Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV. No. 1 — NEW YORK, JANUARY, 1921 — Single Copies, 20 Cents. Subscriptions, $2.00 Per Year.

Published Monthly by Angus Sinclair Co., 114 Liberty St., New York.
Entered as second-class matter January 15, 1902, at the post office at New York, under the Act of March 3, 1879.

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Vol. XXXIV | 114 Liberty Street, New York, January, 1921 | No. 1

Flanging Press and Waste Reclamation

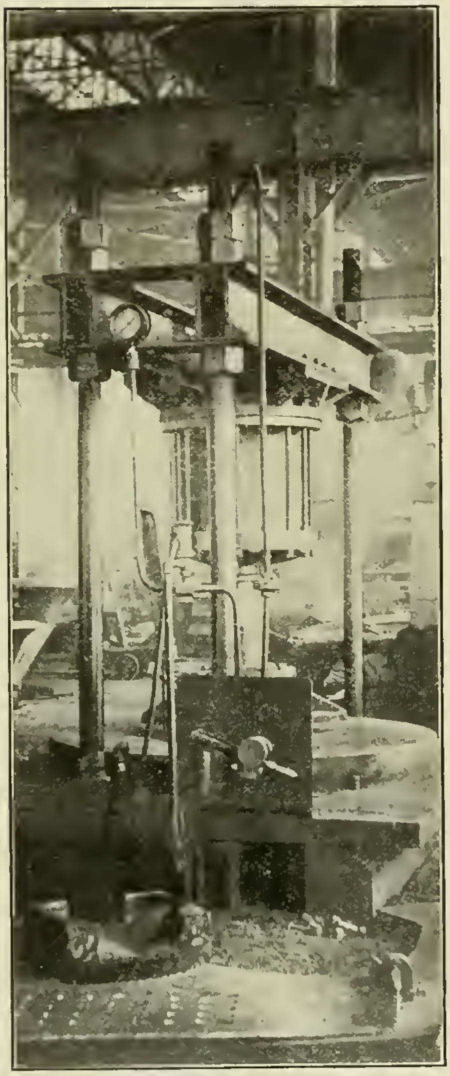
In the boiler shop of the Delaware & Hudson Co. at Watervliet, N. Y., there is a home made flanging press that is doing very efficient work and which has bed of concrete 3 ft. thick. Near the edges at the ends are four uprights each 4½ in. in diameter and 12 ft. 6 in. long to the top of which the cross rail is attached by nuts the ends. At the center of the cross rail there is a heavy casting bolted to the side and beneath this is bolted the cylinder which has an internal diameter of 20 in.

FLANGING PRESS IN THE DELAWARE & HUDSON COMPANY'S SHOPS, WATERVLIET, N. Y.

done entirely away with hand flanging on the standard work. The base of the machine consists of a cast iron plate measuring 10 ft. by 8 ft. by 4½ in thick set on a screwed upon the uprights. The cross-rail is built up of four 12 in. beams set in pairs with top and bottom cover plates with cross plates tying them together at and a piston stroke of 15 in. The piston rod is 7 in. in diameter and has the die bolted to the lower end. Hydraulic pressure of about 80 lbs., per sq. in. is used.

The heating furnace is located about 15 ft. from the press and has a floor area of about 8 ft. by 9 ft. It is fitted with doors front and back operated by air cylinders at the corners and is adapted to burn oil, using burners and appliances supplied by the Railway Materials Co.

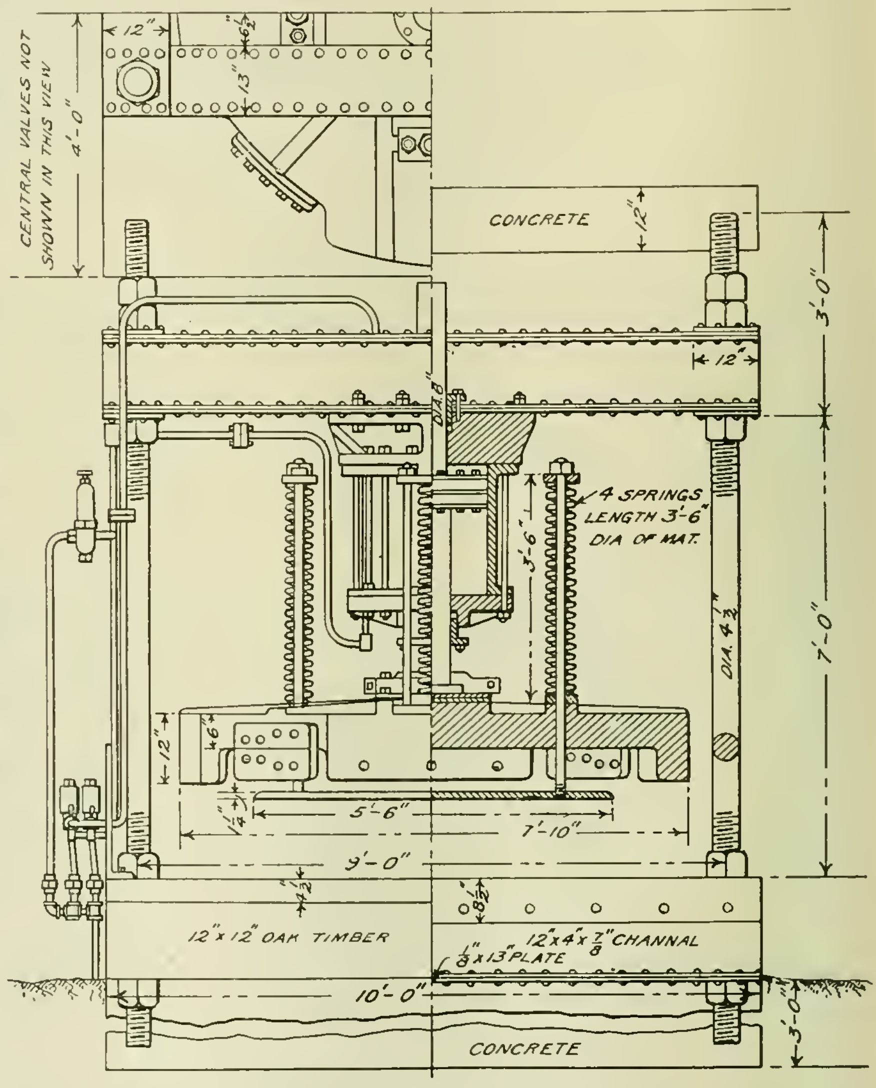
Waste renovation is one of the re-



SIDE VIEW OF FLANGING PRESS

sources of the shops. The plant in which this is done is a very simple affair with only two pieces of power driven machinery. The waste is shipped in from all points on the road and arrives in almost every conceivable state of badness. It comes in barrels and the first thing is to take it out and shake it over a dirt collecting box, where only the loosest particles of dirt and grit are shaken out. It is then dropped into an oil tank having a steam coil at the bottom, which is made to maintain a temperature of about 90° Fahr. The waste lays in this tank for about 10 minutes and during that time it is being forked over, thus loosening the fiber and allowing the dirt and grit to fall to the bottom. The waste is then forked over into a vat with a slatted bottom and allowed to drain for about a half hour. This vat is also fitted with a steam coil and the oil that drains out is clean and can be drawn off ready for use on the road. This drainage amounts to about 200 gallons of oil a month.

After the waste has drained it is thrown into a third vat from which it is taken and shaken out by hand over the first vat and then thrown into barrels as waste saturated with oil and is prepared dope ready for use. This waste saved runs from 60 to 75 barrels per month. The record of one month being 3,765 lbs. of dope used in passenger service and



SECTION VIEW OF FLANGING PRESS, DELAWARE & HUDSON COMPANY SHOPS. WATERVLIET, N. Y.

4,885 lbs. used for freight. This covered all of the passenger requirements of the road. Whereas before the plant was installed the requirements were 200 bales of waste and 100 bbls. per month.

In addition to this drainage method of saving the oil, there is a centrifugal refiner built by the Oil and Waste Saving Machine Co. which is an adjunct of the Galena Oil Co. of Franklin, Pa. This machine carries a central revolving chamber with a lining of burlap and filled with sawdust. This serves to reclaim the dirty oil that lies filled with settlings in the bottom of the first heating tank. This fills up and requires cleaning at the end of each two barrels of oil cleaned.

The other centrifugal machine is used as a washer and will care for from 50 to 60 lbs. at a time. This is put in with 8 lbs. of vaseline and 8 lbs. of soapine, and it is then filled with water enough to cover the waste. After the steam is turned on it requires about an hour to wash this waste so that it is ready to use as coach wiping waste, with the exception of the drying, which is done in a tank filled with steam coils and a natural draft.

The rest of the equipment consists of a steel storage tank for waste that is ready for shipment. This plant employs two men and the output is that given above which represents a total saving of what, without the renovation, would have to be thrown away.

New Pacific and Santa Fe Type Locomotives for the Union Pacific System

The first Pacific type locomotives built by The Baldwin Locomotive Works for the Union Pacific System were designed in 1903. They were included in a group of locomoitve designs prepared for the Associated Lines and were among the heaviest Pacific type engines built at that time.

This design continued the standard until 1911, when a heavier locomotive of the same type was built. This design in turn was subsequently revised to include a superheater and other features intended to improve locomotive economy and efficiency, and a group of locomotives constructed in accordance with these modern plans has recently been built for the Union Pacific Railroad by The Baldwin Locomotive Works.

PACIFIC 4-6-2 TYPE LOCOMOTIVES FOR THE PACIFIC SYSTEM. BALDWIN LOCOMOTIVE WORKS, BUILDERS.

The following table contains the principal dimensions of the three classes built for the Union Pacific and it also includes for purposes of comparison corresponding data for the light Pacific type locomotives built for the United States Railroad Administration:

Date	Cylinders	Drivers	Steam Pressure	Crate Area	Water Heating Su-face	Super-heater Surface	Wt. on Drivers	Wt. total Engine	Tractive Force
1903	22" x 28"	77"	200 lbs.	49.5 sq. ft.	3048 sq. ft.	......	141,000	222,000	29,920
1911	25" x 28"	77"	200 lbs.	70 sq. ft.	4860 sq. ft.	......	164,800	265,500	38,620
1920	25" x 28"	77"	200 lbs.	70.4 sq. ft.	3998 sq. ft.	815 sq. ft.	167,700	278,000	38,640
U. S. R. A. STANDARD ZED LIGHT PACIFIC									
1919	25" x 28"	73"	200 lbs.	66.7 sq. ft.	3341 sq. ft.	794 sq. ft.	167,100	275,770	40,750

The weight of the latest Union Pacific design is only slightly greater than that of the U. S. R. A. engine. The increased tractive force of the latter is due to the use of 73-in. drivers, while its smaller water heating surface is explained by the fact that it has a combustion chamber boiler with tubes 19 feet in length, while in the Union Pacific engine the combustion chamber is omitted and the tubes are 22 feet long.

The main frames of the Union Pacific locomotives are of open hearth cast steel annealed, braced by cross-ties of ample strength. The Commonwealth rear frame cradle is applied. The cylinders are 25 in. in diameter and are bushed with gun iron. The piston valves are 15 in. in diameter with a 6½-in. travel and a ¼-in. lead; the steam lap is 1¼-in.; the exhaust clearance being ⅛-in. The valve motion is Walschaerts controlled by a Ragonnet Type B power reverse. Drifting valves are also applied.

The front of the firebox crown is supported on two T-iron crown bars. The superheater is composed of thirty-two elements. The driving axles and crank pins are heat-treated and the axles are hollow bored.

The tenders of these locomotives are of the Vanderbilt type, equipped with coal pushers. A vestibule is applied and the total weight of tender with coal and water is approximately 183,000 pounds.

The general dimensions of this type of locomotive are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 25 ins. x 28 ins.; valves, piston, 15 ins. diam.

Boiler.—Type, wagon top: Diameter, 74 ins.; thickness of barrel sheets, ¾ ins.; working pressure, 200 lbs.; fuel, soft coal.

Firebox.—Material, steel; staying, radial; length, 120⅝ ins.; width, 84 ins.; depth, front, 87½ ins.; depth, back, 73½ ins.; 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, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Diameter, 5½ ins. and 2¼ ins.; material, steel and iron; thickness, 0.150 ins. and 0.125 ins.; number, 32 and 210; length, 22 ft. 0 ins. and 22 ft. 0 ins.

Heating Surface.—Firebox, 235 sq. ft.; tubes, 3731 sq. ft.; firebrick tubes, 32 sq. ft.; total, 3998 sq. ft.; superheater, 815 sq. ft.; grate area, 70.4 sq. ft.

Driving Wheels.—Diameter, outside, 77 ins.; diameter, center, 70 ins.; journals, main, 11 ins. x 12 ins.; journals, others, 10 ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 33 ins.; journals, 6½ ins. x 12 ins.; diameter, back, 45 ins.; journals, 9 ins. x 14 ins.

Wheel Base.—Driving, 13 ft. 4 ins.; rigid, 13 ft. 4 ins.; total engine, 35 ft. 8 ins.; total engine and tender, 70 ft. 2 5/16 ins.

Weight.—On driving wheels, 167,700 lbs.; on truck, front, 55,700 lbs.; on truck, back, 54,700 lbs.; total engine, 278,100 lbs.; total engine and tender about 461,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 9000 U. S. gals.; fuel capacity, 14 tons; tractive force, 38,640 lbs.; service, passenger.

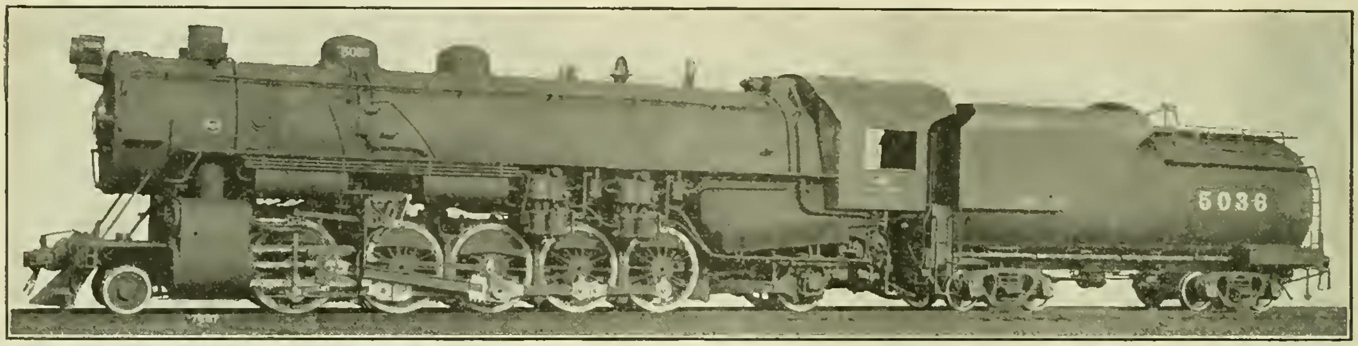
The Santa Fe type locomotives were first built by The Baldwin Locomotive Works for the Union Pacific System in 1917, when a group of 27 locomotives were constructed. Of these fifteen were for the Union Pacific Railroad, six for the Utah Railway, and six for the Los Angeles and Salt Lake Railroad. Those for the last named road used oil for fuel, while the others burned coal.

Twenty-five locomotives of this type have recently been built for the Union Pacific Railroad and two for the Utah Railway. With but few exceptions, these are duplicates of the engines built in 1917.

The main frames are of open hearth vanadium steel. Walschaerts valve motion is used and the setting is the same as that on the Pacific type locomotives, except the lead is reduced to ⅛ in. This amount is more suitable for heavy freight service.

The boiler has a straight top and the tubes are of the same length as those used in the Pacific type. As the total length of the boiler is considerably greater, however, a combustion chamber is installed. A Duplex type of stoker is also applied.

The tenders have a capacity of 12,000 gallons of water and 20 tons of coal. The total weight of tender is 217,000 lbs. The wheels are of rolled steel and the axles have journals 6½ ins. x 12 ins.



SANTA FE 2-10-2 TYPE LOCOMOTIVE FOR THE PACIFIC SYSTEM. BALDWIN LOCOMOTIVE WORKS, BUILDERS.

The general dimensions of these locomotives are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 29½ ins. x 30 ins.; valves, piston, 15 ins. diam.

Boiler.—Type, straight top; diameter, 88 ins.; thickness of barrel sheets ⅞ in., 1 in.; working pressure, 200 lbs.; fuel, soft coal.

Firebox.—Material, steel; staying, radial; length, 126 ins.; width, 96 ins.; depth, front, 93½ ins.; depth, back, 75½ ins.; 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, 6 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Diameter, 5½ ins. and 2¼ ins.; material, steel and iron; thickness, 0.150 ins. and 0.125 ins.; number, 45 and 260; length, 22 ft. 0 ins. and 22 ft. 0 ins.

Heating Surface.—Firebox, 336 sq. ft.; tubes, 4780 sq. ft.; firebrick tubes, 32 sq. ft.; total, 5148 sq. ft.; superheater, 1165 sq. ft.; grate area, 84 sq. ft.

Driving Wheels.—Diameter, outside, 63 ins.; diameter, center, 56 ins.; journals, main 12 ins. x 18 ins.; journals, others, 10 ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 30 ins.; journals, 6½ ins. x 14 ins.; diameter, back, 45 ins.; journals, 9 ins. x 14 ins.

Wheel Base.—Driving, 22 ft. 6 ins.; rigid, 22 ft. 6 ins.; total engine, 41 ft. 5 ins.; total engine and tender, 79 ft. 6 ins.

Weight.—On driving wheels, 286,300 lbs.; on truck, front, 26,200 lbs.; on truck, back, 56,000 lbs.; total engine, 368,500 lbs.; total engine and tender about 585,000 lbs.;

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6½ ins. x 12 ins.; tank capacity, 12,000 U. S. gals.; fuel capacity, 20 tons; tractive force, 70,450 lbs.; service, freight.

Better Railroad Efficiency.

Interstate Commerce Commission reports show for the larger railroads, again under private operation, from January 1 to October 1 a huge improvement in operating efficiency. Some of the extraordinary service gains in round numbers are as follows:

Freight train miles, 451,000,000 as against 395,000,000 for the corresponding period of 1919—a gain of more than fourteen per cent.

Passenger train miles, 409,000,000 as against 391,000,000—a gain of four and a half per cent.

Loaded freight car miles, 11,000,000,000 as against 10,000,000,000—a gain of more than twelve and a half per cent.

Gross ton miles, 669,000,000,000 as against 593,000,000,000—a gain of nearly twelve and three-quarters per cent.

Net ton miles, 331,000,000,000 as against 287,000,000,000—a gain of nearly fifteen and a half per cent.

Car miles a car day, 24.1 as against 22.3—a gain of more than eight per cent.

Net ton miles a day, 486 as against 429 —a gain of more than thirteen and a third per cent.

Nearly 230,000 miles of railroad over which can be handled by more efficient operation, say, fifteen per cent more traffic, are equivalent to an increased trackage of fifteen per cent, or more than 30,000 miles.

The results in many ways are more than was expected.

Train Operating Costs.

Statistics just compiled by the Interstate Commerce Commission showed an increase during September, compared with the same month last year, of fifty cents per train mile in the cost, based on certain selected accounts, of operating a freight train. The total for these selected accounts averaged $2.10 per train mile, compared with $1.60 for the same month last year.

This is not the total cost of operating a train in September as the selected accounts taken by the commission for its compilations included only the average cost per train mile of wages paid enginemen and trainmen, locomotive repairs, fuel, and other locomotive and train supplies and also engine house expenses.

For the same selected accounts but based on the operation of passenger trains, the statistics also showed an increase, the cost for September being $1.11 per passenger train mile. This was an increase of 21 cents over that for September, 1919. As in the case of freight trains, this also was not the total cost of operating passenger trains.

Fuel which averaged 65 cents per freight train mile showed an increase of 20 cents over September, 1919, while the average cost of railroad fuel coal per ton was $4.54, including freight charges, or $1.44 more than one year ago.

Wages paid trainmen averaged 37 3/5 cents per freight train mile, or 11 cents more than for the same month last year, while enginemen received an average of 31½ cents, compared with 23 3/10 cents for the corresponding month in 1919. The cost of repairing locomotives was 50 4/5 cents, or seven cents more than a year ago, while engine house expenses increased two cents during the year so that in September they averaged twelve cents per train mile.

Packing Rings.

At the request of the U. S. Railroad Administration, the Bureau of Standards has investigated the mechanical, chemical and microscopical properties of a number of packing rings furnished with service records. The results are awaited with interest.

The Railroad Section of the American Society of Mechanical Engineers

Papers on Increasing the Capacity of Old Locomotives, and Modernizing Locomotive Terminals

At the American Society of Mechanical Engineers' forty-first annual meeting held in New York City during the second week of December, 1920, a greater variety of subjects were discussed than at any previous meeting of the Society. The subjects embraced power application to a wide field of production ranging from cotton-finishing plants to Diesel engines. The world supply of fuels and fuel conservation, oil-burning practice and methods of injecting fuel oil was ably discussed. In the ever-widening field of the work of the Society, it is particularly gratifying to observe that the railroad section found able and experienced exponents, and the Society is to be congratulated in broadening the scope of its work in various fields and particularly in the important departments pertaining to railroad construction work and the mechanical appliances relating thereto. The entire proceedings embracing the various papers presented and the discussions arising therefrom will appear in due time in the published proceedings of the Society, but with the courteous permission of the Society we are enabled to present a selection of such matter as may be of particular interest to our readers.

Increasing the Capacity of Old Locomotives. By G. B. Smith, Mechanical Engineer, Boston & Maine Railroad.

1. In these days of the high cost of railroading, responsible officers of the mechanical departments realize that the necessity for reducing the cost of all locomotive operation and maintenance is more urgent than ever. Such saving can be accomplished in two ways, one by using new and modern locomotives, the other by rebuilding old types.

2. The purchase of new locomotives is usually confined to the largest units permissible for each type required, and they are equipped with superheaters and other modern devices as selected by the purchaser. Older engines of modern type, but not originally supplied with superheaters, are also being so equipped at general shoppings of these engines on the greater number of the roads of the country, and as rapidly as local conditions will permit. This improvement brings the older locomotives up to the capacity of those more recently purchased, and such reconstruction will undoubtedly be continued until all such locomotives have been modernized. The wisdom and economy of this work are known to all.

3. On the majority of our roads there are still locomotives of the earlier modern types whose general features of construction are satisfactory, and which only require modernizing to make them economical transportation units. Improvements for such classes of locomotives may include, in addition to superheaters, piston valves in place of slide valves, outside valve gears in place of Stephenson motion, and such other improvements as are usually made upon engines at general shoppings.

4. The replacement or betterment of the older locomotives "in kind" is becoming more of a problem where suburban and local passenger service and branch-line traffic still require the maintenance of the lighter types of locomotives that can handle such traffic. Such engines are periodically returned to the shops for repairs, and the frequency of these shoppings could be reduced and mileage between them increased if the time were taken at one shopping to modernize them. Extensive reconstruction, however, requires a longer shopping period and reduces the number of engines available for road service.

5. In an excellent paper presented at the convention of the American Railroad Association last June, G. M. Basford convincingly sets forth the present situation of the railroads. This paper furnishes a strong incentive for making a closer analysis of the conditions on our roads, and developing the greatest program that can possibly be carried out in rehabilitating existing locomotives.

6. Items which are to be considered in any program of increasing locomotive capacity are:

1. Superheater.
2. Pyrometers.
3. Brick Arch.
4. Valve Motion.
5. Mechanical Stoker.
6. Power Reverse Gear.
7. Automatic Fire Door.
8. Feedwater Heater.
9. Improvements for boiler design when new boilers are required.
10. Improved boiler circulation.
11. Increasing firebox heating surface.
12. Flexible staybolts—heating zones.
13. Covering steam pipes.
14. Flange oilers.
15. Automatic driving-box wedges on heavy locomotives.
16. Steam pipe joints at smoke box.
17. Pneumatic bellringer.
18. Chime whistle on freight—more audible to train crew.

7. Factors which will increase the capacity of a locomotive may do so directly or indirectly simply or in connection with others. When setting out to rebuild a locomotive the experienced superintendent appreciates the opportunity to apply many devices and facilities which will standardize the engine in accordance with the railroad company's practice, and in so doing reduce repairs and stores department expense in maintenance.

8. The aggregate of such improvements results in a locomotive which, in proportion to its capacity, will produce service results comparable wth those of entirely modern construction, and at a cost approximately one-half that for a new locomotive of similar capacity. The difficulty in carrying forward an extensive reconstruction programme, however, is in finding the shop facilities either on the railroad or among the locomotive builders, in order to advance the work at a satisfactory rate of progress. Nevertheless, despite this difficulty, the results which could be obtained from the operation of reconstructed locomotives, if they could all be rebuilt within the next few years, would justify a special effort on the part of railroad managements to bring it about.

9. On roads where the number of old locomotives which warrant rebuilding is sufficient to require a period of more than three years to complete the work, it would seem necessary to arrange for enlargement of shop facilities in order to hasten the reconstruction. If, however, adequate shopping facilities are not forthcoming, the improvement programme for locomotives must be confined chiefly to the application of superheaters and the substitution of piston for slide valves, together with the minor but relatively important betterments that may usually be applied at the shopping period. On some roads this work alone will require six years at the present rate to equip what can rightly be called the "early-modern" locomotives.

10. Some of the engines built within the past ten years have developed weaknesses in frames and in parts of running gear. It has proved justifiable to reconstruct them by substituting new parts of stronger design and thus avoid recurring breakages which interrupt both the road service of these engines and the repairs to others.

On roads whose traffic and service conditions now demand and will continue to demand the use of light locomotives for passenger trains and freight trains on branch lines, the better classes of light locomotives should also receive their share of improvements along with the heavier power.

11. Old locomotives requiring new boilers have very generally been scrapped, but where light train service demands no heavier engines than formerly, the writer believes it advisable to rebuild such engines with radial-stay boilers, superheaters, new piston-valve cylinders, main frames when necessary, and outside valve gears. If there is to be no increase in the boiler pressure over that formerly carried by the locomotive and the valve motion has given little trouble by breakages, the Stephenson motion may be connected to the piston valves through the usual rocker-shaft connections.

12. Old locomotives that are unsatisfactory as to wheel arrangement may be rebuilt and changed to another type and service. One road has converted 2-8-0 type or Consolidation locomotives to 0-8-0 switching service by removing the leading truck, applying a new boiler, new cylinders, outside valve gear, power reverse gear, and modifying the frames as required. The boiler was located to properly balance the engine. The use of the running gear and many of the parts of the original locomotive doubtless justifies such extensive reconstruction work where additional switching locomotives are needed.

13. The old eight-wheeled, American-type locomotives having crown-bar boilers with deep fireboxes between frames have become obsolete on many large roads, but on the small roads and on branch-line and local train service in much of the New England territory these engines, modernized as far as consistent, should be carefully considered where the traffic conditions warrant.

14. Because of limiting weight conditions, Mogul or 2-6-0 type locomotives have been assigned to passenger-train service on some outlying divisions. The application of superheater and piston valve steam chests with outside steam-pipe connections as the principal features of improvement, has increased the economy of these engines, added one passenger car to their tonnage capacity, and reduced train delays. Outside valve gears were not applied, shop limitations preventing, but their addition is desirable.

15. Atlantic-type locomotives having outside valve gears have had their capacity and economy increased by the application of the superheater. This work permitted the use of the engine in long-distance through service which was not previously successful.

16. Consolidation locomotives reconstructed with superheaters, new piston-valve cylinders, outside valve gears, new front-frame sections, and frame cross-ties have also had their capacity increased, and have been successfully used in regular freight service on a mountain division greatly needing such power. The cost of the above-mentioned improvements, including heavy general repairs and entirely new fireboxes, would not exceed one-half the cost of new locomotives of the same capacity.

17. When rebuilding locomotives there is a favorable opportunity for replacing old tenders as well, transferring the latter to older locomotives for spare use or as substitutes for damaged equipment. When the condition of old steel tender frames requires that they be replaced, the one-piece steel casting and a larger-capacity tank should be used, as both will reduce future expense in repairs. The success of autogenous welding eliminates any objections to the use of large steel castings for fear of breakages.

18. Tanks should be reconstructed in coal space to permit gravity delivery of the greatest amount of fuel that is possible at the coal gates within reach of the fireman's shovel. Application of power-operated coal pushers should be made to tanks where alterations for the gravity delivery of coal cannot be satisfactorily made and where the service conditions will show a saving in expense by its use over hand methods of shoveling forward coal while on the road or at short lay-over stations. Moving forward the rear coal board or plate on tanks and building higher side plates or "dickies" is one method which has been successful in making the maximum amount of coal accessible at the gates. Furthermore, care must be taken not to overload the journals of the forward truck axles.

19. It is the hope of the author that the discussion which may be brought out at this meeting will result in outlining what practical action should be taken by the various roads to hasten the work of reconstructing old locomotives. The application of all the desirable auxiliaries to old engines is prohibitive without a radical provision for carrying out such a program.

Modernizing Locomotive Terminals. By G. W. Rink, Assistant Superintendent of Motive Power, Central Railroad of New Jersey, N. J.

Locomotive terminals play an important part in the operation of the railroad, as the transportation department is at all times entirely dependent upon them for its supply of serviceable power for the movement of both passenger and freight cars. Should the capacity of the terminal or the facilities for making repairs be inadequate, the result will soon reflect itself in more time being required to prepare engines for service and more frequent detention on the road due to frequent failures.

The general layout of engine terminals, also the extent of shop facilities provided, depends entirely on their location with reference to the general locomotive repair shop. When located in close proximity it is necessary to provide only such facilities as may be necessary to make the general run of roundhouse repairs, depending upon the main shop for the manufacture and supply of a large percentage of materials required for use at the terminal. But when engine terminals are located some distance from the general locomotive repair shops, they should be provided with enlarged facilities so as to perform all the necessary machine, blacksmith, and boiler shop operations required when making more extensive repairs, and be entirely independent of the main shop. It is important, however, to eliminate at the terminals the manufacture of such standard parts as may be produced elsewhere at less cost. At outlying points where only light repairs are made to maintain locomotives in serviceable condition, such facilities as described above are not necessary.

At all important terminals the measure of efficient operation is the time required to prepare locomotives for service and the mileage which can be obtained between shoppings for class repairs. Any saving in time of course permits more intensive use of locomotives when transportation requirements make it necessary, but this saving can only be accomplished by providing a first-class terminal layout with proper equipment so as to enable the terminal organization to handle all engines with promptness and despatch. This requires a properly balanced organization to perform the various classes of work required, and coupled with modern labor and time-saving facilities, should tend to reduce congestion materially and maintain the equipment properly.

The location of the engine terminal with reference to the general locomotive repair shop will have some bearing on the necessity of performing relatively heavy repairs at the terminal. Where they are within reasonable distance of each other, it may be desirable to have a considerable part of the heavy repair work transferred to the main shop, where the repairs can be performed more expeditiously and the engine returned to service. On the other hand, this class of work has a tendency to interfere with the output of the locomotive repair shop, and especially so if it is found difficult to maintain the necessary quota of class repairs, considering the equipment as a whole. In such cases it would appear more desirable to increase the engine-terminal forces and provide sufficient facilities to at least make Class 5 repairs and the general run of heavy running repairs, including the removal and reapplication of a part or complete set of flues.

Where it is found desirable to perform such heavy repair work, it should preferably be done in a small building located adjacent to the machine shop, and provided with several tracks for holding engines and an overhead crane or power-driven locomotive screw hoist to facilitate the removal of all wheels.

This feature is very desirable, especially if heavy locomotives are to be handled. It also increases the track capacity within the roadhouse to that extent and repairs can be made more promptly and economically.

With reference to existing terminals, a careful study of the property will no doubt disclose the fact that improvements can be made whereby greater efficiency may be obtained. Modern facilities should be installed wherever it is possible to produce a saving in time and labor.

The type of coaling stations selected must depend on the number of engines handled, the number of tracks which may be available for coaling engines and the kind of coal to be handled. Some roads in the East use bituminous, broken anthracite, and buckwheat. Where the quantity of coal handled is small, the locomotives can be coaled from an elevated platform, using one-ton buckets or by means of a locomotive crane direct from car. When it is necessary to deliver coal to two or more tracks, a mechanical type of coal-handling apparatus is generally installed. Marked improvements have been made in receiving, hoisting and distributing equipment, which has resulted in smaller operating forces being required. Measuring devices are also installed for recording the amount of coal delivered to tenders. An electric winch should be provided at large terminals at the loaded coal-car track so that cars can be hauled to position over track hopper.

The sandhouse should be located at the coaling station. Sufficient wet-sand storage space should be provided as well as means for drying the sand by coal stove or steam. Compressed air should also be available so that the sand can be delivered to overhead storage bins, having suitable outlets to deliver the sand direct to engine by gravity. All important engine terminals should have a complete installation of this character.

During recent years the tendency when constructing large terminals has been to install pits filled with water. The cinders drop directly into the water and move toward the center of the pit, due to the outer wall sloping inwardly, and are removed either by a locomotive crane or by an overhead crane traversing the entire length of the cinder pit, the cinders being deposited by means of grab buckets directly into cars located on the loading track. The pit is filled with water to a depth of about five feet, water being admitted at one end of the pit and overflow provided at the opposite end. Provision is made to protect the floor of the pit against injury by the grab bucket, by imbedding old rails in the concrete. Due to the quantity of water required for large installations of this character, provision should be made if possible for a supply from a nearby stream or other natural source.

Steam-jet ash conveyors can be installed to advantage where ample supply of steam is available. The system consists of an 8-in. cast-iron pipe made exceedingly hard to withstand wear, with intakes provided at suitable intervals. The cinders are drawn by suction through the main pipe line and then propelled by means of the steam jet direct to car or storage bin, suitably located. Cinders handled in this manner are not wetted down until they enter storage bin, where a water spray is provided. This type of cinder conveyor has proved very satisfactory for handling cinders in power houses and should give good service when installed in connection with small engine terminals.

Inspection pits are now being installed at a number of large engine terminals. These are located on the inbound tracks with the view of making inspection of locomotives before they are placed over the cinder pit. Fires can then be withdrawn when the engines pass over the cinder pit, if inspection develops defects which warrant this procedure, thus saving time and expense involved if engine was inspected within the roundhouse after passing over cinder pit. There are many advantages in having inspection made at this time as the foreman by means of pneumatic tubes can be furnished with both the engineer's and inspector's reports showing work to be done before engines are placed in the shop.

These inspection pits are generally made about 100 ft. long, two in number, and covered with a protection shed. Special arrangements are provided to permit inspectors to enter the pits. Proper drainage and lighting facilities are also provided. In lieu of reporting on inspectors' reports such work as loose nuts, missing cotters, etc., it would be desirable to station at these inspection sheds mechanics who can perform this work at once, thus saving time in locating these defects in the shop after being reported.

Heating and ventilation is of first importance in a modern and efficient roundhouse. With the possible exception of small isolated houses in mild climates a properly designed system combining heating and ventilation should be adopted. An installation of this kind consists of a blower drawing air through hot-blast heaters located in a fan room which forms a projection on the outer wall of the roundhouse. The heated air is discharged through an underground concrete duct system.

A combined heating and ventilating system should supply sufficient air for the quick removal of smoke, gas and vapors. Ventilating sash, louvers and other openings should be provided at the high points of the room to supplement the forced system by directing the flow of air currents and facilitating the removal of hot gases. This feature should be carefully considered, for in roundhouse ventilation it is not so much a question of diluting the air as it is of establishing a positive flow of air which will carry the gases along with it.

It is sometimes necessary, due to the requirements of local ordinances or because the type of house prevents the use of smoke jacks above the locomotive stacks, to install an exhaust system so as to remove gases directly from the locomotive smokestacks. In the latter case connections are made to the smokestacks by means of swinging hoods. This system is not necessary from a ventilating standpoint, and should only be installed where conditions compel its use.

With the usual type of indirect system the fan rooms, one or two in number, depending on the size of the house, should be located midway of the length of the house to be served, thereby reducing the temperature drop of the air in the duct as well as the friction head against which the fan must work. The quantity of air supplied, together with the number, size and location of air outlets, depends largely on the type, size and location of the roundhouse. The amount of heat to be supplied with the air is also a variable factor and should have careful study so as to provide a comfortable working temperature under the conditions obtaining in roundhouse operation.

The question as to whether the fan should be motor- or engine-driven depends on the quantity of exhaust steam available for heating and whether or not it is desired to operate the fan for ventilation in the summer time. The hot-blast heaters should be operated through a two-pipe vacuum system, particularly where exhaust steam is available, so as to reduce the back pressure and provide a positive circulation of steam through all parts of the heaters. The temperature of the air can be regulated to suit the variable outside temperature by subdividing the heater into units with a control valve on each. The fan should be operated at a constant speed so as to make the ventilation independent of the heating and to provide a uniform condition at all times.

Adequate daylight facilities through large window areas, together with light, cheerful surroundings are highly desirable. The windows should be spaced and located so that daylight heating problems are easily solved, and it is quite possible to produce a system uniformly satisfactory and economical in operation and first cost.

In regard to lighting adequate daylight facilities through large window areas, together with light, cheerful surroundings are highly desirable. The windows should be spaced and located so that daylight conditions are fairly uniform. They should also provide sufficient daylight so that artificial light will be required only during those portions of the day when it would be naturally considered necessary. Good natural and artificial light will reduce accidents, provide greater accuracy in workmanship and simplify the supervision of the men.

Much needed improvement is desired in connection with artificial lighting of engine terminals. In the roundhouse proper, lights mounted on the outer wall and reflected between engine pits have given satisfactory results when augmented by sufficient lights suspended from the ceiling to afford general illumination. Machine shops, etc., should be provided with a general or overhead lighting and also supplemented by individual lamps conveniently placed, preferably on brackets, so that they may be adjusted.

For lighting the roundhouse circle, flood lights should be used whenever possible, as general illumination will add considerably to the safe movement of locomotives to and from turntable and engine house. Ashpits can be illuminated by rows of reflector lights placed on poles, and similar provisions should be made at other points beyond turntable or by the use of flood lights on the top of coaling stations. The introduction of many new types of lamps has made it possible to provide better illumination when changing from an old to a new lighting system. A study should be made of the conditions and proper lamps selected for the purpcse.

Facilities should also be provided for washing out boilers, using hot water under pressure and refilling with hot water after washing. The is an actual saving of time as compared to the old system of washing out and refilling with cold water; with this system boilers are washed out more thoroughly and strains within the boiler, due to expansion and contraction, are considerably reduced, with the result that the cost of boiler maintenance is reduced.

There are two types of installation for this purpose in general use, one of which utilizes the blow-off water for washout purposes only, while the other utilizes as much of the blow-off water as necessary for this purpose, and the remainder, after being clarified, for refilling purposes. As blow-off water is always soft and becomes clarified soon after storage, it is, of course, the best water for the generation of steam, and its being used over again in this manner is responsible for the greater efficiency of the latter type of installations.

Hot-water washout and refilling systems can be economically installed in any size to meet the requirements in any engine terminal of moderate size. The usual practice is to deliver washout water at temperatures varying from 100 deg. to 140 deg. Fah. The refilling water generally has an average temperature of approximately 210 deg. Where such have been introduced, there is a material reduction in time required to do this work. Boilers have been blown off, refilled, fired and steam pressure up to 100 lbs. within from two to three hours. This does not include such time as may be required to make necessary repairs to boilers.

The usual wheel-dropping facilities consist of a drop-pit system, which provides for depressed pits at right angles to shop track, using telescoping pneumatic or hydraulic jacks for lowering and raising wheels, separate pits and jacks being installed for handling driver and engine-truck wheels. Generally but one pair of wheels can be handled at one operation, and if necessary to drop all drivers in order to take up lateral or change tires considerable time is taken up in moving engine over drop pit.

Screw-jack locomotive hoists especially designed for unwheeling locomotives are being more extensively used at engine terminals, and their use has made possible a large saving in both time and labor. These hoists operate with a high degree of safety as compared with the drop-pit system; furthermore, they can be located within the roundhouse or installed in a separate building, in which case it would be desirable to also install the wheel lathe and other tools and appliances for taking care of heavy running repairs.

When screw-jack locomotive hoists are installed, it does not eliminate the necessity for providing drop pits in the roundhouse, which may be needed in order to prevent loss of time in making repairs to locomotives which may only require the dropping of a single pair of drivers or engine-truck wheels.

Old and obsolete tools should be replaced by modern machine tools, which insure increased production at lower costs and the work being done more accurately and promptly and power maintained in better condition. Individual motor drive for the larger machines and group drive for the smaller machines is preferable. Ample space should be provided for this department and the class of work to be performed will determine the number and type of machines required.

Space for these departments is generally provided adjacent to the machine shop. Facilities should include steam hammer, forges with down-draft hoods (number and size to suit work to be performed), punch and shear, plate-bending rolls, straightening plate, flange fire, etc. Stock flues, sheet iron and bar iron and steel should be kept outdoors in covered racks.

Autogenous cutting and welding outfits are also considered indispensable and are used principally in making repairs to locomotive fireboxes, engine frames, and in reclaiming miscellaneous parts which can readily be repaired by this process. Provision is also made for the pipefitting, tinsmith and airbrake departments in the machine-shop building. Locker rooms and toilet facilities for both shop men and engine crews are essential. Considerable time in making repairs can be saved by providing jib or overhead cranes in the roundhouse and machine shop, to enable heavy parts of engines to be handled with the least amount of labor.

Oil houses should be separated from other buildings, should be of fireproof construction, and of a size to suit the requirements. The storage tanks are generally in the basement and filled from the floor level above from barrels through pipe line and delivered from storage tanks to the faucets by special hand pumps equipped with measuring devices. When large quantities of oil are used, provisions are made to fill storage tanks in the house direct from tank cars.

The storehouse should comprise a structure of ample size conveniently located to machine shop, with platform and track facilities for handling material to and from cars, building provided with sufficient natural and artificial light, steel shelving, bins, etc., separate alcove for electrical repair shop and provision for office staff on second floor.

Important engine terminals should be provided with a power plant of sufficient size to take care of the future as well as immediate needs of the terminal. In a number of cases this plant is required to provide steam for thawing snow at switches on main-line track leading to the terminal passenger station and supply heat and light to station buildings, and function in general as a service station. Labor-saving devices should be installed in the way of coal and ash-hauling machinery, automatic stokers and large-capacity overhead coal-storage bunkers. Consideration should be given to operating with condensers, requiring a cooling tower if fresh water is used, the surplus water being delivered to flood ashpit for locomotive cinders if this type is used. Tanks of ample capacity should be located at power house with water mains of proper size supplying water for shop use and filling of tenders at terminal tracks, locating water columns away from switches in cold climates to prevent freezing. At smaller terminals, discarded locomotive boilers are used to furnish steam for power and heat. A close study made of these installations will reveal the fact that in many cases money can be saved by the use of modern water-tube boilers.

Other Addresses.

Others addresses included: "Railroad Transportation," by D. E. Willard; "Feeders," by C. A. Morse; "Fuel Conservation," by L. M. Myers, and the report of the Boiler Code Committee.

Report of the Chief Inspector of Locomotive Boilers

Details of Inspection of Other Locomotive Accessories

In the September, 1921, issue of RAILWAY AND LOCOMOTIVE ENGINEER we took the opportunity of publishing an abstract from portions of some advance sheets of the annual report of the chief inspector of locomotive boilers. The portion referred particularly to the urgent need of improved water gauge appliances on locomotive boilers, and attracted wide attention among operating as well as constructing engines. It will be recalled that tests had shown that there was a tendency of the water under a high pressure of steam, when the throttle was opened, to rise higher in the extreme back spaces in the boiler, where the gauge cocks are usually located, than along the crown sheet, thereby showing a false registering of the real level of the water, and inducing a liability to expose a portion of the crown t, leading to overheating and consequent rupture. Many experienced engineers claimed that the records of the test were, in their opinion, exaggerated, but it cannot be imagined that the unimpeachable testimony of the chief inspector and his assistants, accompanied as they were by representatives of the mechanical department of some of the leading railroads, could be other than as described and illustrated by them. It is claimed, and must be admitted, that with the development of the modern locomotive, new difficulties in design, construction, maintenance, and operation have been created. One of these has been an effort to secure an absolutely correct indication of the height of water over the crown sheet, under all conditions of service, and if it is discovered beyond question that there are portions of the modern locomotive boiler where the water level is subject to even limited variations, these parts of the boiler are the parts where the water gauges should not be located.

In referring to the matter at this time, and while it is fully reported upon in the completed report before us, and which extends to over 100 pages, we shall omit making any abstracts from that part of the report and confine ourselves to other interesting details showing the increased activity manifested in locomotive boiler inspection as well as other parts of the locomotive.

At the outset of the report it is shown that in a summary of all accidents and casualties caused by failure of the boiler and its appurtenances for the fiscal year ended June 30, 1912, the first year of the existence of the law, as compared with the year ended June 30, 1920, a decrease of 47 per cent is shown in the number of accidents, a decrease of 48 per cent in the number killed, and a decrease of 49 per cent in the number injured. These decreases are especially gratifying when considering the increased number of locomotives in service and the increased traffic being handled, together with the increased duties imposed on the inspectors by the amendment to the boiler-inspection law, which extended their duties to the entire locomotive and tender and the parts and appurtenances thereof, which has added greatly to their work. These decreases demonstrate the wisdom of complying with the requirements of the law and rules, and the wisdom and foresight of its advocates when requesting its enactment.

During the year the inspectors of this bureau were called upon by the commission to perform various duties not in connection with their regular work, which materially reduced the number of locomotives shown inspected by them, as well as the number ordered out of service, and it appears that certain railroad officials and employes have taken advantage of their temporary absence and permitted locomotives to remain in service with serious defects, which would have been known to them had proper inspections been made and reports rendered as required.

It was found necessary to ask the courts to inflict the penalty provided in section 9 of the law, because of the defective condition in which locomotives were being operated. It is evident that unless an immediate improvement is made by other carriers it will be necessary to file similar suits in the near future. That the law places the burden of proper inspection and repair and compliance with the rules of inspection on the carriers owning or operating the locomotives seems to have been lost sight of, and this is reflected in the number of accidents and casualties during the year.

In the last annual report attention was directed to some violent explosions where the failure of seams united by the autogenous process was a strong contributing factor to the seriousness of the accident. During the year a number of accidents have been investigated where the autogenous welding failed with evident increasing fatal results, in view of which, and considering that the percentage of failures of such welds involved has not decreased, the opinion is that such methods should not be applied on any part of the boiler where the strain to which the structure is subjected is not carried by other construction which fully conforms to the requirements of the law and rules, nor in the so-called low-water zone of a fire box, where overheating and failure are liable to occur. This should apply with equal force to all parts of the locomotive and tender subject to severe strains and shocks, where, through failure, accidents to employes and the traveling public might occur.

A transcribed report showing defects found on all locomotives ordered out of service, and those found approaching violations of the law and rules has been furnished the chief operating officers of the carriers, so that they might be fully informed of the condition of their locomotives, and the inspectors have in all other ways co-operated with the carriers to the fullest extent in bringing about safe and proper conditions.

During the year, 258 applications were filed for extension of time for the removal of flues, as provided in rule 10. Investigation showed that in 31 of these cases the condition of the locomotives was such that no extension could properly be granted. Twenty-five were in such condition that the full extension requested could not be granted, but an extension for a shorter period within the limits of safety was allowed. Ten extensions were granted after defects disclosed by investigation had been repaired. Thirty-seven applications were withdrawn for various reasons and the remaining 155 were granted for the full period requested.

As provided in rule 54, there were filed 1,680 specification cards and 5,584 alteration reports. These were carefully checked in order to determine whether the boilers represented were so constructed as to be in safe and proper condition for service, and that the stresses given had been correctly calculated.

The effective date of the requirements relative to the factor of safety for locomotive boilers, as fixed by the commission's order has made necessary the strengthening of various parts of numerous boilers and a reduction in the working pressure on many of the older and weaker ones.

During the year close attention was given to the equipping of locomotives with headlights that would meet the requirements of the commission's order of December 26, 1916, and December 17, 1917, and reports indicate that on July 1, the date fixed for full compliance with the requirements, practically all locomotives in service were equipped in accordance therewith. These lights are meeting with the hearty approval of employes, and so far as we are able to learn, of the officials in charge, when the locomotives are in operation. The general expression is that "they add greatly to the safety, comfort and economy of operation."

The report strongly recommends the appointment of additional inspectors, the original act of February 17, 1911, limiting the number to 50, being wholly inadequate in view of the fact that their duties not only include the thorough inspection of the locomotive and tender, but they may be said to embrace the leading appurtenances of the entire locomotive, and a drawing up of recommendations involving an exact knowledge of every item that may be capable of improvement.

Among these may be enumerated the recommendation that all locomotives not using oil for fuel have a mechanically operated fire door, so constructed that it may be operated by pressure of the foot on a pedal or other suitable device, located on the floor of the cab or tender, at a proper distance from the fire door, so that it may be conveniently operated by the person firing the locomotive.

This recommendation is based on the results of many investigations of boiler failures of such character as to permit the steam and water contained in the boiler at the time of the accident, to be discharged into the firebox, many times being directed toward the fire door.

The old swing type door, which is largely used at present, is almost invariably blown open, in case of such accidents, and permits the discharging steam and boiling water, with the contents of the fire box, to be blown into the cab of the locomotive, seriously and most frequently scalding and burning the persons therein. Such accidents frequently occur while coal is being put into the fire box, and with the fire door necessarily open, under such circumstances it is impossible for it to be closed.

The automatic fire door would remain closed, if closed when the accidents occur. If open, it would automatically close, the moment the operator's foot was removed from the operating device, thus preventing the direct discharge of the scalding water and fire into the cab of the locomotive, with such serious results.

The automatic fire door is not a new and untried device, as there are thousands of them in service, and they are required by law in some States. The automatic fire door is also of great value in prevention of serious cracks and leaks in fire box sheets, by limiting the time fire doors are open when placing coal on the fire, thus reducing the amount of cold air admitted, which causes loss of temperature, and consequent expansion and contraction, and the setting up of great strains. Their use is also very valuable in the conservation of fuel, which is, at the present time, a most important item.

All locomotives should be provided with a bell so arranged and maintained that it may be operated from the engineer's cab by hand and by power. The reason for this recommendation has been thoroughly discussed on previous occasions, and its necessity seems so apparent that it hardly requires further comment. We believe, however, that this is an appliance which is vital to the safety of the employes and general public at highways and other public places where the railroads traverse. The operation of modern motive power demands the full attention of the enginemen, and it is frequently the case, while passing over road crossings and through congested territories, that the operators are so occupied with their other important duties that it is impossible for them to ring a bell by hand, in order to give warning of approaching danger.

Cabs of all locomotives not equipped with front doors or windows of such size as to permit of easy exit, should have a suitable stirrup or other step, and a horizontal handhold on each side, approximately the full length of the cab, which will enable the enginemen to go from the cab to the running board in front of it; handholds and steps or stirrups to be securely fastened with bolts or rivets; the distance between the steps and handhold to be not less than 60 inches nor more than 72 inches.

This recommendation is based on the result of investigation of accidents of a character which make it impossible for enginemen to remain in the cab and which compel them to make exit through the cab window to the ground or running board. While locomotives are operating at a high speed, to be compelled to jump from the cab window is exceedingly dangerous, and invariably results in serious if not fatal injury.

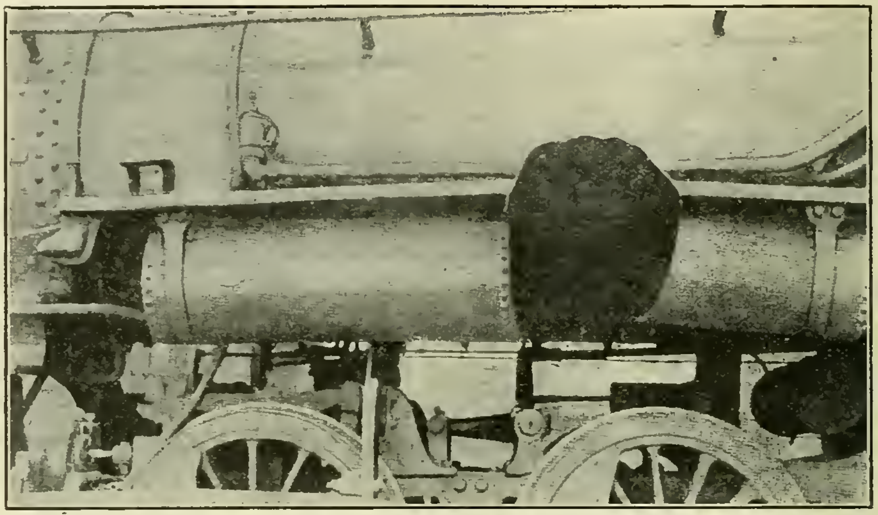


FIG. 1. RUPTURE OF A MAIN RESERVOIR

The front doors or windows on modern locomotives are so small that they will not permit the enginemen to pass out through them, thus making it necessary to climb over the roof of the cab or out through the side window, when necessary to go from the cab to running board in front while in motion.

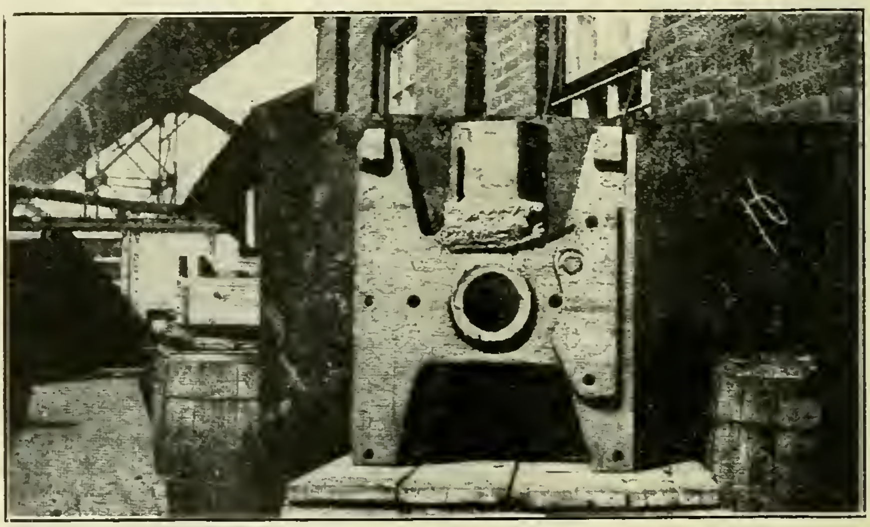


FIG. 2. FAILURE OF A REPAIRED CROSSHEAD

Such arrangements can be applied at a nominal expense and practically without delay to the locomotive, and would add greatly to the safety of the employes. Accidents resulting in fatal injury, which have been investigated by the bureau, show that injury and death would have been avoided had these appliances been in use.

A great number of locomotives in service at this time have been equipped with the appurtenances above recommended, although like many other appliances in use, they are not maintained in a proper condition for service.

As illustrating the activities of the bureau in the inspection of other details apart from the regular periodical examination of locomotive boilers and tenders, a few samples will be of interest, selected at random from the mass of information submitted. Fig. 1 shows the failure of a main air reservoir, which caused serious injury to two employes. Investigation showed that the material where the rupture occurred had corroded away from five-sixteenths of an inch to one thirty-second of an inch in thickness. Had a hammer test been made to this reservoir, as required by the rules, the accident would have been avoided.

Fig. 2 shows a crosshead which failed while in service, causing the instant death of a conductor. An old crack had developed in the piston rod fit, and an attempt had been made to repair it by autogenous welding. The crosshead broke while the locomotive was in service, causing the front cylinder head to be knocked out, and flying parts happened to strike the conductor, causing his death. This method of repairing parts of the locomotive which are subject to great strains and shocks illustrates the extremes to which it is being carried in many instances, and again shows that such methods of repair should be restricted to parts where injury or death will not result through their failure.

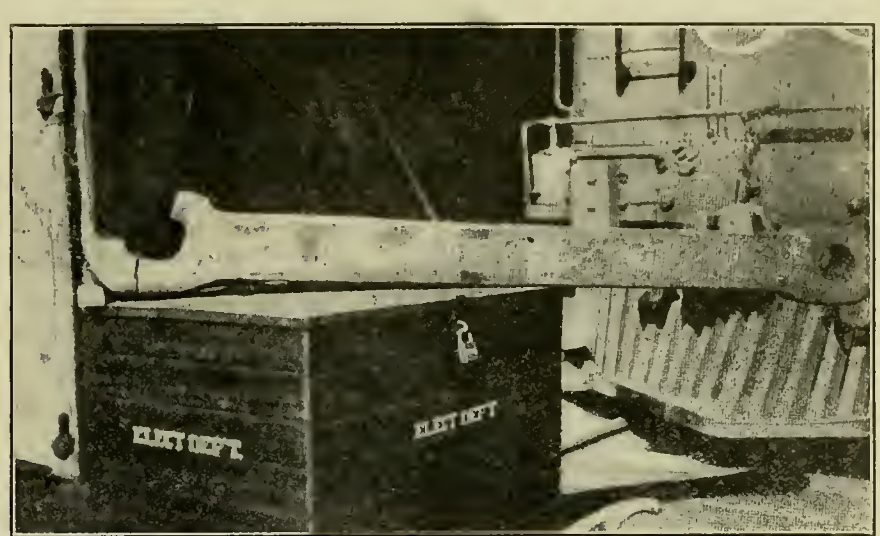


FIG. 3. FAILURE OF A CRYSTALLIZED DRAW BAR.

Fig. 3 shows a drawbar which failed, causing the instant death of one employe. The company's records showed that this drawbar had been removed and annealed 16 days prior to accident; however, our investigation disclosed that the material was badly crystallized where it broke, and it was made evident that if a proper inspection had been made this accident could have been avoided. The safety chains between the locomotive and tender at the time the drawbar broke allowed the locomotive and tender to separate, which is conclusive evidence that they were not of ample strength, as required by the law and rules, and this accident again forcibly illustrates the importance of properly constructing, inspecting and maintaining such parts, and cannot be too strongly impressed upon all concerned.

Some Properties of Boiler Tubes

Scientific Investigation as to the Causes of Failure

Because of the failure of the tubes in a battery of Stirling boilers of the Detroit Edison Co., Prof. Albert E. White made an investigation into the causes therefor, the results of which he gave in a paper presented to the American Society of Mechanical Engineers at its annual meeting in December. The two features of the investigation that are of especial interest to railroad engineers were those regarding the effects obtained by water softening and the considerations relating to the composition and constitution of boiler tubes.

All of the tubes that were replaced in these boilers showed a thin but tough scale on the water side. This scale was sulphate of lime and was thin simply because the quantity of their salt in the boiler feed water was relatively small and where boilers are operated under normal conditions would have warranted no consideration, but, during the winter these boilers were often operated for long periods under a load averaging 80 per cent above the nominal rating for periods extending at times into as many as six days. These load conditions, while not apparently unusually exacting, were in reality very severe when cognizance is taken of the fact that 98 per cent of the boiler feedwater was raw water drawn from the city mains.

Under the investigation as to the constitution of the tubes, examinations of the failed tubes were made metallographically and etchings made.

On the completion of this preliminary survey attention was directed to the causes of tube failure. Excluding that due to imperfect heat transmission resulting from scale, the writer believes that the principal causes can be listed under the following heads:

a Failure due to tube brittleness resulting from absorption by the metal of hydrogen and usually attributable to faulty boiler-feedwater treatment.

b Failure due to blowholes or other imperfections in the metal.

c Failure due to recrystallization of the metal.

Tube Brittleness Resulting from Hydrogen Absorption. The first of these causes, namely, that due to tube brittleness resulting from the absorption by the metal of hydrogen, will not be developed in this paper. The facts are outstanding that contained hydrogen in metal makes it extremely brittle. The facts are further outstanding that certain types of water improperly treated, or all water excessively treated with certain types of boiler compounds, will cause the tubes to absorb hydrogen and become brittle. With intelligent treatment, however, there need be no cause for concern over tube failure from this source.

Failure from Blowholes. Failure from blowholes and other imperfections, the writer believes, should receive greater consideration in the future than has been accorded it in the past. The matter of course goes back to the steel mill and calls for greater emphasis on quality and less on tonnage.

In the photomicrographs of samples of the metal containing blowholes, even a casual scrutiny reveals radiating lines issuing from the center of the cavity.

A photomicrograph of a sample of metal containing blowholes is shown in Fig. 4. The ghost line is evident and even a casual scrutiny reveals radiating lines issuing from the centre of the cavity. This condition is manifest in all of the photomicrographs taken of specimens with blowholes and indicates a lack of continuity of the metal. Should service conditions cause the tube to bag and should a cavity of the pipe be at the nipple of the bag, there is every reason to anticipate a bursting of the tube, with all of the attending dangers and expense.

Failure from Recrystallization. This matter merits much consideration. Recrystallization is accompanied by a marked decrease in the elastic limit and fatigue-resisting properties of the metal manifesting this phenomenon. It will occur if steel with a low carbon content which has previously been mechanically deformed at a temperature below the critical is later heated for a sufficient time to any temperature below that at the critical. The common composition for boiler tubes is such that this class of metal is especially susceptible to this phenomenon. Mechanical deformation to some degree is unfortunately assured by present-day methods of handling tubes, for at the mill tubes are straightened and in many cases actually brought to final size when below the critical temperature. Tubes are often bent during fabrication and erection and are universally rolled into the tube sheet when cold, and the methods of cleaning tubes in service often employ forms of apparatus which produce local deformation by repeated hammer blows. Finally, the time and temperature conditions required for recrystallization are present.

Heating of deformed metal to temperatures approaching the critical, causes crystal growth in very short time periods. Corresponding growth occurs more slowly at lower temperatures, the time periods required for the same increasing very rapidly as the temperature to which the material is heated decreases. Values experimentally determined for temperatures from 1,022° Fahr. to 1,247° Fahr. for one set of conditions are given by the following equations:

T (minutes) = 8 for 1247° Fahr.
T (minutes) = 8 x 3 " 1202° "
T (minutes) = 8×3^2 " 1157° "
T (minutes) = 8×3^3 " 1112° "

or, in general, for temperatures below 1247° Fahr. (675° Cent.)

$$T = 8 \times 3^n$$

where T = time in minutes.
t = temperature in degrees Fahr.
$n = (1247 - t) \div 45$

That the normal method of handling boiler tubes results in mechanical deformation and that this metal as a result, under the proper conditions of time and temperature, will develop large crystals was most clearly shown by the photomicrographs.

In the case of two specimens of tubes that had been so deformed, each showed that the crystals of a specimen have been so deformed, and that a specimen after receiving heat treatment at a temperature below the critical quickly developed grain growth. A comparison of the gram sizes of the two samples indicates that the tube has been sufficiently deformed to respond to the laws of grain growth when the proper conditions for this development are present.

Both tension tests and fatigue tests were made to determine the effect of coarse grains on the physical properties of the tubes. In each of the tension tests three samples per set were employed: the first on metal as received, the second on metal annealed for 10 minutes at 1742 deg. Fahr. and then cooled in the furnace and the third on coarse-grained metal produced by stressing all of the test specimens the same amount and in all cases past the elastic limit and followed by an annealing for three hours at a temperature of 1472 deg. Fahr.

The physical properties of the "as received" samples showed satisfactory metal. The average tensile-strength and elastic-limit values of the "coarse-grain" samples were 27.2 and 58.9 per cent lower than they were for the "as received" samples and indicate, therefore, a decidedly inferior grade of metal. In the fatigue tests, also, the "coarse-grain" metal was 16.2 per cent poorer than the "as received," and 48.70 per cent poorer than the "annealed" metal.

In view of all of the conditions above pointed out there arose a question as to whether or not the present composition of boiler tubes, from the consumer's standpoint, was the most acceptable. Would there be a composition as easy to make from the producer's viewpoint, as easy to install, as resistant to the absorption of hydrogen, more strong, as free, if not freer, from blowholes, and above all less subject to recrystallization?

This is a formidable set of conditions, and yet do not tubes with a carbon content between 0.30 to 0.35 per cent more least 40 per cent stronger as measured by tensile-strength and elastic-limit tests throughout all working temperatures with no detrimental decrease in elongation or reduction; and finally, and most important of all, tubes with the higher carbon range are not subject to recrystallization.

On this last point the literature is suggestive, although there have been no pieces of work as yet published as far as the writer knows which give direct proof.

In view of this condition, therefore, the following test was carried out to ascertain roughly the carbon range in which grain growth on deformed iron when heated at temperatures below the critical range, occurred. Here the word "iron" is used in its generic sense and is intended to include steel and what is commonly called ingot iron.

Five irons were used with carbon varying from 0.006 to 0.315 per cent. Each of the samples was annealed so as to secure freedom from strains and obtain minimum grain size. This treatment was then followed by impressing a 5-mm. ball on each specimen under a load of 3000 kg. Each sample was then heated for four hours at 1247 deg. Fahr., a temperature considerably below the critical for all of the carbon ranges present. The specimens were then examined and the average grain size in the section undeformed and in that portion of the deformed area showing maximum grain size compared.

The results given in Table 1 indicate that iron in carbon ranges from 0.006 to 0.251 per cent, inclusive, undergoes a perceptible grain growth when treated as just described and that iron with a carbon content of 0.315 per cent is not thus visibly subject to grain growth Not only was there evident a marked growth in the ferrite grains for the irons ranging in carbon content from 0.006 to 0.251 per cent, inclusive, but in the irons in this range where there was a visible quantity of carbon existing as pearlite, very apparent agglomeration or balling up of this constituent was in evidence.

TABLE 1. EFFECT OF CARBON CONTENT ON GRAIN GROWTH IN DEFORMED IRON WHEN HEATED BELOW THE CRITICAL TEMPERATURE.

Carbon content, per cent	Number of ferrite grains per square inch: Undeformed	Deformed
0.006	3.9	1.9
0.103	25.4	13.4
0.203	63.4	23.0
0.251	26.3	16.0
0.315	(a)	(a)

(a) Grains too small to count. Photomicrographs from both the undeformed and deformed areas show no appreciable difference in grain size.

perfectly meet all of the above conditions than tubes with a carbon content ranging between 0.08 to 0.18 per cent?

Tubes with this higher carbon range will not be appreciably more difficult to manufacture or to install and there is nothing to indicate that they will absorb hydrogen more readily. It should be possible to make them as free of blowholes; there is no question but that they are at

Service Comparison between Medium-High and Low-Carbon Boiler Tubes

Not only do all theoretical considerations point to the procurement of an increased life for boiler tubes through a raising of the carbon content, but the results of some actual tests on which data are now available seem to indicate and confirm this claim.

This test was started in 1916-1917 by

placing in the front row of four of the 750-hp. Stirling boilers at the Park Place Heating Plant of the Detroit Edison Co. tubes of a medium-high carbon content averaging around 0.30 per cent carbon, and in four other boilers at the same plant operating under the same loads at about the same time tubes with a carbon content between 0.08 and 0.18 per cent.

The results given in the "Service Test" (Table 2) speak for themselves, for of the medium-high carbon tubes only about one-half have been replaced, and of the low-carbon tubes, more than a 100 per cent replacement has been necessary.

This paper has been prepared not for the purpose of suggesting radical changes in boiler-tube composition nor for the purpose of criticizing present boiler-tube manufacturing practices, for all things considered, it is on a very high plane with respect to quality. It has been prepared, however, to present certain facts, especially those relating to grain growth, to which tubes of the commonly accepted composition are so subject; and in view of these facts to question whether tubes with a carbon content varying between 0.30 and 0.35 per cent would not insure longer tube life and safer boiler operation than tubes with a carbon range between 0.08 to 0.18 per cent.

TABLE 2. SERVICE TEST ON MEDIUM-HIGH AND LOW-CARBON BOILER TUBES AT PARK PLACE HEATING PLANT, DETROIT, MICH.

Boiler Number	Installation Number	Installation Date	Replacement Number	Replacement Date
HIGH-CARBON TUBES IN FRONT ROW				
3	29	June 19, 1916	27	July 27, 1918
			15	Summer, 1920
6	29	May 9, 1916	13	Sept. 11, 1917
			5	July 15, 1919
			1	Summer, 1920
7	29	June 19, 1917		
8	29	June 9, 1917		
Totals..	116		61	
LOW-CARBON TUBES IN FRONT ROW				
1	29	Sept. 23, 1916	27	July 12, 1918
			5	Summer, 1920
2	29	Sept. 18, 1916	10	Sept. 28, 1917
			27	July 11, 1920
			7	Summer, 1920
4	29	June 14, 1916	18	Jan. 6, 1917
			5	July 27, 1918
			13	June 17, 1919
			5	Summer, 1920
5	10	June 5, 1916		
	19	Aug. 3, 1917	10	Aug. 3, 1917
Totals..	116		127	

Engine House Organization.

The faculty of presenting a familiar subject in a new light is not given to every one, but that it can be done is evidenced by many of the earnest railroad men who contribute to the meetings of the various railroad clubs throughout the country. Among these E. R. Webb, Master mechanic of the Michigan Central Railroad, at St. Thomas, Ont., is a shining example. His fine faculty of condensation is beyond praise, and worthy of imitation. At a recent meeting of the Central Railway Club, held in Buffalo, a paper prepared by Mr. Webb, but who was unable to be present, was read by M. R. Bensen of the Michigan Central. The subject referred to "Engine House Organization," and was as follows:

To have a proper engine house organization it would be necessary to first have proper supervision. This means to have enough of the right class of men to handle the work according to the size of the engine house and the number of engines despatched per day. The next in connection with the organization is the system of handling the work.

When the engine arrives at the coal dock after making its trip, and has a full pressure of air, the air brake inspector should be assigned to inspect all the air, steam heat and scoop operating equipment and report any defects which he may notice. This inspection should take place while the engineer is inspecting the engine, and be reported to the engine house office as soon as the inspection is finished, so that the work report will be made out at the same time that the work is reported by the engineer.

The engine is then handled by the hostlers, coaled, sanded, fire dumped, watered, washed off and placed in the engine house. As soon as the engine arrives in the engine house, boiler, machinery and tank inspectors should thoroughly inspect it and the work reported to the engine house office as quickly as possible, so that it may be included with reports by the engineer and air inspector. This work should be copied off on forms and distributed to the different departments. When it is finished the heads of these departments should have the men who have done the work sign the slips so that in case of inferior work or other trouble, the work can be traced to those responsible. The foreman should then take the slips into the engine house office, where the work is checked off the work book and the slip filed. As soon as the foreman of each department completes the work on a locomotive he should O. K. the engine on a board, which should be in every engine house, and made so that there is a place for each foreman of a department to O. K. his work. When the engine is reported O. K. on the board, final inspectors should then go over the engine and see that the work has been done properly and that nothing has been missed. The board or reports to the engine house foreman should then be O. K.'d. The engine is then ready for service.

In case an engine comes in that is due for quarterly or monthly inspection, or hydrostatic test, orifice test or washout, a man designated to look after the reports, should have a stenciled sign placed on the front of the engine showing any or all inspections due.

Proper drop pits, machine shops, and tool rooms are a very essential part of the engine house equipment, and should be kept up to a high standard so that the very quickest turns that are always occurring in engine houses will not be delayed on account of having inferior machines, tools or drop pits.

It is also very important that the road foreman of engines should keep in close touch with the engine house organization and report needed work, so that the report of needed work is in the engine house office when the engine arrives at a terminal.

Many other essential features in connection with the engine house equipment add to its efficiency, such as heat, light and ventilation, proper facilities for handling material, wash rooms and lunch rooms. Every effort should be made by the men in connection with the engine house organization to maintain the force in a harmonious and willing spirit as it is essential that all in such an organization pull together.

Railroad Earnings for November.

Considered from the standpoint of what they should earn under the new rates, the railroads in November made a much worse showing than in October, according to reports filed to date with the Interstate Commerce Commission.

With more than 100 Class 1 roads reporting, covering approximately two-thirds of the country's mileage, net operating income for November amounted to $35,000,000. All the carriers in that month should earn $99,598,000 to show their full quota of the 6 per cent return on their property investment. On the basis of the actual earnings of the reporting roads, all those in the Class 1 group will fall short of this total by about $47,000,000.

The figures compiled for October revealed that the carriers fell approximately $20,000,000 short of the amount needed to meet the 6 per cent return. The November returns, however, are better than for the corresponding month of 1919, when net operating income amounted to only $22,000,000.

Suggestions for Greater Economy in the Repair and Maintenance of Steam Locomotives

By M. A. BLAIR, Instructor, Detroit Technical Institute

Unnecessary Work

This heading includes work that is absolutely unnecessary and some work that has been made necessary by the lack of thought or provision for the future. The first is caused by unintelligent work reports. They may be neatly written and clearly worded, but developments prove them unintelligent. Many officials may not believe this to exist to an extent worth noticing, but it does, on nearly every railroad. Many round house foremen do not notice it, for it is what they have been accustomed to for years, and it passes unquestioned. It will be worth while for any round house foreman to make a note of all unnecessary work that is done under his supervision for thirty days. This, of course, along with an effort to learn what is necessary and what is not. He will find many pistons and valves drawn that were not blowing, boiler checks ground in when it is the injector steam ram leaking, or the reverse; distributing valves taken off and examined when a little thought would have showed the trouble to be elsewhere; air pump packing rings changed on one pump, when it is the other pump that needs repairs, and many other things. Admitting, it is sometimes difficult to locate a blow; it certainly is not necessary to draw and examine both pistons, both valves and the by-pass valves. A round house foreman can do nothing to better this: The work is on the book for him, and he can not take any chances. This is one instance where a more intelligent day's work will bear good results.

The second class of work under this heading: Work that is necessary, but that could have been prevented, is caused by the lack of co-operation between the round house and back shop. There are some specific cases of this. On some roads, all main rod brasses, and main connection side rod brasses (where used) have to be reduced within two or three weeks after the engine comes from the back shop. The brasses are bored one sixty-fourth to three sixty-fourths large for the pins and are put up as they come from the boring mill or lathe. It is true, all pins not turned will be slightly tapered and not perfectly round; consequently the machine man can not make a perfect fit, although some men handle a taper pin or journal very nicely, but these are exceptions. But the rod man can fit these brasses in forty-five minutes each, while it requires a machinist and helper in the round house at least two hours to do each brass, for he has to take it down, fit it, and put it up. In the back shop the only additional time required is the time necessary to fit it. It is down and has to be put up. There is to be considered both the mechanic's time and the time the engine is held. Then there are the front knuckle pins which have to clear the main rod. As engines are turned out by many shops, if they were absolutely rigid laterally, there would be possibly a sixteenth of an inch clearance between the main rod and knuckle pin, but as this is not the case, after the first few trips the engine makes the pins are taken out and faced, also the nut or nuts, to prevent striking the main rod. The back shop is the logical place to perform this work. This particular case of knuckle pins is a trifle but, happening many times as it does, and combined with many similar things, is worthy of note. It is by correcting the many small errors that the whole system can be improved.

Another operation in the round house on engines recently from the back shop, is filing the sharp edges of valve, cylinder, and air pump packing rings. Many claim beveled or rounded edges on packing rings are beneficial to lubrication. This is dubious; it is not the practice on marine or stationary steam engines; but if it is beneficial the proper place to file or grind the rings is the back shop and not the round house. All the cylinder, valve and air pump rings can be beveled in the back shop, before they are put in, by one man in an hour. In the round house it takes a machinist and helper at least eight hours to do the same work, as he has to draw the pistons and replace them. In certain places this is a regular system in the round house, on all engines from the back shop. Main and side rod brasses, knuckle pins; cylinder, valve and air pump rings to go over within thirty days.

Brake Rigging

There is much work caused by broken driving brake hangers, hanger pins and other parts of brake rigging. Such accidents necessitate expensive repairs and long hold up to power. Generally, hangers and hanger pins are of sufficient strength to stand the stresses they are subjected to under proper conditions—but they were not designed to stand the stresses main reservoir pressure in the brake cylinders imposes on them. It is a common occurrence to apply the brakes with the independent brake valve and see the brake cylinder pressure rise to or near main reservoir pressure. The circumstance that brake rigging parts are built much stronger than ordinary conditions require is all that prevents more brake rigging failures than there are. In connection with high brake cylinder pressure with an independent application it will be found that the reducing valve to the independent brake valve is stuck open, and the pop-valve on the distributing valve is stuck closed, or the adjusting screw of the pop valve is tightened far beyond the pressure limit set by the proper authorities. Besides the damage to brake rigging and rough braking of a train, tires are often spotted or skidded by this high brake cylinder pressure. Other than adjustments, new brake shoes, cylinder leathers and gaskets, brake rigging work in the round houses can be almost entirely eliminated; by the attention to air pressures, the use of hanger pins and beams with a good radius at all shoulders, instead of a nearly square cut, and the strengthening of certain parts which are known to be weak.

State Ownership Doomed in Germany

German State railroad ownership, long the envied model of European nationalization enthusiasts, is doomed, according to the Berlin correspondent of the New York Journal of Commerce (December 8). The railroads are to be removed from official management, to be separated in their finances entirely from the State finances, and to be put under an independent, publicly controlled corporation which will manage them through non-bureaucratic technical and commercial experts.

On September 22, the Journal of Commerce says, the Cabinet formally came to this decision; and at the same time decided that Federal Posts should be denationalized in the same way.

In March, the railroad department announced that a "self-governing body" would be entrusted with conduct of higher railroad policy. By "self-governing body" is meant an elected council representing the business interests affected by the railroads and also representing the railroad employes. That is, a body more or less of the kind already controlling coal, iron, potash and coal-tar. For this plan, as far as it concerns the railroads, nothing has yet been done. But the decision of September holds good.

Probably denationalization will be carried through piecemeal. The indication of this is another official statement, made by Federal Railroad Minister Groener on the fourth of this month. "The construction and repair shops, hitherto managed along with the traffic branches," said Herr Groener, "will have to be detached, and put under technical control on private business lines."

New 4-4-4 Type Locomotive for the Metropolitan Railway, London, England

By W. PARKER, President, Railway Club, London

Specially designed by the Company's Locomotive Engineer, Mr. Charles Jones, for the duties and conditions prevailing on their country extension lines, eight powerful tank locomotives were recently ordered by the Metropolitan Railway from Messrs. Kerr, Stuart & Co., Ltd., and delivery of the first of these has now been made.

These engines, with their special wheel-grouping, marked flexibility of wheel-base and high speed attainments have proportions such as approximate to those of heavy main line express locomotives, and form a useful addition to the company's locomotive stock.

The following are particulars of the leading dimensions and features:

Cylinders, 19 ins. dia. x 26 ins. stroke. Heating surface, in tubes 765 sq. ft.; flue tubes, 281 sq. ft., 1,046 sq. ft. Heating surface in superheater elements, 268 sq. ft. Heating surface in firebox, 132 sq. ft. Total heating surface, 1,446 sq. ft. Grate area, 214 sq. ft. Working pressure, 160 lbs. per sq. in. Tractive force at 80 per cent boiler pressure, 17,411 lbs. Tractive force per ton of adhesive weight, 446 lbs. Weight of engine, empty, 61 tons. Weight of engine in full working order, 77 tons.

The overall length of locomotive over buffers is 41 ft., 10½ ins., with a total wheelbase of 33 ft., 6 ins., rigid wheelbase, 7 ft., 9 ins., bogie wheel, 6 ft., 6 ins., driving wheels, 5 ft., 9 ins. diameter, bogie wheels, 3 ft. diameter. Adhesive weight of 39 tons on coupled wheels, giving a calculated tractive force of 17,411 lbs. at 80 per cent boiler pressure and 446 lbs. per ton of adhesive weight, a figure calculated to give quick starting.

The outside cylinders are slightly inclined and are actuated by internal admission piston valves 10 ins. diameter, the valve gear being the Walschaert type. The boiler has a barrel of 5 ft. diameter, containing 147 tubes 1¾ ins. outside diameter and 18 superheater smoke tubes 5¼ ins. diameter. The "Belpaire" firebox has a grate area of 21.4 sq. ft. The side and end tanks have a combined capacity of 2,000 gallons and the coal bunker contains 4½ tons of fuel. The locomotive has a neat appearance.

4-4-4 TYPE LOCOMOTIVE FOR THE METROPOLITAN RAILWAY OF LONDON, ENGLAND.

Domestic Exports from the United States by Countries During October, 1920.

STEAM LOCOMOTIVES

Countries	Number	Dollars
France	2	31,417
Italy	2	30,947
Spain	4	152,800
Canada	14	105,702
Panama	4	6,456
Mexico	8	128,223
Cuba	47	1,631,093
Argentina	18	762,000
Brazil	2	32,350
Chile	2	4,940
Peru	2	22,330
China	18	633,000
British India	6	189,000
Japan	2	20,000
Philippine Islands	1	8,630
British West Africa	2	53,662
Portuguese Africa	4	83,200
Total	138	3,894,750

Industrial Railway in Argentina.

Financiers in Argentina contemplate the purchase of the narrow gauge railway which the American army constructed in Bordeaux, France. The material will be transported to the province of Santiago del Estero and reconstructed for the purpose of opening up immense tracts of timber land in that province and in the northern part of Santa Fe. It will furnish a connection with the existing French narrow gauge line. The construction will be economical and the development already assured.

Railroad Equipment in Poland.

It is reported that under normal conditions 150,000 cars will be required for the railroads of Poland. There are at present only about 60,000 and nearly all in bad repair. Orders have been given for about 1,000 and are already being received; 1,200 locomotives have been ordered, and it is hoped that in a year or two the Polish manufacturing establishments will be in a position to meet the bulk of the demands both as to quantity and quality. Works are being rapidly equipped at Posen, Lemberg, and other points.

American Locomotives in Spain.

Fifteen American steam locomotives were recently placed in service on the Andaluces railway in Spain. This is the first instance of the use of American locomotives on this railway system, and it is understood that if these prove satisfactory 40 more will be purchased, 20 more of the same type and 20 heavier engines. At the present time this road is using French, Belgian, German, and British locomotives. The standard Spanish railroad gauge is considerably wider than the American—5 feet 4¾ ins.

Cuban Railways.

The Havana United and other railways in Cuba, are buying large quantities of rolling stock of which they are badly in need, and all of which has come from the United States. There are several smaller railroads also in Cuba, constructed to some isolated portions of the island. Most of these are of standard gauge, and largely controlled by British interests and have previously been supplied with British railroad material. This source of supply has been reduced to a minimum, thereby creating an increasing demand of American material.

Decline in Car Shortage

With reference to car shortage, there was an almost steady increase from March to August, after which the number declined to its lowest level in November. This means that even with the heavy traffic handled by the railways in July and August, they were not fully able to keep up with shippers' demands for cars, and that the situation was gradually gotten under control after September 1. The high week of the period since March 1 was the fourth week in August, with 147,307 cars, while the low week was the third week in November, with 30,724 cars.

In regard to car accumulations, generally known as car congestion, there was steady improvement from April to November. The second week in April showed accumulations of 288,152 cars, which was reduced week by week until the November average of less than 30,000 cars was reached. Normal conditions usually involve some car congestion, especially at seaport terminals,

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:
JAMES KENNEDY, Managing Editor.
GEORGE L. FOWLER, Associate Editor.
J. SNOWDEN BELL, Associate Editor.
A. J. MANSON, Associate Editor.

London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $3.50 or fifteen shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

The Real Cause of Improved Service on the Railroads.

Perhaps the most loudly heralded event in relation to railroad traffic that occurred in the past year was the return of the railroads to their owners. The marked increase in efficiency has been looked upon in many quarters, especially in the seclusion of editorial rooms, as a sign of incapacity in governmental management. The fact seems to be overlooked that the same men, almost without exception, were in charge during the period of government control as were previously engaged in that occupation, and have experienced little change since, other than the usual changes that constantly occur in all widely spread enterprises. Only the conditions were different. Armies and army equipment had a preferential claim on the public highways. Railroad men themselves—the best of them—were called to the battle line. It would be idle to suppose that the usual traffic arrangements or equipment could be maintained. It should be a matter of congratulation that a comparatively fair degree of efficiency was maintained. Even when victory had crowned our efforts in battle, the unusual call for transportation preferences, with their consequent confusion and congestion, was not over, but may be said to have continued until the last battalion, bag and baggage, were returned to whence they came.

