly, and that the main reservoir pressure rises to 140 lbs. when the automatic brake-valve handle is placed on lap position. There should be no excessive leakage from the drain or waste pipe, and none at all when the governor is not in control of the pump. The leakage from the relief port should not be excessive, and there should be none at all when the governor is not in control of the pump.

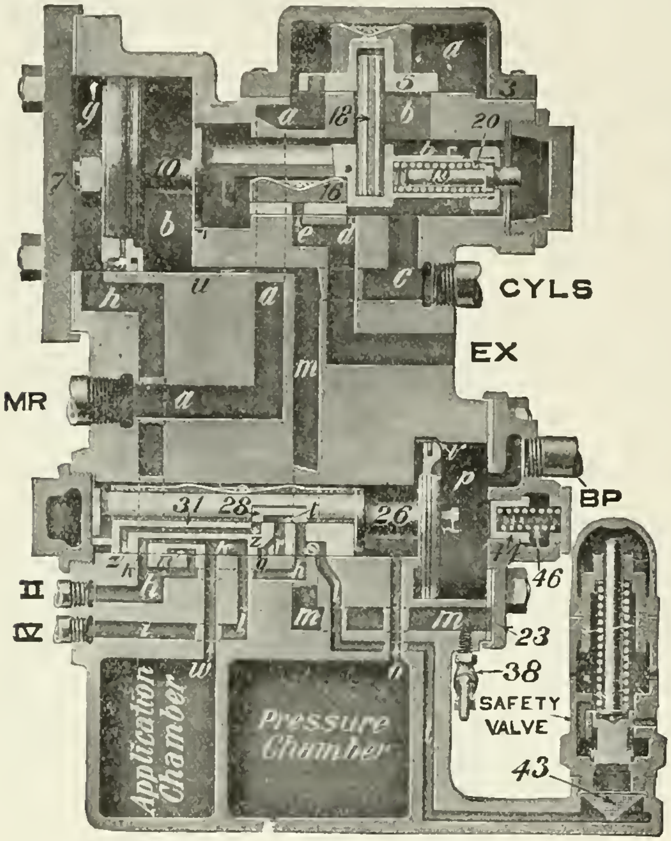
The tops should be tight in the siamese fitting, and the fitting tight in the governor, and there should be no leakage from any of the threaded parts.

It should be observed that the pump does not pound and is not overheated. It should be securely fastened to the bracket and the bracket to the boiler, that the pump strainer is clean and that there is no leak from the gaskets of either the air or steam cylinders. The pump should not be allowed to groan. A pound in the pump as the piston passes either of the ends of its stroke is usually due to too much lift of the discharge valve in the end of the cylinder at which the pound occurs, or too much lift of the receiving valve at the opposite end. Assuming that the pump is not loose and well lubricated, a pound on both ends of the stroke indicates an air or steam piston loose on the rod, and any pound should be given immediate attention, as it is pounding that usually causes the air pump failure.

The suction of air at the strainer should be noticed, and an equal amount should be drawn in on both strokes of the piston, and the suction should be good for nearly the entire stroke of the piston, and will be if the pump is in good condition and not warmer than the natural heat of compression.

The automatic brake should then be applied with a full service reduction and the valve handle placed on driver brake holding position. All the air pipes on the engine will then be filled with compressed air, and should be thoroughly tested for leakage with a lighted torch, and it should be noticed that the distributing-valve reservoir, brake cylinders, main reservoir and all part are firmly fastened to their brackets, and that all air pipes are properly clamped.

The brake cylinders and pipe connections should be reasonably free from leakage, and should never have a leak in excess of 5 lbs. per minute from a 50-lb. cylinder pressure. This leakage can be determined by screwing a plug into the exhaust port of the distributing valve and applying the brake until the cylinder gauge shows 50 lbs., then releasing the application cylinder pressure and watching the fall of the hand on the cylinder gauge. After the test the plug must be removed. Brake cylinder leakage can be determined by leaving the independent brake valve in application position and closing the stop-cock in the the distributing valve supply pipe; the fall of the hand on the cylinder gauge will show leakage in pounds per minute. The application cylinder, application-cylinder pipe, release pipe and release-pipe branch, between the brake valves, must be absolutely tight and free from leakage. A slight leak in any of the pipes mentioned would cause a release of the brake under some conditions. A leak in the application cylinder or application-cylinder pipe would release the brake after an application of either brake, if the valve handle is returned to the lap position.



NO. 6 DISTRIBUTING VALVE. RELEASE POSITION.

The brake-cylinder pistons should be kept within certain limits of travel, and the brake rigging thoroughly inspected after each trip. The calling of attention to a badly worn rod or a missing cotter-key has been the means of preventing many a serious detention.

While the pipes are being tested, the gaskets and exhaust port of the distributing valve should also be tested, and in the cab, the brake valves, feed valves, and signal apparatus. If there is no leakage from the application cylinder pipe, release pipe or brake pipe, the brake will be found applied with the same degree of force that it was before the air pipe test.

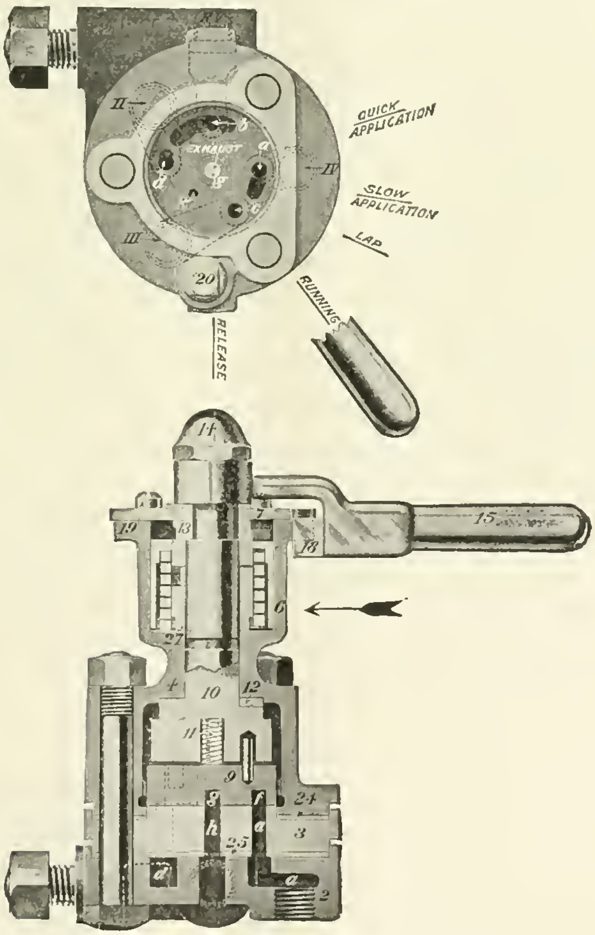
Should the brake leak off or release while the handle is on the driver-brake holding position, and remain applied if the brake-valve handle is placed on lap position, after the application, or when the independent brake is applied and the handle returned to lap position, it indicates leakage from the release-pipe branch between the brake valves.

Should the brake remain applied when the automatic brake is applied and the handle returned to lap position, but release when the independent brake is applied and the handle returned to lap, it indicates leakage from a point in the release pipe between the distributing valve and the independent brake valve. If the brake releases after either brake is applied and the handle returned to lap position, it indicates a leak in the application-cylinder pipe, the application-cylinder cover gasket, or a leak from the drain plug in the application chamber. It should be observed that the equalizing discharge valve of the automatic brake valve responds promptly to light reductions and cuts off the escape of brake-pipe air promptly and perfectly when the handle is returned to lap position. Any leak from the emergency exhaust port should be reported.

The distributing valve should respond promptly and build up brake-cylinder pressure from a light application of either brake. A service application of 10 lbs. should result in a brake-cylinder pressure of 25 lbs., and should remain at this figure. If it increases, brake-pipe leakage should be looked after. If the brake-pipe pressure remains stationary and the pressure in the cylinders increases, it should be reported. If the 10-lb. reduction results in less than 25 lbs. cylinder pressure, with the gauge known to be correct, it indicates a leak at the safety valve of the distributing valve, or a dirty or gummy condition of the movable parts of the distributing valve. The leakage at the safety valve would be noticed only while the equalizing valve is in service application position, or rather, it could not be detected at a time the equalizing valve is in service lap position, but could be detected at any time by an application of the independent brake, the automotic brake being released at the time. If the distributing valve builds up brake-cylinder pressure promptly upon an application of the independent brake, and is slow to respond to an automatic application, there being no safety valve leakage, it indicates a gummy or dirty condition of the equalizing valve of the distributing valve.

It should be known that both brakes can be graduated on and off, and when the independent brake is applied in quick application position, it should take from two to four seconds to apply the brake in full, and from two to three seconds to exhaust all the pressure from the application cylinder. The length of time it will take for the pressure to escape from the brake cylinders depends upon the size of the cylinders and the length of the piston travel. When the independent brake is applied in full, the automatic brake should be applied in a few successive reductions and the safety valve should restrict the brake-cylinder pressure of 68 lbs.; finally the automatic brake valve should be moved to emergency position, and there should be a constant blow from the safety valve, at such time, and the cylinder gauge should indicate about 75 lbs.; failing to do so, it should be reported. If the brake valve does not work freely it is usually due to a dry rotary valve seat, a dry rotary key gasket or a stiff or dry handle latch. It should take from five to six seconds to reduce equalizing-reservior pressure from 110 to 90 lbs., and from six to seven seconds to reduce it from 70 to 50 lbs.

If the equalizing-reservoir pressure reduces faster than the time here given, it indicates an enlarged preliminary exhaust port or leakage from the equalizing reservoir. If it takes longer than this time, it indicates a partly stopped-up preliminary exhaust port or leakage of main reservoir or brake-pipe pressure into the equalizing reservoir.



THE S-6 INDEPENDENT BRAKE VALVE.

Sometimes there is a leak of main-reservoir pressure into the brake pipe that will not show on account of leakage from the brake pipe, and if one is in any doubt about rotary valve or feed-valve leakage, the stop-cock under the brake valve can be closed, and if the equalizing reservoir hand on the gauge rises rapidly, with the handle in running position, but remains stationary when on lap, it indicates feed valve leakage. If the hand rises when the handle is moved to lap position it indicates brake valve leakage.

Occasionally brake pipe leakage occurs at the brake valve service exhaust port, and the equalizing feature of the H 6 brake valve is identical with that of the older types of valves and a leak here will occur from the same causes. Ordinary equalizing reservoir leakage affects the equalizing piston only after the valve handle has passed driver brake holding position and leakage from the brake pipe exhaust port when the handle is in running position is usually due to a piece of dirt or scale having lodged on the seat of the equalizing piston, which can nearly always be blown off by closing the stop cock under the brake valve, making a heavy service reduction and placing the valve handle in release position; this will lift the piston, cause a violent blow at the exhaust port, and usually remove any ordinary collection of dirt on the valve seat.

The foregoing remarks should serve as a guide to an inspector, and the points brought out should be remembered. It is impossible to thoroughly discuss the subject in the space allotted to the Air Brake Department, but the defects of the E. T. brake, which are mentioned from time to time, will assist in furnishing information which should be used in the important work of air brake inspection.

Expansion.

An ordinary poker, such as is used in our homes for stirring up the fire on a winter's night, if allowed to come to the temperature of boiling water, is only about 1/250th of an inch longer than when at the freezing point. This does not mean much to the every-day man, but the expansion of metals due to heat is a very important subject for the bridge engineer or the maintenance of way superintendent.

An accident occurred not long ago in England, due to the expansion of rails. The variation of temperature between winter and summer in many parts of the world is not more than 80 deg. Fahr. Yet this range of temperature is competent to produce a variation in the length of the rails of about two feet in the mile. The effect of this expansion, if it is not "allowed for" in the track, is usually to cause the outer rail on a curve to bulge out more than the inner one and thus throw the track out of gauge. The force exerted by an expanding rail is estimated at about 1,000 lbs. for each degree of temparature.

Don't tell what you are going to do—Do it!

Electrical Department

The Interpole for Railway Motors.

By W. B. Kouwenhoven.

Probably the greatest improvement that has been made in many years in direct current motors in either of the railway or shop types is the interpole. The interpole is variously known as a commutating or an auxillary pole by the different manufacturers. The hardest and most difficult problem that motor designers have to solve is how to build a motor that will run without sparking at the brushes. It is also the problem that most often confronts the user of direct current motors. Electricians apply the name commutation to this feature of motor operation. If a motor runs smoothly without sparking it is said to have perfect commutation. With large railway motors operating on a high voltage a continuous spark or arc is sometimes formed around the commutator between the brushes. This is called flashing over, and is almost invariably caused by sparking. Such flashes usually cause considerable damage to the motors and annoying delays to the service. Poor commutation or sparking also limits the capacity of a motor. Almost all commutation or brush troubles are caused by sparking at the brushes, and it is to remedy this that the interpole was designed.

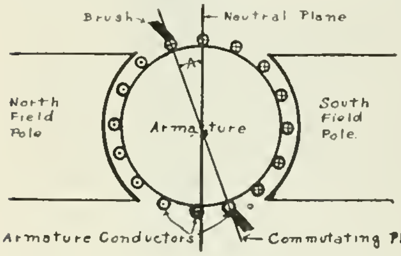


FIG. 1. BIPOLAR MOTOR.

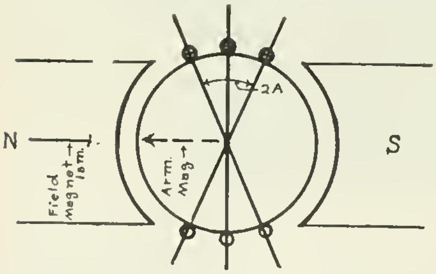


FIG. 2. ARMATURE BACK TURNS.

Sparking on a commutator melts or bites away a small piece of copper from the commutator bar, and a small piece of carbon from the brush, while the mica which separates the bars is not affected. Continuous sparking burns off the corners of the brushes and burns away the commutator bars, leaving the mica projecting up between them. This high mica, as it is called, makes sparking worse, and produces a very rough commutator, with consequent rapid wearing away of the commutator and the brushes. Turning down the commutator and filing it smooth remedies this temporarily but does not reach the cause of the trouble.

In service, railway motors do not run continuously with power on, because there is a period of coasting, or drifting and braking, in which the power is turned off. During this period the roughness that has been caused by sparking is partly corrected by the scraping or scouring action of the brushes. In some cases this action of the brushes serves to keep the commutator smooth, clean, and bright. This scouring of the brushes, however, cannot be depended upon, and although it may keep the commutator comparatively smooth it does not stop the sparking. In shop motors there is no such action.

The action of the interpole in preventing sparking and prolonging the life of the commutator and brushes can best be understood if we consider the relations that exist between the field poles or field magnets of the motor and the magnetism produced by the armature. It will be noticed in a shop motor that the brushes do not touch the commutator at points that are midway between the tips of the field poles, but rather to the rear of this. A plane or straight line passing through the centre of the brushes and of the shaft is called the commutating plane, and a plane passing through the points that lie midway between the pole tips is called the neutral plane. The angle that separates the neutral and commutating planes is called the angle of lag or lead, whichever the case may be. This arrangement of these planes is shown in Fig. 1, which illustrates a simple two-pole motor. Here the commutating plane is seen cutting the neutral plane at an angle A. The small circles arranged around the circumference of the armature represent the armature wires or conductors. Those in which a cross is placed are carrying an electric current, flowing into the paper away from the reader, and those in which a dot is placed are carrying a current flowing out of the paper toward the reader. In the motor represented the commutator is not shown for the sake of clearness; however, the brushes are shown rubbing on the armature wires themselves. The commutator bars are supposed to be connected to wires lying on the same radius.

Often the armature wires are connected to bars lying at an angle of 90 deg. from them. This would bring the neutral plane at right angles to its present position, and would make it pass through the centre of the poles, instead of between them. The effect produced is exactly the same, because the brushes are always placed in such a position that an armature conductor passes from one side of the armature to the other while it is in the commutating plane or zone.

With the brushes in the commutating plane the armature may be looked upon as consisting of two parts. The one part, as shown in Fig. 2, containing the wires lying in the double angle 2A, and the other, as shown in Fig. 3, consisting of the wires that lie mainly under the poles outside of this double angle. If we consider first the wires that lie in the double angle A, Fig. 2, it will be seen that the conductors on top of the armature are paired with those on the bottom, and that each set is carrying current in opposite directions. It immediately becomes evident that this part of the armature is acting as a magnet whose magnetism is opposing and bucking the magnetism of the field poles. The solid arrow in Fig. 2 indicates the direction of the field magnetism, and the dotted arrow, opposing it, that of the armature. This behavior of the armature is called the demagnetizing action of the armature and the turns that lie in the double angle A, the back armature turns or simply back turns.

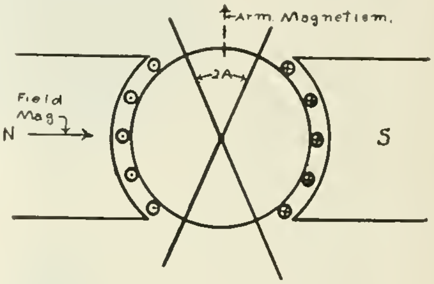


FIG. 3. ARMATURE CROSS TURNS.

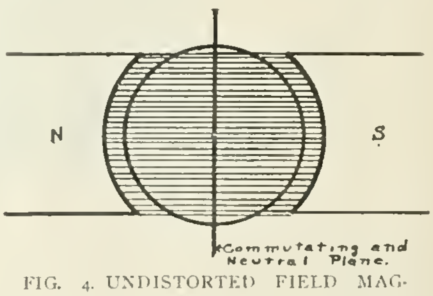


FIG. 4. UNDISTORTED FIELD MAGNETISM.

The other part of the armature containing the conductors that lie outside the angle of 2A is shown in Fig. 3. Here the conductors under the north and south poles of the motor are evenly matched, and each set is carrying a current in opposite directions. The result, as before, is a magnet whose magnetism, however, does not oppose that of the fields, but is at right angles to it, as indicated by the

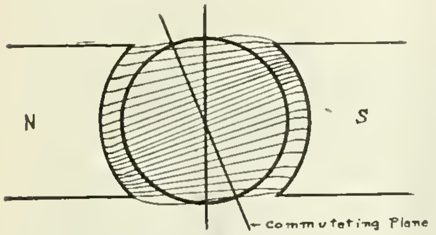


FIG. 5. FIELD MAGNETISM DISTORTED BY ARMATURE REACTION.

dotted arrow. This action of the armature is known as the cross magnetizing action, and the turns that produce it are called the cross armature turns. Thus it is evident that the armature of the shop motor really acts as two magnets which are entirely independent of the field magnets, and this behavior is known as the armature reaction.

Next we must consider what the combined action of the field magnets and the back and cross magnetism of the armature have upon each other. If the armature had no magnetism, then the path of the field magnetism through the armature would be a series of straight lines, as shown in Fig. 4. But the armature does possess magnetism of its own, and when we combine the three magnetic fields there results a shifting or skewing of the magnetism, and the lines are crowded to one side of each pole, as shown in Fig. 5. The back turns are easily overcome, because the field magnets are much more powerful, but the cross turns, however, acting at right angles, pull and shove, and distort the field magnetism, as shown. This might be compared to three men shoving each other; one a large man of great strength corresponding to the fields of the motor, another a small weak man, corresponding to the back turns of the armature, and the third man of fair strength taking the part of the cross turns. The powerful man can easily shove the little fellow who is opposing him along, but in spite of all his strength he is shoved sideways by the third man. In just such manner is the field of the motor distorted by the armature reaction. Moreover, in a motor the back and cross magnetizing effects depend upon the current that the armature is carrying, and therefore when the load is very heavy and the armature current is large the back and cross turns become much stronger and distort the motor's field more.

It was stated above that the brushes are always placed in such a position that an armature conductor passes from one side of the armature to the other while in the commutation plane or zone. This is the point where the field magnetism is very weak, practically zero, and it is the position in which the direction of the current in the conductor can be reversed without sparking. In Fig. 4, where the armature is supposed to have no magnetism, this position coincides with the neutral plane, but in Fig. 5, where the cross and back turns of the armature are acting, the commutating plane lies to the rear, as shown, because at that point the field magnetism is practically zero. If the brushes were placed at a point midway between the poles, that is, in the neutral zone, sparking would take place at the brushes, because now there is a magnetic field of considerable strength at this point. If it was desired to run the motor in the opposite direction, the brushes would have to be shifted through the double angle A in order to coincide with the new commutating plane.

A shop motor is usually required to run in one direction only, and after once set-

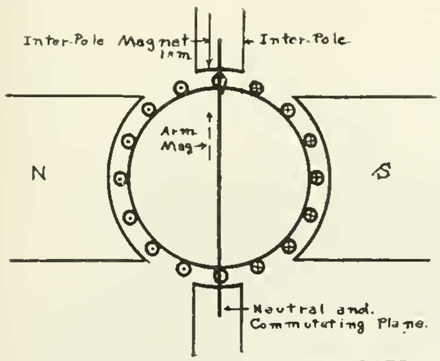


FIG. 6. MOTOR WITH INTERPOLES.

ting the brushes for that direction of rotation little trouble is usually experienced. But in the case of the railway motor conditions are different. A railway motor is required to run in both directions, and for this reason the brushes must be set at the neutral plane, midway between the poles, because this is the point that is best suited for both directions of rotation. If the brushes are set for sparkless commutation for running ahead, then the motor would spark severely when backing, and it is impractical to shift the brushes while on the road. With the brushes in the neutral position practically all of the back armature turns vanish, leaving only the cross turns, which serve to make matters still worse. As there is a considerable magnetic field at this neutral point sparking is sure to take place; however, it is the best that can be done in the case of the ordinary railway motor.

The interpole was applied to railway motors to remedy this state of affairs and to provide sparkless commutation. Let us see what the auxiliary, commutating, or interpole really is before we investigate its action. The interpole is a small pole that is placed midway between the main poles of the motor, as shown in Fig. 6. These poles are placed close to the surface of the armature and wound with a few turns of wire, that is connected in series with the armature winding.

The magnetism that is produced in these small poles is in the opposite direction to that produced by the cross turns of the armature. The poles are so designed that their magnetism is exactly equal to that of the cross turns of the armature, and as the same current passes through both the armature conductors and through the windings on the interpole their magnetism will always be equal and opposite. This neutralizing action of the interpole brings the motor back to the conditions pictured in Fig. 4 and makes it possible to place the brushes at the neutral point. Referring to our former comparison to those men, the interpoles may be compared to a fourth man who is of the same strength as the third, and who is pushing against the third man. The result is that the powerful man has things all his own way and is able to pass across the armature in a practically straight path, as indicated in Fig. 4.

The interpole has been placed on but very few railway motors at the present time. They have found their greatest use in machine shop work where a widely varying speed is desired. Interpoles enable a motor to run without any sparking and reduce the risk of fire and of flashing over, to a minimum. Of late they have begun to enter the railway field, where it is thought that they will prove very efficient.

Another method of neutralizing armature reaction is illusthated in Fig. 7. In this method wires are embedded in slots in the faces of the field poles. These wires are connected in series with the armature conductors and, as shown by the crosses and dots, they carry current flowing in opposite directions to that in the armature conductors. The result is that they neutralize the cross armature

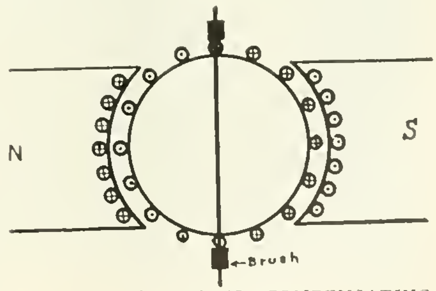


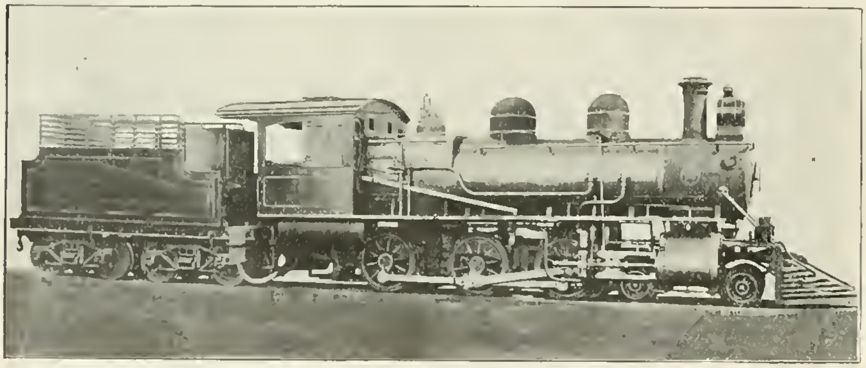
FIG. 7. MOTOR WITH COMPENSATING FIELD WINDING.

turns perfectly and bring the commutating plane and the neutral plane together. This is called a compensated winding, and direct current motors that are equipped with it will run equally well on either alternating or direct current.

Locomotives for South America.

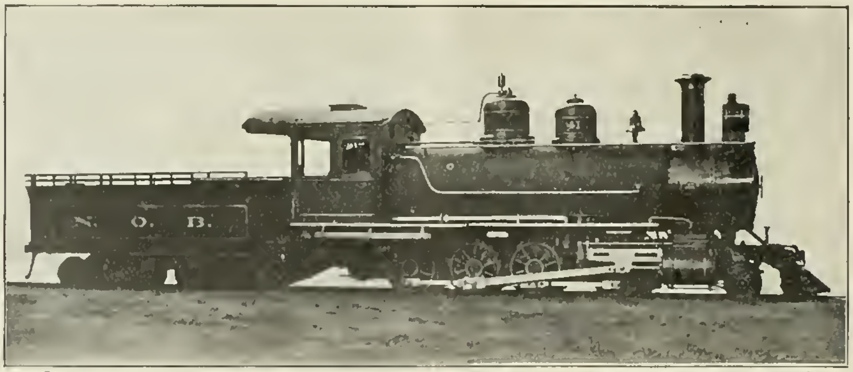
The first locomotives shipped to South America by the Baldwin Locomotive Works were built in 1862 for the Dom Pedro Segundo, now the Central Railway of Brazil. These locomotives at once proved entirely suitable for the conditions existing in South America, and since that time there has been a steady demand on the part of South American lines for American built power.

The accompanying illustrations represent three locomotives recently built by the Baldwin Locomotive Works for South American roads. The gauge of track in each case is one meter, that is 3 ft. 3⅜ ins. about. The first shown in our illustration is a ten-wheel locomotive, Ferrocarill Central Notre, Argentine, This is one of six locomotives, supplied to this line for construction service. The tractive force exerted is 16,630 lbs. The boiler of this locomotive is of the Belpaire type, with copper firebox and brass tubes. The firebox is provided with a brick arch supported on angle irons, and is equipped for burning either coal or wood. The crown and sides of the inside shell are in one piece. The barrel is straight topped, and is composed of two rings. An auxiliary dome is placed over the firebox, and carries the safety valves and whistle. The steam distribution is controlled by inside admission piston valves, which are driven by direct valve gear of the Stephenson type. The links have double suspension hangers, and the motion is transmitted to the valve rods by transmission bars which pass above the first axle. The reversing gear is of the screw type. The equipment includes automatic air brakes on driving and tender wheels, with train connections front and back; also the LeChatelier brake on the cylinders. The boiler is fed by two injectors and one pump, which is driven from the right-hand crosshead. Cast steel is used for many details. The engine truck and tender wheels are steel tired with cast steel plate centers, and were made by the Standard Steel Works Company.



4-6-0 FOR THE FERROCARILL CENTRAL NORTE, ARGENTINE.

Consolidation Type Locomotive No. 41 is one of three in service on the Northwestern Railway of Brazil. These engines exert a tractive force of 20,580 lbs. and were designed to haul a train weighing 240 tons up a straight grade of 2 per cent. The leading truck of this engine is equalized with the first pair of driving wheels, while the three remaining pairs are equalized together. The main rods are connected to the third pair of driving wheels; the eccentrics, however, are placed on the second driving axle, and the link blocks are directly connected to the rockers. This is a simple and exceedingly compact arrangement of valve gear. The boiler is straight topped, with a long firebox placed above the frames. The inside firebox is of steel, and is radially stayed, with one T-bar supporting the front end of the crown. Either wood or coal may be used as fuel. The equipment includes automatic air brakes, with train connections front and back. The tender is carried on arch-bar trucks, and has a steel channel frame and U-shaped tank.



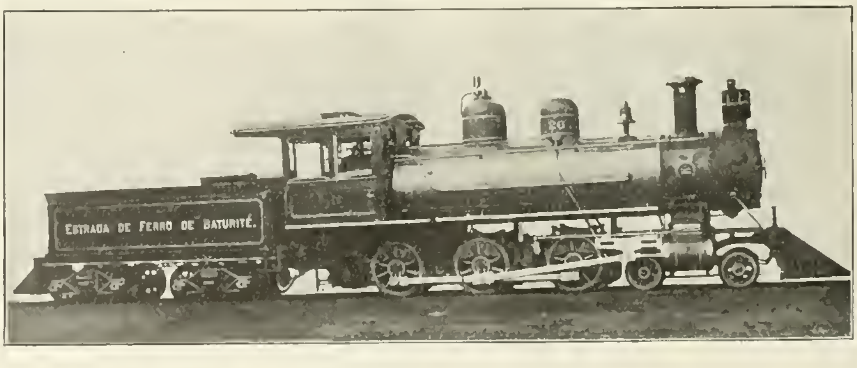
2-8-0 FOR THE NORTHWESTERN RAILWAY OF BRAZIL.

Ten-Wheeled Locomotive, E. de F. de Baturite, Brazil. This locomotive is suitable for general road service, and is capable of exerting a tractive force of 13,110 lbs. The boiler is straight topped, with a steel firebox which is placed above the frames. Wood fuel is used, and the smokebox has an extension front and straight stack. Steam brake equipment is applied to the driving and tender wheels, and the LeChatelier water brake is also fitted.

The principal dimensions of these locomotives are as follows:

	Central Norte	North-Western	E. de F. de Baturite
Cylinders	15" x 22"	17" x 22"	15" x 18"
Drivers, diameter..	43"	42"	42"
Steam pressure, lbs.	170	160	160
Boiler, diameter...	50"	60"	52"
Grate area, sq. ft.	16.2	18.2	15.1
Heating surface, square feet	937	1,390	1,023
Wheel base, engine.	19' 10"	20' 3"	19' 10"
Wheel base, engine	19' 10"	20' 3"	19' 10"
Wheel base, total engine and tender	43' 6"	45' 2"	45' 0"
Weight on drivers.	70,900	85,300	54,200
Weight, total engine	85,050	97,600	71,700
Tank capacity, gals.	2,640	2,200	1,800

In 1884 a patent was granted to a New England inventor for a self-feeding furnace suitable for locomotives. The invention consisted of apparatus for feeding the fuel by gravity from a closed magazine into a horizontal, unobstructed and grateless combustion-chamber, wherein the body of the fuel was fed forward as required. The invention worked admirably—on paper.



TEN-WHEEL ENGINE, ESTRADA DE FERRO DE BATURITE.

A Club Train in India.

Last year the Great Indian Peninsula Railway put on a train of cars to run between Bombay and Poona during the fashionable season, and to further cater for patronage this year they have had built a complete "club" train for this service. Only first-class passengers are carried, and the train includes a combination car, in which a well-fitted bathroom and four separate dressing rooms are provided, two handsome saloons with private staterooms and a cloakroom for hand luggage, a parlor car with smoking room and café and a large dining car on twelve wheels. A small store van with a guard's compartment brings up the rear.

The train is vestibuled throughout and is electrically lighted and has punkah fans in all compartments. It has been specially designed by Mr. A. M. Bell, the car superintendent, for the comfort of daily visitors between the two cities during the season, but when not required on this service, two well-appointed sleeping cars will replace the two day cars, and the train then forms what is practically a touring hotel or club. The drawback to pleasure seekers in India has been the lack of good hotel accommodation, and the enterprising management of the G. I. P. are providing this train to remove the difficulty. By the use of this train a party of tourists will be able to see all the wonders of the empire of India without leaving the comforts of western civilization for a single day.

CLUB TRAIN OF TWELVE CARRIAGES ON THE GREAT INDIAN PENINSULA RAILWAY.

D. L. & W. New Shops at Scranton.

The work on the new repair shops of the Delaware, Lackawanna & Western Railroad at Scranton, Pa., is progressing rapidly and when this extensive plant is completed it will be one of the best equipped in the country. The new shops will contain fifteen departments and the site for this establishment is in heart of the city and consists of about 23 acres. A number of commodious buildings on it are well advanced.

The machine and erective shop measures 588 x 346 ft. This building has six bays in all, two of which are devoted to the erecting shop. The pits are arranged in a transverse direction, and two overhead cranes serve the shop. The upper crane has two 60-ton hoists and one 15-ton auxiliary hoist. In the heavy work bays of the machine shop, tools requiring over 3 h. p. are arranged for individual motor drive.

The basement extends under the light work bays, and in this portion of the building are situated the lockers, washrooms, etc., for the men, and there is a central lunch room with a moderate priced lunch counter. Hydraulic elevators connect the basement with the main floor, and a subway system has been constructed for the transfer of material and for the use of men coming and going to and from their work. The subway is equipped with electric locomotives of suitable dimensions so that the transfer of material can be rapidly made, and as the good drainage obtained on the property, which is largely filled ground, has made it possible to provide basements for a number of the buildings, the subway loading and unloading facilities are excellent. A sixty-stall roundhouse is being built close by the present one and is convenient to the coal pockets.

Dr. Sinclair Is Loyal to Athens.

Iowa City's friend once—Iowa City's friend always! This is a motto that none can dispute.

Dr. Angus Sinclair, of New York City, an old-time railroad man of Iowa City, is the last one to desire to combat the theory. He has written to George S. Carson, acknowledging the receipt of a goodly number of views of the "New Athens," and his note is of interest. He says:

"I was very much pleased to receive your letter and also the photographs. Iowa City seems to be entirely a new place from what it was in the days when I was engineer on the Plug. I was gratified to see such manifestations of its progress."

Mr. Sinclair, himself, has developed remarkably since his days of humble toil in a minor post on the Plug, as the B. C. R. & N. was then known. He is now editor (and president) of the RAILWAY AND LOCOMOTIVE ENGINEERING of New York City, the greatest magazine of its kind in the world. He is also author of a quintet of works on railroad engineering—educational and historical—that rank in the very van of the army of such publications.

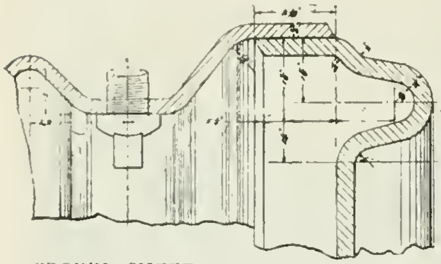
In token of his ability, Purdue University recently conferred the degree of Doctor of Engineering upon the former Iowa Cityan (which fact will explain the new title to A. T. Calkins and other pioneer railroad associates of Dr. Sinclair). The Erie Railroad has also honored the former Hawkeye railroader by naming its new Mallet articulated compound locomotive the "Angus Sinclair." This monster engine is of a type rapidly coming into popular favor. The American Locomotive Company built it for the Erie.—*Iowa City Republican.*

FUNICULAR RAILWAY IN SWITZERLAND.

Corrugated Firebox Sheets.

Everyone knows how a steam pipe laid round the wall of a roundhouse is sometimes arched with quite an artistic curve over a doorway. This curve is really an intentional kink in the pipe and is intended to take up the effect of expansion and contraction, when the pipe is hot or cold. The pipe bends in the easy curves over the door and no harm comes to it with changes of temperature.

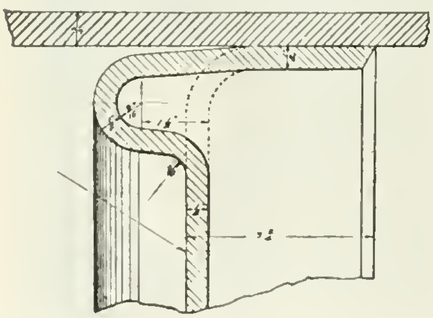
With much the same idea in view Mr.



CROWN SHEET AND FLUE SHEET.

W. H. Wood, of Media, Del., has designed and is building boilers with fireboxes, the sheets of which are intentionally kinked so as to take up the effect of expansion and contraction. Our illustrations show details of one of these boilers, rebuilt for the Great Northern Railroad. The staybolts here are 5 in. centers, ⅞-in. diameter with enlarged ends and between each staybolt the sheet is bent in, for a depth of 1¼ ins. The roof and side sheets are all made out of one piece.

The corrugations are not only intended to deal with the stresses set up in the plates by reason of expansion and contraction, but they also provide a greater heating surface than could be had if the plates were all perfectly straight. They provide this increased heating surface in the best possible place for heating surface to be, viz.: the firebox. In the alteration which is being made in the Great Northern boiler to suit the corrugated firebox several of the tubes formerly in the boiler have had to be left out, but it



CORRUGATION OF FRONT FLUE SHEET.

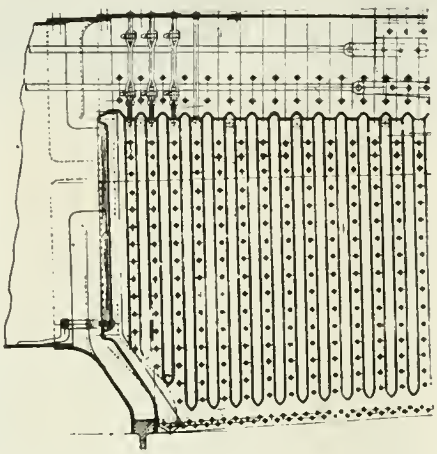
is claimed that the increased heating surface more than makes up for their loss.

Another claim which is made for these fireboxes is that owing to the movement of the plate any scale that would otherwise adhere to the sheets is cracked off and the sheets are always automatically kept clean. In the case of old boilers in which it is desired to use the corrugated box, and where the staybolts are spaced 4 ins. apart, the depth of the bend or corrugation is made 13-16 ins. deep.

Erie's Operating Record.

A financial writer for an Eastern newspaper, in discussing the usefulness and accomplishments of public service and railroad commissions, calls attention to the many duties of such bodies and incidentally comments upon the demands of the New York Commission for punctuality records of passenger trains.

"This innovation," continues the writer, "has brought about some surprises. It is perhaps invidious and unpleasant at times to make comparisons, but in this case, a proper and honest credit should be given because it has been honestly earned. The writer confesses that he has not always been favorably disposed toward the Erie, being unable at times to divorce capitalization from operation, but a spirit of fair-



FIREBOX WITH CORRUGATED SHEETS.

ness compels the statement that the official records give to the Erie undisputed first place for punctuality and safety.

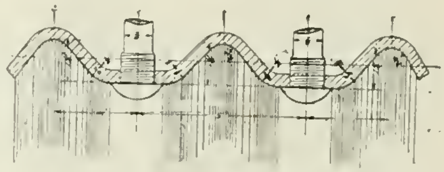
"This statement to some may seem exaggerated, but it is true, nevertheless, despite the jokes and gibes of the past. Perhaps the humorist did not know the facts. The six months' record of the Erie, as shown by the reports, shows a total of 43,174 passenger trains, of which 95 per cent. reached terminals on time. The next best record is that of a competitor which operated 5,100 trains, with a punctuality record of 96 per cent. The Erie is 1 per cent. behind the other road, but operated eight times as many trains.

"But the most favorable and agreeable statement that can be made about the Erie is the fact that it has operated more than 600,000 passenger trains without a single fatality to a passenger.

"Both records impress the student of railroad operations and finances with the fact that the working force is not only extremely competent and capable, but exceedingly careful, as well, of the lives of the traveling public. The Erie has a most valuable asset in its successful operation."—*Erie Employees' Magazine.*

Boiler Washer and Water Heater.

Mr. D. W. Cunningham, assistant superintendent of machinery of the Missouri Pacific Railroad at Argenta, Ark., has secured a patent, No. 927,494, on a water-heating apparatus designed for use in connection with the cleaning of locomotive boilers, and from the experimental use of which very gratifying results have been already obtained. The device consists of two cylindrical receptacles somewhat re-

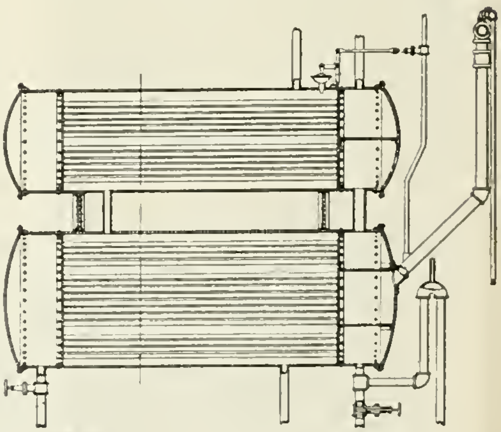


CORRUGATIONS BETWEEN WOOD'S STAY-BOLTS.

sembling locomotive boilers so attached and so fitted with connections that they can receive the steam and hot water from a locomotive boiler which will heat the water already in the apparatus without mixing with it, and the water thus heated is used for washing out the boiler of the locomotive that supplied the steam and also for refilling the same locomotive with clean water at such a temperature that its introduction into the locomotive boiler will not tend to cause undue contraction or expansion, and at the same time be easily brought to the boiling point.

A feature of this clever device is the providing of means whereby the steam and hot water from a number of boilers may be introduced simultaneously without causing a backward pressure on *any* boiler where the pressure may be lower, the combined apparatus making it possible to impart a maximum of the heat to the water in the heater.

It may be added that in the experiments carried on for nearly two years at Valley



CUNNINGHAM'S WASHER AND HEATER.

Junction, Iowa, the total saving in the washing out and refilling of an average of 450 locomotives per month was $515.85.

The man whose keenest joy comes with the sound of the quitting time whistle will never rise above the drudgery he despises.

Items of Personal Interest

Judge Robert S. Lovett has been elected chairman of the Board of Directors of the Union Pacific Railroad, succeeding E. H. Harriman. Although Judge Lovett reaches this exalted position in the railway world through his training as a lawyer, his success in life ought to teach all ambitious young men endowed with energy and perseverance, that their prospects of reaching the top of the railroad world are far from being hopeless. Enemies of the country keep preaching that the poor boy no longer has a chance to raise himself above the madding crowd; but by every case of a new man being drafted to the highest rank through sheer merit, it is revealed that the period when early poverty was no bar to success and when the heart of youth could leap up with hope and get there has not passed by any means. Self help was the abiding faith and sheet anchor of Robert S. Lovett and he moved on to be chairman of the Union Pacific Board of Directors by the quiet force that no resistance can stop. Born on a small farm in Texas in 1860, his prospects in life seemed far from bright, but his natural energy made up for the humbleness of his birth. Natural ambition moved him to seek a higher calling than the farm afforded and he secured a job in a store at ten dollars a month. There he worked hard and gathered up scraps of education that enabled him to take a job as clerk in a freight house on the Houston East and West Texas Railroad. There he worked cheerfully all day and studied law at night. This led to his appointment as local counsel for the road on which he was first employed, and the ability he displayed led to his promotion to the important position of general counsel. The natural course of events was the appointment of Judge Lovett to be general counsel of the Harriman lines, which brought his attractive personality into intimate relationship with Mr. Harriman.

A controlling interest in the Pan American Railway has been secured by Mr. David E. Thompson, United States Ambassador to Mexico. The line extends from San Geronimo on the Tehauntepec National Railway to Mariscal on the Mexican-Guatemalan frontier. It is reported that the road purchased will some day be part of a greater Pan American railway.

The American Railway Master Mechanics' Association have engaged Mr. Geo. L. Fowler to prepare an index of the annual proceedings up to date.

Edward H. Harriman.

In our last issue we commented briefly on the illness of E. H. Harriman and expressed the opinion that his death would be a public misfortunate scarcely second to the death of a president of the United States. That misfortune came on September 9 when Edward H. Harriman was called from his labors forever. Millions of people are mourning the death of the man who was the greatest railroad magnate the world has known. There have been other owners of vast railroad properties who passed with little regret, but Mr. Harriman was of a different type. His dealings with railroad properties were always beneficent, for he was always an improver and regenerator. His peculiar way was to obtain control of properties that had depreciated in value and build them up into first-class lines.

THE LATE E. H. HARRIMAN.

Like many other men who have distinguished themselves in the financial world, Edward H. Harriman was the architect of his own fortune. The son of an Episcopal clergyman, he was reared in poverty, but succeeded in obtaining a good education. When he was about seventeen years old, he began work as a broker's clerk in Wall street, New York. In a few years he accumulated sufficient money to purchase a seat in the Stock Exchange, which put him on the direct road to fortune. Having a particularly clear judgment of coming events and their results, he was able to avail himself of opportunities for money making that few men have enjoyed. He was a seer of wonderful intellect with marvelous capacity for work. These attributes formed the financier who was greater than any king, emperor or any other potentate, for he created his own greatness and passed away cherishing schemes for the benefit of his fellow men.

Mr. J. Snowden Bell is engaged in preparing a history of the early motive power belonging to the Baltimore & Ohio Railroad. No man is so well equipped for preparing such a history. Mr. Bell was a draughtsman on the road in the days when the locomotive was under early development.

Mr. D. L. Jones, heretofore locomotive foreman at Smith's Falls, Ont., has been appointed district master mechanic of District 1, Eastern division, Canadian Pacific Railway, with office at Farnham, Que., vice Mr. E. W. Campion, assigned to other duties.

Mr. C. A. Stark, heretofore shop foreman of the Canadian Pacific Railway at Carleton Junction, Ont., has been appointed locomotive foreman at Smith's Falls, Ont., vice Mr. D. L. Jones, promoted.

Mr. J. E. Weatherford, formerly foreman of the car department of the Houston & Texas Central at Ennis, Tex., has been appointed general foreman of the same department at Houston.

Mr. James George has been appointed foreman of the car department of the Houston & Texas Central at Ennis, Tex., vice Mr. J. E. Weatherford, promoted.

Mr. F. E. Patton has been appointed road foreman of engines on the Mobile & Ohio Railroad at Mobile, Ala.

Mr. J. H. Wilson, heretofore locomotive foreman at Brandon, Man., has been appointed locomotive foreman at Moose Jaw, Sask., on the Canadian Pacific Railway.

Mr. F. W. Saddler, heretofore district master mechanic, Moose Jaw, Sask., on the Canadian Pacific Railway, has been appointed shop foreman on the same road at Kamloops, B. C.

Mr. W. Northgraves has been appointed roundhouse foreman at Brattleboro, Vt., on the Central Vermont Railway.

Mr. C. A. Saylor has been appointed locomotive foreman at Hamilton, Ont., on the Grand Trunk Railway, vice Mr. W. W. Yeager, resigned.

Mr. T. Ryan, heretofore roundhouse foreman at Riviere du Loup, Que., on the Intercolonial Railway, has been appointed acting division master mechanic, vice Mr. F. J. Lozo, resigned.

Mr. Walter Hill has been appointed roundhouse foreman on the Delaware, Lackawanna & Western Railroad at Buffalo, N. Y.

Mr. G. Fred Collins, formerly connected with J. A. Crowley & Co., has accepted a position with the Crucible Steel Co. of America. Mr. Collins has charge of the railway trade of this company and his office is at No. 2 Rector street, New York.

Mr. F. J. Barry has been appointed the acting inspector in charge of air brakes, steam heat and lighting of the New York, Ontario & Western, with office at Middletown, N. Y.

Mr. Charles D. Jenks has been appointed Western sales manager of the Standard Coupler Company, of which Mr. George A. Post is president. The Western Sales office of the company is at Room 1207, Fisher Building, Chicago. Mr Jenks has been connected with the Pressed Steel Car Company for the past seven years, two years in the operating department as assistant to the vice-president in Pittsburgh and five years in the sales department in Chicago. Prior to his connection with the Pressed Steel Car Co. Mr. Jenks was for eight years employed in the Traffic Department of the Pennsylvania Railroad, and for six years he was with the Engineering and Construction Department of the Atlantic Refining Co. in Philadelphia. Mr. Jenks enjoys a wide acquaintance with railway officials and supply men, by whom he is highly esteemed and who will hear with interest of his having become a member of Mr. Post's staff.

Mr. Jesse R. Garrabrandt, formerly signal maintainer of the Erie Railroad at Jersey City, has been appointed assistant supervisor of signals on the New York division and at the terminals.

Mr. A. M. White has been appointed assistant road foreman of engines of Knoxville division of the Southern Railway, headquarters at Knoxville, Tenn.

Mr. L. E. W. Bailey was appointed district master mechanic of the first district, Canadian Pacific Railway.

Mr. James C. Fritts, foreman at the Hoboken, N. J., shops of the Delaware, Lackawanna & Western, has been appointed master car builder, with office at Scranton, Pa., vice Mr. Robert McKenna, resigned.

Mr. J. Barrydale has been appointed assistant superintendent of the car department of the Illinois Central with office at Chicago, Ill.

Mr. A. K. McKillop has been appointed the assistant superintendent of machinery in charge of locomotives on the Illinois Central, with office at Chicago, Ill:

At the recent meeting of the Traveling Engineers' Association at Denver, Colo., the following officers were elected for the year 1909-10. President of the association, Mr. C. F. Richardson, assistant to the general superintendent of motive power Chicago, Rock Island & Pacific, Chicago, Ill. First vice-president, Mr. F. C. Thayer, general foreman of engines Southern Railway, Atlanta, Ga. Second vice-president, Mr. W. C. Hayes, superintendent of locomotive operation Erie Railroad, New York. Third vice-president, Mr. W. C. Corbett, assistant master mechanic on the Michigan Central at Michigan City, Mich. Mr. W. O. Thompson, master car builder on the New York Central at East Buffalo, was elected treasurer and Mr. C. B. Conger, of William Sellers, Inc., Philadelphia, was elected treasurer.

Mr. John A. Lee, shop and enginehouse foreman of the Western Allegheny at Kaylor, Pa., has been appointed master mechanic with office at Kaylor, succeeding Mr. J. H. Marks.

Mr. C. W. Lee has been appointed master mechanic of the Raleigh & Southport, with office at Raleigh, N. C., succeeding Mr. Geo. L. Womble.

Mr. W. L. Kellogg, formerly superintendent of motive power and car department of the Pere Marquette at Detroit, Mich., has been appointed superintendent of motive power of the Cincinnati, Hamilton & Dayton, with office at Lima, O., and will have charge of the locomotive and car departments.

Mr. William Boughton, master mechanic of the Pere Marquette at Saginaw, Mich., has been appointed general master mechanic in charge of locomotive and car departments, with office at Detroit, Mich., vice Mr. W. L. Kellogg, resigned.

Mr. W. P. Plummer has been appointed purchasing agent of the Mexico North Western, with office at New York. This company has taken over the Chihuahua & Pacific, the Sierra Madre & Pacific and the Rio Grande, Sierra Madre & Pacific.

The address delivered by Mr. Oscar F. Ostby, president of the International Acetylene Association, has been issued in pamphlet form. The title of the sixteen-page pamphlet is "Frenzied Legislation and the Headlight Question." Any one who is interested in the subject dealt with by Mr. Ostby will be able to get a copy by addressing him, care of the Commercial Acetylene Company, 80 Broadway, New York.

Mr. C. C. McCain, chairman of the Trunk Line Association, has recently completed a pamphlet entitled "The Diminished Purchasing Power of Railway Earnings," which embodies the results of an exhaustive investigation relative to the present purchasing power of railway earnings as compared with ten years previous. While this inquiry was undertaken on behalf of the interests with which Mr. McCain is associated, the conclusions reached do not necessarily indicate the policy which such roads will follow. The publication of the data and Mr. McCain's deductions based thereon are for the purpose of laying before the public accurate information with respect to a phase of the railway problems not generally understood. The principal argument is to the effect that the ten years which have elapsed since the resumption of industrial activity have been characterized by changes in rates of wages for all kinds of labor and in the price of most commodities, which has resulted in a material alteration in the valuation of money.

Mr. C. J. Cooper, formerly master mechanic of the Toledo & Ohio Central, has accepted the position of mechanical instructor in the Kumamota Higher College of Technology in Japan.

Mr. C. M. Hoffman, master mechanic on the Southern Railroad at Princeton, has resigned in order to accept a position with a Western railway.

Mr. W. L. Allison, formerly mechanical engineer of the Atchison, Topeka & Santa Fe at Chicago, has resigned to become mechanical manager of the Franklin Railway Supply Co. of New York.

There exists among the members of the Master Car Builders' and the Master Mechanics' Association a very decided sentiment in favor of holding the next annual convention at some inland point, such as Saratoga. The people attending these conventions have come to realize that it is not wise to keep going to the same place year after year. The hotel keepers and others of Atlantic City have come to believe that the railroad conventions belong to them, and their exactions are based on that fallacy. A change is highly desirable.

Railroad men are particularly familiar with the sign "O K," meaning all right, as it is generally believed to be a phonetic abbreviation of "all correct." Another version of the origin of the expression has just come to our notice, which says that Orrin Kendall, head of a firm of bakers in Chicago, furnished hard biscuits to the United States army during the war and that every box bore the initial O K, which gave rise to the expression. We are inclined to think the latter explanation far-fetched. Another explanation we have heard was that Otto Kemp, an early train dispatcher on the Erie, used his initials in giving train orders and that they came to stand for all correct or all right.

The United States Government has awarded the mail contract between Torrance and Roswell, New Mexico, to the automobile stage line which has been in operation between these two places since early last summer. The line is 112 miles in length, and the greater part of the run is made straight through the desert. If the traveler between Roswell and Torrance patronizes the railroad instead of the automobile line he is required, by reason of the roundabout rail route, to cover a distance approximating 1,000 miles. The people of Roswell are especially delighted with the motor line because it means to them a saving of forty-eight hours on all mail from Albuquerque, Santa Fe and other points.

Tried It Without Rails.

A remarkable accident occurred on the North Coast Line at Zillmere last week, when a train ran on to a bridge which was undergoing repair, and from which the rails had been removed. The engine kept "on an even keel," but blocked traffic for several days. A temporary deviation of twenty chains and a "pigsty" bridge were built in eighteen hours, and trains were able to get through without delay. The work of transferring the passengers and luggage of the Northern mail train across the break in the meantime occupied two hours.—*The Queenslander.*

QUEENSLAND ENGINE ON A BRIDGE WITHOUT RAILS.

Fire Protection at Altoona.

The fire fighting equipment of the Pennsylvania Railroad at Altoona is probably the most complete of its kind in the country. There is first of all what may be called a regular gridiron system of pipes for the machine and car shop area, and the hydrants connected to the mains are capable of supplying 184 streams of water.

As a precautionary measure and to guard against breakages in the mains or stoppage of flow due to mud or other foreign matter in the pipes, the company have laid parallel mains under the shops and yards, and by the closing of certain gate valves a section of broken or clogged main can be cut out without interfering with the water supply, just as a car with defective brake may be cut out without destroying the efficiency of the brake as a whole.

Many of the buildings at Altoona are four stories high and the method adopted for reaching the tops of such buildings was to unite two lines of hose in a "Siamese" nozzle. A stream of water amounting to 400 gallons a minute from a 2-in. aperture was thrown from one of these nozzles to the top of the machine shop, on the occasion of a recent test. This piece of apparatus is locally known as a "deluge set."

In addition to the system of pipes and hydrants there are conveniently placed in the shops water and sand pails, hose racks, chemical engines, ladders, etc. A reservoir situated in the Pottsgrove Hills behind Altoona has a capacity of 180 million gallons. The reservoir can be called on in case of breakdown of any of the pumps and its height above the shop level is such as to ensure adequate pressure.

Exact Coal Measurement.

In the course of a discussion on Fuel Economy at the Traveling Engineers' Convention at Denver the trend of opinion expressed was that railroad companies lose thousands of dollars weekly owing to the loose manner in which coal is placed upon tenders. Very few railroads can tell with any pretense of accuracy how much coal a locomotive uses in doing its work. Coal delivered from the ordinary coal chute has no approximation to exact weight. Until a change is made from guess work methods to means whereby exact measurement is secured, it is the height of foolishness for railroads to compile performance sheets that are supposed to tell the quantity of coal burned in the fireboxes of the different locomotives.

To the railroad officials who are anxious to change from guess work to accurate measure at their coaling stations we would advise a trial of the Otto Overcut Flexible Coaling Spout, made by the Otto Gas Engine Works, Chicago, Ill.

The report of the proceedings of the fifth annual convention of the International Railway General Foremen's Association, held at Chicago in June last, has just been issued. It fills a closely printed volume of 163 pages, and no better proof of the growing importance of this young and flourishing association could be given than the handsome presentation of this valuable contribution to the engineering literature of our time. The subjects discussed are all of real interest to railway men, and we hope to have the opportunity of presenting in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING a digest of the more important subjects and present briefly the conclusions arrived at upon these subjects by the members of the convention. The compilation and prompt publication of the volume reflects great credit on the secretary, Mr. L. H. Bryan, Two Harbors, Minn.

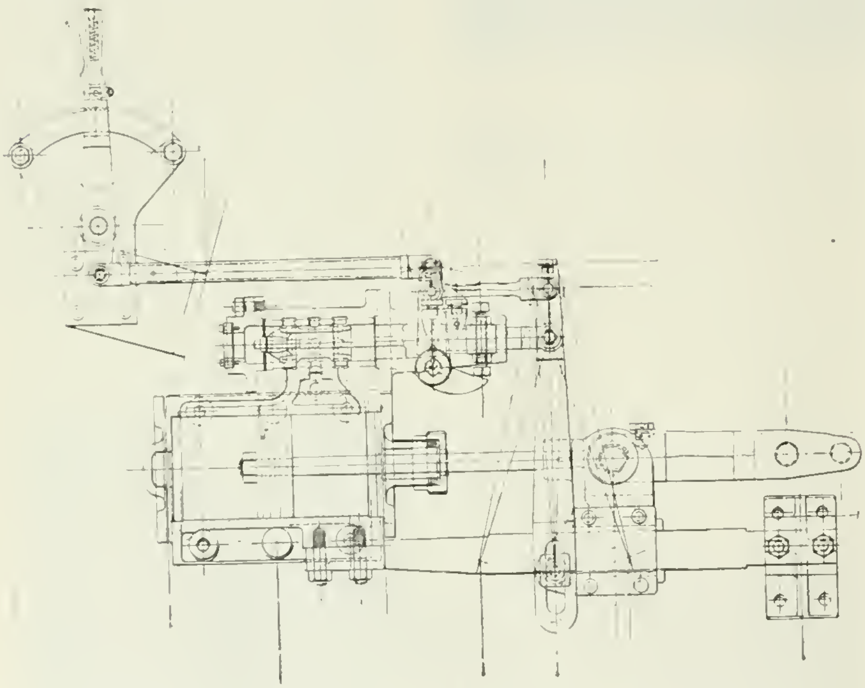
A warm friend of RAILWAY AND LOCOMOTIVE ENGINEERING, who believes it to be an exceptionally valuable educational medium, never losses an opportunity to urge the younger railroad men to subscribe for the paper. To the oft-repeated excuse, "I cannot afford the two dollars," he says, "drop one cigar a week."

WRECK ON NORTH COAST LIMITED AT ZILLMERE, AUSTRALIA.

Ragonnet Power Reversing Gear.

The Ragonnet power gear is operated by compressed air, and is a patented device. It has been applied by the Baldwin Locomotive Works to several Mallet Articulated Compounds built by them. This gear is specially suitable for use on articulated locomotives, where two sets of valve motions must be operated simultaneously. The air cylinder is bolted to the side of the firebox, immediately in front of the cab. Distribution of air is controlled by an inside admission piston valve 3 ins. in diameter, which works in a cast iron bushing provided with suitable ports. The piston of the air cylinder is directly connected to a crosshead which is coupled to the reverse shaft by means of a suitable link. The crosshead has a cast steel body and cast iron gibs, and slides on a single guide bar. The gibs are held in place by a wrought iron plate which carries a projecting stud. This stud engages in a slot which is placed in the lower end of a combining lever. The upper end of the combining lever is connected by means of a rocker and suitable links, with the operating lever in the cab. The stem of the piston valve is also connected with the combining lever, a short distance below the previously mentioned connection to the operating lever. The rocker is provided with safety arms which strike adjustable set screws when the limit of travel of the piston valve on either side of the center line, has been reached.

The operating lever in the cab is locked in place by a toothed sector. When this lever is in its central position, the combining lever stands vertical and the piston valve covers both admission ports. When the operating lever is moved into forward gear to the right, looking at the illustration, the combining lever swings about the crosshead stud as a fulcrum and the piston valve is moved to the left, thus admitting air to the rear end of the cylinder. A forward movement of the piston follows; the combining lever now swings about its upper end as a fulcrum, thus moving the piston valve to the right. The gear is so adjusted that when the link blocks have been shifted to give the desired cut-off as indicated by the position of the operating lever in the cab, the piston valve closes the admission port, and the movement of the piston ceases. It is evident that, when the gear is set for any particular point of cut-off, the piston valve is in its middle position, and a slight movement of the combining lever will shift the valve a distance equal to its inside lap, that is, 1/32 in. and admit air to the cylinder, thus locking the mechanism. In other words, after cut-off of the air has taken place, a further movement of the valve of only 1/16 in. will open the port leading to the opposite end of the cylinder and thus lock the gear.



RAGONNET AIR-DRIVEN REVERSING GEAR FOR LOCOMOTIVES.

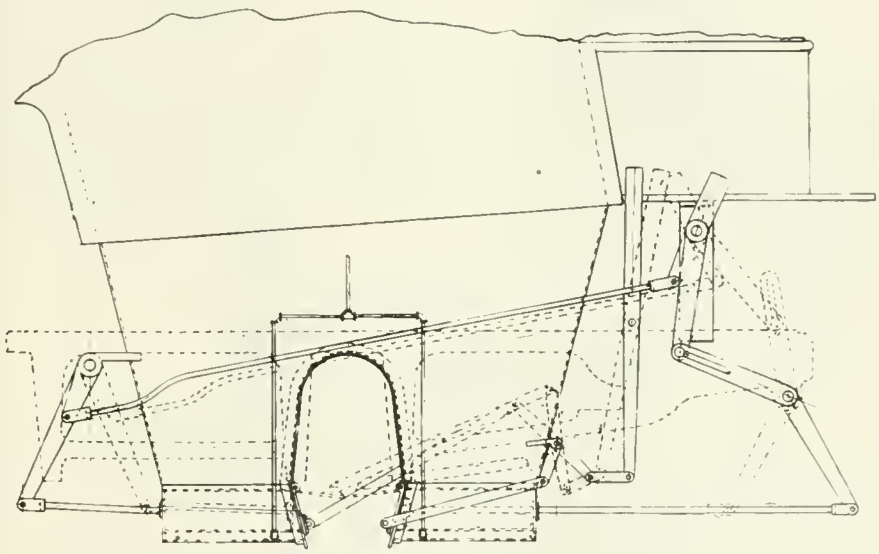
Thus it happens that the reverse lever of these large Mallet engines are not a great deal bigger than the brake valve.

It is pleasing to observe that the press and public of Great Britain have fittingly honored the memory of Matthew Boulton, the partner of James Watt and the friend of Josiah Wedgewood. He was the first man of means and courage who discovered the merits of Watt's engine. He fought his way steadily through a period of financial stress and powerful oppositions, and he carried all before him to success. The people of Birmingham are particularly proud in claiming him as a citizen. James Watt was peculiarly fortunate in engaging the attention of so fine a type of the English gentleman. The rapid degree of favor with which the steam engine was received was owing largely to the generous and intelligent aid of Matthew Boulton.

Atlas Ash Pan.

A type of ash pan designed to meet the requirements of the Federal law, which goes into effect in January, 1910, has lately been patented by Messrs. Swartz and Whelan, of Fort Wayne. The patent No. is 907,197. This pan is arranged so that any leakage from the mud ring will fall outside and not into the pan.

The feature of the pan, which strikes the observer, is the fact that it is fitted with scrapers. These are really like pistons, though of rectangular shape, which by the operation of a lever for each section, may be forced through the length of the pan, thus pushing the ashes out ahead of it. These scrapers, when in normal position, act as dampers for the front and rear of each section. The pan is provided with a double bottom, which may be filled with steam to prevent freezing in winter.



SELF CLEANING ASH PAN FOR LOCOMOTIVES.

Mr. Julius A. Perkins, engineer and inventor, has met with much success in introducing a new method of roller bearings. We are informed that a number of the leading railroads in America and in Europe having cars equipped with these bearings are furnishing the most gratifying reports to Mr. Perkins. He will soon equip the axles of a locomotive with these bearings and the result will be watched with interest by representatives of the leading locomotive constructors and railway men generally. The advantage of the use of the bearings in light vehicles is beyond question, and it will be interesting to note the result of the experiments when Mr. Perkins applies it to a heavy locomotive.

Crucible Hanger.

The Joseph Dixon Crucible Company, of Jersey City, have recently got out a handsome illustrated hanger. The centerpiece is a realistic foundry scene. Brawny bare-armed men are seen in the red glow of the molding room, pouring molten metal from a Dixon crucible into a mold. The illustration was made from a photograph and the picture is true to life. At the top of the hanger is an illustration in black and white of the Dixon plant at Jersey City. The factories and office cover nearly eighty city lots.

The other illustrations on the hanger show the products of this concern that are made especially for foundry and metallurgical purposes and consist of crucibles, stirrers, boxes and covers used in burning electric light filaments and for case-hardening purposes, muffles and phosphorizers, brazing crucibles, dipping cups, skimmers, etc. The letterpress contains some valuable rules for the care and use of crucibles. The Dixon company will be very glad to send one of these hangers or panels to anyone interested. Their address is Jersey City, N. J.

The Railway Post Office.

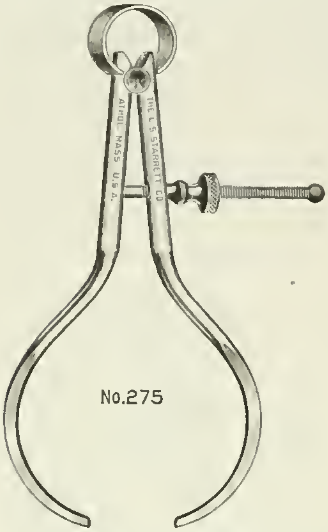
Train men handling postal cars rarely realize the important business that is going on in the front part of the train where the postal clerks conduct their business day and night.

One of the greatest advances ever made in the postal service was the origination of the traveling post office, says Joseph Stewart in the *National Magazine*. This was started in 1862 and has developed into the vast business it has attained.

This railway mail service directs the dispatch of all mails, determines the routes over which they shall be carried, and distributes them en route, so they are ready for delivery to offices along the line, and in some cases makes separations for city delivery upon arrival at large terminals. To conduct this service there are 15,295 officers and clerks employed at a cost of more than $18,300,000 a year. The railway post office lines cover 208,481 miles of steam, electric and steamboat routes.

Some Small Tools.

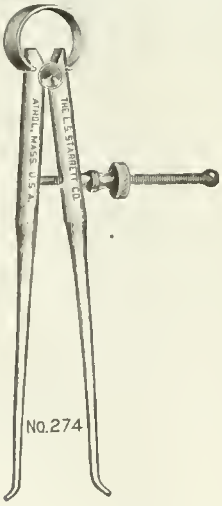
Among the many useful tools made by the L. S. Starrett Company, of Athol, Mass., may be mentioned their toolmakers' calipers and dividers. The calipers are, of course, outside and inside, and they and the dividers are made in five



OUTSIDE CALIPERS.

sizes, ranging from 2 to 6 ins. Our illustrations show the calipers and dividers made from round stock with legs drawn down, so as to make them hard and stiff. The fulcrum stud is hardened and the bows are strong, the screw and nut are nicely fitted, and all are finely finished.

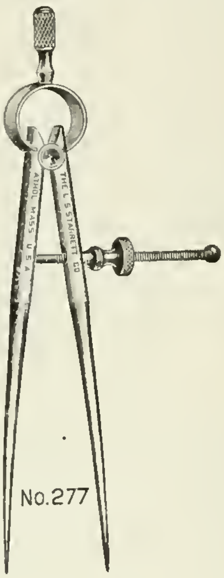
Another useful piece of apparatus made by this company is the level sight attach-



INSIDE CALIPERS.

ments. These are No. 131 on the makers' catalogue. These attachments are made to slip on and off the top side of the Starrett iron levels and are held in place by set screws. They have sight holes, one with a cross wire to line accurately from top of and parallel with the level. Sighting through the holes enables one to use the common level for leveling a plot of ground from a fixed point at long range. These attachments are made to fit 6 in., 9 in., 12 in., 18 in. and 24 in., No. 132 Starrett Levels.

This company also makes what is called a universal bevel protractor with vernier. We give a view of the whole protractor and also a view of a portion of the protractor with the vernier enlarged. The disk of the protractor is graduated in degrees from 0 to 90 degs. each way. The vernier plate is graduated so that 12 divisions on the vernier occupy the same space as 23 divisions on the disk. The difference between the width of one of the 12 spaces on the vernier and two of the 23 spaces on the disk is therefore 1-12 of a space on the disk. Each space on the vernier is 1-12 of a degree, or five minutes, shorter than two spaces on the disk. If a line on the vernier coincides with a line on the disk and the protractor

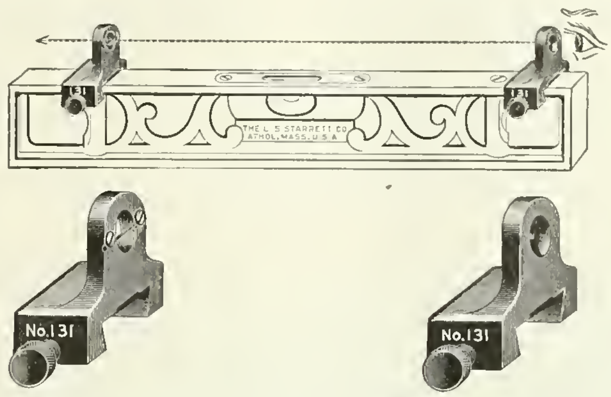


STARRETT DIVIDERS.

head is rotated until the next line on the vernier coincides with the next line on the disk, the vernier has been moved through an arc 1-12 of a degree or five minutes. Write to this company for illustrated and descriptive circulars of any or all of these handy little devices.