Government control of railroads in America need not be looked upon as other than a desperate measure in a desperate emergency. Politicians are neither by training or by instinct qualified to run railroads. As a rule, they have greatly hindered railroad development. The taint of dishonesty that attaches to the general character of politicians manifests itself in the peculiar habit of thinking everybody else dishonest. Hence the absurdly repressive attitude of the governmental commissions that have tended to cramp railroad development, particularly in the present century. In analyzing this evil spirit of repressive paralysis it is not hard to discover that it was based largely on the assumption that owners and promoters of railroads were not to be trusted—that there had been unscrupulous adventurers among them in the early days—which is undeniable—and in the eyes of the shrewd politicians there must be a continued necessity of watching lest a recurrence of frenzied finance swamp legitimate enterprise in a flood of watered stock.

Government control of the railroads has shown the absurdity of this spirit of repression. This is a victory as genuine as the crushing of Kaiserism, and is the underlying motive that led to the passage of the Transportation Act, insuring a fixed minimum of interest on the work involved in transportation, and is the cause of the real progress that is being reported from every railroad throughout the length and breadth of the land. The Interstate Commerce Commissions see with larger, other eyes, and a very considerable measure of common sense seems to have entered into its deliberations, and we indulge a hopeful assurance that instead of seeing the vast enterprises that have opened up the continent with lines of transportation being constantly kept on the brink of bankruptcy, or in the pitiful predicament of beggarly receiverships—crippled in development and defaulting in interest—the day is here now when the accomplished, masterful men who have devoted their energies to the development of railroad traffic are relieved of the haunting, muffled misery of financial failure, and in the clarified atmosphere of substantial economic conditions, can give their undivided attention to the special branches of the work to which they have been trained and called upon to do.

It may also be said that as a natural outcome of this righting of a great wrong, the thrifty, prudent people who are in a position to look for opportunities of investment will not hesitate to risk their honest savings in railroad enterprises. They may rest serene in the cheering confidence of a substantial return, and so beget a satisfying spirit of self-complacency akin to that of a retired banker.

The Actual Superheat.

It was the custom for many years for engineers to base the strength of structures on the ultimate strength of the material that they used and the custom still prevails of calculating the factor of safety on that same basis. But the phenomena of repeated stresses and the fact that the material loaded to or beyond the elastic limit will, eventually, break, has led to the careful consideration of the limit of elasticity as the controlling element in determining the real factor of safety.

Curious enough, the reverse method has prevailed in the determination of the estimates as to the amount of superheat available in a locomotive engine. If the steam pressure is 200 lbs. per sq. in. which corresponds to a saturated steam temperature of 388° Fahr. and the temperature in the superheater header is 625°, then we are said to have 262° of superheat. Whereas the amount of superheat in the steam as it enters the cylinders is much higher than this, especially in the case of the Mallet engine. The drop in steam pressure between the boiler and the high pressure steam chest, even when working at full stroke cut-off and running slowly is very marked. During some recent investigations it was found that in a run over a division that included some very heavy grade work, there was never more than 150 lbs. pressure in the high pressure steam pipe close to the steam chest, and that while running down a river grade at speed of from 20 to 25 miles per hour, the pressure at that same point ranged from 40 to 60 lbs. per sq. in., and that with a boiler pressure ranging from 195 to 200 lbs. per sq. in.

At the same time the steam temperature was indicated as ranging from 500° to 550°. The saturated steam temperature for 40 lbs. pressure is 287° Fahr. and for 60 lbs. it is 308°. So that even with the low temperature here indicated, there was a superheat of from 192° to 263° Fahr. In another case over a long series of observations with the same type of locomotive, the steam pressure being 200 lbs. per sq. in., the average initial pressure was 125 lbs. and the temperature of the superheated steam at the entrance of the steam chest was 625° Fahr., giving an average superheat for the initial cylinder pressure of 268° Fahr.

It is evident that the effect in the cylinder, that is the temperature of the exhaust, will be higher with the amount of superheat that these figures indicate, than if a flat 237° of superheat were to be added as when the total over the saturated steam at 200° lbs. pressure is used. In one case the steam would be considered as having 237° of superheat and in the other it would be 268°. In discussing the amount of superheat with a result that the engine probably shows a greater economy than it would, theoretically, be entitled to were the actual superheat of the steam, as used, to be that which is attributed to it, while the superheat apparatus does not get the credit for the superheat developed in the steam as used.

Of course, as far as engine economy is concerned, it makes no difference to whom it may be attributed and the superheat may be 10° or 500°. The point of interest is that an economy as compared with the saturated steam engine is obtained. But, in an analysis of the cause of the saving it is well to take account of these items in the manifestation of superheat.

Jigs for Drilling

It may be taken as an axiom, that in the designing of jigs there will be five parts for judgment and experience. The matter of actual cost will, of course, come first, and then convenience in handling by the operator; the second factor will include consideration given to the weight of the jig, so as to allow of it being moved about easily. Then, again the designer will have to take into consideration the degree of accuracy required, and will also to some extent have to make allowance for the type of drilling machine in which the jig will probably be used. For instance, it is good practice, and generally the rule in first-class work, to make the base of the jig to stand on either three or four feet. But there are objections to this method. Suppose the jig is to be used for some old type of drilling machine which has seen the best of its days, the table of the drilling machine will brobably be full of holes, and the slots broken away, and it would be impossible to make the jig stand on the table without rocking. In a case of this kind it is better to do away with the feet, and make the base of the jig a flat plate, which would give it a better chance to lie evenly.

Having finally decided on the base of the jig, we must next consider very carefully the article or detail which we intend to drill. If it is a casting and there is any part of this casting machined that will be the part from which we shall work; but if the casting is just the same as when it came from the foundry then we shall have to make allowance for probable variation in size, and, of course, cannot expect to be very accurate. Again, if the article to be drilled is a forging, made on the anvil, and no part of it is machined, there will probably be a still larger variation in size. But if the article should be a drop-stamp forging then we may expect uniformity in size within certain limits. And the designer of drilling jigs for drop-stamp forgings will be well advised to allow for the fact that the print in the drop stamp dies gradually enlarges with use, and that the first forging stamped as compared with, say, the 999th, will show a difference in size. In most cases this increase in size will be immaterial, but it would be very annoying to the operator using the jig to find that after a time he could not get his forgings to sit properly in the jig. Therefore it will be necessary to so construct the jig that it can be very easily enlarged to suit the increased size of a forging, without altering the accuracy of the holes.

The design of a jig will naturally depend on the character of the work to be done, the number of pieces to be drilled and the degree of accuracy necessary in order that pieces drilled may answer the purpose for which they are intended. It is also just as well to remember that it may often be possible, by the use of a jig, to do the work on some old drilling machine which otherwise would have to be done on a more valuable machine. The designer will also have to use his discretion, and see that time is not wasted by working to .002 of an inch, when perhaps 1-6th of an inch will be near enough. After having finally decided on the construction of the jig we shall still have to see that allowance has been made for all cuttings to get away easily.

Locomotive Cylinder Parts

The investigations of the Bureau of Standards has shown that frequent renewal of cylinder parts of locomotives results in greatly increased cost of maintenance to the railroads, and consequently the quality of the cast iron entering into their construction is a matter of paramount importance, particularly from the standpoint of wear. These parts include piston-valve bushings, piston-valve packing rings, piston-valve bull rings, cylinder bushings, piston packing rings and piston-head or bull rings. It was found that ordinary high-silicon cast iron gave unsatisfactory wear, particularly in modern superheater locomotives, and the tendency has been towards a harder and stronger iron.

It was found that air-furnace iron is more uniform in character and in general of somewhat better mechanical properties than cupola iron. The latter, however, often equals or even excels the air-furnace product in mechanical properties. Because of the many variable factors, it was difficult to establish correlation between laboratory and service tests. It was recommended, as a result of the present and other investigations, that the transverse-strength requirements of the Standard American Society for Testing Materials 1¼-inch Arbitration Bar be increased from 3,200 to 3,500 lb. for castings ½ in. or less in thickness, and from 3,500 to 3,800 lb. for castings over ½ in. in thickness.

Outlook for the Year.

Mr. Thomas De Witt Cuyler, chairman of the Association of Railway Executives, commenting on the outlook for the new year claims that "the statement is being made in various quarters that the railroads will shortly seek a further increase in rates. I know of no movement on the part of the railroads for a general increase in rates, nor do I expect any. It is true that the railroad companies are not yet receiving from the increased rates anything like the six per cent return needed. But the railway executives realize that they are trustees of a great public interest in the reduction of railroad operating expenses to the lowest possible figure, and every effort will be made during the coming year to accomplish this by further economics and efficiency.

"Private ownership and operation of railroads as a measure of sound public policy rests largely upon its superior efficiency and economy. In my judgment the American railroad companies during the present year have fully justified, and during the coming year will make every effort to continue to justify, the support and confidence which public opinion in gratifying measure has already accorded them."

A New Milling Tool.

An engineer in Europe has introduced a new device in the form of a milling tool which produces a finished surface equal to the best obtainable with hand filing. The cutting edges of this machine are similar to those of a file, but arranged spirally so that it is only necessary to press the work against the revolving cutter in order to get a true surface. The machine will cut through the mill scale of rolled sections and polish them bright in a remarkably short time. It will similarly cut through a crust of castings and give a bright smooth surface. It is conceded that a mechanic with a new file can cut one-fifth oz. of filings from a rough casting in a quarter of an hour, while the new machine will cut better than 17½ oz. in the same time from the same casting. What is more, the cutting member of the machine is said not to clog, and can therefore be used for a number of metals such as lead, copper, tin and zinc, as well as for such materials as hard rubber, slate, marble, celluloid, hard wood, bone and so on,

Announcement.

Beginning in the February issue of Railway and Locomotive Engineering a series of articles on "The Early History of Railroad Cars," from the pen of J. Snowden Bell, will be published.

Important Announcement by the Pennsylvania Railroad Company.

The Pennsylvania Railroad issued an announcement in the closing days of 1920, that a series of boards had been formed, made up of representatives of the men and the company, for the consideration and settlement of all questions, including discipline, that may arise between the corporation and its employes. The road in making the announcement says that the agreement, "if lived up to in spirit by both sides, in the belief of the management, eliminates any question of strike on the railroad, as far as train operation is concerned."

The right of the men to strike is not limited or curtailed. They may strike if they wish, but the danger of their doing so is greatly minimized. In the new agreement the shop men, telegraphers and the less skilled employes are not included. Eventually it is understood arrangements similar to those made for the men in the train service will be set up. The group of employes is made up of the engineers, firemen, hostlers, conductors, trainmen and switchmen. Those with representatives of the company, have set up what will be known as the "Joint Reviewing Committee of the Pennsylvania Railroad System." On this board the representatives of the men will have equal vote with the company heads. To it all controversies arising in the train and engine service involving rules, working conditions and discipline will be referred for final action. The votes of two-thirds of these will be necessary to obtain a decision.

Junior to this board is a system of regional and division boards. Each division superintendent will meet the chairman of his division each month for the settlement of matters that may arise on the division. The general superintendent will also meet the general chairman each month, as will the general manager of each region. Under this system any matter in controversy first goes to the local chairman and the division superintendent, and will be appealable to the conference, and eventually to the joint reviewing committee.

The results arising from the step that the company and its employes have taken will be watched with keen interest. We are hopeful it may be the beginning of a new era of a settled condition in transportation work, a consummation devoutly to be wished for.

Temperature of Steel in Equatorial Sunshine.

Some investigations carried out by the United States Weather Service to determine the maximum temperatures of steel exposed to the direct rays of the sun are described in a recent issue of the *Monthly Weather Review*. The tests were made at Balboa Heights, near the Panama Canal on steel blocks measuring 2 in. by 2 in. by 12 in., laid on boards on a concrete pavement and sheltered from the wind. The thermometers were immersed in mercury-filled holes in the centres of the blocks. The highest temperature recorded was 133 deg. Fahr., measured at 3.30 p. m. towards the end of April. It is thus suggested that the maximum temperature of steel exposed in that locality is not likely to exceed 140 deg. Fahr. Comparing the climatic conditions with those of various parts of the United States, the investigator estimates that the maximum exposed steel temperatures in the deserts of the Southwest may reach 169 deg. Fahr. or higher. That very noticeable effects are produced by the expansion caused by one-sided heating has been observed in the case of the steel spillway gates of the Panama Canal, the leakage through which is greater in the daytime than at night, on account of the action of the sun shining on one side and causing the gates to buckle or warp slightly. Another set of measurements was made to compare the heating of blocks of steel painted with different colors. At the maximum, from 12 to about 2.30 p. m., with the air temperature in the shade about 88 deg. Fahr., the temperatures of white, red, green and black blocks respectively were 112, 114, 123 and 128 deg.

Shortage in Railroad Earnings.

The Bureau of Railway Economics announces that the class one railroads of the country, according to its calculations, made a net operating income of less than $80,000,000 during the month, as against the $109,000,000 that they should have made, so it holds, to approximate a return at 6 per cent. a year on their capital. This assertion made on the roads' behalf may well foreshadow application to the Interstate Commerce Commission for a supplementary raise in rates.

We pointed out some time ago the fact that the recent earnings coming to notice from time to time failed to justify the extreme favorable expectations that had been formed. It seemed then and seems still that the September inadequacy might be due to temporary drawbacks. Transitions do not generally effect their complete results right away.

Another element has come forward in the past month as likely to affect railroad income. Business depression has become marked. The fall in wholesale prices of manufactured goods and the spread of unemployment form its first manifestation. Reduced merchandise output must follow. This will entail a reduction of railroad traffic; less goods made, less goods carried. Traffic shrinkage will cut railroad gross earnings, and other things being equal, railroad net income as well.

Were the roads their own masters they could take what came. But the Government has taken from them the power to fend for themselves and has explicitly obligated itself to see that they make a living income.

Trucks on Curves.

At the meeting of the Railroad Section of the American Society of Mechanical Engineers, held early in December and presided over by E. B. Katte, chief engineer of electric traction of the New York Central lines, a paper was presented by R. Eksergin, of the Baldwin Locomotive Works, on the subject of the static adjustment of trucks on curves, and contained a thorough analysis of all that may be said to be known on the subject. Lawlord H. Fry, of the Standard Steel Works, contended, however, that a full consideration of the subject had not been manifested in locomotive design. It was claimed that greater consideration should be given to the element of stability in locomotives running at high speeds on a straight track than on the question of compensating for stresses induced by the operation of the locomotive on curves. In the latter case the wheel flanges on one side of the locomotive lie against the ball of the rail in such a manner as to steady the locomotive, whereas on a straight track the nosing of locomotives running at high speeds was a more difficult problem to contend with, and if this difficulty could be overcome by improvements in the design of the running gear, the difficulty in regard to curves would disappear.

Drifting.

Blows caused by drifting an engine with the closed throttle are due to little or no oil reaching the wall of the valve chamber, as the oil will settle in the pocket which is invariably found between the front and the back valve bushings. Air drawn to cylinders through the cylinder cocks is compressed in the cylinders, enters the valve chamber through by-pass valves, but does not have enough expansive force to disturb the oil that settles in the pocket of the valve chamber. And should the oil in the valve chamber pockets be disturbed by the compressed air from cylinders being forced into the valve chamber, it will not travel any further than the valve chamber walls, and if the engine is drifted any distance it will become very dry, causing increased friction both in the valve chamber and cylinder, resulting in the badly worn cylinder packing rings, and sometimes badly worn pistons on saturated engines, while on the super-heated engines the liabilities are greater, owing to the temperature of the cylinder being above the flashing point of the oil. When the throttle is closed the cold air is drawn to the cylinders through the cylinder cocks, which causes the lubricant clinging to the walls to be destroyed and a consequent loss of energy.

Development of the Locomotive Auxiliary Tractor

By J. SNOWDEN BELL

The desirability of effecting a temporary increase in the tractive power of a locomotive having a portion of its weight supported on wheels which were not operative as driving wheels, to be availed of in starting trains or ascending heavy grades, was recognized very early in railroad practice. The unprecedented, and previously supposed impossible, performance, in the year 1836, of the little Norris engine "George Washington", in hauling a load of 31,720 pounds up the inclined plane at Philadelphia, the grade of which was 369 feet to the mile, at a speed of 15½ miles an hour, (which Zerah Colburn said "took the engineering world by storm and was hardly credited") was due to the application of a primitive form of *traction increaser,* by which a portion of the weight of the tender was put on the driving wheels. No record of this device has been preserved, unless possibly, it was that of E. L. Miller, patented June 19, 1834, which was applied by M. W. Baldwin, of Philadelphia, for some years thereafter. Various designs, intended to temporarily increase the weight on driving wheels, have since, from time to time, been proposed and experimented with, but none of them has stood the test of practice sufficiently to receive approval and acceptance.

1. KEITH PATENT NO. 403,758, MAY 21, 1889

Succeeding the *increased weight* traction increaser above noted, the next proposition which was made for effecting an increase in the tractive power of a locomotive above that limited by the weight on its driving wheels, was that of applying a set of independent motors, all taking steam from the locomotive boiler, to truck axles of cars in the train. This design first appears in the U. S. Patent of J. M. Keith, No. 403,758, dated May 21, 1889. The specification makes the following statement.

> "The equipment being such as described, it will be seen that each motor will receive live steam from the boiler independently, and will exert its power upon the particular car to which it is attached. If each motor, for example, be of six horse, a one hundred horse power boiler will supply eighteen motors and propel a train of that number of loaded cars up heavy grades with ease and speed."

A design of the same general character in the subject of U. P. Patent No. 638,-801, granted to R. M. Dixon, December 12, 1899, which is stated as providing

> "an auxiliary motor or motors adapted to assist the locomotive or main propulsive member of the train in quickly starting and hauling heavy trains."

The Keith and Dixon designs are similar, in principle, to the old Sturrock "steam tender," (British Patent No. 1135 of 1863), which was used to a slight extent in England, many years ago, and more recently revived in this country, by the Southern Railway and the Baldwin Locomotive Works, ("Triplex").

2. KRAUSS & CO., PATENT NO. 516,346, MAY 13, 1894

The objections to the application of driving power to vehicles in a train, other than the locomotive which hauls it, are sufficiently apparent to account for the limitation of designs based upon that principle to a comparatively small number of steam driven tenders, and the presentation of means, on other lines, for supplementing the tractive power of the locomotive by applying driving power, during such periods as it might be found necessary or desirable to do so, to an axle of the locomotive which was not, under ordinary working conditions, a driving axle. The earliest instance of such a design that the writer has been able to find of record is that of Krauss & Company, of Munich, Germany, which appears in the United States Patent of R. Helmholtz, (assignor to this Co.), No. 516,436, dated March 13, 1894, a reproduction of Fig. 6 of which is here shown as Fig. 1.

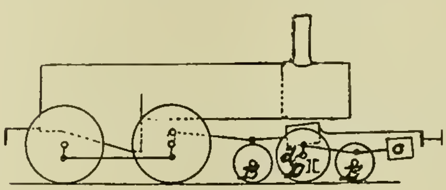


FIG. 1.

As described and shown in the Helmholtz Patent, the tractor is applied in connection with a four wheeled leading truck, and comprises a pair of auxiliary steam cylinders (c), the pistons of which are coupled to cranks on an axle (d), located between the truck wheels (E) and having wheels (D) fixed on it, which, in the ordinary or normal operation of the locomotive, are lifted entirely clear of the track rails. When it is desired to obtain additional tractive power, the axle, (d) of the tractor, is depressed by the pistons of a pair of steam cylinders, so as to bring its wheels (D) into, and maintain them in, driving contract with the rails, and upon the admission of steam to the auxiliary cylinders (c) the wheels (D) operate as driving wheels, the power by which they are rotated correspondingly increasing the tractive power of the locomotive. When the application of this increased tractive power is no longer desired, the pressure is released from the axle, (d), steam shut off from the auxiliary cylinders (c), and the wheels (D) raised clear of the track by springs acting on the axle (d).

3. KRAUSS & CO. APPLICATION ON LOCOMOTIVE, 1897.

The French railroad journal, *Revue Generale des Chemins de Fer,* of April, 1901, illustrates and describes (pp. 398-402, Pl. XXIX) a two cylinder compound locomotive, built by the Krauss works, which was exhibited at the Exposition of 1900, in which the auxiliary tractor of the Helmholtz Patent was applied in the manner above described. In normal operation, the locomotive was of the 4-4-0 type, but when the wheels of the auxiliary axle of the leading truck were applied to the rails, and the axle rotated by the auxiliary driving mechanism, the wheel arrangement became a 6-4-0.

The *Revue* article states that the Krauss Co. had exhibited at Nuremberg, in 1897, an express locomotive in which a similar arrangement was adopted, which, however, had only a single pair of driving wheels. Commenting on the design, the article says: "This evidently rational arrangement, which can be advantageous on certain lines on which exceptionally long and heavy grades are encountered, is not, nevertheless, free from bringing a complication which, certainly, is far from being negligible."

The locomotive that was shown at the Exposition of 1900, is also illustrated and described in *Le Genie Civil,* August 11, 1900, (pp. 265-268, Pl. XXIV), and the side view of the locomotive which appears on page 265, is here reproduced as Fig. 2. Further references to the Helmholtz design will be found in the *Railroad Gazette,* September 7, 1900, p. 589, and the *Railway Engineer,* London, September 1, 1900, p. 260.

4. LEICHTY PATENT NO. 970,512, SEPTEMBER 20, 1910

The auxiliary tractor arrangement of this Patent is, like that of Krauss & Co., designed for application in connection with a four wheeled leading truck, but differs from it in the important particular that it does not comprise an additional axle and pair of driving wheels. It is inaccurately described and imperfectly shown in the Patent, and while it does not appear to possess any elements of practicability, it is here referred to as constituting a step in the development, in its suggestion of the connection and disconnection of a driving shaft, with and from a truck axle, for the application and cessation, respectively, of auxiliary driving power, instead of the depression and elevation of an additional driving axle, as in the prior Helmholtz design.

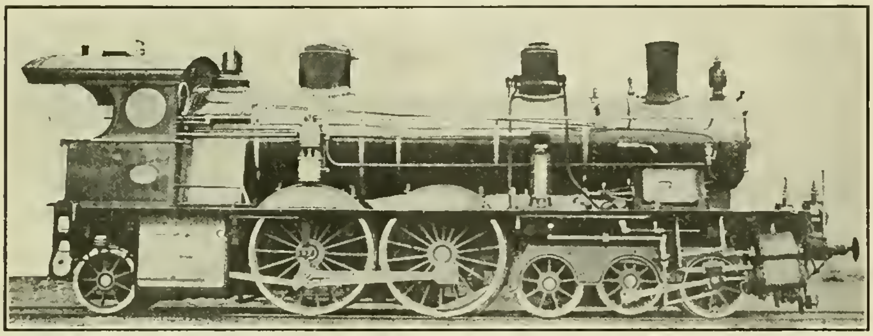


FIG. 2

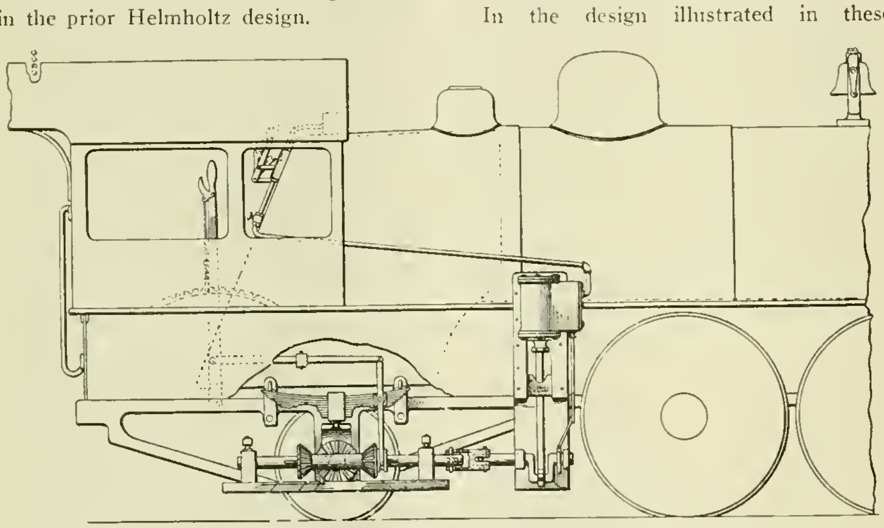


FIG. 3

5. EVANS PATENT NO. 1,136,947, APRIL 27, 1915

The next succeeding step in advance, which is a substantial one, appears in this Patent, and consists in the application of driving power to a trailing axle of the locomotive, instead of to a leading truck. As shown in Fig. 3, which is reproduced from the drawing of the Patent, the shaft of the auxiliary engine carries a slidable sleeve, in which are fixed two bevel pinions, either of which may be moved into engagement with a gear on the trailing axle, accordingly as forward or backward motion is desired, or both may be thrown out of gear. The usual lateral motion of the trailing axle is provided.

The four claims of the Evans Patent are limited to an arrangement of the parts which includes "a flexible joint," in the connection between the motor and the trailer axle, the first, and broadest, being as follows:

"1. A locomotive, having the main driving wheels below the boiler forward of the firebox, a trailer under the firebox and sustaining the weight thereof, and the wheels and axle of which are mounted to shift laterally when taking a curve, an auxiliary engine attached to the boiler, gearing connecting said engine with the trailer axle, and a flexible joint in said connection."

6. INGERSOLL PATENTS NOS. 1,339,395 AND 1,339,513, MAY 11, 1920

In the design illustrated in these Patents, there is a revival of the principle of applying driving power to an axle which is normally only a *supporting* axle, which, as before stated, was proposed by Helmholtz in 1894, together with that of the engagement and disengagement of a motor driven axle with a truck axle, as proposed by Leichty in 1910, and the application of the auxiliary driving power to a trailing axle instead of a leading truck, as in the Evans Patent of 1915. The novel feature of the design consists in a system of fluid pressure and spring actuated pistons and connections, for automatically applying and disconnecting the application of the auxiliary driving power to the truck axle, in accordance with variations of position of the reverse lever of the main engines by the engineer.

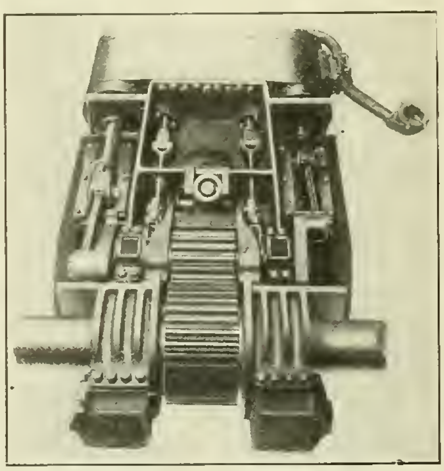


FIG. 4—TWO-CYLINDER ENGINE GEARED TO THE TRAILER AXLE

The Ingersoll tractor, which is termed by the manufacturers who are introducing it, a "booster," was shown during the convention of the American Railroad Association, Section III, at Atlantic City, N. J., in June, 1920, applied on Pacific type locomotive No. 3149 of the New York Central lines. Its construction, other than as to the automatic mechanism above referred to, will be sufficiently clear from the illustration, Fig. 4, and the following brief description which is given in the Bulletin of the manufacturers.

"The Booster consists of a simple two-cylinder steam engine, upon a special design cast steel bed plate, manufactured by the Commonwealth Steel Co. This cast steel bed plate also forms the axle bearings and truck support.

Three-point suspension is provided; two bearings fitting on the trailing axle and a third, which is a ball joint, fitting on the back member of the trailing truck frame. This suspension gives sufficient flexibility to compensate for any torsional movement between trailing truck frame and axle due to equalizing, and in addition, the ball joint is located near the center of gravity of the Booster engine, thereby relieving the bearing on trailing axle normally of the weight and minimizing wear of the Booster bearings."

The appliance is stated, in the Bulletin, as weighing 3,500 pounds and giving 25 to 40 per cent increase in tractive power. A full report of operating tests made with Pacific type engine No. 3149, on the New York Central Lines, will be found in RAILWAY & LOCOMOTIVE ENGINEERING of November, 1920.

7. PFLAGER PATENT NO. 1,357, 928, NOVEMBER 2, 1920

This Patent covers a mounting for the bed plate of the motor of the Ingersoll Patents, which provides three points of support, two of which are on the truck axle, and the third, a sliding and rocking bearing on the truck frame.

8. KELLOGG & SHEEDY PATENT NO. 1,359,-175, NOVEMBER 16, 1920

In this design, as in that of the Evans Patent before noted, the power of the auxiliary motor is applied to a trailing axle, and the characteristic feature of the appliance is the substitution of a rotary motor for the reciprocating engines of the prior designs.

As shown in Fig. 5, which is reproduced from Fig. 2 of the Patent, the rotary motor is mounted directly on the frame of the trailing truck and drives a spur gear on the truck axle. Two pinions are interposed between the motor and the axle gear, one of which is journalled in hangers which swing on the motor shaft, as a pivotal axis, so as to enable the pinion which it carries to be moved into and out of engagement with the gear of the truck axle. The motor is reversible, and the entire appliance is of small compass and appears to be of materially less weight than a double acting reciprocating engine. An auxiliary trailing truck tractor is now under construction for application on the Los Angeles & Salt Lake R. R., but par-

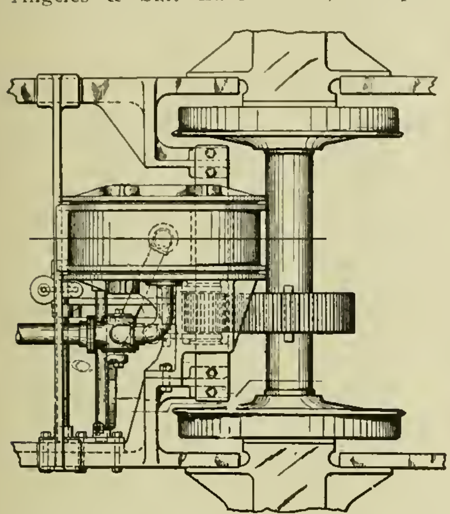


FIG. 5

ticulars of its construction are not yet available.

Based upon the record of development above reviewed, the conclusions of the writer are: *first,* that an appliance whereby a temporary increase of the tractive power of a locomotive may be afforded, will be found to be of substantial practical value; *second,* that the weight and cost of construction and maintenance of such an appliance should be reduced to the minimum; and, *third,* that its design should not contemplate increased power for hauling tonnage after the locomotive has got the train in motion, but should be confined to means for enabling the engine to start the maximum tonnage that it is adapted to handle, from points of rest at which the train could only be started by backing up to more favorable position for a start.

President Willard of the Baltimore & Ohio on the Outlook for the New Year.

"While we have lived in the most interesting period in the World's history, we cannot forget that to many of us the war has brought sorrow and disappointment. However, the war is now happily ended, and, while the cost is yet to be paid, there are many reasons why we should enter the New Year hopeful and with full confidence in the future. Our country has not been invaded by the enemy, we have not lost a million of our young men in battle as has been the case with some of the less fortunate Nations of the world, we have not in this country suffered from drought, crop failure, or great disaster, and we have no cause to fear violent or untried economic or political changes. As a nation we have more than we need of almost everything necessary for life and comfort, and, best of all, we live in a country where all are equal before the law, and where the lowest not only may, but constantly do, rise to the highest station.

Those of us who constitute the Baltimore & Ohio family cannot expect to realize the fullest measure of prosperity as individuals unless the company we serve, and with which we are identified, is also prosperous. I most earnestly request, therefore, the helpful support and co-operation of all—officers and employes alike—in order that we may secure for the Baltimore & Ohio Company, as well as for ourselves, a fair share of the prosperity which I firmly believe the future holds for us all."

Report of the Interstate Commerce Commission.

The annual report of the Interstate Commerce Commission, filed with Congress on December 9, states:

"Comparing August, 1920, with August, 1919, the increased mileage had the effect of increasing the car supply 287,694 cars; the increased tonnage per car had the effect of increasing the car supply approximately 104,942 cars."

The railroad companies have manufactured increased transportation capacity, not out of new cars and locomotives, but out of increased efficiency. If the enlarged capacity provided by the companies during the past nine months had had to be produced by new cars and locomotives, it would have required the expenditure of approximately $2,000,000,000, a sum of money which would have been permanently added to the property value of the railroads, on which the public would ultimately have to pay a return through rates.

In avoiding the expenditure of this $2,000,000,000 or any substantial portion of it; in increasing the efficient use of our present facilities; and in restoring the orderly flow of commodities, the railroads have made a great contribution toward bringing about more normal economic conditions, and have fully met their responsibilities in this period of national readjustment.

For this result, however, the railroad companies do not take sole credit. The help of shippers in promptly loading and unloading cars—using Sundays and holidays as well as weekdays—and the day-and-night, rain-or-shine work of hundreds of thousands of railroad employes in placing and removing those cars and in keeping them moving when once loaded, are gratefully appreciated.

It is the earnest hope of the railroad companies that this will be a National object lesson in the value of co-operation, and will lead shippers, railroad employes, railroad executives and the general public to pull together for an even better showing in 1921.

Double Tracking and Reducing Grades

In addition, a number of important carriers have been double-tracking, strengthening bridges, reducing grades, and other work necessary for the extension of the operation of heavier locomotives and larger capacity cars.

Typical of important projects under foot are the application of heavier power to the Chesapeake & Ohio Railway Company; the building of a double-track on the ruling grade of the Virginian, which will almost double its coal carrying capacity; three big freight yards on the New York, New Haven & Hartford; the elimination of a limiting tunnel on the Delaware & Hudson; the expansion of the Louisville & Jefferson Bridge; the building of a cut-off on the Kanawha & Michigan; flattening curves and reducing grades on the Norfolk Southern; the construction of a big grain elevator at Baltimore by the Pennsylvania Railroad; the enlargement of yard and engine facilities on the Texas & Pacific and the Wheeling & Lake Erie; and the extension of the coal pier of the Western Maryland at Baltimore.

All told, it is estimated that the carriers are spending some $300,000,000 upon such improvements, of which about $70,000,000 is being financed by loans from the fund provided by Section 210 of the Transportation Act, and most of the remainder out of earnings. The operating expenses filed by carriers with Interstate Commerce Commission show that in the six months from March 1 to September 30, the carriers spent approximately $175,000,000 more than in the similar six months of 1919 on the maintenance of their fixed property, and approximately $220,000,000 more than during the similar six months of 1919 on the maintenance of their cars and locomotives.

Some of this increased expenditure, of course, merely reflects the higher wages which the railroads are compelled to pay for such work, but a considerable part of it also represents outright increases in physical reparation necessary to make up deterioration caused during the war period.

Fuel Oil Shortage in Canada.

The oil burning engines of the Canadian Pacific Railway in the Canadian Rockies are now being converted to use coal instead of oil. It is expected that by the first of 1921 all engines running west from Field, British Columbia, to Vancouver will burn coal instead of oil.

Snap Shots By The Wanderer

I had occasion to spend a goodly portion of my nights. some time since in the round-house of a pretty good sized railroad, and one, by the way, that is rather noted for the excellent condition in which it maintains its locomotives and cars. But I think I could live in pretty solid comfort on what it costs that same road to remove from and replace stolen parts on its locomotives. I did not make an examination of its store-house and my inferences are drawn solely from the orders given by the foreman in whose office I spent the greater part of my time. I would hardly state the number of engines that were repaired every night and sent out with parts taken from other engines, but I think that a robbery was committed in order to place fully one-half of them in running condition, and this robbery consisted in the removal and application of all parts of appliances from grate shaker levers to injectors. I wonder who was responsible for the lack of supplies. The road was not poor and the officers were of a high order, but somehow there was this leak, and it was permitted to go on week after week, passing the robbery on from one engine to the next to follow, simply, as it seemed to me, because there was no follow-up.

Like thousands of other unfortunates, I have occasion to use the New York subway trains during the rush hours, and I have been interested to note the difference in the methods of train handling used by the different motormen. Standing at the front door, the signals can be read and the position of the preceding train approximately located. When there has been any delay to a train, those following become bunched and the motorman is constantly confronted by the yellow cautionary signal. There are two ways of passing this signal. One method is to run at high speed through the following block and stop at the next red, with the result that the passengers are continually being subjected to repeated stopping and starting and the company pays the bills for the expensive luxury of such a performance. The other class grasps the situation, estimates the probable average speed of the train ahead, runs at a low but uniform speed, and carries this through from station to station, to the comfort of the passengers and the saving of the company. This thing was emphasized to me the other day by a freight engineer, who said: "I just like to strike an easy gait that I know I can hold, and I know all signals will be clear, and I don't run the danger of break-in-twos." The occasion of the remark was the heading into a division terminal yard just behind the tail lights of a preceding freight, that we had been following for fifty miles. We had stopped just back of this train at a single track bridge that had formed the throat of a double track line. There had been an hour and a half's delay and then we had a long run down a river grade. My man struck his "easy gait" of about 20 miles an hour and held it for the whole distance until he struck a mountain grade, and then he did what he could. Every signal stood at clear as we approached and the throttle and reverse levers were almost untouched, and the brakes were only applied for the water stops. The train ahead was never sighted until we saw its tail lights running into the terminal yard. Certainly it was a beautiful piece of running and a fine exemplification of speed judgment, with the work done at the minimum of cost to the railroad company. No amount of spasmodic speed would have put us into destination one minute earlier. The wonder is that more engineers and motormen do not learn the value of that "easy gait," which does as well as can be done and saves so much material and nervous wear and tear.

The telephone companies of today advertise the fact that it is the "smile in the voice that wins," and centuries ago the Romans had a proverb, *"suaviter in modo, fortiter in re,"* thus recommending suavity in method, and strength in action. And we read and hear preachments advocating courtesy in railroad offices as a means of gaining public good will, and I suppose efforts are being made to train employes to an appreciation and practice of the gentle art. But it has been said that it takes three generations to make a gentleman, and perhaps it is asking too much to expect a boor to put a smile in the voice instanter. But it does seem that a little more progress could be made than is. The occasion for this is that I was in a mountain district recently where trains are scarce and telephone service bad. So I had occasion to inquire at the railroad ticket office for some information, and even asked a favor which, it seems, the regulations would not permit the agent to grant. To refuse would have been all right, but it was not all right to be brutally insolent and turn away in the midst of a passenger's inquiries as to matters pertaining purely to the road. It was information regarding the running of certain extra trains that I needs must have and I thought it would have been an agent's pleasure to have given it. As it was, I picked it up from a casual on the platform after the agent had signified his intention to have no more of me, by turning his back, and going about his work, and not even deigning to look up, when I made further inquiries of him. I wonder what difference it would have made had I told him that I was well acquainted with his superintendent, but I hardly like to use my friends as a lash to bring boors to a sense of duty. I sometimes think that it would be a profitable thing for railroad companies to employ unknown detectives to ask questions of station agents and report the character of their answers, in order to sift out deleterious material and select proper stock for promotion.

It has often occurred to me, and the more I think of it, the more likely it seems that much of the hostility to the railroads on the part of newspapers is not so really real as it is inspired by sensational news. It is so much easier to tear down than it is to build up; so much less exertion to attract attention by vilification and abuse than it is by praise. The life of Dick Turpin is more interesting to the average man than that of Saint Elizabeth. In corroboration of this opinion, a few excerpts from the note book of an engineer may be of interest.

There had been a bad accident. An engineer had run by a signal, crashed into the rear of a passenger train and killed about forty people. In a neighboring city there were two yellow journals, one a little yellower than the other, and each sharing with the public the low opinion of the other. The one of the deeper yellow, straightway started to shield the delinquent engineer and published a long statement to the effect that the engine was in such bad shape and steam was escaping in such quantities from the front that the cab windows were fogged and the signal could not be seen. Here was an opening for the rival yellow. Get pictures of these dilapidated engines en bloc and show the public what an awful thing this railroad was. So straightway a reporter called on the engineer, showed him the article and asked that he inspect the engines involved and make a report to the yellow of lighter shade. The plea was that yellow wanted the truth, the plain unvarnished truth, so as to confute the deep yellow if confutation were possible. The details of the inspection and report were all arranged, when the reporter incidentally asked as to the probable condition in which these engines would be found. When assured that they would probably be found to be in first-class condition, his enthusiasm vanished and a half hour later the arrangement was called off. No sensation, no investigation.

Again, a railroad noted for the high percentage of the safety of its operation had an accident, and was immediately pounced upon by the papers and all manner of exaggerations and untruths were told about it and its methods. So the engineer wrote to ten papers in the same city, offering an article on the road, its methods of purchasing supplies, method of inspection, sanitary precautions and the like. An article that ought to have been of great interest to the public. But it was not available, probably, because it would not have been sensational and would have praised the railroad while previous issues had uttered deep damnation.

And, then, the only comment made by the general manager of the railroad, when told of the attempt, was: "Well, Mr. ———————, I didn't think you would be such a fool as to waste good postage stamps on an errand like that."

He was riding on the tail-end of a train one day when a garrulous individual began a half abuse of the railroad. And while his speech betrayed that he knew nothing of railroading, he was quite jocular over the way in which he had tormented the road in his sheet, the one of deep yellow, for he soon revealed the fact that he was a reporter upon it. "We just go for 'em and give 'em hell," was his comment. "I don't know anything about these matters, and don't want to, but it's easy to stir things up and make a sensation and that's what the public wants and we make a point to give it to them."

And the railroads? They are urged, on every hand, to be more open and above board with the public. Can they be with the newspapers taking the attitude they do? An editorial friend on a technical paper found the making of a good story on a big railroad, but he needed accurate data to make it complete. So he applied to the officer in charge of the department. That officer took the editor into his full confidence and told every detail of the whole thing, and then asked him not to publish anything about it. "We have not done anything illegal, nor anything the least bit out of the way, and if the papers would quote your article as you would write it, we would be delighted with the publicity that we would get. But the trouble is, the reputable papers would probably ignore it, while, take all the care and precaution of which you are capable, and you could not so word it, that the yellow papers could not and would not misquote and distort what you have said so as to give the public a plausible misrepresentation of the whole situation. They could not do us any harm but they could and would cause us a great deal of annoyance. So please do not publish anything in regard to the matter." And nothing was published.

The public wants a sensation and the yellow journals give it to them at the expense of truth, the railroads, the individual or anything else that crosses their path, and the reputable papers will not take the trouble to contradict or set things aright.

What can be done about it?

I don't know.

"'T is true; 't is true, 't is pity; and pity 't is, 't is true."

Report of Operation During October, 1920.

December 2 the Interstate Commerce Commission issued its freight operating statistics of Class I roads for the month of September, 1920, and for the nine months' period ended with September, 1920, compared with the corresponding periods of 1919.

The roads during the month of September, 1920, produced in exclusive freight service 40,651,000,000 net ton-miles. This performance exceeds that of September, 1919, by 1,973,000,000 net ton-miles. The volume of traffic in September, 1920, shows a *decrease* of 2,000,000,000 net ton-miles as compared with August of this year, while a comparison of the corresponding months of last year shows an *increase* of 2,262,000,000 net ton-miles.

It should be recalled that there was a rush in August to take advantage of the old freight rates. This decline in September of this year and the increase recorded in September of last year result in reducing the percentage of increase in September, 1920, over same month of 1919 to 5.1 per cent as against a 17.1 per cent increase shown for August.

The volume of traffic increased 5.1 per cent, the freight train-miles increased 6.7 per cent. The loaded car-miles show an actual decrease of 0.7 per cent, the increase in train-miles being in part explained by an increase of 13.0 per cent in empty car-miles. Because of the increase in empty car-miles, the average train-load shows a decrease of 1.4 per cent, while the car-load increased 6.0 per cent. The per cent loaded of total car-miles shows a decrease of 4.0 per cent and the car-miles per car-day increased 6.4 per cent. The net ton-miles per car-day shows an increase of 7.8 per cent. The cost per freight-train-mile of locomotive repairs, enginemen, trainmen, fuel, enginehouse expense and other locomotive and train supplies shows for the total an increase of 31.3 per cent.

Safety Appliance Ruling in Regard to Cars of Special Construction

Cars of special construction, as contemplated by the Commission's order of March 13, 1911, are cars which can not be equipped with safety appliances as prescribed in the order for any of the specified classes enumerated therein. In the construction of new equipment which does not conform to the specified classes designated in the order, plans shall be submitted to the Commission prior to construction of such cars for the purpose of determining the location and application thereto of all safety appliances required by statute and order of the Commission of March 13, 1911.

Position of Wage-earners.

We do not believe the wage-earning class will be found obdurate when the situation is understood in all its relations. They do not want to lose any real gains, but there are many signs that they will accept lower pay if the purchasing power of their wages is not reduced. That gives a basis for agreement. An official of the American Federation of Labor is quoted as saying that there must be no reduction below the levels of 1914, plus allowance for increases in the cost of living. That sounds all right, but it must be borne in mind that the cost of living is not something imposed upon the wage-earning class from above or from the outside; it is largely dependent upon the wages they insist upon having and their own attitude toward their work. They should not disclaim their proper share of responsibility for the cost of living, or think they can make someone else bear it. Nor can they any more than any other class escape their share of the results of ills and calamities that afflict the world. They may say that they are not responsible for the war or the disorganization of industry which has resulted from the war, but these costs must be borne by society as a whole, with every member bearing some share.—*Bulletin of the National City Bank of New York.*

Coal Consumption and Costs Increase.

According to statistics of the Interstate Commerce Commission, coal consumption by locomotives in road service on the principal lines increased 10,000,000 tons in the first ten months of 1920 as compared to the consumption in the same period last year, the figures being: 1920, 81,752,821 tons; 1919, 71,619,009 tons. The average cost of coal per net ton in 1920 was $3.95 as compared to an average of $3.21 in 1919. The cost of coal in different sections shows great variation. Roads in the New England region are paying $7.72 a ton, while those of the Central West are paying $3.38.

Railroads Making Good.

Concrete evidence that the railways are making good under private control was furnished at the recent meeting of executives at the New Haven board rooms. Statistics for the period from March 1, when Federal control came to an end, to September 1, show that the average movement per car has increased from 22.3 miles a day to 27.4, and the average tonnage per car from 28.3 to 29.6. This gain is equivalent in capital requirements to no less than $2,000,000,000.

To Lay Out a Worm of Increasing Pitch

An Involved Problem Simplified

It is seldom that a draughtsman is called upon to design a worm of increasing pitch unless he happens to be connected with the manufacture of screw conveyors. But, if the demand does come, it is apt to come suddenly and it is well to be prepared.

While this work may appear to be complicated, it is, in reality, a very simple process, and, after the start has been made, all of the calculations can be made on an adding machine.

The principle of an increasing pitch for a worm is that it increases at a certain definite rate for each turn or fraction of a turn. For instance, suppose a worm of 6 in. pitch were to increase ½ in. for each turn. At the start it would have a pitch of 6 in. At the end of the first turn its pitch would be 6½ in.; at the end of the second, it would be 7 in., and so on. While at the end of the first half turn it would be 6¼ in.

It would seem that the simplest method of explaining the method to be pursued in such a piece of work would be to take a concrete example.

Suppose, then, we have a worm of increasing pitch to design that starts with a pitch of 10 in. and increases ¾ in. for each revolution or turn.

Now, as far as this increase is concerned, the original pitch of 10 in. may be regarded as zero, and the increase may be taken as increments of the ¾ in.

First divide the circle into any number of equal parts. For the sake of convenience, we will divide it into 36 equal parts of 10° each. It is evident that, if the increase of pitch is to be uniform, the increase for each 10° will be .73 divided by 36, or .020833 in. So that at the end of 10° of turning the pitch has increased to 10.020833 in.

A screw is nothing but an inclined plane wound about a cylinder, and if we had a screw that increased from a pitch of zero to .020833 in. in 10°, and consider it as an inclined plane, then the average pitch of that screw through that 10° would be one-half of that, or .010416 in. Hence the average pitch of the worm that starts out with a pitch of 10 in. would run at an average of 10.010416 in. through the first 10° of the turn. At the end of 10°, however, it has increased to 10.020833 in., and from 10° to 20° it will be 10.020833 plus .010416 in. or 10.03125 in. of average pitch.

If a screw has a pitch of 10.010416 in. it will advance that distance divided by 36 in 10°, or about .2781 in., and then for each 10° more it will increase this advance by .020833, divided by 36, or .0005787 in. The calculation of the advance for each successive 10° now becomes merely a matter of using the adding machine. Starting with .2781, add .0005787 consecutively until the desired length of worm has been reached, remembering that it takes 36 additions for each turn, except for the first turn, where the 35th addition will complete it. Hence at the end of the first turn, or from 350° to 360° the lineal advance will be .2983545 in., and at the end of the second turn from 350° to 360° it will be .3191877 in.

It would be absurd to think of using these refined measurements in the laying out of the worm. The practical method is to do this work from a base line for each turn, and in order to determine the ordinates for each 10° of the circle, the advance for each consecutive 10° should be added together. Thus:

.2781000 in. = advance for first 10°
.0005787
———
.2786787 in. = advance for second 10°
.0005787
———
.2792574 in. = advance for third 10°
.0005787
———
.2798361 in. = advance for fourth 10°

To get the total advance from the base line add again:

.2781000 in. = advance 0° to 10°
.2786787
———
.5567787 in. = advance 0° to 20°
.2792574
———
.8360361 in. = advance 0° to 30°
.2798361
———
1.1158722 in. = advance 0° to 40°

and so on for a complete turn, when it will be found that the total advance of the worm in one turn, while increasing its pitch from 10 in. to 10¾ in. will be 10.3761810 in., or as it may be considered, 10.375 in. in the laying out.

These figures should be tabulated and arranged to not more than three decimal places, though in the actual laying out of the worm in the drawing room work can only be done to the second place. Such a tabulation for two turns of the worm in question is shown herewith.

Tabulation of Ordinates for Worm of Increasing Pitch.

	Pitch Increase	
Angle Degree.	First Turn. 10 in. to 10.75 in.	Second Turn. 10.75 in. to 11.50 in.
0	.000	.000
10	.278	.299
20	.557	.559
30	.836	.899
40	1.116	1.199
50	1.396	1.500
60	1.677	1.802
70	1.959	2.105
80	2.241	2.408
90	2.524	2.711
100	2.807	3.015
110	3.091	3.320
120	3.375	3.625
130	3.660	3.931
140	3.946	4.238
150	4.232	4.545
160	4.519	4.853
170	4.806	5.161
180	5.094	5.470
190	5.383	5.779
200	5.672	6.089
210	5.962	6.399
220	6.252	6.710
230	6.543	7.022
240	6.834	7.334
250	7.126	7.647
260	7.419	7.960
270	7.712	8.274
280	8.006	8.589
290	8.300	8.904
300	8.595	9.220
310	8.890	9.536
320	9.186	9.853
330	9.483	10.170
340	9.780	10.488
350	10.078	10.807
360	10.376	11.126

This tabulation gives the ordinates or total advance of the worm for each 10° of the circle.

This advance remains the same for any diameter of worm or for any diameter of hub on which the worm is to be built or whether that hub be straight or tapered.

With the ordinates as thus calculated, let the draughtsman first draw a straight horizontal line, F G of any convenient length, as 18 in., and divide it into 36 equal parts, each part representing 10° of a turn, and at each point of division erect perpendiculars thereon and mark them from 0° to 360° consecutively. Then, starting at 10°, lay off the advance of .28 in., on the 20° line lay off .56 in., at 30° lay off .84 in., and so on to the 360° mark. When these points are connected the lower diagram line of Fig. 1 will be drawn and this will be the development of the inclined plane corresponding to an increase of pitch from 10 in. to 10¾ in.

The plane for the second turn can be developed in the same way by drawing a second line and laying off the proper distances as before; starting with .30 in. at the 10° line.

For the sake of convenient reference, the length of each ordinate is marked at its foot for each turn. Also on Fig. 2 of the second turn the grand total of the ordinates is given. This is the sum of the two corresponding ordinates of the first and

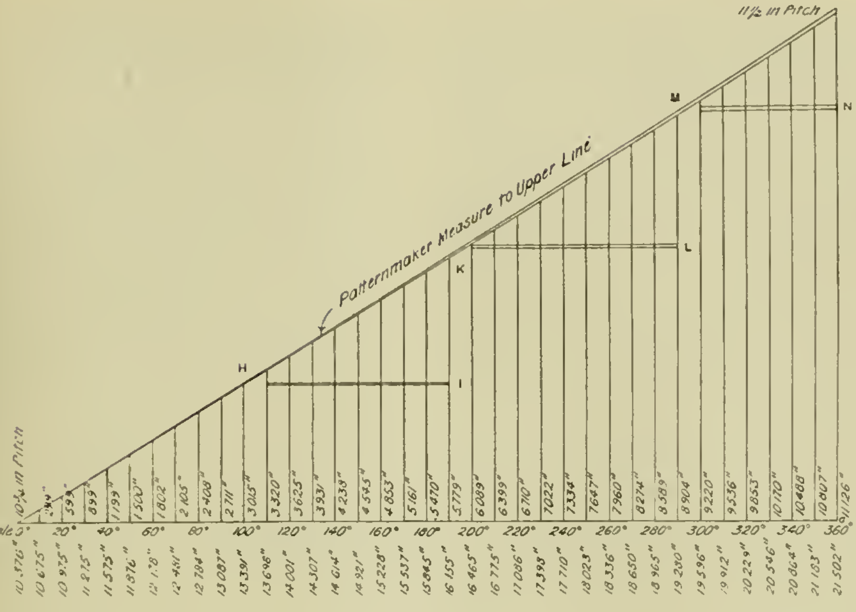


Fig 2

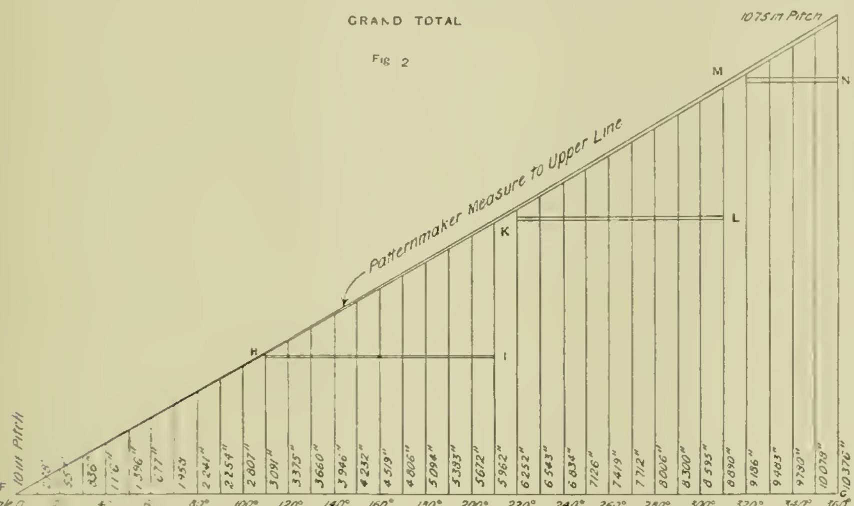


Fig 1

second turn, and represents the distance of the diagram or slope of the second turn from the base line of the first turn.

When this has been done it still remains to develop the second or upper line of the diagram for the guidance of the patternmaker, if the worm is to be cast.

If the worm is to be made of cast iron an allowance of ⅛ in. must be made for shrinkage. Hence each ordinate must be increased by a proportional amount, which can be very readily done by the use of the proportional dividers. Such instruments do not open conveniently to more than 3 in., for which distance the shrinkage allowance will be 1/32. Then on the diagram for the first turn draw the lines HI from 110° to 210°. These lines to be 1/32 in. apart and the lower one 3 in. from the base line FG of the diagram. Draw the lines KL from 220° to 310°; these lines to be 1/16 in. apart and the lower one 6 in. from the base. Finally, draw the lines MN from 320° to 360°; these to be 3/32 in. apart and the lower one 9 in. from the base.

Draw similar lines on the diagram of the second turn.

Then set the proportionals to 3 in. and 3 1/32 in. Set the short legs for each of the ordinates up to and including 100° and lay off the upper line of the diagram by using long legs and laying off from the base line GF. From 110° to 210° use the short legs to measure the distance from the lower line HI to the diagram line, and use the long legs to plot the new line from the upper line HI as a base. Use the same method in the space spanned by the lines KL and draw the upper line. And then repeat in like manner for the lines MN. The diagram is now ready for the patternmaker. Let him turn the hub upon which the worm is to be built, which is here taken to be about 4 ft. long and 4 in. in diameter at the large or starting end and tapered.

At the large end, where the worm of 10 in. pitch is to start, let him make a mark A, Fig. 4, about it. This will be the base line of the worm from which the work is to be laid out. Then on a line parallel to the axis or center line of the hub, let him lay out and mark the circle B at a distance of 10.376 in. from A. This will be the base for the laying out of the second turn. Similar lines C, D and E at the distances indicated on the engraving will be the proper distances to lay out the lines for the bases of the third, fourth and fifth turns, respectively.

As these measurements involve too fine decimals of an inch to be done with the ordinary tools of the pattern shop, they can best be obtained and laid out by using a pair of dividers and setting them to the longest vertical dimension of the ordinates on the diagram at 360°, and using that setting for the laying off of the lines A, B, C, etc.

When this has been done the patternmaker should fasten the hub in a lathe or on a pair of centers with an index plate. Put a marking tool in the tool post and set it to touch the hub exactly at the end of a horizontal diameter as shown in Fig. 4. This adjustment must be carefully made if the hub is tapered, otherwise the line which it scribes will be out of place. The adjustment having been made, run this marking tool the whole length of the hub, making a mark parallel

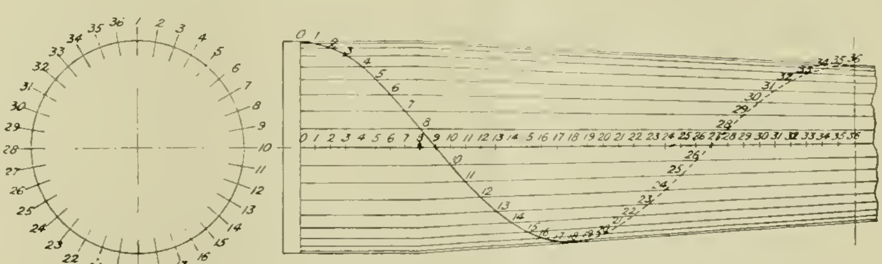


Fig. 3

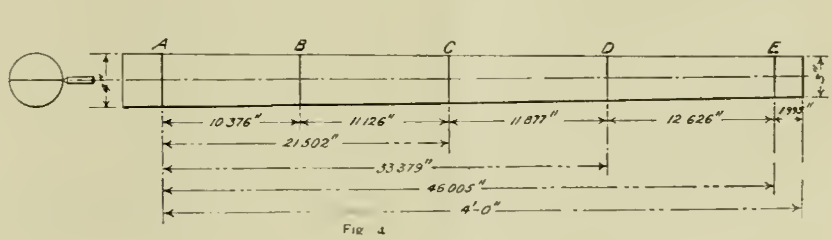


Fig. 4

to the axis as shown in Fig. 3, and mark it 0 or 36.

Then turn the hub through 10° and make a similar mark which should be marked 1. Then turn 10° consecutively and make a similar line for each setting which should be marked 2, 3, 4, etc., until a complete revolution has been made.

When this has been done the hub is ready for the laying out of the worm.

To do this, first take the diagram of the pitch for the first turn of the worm, where the pitch increases from 10 in. to 10¾ in., and set the dividers to the length of the line marked 10°, using the distance from the base to the upper or patternmakers' line, and lay off this distance on the line 1 from the line A, as indicated on Fig. 3 at 1. Then set the dividers to the length of the corresponding vertical line 20° and lay it off on the line 2, and so continue until the length of the line at 360° has been marked on 0 or 36. One complete turn of the worm will then have been laid out.

Then take the diagram for the second turn and proceed in the same manner, using the line B as a base. Then, if there are more turns, use other sheets of diagrams that have been prepared in the same way as those for the first and second turns, as have been already described in detail.

When the points thus laid out have been joined there will result the center line of the worm from which it can be built up in the usual way.

The diagrams have been laid out and the figures drawn so that, if they are followed as drawn, a right-handed thread will be developed. It will be readily understood that, in order to develop a left-handed screw, it will simply be necessary to use the same ordinates, but to lay them off on lines numbered the other way around the hub. Thus line No. 1 becomes No. 35, and No. 35 becomes No. 1; No. 2 becomes No. 34 and No. 34 becomes No. 2, and so on.

The Heating of Railway Buildings

Details of Economical Means and Methods

A timely paper full of valuable suggestions was read before the members of the Canadian Railway Club at the November. meeting in Montreal by R. H. Black, Engineer of Power Plant Construction, Grand Trunk Railway, Montreal, on the subject of "How to heat railway buildings economically." It was interesting and educational, and in view of the universal call for fuel economy, was well worthy the serious consideration of railroad men generally and those who may be entrusted with heating appliances particularly.

In regard to the heating of stations of from 1,500 to 7,500 sq. ft. total floor area, which embrace the majority of ordinary stations, Mr. Black claimed that a hot water heating system should be used with cast iron radiators, and sectional cast iron boiler, burning hard coal and placed for preference in a basement. In the smaller sizes, a hot water heating system is better than a steam system in many ways, although its first cost is about 35 per cent more. The large volume of water in circulation acts as an ideal heat storage, giving up heat when fire is low and storing heat when the fire is bright, thus preventing to a large extent the losses due to overheating of the rooms, and calling for less attention to the furnace. Any man with a furnace in his home will know how to run such a system economically and will usually do so if for no other reason than to save himself trouble.

When we come to a larger station, such as is found at a division point, which is usually of two stories with offices above and sometimes a number of buildings arranged in a row, the hot water system may offer increased cost and construction difficulties which make it advisable to use a steam heating system. In most respects the one pipe gravity steam system with boiler in basement using hard coal or other suitable fuel is the most economical steam heating system that can be adopted, and it is certainly the simplest. There is no possibility of waste of either hot water or steam when the proper air valves are used. Not only the radiators, but the boiler and piping themselves supply heat to the building, and need only be covered when they are likely to give out more heat than is required in the immediate vicinity. Long horizontal mains also need covering to avoid excessive condensation.

The system has the inherent disadvantage that the radiators must be either full on or off. However, with the boiler on the premises and the attendant firing it to suit fluctuating weather conditions, what actually happens is that the radiators are alternately heating and cooling, or not sufficient steam is made to heat them all the time, and this prevents overheating the rooms.

To take advantage of this feature it is most important to so arrange the piping that the colder rooms and more exposed portions of the buildings are given the preference by receiving their steam first. Otherwise it will be found necessary to overheat one portion of the building in order to adequately heat another. With this attended to, it will be found that the system will work well for two or three building that are not more than 100 ft. apart and which have good basements, but under certain circumstances where there is a great difference in exposure or in distance from boiler to radiators, it will be necessary to use special air valves on each radiator and connect them all to a small air pump, or ejector through a system of piping, which, however, need only be very small. This is known as the air line system and has many recommendations, but is usually an unnecessary refinement for railway buildings.

We now come to the first condition in which there is a serious opportunity for waste. A station, office or small shop has to be heated, and as a supply of high pressure steam is available a short distance away, perhaps at the roundhouse it may be proposed to use this. Now it is not usually economical to do so. To begin with there is the loss of heat in the underground pipe supplying the building. With the very best construction this will be about 1 per cent 100 ft., but if the pipe is merely buried in sand, or set in a wooden boxing the loss may he as much as 10 per cent or more.

The condensed steam instead of draining back to the boiler direct must be separated by means of a steam trap. Certain of these traps will then return the condensation direct to the high pressure boiler with very little loss, but these traps need careful attention, as with a one pipe system should the trap stop working the system will rapidly fill with water, and it will take some time to get it working again.

The greatest loss, however, is due to the imperfections of human nature. With an unlimited supply of steam from a distant point it will always be found that the building is overheated, and doors and windows left open even in very cold weather. In fact, radiators are rarely, and in some cases never shut off. One has only to imagine what his coal bill would be if he were to keep his furnace at home going full blast, from October to May, to realize what this means.

It may be argued that the agent or officer in charge should not permit this condition, but a second thought will show that this is one of all duties that can and will be neglected. The only practical way to control the heating of buildings is at the source of heat, and if the baggage man or other employee has to attend the furnace in addition to his other duties, he will bank the fire to make it last, and this is economy, which will far outweigh the difference in cost of hard and soft coal. It is more than likely that the cost of the underground piping and steam traps will equal or exceed the cost of a sectional cast iron boiler, and at even fairly large stations it will often be found possible to have a certain employee attend the furnace, in fact, where there are offices, a janitor is usually employed in any case. What, then, are the conditions that make it advisable to heat a building from an external source of steam? They are as follows:—

When the building is very small, requiring only one or two coils or radiators, and is used by a number of men continually coming in and out. A switch shanty is a good example. There is no one to attend to a stove and the steam will not amount to much. In this case pipe coils may be used with a small steam trap on each coil, properly protected from sediment by means of a dirt trap or dirt pocket (a separator off a freight car is a good thing to use, and can often be obtained from stores). The trap should have no by-pass and should be non-adjustable, except by taking it apart. Run condensation back to the boiler room if not more than 200 feet away, otherwise let it drip outside where it can be seen. A reducing valve is not necessary, no great care need be taken in grading pipes, and as the steam is at high temperature only a small coil is required.

When it is intended to heat an existing building, and there is no basement, a convenient place for a boiler, or when the building is quite large, over 15,000 sq. ft. floor area, and two or more stories, such as large stations or freight sheds, or two or more buildings some distance apart. In this case the one piping gravity system is no longer the best to employ.

We come now to the two pipe vacuum system. On the return end of every radiator is placed a small steam trap, the discharge of which is led back through a separate arrangement of piping to a vacuum pump, which maintains a vacuum up to the outlet from every radiator. This means that all condensation is positively removed, and should the steam pressure at a remote part of the system be so low that the steam cannot flow into the radiator by itself, the trap, being cold, will remain open until the vacuum has drawn the steam in. Radiator traps should be thermostatic in principle and absolutely non-adjustable. Such a system is operated on a very low pressure, one to four pounds being sufficient in any well designed plant.

Its advantages are many, for besides the positive circulation which overcomes all troubles due to long distance and low pressure, it gives a low temperature radiator, which is an important point in economy, as it will not readily cause overheating, and also by using special inlet valves with graduated opening the so-called modulating system is obtained, which allows the heat in individual radiators to be controlled. This is a convenience, but as pointed out before, little economy can be expected therefrom, and modulating valves are only justified in the better grade of office.

The use of traps on every radiator safeguards the system from serious interruptions as the failure of a single trap only affects its own radiator, or at most those nearby, whereas the failure of a trap controlling the whole system may result in waterlogging the system for hours. The vacuum system is not quite perfect, as it cannot be controlled from a central point. It can be made automatic to operate with thermostats but they are very expensive—$50.00 per radiator—and need constant attention, so that its greatest claims to economy are the low temperature and absence of leakage.

Roundhouse heating is a problem in itself but is a difficult one in the northern climate.

It is well recognized that the hot blast system, in which a fan driven by mechanical power draws air through a nest of steam pipes, or cast iron sections and discharges it through ducts to different points, usually the engine pits, is the most satisfactory system that can be used. It is not always recognized, however, what an enormous amount of steam is required to run these plants and they are therefore often made much too large for the boiler capacity provided. Incorporated with a vacuum system to heat the offices the best way to remove the condensation from the blast coils is by connecting it to the same system, using a large size thermostatic trap on every coil. The fan should be engine driven as this permits the widest variation in speed, the exhaust steam being used in the coils.

Handling locomotives in winter is such a difficult matter that the most enthusiastic economist cannot justify fuel saving at the expense of cutting down the heat or reducing the ventilation in the roundhouse. The only justifiable saving is that which prevents waste of condensation or steam. In designing the air ducts, it should be borne in mind that the speed of the air can be much increased over standard practice and therefore the ducts may be made smaller.

In regard to underground piping it may be protected in various ways, but any really good method is very expensive and needs the most careful workmanship and supervision while being installed. For long distances with steam pipes of from 2½ in. to 10 in. and return pipes half the size, the split tile steam conduit cannot be beaten when proper attention is paid to grading and drainage. It cannot be used under tracks unless protected by concrete walls or cast iron pipe.

The replacement of locomotive type boilers can scarcely be justified at some points. It is doubtful whether these boilers are particularly inefficient when provided with good chimney draft and not forced above 70 boiler horse power, that is half the power of a standard return tube boiler. When provided with poor draft and where forced by means of steam jets they waste enormous quantities of fuel and should be replaced as soon as possible. For distances of less than 200 feet a concrete trench with double board top screwed down to cleats set into the concrete may be used to advantage. The pipe covering should be sponge felt or diatamaceous material, magnesia is too fragile.

For piping above ten inches or where several pipes are to be run a tunnel should be considered. For pipes smaller that 2½ inches and distances of not more than 300 feet, it is permissible to use a wooden boxing if the ground is dry as the loss in heat will cost less than the interest on the cost of the more expensive construction. If the ground is wet the pipe had better be carried overhead or if this is impossible it may be cased in an outer pipe which will just fit over the covering, the outer pipe being well covered with a mixture of pitch and sand. All underground piping should be full weight with extra heavy couplings. Complete information in regard to sizes can only be obtained from the leading manufacturers of individual articles.

Cleaning a File.

Take a piece of copper wire, about three-sixteenths of an inch in diameter; flatten out one end, allowing the copper to flatten out sideways to about a quarter of an inch in width. Trim this square across the flattened end, and bend the other in a loop for a handle. When this is done, push the flattened edge across the file the way the teeth run. After a few strokes the copper will become corrugated to fit the teeth of the file, and will remove solder, lead, or anything of that nature, which a wire brush will not do satisfactorily.

Rights of Railway Employees.

At the third annual convention of Division No. 4 of the Railway Employes' Department, American Federation of Labor, held recently at Winnipeg, Man., a resolution was passed protesting against the instructions issued by the president of the Canadian National Railway that any employe of the railway who permits himself to become a candidate for any federal or provincial constituency automatically severs his connection with the company. The incoming executive was instructed to take this matter up immediately with the president of the railway, with a view to having the full rights of the employes restored.

Items of Personal Interest

J. B. Fowler has been appointed division storekeeper on the Pennsylvania with headquarters at Fort Wayne, Ind.

W. W. Haggard has been appointed foreman on the Santa Fe, with office at Winslow, Ariz.

G. W. Bichlmeir, purchasing agent of the Kansas City Southern, has been appointed assistant purchasing agent of the Union Pacific, with headquarters at Omaha, Neb.

P. J. Flynn, general roundhouse foreman of the Erie at Hornell, N. Y., has been appointed general foreman on the Lehigh Valley, with office at Pittston, Pa.

J. Kyle, master mechanic of the Canadian National Railways at Edmonton, Alta., has his jurisdiction extended over the Grand Trunk Pacific lines on that division.

S. L. Landis has been appointed acting master mechanic of the Central Kansas division of the Missouri Pacific, with headquarters at Osawatomie, Kan.

Edward France has been appointed road foreman of locomotives of the Mohawk division of the New York Central, with headquarters at Rensselaer, N. Y.

R. J. Hinkle has been appointed railroad representative of the Garlock Packing Company, Palmyra, N. Y., with headquarters at Philadelphia, Pa.

R. Tuck, roundhouse foreman on the Santa Fe, with office at Richmond, has been promoted to general foreman, with office at Needles, Cal.

Eugene Schull has been appointed master mechanic of the Frisco System, with office at Sapulpa, Okla., succeeding C. F. Coffman, resigned.

O. K. Beck, assistant bridge engineer of the Louisville & Nashville, has resigned to become bridge engineer of the Detroit, Toledo & Ironton.

J. W. Lennon has been appointed master mechanic of the Colorado division of the Missouri Pacific, with headquarters at Hoisington, Kan.

C. H. Temple, superintendent of motive power and car department of the Canadian Pacific, West Lines, has been appointed chief of motive power and rolling stock, with headquarters at Montreal, Que.

F. Osterman, chief clerk of the purchasing department of the Chicago Great Western, has been appointed assistant purchasing agent of the Pere Marquette, with headquarters at Detroit, Mich.

W. F. Thiehoff, assistant general manager of the Chicago, Burlington & Quincy lines west of the Mississippi River, has been appointed general manager, succeeding George W. Holdrege, retired.

L. C. Tyler has been appointed road foreman of engines of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Urbana, Ill., succeeding Charles McCarty, transferred.

J. W. Johnston, chief inspector of car lighting of the Canadian National, with headquarters at Toronto, Can., has had his jurisdiction extended to include the Grand Trunk Pacific.

W. M. Green has been appointed road foreman of engines of the big Sandy division of the Chesapeake & Ohio, with headquarters at Paintsville, Ky., succeeding D. S. Baals.

H. W. Concannon has been appointed division storekeeper of the Salt Lake division of the Southern Pacific, with headquarters at Ogden, Utah, succeeding S. J. De Graff.

W. A. Mordica has been appointed road foreman of engines and assistant trainmaster of the Shelby coal district of the Chesapeake & Ohio, with headquarters at Shelby, Ky.

H. G. Bonney has been appointed assistant master mechanic of the Lehigh & New England, with headquarters at Pen Argyl, Pa., succeeding N. R. Wright, resigned.

D. W. Dower has been appointed signal supervisor of the Los Angeles division of the Southern Pacific, with headquarters at Los Angeles, Cal., succeeding C. A. Veale.

C. M. Harris, manager of the railroad shop section of the industrial department of the Westinghouse Electric Manufacturing Company, has been elected vice-president of the Hagerstown & Frederick, with headquarters at Hagerstown, Md.

L. E. Fletcher, master mechanic on the Atchison, Topeka & Santa Fe, with headquarters at La Junta, Colo., has been promoted to superintendent of shops, with the same headquarters, and G. M. Lawler succeeds Mr. Fletcher.

H. B. Smith has been appointed fuel agent of the Canadian National with headquarters at Kansas City, Mo., succeeding B. B. Brain, whose promotion to purchasing agent was announced last month.

H. W. Williams, formerly assistant engineer in the electrical department of the Chicago, Milwaukee & St. Paul, with headquarters at Seattle, Wash., has been appointed special representative to the general superintendent of motive power, with headquarters at Chicago, Ill.

A. G. Fischer has been appointed master mechanic of the Frisco System, with office at Memphis, Tenn., succeeding G. R. Wilcox, resigned; and William Henry has been appointed assistant master mechanic on the same road, succeeding Mr. Fischer, with office at Monett, Mo.

Joseph Markham, formerly railway sales representative of the E. I. Du Pont de Nemours & Co., has been appointed sales agent of the Pressed Steel Car Company, and the Western Steel Car & Foundry Company, with office in the People's Gas Building, Chicago, Ill.

D. M. Pearsall, superintendent of motive power of the Atlantic Coast Line, second and third divisions, with headquarters at Waycross, Ga., has been transferred as superintendent of motive power, first division with headquarters at Rocky Mount, N. C.

H. P. Rushenery, assistant division storekeeper of the Southern Pacific, with headquarters at Sparks, Nev., has been promoted to division storekeeper, with headquarters at Tracy, Cal., succeeding V. R. Taylor, transferred to Tucson, Ariz.

L. Lavoie, assistant general purchasing agent of the Canadian National with headquarters at Toronto, has been appointed general purchasing agent with the same headquarters succeeding E. Langham, who has retired from active service.

Richard Sanderson, manager of the New York office of the Baldwin Locomotive Works and the Standard Steel Works Company, Philadelphia, Pa., has been transferred to Philadelphia to the position of vice-president, in charge of sales of the Standard Steel Works Company, succeeding Robert Radford, resigned.

H. G. Morgan, office engineer in the signal department of the Illinois Central, with headquarters at Chicago, Ill., has been promoted to signal engineer, succeeding W. M. Vandersluis, who has been appointed secretary of the Illinois Central Electrification Commission, Chicago Terminals.

Charles Scott, supervisor of bridges and buildings on the Buffalo, Rochester & Pittsburgh, with headquarters at Salamanca, N. Y., has been promoted to the position of acting engineer of masonry, with the same headquarters, and W. E. Maley has been appointed acting superintendent of bridges and buildings, succeeding Mr. Scott.

P. O. Wood, division superintendent of the St. Louis-San Francisco, with headquarters at Memphis, Tenn., has been appointed assistant superintendent of motive power, with headquarters at Springfield, Mo. Mr. Wood has been in the employ of the Frisco since 1891, when he entered as machinist's apprentice in the Memphis shops, since which time he has filled nearly every position in the mechanical department, including fireman and engineer. In 1917 he became division superintendent of motive power at Memphis, from which position he was promted as above noted.

Obituary.

James Campbell Currie.

The death of James C. Currie on December 10, by an elevator accident, has suddenly removed a well-known and popular railroad man. Mr. Currie was a native of Scotland and came to America at an early age and entered the service of the Pennsylvania Railroad, and was for many years a locomotive engineer, and a grand officer in the Brotherhood of Locomotive Engineers, and for the last twenty-five years was connected with the Nathan Manufacturing Company of New York. He was particularly expert as an inspector and instructor in the operation of boiler attachments, and of locomotive accessories generally. Mr. Currie was a fine type of the all-round railroad man, and was also active in municipal and fraternal affairs. Some of his relatives made notable records in his native land, among others, Sir James Campbell-Bannerman, a cousin of Mr. Currie's, being Prime Minister of Great Britain for a number of years. Mr. Currie was in his 70th year.

Robert Speer Miller.

Robert S. Miller, master car builder of the New York, Chicago & St. Louis, died suddenly at his home in Cleveland, Ohio, on December 1, in the sixty-fifth year of his age. Mr. Miller entered railroad service in the engineering department of the Chicago & St. Louis in 1879, and in 1882 was employed by the Chicago & St. Louis as foreman in the car department, and rose rapidly to the position of master car builder, which pos'tion he held at the time of his death.

Edward Ford.

Edward Ford, master blacksmith of the Chicago, Milwaukee & St. Paul at Dubuque, Ia., died recently at his home in Dubuque, in the 74th year of his age. Mr. Ford has been in the employ of the road over forty years and was one of the original members of the International Railroad Master Blacksmiths' Association.

Railway Mechanical and Other Conventions.

During 1921 the following are the dates already selected for holding the conventions of the leading mechanical and other conventions in relation to railroad appliances and supplies. The railway supply men's associations are arranging to hold meetings coincidently on the same dates. Full particulars will be available on application to the secretaries of the various associations, whose addresses are appended, at an early date.

May 3-6, 1921—Air Brake Appliance Association, Hotel Sherman, Chicago. Secretary, J. F. Gettrust, 319 West Washington street, Chicago.

June 15-22, 1921—American Railway Association, Section III—Mechanical, Atlantic City, N. J. Secretary, V. R. Hawthorne, 431 South Dearborn street, Chicago.

June 20, 1921—American Train Despatchers' Association, Kansas City, Mo. Secretary, C. L. Darling, Northern Pacific Ry., Spokane, Wash.

June 20-22—American Railway Association, Division VI — Purchases and Stores, Atlantic City, N. J. Secretary, J. P. Murphy, 75 Church street, New York, N. Y.

September 6-9, 1921 — The Traveling Engineers' Association, Hotel Sherman, Chicago. Secretary, W. O. Thompson, New York Central R. R., Cleveland, O.

September 12-14, 1921—International Railway General Foremen's Association, Hotel Sherman, Chicago. Secretary, William Hall, 1064 West Wabasha, Winona, Wis.

September 12-14, 1921—American Railway Tool Foremen's Association, Hotel Sherman, Chicago. Secretary, R. D. Fletcher, 1145 East Marquette road, Chicago.

September 12-14, 1921—American Railroad Master Tinners', Coppersmiths' & Pipe Fitters' Association, Hotel Sherman, Chicago. Secretary, C. Borcherdt, 202 North Hamlin avenue, Chicago.

September 15-17, 1921—Chief Interchange Car Inspectors' and Foremen's Association, Hotel Sherman, Chicago. Secretary, D. B. Wright, 34th and Artesian avenue, Chicago.

Activity of the Traveling Engineers' Association.

The continued activity of the executive committee of the Traveling Engineers' Association is finely illustrated in the series of questions, and the list of subjects submitted by the various committees. The questions request expressions of opinion on the subjects to be prepared and submitted for use in the preparation of the various reports that will be presented to the convention next September. They are as follows:

Committee on "Subjects for Discussion." Desires expressions from membership of what might be considered desirable subjects for discussion. J. H. De Salis, chairman, 405 Highland avenue, E., Syracuse, N. Y.

Committee on "What are the advantages of the self-adjusting wedges, the feed water heater and devices for increasing the tractive power of the locomotive in starting and at slow speed." T. F. Howley, chairman, care of Erie Railroad, Meadville, Pa.

Committee for Discussion: "The best method of operating stoker fired locomotives to obtain the greatest efficiency at the least expense."

First—How many different kinds of stokers in use on the road with which you are connected?

Second—If more than one kind or type is in use do you attempt to assign them to any one division or do you permit them to be mingled on any divisions?

Third—Do you have stokers on both slide-valve (simple) and piston-valve engines?

Fourth—After delivering or imparting instructions, who do you hold responsible for the efficient operation of the stoker, whether the engineer or fireman?

Fifth—What are your instructions on operating the stoker from an economical standpoint?

Sixth—What are your instructions on operating a locomotive from an economical standpoint?

Seventh—What are your methods for caring for stokers at the terminals?

Owing to the title of this subject it will lead into a discussion of stoker operation, as well as the locomotive operation, and as this is the first instance that this subject has been before the convention, we should confine ourselves as much as possible to the locomotive operation instead of strictly the stoker, as the subject must develop the greatest efficiency at the least expense. Joseph Keller, chairman, 48 Terrace street, Wilkes-Barre, Pa.

Committee for discussion: "Recommended practice for conservation of locomotive appurtenances and supplies." J. P. Russell, chairman, 3822 Avenue "C," Birmingham, Alabama.

Chairman of the following subject for discussion: "A comprehensive standard method of employing, educating and examining engineers and firemen." J. B. Hurley, chairman, care of Wabash Railway, Decatur, Illinois.

Committee on the subject: "Distribution of Power and Its Effect on Operating Costs."

By whom are the locomotives assigned on the Grand Districts?

By whom on the local divisions?

What procedure is followed in changing engines from one grand district to another? From one division to another?

What method is followed in assigning engines to runs on each division?

Robert Collett, chairman, Supervisor Fuel and Locomotive Performance, N. Y. C. R. R., Utica, New York.

Books, Bulletins, Etc.

The Practice of Railway Surveying and Permanent Way Work, by S. W. Perrott, C.E., and F. E. Badger, C.E. Published by Longman, Green & Co., Fourth Ave. and 30th St., New York.

This is a notable book on railroad construction by two eminent British engineers who gained their experience on the staffs of two leading English railways supplemented by considerable work in unexplored and undeveloped countries. Many ot the methods described are original, some traditional, and some are those in vogue among American engineers. Little or none of the matter appearing in the 300 pages of the book has previously appeared in print, although both authors are university instructors, and have acquired a thorough mastery of the subject. Numerous drawings, maps and folders illustrate the text, and forms a valuable text book, particularly in the hands of the young permanent way engineer. The paper, letter press and binding are excellent.

Staybolts.

The popular bi-monthly *Digest*, issued by the Flannery Bolt Company, Pittsburgh, Pa., has not reached us as regularly during the past year as formerly, partly, the Editor assures us, on account of the paper shortage, and largely from the enormous demand on the staff to cope with the rush of enquiries in regard to the "F B C" welded flexible staybolt, and naturally these requests had to be taken care of. It is gratifying to learn that in no single instance have service tests developed a defect in the staybolts referred to, and larger installations are being called for. The economic features of the bolt are many, simplicity and durability being the dominant improvements. Those who have been fortunate enough to secure a copy of the "F C B" catalogue will have full instructions to which the December issue is an excellent addition both in description and illustration.

Small Turbo-Generator Sets.

Bulletin No. 42010 A. superseding Bulletin No. 42010, describes and illustrates the small Curtiss steam turbine generating sets built by the General Electric Company, Schenectady, N. Y. These machines have grown in popular favor for many years, particularly in train lighting, and have a capacity up to 300 kw., and operate as high as 3600 r.p.m., the generator at 1200 r.p.m. The smaller direct-current sets are direct-connected and both turbine and generator run at 3600 r.p.m. Recent improvements have resulted in low cost of oil; close speed regulation; conservation rating of generators; absence of noise, and ease of inspection on account of simplicity of construction.

Report of the Chief Inspector of Locomotive Boilers.

The growing importance and value of the work of the Bureau of Locomotive Inspection has never been so fully and clearly set forth as in the ninth annual report. In another part of the present issue of Railway and Locomotive Engineering we have made some condensed abstracts of the report, but the general mass of information makes a moderately sized volume, every page of which is replete with lessons that should be learned by all engaged in locomotive operation and maintenance. Copies of the complete report may be procured from the superintendent of documents, Government Printing Office, Washington, D. C., at 25 cents per copy.

Accident Bulletin No. 75.

The Interstate Commerce Commission's report on railway accidents for the first three months of 1920, shows the continued effects of the safety first movement, with the exception as we have stated before, of trains striking, or being struck by automobiles and trucks. This, of course, is to some extent, attributable to the rapidly increasing number of such vehicles, but is in marked contrast with the lessening number of accidents to trolley cars and all other highway vehicles, and calls loudly for some drastic legislative action in regard to the suicidal or homicidal taint that seems to be growing in the minds of many automobilists.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV | 114 Liberty Street, New York, February, 1921 | No. 2

Waste Reclamation on the Norfolk & Western Railway

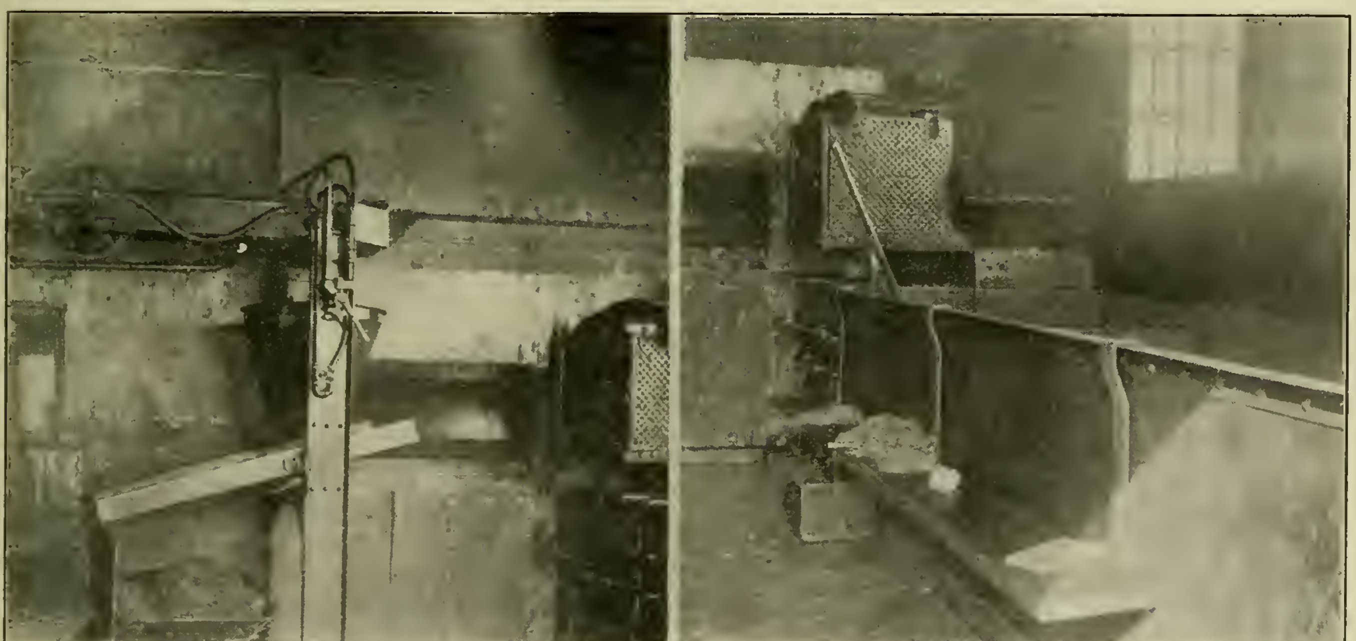
Details of the Apparatus Used and Methods Applied

At the shops of the Norfolk & Western Ry., at Roanoke, Va., the practice of waste reclamation is carried on extensively and successfully. In this plant the waste is handled by hand but all of the work of renovation and reclamation is done mechanically and that by means of very simple mechanism.

The dirty waste is first thrown into a heating tank that is nothing but a rectangular tank about 36 in. deep with a steam coil at the bottom. This tank is partially filled with reclaimed oil so that while the waste is being heated it is flooded with oil. For a tank of waste this treating requires about an hour. It is then forked up into a square box about 2 ft. square made of sheet steel perforated with closely set holes about 5/8 in. in diameter. This box contains a plunger operated by an 8 in. air cylinder. The soaked and treated waste is forked into this box ahead of the plunger, which, when the box is filled, is moved ahead compressing the waste into a comparatively solid bale and squeezing out the surplus oil which runs back into the heating tank.

This bale of waste, which is comparatively dry still contains a great deal of the grit and dirt which caused its condemnation. It is then thrown into a mechanical picker in which it is cleansed of all dirt and made fit for packing boxes again as good as new packing.

The picker consists of an inverted truncated cone made of smokebox netting. It is 26 in. in diameter at the top, is 2 ft. deep and 14 in. in diameter at the bottom. In this the picking cylinder is revolved. This cylinder is about 5 in. in diameter and 15 in. long and is fitted with a number of prongs of 3/8 in. round rods projecting downward at an angle of about 30° with the axis of the cylinder. This cylinder is oscillated to and fro at the rate of about 150 vibrations per minute. This picks and shreds the waste and works it down through the bottom of the hopper from which it falls on to a tray, the bottom of which is formed of a netting of about 1 in. mesh. This tray is raised and dropped with each oscillation of the drum, and as it stands on an incline the waste is jarred up and down over it and finally falls to the floor.



WASTE CLEANER. TANK AND WASTE PRESS.
WASTE RECLAMATION PLANT, NORFOLK & WESTERN RAILWAY.

In the passage over the tray, however, all of the contained grit falls through to the floor, whence it is gathered up and destroyed. The plant recovers about 50 gallons of oil per day. Before the plant was set up, it required about 220 gallons of oil a week to soak packing waste and prepare it for use. Now no new oil is used at all but instead the surplus named is turned over for oiling journals.

The design of the plant was made by

Mr. B. F. Childress, foreman of the car department, who has patented some of the special appliances such as the picker and press.

Repairing Locomotives.

A hue and cry has been raised by the Machinists' Union to the effect that the railroads have made contracts with private concerns for repairing locomotives and cars for the purpose of breaking the union, and that in so doing they have wasted the resources of the companies and entered into a conspiracy with banking interests to defraud because those controlling these interests were also directors in the private concerns obtaining these contracts. And as to further substantiate their claims they set forth as a fact the statement that the prices paid to locomotive builders for repairs have been four times as much as the cost of the same repairs would have been if made in the shops of the railroads.

That a large quantity of repairs have been made by private concerns since the railroads were returned to their owners, but the greater part of this has been due to the fact that the railroads did not have the facilities to do the work that was urgently demanded because of the under-maintenance during federal control. One general manager states that within ten days of the recovery of the property he had fifty-five engines headed for the makers for repairs. In a statement issued by the American Railroad Association, Mr. W. H. Finley, president of the Chicago & Northwestern Railway is quoted as saying that, "at the beginning of federal control we had 175 engines out of service for repairs. At the end of federal control there were 386 engines out of service, and the number of engines that were good for but sixty to eighty days' more service was as much greater at the end of federal control than at the beginning as the number actually out of service."

These are conditions that obtained not alone with the locomotives on one system but with the locomotives and cars on every road in the country. Add to this the unexampled traffic congestion in the spring of 1920, "the railroads took steps which it would have been criminal neglect not to have taken." There was nothing else to do.

It is probable, however, that the number of engines and cars sent to outside shops for repairs would have been very much less than they were had the efficiency of the men remained up to the old standard, but this has fallen off by from forty to fifty per cent in spite of increase of pay; or, perhaps, because of that and federal regulations. In one shop where fifty locomotives were given back shop repairs each month with 715 men before federal control and after fourteen months of that control it required 920 men to turn out forty engines with the same class of repairs. In other words the man-hour efficiency under federal control was 62 per cent of that of private ownership. At a meeting of the New York Railroad Club, Mr. C. E. Chambers, superintendent of the motive power of the Central Railroad of New Jersey, stated that the efficiency of the men under federal control was only about 60 per cent of what it was before that time, a figure that checks very closely with that given above. He also stated that the class A repairs to a freight car which in 1914 would have cost $500 could not be made at the present time for less than $1,800 or $2,000. And this may be the basis of the claim that the roads are paying four times as much for repairs to outside parties than it cost in their own shops. But that the cost in those shops is four times or even any number of times more than they would be under present conditions is without any foundation.

Attention is drawn to the fact, in the circular above referred to that non-comparable figures are compared, because "with regard to cost, the comparative figures given are entirely misleading, as so-called cost figures in railway shops cover substantially only cost of material and labor, most of the expense—overhead, supervision and maintenance—being carried in other railway accounts, and being further misleading because cost in outside shops necessarily includes a reasonable profit."

But there is some probability that, even in the matter of actual outlay the private shops can undercut the railroad shops because of the greater efficiency of the men and the possibility of a lower rate of wages.

As to the charge that the railroads had an ulterior motive in placing their work in outside shops, it is met by the fact that, in this, they "were merely carrying on the practice of following the precedent established by the United States Railroad Administration during similar but lesser emergencies.

"The truth is that the effect of the rules and working conditions still controlling the repair of equipment in railway shops has been disastrous to efficiency and output, and is in itself one of the causes of the abnormal number of cars and locomotives out of repair.

"Insofar as the organizations of railway repair employes have helped to produce a situation in which all of the railway repair work could not be taken care of in railway plants, or where outside plants can now do the work more economically and speedily than railway shops, they have only themselves to blame."

Report of Operation

The failure of the railroads under the new rate structure to come up to the level of earnings provided for by the Esch-Cummins act is due partly to the falling off in traffic as a result of the slowing up in industry.

Internal Combustion Locomotives.

Major W. H. Lee, district locomotive superintendent, Mesopotamia Railways, states in *The Railway Engineer,* that in some parts of the world conditions are distinctly favorable to the introduction of powerful internal combustion locomotives. He points out that in desert countries the use of steam locomotives is often attended with difficulties in regard to water supply. Not only is the water of unsatisfactory quality, but not infrequently, owing to the scarcity of supplies, it is necessary to attach tank wagons behind the tenders of engines in order to enable them to cover the long distances between widely-separated water stations. In such circumstances, and particularly if within reach of an oil district or where oil supplies can conveniently be obtained, there is much to be said for a locomotive operated by internal-combustion engines.

In this connection, it is interesting to note that the Chilean Government has invited plans for an internal-combustion locomotive, suitable for main line service, presumably for duty on sections of line where the employment of steam locomotives is attended with difficulty. On sections of the Mesopotamian Railways, even where water is abundant, it is often of such bad quality that there is every inducement for adopting internal-combustion traction, provided a satisfactory and trustworthy design can be made available. Apart from this, too, in oil-producing countries, there appears no good reason why oil should not be used directly as a motive agent, instead of as fuel for the production of steam. Major Lee raises the question of the "Paragon" system, of which a good deal has been heard in the Press for some years past, though, as far as we can ascertain, nothing tangible has yet resulted. This design has been suggested as likely to meet the requirements of the Chilean Government, and for use on certain sections of the Australian railways, especially on up-country lines penetrating into the waterless areas.

That the subject is receiving attention, both in engineering and in traffic circles, indicates that the production of a really satisfactory internal-combustion locomotive suitable for heavy standard railway traffic is considered to be a real necessity. It may be that the first applications will be to meet special conditions, such as those suggested above, but it is beyond question that the future also holds distinct possibilities in regard to internal-combustion traction as a direct alternative to steam or electric traction. At the same time, we would emphasize, as in our previous comment, the fact that if such a locomotive is to be produced, it must satisfy the conditions which are daily met by steam and electric locomotives, as there can never be more than a limited field for a machine which will do such work.

Mikado, Santa Fe, and Mountain Type Locomotives

For the Chicago, Rock Island and Pacific Railway

The American Locomotive Company has recently completed the construction of ten locomotives of the Mikado 2-8-2 type, fifteen locomotives of the Santa Fe 2-10-2 type, and ten locomotives of the Mountain 4-8-2 type, all at the Brooks shops of the company's works. As fine types of high-powered modern locomotives furnished with the latest improved accessories they call for more than a mere passing notice, and illustrate in a high measure the spirit of enterprise in the Chicago, Rock Island and Pacific Railway, where they are being placed in service. The designs have been perfected under the co-operation and supervision of the company's accomplished engineers, of which W. J. Tollerton is the general mechanical superintendent, together with the experienced construction engineers of the American Locomotive Company.

The accompanying illustrations show the general outline and many of the details of the locomotives, and it is not too much to say that it is assured that they will give a good account of themselves, and prove a valuable addition to the excellent equipment already in the service of the road which now includes nearly seventeen hundred locomotives, the greater number of which are comparatively modern locomotives, and many of them of the high-powered type. The appended details of construction will be of interest as illustrating the fact that while the various types of locomotives have been, generally speaking, standardized during the governmental period of supervision and operation, the choice of many of the most important accessories was left to the determination of the leading engineers of the roads on which the locomotives were to be employed.

MIKADO 2-8-2 TYPE LOCOMOTIVE FOR THE CHICAGO, ROCK ISLAND AND PACIFIC RAILWAY
AMERICAN LOCOMOTIVE COMPANY, BUILDERS.

Mikado, 2-8-2 Type Locomotives

The following data is compiled from the general instructions in regard to details of construction, and method of application of accessories: Copper pipes and valves for water column covered with lagging and pipes so applied that any condensation will drain back to boiler. Westinghouse Air Brake Company to furnish their usual swab arrangement of lubrication. Tank hose, 48 ins. long. Grate bars, finger type with dump at rear end. Spring rigging, A. L. Co.'s standard design of hangers. Hanger at front of trailing spring of loop type. Test gage cock applied in top of boiler shell at highest point of fire-box crown sheet. Air reservoirs tapped at back end of right hand reservoirs for 1 in. pipe for independent air line to air turret in cab. Sand pipes to front of first to front of second and back of third drivers. Air and signal pipes at front end of engine to be clamped so as to allow 8 ins. lateral movement. Tank-filling hole, tender coupler yoke, and coal gate similar to U. S. R. A. engines. Axle bearing pressures, driving front, 178; front inter., 178; main, 83; back, 186; engine truck, 177; trailer truck, 201.

Chambers throttle No. 10 with stem through backhead. Engines fitted with steel back brake shoes as furnished by De Remer-Blatchford Co. O'Malley Beare Valve Co. injector steam valves. Injector checks in accordance with Hancock drawing 625-149. Tender brakes designed to stand increased pressure for high speed brake.

These tenders may later on be used behind passenger engines. Reverse gear A. L. Co. type "E" with fibre packing. Ashton steam gages marked "Safety First." A. L.—150 triple sander—Harry Vissering & Company. Nicholson syphon with tell-tale holes in staybolts according to A. L. Co. practice. Draft gear housing castings cast integral with tender frames. Symington tender journal boxes. Seamless steel furnished by Pittsburgh Steel Products Co. for boiler tubes and superheater flues. Lukens basic firebox steel. Unit-Safety drawbar and Franklin type tender tank. Bushings in brake hangers and equalize stands. Driving and trailing tires purchased from Ry. Steel Spring Co. Tubes and flues 17 ft. 8 ins. long in order to allow clearance for superheater header which requires 46 ins. from tube sheet to center of stack. Main reservoirs 1—18½ ins. x 114 ins. on left side and 1—18½ ins. x 144 ins. on right side. Expansion stays 60; radial stay 190 (flexible). Boiler 43—5½ flues and 205—2¾ tubes. Boiler conical type with decuple seams. Engine truck wheels, 33 ins. rolled steel—Edgewater Steel Co. Tender wheels, 33 ins. rolled steel—Edgewater Steel Co. A. L. Co. pipe clamps. Water gage—lowest reading of water gage glass 5½ ins. above highest point of combustion chamber. Drifting valves—Arrangement consisting of a manually operating device in the way of a 1¾ in. x 1½ in. turret angle valve, and an approved 1¼ in. quick opening starting valve extension stem in cab with two machined bracket boxes bolted to boiler and suitable handle for operating by engineman on his seat. The 1¼ in. pipe to extend from turret to front end of boiler having a copper oil pipe leading from cab, hydrostatic lubricator (present specification to include one more sight feed to suit). The 1¼ in. pipe having a 1 in. tee with 1¼ in. outlet, same includes 1 in. branch pipes to each steam pipe and coupled above oil supply a 1¼ in. tee inserted near cab for emergency oiling of piston valves by engineman in case force feed oil pump fails en route. O'Malley operating valves.

Bell ringer—Viloco. Tender journal box wedges—pressed steel—J. H. Sharp. Reservoir ball joint—Barco. Blow off cock—O'Malley Beare Company. Cylinder cocks—made by A. L. Co. Gage cocks, Perfection—O'Malley Beare Company. Water glass—2 applied—Okadee reflex. Drifting valve—A. L. Co. Standard. Engine trucks—A. L. Co. Standard.

Trailing trucks Ry. Co. Standard, made by A. L. Co. Fire door—Franklin Butterfly. Stoker—Duplex. Headlight case—Pyle Nat. Inter. steam valve—Hancock. Coal sprinkler—Sellers—cold water. Lagging—J. M. Valve gear—Baker. Lubrication—for cylinders—Schlack system of force feed. Flange lubricator—Detroit flange lubricator. Blower elbow—Ry Co. Standard, made by A. L. Co. Tank valve on syphon—Lindstrom. Tank hose strainer—Okadee. Tank hose—Republic Rubber Co. Tender brake beams—Creco Tender frame—Commonwealth. Tender draft gear—Bradford friction. Tender truck side frame—Andrews. Tender side bearings—Stucki. Air connection between engine and tender—Barco. Grate shaker—Franklin.

The following are the general dimensions of this type of locomotive, together with the distinguishing names of accessories not otherwise referred to:

Track Gauge, 4 ft. 8½ ins.; fuel, bituminous coal; cylinder, type, piston valve; diameter, 28 ins.; stroke, 30 ins.; tractive power, simple, 57,100; factor of adhesion, 4.3.

Wheel Base.—Driving, 17 ft. 0 ins; rigid, 17 ft. 0 ins.; total, 35 ft. 4 ins.; total, engine and tender, 72 ft. 11¾ ins.

Weight in working order, 332,000 lbs.; on drivers, 246,000 lbs.; on trailer, 56,000; on engine truck, 30,000 lbs.; engine and tender, 522,000 lbs.

Boiler, type, Conical Conn.; I. D. first ring, 84¼ ins.; working pressure, 180 lbs.

Firebox, type, wide; length, 108 ins.; width, 84 ins.; combustion chamber with length 36 ins.; thickness of crown, ⅜-in.; tube, ⅝-in.; sides, ⅜-in.; back ⅜-in.; throat, ⅝-in.; water space front, 6 ins.; sides, 6 ins.; back, 6 ins.; depth (top of grate to center of lowest tube), 28⅝ ins.; crown staying, 15/16 in.—1 in., and 1⅛ in. radial.

Tubes.—Material, seamless steel; number, 205; diameter, 2¼ ins.; flues, material, seamless steel; number, 43; diameter, 5½ ins.; thickness of tubes, .135 ins.; flues, .150 ins.; tube, length, 17 ft. 8 ins.; spacing, F. 1 in., B. ⅞-in.

Heating Surface.—Tubes, 2,120 sq. ft.; flues, 1,006 sq. ft.; firebox, 257 sq. ft.; thermic syphon, 141 sq. ft.; total, 3,604 sq. ft.

Superheater Surface.—950 sq. ft.; grate area, 63 sq. ft.

Wheels, driving, diameter outside tire, 63 ins.; center diameter, 56 ins.; material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, rolled steel; trailing truck, diameter, 43 ins.; kind, cast steel; tender truck, diameter, 33 ins.; kind, rolled steel; axles, driving journals, main, 11½ ins. x 2 ins.; other, 11 ins. x 13 ins.; engine truck journals, 6½ ins. x 12 ins.; trailing truck journals, 9 ins. x 14 ins.; tender truck journals, 6 ins. x 11 ins.; boxes, driving, main, cast steel; others, cast steel; brake operating, Westinghouse; driver, American; tender, Westinghouse; pump, 1 8½ Cross Compound; reservoir, 1 18½ ins. x 114 ins.; 1 18½ ins. x 144 ins.; engine truck, Woodard; trailing truck, Cole-Scoville; exhaust pipe, single; nozzles, 5⅞ ins.-6 ins.-6⅛ ins.; grate style, rocking; piston, rod diameter, 4½ ins.; piston packing, snap rings; smoke stack, diameter, 19 ins.; top above rail, 15 ft. 7¾ ins.; tender frame, cast steel; tank, style, water log; tank capacity, 10,000 gallons; tank capacity fuel, 16 tons; valves, type, 16 ins.; piston 6¾ ins.; outside lap, 1-1/16 in.; valves, lap or clearance, 0 in.; valves, lead in full gear, 3/16-in.

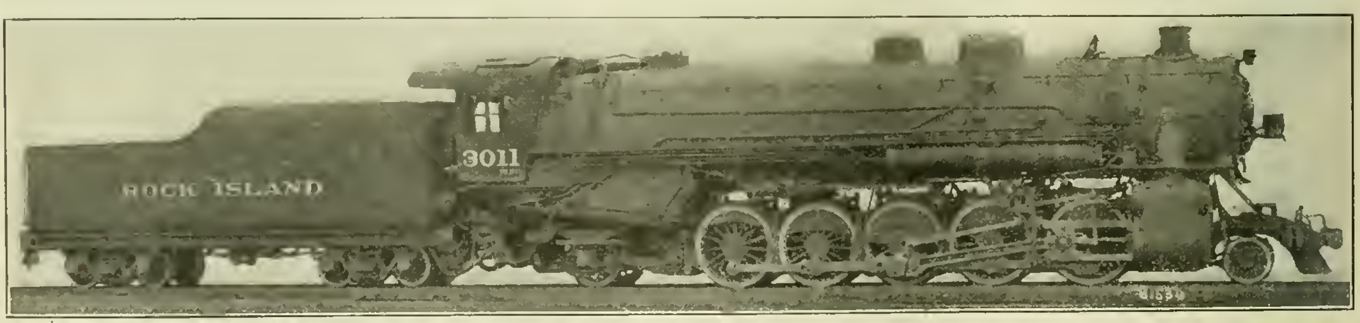
Santa Fe 2-10-2 Type Locomotives.

On this type of locomotives while a number of the details of construction are similar to those of the Mikado type, there are varieties in accessories, and in dimensions, which we deem proper to reproduce in order that an exact comparison may readily be made as to what has been deemed most suitable for the type of engine to which they are applied, and those may be safely looked upon as the best selections that could be made in present day practice. As in the Mikado type already described the copper pipes and valves for water column are covered with lagging. The test gage is also applied to the top of the boiler shell at the highest point of the firebox crown sheet. The sand pipes are placed in front of first and second driver, and to the back of the third driver. The tank filling hole, under coupler yoke, and coal gate to be similar to that of U. S. R. A. engines.

The axle bearing pressures are as follows: driving, front, 203; inter., 203; main, 93; back inter., 203; back inter., 203; engine truck, 152; trailing truck, 199.

Lagging and jacket covering are applied to the entire backhead. The engine brake shoes are furnished by the American Brake Shoe & Foundry Company. The injector steam valve and injector cheeks are supplied by the O'Malley-Beare Valve Company. The boiler is of the conical type with double seams.

Among other details the tender brake is designed to stand increased pressure for high speed brake, as these tenders may afterwards be used on passenger engines. The chamber throttle valve is applied with stem through the back head. Ashton steam gauges are furnished and "Safety First" marked on the dials. The A. L. Company's reverse gear type E is furnished with fibre packing, and piped A. L. Company's standard except a 1 in. line from the main reservoir to the cab for all air operating devices. The Franklin adjustable driving shoes and wedges are of cast iron, and other details include: A. L. 150 triple sander, Harry Vissering & Company; Nicholson syphon with tell-tale holes drilled to A. L. Co.'s standard; draft gear housing castings cast integral with tender frames; Franklin No. 9 pneumatic fire door; copper injector steam pipes; Symington tender journal boxes; seamless steel from Pittsburgh Steel Products Co. for boiler tubes and superheater flues; unit safety drawbar and Franklin type tender tank; bushings in brake hangers and equalizer stands; feed water hose 48 ins. long; tender truck journal, 6 ins. by 11 ins.; combustion chambers, 64 ins. long; boiler tubes, 21 ft. 3 ins. long; depth of crosshead flange, 3½ ins.; tender wheels, 33 ins., rolled steel, Edgewater Steel Co.; engine truck wheels, 33 ins., rolled steel, Edgewater Steel Co.; bell ringer, Viloco; tender journal box wedges, pressed steel, J. H. Sharp; brake shoes, engine, steel back, De Hemer Blatchford Co.; reservoir ball joint, Barco; blow off cock, O'Malley-Beare Co.; cyl. cocks, A. L. Co.; gage cocks, Perfection, O'Malley-Beare Co.;



SANTA FE 2-10-2 TYPE LOCOMOTIVE FOR THE CHICAGO, ROCK ISLAND AND PACIFIC RAILWAY. AMERICAN LOCOMOTIVE COMPANY, BUILDERS.

water glass, 2, applied, Okadee reflex; drifting valve, A. L. Co. Standard; engine trucks, A. L. Co. standard; trailing trucks, Ry Co. Std., made by A. L. Co.; firedoor, Franklin Butterfly; Duplex stoker; Pyle Nat. headlight case; inj. steam valve, O'Malley-Beare; inj. Hancock non-lifting; inter steam valve, Hancock; coal sprinkler, Sellers, cold water; lagging, J. M.; valve gear, Baker; lubrication, for cylinders, Schlack's system of force feed; flange lubricator, Detroit flange lubricator; blower elbow, Ry. Co. Std., made by A. L. Co.; reverse gear, Alco type E; sander and sander valve, Harry Vissering & Co.; tank valve or syphon, Lindstrom; tank hose strainer, Okadee; tank hose, Republic Rubber Co.; tender brake beams, Creco; tender frame, Commonwealth; tender draft gear, Bradford friction; tender truck side frame, Andrews; tender side bearings, Stucki; inj. checks, O'Malley-Beare side checks; air conn. between eng. and tender, Barco; grate shaker, Franklin; syphon, Nicholson firebox syphon.

The following includes other details besides the general dimensions:

Track gauge, 4 ft. 8½ ins.; fuel, bit. coal.

Cyinder, type, piston valve; diam. 30 ins., stroke 32 ins.

Factor of adhesion, 4.29.

Wheel base, driving, 22 ft. 6 ins.; rigid, 16 ft. 6 ins.; total, 41 ft. 3 ins.; total, engine and tender, 80 ft. 2¾ ins.

Weight in working order, 391,000; on drivers, 308,500; on trailer, 57,500; on engine truck, 25,000; on engine and tender, 583,500.

Boiler.—Type, Conical Conn.; I. D. first ring, 84 ins.; working pressure, 185 lbs.

Firebox.—Type, wide; length, 120 ins.; width, 96¼ ins.; combustion chamber, with length, 64 ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; throat, ⅝ in.; water space, front, 5½ ins.; sides, 5 ins.; back 5 ins.; depth (top of grate to center of lowest tube), 28¾ ins.

Crown staying, 15/16 in.—1 in.—1⅛ in. radial.

Tubes.—Material, seamless steel; number, 226; diameter, 2¼ ins.

Flues.—Material, seamless steel; number, 46; diameter, 5½ ins.

Thickness.—Tubes .135 in.; flues, .150 in.

Tube.—Length, 21 ft. 3 ins.; spacing, ⅞-in.

Heating Surface.—Tubes, 2,814 sq. ft.; flues, 1,400 sq. ft.; firebox, 337 sq. ft.; thermic syphon, 141 sq. ft.; total, 4,692 sq. ft.

Superheater Surface.—1,197 sq. ft.

Grate Area.—80.2 sq. ft.

Wheels.—Driving, diameter outside tire, 63 ins.; center diameter, 56 ins.; material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, rolled steel; trailing truck, diameter, 43 ins.; kind, cast steel; tender truck, diameter, 33 ins.; kind, rolled steel.

Axles.—Driving journals, main, 12 ins. x 20 ins.; front, 10 ins. x 19 ins.; other, 10 ins. x 13 ins.; engine truck journals, 6½ ins. x 12 ins.; trailing truck journals, 9 ins. x 14 ins.; tender truck journals, 6 ins. x 11 ins.

Boxes.—Driving, main, cast steel; others, cast steel.

Brake. — Operating, Westinghouse; driver, American; tender, Westinghouse; pump, 1—8½ ins. Cross Compound; reservoir, 2—18½ ins. x 156 ins.

Engine Truck.—Woodward.

Trailing Truck.—Cole-Scoville.

Exhaust Pipe.—Single; nozzles, 7¼ ins.-7½ins.-7¾ ins.

Grate Style.—Rocking.

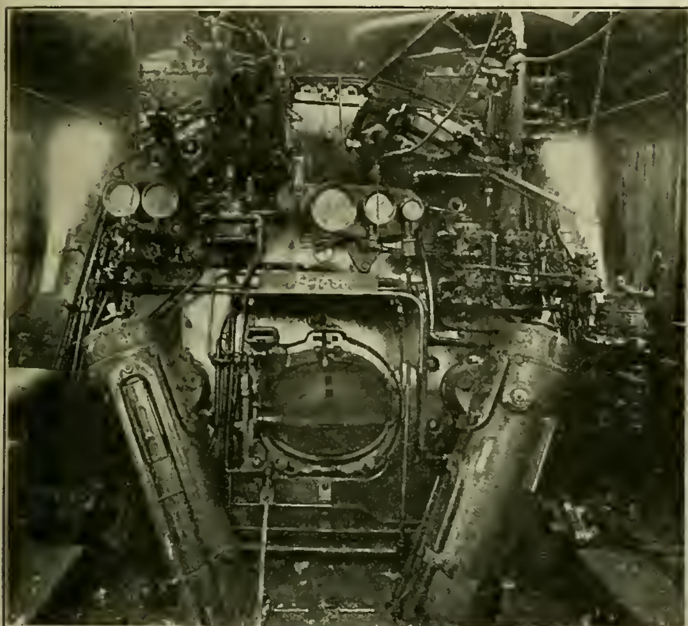
Piston.—Rod diameter, 5 ins.; piston packing, snap ring.

Smoke Stack.—diameter, 19 ins.; top above rail, 15 ft. 8½ ins.

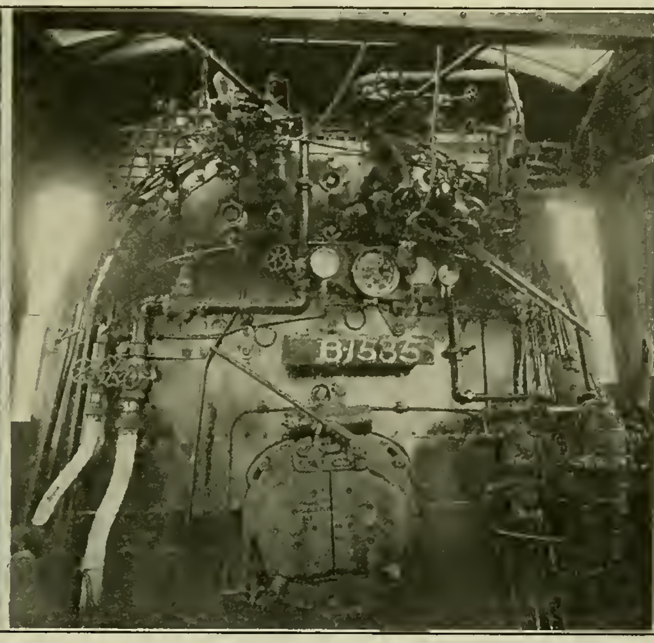
Tender Frame.—Cast steel.

Tank.—Style, water log; capacity, 10,000 gallons; fuel, 16 tons.

Valves.—Type 14 ins.; piston travel, 6¼ ins.; outside lap, 1 1/16 ins.; lap or clearance, 0 ins.; lead in full gear, 3/16 ins.



VIEW OF BOILER BACK HEAD SHOWING ATTACHMENTS IN CAB OF SANTA FE 2-10-2 LOCOMOTIVE.



VIEW OF BOILER BACK HEAD SHOWING ATTACHMENTS ON MOUNTAIN 4-8-2 TYPE LOCOMOTIVE.

Mountain 4-8-2 Type Locomotive.

This type of locomotive is primarily designed for the heavier type of passenger service in the mountainous regions of the West and Southwest. The details and table of dimensions give the data showing the qualities necessary for climbing steep grades at high speeds, requiring great boiler capacity as well as a large factor of adhesion. A close scrutiny of the appended data will be of interest and is furnished in the same detached style as furnishing briefly the essential particulars. These comprise:

Type A double loop superheater. Copper pipes and valves for water column to be covered with lagging and the pipes so applied that any condensation will drain back to boiler. Tank hose, 48 ins. long. Grate bars, finger type with dump at rear end. Trailing truck equalized. Spring hanger, loop type. Test gage cock applied in top of boiler shell at highest point of firebox crown sheet. Air reservoir tapped at back end of right hand reservoirs for 1 in. pipe for independent air line to air turret in cab. Injector delivery pipe along top of running board and anchored to running board brackets. Sand pipes in front of the first to front of the second and back of third drivers. Tank-filling hole tender, coupler yoke, and coal gate similar to U. S. R. A. engines. Axle bearing pressures—Driving front, 176; driving main, 83; driving back inter., 176; driving back, 176; driving engine truck, 150; driving trailer, 201. Crank pin bearing pressure, 200 lbs.; A. L. Co. Standard, 1¼ ins., cylinder cocks. Main driving journals, 12 ins. diameter with 12 ins. fit in driving wheel. Driving wheel base, 19 ft. 10 ins. Engine brake shoes—engines fitted with steel back brake shoes—De Remer, Blatchford Company. Injector steam valve—O'Malley-Beare Company. Flexible staybolts—Throat 115, backhead 100, side 274, connecting chamber 240; total 729. Expansion stays 60, radial stays 190 (flexible). Conical type of boiler, seams decuple. Tank 10,000 gallons capacity. Engine designed so that Duplex stokers may afterward be applied without extensive modification. Radial two machined bracket boxes bolted to boiler and suitable handle for operating by engineman on his seat. The 1¼ in. pipe to extend from turret to front end of boiler having a copper oil pipe leading from cab hydrostatic lubricator (present specification to include one more sight feed to suit). The 1¼ in. pipe to have a 1 in. tee with 1¼ in. outlet, same to include 1 in. branch pipes to each steam pipe and coupled above oil supply. A 1¼ in. tee to be inserted near cab for emergency oiling of piston valves by engineman in case force feed oil pump fails en route. Apply A. L. Co. pipe clamps.

Lateral motion—1 in. lateral motion each side of truck for front driving box. Henry grease cup front end side rods. Inj. check—Hancock. Ordinary type of door flange welded. No extension piston rods. Hancock type "N" nonlifting with inverted handles—injector. Hancock starting valve located outside of cab. A. L. Co. type "E" reverse gear. Long main driving box. Working pressure 200 lbs., which will involve the use of a straight fit in the main axle and main crank pins. Foulder main rod back end. beam, tender frame, back end frame cradle.

Main driving axle—heat treated and hollow bored. Main crank pin—heat treated and hollow bored. Main and side rods—heat treated steel. Piston rods—heat treated steel. Baker gear. Ash pan—special attention given to fitting of ash pan parts so that impossible to drop fire. Part of pan over trailer springs so arranged as to be easily removable to allow the removal or replacing of the spring. Vanadium C. S. frame.

All principal parts of engine fitted to gages and templates and thoroughly interchangeable.

The following are other details of construction and general dimensions:

Track Gauge; 4 ft. 8½ ins.

Fuel.—Bituminous coal.

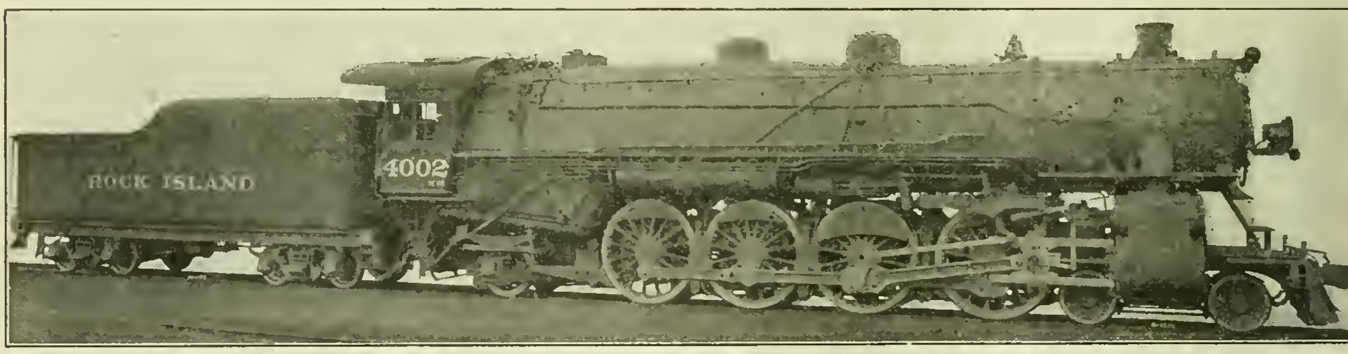
Cylinder.—Type, piston valve; diameter, 28 ins.; stroke 28 ins.

Tractive power, simple, 50,400.

Factor of adhesion, simple, 5.02.

Wheel base, driving, 19 ft. 10 ins.; rigid, 12 ft. 10 ins.; total, 41 ft. 0 ins. total, engine and tender, 79 ft. ¾ ins.

Weight in working order, 369,000; on



MOUNTAIN TYPE LOCOMOTIVE, 4-8-2, FOR THE CHICAGO, ROCK ISLAND AND PACIFIC RAILWAY. AMERICAN LOCOMOTIVE COMPANY, BUILDERS.

buffers applied. Chambers throttle with stem through backhead. Ashton steam gage will have dials marked "Safety First." Reverse gear piped A. L. Co. Standard except an independent 1 in. line from main reservoir to cab for all air operating devices. Safety chains applied at rear of tender. Apply A. L.—150 triple sander as made by Harry Vissering & Company. Barco flexible joints for steam heat connections and air brake connections between engines and tender. Draft gear housing castings to be cast integral with tender frames. Copper injector steam pipes. Patent license plates covering unit safety drawbar and Franklin type tender tank. Detroit Duplex lubricator for air pump. Railway Steel Spring Co.'s driving and trailing tires. Gold steam heat equipment. Drifting valves—Apply arrangement consisting of a manually operating device in the way of a 1¼ in. x 1½ in. turret angle valve, and an improved 1¼ in. quick opening starting valve extension stem in cab with "Security" pin to be used in the rod knuckle joint and crosshead wrist pin. Boiler studs—instead of screwing miscellaneous boiler studs into the boiler shell sheets for such things as hand rail columns, steam gage stands, and pipe supports, arrange for a round piece of bar welded to the boiler shell. The studs to be screwed into these bosses instead of into the shell.

Tanks designed for future application of the stoker. Franklin adjustable driving box shoes and wedges. Nicholson syphon—tell-tale holes in syphon staybolts. Nicholson syphon made in our own shops. The plate material for these syphons same as plates for firebox proper. Water gage—lowest reading of water gage to be 5¼ ins. above highest point of combustion chamber. Engine truck boxes—Spotweld 2¼ ins. mesh No. 11 wire netting in face of engine truck as a binder for babbitt face. Crown, side and combustion chamber sheets in one piece.

Special steel castings: Pilot bumper drivers, 253,000; on trailer, 59,000; on engine truck, 57,000; weight of engine and tender, 559,000.

Boiler.—Type, Conical Conn. I. D. first ring, 80 ins.; working pressure, 200 lbs.

Firebox.—Type, wide; length, 108 ins.; width, 84 ins.; combustion chamber—length 36 ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in; back, ⅜ in.; throat, ⅜ in.; water space front, 6 ins.; sides, 6 ins.; back, 6 ins.; depth (top of grate to center of lowest tube), 29¾ ins.

Crown staying, 15/16 in. radial.

Tubes.—Material, seamless steel; number, 216; diameter, 2¼ ins.

Flues.—Material, seamless steel; number, 45; diameter, 5½ ins.

Thickness.—Tubes, .135 in.; flues, .150 in.

Tube.—Length 22 ft. 5 ins.; spacing, ¾-in.

Heating Surface.—Tubes, 2,838 sq. ft.; flues, 1,445 sq. ft.; firebox, 265 sq. ft.; thermic syphon, 141 sq. ft.; total, 4,689 sq. ft.

Superheater Surface.—1,247 sq. ft.

Grate Area.—63 sq. ft.

Wheels.—Driving diameter outside tire, 74 ins.; center diameter, 66 ins.; material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, rolled steel; trailing truck, diameter, 43 ins.; kind, cast steel; tender truck, diameter, 33 ins.; kind, rolled steel, F 11 ins. x 19 ins.

Axles.—Driving journals, main, 12 ins. x 22 ins.; other, 11 ins. x 13 ins.; engine truck journals, 7 ins. x 12 ins.; trailing truck journals, 9 ins. x 14 ins.; tender, truck journals, 6 ins. x 11 ins.

Boxes.—Driving, main, cast steel; others, cast steel.

Brake. — Operating, Westinghouse; driver, American; truck, American; trailer, American; tender, Westinghouse; air signal, Westinghouse; pump, 1-8½ ins., Cross Compound; reservoir, 2-20¼ ins. x 114 ins.

Engine truck.—Woodard.

Trailing truck—Cole-Scoville.

Exhaust pipe.—Single nozzles, 5⅞ ins.-6 ins.-6⅛ ins.

Grate style.—Rocking.

Piston.—Rod diameter, 4¾ ins.; piston packing, snap rings.

Smoke Stack.—Diameter, 19 ins.; top above rail, 15 ft. 7 ins.

Tender frame.—Cast steel.

Tank.—Style water log; capacity, 10,000 gallons; fuel, 16 tons.

Valves.—Type, 16 ins.; piston travel, 7 ins.; outside lap, 1¼ ins.; lap or clearance, ¼ in.; lead in full gear, 1/16 in. x ¼ in. at 25 per cent cut off.

Service—Passenger.

Important Improvements on the Angus Shops of the Canadian Pacific Railway

The Canadian Pacific Railway Company made many alterations and improvements in the Angus shops at Montreal. These shops have been considered the largest railway shops in the world, and are now larger and more nearly complete than ever. The amount of work undertaken was considerable. The new buildings have added 241,000 sq. ft., or an increase in area of about 16 per cent. In all, the buildings were completed, and the following quantities will give some idea of the magnitude of the work: Concrete, 9,000 cubic yards; brick work, 1,350,000 bricks; lumber and timber, 2,000,000 f.b.m.

A 20-ton locomotive crane was constantly on the work. This was a general utility machine and its full list of duties covered nearly everything that ever developed on construction work. A one-ton truck was also supplied, and owing to the long distance from the work to the various wholesale and retail supply houses, this machine proved a very useful piece of equipment. It was used also for carrying materials from one building to another.

The largest building of the whole contract was the extension to the freight-car shop (on the west end of the existing shop). It is a one-story building with brick walls and steel frame, and is 400 ft. long by 132 ft. wide by 30 ft. high in the main portion, with a lean-to 16 ft. high along the north side. At one corner of the building bed rock was found 6 in. from ground level, but at other parts, rock was as low as 10 ft. from ground level.

The floor is made up of 3 by 4 in. T. & G. boards, laid on the 4-in. side, with 6 by 8-in. sleepers, bedded in a cinder fill, under them. The sash are all of wood, but the whole building is of "daylight" construction. The roof is made of the same material as the floor, and three-ply Barrett ten-year roofing. Columns were at 20-ft. centres longitudinally, and into every bay was built a skylight. There was a large amount of track work to be done, as the tracks outside the old shop had to be moved over considerably to line up properly under the new conditions. In all, six tracks were involved.

The second largest building of this contract was the extension on the west end of the locomotive shop. This building is 497 ft. long by 80 ft. wide by 47 ft. high. The walls are of brick, 16 in. thick up to the crane runway level and 12 in. thick above that. The floor is 1¼-in. mastic, laid on 8 in. of concrete. The roof is carried on steel trusses that bear at each end on steel columns. The truss is 80 ft. long, so a clear floor space is obtained throughout the building.

The columns are stepped in at a height of 25 ft. 2 in. from the floor to give a bearing for the crane runway girder. Owing to the very heavy loads that have to be handled in a shop of this kind, very extensive equipment in the way of overhead cranes had to be provided.

The roof is of the laminated type, built of dressed 2 by 3-in. British Columbia fir, laid on edge and covered with Barrett 3-ply, 10-year roofing. Skylights 13 ft. wide by 70 ft. long were built in each bay. The window frames and sash are of wood construction.

A tower was erected for the handling of bricks and mortar, and a small stiff-leg derrick was set up on the roof to handle the lumber for the roof and the crates of glass for the skylights. A motor-driven circular saw was installed on the roof to cut the material for the roof and the skylights.

The extension at the east end of the locomotive shop was of similar construction, and was handled in practically the same way as that described above. Its length is 242 ft., the other dimensions remaining the same. As this building is to be used for the final work on the locomotives, it was necessary to take into consideration the fires under the boilers and the smoke and steam. Pits were built under each of the four tracks to allow for an examination of the underbody. Mill-type smoke jacks 40 ft. high were hung over each track to carry away the smoke and steam. In addition to these, mill-type ventilators were mounted on the skylights to take care of the smoke and fumes from the oil furnaces and blacksmiths' fires. The floor was of creosoted wood block, laid on concrete.

Reclamation of Scrap.

The *Scientific American* claims that reclaiming and utilizing scrap material has been impressed on the railways by war conditions, and at the recent annual meeting of the American Railway Engineering Association it was shown that many railways have erected special reclamation shops.

A reclamation plant established by the Rock Island Lines at Silvas, Ill., has a scrap dock 48 ft. wide and 1,500 ft. long, with six bins 28 x 42 ft. for storing unsorted scrap, eight bins, 28 x 30 ft., for sorted scrap, and 74 bins of various sizes for sorted scrap. Three traveling gantry cranes of 4 and 10 tons capacity have lifting magnets for 1,500 and 8,500 lb. loads. A shop 25 x 270 ft. contains a 100-lb. hammer, two 150-lb. power hammers, double and single alligator shears, bolt shear, rattler for cleaning, drill press, nut tapping machine, four electric welders, four oxygen welding outfits, air-operated shear, and air-operated punch.

This plant is doing such work as welding cast-iron spokes on driving wheels, building up worn spots on firebox castings with acetylene welding; mating and repairing flange-worn steel-tired wheels before turning, thereby saving a great deal of labor; reclaiming salt deposits from refrigerator cars for use in thawing switches during the winter, and for use in fire barrels; pressing oil from waste (one barrel of waste netting about 20 gal. of oil); burning the waste and reclaiming about 50 lbs. of babbitt, reclaiming barbed wire for use in building rip-rap.

The Regan Automatic Train Control

Intermittent Control Type Tested—Favorably Commented On

The Regan Safety Device Company recently gave a demonstration of its automatic train control system which is being very favorably commented upon. It appears that in some of its features the Regan system is not unlike other methods. It is of the intermittent control type, having a ramp, 100 ft. long, in the "four-foot" at the signal, and a shoe suspended below the center of the rear buffer beam of the engine. There is a relay in a box on the right side of the engine, and on the other side of the engine is a box containing a storage battery for this relay. The relay controls an electro-pneumatic valve behind the steps on the right side, which valve is in the Westinghouse brake connections. The relay is normally energized by current from the storage battery, but this is cut out, when the shoe rises, by a circuit controller on the stem of the shoe. The relay is then, however, joined up electrically by the circuit controller, through the shoe, to the ramp. The latter, when energized and in accordance with the polarity of the ramp, causes the relay to take up one of two positions, but, should the ramp be de-energized when the shoe passes over it, the circuit controller, when moved, will cut out the relay from the storage battery, but cannot switch in the necessary current from the ramp, as the latter is de-energized. The relay would then be de-energized also. The ramp has, therefore, three functions which we will notice as soon as we have referred to two novel features in the Regan system.

On the right wheel of the trailing axle is a speed control. This is a governor similar to that on a stationary engine except that instead of opening or closing the power supply it operates, by a flexible connection, a circuit controlling device adjusted to a pre-determined speed—at the trial last week the speed was set at 24 m.p.h. The other novel feature is the shoe mechanism. The upper part of the shoe stem is carried in a cylinder directly connected to the brake pipe, and the shoe, when the engine is running, is thus kept down. When the shoe goes over a ramp and is raised the air in the cylinder is forced into the brake pipe, but as soon as it is off the ramp the air returns to the cylinder and drives the shoe down to its normal position. The stem of the shoe is hollow and thus, should the shoe be broken off air escapes and the brake is automatically applied.

At each ramp one of three results is attained. Each ramp indicates the position of the signal at which it is placed, but when track circuit is installed it will ensure also that the signal corresponds with the state of the track and, thus will stop a train, regardless of the state of the signal, in case the line is obstructed. No track circuit has been provided in the present demonstration. If, then, a signal be at "clear"—whether a distant or a stop signal is immaterial—the ramp is energized and the polarity positive to the rail. When, now, the shoe is raised and the circuit from the storage battery on the engine to the relay of the electro-pneumatic valve is cut, a momentary circuit is made from the ramp, and this holds the relay in its normal position so that the brake pipe vent remains closed and the control of the main reservoir pressure open so that there is no automatic application of the brake. When the shoe drops as it leaves the ramp the circuit between the relay and the storage battery is restored, and thus the relay continues to be energized for normal running.

Should a signal be in the "caution" position," *i.e.*, a distant at "on" or a three-position signal at 45 deg., the ramp remains energized, but has its polarity reversed. As a consequence, when the shoe rises the relay remains energized, but its position has been changed so that the speed controller—hitherto disconnected electrically from the valve—is put in series with the brake valve magnet. What happens now is that should the engine be travelling faster than the pre-determined speed the brakes get a service application until the speed is reduced to the requisite level. That level reached, the brakes are released, but are immediately reopened should the level again be passed.

This "caution" effect remains until the next signal is reached. Should that be at "clear" the raising of the shoe will restore the *status quo*. If, however, the signal be at "stop" the ramp would be de-energized. As a consequence, when the shoe rises and the storage battery is switched out there will be no current available for the relay and it will be de-energized. This will open the brake pipe vent, close the control of the main reservoir pressure, and the brakes will automatically be applied fully. At the demonstration at Fairlop, the train, at the pre-determined speed of 24 m.p.h., was pulled up in 225 ft. It will be appreciated that a full application can be made from the normal position and need not go through the speed control stage, also that any failure will result in a full application.

After a full application has been made the driver cannot release himself until the train has come to a stand. The release switch is situate in the same box as the relay and cannot be reached from the foot-plate.

Many engineers have commented favorably on the device, but as other devices are being experimented with, it may be some time before any particular selection for general approval is made.

Cleaning Castings.

In cleaning castings of all kinds a goodly amount of brushing with steel wire brushes is desirable to dislodge sand and other adhesive matter, and with some it is an advantage to rub the surface well with a lump of hard coke to scour off dirt that the brush will not remove, while in some cases passing through a tumbling barrel more than repays its cost. Pickling for some hours in strongly acidulated baths for the removal of the silicified surfaces left on some castings is often recommended, and often this improves the cutting of the machine tools; but the practice does not always give the desired results, and if by the use of a carbonaceous facing to the moulds a softer skin is produced it is desirable to use this method rather than that of pickling. The castings in all cases should leave the fettling shop of the foundry in such a state that they can be immediately placed on the machines, and the comparatively small extra cost this involves to the foundry is more than offset by the saving in the machine shops, not to say the saving in stores and avoidable waste; roughly dressed castings always being a source of trouble outside the foundry.

Insulated Tools for Electric Railways.

The introduction of the third rail on electric railways has rendered it difficult to carry on certain repairs on the rails and road bed. Great care must be taken in order that tools will not come in contact with the live rail, and this is by no means a simple matter where common labor is a factor. Several methods have been tried to insulate the tools, such as winding insulating tape about metal parts of tools or using rubber sleeves, but these fail either in the electrical or mechanical sense. From England comes a worthy solution of the insulated tool problem, in the form of special tools which are divided and insulated into short sections. These sections are such that it becomes impossible to span the distance between third rail and regular rail, in an electrical sense. At the same time the strength of the insulated tools is practically that of the uninsulated tools.

Locomotive Boiler Tubes.

Eminent engineering authorities claim that the use of copper plus steel in a locomotive boiler is wrong, and that fireboxes should be made of steel. Experiments to this end were made many years ago, but were abandoned owing to cracking and burning of the plates, which resulted from the use of plates too thick for the purpose. Zinc does form an alloy with steel, such alloy being a real protection to boiler tubes. Steel tubes are now generally conceded by all concerned to be the best material for boiler tubes.

Repairing An Air Compressor At the Shops of the Erie Railroad, Susquehanna, Pa.

The connecting-rod of an air compressor, one of two units operated by the Erie Railroad shops, Susquehanna, Pa., for supplying air pressure to the pneumatic tools used for boiler caulking, chipping boiler plate, etc., recently snapped in two, causing one end of the rod to fly around into a wedged position and exerting such a strain on the machine that the hollow cast-iron back frame of the bed plate broke off.

The cross section of the hollow casting at the fracture measured about 8 x 6 in. at this point, the thickness of two opposite walls being 3 in. the other two opposite walls only ⅞ in.

A new bed plate was ordered, but it was impossible to get it delivered before 60 days. As the idleness of this air compressor cut down the compressed air supply over all the shops 50 per cent, the operators decided to repair it by means of Thermit welding. In welding the casting the bed plate was laid on its side, as shown in Fig. 1. The broken sections of the casting were then lined up by means of bolted straps, as shown, a small gap being left between the two sections to provide space for the Thermit steel later to enter.

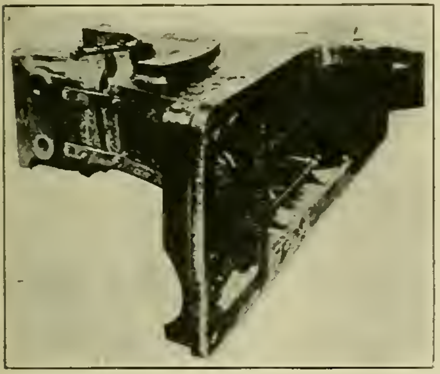


FIG. 1. BROKEN SECTIONS OF CAST IRON AIR COMPRESSOR BACK FRAME LINED UP FOR WELDING.

Yellow pattern wax was then inserted in the space and a mold formed around the wax. A preheating torch was directed into the mold for the purpose of drying out the mold, preheating the sections to be welded and burning out the pattern wax.

Finally when everything was ready to make the weld 300 lbs. of Cast Iron Thermit, a mixture of iron oxide and aluminum, to which was added 3 per cent Ferro Silicon 50/50 per cent and 20 per cent mild steel punchings, were ignited in a crucible suspended over the mold. A chemical reaction at the extremely hot temperature of 5000° Fahr. was started during which the aluminum combined with the oxygen of the iron oxide to form aluminum oxide or slag, in a highly superheated molten state while the iron was set free and produced as liquid steel.

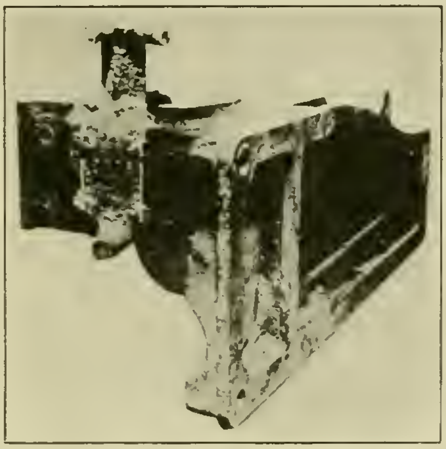


FIG. 2. THERMIT WELDED FRAME BEFORE REMOVING RISER.

The reaction required only about 35 seconds at the end of which time the liquid steel which had precipitated to the bottom of the crucible was tapped through the bottom of the crucible into the mold, thus amalgamating with the broken surfaces of the two sections.

The metal in the weld was allowed to cool slowly after which the mold material was removed, excess metal cut off and the welded bed plate returned to service, as shown in Fig. 3, as strong as ever.

The function of the steel riser shown in Fig. 2 was to hold a supply of steel which would remain liquid for a considerable period of time and take care of all shrinkage, so that when a pipe is formed due to shrinkage this pipe would appear in the riser and not in the weld. Also the riser acted as a depository for loose sand or other foreign matter which might have been washed into it by the Thermit steel in passing through the mold and thus prevented this material from clogging in the weld.

FIG. 3. AIR COMPRESSOR FRAME WELDED AND BACK IN SERVICE.

Locomotive Efficiency

The main reasons for the exceptional efficiency of motive power on the Delaware & Hudson Company lines may be briefly summarized as follows: An unusual degree of co-operation between the officials of the mechanical and transportation departments; efficient organization in the mechanical department; adequate facilities for the inspection and repair of locomotives; systematic inspection and terminal management; close analysis of abundant statistics gathered in the course of handling the motive power; stated minimum requirements in regard to the mileage of freight trains daily on the various divisions; and a regular method of dispatching through freight trains from the principal terminals.

The Oneonta terminal is equipped with two long tracks in which are deep pits filled with water into which the cinders are dumped from the locomotives that have been turned in by the crews after their runs. The cinders dumped from the fireboxes are quenched immediately in water into which they fall.

Connected with each cinder pit are two extra tracks for cleaning fires, etc. An electric crane equipped with a clam-shell bucket is built so that it travels astride each cinder pit. One operator keeps this crane and bucket working on an eight-hour shift and by this means keeps the cinder pit free of accumulations. The cinders are dumped into old cars and are hauled away for ballast, filling and other use. It is possible with the facilities at Oneonta to handle 90 locomotives a day.

Mexico to Purchase Railroad Equipment

A telegram received from Commercial Attaché Jackson, Mexico City, dated January 26, 1921, reports that the minister of finance in Mexico has signed a contract with the American firms for a credit of $5,000,000 with which to purchase railroad equipment. Purchase will be made from the seller offering the best terms.

A Pennsylvania Official Discourses on Apprenticeships

Degree of Skill Disregarded by the U. S. R. Administration

E. T. Wither, vice-president of the Pennsylvania Railroad System, and secretary of the Railway Executives' Committee, at the hearings held before the United States Railroad Labor Board, submitted statements in regard to the training and skill of mechanics and others, particularly in the car departments, which has created considerable discussion at many of the meetings of the organized railway men. The following abstract furnishes a fair estimate of Mr. Wither's statement:

"The training and skill for shop crafts such as Machinists, Boilermakers, Blacksmiths, Sheet Metal Workers, Moulders, Patternmakers, Cabinet Makers, Coach Carpenters, Upholsterers, Letterers and Stripers, and Varnishers is recognized as the highest skill in railroad shops and is comparable with the same class of work performed in the outside industries, being generally obtained by years of experience.

"In connection with the skilled crafts of Machinists, Boilermakers and Blacksmiths, it has for years been the practice to maintain periods of apprenticeships. In the other Metal Crafts, Sheet Metal Workers and Electrical Workers, if there were apprenticeships they were few in number, the mechanics in these crafts having generally been made from helpers. In the Car Department, apprenticeships were in effect under only a limited number of schedules. On the large majority of the railroads, no apprenticeship training was known. Well established practices were in effect under which men were advanced according to their capacity. As a rule, beginners were engaged in repairs to freight cars; they were advanced in rates as they became better qualified. When they showed the necessary ability they were advanced to car builders. In the Coach Department, the work usually was maintained separately from the Freight Car Department. Especially skilled men in the Freight Car Department were transferred to the Coach Department. Prior to the rules promulgated by the Railroad Administration no attempt was made to create an apprenticeship in that department, as it was accepted that it was no distinct trade and young men desired to learn a trade which at the end of four years would make them a mechanic in a skilled trade warranting the payment of the higher rates.

"Under Supplement No. 4 provision was máde for employing carmen at step rates, and graduated according to years of experience, so that, to a very large extent, the present forces on the car repairs, have not spent four years in the several classes of work prescribed for the apprenticeship, i. e., on general freight work, wood and steel; air brake work; mill machine work; general coach work, wood and steel. We venture the statement that very few of the present forces could qualify to this complete provision.

"The men engaged in freight car repairs have devoted practically all their service to that class of work, and experience has shown that the work does not require such full apprenticeship for qualification. The present arrangement also provides for helpers in the Car Department, but with the conditions as to the available supply of labor, immediately preceding provisions for graduated rates based on years of experience, and the further obligation to pay the journeymen rates to all hired mechanics, the provision for helpers has not been of general benefit, it has been possible to only a limited extent to employ helpers in that department particularly because of the line of demarcation between work permissible for a helper to perform and that of the journeymen.

"While we desire in no way to detract from the importance of the shop crafts' work, yet it is manifest that in comparison with many other classes of railroad employes, such as engineers, the train dispatchers, the signalmen, or generally those engaged in train service, the mechanic's responsibility is slight. The responsibility of the mechanic consists largely in carrying out the orders of his foreman and performing the work assigned in a proper mechanical manner. Much of his work is important and requires knowledge and skill, and his training and ability to efficiently perform such assignment constitute the skilled craftsman and is the principal basis which governs his compensation. The output of those mechanics is subject to constant inspection in all of its stages and is usually tested before it is put to the severe test of actual service.

"Prior to January 1, 1918, railroad wage rates by the orderly processes of adjustment extending over a long period of time had reached a point where the rates of the different crafts had been established on such a basis that reasonable differentials existed between the different crafts and occupations, bearing proper and reasonable relation to each other, based on the character of service or degree of skill required.

"General Order No. 27, however, disregarded these relationships by the creation of a minimum rate for all mechanics, while at the same time not raising carmen, helpers and apprentices in a like ratio. This unsettled the relationship that previously existed between the crafts and occupations. Subsequently Supplement No. 4, issued July 25, 1918, in defining the work embraced under the classification of the different shop crafts, disregarded the degree of skill required to perform certain classes of work which resulted in raising large numbers of men to the classification of mechanics whose work prior thereto had only been considered as helpers or unskilled work. It further advanced carmen to a position where the former differential existing between them and the shop or crafts was reduced materially and increased materially over the rate of helper to the mechanical crafts to which prior thereto it bore a close relationship. Orders of the Director General, dated August 25, 1919, advancing all carmen to a rate of 67 cents per hour further decreased previous differentials existing between them and the mechanical crafts where from time immemorial helpers and carmen's rates had been almost on a parity, by this latest order they were given the unwarranted advance of 36 per cent above the rates of helpers.

"It will be noted that the advance over the average rate of 1915 for the entire United States was 125 per cent. There were wide variations in the rates for the employes coming within this classification, with the results that when they were increased to the higher classification, the increases attracted general attention and resulted in perhaps as great adverse comment as any increases granted during Federal control, not only on the part of the public, but by other railroad employes. It is now proposed to remove the slight differential between their rates and those of the accepted skilled mechanics, which could only result in accentuating the existing dissatisfaction, as it will have the effect of advancing their rate to the extent of 186 per cent above the average rate of 1915 for the whole United States."

To the average Joint Protective Board Chairman and others who have had experience in dealing with railroad officials this "stuff" sounds natural, but possibly there are many of our individual members who do not know just what the average railroad official thinks of them and their ability.

We trust all interested will carefully read the foregoing, and if they do, we feel assured they will not further support the contentions of railroad officials that they are not skilled mechanics by frequently referring to themselves as "car toads, car whackers, car knockers," and various other opprobrious names.

Early Cars of the Baltimore & Ohio Railroad

By J. SNOWDEN BELL

No. 1 Four Wheel Freight Car.

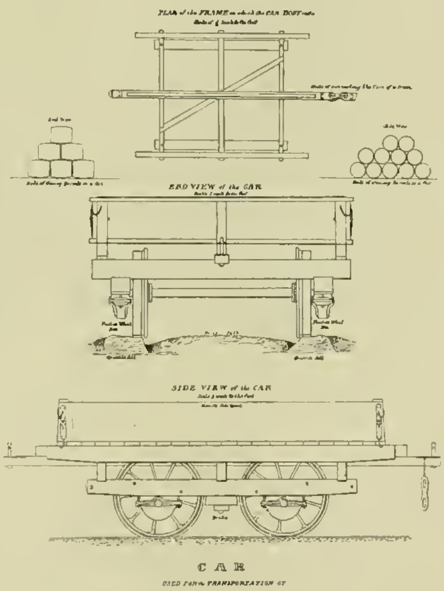
The rolling equipment of the Baltimore & Ohio Railroad, at and for many years after the early date—August, 1830—at which it was opened for the transportation of passengers and freight, by locomotives, included a number of examples of locomotive and car construction which were novel in design and original in its practice, some of which, in general plan and with the improvements in detail and accessories which were subsequently developed, have been perpetuated in the standard practice of the present day. Much was learned by other railroads from these designs, and while it may be that no more remains to be learned from them, they merit a fuller record in railroad history than they have heretofore received. For the purpose of supplementing it, the writer proposes to present, as far as the limited number of drawings and descriptions now available will permit, some examples of the early practice which appear to be noteworthy.

The *American Railroad Journal* of November 28, 1835, confirms the view above expressed in the following statement on page 401, viz.

"It will not be saying too much, we are sure, to denominate them (the Baltimore & Ohio Railroad Co.) the Railroad University of the United States. They have labored long, at great cost, and with a diligence which is worthy of all praise, in the cause, and, what is equally to their credit, they have published annually the results of their experiments, and distributed their reports with a liberal hand, that the world might be cautioned by their errors and instructed by their discoveries. Their reports have, in truth, gone forth as a text book and their road and work-shops have been a lecture room to thousands who are now practicing and improving upon their experience. This country owes to the enterprise, public spirit, and perseverance of the citizens of Baltimore, a debt of gratitude of no ordinary magnitude, as will be seen from the president's report in relation to their improvements upon and performance with their locomotive engines, when compared with the performances of the most powerful engines in Europe, or rather in imagination in 1829, only six years ago."

The accompanying illustrations, which are reproduced, on a reduced scale, from the Fifth Annual Report, 1831, of the company, show a four wheel car for the transportation of flour, and the manner of storing the load. This is doubtless the earliest representation of a B. & O. R. R. car that is in existence. No description of the car is given in the report, but it is shown so clearly in the large print that, beyond the indication of special features of design, a description need not be here made.

Ross Winans, whose remarkable mechanical ability and novelty and boldness of design have well merited the high rank in which he has been placed among early locomotive builders, had been connected with the Machinery Department of the B. & O. R. R. practically from the date of its organization, and, with his partner, George Gillingham, was in charge of that department at the time of the publication of the illustration of this car. It is reasonably probable—indeed, almost certain—that it was designed by him, particularly for the reason that it contains three features which were admittedly originated by him, and which appear in patents granted to him, viz., friction wheel journal bearings, outside journals, and continuous



CAR
USED FOR THE TRANSPORTATION OF
FLOUR
ON THE BALTIMORE AND OHIO RAIL-ROAD

drawbar. The first two of these will be briefly noted, and the latter referred to in a subsequent article.

Ross Winans was granted a patent on October 11, 1828, for what he termed "Winans' Friction-saving Rail-way Carriage," the improvement consisting, as stated in his claim, "in the employment of secondary wheels bearing the loading on their axles, the peripheries of which secondary wheels, are turned by the revolution of the axle of the primary or traveling wheels, the main axle thereof, by its gudgeons, or journals, rolling on, or in, the said peripheries when the carriage is moved."

The casings of the friction or "secondary" wheels are shown in the side and end views of the car, and are marked on the latter, "friction wheel box."

The axle journals, which are, as indicated in the illustrations, on the outsides of the wheels, are the subject of the Winans Patent of July 20, 1831, the claim of which is as follows:

"I therefore declare that the improvement, or improvements, above explained and described, in diminishing the resisteance to motion in wheel carriages to be used on railways, which I claim as my own invention, is the extending the axles each way outside of a pair, or pairs, of wheels, far enough to form external gudgeons, to receive the bearing box of the load body, and diminish as aforesaid, with a view to lessen the resistance of friction, as small as its situation, with the use of the most favorable metal for wear, will permit. Thus conveniently increasing the leverage of the wheels, without impairing their effective strength or durability."

The side and end views of the car, which are on a scale of one inch to the foot, in the original of the illustrations, show the sills to be 10 feet in length; the extreem width of the car 7 feet 8 inches, and the wheels, 30 inches diameter, with a wheel base of 3 feet 8 inches. The primitive "strap" rails, and granite sills, which are shown, will be strange and surprising to railroad men of the present generation.

Last Century Lathe Hands

It is generally believed that the machinists who ran lathes fifty years ago were better mechanics than those of today. They worked their own tools, but such provisions as gauges and specially turned and milled bits and cutters they did not have, nor did they need them. They would make a form cutter with the aid of a file, and make a spring tool themselves.

But now all is provided for the machine shop man. All drawings of work are dealt with by the routing department, and copies sent to the tool-room and jig designers.

The jigs and tools are numbered and specified, as well as the sequence of their use in consecutive operations on the work in hand. The drawing records, the sequence of operations—such as, casting, lining off, turning and milling—and also the jig, tool or register for each operation.

Calipers (inside and outside) and a steel rule, conjointly with marvelous expertness and judgment in the use of these, formed the sum total of the old-time mechanic's tools of precision, and some of the examples of their work still in existence testify to their high merit.

Car Axle Fracture.

In reporting on an accident occurring on a western railroad caused by the fracture of a car axle, the chief of the Bureau of Safety, in a brief summary, states that the fracture of the axle occurred at the wheel seat, the surface of which ranged from 1 to 1½ inches below the face of the hub. It is unusual to witness the fracture of an axle at this place, and is suggestive of some local cause affecting this part of the axle which precipitated rupture.

The journal, including a short section of the wheel seat, was detached at the time of derailment. The journal remained in good condition. The section of wheel seat was bruised by its wabbling motion in the hub at the time of rupture.

Upon pressing off the wheel the character of the surface of the wheel seat was revealed. It showed that a rough cut had been taken in the lathe in turning the axle. The line of rupture had its incipient point at the circumference of the wheel seat, coinciding with a tool mark. Other incipient cracks on the same surface followed similar tool marks.

In brief, the character of the surface of the wheel seat was apparently responsible for the failure of the axle. From information at hand, on the results of repeated stresses on axles, the character of this surface is regarded as an adequate cause for its failure.

Examples are not of infrequent occurrence in which surface defects of this nature have led to failures, although bending and other direct stresses did not reach a maximum at the place of rupture, thus showing the gravity of such defects, although located beyond the most strained zone. However, it is one of the polemics of the case as to just what the stresses actually are at places where the normal stresses are increased by the presence of tool marks or other interruptions to the transmission of strains. Experience has shown, nevertheless, that such surface defects are by no means negligible factors, ruptured members substantiating this point of view, leaving no doubts concerning the necessity of avoiding such contingencies. Steel under the action of repeated stresses is clearly susceptible to premature rupture under the influence of slight surface defects.

This is a matter which demands attention in the manufacture of axles. Slight economy in first cost results from taking a rough cut, in turning an axle, omitting a proper finishing cut, economy incomparable with the dangers involved and expense incurred in its failure in service.

Axles are vital members. Lavish expenditures on interior fittings of cars are out of place if necessary precautions are neglected in the manufacture of the axles. Current methods of inspection appear to have ignored or omitted consideration of the importance which attaches to the proper machining of axles. Specifications governing their tests and acceptance are singularly lacking in reference to this feature, the neglect of which leads to the destruction of the axles and becomes a menace to the safety of travel. It should be sufficient to call attention to these errors of omission to insure the introduction of corrective measures.

Locomotive Fire-boxes.

Arthur Wrench, an eminent British engineer, commenting on the design of locomotive fireboxes, states that the shape of the inner fire-boxes of the locomotive boilers used at the present so widely differ that the average student does not readily see the advantages and disadvantages of the various types used. The three principal are the straight-sided fire-box, the Wooten fire-box and the shape shown in the lower figure are used by the London and North-Western and the Great Northern railways.

The most efficient heating surface is horizontal to the flame, the next best being the one which is horizontally inclined. Then follows the vertical type, and the last being that heating surface which slopes away from the flame.

Considering these four points, it would appear that the fire-box having the greatest crown plate area to the flame, and also its side plates being sloping, would possess the most efficient heating surface. The worst form of fire-box has a portion of its heating surface inclined away from the fire.

The principle of the Wooten fire-box is to present a horizontally inclined heating surface to the flame and also to provide a large grate area. However, it is argued that while the development of the gases is somewhat checked by the diminishing capacity of the Wooten fire-box, the gases in the case of the London and North-Western type are allowed to develop freely when passing from the fire-grate, and before being divided by the tubes. The later type also allows for a large tube heating surface.

The advantages and disadvantages of the types named are as follows: (1) The straight-sided fire-box is simple to construct. It has the minimum crown plate and tube-heating surface, also side plates vertical to the grate. (2) The Wooten fire-box has a large grate area, and its side plates are horizontally inclined to the grate, with a minimum crown plate and tube-heating surface.

The London and North-Western pattern, the most expensive to construct, has one portion of its heating surface vertical, another portion inclined away from the fire-grate; it has also a large crown plate and tube heating surface.

The writer's opinion is that the disadvantage caused by the portion of the heating surface inclining away from the flame cannot be compared to the decided advantage obtained when allowing ample space to give free development to the gases, thus obtaining a large crown and tube heating surface.

The construction of the upper part of this box also opposes a collapse if the stays should break, causing the shape to become strained by the expansion and contraction.

There is much heating surface lost in the adoption of a straight fire-door plate, owing to the pull of the exhaust in the smoke-box. This is illustrated by the extra wear which takes place on the fusible plug which is fitted to the fire-box near the tube plate, compared with that of the fusible plug fitted to the fire-box near the fire-door.

On most American railways a system of water tubes is used passing from the lower portion of the tube plate to the fire-door plate. Also some of the London and South-Western Railway locomotive boilers are fitted with water tubes which pass across the top portions of the fire-box. These devices, while increasing the heating surface, tend to chill the gases and prevent their full development.

Opportunity for American Railway Supplies.

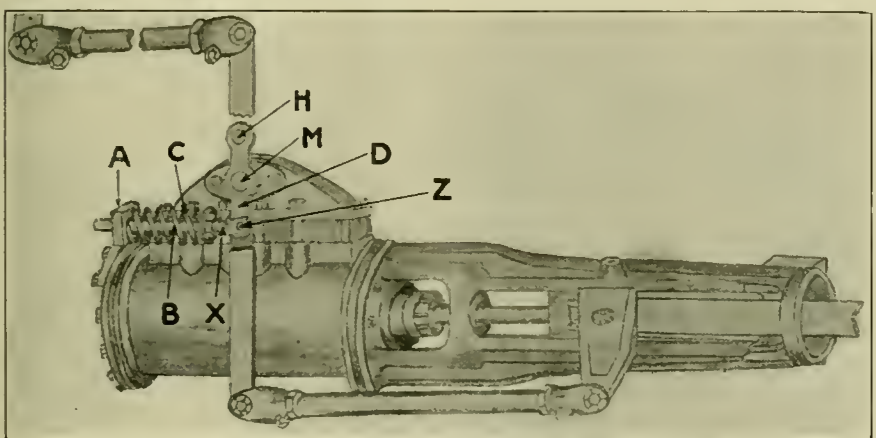
Among the various plans put forward to relieve unemployment in Great Britain during the Winter is the improvement of the permanent way and the renovation of rolling stock in the British railways. A suggestion to this effect was made at a recent meeting of the London Members of Parliament, presided over by the Minister of Labor, and it was recommended that, in addition to the construction of highways in the London district and other portions of the United Kingdom, a large number of unemployed could usefully find employment upon railway reconstruction. That the railways in the United Kingdom contemplate, after the depreciation of their stocks during the war and subsequent to the armistice, substantial measures of reconstruction and repairs is borne out by the number of inquiries which have been received at the London consulate general respecting American railway materials, and, provided delivered prices and quality of materials are in conformity with the British standards, there would appear to be a present opportunity for the London representatives of American firms producing railway supplies to negotiate orders with the principal purchasing agents of the British railways.

Anti-Creeping Device for Power Reverse Gear on Locomotives

The power reverse gear is beyond question a valuable auxiliary on locomotives for moving and adjusting the valve gear to vary the cut-off and the direction of rotation. The operation of the device, as is well known, is made by fluid-pressure acting upon a piston contained in a cylinder, the pressure being controlled by means of suitable valve devices which are under the control of the engineer, whereby the valve devices are moved so as to admit the fluid-pressure to move the piston in the desired direction, which movement restores the valve devices to closed position when the piston has reached the location desired. Experience has shown that owing to the joint control of this mechanism any lost motion arising in the joints has the effect of rendering the piston movement out of proportion to the adjustments, and also causes the piston, instead of remaining quiet at the exact desired position, to perform a continuous reciprocating movement, known as "creeping" between the limits fixed by the amount of looseness. This lost motion, has in many instances become greater than might have been expected, partly from wear and doubtless partly from inaccurate workmanship.

Several locomotives on the Nickel Plate railroad have been equipped for some months with a device that has proved eminently satisfactory in overcoming this oscillation or creeping movement. The device has been thoroughly tested on engines whose reverse gears were already creeping badly and in one test a ⅜-in. bolt was purposely put in a connection having a 15/16-in. hole, a large handicap, which, it is claimed, the device completely overcame by taking up the slack and retaining the piston in its proper position.

The device is the invention of John H. Alter, an engineer, and as shown in the accompanying illustration, consists of the application of a coiled spring, whose function it is to keep the lost motion "bunched" or taken up, so that any movement of the power reverse piston from any source will cause an immediate movement of the power reverse gear, which will promptly check the slightest piston movement before it can move a distance to be noticeable in the sound of the exhausts of the engine, in fact, it is claimed, the piston cannot move or the cut-off vary from the position indicated by the position of the reverse lever.



DETAILS OF POWER GEAR ANTI-CREEPING DEVICE

Referring to the illustration—A is a bracket bolted to, or may be made a part of the back cylinder head; B is the adjusting or valve rocker extension rod, the front end, of which is threaded at the clevis Z, which connects to the lower end of the valve rocker extension D. The adjusting or valve rocker extension rod B is free to work through hole in bracket A, also through compression spring C. The spring C is regulated by an adjusting nut X, the tension of spring being just enough to be felt in pulling back the reverse lever. The valve rocker spindle M, in its stuffing box, serves as a fulcrum to aid the spring in pulling the floating lever back at point H, thus taking up the lost motion in all the lever and pin connections from the notches in the reverse lever quadrant to the pin in the front end of the union link.

It will thus be seen that this improvement represents what may properly be called the finishing touch that makes perfect the power reverse gear, as it can be applied to any type of reverse gear in use, and its cost is so comparatively trifling that it is soon paid for over and over in the reduced cost of repairs—not to speak of the more efficient and economical operation of the locomotive that it provides for so perfectly, thus correcting the only weak feature of the power reverse gear. It may be added that the point may not be weak but the inevitable wear is certain in creating error in the position of the parts attached.

Railroad Electrification.

The problem of the electrification of tracks which run through fairly level and what might be called easy country is represented by the electrified sections of the New York Central and the New York, New Haven and Hartford Railroads, the one using direct current and the New Haven the alternating current. In the interests of the art, it is to be regretted that there has not been any definite statement made public as to the relative cost on these two roads of electric and steam traction. It is true that the installations were made more as a matter of necessity and convenience than with the expectation that there would be any considerable reduction of costs. The change at the Grand Central Terminal was due to the pressure of the law, coupled with the conviction on the part of the New York Central Company that the change from steam to electricity would make possible a great saving in train movements, to say nothing of the possibility of putting the train yard below street level and building the present magnificent terminal, undoubtedly the finest work of its kind in existence and a lasting tribute to Colonel Wilgus, the engineer in charge of the work. We do not know whether the two companies have kept any separate account of the operating costs in the terminal, as distinguished from those of the electrified sections of their main lines.

Successful Electric Welding Process.

Rapid progress is being made with the special process of electric welding which was successfully employed by the British Admiralty during the war in the construction of a "rivetless" 1,000-ton steel barge for transport purposes. The peculiarity of this process is the use of special electrodes covered with flux, which prevents the oxidation of the welding metal. Further, by using electrodes and fluxes of special composition steel of any particular character—mild steel, nickel steel, high-tensile steel, vanadium steel, and so on—can be deposited direct. Cast-iron of good quality can also be obtained by this system of welding. Extensive repairs are being carried out in worn tramway tracks, cracked omnibus wheels, and old motor car shafts, and a company has been formed for the production of welded motor car wheels. An important feature is that only a moderate amount of skill on the part of the operator is required to secure satisfactory results.

New Equipment in 1920.

Under corporate management during the greater part of last year the railroads have made arrangements to purchase approximately 50,000 new freight cars, 1,500 new locomotives, and 1,000 new passenger cars. This will assuredly be added to in the near future.

Snap Shots By The Wanderer

So the Interstate Commerce Commission has interested itself in the rest facilities offered to trainmen at terminals, and has made a report based on replies received from railroads and the secretaries of Young Men's Christian Associations, and that leads to the query as to why the latter are usually so bad. Are the secretaries the sole judges of what is good and proper? Are the places never inspected? Why are they usually so smelly and dirty? I have been caught at roundhouses and division terminals many a time, and on making inquiry as to where I could get something to eat have been told: "There's the Y. M. C. A., but I don't know whether you can stand it." It is rarely that the railroader has a good word to say for it. They just tolerate it. I have one place in mind that I can imagine the secretary writing to the Interstate Commerce Commission: "We have a large building originally built for a summer hotel, the rooms are large and comfortable, there is an exceedingly commodious reading and lounging room for inclement weather, while broad piazzas afford every outdoor comfort when it is warm. A broad mountain stream flows by the house, affording splendid drainage. There is a large dining room and cafeteria, where meals may be obtained at any hour of the day or night. There are ample washing facilities, with bath tub and shower baths and basins, with hot and cold water." All this would be literally true, but it is a case "where every prospect pleases and only man is vile." The place is simply filthy. The great dining room would be fine if the hands of its attendants and their clothing bore any evidence of ever being washed, and what is true of this is true of the rooms. The towels and bed clothes bear every evidence of having been wet, dried and ironed, but not washed. The shower and baths are as open as the canopy of heaven and as public as the highway of the king. Privacy is an undreamed of luxury in their designing. As for drainage, the broad mountain stream probably gets it eventually, but first the slops and garbage are thrown out upon the ground to fester and reek and breed the myriads of flies that infest the place in hot weather. Oh, yes, the pictures and prospectus of the place would make one choose it as a place to live, but the dirt and stench would make a different impression, and to me it seems that the only reason it is not a hotbed of typhoid, and everything else, is that it is swept by mountain breezes and drained by a broad mountain stream.