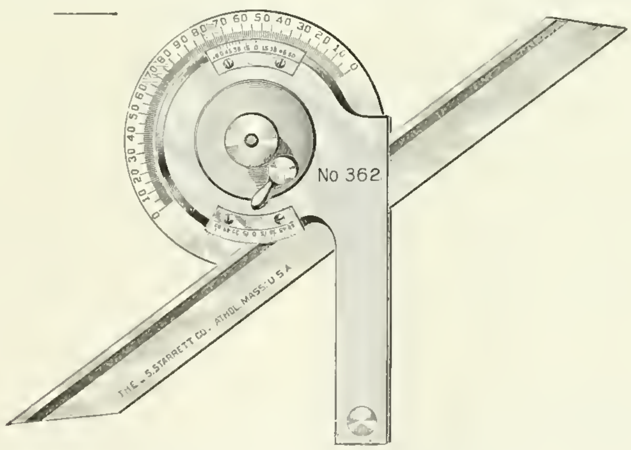
The Open Hearth.

"A Study of the Open Hearth," is the title of an artistic volume of nearly 100 pages, gilt edged and bound in morocco, issued by the Harbison Walker Refractories Company, of Pittsburgh, Pa. The work was originally intended for the use of the operating department of the company, but so much interest has been shown in the treatise, embracing as it does a detailed description of the open hearth furnace and the manufacture of open hearth steel, that the company wisely decided to issue the work in the elegant form before us. The work might well serve as a text-book on the subject. The style is clear, and where technical terms are used, they are explained with a degree of fullness that leaves nothing further to be desired. It is particularly gratifying to observe the generous spirit manifested in the free distribution of this interesting book, presenting as it does an abundance of valuable information which in other hands and in other times would have been locked up as trade secrets.



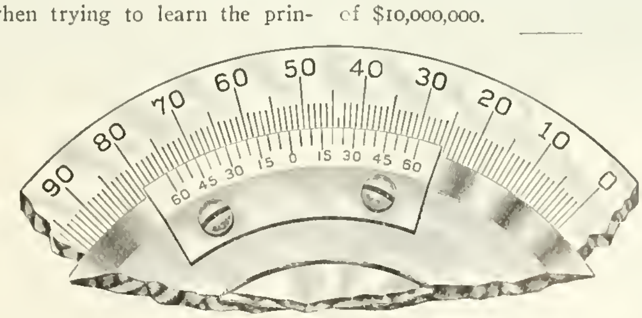
LEVEL SIGHT ATTACHMENTS.

The Baltimore & Ohio Railroad Company in completing their orders for new equipment which were decided upon last month have made a contract with the Baldwin Locomotive Works for 26 Atlantic type passenger locomotives; and also with the American Locomotive Company (Richmond, Va., works) for 34 Consolidation freight locomotives. The B. & O. have also awarded contracts for 500 ventilated box cars; also for 500 refrigerator cars; also for 1,000 box cars and with the General Electric Company of Schenectady for two electric locomotives. These orders will require an expenditure of something over $3,500,000, and together with those given out in August amount to upward of $10,000,000.



STARRETT BEVEL PROTECTOR.

A correspondent asks us the question: "Why should the money raised by taxation be devoted to the training of doctors and lawyers, while the artisans who produce the nation's wealth are left to grope in the dark when trying to learn the principles of their business?" We cannot answer the question, but we know that the tendency of the present day is to provide, at public expense, artisans with instruction concerning the principles of their business.



ENLARGED VIEW OF VERNIER.

Any man may be in good spirits and good temper when he's well dressed. There ain't much credit in that. If I was very ragged and very jolly, then I should begin to feel I'd gained a point.—*Martin Chuzzlewit.*

American Engines for Natal

The American Locomotive Company have recently completed two engines for the Natal Government Railway of South Africa. One of these is a Mallet articulated compound of the 2-6-6-0 type, and the other is a 4-8-2 type, equipped with the builders' latest design of fire-tube superheater with side headers. As the tractive power of the compound engine is only about 12.5 per cent. greater than that of the superheater engine, they will also afford an excellent opportunity for comparison. They will be used in both helper and regular road service. The grades on this road are very heavy, the maximum being 3.3 per cent., and the engines are designed to pass through curves of 300 ft. radius. The gauge of the track is 3 ft. 6 ins. Though in general, both designs follow American locomotive practice throughout, they embody a number of features of English practice, such as copper fireboxes and staybolts, bronze driving boxes and automatic vacuum brakes on the tenders.

The Mallet articulated compound engine has a total weight in working order of 196,000 lbs. Of the total weight 179,500 lbs. is carried on the driving wheels, which gives an average load per axle of about 29,900 lbs. It is designed to deliver a maximum tractive effort working compound of 46,000 lbs. The high-pressure cylinders are 17½ x 26 ins. They are equipped with piston valves, while the low-pressure cylinders are 28 ins. in diameter, with same stroke and are equipped with Allen-Richardson slide valves. In this design of cylinders, the exhaust passages are so arranged that the steam passes through openings in the front of each cylinder casting into a Y-pipe, which is connected to the exhaust pipe in the smokebox by means of elbows and a pipe fitted with a slip joint. This arrangement is necessary in order to increase the length of the exhaust pipe so as to reduce the angle of its deflection when the locomotive passes around a sharp curve.

In order to provide room between the bottom of the smokebox and the top of the low-pressure cylinder castings for the flexible exhaust pipe connections, it was necessary to flatten the bottom of the smokebox so as to give an offset of 5 ins. Both high and low-pressure valves are, of course, operated by the Walschaerts valve gear, and the arrangement of the reversing mechanism is such that the link block of the high-pressure gear is lowered, while that of the low-pressure gear is raised when being thrown into forward motion. In this way the weights of the parts of the two sets of valve motions counterbalance each other. As the high-pressure valves have inside admission and the low pressure outside admission, with this arrangement the eccentric cranks lead their respective main pins in both sets of valve motions. Reversing is effected by means of a screw and hand wheel.

The boiler is of the extended wagon-top type, and the design incorporates a 12-in. combustion chamber in the firebox. This combustion chamber is supported on the bottom and sides by wrought iron braces. Ample water space between it and the shell of the boiler is provided to give good water circulation. The barrel of the boiler measures 65¼ ins. at the front end, contains 230 tubes. 2¼ ins. in diameter, and each 18 ft. long. The total heating surface of the boiler is 2,547 sq. ft., of which the tubes contribute 2,422, and the firebox the remainder. The firebox is 96 ins. long and 60 ins. wide, and provides a grate area of 40 sq. ft.

The 4-8-2 type engine has a total weight in working order of 172,000 lbs., of which 126,700 lbs. is carried on the driving wheels. Because of the use of superheated steam a low-boiler pressure; viz., 160 lbs., is carried. The cylinders are 24 x 24 ins., and the engine is designed to deliver a maximum tractive effort of 41,320 lbs. Superheated steam is distributed to the cylinders by 11-in. piston valves, having inside admission and actuated by the Walschaerts valve gear. This gear is so arranged that the link block is raised when the gear is thrown into forward mo-

4-8-2 ENGINE FOR THE NATAL GOVERNMENT RAILWAYS.

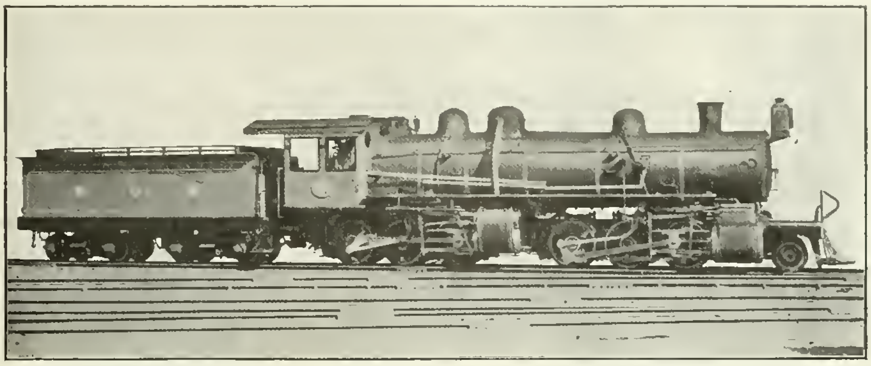
tion and the eccentric crank thus leads the pin. Reversing is effected by a screw and hand wheel as in the Mallet engine.

The frames, which are in two sections, consist of a main frame of wrought iron 4 ins. wide, with single front rail and a rear frame of the slab section, 1¾ ins. wide, for the trailing truck. The rear frame is 12¾ ins. outside of the main frame and is secured to the latter through the medium of a heavy cast steel bracket.

The trailing truck is of the radial outside bearing type. The trailing truck is ing a depth of 27⅛ ins. from the bottom of the mud ring to the shell of the boiler. Both engines are provided with eight-wheel tenders fitted with tanks having a water capacity of 4,000 Imperial gallons and space for 9 tons of coal.

MALLET ENGINE.

Track Gauge—3 ft. 6 ins.
Wheel Base—Driving, 25 ft. 11 ins.; rigid, 8 ft. 4 ins.; total, 33 ft. 2 ins.; total, engine and tender, 60 ft. 2¾ ins.
Weight—In working order, 196,000 lbs.; on drivers, 179,500 lbs.; engine and tender, 295,200 lbs.
Heating Surface—Tubes, 2,422 sq. ft.; firebox, 125 sq. ft.; total, 2,547 sq. ft.
Grate Area—40 sq. ft.



MALLET ARTICULATED ENGINE FOR THE NATAL GOVERNMENT RAILWAYS.

equalized with the rear driving wheels, and all the driving wheels on each side are equalized. An interesting feature of the design, in which it differes from American locomotive practice, will be noticed in the use of plain tires on the leading driving wheels. The engine truck is of the three-point suspension swinging bolster type, and is designed to give a lateral play of 4 ins. on each side of the center. This necessitated the use of a very long center plate and a special design of swing bolster, in order to provide the required clearance between the bolster and the truck frame.

The boiler is of the straight-top type, with Belpaire firebox. The superheater is of the firetube type with side headers, the design being similar to that applied to a consolidation engine built for the Wabash-Pittsburgh Terminal Railway, by the same company, which was illustrated in the June issue of RAILWAY AND LOCOMOTIVE ENGINEERING for this year. The barrel of the boiler measures 66 ins. in diamter at the front end, and is fitted with 172 tubes, 2¼ ins. in diameter, and fifteen 5¼-in. tubes, which contain the superheating pipes. The tubes are 18 ft. 9 ins. long, and the total heating surface of the boiler is 2,417 sq. ft., of which the tubes contribute 2,268 sq. ft. and the firebox the remainder. The superheater has a heating surface of 358 sq. ft.

The firebox is 81 ins. long and 63 ins. wide, and provides for a grate area of 35.4 sq. ft. Full advantage has been taken of the opportunity afforded by the use of trailing wheels to provide a deep firebox. The mud ring is sloped down at a sharp angle toward the front end, giv-

Axles—Driving journals, 8 ins. x 10 ins.; engine truck journals, diameter, 5½ ins.; length. 9 ins.; tender truck journals, 5 ins.; length, 10 ins.
Boiler—Type, extended wagon top; O. D. first ring, 65¼ ins.; working pressure, 200 lbs.; fuel, bituminous coal.
Firebox—Type, semi-wide; length, 96 ins.; width, 60 ins.; thickness of crown, ½ in.; tube (copper), 1 and 1½ ins.; sides, ½ in.; back, ½ in.; water space, front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Crown Staying—Radial.
Tubes—Material, seamless steel; number, 230; diameter, 2¼ ins.; length, 18 ft.; thickness, No. 11 B. W. G.
Piston Rod—Diameter, 3¼ ins.; piston packing, cast iron rings.
Smokestack—Diameter, 16 ins.; top above rail, 12 ft. 5⅛ ins.
Tender Frame—10-in. steel channels.
Tank—Style, "U" shape flat top.
Setting—3/16-in. constant lead.
Driving Wheels—Diameter, outside tire, 45½ ins.; material, cast steel.

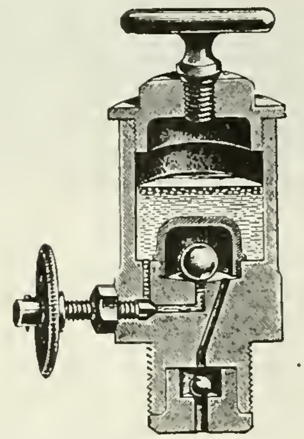
4-8-2 ENGINE.

Cylinder—Type simple; diameter, 24-ins.; stroke, 24 ins.
Track—Gauge, 3 ft. 6 ins.; tractive power, 41,320 lbs.
Wheel Base—Driving, 12 ft. 9 ins.; total, 22 ft. 6 ins.; total, engine and tender, 49 ft. 7 ins.
Weight—In working order, 172,000 lbs.; on drivers, 126,700 lbs.; engine and tender, 271,200 lbs.
Heating Surface—Tubes, 2,268 sq. ft.; firebox, 149 sq. ft.; total, 2,417 sq. ft.; superheater surface, 358 sq. ft.
Grate Area—35.4 sq. ft.
Axles—Driving journals, main, 9 ins. x 10 ins.; others, 8 ins. x 10 ins.; engine truck journals, diameter, 5½ ins.; length, 9 ins.; trailing truck journals, 6 ins.; length, 12 ins.; tender truck journals, 5 ins.; length 10 ins.
Boiler—Type, straight Belpaire; O. D. first ring, 66 ins.; working pressure, 160 lbs.; fuel, bituminous coal.
Firebox—Type, wide; length, 81 ins.; width, 63 ins.; thickness of crown, ½ in.; tube (copper), 1 and 1½ ins.; sides, ½ in.; back, ½ in.; water space, front, 4 ins.; sides, 3 ins.; back, 3 ins.
Crown Staying—Radial.
Tubes—Material, seamless steel; number 172; diameter, 2¼ ins.; length, 18 ft. 9 ins.; gauge No. 11 B. W. G.
Piston Rod—Diameter, 3¾ ins.; piston packing, cast iron rings.
Smokestack—Diameter, 18 ins.; top above rail, 12 ft. 6 ins.
Tender Frame—Steel channels.
Tank—Style, "U" shape level top.
Valves—Type, piston; travel, 5½ ins.; steam lap, 15/16 in.; ex. lap, line and line.
Setting—⅛-in. lead.
Driving Wheels—Outside tire, 45½ ins.

The use of peat as fuel for locomotive firing is being again tested on the Swedish State Railways. The experiments are being carried on with a view to test the merits of various mixtures of peat with coal. The tests so far are said to be of a very satisfactory kind, but no complete report will be made until the various types of locomotives are tested with the various mixtures of peat and coal.

New Lubricator.

A lubricating cup for locomotives, the product of W. H. Bailey & Co., Salford, England, is rapidly coming into favor on British railways. The oil cup is fitted with ball valves, and while the engine is running the balls roll on their seatings, thus admitting the oil which passes to the parts requiring lubrication. When the engine stops, the balls settle in the center of their respective seats and to stop the flow of oil. The lubricator is therefore automatic in its action. An adjustable screw is attached to regulate the flow or feed of oil passing through the opening. They are made in various shapes to suit various requirements of the service.



LUBRICATOR WITH BALL VALVES.

"Flatwist" is a new word made up by the Cleveland Twist Drill Company, of Cleveland, Ohio, and refers to their flat high speed twist drill. This flatwist drill has a Paragon shank and they call it their No. 930. This shank is forged and ground to size from the original bar, without weld or joint, and tapers both on the flat sides and on the rounded edges.

It is a simple strong shank and is the logical drive for a "Flatwist" drill. The Paragon socket with its flat-tapered hole secures the drill firmly and accurately, centering as truly as a regular taper shank, and at the same time distributing the strain of driving along the entire shank, leaving no weak point to break or twist off.

Write to the company if you would like to see a copy of their illustrated folder on the subject.

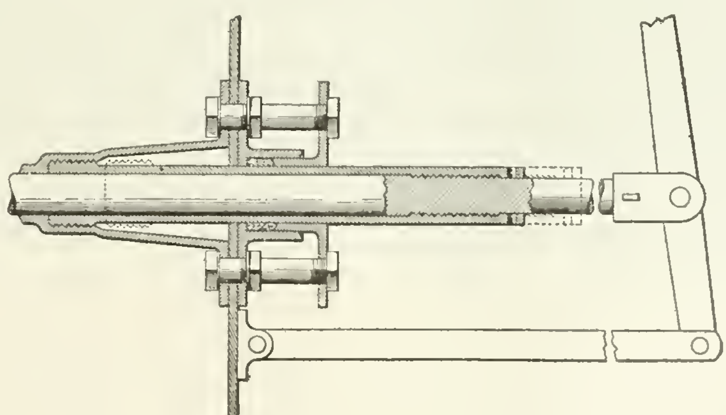
When you are "all done but finishing" you are just half done.—*Maxim.*

The Watson-Stillman Company, of New York, have issued a fine new catalogue, No. 73, containing much new matter that will be of particular interest to all engaged in the use of hydraulic tools for steam and electric railways. Among their latest improvements are several new types of jacks, a motor-driven rail bender, a series of hydro-pneumatic wheel presses which are a great improvement in point of rapidity of action in comparison with the older machines. The catalogue contains 120 pages and almost every page is finely illustrated.

When steamers first came into use very little attention was bestowed upon the consumption of fuel. It was not until the Cunard steamers were started crossing the Atlantic in 1840 that reliable records of fuel consumption began to be kept systematically. The *Britannia,* one of the early Cunarders, used to make the run from Liverpool to New York in about 14 days on a coal consumption of about 4.7 lbs. per indicated horse power per hour. The modern steamers do the work on about 1½ lbs. of coal per horse power per hour.

Packing Throttle Rod with Steam On.

A device which enables one to pack the throttle rod of a locomotive with steam on the boiler has been patented by Messrs. Dexter and Kindig. The latter is an engineer on the Mobile & Ohio Railroad. The patent number is 924,080. The device consists of a sleeve which fits closely on the outside of the throttle-rod and at its outer end the sleeve is screwed on the rod with a thread cut on the interior of the sleeve. Inside the boiler a conical casing containing a screw thread at its small end fits round the throttle rod. A similar screw thread is cut on the outside of the sleeve. This sleeve may thus be screwed into the recess at the back or small end of the conical casing.

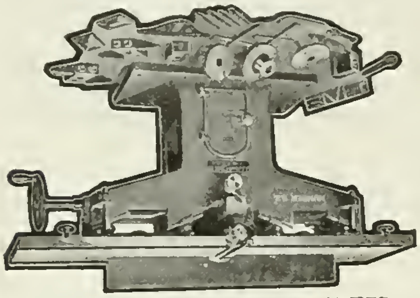


THROTTLE ROD PACKING ARRANGEMENT.

When it is desired to pack the throttle rod with steam on, the throttle valve is shut and the rod is therefore pushed in as far as it generally goes. When in this position a special wrench is applied to the sleeve. Our illustration shows two holes on each side for the reception of the points of the special wrench. These holes are near where the throttle lever is attached to the rod. By turning the special wrench, the sleeve moves along the throttle rod on the thread which is cut on the outside of the rod and the interior of the sleeve. This progress of the sleeve along the rod causes it to move into the boiler and the thread on the outside of this sleeve enters the threaded cavity at the small end of the conical casing. When the sleeve is screwed home it acts like a valve closing the small opening around the rod, through which steam and water might escape. The regular gland may now be slacked back and packing put into the stuffing box in the usual way.

Woodworker for the Repair Shop.

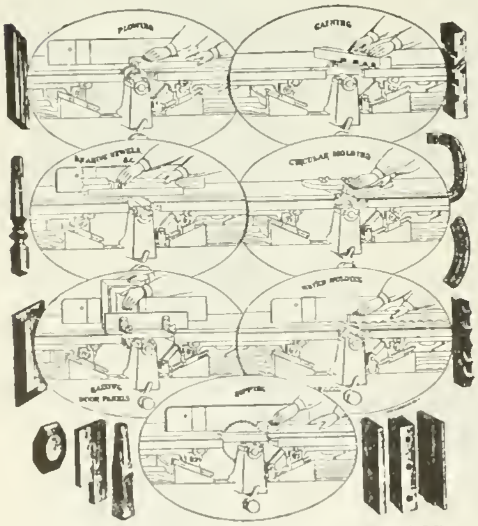
The J. A. Fay & Egan Company, of Cincinnati, Ohio., have just issued a circular containing a full description of their No. 62 Universal Woodworker, together with a number of illustrations,



NO. 63 UNIVERSAL WOODWORKER.

showing the kind of work that can be done on this machine. One of our illustrations shows some of these operations.

True to its name, this woodworker will do a variety of work that usually requires several different machines. For instance, it will plane out of wind, it will surface straight or taper, rabbet door frames, rabbet and face inside blinds. It will



OPERATIONS ON UNIVERSAL WOOD-WORKER.

joint, bevel, gain, chamfer, plow, make glue joints, square up bed posts, table legs, newels, raise panels, either square, bevel or ogee, stick beads, work circular mouldings, etc., rip, cross-cut, tenon, bore, route, rabbet, joint and bead window blinds, work edge mouldings, etc. You are requested to write to the manufacturers for their new circular, which they will be glad to send you.

The Danes apparently are waking up to the fact that they are being left behind in the world of invention. Two brothers named Anderson, in Copenhagen, are said to have nearly perfected an apparatus whereby optical currents can be thrown through a telephone wire, so that the sender of a message may be shown at the other end of the wire. It is said to be something totally different from the transmission by wire of photographic pictures, the vision appearing in natural colors and motions, but in reduced dimensions.

The H. W. Johns-Manville Company, of New York, have just issued a new pamphlet, No. 303, describing and illustrating their latest improvements in Asbestos Roofing. This product is known as the J.-M. Asbestos. It is said to be permanently durable, requiring no painting. It will neither rust, rot, nor burn. For sizes and price list see catalogue.

Railway people who require the use of small power that can be operated at small cost with very little personal attention should send to the Trenton Malleable Iron Company, Trenton, N. J., for their Bulletin 1-A of gas engines. The engines are remarkably simple in design and efficient in action. We do not know of any power better adapted to water stations and to small engine houses.

According to a French statistician, the railway mileage of the principal divisions of the world is as follows: North, Central and South America, 303,000 miles; Europe, 200,000 miles; Asia, 56,200 miles; Africa, 18,500 miles and in Australia, 17,800 miles. The largest percentage of increase since 1903 has been in Africa, where the increase in mileage has approached 25 per cent.

One of the advantages obtained by electric motors for suburban train service is the high rate of acceleration by which the train can be forced quickly into high speed. Common practice permits as high values as 2 to 2½ miles per hour for every second the power has been applied. Steam locomotives produce accelerations of ½ mile per hour for each second or less due to power of locomotive, load and grade.

The Canadian Rocky Mountains possess the most striking mountain scenery to be found on this continent. The Canadian Pacific Railway carries hosts of tourists bent on seeing the beautiful Alpine-like scenery. A curious thing about the visitors is that over 75 per cent. of them hail from the United States. This proves that there is no discrimination on the part of Americans in regard to seeing the beauties of the earth.

A Western paper says that there are about 45,000,000 tons of rails in the 228,000 miles of railways in the United States. For that mileage of single track there would be a little over 24,000,000 tons of rails calculating the average weight at 60 pounds to the yard.

The locomotive blower was first invented in 1852 by A. F. Smith, superintendent Cumberland Valley Railroad, and applied to engine "Novelty."

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXII. 114 Liberty Street, New York, November, 1909. No. 11

Detroit River Tunnel Locomotive.

A series of acceptance tests has been recently completed by the General Electric Company and the Detroit River Tunnel Company, jointly, upon electric locomotive No. 7500, illustrated in our frontice-piece. This is the first of six locomotives to be operated by the Michigan Central in the tunnel under the Detroit River. new yards at Windsor, Ont. The electrified zone, embracing the tunnel with its approaches, terminal tracks and sidings, will cover a distance of approximately 33,000 ft. On the approaches a 2 per cent. grade extends for about 2,000 ft. at each end of the tunnel.

The locomotives are designed for freight, passenger and switching service. electric locomotive, weighing 200,000 lbs. and equipped with four GE-209 motors. The articulated running gear may be roughly considered as consisting of two four-wheel trucks coupled together; but the method of coupling and the relation of the equalizing schemes on the two trucks makes it impossible to consider one truck independently of the other, so that

ELECTRIC LOCOMOTIVE FOR PASSENGER AND FREIGHT SERVICE IN THE DETROIT RIVER TUNNEL.

The electrical equipment of this locomotive, the most powerful ever designed for operation by direct current, was built and installed by the General Electric Comany of Schenectady, N. Y. The mechanical equipment was built by the American Locomotive Company. The Detroit River tunnel will connect the West Detroit yards of the Michigan Central with the

The specifications demand service consisting of hauling an 1800-ton train on the 2 per cent. grade, at a speed of not less than 10 m.p.h., with two locomotives in multiple unit. Their capacity is such that they are capable of repeating trips with this weight of train continuously with a layover of 15 minutes at each end.

It is an articulated, four-axle type of accurately described the whole must be considered as a single running gear hinged or articulated in the middle. Draft gear, buffers and all truck frame members are calculated for buffing stresses of 500,000 lbs. and hauling stresses in proportion.

The suspension is of the locomitive type, the weight being carried on semielliptical springs resting on the journal box saddles. The system of equalization by which these springs are connected together is interesting. The forward truck is side equalized, the two springs on each side being connected together through an equalizer beam. This equalizes the distribution of weight between the two wheels on one side, giving to this truck a two-point support and consequently leaving it in a condition of unstable equilibrium as regards tilting stresses, that is, stresses tending to tip the truck forward or backward. The other end of the running gear, or rear truck is cross equalized. The other two springs on this truck are independent, and are connected directly to the truck frame. This results in a three-point suspension on the rear truck, leaving it in a condition of stable equilibrium, capable of resisting stresses in any direction, whether rolling or tilting. The two trucks are coupled together by a massive hinge, so designed as to enable the rear truck to resist any tilting tendency of the forward truck. In other words, this hinge combines the two trucks into a single articulated running gear, having lateral flexibility with verti-

HEAD-ON VIEW OF THE TUNNEL ELECTRIC.

cal rigidity. Thus the running gear has what may be called a compound three-point suspension. The rear truck has in itself a three-point suspension, while the forward and rear trucks together form an articulated frame having a three-point support of the forward truck and the independent equalization of the rear truck.

Center pins and side bearings are provided on the running gear for the support of the cab. The center pin on the

SIDE VIEW OF GENERAL ELECTRIC LOCOMOTIVE FOR DETROIT RIVER TUNNEL.

forward end is a swivel pin, having a turning motion only; while that on the rear end has a turning and a sliding motion. This construction allows the longitudinal motion necessary to take care of the variation in distance between the truck center pins occurring as the locomotive passes around curves. The side bearings on the front end have a clearance of about ⅛ in. when the cab is standing symetrically, while those on the other end have a clearance of about ½ in.

The cab platform is built of four 10-in. longitudinal channels running the whole length of the locomotive, which are tied together by the end channels and bolster plates. Such ballast as is necessary to bring the weight of the locomotive up to the required amount is bolted to the two center sills. A floor plate, consisting of two sheets of ⅜-in. steel, is riveted to the platform sills and serves to stiffen and square the platform framing. In the operating cab a ⅞-in. wood flooring is placed over this steel floor.

The side and ends of the cab are built of ⅛-in. steel plate, supported by a frame work of small angles. The operating cab occupies the central portion of the locomotive, and covers a floor space of 15 ft. 6 ins. by 10 ft. The cab contains the engineer's seat and such apparatus as naturally belongs in the operating section of a locomotive. Covered receptacles extend from the main cab to the ends of the locomotive, and occupy a floor space of 9 ft. by 6 ft. each. These receptacles contain the air tank, sand boxes, rheostats and contactors.

The difference in width of the receptacles and cab allows room for a narrow platform or running board, extending from the cab along the sides to the front of the locomotive. This running board is in turn protected by hand rails, running around the outside of the locomotive from one side of the cab to the other. The doors of the cab open to this platform, and the steps reaching the ground are carried near the doors.

A type C-79 controller and the operating handles for the air brakes are inside of the cab at the engineer's seat. Sander valves are beside him, and over his head are switches for the headlight and control circuits. Directly in front are illuminated air gauges, ammeter, and a foot-operated trolley valve for raising and lowering the overhead trolley.

A CP-26 air compressor is placed in the

center of the cab. This is a two-stage, four-cylinder compressor, geared to a 600 volt direct current series motor. The compressor has two low-pressure and two high-pressure cylinders, so arranged as to divide the work of compression into four equally distributed impulses per revolution. It has a capacity of 100 cu. ft. piston displacement per minute when pumping against a pressure of 135 lbs. Ample circulating pipes are provided for cooling the air between stages and between pump and tanks, in order that the temperature may be maintained at a moderate value. The compressor is controlled by a governor, consisting of a pneumatically operated piston, controlling the contact of the motor circuit switch, and so arranged as to close or open this circuit at any predetermined limits of pressure.

The motor equipment consists of 4 GE-209 motors. The GE-209 is a standard General Electric box frame motor of and the excessive overloads that the motors will encounter.

The motor is designed for forced ventilation. Air is delivered into the motor frame at the end furthest from the commutator, passes between the field coils and around the armature, and finally escapes through suitable discharge openings over the commutator. The blower used for this purpose has a capacity of 2,000 cu. ft. of air per minute at 2¼-ins. water pressure, and is driven by a direct current series motor. This blower delivers air to the passage between the two center sills, from which the ventilating ducts are tapped off to the motors at appropriate points.

The control system used in the well known Sprague-General Electric multiple unit control, with two master controllers in the cab and the contactors in the receptacles, carried on the locomotive floor. Multiple unit connections have been sup- crease of the draw bar pull is about 6,500 lbs. on the first few steps after which the maximum throughout the remainder of the acceleration is from 2,000 to 3,000 lbs. The practical effect of this smooth acceleration appears to an observer in the caboose that the rear end of the train is started so gradually that the beginning of the motion is almost imperceptible. The locomotive is equipped with third rail shoes to take current from an inverted third rail. It is also fitted with an overhead trolley which, as stated above, can be raised or lowered by a foot-operated valve in front of the motorman.

A full description of the tunnel and how it was built is to be found in RAILWAY AND LOCOMOTIVE ENGINEERING for September, 1907, page 411. An explanation of this frequently used word Torque will be found on page 124 of our March 1906 issue, and to these two fully descriptive articles the reader is referred.

DETROIT RIVER TUNNEL ELECTRIC LOCOMOTIVE HANDLING 1,400-TON FREIGHT TRAIN.

the commutating pole type, and has a rating of approximately 300 h.p. At its one-hour rating the motor will develop a torque of 4,050 lbs. at 1 ft. radius. The gearing between motor and axle has a 4.37 reduction, and the driving wheels are 48 ins. in diameter. With this reduction each motor will develop a tractive effort of 9,000 lbs, at the rail, which gives a total tractive effort for the four motors of 36,000 lbs., at 12 m. p. h. The motors have an overload capacity sufficient to slip the driving wheels, and the locomotive can develop at the slipping point of the wheels an instantaneous tractive effort of 50,000 to 60,000 lbs. The maximum speed of the locomotive running light upon a level track is about 35 m. p. h.

There are two gears and pinions for each motor, one at either end of the shaft. This form of construction was used on account of the unusually heavy torque plied, so that three locomotives may be operated in multiple unit, if necessary. The problem of starting and accelerating a train of from 1,000 to 1,500 tons, which may consist of 40 or 50 cars, is a rather delicate one. Such a train is not a rigid mass, but a long elastic body, and any inequality in the starting torque results in waves of jerking and buffing strains which are very likely to reach abnormal values in some parts of the train. Consequently the control for this locomotive was designed especially to produce a uniform increase of speed and torque during the period of acceleration. The control combinations are arranged so that the motors may be operated four in series, two in series and two in parallel, or four in parallel. There are nine resistance steps in series, eight in series parallel and seven in the parallel position. It was found in the tests that the maximum in-

Some of the principal dimensions of the locomotive are given in the following table:

Number of motors, 4; gear ratio, 4.37; number of driving wheels, 8; diameter of driving wheels, 48 ins.; total wheel base, 27 ft. 6 ins.; rigid wheel base, 9 ft. 6 ins.; length inside knuckles, 39 ft. 6 ins.; length of main cab, 15 ft. 6 ins.; height of cab, 12 ft. 6 ins.; maximum height, trolley up, 15 ft. 6 ins.; maximum height, trolley retracted, 14 ft. 10⅛ ins.; maximum width, 10 ft. 2⅝ ins.; width of cab, 10 ft. 1 15-16 ins.; total weight, 199,000 lbs.

The Alaska-Yukon-Pacific Exposition has awarded grand prizes, which is the highest award, for insulated wires and cables, to the General Electric Company and to John A. Roebling Sons' Company.

4-6-2 on the Canadian Pacific.

The Schenectady Works of the American Locomotive Company have recently completed two Pacific or 4-6-2 type locomotives for the Canadian Pacific Railway, and thirty more of the same design are now under construction at the Montreal Works of these builders. These engines, one of which forms the subject of our illustration, will be used on the divisions between Magantic and Brownville, Me., and between Brownville and McAdam Jct., N. B., a total distance of 223 miles. These two divisions are in rolling country with maximum grades of 1¼ per cent. The engines are designed to handle trains of from 10 to 12 cars, weighing from 500 to 650 tons, running on schedules of 35 miles an hour, including stops.

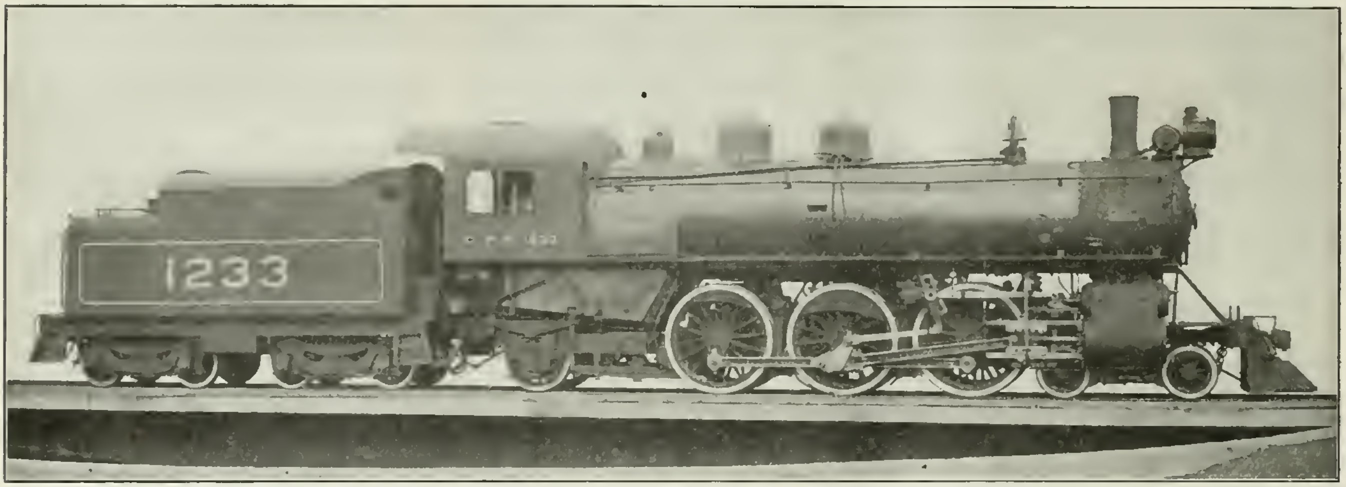
They were built to the railroad company's designs, and are practically duplicates of their standard Class G-1 Pacific type engines, except that they have 69 in. wheels and are equipped with the Walschaerts instead of the Stephenson valve gear. There is also a difference in the size of the firebox, which in the design here illustrated is 94⅛ ins. long and 67⅞ ins. wide.

In working order they have a total weight of 218,000 lbs. of which 136,000 lbs. is carried on the driving wheels, 34,500 lbs. on the trailing wheels, and 47,500 lbs. on the leading truck. The cylinders are 21 by 28 ins., and with driving wheels 69 ins. in diameter and a boiler pressure of 200 lbs., the theoretical maximum tractive power is 30,-400 lbs.

Following the regular practice of the Canadian Pacific for all road engines, superheated steam is used, the superheater being of the Vaughan-Horsey type. Steam is distributed to the cylinder by means of 11-in. piston valves, having inside admission, and, in order to use on these engines the standard cylinders made for engines equipped with the Stephenson link motion, an interesting and ingenious arrangement of valve gear has been employed. In the cylinders, the center of the valve chamber is 3 ins. inside the center of the cylinder which brings the plane of the valve stem about 10 ins. inside that of the eccentric crank pin. Part of this offset is provided by an extension of the outside trunnion of the link carrier which is fitted with a downward extending arm to which the eccentric rod is connected.

The link is carried in a bracket bolted to the front of a heavy cast steel crosstie located between the first and second pair of driving wheels and having liberal bearing on the frames. The center of the link is 3½ ins. outside of the center of the valve stem and this difference is taken care of by an offset in the radius bar. The valve stem is connected to a small crosshead which slides on a single bar supported between a lug on the valve chamber head and a knee secured to the top of the guide bar. The combination lever is placed inside of the guides and is provided with a fork at the upper end, which spans the valve stem crosshead and the front end of the radius bar. As the valves have inside admission, the connection of the radius bar to the combination lever is above the connection of the latter to the valve stem crosshead.

The reverse shaft is carried in bearings bolted to the same crosstie to which the link bracket is secured and a forward extending arm of the shaft is connected to the radius bar by means of a link. This shaft is operated by means of another shaft located between the second and third pair of driving wheels which is connected direct to the reverse lever. Each shaft has a downward extending arm in its center and the two arms are connected by a reach rod. All the parts of the gear have been carefully designed to give the necessary strength and stiffness to prevent springing. The pins, throughout, are case hardened and the bearings provided with wrought iron case hardened bushings, to prevent wear and lost motion. The gear is designed to give a maximum valve travel of 5¾ ins. in forward gear and 5½ ins. in back gear, and is set to give a 15/16 in. constant lead. The valves have 15/16 in. steam lap and a ⅛ in. exhaust clearance. The frames consist of a main frame of cast steel 4½ ins. wide, with double front rails of wrought iron; and a rear section of slab form, 2 ins. wide, which is connected to the main frame by a heavy cast steel crosstie. The trailing truck is the railroad company's standard design of outside bearing radial truck.



4-6-2 TYPE PASSENGER ENGINE FOR THE CANADIAN PACIFIC RAILWAY.
H. H. Vaughan, Assistant to Vice-President. American Locomotive Company, Builders.

The boiler is of the extended wagon top type with slopping back head and throat sheet The barrel measures 67⅜ ins. in diameter outside at the first ring. It is fitted with 193 tubes 2¼ ins. in diameter and 22 tubes 5 ins. in diameter, which contain the superheater tubes. The tubes are 19 ft. 6 ins. long. The total evaporative heating surface of the boiler is 2,951 sq. ft., of which the tubes contribute 2,765 sq. ft. and the firebox the remainder. The superheater has a heating surface of 403 sq. ft. The firebox is 94⅛ ins. long and 67⅞ ins. wide and provides a grate area of 45.6 sq. ft. It is supported at both the front and back by buckle plates. A limited number of Tate flexible staybolts made by the Flannery Bolt Co. of Pittsburgh are used in the back head, throat and sides. The water feed consists of two 10 A. Hancock injectors, one on either side of the firebox. The delivery pipes are, however, connected to a common boiler check placed on the top center line of the boiler, 18 ins. back of the front tube sheet and covered by the bell stand.

The tender is of the railroad company's standard design throughout. The frame is of steel, 13-in. channels being used for the center sills and 10-in. channels for the side sills. It is mounted on two four-wheel trucks of the equalized type. The tank is of the so-called turtle back type and has a capacity of 5,000 Imperial gallons and space for 10 tons of coal.

The dimensions, weights and ratios of the locomotives are as follows:

Weight on drivers ÷ tractive effort....... 4.47
Total weight ÷ tractive effort.......... 7.17
Tractive effort × diameter drivers ÷ heating surface .... 710.
Total heating surface ÷ grate area....... 04.7
Firebox heating surface ÷ total heating surface, per cent. 6.3
Weight on drivers ÷ total heating surface 46.
Total weight ÷ total heating surface...... 73.8
Volume of cylinders, cu. ft. 11.20
Total heating surface ÷ volume of cylinders .... 263.
Grate area ÷ volume of cylinders......... 4.07
Wheel Base.—Driving, 13 ft.; total, 33 ft. 7 in.: total, engine and tender, 60 ft. ¾ in.
Axles.—Driving journals, main, 9½ in. x 12 in.; others, 9 in. x 12 in.; engine truck journals, diameter, 6 in.; length, 10 in.; trailing truck journals, diameter, 7 in.; length, 14 in.; tender truck journals, diameter, 5½ in.; length, 10 in.
Boiler.—Type, extension wagon top; O. D. first ring, 67⅜ in.; working pressure, 200 lbs.; fuel, bituminous coal.
Firebox.—Type, wide; length, 94⅛ in.; width, 67⅞ in.; thickness of crown, ⅜ in.; tube, ½ in.; sides, 5/16 in.; back, ⅜ in.; water space, front, 5 in.; sides, 4½ in.; back, 3½ in.
Crown Staying.—Radial.
Driving Boxes.—Cast steel.
Brake.—Pump, 11 in.; reservoir 1, 22⅜ in. x 38½ in.; other, 22⅜ in. x 95 in.

We recently enjoyed a pleasant visit from Mr. F. A. McKenzie, a member of the editorial staff of the *London Daily Mail*. He has been sent over to describe for the British readers the wonderful strides that Canada is making under the vast railway extensions going on, and how much profit our American merchants are enjoying by pouring the necessities and luxuries of life into the newly opened territories and provinces of the Dominion.

Garratt Locomotive.

The Government railways of Tasmania have recently received an articulated locomotive of novel design. It was built by the firm of Byer, Peacock & Co. Ltd., of Manchester, England. The engine is known as the "Garratt" patent locomotive and is designed to work up grades of 1 in 25, with curves of 1½ chains radius. The gauge of the road is 2 ft.

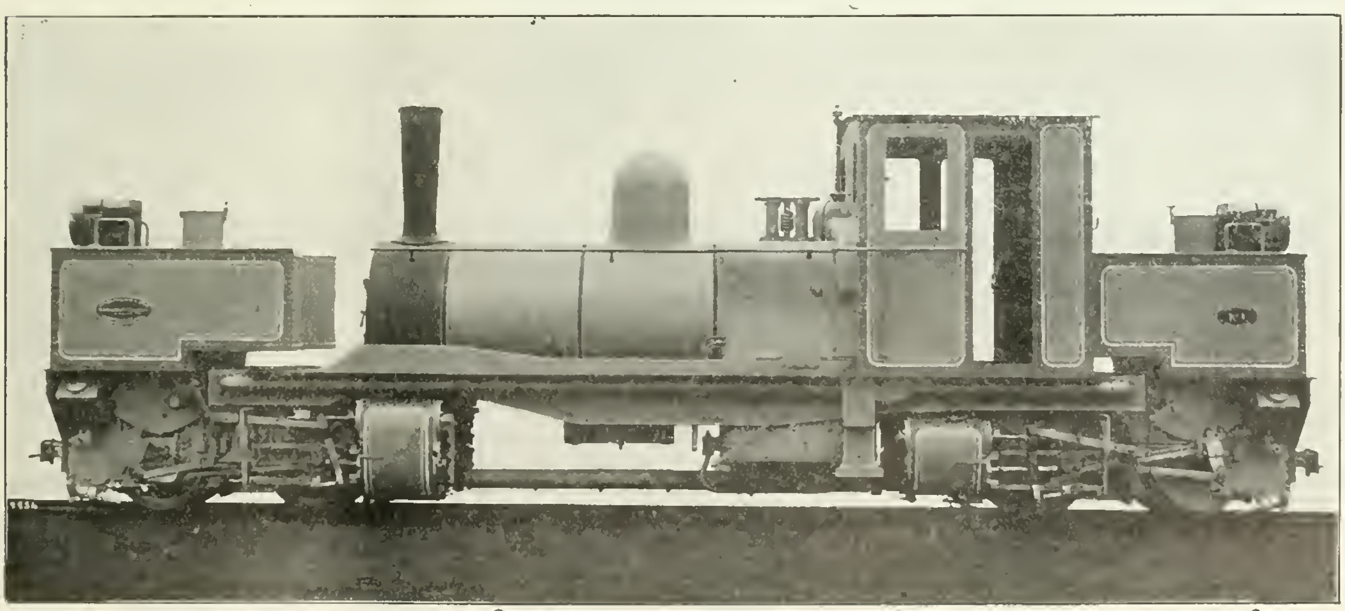
The engine is an articulated compound with one pair of high pressure cylinders 11 x 16 ins., situated at the rear end and one pair of low pressure cylinders 17 x 16 ins. at the front. The driving wheels are arranged in two trucks each having 4 wheels, 2 ft. 7½ ins. in diameter. Our illustration shows the arrangement of wheels, cylinders, etc. The cylinders are placed front to front so that when the locomotive is progressing forward the leading engine is "backing up" as one might say while the rear engine is running forward. Walschaerts valve gear is used.

The method of applying the crank pin and counterbalance is interesting. These are not attached to the wheel as in usual practice but are applied to the projecting end of the axle. The counterbalance is a hammer-shaped extension of the crank and, of course, has the bulk of its weight at the opposite end of the crank pin. The spread of each truck is 4 ft. and the total wheel base of the engine is 26 ft. 9 ins. The distribution of weight results in a slightly increased burden on the rear truck. In working order the front truck carries 16 tons 5 cwts. 1 qt., while that at the firebox end has upon it 17 tons, 5 cwts, 2 qts. Giving a total weight of the whole machine of 33 tons 10 cwts. 3 qts. The coefficient of adhesion with tanks full amounts to 5.3, while with tanks empty it is 4.5.

The boiler is a straight top one 7 ft. long and 3 ft. 11⅛ ins. in diameter. There are 170 tubes each 1¾ ins. outside diameter. These tubes give a heating surface of 568 sq. ft. and the firebox contributes 60 sq. ft., making a total of 628 sq. ft. The grate area is 14.8 sq. ft. which gives a ratio of grate to evaporative surface, as 1 is to 49. The steam pressure is 195 lbs. to the sq. in. The firebox is of the Belpaire type 5 ft. 5 1/16 ins. long by 4 ft. 3⅞ ins. wide by 4 ft. 2 ins. high at the front and 4 ft. 0½ in. high at the back.

The fuel space is of course at the rear and holds a ton of coal. The rear tank also holds 320 gallons of water; the front tank, which contains only water, was a capacity of 520 gallons, making a total of 840 imperial gallons. The engine frame is practically a bridge-girder supported at each end on pivot points through which steam and exhaust connections are made. The cylinders, wheels and tank at each end having a radial motion independent of each other. The entire weight of the engine is, of course, adhesive weight. Altogether the engine is a unique machine.

At the New York November meeting of The American Society of Mechanical Engineers, to be held on the 9th instant, in the Engineering Societies Building, 29 West 39th Street, New York, there will be two papers presented. One by Prof. Gaetano Lanza and Lawrence S. Smith of The Massacusetts Institute of Technology, on "Reinforced Concrete Beams," and the other by Prof. Walter Rautenstrauch of Columbia University, on "Stresses in Curved Machine Members."



GARRATT ARTICULATED LOCOMOTIVE, TASMANIAN GOVERNMENT RAILWAYS.

Traveling Engineers' Convention at Denver

TOOL EQUIPMENT.

The first paper read at the Traveling Engineers' Convention at Denver was the committee's report on "The most economical method of maintaining tool equipment and supplies other than coal, water and sand on locomotives in service." The committee consisted of Messrs. J. A. Talty, Joseph Keller, W. H. Corbett, J. J. Gill and E. Salley.

The report was read by Chairman Talty, and showed that great diversity of practice exists in providing and maintaining tool equipment on locomotives. A very timely discussion followed the reading of the report, one side contending for liberality in the number of tools supplied, while the other side argued in favor of restricting the tool equipment to the smallest practicable limit. A large number of the members took part in the discussion.

FUEL ECONOMY.

The most important business done at the Traveling Engineers' Convention was in connection with a paper on Fuel Economy, contributed by Mr. S. D. Wright, Central of Georgia. The first point made was that engines should be kept in proper condition and that coal should be loaded on the tenders so that no loss occurs and that firemen be instructed on the best methods of doing that work. Harmonious co-operation between engineer and fireman he considered to be essential in avoiding waste. To promote economical use of fuel the coal furnished ought to be of uniform quality and the draft appliances adjusted to suit the coal. He favored a certain size of box for measuring the coal. He had found coal varying in weight from 46 to 52 lbs. to the cubic foot.

Among the fuel saving devices he had noted, were an automatic fire door opener and a patented slide valve that had enabled him to open the nozzle from one eighth to half inch. He considered it very important that provision be made to prevent coal from falling off the tender when it is lurching about at high speed. Considerable attention was given to the waste of fuel that results from scale and boiler impurities. He considered that too little attention is given to defects of cylinder packing and to valves. The judicious use of a little flaked graphite, he said, will reduce friction by forming a glaze on the cylinder walls and valve seats, which in this condition are not so easily affected by an overflow of water or wet steam. Friction overcome or reduced in any manner in locomotive machinery means increase of power developed and fuel saved.

Among the many causes that make engines steam badly are leaky steam pipes, exhaust pipe joints, air leaks in front end. He remarked, "We make tests periodically of steam and exhaust pipes by cold water pressure and it is surprising the leaks detected."

The value of the brick arch cannot be overestimated as a fuel saver and promoter of smoke. Besides it preserves the flues by preventing the cold air from striking them direct. The heat in the arch ignites gases that otherwise would be wasted, it prevents fine coal from passing directly into the flues and prevents spark throwing. He found from test that the arch saved from 9 to 12 per cent. of the fuel.

Referring to the experiments with front ends made by the Master Mechanics' Association, he said that his road had devised a modification of the Master Mechanics' Standard front end and found it very satisfactory. The engines equipped with it are free steamers and easy on fuel.

Mr. Wright gave particulars of tests made with engines having feed water heaters and others with steam superheaters and testified favorably to both means of saving fuel. These means of fuel saving he considered good, but he put strong emphasis upon the necessity for preventing the leakage of steam from stuffing boxes, valves and pistons. He also advised all concerned to try the striking points of pistons to prevent the waste that comes from excessive clearance.

With all the fuel saving appliances and methods used for economy, there is nothing more conducive to good results than the earnest hearty co-operation of the enginemen. There is a friendly rivalry among the men and every one thinks his engine is the best. They keep the engines in good condition by doing all necessary work and keep the men as comfortable as possible.

This is one of the best papers we have ever read and as we cannot publish it in full we heartily advise every person interested in this important subject to procure a copy of the paper from the secretary, Mr. W. O. Thompson, New York Central Railroad, East Buffalo, N. Y.

LOOSE METHODS OF SUPPLYING COAL.

There is nothing more important in promoting the economical operating of locomotives than to have the means of keeping an accurate record of the coal put upon locomotives tenders. In this connection while discussing the paper on Fuel Economy presented to the Traveling Engineers' Convention, Mr. Charles Cotter, Duluth & Iron Range, said:

In speaking with a great many of the traveling engineers here I see that the companies are getting away from keeping an individual record of the coal; that is, they are not weighing the coal or measuring it so that you can tell what your engine takes. My experience has been where the amount of coal taken by each engine is guessed at that you can not only expect a poor coal record but the firemen will degenerate for lack of an incentive to make a coal record.

Mr. Petty, speaking on the same subject, said: I will state that on the N. C. & St. L. we are keeping a record now in freight service on the ton-mileage basis and in passenger service on the car mileage basis. At the end of the run the coal is shoveled down in the tank, which is graduated, as near as we can get at it, and the man who handled the engine in, gets credit for that. The amount of coal that is given to the engine is reported regularly and the coal that he takes on the line of the road is also reported to the fuel inspector and he is given credit at the other end of the terminal. I believe that is about the best way that we can keep it without a great deal of expense, as far as weighing is concerned. We are keeping an individual record. We post that monthly on our bulletin boards and I believe we are getting good results even from those bulletins.

INFLUENCE OF THE ROAD FOREMAN.

Mr. Summers said: I believe that the road foreman can do a great deal toward reducing the amount of coal used by observing the coal on the tank in riding over the road, and even though the engine does not fail for steam, make a record and report to the person handling the fuel in case the coal is not up to the standard that the company has made the agreement to buy. In that way you can keep the coal from getting below the standard and also prevent engine failures and every time you have an engine failure, naturally a certain amount of coal is going to be wasted by the men trying to crowd the engine for steam.

GUESSING AT THE COAL PUT ON.

Mr. David Meadows said: Mr. Cotter from the Duluth & Iron Range has brought up the question of keeping a record of coal consumed on engines. That is a very important question and is something that was taken care of at one time on the road that I represent, the Michigan Central; but of late years we have not kept that record. In the majority of cases on most trunk lines at the present time coal is put on the engine from a link belt coal chute or some coal chute of a similar nature. The quantity of coal that is charged to the engineer bringing the engine in is simply estimated by the engine loader, and on that account we found it very unsatisfactory.

(*Continued on page* 493.)

General Correspondence

One System for Day and Night.

Editor:

I have just finished my perusal of your September number, having noted in this as in previous issues the very pertinent remarks that have been made on the subject of night signaling on railroads. I hope these expressions of opinion will find their way to the notice of the members of the Block Signal and Train Control Board at Washington, which board is at the present time deliberating upon the question of night signaling. Indeed, I have myself pointed out several of these letters to their notice, as bearing upon the utility of the illuminated background system of signaling.

If any criticism could be made of the published letters, it might perhaps be that the main point is overlooked by your correspondents in their desire to express their preferences as to the colors to be used for the three principal indications. You have voiced this sentiment in a foot note asking that attention be turned to the question of whether there is danger in passing a red light on an interlocking signal, when the red light of the automatic signal should not be passed without first coming to a stop. The ambiguity that arises from this usage of red, certainly lessens the significance of a light of that color, while the use of green for clear on one road and for caution on another, without doubt weakens the value of such indications.

Mr. L. R. Clausen, president of the Railway Signal Association, recently stated that in his opinion a "white" light should be used, as formerly, for the clear indication. Other railroad men, to whose opinions importance must be attached, advocate the "green." Indeed, the school of "green for clear" seems to be a little in the lead, though its popularity may be due in some measure to the recommendations of certain associations of railroad men. However, far more important than the individual dangers of white or green, would appear to be the dangers of different indications on different roads being given by the same color, for it is quite within the bounds of possibility for an engineman, fireman, conductor, or flagman, or pilot, who for years had been governed by one system, to find himself upon a road on which the opposite system was in force.

A certain psychological condition of uncertainty always exists after a long established habit of thought, has been reversed and then reinstated. And this condition must often arise, for not only may a man be employed within a short period of time by several roads, but in the modern centralization and co-operation in the use of terminals, an engineman may, while entering one of our great cities, run over the rails and be governed by the signals of as many as four separate and independent roads. Here he may encounter green clear, green caution, orange caution, and then the whole arrangement over again in the opposite direction. If to these difficulties we add those which confuse the use of red, in interlocking, automatic, and switch signals, we have a system far too complicated for ready interpretation and quick action.

In striking contrast to the complications of signaling at night, when travel is most perilous, is the simplicity of the almost universal system of indication by day. This system, once established at night, would not only eliminate the dangers from color-blindness, color-weakness, and the change between form and position, and colored lights, twice daily, but it would harmonize the systems of the various roads to a very great extent. A method of accomplishing this has been proposed. It is the illuminated background system.

RESULT OF A "PITCH-IN," OR REAR COLLISION.

Two years ago an article on railway signaling, by Prof. G. M. Stratton, of Johns Hopkins University, was published in the *Century Magazine*. It was the first note sounded by the public in protest against an alarming condition. The article was almost unnoticed, and as a result nothing has been done to ameliorate the conditions which the professor deplores, except to increase the extent and equipment of the signals which he condemns. His article can scarcely be read without conviction, though unfortunately for the traveling public dollars and cents, or the cost of installing the system there proposed, has proved still more convincing and in an opposite direction. At the present time, when reform seems to be even more in the air, a quotation from this article will not be amiss.

Prof. Stratton says: "But the really grave fault in the present arrangement is not that the signals are changed twice daily, but that the alternate sets are of immensely different value, and the worse signals are in force during the very period of greatest danger. The coming of night, which for so many causes is the most perilous time of travel, makes useless the signals which require the engineer merely to distinguish forms and directions, and brings in their stead colors, which are peculiarly liable to be misread. The difficulties with which the color signals are burdened, I cannot believe are fully known to all."

"In the first place, and perhaps of minor importance, it should not be overlooked that the white light used in the color system is to be entitled "white" only by courtesy, for it comes in reality from the warm yellow flame of an oil lamp, and is uncommonly rich in red rays. When viewed through the smoky air that so often hovers over our railroads, it is for this reason the more liable to take on a reddish tinge, a ruddy effect which even the pure white of the sun cannot escape when brought into the presence of smoke. Now, at the first thought it might seem of no moment that occasionally a "white" signal did appear tinged with red. Would it not at most cause an engineer to delay at a point where he might with perfect safety have advanced? But if he should often see a reddish light which he later discovered to be intended for white, a red light would cease to be quite so startling a deterrent to him; and thereby the chances are at least slightly increased that he will at some critical moment perhaps unconsciously make allowance for the effect of smoke where no smoke whatever exists, and by taking an actually red light for white will dash his train with all the life it holds, headlong into ruin.

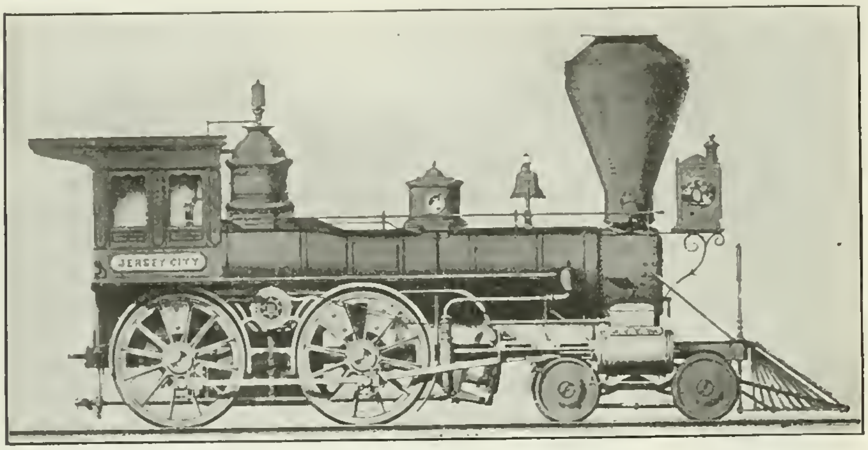
But the present system of block signals at night is ill-adapted not to the eye alone; it gives needless labor to the memory and the attention. It requires the engineer among the innumerable lights that line his track to distinguish those that are to guide him, from those that are of no significance to him at all. Anyone who has ridden in the cab of an express locomotive during its frantic course by night, and seen the engineer, as by a miracle, pick out his 'white' signal amid a swarm of nearby city lights of a hue identical with the one that must direct him. . . . can no longer wonder that signals are occasionally misread or unobserved. He can only marvel that a night express ever reaches its goal in safety. Added, then, to the perils due to the defects of the eye, both normal and abnormal, the present block signals have this serious fault: they do not stand out distinct and apart from numberless other lights that suddenly appear to the engineer, but to which he is expected to give no heed.

"These objections to the use of color in our block signals, for to them I am confining my paper, might perhaps be hardly worth recounting if nothing better could possibly take its place; we might regret that our own safety and the safety of our fellow-men must hang by so slender a thread, and there the matter would end. The situation, however, is not at all so hopeless. We may, whenever we please, do away with color as a means of signaling, and put in its place a better order of signals.

"The plan that I would propose would be to use throughout the 24 hours the kind of signal that is now used only by day. Such an arrangement would have the advantage which lies in perfect uniformity; it would abolish the daily change from form to color. But it would also have the more important excellence, that the signals thus made general are eminently preferable to those which would be crowded out. For inasmuch as the day signals now in use consist of markedly different directions of a semaphore vane, whereof the color is of no importance except to make the projecting arm conspicuous, they are based upon something psychologically sound. The space sense upon which they place their reliance has, like every human power, its imperfections; but these are far less glaring than in the case of color, and are more surely detected when they occur. . . . The feeble color vocabulary of the ordinary male is a fair expression of this native lack of interest in color; and in more than one whole language, differences as great as that between green and blue are left unmarked by separate words. The very frequent lack of any power in us to notice colors, of which enough has already been said, is perhaps the strongest indication that Nature regards lightly this power of ours to catch the fleeting tints and hues of things. The color sense saunters in and out of life as irresponsible as any Harold Skimpole, and seems never to have been intended to bear the brunt of elemental action. To take the responsibility for the traveler's safety away from the color faculty and intrust it to the space sense, is, then, the plain dictate of science."

Much confirmation of the professor's conclusions might be brought to bear in the shape of extracts from the accident bulletins of the Interstate Commerce Commission. There the story is told all over again. "Engineman did not heed red light,' 'Engineman passed automatic block signal indicating stop," 2 a. m.; "Engineman ran at uncontrollable speed," dark, road equipped with block signals, engineman failed to heed caution signal, etc., etc. The instances could be multiplied almost indefinitely until it becomes quite apparent that in at least some of the cases the engineman was unable to distinguish the color, or became confused in the system of indication, or mistook other lights for his signals. More than likely all of these and other disasters are due to some of the defects explained by Prof. Stratton, and would have been impossible had the engineman been able to see the position of the semaphore arm. J. H. W., Jr.

Chicago, Ill.



OLD-TIME 4-4-0 BUILT BY THE JERSEY CITY LOCOMOTIVE WORKS.

Position of Arms at Night.

Editor:

In my letter in the September issue of RAILWAY AND LOCOMOTIVE ENGINEERING I did not refer to the "World" system of signals in speaking of some engineers who desire to see the position of arm at night, but to one or two previous writers who had suggested a desire to see the position in order to verify the color indication. I have never seen the "World" signals, but if a system has been, or can be, devised, whereby the position of the arms can be plainly seen a long distance at night I think it would be a distinct improvement in railway signaling. P. S. WAITE.

Loco. Engr., N. Y., N. H. & H.

Springfield, Mass.

The Signal Question.

Editor:

I am much interested in the signal question and if I may I will give you experience at home in Scotland, and here, in the Argentine. In Britain generally the practice is to treat the distant signal when at danger as a caution signal and for the driver to be prepared to stop at the home signal if it is at danger, but if he gets the distant in the off position when approaching with a train, he knows that all the other signals controlling the road over which he is to run are off also, and he is further assured in this by the knowledge that all the signals are interlocked and the signalman cannot pull off the distant until the home and start signals are off also.

In the Argentine all signals at danger are stop signals, when controlling the road over which the train is running and, during the night on the single line when a crossing has to be made with another train, the second train to arrive has to stop at the distant-signal even, although it may be showing line clear. This system of making all signals controlling the movement of trains on the single line or at junctions a stop signal, is, I think, a good one.

The question as to whether a driver tries to see the signal arm at night is, I think, only confined to drivers who are not very well acquainted with the road, or when the light is showing imperfectly, perhaps half green, half red, although this class of signal is strictly enjoined to be taken as a danger signal. A driver on fast passenger trains couldn't keep time if he depended on seeing the signal arm at night, or he would run risks that no sane man would take. Undoubtedly the colored light is best.

The second question is, I think, not so much against the color of the signal or against its position. I consider it bad practice to have junction signals one over the other on the same signal post; they ought to be placed side by side and in that position the objection to passing a danger signal does not obtain. Signals one over the other are mostly confined to sidings to or from the main line, and are rapidly being abolished; but in any case the driver is guided by the signal for the road over which he is traveling, because he knows there is a diverging route and by seeing the red light he knows that the diverging route is closed to him and he can proceed with confidence. I think signal engineers should aim at simplicity of signals and place them in such a position that a good view can be obtained by the driver in time to bring the fastest train to a stop with ease.

J. A. Robertson,
Driver.

Buenos Aires, Argentina.

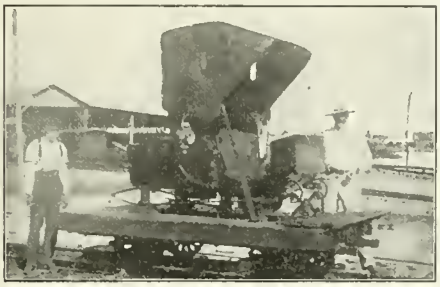
Signal Views.

Editor:

Having read the several discussions on the signal question, I would like to give you some of my views on the same. Now, about the most important part of operating a railroad with safety is the signal system, no matter what kind it may be, so that all the signals should be located in such a way that they could be seen in time to stop the fastest trains, and not like some of our Eastern roads, which have them placed either on a curve, in front of a woods or directly back of it, or among the cross-arms of the telegraph lines, so that they cannot be seen until one is very close to them.

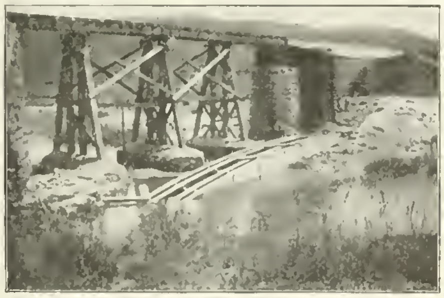
Some time ago I had the pleasure of serving on a committee in which we traveled from Boston to nearly every point in the Middle West, covering about 6,500 miles. We had a grand opportunity of studying the signal systems on the different lines; we rode on the locomotive several hundred miles and when not on the locomotive we were in the observation car on rear of the train, and I must say that there were a great number of signals that were hard to locate both day and night.

On the majority of the Western roads the signals are from 5 to 10 miles apart and on Eastern roads from ½ to 1 mile apart. On some of the Western roads where a green lamp was used for safety and yellow for caution, they might as well have had a dark lamp as far as the engineer was concerned, for in riding on the locomotive and observation car across the plains of Indiana and Illinois we took particular notice of the different colored signal lamps; the red could be seen plainly two miles away, the green and yellow both disappeared in ¾ of a



AUTO. MOUNTED AS AN INSPECTION CAR.

mile, while the white lamp could be seen as far as vision would carry, which is in some places 10 miles. I am one who will always be in favor of red for danger, green for caution and white for safety. There is only one fault in white for safety, and that is if a colored lens should fall out of the spectacle or be broken, white would show. This can almost be eliminated by putting a distant signal to all stop arm signals; this distant signal to be a caution signal only. This caution signal will call the engineer's attention to home or red signal that something is wrong and cause him to look carefully at home signal arm even if lens is broken when he is passing. All careful engineers look for signal arm at night as well as they do in day time. I have never known but one case of lens having been broken in my 30 years' continuous service on a locomotive. I have run under all kinds of signals and systems and at present time am running over 5 divisions.



TEMPORARY BRIDGE REPAIRS.

Now about the signal arm question the Pennsylvania railroad has the best in the world today, as arm works up instead of down, so that if anything happens to the mechanism or to the arm it falls to danger, where old arms would fall to safety position, and as the correspondent on page 382 says snow and sleet cover green and yellow lens so one cannot see them. This is so in foggy weather as well; they cannot be seen, for you can scarcely see a white lamp, located on a post on top of a signal bridge, let alone see a colored glass.

I will also say my views on automatic signals are stop and proceed carefully to next block and for interlocking stop and stay there until you receive a written order to proceed. Now having white for safety they say engineers might take some other white lamp for their signal. Every engineer has to learn the road or division before he can run over it. All block signals are fixed signals; he must know the exact location of each signal and he has no excuse of taking any other white lamp but the signal, as it may be. What we want is our signals placed where we can see them.

Martin H. Lee,
Engineman P. R. R.

Philadelphia, Pa.

[Our correspondent expresses his preference for the upper quadrant signal system because if anything goes wrong the signal arm drops to the stop position. The lower quadrant signals do not drop to safety if anything goes wrong; the spectacle frame is weighted far in excess of the arm, and if anything does go wrong the weight of the spectacle frame pulls the signal up to the stop position.—Editor.]

Brake Cylinder Gasket.

Editor:

Ever since 1869, when Mr. Geo. Westinghouse, Jr., first invented the air brake, there have been many changes made, and these changes, we know, have been all for the betterment of the railway companies' property, and for the benefit of the public service. Everything has been improved from time to time, but, sad to say, there is one thing that, in my opinion, remains to be changed, and it needs it badly, and that is the cylinder gasket P. F. 40 and 50, No. 14. Now, Mr. Editor, you know and every one knows that ever had any thing to do with air brakes, that whenever one of these gaskets blow out or start to leak that brake is useless on that car; not only that, but it is not an easy job to replace it with a new one. This is especially so with steel and steel underframe cars, where everything is so arranged that there is no give to it anywhere. I am speaking of this from experience.

My first work on a railroad was piping, and air brake. For five years I had charge of the air brake department on one of the Eastern roads, and was two years on another, and the rest I have spent as car inspector, and I want to say right here that when a fellow has to do a job like that under cars when the wind blows and the snow is flying, believe me he feels like saying something. As it is now, our Uncle Sam says that every car must have an air brake on it and that every brake must be in working order; and when we get a car like that it must be repaired, and that work is not so easily done at night when a train of 50 or 60 cars stands ready to go on. To replace one of these gaskets will take from 15 to 45 minutes, and sometimes longer. I have seen men

FIG. 1. ST. LOUIS LIMITED OF TRAIN NO. 27.

who could not replace it at all, without taking down all the apparatus.

In all this time in a large railroad yard there are lots of men standing, doing nothing at all, getting overtime watching the poor car inspector work where no one can give him any assistance. Putting in a gasket is not a job that a dozen men can work at. All those men standing around are making suggestions, even the foreman; so many times it happens that not one of these men know anything about the work, never having done it, and they are more bother to the man that does the work than a help to him. Consequently the train is delayed, overtime has to be paid, and the poor car whacker, besides working his fingers off, will get a letter a yard long about it, and will have to tell the M. C. B. how it all happened. I know all this from my own experience for the past twelve years. Those gaskets were not so numerous years ago as they are to-day, especially on these new cars equipped with the N. Y. brakes; I own no stock in any of the air brake companies, but justice demands that the truth be told; I have seen ten gaskets blow out of the New York equipment where I have seen one on the other. This happens more when the road uses oil to lubricate the cylinder instead of grease, and after five or six trips that the car has made on the road the gasket shoots right out of its place.

Now, Mr. Editor, it seems to me, that in this age of many improvements there ought to be some way to improve on this important gasket, as when the gasket has blown out, the brake apparatus on that car is rendered useless. Would not a soft lead gasket or a copper one do? I think it would, and it would give better service. If the railways continue using rubber, let there be deeper space between the flanges of the cylinder and reservoir and place the gasket there with white lead, and the bolts well tightened. I will assure you, sir, that a gasket so placed will stay there as long as the car lasts. To repair a car like that in a train takes time, and to switch said car out of train also takes time, and the time is money lost, and causes delay to shippers.

H. A. JOSEPHS,
Car Inspector, So. Pac.

Los Angeles, Cal.

Hewing to the Line.

Editor:

I see on page 464 of RAILWAY AND LOCOMOTIVE ENGINEERING that A. F. Smith, of Cumberland Valley Railroad, invented the first locomotive blower in 1852 and applied it to engine "Novelty." I would call your attention to engine "Gowan & Marks," on page 148 in the "Development of the Locomotive Engine," by Angus Sinclair; also to A. L. Holley's "American and European Railway Practice," page 113, under head of the steam jet, used by Gray and Chanter in 1837 on the Liverpool and Manchester Railway. I am for "hewing to the line, let chips fall where they may." KNOCKER.

Philadelphia, Pa.

FIG. 2. ST. LOUIS SECTION OF TRAIN NO. 21.

Some of the Pensey's Trains.

Editor:

Enclosed is my subscription for RAILWAY AND LOCOMOTIVE ENGINEERING for this year. I am sending you under separate cover some photographs, but I do not know whether any of them are good enough for copy or not. They are as follows: Fig. 1 is the Pennsylvania's St. Louis, Limited, train No. 27. In Fig. 2 is shown the St. Louis section of the St. Louis-Cincinnati express train No. 21 on the Pennsylvania. Fig. 3 is Express No. 19 on the same road. Fig. 4 is the Cincinnati section of train No. 21. The next, Fig. 5, is a very important piece of railroad equipment. Fig. 5 shows the Pennsylvania's pay car with a standard 4-4-0 engine in front. Fig. 6 is train No. 30. All these photographs were taken near Xenia, Ohio. J. HUMPHREY DEAN.

Joes, Ohio.

Trans-Audine Railway.

Editor:

On my trip from New York to Argentina I arrived at Buenos Ayres in due time, after twenty-seven days sail, which, though pleasant in a way, grew tiresome toward the end. We made the usual calls en route at Bahia, Rio de Janeiro, Santos and Monte Video. Strange as it may seem, Santos has the only harbor, where we docked. At all the others we anchored out from shore and discharged cargo and passengers by lighters, which seemed slow to a Northerner.

Buenos Ayres is a large and live city of over a million people, of all nationalities. Spanish is of course the official language of the country and one hears nothing else. Even those who have to learn the language converse in Spanish after they are here a year or more. After a short stay at Buenos Ayres I went west across the prairies to the mountains. From the car windows the country resembled very much the stretches of country between Winnipeg and Calgary on the Canadian Pacific.

The city of Mendosa, which was destroyed by an earthquake in 1861, is situated at the foot hills of the Andes. It has a population of some 35,000, and is the centre of a large grape producing country, where most of the native wine is made. Everyone uses wine in the Argentine from the best families to the ordinary railway man.

The railway I am now connected with, the Trans-Andine, is 110 miles in length and runs from Mendosa to the Chilian boundry, which is the summit of the Andes. At the summit a tunnel is being constructed, two miles in length; this will be competed by the end of December, and the through service from Buenos Ayres to Valparaiso may commence about the end of May. Owing to the difference of track gauge (the Trans-Andine is one meter wide), a transfer of trains will have to be made at Mendosa on the East and at Los Andes on the West slope. The altitude at Mendosa is 2,500 ft. and at the summit of the Andes it is 10,000 ft. The

FIG. 3. PENNSYLVANIA EXPRESS NO. 19.

adhesion grades are so much as 3 per cent., and on the nine miles of rack or cog road the grades vary from 3 to 7 per cent.

The rack portion of the line is on the twenty-seven miles near the summit. They have the same grades west of the tunnel on the Chilian side. Owing to the rack engines on this twenty-seven mile stretch have to back down the grade which makes it rather awkward in the snow as it may be necessary to have the

FIG. 4. CINCINNATI SECTION OF TRAIN NO. 21.

small pilot plow, we use in the North, put on rear of the tenders.

I am located at Puenta del Inca, ten miles west of the summit tunnel, at an altitude of about 9,000 ft. We have not had the usual fall of snow this winter and the cold has not been severe, but as we have very strong winds, what snow does fall, is all blown into drifts in the cuttings.

During the winter months the line is not opened for through traffic. Passengers are taken over the Coumber in stage coaches some six miles, and most of the time they have to go on foot or on mule back. The railway has the rotary snow plow which was shipped from Paterson, N. J., in 1900 and it has done excellent service on the road last winter when we opened up the line to the summit. Trains have been running west to this point all winter. For ordinary storms and snow fall on the Canadian Pacific we used the wing plow which no doubt you remember well. Mr. Griffiths and I expect to leave for London in October.

Geo. F. Risteen.

Puenta del Inca, Argentina.

Light Throttle and Longer Cut-off.

Editor:

In reading extracts from the address of Mr. H. T. Bentley, Assistant Superintendent of Motive Power of the Chicago & North-Western Railroad, in the last issue of your valuable paper, I cannot agree with him in his findings of fuel economy in running a locomotive from every day experiences on a road which has been noted for its fuel economy.

When the monthly performance sheet was still in use, if an engineer had run his locomotive in strict accordance, with a full open throttle and short cut-off, he would have found his name at the last side of the sheet each month, as was the case with the men who operated their locomotives in this fashion.

In my short experience of nearly eight years on the right side and from five years observation when firing, I have found that the hardest men to help make a fuel record were the full throttle men and they were most of the time in hot water over coal and were not making the time or getting over the road as easy as the men who use a lighter throttle and a little longer cut-off, probably an inch more.

The minute you pull the throttle wide open business gets good for the fireman and you have to increase the flow of water to the boiler in order to maintain it at a level to what was being used. You will also find in operating a locomotive, that at a certain speed, cut-off, and opening of throttle, when the locomotive does her best work in the use of fuel, that when you go above that with a wide open throttle and longer

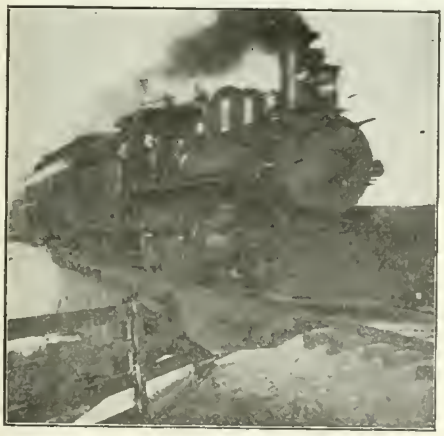


FIG. 5. PAY CAR TRAIN ON THE P. R. R.

cut-off your coal pile starts to disappear a good deal faster.

C. F. Sundberg.

Sioux City, Ia.

English Locomotive Footplate.

Editor:

Most English railroads use the vacuum brake, but about half a dozen, including the Caledonian, Great Eastern, and the London, Brighton and South Coast, use the Westinghouse. A certain number of cars and locomotives have to be fitted with both systems.

The photograph shows the footplate of a British locomotive. I do not say "cab," be it noticed, as most British locomotives have, according to American ideas practically no cab, although the Great Eastern Company have provided a cab; this is the case also on the North Eastern and North British railways.

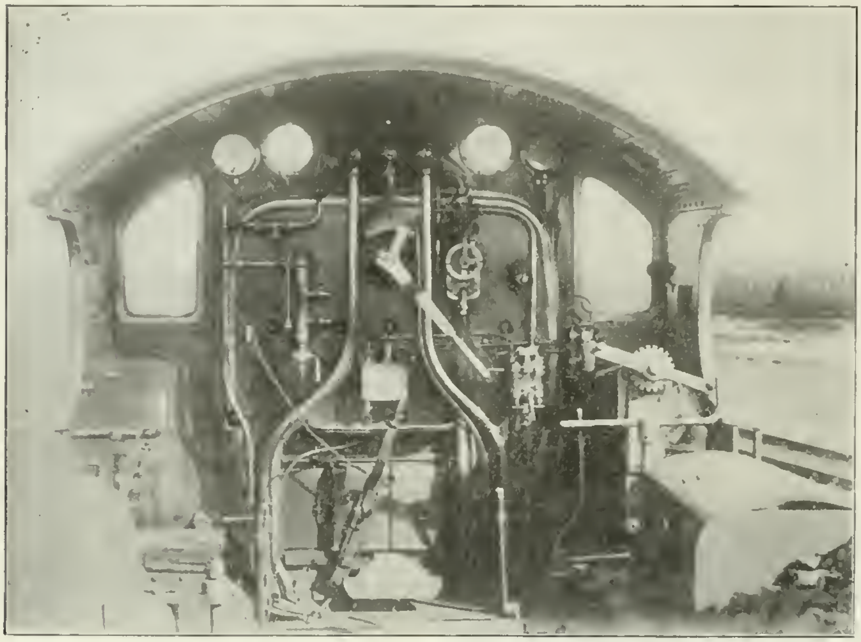
The illustration shows the footplate of one of the latest four cylinder 4-6-0 Great Western locomotives, and is fairly representative of British practice with the following exception. Instead of using a small ejector to maintain the vacuum the Great Western and the London and North-Western use an air pump worked off the cranks, this permits the using of a special pattern of simpler ejector of the company's own design.

Looking at the picture: on the right of the regulator is the vacuum brake ejector and to the right of that again is the steam blast or blower. The right hand gauge is a duplex vacuum gauge showing the amount of vacuum in the train pipe and in the reservoir. The hanging chain blows the whistle; while the screw reversing gear can be seen on the right. Owing to the use of the vacuum brake certain operations, such as reversing, etc., which on some engines are performed by compressed air in America, are done by hand in Great Britain. On the Great Eastern which employs the Westinghouse brake, air reversing is used while steam reversing is used on the London and South Western. The handle in the foreground behind the tool box lifts and lowers the water scoop. To the left of the reversing gear are the sanding levers. At the foot of the picture are the cocks for controlling the water supply from the tender. The handle on the very left secured by a chain is the hand brake to the tender. To the left of the furnace door are two handles for controlling the injectors. The furnace door can be shut either by the lever doors as shown, or by the chain and flap, but the latter is not often used owing to so much air being let into the firebox.

In the older engines on this line the handle to the left of the water gauge was extended outside the cab so that if the glass broke the gauge could be

FIG. 6. P. R. R. TRAIN NO. 30.

shut off without risk of scalding, but the form of guard now fitted does away with the necessity of such a long shaft. Above the water gauge will be seen the pipe for steam heating. The gauge on the left is the pressure gauge; and the three pipes with valves coming down vertically are the steam supplies to the injectors. There are also valves at the top to the two whistles in addition to the chain. Three lubricators will be noticed above the furnace door and to the right, also behind the reversing handle. American engineers will notice that no doors are provided for the fireman when oiling, but in many cases he is expected to climb round the cab. Hand-rails being provided and their securing nuts can be seen on the left wall of the cab.



TYPICAL FOOTPLATE OF MODERN ENGLISH LOCOMOTIVE.

The cars are lighted by gas or electric light; the latter being on the self-contained systems so that no steam is required to drive generators for the light, although, of course, more coal is burnt on trains with these systems of lighting. Headlights are non-existant except as signals to indicate the class of train, so no generators are provided on the engines. Simplicity; I venture to add, is still a feature of British locomotive practice in spite of four cylinders and other complications of modern transportation. AUBREY F. INGLEFIELD.

London, England.

Old Engine on the B. & M.

Editor.

Referring to the Boston & Maine locomotives of 1856, a list of which appeared in your September issue, I send you herewith a copy of an old wood cut illustrating the primitive locomotive "Medford," with one car attached, on the Boston & Maine Railroad over sixty years ago. This engine evidently antedated the one named on the list referred to as being the old "Bangor" renamed. Accompanying the picture is a list of the first ten locomotives on the Boston & Maine, as follows, Andover No. 1, Boston No. 1, Berwick, Cocheco, Dragon, Dover, Haverhill, Medford, Rockingham and Whistler. These did the work until about 1844, the Malden, Reading, Antelope, Portland and Norris following later. If you can reproduce the cut of the "Medford" it may be of interest to your readers. W. A. HAZELBOOM.

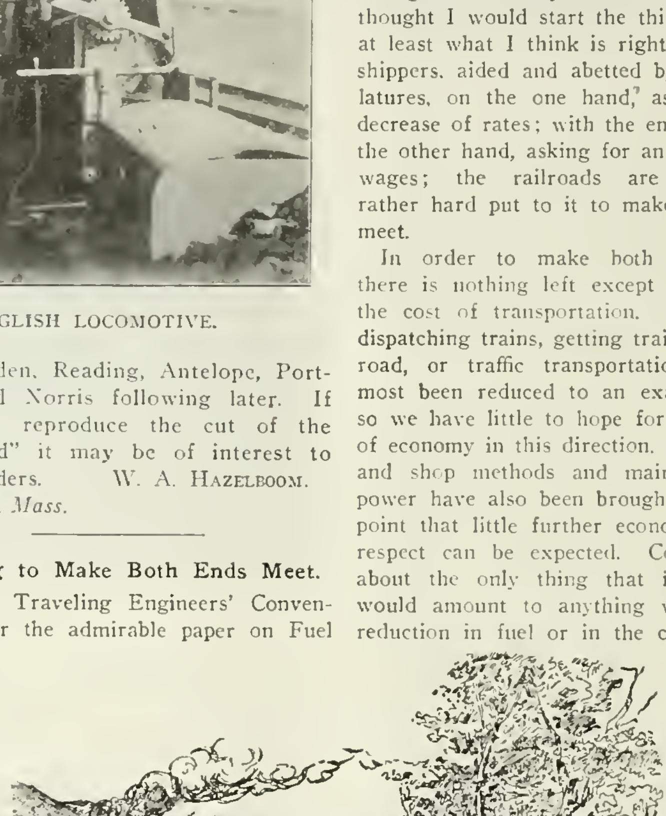
Boston, Mass.

Helping to Make Both Ends Meet.

At the Traveling Engineers' Convention, after the admirable paper on Fuel Economy was read by Mr. S. D. Wright, Central of Georgia, an excellent discussion ensued which was participated in by many members. The remarks made by Mr. F. P. Roesch, of the El Paso & Southwestern, were so comprehensive, that we consider them worthy of being reported as a special article.

Mr. Roesch said: The question of fuel economy is getting to take more prominence every day. In fact, there has been an association organized within the past year composed of railway men, called the American Fuel Association. Its membership is composed of some of the brightest minds in the country. They put in four days on this one subject and then did not get started. So you can see what we may expect if we want to dig into the subject as they did. So I thought that I might get up for fear that some of the arguments might drift back into the old front end proposition, the petticoat or no petticoat, and things like that and get clear away from the subject. I thought I would start the thing right, or at least what I think is right. With the shippers, aided and abetted by the legislatures, on the one hand, asking for a decrease of rates; with the employees, on the other hand, asking for an increase of wages; the railroads are sometimes rather hard put to it to make both ends meet.

In order to make both ends meet there is nothing left except to decrease the cost of transportation. The art of dispatching trains, getting trains over the road, or traffic transportation, has almost been reduced to an exact science; so we have little to hope for in the line of economy in this direction. Shop tools and shop methods and maintenance of power have also been brought to such a point that little further economy in that respect can be expected. Consequently, about the only thing that is left that would amount to anything would be a reduction in fuel or in the cost of producing transportation. It could be reduced in two ways. One way would be to increase the tons hauled per unit of power. The other way would be to decrease the cost of the power used. With the first



SIXTY YEARS AGO ON THE BOSTON & MAINE.

proposition, which means larger engines, we have little to do; that is up to the general manager and superintendent of motive power. With the second proposition, however, decrease in the cost of the power used, we have all to do; which simply means get a little more out of the coal than you are doing at present, because when you get right down to the root of the matter the coal is the power. Although, to digress a little, in examining a fireman not long ago one of the questions asked was, "What is the source of power?" and he said "On the American locomotive, the fireman's back."

In order to decrease the amount of coal used, it would be necessary to start a campaign of education. Now this education should not be confined to the enginemen alone, but should commence at the top and go down to the bottom. If your management insists on burning any certain grade of coal, it does not make any difference what kind it is, and one gentleman stated in Chicago a couple of months ago there was no such thing as a poor coal, this management should be educated to the fact that it takes time to so change an engine so that it can handle any kind of coal, and consequently if he has decided to burn one kind of coal it should be burned continually. Buy one grade of coal and stick to it. Changing the draft of a locomotive is a little bit more of a proposition than simply opening or shutting up the nozzle. It sometimes takes several weeks of good, hard, conscientious work on the part of the road foreman before he is thoroughly satisfied that his engine is now in such condition that he is getting the most out of the coal that he can.

After we get the fellows at the top educated we can come down and educate ourselves a little bit. Then go a little further down and educate the men who are really handling the coal. Educate them to stop the waste. There is more coal wasted, I believe, today, when you take it all round, than there is burned. Some statistician—and that is one of those fellows that hasn't anything to do but sit down and figure—worked it out that there was $600,000,000 worth of smoke going out of the chimneys in the United States every year. That is a whole lot of money, but I believe he is right. I do not mean out of the locomotives alone, but out of all chimneys there is considerably more waste in smoke than we use.

A few years ago Dr. Angus Sinclair, through his magazine, started a campaign against smoke. What was the result? Everybody commenced calling him down. They were not ready to stop the smoke; didn't know enough. Yet it is the same proposition as thirty years ago, when a general manager of a little railroad running out of here, the South Park road, specified all Walschaerts gear, on his engines. The next man came along and knocked it off; but we see today that Colonel Tucker was right; we are putting the Walschaerts gears on. Probably in the course of time we shall see that Dr. Sinclair was right when he started this smoke agitation.

What is black smoke? That is one of the questions in the progressive examination. The answer is: It is unconsumed gases mixed or colored with carbon. We are taught that a pound of coal will furnish 14,500 British thermal units. In order to get that many British thermal units out of a pound of coal, you must get the temperature up high enough so that the oxygen in the air will combine with the hydrocarbons distilled from the coal. If they are not combined with oxygen after being distilled from the coal, they pass off in the form of smoke. We are further taught that if we do not get a perfect mixture of oxygen and hydrocarbon in our firebox, we only get 4,500 British thermal units out of a pound of coal. Consequently, to put the proposition into common form, every time that you see that cloud of black smoke going out of the stack, you see 10,000 or nearly sixty-six per cent. of the heat units going up there in the form of smoke. Now, that is some of the waste that we can stop.

As far as changing front ends is concerned, changing nozzles, putting on superheaters, feed water heaters, and compounding; things like that which could be done to stop the waste of fuel, that is up to the other fellow; we have nothing to do with that as road foremen or traveling engineers; but we have something to do with the man at the wooden end of the scoop and we can stop the waste in that direction, and, as I have just stated, if the engine was smoking all the time sixty-six per cent. of the coal would be going through the stack and thirty-three per cent. would be going into the cylinders.

Too Much Optimism.

The well-known optimistic tendency of American mechanics, inventors and business men sometimes brings failure to machines, processes and appliances that are really efficient when properly managed. This was strikingly shown in relation to oxy-acetylene welding by Mr. A. Davis, Jr., in a paper read at last General Shop Foremen's Convention. He said:

"It was the optimism and over-confidence of the first promoters that caused them to try to perform work without the two absolute essentials, perfected apparatus and experienced skilled workmen. Even at the present time those two factors are not sufficiently considered except by a comparatively few. Until they are recognized, there will be continuous loss of time and money by wasted efforts to perform satisfactory work by oxy-acetylene welding."

The General Electric Company of Schenectady, N. Y., have received grand prizes, which are the highest awards, at the Alaska-Yukon-Pacific Exposition in each class of electrical apparatus in which an exhibit was made by the company. Their apparatus was ranked first in the following divisions: Apparatus for cooking by electricity, apparatus for heating by electricity, automatic motor starters, arc lamps, bonds, cabinets, circuit breakers, cutouts, fans, indicating instruments, integrating instruments, insulated wires, insulated cables, incandescent lamps, mine locomotives, motor generators, motors for direct current, motors for alternating current, recording instruments, rectifiers (mercury arc), sockets, transformers, and wiring devices. G. E. turbines were also entered in the Government exhibit in which no awards were made.

Recently Mr. James J. Hill, chairman of the Board of the Great Northern, gave an interview to Mr. A. D. Albert, who quotes Mr. Hill in the Baltimore *News* as saying on the subject of "Future Transportation Requirements": "The problem of finding railroad equipment today is not what it was ten years ago. There are plenty of cars and engines. What is needed now is terminals, and they are the hardest things to get. The only way, if the road has the money, is to buy improved property in desirable locations, tear down the buildings, and erect terminals on the sites. That's dreadfully expensive. Also it may destroy whole business sections. But where it can be done it may not prove a simple business proposition to get the money.

"The demand is everywhere for more service. The railroads have met that demand as far as they could by increasing the efficiency of their equipment, but there is a limit to that kind of development. I think that limit has been practically reached in the large centers. There are only three ways, then, of raising the money. One is to wait until the increased traffic provides it. That is a very slow way. Another is to raise the freight and passenger tariffs. And the last is to borrow the money (in which event, plainly, the public must pay the interest in the form of charges for service).

"I have for years been urging that the building up of a transportation machine commensurate with the growth of the country should not only be permitted but encouraged in the only two possible ways —first, by encouraging capital to invest in railroad construction, instead of scaring it away by hostile and unjust legislation; and, second, by a comprehensive and rational system of waterway improvement. There is no other way now, nor will there ever be, by which the business of the country can be done."

Whistles and Pipes.

At first sight there does not seem to be much connection between a locomotive whistle and a church organ pipe, and neither there is as far as the uses to which each is put, but from a scientific point of view there is a very close connection between them, and also between them and the wind instruments of an orchestra.

HOTEL AT THE SUMMIT OF THE MT. PILATUS RAILWAY, SWITZERLAND.

The organ pipe may be taken as the typical wind instrument, for it is the simplest of all. The steam whistle of a locomotive is to all intents and purposes an organ pipe, and the sound it gives out is produced in the same way as the tone we hear when an organ pipe is made to "speak."

The organ pipe is a tube of wood or of metal with a partition across its bore, placed at the lower end, and this partition is cut away at the opening or mouth of the pipe so as to make a small thin slit through which air from below the permanent partition is able to blow upward. The upper lip of the mouth of the pipe is beveled to a sharp edge, and this is so placed that air passing up through the thin slit strikes on the sharp edge of the upper lip. This thin sheet of air blown up out of the slit, striking the edge of the lip produces a sort of eddy or flutter of air at the lower end of the column of air standing in the pipe. The property of a column of air thus confined is that from the confused flutter at the mouth it is able to select those vibrations which synchronize with the vibrations necessary to produce what is called the fundamental tone of the pipe. The flutter of air at the mouth sets the air in the pipe vibrating and this causes the musical sound. There is no rush of air through the pipe, but its whole mass is made to vibrate.

The length of a pipe is an important matter in determining the musical note produced. The middle C on the piano is made by 256 vibrations a second and requires a pipe 2 ft. long. A pipe 4 ft. long will sound the octavo below. If the 2-ft. pipe be stopped or closed at the upper end it will give out the same note as the open 4-ft. pipe. A 1-foot. stopped pipe will give the same fundamental tone as a stopped 2-ft. pipe.

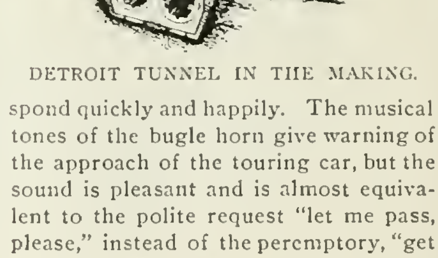
Those familiar with the construction of the locomotive whistle will readily see that it is a stopped organ pipe and has the permanent partition at the bottom and the sharp upper lip at the lower edge of the bell. Steam instead of air produces the flutter at the base of the pipe and the vibrating column of air contained in the bell of the whistle produces the sound.

The chime whistle is practically three stopped organ pipes contained in one bell. One of them is stopped off by a partition perhaps half-way up the bell; the second has a partition higher up and the third is open up to the cap of the whistle bell. The lengths of these three pipes are so proportioned as to produce the notes separated by the intervals which a musicians would describe as one, three, and five. When this whistle is sounded it produces the composite musical tone which we call a chord. The notes C, E, and G are the ones usually employed.

The Gabriel horn used on automobiles is very similar to the chime whistle of a locomotive. There is this difference, however, that whereas the chime whistle is a combination of three stopped organ pipes, the Gabriel horn is made up of three open pipes combined in one tube.

These pipes each have slits on the side, near the upper end of each, placed at different distances from the base so as to make each of the open pipes of unequal length as far as the length of the vibrating columns of air are concerned. When sounded each gives forth its fundamental note, the whole forming practically the same major chord as that of the chime whistle. The horn is blown by the exhaust gas from the automobile engine, after it has passed through the muffler. A simple valve turns the exhaust gas into the horn when sound is wanted and is allowed to escape freely to the air when the horn is not in use.

When whistle or horn is blown all three pipes respond and the full chord is always heard. A rather pleasing change from the automobile "honk" is made by what is called the Gabriel military bugle horn. This is simply four separate pipes usually tuned to C, F, A, C on the musical scale and having separate valves to operate each. Bugle calls and simple airs can be played on this, but in emergency the operation of one valve makes all the pipes speak together. The bugle horn, it is said, has had a most satisfactory effect on pedestrians and those driving horse vehicles on country roads. They respond quickly and happily. The musical tones of the bugle horn give warning of the approach of the touring car, but the sound is pleasant and is almost equivalent to the polite request "let me pass, please," instead of the peremptory, "get out of the way," which seems to come from the ordinary "honk."

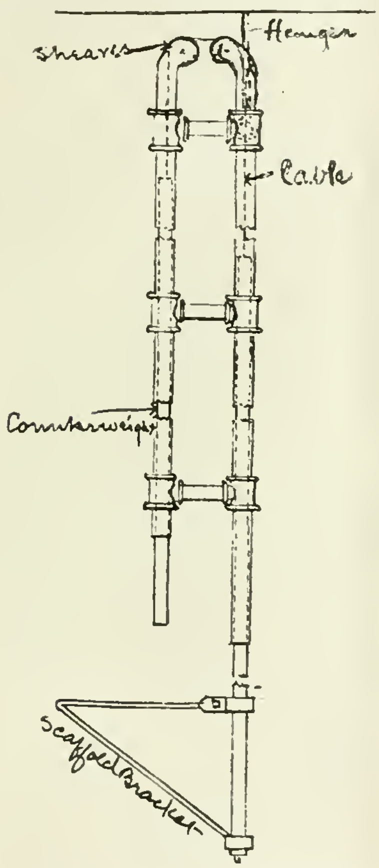


DETROIT TUNNEL IN THE MAKING.

We do not know if the chime whistle has exercised any kindly influence on the railroad tramp or the trespasser on the right of way similar to that credited to the military bugle horn. Statistics seem to prove that it does not. The chime whistle, however, while making no very elaborate claim to music is nevertheless, while doing its duty as a warning sound, always pleasing, and on some roads has been used as a distinguishing feature of passenger trains.

Adjustable Scaffolding for Shops.

A particularly interesting feature of the equipment of the new shops of the St. Louis & San Francisco at Springfield, Mo., is the unique construction and ar-



OUTLINE SKETCH OF SCAFFOLDING.

rangement of the permanent scaffolding which has been erected in both the car repair shop, and the paint shop. The arrangement is such that the brackets upon which the planking is supported can be turned so as to extend in any direction from the support or fixed at any height from the floor, and when not in use can be pushed up out of the way so as to give 7 ft. clearance from the floor.

The supports consist of a double framework of piping, the two pipes being connected and suitably braced by cross-bars, also of piping. The uprights are themselves double, the pipes being placed about 6 ins. apart and connected by T-unions at the points where the cross-bars from the opposite sides of the frame are joined. This entire frame is suspended from the under side of the roof trusses alongside the repair tracks.

The frame as described extends from the roof truss to a point about on a level with the edge of the car roof. Within one of the two pipes forming the supports upon each side of the frame is telescoped a piece of pipe of a smaller size and upon this is carried the bracket which forms a support for the planking. The upper end of the telescoped pipe is connected to a chain which passes over pulleys at the upper end of the frame just below the roof truss, and the chain is carried down in the other pipe of the same side of the frame and attached to a counterweight which telescopes in the other pipe. As the bracket pipe is raised or lowered in the support the counterweight correspondingly lowers or rises and it therefore requires only the slightest push to send the bracket up out of the way when not in use. The bracket is further made adjustable in the height upon its support by the use of a pin which is inserted in holes formed at convenient intervals therein and there are corresponding holes in the downwardly projecting end of the counterweight, by means of which the position of the bracket is permanently fixed on account of the weight of the scaffold planks and their load.

Each of the 22 stalls in the car repair shop and of the 16 stalls in the paint shop is provided with these permanent scaffolds, the arrangement in pairs, as described, enables work to be done on each side of the passageway between adjacent cars.

It will be noted, therefore, that when the brackets are pushed up out of the way, when not in use, the floor is left absolutely free from obstruction.

This scaffold arrangement was worked out especially for this plant by the Arnold company, Chicago, whose engineers were the designers and constructors of the entire plant, which is a complete car and locomotive repair plant.

The planking used for the scaffolds is all of uniform dimensions, 12 feet by 12 by 2 ins., and can thus be used upon any set of supports.

Getting Ahead Not Always Good.

An old couple, who had passed their lives in the quiet of a Derbyshire village, resolved to make a journey to London. The resolution was communicated to their neighbors, who gave them long instructions as to the best methods of taking care of themselves and avoiding city sharpers.

The villagers gathered at the station to see the departure, and all went well until the train reached Bedford. There the old man, in an evil moment, left the compartment, with the result that the train went off without him.

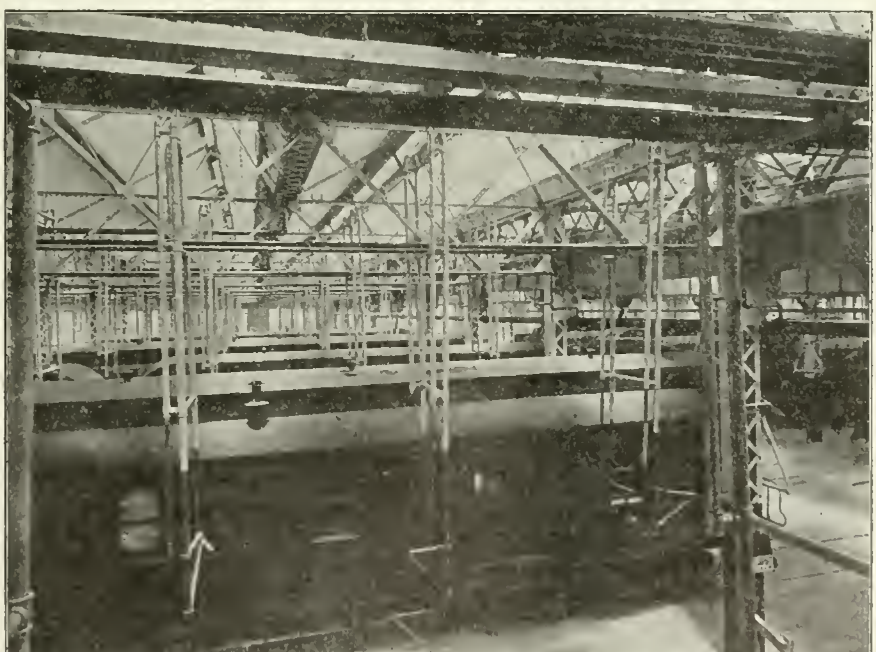
Fortunately an express was due in a few minutes, and the station-master, taking pity on the old countryman's distress, permitted him to board it, so that he was enabled to reach London fully twenty minutes before the arrival of his wife.

He was waiting eagerly at the station when the train came in, and seeing his wife, he rushed joyously up, crying out:

"Hi, Betty, I'm glad to see you agean! I thought we were parted forever!"

The old woman looked at him suspiciously, and remembering all the advice that had been showered upon her, said indignantly:

"Away wi' ye, man! Don't be comin' yer Lunnon tricks wi' me. I left my owd man at t' other station. Be off at once, or I'll call a bobby and hae yer locked up!"—*World Wide.*



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Steel Fireboxes in Europe.

Steel fireboxes are being used on some of the railways of Europe, notably in France and Spain. A recent report of the International Railway Congress gives some interesting information on this subject. As a general rule copper is used by these railways for locomotive fireboxes, but there is a growing tendency among leading railway men on the Continent to investigate at first hand the claims made for steel as a firebox material.

In France it is reported that the Southern Railway has a number of engines running with steel crown sheets which are said to be very satisfactory. The Northern Railway is experimenting with complete steel fireboxes in two of their older type engines. The Paris, Lyons & Mediterranean experimented with steel fireboxes, but that material appears not to have given satisfaction on this line, owing to the cracking of the stayed portions. On the French Government railways an interesting trial has been made of steel in combination with copper. Two engines have been fitted with composite fireboxes, that is, the part of the flue sheet which holds the tubes is made of steel, while the lower portion of the sheet is composed of copper. These dissimilar metals are united by a lap joint with the copper lap next the fire. The seam is just above the brick arch and the copper calking edge is therefore readily accessible. On the whole, these composite flue-sheets have given satisfaction, though, as might have been expected, leaks have from time to time developed.

The Great Southern of Spain has used complete steel fireboxes in two engines for a period covering two years, and the steel fireboxes are reported as being quite satisfactory. These facts serve to show the interest which is being taken in steel fireboxes, and though the steel box may be said to be in the experimental stage in those countries, it is well known to continental engineers that the steel firebox is practically standard in this country, and in the tests which they may make, they are not working entirely in the dark. Local conditions, no doubt, influence results, but it is in all probability only a matter of time when steel will be used to the same extent abroad as it is here.

In the matter of firebox staying, the crown bar has practically disappeared. The radial stayed firebox is most extensively used, though the Belpaire box makes a good showing. The French railways use the Belpaire firebox extensively, but in Belgium, where this form of boiler construction originated the Belpaire box is not the favorite form used. Spain and Portugal use both the radial stayed and the Belpaire firebox. The report makes mention of the general practice of using one or more rows of expansion stays near the flue-sheet. Cylindrical fireboxes such as the Vanderbilt box, is not used on Continental railways.

The Serve tube, which is made with inwardly projecting longitudinal fins so as to provide additional heat absorbing surface, are used extensively in France and in Italy. The objection to the Serve tube, however, is that the fins cause the tube to be very rigid, and on the Belgian State Railway their use was discontinued some years ago, as the flue-sheets were deformed by the thrust of the tubes.

In this connection we may refer to an interesting experiment made with long tubes on the Lake Shore & Michigan Southern some years ago, and of which we gave an account in our November, 1902, issue, page 484. These long tubes were thought at first to vibrate when the engine was working hard, and that this caused the tubes to leak. The experiment revealed the fact that the long tubes did not vibrate, but that there was some sag, not very much, toward the center of the tube, even when the engine was cold. When the flue became hot it expanded, and being held at each end, the expansion of the tube increased the sag. When the engine was worked very hard the sag reached its maximum. In no case did the tube vibrate up and down or sideways in the water, but the alteration in the amount of sag was always, as mathematicians would say, a function of the temperature of the flue itself. From this it is easy to imagine how the action of the stiff and rigid Serve tube might affect the flue-sheets.

The Machlet Process.

The subject of case hardening iron was very interestingly and instructively handled at the recent convention of the Master Blacksmiths' Association in a paper read by Mr. William Donahue. For many purposes, he said, case hardened mild steel is an ideal material, but so little dependence can be placed in the ordinary cementation process to give satisfactory results that the proper extension of case hardening has not taken place.

A process which is likely to give a decided stimulous to the whole science of case hardening is a new process brought out by Mr. A. W. Machlet. This, it is believed, overcomes many of the defects incident to the cementation process. In the Machlet system, the objects to be case hardened are heated to the usual temperature and are then subjected to the action under pressure of a gas heavily laden with carbon. From this gas the articles absorb carbon. Everywhere there is the same pressure, and the interior of small holes, or large surfaces are acted upon uniformly by the carbonizing gas. The penetration of the carbon is thus rendered equal all over any exposed surface. As the carbon is absorbed fresh gas is introduced as the carbonless gas passes off. The container is continually rotated, and this causes what may be called a circulation of the gas over and all around the objects to be case hardened.

The carbonization of articles in the Machlet process is more rapid and more even than that of the usual process, but in the Machlet process, as Mr. Donahue remarks, gas under considerable pressure in a red hot retort, whose walls are softened by the heat, presents a problem not to be dealt with recklessly. The gas itself is not heated in the making, the process being purely chemical. A carbon vapor obtained from an oil is mixed with a neutral gas. It is, in fact, a special product. It is supposed that the molecules of carbon are held in suspension in the gas until absorbed by the glowing iron or steel articles which are to be carbonized.

The furnace used in the Machlet method of case hardening consists essentially of an inner and an outer cylinder. The articles to be case hardened are placed in the inner cylinder and heat is applied through gas burners to the annular space between the inner and outer cylinder. Worm gear is provided to rotate of the cylinder, thus giving all parts of the articles equal exposure to the carbonizing gas. The retort itself is supported upon two wheels at each end, thus providing an anti-friction bearing, and also allowing for the expansion due to the heat.

Special methods are employed for different classes of work, in order to hold them during the rotation of the retort. Thus, if the pieces are rings, they are placed on bars secured in the retort in a longitudinal position. Likewise, if the pieces are round bars, which it is desirable shall not touch each other they may be supported in the perforations of two or more thin discs arranged transversely in the retort. The perforations are made slightly larger than the bars, so as to permit a rolling motion when the retort is rotated.

The hardening operation is also effected by a special apparatus. It consists of the tank which contains the quenching liquid. There is a funnel at one end, and in it the hot pieces are received. They then fall into a funnel-shaped rotating vessel. This is perforated and lies in the quenching liquid. its larger end being next the receiving funnel. The hardening articles pass to this lower and smaller end. Here they are raised and discharged by an apparatus, which is practically a conveyor arranged like a chain pump.

It appears that the new process is capable of very wide application in case hardening. Screws, nails, nuts, etc., may be cheaply treated, and there are many articles which would have their value enhanced by surface hardening.

Accidents to Trespassers.

According to a statement issued by the Pennsylvania Railroad, trespassing on railroad property, in violation of the law, has been responsible for the deaths of 47,416 people in the United States in the last ten years. In the same period, more than 50,000 trespassers were injured. It is in view of these facts that many of the important railroads have determined to redouble their efforts to secure in this country that rigid enforcement of the law against trespassing, which, in England, has reduced the practice, and accidents to trespassers, to a minimum. Figures compiled by the Pennsylvania Railroad alone show that 465 trespassers lost their lives on that System's line in 1899; 781 were killed in 1904; while in 1907 the number reached 915, being an average of almost three for every business day in the year.

It is not only tramps who are killed and injured while trespassing, but also laborers, factory workmen, their wives and children, who use railroad tracks as thoroughfares. This practice gives added significance to the figures from the Pennsylvania System, the tracks of which, lined with factories, run through the densest industrial sections. On these tracks and adjacent property over 11,000 trespassers were arrested in 1908. The alarming death roll from trespassing on railroad property, which from 1899 to 1909 was nearly four-fifths of that suffered by the entire Union Army in all the battles of the civil war, is every year charged up to the railroads, even though these people are killed as a result of their violation of the law, under conditions over which the railroads have no control.

It is stated that the co-operation of State and county authorities has been solicited, but actual punishment of persons violating the laws forbidding trespassing on a railroad's private property has been infrequent. The cost of imprisonment has deterred the local courts from holding those arrested while trespassing on railroad property. The Blair County Pomona Grange met at Bellwood last spring and passed resolutions protesting against railroads driving tramps off their property, on the ground that it forced this undesirable element to pass through farming regions, and that robbery and destruction of property was the result.

The criticism which has been leveled at the Grange resolutions is that they fail to point out a remedy. The railway track is often the shortest line by which pedestrians can reach an objective point, but the convenience of the trespasser is not taken cognizance of by the law. The presence of an unauthorized person on railway right of way constitutes a violation of the law. Often the railway track affords better walking than the ordinary highway and the suggestion made by the Altoona *Mirror* in this connection is sound and to the point. It is in substance that vagrants found on railway tracks instead of being imprisoned and kept, at the public expense, should be put to work on the public highways. The betterment of the ordinary country road would tend to keep people off railway right of way and the fact that those who did trespass would be made to help bring about this desirable state of affairs, seems to be a form of poetic justice which, in such cases, would make the punishment fit the crime.

Healthy Activity.

The employees of the Canadian Pacific Railway resident in Montreal and vicinity have lately formed an Amateur Athletic Association which is wide in its aims and scope. There has always been a manly spirit of healthy rivalry among the company's employees in the Angus shops in the matter of sport, but the new association goes farther. It includes every form of healthy outdoor recreation from swimming to skating and from cricket to photography.

In order to carry out this project a site is to be secured on the river front with club house and park-like grounds surroundings. A portion of the ground will also be set apart definitely for athletics. There is also a summer camp talked of in connection with the association so that members may have an opportunity at moderate cost of spending their vacations in company with congenial spirits.

One of the most commendable features in this voluntary organization is that it will not seek to secure a large membership for the purpose of maintaining a semi-professional team to play matches for others to look on at and enjoy while they take no part. No doubt matches will be played and the honor and standing of the association will be vigorously striven for by those engaged, but the primary object seems to be to bring in all lovers of manly and health-giving pursuits and afford them the means of gratifying their tastes.

Speaking of the effect of such an organization on the citizens of Montreal the *Daily Witness* says: "Though, naturally, the membership is to be restricted to the company's employees, an association on such a scale is bound to exercise an influence that will be felt throughout the whole community —an influence the whole weight of which will be on the side of good citizenship."

This puts the railroad man in a new light, and the fact that the regular and official organization of men, as it exists for the purpose of carrying on the work of a great railway, almost logically suggests the voluntary association of such men for self-improvement, recreation and all that tends to help the advancement of the community. Work for the improvement of their town has been done by the employees of the Bangor & Aroostook, at Milo, Me., by means of concentrated effort, and healthy civic pride has been called into being thereby.

In the British Isles railway men have first aid associations, the members of which compete as teams for first place on their own railway in rendering first aid to the injured, and the winning teams of each road hold an annual tournament for the possession of a pennant. The work of first aid is carried on very efficiently on the Boston & Maine. All these instances show the good influence, on their fellow citizens, which railway men can wield when banded together for some laudable or useful object entirely outside the scope of the duties which naturally devolve upon them as employees of a railroad corporation.

Priming and High Water.

Clean water in a clean boiler is the best preventive of "priming." Whatever foreign admixture there may be in the water it seems to increase in volume when the water is passing off in the form of steam. The steam carries with it mud, sand, and occasionally lime which has a pernicious effect on everything it touches. Occasionally priming occurs even when the water and boiler are fairly clean. The causes of priming are sometimes almost past finding out, but it may be taken for granted that there must be some foreign substance in the water when priming occurs. It is a remarkable fact that new boilers, and boilers newly repaired will begin priming at their first trials, and sometimes settle themselves, as it were, after a few days work. In such instances it is safe to assume that there has been a quantity of oil or other foreign matter in the boiler, and this mixing with the water causes the priming on the occasion of the first trials of the engine.

The theory concerning priming is briefly that the water contains some foreign matter of a more or less soapy nature. Normally when a steam bubble forms down below the level of the water it rises to the surface as a small sphere. The steam bubble bursts the film of water at the surface and is free. In the case of priming water the surface film does not readily burst, but seems, if one may so speak, to be tough like a soap bubble. Innumerable bubbles of steam slow to burst cause an accumulation like froth and this is readily carried into the throttle and appears as water by the time it reaches the valves and cylinders. This priming as it is called must be distinguished from the result of a high water level.

There is a tendency among the younger class of engineers to carry too much water in the boiler. While this may be considered to be acting on the side of safety as far as preventing the scorching of an uncovered crown sheet is concerned, it is a practice that should be avoided as much as possible. With the present form of boiler having the throttle valve located in a comparatively narrow and elevated dome, the rush of steam and the formation of a double vortex near the throttle pipe has the effect of causing the bursting bubbles of steam to throw drops of water toward the throttle, and so in a sense raise the level of the water. An extra amount of water in the boiler lends itself readily to this mixture of water and steam that rushes to the throttle valve, and the showers of water that are seen and heard passing out of the smokestack attest to the difficulties under which the valves and pistons are working.

Many clever devices are in operation testing the presence of water in steam. Generally there is never less than five per cent. of water in steam as used in locomotives. The extensive experiments carried on at the St. Louis Exposition being entirely with clean boilers and fairly clean water, the results need not be taken as any approach to common practice. There is much room for improvement in the matter of perfecting appliances for preventing priming. It is known that distilled water will not prime, while rain water and all other kinds of water will prime sometimes. The various water treating plants used by many railways for the purpose of removing incrusting matter have also the effect of removing the substance which tends to bring about the state of affairs which we call priming.

Good and Bad Sand.

With the heavy trainloads now hauled by locomotives, the matter of sand supply is of greater importance than most people realize. It is not so long ago that the persons in authority over the water supply of railroads began to realize that being wet did not fulfill all the requirements of water for boiler feeding. Water was water and many locating engineers resented questions raised concerning quality. The same with coal and other costly supplies. To question concerning quality was considered impertinent meddling. But the tendency towards guarantees kept marching on and now the sand box supply has come under suspicion.

A certain engine house foreman, who lives on a street partly occupied by a steam railway, was visited occasionally by the railroad chemist. On one of these visits the attention of both was drawn to the excessive amount of wheel slipping the engines were doing and the foreman attributed much of the slipping to the poor quality of sand supplied. The chemist volunteered to analyze the sand and find out its composition. Then the question arose, what constitutes good sand? On investigation it was found that no specification of sand was in possession of the purchasing department. The chemist proceeded, however, to find out the composition of the sand supplied to the company whose engines were noted for slipping and discovered that only about 40 per cent. of the stuff was silicon, the sharp gritty matter that makes the tires bite the rails in slippery weather. The remainder of the sand consisted mostly of minute shells formed of lime, a substance that has very little of the grit that prevents slipping. Besides the lime there was some feldspar, hornblend and aluminum, substances of little value as sand box supplies.

There are two grave objections to inferior sand used to prevent locomotives from slipping. In the first place it fails in its purpose and in the second place its inefficiency leads to a lavish supply which clogs the rail surface and increases the resistance of the wheels. We advise purchasing agents to establish a standard for sand and call for at least 75 per cent. of silicon. Good sand is of greater importance than it receives credit for.

Steam Saving Problems.

The system of superheating the steam used by locomotives has been growing steadily into favor, although it has received set-backs on several railroads where trouble was experienced through the superheating apparatus burning out. The superintendent of a certain division on a Western railway was a great believer in giving every engineer the last car it could haul. Full loading was his motto, but it came to pass when the expense of moving freight was ascertained and analyzed it was found that it cost more money to move a ton on the heavy loading division than it cost where lighter trains were run. This seemed like a paradox, but it was a truth that applies to more things than to overloading locomotives. For instance, it applies to the overheating of superheaters.

A speaker who was discussing the subject of steam superheating at a railroad convention lately insisted that superheat of 100 deg. Fahr. is useless, and that there is no advantage in trying to superheat the steam unless the temperature is almost doubled above that due to the working pressure. That person did not understand the subject very well, and there are others familiarly discoursing on superheated steam who have much to learn concerning the phenomenon.

The steam used in locomotives is known as saturated or anhydrous steam. The term "saturated" confuses a great many people, who receive the impression that saturated in that connection means wet, which is not the case, for anhydrous steam is free from water. But as the steam passes out of the boiler it is constantly at the dew point, ready to revert into water on the least portion of the heat of evaporation being abstracted. As the steam chests and cylinders are colder than the boiler, they act to a great extent as condensers on the entering steam, depriving it of a portion of its energy, because the water resulting from condensation has no power to perform work.

For a long time after the steam engine was invented engineers believed that some mysterious influence neutralized the force due to the evaporation of steam in the boiler. Watt and others demonstrated that the "mysterious influence" was the comparatively cold metal of the steam chest and cylinders which robbed the steam of part of its power to do work. James Watt invented a steam jacket to keep the cylinders warm. It consisted of a steam-tight casing, into which steam was admitted from the boiler. This was vulgarly spoken of as a case of robbing Peter to pay Paul, yet it produced steam saving effects when the steam jackets were properly operated. Through ignorance in design and manipulation, the steam jackets acted as veritable condensers and wasted steam, instead of saving it.

Great hopes were entertained at one time of the advantage to be derived from steam jacketing, and for several years not a few locomotives were provided with steam jackets, the responsible officials holding that engines of that character were peculiarly liable to losses through cylinder condensation. About 1885 Mr. Alexander Borodin experimented extensively with the steam jacketing of locomotimes in Russia, and he seemed to show a saving of from 15 to 20 per cent. in fuel. As the practice was abandoned in a few years we suspect that the saving needed the presence of the inventor to maintain it. Many steam engines in Europe are still equipped with steam jackets sometimes, but the practice has never formed much favor in the United States.

The practice of preventing cylinder condensation by means of steam jackets having been found unsatisfactory for locomotives, attempts to keep the cylinders hot were for a time abandoned, but the losses became more manifest as scientific investigators instituted elaborate tests to find out how much truth there was in the theory of cylinder condensation. Bryan Donkin, a celebrated English engineer, took a very prominent part in this line of investigation, inventing some valuable apparatus to aid in the work. He found that the theories of Watt, Kinnear Clark, Isherwood and others concerning the action of steam in cylinders was substantially correct. The theories in question are that the stream in entering the comparatively cool cylinder, becomes partly condensed through the chilling action of the metal. This continues till the point of cut-off is reached, after which the expanding steam begins to absorb heat from the cylinder metal, thereby cooling it, and so preparing it to act as a condenser for the next period of steam admission.

In the course of his experiments Mr. Donkin found that 16 deg. Fahr. of superheat was sufficient to prevent condensation of steam through the whole period of admission. The demonstrations which Donkin and others made concerning the extent of the steam losses due to cylinder condensation, moved a variety of inventors to begin devising some form of superheater that could be economically applied to locomotives. Some American inventors carried on exhaustive experiments with casing jackets through which the hot gases from the flues were passed, but that plan never worked properly. Among the inventions produced, the superheater patented by Mr. Schmidt of the Prussian State Railways, took the lead and gave the proper cue to various American inventors.

The Schmidt superheater has become a regular feature of German locomotives, and the same device or imitations are becoming very popular on the American continent. Here it has been found that a steam superheater device, successful in Europe, is not necessarily successful in America. The hard work which our locomotives are habitually forced to do, burns out, in a few trips, superheaters that would last throughout an engine's lifetime in Europe. Those who have been familiar with the action of superheaters in stationary engine practice, say that 100 deg. Fahr., is the maximum temperature above the saturated or anhydrous steam that can be employed. We are inclined to think that the efforts to produce much more intense superheat has caused the failures that are so much talked about. The locomotive that overdoes the superheating is not likely to make the best record any more than the locomotive that is habitually overloaded.

Book Notices

The A, B, C of Railroad Signaling. By W. H. Elliott. Published by the Mackenzie-Klink Publishing Company, Chicago. 75 pages. Cloth. Price, 50 cents.

Mr. Elliott, signal engineer of the service of the N. Y. C. & H. R. R., recently delivered a lecture before the Harvard School of Business Administration on the subject of "Railroad Signaling." The growing importance of this branch of railroad work attracted more than ordinary attention to Mr. Elliott's lecture, and it will be gratifying to all interested in signaling to learn that the lecture is now in book form. The subject is treated ably and clearly, and the book should meet with popular favor, especially among the younger railroad men, to whom it is particularly addressed.

Lighting Engineer's Hand-Book. Compiled by L. R. Pomeroy. Published by the Safety Car Heating and Lighting Company, New York. 231 pages. Gilt-edged flexible leather binding. Price, $1.

There is a mass of valuable information in this elegant book which is indispensable to engineers generally, and to car lighting engineers particularly. Mr. Pomeroy's work has the good qualities of condensation and classification. The book is divided into seven sections, embracing Electricity, Lighting, Steam Heat and Heating, Traction, Pipes and Tubes, and Hydraulics. The book seems to us to be as finely fitted for the use of lighting engineers as Kent's popular book is for mechanical engineers.

Standard Train Rule Examination. Seventh Edition. Edited by G. E. Collingwood. Published by the Train Dispatcher's Bulletin, Toledo, Ohio. 126 pages. Leather, $2; cloth, $1.50.

This book, which has already met with much popular favor, is intended for the use of examining officials, and also for the use of trainmen, train dispatchers, telegraph operators, and others who desire to be thoroughly informed in regard to train rules. The rulings of the American Railway Association are carefully followed in every case, and in many ways the present edition is a marked improvement on the preceding editions. Those who have had Mr. Collingwood's "Questions and Answers," as well as those who have not had copies of that popular work, will find in this book much valuable new matter presented in a way that is at once instructive and interesting.

Motorman's Practical Air Brake Instructor. By Geo. R. Denekie. Published by F. J. Drake & Co., Chicago, Ill. 280 pages. Profusely illustrated. Ornamental flexible leather. Price, $1.50.

Mr. G. R. Denekie, master mechanic of the Terre Haute, Indianapolis & Eastern Traction Company, has had exceptional opportunities of obtaining a complete knowledge of the air brake, particularly in its application to electric traction work. The book before us shows how thoroughly he has gone into the matter. The latest information in regard to the subject has been carefully collected, condensed and compiled. As might be expected, the Westinghouse A-M-M Brake equipment figures largely in the book, but the National Straight Air Brake equipment, not only for straight air, but as adapted for automatic service, as well as the General Electric, the Christensen Air Brake, and also the Westinghouse S-M-E are fully described and illustrated.

The proceedings for 1909 of the American Railway Master Mechanics' Association has just been received. It is a volume of 405 pages and of course contains numerous illustrations in connection with the reports presented. There were fifteen of these reports and the following are the subjects covered by them: Bank vs. level firing; castle nuts; fuel economies; lubricating material economies; mechanical stokers; motor cars; revision of standards; revision of the constitution and by-laws; safety valves; steel tires; subjects: superheaters; tender trucks; U. S. Senate bill on boiler inspection; widening gauge of track on curves. The discussions on the reports are given in full and form very interesting and instructive reading. The book may be got from Mr. Joseph W. Taylor, secretary of the association, Old Colony Building, Chicago, Ill.

Watt's Parallel Motion.

A correspondent writes us that he is anxious to have a description of Watt's parallel valve motion, and we must answer him in the outset by saying that the parallel motion devised by Watt had nothing at all to do with valve motion. It was for the purpose of compelling a straight up and down or vertical motion for the crosshead of a beam engine without the use of guide bars.

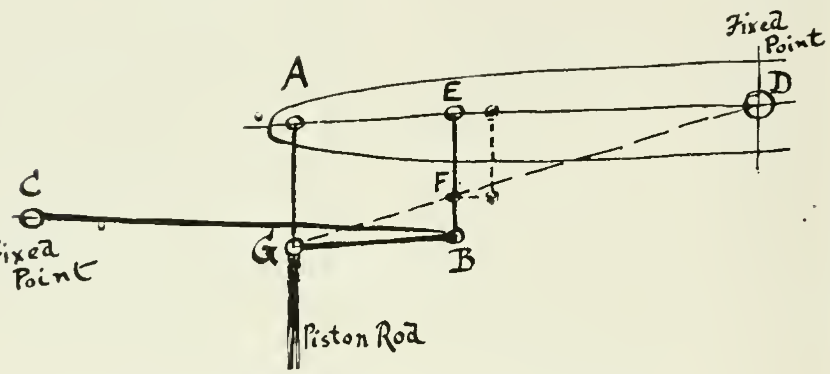
Our illustration shows a skeleton outline of the parallel motion. Watt himself was very much pleased with his solution of this particular problem, which in mechanics may be placed under the head of "Changes of figure of a jointed system of rigid parts." There are a number of forms in which the problem can be presented, which may be more or less useful and interesting to the student, but Watt dealt with a practical problem in engine building and appears to have been glad to escape from the necessity of using guide bars with crosshead made to slide along them.

In the ordinary beam engine the end of the piston rod where we usually put the crosshead must move up and down in a vertical line. That is the end and object of the parallel motion. To the crosshead is attached the lower end of the main link. The motion of the end of the beam, to which the upper end of the main link is attached, is the arc of a circle, with convexity to the left. The result of the motion of a simple connection such as this, would be that the piston rod would be swayed first to the right and then to the left and finally bent out of shape.

In order to overcome this difficulty, a second link parallel to the main link is hung from the beam nearer the pivot point of the beam and a rod joins the crosshead to the lower end of the second link. A bridle rod also is attached to the lower end of the second link and the outer end of the bridle rod is fixed some distance beyond the beam.

It is easily seen by reference to the diagram that the point A moves in the arc of a circle with convexity to the left and the point B follows a curved path with convexity to the right. Both of these points are connected with the crosshead G by bars so that the path of G is approximately a straight line. In fact, the whole parallelogram AEBG changes its shape during each stroke, but it does not alter the length of any of its sides.

The determination of the length of the bridle rod CB is an interesting feature of the problem. The motion would work most accurately in the bridle rod was equal to half the length of the walking beam or working beam as it is more correctly called. If, however, this cannot be done the point F on the second link assumes some importance. This is the point where a line from the pivot point D, of the beam to the crosshead G cuts the second link. This point is generally used as the place where the air pump rod is attached, and connection is sometimes made by the use of a smaller or half link as shown in the diagram by the dotted lines parallel to E F. The point F, however, is, as we said, where the line DG cuts EB. The rule for finding the length of the bridle rod is a somewhat complicated one in proportion, but the relative lengths of the lines BF and FE have the same ratio to each other, that the line DE has to the line CB. Hence the importance of the point F in helping to determine the proportions of the other parts.



OUTLINE SKETCH OF WATT'S PARALLEL MOTION.

Appreciates Merit.

A recent press dispatch from Ottawa says that merit and not seniority is to be considered in making promotions on the Intercolonial Railway of Canada. A circular has been sent out to heads of departments asking them to take note of all employees who display ability in any particular direction. When a young man shows aptitude for any particular line of work and it is thought he could better display his talents in another department a transfer may be in order. It is believed that the adoption of this policy will in the course of a short time greatly increase the efficiency of the staff.

Trivial things, invented and pursued for bread, become very serious matters of fact.—*Cricket on the Hearth.*

U. P. Shops at Omaha.

By Angus Sinclair.

One of the cleanest and most orderly railroad shops that we have visited for some time are the Union Pacific shops at Omaha, of which Mr. G. J. Hatz is superintendent. The machine tools have lately been rearranged in a way that materially increases the output while giving much more room for movement on the floors.

A novelty connected with this shop is that every machinist has a metal drawer for his own use. These neat, cleanly kept drawers make a decided contrast with the greasy wooden ones that become disreputable looking through the contempt of the owner.

The shops are fairly busy with repair work, among that being the changing of one engine a month from compound to simple. The objection held against the compound locomotive, is that it spends too much time in the repair shop. The saving in cost is more than counterbalanced by the hours it is out of service and the annoyance and loss of revenue due to failures on the road. The Union Pacific Railroad have been making a most enviable record of late for having trains on schedule time, and the officials hold wicked sentiments about a locomotive that adds to road failures.

Mr. Hatz is changing the position of all the air brake reservoirs that were set at the side of the wide fireboxes because the reservoir had to be taken down every time that the staybolts on that side required attention.

The controversy about the advantage of cross or longitudinal pits in erecting shops has come home to Mr. Hatz in practical form. He holds that the longitudinal plan involves the waste of about 20 per cent. of the time needed to repair a locomotive.

These shops are much better equipped with first class machine tools than they were ten years ago when I was a frequent visitor. The methods of moving material from shop to shop and among the various machine tools seem to have been made as nearly perfect as circumstances will permit. During my brief visit I received the impression that men and tools were worked in harmony to produce good returns for fair wages and satisfactory working conditions.

A novelty to me in those shops was the repairing of some weed burners made for the road by the Commonwealth Steel Company, of St. Louis. On sand ballasted and on earth ballasted roads which are still quite common west of the Missouri River, keeping down weeds, calls for much tedious labor. If the weeds are not kept below the level of the rails they cause wheel slipping that materially reduces the tractive efficiency of a locomotive. The Commonwealth Steel Company's weed burners are said to do the work of seventy men.

Applied Science Department

THE BAKER-PILLIOD VALVE GEAR.

II. ADJUSTMENT.

In the adjustment of the gearing it may be noted that it is essential that the proportions of the various parts be correctly designed by following a precise formula, aided, if possible, by an adjustable model. The setting of the valves, in the same sense of the words as is used in the care of the Stephenson gearing, would be an idle experiment. This is one of the advantages of the Baker-Pilliod gearing that when properly constructed and adjusted to the locomotive the valve gearing passes outside of the pale of the constant consideration of the engineer or mechanic, and while liable, of course, to a certain amount of wear and possible fracture, it is not subject to those erratic variations so peculiar to some forms of valve gearing. Generally speaking, the eccentric rod is the only part that may occasion a renewal of adjustment, as the wear of the bearings at the main crank or in the main driving boxes may occasion a slight variation in point of length of the eccentric rod. The gear reach rod and eccentric arm as well as the valve rod are all fitted with means for adjustment in regard to length, so that the equalization of the travel of the valve can be readily effected in the original assembling of the parts.

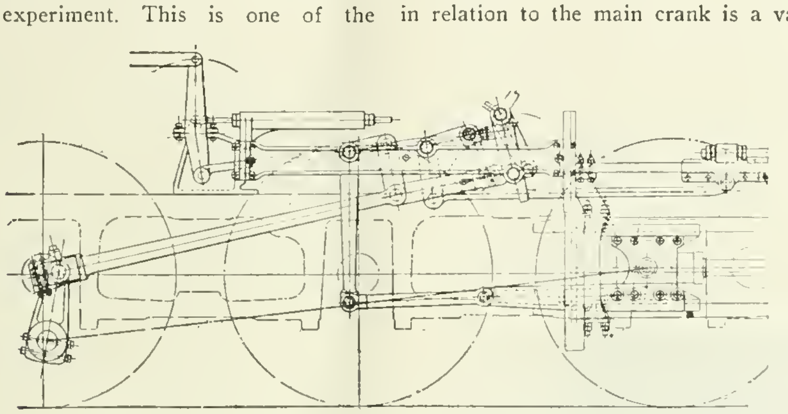


FIG. 1. BAKER-PILLIOD VALVE GEAR ARRANGED FOR INSIDE ADMISSION.

The amount of lead or opening of the valve at the beginning of the piston stroke can be increased or diminished by lengthening or shortening the lower arm of the bell crank. It can be readily seen that by lengthening the arm of the bell crank attached to the valve rod connection that an increase in the length of the valve stroke will be made, and this increase will be added to the amount of valve opening at the end of the piston stroke. A corresponding decrease will occur in the case of shortening the bell crank arm. These organic changes are rarely necessary, and it is questionable whether in the instance of a change in the amount of valve opening being necessary it would not be advisable to make a slight change in the structure of the valve itself by adding to or removing from its overlapping surface such a portion as might be necessary to a prefect adjustment.

The exact position of the eccentric crank in relation to the main crank is a variable point to the designer, and is adapted by him to suit the requirements of the valve gear construction. In the case of an inside admission valve, the return or eccentric crank follows the main crank when the engine is running forward. In the case of an outside admission valve, the eccentric crank is set a corresponding distance ahead of the main crank. The length of the eccentric crank is also a variable quantity to the designer. The eccentric crank used in the case of an inside admission valve being longer than that used in the case of an engine equipped with a valve having outside admission. The necessity for this variation is apparent when it is observed that the angle of inclination of the eccentric rod is an ascending one towards the lifter bar and bell crank. These necessary variations will be readily observed in comparing the illustration of the different positions of the eccentric crank, as shown in Fig. 1, which displays the arrangement of the eccentric crank and lifter bar adapted to an inside, admission valve, with that of Fig. 4, which shows the parts arranged from an outside admission valve.

An admirable feature of the gearing is the fact that all the connections are mechanically positive and the exchange of hardened pins and bushings affords an opportunity of retaining the action of the gearing with a degree of accuracy which leaves little or nothing to be desired in the ready application of means for the maintenance of the wearing parts. This is a marked advance over the use of sliding blocks and cumbrous rockers which cannot be overestimated and reflects much credit on the practical ingenuity of the accomplished inventors.

It need hardly be stated that the gearing is capable of many changes in organic structure and is readily adaptable to any length of valve stroke. In its present form as applied to a large number of American locomotives the throw of the eccentric crank is such as describes a circle of seven inches in diameter producing a valve travel when in full gear of six inches. This could be easily increased or diminished to suit the requirements of any size or design of locomotive. The equable motion of the eccentric rod traveling as it does in parallel precludes the possibility of any of that peculiar variation in motion incident to all movements where circular motion is changed into linear motion and which is such a disturbing factor in the action of the Stephenson shifting link motion, and is not alto-

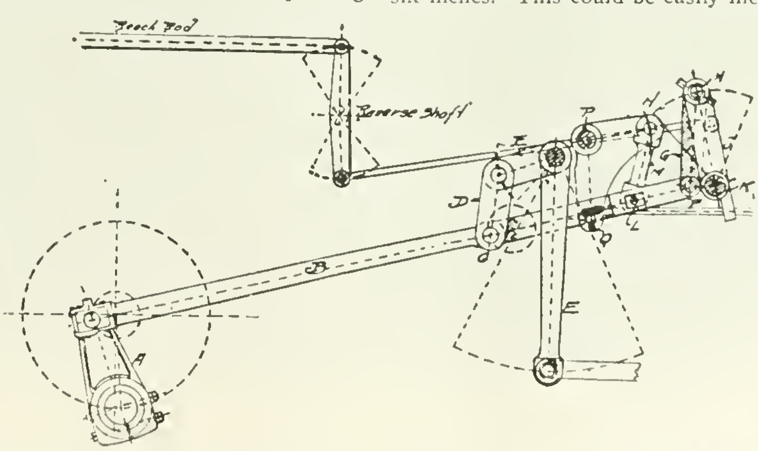


FIG. 4. BAKER-PILLIOD VALVE GEAR ARRANGED FOR OUTSIDE ADMISSION.

gether absent in the Walschaerts valve gearing. This regularity of movement is fully and completely secured by the carriage of the gearing, which is almost entirely supported in a substantial, channeled cradle set between the guide yoke and a cross tie extending over the frames, and which prevents the motion of the valve gearing from having a distorting effect on the frames, and adds much to their necessary rigidity.

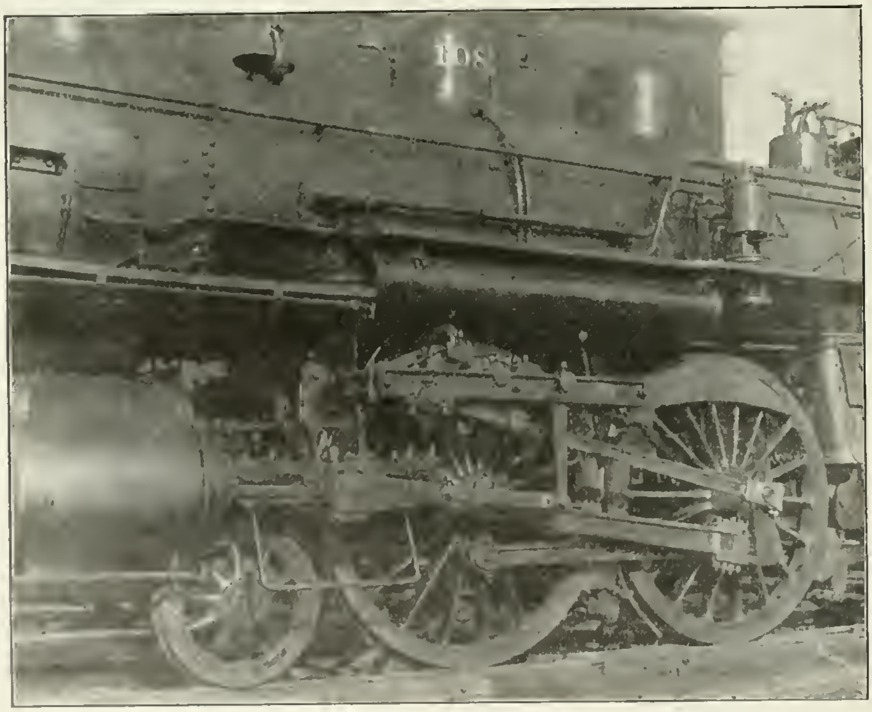
In brief assuming that the design of the valve gearing is correct, the adjustment of the parts is a matter comparatively easy of accomplishment, while the completed, clever contrivance, when once adjusted, has the rare quality of retaining that degree of accuracy which approaches as near to perfection as can be expected in the strenuous segregation of diverse forces that live and move and have their titanic and tumultuous being in locomotive service.

Celebrated Steam Engineers.

XXIII. JAMES MILLHOLLAND.

When a locomotive was being built under the supervision of Peter Cooper in 1830, a bright lad of eighteen years named James Millholland was working on the job. The "Tom Thumb" as the locomotive was named was looked upon by mechanics generally as an idle and dangerous experiment. Millholland thought differently and gave his earnest attention to the construction of locomotives. At twenty-one he was Master Mechanic of the Baltimore & Susquehanna Railroad, and he soon found opportunities for extensive experiments with a view to improving the locomotive. He was the first to construct boilers that extended over the frames of the locomotives, and was successful in using anthracite in the fireboxes that he designed.