This is perhaps an extreme case, but it is typical. In hot weather there are always flies, flies and more flies. Flies off in the country, in the middle of railway yards that afford no breeding place but long stretches of cinders and heaps of ashes and coal, yet entomologists tell us that flies require filth to perpetuate the species. So we naturally charge the superabundance of the pest to the Y. M. C. A., whose back yard is the depository of slops, whose tables and counters have the touch of grease and whose servitors can usually be classed among the great unwashed. It is small wonder, if the association served the soldiers in France no better than it serves here, that the girls of a New York show, representing it, were hissed from the stage.

As for private accommodations, I have been there, too. In going to a strange place, I have found the railroader to be a most reliable source of information as to what is good in the way of accommodations, and I usually follow their guidance, and they do send me to some queer places, but they are always good. I used to see a little shanty near a trunk line on the plains of Ohio, away out in the country, that bore an enormous sign announcing that it was a restaurant. A most unpromising appearance in a most unlikely place. But chance and a freight locomotive landed me there one day, and the engineer suggested that I would do well to take advantage of the chance to get a bite. Well The place was immaculately clean and food of better quality and better cooked was never served. And there are scores of these little places, frequented by engineers and train men that are all that the most fastidious could desire and are clean. So for sleeping accommodations. And I have fallen into many of them, privately owned and managed, that would yield nothing in point of cleanliness and comfort to the best and most expensive of hotels. But my experience with the Y. M. C. A. is that their godliness turns a cold shoulder on their next of kin, which is cleanliness. And my observation based on their recommendations and criticisms lead me to believe that railroad men value cleanliness more than godliness; at least they have invariably recommended clean places to me, and usually mention it as a recommendation.

The railroads are affecting to make great efforts to please the public and makes friends of their patrons lest they should again suffer from the hostility of the law-making powers vested in the people. But there are many little things that might still be done in a follow-up sort of a way that would please their patrons and cost only a little effort, and not the least of these little things is the truthful reporting of the running conditions of the trains, and this seems to be rarely done. To go to an agent as I did, the other night, and be told a half hour before it was due, about a train, "and then when it did not put in an appearance in accordance with the schedule, to be told that it was forty-five minutes late, leaves a very bad taste so far as truthfulness is concerned, for it is difficult to understand how a train could lose forty-five minutes in half an hour, unless it spent part of the time running away from the destination. The agent simply didn't know at the time of the first inquiry. But why didn't he know? Simply because there was no follow-up to see that the despatchers kept him informed. People usually ask that question out of idle curiosity, but frequently because, if the train is late, they can use time to advantage, and it is irritating not to be able to do so because the railroad's representative is not in a position to tell the truth or does not keep himself informed.

And in the line with that is the posting of a 10 minutes late bulletin an hour or so before the train is due, and then while that train is constantly losing time keep that ten minutes bulletin posted until the train rolls in thirty or forty minutes late, to find everybody on the platform angry and hostile to the road, whereas by simply keeping the bulletin up to the mark, of even approximate truthfulness would have satisfied the crowd and would have accepted the situation as a part of the day's work.

One of the greatest causes, so they say, of mine troubles and explosions is the criminal failure of miners to obey orders and regulations. They will smuggle in explosives that are forbidden and will use bare lamps in gas infected galleries. So it is safe to say that ninety-nine out of a hundred, if not nine hundred and ninety-nine out of a thousand, of automobile-railroad accidents are due to the reckless, if not criminal, driving on the part of their drivers. The Long Island Railroad found it necessary to erect crossing gates of such a substantial character that an automobile crashing into them would be stopped and wrecked before reaching the rails. And now the Tennessee legislature has passed a highway law that should do much to prevent an automobile from approaching a railroad track at high speed. The remedy is a hump placed in the surface of the highway not less than fifty or more than 100 feet from the rails. This hump is 6 ins. high and about 6 ft. long. It is to have a concrete finish and so substantially made that an automobile passing at a high speed will give its occupants a toss not apt to be soon forgotten. A warning sign reading "Hump Slow" is to be placed well in advance so that there will be no excuse for not having the machine under control. The matter has already been tested in the courts where a driver running at a speed of 25 miles an hour was thrown out of the machine and had his arm broken. He sued for damages but lost on the ground that there was a warning sign which he disregarded. Mr. Hunter McDonald, the chief engineer of the Nashville, Chattanooga & St. Louis R. R., in a paper on the subject stated that the law is a necessity because "watchmen, wig-wag signals, alarm bells and even safety gates are often ineffective in preventing men from recklessly sacrificing or jeopardizing their own lives or those of their children or friends by what is often nothing less than criminal carelessness."

Locating a Railway by Aeroplane.

According to a recent news letter of the Air Service, United States Army, locating a railway by aeroplane has been carried out by the 3d Aero Squadron, Camp Stotsenburg, Philippine Islands, and one long flight has enabled a railway engineer to determine which one of three general routes will be used for the new road. It is stated that many months and thousands of dollars have been saved in the work. Instead of three parties of locating engineers being sent out to make the survey, only one will now be necessary. The new line is projected by the Manila Railroad Co. as an extension of its line from Cabanatuan, through parts of the provinces of Nueve Ecija and Nueva Vizcaya to Bayombong. The first trip was made with the Chief Engineer of the railway, passing over Mount Arayet and then following the Pampanga River until the railroad line was picked up at Gapan. The river was followed from Cabanatuan on to Pantabangan and over Mt. Pangloriahan, thence to Bayombong.

Welding Rail Joints.

Steam railroads are turning more and more to the use of welding of rail joints where the rails are laid in paved streets, also where main highways cross the tracks, necessitating the welding of a few joints at such points. The Baltimore & Ohio was the first railroad to adopt the welding of rail joints, nearly one hundred joints being welded on Pratt street, Baltimore, in 1917, the rails in this instance weighing 141 lbs. to the yard. The success attending the innovation has led to its extensive use. In the case of highway crossings the general practice is to weld three rails together in the nearest shop and quickly instal them without interfering with the traffic. Once installed, they may be said to require no further attention, as no joint repairs are necessary, many having been in service for a lengthened period without showing signs of weakness or failure.

Unloading a Wrecked Locomotive

Railroads are not usually anxious to advertise accidents and so it will be unnecessary to name names in this instance. The facts are that a Mikado locomotive, hauling a freight train, ran into the rear of a train and demolished some of the cars to a greater, mostly greater, or less extent, as may be inferred from the reproductions of the two small photographs. When the engine stopped it was found to have loaded itself fairly and squarely on top of a flat car having a steel underframe. The engine was standing there, although a little unsteadily, but in such condition that there seemed to be no good reason why it should not be taken to the shop on its own wheels.

The problem before the wrecking master was to get it back upon the rails without

LOCOMOTIVE AT TIME OF ACCIDENT.

upsetting it. The tender was disconnected and hauled away; then the loose wreckage was cleared. The engine was then blocked in place and raised enough to relieve the car. This was then pulled partially out and the engine lowered slightly at the rear, the operation being repeated until the rear end was down on the rails with the front still resting on the car. Then the final operation consisted in hauling the car free and lowering the engine.

The shop facilities were not such that

WRECKED LOCOMOTIVE LOADED ON FLAT CAR.

the engine could be picked up by cranes, but it had to be handled in the yard, where it was jacked and blocked up as shown in the large engraving. And here the repairs were made under the handicap of lack of big shop facilities.

WRECKED LOCOMOTIVE JACKED UP FOR REPAIRS.

A Safety Tour on the Baltimore & Ohio.

A series of instructive meetings to further impress safety upon its employees is being carried on by the Baltimore & Ohio railroad, beginning at New York on January 17, and extending to Jenkins, Ky., which will be reached on February 24. The tour is under the direction of John T. Broderick, superintendent of the safety department of the railroad. "Bulletin," which is a visualization of the various accidents reported by the railroads of the country. The picture is a remarkable production showing the actual operation of standard trains and the proper and improper ways of handling them. At each of the twenty-four places where the pictures are shown the employees or members of their families are furnishing a musical entertainment. Mr. Broderick delivers an address which has the double merit of being brief and impressive. The example is being followed on some other roads, and will undoubtedly become popular on all of the leading railroads in the near future, and may be said to be popular on some of them already.

Railway & Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $3.50 *or fifteen shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

Superheat.

It is evident from comments that have come in regarding an article on "The Actual Superheat," which appeared in the January issue of this paper, that the intent of that article has been misunderstood. The statement that the initial steam pressure in the high-pressure cylinder of certain Mallet locomotives was much below the boiler pressure has been taken to mean that the superheater units were responsible for the wire drawing indicated by that fall in pressure. This is a misinterpretation of the intent. Superheater units have been designed by too many engineers and have been subjected to too close scrutiny for too many years, to be subjected to the suspicion that their designers have been so careless in the proportioning of their parts as to make them so small that they cannot deliver all the steam to the cylinders at full pressure that the boiler can supply. If wire drawing occurs, as it evidently does, it is to the position of the throttle that we must look for the cause. The old controversy of full throttle and short cut-off versus partial throttle and a longer cut-off has not been settled by uniform practice quite yet. Therefore, where throttling does occur, as in the instanceces cited, the actual superheat of the steam is greater than that with which it is usually credited and the results should also be proportionately greater. It is not at all a question of the wire drawing of the steam by the superheater units, but a rise in the actual degrees of superheat when the wire drawing does occur, regardless of its cause, but always bearing in mind that the throttle valve is probably the guilty party.

American Engineering Council.

The Executive Board of the American Engineering Council of the Federated American Engineering Societies are holding sessions beginning on Februory 14th, and continuing for two days. On February 15th the National Council of the American Society of Mechanical Engineers will convene with the society's new president, Edwin S. Carman, presiding. The joint meeting will be held in Syracuse, N. Y., and the object is to endeavor to take such steps as may be calculated to weld the engineering forces of the nation into one great organization whose aim will be to focus technical and scientific effort on the solution of several political and economic problems. The elimination of waste in industry is the problem of the hour, and the engineers are setting themselves in earnest array to ascertain if it is possible to get America's idle back to work, and keep it at work. Ignorance afflicts every human element connected with industry. It is this defect that the engineers are to make an attempt to correct. It is this that accounts for much of the dissatisfaction, discontent and violence which have been so evident in recent months. Undoubtedly it is the lack of information that leads to a misinterpretation of causes and effects.

This is a mighty task that the federated engineers set before themselves. We are all ignorant, because the things that we know are so infinitely small compared to the number of things that we do not know, and never shall know. But with all our limitations there are degrees of comparison, and it is the general belief that we are nearly all capable of improvement. It has long been supposed that the employer knew a great deal, and the employes knew little or nothing. This is a gross error. The engineers should not trouble themselves about beginning at the bottom. They should strike all along the line, directing their heaviest artillery on the intrenched positions. These usually include fossilized, soulless corporations, segregations, frequently of rich men's sons, who never did a day's work and never could, and in all likelihood never will.

Then there is the working men who never work, but make a good living by fomenting discontent. These should be put to work. Working men who have not had the advantage of a good education should be induced, if possible, to read good books, and they will learn something worth learning. The men who read good books become philosophic and run the world. It is the lack of knowledge on the part of rich and poor alike that grievous mistakes are made, and injustice and estranged relationships are the seeds from which prejudices grow, and hence we suffer mentally, physically and financially. The engineers are moving in the right direction, and we will have our eye upon them.

The Fuel Supply.

It is only about 30 years ago that the prophets of disaster were proclaiming from the housetops that unless the waste and extravagance in the cutting and use of the standing timber of Michigan was checked, it would be but a few years before the great primeval pine forests of the state would be wiped out of existence and there would be nothing left but the barren waste of sand to mark their place. But mill owners and lumbermen laughed the prophets of evil to scorn and went their way, leaving devastation in their track, and in a short time all was over, and, for years, the old pine territory of Michigan has been an unproductive desert. And now there are other prohpets who are trying to stay the hand of American wastefulness in coal.

At the last meeting of the American Society of Mechanical Engineers that matter of fuel use and fuel conservation was brought well to the front. Prof. L. P. Breckenridge, of the Sheffield Scientific School, in a paper on the "Fuel Supply of the World" called attention to the rapid increase in coal production that had taken place in this country. Up to 1820 fuel was needed primarily for cooking food and for keeping warm. At that time power was produced by wind for the sailing vessels and by falling water for the grist mill, sawmill, cotton mill, woolen mill and forge. The total amount of coal mined in the United States up to the end of the year 1840 was only 12,000,000 tons, an amount which is now produced in six working days. In fact, the total coal mined up to the end of 1880 was not more than 1,000,000,000 tons, an amount now produced in twenty months.

Fifty years ago the total coal production of the United States was less than one ton per capita (0.96 ton). To-day it is slightly over 6 tons. This great increase is accounted for primarily by our growth as a manufacturing nation, involving great increases in the requirements for transportation, but to this must be added the evident fact that we have surrounded ourselves with many comforts, then unknown, as well as luxuries which still are never found in many foreign countries.

We are rich indeed in fuel, but our wealth of fuel resources should not make us wasteful of these resources which are a world need and which, when once used, may never be replaced.

He urged individual thrift, and to prevent waste of coal he suggested an improvement of mining methods and the operation of the mines more steadily throughout the year instead of only for from 200 to 240 days, as is now done, principally because of a shortage of cars. He also recommended an extension of the use of the by-product coke oven and that of furnace gas for power generation; and, finally, water powers should be developed as widely as possible for transportation and industrial purposes.

This was followed by Mr. David Moffat Myers with a paper on "Fuel Conservation," which opened with the statement that from 75,000,000 to 100,000,000 tons of coal per year could be saved by the adoption in the United States of well-known, well-tried methods of fuel conservation, and this saving would be in addition to a similar reduction in the consumption of other fuels.

There is at present a huge and unnecessary waste of fuel in this country. The waste is everywhere. There is not an industrial plant in the country where 10 to 30 per cent saving of fuel might not be effected by common-sense engineering. Some of the items relating to this waste are as follows:

The need of a definite policy of fuel conservation is urgent. Natural gas, the most nearly ideal of all our natural fuels, to-day is practically gone. Inside of three years there will be no more available for industrial uses, and all owing to our failure to demand a definite policy of conservation. We permitted instead a definite policy of waste.

The next natural fuel to go will be oil. The supply in the United States it is estimated will be used and wasted out of existence in 20 to 30 years. Our production is stated at one million barrels of crude oil a day, which is more than 60 per cent of the world's total output, but this is not enough for our present domestic consumption. The peak of production will be reached in a very few years, whereas the consumption is increasing steadily. The demand for motor fuels is the greatest of all the items of consumption, and fuel oils is said to be the next largest. A bill has been introduced for an appropriation of $250,000 to enable the Department of Agriculture to conduct experiments looking toward the discovery of a new motor fuel. Coal-tar products including benzol are under consideration as well as alcohol. That the expensive method of producing oil from the shale beds of Utah, Colorado, Wyoming and Nevada is being more and more brought to the attention of investors, is an indication of the urgency of the oil situation. All this is occurring years earlier than should have been, owing once more to our lack of a definite policy of fuel conservation.

John Ericsson

It may not be as widely known as it should be that justice is being done to the memory of the most accomplished engineer and machinist that ever lived in America. Not only has the United States Congress, which refused to pay for work that no other man could do but John Ericsson, and which was fairly contracted for, redeemed itself by appropriating $35,000 to erect a marble memorial to perpetuate for all time the memory of the great man, but the Swedish Societies in America have contributed a similar sum. It will be understood that in referring to Congress, the members who repudiated Ericsson and his works, are in their graves and forgotten as they should be. It is only the forgotten who are dead. Ericsson is among the immortals, even if this late recognition had not come.

It is not necessary in an engineering publication to enumerate his trials and his triumphs. His defeat by Stephenson in the momentous competition of the first trial of steam locomotives was accidental. Stephenson had months of preparation, backed by English money. Ericsson had little over a week and his backing was an invisible thing, a hope, a mystery. The Swedish inventor had the best engine constructed up to that time, but it broke down, as a hastily built machine is likely to do. Out of his defeat Ericsson produced the calorie engine, and passed from triumph to triumph. The screw propeller had failed in many hands, but the ingenious Swede made it propel the great ships just as it is to-day. His crowning achievement, however, is generally conceded to be the turreted battleship. The appearance of the "Monitor" at Hampton Roads on that fateful March 9th, 1862, not only swept the flag of the Southern Confederacy from the sea and the seacoast forever, but made junk of the British and other European fleets, and cleared the way for the final triumph of the Union.

Another phase of Ericsson's character has its lessons in these days when the shutting off of emigration is being seriously discussed, and when "one hundred per cent American" is presumed to embrace body and spirit. Ericsson loved his native land with a quenchless fervor, yet in a long, and, latterly, a prosperous lifetime, it never occurred to him to revisit the scenes of his childhood. It seemed as if part of his spirit remained in Sweden, while with the remainder of his great soul on fire, superadded to his almost superhuman physical strength he worked in, and for America, more, perhaps, in his own plane of thought and endeavor, than any other man that ever lived. In the matter of taking vacations, or clamoring for shorter hours, or scheming for higher profits, he was far below one hundred per cent American. As an illustration of his contempt for idle sight-seeing, on being invited to take a trip to Niagara Falls, the restless engineer laconically enquired if "anything was the matter with the Falls." If there had been he might have paused a day and invented a remedy.

It may properly be added that a movement is on foot to erect tablets on the sites of certain buildings in this city with which the life and work of Ericsson is identified, together with similar commemorations of Cornelius H. Delamater, who was so long and so honorably associated with that of the distinguished Swedish inventor. Like Matthew Boulton, the enterprising English construction promoter who gave James Watt, the Scottish inventor, the opportunity of exploiting the steam engine, the name of Delamater should be forever associated with that of Ericsson. Both added a mighty advance in applied science to engineering invention and construction in America and it is doubtful if either one of them could have found opportunities of going very far into the realms of monumental achievement without the other.

Interborough Rapid Transit Rates.

The State of New York and the City of New York have locked horns in regard to the rates on the subways and elevated railroads in New York. Neither of them are to be trusted. The city party, desirous of retaining the five cent fare, are more anxious about securing votes at next election than it is of saving the roads from bankruptcy. The country party should act as a justice. Politicians who see with one eye only are incapable of settling such a question. There should be an honest and capable commission appointed, if such a commission could be found, but it might be as difficult to find five honest men in our midst today as it was in Sodom and Gomorrah. The Interstate Commerce Commission might have settled the question, but it appears to be outside of its jurisdiction. We presume the gentlemen comprising that august body are not sorry. They have troubles of their own. We would not venture to hazard an opinion on the subject further than to affirm that if the present rates are adequate to meet the increased expenses of operation, the Interborough must have been making millions in the old days.

Safety First and Always.

It is reported from official sources that during the last two years it has been difficult to keep safety work going. The pressure for production has been so great that other things had to give way. Changes in the labor departments were incessant and in a constantly shifting force accident prevention inspectors, who were responsible for safety activity, were called to other work, and interest lagged; and particularly during the war it was difficult to maintain practical ways and means of keeping up the safety work. Not only so but it is claimed that the war brought increased carelessness. Human life had been given gloriously and generously, and a spirit of restlessness had been engendered, and hence accident prevention became difficult.

In spite of these facts the safety movement as far as the railroads are concerned is being maintained and as the official reports show may well be looked upon as an example to other industries. Of course the railroad men may properly be looked upon as having some advantage in being engaged in an occupation that, generally speking, remains stable when compared with mny other fields of industry, and hence the circumstances affecting the safety movement are less adverse than in some occupations.

In the continued maintenance of the safety movement it is generally conceded that some kind of committee organization is fundamental to good safety work. The active committee has generally consisted of foremen, either all the foremen in the shops or a representative number. Workers' committees, in some establishments, elected by the men themselves, have done good work in creating the safety spirit. In others they have failed utterly. What is needed is men of real capacity for leadership, and they are rarely found by proclamation. Continual propaganda is the essential feature. Hence bulletins; literature; lectures; general educational material; superadded to which the moving picture shows have been found to be effective in impressing lessons in safety.

Among the successful methods adopted, it may be stated a very efficient committee has in some instances been composed of one representative selected by the foreman of each of the departments. It appears that the workmen more readily make practical suggestions to a representative fellow workman than to a superintendent whose presence not infrequently superinduces a repressive effect on those who have something else to do besides cultivating the gift of eloquence.

Battered Ends of Rails

W. P. Burn, Northern Pacific Railway, Glendive, Mont., commenting on battered ends of rails, states that if they are sawed off, they become battered again, no matter what track conditions are. In regard to his personal observations he states:

"I have had some 25 years' experience on maintenance of way work. At one time, this division of over 400 miles had 56 lb. steel, laid in the early eighties, which was taken up in the early nineties and found to be in good condition, except flange worn on the curves. There were no battered joints or flowing of metal on the lower sides of curves. We then replaced some 200 miles of this with 60 lb. rail, which gave very poor service, and had to be changed on account of battered joints, and the flowing of metal on the low sides of curves after 5 or 6 years' use. This in turn was relaid with 85 lb. rail, which seemed to be the same class of metal as the 66 lb.; it battered badly at the joints and the low sides of curves flowed out to such an extent that it had to be changed out in 5 or 6 years. On a portion of the division, for about 200 miles, we took out the 50 lb. rail and relaid 72 lb. rail. When the 56 lb. rail was taken out, it was in good condition, except flange worn on curves and some rails were surface bent on account of the soft spots in the track. There was not a rail with battered ends and it did not flow on the low side of curves. The 72 lb. rail that was laid on this portion of the track gave good service for 10 or 11 years, and when taken out was in first class condition, except flange worn on the high side of curves. There were no battered joints, and the rail did not flow on the low side of curves. When the 72 lb. rail was taken up, we relaid it with 90 lb. rail. This 90 lb. rail was relaid in 1910, and it does not seen to be wearing very well, flowing badly on the curves, and battered joints showing up pretty frequently. A good many of the curves had to be changed out after the rail was in five years, on account of flowing metal and battered joints. I figure that battered joints are caused by inferior quality of metal and poorly rolled.

"I do not think that the rigidity of the superstructure at the joint has anything to do with the battering of the rails at the ends. My opinion is that the superstruction is not rigid enough. Rolling stock, motive power and volume of traffic has increased very materially in the last 25 years, but our heavy rail should take care of this, and my opinion is that it would if it was made of the right kind of metal, and properly made as was the lighter rail. It must be remembered too that our roadbed has been improved wonderfully during the past 25 years by the widening of banks, cuts which have been ditched out, and by ballasting several times, so that our rail should last longer now than it did formerly under poorer roadbed and track conditions."

The opinions of Mr. Burn, after such a lengthy experience, are worthy of full consideration.

Colloidal Fuels.

For commercial purposes the fuel contains 25 to 40 per cent pulverized coal, held in stable suspension in oil so that the product can be handled and fired with the usual oil-burning apparatus. The solid component may be coal, coke, charcoal, hard pitch, or any carboniferous substance capable of being ground. The fluid component will vary according to its availability in various countries. Tar, and tar oils in combination with oils, may be used when oils are more expensive. Its flow through pipes does not differ materially from crude oils; it is stated in general that the colloidal fuel is more viscous than its fluid component. Carbonizing at the burner tip is not greater with this than with crude oils, and in comparison with the greater number of heat units fired the possibility of slightly increased wear is negligible. Handling the fuel in the furnace is described, and, in connection with its combustion efficiency, it is stated that tests on sea and land prove that for steam-raising purposes it is at least the equal of oil. Lastly, on the all-important question of economy, it is shown that by the use of colloidal fuel there is a gain of a few per cent on account of storage efficiency over straight oil, owing to its higher heat capacity per unit of volume and freedom from evaporation, but the big factor of economy is the saving in cost per given number of heat units over those of straight oil, on account of the coal component being so much cheaper than the oil.

Tank Steel.

Tank steel has, at last, been defined by the Association of American Steel Manufacturers "as a grade to be used for ordinary fabrications or for structural purposes where no particular stresses are required. It should be free from surface defects." The reason for making this definition lies in the fact that, since the outbreak of the war a great deal of "tank steel" has been specified for purposes for which such steel was unsuited and then has had attached to it requirements that would throw the material into a higher classification, without, of course, expecting to pay the extras required by such higher classification. The ruling of the committee is further that if the buyers' specifications stipulate a tensile test from each plate as rolled, the material shall be classified as flange steel. Further, that if a flange steel purchase specifies a homogeneity test in addition to naming chemical and physical properties, the material becomes fire-box steel. Again, that if the steel plate order carries specifications with regard to phosphorus and sulphur limits equivalent to the fire-box grade, the steel shall be regarded as fire-box steel unless the chemical tests are modified.

Suggestions for Greater Economy in the Repair and Maintenance of Steam Locomotives

By M. A. BLAIR, Instructor, Detroit Technical Institute

Management.

Steam locomotive operation and maintenance should have emerged from the experimental stage years ago. For any condition or combination of conditions that is found on any railroad there are many precedents, the greater number of which we should be familiar with. Quick and accurate judgment is not a requisite of good management, and while of value in emergencies it can never supplant thought and study of past experience. For what happened yesterday under certain conditions will surely happen today under the same conditions.

Emergencies will occur in any industry, especially the railroad industry; but there are far too many emergencies in the railroad business today. Indeed, it is a series of emergencies. They are not emergencies, for they are the daily practice, but they are treated as such. Among railroad men, officials and workmen, there exists a line of thought similar to this: "We will get out of the present difficulty the best way we can and then everything will be alright." They extricate themselves from that particular difficulty and are immediately confronted by another. Many of these difficulties can be prevented by our past experience if we will only make use of the knowledge it has given us. We optimistically believe things will be all right in the end, while there are many certain agencies working to an opposite effect. In other words, we are thinking almost entirely in the present, with no remembrance of yesterday, and no provision for tomorrow.

In the motive power department there are engines and men. We will assume that the larger percentage of power is the simple, super-heated steam engine, of fairly heavy and modern construction, outside valve gear, and where warranted equipped with stokers, feed water heaters, compound air pumps or any other device which is an aid to economy. While they are not, we will assume steam and air leads at a minimum. Authorities state that the steam engine as an agent of power is near a state of perfection, beyond which it cannot pass along the lines of the present conception of a steam engine. Others state the locomotive has reached or passed the economical point in weight. Both statements may be accepted for the present. Experience has proven that we may expect nothing from compounding steam except under certain limited conditions. However, the compound locomotive may be more satisfactory in the future than it has been, but it will not affect the present situation. Electric systems will be confined to certain districts and there it will be many years before becoming general.

We find nothing to supplant the simple steam engine or no great improvement that can be made in it. We will have to use the engines as they stand on the rails and, if possible, get better results from them. Assuming that locomotives are hauling the greatest possible tonnage at the highest speed consistent with safety and economy, we can make no improvement in this direction. After considering the question from different angles we come to the conclusion that there are only two possible ways of much better results in the mechanical department: Keeping the engines in service more hours of the twenty-four, or any other unit of time, at a lower cost per hour and maintaining the present locomotive, hour ton mile rate. With the improvements made that are possible in this direction, the steam locomotive may compare favorably in performance with the electric locomotive. The best possible results from the steam locomotive have never been near reached. Much better results are possible with absolutely no expenditure.

In our haste and desire for new and better power, machinery and facilities, we may overlook this. We have never realized what is possible from what we have. There are the men who do the work. Men are the same today as they were ten years ago or fifty years ago. They are no stronger and able to do no more work. That is to expend no more energy. They may be slightly less skilled due to specialization. The railroad men are doing enough work, and eight hours is a fair working day for employee and employer. The statement often heard, "A man will do no more work in eight hours than ten" is erroneous. All other conditions being equal in both cases he will do less in eight. But he will do more useful work under better direction in eight hours than he formerly did in ten. All that can be expected of men is an honest, intelligent day's work. In return for this he should receive a fair day's wages. He is getting it. With the exception of one possible improvement, nothing more can be expected from men. This exception is: A more intelligent day's work. This rests almost entirely with the company . Fifty per cent. of the railroad men do not understand their work or duties as thoroughly as they should. This lack of knowledge is not confined to the workmen. Among officials it is the lack of definite knowledge of what is taking place under them. It is by a mistake or mistakes that we learn, but we should not make the same mistakes for years. It is not the fault of the workman, for generally men do not know any more about their work than necessary to hold a job. The companies are at fault for permitting it. Among mechanics the different lines of work are specialized or should be to an extent that will allow every man to master his particular line. The engineman's work is not so broad as to prevent him having a clear knowledge of his duties. It is not necessary that he know all about a locomotive to perform his duties properly, but there are certain things he should know. One of the greatest obstacles to any improvement is the fact that officials are so busy keeping things moving that they have no time to plan for the future. This is particularly noticeable in the roundhouse. Thoroughly investigate every engine failure for a period of time. It will be found that the greater number are caused by conditions that can be altered. Ninety per cent. of the entire failures can be prevented. The same with delays.

An official's duties should be not merely getting out of trouble, but also keeping out of trouble. He ultimately depends on the men, but it is his duty to direct the work. The same force of foremen and workmen may show widely different results under two different master mechanics. Every locomotive that was ever built has or had weak points that show up in service. There is always something that is not designed properly, or some part or parts that have a tendency to fail or give trouble. It may be springs or parts of spring rigging breaking, brake hangers or brake hanger pins breaking, tires slipping or a number of other things. There is always a cause for these things and there is always a way to prevent them. The cause may not be found where the trouble or failure is. It may be on the other side of the engine or the other end, but it is always there. Any engine or part may fail occasionally—but, when all engines of the same class on a road cause the same trouble for seven or eight years, there is something lacking. An inspection of the engine failure records will prove that this is common on many roads.

For any one to meet with success in the study of efficiency, they must rid themselves of all suppositions and deal with facts only. All the "efficiency systems" tried on railroads have failed to give anything near the expected results. They were extremes and in one direction only:

That of getting more work from the men. This increased work, which possibly was obtained in some cases, had to offset the results of mismanagement in other ways, higher overhead expenses, caused by more timekeepers, inspectors and foremen, and much inferior work before it was a gain. Some shop employed the "speed system" with poor results. Many of the details that are necessary to successful management were entirely forgotten. The main and only thing desired was fast work. That the engines were giving trouble in service was not considered. The main thing seemed to be that they were repaired cheaply, and speed was substituted in place of intelligent supervision. This is no argument against fast work; rather the reverse. Work should be performed as quickly as possible, but conditions should be made such that it is possible to handle work quickly.

The case is rare where a man will not do a fair day's work when it is made possible for him to work. The average man likes to work when circumstances are favorable. The human element in industry cannot be neglected. Work must be made as easy and simple as possible, consistent with the cost and possible results. The simplicity of work should be emphasized. The average man dislikes mental work more than he does physical work. The back shops offer an unlimited field for improvement in this respect. Nothing discourages a man and lowers his output of work so much as having to do his work and manage it to some extent also. He may be a good mechanic and he might make a good foreman, but he cannot do both at the same time.

An example of this may be seen in many back shops. One or more machinists will be working on an engine. There is no certain system to follow. The work will be performed in one way on one engine and a different way on another of the same type, receiving the same class of repairs. There is confusion over the blacksmith and machine work. Some of the machine and blacksmith work that is required last on the floor is finished before other work that must be erected first. There is time lost waiting for this work. A machinist may do three different jobs in six hours, two hours each, if he can finish each one after starting it, but if he is compelled to change from one to the other a few times, the time will easily be lengthened to twelve or more, and he has been busy all the time. This is the usual practice in some shops. Then all the machine shop work will be finished near the same time and the work waits on the machinists, after they have waited on it for days. Many engines remain in the backshop several days longer than they should because of this lack of system. There are so many details to care for and so many unexpected things happening that a foreman is handicapped.

The weakest point in the mechanical department is the overlapping of work in backshops. Many engines go in the backshop for repairs other than number one, possibly to have the tires turned or changed and for new flues. These engines have made their mileage since their previous backshop repairs. New flues are put in, the tires are changed or turned. Very little other work is done, but much work bearing no good results was necessary to do this. Several of the binders may be loose on the frame fits, they are allowed to go, no rod work is done, the wedges are put up, many of them going nearly to the frame. The driving boxes are not taken from the journals. The engine has been in service a year or more and is in a poor condition generally. The spring rigging is distorted from failures of parts, wear and the weakening of springs. This engine returns to service to give constant trouble on the road and in the round house. In from three to nine months the engine is again backshopped. This time it may receive a general overhauling, or it may receive the repairs it did not receive on its previous visit, and the tires and flues will be neglected, as they have been in service only a few months. Either way is poor management. In the former case, much unnecessary and expensive work is done, and in the latter the engine is never in first class condition. It is always half an engine. It never gets all its necessary repairs at the same time. In a five-year period this engine will make more trips to the back shop, spend more time in the round houses, cost more for repairs, and give less service than an engine that goes to the backshop three or even four times for number one repairs. At least ten per cent. of the power in the United States is repaired in this manner. Power should not run till it is a wreck, but the backshop is the proper place to do the work. Round house work is expensive and delays power. As much work as possible should be kept out of the round house.

One road has a system that gives very satisfactory results. They backshop their engines often. Except in cases of wrecks or accidents to almost new engines. Every engine receives number one repairs. On entering the backshop they are stripped, all parts are taken to their proper places by laborers. There is just a common sense system in the blacksmith shop and on machine side; everyone knows exactly what is to be done. All the machined parts are finished near the proper time and taken back to the floor by laborers—not mechanics. There is no confusion, no waiting for machine work. A foreman can plan his work far ahead and meet with almost perfect success.

This road is handicapped in not having a modern shop on the system, but they turn out first class engines, quicker and cheaper than other roads, more favorably situated.

The mileage they get from engines is remarkable, they are ready to go all the time. They get from twelve to fifteen months' almost constant work from an engine. Then it goes in the backshop for two or three weeks and returns to service for another year's hard work.

This road maintains its power in the round houses with half the number of machinists and boilermakers that other roads are employing in round houses turning out a similar number of engines. Their system is, to do the work in the backshop and not the round houses. Unfortunately this road is handicapped by unfavorable circumstances, over which the mechanical department has no control.

The gaining of efficiency in the mechanical department does not depend on any extraordinary means, but simply on doing the ordinary things well.

Water Glasses and Gauge Cocks

By JOHN MITCHELL

Most of the railroad trade papers have recently published the very comprehensive and convincing report of the Chief Inspector of the Bureau of Locomotive Inspection of the I. C. C., on the circulation of the water in a locomotive boiler and the effect of this circulation on the readings of the gauge cocks and water glasses.

This report, while couched in the simplest language, to accomplish what it should, really should be so condensed or digested and put in such simplified form that any man, having occasion to read the water level in a locomotive boiler, whether engineman—machinist—hostler or what not—may understand the underlying principles and know what to expect on any particular locomotive. The effort is therefore made here to formulate a set of "instructions" to accomplish this end. If there is any doubt as to the need of something along this line, it can be dissipated by asking ten men, preferably on some of the roads where the various tests were made, and not more than three of the ten will be able to give an explanation as to the necessity for a gauge cock column.

INSTRUCTIONS ABOUT WATER GLASSES AND GAUGE COCKS.

1. Water Glasses and Gauge Cocks are for the purpose of telling where the water level in the boiler is, primarily so that the crown sheet will always be sufficiently covered to protect it. The lowest reading of the water glass and of the bottom gauge cock is always 3 ins. or more above the crown sheet. Never let the water level get below these readings.

2. To keep from risking your life, you should always try the top and bottom water glass valves and see that they are wide open when you get on an engine, also see that there are no leaks of any extent around the water glass, its connections or fittings. A leak above the water line will cause the glass to show more water than there actually is in the boiler. Next open the drain cock wide, blow all the water out of the glass, close this valve and see whether the water comes back quickly enough to go up beyond its level and then settles down. If the water just comes up slowly and stops at its level, there is an obstruction somewhere in the bottom valve either scale, packing or gasket and should be removed at once. If there is obstruction in the top water glass valve or its connections, the glass will fill up out of sight after blowing off, so if glass fills out of sight with less than three gauge cocks of water, the top valve should be examined by removing the water glass. A reflex type glass either Klinger or Bulls Eye should refill in two or three seconds, a tubular glass in half a second on account of the smaller volume. Glasses showing much variation from these time limits should be disconnected and the trouble located. The next and new feature of water glasses is to examine the steam pipe, if any, to top of water glass and see if water from the highest point of this pipe will all drain to the glass on one side, and to the boiler on the other side; in other words, see that there is no sag or trap in this pipe. Often the top water glass valve is applied so that a pocket or trap is formed in the valve itself. This pipe is, of course, filled with steam when there is steam on the boiler, but the steam is condensing more or less all the time and this condensation must drain into the boiler through the top valve and into the glass. If there is a pocket or trap in the pipe or valve this retains the water of condensation, seals the opening and causes the water in the glass to build up gradually and show too much water. Such traps will cause a false reading of the water glass of from 1 in. to 5½ ins. To test for a trap, drop water slowly where you think there is a trap, which will condense the steam and cause the level in the glass to build up and remain too high.

3. The tests of the I. C. C. proved that when a boiler is generating steam and it is escaping, that the water is circulating so rapidly that it races up the back head and maintains a bank or fountain of water against the back head. On a small boiler with straight back head and no arch or arch tubes this bank was 4 ins. above the true water level. On larger locomotives with sloping back head ,arch tubes and brick arch this bank was 5½ ins. to 6 ins. obove the true water level, and some tests in bad water districts showed as much variation as 11 ins.

Of course the gauge cocks will discharge water from this bank at the back head, if they are applied in the back head or knuckle. As this condition exists only when the boiler is very hot and generating steam and especially when steam is escaping, we would expect the gauge cocks to show too much water under the following conditions: when there is a hot fire and the blower working; when safety valves are open or when engine is working.

To be sure of the accuracy of gauge cocks when applied in the back head or knuckle is impossible and as it will probably be some little time before all engines have their gauge cocks applied to a column, we must not depend on gauge cocks under conditions cited above. The safe way therefore is to test the water glasses as described and never let the water get down below the lowest reading of glass regardless of how many gauge cocks may be showing water. Figure on about 5½ ins. more water in the gauge cocks than actually exists in the boiler. which means if there is actually one gauge over the crown sheet the third gauge cock will show water when the engine is working hard with a hot fire.

After testing a water glass as described and finding it in good condition there is only one other thing that can keep it from registering properly and that is for the bank or fountain of water to extend so far up the back head that it reaches the top water glass valve. This will cause a sealing of the opening and cause the glass to fill up. This could be readily detected under working conditions as the water in glass would rise or fall quickly as the peak of the "bank" reaches the top valve or falls below it. If the glass has as much as a 6 in. reading there is not much danger, as if the level suddenly falls from full it will probably leave at least ½ of water in glass. Should the level fall suddenly below the lowest reading, the glass should be corrected at once, as the top valve would be entirely too low or else the height of the "bank" would be much more than 5 or 6 ins., due probably to too long an arch or to bad water. Any such action of the water glass should be corrected at once. Remember that if the openings are of proper size and so maintained, nothing will affect the proper reading of the water glass except a "trap" or the "bank" of water at the back head reaching up to the top valve.

Potash Vats.

Editor, RAILWAY AND LOCOMOTIVE ENGINEERING:

An important feature of a locomotive shop is the "potash vat," as the time saved in this operation reflects on the shop output more than is sometimes realized by some executives. Every hour saved in the vat means that much quicker the various gangs can have the parts to begin work on.

The tanks are generally in the hands of a laborer and little attention is paid to them unless the foreman is strict.

Many of the tanks are arranged with steam coils in the bottom and if the solution were drained off, you might find 8 inches to 12 inches of mud and grease completely covering the coils and still they are expected to heat up the solution to a boiling point. If the man in charge is told to clean the vat out, he probably will take off the mud that he can get at readily and not touch the dirt that has accumulated between and under the coils. How much better would it be to have the coils around the sides and ends and then the refuse can be removed easily. An economical method is to have a perforated bottom pan which can be lifted out by the crane.

If our housewives or servants when starting to wash dishes would fill the pan up with the greasy dishes and pour boiling water over them and then place the dish pan on the stove to boil for a short period, and then call them clean, we perhaps would not be satisfied with the results if we were compelled to eat off the same dishes the next meal. Instead of following this practice, a dish cloth would be used to keep the soapy water in motion by the various movements of rubbing the dishes.

The desired results are obtained mechanically, in the major part, by the agitation and rubbing, not mechanically by the action of the soap and hot water. Still we will find many potash tanks in shops where locomotive parts are placed into a hot solution with only the slight boiling, if any, than can be obtained from a mud insulated steam coil, and good results are expected.

The looked for agitation can be obtained by placing a ½ in. air pipe over the side and across the bottom of tank; this pipe having 1/16 in. holes drilled about 3 in. pitch nearest the inlet and gradually growing smaller pitch toward the farther end, so as to create an even effect of the air. A small amount of compressed air will create an agitation which will cut down the time for cleaning from 25 per cent to 50 per cent.

While some shops are using a plain caustic soda solution, there are many using prepared commercial cleaners, which carry in solution a percentage of volcanic ash. This gives a desired abrasive action thereby doing much quicker work. X.

Railroads in Conflict With the Labor Unions

Crucial Stage in the Controversy of Railroad Employers and Employees Over Emergency Wage and Other Agreements

That the National Agreements between the railroads and various classes of their employees, standardizing the latter's rules and working conditions throughout the nation, which were instituted during Federal control, should not, in the interests of "honest, efficient and economical management," be continued longer under private operation, was contended by representatives of the railroads before the Railroad Labor Board at the opening of hearings on January 10 on the demand of railway employees for the perpetuation of these agreements.

The reasons for the carriers' opposition to National Agreements were based on the facts that:

(1) They are ultra-restrictive and therefore prevent the "honest, efficient and economical management" demanded by the Transportation Act;

(2) The variable conditions in different sections of the country make the universal application of their provisions impracticable;

(3) The existing rules, the continuation of which is proposed by the men, are capable of various constructions;

(4) The existing agreements provide that the rules contained therein shall apply to all employees of any particular craft regardless of the department of the railroad in which the man is employed, thus leading to a division of jurisdiction and a conflict in the working rules applicable to employees engaged in the same work;

(5) The existing agreements have destroyed acknowledged efficient and economical practices such as the piecework system for regulating rates of pay;

(6) The railroads must have relief from the rules controlling the employment of men, which are so restrictive as to prevent them from obtaining a sufficient number of employees in certain departments, thus interfering with output and causing delay to the movement of traffic;

(7) The agreements contain many rules which provide for payment for work not performed, and thereby cause many millions of dollars of unnecessary expense annually.

E. T. Whiter, for the railroads, said: "The railroads do not object to schedules (the technical term for railway agreements) properly negotiated and entered into with their own employes, as is evidenced by the fact that nearly all, if not all, of the roads represented have had schedules with the various train service organizations for many years.

"Prior to Federal control, some roads had schedules with other classes of their employes; many had no schedules with any crafts other than the train service organizations, but there were no so-called 'National Agreements' which made all rules uniformly the same throughout the country. All roads that did have schedules directly negotiated them to fit their own conditions with their own men, and in every case the railroads had the undisputed right to negotiate their own schedules, which was denied during Federal control.

Origin of the National Agreements

"Under governmental control the railroads were unified, and the Director-General entered into so-called 'National Agreements' with the shopmen, maintenance of way employes, clerks, firemen and oilers, and signalmen. The first of these so-called 'National Agreements' was made with the shop crafts less than six months, and the last, that with the signalmen, only a few days before the return of the roads to their owners.

"These agreements, which were of universal application for the period of Federal control, were specifically recognized by the parties signatory thereto as effective during this period only, and contain nothing that would impose such obligation upon all roads alike after individual responsibility had to be assumed by the separate railroads for their successful operation as separate properties.

"Therefore, we contend that under private control, consideration must necessarily be given to the conditions and peculiarities of operation on the individual properties in the preparation of any regulations governing the working conditions of employes of those properties. The only parties who are fully qualified to consider such regulations are the individual management and their employes.

"We hold also that many of the rules are so worded that they are capable of various constructions and have resulted in so-called interpretations which are in fact new rules; others are impractical of application without incurring excessive penalties. Experience in trying to work under the rules has demonstrated that they have resulted in extraordinary numerous questions from both the employes and the managements. This in itself makes the rules particularly objectionable.

"We respectfully ask, therefore, that this board leave the individual roads free to negotiate their own schedules, so as best to meet justly the widely varying conditions on the different roads."

Says They Will Quit, if Pay Is Cut

S. J. Pegg, international grand secretary-treasurer of United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers, states that:

"Thousands of the brotherhood members, embittered over present wage conditions, are threatening even now to leave their work." While he refused to predict a strike, he declared the men simply will refuse to work for less money, whether union officials want them to or not.

The international grand president and other officials of this brotherhood have gone to Chicago to attend the protest meeting of officers of sixteen major brotherhoods of railroad employees. Resolutions will be drawn and presented to the Labor Board denouncing any attempt to abrogate agreements.

Before national agreements were drawn maintenance of way employees had separate contracts and wage agreements with thirty-six railroads, each differing from the others, and some were satisfactory to the employees. However, when the government assumed control of the roads new agreements were drawn. Although many maintenance of way men were receiving higher wages under individual agreements, others gained many advantages under national contracts.

One of these advantages was an eight-hour day, with time and a half for all overtime.

"Railway officials declare high wages eat up profits, but the membership of our brotherhood cannot be classified with highly paid help," Mr. Pegg said. "The great bulk of our men are allowed a maximum wage of 40 cents an hour, and only 1 per cent are receiving the maximum. More than 33 per cent of our total membership, of more than 100,000 men, receive 26 cents an hour for eight hours' work."

Either Advance Rates or Reduce Expenses

General W. W. Atterbury, vice-president, Pennsylvania Railroad Company, and chairman of the Labor Committee of the Association of Railway Executives, made a statement to the United States Labor Board, of date January 31, 1920, from which we extract the following:

Many railroads are not now earning, and with present operating costs and traffic have no prospect of earning, even their bare operating expenses, leaving them without any net return and unable to meet their fixed charges.

The emergency presented can be met either by an advance in freight and passenger rates, or by a reduction in operating expenses.

With declining prices and wages in industry and agriculture, the country demands that the solvency of the railroads must be assured by a reduction in operating expenses, and not by a further advance of rates.

Mr. Whiter and his committee have far from exhausted their evidence on this subject, and if required to will, of course, proceed But it will be dangerous to continue the consideration of these agreements rule by rule. If the Board follows its present procedure, months will elapse before it can render its decision.

The urgent financial necessities of the railroads will not permit them to wait any such length of time for relief. Long before the present detailed hearings are concluded the Board will be flooded by appeals from individual railroads from all parts of the country for reductions in basic wages. It will be impossible for the Board to hear and dispose of these separate cases upon their merits in time to avoid numerous receiverships and the possibility of a national panic.

When wages have been too low, then harm done has been offset by retroactive increases. Losses of railway net operating income are irreparable. You cannot make retroactive tomorrow the savings that should have been made today.

Your Board cannot possibly write the rules and working conditions of every railroad in this country and adjust them equitably to varying geographical, operating and social conditions.

It rests entirely with your Board to determine within the next few days whether this whole situation shall drift into chaos, and orderly procedure become impossible except at the price of railroad bankruptcy, financial shock and still wider unemployment.

Within the next month or six weeks practically all of the railroads of the country must recruit their unskilled labor forces. It is desirable that a large part of the work for which these men are necessary be concentrated in periods when the same labor is not needed in harvesting the crops. We therefore ask the immediate permission of your Board to pay for unskilled labor not less than the prevailing rate of wages in the various territories served by any carrier in accordance with Section 307, Transportation Act.

I regret the urgency of the foregoing presentation. Its informality does not indicate any intention on the part of the railway companies to violate the principle of orderly procedure in such matters. But to sit by and see this situation develop without bringing it promptly and strongly to the attention of this Board would be to sacrifice the spirit of the Transportation Act.

In our judgment, unless the proposed measures be promptly taken by your Board, a situation will shortly develop in which orderly procedure will become entirely impossible. Your Board will be faced with the gravest responsibilities, which it cannot possibly successfully perform, in a condition of national confusion, if not of chaos.

Railroad Expenses Not Materially Increased by a Raise of Wages

W. S. Carter, president of the Brotherhood of Locomotive Firemen, claims that all of the wage increases received by railroad employees since 1910 have not materially increased labor costs, per 1,000-ton miles, in the compensation of engineers and firemen. Neither the railroads nor the public is paying more to engineers and firemen per unit of product than in the past. During depressions in railroad business the railroads have offset losses by immediately reducing engineers to firemen's positions and laying off many thousands of firemen. The transportation act requires the Labor Board to properly and justly fix compensation of employees and directs the Interstate Commerce Commission to establish passenger and freight rates. This has been done. After having secured enormous returns under the provisions of the act the railroads now propose to grasp all the benefits of the rate increases by reducing the wages of their employees. The enormous sums due by the railroads to the government because of overmaintenance during Federal control will be offset by additional claims against the government for so-called damages during Federal control.

Abolition of Piece Work

E. T. Whiter, chairman of the Conference Committee of Managers of the Railways, made a formal request of the Railroad Labor Board that it permit the reintroduction into railroad work of methods of paying employees that will offer proper incentive to increased effort and give proper and adequate recognition to skill and industry.

"The evidence we have introduced regarding the effects of the abolition of piece work in the shops of railways in every section of the country shows that in every case where the system of piece work—that is, the system of paying employees in proportion to the amount of work that they individually do—was abolished, and the system of guaranteeing day wages substituted, there has been a reduction in the average amount of output per employee per hour, and in most cases these reductions have been from 25 to 50 per cent.

"When the railways were returned to private operation the public expected an increase in their efficiency and economy of operation. We are seeking the abolition of restrictive rules imposed under governmental control, such as this one prohibiting piece work, because unless rules and working conditions can be adopted which tend to promote efficiency the managements of the railways cannot secure the increases in efficiency and economy of operation which are necessary to protect the public from excessive costs of transportation and excessive freight and passenger rates."

Suggests a Plan for Labor Disputes

L. F. Loree, president of the Delaware & Hudson railroad, in the course of an address before the New York Chamber of Commerce claimed that arbitration as a means of settling labor disputes had broken down. He outlined a plan for the settlement of industrial disputes embodying among other features, modification of the right to strike in government utility public service, and pointed out that we had the Erdman act in 1898, then the Newlands act and under it we had arbitrations with the Brotherhood of Locomotive Engineers in 1912 in the East and with the firemen in 1913 and 1914 and with the Railroad Brotherhoods and Trainmen in 1914; then in the West, with the same people in 1915, and the arbitration with the Switchmen's Union in 1915, and then organized labor got tired of arbitration and they refused to arbitrate longer.

"They went to the President with the request that he interfere and he did interfere, and he went to Congress and passed the Adamson bill. So, I say, arbitration has definitely broken down.

"Another thing troublesome in the situation is the attitude of labor on the closed shop question and the boycott.

"The third is the organization of secret societies which cannot, I think, be looked on with unconcern by any civilized government, particularly any one who has reflected upon the jacobin movements which preceded the Revolution in France and those who bear in mind the actions of those who are now threatening the life of the British government.

"In government employment the orderly and continuous administration of governmental activities is imperative. No public servant can obey two masters; he cannot divide his allegiance between the government which he serves and a private organization which under any circumstances might obligate him to suspend his duties, or agrees to assist him morally or fianancially if he does.

"In public utility service the public interest and welfare must be the paramount and controlling consideration. The state should impose such regulations as will assure continuous operation, at the same time providing adequate means for the prompt hearing and adjustment of complaints and disputes."

President Wilson Declines to Interfere

On February 6, the President refused the request of labor union representatives that he investigate railroad executives' claims before the Railroad Labor Board that the carriers must adjust wages or face bankruptcy. He also declined to submit the matter to Congress.

The President set forth his position on the appeals made to him in a telegram addressed jointly to two of the railway labor unions and to the Association of Railway Executives, who also had sent a communication to the White House.

Confidence was expressed by the President that all questions dealing with railroad labor and management might be left safely to the two bodies intrusted under the transportation act with such matters—the Railroad Labor Board and the Interstate Commerce Commission. He accordingly informed the labor and carrier representatives that he was submitting copies of telegrams received from them to these two bodies as "the only action deemed necessary."

The railroad workers in their first telegram, signed by the heads of seven unions and transmitted through B. M. Jewell, president of the railway employes' department of the American Federation of Labor, asked the President to investigate the Carriers' assertion as made by W. W. Atterbury, vice-president of the Pennsylvania lines, before the Railroad Labor Board in Chicago.

Mr. Atterberry had declared that the railroads of the country must be permitted to readjust wages or face the danger of bankruptcy. The union heads asked the President to investigate this statement and if it were found to be based on facts, which the union heads said they doubted, to ask Congress to enact remedial legislation at once.

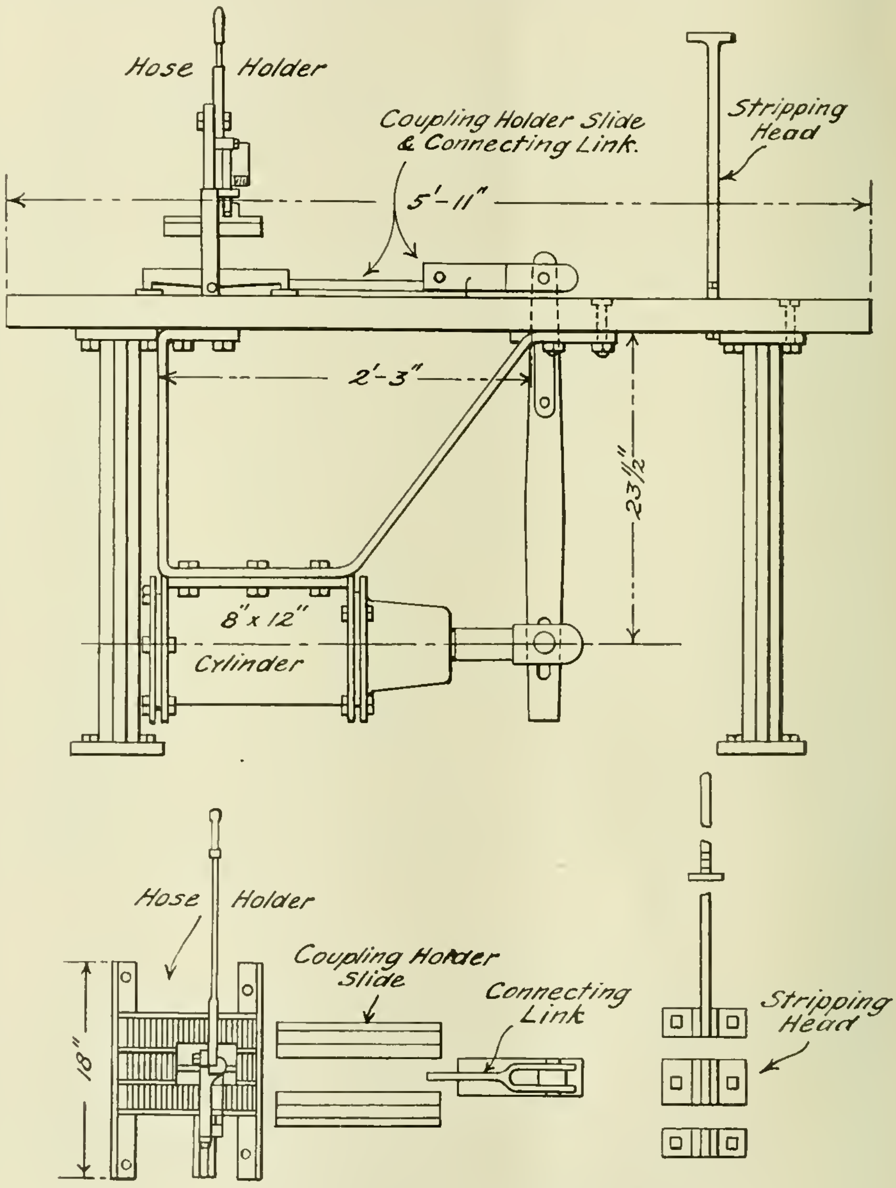
The telegram from the, union heads brought forth a communication from the Association of Railway Executives, who charged that the union request was "Plumb Plan League propaganda." In a second telegram the union heads denied this charge and declared there was no economic justification for any wage readjustments at the present time.

Railway Improvements in China

There is now a through train service between Peking and Pukow. Formerly passengers had to change at Tientsin. Commercial Attaché Julean Arnold understands that the company is to purchase 11 block-steel car trains, of five cars each, to include compartment sleepers and observation coaches, with arrangements which will permit the display of motion pictures, also train service from Peking to Shanghai.

Air Hose Fitting Machine in the Watervliet Shops of the Delaware & Hudson Company

Among other handy shop tools in the Watervliet shops of the Delaware & Hudson Co. there is a very simple hose fitting machine in the air brake shop. It is used both for putting fittings on the hose and for stripping the same. The cross. The air inlet pipe is screwed into the bottom hub and that leading to the cylinder into the one on the left. A fulcrum cast solid with the cross carries an angle lever, the horizontal arm of which is held normally up by the spring

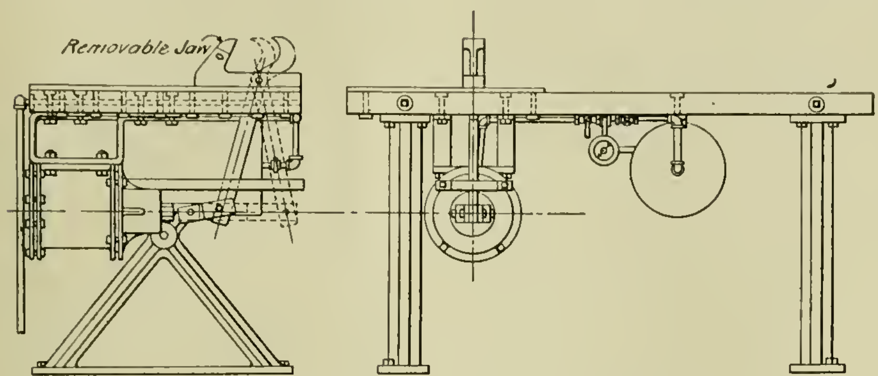


DETAILS—AIR HOSE FITTING MACHINE ON DELAWARE AND HUDSON

motive power is air that is used in an 8-in. freight brake cylinder. It was found, however, after trying the machine that the ordinary piston with its packing could not be used satisfactorily, so it was replaced by a solid steel piston made from a piece of axle with a follower made of boiler plate. A special air inlet valve has been designed for rapid operation. This is shown on an enlarged scale on a separate drawing and consists of a combination inlet and exhaust valve. The body of the valve resembles an ordinary pipe as shown. This presses the vertical arm of the lever against the valve stem shown projecting from the right hand boss. This is the exhaust valve stem, and it is held normally open. The rod bending down from the left hand end of the lever is attached to a treadle on the floor. When this is depressed the valve stem projecting from the top boss is pushed in by the horizontal portion of the lever. This opens the inlet valve and admits air to the cylinder, while the exhaust valve automatically closes as the vertical lever is moved away from its attached stem.

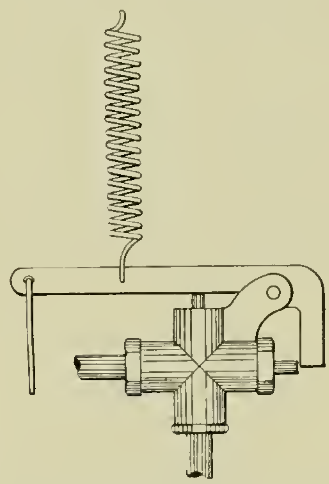
The jaws for clamping the hose are also operated by the air cylinder, and have the shape shown in the illustration. The work done is very rapid and the mechanism is adaptable to the use of splices if it is desired.

The device has been found to be both reliable and economical, and is easy of construction.



HOSE CLAMP FOR AIR HOSE FITTING MACHINE.

AIR HOSE FITTING APPARATUS, DELAWARE & HUDSON SHOPS.



AIR VALVE FOR AIR HOSE FITTING MACHINE.

Efficiency..

The classic illustration of efficiency is the carpenter driving nails. It must be twenty years ago that I learned the astounding fact that it does not pay a carpenter to pick up the nails he drops, because the time spent in the stooping is worth more than the nails. "Any conscientious carpenter," said my informant, "will wish to be efficient." A mistaken conscientiousness will prompt him to go down on his knees and find the lost nail and straighten it, if it is bent, even if he takes half an hour to do so; but an enlightened conscientiousness will lead him to use another nail.

This was all very well. For a moment, I could not help admiring the efficiency expert who first perceived the wastefulness of picking up nails, and the self-control of the carpenter who could restrain his natural impulse to pick up a nail, especially one that so deserved to be pounded good and hard. But soon I began to have doubts. Whose time, I now asked myself, would this devoted craftsman waste, if he should so far forget himself as to pick up a nail—his own, or his employer's? Surely, from his own point of view, whether the time was wasted would depend on whether he was paid by the piece or by the day. I had a plumber in last week who (from my point of view) wasted three hours, conversing entertainingly with any one who would listen, for one hour that he worked; but when I came to pay his bill for four hours' work I realized that in the art of stretching a job, he had attained a finished efficiency.

The only man, I concluded, who can safely make a hobby of efficiency is the efficiency expert. He does not have to follow his own theories, but only to write books about them. No one can begrudge him that pleasure; it is only when, with a Samuel Smilesian optimism, he falls to exhorting the laboring man to make a hobby of his work—a stamping-machine or buttonholing machine or a steam drill or a compressed-air riveter, in all probability, that he becomes worse than inept. Can it, I submit, be done? I could not make a pet of a compressed-air riveter, nor, with the best of intentions, could I embrace within my affections a buttonholing machine. I should try to run it faithfully, of course; but, if I were on the lookout for a hobby, I should select a creature more temperamental.

The high-priests of efficiency, intoning the Gospel of Work, and asking the congregation all to rise and join in singing "MacAndrew's Hymn," no longer thrill the laboring man as once they did. After fifty years of watching the wheels go round, he is ready for recreation. He listens to the gospel of work with his tongue in his cheek, and lets his thoughts wander to what he intends to do during his hours of leisure.

I suggest that in a machine made age like ours, in which we work in gangs and shifts; in which twenty men contribute to the making of a shoe; in which combination and organization and co-operation, and who knows what other ations are the terms that characterize our business and labor; and in which we have become so thoroughly socialized that even the tramp and the hermit seems to have disappeared, it is time that somebody said a good word for the unscientific—that is, the creative—employment of our leisure hours.—*Robert M. Gay in Atlantic. Monthly.*

Welding Side Rods and Fireboxes.

The usual method of making oil cups on side rods that has been the practice for many years has been to forge them on as a part of the rod as shown in Fig. 1. This is expensive but it is quite necessary to have them solid with the rod, as the old form of cup screwed in is soon broken off.

At the shops of the Philadelphia & Reading R. R. the forged on cup has been abandoned and in its place a welded cup as shown in Fig. 2 is used. This consists simply of a bushing turned and threaded in a lathe and then welded in place. A method of construction equally strong and substantial as the forged on cup and far less expensive to make.

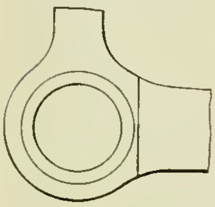
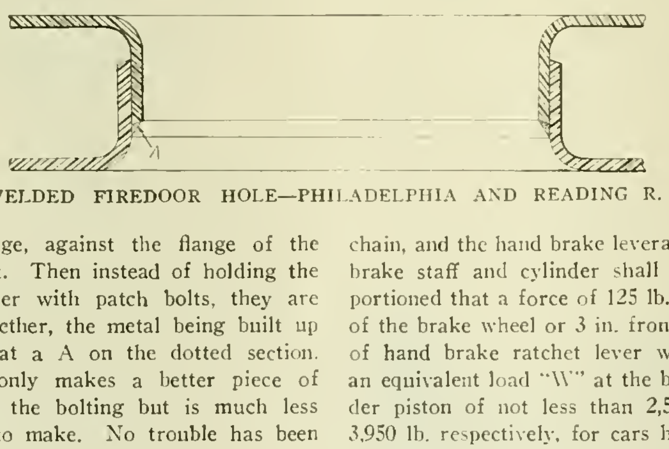


FIG 1 FIG. 2.
WELDED OIL CUP.

Another piece of welding adopted is to be found in the method of making fire door openings. The inner and outer sheets are flanged in the usual way and the flanged position of the inner sheet is then hammered out to a close fit, along its beveled edge, against the flange of the outer sheet. Then instead of holding the two together with patch bolts, they are welded together, the metal being built up as shown at a A on the dotted section. This not only makes a better piece of work than the bolting but is much less expensive to make. No trouble has been experienced with the cracking of the weld or the sheets.



WELDED FIREDOOR HOLE—PHILADELPHIA AND READING R. R.

Adjustment of Brake Power on Tank Cars.

A revision to the previous circular No. S III-11, setting forth the data for hand brakes on tank cars, has been issued by the secretary of Section III Mechanical of the American Railway Association.

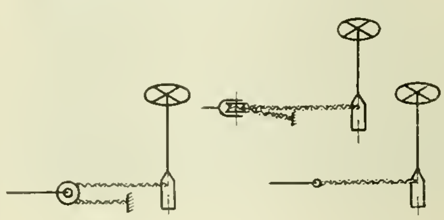
The recommended practice of the association provides that the air brake power for freight equipment should be 60 per cent of the light weight of the car, based on a cylinder pressure of 50 lbs. per sq. in. A paragraph in the previous circular refers to this recommendation as a minimum of 60 per cent, which has caused some to believe that there is no limit to the maximum percentage of brake power that may be employed. Other confusions have occurred and cases have been reported in which the brake power for a car was less than 27 per cent of the empty weight. In some tank cars it has been found that the owners have endeavored to provide the hand brake power specified by lengthening the piston end of the live cylinder lever for the hand brake connection, instead of by the method specified in the circular and the specifications for tank cars, and regardless of the fact that, by so doing, the equalization of the hand brake power on the two trucks is seriously disturbed.

A question has also been raised as to whether the hand brake chain should be connected to the brake staff at the top of the barrel, or at the bottom. To settle these points three revisions of paragraphs have been made, as follows:

The recommended practice of the association provides that the air brake power for freight equipment should be 60 per cent of the light weight of the car, based on a cylinder pressure of 50 lb. per square inch.

With the body and truck levers properly proportioned for 60 per cent braking power on each truck, as specified in the foregoing, and based on the formulæ and diagrams shown herein, the hand brake wheel or hand brake ratchet lever, brake staff at chain, and the hand brake leverage between brake staff and cylinder shall be so proportioned that a force of 125 lb. at the rim of the brake wheel or 3 in. from outer end of hand brake ratchet lever will develop an equivalent load "W" at the brake cylinder piston of not less than 2,500 lb. and 3,950 lb. respectively, for cars having 8-in. and 10-in. cylinders.

The hand brake chain should be connected to the chain anchor and to the brake staff, at top of drum, as shown in the accompanying diagram.



RECOMMENDED METHOD OF ATTACHING BRAKE CHAINS TO STAFF.

Cars are not in accordance with the requirements if (a) the hand brake connection is made to an extension at piston end of live cylinder instead of to the push rod, (b) unless the body and truck levers are properly proportioned for the percentage of brake power specified for the air brake, or (c) on which the percentage of brake power for the hand and air brake is not equal on both trucks.

Hints to Young Enginemen

Don't think just because you have passed the master mechanic's examination on machinery that you are a full-fledged engineer, for you will realize your mistake many times during your early experiences on the right side. In the first place, you may not know how to oil round properly, don't forget that, and if called for some old mill with but one or two exhausts, but enough pounds and other things for good measure to make you forget that trifling defect, you will likely be led to wonder after you have stalled a few times because of lack of steam, or excess of tonnage, whether you really do know much about the game or not, after all. This will be especially true at times when you have a tank of coal that is all slack and a fireman nearly so, one of the kind for instance who has just graduated from a cheese factory and don't know how, because he's too green, or some romantic cigarette fiend who left a ribbon counter for the "position" of fireman because he thought railroading was so fascinating, and never will know how, because he's too ripe.

New Zealand Railway Traffic

Railway traffic in New Zealand showed a marked increase during the period from April 1 to October 16, 1920, when 7,586,002 passengers were carried, as compared with 5,528,043 passengers during the like period of 1919; and 210,305 head of cattle, as compared with 137,826 head; 3,224,518 sheep, as compared with 2,828,500; and 3,339,068 tons of general freight, as compared with 2,937,506 tons for the 1919 period. The revenue during the 1920 period amounted to $16,541,939, as compared with $13,149,694 for the 1919 period, with expenses at $13,938,138, as compared with $9,630,883.

Electrification of Brazilian Railways.

The project under public discussion for several years, rendered of greater importance by the world coal crisis, to electrify the Central Railway of Brazil, the lines of which are conveniently accessible to water power for the generation of electricity, has been passed by the Chamber of Deputies. This bill authorizes the Government to spend not more than 45,000 contos (about $11,000,000) for the purpose of transforming that road from steam to electrical traction, in whole or in sections, as is found most feasible.

Items of Personal Interest

W. A. George has been appointed master mechanic of the Jacksonville Terminal, with office at Jacksonville, Fla.

Paul Lebenbaum has been appointed electrical engineer on the Southern Pacific, with headquarters at San Francisco, Cal., succeeding F. E. Geibel, resigned.

F. O. Ericksen has been appointed car foreman of the Chicago, Rock Island & Pacific, with headquarters at Manly, Ia., succeeding M. B. Flaherty.

A. Peers has been appointed master mechanic on the Canadian Pacific, with headquarters at Moose Jaw, Sask., succeeding W. J. Renix.

G. A. Kell has been appointed safety engineer of the Grand Trunk Railway system, with headquarters at Montreal, Que. Mr. Kell was formerly occupied as traveling engineer on the Grand Trunk.

S. Ennes, general manager of the Baltimore & Ohio, has resigned to accept the position as vice-president and general manager of the Wheeling & Lake Erie, with headquarters at Cleveland, Ohio.

J. E. Wharton, division storekeeper on the Pennsylvania, with headquarters at Toledo, Ohio., has been appointed storekeeper, maintenance of equipment department, with headquarters at Toledo.

J. Gutteridge, foreman of the car department of the Kansas City Southern at Pittsburg, Kan., has been appointed general foreman of the car department, with headquarters at Pittsburg.

John Roberts, general foreman on the Grand Trunk, at Stratford, Ont., has been appointed acting superintendent of motive power, with office at Stratford, succeeding I. C. Garden, promoted.

Frank C. Clark, formerly president of the Chambers Valve Company, has been elected vice-president of the Bradford Gear Company, with headquarters at New York.

M. E. McDonnell, assistant chief chemist of the Pennsylvania, has been appointed chief chemist, with headquarters at Altoona, Pa., succeeding F. N. Pease, retired, and T. W. Fisher has succeeded Dr. McDonnell as assistant chief chemist.

L. A. Guthrie, signal inspector on the Canadian National, with headquarters at Winnipeg, Man., has been promoted to signal supervisor, with jurisdiction over the lines between Winnipeg and Watrous, Sask., with headquarters at Winnipeg.

W. L. Robertson, master mechanic of the Baltimore & Ohio, with headquarters at Washington, Ind., has been appointed superintendent of fuel and locomotive performance, with headquarters at Baltimore, Md., succeeding E. E. Ramey.

George A. Post, president of the Standard Coupler Company, New York, since its organization, has resigned in order to devote himself to other interests with which he is connected. Edmund Walker, vice-president, succeeds Mr. Post.

J. W. Sasser, superintendent of motive power of the Norfolk Southern, has resigned to accept the position of superintendent of motive power of the Virginian, with headquarters at Princeton, Va., succeeding R. E. Jackson, resigned.

D. Fairchild has been appointed acting supervisor of bridges and buildings on the Puget Sound division of the Northern Pacific, with headquarters at Seattle, Wash., succeeding W. E. Bradley, who has been granted a leave of absence.

Alfred A. Klein, apprentice instructor on the Santa Fe, at Richmond, Cal., has been appointed lubrication supervisor on the same road, under C. T. Ripley, general mechanical supervisor. Mr. Klein's headquarters are at Richmond, Cal.

W. D. Hartley, general foreman of the locomotive department of the Atchison, Topeka & Santa Fe, with office at Richmond, Cal., has been promoted to master mechanic at Clovis, N. M., succeeding W. H. Stephens.

William Seeley, foreman of the erecting shops of the Grand Trunk Railway at Stratford, Ont., has been promoted to general shop foreman, and J. B. Dunlop, has been appointed foreman of the erecting shops.

J. W. Lemon, master mechanic on the Central Kansas division of the Missouri Pacific, with headquarters at Osawatomie, Kan., has been transferred to the Colorado division, with headquarters at Hoisington, Kan.

R. A. Pyne has been appointed superintendent of motive power and car department of the Canadian Pacific, with headquarters at Winnipeg, Man., and A. Sturrock has been appointed assistant superintendent of motive power with headquarters also at Winnipeg.

A. Devine has been appointed assistant master mechanic of the Canadian National, with headquarters at Campbellton, N. B., succeeding F. F. Carey, who has been appointed assistant master mechanic of the St. Maurice division, with headquarters at Quebec, Que.

E. A. Murray, master mechanic on the Chesapeake & Ohio, with headquarters at Clifton Forge, Va., has been promoted to shop superintendent at Huntington, W. Va., and C. B. Hitch succeeds Mr. Murray as master mechanic at Clifton Forge.

R. Preston, assistant superintendent of motive power of the Canadian Pacific, with headquarters at Winnipeg, Man., has been promoted to superintendent of motive power and car department, Eastern Lines, with headquarters at Montreal, Que.

W. H. Stephens, master mechanic of the Pecos division of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M., has been promoted to mechanical superintendent of the Southern district, with headquarters at Amarillo, Tex.

J. W. Chandler has been appointed master mechanic of the Northern division of the Kansas City Southern, with headquarters at Pittsburg, Kan., and C. L. Adair has been appointed master mechanic of the Southern division with headquarters at Shreveport, La., succeeding J. N. Chandler.

Joseph Sinkler has resigned his position with the Franklin Railway Supply Company, New York, to become general manager of the railway division of the Pilot Packing Company, with headquarters at the People's Gas Building, Chicago, Ill. Mr. Sinkler has had a wide experience both in the railway operating and railway supply business.

N. J. Denix, master mechanic of the Saskatchewan district of the Canadian Pacific, with headquarters at Moose Jaw, has been appointed master mechanic of the British Columbia district, with headquarters at Vancouver, B. C., and James Gibson has been appointed master mechanic at Moose Jaw, succeeding Mr. Denix.

J. C. Garden, superintendent of motive power of the Grand Trunk, Stratford, Ontario, shops, has been appointed acting general superintendent of motive power and car departments, lines east of Detroit and St. Clair rivers, and consulting engineer, motive power and car departments, Grand Trunk Western lines, with headquarters at Montreal, Que., succeeding W. H. Sample, retired.

John S. MacDonald, dining car inspector of the Pennsylvania Railroad at New York, has just received from King Albert, of Belgium, an award of the Silver Medal of the Order of Leopold II in recognition of the services rendered to the royal party during the tour of the United States made by King Albert last year. Mr. MacDonald was in charge of the dining car arrangements for His Majesty's trip and accompanied the royal party on the tour.

John R. Le Vally, formerly sales engineer in the Chicago office of the Locomotive Superheater Company, has been appointed district manager of the company's office recently opened at 382-388 Union Arcade building, Pittsburgh, Pa. Mr. Le Vally graduated from the Armour Institute of Technology, and has had a wide experience in superintending construction and power plant work, and among his other experiences was nearly two years an officer in the navy, chiefly on the battleship Vermont.

Waldo H. Marshall, chairman of Gillespie Eden Corporation of New York, has been elected director of the Lima Locomotive Works. Mr. Marshall was until quite recently president of the American Locomotive Works, which position he filled for ten years, and resigned to join the firm of J. P. Morgan and Company. Mr. Gillespie remains in the Gillespie Eden Corporation as chairman of the board. Mr. Marshall's election to the board of directors of the Lima Locomotive Works is a valuable acquisition to the enterprising company.

Harry M. Evans, formerly eastern sales manager of the Franklin Railway Supply Company, Inc., has been elected vice-president of this company, with offices at 30 Church street, New York City. Mr. Evans is from Meadville, Pa., and served in various positions in the mechanical transportation and traffic departments of the Erie. He entered the mechanical department of the Franklin Railway Supply Company in October, 1908, as traveling representative. In August, 1916, he became assistant western sales manager, and in January, 1917, was appointed eastern sales manager, which position he held at the time of his recent election to a vice-presidency in the company as above noted.

Lewis A. Larsen, secretary and treasurer of the Lima Locomotive Works, has been elected vice-president of the company, with headquarters at Lima, Ohio. Mr. Larsen is a graduate of Upper Iowa University, and also of the St. Paul College of Law. He entered railroad service in 1897 and for several years filled the position of chief clerk to the superintendent of motive power of the Chicago Great Western. After considerable experience on other western roads he was appointed in 1907 assistant to the vice-president of the American Locomotive Company, and in 1917 he was appointed assistant comptroller. In the same year he became associated with the Lima Locomotive Company, a contributor to railroad literature, a special lecturer in the Alexander Hamilton Institute, New York. Mr. Larsen is a fine type of the western railroad man, polished by education and broadened by experience.

OBITUARY

William Robinson

Dr. William Robinson, inventor of the closed track circuit, upon which the automatic block signal depends, died in Brooklyn, N. Y., last month. He was born in Ireland but had lived in Brooklyn over seventy years. He is credited with many inventions, including one of the earliest processes in electric welding, and the coaster brake used on bicycles. His chief invention, the closed circuit, was tried on the Pennsylvania Railroad in 1871. He introduced his new invention on several roads and in 1878 formed the Union Electric Signal Company, which, in the hands of George Westinghouse, became the Union Switch & Signal Company. Like many other able inventors, his work was hampered by litigation, but found a substantial friend in Theodore N. Ely, chief of motive power of the Pennsylvania, and Mr. Westinghouse. He was in his 81st year, and was unmarried.

Harry R. Warnock.

The death is announced last month of Harry L. Warnock, vice-president in charge of mechanical matters of the Standard Stoker Company, New York, and formerly general superintendent of motive power of the Chicago, Milwaukee & St. Paul. Mr. Warnock was in his fifty-first year, and was born at New Castle, Pa.

Charles H. Armstrong

Charles H. Armstrong, secretary and treasurer of the Armstrong Manufacturing Company, Bridgeport, Conn., died at his home in Bridgeport last month.

Honors to R. C. Richards, Father of the Railway Safety Movements.

R. C. Richards, originator of the safety movements on the Chicago & North Western Railway in 1910, and which has spread not only all over America but all over the world, was fittingly honored at a luncheon tendered to him at the Union League Club, Chicago, on January 15, 1921. A beautiful silver service, suitably inscribed, was presented to Mr. Richards by the members of 85 safety committees engaged in safety work on the Chicago & North Western. An illustration of the real work accomplished is furnished by the reports of accidents occuring during the ten years previous to the inauguration of the movement on the railroad where Mr. Richards was and is still employed, and shows that 417 fewer employees were killed, and 22,600 fewer employees were injured during the succeeding ten years. It is safe to estimate that at least twenty-five times this number would fall short of a correct estimate of what American statistics alone could show. Many of the pretentious slogans and posters are from Mr. Richards, and in spite of his 66 years he is still an active worker on the good cause, and our hope is that he may live to be further honored by a wider constituency.

Hudson River Bridge Corporation

Since resigning from the presidency of the Standard Coupler Company last month, Mr. Post has been elected president of the Hudson River Bridge Corporation. This corporation has been organized for the purpose of building a bridge across the Hudson River from Fifty-seventh street to the Jersey shore near Weehawken. The proposition has been favorably discussed for a number of years and but for the World War might have been further advanced, as the need of such a highway is conceded to be very great. With a man of Mr. Post's wide experience and remarkable abilities as president, the work of the corporation will proceed with all the degree of thoroughness and expedition which might be expected.

Research Graduate Assistantships.

The Engineering Experiment Station, University of Illinois, announces that there will be thirteen vacancies in the scholarships, for which there is an annual stipend of $600 each open to approved American and foreign universities and technical schools who are prepared to undertake graduate study in various branches of engineering, including among others, mechanical, electrical, railway, and civil engineering. Applications must be made not later than the first day of March, 1921. Full information may be obtained from the Director of the Engineering Experiment Station, Urbana, Illinois.

American Railway Engineering Association.

L. A. Downs, vice-president and general manager of the Central of Georgia, Savannah, Ga., has been selected by the nominating committee of the American Railway Engineering Association for the office of president of the association; E. H. Lee, vice-president and general manager of the Chicago and Western Indiana, Chicago, for vice-president; E. H. Fritch, Chicago, as secretary, and G. H. Bremner, district engineer, Bureau of Valuation, Interstate Commerce Commission, as treasurer.

American Railway Association

Daniel Willard, president of the Baltimore & Ohio, has been elected chairman of the board of the American Railway Association, and R. W. Aishton has been elected president of the association. W. G. Besler, president and general manager of the Central Railway of New Jersey, has been elected first vice-president of the association and Hale Holden, president of the Chicago, Burlington & Quincy, second vice-president. J. E. Fairbanks, 75 Church St., New York, general secretary and treasurer.

Chief Engineer of the Westinghouse Air Brake Company Accepts Professorship of Mechanical Engineering at Yale University

Samuel William Dudley.

After 17 years of service in a field which brought him into prominence in steam and electric railway circles, S. W. Dudley, widely known authority on matters pertaining to train and traction control, retired February first as chief engineer of the Westinghouse Air Brake Company, with headquarters at the Wilmerding plant, to accept a professorship of Mechanical Engineering at Yale University.

During his long career with the Air Brake Company, Mr. Dudley won for himself an enviable reputation among his contemporaries in the engineering profession and the high esteem in which he was held by his associates within the organization is evidenced by his steady rise to important places of trust and responsibility.

Starting at the bottom as a special apprentice in 1903, he spent the summer of that year and the next in the foundry and pattern shop and the test department, returning to school to complete a post graduate cuorse during the other seasons. He managed, however, during these periods of vacation employment to acquit himself so well and to display such rare ability along mechanical lines that when he established permanent connections with the organization in 1905, he was attached to the office of the late Walter V. Turner, then mechanical engineer of the Westinghouse Air Brake Company. Here he got his first opportunity to deal with problems of train control in a thoroughly practical manner, being assigned as a member of the party in charge of the first road tests of the Type R triple valve between Pittsburgh and Fairchance on the Pennsylvania Railroad, and later acting as engineer's assistant during a series of important demonstrations of the ET equipment and the Type R passenger triple valve on the New York Central Railroad. He was charged with the responsibility of compiling much of the data relating to these demonstrations, which resulted in the development of the high emergency retained features which were added to the Type R triple valve to complete the Type L, later adopted for the motor cars of the New York Central's electrified zone.

In 1906, Mr. Dudley was assigned to the New York office to follow the installation, operation and maintenance of new air brake equipment that was placed in service on electric locomotives and motor cars during the inauguration of the New York Central's terminal electrification. A year later he was called back to Wilmerding to take charge of the Air Brake Publicity Department, where he remained until 1909, when he was appointed assistant mechanical engineer. Another promotion came in 1910 with his ascension to assistant chief engineer (in charge of operation), and in 1914 he was advanced to the position of chief engineer, which title he retained up to the time of his resignation.

For the past 15 years Mr. Dudley's name has been before the readers of the technical press in connection with articles devoted to air brake problems of universal interest in the transportation field. He enjoys the happy faculty of combining a facile literary style with the keen, analytical insight of the trained engineer and the ability to adapt himself readily to

SAMUEL WILLIAM DUDLEY.

the reader's point of view, with the result that most of his writings are of acknowledged permanent value. Being intimately associated with every development in the art of train braking that has taken place in recent years, he is naturally in a favorable position to discuss the subject with a degree of understanding that very few men have been able to attain.

The flattering statement that a man is "a gentleman and a scholar" is extremely applicable to Mr. Dudley. No better phrase could be found to describe him in character and conduct. He possesses the quiet poise, dignity and intellect that one immediately associates with the chair of the professor which he elects to fill, yet he is extremely simple and straightforward of approach, wholly unaffected in speech, and withal a man whose charm of personality and disposition have made him uncommonly popular in professional and private life.

In identifying himself with Yale University he returns to familiar scenes, having been graduated from that institution with the class of 1900 and completing thereafter a post graduate course which qualified him for his M. E. degree. The Yale authorities, recognizing his broad practical experience as an engineer, and realizing that this, together with his native scholarly attainments, fitted him exceptionally well for academic pursuits, had made repeated attempts to induce him to become a member of the faculty and he finally yielded, principally, he confesses, to enjoy an atmosphere which has captivated him by appealing to his intellectual instincts since his student days when he practiced "tutoring" to help him through his course.

Mr. Dudley is a member of the American Society of Mechanical Engineers, Engineers Society of Western Pennsylvania, New York Railroad Club, University Club of Pittsburgh, Yale Club of Pittsburgh, Yale Engineering Association, American Electric Railway Association and the Air Brake Association.

Extensions During 1920.

The expenditures made by the railroads last year have generally looked toward the enlargement of round houses and engine terminal capacity, the increase of shops, machinery and tools for the repair of equipment, the extension of sidings, additional yard tracks, interlocking devices, automobile signals and heavier rail and ballast.

BOOKS, BULLETINS, ETC.

ELECTRIC TRACTION AND TRANSMISSION ENGINEERING. By Samuel Sheldon and E. Hausman. Published by D. Van Nostrand Co., New York, 319 pages, fully illustrated, cloth.

Electric railway installation is fully described in this popular text-book, which has now reached a second edition. As an introduction to the subject it is especially adapted for the use of students or young engineers. The subject is completely treated from the details of the motors and cars to the larger installation in the power house. The illustrations are supplemented by diagrams and charts. The style is marked by a degree of clearness that leaves nothing to guesswork. The paper, presswork and binding are of the usual excellence of the enterprising publishers,

PROCEEDINGS OF THE AMERICAN SOCIETY OF TESTING MATERIALS. Published by the Society. Two volumes, 160 pages, cloth.

These volumes contain the complete reports of the numerous tests made by the Society during 1920, embracing such subjects as "Corrosion of Iron and Steel," "Cement," "Reinforced Concrete," "Concrete and Concrete Aggregate," "Coatings for Structural Material," and "Analysis of Coal." Standards of metals are also included. Special technical papers submitted to the Society form the bulk of the second volume, and all are of more than usual interest.

Flash and Fire Tests.

The Texas Company's publication *Lubrication*, in addition to other interesting matter, publishes in its latest issue a highly instructive article on the importance of flash and fire tests. As is well known when oil is heated it will give off vapor, the amount of heat necessary to bring this about being influenced largely by the nature or complexity of the oil itself. The temperature at which an oil, upon heating, in the presence of air develops vapors, which, upon the application of a spark or small flame, will ignite or flash, is called the "flash point." Many clever devices have been invented in the way of flash test instruments. About a dozen of them are treated of in the article, and an illustration showing what is known as the Cleveland Open Cup tester, which is, perhaps, the most satisfactory standard to use for the purpose. The article is well worthy of perusal, and copies of the issue may be had on application to the Texas Company, 17 Battery Place, New York City.

Rail Welding.

A new pamphlet No. 39 has been issued by The Metal & Thermit Corporation, New York, describing the latest improvements in the application of the means and methods used in rail welding. In this regard many important economies have been effected, particularly in the necessarily substantial work at highway crossings, and in the more intricate work of frogs, in which the cost of maintenance has been greatly reduced.

Winter in Canada.

Those who rush to Florida at this season of the year do not know what they are missing. To be ensconced in a temperately heated, finely upholstered car on the Canadian Pacific is to have visions that surpass the brilliance of the land of flowers. The dazzling splendors of the white north are finely described and illustrated in a 32-page booklet issued by the company, copies of which may be had on application.

Accident Bulletin No. 76

The second quarterly report, including April, May, June, 1920, shows a continuation of the same marked decrease in the number of accidents resulting in casualties to persons, with the exception, as noted in previous reports, in trains striking or being struck by automobiles, the report showing that in train-service accidents of a total of 385 persons killed, no less than 285 resulted from automobile accidents, and of 1,132 reported as injured, 911 are attributed to automobiles and auto trucks. Legislative enactments are being promulgated in many states looking hopefully towards compelling automobilists to save themselves.

Light, Heat and Power.

A beautiful folder in various rich colors has been issued by Dwight P. Robinson & Co., New York, illustrating and briefly describing eight typical power plants designed and constructed by the company. It is a thing of beauty not easily forgotten.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV 114 Liberty Street, New York, March, 1921 No. 3

Forty-five New Locomotives of the Mikado Type Added to the Heavy Freight Equipment of the Great Northern Railway

The Great Northern Railway has recently received forty-five Mikado type locomotives from the Baldwin Locomotive Works which are, with but few exceptions, duplicates of engines previously built for this road. The first Baldwin locomotives of this type built for the Great Northern were constructed in 1911. This order called for twenty locomotives, which were among the heaviest of their type built at that time. They were equipped with Emerson superheaters and coal pushers, and their design wherever possible, incorporated the standard practice of the railway company.

These locomotives proved so successful in heavy freight service that subsequent orders for additional motive power of this type followed. A group of engines built in 1916 were equipped with Street stokers and power operated grate shakers. The latest (1920) design embraces all of these features with the addition of a Ragonnet Type B power reverse and a brick arch in the firebox. These locomotives are equipped with Duplex stokers, and the locomotive Superheater Company's Type A superheater is installed.

The total number of Baldwin Mikado type locomotives thus far built for the Great Northern is one hundred and ninety. While, as previously explained, the locomotives built on successive orders differ somewhat in details, they represent a remarkably homogeneous group of power, in which interchangeable parts are used as far as practicable. The leading dimensions of the 1920 design are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 28 ins. x 32 ins.; valves, piston, 14 ins. diam.

Boiler.—Type, straight top Belpaire, diameter, 85½ ins.; thickness of barrel sheets, ⅞ ins.; working pressure, 180 lbs.; fuel, soft coal.

Firebox.—Material, steel; staying, radial; length, 117 ins.; width, 96 ins.; depth, front, 84½ ins.; depth, back, 75¾ ins.; thickness of sheets, sides, back and crown, ⅜ in.; tube, ⅝ in.

Water Space.—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Diameter, 5½ ins. and 2¼ ins.; material, steel; thickness, 5½ ins. No. 9 W. G., 2¼ ins. No. 11 W. G.; number, 5½ ins., 45; 2¼ ins., 246; length, 20 ft. 0 in.

Heating Surface.—Firebox, 255 sq. ft.; tubes, 4,177 sq. ft.; firebrick tubes, 28 sq. ft.; total, 4,460 sq. ft.; superheater, 1,128 sq. ft.; grate area 78 sq. ft.

Driving Wheels.—Diameter, outside, 63 ins.; diameter, center, 56 ins.; journals, main, 12 ins. x 16 ins.; journals, others, 10 ins. x 13 ins.

Engine Truck Wheels.—Diameter, front, 33½ ins.; journals, 6½ x 12 ins.; diameter, back, 42½ ins.; journals, 9 ins. x 14 ins.

Wheelbase.—Driving, 16 ft. 9 ins.; rigid, 16 ft. 9 ins.; total engine, 35 ft. 8 ins.; Total engine and tender, 73 ft. 2¼ ins.

Weight—On driving wheels, 242,800 lbs.; on truck, front, 19,500 lbs.; on truck, back, 57,400 lbs.; total engine, 319,700 lbs.; total engine and tender, 512,700 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 10,000 U. S. gals.; fuel capacity, 16 tons; tractive force, 60,900 lbs.; service, freight.

The reports in regard to the operation of the engines already in service are of the most satisfactory kind, and are another proof, if proof were needed, of the adaptability of the Mikado type locomotive for the severe service incidental to railroad operations in the Northwest. In this regard the Mikado type engine, when equipped with all modern improvements, bids fair to maintain its position among the leading types of modern locomotives.

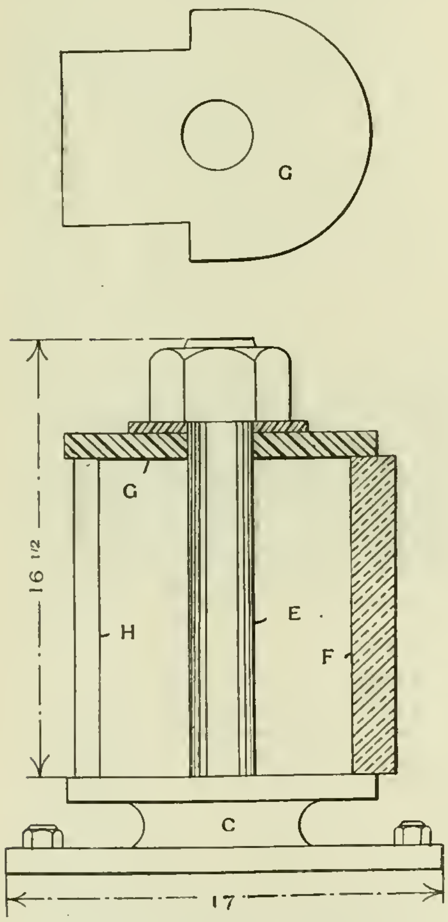
MIKADO 2-8-2 TYPE LOCOMOTIVE FOR THE GREAT NORTHERN RAILWAY—BALDWIN LOCOMOTIVE WORKS, BUILDERS

Chuck for Turning Driving Boxes—Boiler Front Rack—Details of Waste Reclamation Tanks—On the Delaware & Hudson Company

Two very similar methods of turning driving boxes are used in the shops of the Delaware & Hudson Co. at Watervliet, N. Y. In both cases a similar design of chuck for holding the work is used. The turning is done on the outside preparatory to pressing them into the driving boxes.

The short brasses whose length is less than the stroke of the slotting machine are turned, or rather brought to the proper diameter in that machine.

They are held in a chuck like that shown in the accompanying illustration. The base *C* is circular in plan and is bolted centrally to the table of the machine, which can be rotated about its center. This base is 17 in. in diameter and has the upright bolt *E*, 2½ in. rigidly

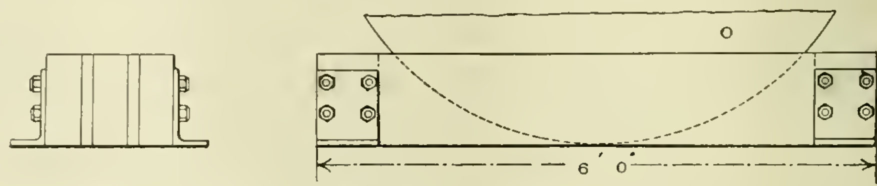


CHUCK FOR TURNING DRIVING BOX BRASSES—DELAWARE & HUDSON COMPANY

attached to it. The brass *F* is clamped to the base by means of the washer *G*, which is of steel and supported by the upright *H*.

It is evident that with the brass properly set and rotated in this chuck the outer surface can be cut to a circle of the proper diameter to press into the box.

Where the brasses are too long to be cut in the slotting machine they are held in



RACK FOR HOLDING FRONTS—DELAWARE & HUDSON COMPANY

a chuck of similar construction except that the base for bolting to the machine is lacking and the chuck is driven by a dog in the faceplate of the lathe on which the work is done.

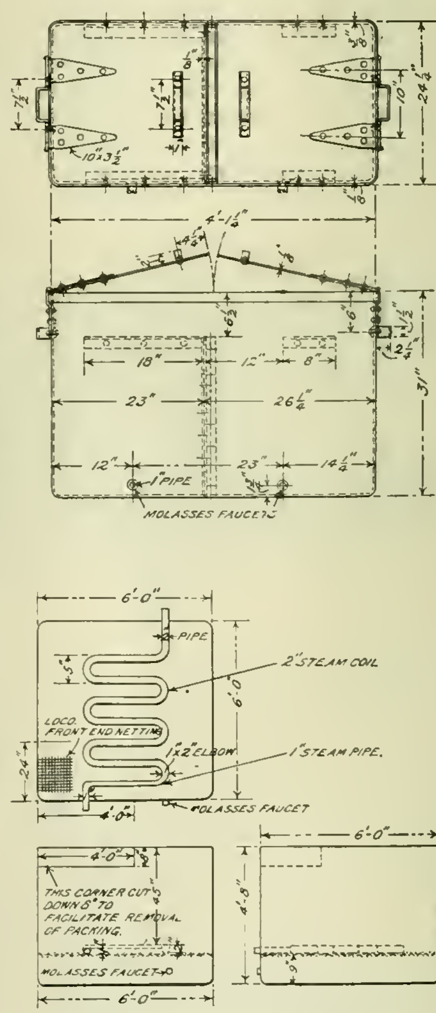
The stacking of cast-iron front ends so that any one can be picked up and used without the disturbing or handling of the others is solved by the use of a very simple rack bolted to the floor. It consists of three pieces of 4½ in. by 12 in. timbers each 6 ft. long and bolted together with separator pieces 1½ in. thick and 8 in. long placed at each end. This leaves a slot 1½ in. wide, 12 in. deep and 5 ft. 8 in. long between each of the two adjacent heavy wooden pieces. The whole is bolted together and to the floor by angles made of 4½ in. by ¾ in. flat steel as shown in the engraving. The rim of the front end *O* is dropped into the slot, and the depth is sufficient to hold it in a nearly vertical position. So that when any particular front end is needed, it can be lifted out and taken away by the overhead crane without disturbing any of the others. At the Watervliet shops there are seven of these racks, affording storage space for fourteen boiler fronts.

In our issue for January a description was published of the method of waste reclamation employed in the Watervliet shops. As no illustrations of the apparatus were published at the time, they are presented here with such dimensions given that they can be used for reproducing it if it is so desired.

The first tank into which the waste is thrown, and which has the steam coil at the bottom, is 6 ft. square and 4 ft. 8 in. deep. The draining netting is placed 9 in. from the bottom and holds the waste while the oil that drops through can be drawn off through the molasses faucet.

The second tank into which the waste is thrown is made of wood 8 ft. 9 in. long, 2 ft. 6 in. wide and 2 ft. 11 in. deep over all. Here again the waste is drained. In it the waste lies on slats that are ¾ in. wide with a ¾ in. space between them.

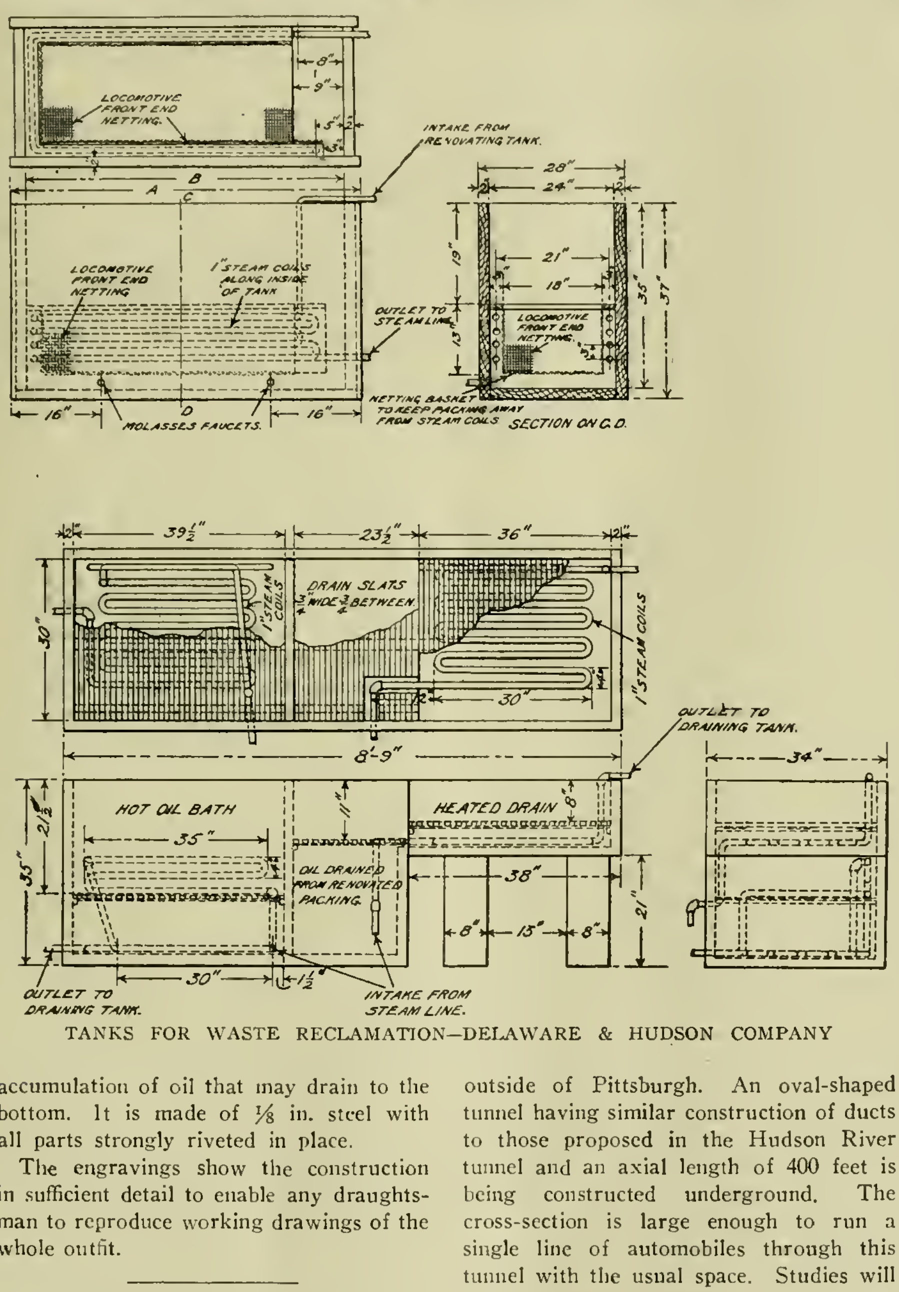
The third set of vats, of which there are two, are also made of wood, and have steam coils at the bottom and along the sides. The dimensions marked *A* and *B* are 5 ft. 6 in. and 6 ft. 4 in. for length and 5 ft. and 5 ft. 9 in. for width, re-



TANKS FOR WASTE RECLAMATION—DELAWARE & HUDSON COMPANY

spectively, while the common size, including the thickness of the bottom, is 3 ft. 1 in. The vats are lined with stock netting above and inside the coils so that the waste does not come into contact with the piping at all.

The fourth receptacle is merely a storage vat 4 ft. 4¼ in long, 3 ft. 11¼ in. wide and 2 ft. 7 in. high, with a pair of hinged covers. Near the bottom there are two molasses faucets for drawing any



TANKS FOR WASTE RECLAMATION—DELAWARE & HUDSON COMPANY

accumulation of oil that may drain to the bottom. It is made of ⅛ in. steel with all parts strongly riveted in place.

The engravings show the construction in sufficient detail to enable any draughtsman to reproduce working drawings of the whole outfit.

The New Hudson River Tunnel

An experimental duct 300 feet long, similar to the proposed ducts in the new Hudson River tunnel, is being constructed at Urbana, Ill., at the Experiment Station of the University of Illinois. The Bureau of Mines is installing special 300 horse power motors and fans for making these experiments. The data obtained will be of fundamental importance, not merely to the ventilation of the Hudson River tunnel, but particularly in the metal-mining industry where air is handled at high velocities. The determination of friction of the flow of air in concrete ducts is urgently needed in view of the growing use of concrete construction in modern metal mining.

The final check on the solution of the three previous problems will be obtained in an experimental tunnel that is now being constructed in the Experimental Mine of the Bureau of Mines at Bruceton, Pa., just outside of Pittsburgh. An oval-shaped tunnel having similar construction of ducts to those proposed in the Hudson River tunnel and an axial length of 400 feet is being constructed underground. The cross-section is large enough to run a single line of automobiles through this tunnel with the usual space. Studies will be made with respect to the following features:

(a) The diffusion of exhaust gases in the cross-section of the tunnel. (b) Temperature conditions as affected by the operation of internal-combustion motors. (c) Physiological effects of temperature, exhaust gases, and smoke under operating conditions. (d) Final check on all previous investigations.

It will thus be seen that the work on the proposed bridge may be said to have been actually begun and the conditions are full of promise that it will be prosecuted diligently.

Powdered Peat as Fuel Satisfactory on Swedish Railways

Tests extending over several months have passed the experimental stage and conclusively demonstrated that peat, reduced to powder or prepared in the form of briquets, makes an excellent substitute for coal as fuel for locomotives The Railway Board of Sweden, satisfied with the results of these long-continued tests on the State railroads, has recently taken over the specially constructed plant at "Hästhagen" bog, near Vislanda, with a capacity of 30,000 tons per annum and which cost 975,000 crowns ($261,300 at normal rate of exchange). An entirely new method of treating peat on a large scale has been adopted. All the machinery in use, invented and constructed by the engineer in charge, Mr. Eklund, appears to be so well adapted for the purpose that the conversion of peat into a cheap and effective fuel requires only a small working force. The peat is dried in the open air as far as possible. Only the hardest and driest lumps are used for ordinary fuel, the remainder being converted into powder or briquets. The plant was originally intended for the manufacture of peat powder only, but it was found that briquets were as well adapted for fuel, hence both are now being made. The discovery was also made that powdered peat becomes a dangerous explosive when subjected to high temperature.

Among the various machine invented by Engineer Eklund is a special "digger," said to be simpler, stronger, and cheaper than any now in use; electric contrivances for transporting peat from the bog to factory; and drying ovens, so constructed as to overcome the tendency of the powder to explode. It is proposed to build another and more extensive plant for the construction of the Eklund machines, to put them on the market in Sweden as well as in foreign countries, and offer them at reasonable prices. Apparently the coal problem, at least as far as Sweden and the Swedish railways are concerned, has been satisfactorily solved.

Edison Looking Ahead

Edison, who reached the age of seventy-four last month, has done much in scientific discovery, but he believes that the near future holds more revolutionary changes than any the present generation has seen. A method of manufacturing gold may, he thinks, be discovered any day; steam power will be altogether superseded by electricity; wood will give place to steel, not only in building, but in the making of furniture; books and newspapers will be printed on nickel instead of paper; and poverty will be utterly wiped out. Recently he has been experimenting along lines which he hopes may set the question of communication with the spirit world beyond a doubt.

Important Questions Submitted to the U. S. Labor Board

Railroad Executives and Railroad Labor Representatives State Their Positions

The United States Labor Board in session at Chicago on February 15, heard arguments on the Atlanta, Birmingham & Atlantic railroad's plea for permission to reduce wages. The case produced a wide variety of evidence, and is said by railroad men to be of greater importance than any other single line dispute yet brought before the board. The argument hinged on whether the board had jurisdiction over the road's financial status, which furnished the railroad's principal reason for wanting to reduce wages. It declared that a reduction of wages was more imperative because the road faced a monthly deficit of $100,000.

W. S. Carter, president of the Brotherhood of Locomotive Firemen and Enginemen, in stating the case for the employees, pointed out that it "has never before been suggested that wages be made to depend on the financial condition of a road. We are willing to make a test case before the courts on the constitutionality of the transportation act. If the contention of the A. B. & A. stands, then on the Delaware, Lackawanna & Western, which is able to pay twice as much, we will come in tomorrow with a request for an increase in wages."

Morris Brandon, counsel for the road, declared that if the board disregarded inability to pay for one road it could do so for all roads, and the result would be chaos. He said the wages granted by Decision No. 2 of the Labor Board last July were the highest ever paid the men and were granted under "extraordinary conditions, when the cost of living was the highest ever known."

No indication was given by the board as to the date when a decision would be rendered, but in view of the importance of the question it was expected to be forthcoming at an early date.

The Labor Committee of the Association of Railway Executives has made extended reports setting forth their claims before the Railroad Labor Board hearings in Chicago, from which we make such extracts as will show the basis of their contention that the National Agreements destroyed the incentives of employees to be efficient, and rendered it impossible for supervising officers to exact efficient work:

"When the resolution instructing the Labor Committee to meet was adopted by your Association, the general condition of the railroads, and especially their financial situation, was very unsatisfactory. The present freight and passenger rates were fixed in August. On the basis of a 6 per cent annual return on the valuation of them, fixed by the Interstate Commerce Commission, in September, October and November, the railways as a whole actually earned in these months, in which an unusually large business was handled, but two-thirds of the return expected.

Between the time the Labor Committee was instructed to meet and the date of its meeting, the railroad situation had rapidly become worse. There had been an unprecedented decline in traffic with most serious effects upon the net operating income. The net operating income, it was estimated, that on a 6 per cent annual basis the railways should earn in December was $86,800,000. The amount they did earn was approximately $17,000,000. The rate of return earned in September was 4.1 per cent; in October, 4.5 per cent; in November, 3.3 per cent; in December, only 1.4 per cent; in the four months, 3.35 per cent.

Telegraphic reports received from individual railways throughout the country showed that the results of operation in January were even worse than in December. Many railroads were not earning, and with the current costs and traffic had no prospect of earning their bare operating expenses, leaving them without any net return to meet their fixed charges.

Over 300,000 railroad cars were idle, as well as hundreds of locomotives, compared with a year ago when there was a shortage of about 60,000 cars. Eliminating idle facilities and tracks it is estimated that at present prices over a billion dollars of equipment was unproductive. Possibly 280,000 men had been discharged by the railroads and the working time of those retained in many cases was reduced.

Meantime, important changes had taken place in other lines of business. The reduction of railway traffic reflected an extensive curtailment of production. In many branches of industry wages were being reduced. This was especially true as to wages of unskilled labor, which, except on the railroads, were being reduced throughout the country.

The suggestions made were: First, that the Board declare that the National Agreements, rules and working conditions coming over from the war period terminate at once, that the question of reasonable and economical rules and working conditions be remanded to negotiations between each carrier and its own employees; and that as the basis for such negotiations, the agreements, rules and working conditions in effect of December 31, 1917, should be re-established. Second, that the Board give immediate permission to the railroads to pay for unskilled labor not less than the prevailing rates of wages in the various territories served by each carrier.

The labor organizations had never presented a single argument or theory in support of the proposition that the same rules and working conditions should be applied to the railways throughout the country regardless of the wide variation in local conditions, although they had ample opportunity to do so.

The financial condition of the railways made it imperative that no effort should be spared to increase the net operating income. This, as we pointed out to the Board, could only be done either by an advance in freight and passenger rates or a reduction in operating expenses, and "with declining prices and wages in industry and agriculture the country demanded that the solvency of the railroads must be assured by a reduction in operating expenses, and not by a further advance in rates."

Not only the evidence which had been presented by Mr. Whiter's committee on behalf of the railroads, but also statistics of the Interstate Commerce Commission, showed that the National Agreements, rules and working conditions forced on the railroads as war measures were causing gross waste and inefficiency, and were among the main reasons why on the present high rates the railways were unable to earn a reasonable return.

We estimated that the elimination of this waste would reduce railway operating expenses at least $300,000,000 a year.

This estimate was conservative, in view of available facts regarding the excessive increases in the number of employes and in the payroll in every branch of railroad service to which the National Agreements, rules and working conditions had been applied.

Between 1914 and 1917, before the wages, rules and working conditions of certain employes had been nationalized, the railways handled an increase in freight traffic of 31 per cent with an increase in the number of their employes of only 93,000, or 3,000 men per one per cent increase in freight traffic.

On the other hand, while, between 1917 and 1920 the increase in their freight business was only about 13 per cent, the increase in the number of their employes, as shown by the statistics of the Interstate Commerce Commission, was 261,000, or over 20,000 men per one per cent increase in freight traffic.

The branches of the service in which the greatest increase in the number of employes occurred are highly significant.

The principal National Agreement was that made with shop crafts. The number of machinists, boilermakers, blacksmiths, electricians, air brake men, car inspectors, car repairers, other skilled shop employes and machinists' helpers and apprentices in

1917 was 302,828. In the first three months of 1920, according to the statistics of the Interstate Commerce Commission, the number of these employes was 443,-774, an increase over 1917 of 140,946, or 47 per cent. The total wages paid to these employes in 1917 was $317,879,549. After the advances in wages granted by the Railroad Labor Board last July, their wages were running approximately $890,-000,000 a year an increase of $572,000,000 annually, or 180 per cent.

Another of the classes of employes covered by the National Agreements is the maintenance of way employes. In 1917 the railways had 350,000 section men and unskilled laborers, and in the first three months of 1920, before the year's maintenance of way work was fairly gotten under way on most roads, they had 376,000. The wages paid to them in 1917 amounted to $220,000,000.

Even on the basis of the number employed in the first three months of 1920—and the average number employed during the year unquestionably was much larger than in the first three months—their wages, after the wage award made by the Railroad Labor Board last July, were running at the rate of $476,000,000 a year, an increase since 1917 of 112 per cent.

The total wages paid by the railways in 1917 were approximately $1,700,000,000. After the Railroad Labor Board's award, and when business was still heavy, the total payroll was running at the rate of approximately $3,700,000,000 a year.

The statistics cited show that this enormous increase in the payroll was not due merely to advances in basic wages. It was due largely to an abnormal increase in the number of employes, and as was naturally to have been expected, the largest increases in the numbers of employes were in those classes which were covered by National Agreements.

The National Agreements destroyed the incentives of employes to do efficient work. They rendered it impossible for supervisory officers to exact efficient work. The large increase in employes and the vast inflation of the payroll were the inevitable results. The payroll of the employes covered by National Agreements also was greatly inflated by arbitrary rules causing payments for work not done, of which almost innumerable examples have been presented to the Railroad Labor Board by Mr. Whiter's committee.

It was because we believed the Labor Board had sufficient testimony and facts from the representatives of both labor unions and the railroad companies to show that these National Agreements, rules and working conditions were causing enormous wastes and inefficiency, and because the railway situation had become so acute as to make further continuance of this waste and inefficiency a menace to the solvency of many railroads and to the national welfare, that your Labor Committee instructed its chairman to appear before the United States Railroad Labor Board on January 31, and suggest immediate abrogation of these agreements, rules and working conditions.

It has been charged before the Railroad Labor Board by spokesmen of the consolidated labor unions that our suggestion that these National Agreements, rules and working conditions be abrogated is a part of a huge plot originating in Wall Street, to break down labor organizations.

The record of the proceedings as outlined shows that the railways began opposing a continuance of these arrangements immediately after their properties were returned to private operation, when production in the country was at its height, when the demand for labor in all lines exceeded the supply, and before the so-called "open-shop" movement in other industries was begun.

The record demonstrates that the railways have acted throughout independently, primarily in their own interest, but also in the interest of the shippers, the farmers and industries.

That record completely disposes of the charge that we began and have continued the effort to prevent continuance of these working rules and arrangements as a part of any attack upon these labor organizations. What we have been trying to do, and all we have been trying to do, is to get the opportunity to deal with our own employes so as to restore the efficiency of labor on these railroads, and if possible avoid non-employment and defer serious wage reductions.

Our effort to do this cannot be construed as an attack upon the labor unions, except upon the assumption that efficiency of labor upon the railroads is incompatible with continuance of the strength and growth of the consolidation of labor unions, represented by Mr. B. M. Jewell and his committee.

The Railroad Labor Board rendered a decision upon our suggestions on February 10. The Board held that it could not approve the re-establishment at once of the agreements, rules and working conditions in effect upon each railroad as of December 31, 1917, because it could not assume without evidence that they were just and reasonable. The Board said that the duty is imposed upon it by the Transportation Act, of determining just and reasonable wages and working conditions for employes of carriers, and "all questions involving the expense of operation or necessities of railroads and the amount of money necessary to secure the successful operation thereof are under the jurisdiction, not of this Board, but of the Interstate Commerce Commission."

It is claimed that the existence of the labor unions is threatened by the action of the Railroad Executives and the outcome will be watched with a degree of earnestness that is to be expected.

Railroad Executives Dispense with Labor Committee

At a meeting of the Association of Railroad Executives representing 101 Companies held in the board rooms of the New York, New Haven & Hartford Railroad in the Grand Central Terminal, New York, on March 4, the first important step in the decentralization of natural bargaining by railroads with their employes on wage questions, and one which railroad executives believe will result eventually in the lowering of freight and passenger rates, was taken by the Association of Railway Executives in abolishing the labor committee.

This committee, of which Gen. W. W. Atterbury of the Pennsylvania Railroad is the head, has been in existence since November, 1919, and was named originally to advise the railroads on the provisions of the transportation act. On March 1, 1920, President Wilson, in a letter to the roads, asked that accumulated wage demands be investigated and acted upon by the railroads, and this work naturally fell to the labor committee. Since that time it has handled all of the wage problems, including the recent hearing before the United States Labor Board.

The dissolution of this committee puts the problem of dealing with employes, in regards to wages, directly up to each road, and each one will now be able to follow its own dictates in meeting local conditions. At the same time the railroads have declined to enter national boards of adjustment.

Just how the abolition of the labor committee will aid the roads in their present plight is a mere guess, at this time, executives say. In effect, it puts each road squarely on its own feet. Conferences already have been called by roads of the Eastern district, with representatives of unskilled labor within the next week, with the hope of reaching an amicable adjustment of the present scale. In case an agreement cannot be reached, the problem will be put up directly to the Labor Board.

The action taken also makes it possible for each road to enter into any agreement it is able to negotiate with its employes, skilled as well as unskilled. It is the intent of the roads, officials say, to get back to the normal costs of operation as quickly as possible in order that freight and passenger rates may be brought down, and this is claimed to be the ultimate object in view in the dissolution of the Labor Committee.

Thomas Dewitt Cuyler, chairman of the Association of Railway Executives, who presided at the meeting, said that the action was taken on the recommendation of the committee itself.

"The committee has now substantially performed its work and its further maintenance is a constant invitation to seek a rational and uniform settlement of labor matters which ought to be settled between each carrier and its own employes," declared Mr. Cuyler. "Many of these settlements should differ on different railroads and in different parts of the country.

"The railroads have never desired national and uniform action on labor matters. But on the termination of Federal control they were faced with certain arrangements which had been applied on each and every railroad without variation. In connection with the national boards of adjustment, the national agreements, now before the the United States Labor Board, and the wages of unskilled labor, the railroads have been moved by one fundamental policy—namely, the endeavor to restore to the individual managements the opportunity of dealing directly with their own employes and of having a reasonable voice in determining the conditions under which they fulfil their individual responsibilities to the public for efficient and economical management."

Mr. Cuyler said that the roads have declined to enter into national boards of adjustment and called attention to the fact that the national agreements are before the Labor Board for decision.

The Superheater Company

Because of the continued expansion of business the Locomotive Superheater Company, which has served the railroads of the world generally and the American railroads particularly with such marked success for a number of years, the growing necessity for greater conservation of fuel in other fields in addition to that of the one represented by the steam locomotives has become so urgent that a full realization of this necessity has resulted in the expansion of the organization, in order to serve the various fields where steam is used for power. Valuable aid has already been rendered to shipowners and operators through the application of Elesco Superheaters. Railroad shop plants, industrial plants, public utility operations and excavatory equipment have also been extensively operated with a greater degree of efficiency and economy by the introduction of the superheating appliances. To render still greater service in effecting economy in fuel by the pre-heating of water, the organization has become actively engaged in the intensive development of feed water heating equipment for locomotive and marine application. With this expansion, the name of the organization has become inadequate; therefore the name of Locomotive Superheater Company is changed to the Superheater Company.

It need hardly be added that the company is in a position to meet the expanding requirements of the railroad and other service with a degree of efficiency that has already met the situation admirably and gives assurance of a continuation of the same in the future.

The American Locomotive Company to Erect a New Locomotive Plant in the St. Louis District

The American Locomotive Company has recently purchased 150 acres of ground located between the plant of the Commonwealth Steel Company at Granite City and the American Car & Foundry plant at Madison. Plans are already in course of preparation for the erection of a locomotive plant, which it is expected will involve an investment of between fifteen and twenty-five million dollars, and give employment to 6,000 men. The choice of a location in what is known as the St. Louis district was made after a careful investigation of the rival advantages of other cities and the chief attraction in favor of St. Louis was the fact that it is nearer than any existing locomotive plant to every railroad center west of the Mississippi, and that, by reason of the centering of trunk lines at the St. Louis terminal, a locomotive plant in the St. Louis district can make deliveries in the St. Louis yards to railroads operating 40 per cent of all the locomotives in the United States.

As is well known the American Locomotive Company has plants in operation at Schenectady and Dunkirk, N. Y.; Pittsburgh, Pa.; Providence, R. I.; Richmond, Va., and at Montreal, Canada. The corporation has a capitalization of fifty millions, and recently reported a surplus of about twenty-two millions. The idea of establishing a new plant in the St. Louis district is conceded to be of decided advantage in many respects, for, while there are at least seven locomotive plants in operation in the Eastern section of the country where 45 per cent. of the locomotives are used, and one plant in the Southern district where about 16 per cent. of the locomotives are used, there are no locomotive plants in the Western half of the country between the Mississippi River and the Pacific Ocean in which nearly 40 per cent. of the locomotives of the country are used. Freight rates and time will both be saved by having a locomotive plant of extensive capacity so much nearer all this Western territory.

Other advantages are apparent at a glance in the St. Louis district. It is conceded to be the natural meeting point of the pig iron product from Northern and Southern furnaces, in addition to which it has within the past few years established two furnaces of its own with a capacity of 900 tons per day. It has the best steel scrap market in the United States, because it occupies the extreme Southwestern salient of the line of heavy steel manufacture—and steel scrap constitutes 30 to 50 per cent. of the charge of open-hearth furnace. A modern open-hearth furnace operates on oil and gas, and the St. Louis district has several large refining plants.

As is also well known there are now in the St. Louis district eighty coke ovens producing high grade metallurgical coke, a rolling mill producing tank sheets, two great steel foundries, an iron foundry producing chilled tank and truck wheels, a plant making anti-friction metals for locomotive bearings, and that among the production of the steel foundries are forward trucks, trailer trucks, under trucks, cast steel pilots, main frames, back end frames, locomotive cradles, drive wheel centers, eccentrics, driving boxes, and one-piece tank frames—it can be readily imagined the reciprocal advantage it will be to these industries to have the new locomotive plant established in the district. The enterprise has already the assurance of marked favor as might have been expected.

The Panama Railroad

The Panama Railroad extends between Colon and Panama, on the eastern side of the canal, and is 47.61 miles long. A branch line, extending from Pedro Miguel to Las Cascadas, and crossing the canal on a floating bridge at Paraiso, was discontinued January 1, 1921. The railroad as built in 1850-55 followed the course of the Chagres River from Gatun to Gamboa, and was for the most part on the west side of the route of the canal. With the building of the canal it was necessary to relocate the railroad throughout practically its whole length. The railroad was an essential factor in the construction of the canal, and is an important adjunct to its operation. It is equipped with 90-pound rails, rock-ballasted track, and automatic signals. It uses modern American rolling stock, including oil-burning locomotives. The way stations are at Mount Hope, Fort Davis, Gatun, Monte Lirio, Frijoles, Darien, Gamboa, Summit, Pedro Miguel, Red Tank, Miraflores Locks, Fort Clayton, Corozal, and Balboa. There are three regular daytime passenger trains each way every day, leaving Colon and Panama, the termini, at the same hours—7.10 a. m., 11 a. m. and 5 p. m. A night train leaves Cristobal (adjoining Colon) at 11.15 p. m., daily except Saturday. On Saturday nights, trains leave Colon and Panama at 11.30; and on Sunday nights at 9.35. The time for crossing the Isthmus by train is 2 hours. The distance is 48 miles. The fare is 5 cents a mile, first-class, or 2½ cents a mile, second-class; the one-way passage, Colon to Panama, or Panama to Colon, is $2.40, first-class; and $1.20, second-class.

Early Cars of the Baltimore & Ohio Railroad

By J. SNOWDEN BELL

No. 2. Eight-Wheel Passenger Car.

Succeeding the four-wheel car for the transportation of flour, which is shown in the issue of *Railway and Locomotive Engineering* of February, 1921, the next earliest representation of a Baltimore & Ohio R.R. car which the writer has been able to develop, appears in Plate V of a very complete French publication, entitled *Histoire et Description des Voies de Communication aux Etats-Unis*, by Michel Chevalier, Paris, 1841. The accompanying illustrations, which are reproduced from Figs, 3, 4 and 5, Plate V, show an eight-wheel passenger car of the Baltimore & Ohio R. R., which is described on pages 17 and 18, but the date of its construction, which was, of course, in, or some time prior to, 1841, is not given.

There can be no reasonable doubt that, like its predecessor, the four-wheel flour car, the passenger car here shown was designed by Ross Winans, and it is in full accord with the specification of a patent which was granted to him October 1, 1834, for an "Improvement in the Construction of Cars or Carriages intended to run on Railroads." The specification of this patent states that "The passenger and other cars in general use upon railroads had four wheels, the axles of which are placed from three and a half to five feet apart; this distance being governed by the nature of the road upon which they run and other considerations." After stating the objections to the four-wheel car, in passing curves, a claim is made for the invention, which is in such general terms as to be practically meaningless, but its legal meaning will be clear from the following interpretation made of it by Chief Justice Taney, viz.:

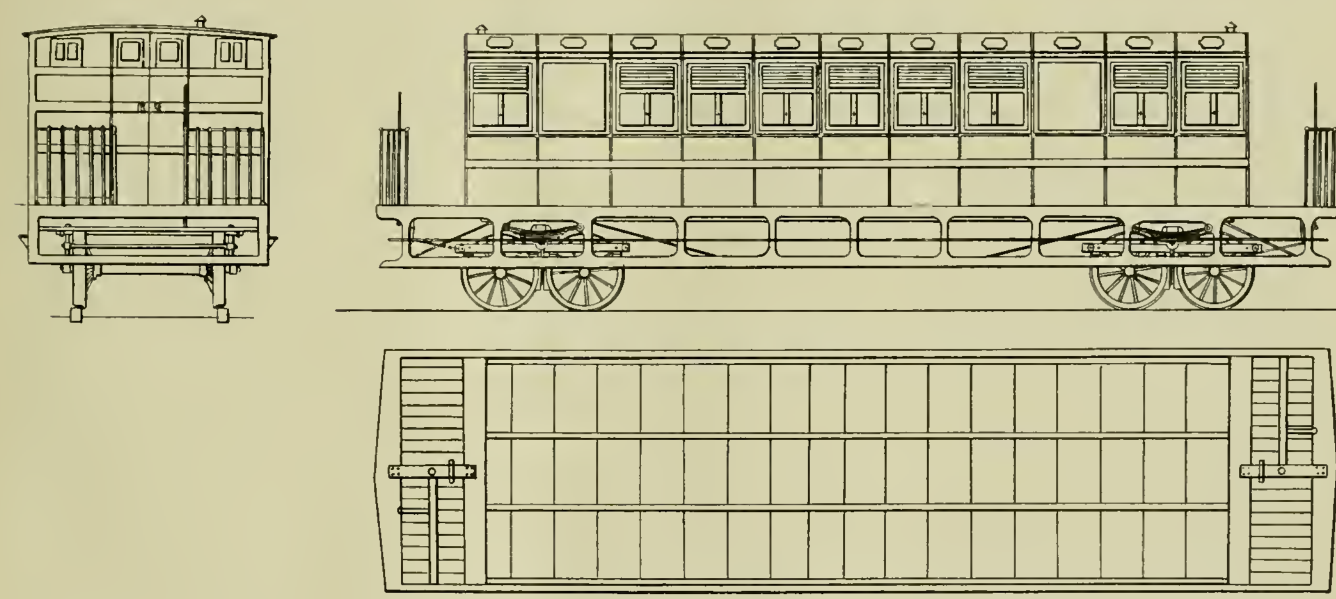
'The leading principle set forth in the specification, upon which the arrangement and connection act to effect the objects aimed at, is, that by the contiguity of the fore and hind wheels of each bearing carriage, and the swivelling motion of the trucks or bearing carriages, the planes of the flanges of the wheels conform more nearly to the line of the rails, and the lateral friction of the flanges on the rails, while entering, passing through and leaving curves, is thereby diminished; while at the same time, in consequence of the two bearing carriages being arranged and connected with the body of a passenger or burden car, by means of the king bolts or center pins and bolsters, placed as remotely from each other as may be desired or can be conveniently done, and with the weight bearing upon the *central* portion of the bolsters and bearing carriages, the injurious effects of the shocks and concussions received from slight irregularities and imperfections of the track, and other minute disturbing causes were greatly lessened."

Suits for infringement of this patent were brought by Mr. Winans against several railroad companies, and the courts sustained the claims of Mr. Winans in each instance.

From the scale marked on the original of the illustrations, the car body would appear to be approximately 27 feet 6 inches long, and 8 feet 6 inches wide; the trucks spaced 22 feet from centre to centre, with a wheel base of 3 feet in each; and the wheels 32 inches diameter, on what the description terms "very massive" axles of 0 m, 10 diameter (3.93 inches). It is also stated that there was a running board on each side for the full length of the car, to be used by passengers for getting into and leaving the car; that each car had at least four doors, one at each end and side doors; and that the baggage, "which is always small in amount," can be placed on the end platforms. The cars weigh, empty, 4,700 to 5,000 kilogrammes (10,340 to 11,000 pounds), that is to say about 100 kilogrammes (220 pounds) for each of the passengers that they can carry, which would therefore be 47 to 50.

The author of the description, M. Chevalier, states that these large eight-wheel cars are distinguished, as to public safety, by two important advantages: First, the breaking of a wheel, or even of an axle, does not expose the passengers to the accidents that would take place, in the same case, with four-wheel cars. Second, that the cars leave the track much less easily, as has been more than once experienced between Baltimore and Washington. Whenever the locomotive left the rails, it has not been followed by any of the cars; the coupling of the first car was broken and it remained on the tracks. With the ordinary four-wheel cars, which have been three times lighter, and not so well based on the track, it is probable that a part of the train would have been derailed, following the locomotive.

The French author concludes with the statement that "The eight-wheel cars, designed and perfected by the Baltimore and Ohio Company, have been adopted by a great number of railroads in America."



EARLY EIGHT-WHEEL PASSENGER CAR, DESIGNED BY ROSS WINANS FOR THE BALTIMORE & OHIO RAILROAD

Herbert Hoover on Individual Waste

An address delivered before the American Engineering Council's Executive board and the Convention of Engineers held in Syracuse, by Herbert Hoover, President, has already attracted considerable attention not only among the engineering fraternity, but among leaders of industry generally. The address was marked by a rare degree of clearness and conciseness as to the causes of industrial unrest and depression, and the following abstract may be taken as the salient features of Mr. Hoover's remarks:

"The waste in our production is measured by the unemployment, the lost time due to labor conflict, the losses in labor turnover, the failure to secure maximum production of the individual due either to misfit or lack of interest. Beyond this again is a wide area of waste in the poor co-ordination of great industries, the failures to transportation, coal and power supplies which re-echo daily to interrupt the steady operation of industry. There are again such other wastes due to lack of standardization, to speculation, to mismanagement, to inefficient national equipment and a hundred other causes. There is a certain proof of deficient production by comparisons of our intense results in 1918, when, with 20% of our man-power withdrawn into the army, we yet produced 20% more commodities than we are doing today. We are probably not producing more than 60 or 70% of our capacity; that is, if we could synchronize all national effort to maximum production, we could produce 30 or 40 % more commodities and service. Our national machine is today doing worse than usual, as witness the 3,000,000 idle men walking our streets. One part of the human measure of this shortage in production is the lack of necessities or comforts to them and their families, and their anxieties as to the future.

No one will suppose that it is ever possible to bring national productivity up to the full 100, but the whole basis of national progress, of an increased standard of living, of better human relations, indeed of the advancement of civilization, depends upon the continuous improvement in productivity. While we currently assume that great advances in living standards are brought about by new and basic invention, yet in fact even a greater field of increasing standards lies in the steady elimination of these wastes. The primary duty of organized society is to enlarge the lives and increase the standards of living of all the people—not of any special class whatever.

There is oft times a superficial dismissal of this subject of maximum production on the assumption that there are positive limits in production due to over-supply. Such assumption has no proper foundation in the broad view of industry as a whole. Too much economic thought on production has delimited its boundaries by the immediate volume of demand of a given commodity. There is no such thing as national over-production, if it produces the right commodities. The commodities or services produced by the whole nation are capable of absorption by the whole nation, if they are of the right character. In other words, if we could attune the whole industrial machine to the highest pitch, agriculture as well as manufacture, an increasing production would mean a directly increasing standard of living. When ten men or one hundred million men divide their united output, they can by doubling their output have twice the amount to divide. The problem in doubling output is to direct it to commodities or services that they can use. There is no limit to the increase of living standards except the limitations of human strain, scientific discovery, mechanical invention and natural resources.

The largest area of waste lies in the large periods of slack production and unemployment, due to the ebb and flow of economic tides between booms and slumps. The ideal would be steadily increasing production—an ideal of no likelihood of exact realization because of inability to ever gauge the advance in growth consumption or the approach of saturation. On the other hand, there are certain possibilities of stabilization worth consideration. For instance, we can classify labor into that engaged in production and service from this equipment. Our studies of industries as a whole show that we usually expand our equipment just at the periods of maximum demand for their products instead of doing our plant expansion during periods of slack consumption. We thus make double demands on labor and we doubly increase unemployment in periods of reduced consumption. That is indeed one of the factors in our great unemployment today. Everyone knows that for our normal productivity, our transportation facilities are today inadequate. We know that we are insufficiently housed, insufficiently equipped in our public roads and our public utilities; that we need an entire revision of our power supply, that we need expansion of our water ways and yet armies of idle men are walking the streets. The reasons why this occurs are not far to seek, in that it is at times of high productivity that capital is most easily obtained. It is then that the necessity of increased equipment most impress men's minds and it is the high hopes of these periods that lead them into the adventure of expansion. Nor is it possible to expect that all industry could be so stabilized as to do its capital construction in periods of depression in commodity demand. Nevertheless, there are some industries that could, by co-operation of the government and co-operation among themselves, be led in this direction. More particularly does this apply to railways, telephones, telegraphs, power supplies, and other public utilities, and to the expenditure upon our state, municipal and national public works.

Another variety of intermittent employment, and thus great waste, lies in certain industries now operating upon an unnecessarily wide seasonal fluctuation, as for instance the bituminous coal industry. This is today one of our worst functioning industries. These mines operate seasonally and erratically. They proceed from gluts to famines, from profiteering to bankruptcy. As already determined by our engineering bodies, the men who mine our coal find work only seventy per cent of their time. In other words, there are thirty per cent more equipment, thirty per cent more men, attached to this industry than are necessary if it were stabilized to continuous operation. The mining engineers have already pointed out the directions in which remedy lies, through storage, through railway rate differentials and other remedies. Through constructive action, an army of men could be released from this industry of necessity to convert some luxury into a necessity of tomorrow. This is no plan to control prices or profits, although through it both the producer and consumer in coal could be placed upon a sounder basis than today. The interest of the consumer and producer, is, however, even less important than relief from the intermittent employment and unemployment within this industry that today brings a train of indefinite human misery and some of our lowest standards of living.

The second largest area of waste in productivity is the eternal amount of labor friction, strikes and lockouts. The varied social and economic forces involved in this problem needs no repetition here. Fundamentally this is not alone a struggle for division of the results of production between capital and labor, but there is also a loss greater from strikes and lockouts in the element of purely human friction and loss outside the area of dispute on wages and hours. The growth of industry into large units has destroyed the old mutuality of interest between employe and employer. Our repetitive processes have tended to destroy the creative instinct and interest in employes; at times their efforts sink to low levels indeed. We will yet have to reorganize the whole employment relationship to find its solution. There is great promise in this field during the past two years, and the progress in this matter is one of the subjects under our inquiry.

Probably the next largest fraction of waste in productivity lies in a too high degree of individualism in certain basic products and tools. In other words, a standardization of certain national utensils makes for economy in distribution, in operation and in repairs. The necessity of maximum production during the war opened a great vista of possibilities in this direction. Such standardization as car couplings, or wheels, and cars generally, represent real progress in this direction. These possibilities lie in a hundred directions. There are all sorts of cases from sizes of chains to the size of automobile wheels. Today dozens of different sizes are placed in the market by manufacturers and entail not only special equipment and skill to produce these many varieties, but also great stocks are required in distribution and losses are entailed due to lack of interchangeability.

Another type of waste lies in our failure to advance our industrial equipment. The Super-Power Board will demonstrate the saving of 25,000,000 to 50,000,000 tons of coal annually by the electrification of our eastern power supply. The St. Lawrence Waterway Commission will demonstrate the saving of five to ten cents a bushel to the farmers of fifteen states by unlocking the lakes to ocean going vessels. Nor will this added efficiency to our national transport injure our present systems of canals and waterways, for we have ever found that the prosperity of an industry blesses them all.

Nor do we believe it is necessary to effect those things by the government. The spirit of co-operation that has been growing in our country during the last thirty years has already solved many things; it has standardized some things and is ripe for initiative toward co-operation of a wide-spread character. The leadership of our Federal government in bringing together the forces is needed. No greater field of service exists than the stimulation of such co-operation. The first step is sane analysis of weakness and sober proposal of remedy. If the facts can be established to an intelligent people such as ours, action is certain even if it be slow. Our engineers are in unique position for this service, and it is your obligation to carry it forward to the success which it merits.

Goggles for Locomotive Engineers

By Gustav Soderberg, Industrial Sanitary Engineer, New York City Department of Health

Since the time the Federal authorities assumed control of the railroads during the war emergency and required every first-class railroad to maintain (if not already installed) a safety department, many employes of the railroads have received the first instance of safeguarding their health. At this time the results of classifying the occupations of those registered under the Selective Service Draft was being carried out, which showed that only thirty-eight (38) journeymen and one hundred and two (102) apprentice locomotive firemen were discovered in each ten thousand (10,000) so registered. This certainly proves that such class of railroad workers are both valuable and rare, especially so in time of impending emergency. Many locomotive firemen have become acquainted with the ones who at time of physical examination for promotion to engineer were not passed by the company doctor on account of defective vision and observed their turning away from the company gates to seek anew (physically handicapped) some form of endeavor wherein a human industrial by-product may engage himself in remunerative employment (invariably at a rate of compensation lower than what he formerly enjoyed).

In due respect to the source of the above, I have found that smoked glass goggles and other highly perfected goggles bring out more clearly the red, green and yellow lights at night and large numbers of locomotive firemen and engineers are wearing such with pronounced success, rules prohibiting their use to the contrary notwithstanding, so wherein lies the merit of the excuse that safe operation of trains is endangered by improper observance of signals where proper colored glass goggles are worn? The rule of some railroads requiring a fireman at all times to be able to verify signals (hand, lantern and semaphore), surely is of no avail. A fireman's attention to the firebox is anything but infrequent since it is a fact that on a division of 150 miles a freight fireman many times passes 8 to 10 tons of coal through the firebox door in as many hours, and in a like distance many passenger firemen dispose from 5 to 6 tons in about 4 hours by way of the same route. Since the firemen on through trains have little time to observe the swiftly passing landscape, the effort of the management toward preserving his vision that he may in due course realize that merited promotion whereby the days of the coal shovel may reflect pleasant memories, is one surely worth while.

With the ever-increasing demand for more power through increased firebox area, the task of the locomotive fireman (especially upon the great trunk lines) becomes more arduous and trying, so to lessen the physical exertion and nervous strain though in a slight degree is sure to react in greater efficiency. It appears to the writer that the goggle question as respects the locomotive fireman and engineer has been lost sight of by many operating officials of railroads, inasmuch as the glare from the firebox or from snow on roads running east and west is a health hazard of which many safety men keep their hands off; also, since dust, cinders and other foreign bodies many times cause loss of the sight of an eye, the condition is not so flagrant as to stir some railroad safety officials to action; lastly, should the provision of a proper colored glass goggle aid in fuel conservation it concerns the fuel conservation department and one safety agent of one of the largest railroads in the country confided to the writer that he couldn't bother himself doing something for another department.

It is maintained by many operating officials of railroads that colored glass goggles change the color of signals, particularly at night. Toleration of the wearing of colored glass goggles by firemen or engineers, on the part of a management in the face of a rule forbidding such, is no less than the confession of a health hazard without aiding in its abatement. It is obvious that in the case of engineers who discover impairment of vision, the goggle should be a fitted one, and not from a "Take one" supplied by the gross. In order to insure full protection the goggles should be worn from the time of filling the lubricator at commencement of trip to arrival at wash-room upon completion of trip.

Without explicit specifications on an order to the purchasing agent to procure goggles for locomotive firemen and engineers, the material furnished may prove a case of "being sold" and no more, for many times such improper goggles are not worn because they are not fitted to the operation. If such a pair of goggles are found almost unused upon the railroad right-of-way, would it be a case of disloyalty or disgust? The writer's opinion is based upon actual experience as a locomotive fireman, talks and survey of stock of many goggle manufacturers, conversations and communications with large and small operating officials including vice-presidents, general managers, road foremen, safety agents and enginemen, and I believe that in many cases the locomotive firemen and engineers are not receiving the intelligent consideration of the eye hazard that their important tasks and responsibilities demand.

Railroad Reconstruction in France

The following details of the condition of the French railroads and their reconstruction since the Armistice demonstrate the rapidity with which France has recovered from the effects of the war. Of the 2,404 kilometers of double track line totally destroyed during the war, all have been completely reconstructed. To permit normal traffic along these lines, it was necessary to wholly rebuild 1,400 signal towers, culverts and small bridges of the total of 1,503 destroyed. In addition, of the 2,785 kilometers of single track line destroyed, 1,810 have been entirely reconstructed and opened to traffic. Work on the remaining 975 kilometers is at present being carried out, but is progressing more slowly because double track line is being built instead of the single track line.

The number of locomotives in France at the signing of the Armistice in service was 14,537. On December 31, 1920, this number had increased to 18,429, of which 14,827 were French, 1,679 German, 1,299 of the Pershing type, and 624 of the American Government type. Orders for 1,200 locomotives are at present being carried out. The number of freight cars at the disposal of the French railroads in November, 1918, totaled 410,308. On the 31st of December, 1920, this number had increased to 518,810, of which 432,038 were French, 48,891 German, 18,194 of the Pershing type, and 19,687 American Government type. Work is at present being carried out on 2,500 freight cars for various roads.

The figures for the railroads of Alsace-Lorraine are not included in the above total. These railroads have at their disposal 1,566 locomotives and 42,297 freight cars. They are to receive from Germany under the terms of the Peace Treaty a further 289 locomotives and 10,000 freight cars.

Not only are the French railroads placing orders for a great deal of new rolling stock and locomotives, but they have opened new repair shops to keep their present material in good condition. In the period immediately following the Armistice, French railroad shops were able to repair 115 locomotives and 88,000 freight cars a month. In 1920, they repaired an average of 190 locomotives and 116,214 freight cars a month.

Further proof of the recovery of French railroads is given by the notable increase in traffic handled during the last three months of 1920, as compared with the last three months of 1919. The 1920 figures show an increase of 80 per cent. in the number of passengers handled, of 95 per cent. in the number of tons of fast freight handled and of 20 per cent. in the number of tons of ordinary freight carried. As a whole, the traffic of French railroads is equal that of before the war.

The work of electrifying certain French roads, which started in 1920, has made rapid progress. The Midi Company has 150 kilometers of double track electric line in operation and the work of electrifying a further 3,000 kilometers of track belonging to this road is actually in progress. The reconstruction of two hydro-electric plants, which will furnish 150,000 H. P. each, to this road, is nearly complete. The road has placed orders for 50 new electric locomotives of the type used by the Chicago, Milwaukee and St. Paul railroad. Two other French railroads have undertaken the electrification of sections of their line, the Orleans, which is electrifying 3,000 kilometers, and the P. L. M., which also is electrifying 3,000 kilometers of road. The electric power for the Orleans road will be furnished by the waterfalls of the Upper-Dordogne, and for the P. L. M., by the falls of the French Alps. The cost of electrifying these roads will be in the neighborhood of 5,000,000,000 frs. The saving in coal will exceed 3,200,000 tons per annum, which, supposing the price of coal per ton to be above or equal to 100 frs., will, at the current rate at which money may be borrowed in France for such work, more than pay the interest on electrification bonds issued.

Plans for Rail Mergers.

Plans of Professor W. Z. Ripley, of Harvard University, for merging the railroads of the country according to regional groups under the provisions of the transportation act have been formulated on a tentative basis. Professor Ripley, who was appointed by the Interstate Commerce Commission to develop plans for consolidation of the carriers, has already submitted to the commission his plan for the Eastern roads.

His scheme for grouping the Southern and Western roads, when completed, will be used as a basis for hearings before the Interstate Commerce Commission. According to the statistical department of Hornblower & Weeks, Professor Ripley is understood to have used the following grouping as the basis for possible mergers:

New York Central and controlled lines, Boston & Maine, Maine Central and Western Maryland.

Delaware, Lackawanna & Western, Lehigh Valley, Delaware & Hudson, Erie, Wabash, Pere Marquette and the Nickel Plate.

Pennsylvania, Norfolk & Western and the New Haven.

Baltimore & Ohio, Reading, Central Railroad of New Jersey, Chesapeake & Ohio and the Virginian Railway.

Louisville & Nashville Atlantic Coast Line and Norfolk & Southern.

Illinois Central and the Seaboard Air Line, Chicago & Northwestern, Chicago, Minneapolis & Omaha and the Great Northern; Southern Railway, Chicago, Indianapolis & Louisville and Florida East Coast Railway; Chicago, Milwaukee & St. Paul and Sioux Ste. Marie.

Northern Pacific, Burlington and Colorado & Southern; Union Pacific, Chicago, Great Western and part of the Central Pacific; Rock Island, Missouri Pacific, Denver & Rio Grande, Western Pacific, Texas & Pacific and the El Paso Southwestern.

Atchison, St. Louis, Southwestern, Frisco and International & Great Northern; Southern Pacific, with part of the Central Pacific, Missouri, Kansas & Texas, Kansas City Southern and Chicago & Alton.

Russian Locomotives Repaired in England

It is reported that twenty Russian locomotives per month are undertaken to be repaired for a period extending over several years by the Sir W. G. Armstrong, Whitwerth Company for the Russia government. Arrangements are nearly completed at the Seatswood works, where considerable alterations were necessary to suit five-foot gauge locomotives. It is admitted that more than half of the locomotives in service are in urgent need of repairs, and the capacity of output may be increased by mutual agreement.

Return on Railway Investment, 1908-1920

The following figures, compiled by the Bureau of Railway Economics, show the return from 1908 to 1920.

Year Ended	Property Investment	Railway Operating Income*	Return on Investment (Per Cent)
June 30, 1908	$13,213,766,540	$645,680,235	4.89
1909	13,609,183,515	732,642,083	5.38
1910	14,557,816,099	826,466,756	5.68
1911	15,612,378,845	768,213,345	4.92
1912	16,004,744,966	751,266,806	4.69
1913	16,588,603,109	831,343,282	5.01
1914	17,153,785,568	705,883,489	4.12
1915	17,441,420,382	727,546,101	4.17
1916	17,689,425,438	1,043,017,290	5.90
Dec. 31, 1916	17,842,776,668	1,100,545,422	6.17
1917	18,574,297,873	986,819,181	5.31
1918	18,984,756,478	682,546,759	3.60
1919	19,272,911,023	509,601,118	2.64
1920	....	150,000,000	0.78

*Railway operating income is operating revenues less operating expenses, taxes and uncollectible railway revenue.

Note—Data for 1908 to 1919 from page 100, Thirty-fourth Annual Report of Interstate Commerce Commission to Congress. Rate of return for 1920 is based on the property investment as of December 31, 1919, the railway operating income for that year being partially estimated.

Explosion in High Pressure Compressed Air Line

By E. D. Gardner, Mining Engineer

An explosion, occurred in a high-pressure compressed-air line in October, 1920, at an Arizona copper mine. The explosion was unusual, and nothing had been noted by the plant operators to indicate the possibility of such an occurrence. The mining company uses compressed-air locomotives to haul about 4,500 tons of ore per day from the stopes to the pockets at two hoisting shafts The ore cars hold five tons each, and are pulled in trains of 20 cars. It is necessary to charge the locomotive with compressed air at both ends of the trip. The air is conveyed from the compressors at the surface to the distributing points underground in special high-pressure four inch steel pipe that was tested to withstand 2,500 pounds per square inch before being installed. The air is delivered to the locomotives at a pressure of 1,000 pounds per square inch. There are no receivers in the system.

The air for running the locomotives is compressed by one three-stage and two four-stage compressors which have capacities of 600 and 300 cubic feet per minute, respectively. These machines are operated by electric power, and are in an end of the main compressor building in which air is compressed to supply the air drills in the mine. Whenever the demand decreases, as at the noon hour, one or more of the compressors are shut down. On this particular occasion, at the end of the noon hour, one of the operators was approaching the high-pressure compressors to start the two smaller machines that were not running, when the explosion took place under the floor a few feet ahead of him. The man was knocked down and received some superficial cuts and bruises, but was not seriously injured. The floor was torn up, the side of the building blown out, and holes knocked in the roof some twenty feet above. The explosion was immediately followed by a fire which was quickly put out by the plant operators with hand fire extinguishers.

At the time of the explosion the 600 cubic foot compressor was running alone, and the pressure in the system at the machine registered 1,040 pounds per square inch. On examination it was found that two 8-foot sections of pipe, about ten feet apart, were completely ruptured into twisted fragments; the rest of the pipe line, apparently, was not injured. The destroyed sections were in that part of the pipe near the large compressor and above the connection from the two smaller machines. It is not definitely known what caused the explosion. Explosions in other compressed-air systems have taken place, and, although of rare occurrence, have caused loss of life. Such explosions are not confined to high-pressure installations and several have occurred at plants compressing air to one hundred pounds per square inch, or less. Explosions of this nature are not to be confused with the rupturing of compressor cylinders from excessive air pressure caused by the discharge valve being closed.

A number of theories have been advanced to account for explosions in air lines, but there is not enough evidence to state positively that any one condition is responsible, and it is possible that there are a number of contributory causes. To obtain a gas explosion two conditions are necessary; first, an explosive mixture, and, second, something to set it off. Enough oil must be fed into the cylinders of an air compressor to lubricate properly the moving parts, and in order to insure this an excess is used which may accumulate somewhere in the system. When oil is fed into the cylinder it is partly vaporized by mechanical action of the air. The quality of the oil used has an important bearing on the operation of the compressor, and is probably the most fruitful cause of explosions in receivers or air lines.

Apparently all cylinders oils are carbonized to some extent in the compressor cylinder, and, if the poorer grades of cylinder oil or those not adapted for the purpose are used, large deposits of carbon may accumulate in the air lines or receivers. This carbon is inflammable, becomes oil soaked, and is always a source of danger. Heated air from the compressor may cause the carbon to burn and thus vaporize the deposited oil in sufficient amount, together with any coming from the compressor, to form with the compressed air an explosive mixture. This mixture may then be exploded by the hot air, or, more likely, by a glowing point of carbon.

The temperature of the air in air compressors increases with the ratio of compression. The temperature at the end of the piston stroke in a single-stage machine, compressing to 100 pounds per square inch, is 425° F. above the intake air. In a 100-pound two-stage compressor with no intercooling, the increase of the air temperature is 180° for each cylinder. The final temperature of the air at the discharge end of the last cylinder of a three-stage machine compressing air to 1,000 pounds per square inch, would be about 1,280°, if the air enters the compressor at 60° and no heat is lost by radiation.

The flash point of a series of paraffin-base compressor oils listed in a pamphlet issued by the Ingersoll-Rand Company varies from 375 to 500°, and the firing point, from 425 to 575°. The flash point of a series of compressor oils with asphalt base varies from 305 to 375°, and the firing point, from 360 to 404°. It will be noted there is only a small margin between the temperatures generated in the cylinders and the flash and the firing points of the lubricating oils. Under high pressure the flash point would be lowered. Even if the oil vapor would not explode at the firing point, as held by some writers, an oil accumulation may start to burn which in itself might supply sufficient heat to cause an explosion. It seems likely, also, that an explosion in air lines could be brought about by the compressors being out of adjustment and the heat in the compressed air building up to a dangerous point.

Leaky valves in compressors are dangerous, and are held by some compressor men as generally being responsible for over-heating the air. In some types of compressors the discharge valve in the last-stage cylinder may not be tight, due to carbon deposits or some other cause, and a small part of the heated air may be drawn back into the cylinder with each stroke and be re-compressed. There is a difference of opinion, however, as to whether a leaky discharge valve can result in excessive over-heating of the compressed air. Theoretically, the air leaking back would cool to the temperature it was in the cylinder before being compressed, but it appears that due to the churning motion of the piston and other heated moving parts, the temperature may build up sufficiently to vaporize the oil and cause an explosion.

Ordinarily, the heat is effectively absorbed in high-pressure installations by a water intercooling system, but any stoppage or restriction of the water-flow would allow the temperature of the air in the compressor to increase rapidly to a dangerous point. In some types of compressors it is possible for the temperatures to build up when the air is not being used, by excessive unloading of the machine if a small leak occurs in the throttle unloading valve. With the compressor running and the valve closed, the intake side of the cylinder is in a vacuum. A small leak in the valve would permit some air to enter the cylinder, but it would be below atmospheric pressure. As the increase of temperature in the air varies with the ratio of compression, excessive heating is possible in this case. For example, under the above conditions, by assuming that the pressure in the intake side is 5 pounds per square inch and the compressor is furnishing air at 105-pound pressure, the ratio of compression would be twenty-one to one against seven to one under normal conditions. Most modern compressors, however, are equipped in such a manner that any air compressed under the above conditions is discharged to the outside atmosphere with no ill effects.

An inefficient oil trap may contribute to the explosion by permitting an unusually large amount of oil to leave the compressor with the air. Oil may burn in the pipe line and cause no damage, or a small explosion may take place with not sufficient force to rupture the pipe line, and carbon monoxide may be generated in the line. It is reported that men have lost their lives from carbon monoxide coming through the compressed-air line to the working face of a drift. To prevent explosions in air lines, the first consideration is to use the proper grade of cylinder oil, and, second, the compressor valves and intercooling system should be kept in good order. An aftercooler would appear desirable in high-pressure installations. Care should be taken that only fresh air be drawn through the intake of the compressor.

The Wear of Journal Brasses

By GEORGE L. FOWLER

The endurance test of car journal brasses, extending over a period of seven years, has recently been concluded on the Brooklyn Rapid Transit R. R. The object of the test was to determine not only the ordinary rate of wear, but the comparative rate of wear of the ordinary standard brass as used by the company and another of the same composition but which had been treated with different percnages of cupro-titanium.

Certain experiments made prior to the starting of the test showed that the scavenging qualities of titanium seemed to work as effectively on the copper-zinc and copper-tin alloys as it had on steel, for materials of the basest and dirtiest had been melted and poured into castings that were clean and sound.

The test was not an extensive one, but it is thought that there were bearings enough and that the time of the test was sufficiently long to give an indication of what might be expected. To which may be added the value of the work as a study of the general rate of wear of journal brasses under the ordinary conditions of surface electric railway operation as well as what can properly be set up as an object to be attained in the wear of such brasses.

For the benefit of those who are not familiar with the titanium treatment of cast metals it may be stated, at the outset, that the effect of titanium is to combine with the contained oxygen and to liquefy the slag so that it rises rapidly to the top of the molten mass, leaving the pure metal to be poured into the mould. The application is made to the metal in the ladle or crucible, and, unless the dose be excessive, there will be no trace of the titanium detectable in the casting.

The specifications for journal bearings of the Brooklyn Rapid Transit R. R. call for the following composition:

Copper	77	per cent.
Tin	8	" "
Lead	15	" "
	100	" "

An attempt was made to produce castings of this composition for the test brasses as treated with titanium.

As a matter of fact there was a slight variation from the specifications both by the standard brasses of the railroad company and those treated with titanium, but not enough to cause any difference in the rate of wear because of composition.

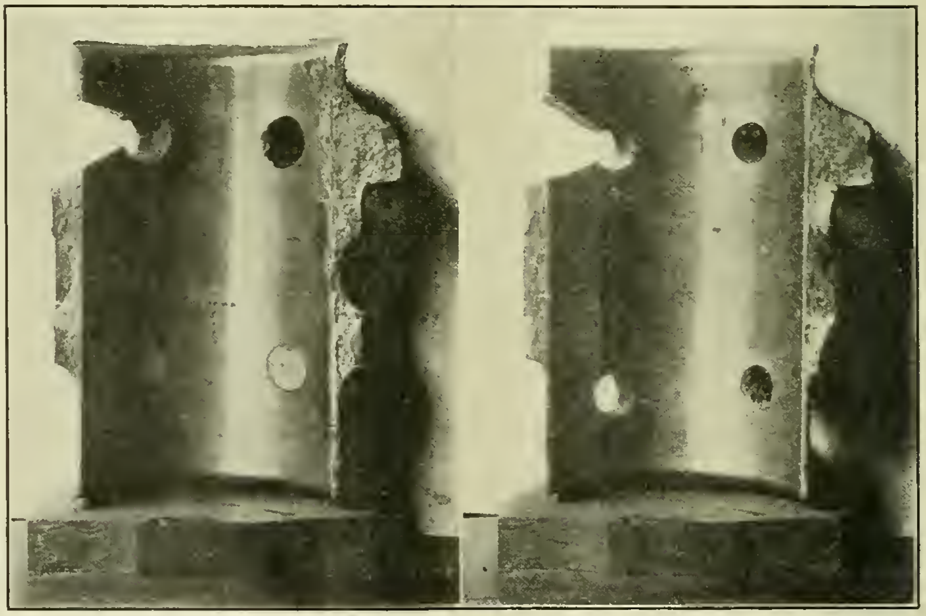
The brasses supplied by the railroad company will be designated as the "Standard" and those treated with titanium as the "Titanium-Treated."

The composition of the two lots were as follows:

	Standard	*Titanium-Treated*
Copper	77.73 per cent.	77.22 per cent.
Lead	13.50 " "	13.96 " "
Tin	6.86 " "	8.61 " "
Zinc	1.16 " "	.06 " "
Iron	.11 " "	.09 " "
Antimony	.54 " "	.06 " "
Nickel	.10 " "	... " "
Phosphorus	...	Trace
	100.00 " "	100.00 " "

The standard brasses were taken from the stock of the railroad company, of which 16 were used. Of the corresponding number of titanium-treated brasses eight had been treated with 8 oz. of cupro-titanium per 100 lbs. or 0.50 per cent. and eight with 12 oz. or 0.75 per cent. by weight.

This was enough to equip four cars, two with each percentage of titanium-treated and all four with the regular standard brasses. The cars were the ordinary eight-wheeled closed car carried on two bogie trucks and weighing about 50,000 lbs. when empty. Add to this 6,000 lbs. as the approximate average weight of the load above the weight of wheels and axles, and we have about 3,500 lbs. for the approximate average load on each journal. The journals were 3¾ in. in diameter and 7 in. long. The brass was of the usual form with a projected area on the journal of 23.625 sq. in., or at the average rate of nearly 150 lbs. per sq. in.



TITANIUM TREATED JOURNAL BRASSES REMOVED FROM CAR AFTER RUNNING 166,831 MILES

The lubrication was effected in the usual way with oil and waste.

The brasses were finished and babbitted before application to the cars with about 4½ oz. of babbitt. They were weighed before and after babbitting on a scale that weighed to grains. At each overhauling of the car they were again weighed, which was at the end of approximately each 18,000 miles of run.

It required about 18,000 miles to wear off the babbitt lining and bring the bearing down to a full bearing on the brass.

Of course all of these brasses did not run for the full time of the test. They were removed for various reasons. Some ran hot and were badly cut, while others were actually worn out. The mileage obtained varied from 16,751 to 166,950 miles, the latter having been run by brasses at the end of the test with a prospective life of 40,000 to 50,000 miles ahead of them.

The average total mileage at the end of the test is meaningless because that average would be raised for both the standard and the titanium-treated brasses had the test been continued until all were worn out.

Taking the brasses, as applied, with their babbitt lining, the average rate of wear for the titanium-treated brasses that had been treated with 0.50 per cent. titanium was 90 grains per 1,000 miles as against 94 grains for the standard brasses of the railroad. That is, the average rate of wear was about 4.3 per cent. less per 1,000 miles for the titanium-treated than for the standard. Or if the life of the standard brasses be placed at 180,000 miles, that of the titanium-treated would be 188,000. This includes the preliminary wearing away of the babbitt.

In the case of the brasses treated with 0.75 per cent. titanium, the wear of the standard brasses, inclusive of the babbitt, was 99 grains per 1,000 miles and the titanium-treated 87 grains. Whereas if the babbitt wear is excluded the rate of wear becomes 93 and 80 grains respectively.

Of if, on the first basis of including the babbitt wear the life of a standard brass be placed at 180,000 miles, that of the titanium-treated would be 249,480 miles. Finally, if we take the two types of titanium-treated brasses having had a treatment of 0.50 and 0.75 per cent titanium, respectively, their corresponding life will be 188,000 and 249,480 miles.

In connection with the wear of these brasses two photographs are shown of the bearing surfaces of a titanium-treated and a standard brass, taken without selection from one of the cars. They had run, at the time of their removal, 166,831 miles, extending over a period of 6 years, 10 months and 18 days. The loss of weight of the titanium-treated brass was 1 lb. 5 oz. 48 grains, and of the standard brass 1 lb. 13 oz. 255 grains, making a loss per 1,000 miles run of 55.4 grains for the titanium-treated and 77.5 grains for the standard. It will be seen, from the photographs, that the bearing surfaces of both brasses were in first class condition. It will also be seen that the surface of the titanium-treated brass is smooth and without blemish, whereas the standard brass is marred with a number of small sand or blow holes. The titanium had been used to obviate such defects.

If these two brasses are taken as typical of those that were removed (and that can be done) we can assume that the average normal rate of wear of the treated brass per 1,000 miles should be at the rate of about 60 grains and that of the standard about 80 grains. These brasses averaged about 9½ lbs. each in weight when new. If kept well lubricated and free from abnormal wear their final worn out weight on removal should be about 6½ lbs., giving 3 lbs. to metal wear. At the rate given above this would make the life mileage of the brass treated with 0.75 per cent. of copper-titanium 350,000 miles and that of the standard 262,500.

This, of course, means care in the matter of lubrication, but these brasses show it to be an attainable goal, and one well worth while trying to reach.

Flanged Wheels on Motor Trucks

In Service of the Creston Consolidated Mining Company

The Four Wheel Drive Auto Company, Clintonville, Wis., has shown a clever innovation by providing traveling de luxe for a number of the company's employees to and from work. The adaptability of the motor truck to operate on railroad tracks has made the four mile ride of thirty-five of the men employed by the Creston Consolidated Mining Company to and from the mines as comfortable as riding in a Pullman car. The motor truck, a 3-ton F. W. D., which formerly was run over rough roads, as shown in the first illustration, has been equipped with flanged wheels, and is now carrying its passengers in real comfort over the smooth steel rails that run from their homes to the mines, as shown in the second illustration. Even the driver has protection from the elements in an all weather cab. Adjustable tarpaulins are readily attached to protect the passengers when the necessity arises. Establishments similarly situated should take notice, and profit by a good example.

MOTOR TRUCK IN COMMON PASSENGER SERVICE   MOTOR TRUCK WITH FLANGED WHEELS ON RAILWAY

To Complete Pacific Great Eastern

Authority has been secured by Premier Oliver, of British Columbia, to borrow $4,000,000 for the completion of the Pacific Great Eastern Railway. It is expected that the line will be in operation to Prince George by March, 1922. A similar amount was borrowed last year, but proved insufficient to complete the line owing to advances in maintenance costs and deficits in operation. The premier stated that $36,0000,000 has been spent to date by the province on the construction of the railway and more would be necessary.

American Society for Steel Treating

Announcement has been made that the American Society for Steel Treating will hold its annual convention and exhibition at Indianapolis, Ind., on September 19 to 24, inclusive, in the Manufacturers' Building at the State Fair Grounds.

Snap Shots By The Wanderer

It is a pleasure to obtain access to railroad shops once more without having to untangle the mass of red tape that intervened between the application for a permit and its probable or at least possible refusal by someone hidden in the depths of the bureau at Washington or elsewhere. For always the railroad shops of this country have been the browzing grounds for engineers and editors who wished to keep posted as to the ways and doings of railroads in the line of shop, locomotive and car devices, as well as of railroad practice in general. Then to have these privileges, which, from long custom had come to be almost looked upon as rights, suddenly abolished was a shock, the meaning of which outsiders can hardly realize. But now that the doors are being thrown wide open again, we are greeting the privilege as one greets an old friend, who has been lost to sight for a time but whose memory is still dear.

Under the regime by which a man's rating was raised to correspond with the dignity of the labor which, by some stretch of bureaucratic imagination, he was supposed to perform, there were some strange and euphemistic titles conferred. We have all heard of the farmer who started an electric pumping motor in the morning and stopped it at night and, when federal control came in, he became an electrician over night and at far higher pay than he had been receiving. But even this, extravagant as it may appear, seems as nothing to a paper promotion in a railroad shop not a thousand miles from New York. Wiping the machinery of a locomotive and, incidental thereto, the daubing of the front end with dope and by use of a brush worn short and stiffened with the slope of many generations has not been dignified with the name of trade. But under the classification of the government, the man with a dope pot became a painter and either he must join the painters' union or a union painter must be given the job to do. It was their prerogative and the caste distinction that regulates the assignment of the cooking processes in India is as nothing to the union prerogative that determines the manner of man that shall put that rough coat of black stuff called "dope" on the front end of a locomotive.

In one of his speeches on Toussaint L'Ouverture, Wendell Phillips states that the only way to teach men liberty is to give them liberty. Like many other sayings this may be paraphrased to read: "The only way to teach men responsibility is to give them responsibility." We have heard much of the rising of locomotive engineers and trainmen to meet sudden and terrific emergencies. Theirs is unsually a spectacular performance that gets into the newspapers, without any detraction from the merit of what they have done. But the quick-witted action of trackmen and signalmen do not always receive the publicity and attention that they deserve. Here are a couple of cases. A long freight train was passing a signal tower when a car was derailed. It was a heavy traffic four track line. Instantly and before any damage was done the signalman threw the signals on the other three tracks to stop. Within thirty seconds one freight and two passenger trains were standing close to the derailed train, three of whose cars were buckled out and obstructing two adjoining tracks. An estimate of the loss of life and property saved would be difficult to make.

Again a stop signal was thrown in front of a passenger train running at a high speed. An emergency application of the brakes brought the train to a sudden stop and stirred up some commotion among the passengers. The engineer, conductor and superintendent of motive power went to the tower and asked the signal man what he did that for. "I don't know, but a freight train passed a few minutes ago and I heard a sound down the track that sounded something like a derailment." Then they went down the track and found three cars rolled over on the passenger track. So the passenger train waited, the passengers grew impatient because of a freight wreck, quite ignorant of the narrow margin that had lain between them and death a few minutes before, while the signalman went on about his work, which was all in a day, as though nothing had happened, and the only credit that he got was in the appreciation of the upper officers and the consciousness of a job well done.

The Secretary of the New York Railroad Branch of the Young Men's Christian Association Takes "The Wanderer" to Task

EDITOR, RAILWAY & LOCOMOTIVE ENGINEERING.