Some of the boilers constructed by Millholland were equipped with combustion chambers, but these were quickly discarded by him, and he adhered to the form of boiler almost similar to what is now known as the Wootten boiler. While experimenting on boiler construction he was also busy on wheel arrangements and produced the first of what is known as the Mogul type of locomotive. Out of his numerous variations in construction also came the balanced throttle valve being the first double seated throttle valve applied to a locomotive. The breaking of cranked axles being of frequent occurrence among the early locomotives owing to the poor forging facilities, Mr. Millholland conceived the idea of adopting cast iron axles, and in view of the fact that the steam pressure used on locomotives was comparatively low at that period, the cast iron axles met the requirements of the service better than the poorly forged axles.



BAKER-PILLIOD VALVE GEAR AS APPLIED TO C. & N.-W. ENGINE.

One of Mr. Millholland's clever inventions was a movable cone which was adapted to increase or diminish the amount of space in the opening of the exhaust nozzle. A system of rods and levers furnished means of adjusting the contrivance from the engine cab. It is a noteworthy fact that this device has been patented several times since Millholland first applied it to locomotive service. He also equipped his locomotives with double smokestacks, one pipe being inside the other, with means at the top of the smokestack for deflecting the cinders into the outer pipe from which they could be readily emptied as occasion required.

Among Millholland's experiments in locomotive construction were several from which he expected great results in climbing service. The most remarkable of these were the kind known as the mountaineer class, having six pairs of driving wheels about four feet in diameter. As may be readily imagined this class of engine gave no end of trouble on curves, and they were finally rebuilt and the number of driving wheels reduced.

In the construction of locomotives for passenger service he was very successful. What is now known as the American type of locomotive was brought to a degree of elegant perfection by Millholland that has not been much surpassed after the lapse of half a century. The valve motion was a compound between the Stephenson and Walschaerts kinds of valve gearing. The link was stationary and oscillated upon a fixed center. There were double slide valves located near the ends of the cylinder shortening the steam passages as much as possible. In short there was scarcely any part of the locomotive upon which Millholland did not make improvements, and it might be wondered at how he found time and means to carry on his extensive alterations and experiments. He was fortunate in being appointed master of machinery of the Philadelphia & Reading Railroad in 1848. His chief aim seems to have been to produce a locomotive that would burn anthracite satisfactorily and also to effect such improvements in the design of locomotives as to make them capable of hauling heavier trains than anything accomplished at the time he did his work. He was eminently successful in both directions, and among the early engineers whose thoughts gave the best form, and produced the greatest force in the application of steam to land transportation, there were few more earnest and successful workers than James Millholland.

Questions Answered

GOOD BRASS POLISHER.

76. R. McR., Toledo, Ohio, asks: What is the best method of polishing brass so that it may remain the same as when it came from the shop?—A. A solution of oxalic acid, that is, oxalic acid mixed with water, will speedily remove any tarnish on

brass. The acid should be washed off with clean water and the brass rubbed with whiting powder and chamois or other soft leather. The careful washing of the brass is important, as the atmosphere quickly tarnishes brass if any of the acid is left upon it. Spirits of turpentine or sweet oil rubbed in with a soft cloth helps in resisting the atmospheric action on all polished metals.

WHO WAS CHORDAL?

77. S. Y. B., St. Paul, Minn., writes: I notice that you occasionally name "Chordal," who appears to be a writer of some merit. To paraphrase the words of our eminent speaker, "who is Chordal, anyhow?"—A. Some twenty-five years ago James W. See, of Hamilton, O., wrote a series of letters under the pen name of "Chordal" to the *American Machinist.* They were celebrated for wit, wisdom, good sense and sound mechanical philosophy. They were published afterward in book form and are for sale in this office, price $2. The mechanic or engineer who has failed to read Chordal's Letters has missed a great treat. Intellectually and from a business standpoint he has missed much instruction.

EARLY FULL PORT OPENING.

78. C. O. F., Salem, Mass., asks. would there be any economy in the operation of a locomotive by using a device that would give a full port opening at 2 ins. travel of piston and would an engine equipped with such a device have advantage in pulling her load over those that have a longer piston travel before getting a full port opening, it being understood that with a device of this kind we get an early release of steam from exhaust side of the valve?—A. Yes there would be a decided advantage in such an arrangement. In stationary practice the Corliss valve gear does the very thing you speak of and in locomotive practice the Walschaerts valve gear is an endeavor to do the same thing. The Baker-Pilliod valve gear, concerning which we have printed several articles in our Applied Science Department, does this very successfully. Read the articles referred to in the September and in this issue of RAILWAY AND LOCOMOTIVE ENGINEERING.

COMPRESSED STEAM LOCOMOTIVE.

79. D. G., Dayton, O., writes: The other day I was asked a question relative to a compressed steam locomotive. I gave the man as intelligent an answer as I could, telling that engines of this kind were in existence, but as to the principle I was unable to give him any information; and I am now writing to ask you if you will enlighten me on the principle of this kind of a locomotive. I would be glad to have all the information you can give me.—A. You probably refer to compressed air locomotives, which are used for special purposes such as mine haulage or in small tunnels where the headroom is restricted and where the atmosphere may not be vitiated by smoke or steam. Such a locomotive carries a strong tank instead of a boiler, and this tank is filled with compressed air at the charging station up to a pressure of perhaps 500 lbs. or more and is then capable of working alone for several hours.

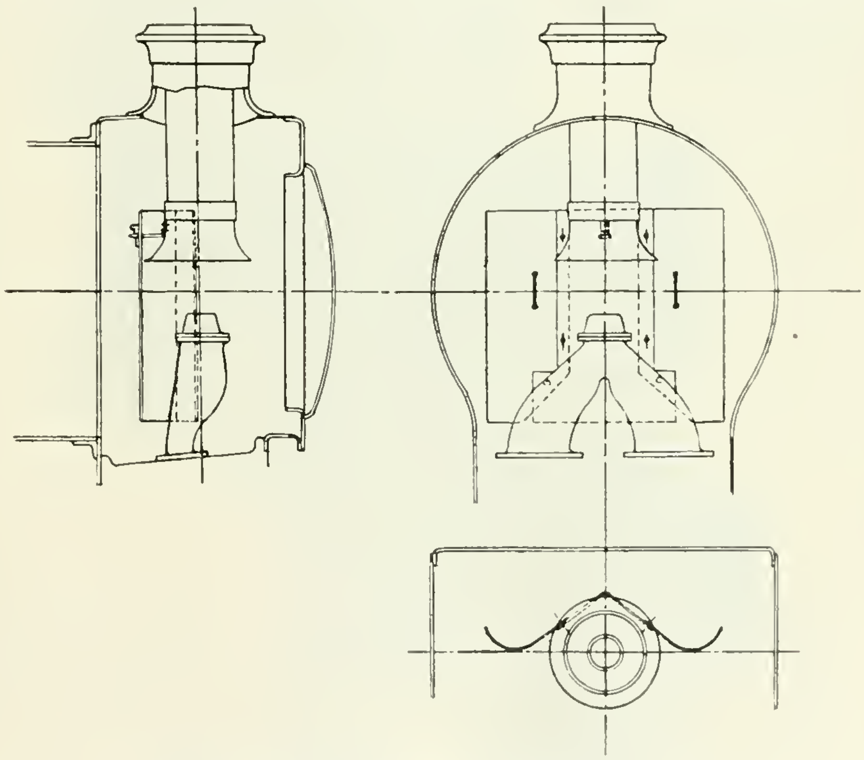
English Spark Arrester.

We are accustomed to think that owing to the dampness of the English climate and the character of the fuel used on many of the railways of Great Britain, that spark arresting devices are not much needed on the other side of the Atlantic. The assumptions are partly negatived by the fact that Mr. W. H. Ivatt, locomotive engineer of the Great Northern Railway of Doncaster England has been making some experiments for the purpose of reducing the number of live sparks thrown out of the smoke stack.

Writing to RAILWAY AND LOCOMOTIVE ENGINEERING on the subject, Mr. Ivatt says: "The experiments have been carried out more with the idea of reducing sparks than for coal consumption, but as far as we have got I do not think the spark arresters are having a bad effect on the coal consumption, but we do not yet know enough to be certain on this point."

The arrangement shown in our illustration has been fitted to one of the Great Northern 8-coupled shunting engines. It consists of a curved plate placed at the back of the blast pipe. This spark arrester is the outcome of a long series of carefully conducted experiments with a variety of appliances. This form of arrester which is a solid plate against which the sparks strike appears to be the most satisfactory form yet tried on this railway. As Mr. Ivatt very truly says each smokebox is a law unto itself, and the curve of the plate has to be altered to suit different engines, but the principle is the same in all.

The action of the arrester appears to be to cause the sparks to be thrown against the plate and deflected in their course before they are carried out of the stack by the action of the blast, and it is the knocking about and the delay of their exit that kills them.



SPARK ARRESTER ON THE GREAT NORTHERN OF ENGLAND.

The alteration in the curve of the spark deflector is occasioned by the varying degree of steaming ability possessed by each engine to which the device has been applied.

Mr. A. Agathocles, an old subscriber to RAILWAY AND LOCOMOTIVE ENGINEERING and for years engineer in chief of rolling stock of the Athens-Pirec-Peloponése Railway, has resigned that position to take charge of the Bureau des Travaux Techniques, Athens, Greece. Mr. Agathocles is interested in receiving information concerning the manufacture of war material, gasoline motors and other classes of American machinery likely to find a market in foreign countries.

Air Brake Department

Conducted by G. W. Kiehm

Correcting Air Pressures.

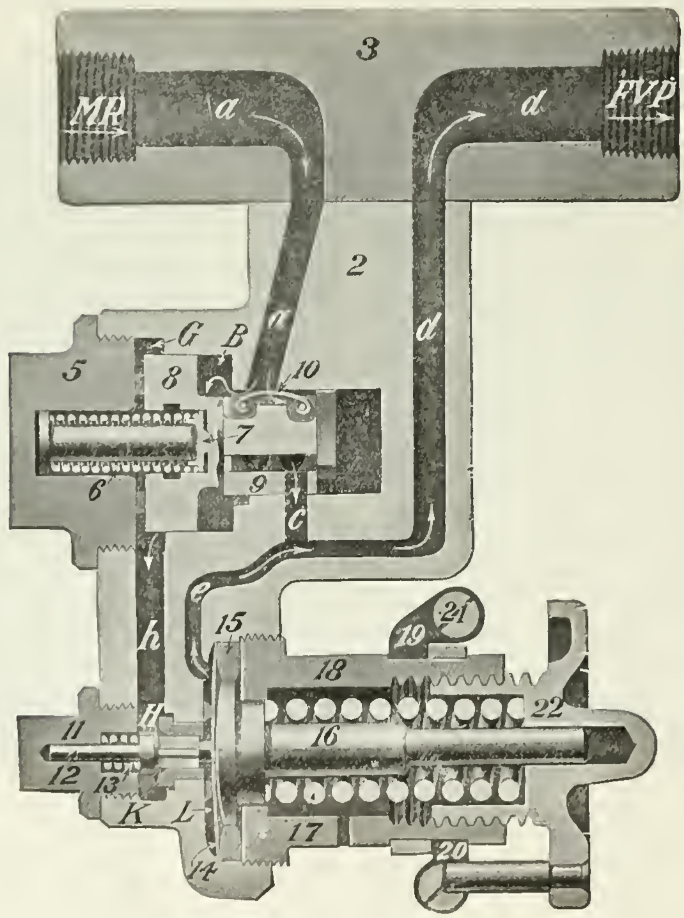
Much that is written on air brake subjects has been thoroughly threshed out by some classes of railway employees but the same subject may be of interest and benefit to another class, and often the same subject presented from a different point of view creates renewed interest. Air brake men are always interested in any discussion of air brake matters, as they have usually derived their knowledge from various, and sometimes unexpected, sources. They do not despise an opinion, no matter how poorly expressed, but are always open to conviction and always ready to entertain a suggestion regardless of where it originated.

It is of course useless to present anything concerning the correction of air pressures or the adjustment of the pump governor and feed valve of the brake equipment on a locomotive to those who know all about it. The operation is so simple that it merely consists of screwing up or slacking off the adjusting nuts of the pump governor or feed valve when those parts are in perfect condition, but when they do not regulate the pressures they are intended to regulate, cleaning has usually to be resorted to, and it is the adjusting after cleaning or repairing that the following remarks apply to:

It is difficult to decide what a roundhouse test should consist of, if there is a more rigid back shop test, for if the governor or feed valve is not in fit condition to leave the repair shop or pass a back shop test it is not in a fit condition to leave the engine house on a locomotive. Both valves are designed to restrict to a certain figure, the pressures they govern, yet allow a very narrow margin of variation in those pressures and allow them to be accummulated as promptly as the size and construction of the parts will permit.

Any leakage from the threaded and fitted parts should not be permitted and leakage from the governor drain or waste pipe, previous to the time the air pressure moves the governor piston, is unnecessary. It is not particularly wasteful of steam, but tends to drain away a large portion of the oil that should pass to the pump. Leakage of air from this point after the governor piston has moved and closed the steam valve, is from the governor piston packing ring and becomes excessive and wasteful long before the governor becomes inoperative from that cause. If this leakage is allowed to continue it increases in volume and eventually the governor does become inoperative. One of the relief ports in the neck of the governor should always be plugged, and it should always be the excess pressure top. By adopting this plan one avoids confusion by sometimes having both ports plugged or both ports open instead of one. There may be said to be four drain or waste ports in the S. F. 4, governor the size of two of which is very important. The size of the other two is not of so much consequence. The waste port in the steam body is ¼ of an inch and that in the spring box above the diaphragms of the high pressure top, about 1/16 of an inch, but the one through the steam valve should be exactly 1/16 and the relief port in the neck or diaphragm body 1/32 of an inch. There should be no leakage from the relief port up to the time the diaphragm is raised by air pressure and there should be no leakage from the port of the spring box at any time. Leakage from the latter point is from or past the diaphragm and usually because the spring box and diaphragm body come together at their threaded parts before the lower end of the spring box can force the diaphragm ring firmly against the diaphragms and shoulder upon which they rest.

When the leak occurs in the maximum pressure top it can escape at the waste port without doing any harm, but when it occurs in the excess pressure top it can enter the feed valve pipe and the brake pipe. This is practically a leak of main reservoir pressure into the brake pipe. This leak should be tested for when the governor is being cleaned and at a time when the upper pipe is disconnected and when there is air pressure under the diaphragms. A leak past the diaphragms of the maximum pressure top often results in the spring box being drawn down on the diaphragm body so tightly, in an effort to stop the leak, that the diaphragm



FEED VALVE, OPEN.

portion is practically ruined while filling the upper, or threaded end of the diaphragm body slightly, all other parts being in good condition, would correct the disorder by allowing the spring box to be drawn down far enough to force the ring against the diaphhagms properly.

In air brake work as in everything else there is a right way of doing things and a way that will pass. In adjusting the air pump governor it should be partly done and tested at a vise bench with an air connection and finished by the air gauge on the engine. In assembling the air portion of the governor at a vise bench after cleaning or repairing it is well to bear in mind the following.

That the relief port is 1/32 of an inch. That the diaphragm valve is not perfectly rigid and can be moved.

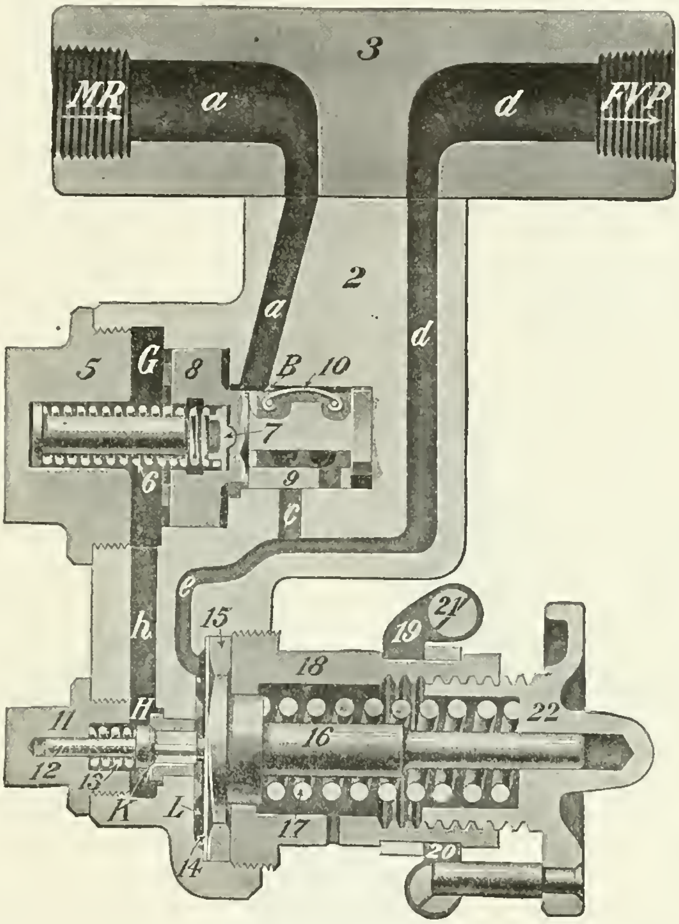
That the diaphragms and ring are perfect and that the spring box is screwed into the diaphragm body hand tight and after the air connection is made and the air turned on it can be tightened down with a wrench until there is no leak at the waste port in the spring box. This prevents the spring box from holding the diaphragms too rigidly, which would render the governor less sensitive.

It should then be observed that the diaphragm valve has sufficient lift by noting the volume of air escaping through the lower opening in the body. The adjusting spring should then be put in and the adjusting nut tightened down until the tension on the spring equals the air pressure. The number of pounds air pressure, and the distance the adjusting nut must be screwed into the spring box to accomplish this should also be observed, and the diaphragm valve should open wide and close off perfectly in one fourth of a turn of the adjusting nut.

If the foregoing is closely observed up to the time the spring is put in, the sensitiveness of the governor will depend upon the condition of the spring, and if the spring has lost its elasticity the governor top cannot be sensitive to operate upon slight variations of pressure. Any permanent set in the spring can be detected by the distance the adjusting nut must be screwed into the spring box to attain certain pressures.

Of course the air portion of the governor can be cleaned and adjusted without removing it from the engine, but in doing this work at a vise bench and testing it, insures a correct operation and very often results in a considerable saving of time. When a disorder develops in the steam body it means repairs, and any repairs to this portion while on the engine is out of the question and in repairing and overhauling, a considerable saving of time is effected by the use of a reamer on the steam valve seat and having on hand a supply of faces off steam valves. It is of course useless to attempt to fit a piston ring in a worn bushing and when the cylinder is true the ring should be fitted tight enough so that by a circular grinding movement the ring can be ground to a bearing in the piston groove as well as to the cylinder. In assembling the parts and testing the steam body there is but little to be observed outside of leakage from the packing ring or from the body, or out of the drain pipe, and that the piston moves down far enough to close the steam valve and that it returns promptly to the end of its stroke when relieved of air pressure. If there is a tension of 20 lbs. on the spring of the excess pressure top of the governor, and the maximum pressure top is adjusted to carry 140 lbs., the governor is provided with an automatic adjustment and permits of a 20 lb. excess pressure in the main reservoir regardless of the brake pipe pressure, and this part needs no further adjustment until it becomes defective.

The brake pipe pressure is adjusted by regulating the hand wheel of the feed valve to 70 lbs. pressure and clamping the stop back of it then to 110 lbs. and tightening the screw in the clamp ahead of the pin on the wheel, the two stops limiting the movement of the hand wheel, allows the high speed brake to be set, or allows a change to low pressure whether the boiler is under steam pressure or cold, and is accomplished in an instant by a slight movement of the hand wheel on the feed valve. The brake pipe feed valve is intended to maintain brake pipe pressure at a certain figure rather than to restrict it to that figure and it should be subjected to, and put in condition to pass a very rigid and exacting test before being put in service. The importance of the feed valve should not be underestimated, the amount of pressure carried in the brake pipe is very important and the feed valve controls it. After cleaning or repairs the feed valve should be tested on a shop test rack made for the purpose and in such a manner that the feed valve to be tested can control a considerable volume of air pressure. It should be placed on this rack after cleaning and the spring box removed and after the pressure is turned on and the blow at the exposed port *c*, stops it should be tested for leakage, there must be no leakage from the cap nuts, from the flush nut, or from the exposed regulating valve. Any leakage from the port *c* comes from the slide valve. After all parts are free from leakage the dia-

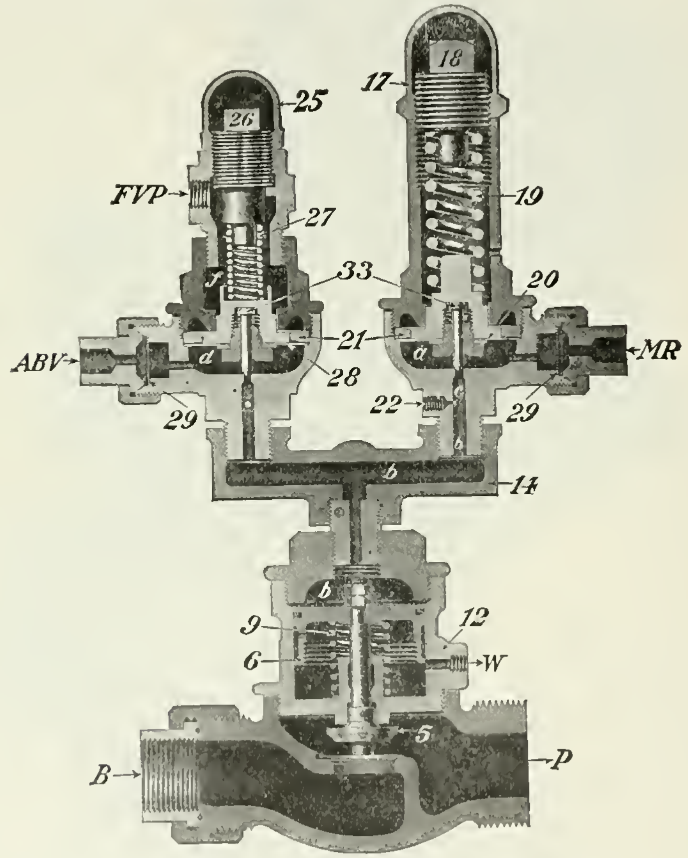


FEED VALVE, CLOSED.

phragms should be put in place and the spring box screwed up. If this results in an increase of pressure in the controlled volume of the rack, the valve must again be tested for leakage and the length of the regulating valve be noted. It should be flush with the shoulders against which the diaphragms rest. If correct the spring can be put in and the adjusting nut screwed up until the feed valve maintains 70 lbs. pressure. It must then be tested for sensitiveness by making a slight leak in the controlled volume and observing the movement of the hand on the gauge, it should move back and forth slightly or fluctuate but not allow a variation of more than 2 lbs. in the controlled volume. If it does allow more it indicates that the supply valve piston is too loose a fit in the bushing

It might be well to add here that the wings on the supply valve piston act as a guide to keep the piston moving back and forth squarely through the bushing, and in facing off the valve and seat it must be kept in line with the piston bushing. In facing off the valve seat a fine file the width of the valve seat, and with two safe edges can be used with advantage, and in scraping and rubbing the slide valve to a perfect bearing on the seat it can be held squarely to seat by making a small dent with a center punch on the inside of the slide valve, and using a short rod with a pointed end turned to a packing hook form. This prevents the valve being held out of square or tipped off the seat or tilted on one edge when being rubbed in.

No special tool or combination square



SECTION OF SF-4 PUMP GOVERNOR.

or that the regulating valve is too short, or that the adjusting spring has lost its elasticity, but before condemning the spring it should be tested in a feed valve that is known to be in good condition. Another effect of too loose a supply valve piston is for the pressure to rise to 65 or 66 lbs., then slowly creep up to 70 lbs. If the controlled volume rises to a figure somewhat beyond 70 lbs., then slowly drops back to 70 it indicates undue frictional resistance to the movement of the supply valve piston or the use of a two heavy or thick lubricant on the piston and in the piston bushing.

is required to keep the slide valve seat in line with the piston bushing. With the flush nut and supply valve piston cap nut removed, the piston bushing end of the feed valve body can be placed on the edge of a surface strip or any perfect surface and a small scale passed through the slide valve bushing which is then in a vertical position. The end of the scale held squarely against the surface strip will form a perfect right angle and the edge of the scale will show the correct line the slide valve seat should have. When out of line, the end of the slide valve seat will be found to be the highest point and should be filed down squarely all the way across to keep the piston from being tilted which would bind it in the bushing during its movement.

The controlled pressure building up slowly during the test may be due to a partly closed port in the feed valve body. Often pieces of cork or gum and dirt are found in the ports. The ports should be positively known to be free from any obstruction when the valve is tested.

The feed valve body alone without any movable parts can be bolted to the rack in a reverse position, or upside down, and by the air pressure turned on. The port *i* blown out then bolted up in its proper position and the port *f* blown out, then the flush nut and supply piston cap screwed in place and the port *e* blown out and the port *h* at the same time. It is sometimes necessary to drill out the latter ports, but in drilling through and removing the plugs in the ends of the ports in the valve body a 3/16 drill will be found to be of the correct size.

What has been said of the feed valve applies to the reducing valve also, as the only difference between them is in the adjusting portion and it should have the same thorough and careful test, for to insure a correct operation of the signal whistle the valve must be in perfect condition; sensitive as it is possible to make it; absolutely free of leakage from the slide valve and regulating valve, or from any outside point to the atmosphere.

Young engineers having to all appearances drifted into other occupations in the past two years has caused, it is said, a scarcity of skilled draughtsmen. The demand for them has been increased by the work of municipalities, architects and various corporations, where the compensation is said to be better than can be obtained from railroads. As a result, with a return of activity in manufacturing, the number of positions reported available exceed the supply of competent men.

The greatest demand seems to be in connection with structural iron, the largest establishments engaged therein making the most strenuous effort to get such men. The opportunity afforded for varied experience and promotion is exceptional. Railways, therefore, are reported to be having difficulty in getting mechanical draughtsmen, and all this is encouraging for the prospective graduates of engineering schools.—*New York Commercial.*

The National Society for the promotion of Industrial Education is very active in the promotion of trade schools. The society is going to hold a convention in Milwaukee on December 1-3.

Electrical Department

Electro-Pneumatic Interlocking.

By W. B. Kouwenhoven.

The earlier systems of interlocking were operated entirely by hand power, and are known as mechanical interlocking systems. But as the size of the terminal to be governed by interlocking grew, hand power became unable to do the work, and what is known as the electro-pneumatic system of interlocking was developed. This system operates all switches locks and signals by compressed air, and controls the application of the compressed air to the switches and signals by electricity. The latest system of interlocking is the all electric system which not only controls the operation of the signals and switches by electricity, but operates them by the same power. These three systems of interlocking are all extensively used today. In this article we will briefly consider the construction and operation of the electro-pneumatic interlocking system; the all electric system will be discussed in a later issue.

Interlocking is defined by the American Railway Association as: "An arrangement of switch, lock and signal appliances so interchanged that their movements must succeed each other in a predetermined order." This definition applies equally well to all forms of interlocking. The essential parts of any interlocking plant are a group of levers concentrated at one point for the operation of certain switches, derails, locks and signals. These levers are so arranged as to make it impossible to give clear signals over conflicting routes. When a movement of a train or a given track is desired, it is necessary to set all switches and derails in their proper positions, and then to lock them before the signal governing the train movement can be cleared.

Locking of Switches and Derails.

The locking of switches and derails is accomplished by a bolt or dog thrust through a hole or a notch in a bar that is attached to the points of the switch. If, for any reason, the switch does not go to its normal or reverse position it is clear that the bolt cannot be thrust through the hole in the bar and the switch locked, thus indicating to the tower man that the switch is not in its proper position. Usually the signals controlling the movements over such tracks are also made to lock the switch by a second bolt lock which makes it impossible to clear the signal unless the switch is in the proper position. At each switch there is placed a bar which lies against the outside of the rail and about one-half inch below the top. This bar is known as a detector bar, and works in connection with the lock on the switch. It must be raised above top level of the rail before the switch can be unlocked, thus making it impossible to unlock and throw a switch while a train is passing.

Interlocking Parts.

The interlocking parts of all types of interlocking machines are similar in construction, the only difference being in size and weight. Interlocking between levers is accomplished in the tower by means of what are known as drivers, bars, dogs and cross locks, which are arranged to slide and to fit into each other in such a manner that the levers must be thrown in a regular order, and the throwing of one lever releases the lever that is to be thrown next. When the throwing of one lever depends upon the position of ten or more other levers, the arrangements of the interlocking parts become a very difficult engineering problem.

Mechanical Interlocking Machines.

Mechanical interlocking machines are all worked by hand power and are connected to the switches and signals by lines of piping and wire. They require considerable effort to operate and take up a large amount of space not only in the tower itself, but also in the yard where the pipes and wires must be run. The most serious objection to them, however, is the fact that with the small stroke available for throwing and locking a switch, the lever may be thrown completely over, but by lost motion, the switch may not be in position, and the fact that the position of a switch may not be the same as that indicated by its lever because of a broken or or buckled pipe line.

Electro-Pneumatic Interlocking.

Electro-pneumatic interlocking has many advantages over mechanical interlocking. It is much quicker in operation, thus making possible extremely rapid movements of trains on congested tracks. It occupies about one-fourth the space, and requires but little effort on the part of the tower man. In its simplest form it operates the switches, locks and signals by compressed air which is admitted to and released from air cylinders by valves controlled by electro-magnets. The electrical circuits for these magnets are made and broken by the movement of levers in the interlocking machine which is in the tower. The movements of all switches, locks and signals operated by the levers are repeated back to the tower by electricity, locking and unlocking these same levers as the position of the switch may indicate. This gives positive indication to the tower man of the positions and movements of all switches, locks and signals which must correspond to the position of the levers operating them.

Power Plants.

The power plant is usually located in the lower story of the tower, which is generally two stories in height. The equipment includes the air compressing and electric plants for the system. The air compressing plant consists of two duplicate air compressors driven by either gas engines or motors, a set of cooling coils and a main air reservoir. The air from the air compressors passes through the cooling coils, where it is reduced to atmospheric temperature, then on to the reservoir, where the moisture is deposited. The reservoir is provided with a stop cock, through which the water which thus collects can be drawn off. The electrical equipment also includes two duplicate generators driven by gas engines or motors, which supply current to two sets of storage batteries. Only a very little current is required to operate the plant. If the interlocking machine is installed at a terminal or other place where there is already an air compressor plant, the compressed air is taken from the existing plant.

Electrical Wiring.

The electric wires which lead from the tower to the various switches and signals which they control are run in fine conduits usually placed about 6 ins. above the ground to insure freedom from moisture. The conduits are provided with frequent terminal boxes in which all splices are made, no splices being allowed in the conduits themselves. The wires are run in five conductor cables, each individual wire being covered with a different colored cotton insulation, in order that it may be readily distinguished from its fellows. There are five wires leading to each switch, having the following names: lock wire, normal wire, reverse wire, and normal and reverse indicating wires. There is also a common return wire. The signals require but two wires.

SWITCH AND LOCK APPARATUS.

The switches are operated by pistons and rods in cylinders varying from 5 to 7½ ins. in diameter, according to weight to be moved. The cylinders with their attachments are fastened to iron plates which are bolted to the ties. The stroke of the cylinders is 8 ins. the first 2 ins. throw the detector bar, the next 4 ins. throws the switch and the last 2 ins. lock it. The admission of air to the main cylinder is controlled by a D-slide valve, similar to the ordinary locomotive slide valve. The slide valve lies between the ends of two small plungers which are connected to two single acting cylinders. These cylinders are each provided with a separate magnet and pin valve for operating them. One of the magnets is called the normal magnet and is operated by current from the normal wire, the other is called the reverse magnet and receives its energy from the reverse wire. In practice one of these wires is always energized, consequently pressure is always against one or the other of the pistons that move the D-slide valve. For additional safety a bolt lock is slipped into a hole in the top of the D-valve. This bolt lock is held in by a spring pressing against a balanced piston. A lock magnet, as it is called, which is connected to the lock wire, operates a pin valve which releases the air above the piston. The pressure of the air below raises the piston, compresses the spring and withdraws the bolt lock.

INTERLOCKING MACHINES.

The interlocking machine is placed in the upper story of the tower. Almost all electro-pneumatic interlocking machines are provided with a track model, which is a miniature reproduction of the yard. On the track model all switches, derails, and signals are shown, and numbered to correspond to the handles governing them, and all tracks are designated by their proper names or numbers. The switches and signals on the track model are mechanically connected to their levers, and show to the operator what route he has lined up.

The operating levers point alternately up and down, and are numbered from left to right. Those pointing up have odd numbers and control the switches. Those pointing down control the signals and are even numbered. Switch levers are inclined normally at an angle of 30 degs. to the left of the vertical and are operated through an angle of 60 degs. to the right. The signal levers point normally down and are capable of operation either to the right or the left. Movement in one direction clearing the inward signal, in the other the outward. A set of mechanical interlocking parts are provided which are identical in every respect except in weight with those of the mechanical machine.

Each lever is attached to a horizontal shaft which performs three distinct functions; first, it drives the mechanical interlocking parts by means of a segmental gear and a rack; second, it rotates a hard rubber roller which carries contact bands for opening and closing the various electrical circuits, and, lastly, two projections or segments which engage two catches or latches which are controlled by two magnets called indicating magnets. The object of these catches is to prevent the tower man placing the lever in the extreme position until the switch or signal has completed its movement. The action of these catches is as follows: The operator in throwing a switch from normal to reverse moves the switch lever to the right until he is stopped by the reverse segment coming up against the reverse latch or catch. The switch in following the movement of the lever closes what is known as a circuit controller, which is connected through the reverse indicating wire to a magnet controlling the reverse latch. Upon the closing of the circuit the magnet releases the latch and allows the operator to place the lever in the extreme position indicating to him that the switch has followed the movement of its lever. Each switch lever has two of these segments, a normal and a reverse, with their normal and reverse indicating magnets, and each signal lever, one.

In addition to this there is on switch levers a loose section of hard rubber at the back of the rubber roller which carries two contacts. This loose section only moves during the last 10 degrees of each lever movement. Underneath the rubber rollers there is a hard rubber plate which carries contact springs of phosphor-bronze which rub on the contact bands of the rollers. The arrangement of these springs and the contact bands is sometimes known as the "combination." There are five bands to each switch lever, three of which press on the roller and are connected to the lock, normal and reverse wires, and two which press on the loose collar, and are connected to the normal and reverse indicating wires. Two contact springs are provided for each signal. The entire machine is inclosed in a hard wood case, provided with glass windows through which the operation may be observed, and which may be readily removed when repairs are necessary.

SWITCH OPERATION.

On throwing a switch from normal to reverse, the towerman moves its switch lever from left to right. The first movement closes the circuit of the lock magnet through the lock wire and withdraws the bolt from the D-slide valve as was explained. Continuing the movement, the circuit through the reverse magnet is next closed and at the same time the circuit of the normal magnet is broken releasing the air back of the piston. Energizing the reverse magnet admits air behind the piston of the reverse plunger, which drives over the slide valve, thereby admitting air to the reverse side of the main piston and at the same time opening the other side to the atmosphere. The lever has now been brought up until the segment stops its further progress by coming into contact with the reverse indicating latch. When the switch has completed its movement of unlocking itself, throwing the detector bar and locking itself in its reverse position it closes what is called a circuit controller which energizes the magnet and releases the indicating latch, permitting the tower man to move the lever to its extreme position. This breaks the lock magnet circuit and allows the bolt lock to lock the valve in its reverse position. The last 10 degrees of the movement carries with it the loose rubber collar mentioned above. This breaks the circuit of the reverse indicating magnet and closes that of the normal indicating magnet, thus putting everything in readiness for the throwing of the switch back to normal.

Sometimes two switches are thrown by a single lever. In this case the indicating circuits are led through both switches in series making it necessary for both switches to be in their correct position before the lever can be moved to its extreme position. As the lever is moved from normal to reverse the segmental gears drive the rack and mechanical interlocking parts, unlocking the next lever to be thrown.

The signal lever as stated above is provided with a segment and a latch which engages it. The latch is controlled by a magnet that is connected with the lock magnet of the switch. When the switch is in its proper place the magnet is energized and the latch releases the segment, holding the signal lever. The movement of the lever closes the circuit of the electro-magnet that operates the pin valve on the air cylinder, admitting air to the cylinder and clearing the signal. The mechanism throughout is very carefully made and adjusted, as a very small amount of lost motion would cause trouble.

Traveling Engineers' Convention.

(*Continued from page 470.*)

In fact, we all understand that our engineers are usually very intelligent men, and it is useless to run up against a man and tell him his record is very poor when he can turn around and tell you, "I know that I am not getting a fair show at the coal chute. I came in last trip and got a check for seven tons, and I know I only required five." You take it up with the coal man; he was 500 tons short and had to make it up somewhere. Somebody had received the benefit of this 500 tons shortage and somebody had to suffer for it. Unless the coal is weighed or measured, and then weighed or measured on engine, I do not see where you have any direct basis to figure the amount of coal you have or the tonnage hauled per ton of coal. I realize as well as anybody that if we had some accurate method of stating the number of tons of coal consumed, it would be worth a great deal of money to the company and would certainly be a great advantage to the traveling engineer in bringing about results; but with the method employed on most roads it is simply a great big guess.

SCALE EFFECTS.

Continuing Mr. Meadows said: There is one question I wish to ask Mr. Wright. I notice where he mentions about the collection of scale, the paper reads: "As the scale formation increased in thickness we were forced to gradually reduce the size of the nozzle, with the resultant increase of coal consumed." That does not occur to me as agreeing with my experience. I presume that the nozzle in this case, the opening, was reduced simply because the engine was not steaming.

My experience has been that an engine that does not steam is a wasteful engine. I have always found that a fireman, if engine is getting to the uneasy point, hardly holding her there, always goes to the coal pile and increases the amount of the coal put in, when possibly he should decrease it. It has been my experience that reducing the nozzle generally increases the consumption of coal.

No doubt there are many roads that are running with an extremely small nozzle, and for quite a long time on the Michigan Central we labored under the delusion that the engine had to have a certain sized nozzle whether the engine steamed or not. But we got out of the rut. At the present time we have pretty good steaming engines; hardly ever have a steam failure; but we do not run with as large a nozzle as we did a few years ago. I can cite cases where engines have been running along perhaps just merely making the steam. The engineman would come in and state the engine does not make sufficient steam to make a good run; he could simply nurse the engine along and make running time and perhaps make up five or ten minutes. Invariably in this case a slight reduction in the nozzle brought in better time, better steaming engine and economy in the fuel consumed. On the division where I am located we had one engine that would come in every morning on a very heavy passenger train. Each morning the engineer reported the engine did not make sufficient steam to make a good run. We could not find any defects in the engine; everything apparently in first class condition. That continued for a number of trips. Coming down one morning (possibly the coal was not quite so good, it was in the winter) the engine failed for steam. Time lost, about twenty minutes. On a trunk line like the Michigan Central that means a good deal; there was a good deal of correspondence. The foreman acquainted me with the facts. I knew pretty well the condition of the engine and I asked him to bridge the nozzle. He did so. I also asked the engineer to make me a clear report when he came back of the performance of the engine. That engine had 21 x 26 in. cylinders. It was running with a five and five-eighths nozzle. We had other engines that possibly could do pretty well with that size of nozzle up there. The foreman put this bridge in the nozzle and the engineer returned the next morning and stated that the engine had never done better; it was light on the fuel, apparently used less water and made any amount of steam, and he had made a better run than he had made in the month or two that he had been running the engine previously. There might be a good deal more history to that which does not bear on this case, but the point comes out that it is a question in some modern engines whether an extremely large nozzle is always beneficial. I am inclined to believe that a certain amount of back pressure or compression is a benefit.

INDIVIDUAL COAL RECORDS.

Mr. John McManamy, of the Pere Marquette remarked: I would like to reply to our friend from the Duluth, Mesaba & Northern road, in regard to the invidual fuel records, that they are not being kept on a great many railroads at the present time. It would be a benefit if we were able to keep individual fuel records, but that again brings up the question of dollars and cents. Where we are using the link belt coaling station or the Adams & Westlake coaling station, and each chute will consume from 80 to 100 lbs., it is an utter impossibility to get the exact amount of coal placed on each locomotive except by weighing the tanks before they are coaled and weighing them again after they are coaled. That would mean the installation of a pair of scales at the coaling station and the expense of weighing the coal. While it is true we do not get the individual coal record, we do get the exact amount of coal that is burned by the locomotives on that division, and I believe now is the time that it is up to the road foreman of engines to appeal to the pride of all the men and work up a friendly rivalry on the part of the men to induce each engineer and fireman to save a little fuel on each trip, and the pounds saved there will make a decided improvement in the fuel consumption during the current year.

HEATING FEED WATER.

I notice in this paper that he stated he is heating the water in his heater up to 170 degs. temperature and using a pump to put the water into the boiler. I believe he is making more saving on that than in any other one line. While it is a matter of fact that we haven't any injectors today that will put water into the boiler at 170 degs., we have injectors that will put water into the boiler at 125 to 136 degs. One British thermal unit is the amount of heat that is necessary to raise the temperature of one pound of water from 39 to 40 degs. Fahr. or one degree higher. If we could raise the temperature from 39 to 89 degs., or 50 degs. higher, and we are perfectly safe in raising it 50 degs., we would save 50 British thermal units for every pound of water that was fed into the locomotive boiler, providing we heated this water with exhaust steam that was not costing us anything to heat the water before it passed into the boiler. One gallon of water weighs 8⅓ lbs. and would require 416½ British thermal units to raise its temperature 50 degs. A conservative estimate of the amount of water used on a passenger train would be 100 gallons per mile, and on a freight train would be 200 gallons per mile. By raising the temperature 50 degs. it would save 46,500 British thermal units per mile in passenger service and 83,300 British thermal units per mile in freight service. One pound of pure carbon contains, and when properly combined with oxygen will give off, 14,500 British thermal units of heat. Raising the temperature of the feed water 50 degs. would mean a saving in passenger service of as many British thermal units as could be produced by the complete combustion of 321 lbs. of pure carbon, and in freight service of 643 lbs. of pure carbon if it were burned to complete combustion.

Now, it is well known that carbon is not burned to complete combustion. We do not have complete combustion in the locomotive firebox. There is not a road foreman of engines or an engineer within the sound of my voice at the present time that would think of throwing off of the tender of his locomotive 643 lbs. of pure carbon per mile. The best coal or the average coal that we are using throughout the country today is only sixty per cent. carbon, and by figuring the amount of saving that would be made in raising the temperature of the feed water only 50 degs., there would be an enormous saving to the railroads throughout this country.

EFFECT OF FIXING THE ENGINE.

Mr. J. F. Emerson, Central of Georgia, talking about scale on the flues and the size of the nozzle, said: We have got a traveling fireman here somewhere. We had a coal eater before we took it into the shop. We overhauled it. The engineer was making sixteen miles per ton of coal in passenger service. He was a good man and I knew it, but I thought he was not taking the interest he ought to take. He said, "Fix my engine like some other fellow's engine and I will get off the bottom of the list." I said, "All right, we will fix your engine." We took his engine in, gave him a new set of flues, started out 6⅛-in. nozzle, finally increased it to 6⅜ ins. and we ran him on a test where the coal was weighed to him in sacks and he made thirty-eight miles to the ton of coal between terminals and the coal was light burning coal; practically speaking, it was all carbon. We had another engine that made forty some odd miles between terminals. That engine nozzle was 6½ in. Before she went into the shop that engine made about twenty-five miles and the scale on the flue was ⅜ in. thick.

HARD WORK DEMANDS COAL.

Mr. Summers said: I am of the opinion that as to fuel and nozzle we have got to be governed by the conditions altogether. While some one has said that all coal is good, I find that some coal is better than others, and the conditions are different. Where you have a piece of territory where an engine is to be worked at maximum capacity for a long distance, it is necessary to have steam. In other conditions, where you have a piece of track where the engine can be worked with the shortest possible cut-off, you can use a little less steam. And us fellows that have 200 lbs. all the time, we have got to have steam, entirely regardless of coal. Mr. Roesch has spoken of two conditions we are up against, the reduction in rates and the increase of employees' pay, but there is another condition that we are up against too, that means more coal burned now than formerly, and that is dispatch. The public is demanding dispatch in passenger and freight service daily and the man that can hand over the goods is the fellow that gets the trade. We all want the trade. It is necessary for pay day, and naturally we have got to figure on getting the trains over the road with dispatch, whether we burn a little more coal or not, and I do not think any of us can be governed by any particular size of nozzle. Some men may be able to run a 6-in. nozzle with a 21-in. cylinder, but we can't do it.

Mr. Wright said: The gentlemen seem to be under the impression that we are using a smaller nozzle and sacrificing steam. We have to steam too, and we have got a dispatcher with a little red pencil that just delights in putting in the engine failures. We have some fast freights and passenger trains too that will compare with any ordinary railroad. We are handling trains right up to the capacity of the engine.

SAVING FUEL ON THE SANTA FE.

Mr. John M. Lynch, of the Santa Fe, said: I may try to explain our methods of handling fuel on the Santa Fe: Up to July, 1907, on a 1,000 ton-mile basis we consumed 254 lbs. of fuel. This was getting so high that our higher officials saw that the fuel proposition would have to have some attention. We organized a fuel department. Up to July, 1908, the first month that this fuel department took charge of the fuel, we consumed 226 lbs. of fuel to a 1,000 ton-mile. To-day we are consuming 209 lbs. of fuel per 1,000 ton-mile. This is due practically to close supervision. A monthly report is got out showing the number of ton-miles made by each engineer and fireman, the pounds of fuel consumed per 1,000 ton-miles and his gain or saving. I am sent a copy of this report, also a copy is placed in the engine room in a conspicuous place where each engineer and fireman can see his own record. I notice the engine or engineer that is below the average, and I aim to get after this engine or engineer as soon as possible and see if we cannot remedy the cause. However, all engineers have considerable pride and are anxious to have their record even above the average, and it has a wonderful effect, the placing this report in a conspicuous place. By this supervision of our fuel we have decreased the consumption eighteen per cent., saving the Santa Fe Company approximately a million and a half dollars in one year. We are adopting brick arches on all of our engines, which is making a wonderful increase. We are also adopting superheaters. In fact, we are using every means we know of to save a pound of fuel.

PRAISE FOR THE SUPERHEATER.

I would like to cite to you a test that was recently made in the last month with two tandem-compound engines. One was equipped with the two-stage superheater invented by our assistant superintendent of motive power, Mr. H. W. Jacobs. The other was simply a tandem-compound engine, both carrying the same steam pressure. Engine 901 was the engine equipped with the superheater. Engine 923 is the compound engine. The tonnage hauled on one trip by engine 901 was 1,327 tons. This was on a ruling grade of 113 per cent. The number of cars was forty-eight. 1,000 ton-miles, 109. Time on the road, six hours and three minutes. Number of stops, four. Delayed time, one hour and six minutes. Running time, seven hours and fifty-seven minutes. 152,400 lbs. of water consumed; 21,948 lbs. of coal consumed. Coal per 1,000 ton-mile was 201.3 lbs. That was the first test made by engine 901 with the superheater.

The next trip was made by engine 923 without the superheater. This engine had 1,250 tons, seventy-two cars; 1,000 ton-miles, 101.9. Time on the road, six hours and seventeen minutes; number of stops, six; delayed time, forty-nine minutes; running time, five hours and twenty-eight minutes; 168,750 lbs. of water consumed; 24,717 lbs. of coal consumed. You will see there the economy in the two engines on the consumption of water. You will see the saving on the fuel, as the engine with the superheater only consumed 21,948 lbs. of fuel.

Another test that was made on the 901: We had 1,328 tons. We consumed 157,550 gallons of water and 22,216 lbs. of coal. The next trip made on 923 with 1,176 tons we consumed 178,400 gallons of water and 26,133 lbs. of fuel. So you can see the advantage of the superheater. Both of these engines were equipped with brick arches. There were 201 and 205 lbs. of fuel used per 1,000 ton-mile on this engine with the superheater, compared with the tandem without the superheater 244 lbs. and 272 lbs.

EFFECT OF SAVING ONE SCOOPFUL IN 100.

Mr. Roesch rose to speak and said: I do not know that we, as traveling engineers, can take any credit to ourselves for any reduction in the amount of fuel consumed by an engine equipped with a superheater over one not so equipped. That credit belongs to the superheater and is aside from the present subject. That is something that, as I said before, the superintendent of motive power or management of the railroad must take up. We have got to save coal with the appliances that we have at our hands, which are the present-day locomotive and the fireman. If you go to your fireman and say, "Billy, if you were to save one scoopful out of every 100, I think we could raise your pay next year," I think Billy would save that one scoopful. On the road with which I am connected at present our fuel bill last year was a little bit over one million dollars. If Billy had saved one scoopful out of every 100 he would have saved the company $10,000, that is one per cent. I think he could even save two scoopfuls. I think the road foreman of engines in going over the road could instruct the fireman how to save at least two scoopfuls of coal that he has been throwing away. I believe also he could instruct the roundhouse foreman how he might save two scoopfuls of coal by shortening the drawbars between the engine and tank. He might also show the hostler how he could save a couple of scoops of coal by not putting so much on the tank. He might also show the engineer how he might save a little coal by handling the engine a little bit differently. In fact, there are hundreds of ways in which we could save coal with our present appliances and those are the appliances that we want to use.

LIES AND STATISTICS.

Now, I do not mean to decry any statistics or figures or anything like that that might be presented here today, but a good many of us have heard that axiom that Mr. W. E. Symons expressed one time: there are lies, damned lies and statistics. And, really, if you were to get right down to it, you will find one man claiming 25 per cent. saving on account of compounding. It is a very common thing to hear of a compound locomotive that saves 25 per cent. fuel. The feed water heater, we are told, will save 20 per cent. Now we are going to compound and get 25 per cent. compounding; we get 20 per cent. from heating our feed water; that is 45. Dr. Robert Gasby, who is an authority on superheating, says you can save 35 per cent. superheating. Forty-five and 35 is 80. Now we will get another little device on there and we will save 20 more per cent., which is 100. Then we will add on another device and then we will just stick our engine out back of the round house and start a coal mine. We are making coal now.

TON-MILE STATISTICS.

But speaking about these ton-mile statistics. Ton-mile statistics are all right, if applied under exactly similar conditions all the time and on similar roads or on the same territory. There is no question but that the statistics we have just heard show very excellent results; but I want to show you some statistics or tell you about some statistics that show up the peculiarities of statistics. As some of you may be aware, where I am located we handle the heaviest freight train in the world handled by one locomotive, 5,000 tons, handled by a Decapod locomotive, and that train goes over the road every day. The coal consumption one way, as shown by our performance sheet, is 490 lbs. per 1,000 ton-miles; but the coal consumption in the other direction is 2 lbs. per 1,000 ton-miles, by exactly the same engine, handling identically the same train over identically the same track, for the simple reason that it is up-hill one way and the engine handles empties, and it is downhill the other way, and she handles all loads. So it knocks the statistics in the head.

COAL SAVING SCOOP.

Mr. C. F. Thayer, of the Southern Railroad, said: The remark Mr. Roesch made about our not being in position to design the power, but that we could work on the wooden end of the scoop, is timely. We, of course, always instruct our firemen how to handle coal and how to handle it economically, and I was very much interested in a little test that was conducted about a month ago of a device to accomplish the purpose of having the coal scattered as it is placed in the firebox, simply a scoop designed to accomplish that. We conducted a test over that 1,000 miles of road on different engines. It showed a saving of from one to three pounds of coal per engine-mile.

EXPENSIVE ADVICE.

Dr. Angus Sinclair, editor of RAILWAY AND LOCOMOTIVE ENGINEERING, said: I think Mr. Roesch made some remarks about a certain publication I made at one time concerning smoke and its prevention. He was perfectly right in saying that I was a little previous, a little ahead of my time. I was on a certain railway for about ten days, watching the performance of the engines and they were doing the work practically without smoke, and I knew that they were doing the work very economically in the use of fuel. The one to a great extent follows the other I got out a description of what was done, published it, and I found that I was so much ahead of my time that I lost about 5,000 subscribers on account of it. The men were not ready yet for smokeless firing, but of course I did not think it was right of the firemen to drop my paper because I told them how firing surely could be done without causing smoke.

The fact is, the managers of a number of railroads were much more to blame for the punishment I received than the firemen were. These managers sent out orders that their firemen must fire without smoke, other men were firing without smoke on a certain road and there was no reason why their firemen should not do the same, and that aggravated the men. No extra facilities were provided for doing the work. On the road where I had been the officials did everything in their power to help the men to fire properly and smokelessly. On the other hand, the managers and superintendents who ordered their men to fire without smoke merely just gave the order; they thought that was sufficient. They did not think it was necessary to attend to the condition of the fireboxes or draft appliances, or see that they had brick arches or anything of that sort that they had or were doing on the other road. They just gave the order, and it caused a great deal of feeling against me, and I guess it has not altogether gone yet.

LESS SMOKE NOW.

In spite of all that, there has been a very great improvement in the condition of engine firing since that time, as any one can see who goes and looks at the locomotives on any road in the country, I don't care where it is. There has been a great improvement in that respect which has been growing in the last ten years.

I think, however, when general officers demand greater economy in fuel that they should start themselves to help out the economy. On the majority of roads, I guess, coal is bought without any consideration of its quality or of its condition for steam making. A ton of coal is a ton of coal, no matter what heat giving properties it contains, and I do not know of any method of purchasing valuable supplies that is done so blindly and so ignorantly as the purchase of coal is. You can take two coal mines, the coal of one contains a fairly high percentage of carbon and the other quite low; yet those who purchase the coal will pay as much for the low quality as they do for the high, and they expect the engineman to make as good records with bad coal as those who have the finest coal that can be bought in the country.

IMPROVE METHODS OF COALING.

I have always thought that the practice of coaling engines is responsible for a great deal of the carelessness about saving fuel. When there is no method of telling how much coal a man has received it is not human nature to expect that he would show very much care in the use of it. It is thrown on wholesale and the tendency is to use it wholesale. If railroad companies would go to the expense of weighing their coal they would find the practice more conducive to economy than anything yet tried. It is done in many places. I do not know any road where it is practised very particularly in this country, but it is done in other countries; it is done regularly in some places; they know to a very few pounds how much coal is put on to the tender and how much coal has been used. When it is so very important that coal saving should be effected, I think it would pay every railroad company to put a set of scales at each coaling station and see that the quantity of coal put on the tender is properly recorded. Of course, that would require a little outlay in the first instance; not so very great considering the saving that is possible, but it would show the men that those at the head of the company are trying to have the coal question treated intelligently and honestly. "Be more saving of your coal, use less coal, use less coal," it is nonsense that such expressions should be shouted all the time when no one can tell how much coal you are getting.

EDUCATE ENGINEMEN AND TRAIN DISPATCHERS.

Mr. J. D. Benjamin of the Chicago & North-Western said: I think Mr. Roesch hit the mark when he said the road foreman should educate the engineer to operate his engine more conomically and educate the fireman how to save his coal; but the question arises, can he educate the train dispatcher how to co-operate with the engineer and the fireman to save this? Now the fireman, as a rule, is an intelligent man and he is going to pay attention to what the road foreman says, and he will try to save that scoop of coal if he has any interest in his position, and I believe he has. When he gets to the next station and waits on a side track for a belated train he has wasted that much coal and a good deal more.

GUESSING AT COALING STATIONS.

When he gets to a coal station he gets to a chute, the spout is dropped down the same as a water spout. He asks the man, "How many tickets do you want?" He can't understand what the man says who is operating the coal tank, because he doesn't speak the English language. What is the result? He tears off a bunch of tickets, hands them up and off he goes. The saving of fuel is not all on the engineer or fireman. It is not all in the drafting of the engine. It is not in the roundhouse or scale on the flue. We must have co-operation from the operating department, and I do not know whether it is the province of this Association to bring about a co-operative action on the part of that department to assist us in economy in fuel, for which we are working.

(*To be continued.*)

Cutting Quadrant Teeth.

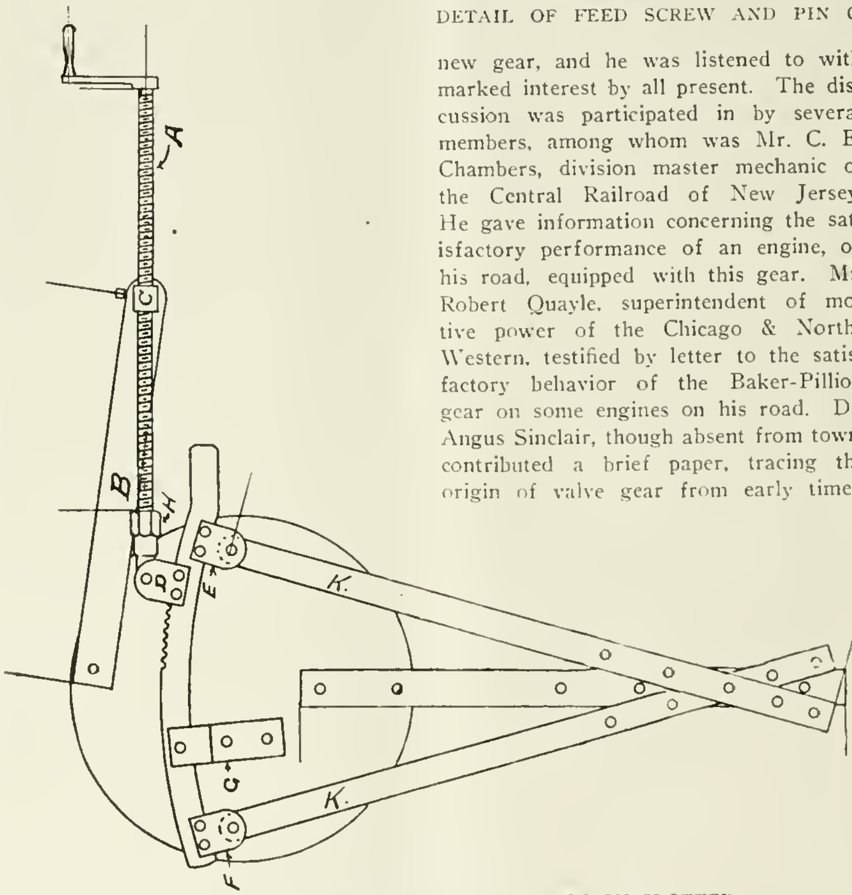
A very ingenious arrangement of a few bars of iron, a screw and suitable connections, enables the work of finishing links or cutting teeth in quadrants to be done accurately and without trouble. The device of which we write has been got out by Mr. C. H. Voges, general foreman of the Big Four shops at Bellefontaine, Ohio.

If the teeth in a quadrant are to be cut, the idea is to place the quadrant on the table of a slotting machine. The quadrant when set in the heads E and F, it is held so that the required clearance for the cutting tool is secured and it is also held down under an offset clamp G, a set-screw being used to tighten it in place and suitable packing pieces under the quadrant prevent it being sprung out of shape.

The quadrant is fastened by the pressure of set screws in the heads E and F and these slide on the slotter table. These heads are pinned to the radius bars K.K. The ends of these bars have each a number of holes drilled in them so that the radius of the quadrant may easily be found and a pivot bolt inserted where the bars cross each other. A short straight bar 3 ins. wide bolts to the slotter table and the other end of it takes in the pivot bolt. This prevents the slotter table from turning on its own center. The heads of the radius bars E and F are made with pin joints so as to allow for easy adjustment, and even if the heads were applied without great exactitude the perfect radial movement of the quadrant would yet be assured.

The movement of the quadrant is effected by the turning of the long screw A at the end of which a handle is placed. The head D is secured to the quadrant by set screws and a pin unites it to the screw head H. The screw A terminates in the screw head H by a flat head, which allows the screw to revolve without turning H.

In order to make the turning of the screw effective a flat bar, B, is bolted to the slotter table and a nut and bushed bolt hold it securely at C. The bushing is placed so that the nut may be raised or lowered. The bushing being clamped by a set screw allows bolt and nut to turn to suit the position of the screw, as D follows the radial motion imparted to the quadrant. The slotter table being held so that it cannot revolve, C is a fixed point.

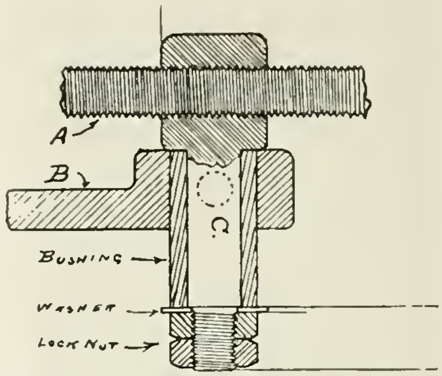


DEVICE FOR HOLDING QUADRANT, OR LINK ON SLOTTER.

The pivot bolt is carried on a suitable frame not shown in our engravings. The whole arrangement is simple, as it is ingenious and not expensive to make. Mr. Voges assures us that a quadrant or link finished in this device is perfect in every respect. After it is planed it is put in the device and no time is spent in laying it off. The device is therefore a time and labor saver.

Paper on the Baker-Pilliod Valve Gear.

At the last meeting of the New York Railroad Club an instructive paper on the Baker-Pilliod valve gear was read by Mr. James Kennedy, of the editorial staff of RAILWAY AND LOCOMOTIVE ENGINEERING. Mr. Kennedy's paper dealt with the construction and adjustments of this



DETAIL OF FEED SCREW AND PIN C.

new gear, and he was listened to with marked interest by all present. The discussion was participated in by several members, among whom was Mr. C. E. Chambers, division master mechanic of the Central Railroad of New Jersey. He gave information concerning the satisfactory performance of an engine, on his road, equipped with this gear. Mr. Robert Quayle, superintendent of motive power of the Chicago & North-Western, testified by letter to the satisfactory behavior of the Baker-Pilliod gear on some engines on his road. Dr. Angus Sinclair, though absent from town, contributed a brief paper, tracing the origin of valve gear from early times. Mr. G. H. Henderson and Mr. Geo. L. Fowler also took part in the discussion, and Mr. Pilliod, the inventor of the gear, made a few remarks on the topic of the evening and answered some questions. Copies of the paper and the discussion may be had by applying to the secretary of the club, Mr. Harry D. Vought, 95 Liberty street, New York.

Items of Personal Interest

Mr. A. C. Hinckley, formerly master mechanic of the Cincinnati, Hamilton & Dayton at Lima, O., has gone to South Dakota.

Mr. C. Sasser has been appointed master mechanic of the Southern Railway at Charleston, S. C., vice Mr. G. N. Howson, transferred.

Mr. Chas. M. Hoffman, master mechanic of the Southern Railway at Louisville, has resigned to enter the service of the Rock Island.

Mr. J. D. Scott has been appointed locomotive foreman of the Grand Trunk Railway at Brockville, Ont., vice Mr. W. H. Walker, resigned.

Mr. George H. Smeltzer has been given the title of superintendent of locomotive and car shops on the Philadelphia & Reading at Reading, Pa.

Mr. M. G. Brown has been appointed master mechanic of the Gulf & Ship Island, with office at Gulfport, Miss., vice Mr. H. H. Hale, resigned.

Mr. W. J. Renix, heretofore acting locomotive foreman of the Canadian Pacific at Brandon, Man., has been appointed shop foreman at the same point.

Mr. H. W. Craig has been appointed divisional car foreman of the western division of the Canadian Pacific Railway, with office at Calgary, Alta.

Mr. V. Saidon, heretofore a fitter in the shop, has been appointed acting roundhouse foreman on the Intercolonial Railway at Reviere du Loup, Quebec.

Mr. J. J. Connors has been appointed acting general foreman of the Houston & Texas Central, with office at Ennis, Tex., vice Mr. J. F. Murphy, deceased.

Mr. G. N. Howson, master mechanic of the Southern Railway at Alexandria, Va., has been transferred to Princeton, Ind., vice Mr. C. M. Hoffman, resigned.

Mr. H. W. Dummert, heretofore a fitter and machinist in the shops has been appointed shop foreman of the Canadian Pacific Railway at Carleton Junction, Ont.

Mr. E. S. Wortham has been appointed assistant to the vice-president and purchasing agent of the Minneapolis & St. Louis Railroad, with office in Chicago, Ill.

Mr. T. Bates, heretofore locomotive foreman on the Canadian Pacific Railway, at Moose Jaw, Sask., has been appointed general foreman at Calgary, Alta.

Mr. T. Young, heretofore locomotive foreman of the Grand Trunk Pacific Railway at Biggar, Sask., has been appointed traveling engineer, with headquarters at Biggar, Sask.

Mr. W. M. Perrine has been appointed master mechanic of the New Jersey Central and of the Lehigh & Susquehanna divisions of the Central Railroad of New Jersey, at Jersey City, N. J.

Mr. Arthur Hughes, foreman of the Lake Erie & Western blacksmith department, has resigned to accept a more important position in the shops of the Clover Leaf at Frankfort, Ind.

Mr. G. P. Morton, heretofore locomotive foreman of the Canadian Pacific Railway at Chapleau, Ont., has been appointed assistant shop foreman at North Bay, Ont., vice Mr. Gildea, tansferred.

Mr. H. H. Hale, who recently resigned as master mechanic of the Gulf & Ship Island, has been appointed a master mechanic of the Cincinnati, Hamilton & Dayton, with office at Lima, Ohio.

Mr. A. A. Sheppard, heretofore locomotive foreman of the Canadian Pacific Railway at Schreiber, Ont., has been appointed locomotive foreman at Chapleau, Ont., vice Mr. G. P. Morton, transferred.

Mr. W. J. O'Neil, formerly general foreman on the Rock Island & Gulf at Shawnee, Okla., has been appointed master mechanic on the same road at Fort Worth, Tex., vice Mr. P. J. Colligan, promoted.

Mr. P. J. Colligan, master mechanic of the Rock Island & Gulf at Fort Worth, has been promoted to division master mechanic at Dalhart, with jurisdiction over three branches of the Rock Island system.

Mr. J. R. Gildea, heretofore assistant shop foreman of the Canadian Pacific Railway at North Bay, Ont., has been appointed locomotive foreman at Schreiber, Ont., vice Mr. A. A. Sheppard, transferred.

Mr. Daniel H. Deeter, formerly master mechanic of the Philadelphia & Reading, at Reading, Pa., has been appointed general macter mechanic of that road with headquarters at Reading, Pa. The position is a new one.

Mr. J. R. Fegan, formerly shop foreman of the Chicago & North-Western at Missouri Valley, Iowa, has been appointed superintendent of motive power of the Boise, Nampa & Owyhee Railway at Nampa, Idaho.

Mr. William L. Jones, general car foreman of the St. Louis & Louisville lines of the Southern, has resigned, and gone to Kingsville, Tex., where he takes a similar position with the St. Louis, Brownsville & Mexico.

Mr. G. A. G. Bartlett, heretofore locomotive engineer, running out of McAdam Junction, N. B., has been appointed assistant air brake instructor of the Canadian Pacific Railway, and is assistant to Mr. C. W. Carey on the air brake car.

Mr. P. Maher has been appointed superintendent of motive power and equipment of the Minneapolis & St. Louis Railroad in addition to his duties as superintendent of motive power of the Chicago & Alton, with office at Bloomington, Ill.

Mr. W. Boughton, heretofore master mechanic on the Pere Marquette Railroad at Saginaw, Mich., has been appointed general master mechanic in charge of locomotive and car department of the same road, with office at Detroit, Mich., vice Mr. W. L. Kellog, resigned.

Mr. W. L. Kellog, formerly superintendent of motive power and car department of the Pere Marquette Railroad at Detroit, Mich., has been appointed superintendent of motive power in charge of locomotive and car departments of the Cincinnati, Hamilton & Dayton, with office at Lima, Ohio.

Mr. George C. Jerome, of Jerome & Elliott, the celebrated stuffing box packing makers of Chicago, has decided to take the active part of traveling representative for the firm. Mr. Jerome had been in precarious health for several years but he is now entirely well and looks forward with pleasure to an active career.

Mr. F. C. Reed, who was formerly general foreman at Monroe, La., on the St. Louis, Iron Mountain & Southern Railway for the past nineteen months, having been formerly at Memphis as general foreman on the same road, has now been promoted to the position of master mechanic of the Union Railway at Memphis, Tenn.

Mr. Francis W. Lane, who was for years so favorably known on the editorial staff of the *Railway Age,* is now engineering correspondent in the United States for *The Times,* London. This paper publishes an Engineering Supplement weekly, which generally contains interesting matter contributed by Mr. Lane.

Mr. Marvin Hughitt, who is president of the Chicago & North-Western Railway, has been recently elected a director of the New York Central Railroad, the Michigan Central Railroad and the Lake Shore & Michigan Southern Railway to fill the places on these boards rendered vacant by the death of the late E. H. Harriman.

Mr. W. E. Symons, superintendent of motive power of the Chicago Great Western, has resigned and is now located in Postal Telegraph Building, Chicago. For the last few years Mr. Symons has been largely engaged doing special work for railway companies, such as examining rolling stock and other property. These are duties for which Mr. Symons is peculiarly well fitted and he is ready to engage in them again or to take charge of a mechanical department.

Mr. Robert S. Lovett, chairman of board of directors of the Union Pacific, has recently been elected president of that road, and now fills the position formerly occupied by the late E. H. Harriman. Mr. Lovett has also been elected a director of the Illinois Central Railroad to fill the vacancy caused by Mr. Harriman's death.

Mr. F. W. Mahl, general purchasing agent of the Denver & Rio Grande, has resigned to become assistant to Mr. Julius Kruttschnitt, director of maintenance and operation for the Harriman Lines. Mr. Mahl is a trained mechanical engineer with considerable experience in railroad work, which makes him a valuable assistant to Mr. Kruttschnitt.

Among the old motive power men who made their mark on railway machinery and retired to enjoy a life of ease on their way towards the sunset of life, Mr. Schlacks, who was long superintendent of machinery of the Illinois Central Railroad, holds a conspicuous place. Mr. Schlacks is still a hale and hearty man, enjoying robust health and as full of hilarity as he was while in the pride of youth. He now lives in a very comfortable home in Chicago, but takes a trip away from it occasionally to inspect rolling stock under construction for past employers. These trips are brief pleasure outings, for Mr. Schlacks does not require help any more in breadwinning. The shrewd investments he made during his active business career take care of that, and he still keeps up the habit of picking up pieces of property whose value magnify quickly under his fostering care.