Sir: My attention has been called to an article in your February issue, entitled "Snap Shots By the Wanderer." A more appropriate caption would have been "Snap Judgment of a Blunderer." The article in question is a diatribe against the Railroad Branch of the Young Men's Christian Association, an organization which has rendered invaluable service to railroad men for the past forty years, and has pleased the railroad authorities so well that they have established it at 285 division points, and made it a trusted ally in the great work of railroad operation. From the side of the railroad men in the ranks, their opinion may be fairly gleaned from the phenomenal increase in the membership of the organization, the great and constantly growing patronage they give it, and from the fact that the railroad men from unorganized points have always been among the prime movers in an effort to get the work of the Railroad Branch extended so that they could enjoy its facilities. "It is rarely that the railroader has a good word to say for it," vouchsafes your correspondent. "They just tolerate it." It is at this point that the Wanderer strays so far from the pathway of truth that he incriminates himself. We are inclined, however, to be charitable, and to believe that what he meant to say was, that within the restricted range of his observation, he had only come in contact with knockers, a species of the genus homo that is occasionally found even in the virtuous occupation of railroading.

On the other hand, your contributor has had a remarkably happy experience with shanty restaurants kept by private parties. His lucky star guided him away from all that class of railroad terminal restaurants made famous by the raconteurs, and steered him only to utopian places deserving such extravagant tributes as, "the place was immaculately clean, and food of better quality or better cooked was never served." They are "all that the most fastidious could desire," and "yield nothing in point of cleanliness and comfort to the best and most expensive of hotels." The intrepid Columbus had nothing on your correspondent as a discoverer. A man who with one eye could see so much of bad in the Railroad "Y," and so much of heaven in the privately owned places with the other, is certainly gifted with more than ordinary human perception.

If the private places our friend honored with his presence deserve the tributes he pays to them, we grudge them no encomium, however flowery and elaborate. The thing the present writer objects to is a deliberate attempt to injure the Railroad Branch of the Young Men's Christian Association, as an organization, by the reprehensible method of writing all that he knows that is unfavorable, and making no attempt to ascertain the other side of the story. It is absolutely true that muck-rakers could find Railroad Branch buildings that are poorly equipped and badly kept. Unfortunately, there is no line of human endeavor against which something bad cannot be found (if we except the privately run railroad restaurants our friend has visited). "You can criticise a dying groan."

The Railroad Branch of the Y. M. C. A. does not ask anyone to condone its faults. We do not do it ourselves, nor do we thank anyone else for doing it. In the last analysis, we are just about average performers. But we claim the right to be judged at our total worth. The organization is good enough so that some fifteen or sixteen railroad club houses that were formerly operated by the companies themselves have been turned over to the association to run. It was good enough last year to attract a patronage of 795,000 different railroad men, for whom it provided 9,344,000 meals served at cost, 3,555,000 beds at a merely nominal price, and 2,182,000 baths for which no charge was made. The daily attendance at its buildings through the year was 53,000. It is good enough so that when its nation-wide membership campaign was on, a little less than a year ago, the men of the ranks doffed their coats and enlisted as volunteers to bring in 40,000 new members, to share its benefits with them. "They just tolerate it," do they, Mr. Wanderer? If that be toleration, mix a little of it with your future articles.

WARD W. ADAIR.

Reply by "The Wanderer"

There was no intention in the Wanderer's article to place a blanket condemnation on all Y. M. C. A. houses because of the evident impossibility of any one man being familiar with each of them. It was simply an impression given by a number of them and using, as the article stated, "perhaps an extreme but typical case" as an illustration. But so closely did the pen picture tally with the original that it was recognized by those familiar with it. The idea presented was to the effect that these places are not all that they should be in the matter of cleanliness and this is borne out by other observers besides the Wanderer. There was no "deliberate attempt to injure the Railroad Branch of the Young Men's Christian Association," but rather to call attention to one of its defects and possibly to arouse the officers of the association to wipe out that defect. If the article can only serve the purpose of bringing the one awful example into the line of hygienic cleanliness, it and even the feeling that it has aroused will have been well worth while. And finally, attention is called to the statistics offered and the suggestion is made that mere volume is not exactly a true criterion of the palatability of the millions of meals served, the cleanliness of the three million beds occupied or the privacy given to the two million bathers. The correspondent admits that there may be faults and inferentially a possibility of improvement, and if this be made, the columns of this paper will most willingly advertise that fact.

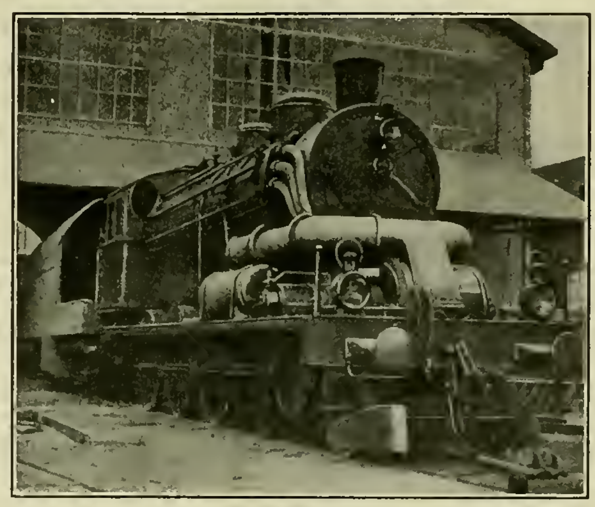
The Fastest British Express

At present the fastest start-to-stop run in the British Isles is performed by the 4.20 p. m. express from Forfar to Perth, Caledonian Railway, covering the 32½ miles in 34 minutes, at an average speed of 57.4 miles per hour.

A Steam Turbine Locomotive

In Operation on the Swiss Railways

When William Avery (who, by the way, was a relative of the late John E. Sweet) built his Hero reaction steam turbines nearly ninety years ago and used them for operating sawmills and wood-working shops in New York State and elsewhere, he took a chance at trying out one for the motive power of a locomotive on the Newark, N. J., meadows. Mr. Sweet has described the turbine as having a 7-ft. arm which rotated at enormous velocity and had a speed at its tips of 14½ miles per minute. It is not surprising that the machine ended its life in a ditch beside the track.



EXPERIMENTAL TURBINE LOCOMOTIVE, SWISS FEDERAL RAILWAYS

From that day to this there has been comparatively little effort to apply the steam turbine to locomotives. According to the *Railway Gazette* of London, however, a turbine-driven locomotive is now being tried on the Swiss Federal Railways. It is converted from a standard 4-6-0 type as used on the Federal Railways. The turbine is reversible and is placed in front of the smokebox, power being transmitted by 30 to 1 gearing to a horizontal crankshaft placed above the leading truck, the rods of the six coupled wheels being extended forward and connecting with the crankpin at each end of the crankshaft.

The engine is designed for a turbine speed of 8,000 r.p.m., giving a running speed of 49 miles an hour. The boiler is equipped with a superheater and a condenser is fitted below it, utilizing water from the tender, to which latter it is returned for cooling by being allowed to fall in narrow streams from the roof extending over the tender, which is designed for the purpose. As there is no blast nozzle an air draft through ventilators is used for maintaining the required action on the fire, in conjunction with a blower. It is claimed that while making the trial trips the engine has shown a fuel economy 25 per cent under that of the compound locomotives in service, while it runs very smoothly at high speeds, this being accounted for by the reduction of the reciprocating parts. The special equipment was designed by Mr. Zoelly, of Escher Wyss and Company, Zurich, and applied to the locomotive at the Swiss Locomotive Works at Winterthur.

Baldwin Locomotive Works Annual Report.

The annual report of the Baldwin Locomotive Works for 1920 showed gross sales totaling $78,542,666, compared with $84,307,777 in 1919. The company earned net profits of $4,428,519 in 1920, against $5,776,243 in 1919.

The full 7 per cent dividends on both common and preferred ($20,000,000 of each outstanding) call for $2,800,000, so that last year there was a surplus of $1,628,519 from the year's operations. The earnings on the common amounted to $15.01 last year and $21.76 the year before.

The company does not include in the net profits for the year any of the estimated profits on deferred payment business done. The deferred business last year was of large volume. Of the total gross sales $22,307,718 were deferred, and on this business there was an estimated profit of $2,878,751. Part, probably a considerable part, of this will eventually be added to surplus.

More interesting than the income account is the balance sheet as of December 31, 1920. It will be recalled that a year ago, when the 1919 annual report was made public, it was announced that during 1920 the Eddystone Munitions Company (the "war baby" of the Baldwin) would be completely liquidated. This promise was carried out, and there was a final balance of $1,515,264 to be carried to the balance sheet surplus of the parent company.

The 1920 output of locomotives is not given in the annual report, but it is understood to have been 1,545—divided about equally between foreign and domestic business.

At the present time the company has been called upon to engage in special repair work and the adaptability of the resources has been finely exemplified to meet the emergency.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:
JAMES KENNEDY, Managing Editor.
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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd.,
3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $3.50 *or fifteen shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

The Railroad Controversy

From the mass of conflicting claims and opinions submitted to the Railroad Labor Board during the last two months little has been accomplished beyond increasing the paralyzing effect on railroads generally and the renewal of mechanical equipment particularly. In justice to the Labor Board it may be allowed that the members have stated their own position with a degree of clearness that does them credit. They have decided against permitting the roads to reduce wages in advance of a full hearing on both sides with regard to the fairness of continuing to work under the existing agreements. Not only so, but the question at issue should be discussed by the railroad representatives and the representatives of the employees before coming before the Labor Board. In regard to the latter question it may readily be assumed that the railroad representatives were of opinion that the questions involved were such as did not admit of delay, and furthermore that the disagreement of the railroad and employees was a foregone conclusion.

Be that as it may much difference of opinion exists as to the real character of the application made to the Railroad Labor Board by the railroad representatives. What has been asked by the roads is an annulment of five national agreements, and at least a dozen other sets of rules and working conditions that were placed in operation by the Federal railroad administration during the time that the railroads were in its hands. Many of these rules do not affect what may be called basic wage rates, but are minor details in the application of rates of wages which materially affect the amount of wages paid to employees.

It is contended by the railroads that these minor rules encourage "slackerism," and should be abolished, and, furthermore, that the Labor Board is authorized under the Esch-Cummins act to decide all disputes with respect to wages. The railroads claim that the action of their representatives has been regular, and that there is no necessity for prior action either by representatives or local territorial boards. They also claim that the Federal railroad administration was not hampered by any need of economy in operation. Being a national body it made wages and working conditions identical throughout the country, and took no note of inequalities which naturally regulate different scales of wages in different parts of the country. In brief the main objection to the present system established by law is that it takes away from the owners of the railroads the power to control expenditure and to adapt it to rate and operating expenses.

Last month we presented abstracts from Mr. Jewell's defense of the labor organizations, and since that time Frank P Walsh, attorney for the railroad employees' interest, has been active in the matter, and charges a group of men with simulating railroad bankruptcy for the purpose of deceiving the country and taking part of the employees' present pay away from them. Such a charge requires prompt and full substantiation, if true. In all such controversies similar to that of railroad wages, charges calculated to harp upon ancient sentiments against one side or the other come naturally into currency. Many believe that carrier companies would go to the costly uncertainty of receivership in order to conceal by some obscure process an undeserved gain. The likelihood of such a thing in the case of the railroads deserves all the efforts that the incisive mind of Mr. Walsh, acting in the interests of his clients, can bring from any source to establish its proof, and until the proof is forthcoming the complaint that the railroads cannot meet their expenses under the present condition, is not only worthy of belief but is fortified with such assurances that hardly admits of doubt.

The roads make returns to the government on standard forms, specific and minute in detail. The keeping of railroad accounts has outgrown the old unreliable methods. The tricks in vogue in the last century are forgotten as they should be. The railroads have been running under Federal supervision for thirty-four years. Their exact valuation, or as near as mere human experience can calculate anything of varying value, has been established, the income and expenditures have rarely been called in question, and upon these accepted facts rates were raised. It is apparent at the first glance at the present condition of the roads that the rates were not raised enough to meet the increase of expenses, and it would seem reasonable to expect that the same authority that passed enactments allowing the raising of rates last year, could raise the rates still further to meet the shortcomings that still seem to exist.

We desire to be understood as not taking sides one way or the other on this momentous question. We are well aware from long and hard experience that railroad men were poorly paid at times when the railroads were making fairly good returns on the investments made, and none were good enough to increase the meager remuneration of those who performed the real work, except under compulsion. It seems curious that it should be looked upon as a national calamity if it can be shown that some railroad employees are being overpaid during a period when what is known as the cost of living is so excessively high, and few seem to remember that the same class of employees were shamefully underpaid at a time when the cost of living was, to say the least, high enough to be in many instances almost beyond the elemental wants of common humanity. Our hope and assurance is that out of the controversy good may come, and come speedily.

Canadian National Railways

There is a marked similarity between the condition of the railroads of the United States and the Canadian National Railways. If there is any difference the Canadians have the worst of it. With the most accomplished railroad men as the heads of the great enterprises the government acts as if they were not to be trusted. The reasonable requests for appropriations are either cut down to a miserly minimum or they are rejected altogether. It is not our purpose to go into details, but the fact that settlers are encouraged to take up lands in the vicinity of the numerous branches of the great intercolonial roads, and then the roads cease to operate on account of the lack of maintenance and equipment, is, to say the least, bad statesmanship. There seems to be no voice raised in behalf of the disappointed emigrant farmer, and the result, as may be expected, the emigrant will emigrate again. Not only so, but the engineering fraternity calling attention to the wooden bridges tumbling into ruins, as they do after twelve or fifteen years, should be heeded, and the construction of the durable steel structures would give employment to thousands of the best class of workmen, and the farmer and the artisan would go hand in hand, and the market of home products would gladden the great plains and the wheat fields would glisten into green and gold.

This is no poetic dream. At the end of the American Civil War, if there was any gold in the country it was in Wall street. But there were printing presses in Washington, and they turned out millions of what was known as "greenbacks," and with these they opened up a pathway to the Pacific Ocean, and unlocked the treasures of the great West, and in less than a dozen years the paper money was as good as gold. In spite of "wild-cat banks" and other misleading schemes, there were statesmen in those days who had prophetic vision of the future and could see into the days that are to be. We are not short of opportunity, we are short of real men who can "take occasion by the hand and make the bounds of Empire wider yet."

Turning for a moment to the condition in Europe, it is a singular circumstance that the most devastated portions of that continent seem to have the finest spirit of resiliency. The same spirit that triumphed in battling for the right rises to the occasion, and the means are promptly forthcoming not only to re-establish the ruined pathways of commerce but to improve them. France is already on her feet. Belgium has the promise of a golden summer at hand, in spite of the fact that the railroad rates, the price of traffic, are enormous.

The trouble with American statesmen generally, if we may so classify the glib-tongued politicians, of whom we have more than enough, is not so much a lack of intelligence, as it is the narrow, selfish spirit that exalts their own interests into monumental importance as compared with the welfare of the country. Their intellectual eyes are largely turned to the next election. They are more concerned in building their own fences than in repairing the fences of others. They instinctively feel that if they vote to raise needed taxes they will likely be elected to stay at home, and thus "enterprises of great pith and moment with this regard are turned aside and lose the name of action." We are not without hope, however, that the people themslves will see the necessities of the hour, but large bodies, of which the common people are a mighty example, move slowly.

The Indiana Disaster

The appalling disaster occurring on the evening of February 27, when a westbound New York Central train crashed into a derailed eastbound Michigan Central train at a crossing at Porter, Indiana, and which has already been the subject of much distorted statements in the daily press, has now been thoroughly investigated by expert authority and the facts in regard to the accident are briefly these: The Michigan Central train known as the Canadian Express, left Chicago at 5.05 p. m. on the date already referred to, bound for Toronto, Canada. The train was carrying several hundred passengers. Engineer N. S. Long and Fireman George F. Blockson, were in charge of engine No. 8,306, train No. 20. When the train approached the level crossing of the New York Central lines at Porter, it so happened that coincidently the New York Central express known as the "Interstate" from Boston to Chicago, with a long train of steel Pullman coaches came along, Engineer Claude Johnson, and George Deland, fireman, both of Elkhart, Ind., in charge. Both trains were running at a high rate of speed, the Michigan Central train at about forty-five miles an hour, and the New York Central estimated at about sixty miles an hour.

Some of the first grossly exaggerated reports claimed that the towerman of the crossing, who was responsible for the signals, was at fault, but the official investigation shows conclusively that the towerman had set the signals against the Michigan Central train, thereby giving the right of way clear to the New York Central train. It is not necessary to describe in detail the operation of the signals. The equipment was of the best, and the signals set against the approach of the Michigan Central train to the point of collision coincidentally opened a safety or derailing switch so that in the event of the engineer on the Michigan Central road failing to observe the signals the train would be switched off the main track and leave the New York Central line clear. The high rate of speed at which the Michigan Central train was moving, and the consequent momentum acquired carried it nearly in a straight line along the ties about three hundred feet before it stopped with a wooden coach directly on the track in front of the oncoming New York Central train, which has officially been declared as in no way to blame for the consequent loss of the lives of thirty-seven persons including the engineer and fireman of the New York Central engine, which, fortunately, were the only fatalities occurring on the New York Central train.

Following the investigation, Henry Schearer, general manager of the Michigan Central Lines, issued the following statement, of date March 1, "In the matter of the unfortunate collision at the crossing of the New York Central and Michigan Central railroads, at Porter, Ind., Sunday, February 27, New York Central train No. 151, and Michigan Central No. 20, after careful investigation of the facts with all interested employees and conference with officials just completed, it has been determined that engineer W. S. Long and fireman George F. Blockson, engine 8,306, train No. 20, violated rules and regulations in failing to observe and properly obey signal indications, and will be forthwith dismissed from the service."

Members of the Interstate Commerce Commission, embracing H. D. Lyon, official engineer; W. H. Harland, signal engineer, and I. S. Hawley and B. Craig, inspectors, came directly from Washington, and made a preliminary investigation on March 1. It is not expected that the result of their investigation will change the responsibility of the accident on any others concerned, but it is to be hoped that the Commission empowered with the matter of continued experiments on devices looking toward the adoption of an automatic control will be induced to make some recommendation that may result in lessening the constant danger that attends mere human fallibility.

In this latter regard at the first glance it seems strange that two men, both with exceptionally good records, should pass unnoticed the regularly displayed signals with which they had become so familiar, but there is even in this familiarity an unconscious danger, a psychological phenomena, which may be said to be past finding out, and calls out for anything that may aid in lessening the chance of a recurrence of such appalling disasters. It is also noteworthy that delays in investigation of new devices seem inevitable, and the fact that seven years have elapsed since special commissions were established to experiment in automatic control devices creates suspicion as to the spirit of activity permeating the minds of the investigators, and the celerity with which the great war and other apparently reasonable excuses are advanced in extenuation of the lack of progress which is looked for, and through which this disaster cries aloud.

Has the Limit of Locomotive Capacity Been Reached?

Prophesying is probably the most unsafe and hazardous mental amusement in which a man can engage, especially if the prophecy has to do with future developments along any line of human endeavor and especially if it places a limit upon that development.

Many times within the past three decades it has seemed to many that the limitation had been reached in the size and power of American locomotives, and then came something bigger and stronger. So with this hazard of trying to foretell what the future has to bring forth let us look at present conditions.

There is at least one standard in our railroad practice that would be very difficult and expensive to change and that is the car coupler. The shape and size of the head and knuckle are used upon the more than two million cars of the country making approximately five million couplers in use. To change even a minor detail of this standard would be a task the magnitude of which would deter even the most radical of engineers from proposing. So it does seem that this is finally a fixed quantity. As at present constructed a very high grade of material is used, by which the elastic limit of the coupler is about 200,000 lbs. This limit could probably he raised by the use of a still higher grade of material, but it is doubtful if the extra strength obtained would be worth the additional cost. Besides that, until all cars were equipped with couplers made of this special high grade material, the chain would still have only the strength of its weakest link, and the extra strength would not be available until all cars were so equipped.

Now, engineers have long since learned that it is not safe to stress material above or even up to its laboratory limit of elasticity if breakages are to be avoided. Hence if we are to keep our maximum drawbar pull below the limit of elasticity of the coupler, as it seems reasonable that we should, then the question arises as to how much leeway should be allowed. Certainly if the couplers are to be stressed to 75 per cent of their limit of elasticity in regular service, we are going as far as we ought. This then would limit the drawbar pull to 150,000 lbs.

If the drawbar pull is so limited and we take four as the factor of adhesion of the wheel to the rails we have a proposed maximum weight on driving wheels of a road locomotive, that is to haul a train, of 600,000 lbs., and this limit has been reached. There may be places, where cars of special construction are used, at which heavier engines may be found to be economical, but for general road service, where mixed trains (that is, trains made up of any home and foreign cars offered) are to be hauled a drawbar pull of 150,000 lbs. is about the maximum that can now be used with safety.

Let us also approach the subject from another standpoint.

For many years it has been the bridges that has limited wheel loads. And as the latter have been increased the bridges have been strengthened to keep pace with the requirements of the heavier rolling stock. That was a comparatively easy proposition. But the time came, in the growth of wheel loads, when the roadbed ceased to be able to carry them, and when locomotive weights rose to 70,000 lbs. per axle it was found that the limit of the roadbed had been reached and that rails weighing 130 lbs. per yard were necessary, in order to carry the load. The cold rolling effect on the head of the rail is very great and a halt seems to have been called. Rails are now made with a carbon content of from .70 to .80 per cent and that would seem to be about the top notch of safe limit. Of course the rails could be hardened, but few people who know would care to have hardened rails under them when running at high speed in cold weather. Or the rails might be heat treated, but any heat treatment to which they might be subjected would be apt to increase any internal defects and so can hardly be recommended as a remedy for present conditions and certainly not as an improvement.

There is another thing that could be done and that is to use manganese steel. This does not abrade but it cannot be cut except when hot. It must be quenched and it rolls out badly so that its one advantage of extreme hardness and resistance to wear is more than offset by its attendant disadvantages.

So there we are and it does seem as though we had really pretty nearly if not quite reached our limit. But, as Lord Dundreary says, it is one of those things that no fellow can tell.

Valve-Setting on Passenger and Freight Locomotives

Valve-setters generally agree that the passenger engine should have a greater amount of lead or valve opening at the end of the piston stroke, thereby giving a larger, and unrestricted supply of steam to the cylinder at the beginning of the return stroke, and avoiding the wire-drawing of the steam at high piston speeds. It also has the effect of increasing the exhaust port opening, which can be realized when it is considered that the exhaust port opening near the end of the piston stroke must always be equal to the sum of the steam-lap in addition to the amount of lead opening and exhaust clearance, so that the greater any of these three properties are, the greater by that amount should the exhaust port opening be at the end of the piston stroke.

On the other hand the freight engine should have a smaller amount of lead, in order to get a slightly later cut-off that will increase the starting effort, and as this class of engine works at a relatively slower speed, it is not so subject to wire-drawing as the passenger engine, the latter having a greater steam lap that has the the effect of lengthening the period of expansion, and also increases the amount of exhaust port opening, to which we have already alluded. The freight engine, having a smaller amount of steam lap, allows a slightly later cut-off in full gear, and although it reduces the period of expansion to a small extent, the effect is almost neutralized by the reduction or total elimination of the exhaust clearance.

The passenger engine, having a greater exhaust clearance, hastens the release and delays the closure point, but what is really more important, it increases the exhaust port opening to the amount necessary to keep the compression below the limit that will give a smooth running engine at the high speeds at which it has to operate. The freight engine, having little or no exhaust clearance, has the effect of delaying the release, which is an advantage. It also has the effect of advancing the closure point, restricting the exhaust port opening, but there are no ill effects to be found from this at the long cut-offs and relatively slow speed at which the piston moves.

From this comparison it can be seen that the valve-setting on the passenger engine has been developed to give a quick and free running engine at high speeds and short cut-offs, while the chief consideration in regard to the freight engine valve-setting is to obtain the greater possible tractive effort at moderate speeds, and to run at comparatively long cut-offs with the greatest possible economy by delaying the release point as far as possible.

Automatic Train Control

A special meeting of the Interstate Commerce Commission Bureau of Safety was held on February 15, 1921, at which the American Railroad Association Joint Committee on Automatic Train Control presented a report of progress, showing a revision of the requirements regarding the functions expected from automatic train control devices. The changes from those already issued by the American Railroad Administration some time ago were slight and unimportant and were briefly summarized as follows:

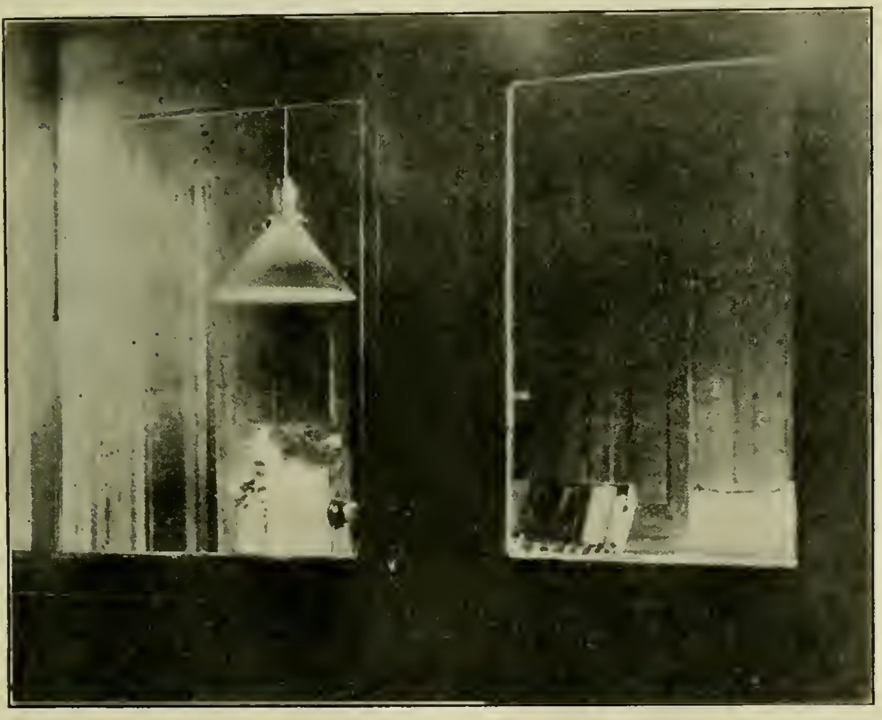
"The functions to be accomplished and the specifications and requirements to which a device to be installed in any designated location must conform will of necessity be determined by traffic, operating and other local conditions, and can be prescribed in detail only when the specific location for an installation has been designated. In connection with these test installations now in contemplation, it may be necessary to establish specifications and requirements merely tentative at the outset and subject to modification and development as the work progresses. Such specifications and requirements for several test installations, together with records of alterations in the installations which may become necessary in the course of the tests, should furnish data from which the commission may ultimately prepare specifications and requirements to be prescribed in accordance with the terms of the law."

Thinking and Acting.

If the employee is not permitted to think for himself, to think out his problems, to think how the thing should be done most economically, how can we expect him to be broad and independent.—E. E. Nash.

Foreman's Office in a Locomotive Cab on the Norfolk & Western

It is a singular circumstance that is frequently remarked upon that in the laying out of new shops, where the best engineering efforts are made to bring all of the mechanical sections under one roof, there is seldom any thought given to the necessary accomodation of the shop superintendent or general foreman. We recall visiting a colossal establishment covering several acres where even the paint shop was under the same roof as the machine, blacksmith and boiler shop. The shop superintendent was left out in the cold. There was no reserved spot where he could place the soles of his weary feet, not speaking of his multiplex collection of blue prints and miscellaneous notes and queries, and his accumulating weary wilderness of mail, including papers and in by day, and the radiant glow of Edison's electric lamp by night. Then there is an Etruscan vase filled with rainbow blossoms every morning, summer and winter, in fact there seems to be no winter there. His work goes on like a sweet song. As the poet says:—"There is no sorrow in thy song, no winter in thy year." Like Diogenes with his tub he is philosophically serene. Or rather like Alexander when he gave away cities and towns to his choicest soldiers, one had the thoughtfulness to ask the great man what he kept for himself, and the mighty conqueror replied that he kept his sword. So it is that the capable man never grumbles. We are not preaching against improvements. We are preach- the everlasting gospel of trying to get along with what we have, and when the



VIEW OF A FOREMAN'S OFFICE IN A LOCOMOTIVE CAB

pamphlets. A shattered wing of a partially demolished antedeluvian relic of a prehistoric period remained, a primitive kind of roomy sentry-box where a corporal's guard might have been ensconced in the civil war times, and the superintendent ensconced himself unconcernedly there and went on with his work.

We have referred before to the foreman of the car department of the Roanoke shops of the Norfolk & Western Railway, J. D. Mayo, and we have been furnished with a photograph of his office. It consists of a discarded locomotive cab, and we take pleasure in reproducing a side view of the structure. Mr. Mayo desires nothing better. It was his own choosing. He has the unclouded sunshine streaming golden time comes when the railroads will have bulging bank accounts, no kind of marble structure, ornamented with the portraits of past-presidents, or the busts of by-gone big-wigs will bring more contentment to a man of Mr. Mayo's mind, because he has the elements that make for contentment under any condition within him.

New Rails and Ties on the Pennsylvania in 1920.

About 95,000 tons of new steel rails and 5,300,000 new cross ties were used last year in the railroad's effort to keep its tracks safe and comfortable. Of the 95,000 tons of new rail laid in 1920, 82,500 tons, or 87 per cent, was heavy 130 pound rail. The use of heavier than 100 pound rail was commenced by the Pennsylvania Railroad in 1915 and at the present time only a small percentage of rail used on the system is less than 130 pounds.

Steel rails for 1920 use cost approximately $48 a ton, an increase of $8, or 20 per cent over the previous year's cost and 63 per cent more than the cost of rails ten years ago. Cross ties cost the Pennsylvania Railroad 32 per cent more in 1920 than in 1919 and 153 per cent more than ten years ago.

Removing Side Rods

In taking down the connecting rods of a locomotive it has been one of the standing rules to govern engineers, that in case of an accident necessitating the removal of a side rod, the engine should not proceed until the corresponding rod, or rods, on the opposite side of engine were also removed, and there were no exceptions to that rule. We have found, however, that there are cases where that is not necessary, as where the engine is disabled so the engine can only be run on one side.

Say, for instance, the left main pin is knocked off a six-wheel connected engine. That would remove all side rods on that side. But there is no need of taking down the side rods on the good side in such a case if it is desired to run the engine on one side or be towed.

If damage results from leaving up a side rod when the opposite one is down it is caused by the power of the opposite side of the engine, but when the main pin is gone there can be no power exerted on that side, hence no damage can result to rods on the good side.

Were it not for the helplessness of the single engine when on the center, there is no reason why the locomotive could not be run as a single engine all the time. The fact that it would need side rods to couple the drivers would not stand in the way.

Railroad Projects in Jugoslavia.

It is reported that a railway is projected from Belgrade to the Adriatic, and is being studied in the ministry of transportation. The line will be double tracked and permit of a speed of 45 miles per hour. It is hoped that the plans will be completed by the end of spring so that definite work may be begun.

In Czechoslovakia.

There are 8,297.8 miles (13,362 kilometers) of railway lines in Czechoslovakia, of which 4,928.2 miles (7,936 kilometers) are owned by the state. The remaining 3,369.5 miles (5,426 kilometers) are privately owned and include many small local railroads, electric traction companies, etc. Of the State railways, 801.7 miles (1,290 kilometers) are double-tracked, and of the privately owned roads 199.9 miles (322 kilometers).

Six Pacific Locomotives for the Reid Newfoundland Company

The Reid Newfoundland Company operates a railway on the island of Newfoundland, extending from St. John's to Port-aux-Basques, a distance of 546 miles. The character of much of the country is extremely hilly and the motive power used in passenger and freight service is designed to operate on grades of 2 per cent and curves of 14 degrees. The track is laid with 50 pound rails and the gauge is 3 feet 6 inches. Much of the passenger traffic is handled by Baldwin engines of the ten-wheeled (4-6-0) type, the most recent of which were built in 1917. The Baldwin Locomotive Works have recently constructed 6 Pacific (4-6-2) type locomotives which are designed to meet the requirements of heavier traffic. A brief comparison between the ten-wheelers and Pacifics is as follows:

The boilers of the Pacific type locomotives are of the straight top type with Belpaire fireboxes, and are equipped with superheaters. The boilers are designed to carry a pressure of 200 pounds, although the working pressure used in service is 170 pounds. The machinery is designed for a boiler pressure of 190 pounds should it be found desirable subsequently to raise the pressure. Brick arches are installed and are supported on tubes. The front of the firebox crown is supported on two rows of Baldwin expansion stays and the tubes are welded into the back tube sheet.

The cylinders are 17 inches in diameter with a 24-in. stroke and the steam distribution is controlled by 8-in. piston valves operated by Walschaert valve motion. The cylinders are fitted with cast-iron bushings.

The frames have single front rails with extra heavy bumpers designed to resist snow bucking. Hodges trailing trucks are used. The equipment includes M. C. B. couplers, Westinghouse air brakes, electric headlights, air sanders and steam heat. The extreme height of these locomotives is 12 ft. 6 ins. and the width 9 ft. 3 ins.

The tenders are of the eight-wheel type having a capacity of 3,600 U. S. gallons of water and 9 tons of coal. The frames are constructed of steel channels with steel plate bumpers. The trucks are of the arch-bar type with cast steel bumpers and chilled cast-iron wheels.

PACIFIC 4-6-2 TYPE LOCOMOTIVE FOR THE REID NEWFOUNDLAND COMPANY. BALDWIN LOCOMOTIVE WORKS, BUILDERS

	Ten-Wheeled Type	Pacific Type
Cylinders	17 ins. x 22 ins.	17 ins. x 24 ins.
Valves	Balanced Slide	Piston, 8 in. diam.
Boiler Type	Straight Top	Straight Top Belpaire
Diameter	56 ins.	56 ins.
Working pressure	160 lbs.	170 lbs.
Firebox—Length	89⅝ ins.	66 3/16 ins.
Width	29 ins.	60⅛ ins.
Tubes—Diameter	2 ins.	5⅜ ins. and 2 ins.
Number	184	5⅜ ins., 18; 2 ins. 111
Length	12 ft. 0 in.	16 ft. 0 in.
Heating Surface—Firebox	106 sq. ft.	93 sq. ft.
Tubes	1,148 sq. ft.	1,358 sq. ft.
Firebrick tubes	....	12 sq. ft.
Total	1,254 sq. ft.	1,463 sq. ft.
Superheater	....	343 sq. ft.
Grate Area	18 sq. ft.	27.6 sq. ft.
Driving Wheels—Diameter	50 ins.	52 ins.
Journals, main	7 ins. x 8 ins.	7½ ins. x 8 ins.
Journals, others	7 ins. x 8 ins.	7 ins. x 8 ins.
Engine Truck—Front, diameter	26 ins.	30 ins.
Back, diameter	....	30 ins.
Wheel Base—Driving	11 ft. 0 in.	10 ft. 0 in.
Total engine	20 ft. 5 ins.	27 ft. 3 ins.
Total engine and tender	47 ft. 9 ins.	50 ft. 8 ins.
Weight—On driving wheels	72,700 lbs.	78,000 lbs.
Total engine	92,100 lbs.	115,000 lbs.
Total engine and tender	148, 000 lbs.	199,000 lbs.
Tender—Tank capacity	2,800 U. S. gals.	3,600 U. S. gals.
Fuel capacity	5 Tons	9 Tons
Tractive Force	17,300 lbs.	19,250 lbs.

The Superheater and the Brick Arch

An interesting test to determine the economic value of the superheater and the brick arch was made some time ago by the American Locomotive Company. The engine used for the purpose was a Mallet compound that had been designed for heavy pushing service, though the tests were made in road service at higher speeds than those at which the engine had been designed to run.

When the engine was run without either superheater or arch the coal consumption was .118 lbs. per ton mile. With the superheater in use this consumption dropped to .0914 lbs., thus effecting a saving of 22.5 per cent. With the brick arch applied the consumption was .0788 lbs., making a total saving of 33.2 per cent. or adding 10.7 per cent to that effected by the superheater alone.

On the basis of ton miles per pound of coal the increase was 29 and 50 per cent respectively.

It is probable that if an engine had been used that was designed for the speeds at which these tests were run, still better results would have been obtained, but as it was, it furnished a very convincing proof of the remarkable degree of economy that can, under any condition, be secured by the use of these appliances on locomotives.

The Eddystone Plant of the Baldwin Locomotive Works in Moving Pictures

At a recent meeting of the Central Railway Club held in Buffalo, A. H. Ehle, General Domestic Sales Manager of the Baldwin Locomotive Works, furnished an interesting entertainment to the members and guests by the presentation of moving pictures showing views of the principal steps in the building of a locomotive. The works, as is well known, was founded by Matthias W. Baldwin in 1831, and have built over 54,000 locomotives. The maximum production was reached in 1918, when a total of 3,580 locomotives was built. The company operates two plants, located at Philadelphia and Eddystone, Pa., and when working at full capacity these plants employ a total of 21,500 men.

Mr. Ehle's program opened with a view of the first Baldwin locomotive—"Old Ironsides," followed by a view of a large Mallet locomotive running a trial trip on the test track at the Eddystone plant. The views of the Eddystone plant were particularly interesting, occupying as it does, a tract of nearly 600 acres on the shore of the Delaware river, and is not only connected with three of the leading railroads of the country, but is also provided with docking facilities where seagoing vessels can be loaded for shipment for any part of the world.

The complete details of the casting of cylinders were shown, followed in rapid succession by the various machining processes, including the bushing. The punching and drilling and bending of boiler plates proceeded, as many as five plates being drilled at one time with a degree of rapidity that was amazing. The making of a dome seemed to surprise many of the spectators, the dome being made of one piece, three operations on the press being sufficient to bring it to its perfect form. The riveting machines were also marvels of dexterity, the entire boiler, temporarily bolted together, being raised or lowered vertically, to engage the batteries of riveters. The welding of firebox seams proceeded, and coincidentally, combustion chambers, dispensing with the use of rivets. Presently the engine was on its wheels, and the high spots were all brought into the glare of the electric light, revealing the entire series of operations, in half an hour, what in real practice takes at least a week. In brief, a visit to the Baldwin Locomotive Works would be little else than a waste of time. Mr. Ehle's moving panorama presents every operation in such minute detail, and at the same time with such a saving of effort on the part of the spectator that it surely would be a great educational feature if it could be made popular and take the place of the debilitating balderdash seen in the average "movies" that is nothing but a prostitution of a marvelous invention.

The last reel shows a number of interesting miscellaneous views. These include the packing of a small Baldwin internal combustion locomotive for foreign shipment; the weighing of a heavy Santa Fe type locomotive on individual scales placed under each wheel; and pictures of a high-powered electric passenger locomotive, surrounded by a group of steam locomotives. The final views represent the seven- and fourteen-inch gun-mounts built for the United States Navy during the war period. The seven-inch mount is of the caterpillar type, with broad treads designed so that it can be hauled over rough roads and soft soil. These guns are transported in service by means of tractors of 120 horse-power. The fourteen inch mount is of the improved railway type, running on forty wheels and carrying a 50 calibre naval gun. This weapon can be elevated at angles up to forty-three degrees and has a maximum range of about thirty miles. The mount shown is an improvement of those built by the Baldwin Locomotive Works early in 1918, five of which latter were sent abroad where they were successfully used against the German lines of communication previous to the signing of the armistice. With these earlier mounts it was necessary to transfer the weight of the gun to a pit foundation when firing at angles of more than fifteen degrees; but the new mount, shown in the picture, is designed so that the gun can be elevated and fired at all angles up to the aforesaid forty-three degrees without transferring the weight from the supporting trucks.

Swedish Railways Adopt Disk Bearings

The Swedish State recently placed an order for car axles, bearing boxes of cast iron with disk bearing stamped cylinders and nuts, and this order will be the forerunner of others. It is expected that disk bearings will soon come into general use upon Swedish railways. It is stated that extensive trials were conducted between Stockholm and Goteborg before it was decided to adopt these bearings.

Railway Extensions in Italy

The new railway line direct between Rome and Naples, when completed will make possible a reduction from 5 to 2½ hours for the running time between these two cities. Over twenty miles between Rome and Carano are already completed and equipped with a single track on which service is now being maintained. The roadbed is completed for over 60 miles. Efforts are made to complete the work, as soon as possible.

Railway Improvements in Siberia

The Chinese Eastern Railway has been making considerable improvements in service and the company expects to run electric-lighted trains, with dining cars, between Harbin and Vladivostok, and after this line is running smoothly the service between Harbin and Manchuli will be improved. The belief is expressed that conditions in Siberia are more stabilized and that the resumption of trade relations will come soon.

New Bridge Over the Colorado River

At the bottom of the Grand Canyon of the Colorado—nearly 5,000 feet below the rim at El Tovar—the United States, through the National Park Service, is now building a suspension bridge across the Colorado River. It will be the only bridge crossing of that river above Needles, Cal., which is more than 500 miles below where the Grand and the Green join to form the Colorado.

Construction of Railway Rolling Stock in Austria

It is officially reported that the four locomotive works in Austria have a production capacity of 400 engines and tenders annually. During 1920, however, they have been able to deliver only half of this amount, on account of shortage of coal and iron. They now have orders for 76 locomotives, 700 cars, numerous repairs, and special rolling stock and machines. By these orders, together with export obligations, they are provided with work for the next few months, so that on the whole the locomotive works and car shops of Austria are running on a basis of some profit.

Domestic Exports from the United States, by Countries, During December, 1920

Steam Locomotives

Countries—	Number	Dollars
Canada	8	121,046
Honduras	1	3,525
Salvador	3	61,550
Mexico	4	33,000
Jamaica	1	14,350
Cuba	52	1,642,160
Argentina	7	297,500
Brazil	46	1,593,023
Chile	1	10,000
Colombia	1	2,000
China	6	383,024
Dutch East Indies	4	19,000
Japan	5	33,500
New Zealand	1	11,000
Philippine Islands	2	14,900
Egypt	12	507,329
Total	154	4,746,907

Case Hardening by Dipping.

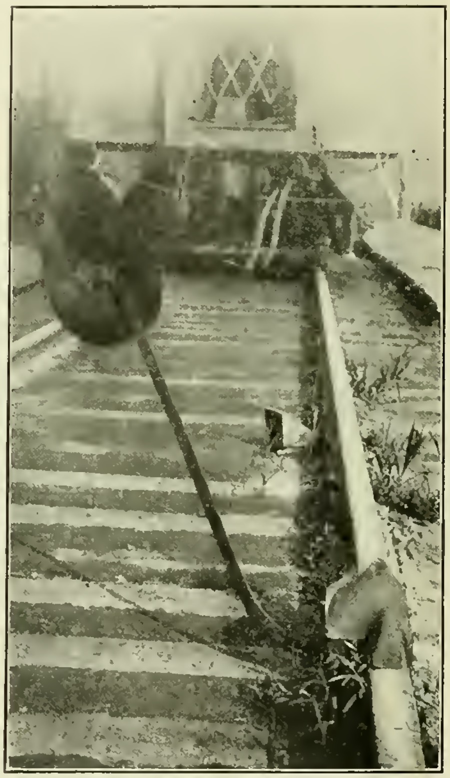
Our enterprising and reliable contemporary, *The Practical Engineer* of London England, furnishes many useful hints in mechanical appliances and methods of treatment, and as an example we quote a short article on the above subject: "When only a thin casing of hard metal is wanted on a long or otherwise awkward piece of iron or steel, the usual practice of pack-hardening proves rather a difficult proposition, and some other method becomes desirable. For this reason it is often thought advisable to use a dipping process, the dip most usually being dependent on potassium cyanide for its efficiency. Very often the dip consists of 1 lb. potassium cyanide dissolved in each gallon of clean rainwater, but at times a dip of 2 lb. potassium ferro-cyanide and 4 oz. common salt to the gallon of water is used, both being effective for the purpose intended. Most hardeners have their own favored dips, however, and some of these are so wonderfully compounded that it is difficult to understand why they have any appreciable effect on account of the neutralization of so many of their constituents. Anyhow, the two given above are as effective and simple as any. In working, the finished article is heated to a bright red—from 750 deg. to 850 deg. Cent.—in a non-oxidizing flame or furnace, and are plunged directly into the dip and swung around in it until black, and are again reheated and dipped, this being repeated until it is considered that the casing is thick enough; after the last heating the article being quenched right out in the dip. The casing produced, although probably not more than one-sixty-fourth of an inch in thickness, is usually very hard, and is very durable when run in properly lubricated anti-friction metal bearings, but it usually has the defect of being plentifully charged with hair-like cracks which, under some conditions of working, would be likely to cause some amount of trouble. Owing to these cracks it is more often desirable to use pack-hardening in cases where the furnace permits of flasks of sufficient size being dealt with. It is almost needless to point out that the cyanide dips are extremely poisonous, that the fumes should not be inhaled, and that the solution shall not touch cuts or sores, or the poison will be absorbed with dangerous results."

Railway Projects in Spain

The Spanish Northern Railway will buy at an early date, through the Spanish Government, machinery and equipment for the electrification of a part of its lines. Contracts are also being made for a new railway from Loria to Castejon. Locomotives and cars will be purchased for the new road this year, and it is stated that estimates are expected to be favorably received from American manufacturers.

The Derailing Flag on the Virginian Railroad

Reference has already been made in our pages to the introduction of a combination blue flag and derail in use on the Virginian Railroad. Flags of other types are not always heeded as they should be. In this new type of flag, when properly placed, there has been no instance in which it has been disregarded. As shown in the accompanying illustration it consists of a simply constructed and light derailing frog which is adapted to be placed securely in position on the rail, and attached to which is a light rod projecting at a rising angle towards the center of the track, and to which is attached a metal disk of considerable size painted blue, and readily seen at a considerable distance. It is generally placed at a distance of about forty feet from the car it is intended to protect, so that even a rapidly moving car or engine would be stopped on the ties before reaching the car protected.



VIRGINIA RAILROAD BLUE FLAG AND DERAIL

In the case of the derailing device and flag described and illustrated, the derailing appliance, consisting of a movable metal piece, is so shaped that when placed over the rail, it will lift and guide the wheel flange over the rail to the outside of the track. As is well known the blue flag denotes that car inspectors are at work under or about the train or car and that it cannot be moved or coupled to until the blue signal is removed by the car inspectors. In the night time lanterns, with colored glass globes are used instead of flags, and the colored light has the same meaning as the colored flag.

First Railroad Built

Harlon R. Hoyt, an eminent authority in the history of railroads states that for the transportation of the granite of which Bunker Hill monument was to be built, a railway was completed at Quincy, Mass., in 1827, by Gridley Bryant and T. H. Perkins. It was operated by horse power. This was the first railway in the United States.

Bryant is accredited with the invention of the switch, as well as of the first eight-wheeled car. The wooden rails of the track were reinforced with an iron plating to make them more durable.

However, the first steam locomotive to be made in America had been constructed in 1797 by A. Kingley, who tried it out upon the streets of Hartford, Conn. The first railway charter was granted in 1825 to the Mohawk & Hudson Co., New York City, but through lack of funds, the company could not undertake construction. Hon. Charles Carroll of Carrollton, the last surviving signer of the Declaration of Independence, laid the cornerstone of the Baltimore & Ohio railroad on July 4, 1828, a road intended for horse cars only.

The first locomotive trip on a railway which was made in America was effected with an English-made engine. The trip was made by Horatio Allan, a New York engineer, over the Carbondale & Honesdale railroad, which ran from the Lackawaxen canal to the Lackawanna river, to afford coal transportation from Luzerne County, Pa.

The first railroad locomotive of American manufacture to be successfully used was run on the South Carolina railroad, the first road constructed in this country for the exclusive use of locomotives. That was an engine known as "The Best Friend," afterwards rechristened "The Phoenix," designed by E. L. Miller of Charleston, and built by the West Point Foundry on the Hudson. It ran successfully for two years, when it was destroyed by an explosion. Its first trip was made on Dec. 9, 1830.

During the same year, Peter Cooper built an engine at his iron works at Canton, Md. It was christened the "Tom Thumb" and tried out on the Baltimore & Ohio railroad. While it was theoretically practical, it was found to be too small for general service and was soon abandoned.

Proposed New Railway for Northern Manitoba

The proposal for the construction of a railway in northern Manitoba is one of the important questions to come before the provincial legislature at its present session. The line, if constructed, would open up a large mineral district, as well as give access to the Flin Flon copper mine, its objective. Authority for the survey for the railway, at an approximate cost of $15,000, has been made.

Track Scales

The Bureau of Standards has been conducting investigations in regard to the accuracy of railroad track scales. For this purpose there have been three equipments in operation, particularly adapted to weighing material in carload lots Some of the scales tested are used exclusively for coal and some for coal and other commodities also. The bureau with its limited equipment, tests all the scales possible each year, and up to the present time has tested some 3,000 scales, these being located in every State of the United States; but, without very voluminous reports, it would be impossible to tell the condition of scales tested except in a general way. About 40 per cent. of all the railroad and industrial scales tested so far have been found to be within the tolerance fixed by the bureau—which is practically the same tolerance as is fixed by the American Railroad Association—and about 60 per cent. of the scales have been outside of that tolerance. The tolerance is 200 pounds on 100,000 pounds, or two-tenths of 1 per cent. All scales tested by bureau equipment on some railroads have been found inaccurate. On one or two roads all scales tested by the bureau equipments have been found accurate. The other roads necessarily lie in between. Some scales are usually accurate and some are usually inaccurate. Quite often the inaccuracies have amounted to six or seven or eight thousand pounds, or even more. Instances of gross inaccuracies, such inaccuracies that the indication of the scale could not be depended upon in any way at all as an indication of weight, have been found in the investigation. In many cases weights which are determined to fix the amount of freight charges are by agreement between buyer and seller, also used in disposing of the goods. In justice to the railroads it can be said that they do not accept the responsibility for weights used in that way.

Railroads and Transportation

January railroad traffic in the entire country, as measured by car loadings, was the smallest of any month since February, 1919, not even excluding the strike month of 1920 when the movement of freight was considerably below any other month in that year. The total number of cars loaded with revenue freight in the month of January was 15 per cent below the loadings in December and more than 23 per cent. below January, 1920. Car loadings for all the railroads showed a further, although slight, reduction in the first week in February.

The movement of freight on the railroads having terminals at New York City increased somewhat during the first half of Fabruary. One railroad, the freight traffic of which is usually a good index of the general situation, reported that its car loadings in the first fifteen days of the month were 8 per cent above the loadings in the last 15 days of January. This is probably slightly greater than the normal seasonal increase in traffic.

This increase resulted chiefly from the larger shipments of miscellaneous freight, mainly manufactured goods, a class of freight which had shown the greatest decline during the previous three months. A larger movement of automobile supplies, parts and equipment, toward Detroit is a factor in increased westbound traffic. There has also been a gain in recent weeks in the loadings of coal.

Fire Losses by Locomotive Sparks

It is reported by the Mutual Fire Prevention Bureau that the fire losses in 1919 of 75 railroads, analyzed by origin classification show that out of a total of 9,194 fires, 3,080 were caused by sparks from locomotives. The Bureau claims that locomotives sparks are largely preventable.

In the meantime mill and elevator owners having property adjacent to the railroad right of way should give particular attention to making their plants proof against sparks. The old shingle roof is fast disappearing along the railroads. Weeds and grass should not be permitted to grow close to frame buildings, windows that are to be left open should be carefully screened, and broken windows quickly replaced, loose iron cladding and broken siding repaired, litter not allowed to accumulate, and car doors should be piled at a safe distance from the building. Birds' nests in eaves and cornices cause many locomotive spark fires.

Lettering and Marking of Freight Equipment Cars.

The Secretaries of the Mechanical Division of the American Railway Association desire again to impress upon all owners of cars operating in interchange the importance of preserving the identity of such cars by maintaining distinct initials and numbers, in order to avoid the numerous errors resulting from indistinct marks. Also, in many cases, one or more figures of the car number or portions of the initials have been omitted when making repairs; in other cases, incorrect numbers or initials have been applied in restencilling the car.

It is urged that all railroads and private car owners proceed at once to restencil or brighten the initials and numbers on cars requiring such attention in order that the desired improvement may be accomplished as early as possible. Charge for restencilling cars to preserve identity may be made against the owners, except as otherwise provided in the Rules of Interchange. See Item 190, Rule 101 and Rule 102.

Under Rule 17, Section A, it is permissible to substitute the standard of the Association for lettering and marking cars in lieu of the standard of the car owner, except that the reporting marks assigned by the Transportation Division to be placed between horizontal bars will not be used unless they have been adopted by the car owner. With reference to the proposition of marking freight equipment cars to show load limit in lieu of nominal capacity, it has been decided that no action will be taken at this time to require load limit marking on cars. Therefore, it will be proper to stencil new cars, as well as existing cars, in accordance with the present standards of the Association as shown on A. R. A. Sheet 26, which provide for nominal capacity markings.

Employes Must Heed Safety Laws

The Industrial Commission of Wisconsin proposes to deal vigorously with violators of the safety laws. In 1920 increased compensation was recommended in nearly 30 per cent of the accident cases investigated by the Industrial Commission, according to announcement by E. E. Witte, commission secretary. There were 2,616 accidents investigated to determine whether or not employes or their dependents were entitled to increased compensation. In 757 cases reports of investigators indicated that accidents were due to violations of the safety laws. Systematic investigations of accidents to determine whether they were due to violations of the safety laws have been made by the industrial commission only during the last year. All reports upon accidents are now investigated by the safety and sanitation department of the commission as soon as they are received. If there is any question about the accident which suggests that it might have been due to a violation of law, the case is investigated by a field deputy.

Standardization of Insulated Wires and Cables

At the instance of the American Railway Association a conference was called by the American Standards Committee to consider the standardization of insulated wires and cables. The conference was held in New York on February 2, and was attended by representatives of fourteen national organizations. It was unanimously decided that "the unification of specifications for wires and cable for other than telephone and telegraph use should be undertaken under one general plan, covering all the important uses." It was deemed desirable to have all the American wire and cable standards assembled in a single book, as has already been done by some European organizations with general approval.

Selection and Use of Grinding Wheels

The grinding wheel is a modern machine-shop tool. It is nothing more than an aggregation of sharp abrasive particles held together by some suitable matrix in a homogeneous mass, usually in the form of a disc. When revolved rapidly, the particles on the periphery penetrate the surface of the work held against it and cut off chips, which when produced by a properly selected wheel, should be similar to those obtained by a lathe tool, well formed but much smaller. The millions of cutting teeth, as they remove the chips, must themselves wear away the attrition, and if they are to be efficient, must keep sharp. The bond in an ideal wheel should wear away with the same rapidity as the grain particles.

There is a great difference in chips cut respectively by properly and improperly selected wheels. In the one case the chips are well defined, with sharp contours, while in the other they are in many cases globular and irregular, indicating clearly the influence of great heat with consequent burning and loss of power.

Four principal factors establish the characteristics of grinding wheels:

1. Abrasive (aluminous or silicon carbide).
2. Bond (kind and process).
3. Grain (size of abrasive particles).
4. Grade (hardness or holding power of bond).

For the correct selection of a wheel the character of the work must be analyzed and the following factors considered:

1. Mounting (rigid or light).
2. Speed (surface feet per minute).
3. Contact (sharp, medium or broad).
4. Kind of material (steel and iron, hard or soft, alloy, non-metallic).
5. Kind of finish required.

Types of Machines

The mounting of a grinding wheel has an important influence on the selection of grain and grade. As a general rule the more rigidly a wheel is supported so that it revolves in as nearly a true circle and plane as is mechanically possible, the softer the grade may be. Conversely, to overcome the disintegrating shocks to which a weak and wobbly wheel is subjected, demands a harder wheel.

Considered broadly, grinding is of two kinds; hand and precision. The former includes all sorts of rough grinding on castings or other parts where the quick removal of metal is the primary object and precision is not required. It also includes certain kinds of tool grinding which depend on the skill of the operator, but in this class of work it is usually confined to the rougher tools for lathes, planers and similar machines.

Three types of machines are employed, floor and bench stands, swing frame and flexible shaft machines. The floor stand, being the most rigid of these types, may be fitted for some operations with comparatively soft wheels. For various kinds of tool grinding or light general work, medium grades are employed, while for heavy castings such as journal boxes and for very sharp work, hard grades are necessary.

Swing frame machines are subject to much vibration, due to their usually light construction and to the manner of application. Their wheels are given much abuse, for they are brought down upon the casting with great force. Vibrations, transmitted as a rapidly intermittent series of shocks at the wheel face, exercise a destructive influence on the structure. Unless grain particles are firmly held, they may be split off before they have performed their measure of work, and consequently harder grades must be selected.

The flexible shaft machine is not much used, but finds application where the parts to be ground are clumsy and have corners or recesses that can be reached only by a wheel so mounted that it can be presented to the work at the will of the operator. Bath tubs, sinks, certain railway castings and similar work are ground in this manner. With little to support the wheel and only the hand of the operator to guide and steady it, it is compelled to overcome the shocks resulting from the many irregularities of surface, and therefore needs to be of hard grade.

Precision grinding machines, as their name implies, are designed to do fine work; but while removing material, they are intended to bring the work to size accurately and quickly. They are of many kinds, for cylindrical, surface and internal grinding, and in every case the designers, recognizing the need of a wheel rotating in a true circle and plane, have put weight as well as fine machine work into the operating mechanism, so that rotating parts may run as free from vibration as possible. Naturally, with liberal spindle bearings, perfect lubrication and accurate sleeves or collars, the vibration-absorbing parts permit of the use of wheels as soft as other factors in the operation may dictate.

Steel Sleepers Compared with Wood

Some notes on this subject are contributed in the columns of the *Ingegneria Italiana* by Mr. F. Bondolfi. He points out that in the industrial zone in Germany in the Essen, Cologne, and Elberfeld section, steel sleepers have been largely employed, not on account of their relative cheapness, but more particularly owing to their greater strength and reliability compared with wooden sleepers. In Switzerland, also, steel sleepers are largely used. On the Baden Railway 2,508 km. are of steel, and only 32 km. of wood, and these latter were necessary for use in a tunnel. Those who favor wood fall into an error by introducing into their calculations the value recovered after use, but this only realizes at a very much deferred date.

Strap-hanging Abolished in London

The heads of departments in the subways in New York and elsewhere in America might well take a lesson from the Metropolitan Railway in London, England. Strap-hanging is a thing of the past; overhead and horizontal rods are provided on to which standing passengers can hold. Seats have been improved both in comfort and appearance, the very prevalent rattan upholstery having given place to pegamoid. We may point out finally that the increase by a large percentage of the number of cars in use means longer trains and less crowded trains during the rush hours, as well as a greater carrying capacity for the railways. In some cases at least the trains during the busy hours are now as long as the station platforms will permit. The most clamant reform now is the promised enlargement of the tunnels of the City and South London Railway. These tunnels are smaller than those of any of the other lines, and their "stretching" is needed so that more roomy cars can be provided. The work, however, means a good deal of expense, and times are not favorable for raising additional capital. Still, the companies concerned regard the matter as urgent, and the work is likely to be taken in hand as soon as possible. But for the war it would probably have been finished by this time. As it is, much real progress is being made, particularly in the underground service where the requirements are growing in unexpected magnitude.

A Franco-British Asiatic Railway

It is reported that movement is on foot in circles closely connected with the French Colonies in Further India to promote the construction of a railway which will connect up the British and French possessions and spheres of influence in that quarter of the globe, and also bring them into direct railway connection with Europe. The line would traverse Siam, Burmah, India and Persia, link up with the Baghdad Railway, and thus be joined up to the European systems. Further, a competing line is intended to be laid through Syria to ensure sea communication via the Mediterranean with France and England. The promoters consider that the general business, political and military interests, that this great line would serve could not fail to bind the two countries in closer union.

Automobile Accidents

It is officially reported that the actual number of accidents caused by automobiles in recent years is greater than that of railway accidents. Referring to exact data for the year 1919 it is stated that: "Automobile accidents in the United States claimed 1,474 more victims in 1919 than were killed in accidents on American railways. Deaths from automobile accidents showed a total of 7,969 for the Census Bureau's registration area, comprising about 80 per cent of the country's total population. In 66 of the large cities there were 3,808. In railway accidents, the Interstate Commerce Commission reports 6,495 killed (less than for any previous year since 1898). This included 2,553 trespassers and 1,882 other persons, not either passengers or employes, of whom a large percentage were the victims of collisions between automobiles and railway trains."

The Compound Locomotive

A writer in a contemporary engineering publication states that slowly but surely the superheater is crowding the compound engines out. The latest report of such comes from the Minneapolis, St. Paul and Sault Sainte Marie Railroad, where a number of compound engines of the consolidation type were recently converted into simple, superheater engines.

A comparison in the performance of these engines as compounded and superheated developed the fact that the latter used ten per cent. less fuel, although the water evaporation per pound of coal was in favor of the compound engine.

This fact brings us to an interesting problem as to how, if that were true, the superheater could show greater fuel economy than the other, as there is a loss of evaporative efficiency in the boiler of the superheater engine, due to the reduced heating or flue surface resulting from replacing the many smaller upper flues by the larger superheater tubes, but that loss is more than overcome by the more economical use of the superheated steam at the high cylinder temperature possible to maintain by superheating.

No one will regret the passing of the compound engine, for of all the various types with which the engineer has had to contend, in our day, the compound was easily the worst, and our interest in their passing is all the greater when their going furnishes so good a lesson in the steam economy resulting from superheating.

Metal Culverts

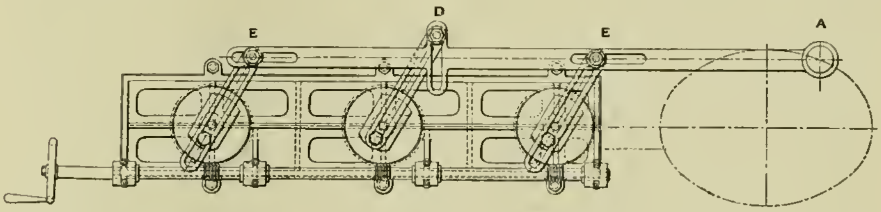
Hon. A. J. McLean, minister of public works, Alberta, Canada, says that special attention has been given to the question of the type of culverts to be used in road construction in Alberta, and it was decided that the most satisfactory results in that province had been secured from the use of corrugated metal culverts, and it was considered that these culverts are better suited to conditions encountered in Alberta than concrete or wooden culverts. Metal culverts will therefore be the standard adopted by the department in the future, with 18 in. as the minimum size.

Ellipsograph for Manhole Cutting

We are indebted to *Engineering* for an illustration of a very clever arrangement of ellipsograph designed to draw and cut an elliptical manhole in boiler sheets. The principle of operation is so simple that it is strange that it has not been developed before.

The special work that the apparatus is intended to perform is the cutting of holes in boiler plate, which is accomplished by attaching an oxy-acetylene torch to the end of the bar at A.

The bar is supported by pins at the ends of the cranks E, which work in the slots as indicated. It will be seen that if the two cranks B are turned in unison the bar will be held parallel to itself provided its



DETAILS OF ELLIPSOGRAPH FOR MANHOLE CUTTING

motion to the right and left is so controlled that the pins of E occupy the same relative positions in their respective slots at all times. This is accomplished by the pin at the end of the crank D which works in a vertical slot in the bar. As the three pins move to and fro in their slots the result of their action is the same as that of a crank pin working in a scotch yoke where the effect of the angularity of the connecting rod is entirely done away with. As the angular motion of the three cranks is the same the effect is that the two at the ends give the bar an up and down motion and hold it parallel to itself, while the lateral or horizontal motion is imparted by the crank D.

If all three of the cranks, E. D. E, are of the same length it is evident that the path of motion of the bar will be a circle. To give it an elliptical motion the length of the crank D is made equal to one-half the major axis of the ellipse which it is desired to draw, and those of the cranks E E equal to one-half the minor axis. Though, of course, a reversal of this would accomplish the same result except that the major axis would then be vertical instead of horizontal. The device was designed by Mr. J. McNeil, of Glasgow, Scotland, and is in successful operation.

Railroad Engineering Practice Adopted

With these changes in required loads coming so rapidly, it is not surprising that it soon became standard practice to provide for 15-ton concentrated loads on concrete floors. These sudden and drastic changes in practice gave rise to sharp advances in demands on the public purse, and consequently higher tax rates. It is not surprising, therefore, to find municipal councils, while demanding the best, really encouraging the cheapest in an effort to keep down what had hitherto seemed reasonable prices.

About this time highway engineers had adopted railroad engineering practice, which had recognized that the necessity for replacement of the early pin-connected structures was not due to their inability to carry loads in excess of those for which they were designed, but to their being literally shaken to pieces, owing to the insufficiency of the lateral bracing and general looseness and weakness of all details. In conformity, therefore, with railroad practice, the pin-connected type was discontinued in all new highway structures, and this—together with proper attention being given to bracing and floor connections—has resulted in much superior and more durable results.

In 1911 new up-to-date specifications were introduced by this Department demanding details of construction equal to the best railroad practice. At the same time legislation was introduced requiring all bridges to be built to these specifications. This has resulted in plans for several hundred bridges being submitted to this department for review and approval.

Cost of Electrification

In answer to many enquiries in regard to the cost of railroad, it is stated on reliable authority that the electrificaion of the Chicago, Milwaukee & St. Paul, extending to 440 miles, cost nearly $13,000,000. This includes the cost of 42 freight and passenger locomotives and also two switching locomotives. The heavier locomotives cost about $130,000 each, and they take the place of 112 steam locomotives, costing nearly the same as the electric locomotives. It need hardly be added that the costs of new equipment and repairs at the present time cost much more, the increase during the war time being about 50 per cent.

The Creeping of Rails

J. A. L. Waddell, D. E. county engineer, New York, was commissioned to investigate and report on the phenomenon of the creeping of railway rails, and reported recently that the primary cause of the fundamental trouble is traffic; because, when a stretch of track is absolutely idle, there is no creeping on it whatsoever. It is true that other influences, such as temperature changes and weather conditions, aggravate the difficulty, but, alone, they are powerless to cause it. Wave action of rails and ties in front of the passing wheels pushes the rails ahead, and if they are firmly spiked to the ties, the latter move forward, carrying the ballast with them. Again, the traction of the locomotive drivers and the friction of all braked wheels tend to impart a longitudinal motion to the rails. Long cars and widely spaced axles and trucks augment materially the amount of creeping, as does also unbalanced traffic; but these are unfavorable conditions that may very properly be termed unavoidable. The principal avoidable ones, however, are yielding roadbed, lack of thorough drainage, soft or decaying ties, unequal spacing of ties, badly adjusted super elevation of outer rails on curves, rails too light for the traffic, inefficient or badly maintained rail joints, either scant or excessive provision for rail expansion, inadequate or defectively maintained gauge, poor or insufficient ballast, and improper use of train brakes. If the avoidable evils thus listed were effectively corrected, a large proportion of the trouble experienced from creeping track would no longer exist.

Rail creeping increases with the amount of traffic, although not necessarily in direct ratio; is greater on down grade than on up grade; on a single track line is larger in the direction of the preponderance of traffic; in general, is of like amount on tangent and on curve; is often quite different on the opposite rails of a track; is of more serious import on light rails than on heavy ones; is less with firm roadbed than with soft; decreases with improvement in quality of ballast and with augmentation of its depth; varies with changes of temperature, season of year, and weather conditions; is reduced by improving the character of rail splicing; is not materially affected by the use or nonuse of tie plates; enlarges with the spacing of wheels and trucks; and augments with the speed of trains and with the weights of locomotives and loaded cars.

The longitudinal forces in track developed by creeping, and the horizontal pull between rail anchors and rails is a question to be settled by experiments and not by mathematics. With all due deference to mathematicians in general and to professors of engineering in particular, it can be stated that the question of rail creeping is not one which will properly lend itself to the manipulation of equations based on hypothetical assumptions, because the governing conditions in respect to wave action of rails and track under traffic are far too varied, complicated and uncertain, to warrant any attempt to investigate the subject mathematically. A few valuable experiments have been made to determine the longitudinal thrust of track from creeping, but the results thereof require confirmation by an elaborate series of tests before being accepted as standard or final by railway men. The inauguration and carrying out of such a series of experiments is naturally the function of the American Railway Engineering Association, which has already done so much to improve the science and art of railway construction in America; and the writer hopes that that organization will soon undertake such a series of tests as will settle this question with sufficient accuracy for all practical purposes.

Rail anchors, or anti-creepers, may be divided into two general classes, viz., those which attach to the ties and those which are buried in the ballast. The former type is often effective when the track conditions are first class, but usually fail when they are not, and in that case the second type should be used. To be really effective, however, the latter should extend into the ballast well below the elevation of the bottoms of the ties, because otherwise they would move along with the ballast between the ties, which ballast, of necessity, travels with the track. The writer recognizes that, in some cases, the use of such ballast anchors might involve questions of electrolysis of serious import, but believes that these can be satisfactorily solved by proper design, supplemented by experiment. The writer is of the opinion that, in cases of excessive creeping on soft roadbed and ineffectively ballasted track, the best solution of the problem would be the placing of deadmen, of either reinforced concrete or creosoted timbers, in the embankment well below formation level, and connecting both rails thereto by strong, adjustable rods running upward between ties at an angle of about 45° to the vertical. If the creeping tendency is always in one direction, one such rod per anchored rail would suffice; but if it is in both directions, two of them would be necessary. How far apart the deadmen should be would depend altogether on the tendency of the track to creep. Two or three on each stretch of moving track might first be tried; and if they should prove to be inadequate, more could be added at any time. It is submitted that this method of preventing creeping ought to be much less expensive than making the track truly first class. The details of the suggested anchorage cannot well be evolved before the creeping is determined.

Instead of the suggested deadman, there could be substituted a pair of fairly long 12 x 12 in. creosoted piles, driven just outside the rails, with their tops at the elevation of the base of the rail, and two 8 x 12 or 10 x 12 in. ties laid flat, spiked or bolted tight against them, with several pairs of short blocks or spacers between adjacent ties directly under the rails on each side of the pair of piles. Then, if a type of anti-creeper were evolved, which would grip the rail so effectively that it could not slip through, and if several of these anti-creepers were used for each rail and were attached to the ties, a combination would be effected that would absolutely prevent all creeping, unless the thrust were great enough either to snap off the piles or to tip them out of plumb by compressing the earth and moving the ballast near their tops. It is, of course, possible that the thrust would be great enough to effect one of these results; but, if so, the remedy evidently would be to put in more pairs of piles with their adjacent short spacer blocks.

In respect to the prevention of rail creeping on important bridges, the writer's practice is to fasten the rails firmly to the deck at the middle of each span and let them slide on tie plates out to the ends thereof, where a break in the track over each pier is provided.

Finally, the writer desires to state in relation to rail creeping what he said 40 years ago in a paper entitled "Railroad Drainage," viz., that the effective drainage of both roadbed and right of way is the main essential in good railway engineering practice.

Good Record on the Pennsylvania

During the month of January, passenger train performance on the Eastern Region of the Pennsylvania Railroad broke all records since the Pennsylvania resumed the management of its property last March. In this month, 81,713 passenger trains were operated in this region. Of the total trains run 91.7 per cent arrived at destination on time and 95.8 per cent made schedule time.

In comparison with January last year not only were more passenger trains operated in the same month this year, but the number arriving on time and making schedule time shows a marked improvement over a year ago. In January last year only 77 per cent of the trains operated on the divisions now making up the Eastern Region were on time and 87.4 per cent of them made schedule time.

All of the eighteen divisions included in the Eastern Region report an improvement this year in the movement of passenger trains. In every division more than 90 per cent of the trains operated made schedule time in January and in all but four of the divisions 90 per cent.

Items of Personal Interest

Charles White has been appointed general foreman on the Santa Fe, with office at Newton, Kan.

Lee Stanford has been appointed roundhouse foreman on the Santa Fe, with office at Gallup, N. M.

J. W. Gibbons, Jr., has been appointed roundhouse foreman on the Union Pacific, with office at Marysville, Kan.

W. D. Deveny has been appointed shop superintendent on the Sante Fe, with office at Topeka, Kan., succeeding N. J. Dury.

F. L. Holt, general foreman of the Missouri Pacific at Wichita, Kan., has been appointed master mechanic on the same road, with office at Staten, Mo.

O. J. Greenwell has been appointed master car repairer on the Tucson division of the Southern Pacific, with office at Tucson, Ariz.

A. S. Abbott, mechanical superintendent of the Miami Mineral Belt and the Oklahoma Southwestern, has removed his headquarters from Miami to Oklahoma City, Okla.

C. J. Sevier has been appointed assistant to the superintendent of maintenance of equipment of the Western Maryland, with headquarters at Hagerstown, Md.

H. N. Salmon, Jr., has been appointed acting fuel agent on the Missouri Pacific, with headquarters at St. Louis, Mo., succeeding W. P. Hawkins.

O. J. Greenwell has been appointed master car repairer on the Tucson division of the Southern Pacific, with headquarters at Tucson, Ariz., succeeding A. G. Sanders.

H. M. Allen, locomotive fireman on the Canadian Pacific, with headquarters at Alyth, Alta., has been appointed master mechanic on the Kenora division, with headquarters at Kenora, Ont.

John E. Garretson, general foreman on the Chesapeake & Ohio, with office at Winton, W. V., has been transferred to a similar position at Winton, W. Va.

A. J. Krueger, shop inspector of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, has been appointed master car builder, with headquarters at Cleveland, succeeding R. W. Miller, deceased.

H. A. Amy, locomotive foreman on the Canadian Pacific, with headquarters at North Bay, Ont., has been appointed master mechanic, with headquarters at Ottawa, Ont., and E. G. Freeman, locomotive foreman at Cartier, Ont., succeeds Mr. Amy.

Alba B. Johnson, formerly president of the Baldwin Locomotive Works, has resigned from the board of directors of that company, and also as a director of the Standard Steel Works, Philadelphia, and John M. Hanson, president of the Standard Car Company, Pittsburgh, has been elected a director and member of the executive committee of the Baldwin Locomotive Works, and W. L. Austin, vice-chairman of the board of directors of the Baldwin Locomotive Works, has been elected a director of the Standard Steel Works, succeeding Mr. Johnson.

John L. Bacon has been appointed manager of service and inspection department of the Franklin Railway Supply Company, with headquarters at New York.

H. D. Lyon, inspector of the Bureau of Safety of the Interstate Commerce Commission, has been appointed senior railway signal engineer of the bureau, and is at present engaged in the development of automatic train control.

G. S. Goodwin, corporation mechanical engineer of the Chicago, Rock Island and Pacific, has been appointed mechanical engineer of that system, with headquarters at Chicago, Ill.

O. C. Cromwell has been appointed assistant to the chief of motive power and equipment of the Baltimore and Ohio, with headquarters at Baltimore, Md.

G. E. McGann has been appointed master mechanic of the Pittsburgh division of the Baltimore and Ohio, with headquarters at Glenwood, Pa., succeeding W. C. Burel, resigned.

J. E. Gould, master mechanic of the Charlotte Harbor and Northern, with headquarters at Arcadia, Fla., has been appointed master mechanic of the Cumberland and Manchester, with headquarters at Barbourville, Ky., and F. S. Markett succeeds Mr. Gould at Arcadia.

G. W. Ray, master mechanic on the Western division of the Chicago and Alton, with headquarters at Slater, Mo., has been transferred to the Northern and Southern divisions, with headquarters at Bloomington, Ill., and F. Stone succeeds Mr. Ray.

W. J. Tollerton, general mechanical superintendent of the Chicago, Rock Island and Pacific, and chairman of the mechanical division of the American Railway Association, has been appointed to report on passenger carriages to the International Railway Congress to be held at Rome, Italy, in April, 1922.

Nathan L. Miller, Governor of New York, has submitted to the State Legislature propositions aiming at a reorganization of the Public Service Commission, with a view to provide for the relief of the subway and elevated lines of New York City. Under the present condition it is claimed that the bankruptcy of the roads is inevitable.

Samuel J. Hungerford, assistant vice-president af the Canadian National Railways, has been appointed vice-president in charge of operation and maintenance. Mr. Hungerford has progressed rapidly from the time he entered the Farnham shop, Quebec, as a machinist-apprentice, to the vice-presidency of one of the world's greatest railway systems.

N. H. Ogborn has been elected president and general manager of the Dayton, Toledo & Chicago, with headquarters at Dayton, Ohio, succeeding John Ringling. J. H. Lane has been elected secretary, with headquarters also at Dayton.

Samuel D. Sleeth, superintendent of the foundry of the Westinghouse Air Brake Company, Wilmerding, Pa., has been granted a three months' leave of absence, and is already on a tour to Europe. Mr. Sleeth is credited with the introduction of what is known as the continuous pouring system for foundries, which was first installed in the foundry of the Westinghouse Air Brake Company. Mr. Sleeth is also credited with the record for over fifty years' continuous service with the company.

Laurence W. Wallace was elected secretary of the American Engineering Council at the meeting of the Executive Board held in Syracuse, N. Y., last month. Mr. Wallace is well known as an author of technical works. This volume on "Car Design" is used as a text-book as well as generally by designers. He has also written instruction books for railway educational departments, and papers on engineering and management topics before railway and management societies. Mr. Wallace is a member of the American Society of Mechanical Engineers, the International Railway Fuel Association, Master Car Builders and other associations. The Engineering Council has established permanent national headquarters in the McLachland Building, Washington, D. C., where Mr. Wallace will have his office.

William F. Cutter, president of the Southern Wheel Company, St. Louis, Mo., has been elected vice-president of the American Brake Shoe & Foundry Company, with headquarters at New York, and William B. Given, Jr., assistant vice-president, has also been elected a vice-president.

Harry M. Evans, eastern sales manager of the Franklin Railway Supply Company, New York, has been elected vice-president of the company, with offices at 30 Church street, New York. Mr. Evans has had over twelve years' experience in the sales department of the company, previous to which he had filled various positions on the Erie railroad, chiefly in the mechanical department.

A. T. Kuehner, mechanical engineer on the Baltimore & Ohio, has been appointed mechanical engineer of the Standard Stoker Company. Mr. Kuehner is the inventor of the Keener journal box for locomotive drivers and trucks, which is being manufactured and placed on the market by the Standard Stoker Company.

N. T. Abington has been appointed night roundhouse foreman of the Rock Island at Herington, Kans., succeeding S. L. Hamilton, resigned.

L. A. S. Wood has been appointed manager of the illuminating section of the supply department of the Westinghouse Electric & Manufacturing Company, at South Bend, Ind.

Alexander England has been appointed chief engineer of the Westinghouse Air Brake Company, succeeding S. W. Dudley, who, as announced last month, joined the Faculty of Yale University as Professor of Mechanical Engineering. Mr. England has been a member of the Air Brake organization for the past 22 years and had occupied the position of assistant chief engineer since shortly after the appointment of Mr. Dudley as chief engineer in 1914. He is regarded as a man of sound judgment and discernment in the treatment of engineering problems and is the author of a number of important mechanical improvements in connection with the company's products, especially as concerns the development of the Westinghouse steam and motor-driven air compressors for railroad and traction service. Mr. England learned engineering in Dundee, Scotland, and after some marine engineering and other special experience joined the Westinghouse Air Brake Company in 1898, and has been in the service of the company continuously since that time. Other changes announced are as follows: R. E. Miller, Engineer of Tests and Inspection, promoted to Superintendent of Tests and Inspection; W. E. Dean, Assistant Engineer of Tests, promoted to Engineer of Tests; and A. A. Mackert, Chief Inspector, promoted to Engineer of Inspection. Mr. England will report to C. C. Farmer, Director of Engineering of the Westinghouse Air Brake Company, and will maintain his headquarters at the Wilmerding plant.

Henry B. Oatley has been elected Vice President in charge of engineering department of the Superheater Company, with offices at 30 Church street, New York. Mr. Oatley received his engineering education at the University of Rochester and the University of Vermont, graduating from the latter in 1900 with the degree of Mechanical Engineer. Upon graduation he entered the service of the Schenectady Locomotive Works. His experience while on this work was very broad embracing locomotive design and shop testing. He was associated with Mr. F. W. Cole, in the early development of the superheater for locomotives by that company. In 1910 upon the formation of the Locomotive Superheater Company he accepted the position of Mechanical Engineer and in 1916 was appointed Chief Engineer for this company, which position he held at the time of his election above noted. In April, 1917, he was granted a leave of absence and served as an officer in the U. S. Navy on the battleships "Ohio" and "Indiana." He entered service with the First N. Y. Naval Militia which was the first body of armed troops to move after the declaration of war with Germany. Mr. Oatley is a recognized authority on superheating, and has been an active factor in its development. He is in a large measure responsible for putting Superheater design upon a practical operating and manufacturing basis in locomotive,

ALEXANDER ENGLAND

marine and stationary practice and, without sacrifice of efficiency, has developed uniformity of sizes and design.

Gilbert E. Ryder has been elected Vice President of the Superheater Company in charge of sales department, with office in New York. Mr. Ryder studied engineering at the University of Wisconsin and also at the University of Illinois. His railroad experience began with apprenticeship on the Chicago, Milwaukee & Saint Paul Railway and included service as a journeyman in the mechanical department of that road at Dubuque, Iowa, Ottumwa, Iowa, and West Milwaukee, covering five years. Engineering experience followed in the fuel testing bureau of the Technologic Branch of the United States Geological Survey. He later served the City of Chicago as deputy Smoke Inspector in charge of Locomotives which placed him again in intimate contact with the locomotive fuel conservation problem. This was followed by Editorship of the *Railway Review* of Chicago after which he entered the service of the Locomotive Superheater Company 10 years ago. He became a member of the service department and later took charge of that department which to-day is responsible for the operation of 30,000 Superheaters on locomotives in this country alone in addition to stationary and marine applications. He also developed and had charge of the publicity department. Mr. Ryder takes responsibility of the sales of this company, (railroad, stationary, and marine) with an unusual preparation in wide and very valuable engineering and practical experience.

Mr. Charles H. True has recently been elected Vice President of the Superheater Company, in charge of production with offices at East Chicago, Indiana. Mr. True was educated at the Public Schools of Schuyler, Nebraska, and the University of Nebraska, graduating in 1898, with the degree of Electrical Engineer. Immediately upon graduation he entered the service of the Union Pacific Railway, at Omaha, and served in both the Locomotive and Car Shops. In 1902 he became Round House Foreman at Grand Island, Nebraska, and in 1903 resigned from the Union Pacific to take a similar position at Trenton, Missouri, with the Chicago Rock Island & Pacific Railway. In October of the same year he was transferred to the Silvis Shops, as Assistant Superintendent of Shops. In 1905 he accepted the position of Mechanical Engineer with the Railway Materials Company, at Chicago, and was engaged in the design of Metallurgical Furnaces for blacksmith shops and boiler shops. In 1910 he refitted and took charge of the Phoenixville, Pa. Plant of this company. In 1912 he resigned his position with the Railway Materials Company to become Works Manager of the Locomotive Superheater Company at East Chicago, Indiana, which position he held at the time of his recent election to the Vice Presidency as above noted. During the time he was Works Manager he was actively associated in the Mechanical Development of Superheaters for Locomotive, Marine, and Stationary Boilers. Mr. True is a member of the American Society of Mechanical Engineers and other engineering societies.

American Society of Mechanical Engineers

May 23rd, and continuing four days until May 26, 1921, has been set as the date of the Spring meeting of the American Society of Mechanical Engineers. The Congress Hotel, Chicago, Ill., has been selected as the place of meeting. Among the subjects that will be discussed are Fuels, Material Handling, Machine Shops, Power and Railroads. The prospects are that the meeting will be largely attended.