For the last few years Mr. J. H. Setchel, long secretary of the American Railway Master Mechanic's Association, has been associated with Messrs. Jerome & Elliott of Chicago as sales agent. He has lately come to the conclusion that he has done enough active work for one man so he has retired to spend the remainder of his days at ease in his fine home in Cuba, N. Y. Jerome & Elliott were very reluctant to let Mr. Setchel retire, but he could not be persuaded to remain in harness any longer. Mr. Setchel, according to Sinclair's "Development of the Locomotive Engine," was born in New York 73 years ago and during the whole of his long life was engaged in railroad work or with those who made things for railroad use. The "Best Friend," the first practical locomotive used in the United States, was only six years old when James Setchel was born, so he has witnessed the railway era from the beginning. It is amazing to contemplate the stupenduous changes that have impressed the world in the lifetime of one person.

Hydro-Pneumatic.

The almost universal practice of equipping roundhouses and locomotive repair shops with air pressure pipe lines was recognized several years ago by the Watson-Stillman Company, of New York, when they introduced a new design of 15 and 30-ton pit jacks in which air pressure was utilized to accelerate the work of the jack. The favor with which this new operating device was received has caused the Watson-Stillman Company to bring out a larger size of the hydro-pneumatic pit jack to meet the increased weight of modern rolling stock. The capacity of the new size is 45 tons. The one illustrated, which was built for the St. Louis & Southwestern Railroad, runs on a 24 in. track, has a 4¾ in. ram with 54 ins. stroke. It has a clearance of 5⅜ ins. from the rail to the bottom of the saddle. It is 2 ft. 10 ins. from rail to top of saddle when down, and extends down into the pit three feet. The top is 7⅜ ins. from the top of the rail. The hydro-pneumatic operating system gives this

NEW HYDRO-PNEUMATIC JACK.

jack the quick movement of a pneumatic tool in pushing the ram up to its work. This effects a considerable saving of time. After the jack has been placed in position, air from the shop system is admitted on top of the liquid in the cistern. This forces the water through the pump until the ram comes to a bearing under the load. A few strokes of the hydraulic pump will then raise the wheels sufficiently to remove the sections of track. The saddle is lowered in the usual way by the valve stem key. The Watson-Stillman pit jack has retained its popularity for many years. The original form from which this improved device has come, was illustrated and described in the January, 1888, issue of the *Locomotive Engineer*, the name under which our magazine was started.

Thermit and a 4-inch Pipe.

A very successful piece of Thermit welding was recently done on a 4-in. double extra heavy pipe line at the West Albany shops of the New York Central. The success of the weld consisted not only in making a butt joint capable of resisting very high fluid pressure within the pipe, but in not reducing its bore or forming any internal obstacle to the flow of liquid through the pipe.

The method of doing the work differs from the process usually employed with Thermit. In this case the pipe ends were squared and clamped firmly together. A cast-iron mold was then placed in position around the pipe at the joint and the Thermit ignited in a flat bottom crucible. When the reaction has subsided, the contents of the crucible were poured into the mold, the slag going in first and covering the pipe and the interior of the mold with a protective coating which prevents the steel from coming in contact with these parts. This highly heated mass brings the ends of the pipe to a fusing temperature, at which time the clamps are tightened up, drawing the ends together thus making a butt-weld at the joint. The mold may then be removed and the Thermit mass knocked away from the end of the pipe to which it does not adhere, owing to the fact that the slag will not stick to either the mold or the pipe.

As a matter of fact the Thermit here acted as a convenient means for bringing the ends of the pipes to a welding temperature, and did not add metal to the weld. Not only was the pipe evenly heated all round by this means, but the butt joint was all the time enveloped in the mass of Thermit and slag which effectually protected the hot ends from the atmosphere and thus prevented the iron burning away. When the clamp was tightened the hot ends of the pipes were up-set, but the pipe only thickened on the outside. This may result from the inside surface of the pipe being at a slightly lower temperature than the outside and also from the fact that the flow of pipe metal when the ends were pressed together would naturally seek the outside and so thicken the pipe wall externally. Any tendency to flow inward, would be from a larger circumference to a smaller, and this would produce a compressive strain on the particles which as the metal is free to flow in the opposite direction, it took that course. The result is that though the pipe was slightly thicker outside like a wipe-joint it was of the same diameter internally. The welded pipe is habitually worked with an internal pressure of about 1,500 lbs. The test pressure of double that, was held for ten hours after welding.

Simple Passenger 4-6-0 for the Frisco.

The Baldwin Locomotive Works have recently delivered to the St. Louis & San Francisco Railroad, 10 passenger locomotives of the 10-wheel type. These are among the heaviest engines of this class so far constructed by the builders, as they have a total weight of 194,450 lbs. in working order. The cylinders are 23 by 26 ins. and the driving wheels are 69 ins. in diameter, the resulting tractive force with a steam pressure of 200 lbs., being 33,900 lbs. As the weight on the driving-wheels is 141,050 lbs. and the factor of adhesion is therefore 4.16.

The cylinders are arranged for double front rails, and the castings are bolted to the smoke box and to each other by a double row of 1¼ in. bolts. The valves are of the internal admission piston type, 13 ins. in diameter, and work in bushings ⅝ in. thick. The by-pass valve consists of a plate which rests on a horizontal seat, and normally covers openings leading to the live steam ports. When the throttle is open, the plate is held down by boiler pressure which acts on its upper surface. Excessive pressure within the cylinders will cause the plate to lift from its seat, thus opening communication between the two live steam ports. The center lines of the steam chests are placed 4½ ins. outside the center lines of the cylinders, thus making possible a simple arrangement of Walschaerts valve gear with all moving parts in practically the same vertical plane. As the engine is equipped with inside admission valves, the eccentric cranks follow the pins. The cranks are of cast steel, and are secured to the main pins by a tapered fit and through bolt. A substantial steel casting, secured to each frame by three 1¼ in. bolts, supports, at each end, a combined link and reverse shaft bearing. The links are of the built up type, with cast steel side plates. Each radius rod is made in one piece, the jaw which holds the hanger and link block being slotted out. The combining levers are placed back of the cross heads, and are coupled directly to the valve rods, which are supported in bearings bolted to the guide yoke. The valves are set with a constant lead of ¼ in. and a maximum travel of 6 ins. The steam lap is one in. and the exhaust clearance ⅛ in. The frames are of cast steel, 4½ ins. wide, with double front rails of wrought iron. The lower rail is double keyed, while the top rail is hooked to the main frame, without keys. The pedestal binders are lugged and bolted to the pedestals.

The boiler is of the wagon top type with a wide firebox and sloping throat and back head. The center line is placed 9 ft. 8 ins. above the rail, and the depth of the throat from the underside of the barrel to the bottom of the mud ring, is 23⅛ ins. By spacing the second and third pairs of driving-wheels 9 ft. apart, ample room is secured for a wide firebox with a moderate inclination of the grate. The mud ring is supported on sliding shoes in front and a buckle plate at the rear.

The firebox is radially stayed, with two T-irons supporting the front end of the crown. The roof and side sheets are in three pieces, with a double riveted lap seam on each side; while the crown and sides of the inside box are in one piece. The boiler barrel is built up of three rings, with the gusset in the middle. The longitudinal seams are butt-jointed and sextuple riveted, and are welded at each end. The seam on the dome ring is placed on the top center line and is welded throughout its entire length, with a heavy liner inside.

The tender is furnished with a steel channel frame and water bottom tank. The trucks are of the arch bar type with cast steel bolsters, triple elliptic springs and steel tired wheels. Some of the principal dimensions are here appended for reference.

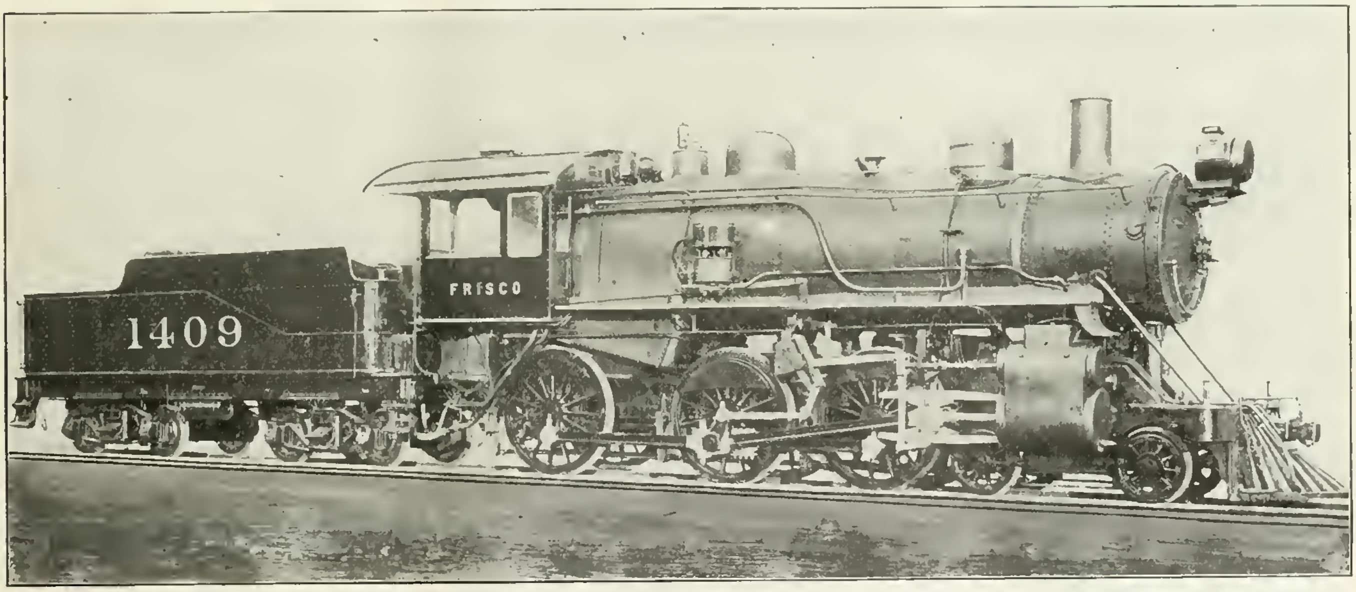
Boiler.—Type, wagon top; material, steel; diameter, 68 in.; thickness of sheets, 11/16 x ¾ in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 101¾ in.; width, 67¼ in.; depth, front, 77⅜ in.; depth, back, 59⅛ in.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space.—Front, 4 in.; sides, 3½ in.; back, 3½ in.

Tubes.—Material, iron; wire gauge, No. 11; number, 364; diameter, 2 in.; length, 15 ft. 1½ in.

Heating Surface.—Firebox, 172 sq. ft.; tubes, 2,867 sq. ft.; Total, 3,039 sq. ft.; grate area, 47.7 sq. ft.



SIMPLE TEN-WHEEL ENGINE FOR THE FRISCO SYSTEM.

Geo. A. Hancock, General Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Driving Wheels.—Diameter, outside, 69 in.; journals, main, 10 in. x 12 in.; journals, others, 9 in. x 12 in.

Engine Truck Wheels.—Diameter, front, 33 in.; journals, 6½ in. x 10 in.

Wheel Base.—Driving, 15 ft. 10 in.; total engine, 26 ft. 10 in.; total engine and tender, 57 ft. 10 in.

Weight.—On driving wheels, 141,050 lbs.; on truck, front, 53,400 lbs.; total engine, 194,450 lbs.; total engine and tender, about 315,000 lbs.

Tender.—Wheels, diameter, 33 in.; journals, 5½ in. x 10 in.; tank capacity, 6,000 gals.; fuel capacity, 12 tons.

There has been a tendency to use locomotive boilers for providing power for locomotive repair shops, but it is not a good practice, for the boilers require much attention to keep them in working order, and they are expensive on fuel. One of the sensible changes made by the Erie Railroad lately was installing a set of Babcock & Wilcox boilers in the shops at Susquehanna. The change relieved seventeen locomotive boilers located about the different shops.

British Locomotive Practice

By Aubrey F. Inglefield

The British locomotives of today have been designed to meet the following requirement: High speeds with haulage of heavier loads than formerly. In America these conditions have been met with "Pacifics" and monsters of various kinds.

On the Great Western Railway is one of the longest non-stop runs in the world, London to Plymouth, 225¾ miles. This is performed daily by the "Cornish Riviera Limited" at 54.8 miles an hour. The fastest run in Great Britain is on the Great Western, from London to Bristol via Bath in 2 hours, at an average speed of 59.1 miles an hour. In fact there are now 155 non-stop runs of over 100 miles in length performed daily in Great Britain, with a minimum speed of 44 miles per hour.

Loads have grown in Great Britain in the same manner as in America and while the number of cars to a train is not limited the power that can be exerted by one locomotive is limited. It should be remembered that while the gauge is 4 ft. 8½ ins. as in America, there are 2 ft. 6 ins. less height, and 2 ft. less breadth. The railroads did not in Britain exploit virgin soil as in the United States, but were built in districts already thickly populated. For these reasons the curves are often sharp their appearance the Great Northern of England introduced the type into Great Britain. These engines had 6 ft. 7½ ins. driving wheels, 1442.1 sq. ft. of heating surface, with cylinders 18¾ ins. by 26 ins. One was fitted with four simple cylinders 15 ins. by 20 ins. In the light of recent developments this will be seen to be an important step. Later engines of this class were fitted with stronger frames to take a larger boiler. These engines handled the heavy East Coast joint trains to Scotland until 1903 when the class appeared shown in our illustration of Engine No. 288. These engines had the first modified Wootten fireboxes in Great Britain. Almost precisely similar engines are running on the London, Brighton and South Coast Railway, the difference being merely a smaller tender and a few dimensions very minutely different. With the exception that the Great Eastern Railway had, in addition, an experimental 0-10-0 tank; these are the only locomotives in Great Britain with these fireboxes.

As some of the lines which constructed "Atlantics" are by no means easy, as far as grades are concerned, such as the Great Western and Great Central, these railroads built their 4-4-2 locomotives to be easily convertible to 4-4-0's. As an ex-

ATLANTIC TYPE ON THE GREAT NORTHERN OF ENGLAND.

and space generally is restricted; speeds, therefore, have frequently to be materially reduced, thus spoiling the averages. Also, it must be remembered that the population is more evenly spread in Great Britain than in the United States, and that most of the manufactures that can be found in any country are gathered together in an area a little less than Minnesota and Connecticut together.

Three years after the famous 4-4-2 engines of the Atlantic City Railroad made

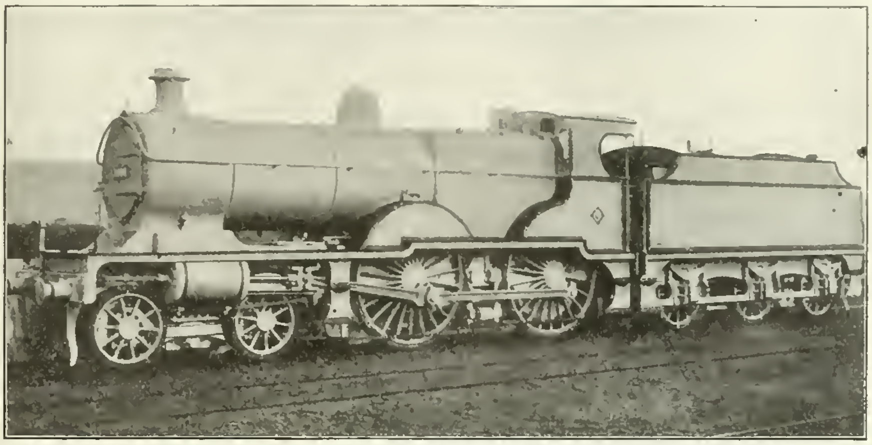
ample: One of the Great Western engines was built as a 4-6-0, then converted to an "Atlantic," and is now a 4-6-0 again. On this road all "Atlantics" and 4-6-0's are standard and were built so as to require very little alteration if it should be found necessary to change the wheel arrangement. In fact, as the "Atlantics" come in for heavy repairs they are being converted to 4-6-0's.

Until recently "double heading" was resorted to on many lines, as the engines were entirely inadequate to cope with the heaviest trains. These lines started by building large boilered 4-4-0's. Some of the best examples are the Midland compounds, the "Precursor" class on the London and Northwestern, and the "Claud Hamilton" class on the Great Eastern.

Compounds on the Smith-Johnson system are being built in large numbers for the Midland Railway, and two Great Central engines are being tried, in order to discover whether three cylinder compounds or simples are best. Four engines are engaged in this trial; two are 4-6-0 and two are 4-4-2, one of each wheel arrangement being simple and the other compound. All these engines are readily convertible to two cylinders simple.

The Midland engines are the largest engines on that road, and although light trains are the rule they have sometimes to be assisted. American influences will be noticed in the numbering of the locomotives. Thus far this is the only road to adopt the system. The two low pressure cylinders are 21 ins. in diameter and the high pressure cylinders 19 ins., with 26-in. stroke for both. The Smith system consists in having an equilibrium valve between the h.p. and the l.p. steam chests, and a three-ported gridiron regulator; so that when the engine is started, high pressure steam passes to the high pressure cylinder and also to the low pressure cylinders through a reducing valve. As the regulator is open further, the main valve closes the opening to the low pressure cylinders and gradually opens wide the main steam pipe. The auxiliary pipes to the l.p. cylinders are closed when the handle has been moved through about 30 degs. from the shut position, and it is at this point that the engine commences to work compound. Should extra power be desired when starting, the spring of the reducing valve is subjected to a higher tension by a hand wheel in the cab and steam is admitted to the l.p. cylinders at anything between 50 lbs. and 150 lbs. per sq. in., as desired. If the pressure in the low pressure chests rises to that in the high pressure chests the equilibrium valve works and the high-pressure cylinder is cut out, the engine working as a simple.

Rebuilding is a great feature of British locomotive policy, and one of the most striking examples is a 2-4-0 class on the Great Eastern Railway. Some have been rebuilt with a bogie and others with the



ENGLISH 4-4-0 NUMBERED LIKE AMERICAN ENGINE.

2-4-0 arrangement, all having large boilers, but the result is a powerful locomotive of moderate size. Painted dark blue with red lining and a copper-capped funnel, these engines present a very handsome appearance. The "Claud Hamilton" class, which are almost identical, but rather larger, take the "Norfolk Coast Express," which sometimes amounts to 400 tons, on a non-stop run of 130 miles to North Walsham at an average speed of 49.7 miles per hour. "Not a very fast schedule," you will say; but you must consider that there are no less than eight compulsory speed reductions, two of which are as low as 15 miles an hour and that there are several extremely sharp curves to be negotiated, not to mention grades of 1 in 73, 1 in 84, and 1 in 94, besides several others not so steep. The dimensions of Engine No. 1035 are cylinders, 18 ins. by 24 ins.; diameter of driving wheels, 7 ft. Steam pressure, 180 lbs.

The Great Western Railway which started with 4-6-0's in 1903, tried also "Atlantics" with the standard large size boilers. There are now two classes of two-cylinder 4-6-0's and three classes of four-cylinder 4-6-0's. For second class work, 4-4-0's are being built to the number of 15 or so every year. In 1906 were built the "County Class." The 4-4-0 engines usually vary somewhat, such as inside cylinders or the design of the outside frame plates. The 4-6-0's also differ in very small details. On the Great Western locomotives, coned boilers are used. The position of the valves also shows American influence. The Belpaire firebox is also a feature, as in these engines it takes the place of the steam dome, the throttle being situated forward of the firebox. The Belpaire firebox is being now very frequently adopted on British locomotives.

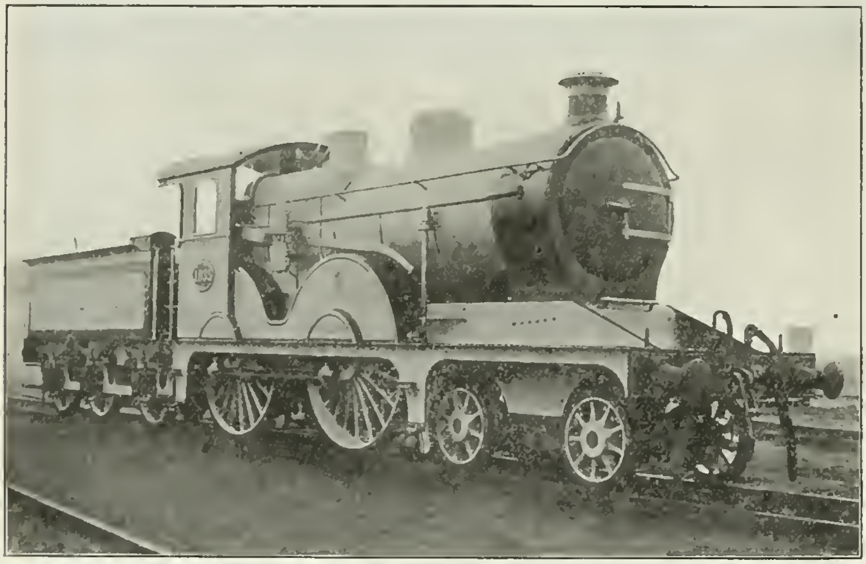
In 1906 the Great Western brought out the "North Star," an Atlantic with four simple cylinders, the remainder of the class are 4-6-0. This class are so successful that four-cylinder simple locomotives of this class appear every year to the number of ten. In 1908 appeared the only "Pacific" in Great Britain, named "The Great Bear." This engine practically fills the English loading gauge and seems so far to be the limit of British construction. This engine has not yet been repeated.

At the end of last year the Lancashire and Yorkshire Railway brought out a 4-6-0 locomotive for fast express and freight work. On comparing these four-cylinder engines it appears that only the London and South Western engine has valve gear showing. The reason for this is that the engine has four sets of gear, while the others have only two. The valve gear in these engines is direct to the center cylinders and works the outside cylinders by rockers. The gear is the Walschaerts, and in the Lancashire and Yorkshire engine, the Joy. The inner gears of the South Western engine are Stephenson's, the outer ones being Walschaerts.

These engines are interesting, as they are all designed for the same work: fast express and freight work in hilly districts. The South Western and Great Western engines work in the same district, Devonshire and Plymouth, the South Western engines working from Salisbury to the westward. The Great Western engines, however, work from London and do the longest non-stop run: London to Plymouth, 225¾ miles, though as far as Westbury the Great Western line is practically level.

Owing to the shortness of the main lines on some roads certain railroads can run some of their express trains by tank engines. The railroads that make a feature of this are the London, Brighton & South Coast, and the London, Tilbury & Southend. The longest express route on the Brighton line is from London to Portsmouth, 85 miles. On the Southend Railroad, the main line to Southend has only a length of 35¾ miles. The locomotive is one of the latest class and sometimes takes the "Southern Belle Limited" to Brighton, 51 miles in 60 minutes. This train is a Pullman express built last year, having every luxury for journeys of one hour only; the weight is 280 tons.

But even more meritorious is the following: Lest at any point the locomotive of the "Cornish Riveria Limited" should break down, powerful tank engines of the 4-4-2 and 2-6-2 classes are stationed at various points on the route. On one occasion the regular 4-6-0 engine failed at Westbury and the tank engine, held in reserve for the purpose, was put to haul the train of 350 tons to London, 95½ miles, scheduled in 1 hour 37 minutes, or just under a mile a minute. The train arrived to schedule. When considering this performance it must be remembered that this line is practically level.



GREAT EASTERN WITH WESTINGHOUSE AND WITH VACUUM BRAKES.

McCord & Co. Force Feed Lubricator.

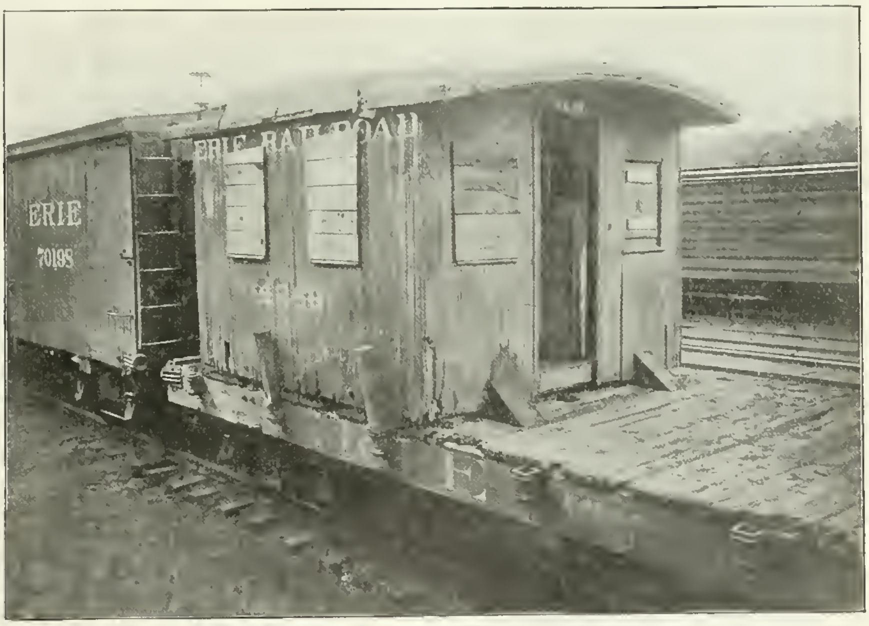
The Philadelphia Reading Railroad recently put into service a three-cylinder simple engine, designed by Mr. Howard D. Taylor, superintendent of motive power of the road. The engine was celebrated for the high speed it readily attained, but extreme annoyance was caused by the driving wheel boxes running hot. Every effort was made to remedy the defect without success until some one suggested that they try the McCord force feed lubricator which was done, and the device proved an entire remedy.

The McCord force feed lubricator will be found illustrated on page 427, September, 1907. It is made by Mc-

Cord & Co., Chicago, and is a device well worthy of greater patronage than it has received. Oil is forced from one reservoir to all the bearings requiring lubrication, and the supply can easily be regulated to meet the requirements. Full particulars of this lubricator can be obtained on application to McCord & Co., Old Colony Building, Chicago.

Farthest North Car.

Our illustration shows the body of old Erie caboose No. 4259 mounted on an Erie flat car. The old caboose has the honor of being the only railroad car concerned in the pursuit of the pole. This car has reached the farthest north point of any railroad vehicle in the world. The caboose was bought by Commander Peary and taken by him on the "Windward" to Etah in 1898 and there used as a temporary dwelling or storehouse. The flat car shown in our half tone makes no claim to pole finding. It is but the humble means by which caboose body No. 4259 was transported to the wharf for shipment on the "Windward."



"FARTHEST NORTH" RAILROAD CAR, ERIE NO. 4259.

The Baltimore & Ohio Railroad have just closed contracts for extensive shop improvements at Benwood, W. Va., covering an expenditure of $150,000. It will practically mean the rebuilding of the Benwood shops. The improvements include: A 23-stall engine house, with turntable and pit 80 ft. long; an oil house 30 by 58 ft; storehouse 30 by 70 ft., with platform 20 by 30 ft.; machine shop, blacksmith shop, boiler and engine rooms 60 by 184 ft., with brick stack 125 ft. high; sand house 22 by 94 ft., with tower 13 by 15 ft.; carpenter shop 35 by 82 ft.; material storage platform 25 by 90 ft.; shaving shed 12 by 33 ft.; casting storage platform 39 by 60 ft.; pipe, bar iron and sheet metal storage racks 20 by 38 ft.; two scrap bins 20 by 42 ft, and 20 by 70 ft., respectively; locomotive cleaning platform 19 by 75 ft. There will also be installed a new system of water supply and fire protection; also a complete sewerage system. The larger buildings will be of brick and concrete. Work will be begun at once, and it is expected that the new shops will be completed by Feb. 1, 1910.

The W. H. Johns-Manville Company of New York have issued a little pamphlet which deals with the Morris metallic packing suitable for stationary and marine engines, gas engines, steam locomotives, steam pumps, air and gas compressors. The Morris metallic packing is made of a specially treated soft gray cast iron, which, when thoroughly lubricated, is said to develop a bluish glazed skin which very satisfactorily resists wear. The packing consists of a series of parts, having ground joints, which are held together on the rod by a spring. Write to this company for a copy of the pamphlet on Morris metallic packing if you are interested, or you can get the general packing catalogue if you wish it.

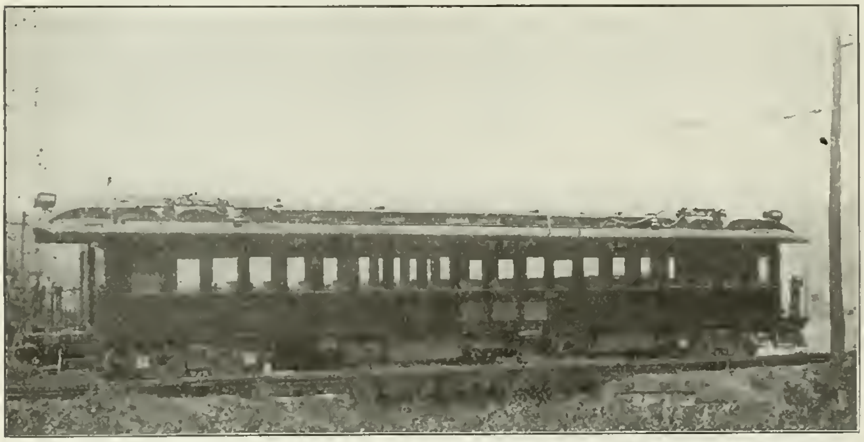
The Detroit Seamless Tubes Company, of Detroit, Mich., are now erecting a large addition to their factory, and installing additional equipment which will increase their capacity about 30 per cent. This is made necessary by the rapidly increasing demand for their "Detroit" locomotive flues and mechanical tubing.

Life is a mirror; if you frown at it, it frowns back; if you smile, it returns the greeting.—*Thackeray*.

New Haven Suburban Motor Car.

At the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company, there is now being installed the electrical equipment of a number of motor cars for the suburban service of the New York, New Haven & Hartford Railroad. These cars are designed to operate on both the 11,000-volt alternating current of the New Haven line, and also on the 600-volt direct current, third-rail section of the N. Y. C. entering the New York terminal.

By reason of the fact that the New York, New Haven & Hartford trains are required to operate on the New York Central direct current, the control equipment for effecting a change from alternating to direct current is necessarily more extensive than if the control had been arranged for alternating current operation alone, but as seen in our illustration, this auxiliary apparatus has been so well distributed under the floor of the car that there is ample room for everything in the space between the trucks.



SUBURBAN MOTOR CAR ON THE N. Y., N. H. & H.

These cars, which are intended to pull trailers, are equipped with four series compensated motors. These and the step-down auto-transformers are supplied with forced ventilation from the blower system. When the equipment is used under forced ventilation the one-hour railway rating of each motor is 200 horse power. Each car is guaranteed to haul two 50-ton trailers and when so operating will accelerate normally at a rate of 0.7 miles per hour, per second.

The arrangement of motors differs from that of any other cars in use in this country, in having the motor geared to a quill surrounding the axle, which is geared to the driving wheels by means of dividing springs of the same type as are used successfully on the New Haven locomotives. The cars are seventy feet in length, weigh 86 tons, and have a seating capacity for seventy-two persons. They are fire-proof, being of steel construction throughout, and are handsomely finished. They are said to be very easy-riding cars. A very full description of the alternating and direct current sections of the New York, New Haven & Hartford railway was given in the May, 1909, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 187, to which the reader is referred.

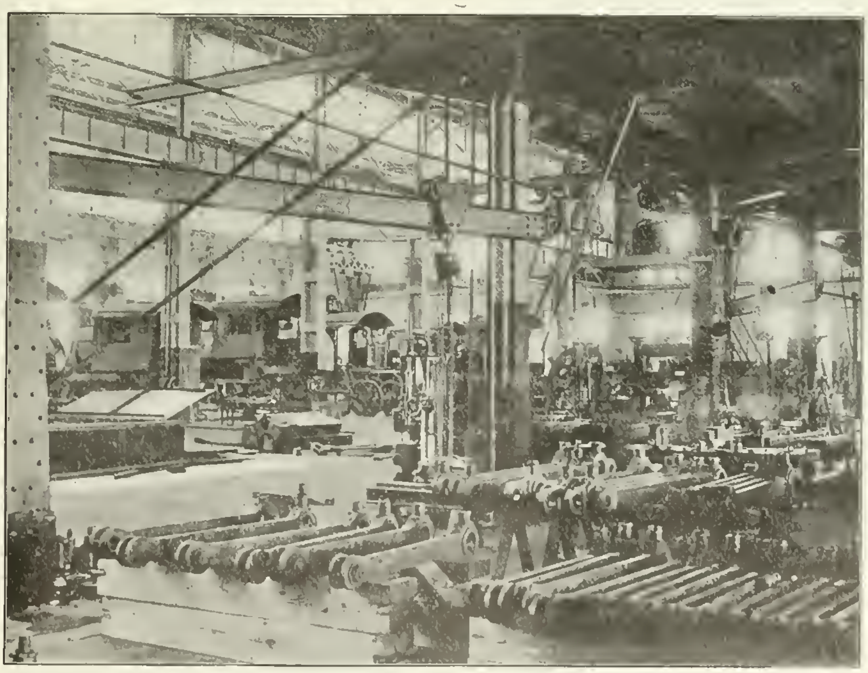
A very neat and artistic folder concerning archbar nut locks, and reservoir bolts, also continuous nut locks for air cylinder bolts, for carrier iron bolts, etc. has just been received at this office. The nut lock is a thin metal strip with a hole or holes in it, by which it is slipped over the end of a bolt. A lateral extension is bent over the corner of the archbar, bracket cover, or whatever it may be, then the nut screwed down tight, on the face of the flat band. In order to increase the friction between nut and lock a few little projections have been pressed in the lock, and it is down on these that the nut is tightened. These little warts, as they may be called, are pressed down flat, and, being springy, they so increase the friction below the nut as to hold it securely in place. The continuous nut locks is the name given to the strip of thin steel when it includes two or more holes. The strip cannot turn owing to the lip which is bent down over the corners nearest to the bolt, which is being held, and the increased friction between nut and lock secures the nut. This ingenious device is made by the Keystone Nut-Lock Manufacturing Company, of Pittsburgh, Pa., which is one of the concerns controlled by the well-known Flannery Bolt Company of Pittsburgh. Write for circular or folder, it being illustrated, you can see at a glance the utility of the device.

Mr. W. R. Toppan, vice-president and general manager of the L. M. Booth company, has closed a contract with the Vandalia Railroad for a Booth water softener having a treating capacity of 40,000 gallons per hour, and a 350,000 gallon steel storage tank to be installed in connection with the new shops at Terre Haute, Ind. The Booth Water Softener now under construction upon the C. R. I. & P. Ry., at Sayre, Okla., we understand, will be put into operation in a short time. The simplicity and convenience of operation of the Booth Company's Type "F" softener called forth very favorable comment at the Master Mechanics' convention this year, and now that railroads are again placing orders for such equipment, further substantial approval of this apparatus may be expected.

Well-Arranged Rod Department.

A more completely equipped and convienently arranged rod department than that of the new shops of the St. Louis & San Francisco, at Springfield, Mo., would be difficult to find. The details were worked out by Messrs. W. A. Nettleton and George A. Hancock, of the motive power department of the road in collaboration with the engineers of the Arnold Company, who planned and supervised the erection of the whole plant. The erecting shop has a capacity for the repair of 25 locomotives at one time and it is expected that this number will eventually be increased to 35. The rod department occupies a space under the gallery on the machine side of the building about 100 ft. from the end and next to the tool room and to the space where piston, link and eccentric work is carried on.

The department is served by two 16-foot jib-cranes, mounted upon the building columns with a combined reach to the floor of the middle bay under the traveling cranes and to the machines upon which the heavy parts of the work are done. The space is further served by two trolleys on I-beam tracks suspended from the gallery floor beams and extending far enough beyond the edge of the gallery to be used in picking up material from the floor or taking it from the overhead traveling cranes. The trolleys and cranes are clearly shown in the accompanying engraving, as is also the location of the department near the pickling tank and the erecting floor. Each of the jib-cranes swings across the path of one of the trolleys and work can thus be handled conveniently over the whole space.



ROD DEPARTMENT, ST. L. & S. F., SPRINGFIELD, MO.

The B. F. Goodrich Company of New York has just finished, in New York City, one of the most admirably equipped buildings for the handling of their rubber products, especially tires, that there is in America. The structure is a notable addition to the business buildings of the neighborhood where it stands, which is on Broadway next to the corner of Fifty-seventh street.

There are twelve floors, and a basement. The latter is used entirely for the storage of automobile tires. The rear of the ground or street floor, is a receiving and shipping room. The front is a large salesroom.

The eighth floor has been given over mostly to offices for the manager and salesmen. The rear is a storeroom for the stock of mechanical rubber goods. Above, on the ninth floor, are the general offices for the clerks. The next floor, for the company's use, is the eleventh—a large stockroom for specialties, such as druggists', surgeons' and stationers' rubber sundries. On the top, or twelfth, floor, are complete automobile tire repair facilities. Throughout this building no mechanical device for the ready handling of heavy stock has been omitted. There are special automobile elevators. One of these has a turntable floor. There is also a general freight lift. In addition, two passenger elevators are provided, and an electric dumb waiter, adjusted to stop automatically at any floor. Mr. W. H. Yule is general manager, with Mr. H. C. Miller in charge of the automobile tire department.

We are informed that the Pilliod Company of Swanton, Ohio, makers of the Baker-Pilliod valve gear, are erecting at Swanton an additional factory 180 x 50 ft., and have purchased about $20,000 worth of new machinery for this factory. They expect to have it in operation by December 1, at which time they will be able to turn out five Baker-Pilliod valve gears a day. We are also informed that within the last two weeks this company have received orders for this gear for 4 consolidation engines for the Mexican Railroad, also for 2 ten-wheel engines for the Missouri & North Arkansas; 5 Mallet type engines for the Norfolk & Western; 15 ten-wheel passenger engines for the Sea Board Air Line, and 6 switching engines for the Central Railway of New Jersey.

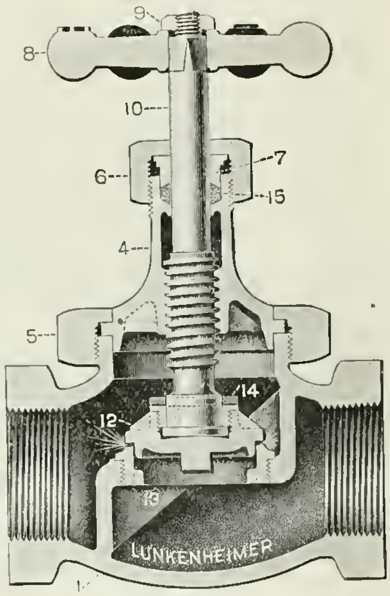
The Ajax Manufacturing Company of Cleveland are making important improvements in their works, with the view of increasing their capacity. Their well-known bulldozer has been a favorite in blacksmith shops for years. It used to be made of cast iron, but constant increase of capacity rendered cast iron too weak and cast steel has now been substituted. This change has enabled the company to dispense with their iron foundry, and they are using the space for outlaying the machine shop. President Blakesley is working out various problems for the improvement of the company's business.

Great activity on railway building in Brazil has lately developed, a much to be desired change, for this line of enterprise has been admost paralized for years. The extension of telephone and telegraph lines is also going on very actively.

Improved Valve.

The valve which we here illustrate we are informed, has been adopted by a number of leading railroads on account of its durability and efficiency. It is made of a bronze composition containing a high percentage of copper and tin and is intended to stand long and severe usage. The principal feature in the design of this valve is the construction of the seat and disc. The disc, marked 12 in the cut, is provided with a tubular extension, which enters the valve seat ring, 13. Its principal function is the preservation of the seat, which is accomplished in a two-fold manner. First, as it enters the seat, it deflects the current of steam from the seat ring face, thus preventing the wire-drawing which would otherwise occur. This feature is important in case the valve should be left partly open for any length of time. Secondly, the seating surface is kept free from scale and grit by the action of the thin current of steam discharged over it as the disc is brought home.

Another function of this extension ring is the prevention of water-hammer, which is caused by the sudden admission of steam, for no matter how quickly the hand-wheel may be operated, this tubular extension will



IMPROVED GLOBE VALVE.

only permit the steam to enter gradually.

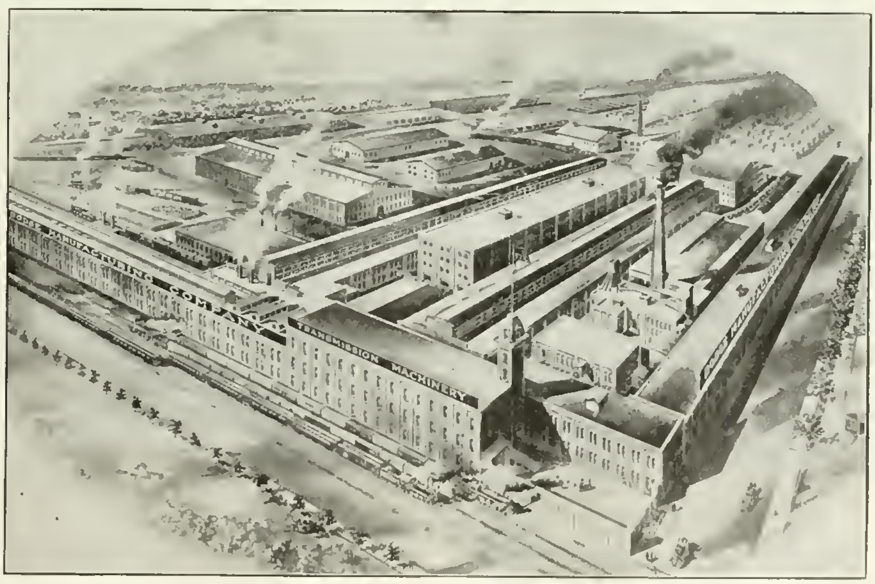
The seat 13, which is made of nickel, is renewable, and can be removed from the valve body by using a flat bar to engage the lugs on the inside of the ring. Attention is called to the fact that the seat may be reground a number of times before it is necessary to renew it. Not only is the seat renewable, but all of the other wearing parts, including the disc, can be renewed when necessary. The hub is securely held to the body by means of a union ring, owing to which it is impossible for the hub and body to become corroded together, as the thread which holds the union ring to the body is protected at all times from the action of the steam, the joint being made between the flange on the hub and the neck of the body. This connection also acts as a tie or binder in screwing over the body, and tends to strengthen the valve. The stuffing-box can be repacked under pressure when the valve is wide open, as a shoulder on the stem, directly above the threads, forms a seat beneath the stuffing-box.

The valve is guaranteed for working pressure up to 200 lbs., and is made in globe, angle and cross patterns, with screw or finger ends.

We are told that this valve is being used by the Union Pacific for use on ash-pan equipment. Their approval depended largely upon the valve's durability, a feature of importance when used for this purpose, as the valves, when in use, are but slightly opened, thereby subjecting the seating surfaces to very considerable wear by the water between them.

The Lunkenheimer Company, of Cincinnati, Ohio, are the manufacturers of this improved valve, which is known by the trade name "Renewo," and they state that they are willing to furnish samples for inspection. They have recently issued an attractive booklet thoroughly describing and illustrating this valve, which they will be pleased to send it to any one interested, and who applies to them for a copy.

In the manufacture of machinery for the mechanical transmission of power, the Dodge Manufacturing Company, of Mishawaka, Ind., have a remarkably large and well equipped plant, whose buildings cover nearly 40 acres in a 60-acre location on the Lake Shore & Michigan Southern Railway. The consumption of raw materials, the production of finished goods, and the capacities of the power and mechanical equipment, are evidence of the extensiveness of the factory. There is annually consumed 20,000 tons of pig iron, 7,000,000 ft. of lumber, 900 tons of steel and structural iron, 6,200 tons of steel shafting, and 9,000 tons of coal. The steam boilers have a capacity of 1,500 h. p., and the steam engines 1,500 h. p., with electric generators of 250 k. w. The steel shop in which the Eureka water softener and purifier is made, has a capacity of 52 fully equipped machines per annum. There are annually produced 250,000 "Independence" wood split pulleys, 100,000 "Dodge Standard" iron split pulleys, 90,000 solid iron pulleys, 95,000 hangers, 150,000 bearings of all types, 4,000 friction clutches and more than 2,000,000 lbs. of bearing metal.



WORKS OF THE DODGE MANUFACTURING COMPANY AT MISHAWAKA, IND.

Don't Kick Him.

Among the many good things said in the address made by Mr. Robert Quayle at the opening of the General Foremen's Association was:

"You go to your shops when you go home. There is a fellow there with whom you have not been on the best of terms. He has done something you did not like. We are prone to simply give that fellow a kick. That is not the act of a big man; it represents a small, mean spirit. You make yourself smaller every time you do such a thing. It is an easy thing for an official to throw another man down, but your aim in life should be to lift people up. What can I do to make a man better? What can I do to make him a better factor in the niche that he fills in life? If somebody has knocked him down, pick him up and say: 'I am your friend; what can I do for you?' What have you done? You have made a friend of that man. From that moment he sits up nights to work for you, as he is ready to work every day to show you that he is the right kind of man. Then that fellow goes out and says you are all right. He is heralding your name with praise everywhere."

Shop Organization.

At the General Foremen's convention Mr. P. F. Flavin said: "Many of the railroad systems of the Northwest have adopted the plan of calling every master mechanic within a given area on short notice for discussion of the work they are doing. They do that to test the organization of the men left behind. When a mechanical official cannot absent himself for a few days it is proof positive that something is wrong with the organization he leaves behind."

We are informed that Mr. James E. Ganson, air brake instructor on the Pittsburgh, Cincinnati, Chicago & St. Louis, at Columbus, Ohio, has patented a track sander (Patent No. 933972). In this device air is blown down the sand pipes, the sand is drawn by vacuum through an orifice under the ordinary hand sand-valves when they are closed. There is a small deflector plate just above the opening under the valves and a ¼ in. pipe screwed down through the center of these plates, and leading to the outside sand box. This is to bring free atmospheric air in close proximity to the openings, thus preventing a vacuum or partial vacuum from forming in the box when air is drawn from it by the ejectors in the sand pipes.

Anything that brings railroad employees into close intimacy is calculated to produce more efficient and harmonious work, besides contributing to the pleasure of all concerned. We are therefore pleased to learn that the Wilmington Veteran Employees' Association has been formed. It is composed of employees of the Maryland division of the Pennsylvania Railroad. The purpose of the organization is social intercourse and the promotion of social intercourse, and friendly relations between people engaged in the same occupation. While remaining employees of the Maryland division of the Pennsylvania all are eligible for membership. The officers are: Mr. J. W. Agnew, president; Mr. F. T. Briggs, vice-president; Mr. F. R. Heaton, secretary; Mr. B. Hygate, treasurer. Our correspondent, Mr. Frank S. Stone, engine inspector, Wilmington, Del., is an active and zealous member.

Work is about to be begun on the Hudson Bay Railway. Some New York financiers have interested themselves in the matter. The road will start from Churchill and run directly west via Athabasca Lake to the Pacific through Yellowhead Pass. Another branch will run from Churchill in a southerly direction to Lake Winnipeg. As soon as a considerable portion of the line is in working order the White Star Steamship Line will start a regular service and Churchill on Hudson Bay will become one of the chief ports of traffic in the Dominion.

The National Railway Devices Company, Chicago, have put upon the market an automatic fire door opener which is greatly valued by locomotive firemen. The pushing of the releasing spring of the door causes the connections of a floating piston to pull open the door. This is a cheap aid to firemen which ought to be encouraged.

When people have been exposed to the raw heat-killing weather of fall and winter, face and hands demand comforting treatment. In that case nothing is quite so good as anointing with 1826 Farina Cologne, made by M. H. Mullin, 744 Broadway, New York, and sold by all stores handling perfumery. Insist on 1826 Farina Cologne, the number possessing a mystic significance.

Railway and Locomotive Engineering

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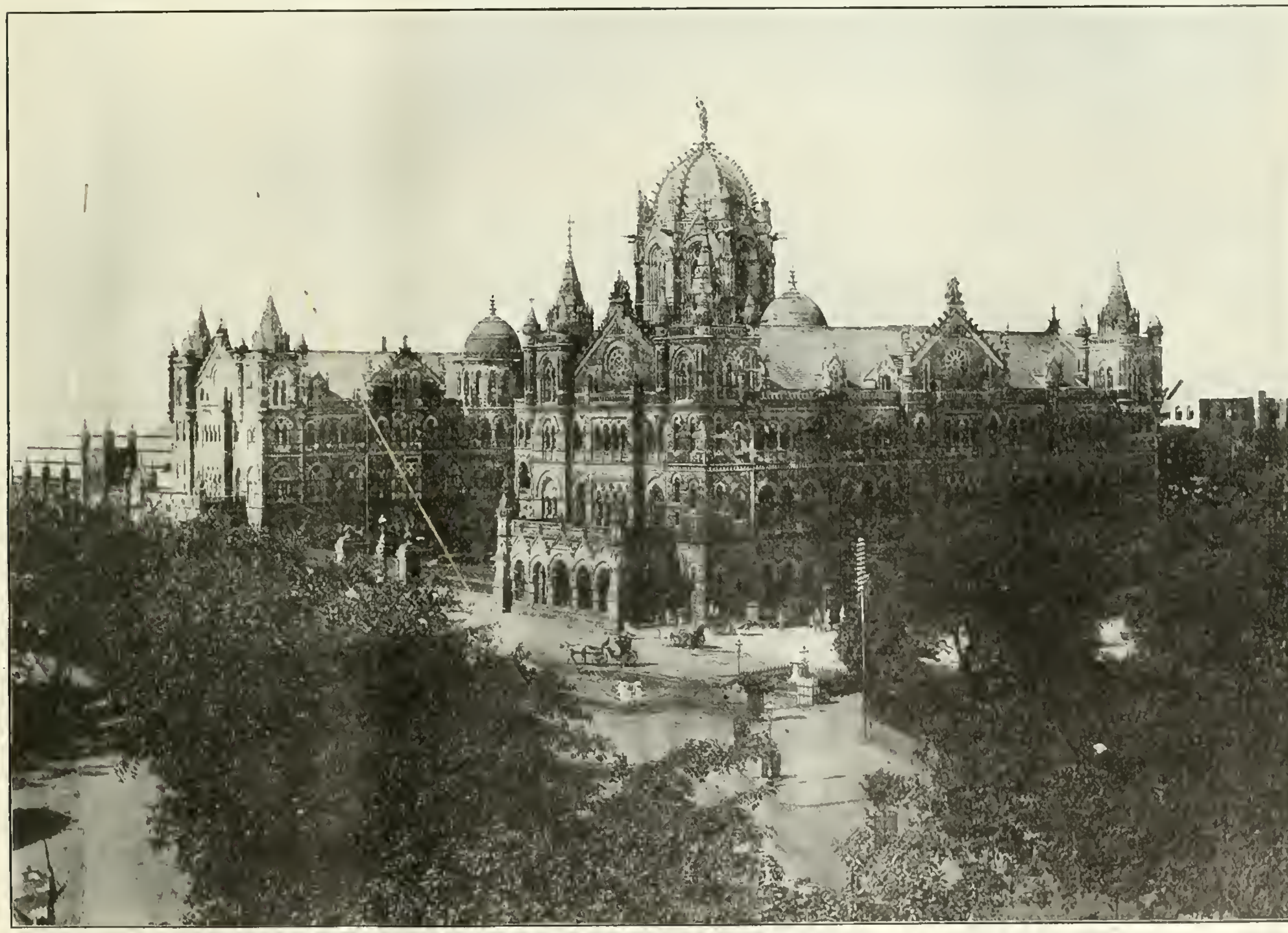
Railroad Pictures from India.

On the leading railways of India the practice of rebuilding all the old rolling stock is being abandoned, and out-of date locomotives and cars are being replaced by new plant of modern design and construction. The chief railways are the property of the state, but are operated by different companies under guarantee, the expenditure being controlled by a government department. At present there are upwards of 28 roads under construction.

At this transition stage, the Indian railways offer some interesting specimens of early types of equipment as well as modern stock. One of the oldest locomotives at present in service is shown in Fig. 1, which represents a little tank engine, "Fawn," belonging to the East Indian Railway Company and built for them by the old firm of Slaughter, Gunning & Co., at Bristol, in 1857; it is No. 353 of their build. Three of these engines were built and named "Multum in Parvo," "Fawn" and "Snake." They had cylinders 14 x 22 ins., driving wheels 6 ft. 6 ins. in diameter, and the leading and trailing wheels 4 ft. in diameter. Total weight 29 tons. Locomotives of this type were used on the railway soon after it was opened between Howrah (Calcutta) and Raneegange, a distance of 125¾ miles. During the days of the Indian Mutiny engines of the "Fawn" type were used to haul the troop trains over the line, and a sister engine, the "Express," now stands on a pedestal outside the Jamalpur shops of the East Indian Railway, with the following inscription below it: "This locomotive was the first which ran on the East Indian Railway between Howrah and Raneegange and conveyed troop trains to Raneegange in the memorable year of 1857, was placed on this pedestal January 22, 1901, as a fitting memorial in these works of the termination of the glorious reign of our beloved Empress and Queen, Victoria the Good."



VICTORIA TERMINUS OF THE GREAT INDIAN PENINSULA RAILWAY AT BOMBAY.

The East Indian Railway Company now operates some 2,100 miles of track, and one of the locomotive sheds of the road appears in Fig. 2.

When we come to the principal railway of India, of which Sir Andrew R. Scoble is chairman, we find much of interest. The train shown in Fig. 3 is one of the suburban trains of old stock of the Great Indian Peninsular Railway (known as the G. I. P.) entering the yard. The handsome Victoria terminus is illustrated in our frontispiece. These trains of short four-wheel compartment carriages are shortly to give place to new open cars over 60 ft. long, running on trucks similar to the general American type. These have been designed by the car superintendent, Mr. A. M. Bell, and are built at the Parel Works, Bombay. In Fig. 4 we have a good example of a main line train of four-wheel carriages entering the same station; while Fig. 5 represents one of the "crack" expresses leaving it. The sunshades, which will be noticed on these cars, are being abandoned on the newer equipment, as a non-conducting lining for the roof has been substituted. The six-coupled 10-wheel locomotive shown heading the train was built by the North British Locomotive Works at Glasgow.

FIG. 1. EAST INDIAN RAILWAY COMPANY'S ENGINE "FAWN."

To give some idea of the great number of passengers carried by trains in India, it may be mentioned that this fine express train can accommodate 30 first-class, 60 second-class, and no less than 480 third-class passengers, the latter being nearly all natives, who appear to delight in herding together as close as they possibly can, despite the usual sultry state of the Indian climate. Poona, the point to which these trains run, 120 miles distant, is a large solitary station and a health resort, situated high up on the plains which follows the ascent of the Ghat mountains.

The locomotive has cylinders 21 x 26 ins. and drivers 74 ins. in diameter, bogie wheels 42 ins., heating surface of boiler 1,770.2 sq. ft., grate area 30.75 sq. ft. Working pressure 180 lbs. per sq. in. Weight of engine and tender loaded 224,000 lbs. By way of contrast as to what can be done on narraw gauge lines, Fig. 6 illustrates a very similar engine one on the Bengal North Western Railway, a narrow gauge road. There are two principal gauges of the track in India, viz., 5 ft. 6 ins., called wide gauge, and one metre, or 3 ft. 3⅜ ins., the narrow. Other gauges exist, and Fig. 7 shows two locomotives of the Gwalior State line which is only 2-ft. gauge. This little railway, originally a plaything of the Prince of the State, now extends to over 200 miles of track and carries an enormous number of passengers and tons of freight. Freight is generally handled at present by six-wheel connected engines, eight-wheel coupled locomotives are, however, on order and loads are to be increased. The standard 16-ton four-wheel steel car will probably have to give way to 40 or 50-ton capacity vehicles, and the equipment with automatic brakes is in contemplation, together with improved couplings.—*A. R. B.*

Fast Work at Winnipeg.

The men of the locomotive department of the Canadian Pacific shops at Winnipeg, Man., had an opportunity to overhaul and make general repairs to a large freight engine in the shortest possible continuous time. The repairs were completed in 57½ hours, counting to the beginning of the trial trip. Work having commenced at 7 a. m. on Monday, Oct. 11, was finished at 4.30 p. m., Wednesday, Oct. 13. The engine leaving the city with a freight train at 7.50 p. m. the same day. No preparation had been made in advance beyond arranging a minimum schedule for the employees' guidance; but their efforts were such that they beat the schedule by over 50 per cent.

The engine, No. 712, is of the D-10 class, company's classification, having ten wheels, cylinders 21 by 28 ins., and weighing 190,000 lbs. The total weight of engine and tender, when ready for service, being 315,000 lbs. It is fitted with a Vaughan-Horsey superheater, and the replacing of this superheater after the tubes were completed and

FIG. 5. ONE OF THE G. I. P. "CRACK" EXPRESS TRAINS.

the boiler tested consumed about ten hours, after the rest of the work was finished, so that the engine would have been ready for service ten hours earlier had it been of the ordinary type using saturated steam.

The engine was given a thorough

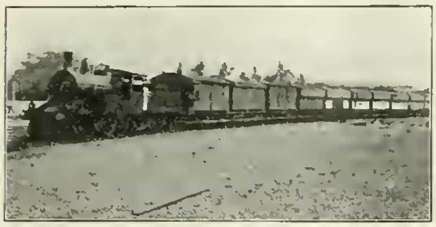


FIG. 4. MAIN LINE TRAIN G. I. P.

overhauling in every particular, and all alterations and improvements were made in accordance with regular instructions, nothing being neglected. A large amount of new material was machined up and applied, such as new sets of driving tires, driving box brasses, driving box liners, shoes and wedges. Main and side rod brasses, motion pins and bushes, piston and valve rings, piston head and ashpan. The 244 2-in. and 22 5-in. tubes (the latter being used in connection with the superheater), were removed and replaced; the boiler was carefully scaled and washed while they were out; the tube holes being also reemed. A new form of duplex boiler check and bell stand was also applied to the top of boiler, which necessitated new discharge pipes.

Altogether it was a very creditable piece of work, and Mr. S. J. Hunger-

FIG. 3. SUBURBAN TRAIN ENTERING BOMBAY.

ford, superintendent of shops, and Mr. R. R. Neild, general foreman, are to be congratulated on the loyalty and ability of the men under them. Mr. R. Wilkinson was in charge of the work.

Remained Quite Stationary.

I heard of a chap who worked in a hardware store for five years, and in

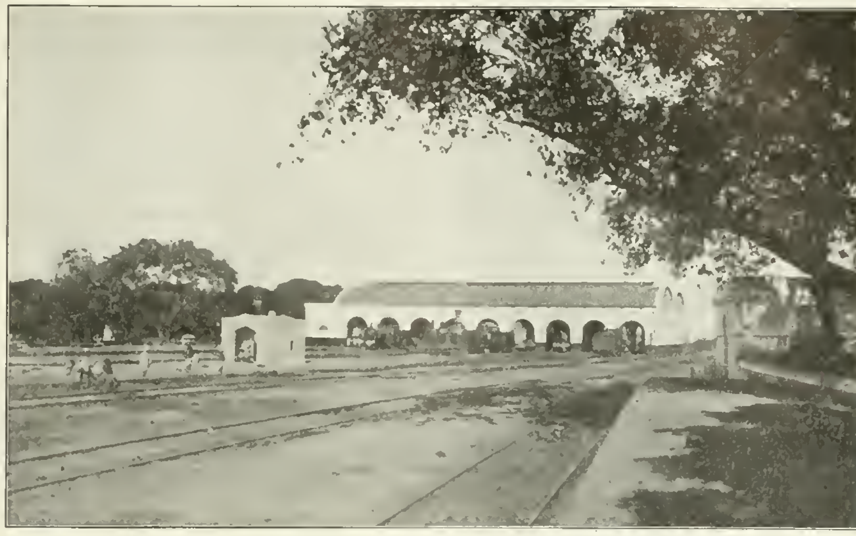


FIG. 2. LOCOMOTIVE SHED AT JHAJHA, INDIA.

that time he never learned a thing nor had his pay increased, says a writer in

FIG. 6. SIX COUPLED ENGINE AND TRAIN, BENGAL NORTHWESTERN.

the *Apprentice Bulletin*. He was employed first to dust shelves. He prided himself on being a good duster. He was —that's why he was kept at it—he never learned to do anything else.

A friend dropped in one day and said: "Well, how are you getting along?"

"Oh, just the same as usual. I still get $5 a week for dusting shelves."

"For dusting shelves? You mean for reading a hardware catalogue, don't you?"

"No, I don't; I mean just what I said. In all the five years I've worked her I never saw a catalogue.

"Well, then, open your eyes. Some people never learn more because they never see more to learn. Those shelves you dust are your catalogue. What are those things I see there in those long boxes?"

"Those are ship augers."

"What are they for?"

"I don't know."

"How much are they?"

"I don't know; they never tell a fellow a thing."

"Whose make are they?"

"I don't know."

"What sizes have you?"

"Well, the box says they are made in

FIG. 7. ENGINES OF THE GALIOR LIGHT RAILWAY.

sixteenths, but I don't know what sizes we've got."

"No wonder you get but $5 a week. You don't deserve any more. With your five years' experience you should be a well informed hardware man."

"That's so. I never thought of that. Do you suppose I could learn anything now?"

Traveling Engineers' Convention at Denver

(*Continued from page 496.*)

HANDLE ENGINES PROPERLY.

Mr. Harry Bentley, of the C., R. I. & P. said: I contend that the economy of a locomotive depends entirely upon three factors. First, the amount of steam used; second, the manner in which it is used; third, never pump your machine when steam is shut off. Of course you say, how are you going to get around that? I will show you. Upon the amount of steam used and the manner in which it is used, depends the economy of your machine. We have to overcome great waste in the overloading of tanks. I have had more troubles than a fly in a tar bucket trying to keep men from overloading the tanks but we are getting results. We are saving fuel that way.

VOLUME OF STEAM USED.

A similar meeting to this I hold every month with my engineers. I have got them sufficiently interested so that they go along the lines that I lay out for them. We are always speaking of educating the fireman; of course that is necessary. But, gentlemen, did it ever occur to you to keep your eye on the man on the right hand side? Just because he is a Brotherhood engineer, is he infallible? He is just as likely to make mistakes as before. Keep your eye on him also. I instruct our men that economy is this: hook her back or hook her up as far as consistent with doing the work, I don't care how far you hook her up. For instance, a man gets her up six inches. What is the result? At six inches he uses approximately three-tenths of a pound of steam. Now, in making one revolution she will take four times three-tenths, which, of course, is twelve tenths, which is one and two-tenths. She makes in one mile 320 revolutions; consequently we use 320 times six-tenths, which is how much? When he hooks her up as far as consistent with doing the work, that is where he is doing the most economical work, he should use a wide open throttle. When I speak of a wide open throttle I mean the square of the valve. It is useless to pull the tail out to the tank, but open her up to the tail of the valve. The result is you approximate as nearly as possible to the boiler pressure. Of course, you say you cannot handle all your trains at six inches. I don't care where you put her. Put her at eight inches. At eight inches with a full throttle what is the result?

FIRING BY TELEGRAPH POLES.

I have got my firemen so fully interested that they count the telegraph poles that they run between fires. We ran twenty-six, twenty-seven and thirty poles between fires. We are making thirty miles an hour. I said, "Now, put her in the ten-inch notch and restrict your throttle so that she will do the same work." The result instantly made itself manifest. For the next fifteen miles we only made approximately one-half as many telegraph poles between each firing as we did before. So I still contend that economy depends upon the quantity of steam used and the manner in which it is used.

CAREFUL BOILER FEEDING.

Another thing, instruct your men, under no consideration to pump the machine when she is not using steam. I think one of the presiding officers was on the train with me recently and we stopped but one minute for a semaphore. The rule is when the signal is against us we stop one minute and proceed On this occasion we had a train of approximately 450 tons, it was our regular Mountain Flyer. The injector was working that minute. What was the result? The indicator went back. I said, shut her off. While he had that injector working but a minute he injected probably seventy-five gallons of water into the boiler. The injector at the very best will inject, water at about 143 degs., the temperature of water at 200 lbs. pressure is 381 degs. Now, then, the moment he pulled out what made that boiler pressure go back? It was because of that seventy-five gallons of water, it had cooled her off. If you will instruct your men along that line the result will be that you will gain a great deal of economy in fuel, because that fireman fired for a number of miles to restore that heat. The amount of coal he put in then would have taken him fifteen miles if the engineer had shut his injector off. I know just as well as you do that you can not always wait to put the water in, but you can make this provision. You have got the water glass there to show what is going on. The moment it becomes necessary to put water in let him meet the conditions by putting the blower on, then screw the injector down as fine as he possibly can and then he will drop as nearly as possible a uniform temperature between the top and bottom of the boiler. Now, remember, if you have got your boiler 278 degs. above, yet you are putting cold water in it. The specific gravity falls and the water falls to the leg of the boiler. Incidentally it will go up in the flues. The flues loosen up. Now, then, if you will go to work and create motion in that water when you get ready to pull out you won't have hot water round the flues. My meetings have borne fruit to some extent and I keep punching at them.

LOSING COAL OFF THE TENDER.

And when it comes to other economies: Now, for instance, Mr. Roesch brought the point out very forcibly that we lose more coal going down one of our long grades than we are able to save over the division on account of the long drawbars. Consequently I advocate keeping our drawbars short. We have even gone so far that I have supplied my men with plates to put in behind the wedge to keep it up as far as possible.

BOILER WASHING.

At my meetings I requested my boiler washer to be present, showing him what it meant if the slightest amount of mud was present and what took place. We were talking a few moments ago of what a slight scale would do. It will increase fuel consumption enormously, but what will it mean to a sheet when we have a lot of mud there? Are you gentlemen aware what the difference is between a sheet that is right in your fire and a sheet that is against the atmosphere, when the atmosphere in the firebox is 2,300 or 2,500 degs.? If your sheet is clean I will guarantee there is not forty degrees difference between the sheet that is right in the fire and one in the atmosphere, but the moment you have a slight amount of mud there the difference is enormous; it will run up to where it almost spoils the steel. It pulls in, and the steel is practically burning; it becomes red hot. So you see on account of the water being unable to get near that sheet it heats to a great degree. There is an absolute necessity to have the boiler clean, and if you hold these meetings have the men in your roundhouse attend them just as much as your engineers and firemen.

SAVING BY SHOVELFULS.

Mr. Roesch broached the subject of saving one shovelful out of 100, or perhaps two. When I put that to my men they asked me whether I asked them to count the shovelfuls over the division. I said, "Boys, I expect you to render the very best service you can to the company." I have a great many records of recent tests where we pulled 1,310 tons on 620 shovelfuls thirty-five miles. Well, it showed the man was willing to enter into this method of ascertaining whether he could economize or not. Now, perhaps when he goes out with a train of approximately the same tonnage, he can save a few shovelfuls on that. He will let me know. Those are my instructions to him. When you can get your men interested sufficiently to work along these lines you will get results. So I say while we are up here and find perhaps 101 methods of saving, it is upon you, gentlemen, to put it into effect among your men. That will be a little difficult for you at first.

METHODS OF FIRING.

I instructed them along a line, I would not term it bank firing, it is not bank firing. Some people might object to it but I did get results. I instructed the men when they get the fire level, good and solid to alternate in their firing, and I restricted them to anywhere from four to five shovelfuls to the fire. For instance, you put five or six shovelfuls on this side, next on the back, then on the other side. What I aimed at was to fire alternately to one side and the other across the rear. When you fire an engine in that manner the hydrocarbons, as they are liberated will pass over this incandescent surface and ignite. As Mr. Roesch and others have brought out, a pound of carbon gives you 14.500 British thermal units. That is all right, providing you have the coal that contains the carbon. Up to a recent date I had a very serious condition to contend with, namely, that I had from ten to twelve kinds of fuel; but through the assistance of our fuel clerk the conditions are becoming more uniform in that direction, so much so that I have been able to increase on our engines' nozzles.

FEED WATER HEATED.

Mr. John McManamy, of the Pere Marquette, continuing the discussion, said: I want to say just one word in regard to the statement made by Mr. Roesch a few moments ago relative to statistics. He was figuring up where the statement had been made that there was a 20 per cent. saving by the feed-water heater. I believe Mr. Roesch in his enthusiasm overshot the mark on that. The statement made on that was that by raising the temperature of the feed water fifty degrees we save as much heat as is contained in 421 lbs. of pure carbon, each 100 miles. If that would be 20 per cent. the other 80 per cent., and including this 20 per cent., would be 1,605 lbs. of carbon for 100 miles, or 133 miles per ton of coal. Then in figuring up what he was doing on his road, showing the swing that was made going down one way with the loads and going up the other way with the empties, he referred to the performance sheet, and I hope he won't think I am unkind if I ask him if these are any different kind of statistics than the others. That is a statistical statement just the same as the other, and I believe one kind of statistics just about the same as another.

SPREAD THE TELEGRAPH POLES.

I believe Mr. Bentley has accomplished a great deal on the Rock Island Railway in educating his men up in the way he has done. There was a new idea occurred to me during Mr. Bentley's talk. He states that on the Rock Island Railway he has men educated so that they are counting the telegraph poles and putting in a fire as they pass the telegraph pole. Now, would it not be an excellent idea to advocate that when we have got the men counting the telegraph poles, after we have them educated up to that degree, we then prevail upon our companies to space the telegraph poles further apart? (Applause and laughter.)

WANTS COAL WEIGHED.

Mr. L. B. Hart, of the Baltimore & Ohio, said: I do not think any one will deny that this is a matter of education and a matter of education which cuts a considerable figure, and I would like to say this for the engineers and firemen, that the matter of educating the engineers and firemen I think would be considerably simplified if they only knew that the company, the road foreman of engines and everybody else concerned, knew how much coal was put on the tank and knew how much was consumed. That is, I think the coal should be weighed, and I think it would pay to weigh the coal and then it would eliminate any possibility of sharp practice on the part of any one that was unscrupulous, be it engineer, fireman or coal chute man, and then the man would get the credit that was entitled to it.

Mr. C. E. Rush, of the Lake Shore, said: About weighing the coal? From our experience in fuel economy or getting at the actual amount of coal burned, we find it necessary to pro rate all loss in coal on the engines at that point. Coal is delivered to them at the miner's weight. Coal lost en route, stolen, etc., is charged to the engine as actually burned. This, of course, is a loss that should be stopped. The company is paying for that coal, the enginemen are charged with using it and it forms quite an item.

MISLEADING ENGINE TESTS.

In regard to the tests. Referring to Mr. Roesch's statement in regard to statistics I agree with him to this extent: Most of the tests that have been made in years past on railroads have been with an engine in perfect condition. They have picked the engineer and the fireman. They have picked the tonnage of the train. The train dispatchers everyone were notified that those were test trains and they would have to expedite their movements. The result was that when one got through with the test there was but little information. You have not dealt with the daily conditions on the road. You have not measured your men by the general class that you have. You do not have all 100 per cent. men. They will range, we will say, from 50 to 100. You have got to operate your trains and engines with the men that you have. Of course, any system of education which betters their information is of advantage in the saving of fuel and handling of trains.

TRAINING OF FIREMEN—EFFICIENCY CARDS.

We found that the time with the fireman is right at the beginning. We begin at the start and let them understand what we expect of them, and if their efficiency is not a fair comparison with the average, why then they are dropped from the service. We have efficiency cards, which are kept and issued every six months from the road foreman's office. We also have a coal report, or what is a performance sheet, made out by the engineer and filled in by the engineer at the expiration of the trip. We are doing that now on the fast freights and intend eventually to carry it into slow freight service. It shows the engine number, the amount of coal burned, the tonnage of the train, or the number of cars, at least, where the tonnage cannot be obtained, and whether the fireman fires heavy or light, and what the engineer's view of his performance is. That is shown on each of these reports.

Our firemen get off on one portion of the division and the engineers run through. For that reason each engineer has two firemen, and engineers seldom have the same fireman two successive trips over any portion of the division, and they see all the different firemen and they are able to pronounce to a great extent on their capacity. That helps the road foreman in pronouncing on the efficiency or ability of the firemen. Of course this efficiency card goes into a whole lot of other details that help to make good firemen, such as the matter of reporting promptly and regularly, concerning their habits and their not laying off promiscuously, and all such things; but the principal feature we are speaking of now is with reference to their performance as firemen.

When they come to their first examination we show them by the performance sheet, that is as near as we come to statistics, what the preceding class of firemen did before them and what they are doing, and we hold them up in comparison with the former class of fireman that are in that service that are advanced from time to time. That gives them an understanding of what they are doing. We also show to them at the same time that their performance will be watched, and if it falls far below on their efficiency card they are called in and notified of the fact. If they do not improve they may expect to be dropped from the service.

We have followed up that system, and in addition to that we are now arranging to hold meetings at different points on the road to reach our firemen and endeavoring as far as possible to educate them in what they should know. However, our experience is if you go into scientific problems with the average fireman or engineer you are going to get him confused, and, as a rule, you do not get much from him. You can tell him a whole lot of things that happen, but the question as to whether he can apply those things or not is doubtful.

We used to run tests as I have just described, that is, we picked the engine and the man and the train and all that. Now we run our tests right along as in actual service. We do not pick the engine; we take whatever engine is there. We take whatever man stands to go, and whatever train the yard master sees fit to put on, and we measure them, one train with another, from day to day, and we find that we get more satisfactory results, nearer what the actual conditions are, and it gives us a great deal better information.

EFFECT OF RAPID TRANSIT.

Another thing that the gentleman referred to was rapid transit. We have found in our experience that in figuring the tonnage of trains and coal consumed per 1,000-ton mile, we did not go far enough with it. We found it was necessary in order to get accurate results to carry it into ton miles per hour. If a train hauls a train of 1,000 tons a given distance in two hours and the next day they are required to haul the same tonnage the same distance in an hour, it makes a considerable difference in fuel performance, and we find if we carry those figures into ton miles per hour we get an altogether different kind of figures in comparison than in ton miles. They used to carry it into engine miles, that was as far as they went; then into ton miles. Now we carry it into ton miles per hour and we find we get an altogether different set of figures and really more satisfactory figures in the performance of the engine.

SAVING FROM WASTE.

We have found we get better results in saving the fuel that is otherwise wasted, actually wasted, a really more important quantity, than can be measured by any other method that can be mentioned, such as changing the front end or anything else. Of course, we all know on a railroad the better condition the cars and engines are in, the better condition the boilers are in, the frequent changing of flues, have all to do with economy; but when it comes to comparing any of those things with the fuel wasted on a railroad it is almost nothing.

WHERE THEY WEIGH THE COAL.

Mr. Busby, of the A., T. & S. F., said: I am situated on the low grade line to California of the Santa Fe, and on that line we have coal chutes, and weigh all the coal that is put on the locomotive, so that we know exactly what they get. We see that none of the tanks are overloaded. We do not waste any there. We very closely watch the handling of the locomotive by the engineers. We watch the firemen very closely. We keep, I believe, as good a record on the coal business as any railroad in the United States, or in the world, as far as that is concerned, and when we find an engineer or a fireman whose record is poor, or below the average, we go to him and talk to him, and we talk nicely and pleasantly to him, and if he lays the trouble to his locomotive then we go to the engine and we ride on the engine with him, and see where the trouble is. If it is in the engine we rectify it. If it is in the man we talk to him again, and, so to speak, straighten him out.

SAVING COAL IS A COMBINATION.

There are a great many ways of saving coal and we have made a great saving in coal by following up this method. Saving coal is a combination of everything. If you find your engine packing rings are blowing have them removed. If it is the packing of your valve have that fixed. If your steam pipes are blowing get right after them. Do not depend entirely on the engineer to go to the work book to have it done, but you go right into your master mechanic and tell him that the engine is wasting fuel, and see how quick he will take hold of the matter. I do not intend to give a long talk, but that is our method of handling the coal business and it is a great saving.

BELIEVE IN SINCLAIR'S ARTICLES.

I want Dr. Sinclair to understand that we read his articles on smoke a good many years ago and have not forgotten them. We have been following that matter up right along. We talk to our men about smoke. We don't want it. We want to burn it up. We want Dr. Sinclair to understand that on our line we are still with him on that proposition.

KEEP ENGINE IN GOOD ORDER.

Mr. Miller: I do not think we, as traveling engineers, can accomplish more in the direction of saving fuel than to follow up the locomotives in the line of having repairs made, such as leaking steam pipes, or to hunt the trouble up when the engine is failing for steam. We haven't a great deal of trouble with engines failing for steam on our railroad, for the reason that we get good fuel. We run Pittsburgh gas coal one direction, eastward, and coming west we burn what is known in our country as Somerset smokeless coal. There is such a vast difference in the two fuels that we have to strike a medium on the exhaust. Going east we could run a five-and-a-half-inch nozzle in our large consolidation engines, but on account of the quality of the fuel used coming west we are compelled to reduce the nozzle to such an extent that we can have steam both ways. I believe, too, that we, as road foremen of engines, can do a great deal in looking after the firemen. I have had some experience in disciplining firemen on my division when they failed. I have taken them off after runs and made them ride with a fireman that I knew was a coal saver and fired with a light fire, and I found that it did more good than to give them ten or fifteen days lay off.

(*To be continued.*)

Proposed Electrification.

Press despatches from Chicago state that the officers of the Illinois Central Railroad have come to the conclusion that the cost of electrification in connection with their suburban business is prohibitive and have so informed the authorities of the city of Chicago. The railroad's view of the case was presented to the Health Commissioner and the members of the City Council at a conference with Mr. Harahan, who made his position clear by stating that he believed the cost of the improvements to be greater than the company would be warranted in making. As stated to the conferees, President Harahan proposes to report to the stockholders that the electrification of the company's suburban lines will mean a reduction in their dividends, probably of 2 per cent.

The East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company are beginning work on a very heavy order for railroad motors for the Long Island Railroad, which represent almost a million dollars. This calls for 260 motors of 200 h.p. each, which will be used to equip some part of the cars on the Long Island system. This order is owing to the extension which the Pennsylvania Railroad people are now making at terminals and tunnels under the North and East Rivers at New York.

General Correspondence

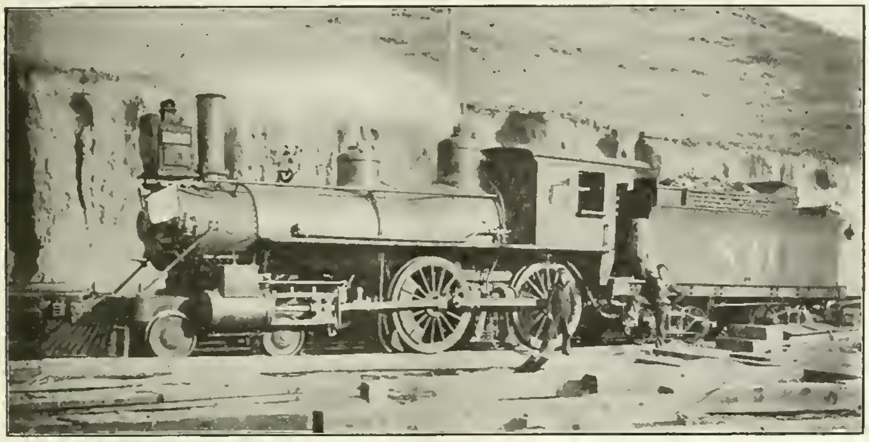
Some More U. P. Engines.

Editor:

Being very much interested in the Union Pacific engines illustrated in the August number, I am enclosing you two photographs of engine 737, a diamond stack, and engine 841, equipped with a straight stack, thinking they might interest some of the Union Pacific readers.

These photographs were taken near Evanston, Wyo., in 1902, but do not know whether they are Baldwins or Grants. Probably some of the U. P. veterans may recognize them. L. J. LAPSLEY.

B. & O. Gen. Offices, Baltimore.



UNION PACIFIC ENGINE NO. 841, PHOTOGRAPHED NEAR EVANSTON, WYO.

Likes World Signal

Editor:

Your policy of inviting the discussion of the signal question has brought out many ideas, and I wish to say that as this question is being pretty thoroughly threshed out in the "General Correspondence" columns of your valuable magazine, I believe there is very little left for me to add.

I have always thought that there have been too many colored lights to contend with, and the likelihood of confusion along the road is greatly increased by the fact that there are frequently lights along the way, used by automobilists, in residences, etc., which are of the same colors as those used in the standard signals of today. The chance of a red (danger), or green (caution) lense becoming lost out or broken and thus giving, apparently, a clear block, is another strong reason why the number of colored lights should be reduced to the smallest degree.

I believe the nearest solution to the elimination of colored lights is in the new World signal. I had the pleasure of witnessing a number of tests made with this signal alongside of the standard red, green and white lights by night and the standard semaphore arm by daylight and strongly recommend the World signal as being far more practical than any I have ever seen. The white background enabled us to see the position of the signal arm in daylight at a much longer distance than we could see the standard semaphore arm, which was lost to view while the arm on the World signal was still very plainly visible. It does away with the popular complaint that semaphore arms are hard to distinguish with hills and trees for a background.

At night, under most unfavorable conditions, consisting of a heavy drifting mist and dense fog, the illuminated background plainly showed the position of the signal arm, long after the standard lights had been obscured in the fog. All in all, I think it is the simplest, safest and best signal that I have seen. B. TYRONE.

Tyrone, Pa.

Springless Brake Cylinders.

Editor:

I am always pleased to see what Mr. G. W. Kiehm says relative to the air brake, because it touches a tender spot on me, for I am the inventor and patentee of an out-and-out system of straight air brakes. Of the twenty-four unique features in the patent I have decided to come back to the springless brake cylinder, because it has proved itself to work automatically and interchangeably with others, regardless of where it is placed in the train.

The springless brake cylinders have no grooves. The motion of the large and small pistons are controlled by air force in application and release. This cylinder has a record of twenty-two and a half months of continuous action and without oiling any parts, nor has any shop work been done during this period, and there have been no skidded wheels. Wintry weather has had no effect upon it. I would be glad to hear from your readers on this subject. Inasmuch as my years are 81, excuse composition and penmanship. WM. WILLIAMS.

Huntington, Pa.

First Rhode Island on the Old Colony.

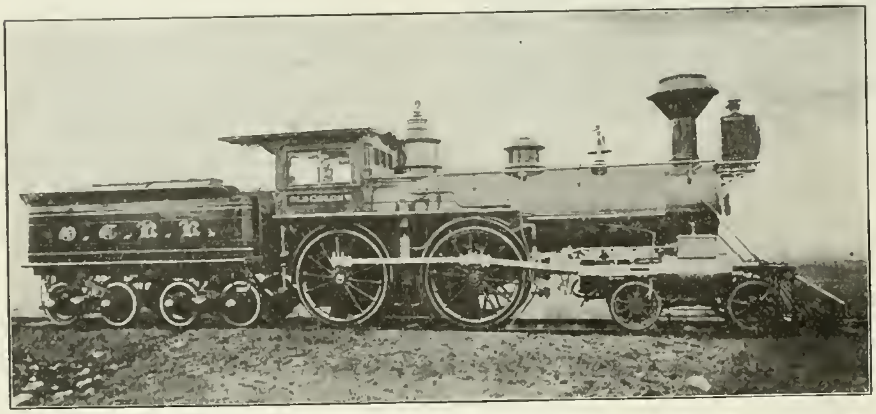
Editor:

No locomotive of other days in New England is more entitled to honorable mention than the one here illustrated, selected as the standard bearer for the historic railroad to which she belonged.

U. P. ENGINE NO. 737 HAULING TRAIN AND PUSHING OBSERVATION CAR.

It is only about eight years since the famous "Old Colony" (No. 637, N. Y., N. H. & H.) was dismantled at the South Boston shops, and the patched and rusted boiler loaded on a flat car to be removed forever from the vicinity of its long and useful service. The "Old Colony" was the first Rhode

Island engine owned by the Old Colony Railroad, and its origin dates back to 1869, when Supt. J. H. French gave her the name she afterwards proved herself so worthy to bear. This engine was followed on the list by the "Narragansett" from the Taunton Locomotive Works, both being built with the object that the better one of the two should be assigned permanently to haul the steamboat express, then the heaviest train running out of Boston. The "Old Colony" could not make steam, and was soon taken back by the builders and furnished with a new boiler. The "Narragansett" could not use her steam to advantage, and was therefore disqualified. Many thought the latter was never given a fair chance, but engineer John Lufkin, now deceased, who ran the boat train for years, subjected both engines to thorough tests and the "Old Colony" carried off the honors, earning for herself the enviable title, "Pride of the Boat Train."



"OLD COLONY," 4-4-0 ENGINE ON THE OLD COLONY RAILROAD.

The "Old Colony" figured in serious accidents, once being thrown from the track by obstructions placed there with malicious intent. Engineer Lufkin was severely scalded. The Randolph disaster in which this engine was involved was one of the most destructive accidents to rolling stock in the history of the road. This happened in Centennial year, when travel was unusually heavy. The steamboat express left Fall River early in the morning, Oct. 13, 1876, upon arrival of the boat from New York. The train was made up of fourteen cars, hauled by the "Falmouth" and the "Old Colony" double-headed. At Randolph they collided with the engine "Pacific," which was backing a long train of freight cars from the main line on to a siding. The express was reported to be late, but traveling at a high rate of speed, made up lost time and its proximity was evidently not realized when the freight started to occupy the main line. The three locomotives were stripped clean, and two or three cars on each train were badly broken. The late J. K. Taylor, master of machinery of the Old Colony Railroad at that time, happened to be a passenger on the express, and came to the front to look upon the havoc wrought by the collision, and superintend the work of getting the wrecked locomotives back to Boston.

Mr. Taylor took great pride in the repairing and refitting of these engines. An idea of the artistic ornamentation of the "Old Colony" may be had from the picture which was taken shortly after the engine came from the shops. The "Falmouth" and "Pacific" were equally elaborate, but both different in design and coloring. The "Pacific" was one of four locomotives built by the Baldwin Locomotive Works for the Northern Pacific, but for some reason rejected by the big western railroad. The Old Colony Railroad purchased them and they were brought east. Mr. Taylor named them Easton (69), Northern (70), Pacific (71) and Milton (72). They were, as far as I have been able to learn, the first Baldwin locomotives owned by this road. The boiler of the "Northern" was renewed, and the engine, as No. 2019, N. Y., N. H. & H. may still be in service. The other three have long since gone the way of the most of the locomotives of Mr. Taylor's regime and time.

W. A. Hazelboom.

Boston, Mass.

Old Engines on the P. R. R.

Editor:

Washington, D. C., is situated on the Pennsylvania Railroad, and for some time I have been interested in the locomotives in use on this system. As I have spent a good deal of my time about the yards and roundhouses of the road and have nearly always taken the P. R. R. when traveling to or from the west I have naturally seen a good deal of the engines. My favorite machines were always those with the Pennsylvania smokestack, and for passenger service, the eight-wheelers with wheel covers and innumerable little features which always marked them as P. R. R. engines.

A few years ago the road removed the wheel covers from its passenger locomotives, but otherwise left them as before. Recently the engines of the

FIG. 1. ENGINE 5012 AT BOWIE, MD.

company have not been quite so different in appearance from those of other roads, though they still have a "Pennsy" look about them. These modern machines are well known, but the older ones may not be, and therefore the following notes and photographs may be of interest. Fig. 1 represents an "American" type locomotive, No. 5012, at Bowie, Maryland. Bowie is the northern terminal of the Popes Creek branch, and this engine handles the passenger train twice a day over the line from the main line at Bowie to the southern terminal. The engine is kept up in fine shape and hauls very heavy loads for such a small locomotive.

Engines "Billy" and "Teddy," shown in Figs. 2 and 3, are locomotives on the Chesapeake Beach Railway. This is a short line running from Chesapeake Junction to tidewater at Chesapeake Beach. The engines were bought from the P. R. R., and are really the property of the American Signal Co., who make tests of their cab-signal on the C. B. line. These engines are of the same type as No. 5012, and show the Pennsy stack, cab, domes, etc. They are in good shape, as can be seen from the pictures.

Fig. 4 shows "Class P," No. 5060, in the old yards at Washington. There

FIG. 2. C. B. RY., "BILLY."

are several sizes of these engines, some a good deal larger than this one. A fine picture of one of these engines came out in "Railway & Locomotive Engineering" (or rather "Locomotive

Engineering," as it was then called) for December, 1893. Many "Class P's:" are in use to-day, but especially between Baltimore and New York.

The last two pictures, Figs. 5 and 6, were taken in the yards of the Union Station, Chicago, Ill. The first gives a good idea of the appearance of six-wheel switches No. 7051, and Fig. 6 is of engine 741. Engines No. 7051, and others of same class, are unusual in one respect at least. They have side-door cabs and yet are not tank engines. This construction is scarcely ever seen off the P. R. R. In fact the only engine I ever recall with a side-door cab and separate tender on any other road was on the Norfolk & Western, six-wheel switcher No. 130, at Lynchburg, Va. It makes the cab comfortable in bad weather and especially in backing up.

The last picture is of six-wheel switches, No. 741, with ordinary cab and differing from 7051 in having the main rods on the rear drivers.

Besides these engines there was a type used in the late 80's for passenger

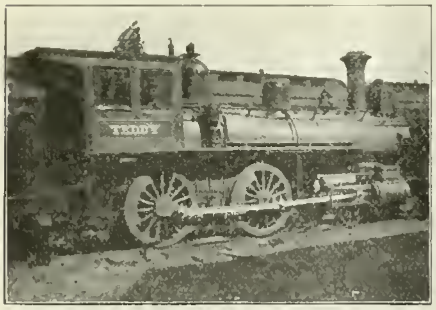


FIG. 3. C. P. RY., "TEDDY."

service that always seemed very handsome to me. They were eight-wheelers, with sand boxes in wheel-covers instead of on top of boiler, and were used on the fast express trains for some time. I never learned their class till I wrote to RAILWAY AND LOCOMOTIVE ENGINEERING recently and in a few days received a most interesting letter telling me they were known as "Class K."

If any readers of this letter are interested in the motive power of the P. R. R. I would like to hear from them through our mutual friend, RAILWAY AND LOCOMOTIVE ENGINEERING. I would particularly like to see some photographs of the eight-wheelers before the removal of their wheel-covers, etc.

HUGH G. BOUTELL,

Washington, D. C.

Railway Clubs of the So. Pac.

"It is their care that the gear engages,
It is their care that the switches lock."
—*Kipling.*

Editor:

It is not a far cry back to the time when a plan for such an institution as a club for the workers of a railway company, supported by the company, would have been an idle dream, and anyone suggesting such a scheme to a board of directors would have been thought a sentimental idealist not worth the time of an interview. But more and more, as time goes on, do we find

FIG. 4. CLASS "P." ENGINE, P. R. R.

a growing appreciation of the fact that, for the same reason that a machine must not be left exposed in a damp place, for fear of rust, the man who runs that machine must not be allowed to live in conditions which tend to degrade his physical and moral sensibilities. That a great railroad corporation is inaugurating a system of clubhouses in which its employees may rest and recreate themselves while off duty, and is finding the expenditure to be a negligible quantity in comparison to the returns in increased efficiency and a lengthened average period of service, is a conclusive refutation of the old theories and a promise of better things to come.

The engineer and fireman of a passenger train have as much depending on them as any other two workmen in the world. The machine which they handle has been brought to its present state of perfection only through years of study and experiment. It is constantly guarded and kept in the pink of condition. Not a part of its mechanism but receives the inspection of experts and grooms are constantly in attendance to see that it lacks for nothing. Yet when the men who operate

FIG. 5. SIDE DOOR IN CAB.

this giant leave it at the roundhouse to be nursed and cared for till its next trip, they, the engineer and fireman, are usually turned over to the tender mercies of the saloon and its adjuncts or the alternative of a dirty room and a foul bed. What wonder if occasionally, one of these human engines slips a cog and some of the sons of Mary are hurled to death.

It is the purpose of the Southern Pacific to inaugurate a system that shall care for its men in the same efficient way that its rolling stock is tended. The idea was of slow growth, and it required actual demonstration to convince hard-headed railroad business men that the scheme, if carried out, would save thousands of dollars. Mr. F. G. Athearn, superintendent of railway clubs for the Southern Pacific, has undertaken the task of overcoming the skepticism on this point, and he has been allowed to proceed with caution into the first block. Mr. Athearn's scheme is to have the railway club management a regular department of the company just as much as the department of maintenance of way. It has been demonstrated by experience that clubs and clubhouses under the management of railroad workers peter out in the end. The railroad man is shifting about to such an extent that anything in the way of permanent support of such an institution by him is out of the question, and endowed clubs have invariably failed after the original benefactor died.

Mr. Athearn's plan is to have a sys-

FIG 6. SIX-WHEEL SWITCHER.

tem of clubhouses located at all the cutting out points—these clubs to afford a man the same advantages that are offered to a business man at his private club, and with charges so reasonable and equipment so good that he will have no reason or desire to leave his quarters from the time he drops off his engine till he resumes his charge. Moreover, the club is to be for all the men. There is a sentiment against the Y. M. C. A. clubs among a great many railroad men. Whether this is right or wrong it does exist and prevents many men from enjoying the benefits of such institutions. There is no religious restriction under Mr. Athearn's régime, and the only requirement is that the men sign a statement saying that they are bona-fide employees of the Southern Pacific system, and agree to conduct themselves in a gentlemanly manner while enjoying the privileges of the house. No prohibitive notices are permitted on the walls.

The first club was a small affair opened in the town of Tucson, Ariz., in April, 1906. In the words of its first secretary, Tucson was "a wild and woolly place," and, at that time afforded nothing in the way of entertainment or even decent warmth, light and comfort outside of the saloons. Efficient men would not stay in Tucson as it was before the days of the club. But now the tired, hot, grimy man of the road can slip off his engine at Tucson, take a bath, buy a cigar or soft drink, read from a selection of three thousand books, or play a game of billiards, pool or cards without stepping outside of this house—which is entirely at his disposal. And the cigars and drinks are dispensed by a man with a white uniform, the books are good and well kept; the billiard and pool tables are the best that can be obtained, and the cards are clean.

Everything about these houses is of the first quality. It is a well-demonstrated psychological fact that a clean, new, well-kept object, whether tool, furniture or game, will receive far more careful use than one which is old and worn. That the men appreciate the beautiful woodwork, furniture and fittings, is attested by the fact that there has not been one act of vandalism since the beginning.

The opening of the second club followed that of the first closely, being

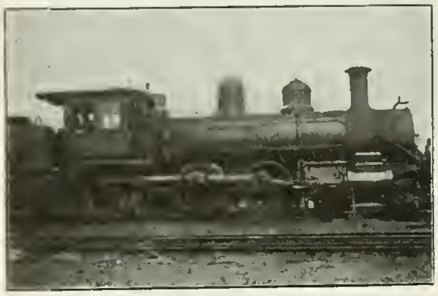


FIG. 1. W CLASS "YANKEE."

but a few months later and in the same year—1906. This second one is also a small club, and is at Dunsmuir, in the extreme north of California. The third club contains, besides all the conveiences of its predecessors, a rest room. Iron beds of the most approved construction, furnished with bedding of the very best, and thoroughly clean, offer a pleasing contrast to the foul-smelling dirty beds of the, often, filthy rooming houses. This third club is in Yuma, Ariz. Each new design of clubhouse is an improvement over the others. The latest house at Rosedale Jct., eighteen miles from Sacramento, was opened June, 1908. It is the largest and most complete, so far, containing, besides the other features, a carefully appointed restaurant and barber shop. A man may have all his wants filled and never leave the house from the time he enters it till he is on duty again.

The proposed Glenns Ferry house is a representative of the latest type. The exterior is after the Elizabethan style, with shingled exterior save in the gables, where plaster and timber are used. The general design and appearance is very attractive. The entrance leads into a vestibule which opens directly on the recreation room. This room is about 22 x 24 ft. and occupies the center of the first floor. Directly across from the entrance a large open fire place, with built-in seats on either

FIG. 2. V CLASS BALDWIN ENGINE.

side, gives an appearance of homeliness and hospitality. It is, in fact, a most comfortable ingle-nook. In common with all the downstairs living rooms the recreation room has a heavy beam ceiling and a seven-foot board and batton wainscot.

A house of this type requires a crew of fourteen men. The chief is the secretary and under him are two assistants, a night and a day secretary. These men are selected primarily for their ability to handle their fellows and are, as a rule, college athletes or settlement workers. They know the strings that operate the human heart. Then there are two porters and two full restaurant crews. These men are just as much a part of the railway service as any engineer or conductor, and are paid direct by the company. There is no direct profit from the houses. Though they are not charitable institutions the prices asked are minimum. A bath with two towels in a fine, clean, porcelain tub costs only ten cents; a bed, fifteen cents. The charge for billiards or pool is five cents per cue per hour. A good meal can be had for twelve and a half

FIG. 3. DdE, 46-2 ENGINE.

cents. The reading room, with its standard works of reference and fiction and the latest novels and technical works is free to all. The novels are transferred from one club to another so that there is always a fresh lot from which to select.

The plan is, eventually, to have sixteen of these clubs at different points on the Pacific system of the Southern Pacific. The Union Pacific and Oregon Short Line Railroad are to have their quota at no distant date.

STANLEY G. HORWOOD,
Minneapolis, Minn.

Some Australians.

Editor:

I am enclosing a few snap shots that may interest you. All our engines are classed and numbered from A to Z. The even numbers are passenger and the odd numbers are goods engines. We have four in the A class, viz. A, Aa, A1, A2, and three D class, viz. D, Dd, Dde, for different patterns, makers and so on. Figure 1 is a 4-6-0 in the W class and still doing service on cross country roads.

On seeing the Australian engines a blue jacket from the fleet, thinking of his own island, remarked: "They have even got our trains and engines."

Fig. 2 is a Baldwin and is our heaviest goods engine. She is in the

FIG. 4. Z CLASS, TANK ENGINE.

V class with 2-8-0 wheel arrangement, Vauclain compound, carries 200 lb. and has 4 ft. 6 in. driving wheels. Sellers injectors and Westinghouse brakes. The DdE class I spoke of is shown in Fig. 3. This engine was built at the railway company's shops. She is a 4-6-2 tank engine with 5-ft. driving wheels and carries 185 lbs. of steam. Fig. 4 is in the Z class, used on the outer circle lines which are feeders for the main line. I read your paper with great interest and wish it every success. SOUTHERN CROSS.

Melbourne, Australia.

They Say "Engine-Driver," You Know.

Editor:

In yesterday's issue of one of your contemporaries, which will be recognized without designation by its invariable, and obviously intentional, misuse of plain English in the regard referred to, I observe a news item reporting a collision on the Nashville, Chattanooga & St. Louis Railway in which it is stated that among the dead are: William Hogan, "traveling engine driver"; Joseph Gower, "engine driver on passenger train"; and Jesse Tarkinton, "engine driver on freight train."

Enquiry of any railroad officer will substantiate my statement that neither the N. C. & St. L. Railway nor any other railroad in the United States, carries on its payrolls, or designates any of its employees as an "engine driver" or a "traveling engine driver." Railroads in the United States have "traveling engineers," and many of these are members of a most respectable body, the "Traveling Engineers' Association." The men who run their locomotives are, in some cases, designated as "engineers," and in others as "enginemen," but in no instance are they called, or known to anyone, as "engine drivers."

The deliberate and absolutely unwarranted misuse of the term "engine driver," with the slur which it implies, by the journal which published the item referred to, seems to me to be a piece of cheap and sloppy snobbery.

J. Snowden Bell.

New York, N. Y.

[We cordially sympathize with the expressions in Mr. Bell's letter, and we have repeatedly commented in the same strain; but it seems impossible to prevent one or two New York dailies from indulging in the un-American practice of referring to locomotive engineers as engine drivers, the name applied to that class of men in Great Britain. In the British Isles it is no slur to speak of enginemen as engine drivers, because this has been the term used from the beginning of railway operation, but applying the name to men accustomed to be called engineers is insulting, because it is done with malice aforethought.—Editor.]

Help from R. & L. E.

Editor:

I want to get your paper regularly, as otherwise one cannot follow up the reading as he should. I have been a subscriber for your paper for about four years. About thirteen months ago I was promoted to the position of driver. I may say, I have got a great deal of my knowledge from your valuable columns. I always mention your paper to new beginners.

In Australia we are in our infancy as compared with your railroad engineering, but I am pleased to say we have made great strides in the last four years. Our first locomotives of twenty years ago are becoming obsolete. In my opinion we shall never be quite up-to-date with government-owned railways—too much influence brought to bear on the heads of departments. You see the muddlers get on better, in some cases, than those who show a little ability. Hence they become careless.

X. Y. Z.

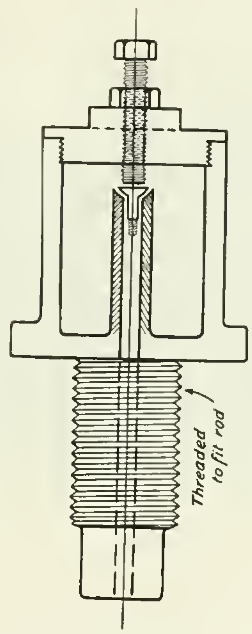
Gladstone, Queensland.

Can't Lose This Cup.

Editor:

Owing to the fact that there are still a number of locomotives in service, not having oil cups forged on parallel-rods, the enclosed sketch of a combination bushing set-screw and oil cup may be of interest to some of your readers who have had trouble from losing cups. In making the set-screw cup, material about 2½ or 3 ins. longer than usual is employed and turned out at one end for the cup, the other end threaded to fit rod snugly so it is necessary to use a wrench all the way. An ordinary wood screw feeder and cap with adjusting screw completes the arrangement.

From the construction of the cup it



ADJUSTABLE OIL CUP.

is evident that the part screwed into the rod is deeper than usual, and the feed is regulated by the small valve at the top of the oil way. The position of the set-screw governs the lift of the valve. Trouble from lost oil cups ceases with the use of this combination.

A. H.

Wheeling, W. Va.

Misplaced Credit.

On page 444 of our October number appears a very interesting article on the Rationale of Coal Economy, which is credited to Mr. H. T. Bentley, assistant superintendent of motive power of the Chicago & North Western Railway. We regret to say that the credit in this case was misplaced and belonged to our friend, Mr. H. Bentley, road foreman of equipment of the Chicago, Rock Island & Pacific Railway. Mr. Harry Bentley writes with so profound knowledge of economy in the use of steam that it is very unfair to deprive him of credit for a line of information that few engineers possess. In givng credit where it belongs it is only fair to say that Mr. H. T. Bentley wrote to us promptly:

"In looking over your magazine for October, 1909, I noticed an article on the "Rationale of Coal Economy," and in reading it find I am credited with giving an address before the Iowa Railway Club on this subject. While I would have been pleased to be the author of the very interesting data given, yet the glory belongs to some one else, and I sincerely hope you will give the proper party credit for it in your next issue."

That letter followed the editor to Denver, where it lay about for a week or two, then it went to Chicago and lingered in a hotel there for several weeks more, long enough to delay our amend honorable from appearing in the November issue.

In addition to the order for 50 more of the heaviest type freight locomotives recently placed with the American Locomotive Company the Baltimore & Ohio board of directors, at their last meeting, authorized the purchase of 3,600 steel hoppers and 1,000 steel underframe box cars. Six millions of dollars will be the disbursement called for in increasing the orders not long ago placed for new equipment. The new equipment will consist of 110 locomotives, 2,500 box cars, 1,000 gondola cars, 500 refrigerator cars, 2,000 coke cars and 4,000 hopper cars. The locomotives, as also the cars, are all to be of the largest capacity; the cars to be made of steel and of the latest design. Coal shippers will learn of the big order for steel hoppers with much relief, and also of the great activity in the company's shops, getting the present equipment into good condition for immediate service.

Rust-Proofing.

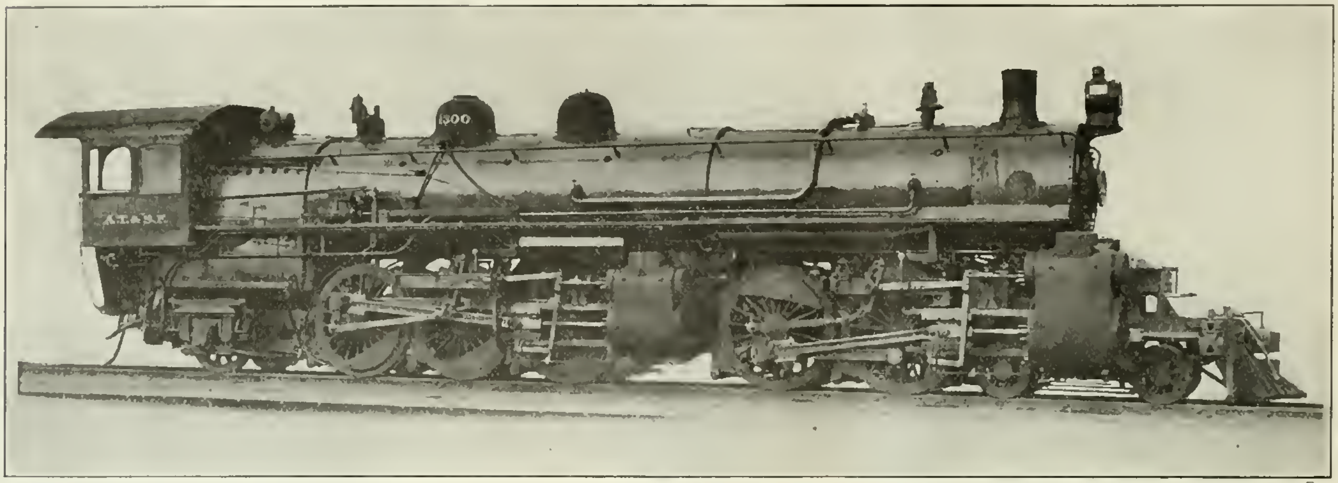
A German firm has discovered a new process for rendering iron and steel proof against rust. It was already known that an electrolytic deposit of zinc on the surface of iron and steel is effective against rust, and the use of lead as a coating is also well known. The combination of the two metals has been found very effective by first coating with lead and afterward with electro-zinc. The two combine and form an alloy with a perfect rust-proofing effect.

There used to be a saying in Germany that every hair in a carpenters head measured ⅛ inch. That was about as close as a carpenter would measure. The machinist has brought the refinement that deals with one-thousandth of an inch.

Mallet Compound Passenger for the Atchison, Topeka & Santa Fe

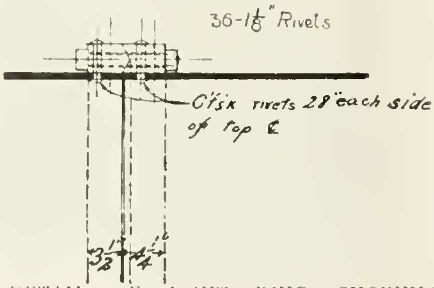
The Baldwin Locomotive Works have recently completed two Mallet Articulated locomotives for the Atchison, Topeka & Santa Fe Railway. Apart from their constructive details, which embody various new features, these engines are of special interest as Mallet locomotives, because they are intended for passenger service. The tractive force exerted is 53,000 lbs., and as far as weight and hauling capacity are concerned, these locomotives mark a great advance over the heaviest passenger engines heretofore used.

The 4-4-6-2 wheel arrangement has been adopted for this design, and so applied that the engine is capable of readily traversing 16 deg. curves. The leading truck has a rigid center; the driving tires are all flanged, and the trailing truck is of the Rushton type, with outside journals. The equalization of the forward group is similar to that of an eight-wheel locomotive, namely, the truck is independent; while the drivers of the rear group are equalized with the trailing truck, precisely as in a pacific type locomotive. The articulated frame connection is similar to that used on the consolidation Mallet engines recently built at the Baldwin works for the Southern Pacific Company. The front and rear frames are joined by a cast steel radius bar, which is bolted to the upper and lower rails of the front frames, and this constitutes an exceedingly strong transverse brace.



COMPOUND ARTICULATED MALLET 4-4-6-2 FOR THE ATCHISON, TOPEKA & SANTA FE.
W. F. Buck, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The boiler is equipped with a firebox of the Jacobs-Shupert type, in addition to which there is a feed-water heater, a superheater, and also a reheater between the high and low pressure cylinders. The construction of the Jacobs-Shupert firebox was fully described and illustrated in the August issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 357. The inner and outer shells each consist of a series of steel plates, which are flanged to a channel section. Between each pair of channels is riveted a stay plate. These stay plates unite the inner and outer shells, and have suitable openings cut in them to permit steam and water to circulate freely. The flanges of the channels comprising the inner shell are placed on the water side; while in the case of the outer shell the flanges are on the outside. With this arrangement the operation of riveting is facilitated, and no rivet heads are exposed to the direct action of the fire. The channel webs are suitably cambered to resist pressure. Large openings are cut in the stay plates over the crown, and here the bracing is effected by means of expansion links. The throat and back head are stayed by bolts, in the usual manner. All stay bolts are of course avoided in the sides and crown, and are replaced by the stay plates and expansion links, which are sufficiently flexible to insure freedom from breakage.



DETAIL OF JOINT RING, SHOWING V-SHAPED NOTCH.

In this Santa Fe engine the inside and outside shells are each built up of 12 channel sections, which are united at the bottom, to a double riveted mud ring of ordinary construction. The fire tubes are 19 ft. long; they terminate in a combustion chamber 10 ft. 9 ins. long, in front of which is the feed-water heater section. This water heater chamber is 7 ft. in length; it is traversed by 314 tubes, 2¼ ins. in diameter, and is kept filled by two non-lifting injectors placed to the right and left under the cab. The feed discharges through an outlet on the top center line of the heater, and is then forced into the boiler proper through two checks, placed right and left a short distance back of the front tube sheet. The combustion chamber is surrounded by a separable joint, which is made by two rings; one is riveted to the front section and one to the back section, and butted with a V-shaped fit. The rings are united by 36 horizontal bolts, 1¼ ins. in diameter. A good idea of the method of taking this locomotive apart, if one may so say, is to be had by a perusal of the illustrated article in our September issue, page 416, in which this feature of the Baldwin articulated compounds is very fully described.

Oil fuel is used in these locomotives. The burner is placed in the front end of the firebox, and the oil is fed through a heater consisting simply of a long steam jacketed pipe. These details are arranged in accordance with the railway company's practice. The steam dome is placed well forward, and connection between the throttle valve and superheater is effected by a cast iron dry pipe. The superheater is placed in the combustion chamber; it is of the Santa Fe type, and consists of a cylindrical drum, traversed by fire tubes.

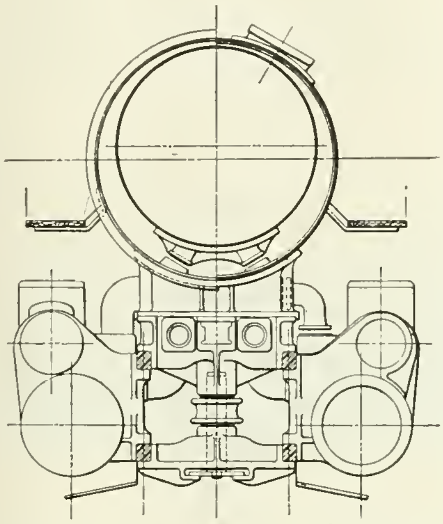
The drum is fitted with internal baffle plates, by means of which the steam is compelled to circulate around the tubes; while a transverse partition divides it into two main compartments. The rear compartment is used as the superheater, while the front compartment constitutes the reheater.

Short connecting pipes convey the steam from the superheater to the high-pressure steam chest, where the distribution is controlled by inside admission piston valves, 13 ins. in diameter. The exhaust from the high pressure cylinders is passed through the reheater, and then enters a single pipe placed on the center line of the engine. This pipe is fitted with two ball joints and a slip joint; a short distance back of the low pressure cylinders it divides, and separate leads convey the steam to the low pressure steam chests. Here the distribution is controlled by outside admission piston valves, 15 ins. in diameter. The exhaust pipes are led forward, ahead of the low pressure cylinders, and are united into a single flexible pipe which conveys the steam to the blast pipe in the smoke box. This arrangement was adopted in order to secure a fairly long pipe, and so avoid excessive slip in the joint when the engine is traversing curves.

Walschaerts valve motion is used throughout, and is controlled by the Ragonnet reverse gear. This interesting form of power reversing gear, operated by compressed air, was illustrated and described in our October paper, page 456, to which the reader is referred. The connection between the high and low pressure reverse shafts is effected by a single reach rod, placed on the center line of the engine. This rod is fitted with a universal joint which is guided between the inner walls of the high pressure cylinder saddle. The gear is so connected that all the radius rods are down when running ahead.

The front frames of this engine are stopped immediately behind the low pressure cylinders, and are bolted and keyed to a large steel box-casting. This casting supports the low pressure cylders, and to it is bolted the truck center pin. The front bumper and deck plate are also of cast steel. The overhang of the boiler is carried on the front frames by a single support, placed between the two pairs of driving wheels. This support also acts as a centering device. It consists of two steel castings, between which is interposed a cast iron shoe, 2 ins. thick. Clamps are fitted to prevent the frames from dropping away when the engine is lifted from the rails.

The tender of this locomotive is, in



SECTION THROUGH H. P. CYLINDER.

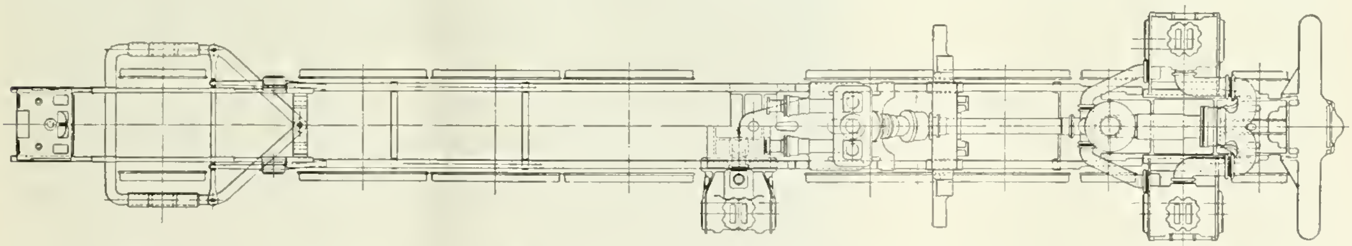
its way, quite as interesting as the engine. The oil and water tanks are of 4,000 and 12,000 gallons capacity respectively, and are rectangular in cross section. The front and back bumpers are of cast steel; the frame center sills consist of 15-in. channels, and the side sills of 12-in. channels. The trucks are of the six-wheel, equalized pedestal type; the wheels are steel-tired with cast steel spoke centers, and were made by the Standard Steel Works Company of Philadelphia. The truck frames and pedestals are of cast steel, and each truck has two bolsters, which are suspended on swing links between the center and outside axles. The center plate is in one piece, with a heavy steel casting which is seated on the bolsters, and bridges the middle transoms. These latter are cast in one piece with the truck frame.

This engine unquestionably marks an epoch in the development of the American passenger locomotive. This is true, not only because of its type and size, but also because it combines, to a degree not heretofore attained, those features which have proved of great value in reducing fuel and water consumption, viz: feed-water heating, superheating and compounding. The engine has been designed in the light of considerable experience with heavy articulated locomotives, and there is every reason to believe that its performance will be satisfactory.

Cylinders, 24 ins. and 38 ins. x 28 ins.
Valves.—Balanced piston.
Boiler—Type, straight; material, steel; diameter, 72 ins.; thickness of sheets, 11-16 ins.; working pressure, 200 lbs.; fuel, oil.
Fire-Box—Material, steel; length, 119⅝ ins.; width, 63¼ ins.; depth, front, 74 ins.; depth, back, 74 ins.; thickness of sheets, sides, 5-16 ins.; back, ⅜ ins.; crown, 5-16 ins.; tube, 9-16 ins.
Water Space—Front, 5 ins.; sides, 5* ins.; back, 5 ins.
Fire-Tubes—Material, steel; wire gauge, No. 11; number, 294; diameter, 2¼ ins.; length, 19 ft. 0 in.
Feed-water heater.
Tubes—Material, steel; thickness, No. 11 W. G.; number, 314; diameter, 2¼ ins.; length, 7 ft. 0 in.
Fire-Box—Jacobs-Shupert type.
Superheater—Santa Fe type.
Reheater—Santa Fe type.
Superheating Surface—323 sq. ft.
Reheating surface—798 sq. ft.
Heating Surface—Fire-box, 202 sq. ft.; fire-tubes, 3,275 sq. ft.
Feed-Water Heater—Tubes, 1,279 sq. ft.; total, 4,756 sq. ft.; grate area, 52.5 sq. ft.
Driving Wheels—Diameter, outside, 73 ins.; journals, main, 11 ins. x 12 ins.; others, 9 ins. x 12 ins.
Engine Truck Wheels—Diameter, front, 31¼ ins.; journals, 6 ins. x 10 ins.; diameter, back, 50 ins.; journals, 8 ins. x 14 ins.
Wheel Base Driving—30 ft. 4 ins.; rigid, front, 6 ft. 4 ins.; back, 12 ft. 8 ins.; total engine, 51 ft. 11 ins.; total engine and tender, 94 ft. 5½ ins.
Weight—On driving wheels, 268,000 lbs.; on truck, front, 58,050 lbs.; on truck, back, 50,400 lbs.; total engine, 376,450 lbs.; total engine and tender, about 600,000 lbs.
Tender—Wheels, 12 in number; diameter of wheels, 34¼ ins.; journals, 5½ ins. x 10 ins.; tank capacity, 12,000 gals. water; fuel, 4,000 gals. oil; service, passenger.

Introduction of Steel Fireboxes.

One of the first problems taken up by the Master Mechanics' Convention when first formed was investigating the reliability of steel as material for the construction of locomotive fireboxes. Up to that time (1869) nearly all fireboxes used in locomotives in America were made of copper or iron, and much trouble was experienced in keeping the fireboxes in condition to hold water. The iron sheets laminated and cracked, while the copper thinned out so rapidly that fracture often happened. Among the first master mechanics to try steel was Mr. H. Anderson, of the Chicago & North-Western, who introduced fireboxes of "Cyclops" steel, while the Pennsylvania Railroad introduced fireboxes of steel made by Hussy, Wells & Co., Pittsburgh. These experiments proved so successful that steel came gradually into favor, but great opposition was manifested against it for many years.



PLAN OF BALDWIN ARTICULATED COMPOUND, SHOWING POSITION OF CYLINDERS AND JOINTED FRAME.

The Silvis Shops of the Chicago, Rock Island & Pacific

By Angus Sinclair

The name of the Chicago, Rock Island & Pacific Railway repair shops at East Moline had been familiar to my ears almost from the day the first foundation trench was dug. To confess the truth, I felt a little jealous of the place, for it seemed to absorb in itself some of the glory and good repute that belonged to my old haven of activity in Cedar Rapids, Ia., the shops that I believed turned out more work per man than any repair shop of the country.

GENERAL VIEW OF THE C., R. I. & P. SHOPS AT SILVIS, ILL.

A PASSING VIEW.

The first glimpse I obtained of the new shops, now having a station of their own called Silvis, was in the course of a trip from Omaha to Chicago. For some nine hours I had been gazing upon the rolling prairies of Iowa with their interminable fields of corn, followed by more cornfields that became monotonous as the hours moved their slow gait. Approaching the Mississippi River broke the resentment that too much corn was engendering, and the familiar sights of Davenport, Rock Island and Moline brought back consciousness of having reached centers of human activities. These places make every reflective traveler sit up and take notice. They form a great industrial hive built up by pure human grit and energy. They have the Father of Waters for a neighbor good to look upon; but he gives nothing to the towns except a little water power and some rafting products. Yet in a stretch of ten miles which includes the river's bed, three cities aggregating nearly one hundred thousand people have come into existence with no better foundation or raison d'etre than the pluck and energy of the leading inhabitants.

On the Illinois side the Rock Island road traverses the flat "bottom" land on the bank of the river, that had been lakes long after the ocean that at one time covered that part of creation had dried up or gone elsewhere. No matter for that; the land is dry enough now. On one of the level bottoms I found the big shops all spick and span new buildings with plenty of room for extensions. That was apparent at a passing glimpse.

A few months later I accidentally met Mr. G. W. Seidel, superintendent of these shops, and he invited me so cordially to visit the place that I was ashamed to say that I had taken a passing look of his establishment, but I lost no time in getting there. This is a rather long introduction, but the subject justifies the space.

ARRANGEMENT OF SHOPS.

The plan and style of the shops can readily be understood from the annexed engravings. The details deserve more than passing attention, for the arrangement was the result of long exhaustive study by Mr. C. A. Seley, mechanical engineer of the company, who made himself familiar with all the repair shops of any consequence in the railroad world in order to select the best means for effecting repairs on locomotives at the least possible expense. The intention was to provide facilities for repairing sixty locomotives per month, a requirement that has scarcely been met, but the shortcoming has not been the fault of the shops as a whole, but from certain departments being unequal to the drain upon them.

CAPACITY OF SHOPS.

The main shop conspicuous in the engraving is 276.8 x 860.2 ft., and forms the erecting shop and machine shop. The erecting shop, with its two lines of pits, occupies the middle of the building, flanked on each side by machine tools and other appliances necessary for fashioning and finishing the multitude of parts required in the immense volume of repairs. A modern locomotive run down so that it can no longer be operated economically demands the expenditure of a vast amount of skilful labor to give it a new lease of life, and the work to be done is so diverse that a bewildering variety of tools is called into service to form and finish the parts at the lowest possible expense.

PIT ARRANGEMENT.

The most striking superficial feature of these shops is the pits, 38 in number, which are not set at right angles as cross pits generally are, but at an angle of about 75 deg. This arrangement was made to enable the two overhead traveling cranes to get closer together in carrying engines to or from the repair pits. The plan works conveniently, which is the principal consideration. With the modern methods of repairing locomotives it does not seem to me that pits are of much consequence. The engines are stripped of everything needing repairs before they are carried to the pits. So little work has to be done under the engine in assembling or applying the repaired parts that a track raised a foot or two above the floor ought to give room for the workmen doing the erecting.

OVERHEAD CRANES LIFTING AN ENGINE, SILVIS SHOPS, C., R. I. & P.

FOLLOWING THE WORK.

In order to judge of how systematically the work of repairing was done in these shops I followed on invitation one engine from the time it entered the erecting shop until it emerged ready for a new conflict of train hauling. On entering from the yards at the east end of the shop the engine is pushed upon the stripping track and a gang of laborers skilled in tearing apart operations strips the engine of every part that requires repairing, the needs of each individual engine being known to the foreman in charge. The parts taken off are marked for identification and placed on cars or other provisions of transportation and taken to the tools where the repairs are to be carried out. What remains of the engine is then taken hold of by two overhead cranes and carried to the pit destined for that particular locomotive.

RECORDS OF WORK REQUIRED.

The preceding paragraph outlines the system of repairing engines but many details are under control before an engine leaves the yard. The history of the engine since it went into service after the previous thorough repair is known to the shop superintendent, and a report is put upon record of what work the engine requires. This system of records is made use of to prevent too much of one class of repairs from being called for at one time. One engine may need heavy boiler repairs while another must have new cylinders and a third calls for heavy work on running gear and actuating motion. The record sheets that are prepared in advance of the original entry to the erecting shop make the balancing of the repair an easy matter, and each shop foreman is informed in advance of what must be done to every engine that he will control in its passage through the shop. There are seven or eight erecting shop foremen who carry out the functions of the gang boss of smaller shops.

The systematic method of conducting repairs in a large shop like this aims to find out every detail of repairs required by each engine and to notify the various shop foremen in advance of the work they will be required to do. This prevents delays, the boiler shop foreman, the foreman blacksmith and others being ready to grasp the work as soon as it enters the shops where they are in charge.

DISTRIBUTING THE PARTS.

As I note an engine falling to pieces under the nimble hands of the stripping gang I find the parts are carefully arranged and marked for the tool or place where repairs will be made. All parts that are greasy are taken to a huge lye charged vat and properly cleaned. That is done before they go into the hands of the machinists.

When the engine trucks are taken out they are placed upon tracks on the floor raised about eighteen inches and there all repairs are carried out in the same way that repairs are done to engines standing over pits. If the cab needs any repairs it is taken to the mechanics who do the work, then it is moved to racks which are raised sufficiently to permit free intercourse beneath them. As all modern cabs are steel they require very little repairing.

Located immediately on the outside end of the pits is a row of heavy tools that flank the whole of the erecting shop. In a general way these are heavy tools whose products can be handled by one of the overhead cranes that traverse the whole shop.

A RAMBLE ABOUT THE SHOPS.

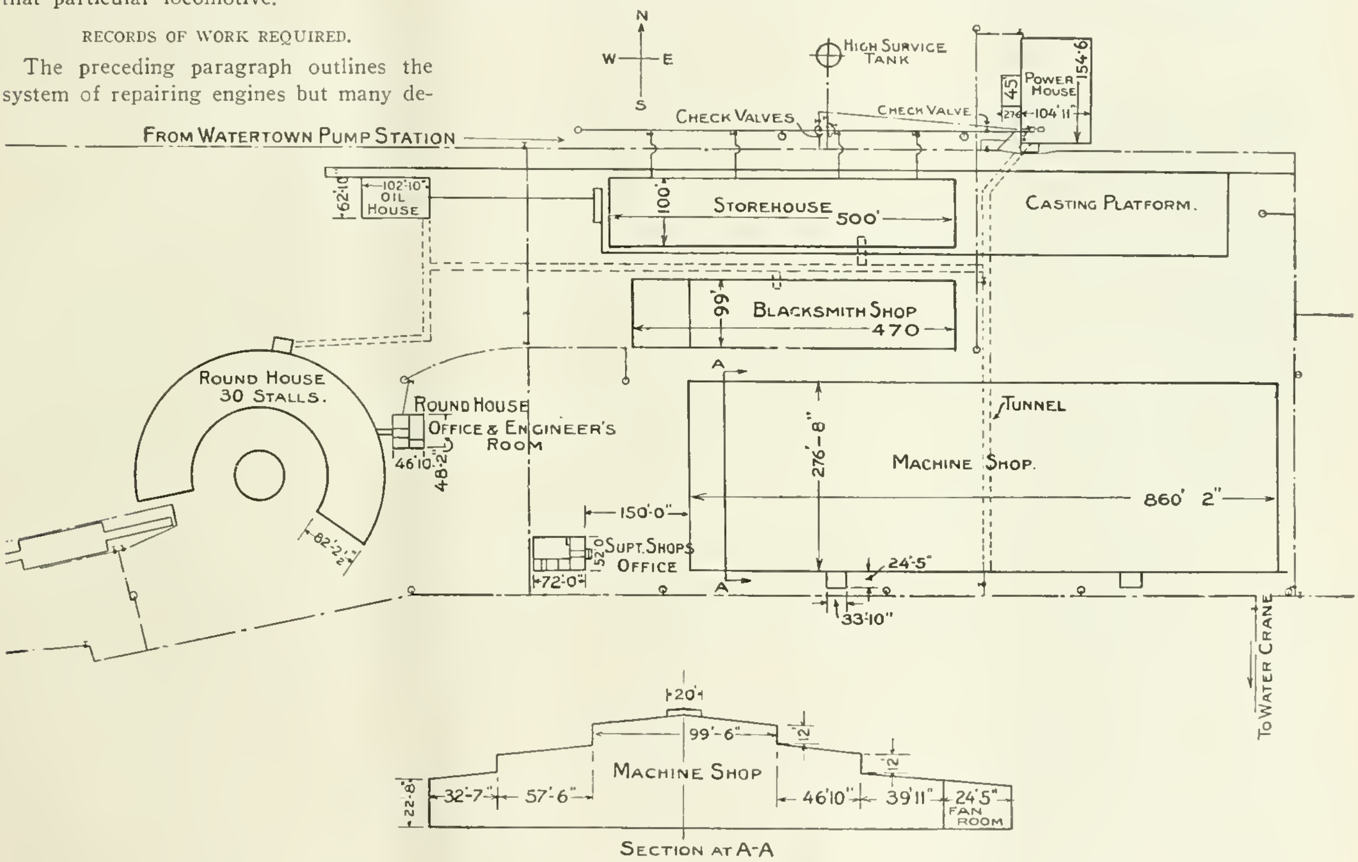
Entering the building from the east we find the left hand side devoted mostly to tools. That is the machine shop proper, but it has other useful tenants. In starting to walk through we find ourselves first in a finely equipped babbitting department, where there is a brass cupola and a variety of special appliances by which the art of applying babbitt metal is made rapid and easy.

Wending our way westward among a variety of tools with plenty of room we come upon a busy crowd of workmen who do the skilled work of the piston, valve and crosshead department. Onward we go again amidst tools galore slicing off metal as if it were cheese and we reach the offices. One accommodates the assistant superintendent, another the shop draftsman, while one is called the emergency room. Here are persons skilled in surgery and in giving first aid to the wounded. It is said to be a useful and humane auxiliary to the shops, but it was new to me.

TOOL ROOMS.

Near the offices are the tool rooms. These are remarkably well equipped, not only with the small tools of the usual

(*Continued on page* 544.)



GROUND PLAN OF YARD AND SECTION OF THE SILVIS MACHINE SHOPS OF THE C., R. I. & P.

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Wasting of Fuel.

Professor W. F. M. Goss, who is a member of the United States Geological Survey, has prepared a "bulletin" in which the statement is made that the locomotives in service on the railroads of this country consume more than one-fifth of the total coal production of the United States. This amount is so large, says Professor Goss, that any small saving that can be made effective in locomotive practice at once becomes an important factor in conserving the fuel supply of the nation. For this reason the United States Geological Survey has given attention to the special problems of combustion in locomotive boilers.

In giving his conclusions as the result of the tests, Professor Goss says: "There were in 1906, on the railroads of the United States, 51,000 locomotives. It is estimated that these locomotives consumed during the year not less than 90,000,000 tons of fuel at a cost of $170,500,000. That wastes occur in the use of fuel in locomotive practice is a matter well understood by all who have given serious attention to the subject, and the tests which have been made show some channels through which these wastes occur. These results are perhaps more favorable to economy than those attained by the average locomotive of the country, as the coal used in the tests was of superior quality, the type of locomotive employed was better than the average, and the standards observed in the maintenance of the locomotive were more exacting. But the effect on boiler performance arising from these differences is not great and, so far as they apply the results may be accepted as fairly representative of the general locomotive practice of the country. They apply, however, only when the locomotive is running under constant conditions of operation. They do not include the incidental expenditures of fuel which are involved in the starting of fires, in the switching of engines, and in the maintenance of steam pressure while the locomotive is standing, nor do they include a measure of the heat losses occasioned by the discharge of steam through the safety valve."

Professor Goss then gives a table analyzing the use made of the 90,000,000 tons of coal used by locomotives and estimates that the heat of 27,360,000 tons is wasted through incomplete combustion, heat of gases discharged through the stack, through cinders and sparks, through unconsumed fuel in the ash, through radiation and through leakage of steam water, etc.

The bulletin expresses the opinion that most of the losses mentioned might be reduced, but the strongest point reads:

"Opportunities for incidental savings are to be found in improved flame ways such as are to be procured by the application of brick arches or other devices. Such losses may also be reduced by greater care in the selection of fuel and in the preparation of the fuel for the service in which it is used. It is not unreasonable to expect that the entire loss covered by this item will in time be overcome."

Improvements in the selection of fuel and in its preparation for services are changes very much to be desired, though that will greatly reduce the motive power expenses; but we can see other reforms that will have greater influence in reducing the magnitude of the fuel bills. There are few railroad managers who fail to recognize the importance of reducing the quantity of fuel used by locomotives, but most of them have gone the wrong way in trying to effect saving. The two men upon a locomotive most potent in power to waste or to save fuel are the engineer and fireman, and these men have rarely been treated in the manner likely to excite their most active interest in doing the work with the smallest possible expenditure of fuel. Railway officials have been sufficiently aware that saving of fuel lay with the enginemen, but they have not made provision for telling with exactness how much coal was burned by individuel locomotives. Handling the coal has been so loosely done that nothing more than an approximation of the quantity put upon tenders was possible. Performance sheets came into vogue on some roads, but the men laughed at the figures, knowing their want of accuracy. With such a condition existing it was contrary to human nature to expect enginemen to attempt making records for fuel saving.

The officials controlling the installation of appliances for delivering the fuel at coal stations have striven from year to year to reduce the cost of handling the coal. Every reduction of a cent or two per ton handled has been boasted about as a triumph in the line of economy, when it is safe to say that every cent saved in that way cost the company dollars through the want of accuracy that resulted from handling coal as if it were sand or gravel.

There are several methods of handling coal on the market, whose apparatus can be depended upon to come within two per cent. of the reputed weight, notably the equipment handled by the Otto Gas Engine Company. Loose methods of handling coal have prevailed so long that all concerned in coal consumption have been educated to favor waste instead of being impressed with ideas of saving. During a period, when the engine performance sheet was yet believed in by the officials, the writer was running an engine upon a regular run, and he began trying to make for himself a good fuel record. The fireman became interested and engaged in the novel practice of trying to save coal. After two performance sheets had come out and my record was among the worst, the coal check clerk was interviewed. He was very frank in explaining how my record was different from what was expected. "You see," he explained, "that the engines supplied do not cover all the coal taken from the chutes, and the shortage must be accounted for somehow. You had turned in the fewest proportion of tickets for the mileage made, so you were charged with the shortage at two coal stations." He believed that having a good coal record was of no consequence whatever, and similar sentiments are widespread today.

Tubes and Tube Sheets in Europe.

In a recent report made to the International Railway Congress some very interesting facts concerning boiler practice in Europe are brought out. Last month we gave a brief synopsis of some of the principal facts concerning the use of steel in locomotive fireboxes. The report contains a good deal of information regarding the Continental practice in regard to locomotive flues, the method of setting them and the means taken on some roads to prevent leaking and the cracking of the bridges between flue holes.

It is interesting to know that the Dudgeon tube expander is extensively used. In another column of this issue we are able to present to our readers a number of interesting features concerning the life and work of that talented inventor. The Boyer and the Caramen tools are also used. As a rule the flue holes are slightly tapered in the flue sheet, so as to make a conical joint between flue and sheet.

Some railways use steel tubes, and where this is done no ferrule is used. The brass tube, however, requires the ferrule not only to help to keep it tight but to protect the ends against the action of the flame. The ferrules vary in thickness, being from 3-32 to 5-32 of an inch in thickness. Ferrules of this thickness seriously reduce the opening of the tube into the firebox. Steel tubes not having any ferrules are beaded over at the firebox end, and often the same practice is followed in the smoke box. On the Belgian State Railway they use brass tubes, beaded. The general rule for the arrangement of flues on the Continental railways is in vertical rows. Where tubes of 2 ins. diameter are used the American practice of spacing them 2⅝ ins. centers is usually followed. Where copper tube sheets are used the plates are made hard by being hammered cold where the tubes are put in, and this treatment causes the tube to be more securely held and the expanding of the tube in the hardened sheet is more effective.

Increase of boiler pressure has been the rule on European railways, much the same as it is with us. In France pressures of 215 and 228 lbs. are common in engines of modern and comparatively modern construction. The Southern Railway of France has used stay rods between the flue sheets in addition to the dependence placed on tight flues as boiler stays. It may be judged from the report that in a general way the cost of boiler maintenance has increased where the higher pressures have appeared, and this result is not entirely unknown among ourselves.

In the matter of boiler repairs the cracking of the bridges is generally dealt with in one or two ways. One of these is called the Ragno system. It consists of using a copper sheet 3-32 or ⅛ of an inch thick, placed inside the sheet behind the crack, and fitted up closely to the sheet. This thin copper sheet is held in place by ferrules inserted in the tube holes and beaded over inside and out. Another method of repairing a cracked bridge, is that copper rings are screwed in the tube hole and beaded over. If the crack extends from one flue hole to another a copper piece resembling the figure 8 is applied, which reaches from flue hole to flue hole. Sometimes a stud is screwed into the crack before the copper rings are applied.

The Tool Room.

The machine shop tool room is assuming such large proportions that it has become a matter of much concern to machine shop foremen and others in large manufacturing and repairing establishments to provide suitable accommodation for the growing variety of tools as well as establishing a simple method of classifying and arranging them when in the tool room as well as a ready distribution of them when they are called for. Several eminent engineers have already given their attention to the subject, but the result of their work has been more calculated to provide a special system adapted to some particular factory or shop rather than to produce a method sufficiently elastic to suit the varied and growing requirements of general use. We have been much interested in the variety of systems that may be observed in the leading railroad shops and are hopeful that the subject may be taken up at an early date by the various associations interested in machine shop work, as no kind of engineering skill of a merely theoretical kind can match with the knowledge that may be gathered from the individual experiences of men who are actually engaged in the work under consideration.

To begin at the beginning is the secret of the success of many undertakings, and the fact has grown upon us that those shops where a thorough card system is in vogue in regard to tools and their uses seem to get the work done with less friction and less loss of time than is the case in those shops where no card system exists. The card system that we refer to implies a systematic method of numbering the pieces of work that may pass through the hands of the workmen in any particular establishment. The number of operations in their order, the number of tools required and their specific markings are set down to which in a general way the average time taken in the operations may be added. This system does not necessarily imply a piecework system, but as a guide to the mechanic as a prompt method of indicating the number and kind of tools required in executing certain kinds of work it is a very marked improvement over the older method of allowing the individual to perform the work in his own way.

The mere matter of storing the tools must necessarily remain an open question which will readily be solved by the intelligent foreman and superintendent to suit the requirements of the situation. The distribution of the tools also will depend largely upon the size of the shop. We observe in some of the larger shops that the telephone is already in use in making demands upon a central tool room in some shops, where boys are employed in collecting and distributing tools. In others a clever system of carriers, such as are used in the larger department stores is in use, and in opening this subject it would be of real value to our thousands of readers who are engaged in machine shops if some of our railway men interested in the subject would kindly give us their views on this subject of great and growing importance in machine shop practice.

Peking to Kalgan.

A railroad has recently been opened in China which is perhaps deserving of more attention than such an event would receive in our own country. The Chinese road is from Peking to Kalgan, and is 122 miles long. Its great commercial importance in the Celestial Empire is beyond question, but the fact that it is the first railway of importance in that land which has been built by the Chinese themselves is a very significant fact. The rails and the rolling stock were imported, but the recognition of the need for such a road, its financing and its construction were Chinese, and it is operated and controlled by Chinese.

This road runs up the valley of the Yung-ting river from Peking, and follows a northwesterly direction to Kalgan. This city is the meeting point of several of the principal caravan routes from Mongolia, and the railroad, although only a few months in operation, has received a large and growing volume of traffic which has unquestionably proved the wisdom of the promoters of the new railway. Surveys have already been made with a view of extending the road westward from Kalgan across the province of Shan-se to the Hoang-ho river. This province contains vast deposits of anthracite coal, said to be from 40 to 80 ft. thick. Bituminous coal deposits are also found in this region almost equal to those of anthracite, which latter are estimated to occupy an area of about 13,000 square miles. Shan-se has the best system of highways in the Chinese Empire, and practically all the coal used is supplied from this province.

These easy artificial means of communication, when used as feeders to the new railway, will bring an enormous volume of business for the iron horse to handle. As this traffic develops it is probable that other extensions will follow the one now projected. The road as it now stands from Peking to

Kalgan has been built without the necessity of borrowing money. The funds necessary for its construction were provided out of the earnings of the Northern Railways of China, and the fact that the whole of the work has been done by home labor has had the effect of developing and employing a staff of active young Chinese engineers who can be relied upon in further enterprises of a similar kind. The building of this railway indicates that the Chinese believe in developing their country's resources and of establishing their own industries and handling the traffic thus created, with their own men and in their own way, though the influence of American and European methods will no doubt be easily apparent.

Knowledge is Power.

Germany bulks big on the horizon these days, but it is not with her Dreadnought race with Great Britain that we have to do. German methods of technical instruction for her people have won the admiration of all. The German idea is to train industrial workers as thoroughly and as exactly as soldiers are trained. The instruction given in that country aims to develop youthful talent along the line of least resistance, and by that we mean that the natural bent or the natural inclination of a young man is encouraged, be he in embryo an inventor, a searcher for the hidden secrets of nature, a skilful manipulator of machines, or a designer. It is in short an effort to train a man to do excellently that which he seems naturally fitted to do.