American Railway Association Mechanical Division

The annual meeting of the Mechanical Division, American Railway Association, will be held in Atlantic City, N. J., June 15-22, inclusive, 1921. The reports of committees investigating car matters will be received and discussed on Wednesday, Thursday and Friday, June 15-17, inclusive, and reports of committees investigating locomotive matters will be received and discussed on Monday, Tuesday and Wednesday, June 20-22, inclusive. A circular furnishing all necessary information is being issued by the secretaries, J. E. Fairbanks, general secretary, Master Car Builders; V. R. Hawthorne, secretary, Master Mechanics. Office of secretary, 1426 Manhattan Building, 431 South Dearborn street, Chicago, Ill.

Locomotive Superheater Company Takes Over Locomotive Feed Water Heater.

The Locomotive Superheater Company has acquired the patents and business of the Locomotive Feed Water Heater Company.

Feed water heating and superheating have many factors in common, and logically the former can best be perfected by a combined organization broadly experienced and trained in this field. During the past few years remarkable progress has been made in successfully adapting feed water heaters to locomotives, and if the thermal efficiency of the locomotive is to be further increased the development of the feed water heater should be conducted with a full knowledge of the engineering features of the superheater.

The Locomotive Superheater Company will conduct the further application of the apparatus for preheating feed water through its regular engineering, inspection and service organizations to which has been added the operating organization of the Locomotive Feed Water Heater Company. This consolidation of resources and effort promises more intensified development and better service to the railroads.

Butler Drawbar Attachment Company

Announcement has been made by the Butler Drawbar Attachment Company that a sale has been made of their Draft Gear business, assets and goodwill, to the National Malleable Catsings Company of Cleveland, Ohio, through whom their business has been satisfactorily transacted for many years. The National Malleable Castings Company are in the best possible position to furnish correct castings and reliable materials for any of the Butler Draft Gears, whether Single Spring Attachments, Tandem or Butler-Piper Friction of their various types, with their usual prompt and efficient service.

The Frank Thomson Scholarships

There are two Frank Thomson scholarships available this year, amounting to a yearly sum of $600 each. They were created in 1907 by the children of the late Frank Thomson, formerly President of the Pennsylvania Railroad Company, in memory of their father. These scholarships were designed to give the sons of living and deceased employes an opportunity to secure a technical education, thereby better qualifying them for employment by the Pennsylvania Railroad System.

In all there are eight Frank Thomson scholarships for a period of four years each. Two of them are awarded each year, and entitle the successful candidate to select the university, college or technical school which he desires to attend, subject, however, to the approval of the Railroad Company. The competitive examinations are conducted by the College Entrance Examination Board of New York City, during the month of June, and embrace subjects corresponding, in general, to the entrance requirements of the scientific departments of the higher class universities, colleges and technical schools.

The Pennsylvania Warns Engineers and Firemen

Personal letters are being sent to all engineers, firemen and trainmen, on the New York Division of the Pennsylvania Railroad, urging upon them stricter observance of safety rules in the interest of protecting their own lives. "During the past year," says a letter to the engineers, "there have been a number of Train Service employes killed and injured, included in which category are engineers and firemen. The causes ascribed for the casualties vary, but a careful study indicates that some of the employes were killed and injured due to the failure to observe rules promulgated for their protection and the indulgence in unsafe practices. Employes, particularly inexperienced men, should be continually warned of the necessity of protecting themselves. It is desired that every effort be made to minimize casualties to engineers, firemen and other employes, and your earnest co-operation is urgently requested."

BOOKS, BULLETINS, CATALOGS, ETC.

QUESTIONS AND ANSWERS ON HANDLING OF TRAINS, PASSENGER AND FREIGHT. 427 questions and answers, compiled and published by the Air Brake Association.

In the matter of the best authority this book is absolutely reliable. In point of instruction it presents in the briefest possible way what is necessary to be known in train handling. In point of conciseness it is a model of condensation and is free from the common fault of more pretentious volumes in exhausting the seeker after information before it exhausts the subject. We do not know of any other work that gives so much exact information in so compact a form. It has the double merit of reducing the time taken up in study, and presents the variety of matter with such a degree of clearness that the facts presented are easily remembered. Thus while much of the matter may not be altogether new to those who have had experience the matter is put in a new form, and is classified under a variety of headings rendering the information that may be sought for easily discovered. For example compresser troubles are treated separately. Starting and Slacking are treated jointly as they should be. The Locating of Undesired Quick Action is treated at some length, and shows how carefully the experienced compilers have mastered the subject. The same may be said of Releasing and Stopping, and other details, train slack, which permits of shocks, is more fully explained than we have hitherto seen on any similar work. The book is printed on fine toned paper and substantially bound in stiff pressboard cover, and may be purchased through the Angus Sinclair Company, 114 Liberty Street, New York. 50 cents per copy, postage prepaid.

QUESTIONS AND ANSWERS ON THE MAINTENANCE OF STEAM DRIVEN AIR COMPRESSORS. 235 questions and answers. Prepared under the auspices of the Air Brake Association.

This work treats in compact form the operation, installation and maintenance of the single stage, the duplex and the cross compound types of machines, and has thirty-six illustrations, including diagrams and sectional views furnishing the complete details of the parts referred to. The illustrations are unusually fine and show the moving parts in various positions so that the student has no difficulty in following the operations of the intricate mechanism described. It should meet with much popular favor among engineers, firemen and shopmen. The brevity and conciseness with which some of the subjects are treated instead of falling short of all that is necessary as in emergency, such as when the "Compresser Stops or Refuses to Start," the book might be consulted and all that could possibly have caused the delay be revealed in a few minutes. "General Overhauling" is treated at some length, showing the entire operations necessary, so that a mechanic on possession of the book needs no other instructor. the book is substantially bound and in very durable covers and sold by the

Angus Sinclair Company, 114 Liberty Street, New York, 50 cents per copy, postage prepaid.

QUESTIONS AND ANSWERS ON THE MAINTENANCE OF FREIGHT BRAKES. 149 questions and answers. Compiled under the supervision of the Air Brake Association.

An excellent feature of this book is the illustrations furnished of the Airbrake Cleaner's Tools and Equipment, which shows all that is necessary in the way of appliances with the work required in keeping the appliances clean as they should be. Twenty-eight items are specified, including supply of light air brake parts and clean triple valves, as well as a supply of packing expanders, and cans and other receptacles, the replacing of brake cylinder pistons, triple valve application, piston travel adjustment, brake cylinder leakage tests, retaining valve pipe inspection and installation, various valves and angle cock tests, as well as particulars in regard to stencil and stencil records, are all made clear. Pipe specifications are shown in illustrated detail in regard to the retaining valve, and the best method of testing the same is described. The book is also uniformly printed and bound on the same durable material as the company's other handbooks. On sale by the Angus Sinclair Company, 114 Liberty Street, New York, 50 cents per copy.

THE WELDING ENCYCLOPEDIA. Published by the Welding Engineer Publishing Co., 608 South Dearborn street, Chicago, Ill. 326 pages, 375 illustrations. Bound in cloth.

This is the first book of its kind, and may be said to fill a real want. It furnishes at once a complete reference and instruction book on autogenous welding by every variety of method. A carefully compiled dictionary gives definitions and many illustrations of all words, terms and trade names used in the welding trade. Every kind of welding is fully treated in separate chapters, with a degree of fullness that leaves nothing to be desired. The various rules and regulations in regard to welding adopted by the various States, as well as the various organized engineering and insurance bodies are also appended. Numerous charts illustrate the right as well as the wrong way of welding. Welding equipment and supplies are condensed into a convenient and ready catalogue that is at once reliable and complete, and is at once a buyer's index and a vision of the advanced state of the art. In brief, it answers every question, and opens up new channels of information to those who desire to know all that is to be known about autogenous welding.

Clamshell Buckets

The Lakewood Engineering Company announces a new 16-page booklet in two colors illustrating Lakewood Clamshell Buckets in use on various types of cranes. The purpose of this booklet is to show Lakewood Clamshell Buckets operating under various conditions, in various types of material, and to demonstrate the "digging down" feature of the bucket. Of particular interest is the almost complete absence of text matter. The whole story has been told in pictures. A copy of this booklet will be sent to any reader on request to the company.

Comparative Railway Statistics.

The Bureau of Railway Economics has issued a new bulletin which is the third in the series. Thirty countries have been made the subject of this study and are all listed. The combined railway mileage is approximately 639,000 miles, or about seven-eighths of the total mileage of the world.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV | 114 Liberty Street, New York, April, 1921 | No. 4

Successful Test of the Automatic Straight Air Brake on the Norfolk & Western Railway

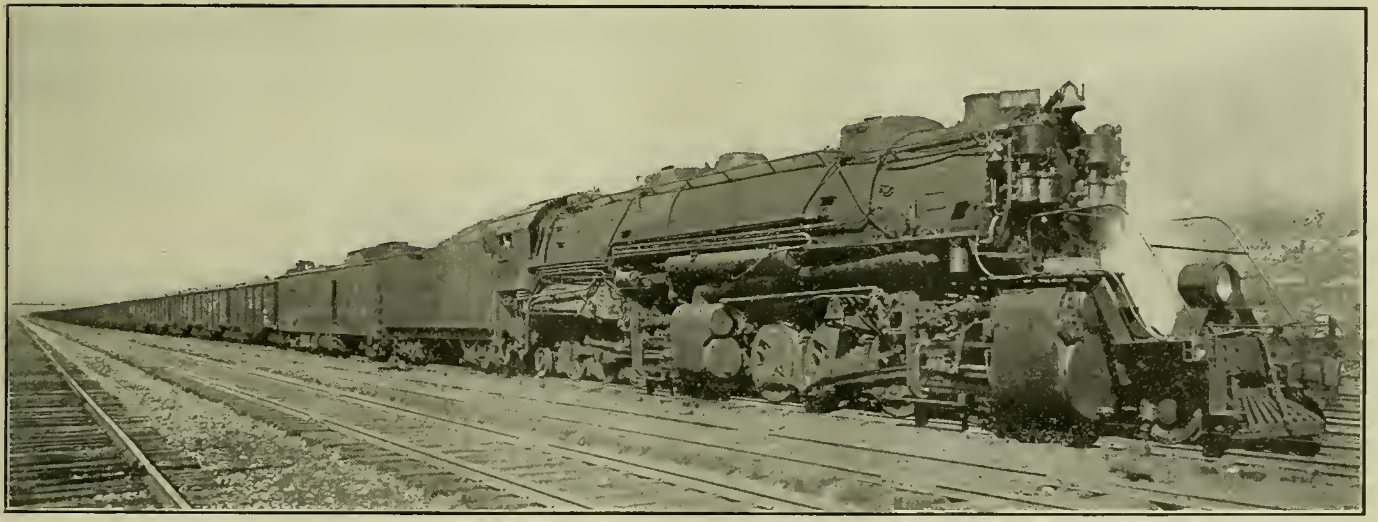
The Norfolk & Western Railway have recently built five hundred coal cars of 100-tons capacity and have equipped one hundred of them with the new design of triple valve of the Automatic Straight Air Brake Co. that was illustrated and described in RAILWAY AND LOCOMOTIVE ENGINEERING for May, 1920. This triple valve is a simplification of the earlier design that was used in the tests on the Virginian Railroad in 1918, and performs all of the functions of that design with some additional refinements such as a quickening of the graduated release of the train as a whole and the non-overcharge of the auxiliary reservoir in graduated release.

The application of these brakes to the cars was begun last October and, since that time, as the cars were put into service, they have been running in trains mixed in with the regular brakes.

The regular length of a train made up of these cars is thirty-five, giving a total tonnage, when loaded, of about 4,445 tons exclusive of the engine and the caboose. A preliminary test was made of one of these trains, made up exclusively of cars equipped with the A. S. A. brakes, on February 15, 1921, between Bluefield, West Va., and Roanoke, Va., a distance of about 103 miles. The profile of this section of the road consists, as shown by the accompanying profile, of a down grade for 24 miles, that averages about 1.3 per cent. though there is a section about two miles long near Bluefield, of 1.6 per cent. This is followed by an up grade for 47 miles; the first 39 of which is up the New River and averages about 0.1 per cent. with short sections of 0.2 per cent. and level stretches. Then there is a run of 8 miles up the western slope of the Allegheny Mountains on a grade of about 0.9 per cent. Then 22 miles down the eastern slope of the Alleghenies, where there was a maximum grade of 1.32 per cent. for 11 miles, followed by lighter grades into Roanoke.

In addition to the running test a number of standing tests were made. The results of the whole were so satisfactory that it was decided to make a similar test with a train made up of seventy of these 100-ton cars, all equipped with the A. S. A. brake.

The tests were run on March 24 to 26 inclusive. The standing tests were made in the Bluefield yard. It was found that, in these, the results were erratic as far as the first car was concerned because of a leak in the pipe connecting the emergency reservoir with the recording gauge on the chronograph. This was located and corrected before the running test was made and on the trip from Bluefield to Roanoke this brake worked as it should.



TEST TRAIN OF SEVENTY 100-TON CARS EQUIPPED WITH AUTOMATIC STRAIGHT AIR BRAKE, WITH TOTAL WEIGHT OF 9,355 TONS, NORFOLK & WESTERN RAILWAY

The locomotive used was a 2-8-8-2 Mallet having the following dimensions:

Total weight ....531,000 lbs.
Weight on drivers............478,000 lbs.

Diam. high pressure cylinder..	25 in.
Diam. low pressure cyclinder..	39 in.
Piston stroke	32 in.
Steam pressure	240 lbs.
Diam. of drivers	57 in.
Tractive power	107,373 lbs.
Heating surface	7,639 sq. ft.
Grate area	96.3 sq. ft.
Weight of tender	81,100 lbs.
Tank capacity	12,000 gals.
Coal capacity	18 tons

The train was made up of the Norfolk & Western dynamometer car; seventy loaded coal cars and three cabooses, the weights of which were:

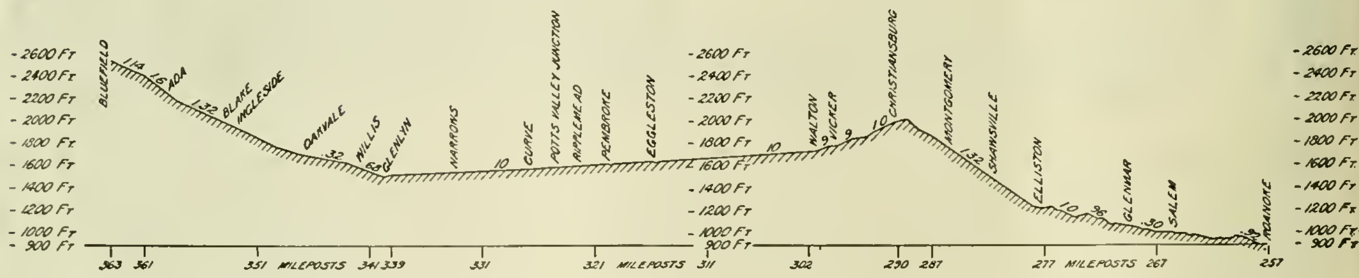
Dynamometer car	60 tons
Seventy cars	8,857 tons
Cabooses	64 tons
Total	8,981 tons

Add to this the 374 tons of engine and tender and we have a total weight of train of 9,355 tons. This, we believe, is the heaviest train ever taken down such a grade with a single engine by the use of the air brakes alone.

The engine was fitted with two 8½ in. compound compressors, each of which was fitted with an electrical contact by means of which each stroke of each pump was recorded on the paper of the chronograph in the dynamometer car.

The engineer's brake valve was fitted with electrical contacts that were wired to the chronograph, by which each position of the brake handle was recorded, whether in service, lap, running, release or emergency positions.

The chronograph also recorded the brakepipe, brake cylinder and auxiliary reservoir pressures on the dynamometer car; the speed of the train; the drawbar pull between the tender and dynamometer car; the speed of the train, in miles per hour; the strokes of the air compressors; and each six seconds of elapsed time; and the development of 15 lbs. brake cylinder pressure on the 1st, 27th, 57th and 70th cars.

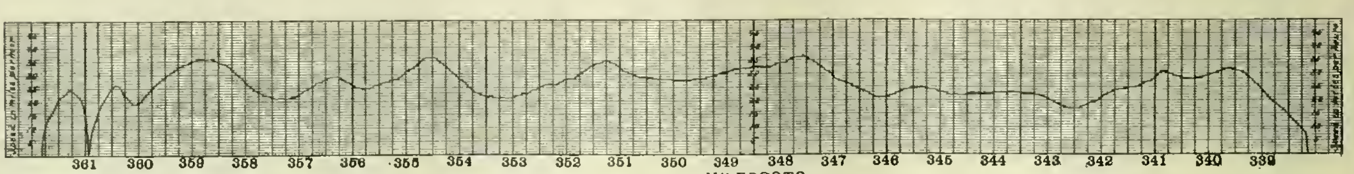


PROFILE OF NORFOLK & WESTERN RY. FROM BLUEFIELD, WEST VIRGINIA. TO ROANOKE, VA.

ONE-HUNDRED-TON CAPACITY COAL CAR OF NORFOLK & WESTERN R. R. EQUIPPED WITH AUTOMATIC STRAIGHT AIR BRAKES AND N. & W. SIX-WHEELED TRUCKS

Pressure gauges were attached to the brake cylinders of the 1st, 27th, 57th and 70th cars. These were fitted with electrical contacts that were closed when a pressure of 15 lbs. per sq. in. had been developed in the brake cylinders and remained closed until the pressure had fallen below that point on the release. These events were recorded by the chronograph in the dynamometer car.

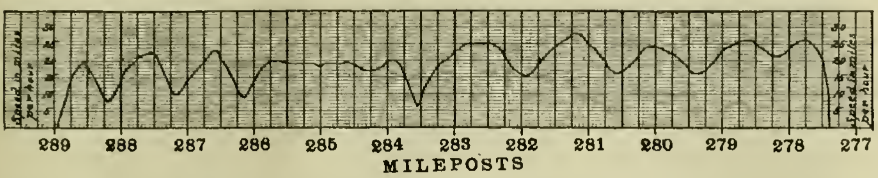
Trainagraphs were also placed on the



SPEED CURVE OF TEST TRAIN DOWN GRADE FROM BLUEFIELD TO GLEN LYN—DIRECTION OF TRAIN MOVEMENT LEFT TO RIGHT

1st, 15th, 45th, 57th, 60th and 70th cars. These instruments made a continuous record of the pressures in the brake cylinder, auxiliary reservoir and brakepipe of the several cars.

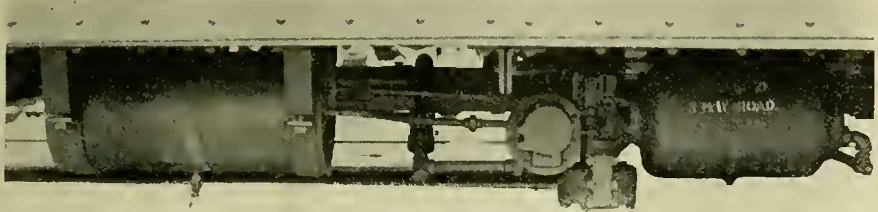
After the standing tests, which were made on March 24 and 25, the running



SPEED CURVE OF TEST TRAIN DOWN EASTERN SLOPE OF ALLEGHENY MOUNTAINS. DIRECTION OF TRAIN MOVEMENT, LEFT TO RIGHT

test was made on Saturday, March 26, from Bluefield to Roanoke, starting from the former place at 8.19 a. m.

The brakes on the engine were cut out. An A. S. A. triple valve had been applied to the dynamometer car and this with all



A. S. A. TRIPLE VALVE ATTACHED TO CAR

those on the train were placed in graduated release and were in that position both on the run from Bluefield to Glen Lyn and from Christiansburg at the summit of the Alleghenies to Roanoke. The brakes on the three cabooses, at the rear of the train, were all cut out, so that there was an unbraked element at each end of the train. Finally the vent valve on the tender was plugged so that the emergency applications made on the run were obtained without any assistance from this valve.

The yard at Bluefield lies on a grade of about 1 per cent so that, when the train started, it quickly picked up speed until it was running at a little more than 24 miles an hour.

Then came the first application of the brakes, in order to stop the train to take on the caboose of the train crew. The reproduced copies of the trainagraph records show how the brakes responded. In this connection attention is called to the fact that this was the first application of the A. S. A. brakes that the engineer in charge had ever made on a moving train, having had no previous experience in the handling of the brake except to make a terminal test of the train about fifteen minutes previously. So that this was his first opportunity to get the feel of the brakes on a moving train. Yet the stop was made without causing the slightest shocks to any part of the train from a speed of about 24 miles per hour. This absence of shock was characteristic of all of the work during the day.

This first stop demonstrated to the engineer that he had complete control of the train and could play with it as he saw fit thereafter. In this instance the train was brought to a stop from a speed of 24.5 miles an hour, the caboose attached and a start made after a full release in four minutes, the actual stop having been made from 24.5 miles an hour in about 2,000 feet. Again, when the speed had risen to 36 miles an hour, there was an immediate response to the brakes and the speed was reduced to 21 miles an hour in about 7,000 feet after which the train was allowed to increase in speed again.

The diagrams show the application as effected by two service applications, with the graduated release after the train had come to a stop.

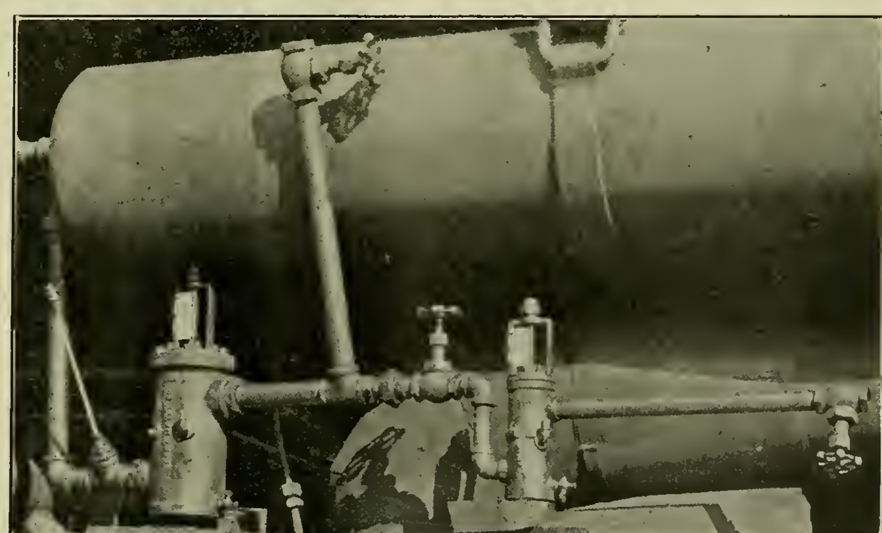
After the caboose had been attached, the train was again started and ran to the foot of the grade and on one mile beyond to Lurich where the first stop was made for water.

The distance from the point of starting to the foot of the grade at mile post 340 is 21 miles. The average speed in running this distance was about 23.9 miles per hour. The highest speed attained was 36.5 miles per hour, and the lowest, after the first acceleration was 17 miles per hour. The variations are shown graphically on the speed diagram, and from this it will be seen that, while there were fluctuations of about 14 miles per hour in two miles during the early portion of the run, when the engineer was finding himself, there was a run of three miles between mileposts 346 and 343 where the total variation in speed was only 3.5 miles per hour. And this after the engineer had had but 45 minutes' experience in the handling of the brake on a moving train.

The diagrams reproducing the trainagraph records show the manner in which the brakes were applied. It will be seen from these that there was an immediate response throughout the whole train to each application. The average brake cylinder pressure developed on the hill from the starting point with the locomotive near milepost 261 to the reaching of the foot of the grade at milepost 240 by the front end of the train was as follows:

Car 1	10.51 lbs.
Car 15	8.64 lbs.
Car 45	10.85 lbs.
Car 57	21.87 lbs.
Car 60	17.26 lbs.
Car 70	20.18 lbs.

As there was nearly four miles at the foot of the grade where no brake ap-



TOOLOMETERS USED FOR CALIBRATING AIR COMPRESSORS.

plications were made, the average brake cylinder pressures would be somewhat higher than that if we take that average, for each car, from the time of the first application to that of the last full release before reaching the foot of the grade.

On that basis the averages areas follows:

Car 1	15.50 lbs.
Car 15	12.75 lbs.
Car 45	13.93 lbs.
Car 57	21.87 lbs.
Car 60	22.83 lbs.
Car 70	28.29 lbs.

If we take the average of the pressures during the period of application only these pressures become for

Car 1	20.66 lbs.
Car 15	18.63 lbs.
Car 45	14.37 lbs.
Car 57	21.87 lbs.
Car 60	22.83 lbs.
Car 70	28.29 lbs.

The indications from these figures are that the whole train was braking as a unit and that is each car was doing its own braking, with a slight excess towards the rear, thus having a tendency to stretch the train.

The maximum pressures developed in the several brake cylinders were for

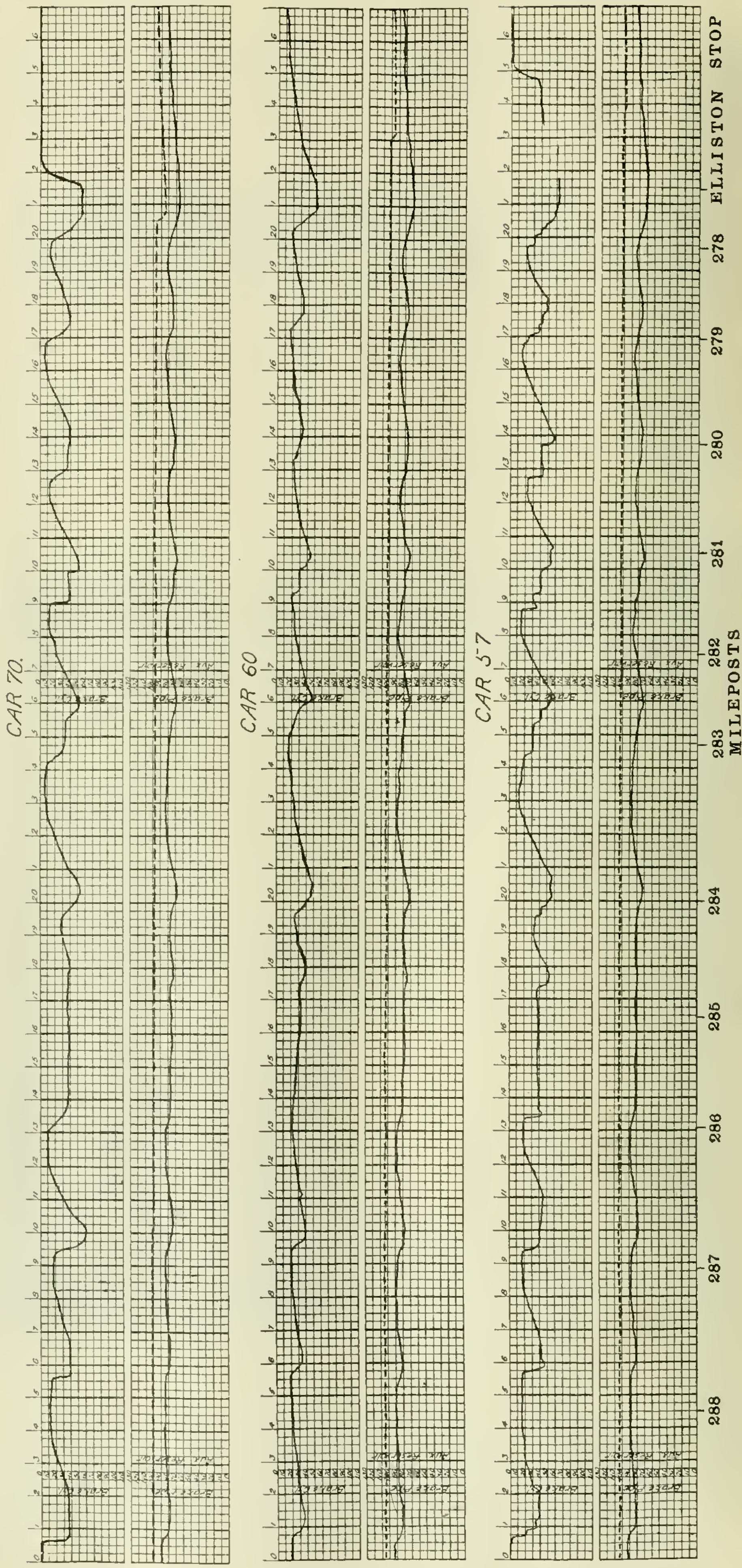
Car 1	65 lbs.
Car 15	65 lbs.
Car 45	65 lbs.
Car 57	65 lbs.
Car 60	60 lbs.
Car 70	67 lbs.

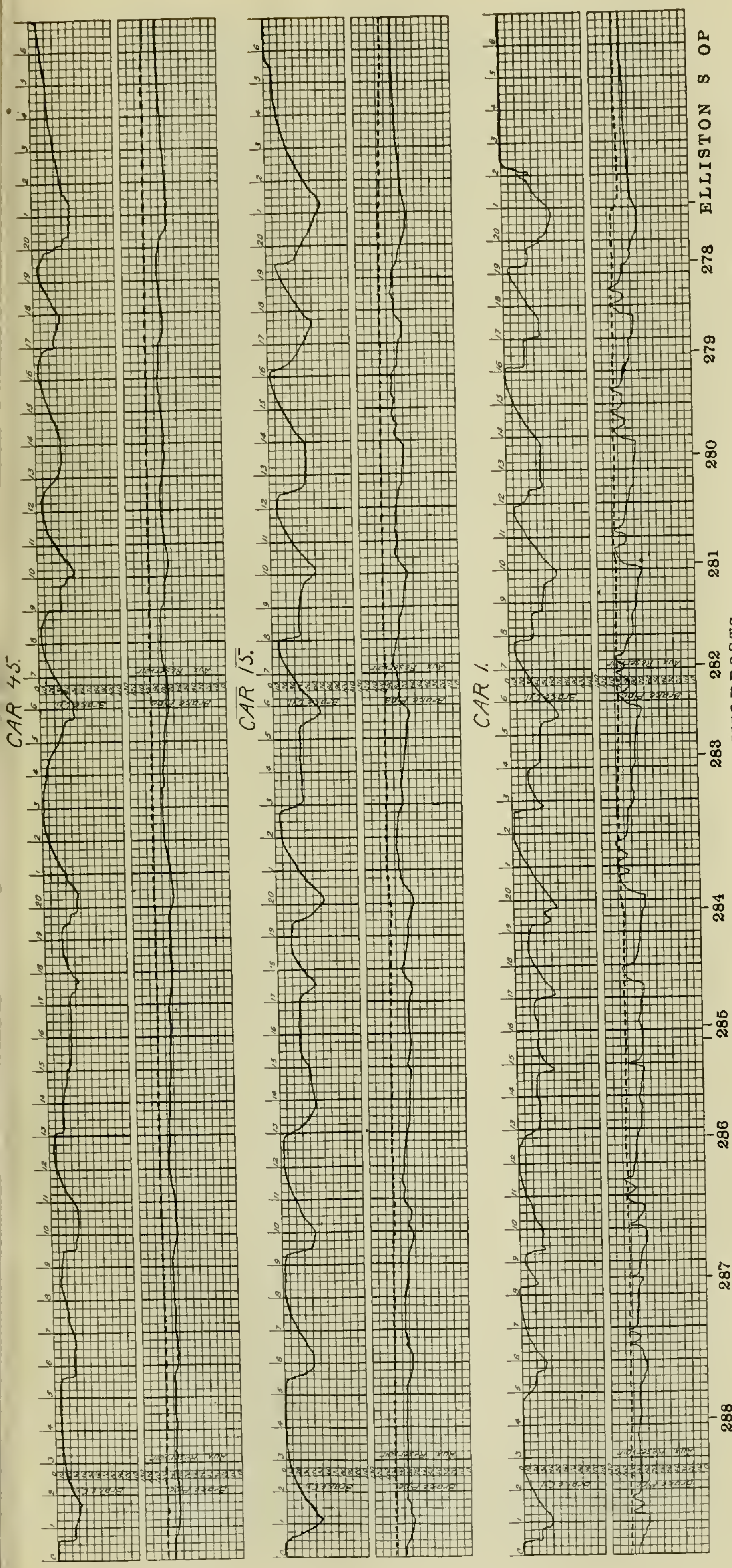
In all of which a great uniformity of operation is indicated.

The fact that the speed of the train rose to 36 miles an hour might lead to the suspicion that it was running away. But there are two indications to refute such a suspicion. One is the actual record of the speeds as given by the diagram where deceleration is shown to have taken place at intervals with the speed dropping to about 21 miles per hour. The other is the trainagraph records of the auxiliary reservoir and brakepipe pressures. These show the pressure in the former to have remained up to the full charging point throughout the whole period of the run. This supply was, therefore, always available for an emergency application had the train gotten beyond control, which it evidently did not. In fact the trainagraphs show that, when the train was running at a speed of 36 miles an hour, on the Bluefield grade, the brakes were not in application and the full brakepipe pressure was available to stop the train.

After leaving the water stop at Lurich, there was a long haul of 47 miles up the New River and the western slope to the summit of the Alleghenies. This portion of the run is uninteresting from the standpoint of the brakes, except for an application at Christiansburg.

On the haul up the mountain a helper locomotive was coupled ahead of the regular engine. As the train entered the Christiansburg yard this locomotive was cut loose and started to run ahead to take a siding; it being the intention to have the train proceed without stopping. As





TRAINAGRAPH RECORDS OF RUN OF TEST TRAIN DOWN EASTERN SLOPE OF ALLEGHENY MOUNTAINS. DIRECTION OF TRAIN MOVEMENT, LEFT TO RIGHT

the leading engine was uncoupled the engineer of the train made a service application in order to give the other engine time to get out of the way. The work was done, however, just in the face of an automatic block signal; which, when the leading engine passed it, went to stop position. As the rules against passing an automatic block at stop are rigidly enforced on the Norfolk & Western, the train engineer threw his brake into the emergency position in order to stop at the signal. There was thus a service application followed by an emergency. The action of the brakes is clearly shown by the records of the trainagraphs that are here reproduced. These show the service followed by the emergency application with the drop of brakepipe pressure and the equalization of the auxiliary reservoir pressure with the release of the brakes. The period of release varied from 1 min. 15 secs. on car 57 to 4 min. on car 60. The stop was made without shock on any part of the train.

After this stop and the release of the brakes the train started down the eastern slope of the Alleghenies. As upon the other grade, all of the brakes were placed in graduated release, no retaining valves being on any of the cars.

The average brake cylinder pressures developed on this grade were somewhat higher than for the grade out of Bluefield. Taking the time covered by the run from the start at Christiansburg to the stop at Elliston, these averages were:

Car 1	24.42 lbs.
Car 15	27.83 lbs.
Car 45	22.72 lbs.
Car 57	30.27 lbs.
Car 60	27.36 lbs.
Car 70	26.10 lbs.

At the same time the maximum brake cylinder pressures developed on the several cars were:

Car 1	67 lbs.
Car 15	63 lbs.
Car 45	50 lbs.
Car 57	60 lbs.
Car 60	57 lbs.
Car 70	62 lbs.

Here again the pressures show that the train was braking as a unit, each car performing its own share of the work.

On starting down this grade the engineer had had nearly seven hours' experience, and, just as the speed was more uniform near the foot of the Bluefield grade than at the start, so here the average for the whole grade was more uniform. The average speed of the train from the start at Christiansburg to the stop at Elliston, was 16.4 miles per hour with a maximum speed of 25 miles an hour and a minimum after the first acceleration and before the last deceleration of 6 miles per hour. The evenness of the running is worthy of attention. For example, between mile posts 286 and 283, the extreme variation in speed was 6 miles per hour, while between mile posts 285 and 284 it was only 2.5 miles per hour. Such records indicate the completeness with which the train was under control.

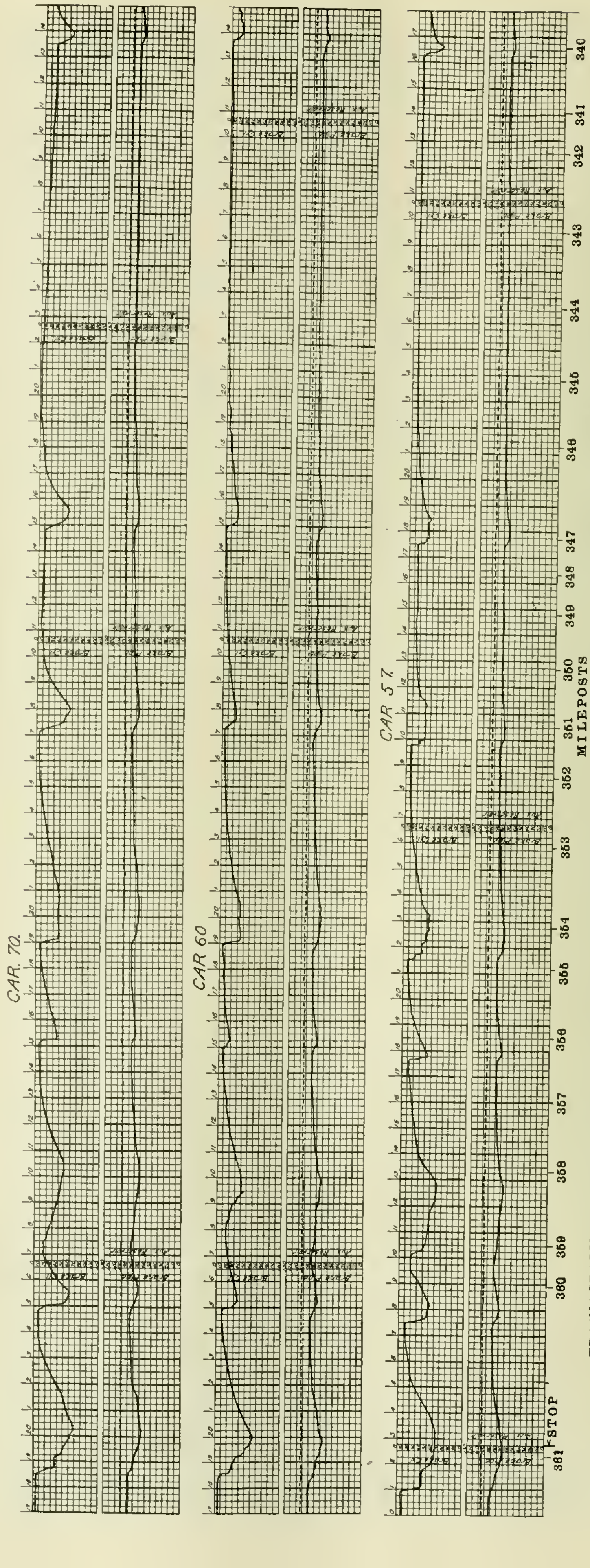
Before starting on the run from Bluefield tests were made to determine the brakepipe leakage, both with all brakes cut out and with the brakes cut in. With the brakes cut out the leakage for the whole train was 6.5 lbs. in five minutes, on the engine, from an initial pressure of 87 lbs. With the brakes cut in there was a loss of 13 lbs. from 85 to 72 lbs. on the engine, in five minutes.

In order to determine the amount of air required to operate the brakes on the road the pumps were calibrated on the day before the run.

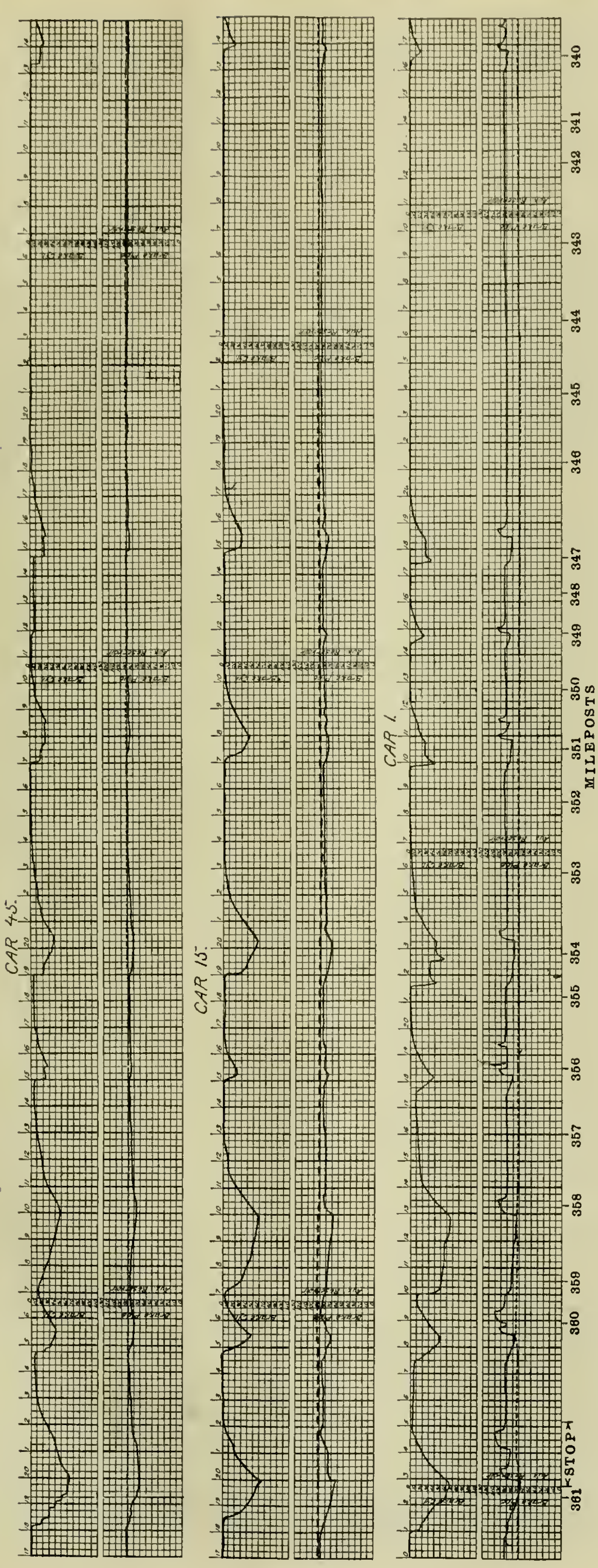
It was found that, when running at a speed of seventy-five double strokes per minute or less, the diagram of air delivery on the basis of strokes per minute was a straight line. The record of the pump strokes on the run down the grade out of Bluefield shows that in a period of 52 minutes and 10 seconds while running from mile post 360 to mile post 340, one pump made 998 strokes and the other 1,089 strokes. This work was not evenly divided, of course, over the whole run, but separated into groups where the pumps would make from three to a hundred strokes at a time and then stop. At such times the average rate of running would be at the rate of from 45 to 60 return strokes per minute. If we assume an average rate of running of 55 return strokes per minute, the delivery would be 65 cu. ft. of air or about 1.18 cu. ft. per stroke. Taking this as the average delivery, the total amount of air used by the brakes on this run of 20 miles would be approximately 2,463 cu. ft. or 35.2 cu. ft. per car or about .68 cu. ft. per car per minute.

On the run down the eastern slope of the Alleghenies from Christiansburg to Elliston, a distance of about 12 miles, and lasting for 42 minutes 30 secs., the total number of return strokes made by the two pumps was 1,105, which on the same basis of delivery puts the air consumption of the brakes at 1,304 cu. ft. or about 18.6 cu. ft. per car or a little less than .43 cu. ft. per car per minute.

This is so far below the capacity of the pumps to supply, that a train of one hundred of these cars could probably have been handled with equal facility by a single engine. In fact, the air consumption on the grades was just below the capacity of a single 9½-in. pump, and the demands made upon the air supply for the whole length of the run was well below the capacity of but one of the pumps with which the engine was equipped. There will probably be a slight variation from these figures in



TRAINAGRAPH RECORD OF RUN OF TEST TRAIN FROM BLUEFIELD TO GLEN LYN. DIRECTION OF TRAIN MOVEMENT, LEFT TO RIGHT



TRAINAGRAPH RECORD OF RUN OF TEST TRAIN FROM BLUEFIELD TO GLEN LYN. DIRECTION OF TRAIN MOVEMENT, LEFT TO RIGHT

the final analysis but they may be relied upon as being essentially correct.

The test will be acknowledged as one of exceptional severity and as bearing out the promise of the government tests of two years ago on the Virginian Railroad, that it will give complete train control under all operating conditions.

A large number of representatives were present from railroads all over the country, and from the technical press and the Bureau of Safety, as well as from the Norfolk & Western Ry. and the Automatic Straight Air Brake Co. These were as follows:

Atchison, Topeka & Santa Fe, George H. Wood, general air brake instructor; Atlantic Coast Line, E. Z. Mann, air brake inspector; Boston & Maine, H. F. Wood, master mechanic; Chesapeake & Ohio, R. E. Anderson, air brake instructor; Chicago & Eastern Illinois, Ed. Dahms, foreman air brake repairs, Ed. Laking, air brake supervisor; Delaware, Lackawanna & Western, P. J. Langan, general air brake instructor; Denver & Rio Grande, C. H. Rawlings, general air brake instructor; V. H. McGinnis, general trav. eng. and mech. inspector; W. O. Cook, Asst. Supt. M. P. and Car Department; Denver & Salt Lake, F. A. Kenney, road foreman of equipment; El Paso & Southwestern, A. G. Newell, road foreman of engines; Erie Railroad, T. W. Dow, general air brake inspector; Elgin, Joliet & Eastern, C. L. Wilson, traveling engineer; Lehigh Valley, G. E. Burgess, air brake instructor; John Roney, assistant trainmaster; Louisville & Nashville, Frank Sherman, air brake instructor; W. W. Spruell, traveling engineer; Missouri, Kansas & Texas, C. T. McElvaney, air brake inspector; W. H. McCune, master mechanic; Nickel Plate, J. J. Rossiter, road foreman of engines; L. A. Jewell, air brake foreman and supervisor; New York Central, R. M. Long, supervisor air brakes, P. & L. E. R. R.; H. S. Walton, supervisor air brakes, B. & A. R. R.; New York, New Haven & Hartford, G. E. Terwilliger, general air brake inspector; Philadelphia & Reading, E. A. Borell, engineer of motive power; R. B. Rasbridge, superintendent car department; Rock Island Lines, W. J. Hartman, air brake instructor; H. Clewer, general superintendent of fuel economy; Seaboard Air Line, A. R. Pugh, general air brake inspector; W. J. Pardue, master car builder; A. M. Hilborn, general car inspector; Union Pacific, J. L. Mohun, mechanical expert; Virginian, J. W. Sasser, superintendent motive power; E. M. Jenkins, mechanical engineer; Wabash, W. H. Davies, supervisor of air brakes; M. L. Akers, of General Agent, C. & O. R. R., Louisville, Ky.; R. L. MacDuffie, of Wendell & MacDuffie Co., New York, N. Y.; H. B. MacFarland, Consulting Engineer, Chicago, Illinois; Spencer Otis, of National Boiler Washing Co., Chicago, Illinois; E. C. Van Dyke, of Knauth, Nachod & Kuhne, New York, N. Y.; A. V. Wainwright, Consulting Engineer, New York, N. Y.; George L. Wilkinson, Chicago, Illinois.

The representatives of the Bureau of Safety of the Interstate Commerce Commission were: W. J. Patterson, assistant chief; A. M. Banks, inspector; William L. Barry, inspector; Oscar C. Cash, inspector.

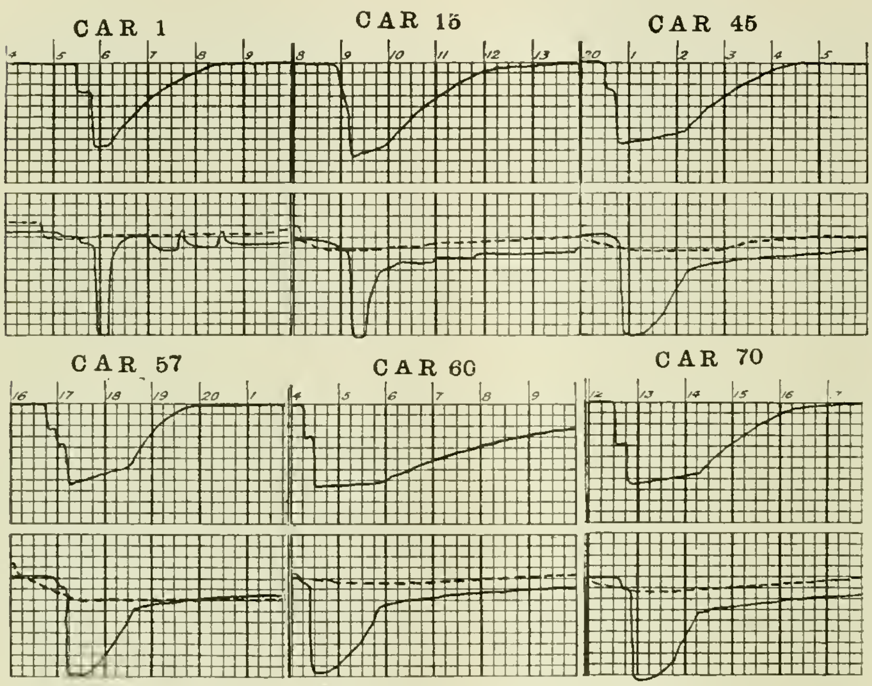
The representatives of the technical press were: George L. Fowler, RAILWAY & LOCOMOTIVE ENGINEERING; F. A. Korsmeyer, *Wall Street Journal;* L. G. Plant, *Railway Review;* A. F. Steubing, *Railway Age;* M. J. Woodworth, *New York News Bureau.*

The Norfolk & Western Ry. representatives were: Alex Kearney, superintendent of motive power; John A. Pilcher, mechanical engineer; C. H. Quinn, chief electrical engineer; H. W. Coddington, engineer of tests (in charge of records); C. M. Kidd, air brake inspector; J. J. Barry, general master mechanic; C. L. Dickinson, car foreman; J. M. McIlheny, terminal trainmaster; E. W. Ford, air brake foreman.

The officers of the Automatic Straight Air Brake Co. present were: W. F. McGuire, vice-president of George W. Goethals & Co., Inc.; George M. Wells, vice-president of George W. Goethals & Co., Inc.; H. I. Miller, vice-president and general manager; Archibald M. McCrea, vice-president; Spencer G. Neal, chief engineer; M. E. Hamilton, field service engineer; F. C. Herr, special agent.

The operators and observers on the observation train were: E. B. Lewis, dynamometer operator; Bernard Cook, observer on locomotive; J. S. Scott, extra on dynamometer car and locomotive; W. B. McPherson, observer on rear of train.

The train crew consisted of: J. J. Chapman, engineman; J. B. Philpot, fireman; W. Gordon, conductor; F. H. Kirby, brakeman; W. J. Bryant, brakeman.



TRAINAGRAPH RECORDS OF EMERGENCY APPLICATION OF BRAKES AFTER SERVICE APPLICATION. TEST TRAIN AT CHRISTIANSBURG, VA.

At the conclusion of the run it was generally agreed that the test had been most successful and the officers of the Norfolk & Western Ry. authorized the statement to be made that it had been most satisfactory to them. That the test was undertaken at all speaks for the confidence which these officers had in the functioning of the mechanism of the brake, for the test was made with a train of just twice the weight and length of that ordinarily handled and that without any preliminary experimenting or building up of trains by which this maximum loading was gradually attained.

Capetown to Calcutta by Rail

It appears that in a short time trains, fired with oil from the Persian fields, will thunder along trade routes which plodding camels marked out when all the world was young. Already one may dine in Cairo and have luncheon the following day in Jerusalem. The step to Aleppo, Mosul and Bagdad is short and all but 300 miles of the line is now open to traffic.

However, popular the route through Central Europe along the famous Berlin-to-Bagdad lines becomes it seems assured that the line of communication between the valleys of the Euphrates and the Tigris shall be kept in a state of perfection. There will be no tunnels on this trail of the modern caravan, and an absence of heavy grates throughout a large part of the right-of-way will make it possible for the Cairo-to-Calcutta express to beat the fastest sea route by several days.

Slowly but surely the iron rails are reaching out to bind Capetown to Cairo and Suez to Shanghai by way of Persia, India, Burma, and the Yangtse Valley. The path of Empire in the future will not alone be traced by the wakes of passing steamers, but also by bold bands of shining steel. The supreme strategy of a railway that will connect the valleys of the Nile, the Tigris and the Euphrates the Indus, the Ganges, the Irriwaddy and the Yangtse lies in the fact that it will be flanked by the most thickly settled portions of the world's surface, and can from the first have commercial as well as strategic value.

Syria is the hub of the Afro-Eurasian continents, and with every railway that reaches out to Bremen, Baku, Bokhara, Burma, or Bloemfontein, the central region of the world's greatest land mass achieves new significance.

Heaviest Locomotives on the Canadian Pacific Railway

Our esteemed contemporary *The Canadian Railway and Marine World* assures that the largest locomotives on the British Columbia are of the decapod 2-10-2 type, known as the R-3 class, locomotives of this class being in the 5700 series. Following are some of the principal details:—

Tractive effort	54,000 lb.
Total weight of engine	240,000 lb.
Loaded weight of tender	180,000 lb.
Total weight of engine and tender combined	420,000 lb.

The largest locomotive in the Province of British Columbia, in fact on the C. P. R. system, is the Santa Fe (2-10-2) type, the locomotives of this class being in the 5,800 series. Following are some of the principal details:—

Cylinders	26½ x 32 in.
Driving wheels	58 in.
Tractive effort	65,870 lb.
Weight on drivers	275,000 lb.
Total weight of engine in working order	354,600 lb.
Loaded weight of tender	180,000 lb.
Total weight of engine and tender combined	534,600 lb.

The C. P. R. has 15 Santa Fe locomotives in service, 3 on the Quebec District and 12 on the Alberta District.

The dividing point between the Alberta and British Columbia districts is at Field, B. C., 2201.2 miles from Montreal and 505.3 from Vancouver. Field itself is in the B. C. District.

National Importance of the Railroad Problem

Executives and Employees Ably Represented Before the United States Labor Board

It is gratifying to learn from many sources that the attitude of Railway and Locomotive Engineering on the momentous questions affecting the railroads and the employees is one of fairness to all concerned. Editors are largely like politicians, —they see with one eye only. The true province of the press should be to present the reflex of the passing events as they arise with a feeling amounting to conviction that the intelligent reader is as capable of forming opinions as the editor may be, and while the celebrated saying of Pascal that "what is true on one side of the Pyrenees is false on the other," is an everlasting truth, it will be found that in all controversies there comes a time when a spirit of compromise returns, and what is termed a working agreement heralds a period of peace. This we hope for in the present controversy. Meanwhile it is our place and privilege to chronicle such statements from the most reliable sources that come to us.

It is evident that whatever the outcome of the dispute between railroads and authorities over the wage scales, the employee organizations, it is worthy of note, do not assume the attitude of power that they took less than a year ago. The superabundance of available workers ready for a great variety of manual tasks has rendered the railroad strike, if not a thing of the past, at least a hazardous proceeding. To strike now would in many instances amount to inviting a number of men already idle to compete for each vacant job. The binding nature of the 1920 agreement has been within the limit set. The urgency of the employed for all the pay they could get cannot of itself stand against railroad economy.

The amount of income to meet the increase of expenses of the railroads was not sufficiently provided for under the war regime, as it should have been, and is not provided for now. The roads were turned back to private operation, tied hand and foot by the railroad administration's spend-first and earn-later policy. That is why they are now loudly demanding some measure of economic freedom. That is why the Esch-Cummins act has been so far pathetically disappointing. Either the rates must be raised, or the expenses reduced to bring about a reasonable conclusion. The scheme might have worked if the volume of railroads' traffic had remained as a whole at the full measure of their carrying capacity. But traffic did not stay up, and, of course, less traffic brought less gross revenue for the carriers. Even the fool is wise after the event, and among the clamor of voices we cannot recall hearing one that prophesied the present contingency.

As it is we all seem to have grown wise again all of a sudden, and if it is true that in the multitude of counsel there is wisdom, something should be expected, and it is natural and proper that the United States Senate should be listened to, as the fact remains that whether they have the first word or not they will likely have the last word in this as in other questions of national importance. Senator Cummins, the leading authority in the Senate in railroad matters, had under consideration last month a comprehensive plan for conducting railway transportation, which is aimed to produce great savings, to increase facilities and service, and to lower both passenger fare and freight rates.

The plans are contained in a statement by S. Davies Warfield, president of the National Association of Owners of Railroad Securities. The solution of the national transportation problem, according to Mr. Warfield's statement, lies in the organization of a body to be known as the National Railway Service Board to bring about economical operation.

In a letter to Senator Cummins Mr. Warfield explains that unless intensive economical methods in railway administration are adopted there is no alternative but Government operation, followed ultimately by Government ownership.

The plan, summarized, follows:

The Interstate Commerce Commission would select five from among its members to constitute the service division to have supervision and initiatory and regulatory powers through the board or staff of the National Railway Service.

The board would consist of forty members, subdivided into two divisions—finance and administrative and railroad officials, twenty members each.

Subordinate to the board would be four group railway boards, each organized and selected from each of the four rate territories into which the commission has divided the country. Four boards in all, each to consist of seven members, five selected by the railroads of each group and two from the shippers located in each group territory. (The twenty officials forming these four boards will serve as the railway officials division of the National Railway Service Board.)

Ten committees of five members each to co-operate with each of the four group boards and selected from the railroads of each group. This means four group railway boards and forty committees in all. These committees will cover a large range of investigation and report, their subjects including the normal equipment requirements of each railroad; additional equipment to be leased from the National Railway Service; standardization of equipment; useless expenditures incident to wasteful competition; a study of joint use of terminals, yards and shop facilities; surplus property not required in legitimate transportation—cost at carrying; purchases of fuel and supplies; application of a standard of efficiency in railroad operations; working conditions, wages and the like.

The National Railway Service Corporation, recently organized by the association of security owners, to furnish equipment to the carriers by conditional sale or lease is superseded by the National Railway Service with extended powers for financing and leasing equipment. The twenty trustees of the service corporation will serve as the finance and administrative division of the National Railway Service Board.

Under the plan proposed by the association the Railway Service Board is to be formed by act of Congress, as urged by the association in 1919 when its suggestions were made leading to the provisions in the transportation act for the adjustment of rates to yield 5½ to 6 per cent. on the aggregate value of railroad property, with a division of excess earnings. The proposal for this organization to insure intensive economies was not then acted upon by Congress, although it was said to be essential to give full effect to the suggestions that were adopted.

Meanwhile whatever disposition Mr. Cummins, as chairman of the Senate Committee on Interstate Commerce, and his committee, may make of the proposed plan, it will be remembered that the national association of owners of railroad securities played an important part in the writing of the Esch-Cummins act last year, and Mr. Warfield, in a printed statement outlining the new suggestions, says that the act would have been a success but for declining tonnage, and makes new recommendations which he believes necessary to bolster up the present legislation. Part of the new plan was urged in 1919, but Congress did not act upon it.

Turning our attention to the controversy as presented before the meetings of the Labor Board held in Chicago during last month, it is interesting to watch the men who may be said to be in the heat of the action, and whose views are therefore worthy of due consideration, as representing the views of those most vitally interested and whose freedom of speech needs no excuse, as in the heat of debate it is not infrequent that flashes of truth, otherwise unrevealed, come luminous as lightning, and should not be overlooked.

On March 21, at a meeting of the Board, Brigadier General W. W. Atterbury, vice-president of the Pennsylvania Railroad and former chairman of the railway executives' labor committee, took an emphatic stand against national agreements, which he termed "prolific of misunderstandings."

Questioning by Frank P. Walsh, counsel for the union, brought vigorous replies from General Atterbury and time and again the witness replied by cross questioning his interrogator. Charges that the union leaders did not really represent the employees and that national rules were used to procure employment for more men and extract money from the roads on technicalities were hurled across the table as the General took the stand against all rules of national application.

The gist of General Atterbury's testimony may be summarized thus:

Rules should be negotiated between officials of the roads and their own employees, across the conference table "like a game of poker."

The eight-hour day could not be universally applied to all employees, especially train service men, "because the Lord didn't build the railroads that way."

The establishment of the hourly basis of shop work has destroyed the energy and initiative of shop employees and abolition of piece work would be the "most dreadful thing that could happen to railroad employees."

National rules constitute a dog-collar around the necks of the railroads, which would be free to negotiate their own rules with their own employees "the minute the board cuts the dog-collar." General Atterbury was referring to a cartoon from a labor paper representing national agreements as a collar on a dog labeled "railroads" and led by "labor."

Two charges against union officials were laid down by the general in the climax of the day's testimony. He declared that although the national agreements had the object of employing more men he was "a better friend of my men than any of the union men at this table." The declaration brought from Mr. Walsh a query whether General Atterbury represented the section hands of his road.

"No, but you do not. Those men are not represented here," General Atterbury replied.

Shortly afterward, in a discussion of specific rules, General Atterbury demanded that the rules be interpreted clearly and words defined. Mr. Walsh said he thought the ordinary meaning of words applied. This brought a quick retort from the witness: "Yes, but when it comes to devising means and methods of getting money out of a rule you gentlemen are the most expert of any I know."

"These rules appear very clear to me, General Atterbury," Mr. Walsh said.

"That's because you don't know anything about them," the witness replied.

Throughout the day General Atterbury maintained that no set of rules could be negotiated which would have a national application and declared the only satisfactory way of agreeing on rules was by direct conference between the officers who would apply the rules and the employees whom they would affect.

In his testimony General Atterbury said that he had always been able to negotiate with his employees, but that the national agreements had made it impossible to confer with the Pennsylvania employees because of the interference of union officials. He read from several American Federation of Labor Bulletins. which, he said, "throttled the employees."

General Atterbury read a statement earlier in the day which declared the American people had reached "the parting of the ways."

"No more serious question confronts us to-day," he said. "One road leads to government ownership, nationalization, Plumb plan-ism and syndicalism—the other road to industrial peace and the continuation of that individual initiative, energy and responsibility which is peculiarly American. The sign board on one road is 'national agreements'; on the other road 'negotiate directly with your own employees."

General Atterbury declared he had no fight with organized labor as such and said that within "reasonable limits it is a healthy spur to bring about fair conditions."

B. M. Jewell, representing the labor unions, raised some fundamental questions as to labor standards. He said that the "bill of rights" comprised demands "sanctioned by enlightened public opinion." This is a sanction which, if it exists, may be legitimately appealed to by railroad workers, for, whatever may be the case in private industry, the railroads are affected by a public interest and have been, in fact, brought thoroughly under public control.

The railroad unions take the position that their share of the gross operating revenue must not be diminished—that the "bill of rights" may not be abridged under any circumstances. The only logical inference, then, from their argument is that the share of the operators must be increased by another advance in freight and passenger rates or by a continuance of the government subsidies paid the roads under the defunct Federal Railroad Administration.

It is right that the unions should have their hearing before the Railroad Labor Board, as the law contemplates. But their case is not primarily against the roads, which nominally employ them. It is directed to the public, which is the real employer.

It must be admitted that the Labor Board was giving a large latitude to General Atterbury, fresh from the fields of France, and full of a militant spirit, but he found his match in the super-subtle Mr. Walsh who champions coolly and clearly the cause of the railroad men who do the real work, and whose rights, under the law as it now exists, he calmly maintains. We regret that we have not space to follow the two leading combatants, but as the subject is so full of vital interest we will make room for further extracts bearing upon the questions at issue.

General Atterbury contended that he could negotiate agreements with his own employees, but that no just and reasonable agreements applicable to the entire country could be written by anybody. He also maintained the right of the minority to a voice and charged the unions with assuming to represent all employees and using coercion in attempting to make them join the union.

Attorney Walsh opened his charges of a spy system on the Pennsylvania with a statement that $800,000 had been spent in 1914 on the road's police system. Gen. Atterbury explained that this amount covered all protective measures, such as crossing watchmen and similar employees. Under questioning, however, he admitted that the road did maintain a spy system, but declared he could not say how much had been spent on that department.

When Mr. Walsh asked the witness if the road did not have "little arsenals at various points where you kept guns and revolvers," Chairman R. M. Barton halted the examination on the ground that it was getting away from the inquiry ordered by the board. Several board members joined in the subsequent discussion, but O. A. Wharton, labor leader, finally insisted that the examination continue.

Mr. Walsh then explained that the rule on discrimination against any employee because of union affiliation was the "most important rule there is." His questions, he said, were intended to show that "a situation might arise and had arisen on the Pennsylvania where disputes between employees and the road could not be settled, despite Gen. Atterbury's statement that all the men on the road had grown up together."

Gen. Atterbury introduced a union bulletin, which informed shop craft employees that there would be "no seniority provisions for or positions provided for any other than employees and members of the organizations affiliated with the railway employees department of the American Federation of Labor." This bulletin was a direct attempt, Gen. Atterbury asserted, to force non-union men to join the union or lose their seniority rights.

A closed shop, either union or non-union, was denounced by the General, who said a worker should have the right to be or not to be a union man.

The General also read from a declaration of principles by the Cleveland Chamber of Commerce and signed, among others, by Warren S. Stone, president of the engineers, and W. G. Lee, head of the trainmen. This declaration said "freedom of contract should never be impaired" and declared employees and employer should negotiate agreements for their own guidance. This principle, Gen. Atterbury said, was the same on which the railroads took their stand.

Getting among the rank and file, who are called upon by many of the railroad officials to discuss the questions so important to employer and employees it is interesting to note that the marine employees of the railroads in and about New York harbor have agreed to accept the wage scale which was in effect before the United States Railroad Board increased their wages last year. The increase then granted was exactly the amount by which the railroads now propose to reduce the wages of these employees, running from 17.2 per cent for masters and mates and from 15 to 30 per cent for all others, including deckhands, bargemen, sweepers and other employees on the floating equipment.

But while the wage question, so far as it affected the marine workers was being settled, the possibility of a strike in at least one other division of the railroads' employees loomed larger. The Eastern Federation of the Brotherhood of Railway and Steamship Clerks, Freight Handlers, Express and Station Employees sent a resolution to E. H. Fitzgerald, grand president of the brotherhood, urging him to authorize a referendum strike ballot for immediate use should the railroads decline to obey the mandates of the transportation act of 1920.

The federation has a membership of 85,000. The resolution pledges its full economic force to protect the present standards of labor, and warns the railroad officials that they must carry out the letter and the spirit of the transportation act, and that "arbitrary action of some railroad officials in reducing wages undoubtedly will be the spark which will set the entire transportation system into a chaos and industrial revolution.

"We strongly resent and voice our opposition," says the resolution, "to the attacks being made upon the railroad labor union for the purpose of instigating un-American conditions of starvation wages and twelve hours a day. Abolishing payment for overtime work and installing the abominable and nefarious practices which were current in our craft only a few years ago is condemned, and we pledge our full economic force to protect our present standards."

The policy of the conferences which settled the wage questions affecting the marine workers, and which are now being held by practically all of the railroads, is for the manager of a department to fix a day and an hour and meet the men personally, explaining to them the necessity for a reduction in wages at this time. Each man employed on the floating equipment has the opportunity of a hearing, and each man is asked to personally sign a form agreement, which cuts the recent increase from his wages.

The employees, according to their representatives and to executives with whom they are holding the conferences, do not strenuously object to the wage cut at this time, but are protesting against any increase in the eight hour day. In every case they have been assured by the executives that the roads have no idea of lengthening the work day at this time.

Half a dozen classes of the workers on the New York Central's floating equipment went through the conference mill and the men on emerging said that they had agreed to the cuts and had signed forms to this effect. Not a single group of those interviewed by officials of the New York Central refused to continue work at the reduced scale.

Officials says that the workers may be roughly divided into two classes, and they have about determined as to what to expect from each group. If the group in conference is composed of all Americans the decrease is accepted immediately. In groups where the foreign element is predominant the signatures are secured, the executives say, only after quite a bit of grumbling by the men.

The present scale for masters, pilots or captains on marine equipment owned by the railroads is $220 a month; for mates and first officers, $150; for tugboats, steam lighter captains, masters, pilots and captains, $220; for pilots, $200 and mates $150. The others scale down from these figures to $100 a month.

One of the developments of the day was the decision of each road to give out, individually, any news to be made public about the conferences. Heretofore it has been made public by J. E. Fairbanks, secretary of the General Managers' Association.

General Chairman Enke, of the Lehigh Valley Railway System division of the Maintenance of Way employees and railway shop laborers, stated that a committee of the employees were submitting to the company a refusal to accept the wage reduction proposals offered by the road, and that the Lackawanna and Jersey Central employees would also refuse to submit to the proposed reduction.

Daniel Willard, president of the Baltimore & Ohio, commenting on the situation, gave it as his opinion that railroad wages will fall in proportion to the drop in the cost of living, but the reduction in wages will not reduce rates.

Meanwhile the railway executives are holding meetings, and it was learned that the roads welcome an inquiry such as is proposed by Senator Cummins and that the developments of the railroad's case for presentation in the expected probe are completed.

It was explained that the railroads want to get back to the policy of "home rule." They want to get away from being tied up wholesale with standard agreements and contracts, and want to deal directly with their own employees. It was stated that the railway association will do nothing to prevent the formation of these boards, but, on the other hand, it will take no part in promoting their establishment. It is understood that the roads in each of the regions will meet to discuss the subject with the trainmen at the latter's request.

Another development in the railroad situation last month was the decision of the common laborers and semi-skilled employees of the Jersey Central Railroad to reject the road's proposals that the men accept a reduction in wages. The decision was handed to the railroad officials at a conference with the men's representatives in Jersey City the same day. The proposed cut amounted to about 20 per cent. A conference with mechanics of the line was also held.

L. A. McGinley, general chairman of the federation of all mechanical and labor crafts on the Jersey Central, said he told the system heads that the men regarded the present scale as reasonable and that the question of reduction should be left to the United States Labor Board.

Charles Stein, assistant to President Bessler, of the line, said he pointed out to the workers the general financial and industrial situation, and tried to convince the representatives of the men that a readjustment of wages rates was necessary.

This is the fifth system upon which the employees have rejected proposed wage cuts, the others being the New York Central, the New York, New Haven & Hartford, the Lehigh Valley and the Delaware, Lackawanna & Western. The appeals of several of these lines for authorization to put the proposed reductions into effect on April 1 and 15 are already in the hands of the Labor Board.

Other bodies, as may be expected, are taking a hand in the controversy. The Chamber of Commerce of Kansas City, Mo., has submitted a series of questions to the United States Labor Board at Chicago, and all of the questions, it is asserted, are based on statistics which have been placed in the hands of the writers of the letter, and while they are put in the form of queries they constitute claims of statements of fact. Some of the most noteworthy questions which the Labor Board is asked to answer are as follows:

"Is it true that under the present classification rules of the shop crafts, in order to change a nozzle in the front end of a locomotive it is necessary to call a boilermaker and his helper to open the door; to call a pipe man and his helper to remove the blower pipe; and to call a machinist and his helper to remove the tip; also for the same force to be employed in putting on the new tip?

"Is it true that before Federal control a machinist's helper, or a handy man, could put in this nozzle tip alone?

"Is it true that men working on trucks, spring work and kindred occupations, and paid, before Federal control, handy men's or helpers' wages, or a shade above common laborers' pay, were made mechanics by Supplement 4 issued by Mr. McAdoo, and are now receiving 85 cents an hour, mechanics' pay?

"Is it true that these mechanics are called 'McAdoo mechanics' because they were made mechanics by the Director-General of Railroads and not by experience?

"Is it true that men employed to couple and uncouple hose between the cars (not as difficult or hazardous a task as hitching a span of mules) are now classed as car men, receiving 80 cents an hour, with time and one-half for Sundays and holidays, averaging $215 a month, for working seven hours and forty minutes a day?

"Is it true that if a shopman is held after his regular eight hour assignment to complete a job, for, say, one hour and fifteen minutes, he would receive pay for six and one-half hours for his one hour and fifteen minutes work?

"Is it true that under the present shop rules all shop employees are allowed one hour a week without performing any service—time is allowed on the pretext of checking themselves in and out of the shop?

"Is it true that this bonus hour costs the railroads $12,000,000 per year?"

It would be interesting to note the replies that the Labor Board will make to these questions, if any, but in justice to the Board it may readily be imagined that it would be impossible to pronounce on every item of interest that has come under their notice. Not only so, but as changes are being made in the personnel of the Board, it will in all likelihood be some weeks at least before any all-embracing decision will be arrived at. Meanwhile it is gratifying to note that a lessened degree of initiation is being manifested among the labor men generally, and as it is unquestioned that there is a tendency already manifested towards a lowering of prices of some of the commodities affecting the high cost of living, much will no doubt depend on the continuance of this trend as affecting the minds of the members of the Labor Board in arriving at a decision. It will be remembered that during 1916 and 1917 while the net operating income of the railways was fairly high, the rates of wages remained low, or at least were slow in being raised in the face of the rapidly climbing cost of living, and it should not be wondered at if a similar degree of tardiness should appear in the downward tendency so earnestly urged by the railway executives.

Meanwhile, the public is being well informed by the railway executives as to the averages rates of pay of railroad men now in vogue. Their official statement is as follows:

Railroad Pay 1917-1920

The following table shows the average monthly compensation of certain classes of railroad employees in 1917 and the average monthly pay of the same classes based on compilations of the Interstate Commerce Commission as to the compensation paid during July, August and September, 1920, following the wage increase granted by the Railroad Labor Board on July 20, 1920. Both averages are much lower than the pay received by employees who worked full time.

	1917	1920
Unskilled laborers	$ 57.92	$118.14
Machinists	116.17	195.11
Boiler makers	118.75	202.02
Blacksmiths	104.83	186.10
Electricians	85.83	184.44
Car inspectors	95.08	203.25
Car repairers	82.75	183.74
Other skilled laborers	88.75	185.20
Mechanics' helpers and apprentices	68.33	139.06
Train Disp. and directors	150.08	266.10
Yard engineers and motormen	149.25	237.56
Yard firemen and helpers	91.17	181.30
Yard conductors (or foremen)	132.08	228.85
Hostlers	103.67	182.02
Road freight engineers and motormen	175.67	303.80
Road freight firemen and helpers	106.25	219.27
Road freight conductors	154.58	266.20
Road freight brakemen and flagmen	100.17	209.82
Road pass. eng. and motormen	186.08	288.61
Road pass. firemen and helpers	112.83	218.59
Road pass. conductors	163.83	261.42
Road pass. brakemen and flagmen	91.17	186.52

In conclusion it is worthy of note that on March 31, President Harding began to take immediate action to assist the railroads. He has been officially informed that unless ameliorating measures are found, certain lines will assuredly be in the hands of receivers by July 1. It also became apparent that virtually the entire Cabinet and other agencies of the Government are devoting much time to the railroad problem. The President has had conferences with Chairman Edgar E. Clark of the Interstate Commerce Commission and Chairman R. M. Barton of the Railroad Labor Board, who brought to the conference detailed data on wages, rates, earnings and other matters relating to the roads.

The President also went over the situation with Senator Kellogg of Minnesota, a member of the Senate Interstate Commerce Committee. He has also conferred occasionally with Senator Cummins, chairman of the Senate committee on the same subject, the purpose of these conferences evidently being to obtain full information in which to bare recommendations to Congress. It is not assumed that the President made any suggestions to the two chairmen referred to. The means of handling the problem will likely be determined at the Cabinet meetings, after which it is expected that the recommendations to Congress will be made. Mr. Harding has no intention of going over the heads of the Interstate Commerce Commission or the Labor Board.

While the railroad situation will probably figure prominently in his message to the special session of Congress, it is indicated clearly that he will seek the remedy for the present situation in the agencies already created for regulating the roads. He will probably use the railroad situation as an illustration for what he considers the pressing need of a protective tariff.

President Harding's immediate action may be a recommendation for a reduction in wages, a reduction of rates, or both. Simultaneous reduction of both is considered the most probable suggestion from the White House. Apart from this the Interstate Commerce Commission is at work on a plan for arbitrary and drastic reduction of railroad rates on commodities which are shipped in competition with imports.

The Interstate Commerce Commission has already begun permitting reduction in railroad tariffs on certain commodities, particularly cattle and alfalfa, in which traffic has been at a standstill. Authorization for reduction of rates on wheat, cotton and other commodities is expected soon.

It was understood that former President Taft's recent talk with President Harding related to the railroad situation and that he suggested the conference with the chairmen of the Interstate Commerce Commission and the Railroad Labor Board. He is said to have come as a spokesman for the railroads to urge reduced labor costs. Railroad operators are bringing much pressure to bear on the President for reductions in wages of railroad employees.

General wage reductions for the railroad employees will not be put into effect without a fight from agencies of the railroad labor organizations. It is felt that the railroads have failed under private operation and control and that the only way out of the difficulty will be a return to Government operation.

Mr. Harding is expected to give his approval to the investigation into the whole railroad problem by the Senate Interstate Commerce Committee, which is to be proposed by Senator Cummins in the special session.

Chairman Clark, it is said, took the position that railroad rates could not be reduced while operation costs, including wages, were at the present high level. It was agreed that rates should be reduced to stimulate traffic, but there seems little chance of this, while wages stay up.

That the employees will accept a reasonable reduction in wages and the ending of apparent inconsistencies caused by the national agreements if principles of collective bargaining, for which they are fighting, are recognized, is the view expressed in some quarters. Most of the railroad employees have no desire for a strike if they are not asked to sacrifice too much. And wages were increased so much during the war that some feel that cuts averaging 12 to 15 per cent would not cause disastrous strikes, but it would be idle to predict any definite action at this time.

Early Cars of the Baltimore & Ohio Railroad

By J. SNOWDEN BELL

No. 3 Winans Coal Hopper

The Baltimore & Ohio "coal hopper," which was another of the products of the mechanical ability of Ross Winans, and is the subject of Patent No. 5175, granted to him June 26, 1847, is a striking instance of originality of design and practical value in the service for which it was intended. In fact, it is the basis upon which the modern bottom discharge hopper cars have been developed. Between the date of the original application of this car on the Baltimore & Ohio Railroad, which was about the year 1847, and that of the introduction, on that road, of coal cars of the present standard type, the date of which has not been found of record, but which was probably some time in the eighties, a large number of the coal hoppers, aggregating three thousand or more, was in service on the Baltimore & Ohio, and Cumberland & Pennsylvania Railroads, Barton Coal Co., and by other users. The most of these were eight wheel, but there was also a considerable number of six wheel.

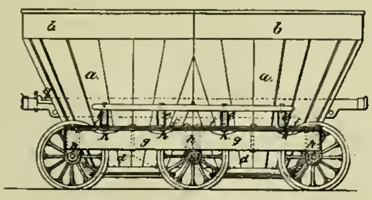


FIG. 1

The essential structural principle of the coal hopper will be readily understood from the side view (Fig. 1), and plan view (Fig. 2), which are reproduced from Figs. 5 and 6 of the Winans Patent No. 5175, in connection with the following extract from the specification:

"The transportation of coal and all other heavy articles in lumps has been attended with great injury to the cars—requiring the bodies to be constructed with great strength to resist the outward pressure on the sides as well as the vertical pressure on the bottom, due, not only to the weight of the mass, but the mobility of the lumps among each other, tending to 'pack,' as it is technically termed. Experience has shown that cars on the old mode of construction cannot be made to carry a load greater than its own weight, but by my improvement I am enabled to make cars of greater durability than those heretofore made which will transport double their own weight of coal, etc.

"The principle of my invention by which I am enabled to attain this important end consists in making the body, or a portion thereof, conical, by which the area of the bottom is reduced and the load exerts an equal strain on all parts, and which does not tend to change the form but to exert an equal strain in the direction of the circle. At the same time this form presents the important advantage by the reduced size of the lower part thereof to

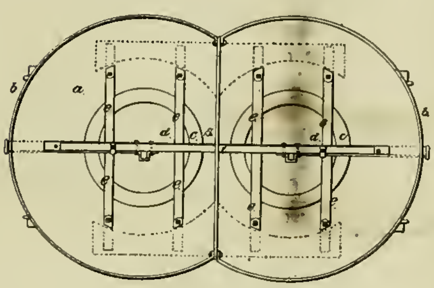


FIG. 2

extend down within the truck and between the axles, thereby lowering the center of gravity of the load."

Another feature which is shown and described in the patent, is a continuous draw bar, which is secured to cross bars of the frame. its purpose being, as stated in the specification, "to relieve the body from the strain due to the draft." The design of continuous draw bar which was later applied in the coal hoppers will be hereinafter described.

In the suit of *Winans vs. Denmead*, which was brought for infringement of this patent, it appeared from the testimony, that cars constructed by Mr. Winans, in accordance with the patent specification, while weighing only 5,700 pounds each, carried 18,550 pounds of coal; that the thickness of the sheet iron of the bodies was 3/32 of an inch; and the band around the top of the bodies was ¼ x 2 inches. The cars referred to were used in the transportation of coal from mines near Cumberland to Baltimore. The claim of Mr. Winans that cars of his patented design "will transport double their own weight of coal, etc.," was thus shown to be not fully warranted, but also much more moderate than he might have correctly made.

The characteristic feature of novelty of the Winans coal hopper was, as stated in the claim of the Winans Patent No. 5175, and shown in Figs. 1 and 2: "Making the body of a car for the transportation of coal, etc., *in the form of a frustum of a cone*," but, in actual practice, the upper portion of each of the sections which formed the body, was in the form of a frustum of a *cylinder*, and was much *deeper* than the lower conical portion. As shown in the patent, the cylindrical frustum top portion was of comparatively small depth, and the greatly deeper bottom portion was in the form of a frustum of a cone.

Figs. 3, 4 and 5, which illustrate the latest form in which the Winans coal hopper was built, are reproduced, on a reduced scale, from a blue print, of the Baltimore & Ohio R. R. Co., No. 2102, entitled "COAL HOPPER built by B. & O. R. R. Co., J. C. Davis, M. of M., Scale 1½ in. = 1 ft., June, 1879," and the special features of the car, while not fully shown in the drawing, will be sufficiently clear from a brief description.

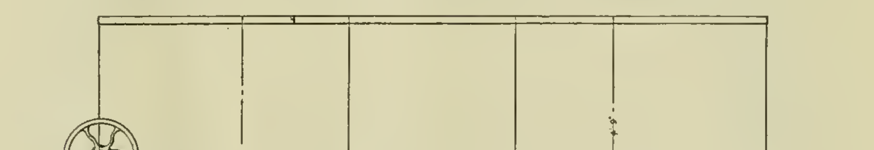


FIG. 3

The underframe was composed of longitudinal and end wooden sills, and the conical hopper bottoms of the three sheet iron sections of the body, projected downwardly between the side sills, and were furnished with drop doors. There being no intermediate sills, free discharge of the load was permitted. The car would, at first sight, appear to have been carried

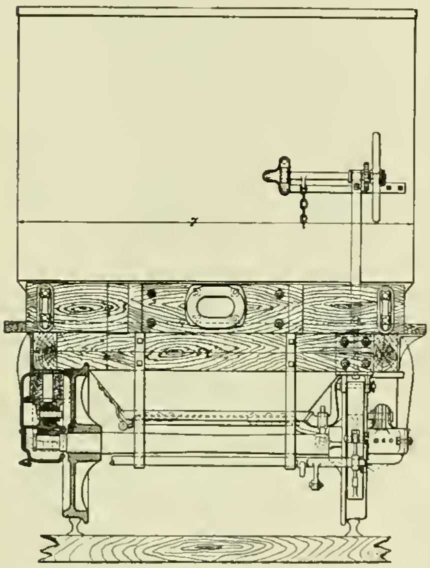


FIG. 4

on two four wheel *trucks*, but such was not the fact, as all four axles remained parallel, as well on curves as on tangents, no swivelling movement being provided for. The wheel base was only 10 feet 6 inches, and the parallelism of the axles, while not desirable, was not found to be substantially objectionable.