This is in plain English an endeavor to eliminate the tendency of round pegs to get into square holes. The root of the matter is that the German schools which lead up to the high schools, and indeed the whole of the primary training keeps technical development in view, and so to speak, dovetails into it. From the start there is a pronounced bias in the direction of industrial education.

The technical high schools of Germany have four departments in which the youthful mechanical engineer, the architect, the civil engineer, and the technical chemist are taught. Darmstadt and Karisruhe maintain a special department for electro-technology. Generally this subject is included in the department of mechanical engineering. Berlin has made a special department of shipbuilding. Great Britain and the United States have both carefully studied German methods, and in each similar schools have been established, but they have not yet surpassed the German model.

It is not yet safe to say that war shall be no more, but it is extremely improbable that any long series of conflicts, such as the Napoleonic wars, would ever be permitted by the growing world sentiment for peace, but in the present-day commercial rivalry between nations, healthy and legitimate as it is, the man who "knows how" is the man who has to be reckoned with.

Many of our readers may be too old to go to school now, and the pressure of circumstances may prevent some of our younger men from ever seeing inside the doors of a college, but a man is never too old to learn, and the beauty of knowledge is that its power for success in no wise depends upon how it has been picked up or acquired.

It is the national perception that knowledge is power which has brought into being the systems of technical instruction which we find adopted by the leading peoples of the world, and what is true of a nation is true of an individual. The more he has learned concerning the useful arts and handicrafts the better equipped he is for the work in life that he has to do.

There are many who believe that war in its worst form has passed away, but if this is true, it has been replaced by a form of competition no less keen and for which mankind will at length be compelled from the very circumstances of the case to beat its swords into ploughshares and its spears into pruninghooks.

All this has for us of the railway world one lesson, and that is, that it is our duty to search out and discover and diligently study and keep on studying the best way to do our work so that the aggregate result will be that the railways of our country will be the safest and the best operated highways of commerce in the whole world.

Classification of Locomotives.

It is gratifying to observe in the larger railroads a tendency towards distinct types of locomotives for the separate kinds of service, and it becomes all who are interested in the welfare of railroad men to encourage this tendency to the end that the distinction between separate classes may be so marked as to be distinguishable to the average railroad man. While it may be considered fortunate that we all have a right to enter the realm of untried experiments with a view to aid in the harnessing of the elemental forces of nature, it is doubtful if mere changes of form and variety in petty details in a machine so important as the locomotive should be encouraged.

There are some railroads in which the number of different types of locomotives far exceed the number of letters of the alphabet, so that the classification of the locomotives, when seen in writing, look like an algebraic equation. To be told that a particular locomotive belongs to the "D-13-b" class opens up a procession of locomotives passing through subterranean caverns of the memory at least a mile long, and life is too short to encourage the hope that the ordinary mind could ever grasp the intricacies of such complex enumeration. To fully comprehend the matter, it would require a mind on the same plane with the boy who learned by heart the entire New Testament. It should be recalled, however, that the boy never did anything else worth recording.

In examining, however briefly, into the character of these classifications, it will be found that many of them have a strong family resemblance to each other, and might safely be classified under one heading. In fact, many locomotives pass from one class into another after undergoing some slight alterations, so that the present marking of a particular locomotive is no guarantee that it will be found in the same category next year.

Several unsuccessful attempts have been made to rectify the incongruities of the system. A clever device was suggested at the Master Mechanics' Convention some years ago, the aim being to classify locomotives by suggestive letters, as "C" for consolidation; "T" for ten-wheel, adding a number of figures to indicate the tractive power of the locomotive. Thus, "C-30" would indicate a consolidation locomotive of approximately 30,000 pounds' tractive power. We are hopeful that something of this kind will be adopted in the future. Meanwhile, as we stated before, the alphabet is too short to reach round the variety of classes, and the suggestion was not adopted. The alphabetical scheme fell through at once, because the American and Atlantic types of locomotives would lay equal claim to the letter A, while the Columbia class would set up rival claims with the Consolidation, while the Mountaineer, Mikado and Mastodon would not mend matters.

Some systems seem to us more intelligible than others. Some have classifications that have one name for road service, but when the locomotive comes to the shop it gets another name. At first glance this does not seem to clear the air to any extent, but its promoters claim that it meets the situation so fully that it leaves little or nothing to be desired. As we stated at the outset, we are not without hope that the entanglement will rectify itself in the fullness of time. In some quarters the clouds of alphabetic and numerical characters are already disappearing, and in the clear sky of common sense the stars are shining through.

All this may be thought to be beside the mark, as the rather complicated methods of representing the class in which a locomotive stands are used almost exclusively on the road owning the machine. Our contention is, rather, that as it seems necessary for each road, for its own special information, to go farther than simply the wheel arrangement, the special system might possibly be made intelligible to outsiders. Such a system would be useful for purposes of comparison of similar engines on different roads.

Meanwhile we would not be misunderstood in having it supposed that we do not realize the value of the system of classification by wheels. It is the only method so far that is universally intelligible, and if it could be added to by some simple method that would at once indicate the tractive power of the locomotive or its cylinders or wheel size, it would, we think, fill a long-felt want among railroad men in general.

Book Notices

Manual for Engineers. By Chas. E. Ferris, B.S. Published by the University of Knoxville, Tenn. 246 pages. Flexible leather. Price, 50 cents.

A collection of tables and other data for engineers and business men. It is in a compact and elegant form, and is one of those works of ready reference that should find a place in the offices of business men as well as in the pocket of the engineer. Professor Ferris has been eminently successful in compiling a manual that has already reached the thirteenth edition, and it may be said in a word that each edition has shown some marked improvement over its predecessor. The advertisements which occupy a considerable space at the end of the book enhance, and in many instances tend to illustrate, the text.

The "Mechanical World" Pocket Diary and Year Book for 1910. Published by Emmott & Co., Manchester, England. 390 pages. Price 50 cents.

This handy cyclopedia of mechanical information, containing a collection of useful engineering notes, rules, tables and data is one of the most welcome annual visitors in the mechanical world. Among the new matter in this year's publication is a section devoted to oil engines, including a number of valuable notes on crude oil engines. Copies can be had direct from the publishers.

First Aid to the Disabled Locomotive Engine. By John M. Burley, Bedford, Pa. 292 pages. Cloth. Price $1.50.

The aim of the author of this book has been to present some information from practical experience that will assist the locomotive engineer, firemen and trainmen to prevent some of the failures and defects in the mechanical appliances used on railways. In the case of failures, numerous descriptions of the methods of making temporary repairs are added. The book has the merit of treating the subjects briefly. It is printed on fine paper, and the numerous illustrations enhance the value of the work.

Railway Signaling in Theory and Practice. By James B. Latimer, Signal Engineer C., B. & Q. R.R. Published by the Mackenzie-Klink Publishing Co., Chicago. 420 pages. Cloth. Price $2.00.

This is a valuable addition to the railroad literature of our time, and is especially adapted to the requirements of the young railroad man, who may safely take this work as an elementary text-book on the subject of railway signaling. The author has had exceptional advantages in a service extending over twenty years in the operating department and seven years as signal engineer on one of the chief railroads of America. The style is well adapted to the requirements of the average railway man, and the numerous illustrations aid greatly in enhancing the educational value of the work.

The Standard Guide for Locomotive Engineers and Firemen and Railway Machinists. By Ed. Turner. Published by Laird and Lee, Chicago. 200 pages. Leather binding. Vest-pocket size. Price, 75 cents.

This illustrated pocket manual will be found to be a handy guide in cases of emergency to engineers, firemen and machinists. It briefly describes what to do in case of breakdowns, and also presents in a condensed form standard rules in regard to signals, and furnishes definitions of railroad terms. The size of the book makes it very convenient to be carried in the pocket while at work, while the fine binding insures its durability.

The Universal Directory of Railway Officials, 1909. Published by the Directory Publishing Company, London. 712 pages. Cloth. Price, $4.00.

The present edition of this standard directory of railway officials is the most complete work of the kind yet published, and has become indespensable to all interested in railway matters throughout the world. The large increase in the number of pages devoted to railway officials in Asia is a marked feature of the book. Copies may be ordered from A. Fenton Walker, 143 Liberty street, New York, N. Y.

"Fuel Tests with Illinois Coal," by L. P. Breckenridge and Paul Diserens, is issued by the Engineering Experiment Station of the University of Illinois as Circular No. 3. It consists of a compilation of data relating solely to the coals of the State of Illinois, selected from the complete reports of the government investigations on the fuels of the United States. Copies of Circular No. 3 may be obtained gratis upon application to Prof. W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Introduction of Six Wheel Trucks.

At the third annual Convention of the Master Car Builders' Association, held in Chicago in 1869, Mr. M. P. Ford, of the Little Marine and Columbus Railroad introduced the motion: "It is the sense of this meeting that six-wheel trucks for the passenger and sleeping cars are the safest, and all things considered best adapted for use on our roads."

That resolution was adopted with the proviso that the subject would be discussed at succeeding meetings, but no more official action was taken upon it. The use of six-wheel trucks was introduced mostly by sleeping car companies and no objection was ever raised against their use.

A multitude of weak, imitative natures are always lying by, ready to go mad upon the next wrong idea that may be broached. —*Our Mutual Friend.*

Atlantic City Again.

At a joint meeting of the executive committee of the Master Mechanics' and of the Master Car Builders' Associations held in New York early in November, it was unanimously decided to hold the railway conventions in June, at Atlantic City. This decision was reached after representatives of the municipal and hotel interests of Saratoga Springs and of Atlantic City had presented their claims. The M. C. B. convention will be held on 15th, 16th and 17th of June and the Master Mechanics' convention will follow on the 20th, 21st and 22nd of June. The hotel rates in Atlantic City will remain the same as they were at the last convention.

Railway Business Association Dinner.

About a year ago, when the business depression had scarcely begun to lift, a number of prominent railway supply men organized the Railway Business Association, whose purpose was to defend railway companies from the wanton attacks of politicians, and to cultivate in the minds of the people fairness towards railway interests.

The year's experience having convinced the leading spirits in the Railway Business Association that the work performed had been satisfactory, it was determined to celebrate the occasion by a banquet which was held at the Waldorf-Astoria, New York, on Nev. 10. Covers were set for over 600 guests, and the list included representation from all parts of the country.

Among those at the speakers' table were Messrs. J. S. Darst, Ira B. Mills, E. G. Miner, S. S. McClure, H. M. Byllesby, W. P. Hypes, John Kirby, Jr., J. Edward Simmons. Chauncey M. Depew, T. A. Griffin, Frank W. Stevens, J. Pierpont Morgan, George A. Post, George Westinghouse, Martin A. Knapp, Frank A. Vanderlip, E. M. Skinner, Henry R. Towne, Alfred A. Pope, St. Clair McKelway, W. G. Besler, James Speyer, A. F. Gates, Edward Gillette and Judge Nathaniel Ewing. Among the other guests were Robert C. Clowry, William E. Corey, Ralph M. Easley, J. T. Harahan, E. T. Jeffery, L. F. Loree, Paul Morton, Ralph Peters, Charles M. Schwab, George R. Sheldon, Theodore P. Shonts and Isidor Straus.

Mr. George A. Post was toastmaster, and opening the proceedings by explaining the purpose of the association, at the same time taking the stand that the public and the railway companies are benefited by the work done by the Railway Business Association. The manufacturers of railway equipment who constitute the membership of this association he said, are even more interested in the prosperity of railroads than the officials are, for, he said, many of us have our all in the equipments used in making railway appliances. Public wrath towards railways has a terribly malign consequence for the railway supply man, greater and graver than for the average railway manager. We are organized for self interest. We are dominated by that most potent of all human desires—self preservation.

This appeal is made to railway folks from baggage handler to executive; to those who are patrons of the railway and to public officials clothed with authority in dealing with railway matters. It is the high hope of the Railway Business Association that the time may come when public wrath will be as quickly aroused against anyone who would seek to harm a properly conducted, square-dealing railway, as it would be aroused against an offending railway. The condition precedent to this state of the public mind is that unremitting attention be given to that branch of railway engineering having for its functions the maintenance of public good will.

The labors of the association have been devoted to the work of creating a public opinion more favorable to railway interests than it has been. They have taken no part in the affairs of any faction. In the same manner complete independence has been maintained towards railway officers, and the association has refrained from discussing questions arising between railways and their employees. Efforts have been fairly successful in our policy to act as conciliator between the public and railways. Substantial progress has been made in convincing the public that unwise restriction of railways curtails industrial employment and thus hurts all business. The Railway Business Association should be made a permanent organization. It should have for its purpose to assist the railways on one hand in their problem of pleasing the public, and to exert on the other such an influence on the public and public officials as will tend to promote wise regulation, fair alike to the public and the railways.

We regret being unable to publish Mr. Post's magnificent address in full. We believe that copies of all the addresses may be obtained by application to the Railway Business Association, No. 2 Rector street, New York.

Hon. John C. Spooner, of Wisconsin, was the first speaker. He said:

"The railroad companies for many years held the idea that because they had the power to fix rates the State was without the power to regulate those rates. For many years the people bore with considerable patience that misconception by the railroads of their real rights. Everybody knows that the railroads could never have been created without the use of the corporate entity. Partnerships would never have been successful in the building of railroads.

"But the public does not understand its relation to the railroads. It has been told that they are public corporations and it has been taught to believe that the power of the public over public corporations is supreme. But the railroad is not a public corporation. The Supreme Court has decided that it is private property, and private property has the protection of the Constitution against the public and against private individuals."

In speaking of the organization of the association, Mr. Spooner said that it came into being one year ago at the end of a great panic. "And God knows," he continued, "but for the genius and strength of J. P. Morgan, who would have stemmed the tide of that panic? It could not, perhaps would not, have been stemmed."

At this the meeting broke into frantic cheers, which were kept up until Mr. Morgan rose and bowed his acknowledgment.

Mr. E. P. Ripley, president of the Atchison, Topeka & Santa Fe, said that the old idea of "The public be damned!" had passed out; and instead of it the railroads had been compelled to recognize that the people were the final arbiters of their fate. In outlining his scheme for promoting better relations between the public and the railroads, he said:

"In this country the people rule—and in the long run that system, that method, or that personality that does not meet the approbation of the public cannot succeed. Acknowledging as we must that the public is all powerful, the question is, how may we satisfy our masters and thus mitigate our woes and preserve our properties.

"The answer to this question was that railroad companies must watch public opinion and grant reasonable demands."

Representative Hepburn, of Iowa, defended Government control of railroads and favored extension of the practice. He also favored laws to prevent railroad companies from increasing their capital stock until approved by the Government

Mr. W. C. Brown, president of the New York Central Lines, mentioned the expense of building a modern warship and told how many acres of model farms could be maintained for the money uselessly spent for the navy. He dwelt upon the small average grain yield of our farms due to ignorance that would be dissipated if the nation carried on the education that would result from establishing of model farms. A movement of this kind is held to be urgently called for as agriculture is going backward instead of improving. He intends recommending the owners of the New York Central Lines to purchase farms that can be operated as experimental farms according to the most advanced methods.

Mr. W. H. Marshall, president of the American Locomotive Company, said that two facts stand out prominently in the business situation; first, that we are suffering from excess of legislation; second, that in too many cases the management of railways do not reach the heart and sympathy of the people. Illustrating his first point he said that in the United States, one bill is introduced for every 1,000 inhabitants; in Great Britain, one bill for 77,000 inhabitants. He insisted that railways ought to be consulted concerning proposed legislation. More consideration ought to be given to the small shipper, to the passenger who travels only a few miles on the trains of a railway to local communities. Just dealing by railway companies has a two fold reward. It brings appreciation from the public and it improves relations between employer and employee.

At the business meeting, in addition to the re-election of Mr. Post as president, Mr. Charles A. Moore was elected treasurer and Messrs. H. H. Westinghouse, O. H. Cutler, W. H. Marshall, E. S. S. Keith, A. H. Mulliken and O. P. Letchworth were elected vice-presidents.

The speeches at this banquet serve to show the lively interest taken in the subject by railroad officials and supply men, and it ought to bear good fruit.

Applied Science Department

The Joy Valve Gear.

In Dr. Angus Sinclair's monumental work "Development of the Locomotive Engine," there are about fifty different types of locomotive valve gearing described and illustrated, and, while many of these are merely variations of two distinct types, all of them bear evidences of a high order of mechanical ingenuity, and it would seem as if the problem of steam distribution is one that has engaged the attention of the brightest minds in the realm of steam engineering and that the complete solution of the problem, like the squaring of the circle, is one that eludes and ever will elude the seeker after perfection. Even the survival of the fittest is often hindered by ignorance and prejudice, and it is marvelous with what tenacity the mechanical mind will cleave to established institutions. It may be remarked that the most successful inventions and variations in locomotive engine valve gearing have been made by skilled mechanicians whose experience in actual work has sharpened their intellects and in many cases rendered the application of their theories comparatively easy by giving an opportunity in the locations where they were employed to test the merits of their devices.

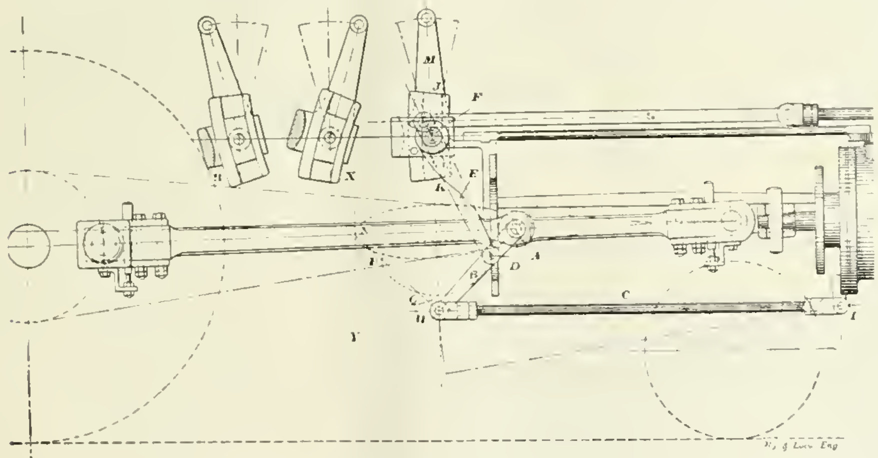


FIG. 1. ELEVATION OF JOY'S VALVE GEAR.

David Joy, an English locomotive superintendent, patented a valve motion in 1879. Although belonging to the radial gear variety of valve motions, it has several features distinctively its own. It has neither eccentric nor crank, the valve deriving its movement from a system of levers connected with the main rod and varied by the application of a sliding link.

The motion for the valve is taken directly from the connecting rod and by utilizing independently the backward and forward action of the rod, due to the reciprocating motion of the piston, and combining this with the vibrating action of the rod up and down, a movement results which is used to actuate the valves of engines having any combination of lap and lead, and giving an almost mathematically correct cut-off for both sides of the piston for forward and backward motion, and for all points of expansion intermediately. The action of the gear may be understood by reference to the engravings, Figs. 1, 2, 3 and 4, which are respectively an elevation, plan, a transverse section on *XY* of Fig. 1 looking forward, and modified arrangement of the gear.

From a point, *A*, Fig. 1, in the connecting rod, motion is imparted to a vibrating link, *B*, constrained at its lower end, *H*, to move vertically by the radius rod, *C*, which is pivoted at *I*. From a point, *D*, on this vibrating link, *B*, horizontal motion is communicated to the lower end of a lever, *E*, from the upper end of which lever the motion is transmitted to the valve spindle by the rod *G*. The center or fulcrum, *F*, of the lever *E*, partakes also of the vertical movement of the connecting rod to an extent equal to the amount of its vibration at the point *A*; the center F is for this purpose carried vertically in blocks which slide in slots in the links *JK*, which are curved to a radius equal to the length of the rod *G*, connecting the lever *F* to the valve spindle. These links are attached to a shaft, *L*, Figs. 2 and 3, corresponding to the ordinary lifting shaft of a link motion. The center of this shaft corresponds to the position in which the ful-

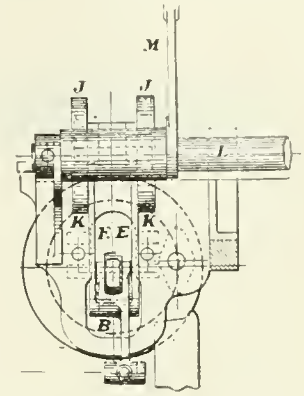


FIG. 3. SECTION OF GEAR.

crum, *F*, of the lever, *E*, is represented in Fig. 1. The shaft, *L*, and the links can be partially rotated on the center of the former, so that the slots in the links will be inclined over to either side of a vertical position, as shown at *W* and *X*. This is done by means of an ordinary reverse lever connected to the upper arm, *M*, attached to the shaft, *L*. When the links are thus inclined, the vertical movement of the lever, *E*, causes the blocks in the links and the center, *F*, to traverse a path inclined to a vertical center line; and to diverge from it to either side. The center, *F*, therefore, has a horizontal movement, the extent of which depends upon the degree of inclination of the links, and the direction of which is governed by their position.

The forward or backward motion of the engine is governed by giving the slots this inclined position on one or other side of the vertical center line; and the amount of expansion depends on the amount of the inclination, the exactly central or vertical position being "mid-gear." In that position steam is admitted at each end of the stroke to the amount only of the lead; and this is done exactly equally on each side of the center line, the amount of lead being constant for forward and backward motion, and for all degrees of expansion. Thus when the crank is set at the end of the stroke

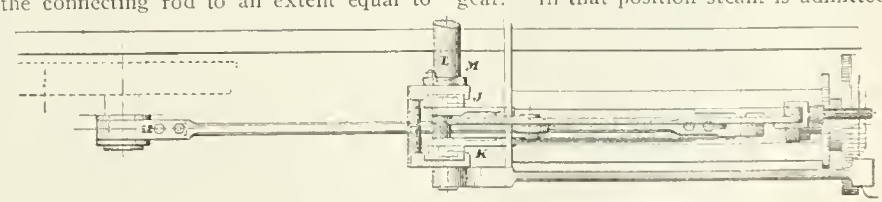


FIG. 2. PLAN OF THE JOY VALVE GEAR.

either way, the center, F, of the valve lever coincides with the center of the slot, and, therefore, the slot may be moved over from forward to backward gear without affecting the valve at all.

It will be seen at a glance that if the lower end, D, of the lever, E, were attached directly to the point, A, on the connecting rod, it would travel in the path of the ellipse, AN, represented by dotted lines, and there would be imparted to the center, F, of that lever, an unequal vibration above and below the center of the links, JK. The extent of inequality would be twice the versed-sine of the arc described by the lower end, D, of the lever, E, and this would give an unequal port and unequal cut-off for the two ends of the stroke. But this error is corrected by attaching the lower end, D, of the lever, E, to the vibrating link, B; for while the point A in the connecting rod is performing a nearly true ellipse, the point D in the vibrating link B is moving in a figure, $DOPQ$, Fig. 1, like an ellipse bulged out on the lower side, and this irregularity is so set as to be equal in amount to the versed-sine of the arc described by the lower end, D, of the lever, E, thus correcting the above error, and giving an equal travel to the center, F, of the lever above and below the center of the slot. At the same time the error introduced by the movement of the end of the valve-rod, G, is corrected by curving the slots or links, JK, to a radius equal to the length of G.

Referring again to the equalizing of the traverse of the center, F, of the lever, E, in the slot, JK, the unequal traverse may be either under corrected or over corrected by shifting the point D in the vibrating link, B, near to or further from A; by this means a later point of cut-off may be given to either end of the cylinder at will, and the engine may thus have more steam admitted to one side of the piston than to the other, if required. The same thing may be done for the lead. By altering the position of the crank for which the lever center, F, coincides with the center of the slots, JK, an increased or diminished lead may be given. The central positions and exact connections are, however, in all cases standard and equal.

Hitherto the center, F, of the lever, E, which gives motion to the valve spindle, has been described as carried in curved slots. This plan is given as the most simple to manufacture, but if preferred the center, F, may be carried by a radius rod so that its vibration will make the center, F, of the lever, E, describe identically the same arc as if moving in the slots JK.

In locomotives with small wheels the link, C, may come so low down as to be in danger of being knocked off. For such cases, and for others when it may be considered desirable, Mr. Joy proposed the plan shown in Fig. 4, in which the link, B, is cut off at the center, D, and is connected at that point by a rod, S, to a crank, T, on the end of the crankpin. The movement of the valve produced by this mechanism is almost identical with the other.

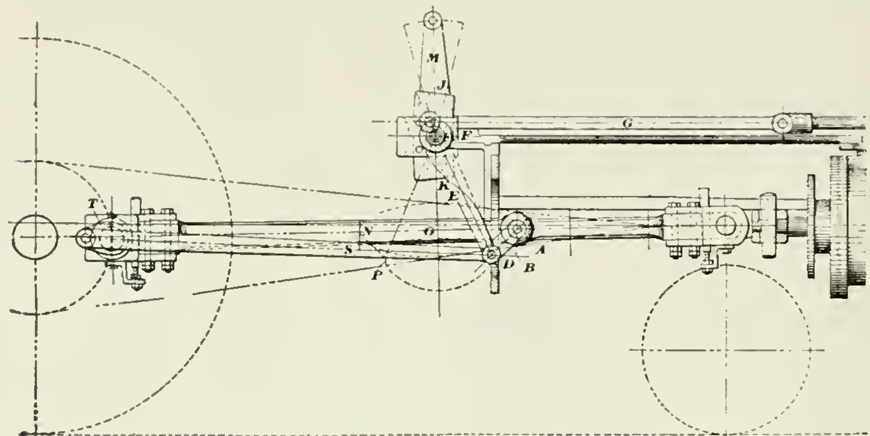


FIG. 4. JOY'S GEAR MODIFIED SO AS TO RAISE PARTS FROM TRACK.

The Joy valve gearing has met with considerable favor on a few of the British railways, notably on the Great Western Railway of England. This railroad, constructed by the justly celebrated engineer, Brunel, is among the best built and maintained railways in the world. The long, straight stretches of flat lands over which most of the road passes form an excellent opportunity for fine roadbeds, and consequently the locomotives are comparatively free from those vibratory oscillations which are a severe test on the rigidity of almost all forms of valve gearing. It will be readily observed that any vertical disturbance on the main rods of locomotives equipped with the Joy valve gear would have a particularly distorting effect on the gearing, and this is the cause of the very limited use to which the gearing has been put on American railroads. As roadbeds improve, the gearing may come into more popular favor. It unquestionably takes its place among the leading devices used in steam distribution. Like the Corliss valve gearing and others of real merit, the Joy valve gearing has advantages peculiarly its own, but its best work can only be done under conditions which we are not likely to reach for many years to come.

Celebrated Steam Engines.

XXV. Richard Dudgeon.

Over fifty years ago a tall, raw-boned, young Scottish mechanic drifted into the railroad shops on the east coast of America. He could work about twice as much as the average mechanic. He was an all-round machinist of the old school. He was of an inventive turn of mind, and the idea of a fountain pen occurred to him. It was while experimenting with this novelty at night and working in the railroad shop by day, that the idea of the hydraulic jack occurred to him. Strong as he was he grew tired of the screw jacks with which they raised locomotives, and turned his thoughts from the fountain pen to the lifting jack. It was a success from the start, and while there have been improvements and adaptations on Richard Dudgeon's original hydraulic jack, like Watt's steam engine, it remains much the same as it came from the hands of the clever inventor.

After establishing the manufacture of the hydraulic jacks in America, he carried his invention to England and, securing a patent there, he was about to open a manufacturing plant when he discovered that a rival, who was afterwards known as Sir Richard Tangye, had made some unimportant change on the hydraulic jack and also secured a patent. Mr. Dudgeon protested, but a prolonged lawsuit was a luxury that he could not afford to indulge in at that time, so he returned to America. It may be mentioned in this connection that while Mr. Dudgeon was unquestionably the original inventor of the hydraulic jack, Mr. Tangye received and accepted much credit for an invention which was not his own. This was particularly the case in the launching of the steamship *Great Eastern*, which, on account of its great weight, had sunk in the ship yard so much that it was found to be impossible to launch the vessel in the usual way. The hydraulic jack was called into effective service and much praise was bestowed on Mr. Tangye which really belonged to Mr. Dudgeon. It was stated that Brunel, the eminent engineer and designer of the *Great Eastern*, always acknowledged the precedence of Mr. Dudgeon's claims to the masterly invention.

Meanwhile Dudgeon was not resting idly on his hard won laurels. He produced a steam carriage fitted with a boiler of the multitubular kind and coincident with the construction of the boiler he invented a flue expander. The steam carriage accommodated eight passengers, but like many other clever adaptations of the steam engine it seemed to be ahead of its time. The "White" steamer of our own day is undoubtedly an improvement on Dudgeon's road carriage, but the changes are really mere matters of elegance in fittings and furnishings.

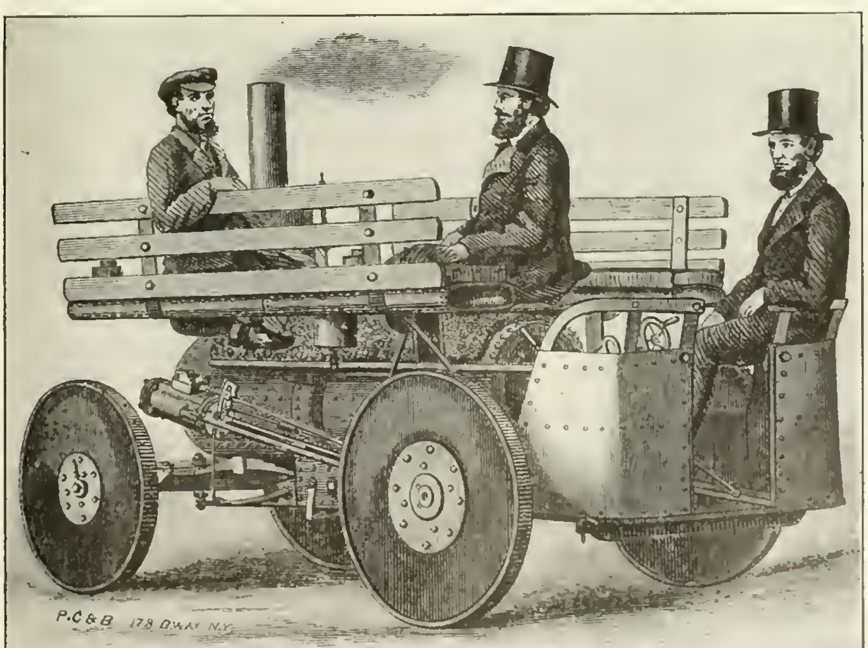
The tube expander filled a long-felt want, if we may use an old phrase. From a simple contrivance resembling a fishing reel in which three small rollers were enclosed, each capable of being spread outwardly by a taper pin and revolved by an adjustable lever, or bar. The contrivance soon took on an elegant and substantial appearance. No tool ever rose more rapidly into popular favor. Dudgeon's jacks and expanders did the work of ten or twenty men, and the inventor became at once a real benefactor to railway men and mechanics generally. Fortune came to him quickly, but he went on modestly as ever with new experiments. In his second visit to Europe he was warmly received by the leading engineering societies, and gold medals and diplomas came thick upon him. He received permission from the British Government to experiment with his flying machine. He was allowed to use the grounds of the Arsenal at Woolwich for his experiments in this direction. That man could fly was one of Dudgeon's pet theories, and doubtless if the gasolene motor had been in existence in his day he would have succeeded in his experiments. As it was, the machinery of his flying machine could not be sufficiently lightened to maintain an even flight. He had studied the flight of birds and observed that all the heavier birds raise their wings slowly and bring them down swiftly, thus beating the intangible atmosphere and sustaining a weight many times heavier than the air, that is bulk for bulk. His method of propulsion was exactly similar to that now used on the most successful aeroplanes, that is by means of a rotary propeller. The suspending power by means of wings driven by a steam motor was found to be inadequate to the task.

He next turned his attention to the steam hammer which hitherto had been very apt to get out of order. Dudgeon's method of cushioning the columns and solidifying the entire machine, virtually making the hammer and block one solid structure, rendered the steam hammer almost free from wear, and Dudgeon may be said to have perfected Nasmyth's masterly invention.

Among his latest inventions was a rotary engine, the forerunner of the modern turbine. The fine fitting of the valves surrounding the rim of the revolving motor rendered the engine too expensive to compete against the ordinary reciprocating steam engine, but the smooth running of this machine was the theme of general admiration, and the result of Dudgeon's valuable experimenting was used in perfecting the steam turbines now in use.

It is gratifying to know that the extensive machine works established by Mr. Dudgeon in New York City are still in flourishing operation, and although the patents on his many valuable inventions have long ago expired the fine products begun under his supervision are still maintaining, and in some instances improving upon, their original excellence.

ORIGINAL DUDGEON TUBE EXPANDER PHOTOGRAPHED FROM SPECIMEN PRESERVED IN THE SHOP.



DUDGEON'S ROAD CARRIAGE A FORERUNNER OF THE AUTOMOBILE.

When the shop surveyor proceeds to remove a chip or spark from a sufferer's eye, he generally employs a knife blade. If he would have the blade thoroughly magnetized before beginning the operation it would often draw out out the source of pain without touching the eye.

Questions Answered

SIGNAL INDICATOR.

80. J. T. W., Boston, writes: I would like to know the use of the small piece of blue glass which swings back of the lantern on a railroad signal, so that when the signal is in the danger position it covers a small hole in the back of the lantern, and when in the clear position it leaves it open. In other words it is in line with the red glass in the spectacle case.—A. What you have seen is usually on ground or switch signals. The small hole in the back of the lantern is for the purpose of indicating to any one behind the signal that there is one there and that it is lit. When the signal stands at clear the little indicator shows white, in order to make apparent the position of the signal. When the signal is at danger as you call it, the blue glass indicates the fact. The color blue is used so that it shall not be taken as a signal but shall be known for what it is, an indicator. It is a mistake to speak of a red light on a switch signal or on an interlocking plant as indicating "danger." What it indicates is a route either open or closed. In the

case of switch signals the red indicates the diverging route which may be taken or used quite legitimately. The interlocking red indicates that a particular route is barred and is not to be used. The automatic red is, in one sense, the only real danger signal, for this implies a stop. These uses of the red light constitute what may be called the ambiguity of its meaning and it is on this point that many of our correspondents have written.

BRAKES CREEPING ON.

81. "Wants to Know," West Fort William, O.: (a) We have an engine here equipped with the H6 Westinghouse brake and the brake creeps on when the brake valve handles are in their running positions. What could cause this?—A. The same thing that could cause the older G6 or A1 type of brake to creep on causes this to creep on, which is, brake pipe leakage that is not promptly supplied by the feed valve. The feed valve should not allow a variation of over 2 lbs. in brake pipe pressure; if it does, brake pipe leakage might allow the equalizing valve to be moved to application position, which would result in an application of the brake. When the feed valve opens again to supply the brake pipe, the equalizing valve will be forced to release position, everything else being in good condition. When testing a feed valve for sensitiveness the air gauge must be correct and register slight variations in pressure.

(b) On this same engine the reducing valve is set at 45 lbs., but when the independent brake is applied the hand on the cylinder gauge goes up to 60 lbs. Where does the air that builds cylinder pressure from 45 to 60 lbs. come from?—A. It comes from the pressure chamber of the distributing valve, as stated, before the movement of the equalizing valve would allow a flow of air from the pressure chamber into the application cylinder.

STEAM-MAKING AND SCALE.

82. Subscriber, Covington, Ky., asks: How can I find the loss of heat due to scale on boiler flues, and would it make any difference if the scale was calcium sulphate or some other scale forming matter?—A. The composition of the scale would make some difference but not enough to be very much in favor of one kind of scale as against another. All scale intercepts heat. Some years ago a test was made on the Illinois Central in connection with the University of Illinois for the purpose of finding out the effect of scale on the steam-making qualities of an engine. The detailed description of the test is given in Henderson's "Locomotive Operation." An engine had run twenty-one months and had scale on the principal heating surfaces about three-sixty-fourths of an inch thick. Before removing this scale the boiler had an average evaporative capacity of 5.99 lbs. of water for each square foot of heating surface, the rate of combustion being .94 lbs. of coal per square foot of heating surface per hour. After removing the scale the average rose to 6.78 lbs. of water per square foot of heating surface, with a combustion rate of .97 lbs. of coal per square foot of heating surface per hour. Cleaning the boiler resulted in about 13 per cent. increase in the steam-making capacity of this boiler.

PRONUNCIATION OF NAMES.

83. Subscriber, Covington, Ky., writes: How do you pronounce the words Mallet and Walschaerts?—A. The first word is French and is pronounced as if spelled "Malay." The second word is Belgian and in that language is pronounced as if spelled "Valskaerts." In this country and in England the word in its Anglasized form is generally pronounced "Walshirts."

LEAKY AUXILIARY RESERVOIR TUBE.

84. B. J., Richmond, Va., asks: What is the quickest and most positive way to detect a leaky tube in the freight auxiliary reservoir?—A. When a triple valve known to be in good condition is bolted to a reservoir with a leaky tube, the blow of air from the triple valve exhaust port while the brake is released will indicate a leaky tube. If there is any doubt as to whether a blow of air from the triple valve exhaust port is from the triple valve itself; from the body gasket or from the reservoir tube, the triple valve can be bolted to the reservoir with the body gasket upside down, or if an H2 or K2 triple, bolt up with the body gasket one-third of a turn out of position so as to lap the brake cylinder port. If the brake then applies as the reservoir is charging or if there is a blow past the packing leather, air must be leaking from the auxiliary reservoir into the brake cylinder either through a defective tube or through the wall dividing the reservoir and brake cylinder.

INJECTOR CAPACITY.

85. Subscriber, Covington, Ky., asks: What number of gallons of water will a No. 10 Hancock inspirator supply to a boiler with 200 lbs. steam pressure; also what quantity of water will Monitor injectors No. 9 and No. 10 put into a boiler with pressure of 200 lbs. and pressure of 160 lbs.?—A. The catalogue figures for a Monitor No. 9 at 200 lbs. pressure are 2,940 gallons an hour. The No. 10 Monitor will, under the same pressure, supply 3,750 gallons an hour. The capacity of the injectors under 160 lbs. is not stated. It is possible to somewhat improve on the average quantity here stated if the injector connections are of ample size, without obstructions, with few bends, and water freely supplied from the tender, and with steam pressure maintained up to or even slightly over 200 lbs. The No. 10 type A Hancock inspirator delivers 4,068 gallons per hour under a pressure of 210 lbs. There are no figures given by the manufacturers for a pressure of 200 lbs.

RECORDS OF PATENTS.

86. R. M. B., Newark, N. J., asks: How can I obtain reliable information about all patents obtained for attachments to locomotives?—A. The Patent Office Gazette gives records of all patents issued in the United States. Write to the Commissioner at Washington, D. C.

ANGLE OF TWIST DRILLS.

87. Manager, Manila, Isle de Luzon, writes: I am in charge of a shop having very good machinists and good tools, but there is no tool-grinding machine, and there is difference of opinion about the proper angle for twist drills. RAILWAY AND LOCOMOTIVE ENGINEERING is popular here, and your opinion on this question would settle it.—A. We should advise you to adhere to the angle of the drill as it comes from the makers. The angle formed by the lip and body of the drill is generally 60 degs.

NO NAME GIVEN.

88. Enquirer, Calgary, Alba., writes: Please answer the following questions through the columns of your paper, etc., etc.?—A. You have not complied with the conditions necessary to get an answer. Every correspondent to RAILWAY AND LOCOMOTIVE ENGINEERING is expected to give his name and address, not necessarily for publication, but as a guarantee of good faith.

The Seaboard Air Line Railway have awarded contracts to the Baldwin Locomotive Works for 15 passenger and 5 switching engines, and to the Pressed Steel Car Company, of Pittsburgh, for 1,000 box cars, 25 stock cars and one 60-ton steam wrecking car. Three passenger coaches, 3 combination passenger and baggage cars, 4 combination mail and baggage cars and 5 express cars have also been ordered from another company.

The Alaska-Yukon-Pacific Exposition has awarded to the General Electric Company a grand prize on general exhibit of electrical apparatus and completely furnished model apartment.

Air Brake Department

Conducted by G. W. Kiehm

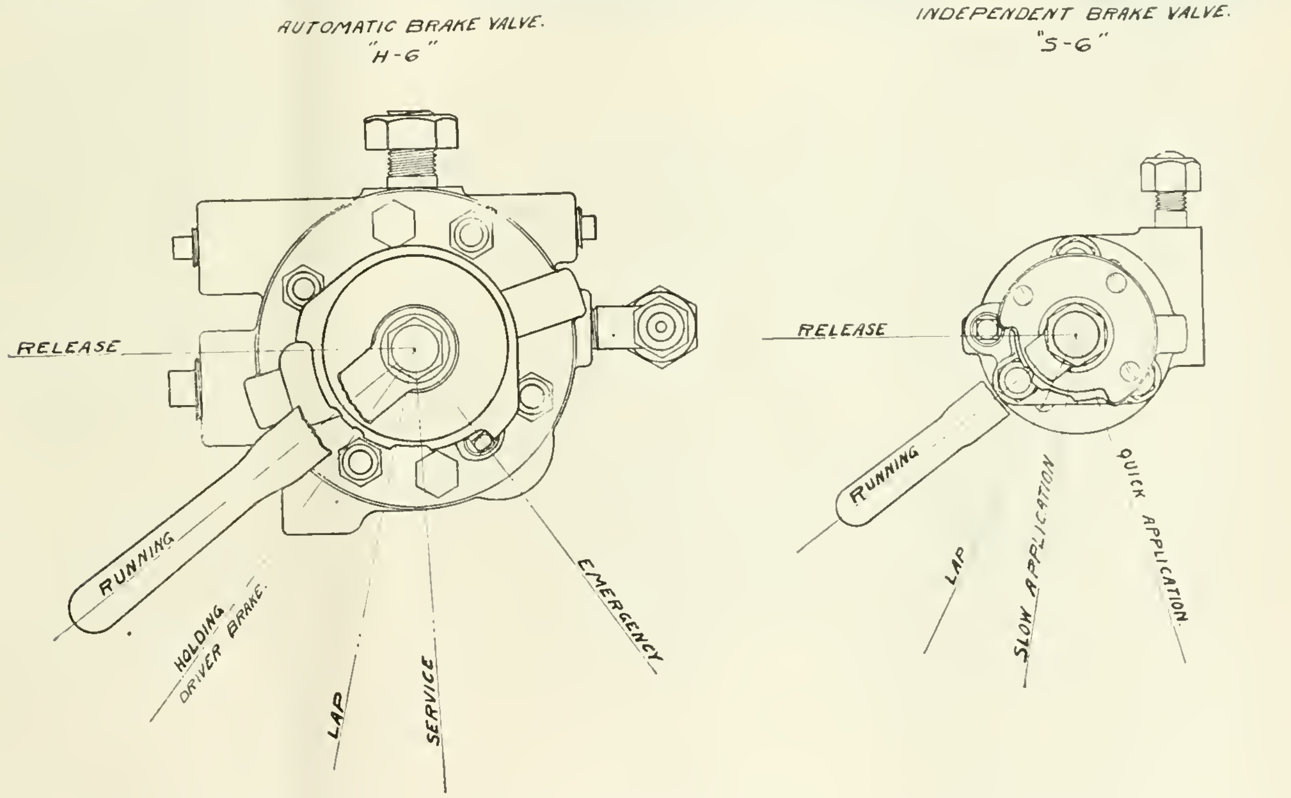
Defective H-6 Brake on the Road.

The series of articles on the H-6 brake which have appeared during the past year have gone over the subjects of operation, inspection, defects and tests to locate them, and what can be done in cases of broken air pipes while out on the road. They had no particular reference to the illustration used with them, it being considered that the names of parts, construction and operation could be learned quicker and more conveniently from the pamphlets describing this apparatus. The pamphlets referred to are really an air brake book and a work of art, furnished gratuitously by the Westinghouse Air Brake Co. to any railroad men interested in this equipment, and while it is no suggestion from the company, a spirit of fairness will prompt the reader to enclose stamps to cover postage when making a request for a copy. We feel that the series of articles have, for the time being, covered the subject pretty thoroughly, but we will offer a few suggestions as to what can be done in cases of emergency, or in the event of any failure of the different valves comprising this equipment, while out on the road, the question of breaking air pipes will be ignored as they have been mentioned in the February, March and April numbers of 1909.

The main line of the modern railroad is a very poor place to experiment with defective brake equipment, or to experiment with any other part of the locomotive, and when compelled to stop because of the failure of any of the parts, the thought uppermost in the mind of the man in charge of the locomotive should be, how to again get the train in motion or into the nearest siding in the shortest possible space of time.

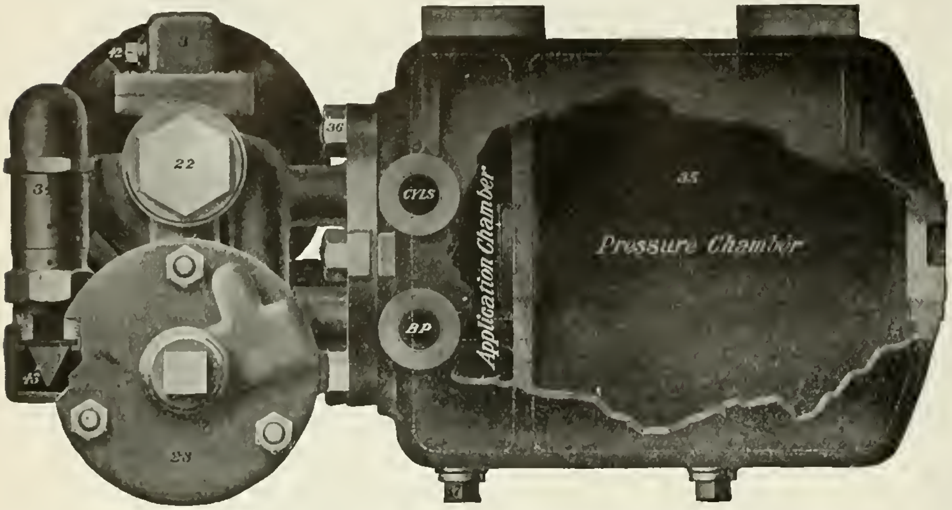
It is well at such times to be guided by an instinct of self-preservation, to pursue a safe and intelligent course, for it is much easier to reason out what should have been done, at the next meeting with the air brake instructor, or with the road foreman of engines than it is to reason it out the instant that the defect develops, and furthermore, the official who investigates the cause of the detention has plenty of time to decide in his own mind what should have been done at the time. With a view of making the right move at the right time let us begin by considering what should be done in case of an air pump failure, or in case the air pump stops at some point on the road.

It is assumed that the engine is in passenger service and equipped with the H-6 brake, and no matter what size or make of air pump is in use, it is generally understood that if the pump is broken no repairs can be made on the road, and it should not be attempted, but if there is nothing wrong with the pump itself, it is strictly up to the engineer to again get it started. He must know positively before deciding that the pump has failed, first; that the pump was well lubricated, he must not be content with merely knowing that drops of oil are feeding from the lubricator. Second, he must know that the pump is getting a full supply of steam. In determining this it is sometimes necessary to break the joint between the governor and the pump, although it is not always necessary to disconnect the steam pipe. If, when approaching the pump, air is blowing freely from the relief port in the neck of the governor, it is not necessary to bother with the steam pipe, as it is evident that the governor steam valve is closed. Third, it must be known that the pump is free to exhaust the steam, after it is found that it is getting a full supply. In order to ascertain this it might be necessary to break



POSITIONS OF HANDLE OF THE H6 AND THE S6 BRAKE VALVE.

the exhaust pipe connection, and if the train is heated with exhaust steam from the air pump, the valve, or three-way-cock used in the exhaust pipe, must be known to be open either to the heating reservoir or to the atmosphere.



NO. 6 DISTRIBUTING VALVE AND DOUBLE CHAMBER RESERVOIR.

After clearly ascertaining that the pump is well lubricated, getting steam, and that the exhaust is not obstructed, it is safe to conclude that the pump is broken or disabled, and the train must be moved without an air brake to some point where another engine is available. Each railroad has certain rules governing such cases, and the Interstate law will permit, or rather overlook, cases where it is absolutely necessary to move trains under such conditions.

In considering what to do with a governor that develops a defect, one's action depends somewhat upon whether the governor does not stop the pump when the proper pressures are attained, or whether it will not allow the pump to work again. In the former case it is only necessary to regulate the speed of the pump by means of the throttle, the latter case of the governor not allowing the pump to start, could be due to a stopped-up relief port, a diaphragm valve being off its seat, or to the governor piston having stuck.

If the governor should stop the pump and not allow it to start again the pressures as indicated by the air gauge should be noted, and if the brake pipe pressure has fallen somewhat, leaving the main reservoir pressure at, or very near, its maximum, the brake valve handle should be moved to release position for an instant, and if the cause of the governor shutting off the steam is due to the feed valve not having maintained brake pipe pressure at the desired figure, the pump will then start up promptly. If the pump will not start when the handle is moved to release position the handle should then be moved to the lap position to cut off the flow of air through the operating pipe; if the pump then starts to work and stops again when the handle is placed in running position and allows main reservoir and brake pipe pressures to fall below what they are adjusted for, the excess pressure top is defective, and the handle can again be moved to lap position and a blind gasket can be inserted in the union connection in the operating pipe at the brake valve, to cut off the flow of air to this top, leaving the high-pressure top to control the main reservoir pressure to the end of the trip.

An action of this kind could be due to the upper or excess pressure pipe of the governor becoming closed with dirt or to being partially closed, and a leak starting in the pipe near the governor so that the air pressure, necessary to assist the spring in forcing the diaphragm valve to its seat, could not accumulate, the same action might also be due to a piece of scale or dirt lodging under the diaphragm valve. Putting a blind gasket in the operating pipe is the quicker and easier method of overcoming the trouble for the time being.

If the governor will not allow the pump to start, due to a closed or stopped-up relief port it is only necessary to use a pin to open it, but matters of this kind should be attended to before the engine leaves the engine house. The air escaping from this port, when the governor is in control of the pump, makes sufficient noise to attract attention while oiling or inspecting the engine, and while a governor may appear to operate in a satisfactory manner, even if the port is closed, it should be kept open. If it is closed and the governor remains reasonably sensitive to changes in pressure, it means that there is a leak either at the threaded parts of the siamese fitting, past the governor piston packing ring, or the leak is in the threads at the upper end of the governor cylinder, and this should be given attention.

Knowing that this port is open, may be a very insignificant matter, as a general rule, if the action of the governor is not erratic as a result, but it may be of considerable importance in the event of a pump failure or a governor developing another defect while out on the road, and to know that it was open when leaving the engine house may save valuable time and possibly some criticism from superiors on the result of guesswork on the road.

If the relief port is open at the beginning of the trip it is not likely to become closed during that trip, as the collection of oil and dirt forms and reduces the opening gradually, and it very seldom closes entirely in a short time. About the most disagreeable defect of the three originally mentioned is the stuck or sticking governor piston, and it is invariably the result of attempting to make a passable job of fitting a ring in a worn cylinder.

If an engine with a governor in such a condition gets away from the engine house and the piston once sticks it is likely to stick again, tapping the governor body with a hammer or wrench will usually loosen it and it will stick again when the pressure is pumped up.

This is not only annoying but dangerous, and the safest proceeding is to put a blind gasket in the operating pipe at the brake valve and allow the fireman to run the adjusting nut on the high-pressure top down all the way and use the throttle to regulate the speed of the pump.

From the foregoing it appears that the safest method in case the pump suddenly stops, with either governor or pump at fault, is to first be sure the pump is getting oil, then to try to start the pump by tapping it and the governor steam body; and there being no blow of air at the relief port the next move would he to break the joint between the governor and the pump, and if the pump is getting steam it is good policy to slack off the union nut at the exhaust pipe connection and pry the pipe away a short distance, especially if there is any heating attachment in this pipe, and if the pump does not start during this proceeding it must be broken. Of course if the pump develops a terrific pound which continues until the pump stops it is pretty certain that the pump is broken, and a close investigation is usually unnecessary.

In case the pump does not stop running but fails to compress air on either stroke, all that can be done is to observe that the strainer is not closed with dirt or by something having been blown over it, and in case of one of the air valves sticking it can often be loosened by tapping the caps or cages. The manner in which the troublesome valve can be detected and other minor matters concerning air pumps are generally known to engine crews.

What can be done under certain conditions in a case of a disabled brake valve has been mentioned in "Broken Air Pipes," and it is very seldom that a brake valve becomes disabled; there is, of course, always a possibility of a piece of the chipped-out end of a broken pipe lodging under the equalizing discharge valve and holding it off its seat. In such a case it would only be necessary to plug the exhaust port and make the applications by going slowly toward emergency position.

A very few instances are known where the brake valve handle was broken off or where the rotary key was twisted off or become disengaged from the rotary valve; but should this occur while the train is in motion, and near a stopping point, a very prompt movement on the part of the engineer is in order, and we could not advise him to attempt to reach an angle cock on the pilot as there may be a stop cock used, and it may be under the running board or under the pilot, but rather to use his foot or a coal maul and break off the brake valve tee from the valve body and try to reach a stop or angle cock later on if found necessary.

In the event of a defective feed valve which allows main reservoir pressure to enter the brake pipe, the high-pressure top should be adjusted to 110 lbs., to avoid a higher brake pipe pressure, and in case the defective feed valve prevents air from entering the brake pipe, or to state it differently, if air will not enter the brake pipe when the handle of the brake valve is in running position, the only course left open is to get it back into train by turning the handle to release position.

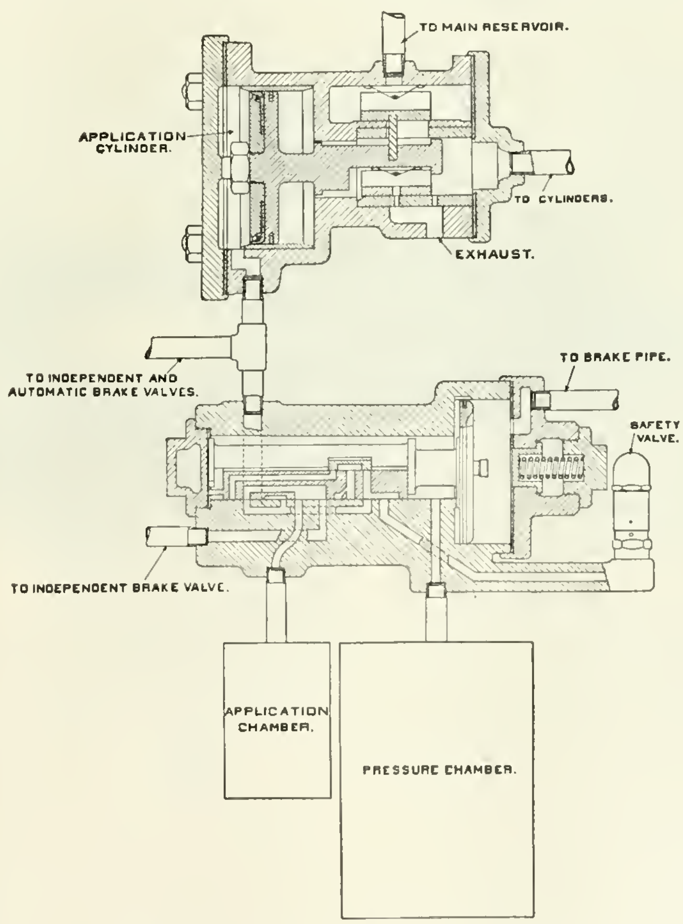
In the first case the excess pressure governor top cannot interfere as it is rendered inoperative by the rise of brake pipe pressure; in the second case, the excess pressure top will stop the pump making the movement to release position necessary to again start it.

When the feed valve will not open it is usually due to the port through the regulating valve seat becoming closed with dirt. A glance at the B-6 feed valve will show that this is not likely to occur with this valve, but because the engine is equipped with the H-6 brake it is no assurance that it has the B-6 feed valve, as the repairmen are not always so particular concerning small matters.

It will be understood that it is not necessary to lose any time on the road on account of defective governors, feed valves or air gauges. If the red hand on the air gauge comes loose on the pinion and falls down against the peg the black hand remaining at 110 lbs. would give assurance that there was nothing seriously wrong, or if the black hand fell, due to its coming loose, the black hand on the cylinder or smaller gauge will still show brake pipe pressure. The reducing valve and independent brake valve can be ignored in this connection, as they are not absolutely essential to a train movement.

Two distributing valve defects that would cause a detention have been mentioned, and if the distributing valve should stick and refuse to release the brake, or if the brake could not be released with either the automatic or independent brake, it would be necessary to close the stop-cock in the distributing valve supply pipe and uncouple the brake cylinder hose between the engine and tender. The effect of, and the remedy for a stuck quick-action slide valve has also been mentioned.

In case of a failure of any part of the brake rigging on the engine, the stop-cock in the brake cylinder pipe can be closed. To cut out the tender brake the stop-cock in the pipe leading to it can be closed, and to cut out both engine and tender brake the stop-cock in the distributing valve supply pipe should be closed. To cut out the brake valve for double heading purposes, or to be hauled in the train, the stop-cock under the brake valve must be closed.



ELEMENTS OF NO. 6 DISTRIBUTING VALVE.

Shay Locomotives.

The Chesapeake & Ohio Railway which have in service several Shay geared locomotives made by the Lima Locomotive Works, have given an order for another very powerful engine of the Shay type. The officials of the Chesapeake & Ohio Railway speak very favorably concerning the efficiency of the Shay engines, and their low cost of repairs considering the very heavy work they do.

Stands Out for the Best.

Senator Depew, railroad president, and famous after-dinner speaker, is not exactly a teetotaller, but he has an ingenious method of dealing with people who offer him a drink that makes most of them hold their breath and their money. The Senator will accept nothing short of a drink of champagne, and he told a meeting of railroad men lately that his discrimination against cheap tipple has an excellent influence in promoting temperance.

There is no man that imparteth his joys to his friend, but he joyeth the more; and no man that imparteth his griefs to his friend, but he grieveth the less.—*Bacon.*

Electrical Department

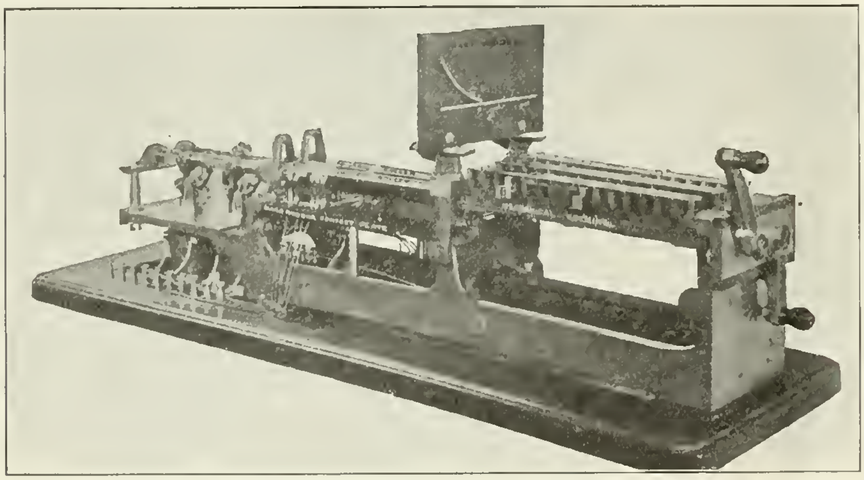
Electric Interlocking.

W. B. Kouwenhoven.

Electric interlocking not only controls the operation but operates as well all switches, signals and derails by electricity. As in the electro-pneumatic system the movements of all switches and signals are repeated back to the tower by an electric current locking these same levers as the position of the switch may indicate. It is not safe to assume that a switch or signal always follows the movement of its lever. The movement of the lever simply turns on the power; the wires may be broken, or disconnected, or they may be grounded, and the power may never reach the switch. In order that there may be no failure of the movement of the switch following that of its lever the lever movement is divided into two parts, a preliminary and a final movement. The preliminary movement turns on the power and throws the switch. The final movement locks or unlocks other levers whose positions depend upon that of the lever in question. The lever is stopped at the end of the preliminary movement by a segment or projection coming into contact with a catch or stop which is known as the indicating latch. The releasing of this latch serves as an indication to the tower man that the switch has moved home and permits him to complete the final movement of the lever.

The method of releasing this latch and indicating to the tower man that the switch has moved home is of prime importance in electric interlocking plants. In fact it is necessary to have some form of indicating device in all interlocking systems to indicate to the tower man that the position of a switch or signal and its lever are in accord. The problem in electric interlocking is to obtain a satisfactory current for indicating purposes. Current taken from the main battery is not satisfactory because if a wire should become grounded or if two wires should become crossed a false indication might easily result. There are two sources of current that fulfill the requirements for an indicating current in an interlocking plant: one method is to use a current generated by the motor itself, and the other is to transform the motor current into an alternating current for indicating purposes. We will consider the second system only.

The power equipment consists of two duplicate generators driven by either motors or gas engines, and storage batteries. The voltage usually employed is 110 volts.



ELECTRO-PNEUMATIC INTERLOCKING MECHANISM.

The electric wires run in pine conduits placed about 6 ins. above the ground, as was explained in the November issue of Railway and Locomotive Engineering. There are but three wires leading to each switch; namely, a reverse wire, a normal, and a common return. The reverse and normal wires serve as indicating, as well as operating wires. The operating wire of one movement becomes the indicating wire of the same movement.

The switches are operated by small motors of 1.5 horse-power each, operating on 110 volts direct current. The shaft of the motor is connected by means of a magnetic clutch to a shaft in the same line which carries a cam drum for operating the switch and lock mechanism.

A speed reduction gearing of the ratio of 25 to 1 is interposed between the two shafts. There is also a safety controller whose duty is to prevent operation of the switch by stray currents. The motors are provided with two separate field coils, one connected to the normal wire and the other to the reverse wire. These field coils are wound in opposite directions so that the battery current flowing through them will produce opposite magnetizing effects, while always flowing in the same direction through the armature. A simple means is thus provided for reversing the direction of rotation of the motor, which is accomplished by simply connecting the operating lever to either the normal or reverse wires.

On the cam drum shaft there are two cams or worms, one for operating the detector bar and lock and the other for throwing the switch. Each cam slot for a portion of its travel is at right angles to the shaft, and for the remaining portion diagonal to the shaft. If the lug on the driving bar for the switch or the lock is in the first portion of the slot no motion takes place; but when the lug is in the diagonal portion there is movement of the switch or lock. When the cam drums are revolved by the motor the lug working the lock and detector bar immediately begins to move, unlocking the switch and raising the bar. When they have completed this movement they come to rest and the movement of the switch begins. After the switch has been thrown, further movement of the lug controlling the lock, locks the switch in its new position and closes the indicating circuit.

The use of the magnetic clutch between the motor shaft and the cam drum shaft permits the instantaneous disconnection of the latter as soon as the switch has been moved home and locked. If for any reason the switch should be blocked and obstructed so that it could not complete its movements the clutch will slip, thus preventing any overstraining of the mechanism. The motor clutch drum and safety controller are all mounted on a steel base plate which is long and narrow, and occupies but very little space between the tracks.

In this method the direct current of the battery is transformed into a pulsating current, which passes through the primary of a transformer placed in the interlocking machine. In the secondary of the transformer an alternating current is produced which serves to run an induction motor which releases the indicating latch.

A copper ring is placed on the motor shaft next to the commutator. This ring, usually known as a slip ring, is connected to one of the segments of the commutator. The motor is provided with three brushes, a common brush, connected to the common return wire; an operating brush, connected to either operating wire as the case may be, and a third, the indicating brush, pressing on the slip ring. The other two brushes rest on the commutator. The primary coil of the transformer is connected in series with the operating circuit, so that the operating current must pass through it.

When the switch has completed its movement the operating wire is shifted from the operating brush to the indicating brush, pressing on the slip ring, as was stated above. The motor will continue to run, current entering the slip ring at the indicating brush will pass out at the common brush. This current will rise and fall as the segment to which the slip ring is attached alternately approaches and recedes from the common brush. This causes a pulsating current to flow through the circuit and through the primary of the transformer. This will set up a magnetism alternately rising and falling in the iron of the transformer, which will produce an alternating current in the secondary. This alternating current drives an induction motor which releases the latch and permits the final movement of the lever. An induction motor is a type of motor that will run on alternating current only. Direct current has no appreciable effect upon it.

If an accidental contact should be formed between a wire of a switch that was in the act of being thrown a false indication would not result, because only a direct current ould flow in the circuit and this would have no effect on the induction motor. If a contact should be made with a wire of a switch that was in the act of indicating while the former one was moving, no false indication would be given, because the operating wire would be connected to the oprating brush of the motor, thus holding the current steady, and the pulsating current of the other switch would not affect the induction motor of the one in question.

The interlocking machines and the electric interlocking plants are similar in construction and appearance to those of the electro-pneumatic system with one exception, the indicating apparatus of the electric machine is adapted to alternating current. The indicating latches are controlled by small induction motors, which have their armature shafts in a vertical position. On this shaft is placed a device similar to the balls on the governor of a stationary engine. When the motors revolve the balls fly outward, lifting the latch and permitting the final movement of the lever. A transformer is also added for

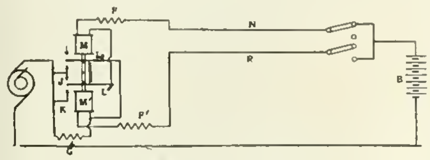
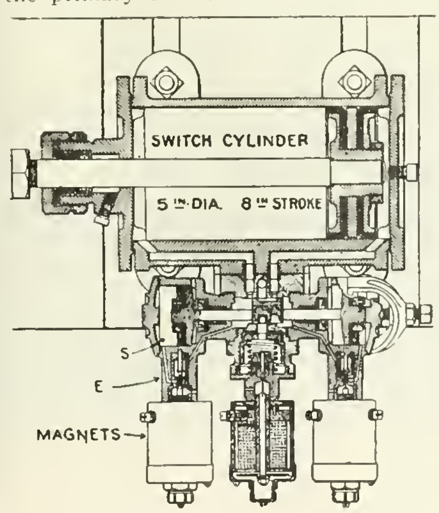


FIG. 1. WIRING OF SAFETY CIRCUIT CONTROLLER.

each lever in the machine to furnish alternating current for the induction motor.

In throwing a switch from normal to reverse the tower man moves its lever from left to right. When he has completed the preliminary movement of the lever he is stopped by the segment coming intc contact with the latch. As soon as the preliminary movement is started current is supplied to the motor through the proper field coil and the motor begins to revolve. The switch is unlocked, thrown and locked in its new position as already explained. The magnetic clutch disconnects the cam drum shaft and the operating wire is shifted to the indicating brush. As a result a pulsating current flows through the primary of the transformer in the



SECTION OF OPERATING CYLINDER.

interlocking machine and generates in its secondary coil an alternating current. This alternating current drives the induction motor causing the balls to fly apart, lifting the indicating latch. This permits the tower man to complete the movement and tells him that the switch has correctly followed the movement of its lever.

The purpose of the safety controller is to prevent the operation of the switch by stray currents which might leak in, possibly due to an accidental grounding or short circuiting of the wires. This is quite as important as the obtaining of a proper indicating current, because if a stray current should reach a switch or signal motor, causing an improper movement of the switch or signal, the consequences might be serious. Fig. 1 illustrates the wiring of the safety circuit controller divested of all unnecessary circuits. In this figure, N and R are the normal and reverse operating wires respectively; F and F^1 are the two field coils of the motor, M and M^1 are two electro-magnets for operating two circuit controllers, L and L^1, which are connected together by a spring; B is the storage battery, J and K are contacts, and G is a resistance whose value is about five times that of the field resistance.

The reverse wire R is the one that will be used to lead current for the next movement of the switch. The tower man moves his operating lever so that current from the battery will flow through the wire R, through the field F^1, through the magnet M^1, and through the resistance G into the armature and back through the common return wire to the battery. This current starts the motor. The magnet M^1 attracts the circuit controller L^1 against the contact K,.and as there is no current flowing in M, the circuit controller L will be pulled against the contact J by the spring. This will short circuit the resistance G^1, and the motor will run at full speed, throwing the track switch as was intended by the tower operator.

If the lever were to remain in the position as shown and current should enter the wire R through a break in the insulation, this current, leaking into the wire, would flow through the field F^1, through M^1 and the resistance G^1 into the armature. M^1 would attract its circuit controller L^1 against the contact K. But as the switch lever has not been moved, current from the battery will now flow through the field F, through the magnet M, through L and into the armature. This current will magnetize M and it will retain its lever L against the pull of the spring. Now the current that leaks into R and passes through F^1 must pass through the high resistance G before reaching the armature. Therefore the current in the field F will be five times as strong as that through the field F^1. For this reason the field magnetism produced by F will be very much stronger than that produced by F^1, and the motor will rotate idly in the same direction it did in making the last switch movement, and no dangerous result will be produced.

Thus it appears that the important result of eliminating and chance of a false indication is secured by this ingenious arrangement.

Four-Cylinder Simple Engine for the Rock Island

The American Locomotive Company have recently completed two very interesting locomotives for the Chicago, Rock Island & Pacific Railroad. These are of the Atlantic type and are equipped with four simple cylinders, arranged on the balanced principle and using superheated steam. Although not the first simple balanced engines to be built in this country, they are the first designed for regular high-speed passenger service; the only other example of the use of the balanced principle in combination with simple cylinders which we know of is the inspection engine built in 1906 at the Collinwood shops of the Lake Shore & Michigan Southern Railway.

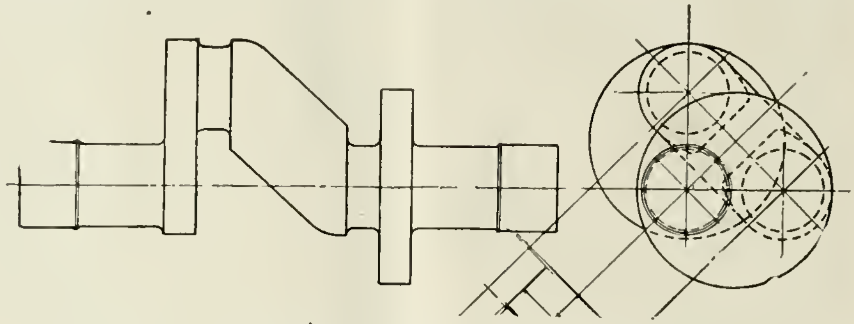
In the case of the engines, here illustrated, a balanced locomotive was decided upon because it is easier on track and bridges, and owing to the excellent results obtained with superheater engines on the Rock Island during the last few years, the railroad officials selected the four-clinder simple engine equipped with superheater in preference to the compound. In the road's classification they are known as the class W-28, in which the numerals denote so many 1,000 lbs. of tractive power.

In working order they have a total weight of 202,000 lbs., of which 116,000 lbs. is carried on the driving wheels. This is an increase of 14,000 lbs. over the weight on driving wheels of the Rock Island's standard design of two-cylinder Atlantic type engine, but this increase has been considered permissible because of the balancing of the reciprocating parts and the elimination of the hammer blow. In the arrangement of cylinders, the design follows the Von Borries balanced compound locomotive, the four cylinders being set in the same transverse and horizontal planes.

The cylinder casting is made in two parts with half saddles, each part containing an inside and outside cylinder and a steam chest placed above and between them. Each cylinder is 17½ ins. by 26 ins. Owing to the use of superheated steam, the boiler pressure has been reduced to 160 lbs. All four cylinders drive on the front main axle and driving wheels, the main rods of the two outside cylinders being connected to crank pins on the wheels in the usual manner and the inside cylinders being connected to the axle, which is cranked for that purpose. The crank axle, a detailed drawing of which we show, is a solid forging and of strong construction. The bearings are 11 ins. in diameter throughout, and the driving box journal and journal for the back end of the main rod of the inside cylinder are connected by a circular disk 4¼ ins. wide. The crank pins are connected by a rectangular section 10½ by 13 ins., the whole forming a very substantial arrangement.

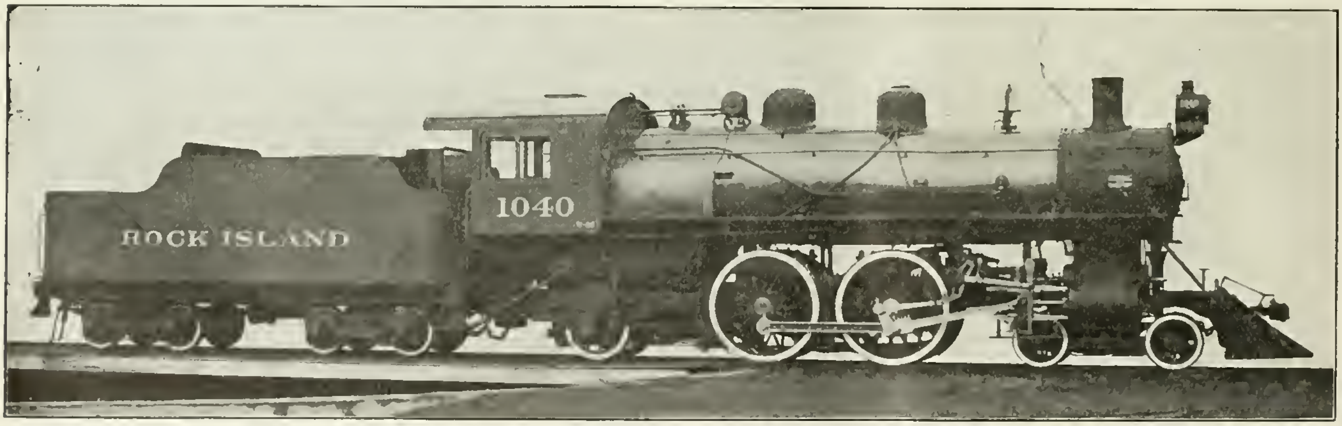
In order to obtain a good length of main rod the cylinders are placed about 3 ft. further ahead of the front drivers than usual in this type of engine, the distance between the center of the cylinders and that of the front driving axle being being 11 ft. This gives a main rod 84 ins. long.

Increasing the normal distance between the front drivers and the cylinders involved an increase in the length of the boiler; but in this instance, it was accomplished with an increase of only 2 ft. in the length of the tubes.



CRANK AXLE OF ROCK ISLAND, FOUR CYLINDER SIMPLE.

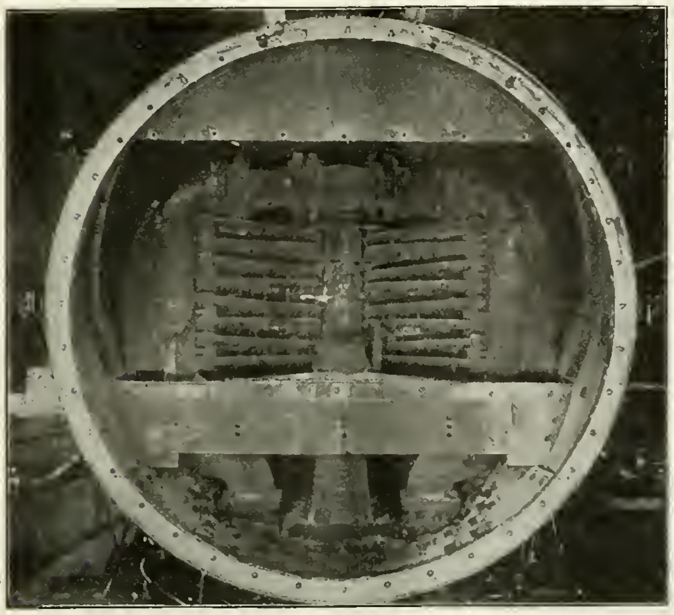
A very cleverly arranged valve motion has been employed. Superheated steam is distributed to the inside and outside cylinders on each side by two 10-in. hollow piston valves carried on a single stem and actuated by the Walschaerts valve gear. Both valves have inside admission and outside exhaust. The live steam passage branches a short distance down from its connection with the steam pipe and one part leads to the center of each valve. The front valve controls the admission of steam to the forward ports of the two cylinders, while the rear valve serves their back ports, the inside ends of the two valves operating the outside cylinder. This results in such an arrangement that while, as mentioned above, each valve has inside admission, in combination they make what is the same as an outside admission valve for the outside cylinder and an inside admission valve for the inside cylinder. As the valve gear is connected to the crosshead of the outside cylinder, it is accordingly arranged for an outside admission valve. The piston valve is of special design for use with superheated steam.



FOUR CYLINDER BALANCED SIMPLE ENGINE WITH SUPERHEATER FOR THE C., R. I. & P.

W. A. Nettleton, General Superintendent of Motive Power. American Locomotive Company, Bulders.

The arrangement of the Walschaerts valve gear is worthy of notice as being a simple, compact and satisfactory design of this type of gear. The link is carried in a cast steel bracket bolted to the front of a yoke or cross-tie a little ahead of the front driving wheels. A longitudinal bearer, extending between this cross-tie and the guide yoke, furnishes support for the bearings of the reversing shaft, the forward-extending arm of which is connected by means of a link to the radius bar a little ahead of the center of the link. The front end of the radius bar has a pin connection to the combination lever, the upper end of which has a similar connection to the downward-extending arm of the rocker which transmits the motion to the valve and is carried in a bearing secured to the guide yoke. The inside arm of the rocker-shaft is connected to the valve rod by means of a block which works in a yoke in the rod. The rear end of the valve rod is extended and slides in a guide bolted to the back of the yoke. The upper end of the combination lever is offset by ⅝ of an inch. This was necessary in order to neutralize the effect on the valve events of the angularity of the main rods, and to give as nearly equal cut-offs as it is possible to obtain in two cylinders connected at 180 degs. to each other and operated by two valves deriving their motion from a single gear.



VIEW OF AMERICAN LOCOMOTIVE CO.'S SUPERHEATER.

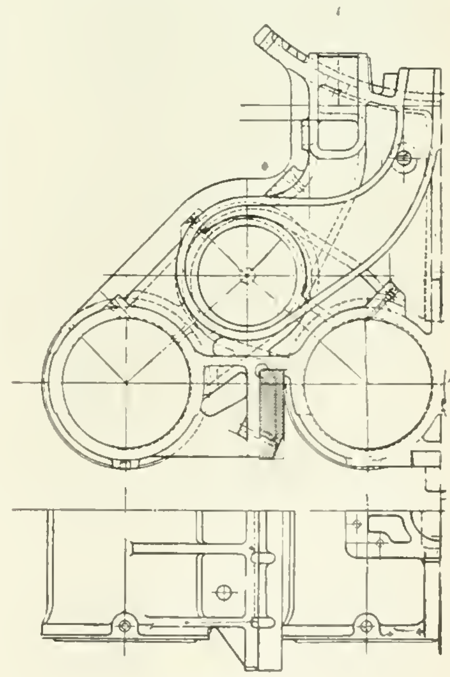
The frames of this engine consist of a main frame of cast steel 4½ ins. wide, with a single front rail 3¼ ins. in width, cast integral with it, and a slabbed rear section spliced to the main frame just back of the rear driving wheel. There is also an outside supplementary frame which carries the trailing journal box and which is connected to the inside frame through the medium of heavy steel spacing castings.

A very strong and substantial system of frame bracing has been employed. This includes, in addition to the cast steel foot plate at the rear of the frames, a cross-tie between the frames just ahead of the front end of the firebox; another back of the rear pedestals; one, having a bearing of 41½ ins. on the upper rails of the frames, between the front and rear driving wheels and one spanning the lower rails of the frames immediately back of the forward pedestals, all of these being of cast steel. The frames are further braced together by the cross-tie ahead of the front driving wheels, which furnishes the support for the link bracket, and by the heavy guide yoke. The boiler is braced to the frames at all of these points by steel plates.

The boiler is of the radial stayed extended wagon top type with sloping backhead and throat sheet. The barrel measures 68⅛ ins. in diameter outside at the front ring. It contains 206 tubes 2 ins. in diameter and 24 tubes 5¼ ins. in diameter outside, which contain the superheater pipes. The tubes are 18 ft. long. The boiler has a total heating surface of 3,132 sq. ft., of which the tubes contribute 2,551 sq. ft., and the firebox the remainder. The firebox is 102 3-16 ins. long and 60⅜ ins. wide, and provides a grate area of 42.8 sq. ft. The superheater is the builder's latest design of fire-tube superheater with side headers, similar to the arrangement applied to a Consolidation engine built for the Wabash-Pittsburgh Terminal Railway, except that it is designed to give a higher degree of superheat. A description of the Pittsburgh Terminal engine was given in RAILWAY AND LOCOMOTIVE ENGINEERING for June, 1909, page 244. In the design applied to the Rock Island engine each 5¼-in. tube contains four 1½-in. superheating tubes arranged in double pairs and connected at the ends by return bends. The inside members of the two pairs are formed of a single tube which is looped at the front end, thus compelling the steam to traverse four times the length of the tubes in its passage from the dry pipe to the cylinders. This arrangement not only gives as high a degree of superheat as it is practicable to obtain, but also reduces the number of steam joints to a minimum, there being only one inlet and one outlet for each four superheater tubes. The ends of the superheating pipes are bent around horizontally with a large radius to meet the side headers. In this way freedom for expansion and contraction of the superheater tubes is provided. The inlet and outlet pipes of each four-tube superheater element are connected by a gland and secured to their connections with the header by a single bolt passing through the header with the nut and thread on the outside. Access is given to these bolts from the outside by means of covered openings in the side of the smoke box. A damper automatically operated by a steam cylinder connected to the steam chest controls the passage of gases through the 5¼-in. tubes and around the superheating pipes.

The cylinders and valves are lubricated by Nathan seven sight-feed lubricator, and Campbell graphite cups are also provided for the cylinders. Careful attention was given to the location of the various fittings on the boiler backhead, with the result that a very convenient cab arrangement was effected.

The tender is equipped with a water bottom tank, having a capacity of 7,500 gallons and space for 13 tons of coal. The tank is mounted on a solid cast steel tender frame manufactured by the Commonwealth Steel Company, of St. Louis, Mo. The tender trucks are of the four-wheel equalized pedestal type, with cast steel bolster.



SECTION THROUGH CYLINDERS AND VALVE CHAMBER.

This type of engine, viz: the four-cylinder simple is new in America, but seems to have given very satisfactory results in Great Britain, where it has been in use for some time. An interesting comparison can be made between this engine and the "Star" class on the Great Western Railway of England by turning to page 343 of our August, 1908, issue. The "Evening Star" has only two sets of Walschaerts valve gear, operating four main valves. The Rock Island arrangement for practically doing the same thing has a more compact design of valve chamber. Both English and American engines use two sets of valve motion to operate four valves. A few of the principal dimensions of the C., R. I. & P. machine are here appended for reference:

Tractive Power—29,600.
Wheel Base—Driving, 7 ft.; total, 30 ft. 10 ins.; total, engine and tender, 62 ft. 8½ ins.
Weight—In working order, 202,000 lbs.; on drivers, 116,000 lbs.; engine and tender, 351,900 lbs.
Heating Surface—Tubes, 2,551 sq. ft.; firebox, 175 sq. ft.; superheater, 406 sq. ft.; total, 3,132 sq. ft.
Grate Area—42.8 sq. ft.
Axles—Driving journals, 11 x 11 ins.; engine truck journals, diameter, 6 x 12 ins.; trailing truck journals, diameter, 8 x 14 ins.; tender truck journals, diameter, 5½ x 10 ins.
Firebox—Type, wide; length, 102 3/16 ins.; width, 60¾ ins.; thickness of crown, 5/16 in.; tube, ½ in.; sides, 5/16 in.; back, 5/16 in.; water space, front, 5 ins.; sides, 4½ ins.; back, 4½ ins.
Crown Stayings—Radial.
Tubes—Length, 18 ft.; gauge, No. 11 B. W. G.;
Air Pump—1 ft. 6 ins.; 2 reservoir, 15¼ x 140 ins.
Engine Truck—4-wheel swing center bearing.
Trailing Truck—Rigid, with outside journals.
Piston-rod—Diameter, 3 ins.
Smoke Stack—Diameter, 18 ins.; top above rail, 15 ft. 1 9/16 ins.
Main Valves—Type, piston; travel, 5 ins.
Setting—Clearance, ⅛ in. front and back ports; 1 1/32 ins. lap at front ports; 31/32 in. at back; 7/32 in. lead front; 9/32 in. lead back, constant.
Wheels—Driving, diameter outside tire, 73 ins.; driving material, cast steel.

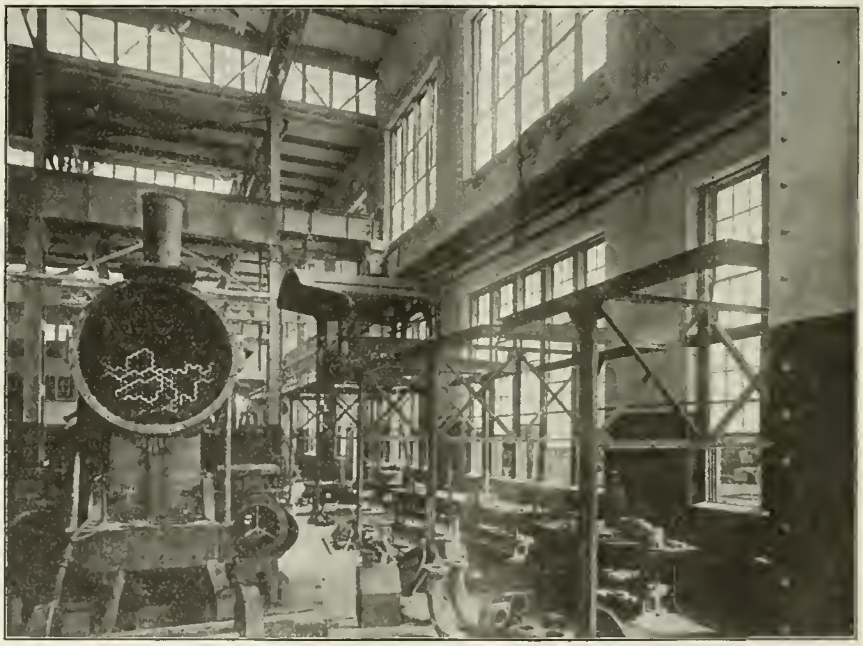
Place for Locomotive Cabs.

Ordinarily, the disposal of the cabs of locomotives undergoing repair in the shop is one of the troubles of the shop foreman. It is customary to drop them in the nearest available space, which is generally the passageway between tracks. This means an obstruction of space which is seldom too large for its legitimate purposes and, though probably not more than one in four or five locomotives under repair requires the removal of the cab, it seems sometimes as if the infrequency emphasizes the objectionableness of the necessity because if such removal were a regular part of every job probably some means for storing cabs would be part of the erecting shop layout.

In the new shops of the St. Louis & San Francisco at Springfield, Mo., the Arnold Company, by whom the shops were designed and constructed, have provided for the cabs. An arrangement has been adopted which seems worth consideration in the planning of any plant.

The locomotive erecting shop at Springfield is served by two cranes over the same floor, one of 100 tons and the other of 10 tons capacity. In the layout of the building it was necessary to provide for a half-bay at one end of the shop as a pocket into which one of the cranes could be run in order that the other might pass. This space, seemingly of little use in the general scheme, has been made to serve a very useful purpose, as shown in our illustration. It is a storage space for the cabs removed from locomotives under repair. Brackets or racks of channel section have been erected, five in number, in this half-bay, each large enough to support a locomotive cab, and with space between adjacent brackets wide enough to allow for the passage of the cables from the traveling crane. The space below each which in the engraving is shown as it was while the shops were in progress of construction, seem to be encumbered with benches, etc., which do not belong there. When this space is clear it is sufficient to hold a cab, so that the five brackets and the alternate, intervening spaces afford storage room for nine cabs, or about the number likely to need storage at any one time in a shop affording repair room for 35 locomotives, more than the present capacity of the shop.

By reason of the staggered arrangement of the storage space on and underneath the racks and the openings between adjacent racks, the presence of cabs upon the racks offers no hindrance to the handling of cabs into and out of the space below by the use of the crane. The brackets are also so arranged with reference to the shop tracks that cabs may be removed from above or below them and placed directly upon the shop trucks for transfer to any part of the erecting shop. The carpenter shop for cab work is located on the other side of the floor directly opposite the cab storage racks and is connected with them by shop tracks. The arrangement is clearly shown in the engraving, and not only the utilization of space but the general convenience are at once apparent.



METHOD OF STORING CABS, SPRINGFIELD SHOPS OF THE FRISCO.

Pension Plan on the N. Y. C.

The New York Central Lines have adopted a pension system which will go into effect Jan., 1910. It has been arranged that employees, on reaching the age of 70 are retired. If they have been continuously in the service of the company for at least 10 years immediately preceding their retirement they will be entitled to a pension. An employee who has been at least 20 years in continuous service and has become unfit for duty may be retired with a pension although he has not reached the 70-year age limit.

The amount of the pension is 1 per cent. for each year of continuous service based upon the average rate of pay received for the 10 years next preceding retirement.

The administrative board which has been appointed to manage the pensions is composed of the following officials of the New York Central Lines: Messrs. J. Cartensen, A. H. Smith, C. E. Schaff, A. H. Harris, R. M. L'Hommedieu, J. F. Deems, D. C. Moon, J. Q. Van Winkle. About 1,735 employees will be affected immediately. The pensions will cost about $500,000 a year.

Items of Personal Interest

Mr. T. J. McPherson has been appointed master mechanic of the Peoria & Pekin Union, with office at Peoria, Ill.

Mr. W. J. Dawson has been appointed car inspector at Brantford, Ontario, on the Grand Trunk, vice Mr. A. Reid transferred.

Mr. George H. Grone has been promoted to assistant purchasing agent of the Pennsylvania Railroad, with office at Philadelphia, Pa.

Mr. Edward Mahoy has been appointed traveling engineer on the Detroit, Toledo & Ironton, vice Mr. A. Powers resigned.

Mr. J. M. Mack has been appointed locomotive foreman of the Canadian Pacific at Arcola, Sask., vice Mr. S. M. Miller, transferred.

Mr. B. M. Shook has been appointed examiner in charge of the signal instruction car on the Pennsylvania Railroad at Altoona, Pa.

Mr. J. S. Rugg has been appointed locomotive foreman of the Canadian Pacific at Neudorf, Sask., vice Mr. H. A. Keswick, transferred.

Mr. Albert Powers, formerly traveling engineer of the Detroit, Toledo & Ironton, has resigned to enter the service of the Denver & Rio Grande.

Mr. C. J. Kennedy has been appointed master mechanic of the Denver, Boulder & Western, with office at Boulder, Colo., succeeding Mr. J. C. Sauer.

Mr. G. W. Lillie, supervisor car department of the St. Louis & San Francisco, has been appointed superintendent of the new Springfield, Mo., shops.

Mr. W. C. Davis has been appointed signal engineer on the Chicago, Great Western after serving on the Chicago & Alton, in that capacity for the past five years.

Mr. T. W. Jackman has been appointed master mechanic of the Montana division of the Oregon Short Line, with office at Pocatello, Idaho, vice Mr. Henry Carrick, retired.

Mr. B. Briard has been appointed purchasing agent of the Chicago-Great Western Railway Company, with office in Chicago, vice Mr. A. D. Ward, resigned.

Mr. A. Reid, heretofore car inspector on the Grand Trunk at Brantford, Ontario, has been appointed car foreman at Sarnia tunnel, vice Mr. J. Morrison, transferred.

Mr. Robert C. Burns has been appointed general air brake and steam heat inspector of the Pennsylvania under the general superintendent of motive power at Altoona, Pa.

Mr. J. N. Mowery, heretofore mechanical engineer of the Lehigh Valley at South Bethlehem, has been appointed assistant master mechanic on the same road with office at Auburn, N. Y.

Mr. H. A. Keswick, heretofore locomotive foreman of the Canadian Pacific, at Neudorf, Sask., has been appointed locomotive foreman at Field, B. C., succeeding Mr. A. E. Bennetts.

Mr. Samuel G. Thompson has been appointed assistant engineer of motive power on the Philadelphia & Reading Railroad. The positions of mechanical and electrical engineer are abolished.

Mr. W. A. Webb, assistant to the vice-president of the Colorado & Southern, has been made general purchasing agent of the road in addition to his other duties, succeeding Mr. F. W. Mahl.

Mr. Louis Lavoie, formerly on the personal staff of the general manager of the Intercolonial Railway, has been appointed general purchasing agent of the road with headquarters at Ottawa, Ontario, Canada.

Mr. F. D. Ferry, agent of the Louisville, Henderson & St. Louis Railway, has been appointed paymaster and purchasing agent of the same road, with office at Louisville, Ky., vice Mr. Florian Cox, resigned.

Mr. George W. Hulsizer, formerly with the Southern Railway at Washington, D. C., has been appointed signal engineer of the Chicago & Alton, with office at Bloomington, Ill., vice Mr. Geo. W. Davis, resigned.

Mr. F. C. Reed, who was lately appointed master mechanic of the Union Railway at Memphis, Tenn., has been transferred as master mechanic to McGehee, Ark., on the St. Louis Iron Mountain and Southern Railway.

Mr. Daniel H. Deteer, division master mechanic of the Philadelphia & Reading at Reading, Pa., has been appointed to the new position of general master mechanic on the same road and on the subsidiary lines, with office at Reading, Pa.

Mr. John Stewart, heretofore locomotive engineer on the Intercolonial Railway of Canada, has been appointed acting master mechanic of the Eastern Division with offices at Moncton, N. B., vice Mr. N. L. Rand, master mechanic, placed on the pension list.

Mr. Michael Corrigan holds the record for continuous service on the Erie. He began working for the company at Port Jervis in 1855. He has been acting foreman of the rail shop for forty-four years. He is a strong man yet, with a bright eye and a happy smile for everybody. He is good for another generation.

Mr. Edward Wobrien, general superintendent of the Vulcan Iron Works, Wilkes-Barre, Pa., has just completed twenty years service in charge of that company's extensive works. He looks good for twenty years more. He is keenly alive to every new improvement in machine shop appliances and practice.

Mr. R. S. Lovett, president of the Union Pacific Railroad, has been elected a member of the board of directors of the Baltimore & Ohio, to fill the vacancy caused by the death of the late E. H. Harriman, Mr. Lovett has also been elected president of the Oregon Short Line Railway Company.

Mr. H. B. Whipple has left the service of the New York Central to take a position with the New York Dock Company as assistant general superintendent. This new position is in the nature of railroad work as the place where he is located is a large terminal. Mr. Whipple's headquarters are in Brooklyn, N. Y.

Mr. J. H. Foster, of the Scranton Correspondence School, has just returned from a trip to Europe. He has arranged for the establishment of a branch office in London, England. The comments of the British press are extremely favorable to American educational methods, and the success of the British branch of the correspondence school is already assured.

Mr. Charles James, master mechanic of the Erie shops at Port Jervis is winning golden opinions from all sorts of railway men. He has been twenty years in the employ of the company and has climbed the ladder of promotion step by step, and is still young. He is a great believer in good railroad literature, and is a man of wide reading and experience.

Mr. John G. Neuffer has been appointed superintendent of motive power of the Chicago-Great Western Railway, with office at Chicago, Ill. Mr. Neuffer was superintendent of machinery of the Illinois Central and of the Indianapolis Southern up to the time that he took this position on the Chicago-Great Western, vice Mr. W. E. Symons, assigned to special service.

Mr. Robert B. Keller, technical instructor of apprentices in the Erie shops at Dunmore, Pa., is one of the most scholarly and accomplished railway men that we have met, in a long time. He is a graduate of Purdue University, where he took the degree of Bachelor of Science, under Professor Goss. He is a Kentuckian by birth, and is an all round mechanic, an eloquent speaker and a born teacher.

Mr. W. B. Bunnell, photographer of the D. L. & W. railroad, with offices at Scranton, is making a record for excellent work that would be difficult to surpass. His views of the extensive new Lackawanna shops at Scranton, are the perfection of the photographer's art. We expect to find room in an early number of RAILWAY AND LOCOMOTIVE ENGINEERING for some samples of Mr. Bunnells' work.

Mr. H. A. Gillis, who formerly was general superintendent of the Richmond Locomotive Works, for the American Locomotive Company, and who is now partner with the firm of Messrs. Fowler, Hardesty & Gillis, consulting engineers, Home Life Building, Washington, D. C., are the Southern representatives for the Wm. H. Wood Loco. Firebox and Tube Plate Co., of Media, Pa.

Mr. William D. Chaffee has been appointed general foreman at Rensselaer engine house, succeeding Mr. Thomas Mahar, promoted to master mechanic. Mr. Chaffee served his time as machinist in the West Albany shops of the New York Central Railroad. He has held various positions of importance along the line of this road and comes to Rensselaer from West Albany engine house, where he was the general foreman.

Mr. W. S. Haines, master mechanic of the Erie shops at Dunmore, Pa., is a fine specimen of the stalwart mechanic who is not afraid to put his hand to any piece of work that may be doing. He has managed to gather a fine body of men around him and he is very popular among them. He is a believer in the law of loving kindness and keeps his heart young and sweet by an occasional visit to the woods. He is a good shot. No furred or feathered denizen of the forest can escape him.

Mr. Thomas Mahar, formerly general foreman at the Rensselaer engine house of the New York Central, has been appointed master mechanic of the Harlem and Putnam divisions of the same road. Mr. Mahar served his time as machinist in the Oswego shops of the Rome, Watertown & Ogdensburg, now a division of the N. Y. C. He has held a number of prominent positions at various points and comes into the ranks of the master mechanics admirably well equipped for the duties he has to perform

Mr. Charles M. Hayes, second vice-president and general manager of the Grant Trunk Railway, has been elected president of the company, vice Sir Charles R. Wilson retired. The report of the board of directors says: Mr. Hays' work on the G. T. R. entitles him to the position of president.

Mr. Charles A. Wright has been appointed general foreman of the Harlem division of the New York Central, with headquarters at North White Plains. He served his time as machinist in the West Albany shops, and held various positions of importance in that plant, including the position of erecting shop foreman. He has also had large experience in engine house work, his previous position having been that of engine house foreman at the Rensselaer terminal. Mr. Wright succeeds Mr. John J. Brady, who is leaving the service of the company to take a position with the Heine Safety Boiler Company.

Mr. John Gorman has been appointed general foreman of the West Albany engine houses of the New York Central Railroad, succeeding Mr. W. D. Chaffee, transferred to the Rensselaer engine house. Mr. Gorman was brought up on the Rome, Watertown & Ogdensburg, having served his time as machinist in the Oswego shops. He filled every position of importance at that point, and was brought to West Albany a few months ago to take charge of the erecting shop there. Mr. Gorman has a host of friends along the line of the New York Central who will be much pleased to hear of his promotion.

For months the manufacturers of newspaper rumors have been busy announcing that Mr. Lucius Tuttle, president of the Boston & Maine, was about to tumble upwards to make room for a successor. On Nov. 17, the directors of the Boston & Maine proved what they and the business world thought of Mr. Tuttle by reelecting him president. Mr. Tuttle's term of sixteen years served as president of the Boston & Maine Railroad has meant steady progress and prosperity with constant spread of good feeling among the company's patrons and among the people of New England, whose voice and opinion are all powerful in preventing birds of prey from tearing the vitals out of corporations. Mr. Tuttle, with his genial smile and kindly word, is certainly in the right place.

Mr. Thomas P. McAvoy has been appointed foreman of one of the erecting departments in the West Albany shops of the New York Central Railroad, succeeding Mr. John Gorman, promoted. Mr. McAvoy served his time as machinist at the Corning shops at the Fall Brook Railway, now part of the Pennsylvania division of the N. Y. C. He was later transferred to the Avis shops and from there he went to West Albany as a piece-work inspector. The selection of Mr. McAvoy for the important position he will fill is one which stands out prominently as an illustration of what a young man with ability and force of character can do. One reason that Mr. McAvoy was selected for the position of piece-work inspector was the rapidity with which he could do all kinds of locomotive work, and while in that position his faithfulness and good judgment earned for him the promotion which he has received.

Mr. R. L. McIntosh, formerly assistant mechanical engineer of the Missouri Pacific Railway, has resigned his position to enter the employ of the Commonwealth Steel Company at their Granite City shops. The steel company is to be congratulated upon securing the services of Mr. McIntosh, who has made for himself a splendid reputation in the mechanical world. He was born in Milwaukee in 1879, graduated from the College of the City of New York in 1901 and served as special apprentice in the Susquehanna shops of the Erie Railroad. He worked as a mechanic in the West Milwaukee shops of the C., M. & St. P. Ry., and from 1901 to 1905 he was employed by the Northern Pacific as material inspector, engineer of tests, mechanical office assistant and shop assistant. He was made assistant mechanical engineer of the Missouri Pacific in 1906, which position he resigned to go with the Commonwealth Steel Company. Mr. McIntosh has many friends throughout the country and all wish him success in his new work.

Mr. H. G. Locke has been appointed travelling passenger agent of the Chicago Great Western, with office at No. 208 Old South Building, Boston, Mass.

Obituary.

Just as we go to press we learn with deep regret of the death of R. M. Van Arsdale, publisher and proprietor of the *American Engineer and Railroad Journal*. Mr. Van Arsdale was a strong and vigorous man but succumbed to a stroke of appoplexy on the night of Nov. 23.

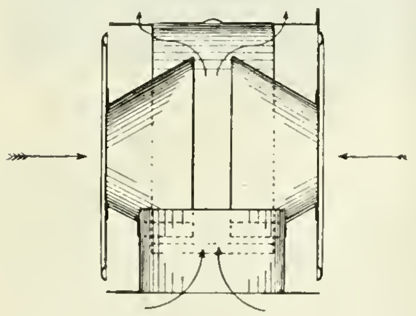
Improvements in Marine Turbines.

For more than two years there have been momentous discussions in the parliaments of England and Germany and in the daily and technical press of all countries in regard to the keen competition (especially between England and Germany) in the building of powerful and swift battleships and battleship cruisers; and in the press of this country much has been said as to the necessity for the United States maintaining its relative position in the power and speed of its naval vessels.

Bearing upon this subject, the Westinghouse Machine Company, at East Pittsburgh, have recently devised a new marine turbine engine and machinery, which, while costing less and weighing only about one-half as much as the turbine machinery successfully used on British vessels, will effect not only a great economy in fuel, but will also permit of much higher speeds in cases of emergencies. Were the United States Government to apply this type of marine turbine to the large 26,000-ton battleships for which contracts have only just been let, we could have the fastest battleships yet projected by any nation.

Gold's Cyclone Ventilator.

The ventilation of passenger cars is so intimately connected with the question of heating that it is only natural and logical that the more progressive car heating companies should be prepared to furnish ventilators to act in conjunction with the heating apparatus, and in this connection



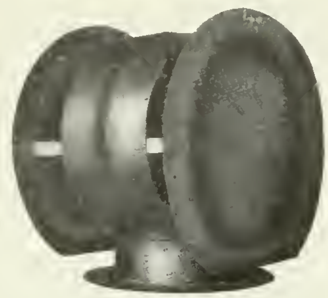
SECTION OF VENTILATOR.

the new ventilator recently brought out by the Gold Car Heating & Lighting Company, of New York, is of particular interest.

The new "Cyclone" ventilator, manufactured by this company, for educting air, is illustrated by the photograph, the opening into the car being 5 ins. in diameter, the outside diameter of the ventilator 10¼ ins., while the thickness is about 7½ ins. It is made of heavy galvanized iron, thoroughly riveted together so as to stand comparatively rough usage.

In order to determine the efficiency of this ventilator, tests were made similar to those conducted by the Master Car Builders' Committee in 1894. The effect of a moving train was produced by testing the ventilator in front of a Sirocco blower, with 16 in. outlet, the blower being driven by a motor, so that various speeds could be obtained up to 50 miles an hour. In order to make the test comparative with those of the M. C. B. Committee, above referred to, the ventilator was tested 3 ft. 2 ins. from the nozzle of the blower, the velocities of the air being determined by means of a Taglibue draft gauge, as the higher velocities were too severe for the anemometer, which could be used at lower speeds.

In making these tests the ventilator was secured to the side of a box in a similar manner to its location on the side deck of a passenger car. An anemometer was placed immediately inside of the opening and the velocity of eduction was measured by this anemometer. In a general way, it shows that at a speed of 49 miles per hour, the velocity of eduction was 1,530 feet, and at 30



CYCLONE VENTILATOR.

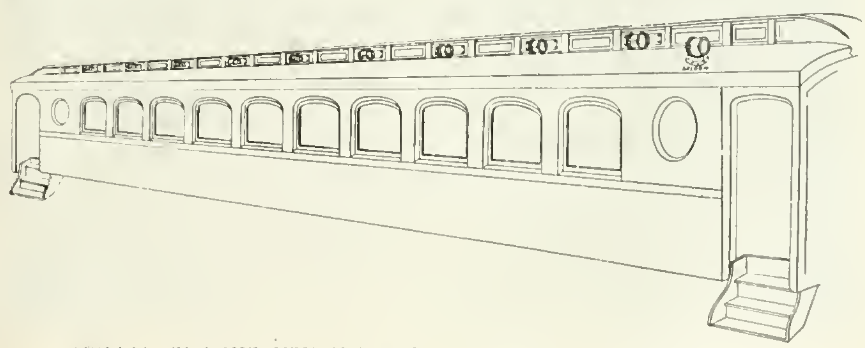
miles per hour the air was pulled out of the box through the ventilator at a speed of 930 feet a minute.

In order to obtain some comparison between the "Cyclone" and those that were tested in 1894, by the M. C. B. Committee, one of the type of ventilators giving the best results in that test was submitted to the same treatment as the "Cyclone" ventilator. From these tests it was evident that the velocity of eduction through the ventilator, with which comparison was made, was not quite two-thirds that of the "Cyclone" ventilator, and while the "Cyclone" ventilator was 5 ins. in diameter at the neck connecting to the deck of the car, the ventilator against which it was tested was only 4 ins. in diameter, and in determining the volume of eduction it seems fair to consider that if a 5 in. size had been available, the velocities would have been the same and the quantity of air removed would be in direct proportion to the areas of the necks of the two ventilators.

At 49½ miles per hour (which was the speed at which the M. C. B. Committee tests were made) there were 210 cu. ft. of air educated from the interior of the box or car per minute. With the 4 in. ventilator, with which this was compared, there were 87 cu. ft. per minute educted at 49½ miles per hour. If, however, we increase this value by the ratio of a 5 in. circle to a 4 in. circle, the volume of eduction would be 137 cu. ft. per minute, at 49½ miles per hour. It is evident, therefore, that the "Cyclone" ventilator has a capacity of fully 50 per cent. in excess of the ventilator against which it was tested. These tests gave 90 ft. per minute as the greatest volume of air removed from the interior of a car with a ventilator, at 49½ miles per hour, so the relative value of the "Cyclone" ventilator is evidenced from a comparison of these figures.

In connection with the heating and ventilation of passenger cars it was determined by one of the largest railroads in the country that an allowance of 1,000 cu. ft. of air per passenger per hour would be sufficient for satisfactory ventilation, and the removal of carbonic acid and other noxious gases. If we consider that the express train averages 40 miles an hour speed, we find that the capacity of the "Cyclone" ventilator is 170 cu. ft. per minute, or 10,200 cu. ft. per hour. On express trains the doors are not opened frequently, and entire dependence must be placed upon the ventilators. Thus, it is evident that one ventilator would be sufficient for ten passengers under the assumptions above made, or that a car seating eighty passengers would only require 8 ventilators.

The sketch shows that it is possible to place many more ventilators in the deck of a passenger car than would be absolutely necessary, and it also shows that these ventilators can be placed on a horizontal roof surface, as, for instance, the ceiling of the salon, as well as on the vertical surface of the sides of the deck, and in either case the efficiency of the ventilator, as an exhauster of air within the car, will be dependent upon the speed of the train. Under these conditions, there will be no difficulty in maintaining the interior of the car entirely comfortable and free from unpleasant odors or obnoxious gases, as the capacity of the ventilator is so great that there would be no difficulty in removing these from the car and keeping the air pure and healthy. This ventilator is also adaptable to refrigerator cars, and when so used gives the perfect ventilation so necessary for the preservation of fruits and vegetables.



GOLD'S CYCLONE VENTILATORS APPLIED TO A PASSENGER CAR.

Silvis Shops of the C., R. I. & P.

(*Continued from page* 523.)

type, but it is an excellent tool making factory. They do not attempt to make tools to compete with Billings & Spencer, or with L. S. Starrett, but they make all the special tools used in all the shops and they are unusually numerous and of highly varied forms. I have heard some one say that you could tell the character of work turned out of a shop by examining the scrap heap. I have haunted many a scrap heap to verify that saying but never succeeded. The tool room and the method of keeping small tools have always been my gauge as to the character of the shop. Certain geologists know so much about the rocks that they can tell from whence a rare stone has come, no matter how far away from its native formation it may be. Some students in London once made a severe test of Sir Roderick Murchison in this way. One of them found an odd piece of stone among ballast that had been discharged from a ship. It was taken to the great geologist with the tale that it had been found near London. That may be, was the comment, but it was brought from China in some ship.

SPEAKING FINGER MARKS.

I do not pretend to be much of a shop expert, but I think that were I led blindfolded into any tool shop in active operation I could tell approximately the output of the works and the character of the work done. My thoughts when standing in the tool room at Silvis were to the effect that the Rock Island Company was to be congratulated upon having G. W. Seidel as a shop manager. The finger marks of an excellent manager were imprinted everywhere in the number of special appliances for saving labor, upon the arrangement of tools, upon the orderly methods of carrying on the work, but nowhere were those finger marks more apparent than in the tool room.

Next neighbor to the tool room is the brass department, where nearly all the work in brass is done—well done, too. The place is filled with the best brass working tools and none of them were idle.

Then comes the rod department, followed by the tin, copper and pipe department, which takes me to the end of that side of the shop. It is not my purpose to comment on the various departments on the other side of the shop except those that for good reason left their mark upon my note book.

At the first stage of my return journey I pass the carpenter shop, the paint shop, the driver brake department, the grate department, and the steam pipe department, all evidently well managed, but none calling for special comment. Between the last three departments and the erecting pits a novelty drew my attention in the shape of tender truck repair tracks and tank racks. Like the engine repair tracks mentioned already, the tender repair tracks are raised about eighteen inches above the floor, while the tank racks are high enough to permit people or trucks to pass freely beneath. This department is near the middle of the shop and has accommodation for about fifty tenders with their trucks. The elevated tank racks make a remarkably good space-saving arrangement.

VIEW OF C., R. I. & P. FREIGHT YARD AT SILVIS, ILL.

MACHINE SHOP, SILVIS PLANT C., R. I. & P.

THE FLUE SHOP.

What came next was to me about the most interesting part of the establishment, although it was merely that region notorious for noise and turmoil—the flue shop. This one is different from most flue departments, being really a shop instead of a place for flue flagellating in a dark corner of the boiler shop. Nothing pays better than good light in a shop where mechanical operations are going on, and this one has all that could be desired. A look around this part brings the reflection—flue work forms an important part of the repairs done to the engines that bring their maladies to this hospital.

The first thing that struck me, however, was the absence of the flue rattler. Once upon a time, when I was an engine house foreman, they located a flue rattler under my office window. I have not yet forgotten the emotions that rattler aroused in my breast. It almost moved me to acquire the habit of swearing before I had it removed. On investigation I found the flue rattler at Silvis was located under the flue shop floor and run in water. It makes no distracting noise.

It is curious that no satisfactory substitute has been found for the flue rattler. In my time I have seen about half a dozen mechanical flue cleaners guaranteed to do the work better than a rattler and in half the time. I have also seen fragments of most of these mechanical cleaners holding conspicuous positions in scrap heaps.

Very good facilities are provided for handling the flues, and they are made the most of, for the small force turns out about 21,000 flues a month from two fires. There is a turn table in the middle of the shop on which a flat car loaded with flues from the rattler can be turned to tracks leading to the swedgers and furnaces, or to the annealing furnace. The latter holds a full set of flue ends.

THE BOILER SHOP.

The flue shop, although self contained, is part of the boiler shop, which fills the eastern end of the building. This shop has a good equipment of the most modern boiler making tools. The limestone regions traversed by most of the Rock Island lines give hard feed-water, which makes boiler repairs unusually heavy, hence the boiler shop is rather overworked. The arrangement of the tools seems to be all that could be desired. The hydraulic puches, shears, etc., are served by small lifting cranes, but the overhead cranes do all the heavy lifting and carrying. Pneumatic riveters are largely used, and that work is called "gun" riveting. All staybolts are driven by hand. Multiple punching is much used. The edges of new boiler sheets are all milled instead of chipped. There is a powerful Bement & Miles hydraulic riveter. The boiler shop seems to be filled with that make of tools.

BLACKSMITH SHOP.

The smithy is one of the best tool equipped shops I have ever visited. A novel feature of the place is small three-wheel iron wagons that are constantly in use transporting loads of small articles. Among the odd tools I noted were: An air squeezer for straightening brake beams, a portable pneumatic hammer for straightening coupler pockets, a home-made tool for punching bolt cotter holes, an attachment to an Ajax forging machine which makes bolts by two blows putting on the head, a machine that punches six holes and cuts off. There is a Williams & Co. eye-bolt binding machine that was highly spoken of. The spring making department has equipment resembling those seen in first-class spring making plants, and the processes are similar.

CONVENIENCES.

One impression received in going about these shops is that the tools have been located so that plenty of room is provided for moving the work. Although the tools seem crowded in some places, there is no difficulty in going about among them. Great care has been taken to provide the men working on the engines with portable tools for small jobs, that save trips to the machine shop. There are work benches beside each engine, and there are eight emery wheels in the erecting shop. Then there are several small lathes, for bolt work, with two speeds only that save many a step. A striking feature about the place is the number of raised racks that keep parts of equipment away from peoples' feet. Several Sellers' tool grinders are in evidence in these shops.

The B. F. Sturtevant system of heating and ventilating is used in this plant and gives great satisfaction.

SPECIAL LABOR-SAVING DEVICES.

The tools used and the methods of doing work are not much different from what one sees in any first-class well-managed railroad repair shop, but there are things to be found here that are not duplicated in any shop I know about. These are special tools and methods for saving labor and for quickening the operation. I have mentioned some of the special tools. Others are: An angle-cock grinding apparatus, a packing moulder, an oil burner for use in welding frames, air motor driven valve setting machine, hydraulic bolt puller, jig to form brake shoe, staybolt cutter, jig for babbitting driving boxes, crossheads, etc.; device for removing burrs from packing; multiple punches various forms of air hoists, machine for molding old lagging, making it as good as new; tool holder for boring side rods in drill press, air valve facing machine, chuck for reaming frame bolt holes, spindle drill press, flue swedging apparatus, air motor tester, sand papering machine, jig for cutting driving box plugs, multiple drill that drills at once four holes in eccentric then threads them, in next operation; portable shears for scrap dock and a variety of others that I missed seeing

I do not know if these appliances have been covered by patents, but most of them ought to be, for reasons explained in an article on page 437, of the October number of RAILWAY AND LOCOMOTIVE ENGINEERING.

POWER-HOUSE.

The power-house is a remarkably clean establishment and has every indication that tells about efficiency. Six Babcock & Wheeler boilers supply steam to two Buckeye engines, which are connected direct with electric generators. The pneumatic machinery used extensively in the boiler shop obtains vitality from two Ingersoll-Sargent air compressors; while the hydraulic appliances freely used receive force from two Worthington pumps.

THE TOOLS.

The tool equipment of the shops makes a list too formidable for one day's study and observation. The shop list begins with four Niles driving wheel lathes that are kept busy even with the high speed steel tools slicing away as they do. Then there is a Pond car wheel lathe, a special locomotive axle lathe, a double car axle lathe, a bolt threader, then a long array of lathes of many kinds, common lathes, axle lathes, turret lathes, gap lathes, portable lathes and others counting up 56 total. Then there are 13 planers, 12 boring mills, 27 drill presses, 21 emery wheels, 13 grinders of various types and 145 other tools, making a total of 287.

Various forms of Niles-Bement-Pond tools indicate that Jas. K. Cullen must have been very active when the selection of these shop tools was under consideration, for he got the lion's share. Some of Seller's tools are prominent, and most of the bolt cutters are from the Acme Machinery Company of Cleveland. Identifying different makes of tools is found no easy matter during a flying visit. Such tools as the Bullock boring mills stand out prominently enough for recognition, but many are lost in the crowd.

The shafting is kept polished by vulcanized fibre disks that run along in odd little journeys that lap up all causes for rust or corrosion. It is curious to watch these disks rambling about like robins chasing grasshoppers.

A neat way of overcoming a difficulty was carried out on one of the tools. They wanted a radial drill to run at high speed and reached the purpose by putting an electric motor on the top of the tool.

Power transmission by electricity is largely used in the shops, most of the machinery having been supplied by the General Electric Company. There are some motor and electrical appliances that were furnished by the Crocker-Wheeler Company and by the Westinghouse Electric Company. The installment was arranged by Mr. L. M. Pomeroy, and is highly satisfactory. "Cela va sans dire" any Frenchman would exclaim who knew the painstaking habits of Mr. Pomeroy.

After the works were put in operation complaints were heard that the power transmitted by the electric machinery was insufficient. To ascertain the truth of these rumors Mr. Liley, mechanical engineer, carried out a series of tests, plotting the degree of power reaching the tools at different hours of the day. That silenced the species of criticism that is apt to be raised upon all new, novel methods, no matter how much better than the old ones they may be.

EFFECT OF GOOD ORGANIZATION.

Mr. Seidel happened to be absent the day I visited the shops, but I found a remarkably good guide in Mr. Brown, draughtsman of the shops, who has enjoyed remarkably wide experience for a young man, and has the capacity for profiting by experience. Mr. Seidel is not one of the superintendents who think that work would be paralized if they failed to show a frowning visage in the shops for a single day. The true mark of executive ability is to organize the business so that it will run itself, a condition conspicuous in this place.

The officers who help Mr. Seidel to keep this ship of industry moving are: J. E. Kilker, assistant superintendent; C. B. Daily, general foreman; W. B. Wood, machine shop foreman; W. M. Wilson, foreman boilermaker; George Tubbury, foreman blacksmith; F. J. Glover, chief shop engineer and electrician; J. M. Whalen, round-house foreman. I was indebted particularly to Mr. Whalen for information about the place.

The Armstrong Brothers Tool Company, of Chicago, commonly called the "tool holder people," have just issued their Catalogue No. 18, which may be had by anyone who writes to them for a copy. It is needless to say that they have tool holders for turning, planing, boring, slotting, threading, cutting off and drilling metals. This catalogue contains some recent additions to their line of goods. There is on pages 68 and 69 of this catalogue an illustrated description of their automatic drill drifts. These drifts are practically hammer and drift in one. When using, the point of the blade is inserted in the slot of the drill socket and the handle is forcibly driven up the blade, until it strikes the butt end of drift blade. The blow is usually sufficient to remove the most stubborn drill. They have also the plane drill drift on which a hammer is used. Their standard reversible ratchet drills shown on catalogue page 61 are such that, the combination includes a sleeve ratchet for Morse taper shank drills, square taper socket to fit it and a short spindle with feed screw by means of which the ratchet can be converted into a boiler ratchet or adapted to receive square taper shank drills.

Funny Ones on the Road.

"That poison-faced moonlight master mechanic" was the pleasant reference made by Mr. Fogarty, locomotive engineer on the Alkali South-Western, when he had occasion to speak of the gentleman in charge of the round house at night. Whether or not that highly esteemed functionary was possessed of a repulsive visage, matters little. In the discharge of his official duties, most of which were purely routine, he seemed to Mr. Fogarty not only to be entirely responsible for his highly objectionable face, but to be possessed of considerable "nerve" when he assigned engine 278 to Mr. Fogarty for train 47, then 35 minutes late, on the evening in question.

This and other incidents are narrated in a very amusing booklet called "Midnight on the Alkali South-Western," which has been issued by the Ralston Steel Car Company, of Columbus, Ohio, for the purpose of furnishing a moment of relaxation to the reader. Smoky Hall, the battleship fireman, disparagingly compares his hard lot on the Alkali road with the more or less happy times experienced on other lines where the "eagle-eyes" made some sort of pretension to being real engineers, and Spotty Murphy, the switchman, avers that when he is unfortunately compelled to listen to the talk of a "bum scoop," he experiences pain. There are eight or ten characters portrayed with humorous exaggeration in the little book, which is cleverly illustrated in pen and ink sketches, by Mr. C. D. F. Ball. The characters reveal themselves in their own dialect. They use the language of the road, and their emblematical talk is rich. The little book is free for the asking, and a post card request will bring you something that you can read with a smile and then fit on the "other fellow."

Corrugated Firebox.

Those who are anxious to examine the kind of firebox and tube plates made by the Wm. H. Wood Locomotive Firebox Co., of Media, Pa., can do so by a visit to the Baldwin Locomotive Works at Philadelphia, Pa. Mr. Wood has a complete firebox on exhibition at that place. On page 452 in the October issue of Railway and Locomotive Engineering may be found a very full description of the corrugated firebox designed with the intention of reducing staybolt breakage, and incidentally increasing the heating surface of the box.

Manometers and Gauges.

In former times the word manometer was used to designate that which we now call a pressure gauge. Manometer really means a "rare measurer," and the name was applied to an instrument delicate enough to register the pressure of the blood in the arteries and so the earliest fluid pressure gauges were called manometers, and, indeed, this name is still retained in South America and on the Continent of Europe. The ordinary steam gauge on a locomotive is nevertheless a manometer, for the accurate measurement of fluid pressures is a wonderful thing, even if we can no longer use the Greek word to signify its being rare.

The well-known Utica Steam Gauge Company, of which Mr. A. G. Wood is president, have for many years been one of the most successful makers of gauges for showing boiler pressures, though they made use of a principle quite different from that employed by Bourdon, the inventor of the earliest form of metallic manometer. The Utica gauge causes a needle to move over the face of a dial in accordance with the slight bulging or sinking of what they call a capsular spring. The capsular spring is briefly two corrugated disks made of a special bronze composition containing a liberal percentage of phosphorus. The disks are connected by a retaining band folded over the edge of the disks, so that the capsular spring looks like a little hollow case with corrugated surfaces. The capsule, for such it really is, is attached firmly at the center of the under disk to the connection through which steam reaches the space between the disks. The corrugations of each disk and the hinge-like retaining band permit the whole capsule to bulge up in the center more or less when inflated with steam at higher pressure or lower pressure. The movement of the center of the capsule up and down in accordance with the fluctuations of the steam pressure within it is taken advantage of to operate the gauge needle. Between the needle and the capsular spring is a series of levers, a radial rack, a little pinion on the needle shaft and a light spiral spring to bring the needle back to zero and to take up any back lash as the pressure falls. This is briefly the mechanism of the Utica steam gauge, and it has given entire satisfaction during the many years it has been on the market. The later forms have, however, an easy and quick method of adjustment whereby the free end of the lever resting on the capsule can be set in the correct position without taking out any of the gauge mechanism.

The capsular principle has been up to the present time the distinctive feature of Utica gauges, and it is still retained in the improved form. The company with a view of giving to steam users the choice of types have now taken up the manufacture of Bourdon gauges as well, and have made an improvement on the method of mechanical construction usually employed.

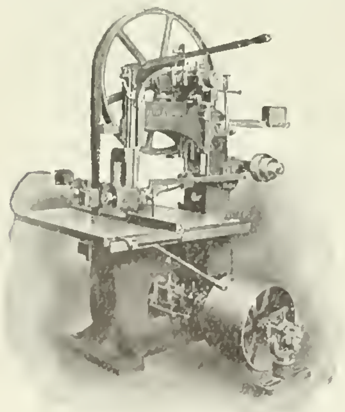
The Bourdon principle is briefly, a flattened, seamless brass tube bent in the form of an open ring, the two ends being perhaps a couple of inches apart. The tube is supported below so that equal arcs of the tube rise up from this support on each side. The Bourdon ring is carefully fitted and is passed through a suitable opening in the otherwise solid support or socket. The ring is, to use a shop expression, "sweatted" in position and practically becomes one with the socket as it is put in when the socket is hot. The method of introducing steam into the tube is as ingenious as it is simple. A small hole drilled up through the socket enters the lower side of the flat tube and when in use steam enters from below and fills the tube.

The advantage of this method of construction is that the tube is all one piece and has no joints to break or become loose, where it is held by the socket. Only one wall of the tube is pierced for the entrance of steam and the whole mechanism is entirely independent of the case and can be taken out when necessary by simply unscrewing the steam connection below the socket. The frame for holding the levers, rack and pinion is fastened to the socket, and all the spindles and bushings are made of hard German silver in order to resist wear. The teeth of the segment or radial rack are reinforced so as to give a wide bearing. The link from the left-hand end of the Bourdon ring is folded back on itself where it meets the links from the right-hand end and in this way a double bearing is afforded for the small steel pin which forms the pivot between them.

The Utica Steam Gauge Company, while maintaining the excellence of the capsular principle have simply added another string to their bow by bringing out the Bourdon gauge with improvements which are intended to facilitate its use and prolong its life. A railway company in exercising its preference for one or other form of gauge has the satisfaction of knowing that in either case the workmanship of the gauge selected is of the best, and that both forms have been improved in those small details which mean so much to the user, and which help to keep maintenance and repair charges down to a minimum while insuring accuracy and durability in operation.

Band Rip Saw.

The machine shown in our illustration represents the J. A. Fay & Egan Company's band rip saw for general work. It is equally efficient in ripping light and heavy material as it runs a very thin blade at a high speed, and these are the essentials for the rapid and economical production of fine lumber. The high speed is obtained by the application of Fay & Egan's patent knife-edge straining device and solid lower wheel. The machine has capac-

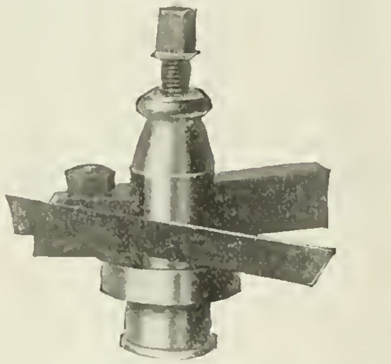


BAND RIP SAW.

ity for ripping material up to 24 ins. wide and 12 ins. thick.

In the descriptive circular, recently issued by the manufacturers, they illustrate this machine with motor drive. This matter of motor drive applies to all the five hundred different woodworking tools made by this concern. For further information you are requested to write the company Cincinnati, O., and they will be pleased to send you descriptive circular by return mail.

Lang's tool holder for locomotive shops is an ingenious way of providing a method of securing a lathe tool properly in place With this tool holder a triangular cutter is used which is about twice the size of the usual square cutter. It is intended to be a more satisfactory substitute for the large solid forged tools, where heavy roughing work has to be done. Being



LANG'S TOOL HOLDER.

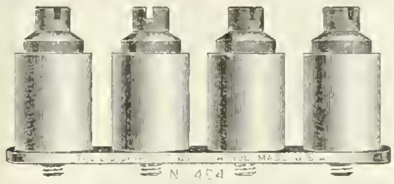
efficient in this class of work it is also very satisfactory for light finishing cuts. The triangular shape of tool gives a good cutting edge, with large heat radiating surface, and the clearance is all that can be desired. The holder has a V-shaped trough if one may so say, in which the triangular cutter or tool is set and held. The cutter is made in rights and lefts and special shaped shanks are provided for use in vertical boring mills. Steel of triangular sections can be bought as well as other shapes and as it weighs less than the square sections, its cost is less. Our illustration shows the method of clamping, and the support under the cutting edge runs out well under the tool. The G. R. Lang Company, of Meadville, Pa., are the makers of this useful shop device and will be very happy to send a copy of the illustrated folder and price list to any one who is interested enough to write to them for a copy.

Turbine Locomotive.

What is described as a steam turbine electric locomotive is being built at the North British Locomotive Works in Glasgow. The new machine has a boiler of the ordinary locomotive type, which is fitted with a superheater, and coal and water are carried in the side bunkers and side water tanks, steam from the boiler is led to a turbine of the impulse type running at a speed of 3,000 revolutions a minute, to which is directly coupled a continuous-current, variable-voltage dynamo or generator. The dynamo supplies electrical energy of from 200 to 600 volts to four series-wound traction motors, the armatures of which are built on the four main or driving axles of the locomotive. The exhaust steam from the turbine passes into an ejector condenser, and is, together with the circulating condensing water, delivered eventually to the hot well. A fan is used to provide the necessary draught for the furnace as the exhaust steam is condensed. The turbine does not require any internal lubrication so that this water of condensation is free from oil. The whole is carried on a strong under frame which rests on two 4-wheel trucks. Each truck carries two of the four motors already referred to.

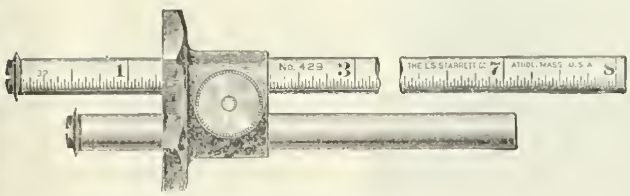
Small Tools.

There are some cleverly devised and neatly made small tools to be had from a well-known manufacturing company in Athol, Mass. One of their specialties is a carpenter's scratch gauge. The head of this gauge is made from case hardened steel with octagon shaped edges. Two 5-16 in. bars, one plain, 4 ins. long, and one graduated in 32nds of an inch, 8 ins. long, with sharp rotating cutters on the ends, slide through the head. Either is adjustable in relation to the other, and may be used to make two marks at once, or by slipping one back into the head out of the way, the other bar may be used for single lines.



TOOL MAKERS' BUTTONS.

Another useful device suitable for a modern railway shop where time-saving devices jigs, etc., are constantly being made. We refer to Toolmakers' buttons with screws and washers. These Buttons are hardened and ground to standard size, 4 x ½ ins., and are used to locate holes to be chucked and bushed for jigs where absolute accuracy is required. The method of using them is to lay out the jig piece, prick punch, drill and tap for button screws. Fasten on the buttons, strap the pieces to an angle iron and place it on a surface plate, where by aid of a surface gauge, the buttons, with holes larger than the screws, are brought to the desired location. Next strap the angle iron with button pieces to lathe face plate, bringing one of the buttons to run true with the center. This done, remove the button and chuck and ream the hole.



CARPENTER'S SCRATCH GAUGE NO. 429.

Write to the L. S. Starrett Company at the address given above if you are interested in knowing more about these tools.

Zeal Without Knowledge.

Mr. E. P. Ripley, president of the Santa Fe, in his speech at the Railway Business Association annual dinner repeated the saying that, "when God sent a current of common sense through the universe most of the reformers wore rubber boots and stood on glass." Our troubles, he continued, are with this class—well meaning men who have zeal without knowledge, and enthusiasm without sanity. These we may not reach but the great mass of the solid and substantial citizenship may perhaps be induced to stop and consider whither we are drifting and whether this greatest of the nation's industries is being fairly treated.

What they call "service," is one of the chief characteristics of the Dodge Manufacturing Company (power transmission engineers and manufacturers of the Dodge line of transmission machinery, Mishawaka, Ind.). This ability to render service is largely based upon the maintenance of stores and warehouses in many of the principal cities of the country, in connection with expert engineering departments, which makes possible immediate deliveries and the solution of knotty transmission problems. From time to time the Dodge people have enlarged and extended this service until it now takes in eleven points. Boston, New York, Brooklyn, Pittsburgh, Philadelphia, Cincinnati, Chicago, St. Louis, Minneapolis, Atlanta and London, England. The newest branches, those at Minneapolis and Atlanta will serve the two-fold purpose of local stores and distributing stations for the Northwest and the Southland. The Minneapolis store is at 202-204 Third street South, and the warehouse at 312 to 320 First street North. The company's agency arrangement with the Minneapolis Steel & Machinery Company has been discontinued. Mr. Burke Richards, former resident salesman at Cleveland, Ohio, has been promoted, and is now manager of the Minneapolis branch. The Atlanta branch and warehouse is at 54 Marietta street. Mr. S. L. Dickey, resident salesman at that place has been appointed manager, but no change has been made with any of the agency connections in the South.

Union Pacific Bureau of Information.

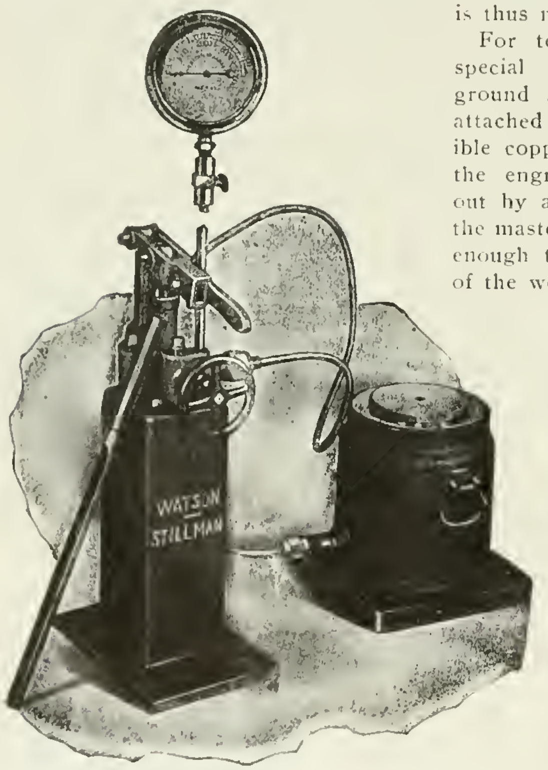
The Union Pacific Railroad management are organizing a railroad college on the lines described in our issue of August last. The instruction department goes by the modest name of the Bureau of Information.

Employees in every department of the service will be given free instruction by experts. The three objects aimed at in establishing this school are assisting employees to assume greater responsibility, increasing the knowledge and efficiency of employees and preparing prospective employees for the service.

"The new educational bureau will give to the men in the service of date practice from leading authorities in opportunity to qualify, without any expense to themselves, for higher duties in the service," said Vice-President Mohler. "The educational feature is from a practical standpoint, the conditions in modern operation are constantly changing, and in this respect the men will get up-to-date practice from leading authorities in each of the various departments."

Calibrating Apparatus.

The bursting of machine parts and fittings from excessive fluid pressure is usually accompanied by considerable danger, expense and delays for repairs. This is especially true with the extremely high working pressures under which liquids and air are often used. It is, therefore, quite important to know the pressure in any apparatus using these sources of power, and for this reason gauges should be calibrated at regular intervals. Under the higher hydraulic pressures it is frequently the case that the same gauge will show different percentages of error at different pressure readings, and these can be compensated for after ascertaining the true pressure only by comparing with a "master" gauge of known accuracy or by loading with a known pressure.



IMPROVED GAUGE CALIBRATING APPARATUS.

The apparatus which we here illustrate performs these two functions of testing by comparison with a master gauge and of testing the accuracy of the master itself.

For the first, only the part on top of the stand is required. This consists primarily of a cross made of hydraulic bronze. The gauge being tested, which may register any pressures up to 16,000 lbs. per sq. in., and the master gauge are attached to the front and back ends of the cross respectively. At the left is a crank-operated screw displacement piston, by means of which the desired pressure may be produced within the pressure chamber. A suitable stuffing box prevents leakage past the piston. To the right is connected a stop valve and filling cylinder. This permits some of the liquid to be withdrawn from the pressure chamber before removing the gauge being tested and it also permits filling after a gauge is put on. There is thus no danger of spilling the oil.

For testing the master gauge the special weight-loaded hardened and ground steel piston and cylinder are attached at the right by means of flexible copper tubing, which is shown in the engraving. These parts are cut out by a stop valve when not testing the master gauge. The cylinder is long enough to have the center of gravity of the weight below the center of support. When the weights are revolved the friction due to lifting the weights is practically eliminated. The apparatus is made by the Watson-Stillman Company of New York.

The American Locomotive Company of New York have recently issued Bulletin No. 1, illustrating and describing their new type "S" short wheel base electric motor truck with steel plate side frames, for city service. The important advantage claimed for the plate frame form of construction is the reduction in weight thereby effected. Compared with a bar frame truck of the same capacity, this type of truck is said to weigh fram 1,000 to 1,500 lbs. less. In this Bulletin are also illustrated and described two new and interesting adjustable swing link devices, which are applicable to any of the builders' types of trucks, with swinging bolsters. One of these devices is arranged for adjusting the height of the car body; while the other permits of the same adjustment and also of changing the angularity of the swing links to suit the service conditions and give the easy riding qualities to the car. The company will be happy to send a copy of this bulletin to anyone who is interested enough to apply to them direct.

A customer of the Pennsylvania Forge Company, Philadelphia, Pa., had been using carbon dies on very severe service for hot forging and drawing work. These dies had given an average service of two days, breaking from crystallization and from other defects developed in the steel. They decided to try vanadium steel in the hope that the remarkable properties of vanadium in retarding or eliminating crystallization would give the dies a longer period of usefulness. Some vanadium steel was purchased from the Bethlehem Steel Company and vanadium steel dies were made therefrom. We have been informed by the Pennsylvania Forge Company that the dies were used in the same manner, by the same man, on the same machine and for the same service as the carbon dies. The have been in use over four months.

The 30th annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies building, No. 29 West 39th street, New York, Dec. 7 to 10. The entire social entertainment will be in charge of the members resident in and about New York, under the immediate direction of a local committee appointed by them, of which Mr. William D. Hoxil is chairman.

The General Electric Company, of Schenectady, N. Y., have sold to the Southern Railway two of their latest type of gas-electric motor cars. These cars are equipped with standard commutating-pole railway motors of 100 h. p. Two of these motors are on the forward truck, giving a motor capacity of 200 h. p. to each car. The current is supplied from a 600-volt generator, which is direct coupled to an 8-cylinder gas engine in the forward compartment. A controller similar to that used on an ordinary trolley car is conveniently placed for the operator, and through this the current passes from the generator to the motors. Combined straight and automatic air brakes are provided with the usual valves and accessories. The car bodies are of steel, about 55 ft. long, with a seating capacity for 52 passengers. There are both rear and center entrances, thus furnishing a convenient means of dividing the two classes of passengers as required in the South. The cars have electric light. The order for these cars was placed with the General Electric Company after a thorough test of this type of car between Manassas and Strasburg last summer.

The Houghton Line is the name of a little booklet got out by E. F. Houghton & Company, of Philadelphia. This is the firm that manufacture the "Vim" leather for making air brake leather packing where the cupping is done in a very scientific way. The booklet explains about the Vim leather, but it contains a lot of very readable matter in the form of proverbs and some pleasant argumentative little essays on interesting subjects. The Houghton people will send you a copy if you write to them for one. Their address is station "Q," Philadelphia, Pa.

We are informed that the officers of the Pressed Steel Car Company and Western Steel Car & Foundry Company for the Southern district, will be removed from Atlanta, Ga., to the Munsey Building, Washington, D. C., Mr. I. O. Cameron, manager of sales is in charge of the offices.

The Monarch Emery and Corundum Wheel Company, of Camden, N. J., has been changed to the Monarch Grinding Wheel Co. The change of name will make no change in the company's policy which has been to make the best wheel on the market.

We are informed that the British Corporation for the Survey and Registry of Shipping at Glasgow, after exhaustive tests, have sanctioned the use of the Thermit Process for repairs to sternposts, lower portions of rudder frames and all work of a similar character.

When we cease to look back on any experience as too hard, we have made a decided step in wise adjustment to life. —*Dresser.*

New Book on Valve Gears.

We are pleased to announce the publication during December, of a new work on "The Valve-setters Guide," from the pen of our associate editor Mr. James Kennedy. The work will embrace a comprehensive treatise on the construction and adjustment of four of the most popular locomotive valve gears used in America, viz.: the Stephenson, Walschaerts, Baker-Pilliod and Joy valve gears. Mr. Kennedy has had an extensive practical experience in the construction and repair of locomotives, and is an acknowledged expert on the subject of valve gearings. His style of writing is such as recommends itself to the beginner as well as to the advanced student. The book will be of convenient size, substantially bound, and sold for fifty cents a copy. Orders will now be received at this office for first edition [illegible]ch will appear early in January 1910.

The Lehigh Valley Railroad have for some time past been equipping their sleeping and parlor cars with electric lights. These include berth lights in the sleeping cars. Dental lavatories and other modern conveniences are also being provided. Some of these cars are now in operation, and as soon as others are equipped, they will be put in service.