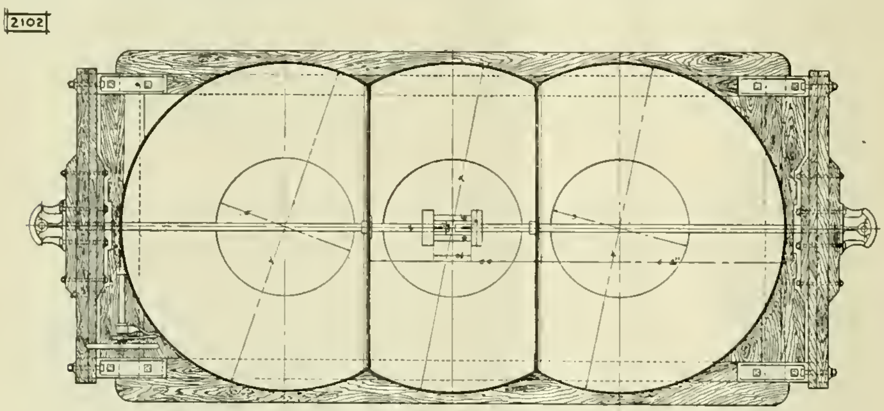


FIG. 5

The journal boxes of the two axles at each end of the car were bolted to pairs of equalizers, 5 x ⅞ inches, which passed through hangers, bolted to the side sills and extending downwardly between the wheels of the two end axles. The underframe was supported on the equalizers by rubber springs, fitted in the equalizer hangers. The wheels were 31 inches in diameter, and the axle journals 3 inches. The car body was 14 feet long over all, and the diameter of the body sections was 7 feet. The side sills were 15 feet 10½ inches long.

As shown quite clearly in the plan view, the continuous draw bar, which performed the very important function of relieving the car body from draft strains, was composed of two 2-inch rods, which extended centrally through the car body, and were connected, at the middle of its length, by a turn-buckle and keys. Heads on the opposite ends of the rods bore against flanges on the coupler castings, which were bolted to transverse spring beams, the ends of which were, in turn, bolted to the side sills. This made a simple, strong, and inexpensive draw bar, which relieved the car body from all strain other than the normal one of carrying its load.

A blue print in the book of car diagrams of the company indicates the weight of the latest pattern of eight wheel coal hoppers to have been 12,800 pounds, and their capacity 26,000 pounds, and a Superintendent of Motive Power of the Baltimore & Ohio R. R., now dead, stated to the writer, that the old Winans camel engines hauled 45 loaded eight wheel coal hoppers, from Piedmont to North Mountain, on that road. It is also the fact that these eight wheel hoppers were built for the remarkably low sum of $375.

The six wheel coal hoppers, with two body sections, as shown in an earlier print of a Baltimore & Ohio drawing, No. 46, Case 59 (not dated), differed from the eight wheel hoppers above described, both in dimensions and in structural details, among others, in having iron underframes and leaf springs. Their wheel base was only 6 feet 8 inches; length of body, 10 feet 1 inch; diameter of body sections, 6 feet 6 inches; length of frame, 11 feet 3 inches; and height above rail, 6 feet 8½ inches.

In view of the practical experience of Ross Winans in the construction and operation of both locomotive and car equipment, it is reasonable to accept, as correct, the statement made by him in the specification of his Patent No. 5175, to the effect that a car on the old mode of construction could not be made to carry a load greater than its own weight, and if this is the fact, the great improvement which was brought about by his coal hopper would alone make it worthy of a prominent place in the history of American railroad equipment. In consideration of its early date, it may favorably be compared with its successor, the modern heavy steel drop bottom car, and the consideration of its various features of construction cannot fail to be found both novel and interesting by those whose observation and experience of railroad equipment began after the coal hopper had passed out of use and of general recollection.

Handling Hot Boxes

The manufacturers of lubricating oils and greases state that driving box compound will not lubricate unless a reciprocating motion occurs, such as in driving boxes and main or connecting rods. On straight rotation, as in car journal boxes, compound has never proved satisfactory.

Lubrication conveys the wrong meaning to many. Oil or grease merely separates the metals and the brass rides on small particles of oil. Wool waste, under most conditions, serves its purpose better than cotton as it possesses greater resiliency. Water serves a purpose if used correctly.

The following methods of handling hot boxes have been given by lubricating experts: A hot box is a sick box and like a sick man, requires different treatment than a cool box. Pails of water should be dashed inside the box through the box lid opening. A short time should elapse between the water treatments in order to let the journal regain some of its warmth. This is known as water annealing. If too much water is used the journal will not have a chance to anneal—in fact, a process of hardening will take place.

The car should be re-brassed but before applying the new brass the journal and brass wearing face should be covered with the thick grease which is always found on the wheel plates near the rim of the wheels. Old dope should be removed and after the brass is inserted and jack let down the box should be packed with the old soggy dope from another box, as this is better material for a hot box than new dope. Enough should be taken from the other boxes to insure good dope contact with the journal and new dope can be inserted in the boxes robbed. If fresh oil is required for the hot box it should be sparingly used. Ice may be used but the method as outlined above should do the work if the above instructions are followed.

Railway Men's Conference

The second annual conference of International Railway Men will be held this month in Geneva, Switzerland. The conference held in London last year was said to represent nearly a million and a half of railway men.

Snap Shots By The Wanderer

"Lawing," as they sometimes call it in Vermont, is somewhat removed from railroad mechanical work, but railroad mechanics are sometimes involved in "lawing." And especially are these men called upon to testify regarding things that do and might happen to the mechanisms under their charge, and right there lies a danger. A professor in one of the big universities who has rather cultivated the business of giving expert testimony, once said to me: "Of course an expert's business is to testify as he is paid to testify even if he does have to stretch things." And later that same professor ruined a client's case, and fainted under a third degree cross-examination because he did stretch matters.

All this is suggested by the attitude of a master mechanic in a suit not long ago. He had given some testimony that bore every evidence of having been stretched, and was being subjected to a very painful cross-examination and had been confronted with certain engineers' reports that flatly contradicted his direct testimony. In order to protect himself he made the astounding statement that the engineers' reports, as to engine condition and engine performances and failures, were not reliable because, at the end of his run, the engineer was tired and anxious to go home. It did not save his own scalp and anyone can readily imagine the predicament that the record of such testimony would place the railroad in, if it were trying to sustain a case on the reports of its enginemen.

Men frequently feel that there is a kind of glamor accompanying a call to testify in court and there is usually an inclination to *stretch* things some in favor of their employing company. But it is dangerous as well as disreputable business and they had best have none of it, and can only serve to lower the witness in the esteem of the very men who encourage him to do the stretching. Tell "the truth, the whole truth and nothing but the truth," and then stop. If an employer or his claim agent does not want that, let him go elsewhere for his stretchers.

Only a few weeks ago a statement was made in public that the man-hour efficiency in railroad shops had fallen off 40 per cent during the period of government control, or that, at the end of that time it was only up to 60 per cent of pre-war status. This was checked by actual records in a number of instances giving results varying from 60 to 65 per cent. But within the past few weeks there has been a decided change for the better. The men are apparently working with a better will and more vigor until recently estimates place the rise up to as much as 75 or even 80 per cent of pre-war output. This is a heartening up of the labor situation, and is a most healthy reaction against the depressing tendencies under which work has been done.

By what good chance "Those things are managed so well in France I cannot say," but we get strange stories of what they do with their brakepipes in the way of securing a tightness of which we do not even dream. My first rude shock as to brakepipe leakage came to me in the caboose of a ten-car milk train, from which I could see that the air compressor was working for more than half the time, though we were making an express run and stopping only for water. Since then, I have learned that the air compressor has few leisure moments in ordinary freight service. And yet we hear most marvelous stories of how the French engineer is paid a bonus on the coal which he saves, and how, in order to save coal, he looks even to the saving of the steam required to operate the air compressor if it were to run uselessly. So when the system is charged he just closes the valve in the steam pipe and runs from stop to stop on his stored supply of air. If that be true then the condition of the brakepipe, hose and hose couplings must be superior to anything we have ever had in this country. Even on the rumor of the existence of such a state of affairs it seems as though it would be well to investigate and, then, if it were found to be true it would certainly be a paying proposition for any large railroad to send to France to learn as to how the thing is done.

If we assume a drop in pressure of 3 lbs. per minute in the brakepipe of a 60-car train, and consider this to be a continuous performance for the ten hours that it may take the train to run over a division; without making more than an approximate estimate as to the air losses, they are probably at least one cubic foot per minute or 600 cubic feet for the run. Well, the French engineer thinks this worth saving and we don't, or at least we don't seem to.

But suppose we did make the plunge and make a great showing of an attempt to throttle the activities of the air compressor, what then? Have we got the stamina to keep it up? If there is any one thing that the average American can do with greater carefreeness than his own and the other fellow's resources, especially the other fellow's. He will start out with a "loud da capo and brazen repeat" and with the attraction of much attention will make great preparations and arouse great expectations. Then as soon as the eyes of the gaping crowd, whom his noise has attracted, are withdrawn, he too forgets what he had in mind and turns his attention "to some new thing." And so he fails to keep the fire pails in his shops or the barrels on his buildings and bridges filled with water, and neglects to close his safety first gate because no one has been hurt for so long a time that no one ever will be. Like the man who noticed that whenever he lived through the month of February, he had always lived through the balance of the year.

It was vividly recalled to me in the smoking room of a sleeping car recently the thought as to the real value to the community as a whole of the man who devotes his life, or a goodly portion of it, to the fostering of discontent in the individual and the stirring up of a bitterness of feeling between the individual employe and his employer. I had heard the Pullman conductor rather grumbling over his conditions of service on the platform before the train started. There happened to be among the passengers a very prominent labor leader. And the conductor was highly flattered by the attention which the great man condescended to bestow upon him; a condescension so great and so apparent that he would have resented it with all his nature had it come from the president of the company that employed him. It was in the smoking room that I heard them talking. I cannot say that the actual statements made by the leader were false, but there was just enough innuendo thrown into what was said to make the man feel that he was being imposed upon and being so ground down by the corporation employing him that he fairly raged with hate and impotent fury.

Now was that a kindness to the man? Did it tend to make him a better man and employe? Did it put him in such a frame of mind that the performance of his duties would be such as to attract attention and lead to preferment and promotion? Was it likely to make him a better husband and father? In short, would he, after such a conversation, be apt to be a happier man and a citizen more valuable to the community than before? But with the same subtleness of innuendo the leader led to the inference that he and he alone was the only proper person to show the way out of the wilderness of oppression. I cannot say that the personal policies of all leaders are like that, but if the members of all of the great railroad brotherhoods are treated and misguided as this individual was then there is small wonder that railroads are not getting the service for which they are paying, and it is of much wonder that they get even as much as they do. Men, as a rule do little thinking, and what they do is more easily led into evil channels than good, hence the great responsibility to their country and the world of those men who essay to guide a great unthinking mass of followers.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:
JAMES KENNEDY, Managing Editor.
GEORGE L. FOWLER, Associate Editor.
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A. J. MANSON, Associate Editor.

London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $3.50 or fifteen shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

Work of the American Engineering Standards Committee

It is interesting to observe that although the American Engineering Standards Committee has been actively at work for only slightly more than one year, and much of the time and effort of the Committee has necessarily been spent in laying a basis for work the fruition of which will require at least two or three years, yet considerable progress has already been made in the unification of the more important standards and in overcoming the confusion that was being produced by the numerous organizations (more than 100) that hitherto published engineering standards without systematic co-operation among themselves.

Among other detail work prior to January 1, 1921, there had been approved by the Committee "American Standard Pipe Threads." This subject had gone through the regular procedure of a sectional committee, at a number of conferences held in Europe prior to a proposed meeting of the Commission for an International Standard Pipe Thread. The Committee has a satisfactory understanding with the National Screw Thread Commission, and the work of the sectional committee will naturally be based to a large extent on the work accomplished by the Commission.

The rating and marking electrical machinery and apparatus, are also among the projects in hand, as also are ball bearings, gages, gears, nuts and bolt heads, pipe flanges and fittings, and machine tools. The mechanical transmission of power, including power control, are also all being discussed, and plans looking toward standardization will soon be formulated.

These are only a few of the subjects taken in hand by the committee, and referred to special boards and commissions, and the work undertaken by the Standards Committee may be said to be making progress in the hands of the most accomplished experts of our time. Some of these deserve special mention, as do certain other projects upon the organization of which considerable work has already been done. Among others a comprehensive programme of industrial safety codes has formed an important part of the Committee's work. In the past there have been a large number of organizations formulating safety codes. A conference of all bodies interested in the subject was called by the Bureau of Standards, January 15, 1919, to consider the possibility of preparing national safety codes which might be generally used throughout the country instead of having a large number of such codes, differing considerably from state to state. After extensive discussion a second conference was held December 8, 1919, at which more than a hundred organizations were represented and at which it was unanimously voted that a comprehensive programme of safety codes should be undertaken, and that it should be carried out under the auspices and rules of procedure of the American Engineering Standards Committee, in order that there be proper co-ordination, elimination of overlap, etc. Active work is now in progress on twenty-four such codes. State commissions, which are the bodies responsible for the legal adoption and enforcement of safety codes, associations of insurance companies, national engineering societies, manufacturers' and industrial associations, labor and civic organizations, and technical bureaus of the Federal Government, are all heartily co-operating in the work. The committees responsible for the formulation of each of the codes are made up of representatives of such of these bodies as are interested in the particular code in question.

There are now national standardizing bodies in Austria, Belgium, Canada, France, Germany, Great Britain, Holland, Italy, Sweden, and Switzerland. The Committee is in touch with all of these and is actively co-operating with several of them; for example (in addition to those already mentioned), with the Swiss in the matter of ball bearings and nuts and bolt heads, the Belgians on zinc, the British on gages and machine tools, and the Canadians on elevators and some of the safety codes.

In one important particular the method of work of the Committee differs from that of the foreign national bodies. When the Committee was formed there were already a large number of organizations doing standardization work some of whom had accomplished, and were engaged in, very important work. This led to a policy of decentralization. Each sectional committee is organized by, and under the leadership of, one or more of the principal bodies interested. Such bodies are known as "sponsors." The Committee has decided "if it is the desire of any industry to have a general committee, representative of the industry as a whole, as a means of developing and correlating the standardization work of the industry, the arrangement will be eminently satisfactory to the American Engineering Standards Committee." Two such general correlating committees have already been formed,—one for Safety Codes, and one for mining standardization.

As a result of a year's experience, the Rules of Procedure were completely redrafted in October, 1920. Clarification in light of experience was the principal consideration in the revision, and but very few changes in substance, and those minor ones, were made. The most important of these are explicit recognition of the representation of organizations as such in the make-up of the sectional committees, and the introduction of a greater flexibility into parts of the rules.

It is planned that the office shall serve as a bureau of information on engineering standardization, keeping in touch with all that is going on in connection with standardization both in America and abroad, so that full and reliable information on any subject in connection with standardization work may be promptly given. While only an extremely modest beginning has been made, it has usually been possible to give some assistance in response to the frequent calls for information which are even now received. It is hoped, however, that in the near future means will be provided to build up a really efficient and effective information service. The functions of such a service should not be limited to answering inquiries and to providing information for the use of sectional committees, but information of interest to the various branches of our technical industries should be placed at their disposal promptly, both through direct contact with the various industrial associations, and through the technical press.

Copies of reports on subjects embraced in the scope of the work of the Committee may be obtained by addressing a request to the American Engineering Standards Committee, 29 West 39th street, New York.

Patent Office Predicament

In ways that are dark nearly all governmental commissions are wrapped in mystery. Like moles they work in the dark, but it must not be imagined that they are idle. A bill the purpose of which was to furnish some measure of relief to the congested condition of the Patent Office, and known as the Nolan bill, failed to pass at the last session of Congress, and its failure is attributed to the Federal Trade Commission section. It is believed that this section is a dangerous measure in itself and will open a most unfortunate activity for the government.

The bill in question formed for the relief of the Patent Office, after passing the House of Representatives with satisfactory provisions, failed to pass the Senate with those same provisions, solely because of the addition to it of an unrelated section, known as the Federal Trade Commission Section. The opposition in the Senate to this undesirable section is determined and has expressed an intention to prevent the Patent Office from getting the desired relief, unless the Federal Trade Section is removed from the bill.

More than preventing the Patent Office relief, however, the Federal Trade Section is believed to be a dangerous measure in itself. It provides that the Federal Trade Commission may receive assignments of and administer inventions and patents from governmental employes and is an entering wedge for further legislation to empower the Trade Commission to receive patents from non-governmental inventors or owners.

An exclusive license would have to be granted, at least for a few years, to induce any one to undertake the almost always necessary development expense, and the Trade Commission would surely be charged with favoritism in granting such a license. In order to protect its licensees, the Trade Commission would have to sue infringers, a most unfortunate actvity for the government. The industries would close their doors to the government employes fearing to disclose to them their secrets or unpatented inventions, and research by the industries would be discouraged for fear that government employes, using government facilities, might reach the result first and patent it.

The Trade Commission, owning a large body of patents, in case that one of its patents was found to be infringed during or at the close of a frequently very expensive development by private interests would be able to dictate in the license the price at which the article, which was the object of the development, could be sold, or to dictate other similar conditions, thus depriving the development of much of its value; and could even require the licensee, as a condition for granting the needed license, to practically destroy some of its unrelated patents, as by licensing the trade generally when it would prefer to retain the monopoly for itself.

The foregoing and other objections would result in making patents less desirable to own or to purchase, and consequently would decrease the incentive to produce inventions, which production is the main purpose of our patent system. The proposed section is unnecessary for the protection of government employes, since they now have all the rights which non-governmental employes have to patent inventions and to sell them. It is therefore believed that the Federal Trade Commission section should not be enacted into law in any form, even as a separate bill.

Choosing Coal by the Microscope

The selection of the particular coal to give the best results for certain purposes has always been an important matter for the engineer. Today, with the enhanced cost of coal it has become a vital problem. Hitherto it has been the custom to rely upon chemical compositions and tests of the heat value of the coal, but the engineer of a leading firm which buys about a quarter of a million tons of coal every year for various uses confirms the suspicion that something more is needed before the most economical coal in each case can be determined. He has worked out a series of microscopic tests by which various coals are classified, each class being most efficient for steam raising, or gas production, or some other particular service. The method adopted is to grind the surface of a small sample of coal exceedingly smooth, fix it by the smooth surface to a piece of glass and grind away the remainder until a slice thin enough to transmit light remains on the glass. When examined under the microscope this slice reveals the inner structure of the coal. The behavior of the coal when fixed corresponds to its structure, which thus provides an index to the use which ought to be made of the coal. The same investigator has found that very uniform results are given by samples from the one seam of coal, so that one or two tests are sufficient to determine the qualities of the seam. If this method is developed it will become possible to order coals according to an exact specification much as is now done with special steels and alloys.

Autogenous Welding

The practice of welding "backwards" is extending but slowly, as although an economy of gas and welding metal is claimed for this method, it is difficult to persuade welders to alter their methods of operation.

It can be said that in many workshops too much gas is used when welding a joint. As an example, when welding plates the torch is sometimes passed along the full length of the joint to deepen the chamfer, after which the metal is filled in, commencing from the end again. Thus the time required and the gas used to complete the work is 50 per cent, or even 100 per cent, more than is actually necessary The advantage of welding backwards is that the width of the joint can be kept at its minimum. The difference in the width of joints made by this method and those made in the more usual way is not great for plates of 3 or 4 mm., but for plates of 6 mm. and upwards it is considerable. It is also possible to reduce the angle of the chamfer, which, however, cannot be less than 30° on each plate. The width of the weld should only slightly exceed twice the thickness of the plates. Tests have been made to determine whether welds could be made by this method without chamfering the edges of the plates, and satisfactory joints were made by making the gap between the edges approximately one-half the thickness of the plates, but the work could not be done so rapidly. (M. Piette.)

The Steam Locomotive

The steam locomotive still retains pride of place on the railways of this country, and there is little or no evidence of its being challenged in the near future except in a restricted measure. The day of electric traction for all classes of traffic is certain to dawn sooner or later, but, according to the signs, that day is as yet afar off. Similarly with the internal combustion and other alternate forms of locomotives on railways; evolution must necessarily be distributed over lengthy periods and the replacement of the steam locomotive is bound to be slow and partial, rather than a rapid change. It is, after all, the steam locomotive that has created railway traffic, and in many ways railway construction and operation are based upon conditions in which that method of propulsion is a more or less deciding factor. For that reason, therefore, we believe, as so many others do, that the locomotive in its present-day accepted form, improved by the means still available, internal as well as external, will continue for some very considerable time ahead to represent the principal factor in the hauling of railway trains.

Railroad Employees Ask a Conference with the President

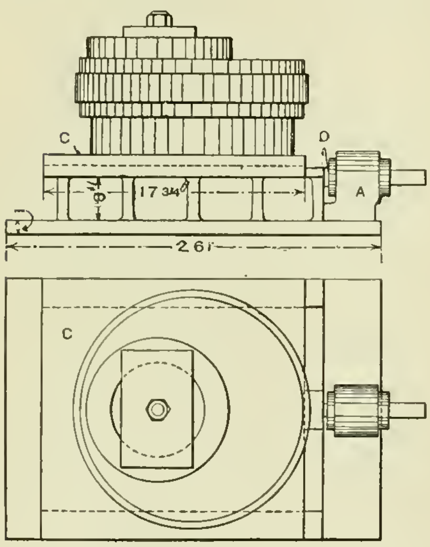
The railroad employees asked the President to call a conference of executives and labor unions to settle problems of wages and rules. The employees are anxious to obtain such a conference on national lines, as by entering it, the railroads would, in a sense, recognize the principle of collective bargaining and be defeated in their purpose of settling each case individually. The executives have refused to enter such a conference.

Shop Kinks—Delaware & Hudson Company

We present herewith four handy shop tools that are in use in the shops of the Delaware & Hudson Co., at Watervliet, New York.

Chuck for Boring and Turning Eccentrics

The illustration shows a chuck for holding eccentrics on a boring machine by which they can be bored and turned with one setting. The chuck has a base 26 in. long and 18 in. wide which is bolted to the table of the machine. This base has an upwardly projecting lug *A* through which the shank of an operating screw *D* passes and which has a squared crank stem on the outside by which it is turned. There are two ways on the base which



DETAILS OF CHUCK FOR BORING AND TURNING ECCENTRICS

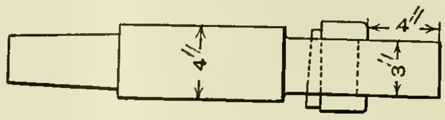
are planed to take dovetailed slides on the sliding portion of the chuck *C* to which the eccentric is directly bolted. This sliding portion has a nut on the underside that engages the screw *D* so that, as the latter is turned, the slide may be moved back and forth.

The two halves of the eccentric are first planed and bolted together with the regular holding bolts. It is then bolted down to the sliding portion or platen of the chuck *C* with bolts and straps in the usual manner; but so set that the proposed centers of the axle seat and the outside circumference of the eccentric are on a line with the adjusting screw of the chuck.

The eccentric is then adjusted so that the hub is central with the boring bar and the wheel seat is bored. Then, for clearance purposes, it usually becomes necessary to remove the clamping bolts of the eccentric and a strap over the hub is used with a bolt through the wheel seat, as shown in the engraving. The chuck is then moved over by the amount of the eccentricity of the eccentric and the outside is turned. This not only saves an extra setting of the eccentric for the work but expedites it, and avoids the use of heavy counterbalance weights which would have to be used if the eccentric were to be turned in a lathe.

Boring Bar for Side Rods

The side rods using solid brasses are bored in a drilling machine with a solid



DETAILS OF BORING BAR FOR SIDE RODS

cutter set in an ordinary boring bar that is provided with a leading tip.

The rod is first laid out and a hole 3 in. in diameter is drilled for the crankpin brass and one 2½ in. in diameter for the knuckle pin. These are the diameters of the grinding tips of the boring bars that are used and by means of which the removal of the balance of the metal is accomplished.

With the heavy drilling machines used it is possible to enlarge the original hole by about 2 in. in diameter for each cut; that is, take a cut 1 in. wide. This makes it possible to bore a hole 9 in. in diameter in three cuts after the original hole has been drilled.

It takes about four hours to bore a hole when the rod is 5 in. thick. To this, 15 minutes must be added for drilling the pilot hole. This time makes no allowance for the settig of the rod in the machine.

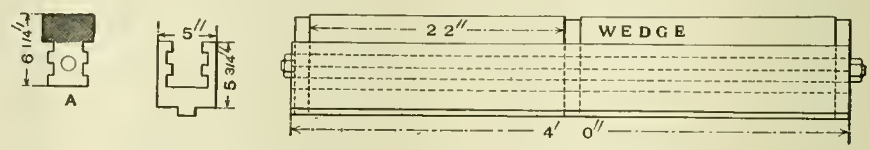
Chuck for Planing Shoes and Wedges

This chuck can be built up so as to extend the full length of the planer bed. Its base is formed of a series of cast iron channels each having the section and approximate dimensions of that shown in the accompanying engraving. Each one of these sections is 4 ft. long and three of them, with a shorter one, 2 ft. long, are placed end to end on the planer bed, thus forming a chuck 14 ft. long.

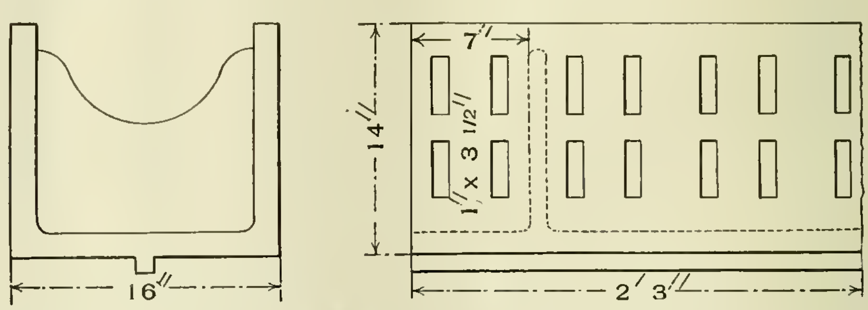
The rest of the chuck is made up of a 1¼ in. diameter rod about 18 ft. long and threaded at each end, and a number of separator pieces *A* of the section shown and which are made to fit loosely into the cross section of the base.

These separator pieces are made of steel and have their two faces, at the upper end, grooved to form teeth to bite into the metal of the shoes or wedges which they are to hold, as indicated by the double cross hatching.

In setting up the machine the base is first bolted to the platen of the planer and the wedges laid on the upper edge with a separator between each two and one separator at each end of the string of pieces to be planed. The 1¼ in. threaded bolt is next run through the holes in the separators and a piece of pipe about 12 in. long is slipped over the end as a spacer between the end separator next to the shoes and another put on at the end of the pipe, an arrangement that will be readily understood although not shown in the engraving. Then outside of this comes another piece of pipe and beyond this, at each end, the nut.



DETAILS OF CHUCK FOR PLANING SHOES AND WEDGES



DETAILS OF FRAME FOR CLAMPING DRIVING BOXES AND ECCENTRIC CRANKS

It will be seen that, as the separators are fitted loosely into the grooves of the base, the tendency of those, against the ends, of the line of shoes, will be to have their upper ends tilted outward, thus binding against the top of the base. While the tightening of the nuts will, at the same time, tend to push the bottoms of the separators at the ends inward, also binding them.

Those between the shoes have no tendency to tilt but their teeth bite into the metal of the shoes or wedges and thus hold their ends down against the top of the base.

With two rows of these chucks on a double-headed planer, it is possible to plane twelve shoes or wedges at once.

The number of parts that enter into such a set-up makes it necessary to draw up the nuts as tightly as possible, for which purpose a wrench with a handle 5 ft. 9 in. long is used.

Frame for Clamping Driving Boxes and Eccentric Cranks

A somewhat similar base is used for holding driving boxes to a planer. It consists of a cast-iron channel cast in lengths of from 6 ft. to 8 ft. and having legs of different heights according to the size of the box with which they are to be used; the cross section shown being one that may be taken as typical.

The bottom and the two outsides are finished and the vertical legs are perforated with a series of 1 in. by 3½ in. slots to take the bolts that hold the boxes in place. The cross ribs are spaced at intervals of about 2 ft. and are 1 in. thick.

To use the frame it is bolted to the planer in the usual way with T-bolts slipped into the platen slots. The boxes are first finished on the two faces at the end of the journal bearing and are then fastened by bolts and straps to the frame; one set of boxes on each side. This makes it possible, on a double-headed planer, to finish the planing of the wedge and shoe bearings of two lines of boxes at the same time. When one side has been planed, it is necessary to turn the boxes over, in order to finish the other side.

Preventing Deformation of Welded Work

The causes of deformation of welded parts are dealt with, and methods of preventing its occurrence are explained in an article by M. Piette, quoted by the *Technical Review* from the *Revue de la Soudure Autogène.* The expansion and contraction of the metal cannot be suppressed, but it is possible to take such measures that the bad effects are annulled.

It is understood that if the edges to be welded could be heated along their whole length simultaneously they would expand regularly, and on cooling the length of the finished joint would be the same as that of the pieces before the operation commenced, and there would be no deformation either longitudinally or transversely. With a torch this is not possible, as small portions of the joint are heated successively, and as a consequence expansion and contraction occur at the same time at different points along the line of operation, thus causing deformation in the finished article. Generally speaking it can be said that when executed under ordinary conditions a weld is shorter than the edges before welding. The width of the plates also influences the amount of deformation, not on account of conductivity but because of the resistance offered by the weight, which tends to reduce the deformation and to increase the internal stresses.

In order to avoid deformation as much as possible one or more of the following methods may be applied:—

1. Divide the welding so that the effects of contraction are neutralized. 2. Bend the parts so that on contracting they tend to regain the correct shape. 3. Produce local contraction by cooling suitable points previously heated to redness, thus producing expansion at other points. 4. Pre-heat the pieces to be welded.

A number of examples of work follow, these being cases frequently met with in everyday practice, and consisting of the welding of tin plates, tubes, etc. The steps to be taken in order to minimize deformation are indicated for each case.

The Hudson Tunnel

The New York State Bridge and Tunnel Commission in a report to the Governor state that the New York-New Jersey Vehicular Tunnel will be opened for traffic on December, 1924.

According to the report, Mr. C. M. Holland, the chief engineer of the commission, has prepared a schedule of contracts, which, if carried out, will make possible the completion of the work by the date mentioned. It was pointed out, however, that in order to live up to the schedule it would be necessary to have money available in order promptly to let the contracts.

The tunnel, which is being constructed by the States of New York and New Jersey, will be the largest in the world for vehicular traffic. The estimated cost will be $28,669,000. New Jersey already has provided for its share of the total cost, having held a referendum on a bond issue. The New York Legislature has appropriated $2,000,000, and bills asking for an additional appropriation of $5,000,000 have been introduced at the current session.

Actual physical construction has begun on the New York side and is progressing rapidly, the report says, while work is expected to be started on the New Jersey end on April 16.

Peat in Minnesota

The peat operations of the Hennepin Company have comprised the work of excavating and air-drying on a 60-acre tract, three miles from the city limits of Minneapolis. The peat on this bog averages 7 ft. in depth. It is excavated by the Garnett peat machine, which digs, macerates, spreads and cuts into briquettes in one operation. The machine requires one man to operate, and has a capacity of 100 tons of air-dried peat per day. The dry pulverized peat contains about 3 per cent moisture, 10 per cent ash, 0.32 per cent sulphur, and from 9,000 to 10,000 B.t.u. per lb. Results of tests showed that about 10 per cent more peat was required to carry the same load than with pulverized coal. Pulverized peat burns with a longer flame than pulverized coal, due to its volatile content and weight, and from the nature of the fuel the quantity of air for combustion can be greatly reduced from that required for coal. The Bureau of Mines, University of Minnesota, estimates that there are in that State alone seven billion tons of peat, the greater portion of which is available for fuel.

Alloys

According to a recent patent by F. P. Treanor, the Carnival, Gallowgate, Glasgow, alloys for filling-in defects in castings, particularly internal-combustion engine cylinders, consist of about 40-45 per cent of lead, 12-15 per cent of antimony, 34-40 per cent of tin, and 6-11 per cent of copper. Separate alloys are first made of the lead, antimony, and a small part of the tin, and of the copper and the remainder of the tin, and the two alloys so produced are made into the final alloy. The alloy may be applied to the casting in the manner described in certain specifications or by cleaning the cavity mechanically and chemically, running in the alloy with a flux, and working it with a copper bit and a hot flame. An alloy comprising 5-45 per cent of lead, 10-25 per cent of antimony, 30-70 per cent of tin, and 15-40 per cent of copper, with traces of iron, also is referred to.

Drought Hinders the Swiss Railroads

The electrification of the whole of the Swiss federal railway system was started a few years ago and is well under way. Under drought conditions it was found necessary to run the electrified portions of the system with the old steam locomotives, as was done after a mild winter three years ago, but this time on a much more extensive scale. A strong hope is being expressed that the unusual drought would shortly be relieved by heavy spring rains, raising the lakes, swelling the dried up or dwindled torrents, and restoring the economic life of Switzerland to a normal basis in preparation for the great summer influx of tourists from all over the world.

It may be stated that droughts of the kind referred to have been of extremely rare occurrence, so much so, that in planning the electrification of the Swiss railroads, it did not seem to enter into the minds of the engineers that such a contingency might arise.

Official Report of the War Industries Board—Details of Construction of Locomotives and Cars

The report of the War Industries Board which has just been issued from the Government printing office has the quality of absorbing interest commensurate with the subject of which it treats. Covering as it does more than 400 pages it is all-embracing in its scope, and may be looked on as an authoritative compendium of the gigantic work accomplished in our industrial life during a period of unparaleled stress in meeting the many problems involved in the participation of the great war. During the period before the country became a party to the conflict, much of the attention of those who fostered preparation for the inevitable day was devoted to plans for a trained personnel. The speed with which an army grew from 200,000 to 4,000,000 men and the success with which it was being moved to Europe at the rate of 225,000 troops per month during the summer of 1918 was an accomplishment new to history and a phenomenon which amazed not only our enemies but our allies.

The construction of locomotives and cars with which railway men are particularly interested, grew out of what was known as the Advisory Committee of Plants and Munitions. This committee was formed May 28, 1918, to take over the work of the committee on production of the council. S. M. Vauclain, who had been chairman of the Munitions Standards Board, then of the committee of production, became chairman of the advisory committee and took with him the records and most of the personnel of the early organization. The committee worked in a general way to stimulate production, to advise on plant extensions, etc. Particular attention was given to the production of freight cars and locomotives for the army. Work on standardization of types of cars and locomotives was carried on. The committee was given a special assignment to assist the Czech-Slovak Government in securing supplies in this country. The plan at the end was to have the work of this committee absorbed by the Facilities Division on the one hand and the Railway Supply Section on the other. The chairman had arranged to go to France as manager of the Chateauroux tank plant.

The Railway Equipment and Supplies Section was formed on July 30, 1918, with J. Rogers Flannery as chief. During the earlier period the Advisory Committee on Plants and Munitions had been doing very important work in aiding the Railroad Administration and United States military railways in standardizing types of locomotives and cars and following up their production. But in July so many conflicting orders were being received for cars and locomotives from the different branches of this Government and from the Allies and manufacturers were having so much difficulty in securing materials, that a central channel for the distribution of orders and for laying down a plan of delivery of the products was decided upon.

The two large problems related to (1) locomotives and (2) freight cars. The former was on account of the limited productive capacity as well as the difficulty in securing sufficient iron and steel; the latter lay chiefly in the iron, steel and lumber supply.

The report states briefly that there are only three builders of locomotives in the United States, besides a few companies which turn out smaller engines. The Railroad Administration ordered 1,415 large steam locomotives in April, 1918, and was very anxious for speedy delivery. On July 23, 1918, the United States Military Railways ordered 510 standard-gauge locomotives from the Baldwin Locomotive Works and insisted upon immediate prosecution of the order. The Railroad Administration was extremely anxious that the military locomotives should not interfere with its order. It was understood that further orders would come from the A. E. F. Plans were considered for adding to the facilities of the Baldwin and American companies at Government expense to the amount of $25,000,000.

A general meeting was held of locomotive builders and representatives of our Government and of the Allied Governments. A requirement of about 9,000 locomotives to be supplied between July, 1918, and December, 1919, appeared. This was clearly greater than existing capacities could fulfill. But the delays inevitable in the construction of new plants under circumstances as they were at that time pointed to the fact that no relief could be hoped for earlier than the middle of 1919 under a new facilities plan.

There were about 65,000 engines in use in the country. It was suggested that the Railroad Administration wage an aggressive campaign of general repair work at all shops, that old locomotives might be returned to service and the administration's demand for new ones be considerably reduced. This plan was carried out. No new plants were started, and the "Pershing engine program" was given a high preference. It was decided that the Baldwin Works should concentrate on the military standard-gauge engines and that the American and Lima companies should turn out administration engines exclusively. Under this plan the Baldwin Works was turning out the standard military engines at the rate of 256 per month before the end of the war period. For the week ending October 26, 1918, the Baldwin Works turned out 87 engines. The British and French were taking whatever production was not required by the A. E. F.

The Italian government was unable to adopt our standard military engine because it was too heavy, our so-called "Pershing engine" weighing 83 tons, while the Italian engine weighs 75 tons, but the Italian government was particularly eager to place a large order for locomotives here. The American Locomotive Co. had built Italian engines and possessed patterns, but for several weeks it could not devise a way to find facility space for the Italian order. The Baldwin Co. offered to take over the patterns and undertake the work, and plans were under way for doing this when the American Locomotive Co. came forward with an offer to construct them at its Montreal plant, and the order was finally placed that way.

The war brought out a demand for hundreds of narrow-gauge steam locomotives and large gasoline locomotives. The larger companies, particularly the Baldwin Works, had experts and drawings for this work. But because their plants were filled to capacity with orders for standard engines most of this business had to be distributed among the builders of small mining and industrial engines. Drawing and specifications as well as skilled workmen, were turned over by the larger companies to the smaller ones in order to facilitate this work.

In regard to the construction of freight cars there were 30 car builders in the country capable of turning out freight cars for the Railroad Administration and for the American Expeditionary Forces. December, 1917, when the Railroad Administration took control of the roads, saw this industry running at very low ebb. In April, 1918, the administration ordered 100,000 standard-gauge freight cars, distributing the order among 16 builders. Great difficulty was experienced in procuring the raw materials and in rehabilitating the organizations. Orders were placed with all the car companies at the same time, and efforts were made by all of the concerns to get simultaneous deliveries of the various materials. By the time deliveries were beginning the United States Military Railways placed orders with the same companies and 14 additional companies for 30,000 freight cars. An A-5 priority was obtained for the military cars, which, gave them preference over orders for administration cars, which rated only a B-1 priority.

A schedule of deliveries for the military cars calling for rush work was outlined. This naturally retarded the building of the administration cars, whereupon the Railroad Administration recommended that orders be placed in Canada for as many as possible of the new equipment, but the representatives of the military railways objected to this on the ground that too much time would be lost in shipping the raw materials to Canada and that labor conditions were not good there. Finally a schedule of distribution of the new order, and a new schedule of deliveries for all orders was drawn up and approved by both parties.

In order to assist the manufacture of cars and locomotives in securing their material as quickly as possible, this section, with the approval of the Steel division and the Lumber section, handled all standard forms for allocation of steel and lumber for these manufacturers.

Standard forms were adopted by the section on which the railroad equipment manufacturers reported at the beginning of each month delivery of materials required for the following month, and from the data the section furnished the Director of Steel supply with a statement of the steel tonnage required by each manufacturer from month to month. By this method orders which had been allocated were followed through to delivery.

Definite monthly schedules of shipments from the steel manufacturers were arranged for in order that the railway equipment manufacturers might lay out their programmes of work with some certainty of receiving materials. The manufacturers of specialties, who furnished their products to the builders of cars and locomotives, were builders themselves. Under this system a certain percentage of the steel tonnage of the country was set aside for railroad purposes each month, the amount being determined upon by conference between the section and the steel division. The section kept a close watch on the production of both cars and locomotives throughout the country by a system of weekly reports of output from each builder. The entire routine had just become completely established, and seemed to be working well when the armistice made a further application unnecessary.

It is interesting and illuminating to note, by way of an appendix relative to the report, an itemized tabulation of the production of locomotives in the United States from 1911 to 1918 inclusive, from which it will be seen at a glance that the extraordinary efforts made during the war period of 1917 and 1918 did not surpass, if it equaled, the production during 1913, the year preceding the beginning of the war.

The following is the tabulated form as it appears in the official report of the War Industries Board.

PRODUCTION OF LOCOMOTIVES IN UNITED STATES, 1911-1918

FOR DOMESTIC USE

Builder	1911	1912	1913	1914	1915	1916	1917	1918 U. S. Railroad Administration[1]	1918 Other Domestic[1]
Baldwin	1,276	1,162	1,564	464	239	744	518	570	99
American	1,190	1,835	2,004	610	317	973	736	347	805
Lima	118	141	172	208	125	240	253	4	313
Total	2,584	3,138	3,740	1,282	681	1,957	1,507	921	1,217

FOR FOREIGN USE

Builder	1911	1912	1913	1914	1915	1916	1917 U. S. military	1917 All others	1918 U. S. military	1918 All others[1]
Baldwin	174	218	226	136	451	551	830	874	596	763
American	103	101	91	74	242	245	150	655	85	406
Lima	36	31	25	15	4	11	...	11	...	8
Total	313	350	342	225	697	807	980	1,540	681	1,177
Grand total	2,897	2,488	4,082	1,507	1,378	2,764	2,487	1,540	1,602	2,394
Total	...	...	...	...	...	...	4,027		3,996	

[1]January 1 to October 31, 1918.

Erie Locomotive No. 2926, Duplex Stoker-Fired, Makes Continuous Trip Over Three Divisions, 332 Miles

To demonstrate that a trip for a locomotive need not necessarily be limited to one division of one hundred miles or so, as has been generally the fixed practice on railroads for many years past, the management of the Erie Railroad recently planned a test run by which one of its through New York-Chicago passenger trains would be hauled over three divisions by one engine alone, instead of using three engines for three divisions, as is the practice at the present time.

This test was based on the belief that the superior firing service of the modern mechanical stoker on heavy locomotives and long runs would render fire cleaning unnecessary at the end of each division. It was also to eliminate the costs of terminal handling such as changing engines, cleaning fires, coaling, turn table and round house service, time consumed, etc. It was believed these costs could be divided by three.

Accordingly on February 24, heavy Pacific type engine No. 2926 equipped with a Duplex Stoker attached to Erie Train No. 3, consisting of one mail car, one express car, two coaches, two Pullmans and one dining car, left Jersey City 12.18 P. M. for a continuous trip over the New York, Delaware and Susquehanna divisions, a total distance of 332.3 miles, arriving at Hornell, the final terminal at 11.28 P. M. on time, having covered this distance without incident in nine hours and 13 minutes. On the return trip, February 25, the same engine, No. 2926, left Hornell at 10.57 A. M., one hour and 1 minute late, with Train No. 4, consisting of one mail car, one express car, two coaches, two Pullmans and one dining car, arriving at Jersey City at 7 P. M. on time. There was no hand firing done or rake used during the round trip of 664.6 miles.

Three different crews took the engine over the three divisions. The fire was clean on arrival at both the Jersey City and Hornell terminals, ash pan being reasonably free from ash and not in any way clogged. Insofar as the condition of the engine was concerned, it could have been placed on another train and sent over three more divisions.

This trip demonstrated very clearly the practicability of one engine covering three divisions, and this was only made possible by this heavy, high speed Pacific type engine being mechanically fired.

The Farthest North Railroad

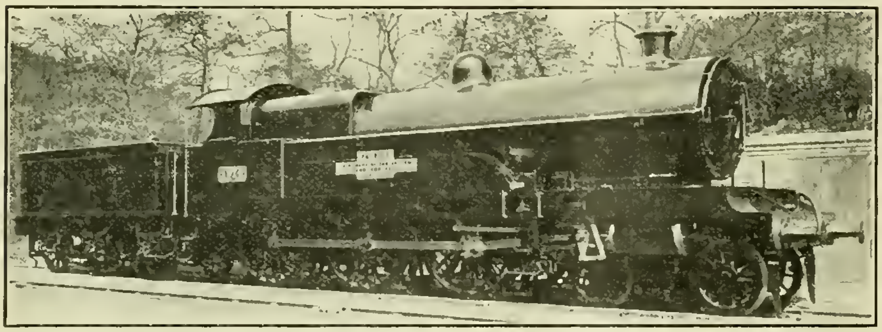
It is officially reported that the new electric railway from Sörvaranger to Kirkenes, in Norway, principally constructed for the transport of ore from the mines at Björnevand to the ice-free harbor at the latter terminus has recently been opened to raffic. Power is obained from a hydro-electric plant at Sörvaranger.

British Express Locomotive War Memorial

By W. PARKER, President Railway Club, London, England

In the British Isles the memorials established by the different railway companies in honor of the railwaymen who fell in the Great European War are of varied character. In some places tablets and monuments have been erected to place on record the supreme sacrifice of employes in the railway industry who lost their lives in the sanguinary struggle for mastery.

The latest memorial is unique in its kind. The London and North Western Railway—which claims to be the "biggest joint stock corporation in the world" and includes what were formerly forty-five independent railways, has dedicated the most recent "Claughton" type passenger express locomotive engine, built at their world-famous works at Crewe, to the memory of the nearly three thousand fallen London and North Western Railway employes.



WAR MEMORIAL LOCOMOTIVE ON THE LONDON AND NORTH WESTERN RAILWAY

In passing it may be remarked that of the 186,475 railwaymen of Great Britain and Ireland who joined the armed forces, no fewer than 18,957 were killed in action or died of wounds, etc.

The memorial locomotive is numbered 1914 after the year in which the hostilities began and bears on its splasher a plate carrying the following inscription:

PATRIOT

IN MEMORY OF THE FALLEN

L. & N. W. R. EMPLOYES

1914-1919

As will be seen by the photograph reproduced on this page the engine is of the 4-6-0 type. This class of locomotive introduced into the service of the London and North Western Railway in 1913 is called the "Claughton," after Sir Gilbert Claughton, Bart., the chairman of the company. The first engine of the type was named after the gallant baronet and was numbered 2222. Built from the designs of the Company's Chief Mechanical Engineer, Mr. C. J. Bowen Cooke, its principal dimensions were: Cylinders (4), 16 in. diameter, 26 in. stroke. Diameter of coupled wheels, 6 ft. 9 in. Steam pressure, 175 lbs. per sq. in. Total heating surface 2232 sq. ft. Grate area, 30.5 sq. ft. Weight of engine and tender in working order 117 tons.

The London and North Western Railway locomotives are in appearance very smart machines, to say nothing of their excellent working records. The standard color is black, picked out with narrow red and white stripes. In the early days of the railway the locomotives were painted in various hues and when a standard design was advocated, the company's chairman of the day was asked what color he would like adopted, and it is recorded he straightway settled the question by remarking, "I don't care what color the engines are, so long as they are black."

The London and North Western Railway Locomotive Works at Crewe cover 137 acres, 48 of which are covered in. The normal number of workmen employed is 8,800. Crewe, a town of 43,000 inhabitants, is wholly dependent upon the railway for its welfare. The photograph here reproduced was taken on a siding near the chief offices, a circumstance not easily apparent from the attractive arboreal background.

Mr. C. J. Bowen Cooke, the designer and builder of the memorial locomotive, entered Crewe Works as a premium apprentice in 1875 and attained his present position—which in Europe is considered the "blue riband" of the locomotive world —in 1909. Mr. Cooke is a member of the British Institution of Civil Engineers, and a writer of text books on the history, construction and development of the locomotive engine.

Removing Side Rods

Editor RAILWAY AND LOCOMOTIVE ENGINEERING:

On page 79 of the March number of the RAILWAY AND LOCOMOTIVE ENGINEERING was an article suggesting, that in case of the removal of all rods from one side of a locomotive, the rods should be left up on the side opposite the break.

I wish to say in regard to leaving side rods up on one side with side and main rods removed from the other side of a locomotive, there are two ways that further damage may result. First, when side rod bearings are much worn and in starting the engine, if the drivers start to slip, and sand stops the front of rear driver from turning just before the dead center is reached, the main driver will turn past the center by slipping on rail, the other driver stopped by sand, and the engine will stand with one pin down on main driver, and the pin up on the forward of rear driver. In that case, if forward driver is one concerned, the guides prevent getting rod off end of forward pin, and it will cause some trouble to disconnect.

Again, when the one sided engine is drifting and brought to a stop with the brake, if one pair of wheels start sliding as the engine comes to dead center, it will probably take off every pin on that side of engine with side rod up. I have seen every pin broken when engine did not run two inches beyond point where the pins let go from wheel sliding.

I think from the above it may be readily seen that there is much danger of further damage by running with one side rod up. However, if it should be necessary to do it (and there are many times where it is necesssary to move engine with one side rod up quickly), have engine moved with another engine and with driver brake cut out.

W. S. HUTCHINS.

March 21, 1921. Greenfield, Mass.

Coal vs. Oil for Locomotives

At the International Railway Fuel Association's last annual meeting at Chicago, figures were presented relating to comparisons made on the Santa Fe System where one half of the locomotives have been constructed or converted to burn oil. It was stated that the life of a boiler fired with coal is about 10% greater than one fired with oil, and that the life of the tubes is about 40% higher in the coal burners.

Railroad and Transportation

It is reported from railroads terminating at New York that the rapid decline in operations in the past four months has, in all likelihood, been accelerated by an increasing use of the Panama Canal for coast to coast traffic. In the early part of 1920 railroad congestion became so great that two months or more were often required to carry goods from San Francisco to New York as compared with 14 to 25 days under normal conditions. Ocean carriers can make similar delivery in 18 to 26 days, and with an increasing number of ships available, there have been regular shipments of lumber and of some other products from the west to the east through the canal.

Engine Terminals and Repair Shops

Valuable Suggestions on the Need of Modernizing Equipment

The importance of modernizing engine terminals and repair shops has called forth many valuable suggestions from time to time, and the determination to make such improvements as are essential to keeping pace with the requirements of the best railway service may be said to be settled among leading railway men, and nothing but the lack of means has hindered the work of reconstruction in this regard that would have been already accomplished, and which, in spite of deterring conditions has already made considerable progress. Many extensive plans are already perfected and only await the advent of improved conditions to blossom into accomplishment. It is universally hoped that in the near future important advances will be made, and it is well that the best minds should give their earnest attention to the subject.

The matter came up very prominently before the members of the Central Railway Club at the March meeting in Buffalo, N. Y., where W. E. Stitt, Chief Engineer of the Austin Company, Cleveland, Ohio, presented a paper on the subject. The accomplished engineer showed how thoroughly he had mastered the subject, and we take pleasure in making such extracts as may illustrate the more salient features of his presentation of opinions gathered in his wide experience.

In introducing the subject, Mr. Stitt stated that many papers prepared heretofore on "Modern Engine Terminals and Repair Shops" have dealt primarily with the general layout of the terminals. In so doing, the results contributed to the successful operation of railway terminals by proper design of terminal buildings has been rather briefly disposed of. Too much stress and emphasis cannot be attached to the important role that the buildings play in the field. They are not simply shelters, but they, themselves, are appliances in that they support labor saving devices such as cranes, monorails, line shafting, and other equipment. Besides this they house other facilities, as well as provide there facilities with space, light and ventilation.

In these days of rapid and sweeping changes in the things that we are most intimately in contact with, and in the radical changes in our laws, as well as in the rulings of the various commissions appointed to administer our laws, we are brought suddenly face to face with large and very important problems. The railway field has been subjected to these sudden changes as much, if not more, than any other industrial activity. Our industrial magazines teem with articles which are primarily intended to assist us in meeting the situation.

One of the prime requisites of the up-to-date terminal is to have modern terminal buildings, or in other words, the character of the terminal buildings determines, to a very large extent, not only the present facilities at a terminal, but also in a considerable measure the facilities it is possible to add to an existing terminal. The importance which the buildings play in the successful operation of a terminal is readily appreciated and conceded by all.

Because of the many classes and sizes of terminals and the many uses to which these buildings are put, it is impossible to determine on a type which is suitable for all conditions. For this reason considerable thought and attention have been given to the development, design and construction of modern terminal buildings. This as the writer sees it, is a most perplexing problem to the railway executives who are responsible for providing terminal facilities.

A further fact complicates the situation in that it is very difficult to add modern facilities to an existing plant which is designed and constructed without the contemplation of such added facilities. This is true, very often, because the plant has become surrounded by the city in which it is located. This makes reasonable priced land frequently unavailable for building additional units. Also, it is impossible to install crane runways and other labor saving devices in existing buildings, due to lack of clearance and insufficient strength in the existing structures.

Assuming, therefore, that the railway executive is more conversant with the facilities required for his terminals and admitting that the location and layout of each terminal is a separate, individual problem in each case—what is there, then, to influence the design of the terminal more than the major features of the terminal buildings? The major design of course, must be followed up by the detail design.

The design which is not based on modern practice should be superseded.

The older types of terminal buildings of all classifications, including engine houses and repair shops, hardly without exception have been—as considered in contrast with the modern terminal buildings—low, poorly lighted and ventilated, devoid of proper sanitary facilities, rest rooms, artificial lighting and heating. The advent of the overhead, electric traveling crane, as well as the modern smoke exhausting devices and other such improvements, have thrown many of the older type buildings into the obsolete class.

Other changes such as the substitution of structural steel and reinforced concrete for timber, the substitution of concrete for rubble masonry or brickwork, the substitution of steel sash for wood sash, and many other well-known changes have had a marked effect in bringing about a striking contrast between the old and new terminal buildings.

The function of engine terminals has been ably defined as a means to provide adequate facilities for the proper maintenance and repair of locomotives and current routine operations as inspecting, cleaning, coaling, sanding, washing within the shortest possible time. Any factor, therefore, that will minimize this time is well worth our consideration. The human element as well as the mechanical element works to better advantage under proper environment and treatment. You cannot expect to accomplish good results in a short time in a dingy, smoke-filled, dark building. Terminal operations in many cases are and should always be time table scheduled. You can only put the schedule as an effective basis, consistent with the rest of your improved facilities, when you have the proper designed buildings to house these facilities.

In connection with the design of modern railway terminal buildings we should remember that the ventilation of the roundhouse is not so much a question of diluting the air as it is of establishing a positive flow of air which will carry the gases along with it.

The proper design of railway terminal buildings usually suggests itself after due consideration has been given to the facilities required for the terminal in question. By this I mean the work to be performed rather than the equipment required. In this regard the operating executive is surely most conversant with the requirements. This is true in general industrial work as well as in the railway field. Our observation indicates the railway executive needs support in determining the equipment and the general and detail design of the buildings on account of their intimate relations with the equipment to be installed.

It has been said in an engineering article that "The author has purposely omitted reference to detail construction of buildings as these features generally conform to the railroads' standard practice." This is naturally applicable only to railroads having enough new construction under way to enable them to keep their standards up-to-date; likewise to enable them to maintain an organization of the proper experience and training as well as adequate capacity for this work.

If the railroad has not had the recent new construction work their engineering organization is not enabled to keep step with the development in latest designing and construction methods. This has to do with railroads equally as well as it has to do with general industrial organizations.

For this reason an engineering organization which is actively and continuously engaged in designing railway structures can bring a material support to the railway executive who is contemplating expansion.

The next step in the design is a careful review of the facilities required, as set up by the railway executive most conversant with the conditions involved.

A common error made on all kinds of designing work, is in the ignoring of the financial resources of the owner by the engineer. This practice frequently leads to the preparation of elaborate, expensive designs, entirely unsuited to the situation. Then, when estimates are prepared the mistake is realized and the work either postponed, due to lack of available funds, a considerable time and money are lost in the preparation of revised designs. To properly make designs for railway buildings, it is necessary that the designer have a working knowledge of railway requirements, as well as that of being familiar with modern terminal construction. As a matter of fact, it requires an engineering corps to do the work properly. In such a corps the men will have had experience covering different operations of the design. For instance, one man may be an expert on layout, another man an expert on structural design, while still another man, or a group of men will be experts on the trades involved by the mechanical and electrical equipment.

By adhering to these principles, together with the added advantage of close co-operation with the railway executive, who defines the needs and requirements for the particular problem in hand, there is a definite plan of action provided. Successful builders making a practice of constructing railway terminals have come to the realization of the advantages of operating in the manner outlined above and have included in their own organizations men qualified to handle the work as just suggested and thus give support and the benefit of their training and experience to railway executives frequently not otherwise obtainable. The combination of the designing organization under one management gives the benefit of otherwise unavailable resources and reduces the responsibility to a minimum.

When operating in this capacity the builder has the added advantage of knowing costs of various designs and operations, which helps materially in selecting the proper design as well as in the preparation of preliminary and detail estimates.

The modern railway terminal buildings should be the result of close observation in determining the needs of railway men. As a consequence certain types of construction have been generally accepted and those most commonly used have been more or less standardized.

Standardization should be used only where standard buildings or equipment meet the necessary requirements.

Years of experience in the designing of all kinds of industrial buildings, including railway terminal buildings, point to one very marked lesson, which is this—whereever it is possible to secure flexibility in the design, without an appreciable added expense, it is the essence of good designing to embrace all such opportunities. If a provision in the layout of the buildings for a railway terminal will permit of more than one arrangement for future expansion, it generally results to advantage to use such a design. Regardless of how sure you are that your future development will be along certain lines, it has become a matter of note that there will be some changed conditions interposed before the future extension is built. This will require a different development from that originally contemplated. For instance, take the conditions imposed upon the railroads by the passage of the Adamson Law. The passage of this law imposed entirely new conditions which determined the desirable locations of railway terminals. Where a heretofore unimportant terminal became of more importance, due to the workings of this new law; provisions for expanding the terminal facilities, both in buildings and in equipment, would have been a marked advantage. Otherwise, where no provision for expansion was made an entirely new terminal layout would have been required.

For instance, if it has been determined to build a terminal at a certain location, the more tentative assumptions which can be made before the general proportions of the building are determined and the general layout of the terminal is drawn up, the more expeditiously can the designing work and estimating work be prosecuted. Certainly, you cannot make a general layout for a terminal without knowing which buildings you contemplate erecting there and approximately the size and character of the buildings. For this reason, then, early decisions relative to the design and character of the buildings become paramount. Where there is a lack of such decisions being made by executives, there results improper designs, lost motion in general, increased cost of designing and estimating and other numerous difficulties. When the executive himself does not make the decision, certain assumptions have to be made by his subordinates. These subordinates make their assumptions to the best of their ability, taking into consideration the information they have at hand. Naturally, they do not have access to the resources of the company to the same degree that is available to the executive.

In order for a design to be a proper design, it must be economically right—no more—no less. By improper designs I mean designs which are not economically right. In other words, designs which are too expensive or too inexpensive, for the purpose contemplated, rather than faulty designs. Doubtless, the executive will find it desirable to avail himself of the support of available assistance in making these early assumptions.

By the executive's remission in failing to arrive at decisions, his subordinates are forced to make decisions and set up designs on the basis of something which has appealed to them. This appeal may be prompted by numerous desires. For instance, it may be prompted by a desire to design buildings which are absolutely "the last word" in buildings of the class under consideration.

Assuming this occurs and the designs approved, and the estimates prepared, it may then be realized that the design is not sufficiently economical to promote the best interests of the company. In such cases, a new design may be called for; in other cases, the building might have to be constructed and a fixed charge incurred which is not warranted by the resources and the policies of the company.

It may seem that we are going into considerable detail, but when we call your attention to the fact that months of time with attendant expense and delays, incident thereto, have resulted from the very lack of early tentative assumptions, we feel quite sure that you will agree that this is not a detail matter, but the essence of the more desirable procedure when the undertaking for the design of a terminal, or for that matter, any major project is started.

Flat Electrode Welding

A writer to the *Electrical World* points out that the use of flat electrodes in the place of the usual cylindrical type results in a great saving of time, and calls for considerably less skill upon the part of the operator. When operating upon a "V" shaped opening, the flat electrode will assume a corresponding shape owing to the fact that the arc centres at those points closest to the metal, and thus melts off the electrode for a uniform distance. This relieves the operator of the task of skillfully moving the electrode from side to side and down into the notch. When using this electrode, it is only necessary for the welder to carry one size, and to use it either flat or edgewise for wider or narrower seams. The flat electrode is also eminently fitted for automatic welding machines, since it will give broad runs without side motion.

The Counterbalancing of Locomotives

Generally Approved Rules and Principles

In reply to special enquirers in regard to counterbalancing, the report adopted at a meeting of the American Railway Master Mechanic's Association, some years ago, has been generally accepted as the guiding rules and principles. Briefly stated, the reciprocating parts are piston head, rod and nut; cross-head cross-head key, pin and nuts; approximately one-half the total weight of the main rod; arm and link fastened to outside valve gear. Each driving wheel should have sufficient weight added to counterbalance exactly the weight of its revolving parts, which are: Crank pin, crank pin hub, and the proportion of the weight of the side rods attached to the pin. The main driving wheel should have added approximately one-half the total weight of the main rod, plus two-thirds the weight of the eccentric arm, considered acting at crank pin distance, for outside valve gear.

Cross-counterbalancing, to correct the disturbances caused by the parts revolving in different planes, is thought to be unnecessary with outside cylinders, on account of the disturbing forces being slight when compared to the principal reciprocating and centrifugal forces. The overbalance which is used to counteract the desired portion of the weight of the reciprocating parts should be distributed as nearly equal as possible among all driving wheels, adding to it the weight of the revolving parts for each wheel. The sum for each wheel, if placed at a distance from the driving wheel center equal to the length of the crank, or a proportionally less weight if at a greater distance, will be the counterbalance required.

Centrifugal and reciprocating forces are usually figured at a speed in miles per hour equal to the diameter of the driving wheels in inches, which may be considered as a maximum for good practice. This is ordinarily referred to as "diameter-speed." At this speed the reciprocating parts, due to the laws of inertia, tend to continue their motion at the end of each stroke with a force equal to about forty times their weight. The overbalance exerts a centrifugal force equal to about forty times its weight, and is at a minimum at the top and bottom position of the crank. This force is added to the static weight in the lower position of the counterbalance, and is opposed to the weight in the upper position. Approximately one-fortieth of the static weight on a wheel will therefore give the weight of the reciprocating parts which could be balanced without causing the wheel to run from the track at diameter-speed. This amount of balance would also double the load on the rail when the balance is down.

If W-overbalance or excess weight at one-half stroke distance, then the dynamic augment at different strokes is as follows:

Stroke in inches	Dynamic augment	
18	29.1 x W	at diameter speed
20	32.3 x W	" " "
22	35.5 x W	" " "
24	38.5 x W	" " "
26	41.7 x W	" " "
28	44.9 x W	" " "
30	48.4 x W	" " "
32	51.7 x W	" " "
34	54.9 x W	" " "

A simple counterbalancing rule, expressed in general terms, which would give good average results when applied to any class of locomotives in any service, may be stated as follows: Keep the total weight of the reciprocating parts on each side of the locomotive below 1-160th part of the total weight of the locomotive in working order, and then balance one-half the weight of the reciprocating parts.

The above general rule is based upon diameter-speed, and should keep the dynamic augment well within the limits of good practice. where the normal speed is considerably below the diameter-speed, it may be desirable to increase the proportion of the recipocating weights to be balanced to as much as 60 per cent or 65 per cent.

Another counterbalancing rule is, to set an arbitrary percentage which the dynamic fuse of the overbalance will be allowed to increase the static weight, for example: If it is desired that the dynamic force of the overbalance at a speed in miles per hour equal to the diameter of the driving wheel in inches, should not increase the static weight on a wheel more than 50 per cent, calculations should be made as follows:

4-4-2 type locomotive with 26 ins. stroke.

Given: Static weight on one wheel=30,000 lbs.

To find: Maximum permissible weight of reciprocating parts to be balanced in one wheel=W.

$$W = \frac{\text{50 per cent static weight on one wheel} \times .312}{\text{crank and radius in inches}}$$

$$W = \frac{15{,}000 \times .312}{13} = 360 \text{ lbs.}$$

Therefore: The total reciprocating weight to be balanced on one side of the locomotive would be 720 lbs. With 50 per cent of the total reciprocating parts balanced on one side, the total weight of these parts must be designed to weigh 1440 lbs.

The converse of this is: Given: Weight of reciprocating parts balanced in one wheel W = 360 lbs.

To find dynamic augment = A.

$A = W \times 3.2 \times$ crank radius in inches.

$A = 360 \times 3.2 \times 13 = 15.000$ lbs.

Therefore: 15,000 lbs. dynamic weight is added to the 30,000 lbs. static weight, giving a total of 45,000 lbs. on the rail.

The dynamic weight may be expressed in a percentage of the static weight on one driving wheel. An increase of 50 per cent in the static weight on the driver at diameter-speed would represent good average practice, while much less than this percentage is greatly to be desired. The secret of proper counterbalancing for any class of locomotive in any service is to reduce the weight of the reciprocating parts as far as possible. Great benefit will be obtained if the railroads generally will determine the maximum load that they can carry on the rails, bridges, etc., and then reduce the weight of the reciprocating parts to a point where the dynamic augment of the parts balanced will be only a small proportion of this maximum allowed load.

Special designs of piston heads, crossheads, hollow piston rods, and the use of high grade materials, including heat-treated carbon and alloy steel, aluminum, etc., make it possible to construct very light parts, the expense of which will be many times justified by the consequent saving in repairs to equipment and track, as well as the saving due to the increase in tractive power of the locomotive. With a refinement of design along these lines, it is altogether possible to construct reciprocating parts approaching in lightness 1/240th part of the total weight of the locomotive in working order, instead of 1/160th part as expressed in the previously mentioned general rule representing a fair average. With an increased tendency toward these very light parts, the percentage of parts balanced or unbalanced becomes less and less a factor. Greater efficiency is thus given to the locomotive, in that more and more of the weight allowable on the rail will be used in starting and pulling the train.

Dust Shields for Oil Boxes

Many substitutes for leather have recently been placed on the market. One is paper felt manufactured in Sweden, which, being cheap, and non-absorbent, is said to be well adapted for use as dust-guards in journals of railway carriages. The State railways in Sweden, after careful trials, have adopted its use, and they are reported to have proved very satisfactory. Paper felt dust shields do not become elongated, as leather and ordinary felt shields do. Those made of paper felt fit snugly round the axle at all times. It is also further claimed that paper felt does not harden, and is not influenced either by oil or water.

The Labor Problem in Relation to the Railroads

By Daniel Willard, President of the Baltimore & Ohio Railroad

An important contribution to the discussion of the questions affecting the future of the railroads was the presentation of an address by Daniel Willard, President of the Baltimore and Ohio, railroad company to the Railway Business Association, New York, on March 31, 1921. We take pleasure in reproducing the address verbatim:

"We ought not to minimize the importance of the labor problem in its relation to the railroad question as a whole. In no country in the world do the people make such great use of the steam railroads as do the people in the United States. This is clearly indicated by the official records which show that in the United States the steam railroads move upon the average more than 4,000 tons one mile per annum for each man, woman and child in our entire country, while the latest figures available show that the railroads in Europe move, on the average, something less than 600 tons per capita per annum.

The greater use made of the railroads by the people in this country is of course influenced largely by the fact that our country is of great extent and is rich in natural resources—mineral, agricultural and marine—and it has come about that in the city of New York, as an example, the flour used, I take it, is made largely from wheat grown in Minnesota and North Dakota. The beef which is eaten here was perhaps bred in Texas, developed in Wyoming, fattened in Iowa and slaughtered in Chicago.

In short, it has generally been found advantageous, because more economical, to procure our flour, meats, minerals, forest products, etc., where they can be produced or obtained at the lowest initial cost and then transport them, largely by rail, to the point of ultimate consumption, the entire transportation cost being much less than the difference in initial cost of production in different parts of the country.

With this in mind it is manifestly important that there should be continuity of service by the railroads in a country such as ours, and one of the important problems before Congress was to insure if possible continuity of service, by guarding against the interruption of the service, by any misunderstandings and disputes which might possibly arise between the railroad managers and their employes.

In fact, Congress in the Transportation Act has created for this particular purpose a special Labor Court consisting of the same number as the Supreme Court of the United States, appointed in the same way, that is to say, by the President and confirmed by the Senate, and has given the Board or Court a status and dignity in keeping with its importance. The law says that it shall be the duty of the Board to establish rates of pay and standards of working conditions which, in the opinion of the Board, shall be just and reasonable.

It may indeed be said that Congress by this Act has made a preferred class of the railroad workers, because so far as I know this is the first and only time that Congress has ever definitely said that any particular class of the people should be given at all times and under all circumstances just and reasonable wages and working conditions.

Of course Congress did not do this primarily in the interest of the workers. Congress acted only as it had a right to act in the interests of the Nation as a whole. Congress provided or aimed to provide by law so that the railroad workers would at all times be assured of just as good wages and just as good working conditions without striking as they could reasonably expect to secure if they did strike, for it is clear that no one could justify or expect to win a strike for wages or working conditions that would be unjust or unreasonable.

While some criticism has been voiced against the Labor provision of the Act, not only by the employes, but by the employers as well, I am still hopeful that this feature of the Act will eventually prove to be wise and satisfactory, and if the other features of the new legislation work out as it was the intention and belief of Congress that they would work out, then I think Congress has made private ownership and operation of the railroads in this country possible, but whether private ownership and operation of the railroads endures—having been made possible—depends largely if not wholly upon whether the railroads under private ownership and operation are able to give and do give the public satisfactory service.

At the present time it would seem that there is a majority, in fact a large majority, of public opinion in favor of private ownership and operation, but we have seen public opinion change suddenly, and I have no doubt that it would change again just as quickly, and react just as strongly against private ownership, if the public felt that upon the whole they would be likely to get more satisfactory service some other way.

As I view the matter, private ownership and operation of the railroads is still on trial in this country, but it has everything in its favor and it ought to win and I believe it will win if the managers, measured by the service which they give the public, deserve to win.

Since the termination of Federal control we have actually seen the railroads, operated by private management under the provisions of the Esch-Cummins Act, move in 1920, 9,000,000,000 ton miles more than in 1918, employing substantially the same facilities.

We have seen the Interstate Commerce Commission, under the terms of the same act, promptly authorize such rate increases as would, in its opinion, fulfill the requirements of the Act, and we have also seen one of the most complex labor situations ever developed, dealt with in orderly fashion by the agencies created by the Act, without interruption of the transportation service.

The very fact of the controversy in Chicago speaks volumes for the Act. Questions involving wages and working conditions affecting nearly 2,000,000 human beings are certain to bring out points of difference, and if the contestants should sometimes raise their voices above the conventional pitch of polite society, it would not follow that the law had failed —on the contrary, it would indicate that the problem was being worked out just as Congress intended it should be, and without interruption of the service.

I am inclined to think that under the present law wages of railway workers as a whole may be somewhat higher in the future than would be the case were there no such law, but even so, if the public is thereby assured freedom from interruptions of service, the immunity so purchased will be well worth the price."

Equipment for Electric Railways in South Africa

Trade Commissioner Stevenson, of Johannesburg, South Africa, cables under date of March 27 that tenders are being invited for the supplying of overhead equipment, switches, gears and accessory track equipment for electric railways in South Africa. It is stated that specifications covering this equipment are on file with the South African High Commissioner, Trafalgar Square, London, at £5 2s. for the first copy and £2 2s. for each additional copy. Bids are to close June 22.

Rolling Stock and Labor in Finland

Finnish State railways have at present 1,000 passenger cars, 13,030 freight cars, and 550 locomotives—all steadily increasing in number.

During the past year about 2,635 workmen have been employed in the different workshops of the State railways, of which number 368 were apprentices.

Divergent Laws Relating to Train Crews

Divergent courses are apparent in laws relating to train crews on railroads, the Missouri statute on this subject being repealed (p. 247), while in North Dakota companies operating four trains in 24 hours are required to man their trains according to the provisions of the law (ch. 169). The Missouri law had been repealed by a referendum vote in 1914. In Ohio the existing law is made applicable to all roads and not merely to those operating four trains in 24 hours (p. 687). The prescribed crew must be placed on trains running as much as 3 miles instead of 25 as formerly.

The protection of workmen on repair tracks is considered in the laws of Minnesota (ch. 514) and North Dakota (ch. 172). Shelters must be constructed where as many as six men are employed in repair work as long as 30 days, in the first case, and where five or more employes are regularly engaged, in the second.

A Missouri statute (p. 256) amends a law relative to offenses of railroad employes, prescribing a fine for running an engine out of repair, and if a fatal accident occurs there may be prosecution for manslaughter. In Michigan (No. 342) railway trains are required to be supplied with first-aid kits equipped as prescribed by the act.

Safety on the Baltimore & Ohio

In regard to safety on the Baltimore & Ohio it is stated by the Safety Department that at least 138 lives have been saved in the last five years. The difference between the total employes killed on the Baltimore & Ohio in the five years between 1911 and 1915, and between the five-year period from 1916 to 1920, is 138. The difference in the number of employes injured in these same periods is 11,594. In the latter five-year period the number killed and injured was less than in the previous five-year period.

Coal Production in Nova Scotia

Interesting figures concerning the coal production in Nova Scotia for the year ending September 30, 1920, are found in the report made by the Commissioner of Works and Mines. The output of coal for the year is given as 5,687,970 tons, an increase of 683,213 tons over the production in 1919, while the sales increased from 4,459,642 tons in 1919 to 5,087,744 tons for the period under review, an increase of 628,096 tons.

Shipments to the United States for 1920 amounted to 27,439 tons, a decrease of 48,374 tons compared with 1919. Shipments to the St. Lawrence ports were 240,071 tons, a reduction of 104,591 tons as compared with previous year. Shipments to Europe rose from 64,418 tons for 1919 to 527,727 for 1920, an increase of 463,309 tons.

There were eight mines either opened or reopened during the year. The total number of men employed at the mines was 11,300, an increase of 586 over the previous year. This increase in the producing force not only resulted in greater production, but increased the output per man employed by 36 tons over that of last year.

The World's Supply of Fuel Oil

The world's actual production in 1920 was about 700,000,000 barrels, of which Mexico produced 155,000,000 and the United State 445,000,000. Mr. White states that the potential capacity of Mexico, by which he means the amount that could be obtained by thorough exploitation, was, for 1920, 747,000,000 barrels. The average production in Mexico for that year was 1,000 barrels a day for each well. There are twenty-five wells in Mexico that will flow 24,000 barrels per day, a total of 600,000 barrels. The known oil regions of Mexico are divided into three areas.

Many tables are given showing ratios of increase and other data. The total world deposits of petroleum are estimated at a little over forty-three thousand million barrels, which amount is about equally distributed in the two hemispheres. There are much larger deposits north of the equator than south, but this may be due partly to the greater land area in the former. No estimate can be made as to what may be under the sea.

Although the United States is producing at present about two-thirds of the world output, yet over 100,000,000 barrels were imported to meet the consumption. In this fact lies the importance of the oil question to the United States.

Conditions on the Italian State Railways

Inquiries into the causes that have brought about the bad service rendered by the Italian State Railways shows that since the period immediately preceding the war the number of locomotives in the same period fell from 4,400 to 4,200. This diminution accompanied an increase in the length of line operated amounting to 1,500 kilometers. Locomotives have not yet recovered from the hard usage undergone in meeting war demands. It was necessary at times, due to lack of steamers during the war, to send Italian engines to Marseille, whence they were compelled to haul back 900-ton trains to Genoa, although the maximum capacity of these engines was rated at 650 tons. Proper repairs and the building of new locomotives were slighted during hostilities, and since the cessation of hostilities various dislocations and labor conditions have interfered with construction work in this line.

At present 1,675 engines are awaiting repairs which can not be delayed any longer, and 540 new locomotives which were ordered some time ago have not been delivered.

Privately owned shops have to be called upon to make major repairs, since the machine shops of the State Railways are only adapted for small repairs.

Safety on the Long Island Railroad

The persistent effort maintained by the Safety Committee on the Long Island Railroad during 1920 shows a very substantial reduction in the number of fatalities and personal injuries to passengers, employees, trespassers and other persons. A comparison presented below of the accident statistics covering the last three years indicates clearly the splendid progress that is constantly being made in the paramount task of saving life and limb by preventing death and injury on railroad property. At a glance the following comparative tables show what the railroad has accomplished in the matter of safety since 1918:

	Passengers		Employees		Grade Crossings		Trespassers	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
1918....	7	1,063	20	1,265	27	209	18	8
1919....	0	739	12	1,248	10	29	10	2
1920....	0	414	13	825	5	7	7	7

The British Coal Situation

It is reported that the coal production in Great Britain ceased with the general miners' strike effective on April 1, and that coal exports are prohibited except under special licenses. It is stated that certain exporters are negotiating for American coal to fill contracts in the continental market. The situation is expected to be of short duration, as the funds of the federation are low and the action of the miners is not supported by public opinion, and it is generally believed that Lloyd George will find some method of placating the miners. His recent settlement of the railroad strike was an admirable example of his rare ability, and it is a foregone conclusion that if the labor element is determined to appeal to the country they will find themselves in a much smaller minority, and the likelihood of measures being taken to compel a resumption of activity in all industries relating to the common necessit'es of life.

Chinese to Order More Locomotives

The Chinese government is inviting tenders on 41 locomotives for the Chinese government railways under the $6,000,000 Mexican loan made by a group of Chinese bankers to the government for the purpose of purchasing necessary locomotives and cars. These tenders on the locomotives are to be opened at Peking, China, on June 15, 1921.

Items of Personal Interest

D. G. McCormick has been appointed mechanical engineer of the Mobile & Ohio, with headquarters at St. Louis, Mo.

Edward Bickerton has been appointed general foreman of the Canadian National Railways, with office at Port Arthur, Ont.

H. D. Eddy has been appointed roundhouse foreman on the Atchison, Topeka & Santa Fe, with office at Bakersfield, Calif.

W. D. Simpson has been appointed division engineer of the Florida division of the Seaboard Air Line, succeeding B. Land, Jr., resigned.

E. J. Strong, roundhouse foreman of the Chicago, Milwaukee & St. Paul, with office at Marquette, Ia., has been transferred to a similar position at Dubuque, Ia.

F. S. Markett has been appointed master mechanic of the Charlotte Harbor & Northern, with office at Arcadia, Fla., succeeding J. E. Gould, transferred.

Guy T. Mohler has been appointed terminal road foreman of engines of the Atchison, Topeka & Santa Fe, at Needles, Cal., succeeding Earl Gilbert, transferred.

E. J. Summers, smoke inspector on the Chicago, Milwaukee & St Paul, has been appointed fuel supervisor over the entire system, with headquarters at Chicago, Ill.

G. A. Howard has been appointed chief despatcher of the Brownsville division of the Canadian Pacific, with office at Brownsville Junction, Me., succeeding J. W. Todd, transferred.

J. B. Merritt has been appointed road foreman of engines of the second district, New Mexico division of the Atchison, Topeka & Santa Fe, with headquarters at Raton, N. M.

E. E. Chapman, assistant engineer of tests of the Atchison, Topeka & Santa Fe, has been appointed engineer of tests, with headquarters at Topeka, Kan., succeeding H. B. MacFarland, resigned.

W. B. McPartland has been appointed superintendent of motive power of the Denver & Salt Lake, with headquarters at Denver, Colo., succeeding J. J. Connors, who has resigned on account of failing health.

John J. Esch has been appointed by President Harding a member of the Interstate Commerce Commission, and has already entered upon his duties, pending confirmation by the Senate. Two vacancies exist, which will be filled in the near future.

W. A. Bowden, chief engineer of the Department of Railways and Canals, Ottawa, is on a trip to the Panama Canal for the purpose of examining certain features of canal operation and terminals, preparatory to making his report on the proposed St. Lawrence canalization project.

G. W. Abbott, division engineer of the Boston division of the Boston & Albany, has been appointed principal assistant engineer, with headquarters at Boston, Mass., and W. B. Knight, division engineer of the Albany division, has succeeded Mr. Abbott as division engineer of the Boston division.

James R. Bibbins has been appointed manager of the newly created Department of Transportation and Communication, a branch of the Chamber of Commerce of the United States. Mr. Bibbins has had a wide experience in rapid transit problems, railroad and port terminal activities in New York, Chicago, Baltimore and New Orleans. The new department will have a wide range of activities including steam and electric transportation.

A. J. Manson has been appointed manager of the Railway Division, New York office, of the Westinghouse Electric & Manufacturing Company. After graduating from Massachusetts Institute of Technology in 1905 he entered the company's engineering apprenticeship course. He was active in the electrification of the New Haven Railroad and the Pennsylvania Railroad into New York City, and during the past few years has been connected with the sales organization in New York.

Harold N. Parkinson has been appointed instructor in railway mechanical engineering in the College of Engineering, University of Illinois. Mr. Parkinson was employed as tracer and detailer in the Milwaukee shops of the Chicago, Milwaukee & St. Paul during 1913 to 1915, and during vacations while at Purdue University from which institution he graduated in 1918 with the degree of Bachelor of Science in mechanical engineering. From 1918 to 1921 he was employed as draftsman and designer in the mechanical department of the Chicago, Milwaukee & St. Paul.

J. W. Small, formerly superintendent of the motive power of the Seaboard Air Line, has been appointed superintendent of motive power of the Cuba Railroad with headquarters at Camaguey, Cuba, succeeding M. B. McPartland. Mr. Small has had a wide experience in the mechanical department of the leading railroads, particularly in the West and Southwest, and in 1913 was appointed superintendent of the motive power of the Seaboard Air Line, and at the entry of the United States into the war, when the railroads were taken over by the government, Mr. Small served for some time as mechanical assistant to the regional director of the Southern region, and latterly as mechanical staff officer to the regional director of the Southern region, returning to the Seaboard Air Line on the resumption of the railroads by the owners.

Pennsylvania Railroad Men Confer on the Rates of Pay

For the purpose of discussing the proposed revision of salaries and wages, a series of conferences are being held by the Pennsylvania System with the representatives of subordinate officials and employees who were invited to attend. The object is stated to be that of reaching an agreement as to what constitutes just and reasonable rates of pay in the light of present conditions. The conferences are being held in Pittsburgh, Pa., the most centrally located city in the territory. Leave of absence has been granted to all employes designated as representatives, and furnished with the necessary transportation. Beginning on March 31, the meetings will be continued until April 16.

The procedure is in strict accordance with the terms of the Transportation Act of 1920 which provides that in the event of inability to reach an agreement respecting wage revisions at conferences such as these being held by the Pennsylvania representatives, the matter shall be referred to the United States Labor Board.

Proposed June Meeting of the American Railroad Association

On March 30, a meeting of the General Committee of the Mechanical Division of the American Railway Association was held in New York, and decisive action was taken in regard to the annual meeting next June. It is proposed that a business session will be held at the Hotel Drake. Chicago, Ill., on June 15 and 16, instead of the convention that was expected to be held as formerly at Atlantic City, N. J. The reports of standing and special committees have been considerably modified, on account of the limited time allowed for the proposed June session. Reports will be received on the following subjects: "Prices for Labor and Materials"; "Car Construction"; "Loading Rules"; "Brake Shoe and Brake Beam Equipment"; "Train Brake and Signal Equipment"; "Specifications and Tests for Materials"; "Tank Cars," and "Standard Methods of Packing Journal Boxes." The discussion of these subjects in addition to the general routine business will, doubtless, be sufficient to occupy the entire time of the proposed sessions.

Annual Report of the Westinghouse Air Brake Company

The annual report of the Westinghouse Air Brake Company issued early in April, 1921, showed gratifying results in the adoption of the policy of the logical consolidation with the Union Switch & Signal Company. The Westinghouse Brake Company, Ltd., of England, and the important signal companies of Europe have also amalgamated and the result has proved to be advantageous. The title of the Westinghouse Brake Company, Ltd., has been changed to Westinghouse Brake & Saxby Signal Company, Ltd., of England, a holding company; either all or a controlling interest in the following signal companies was secured on a fair appraisal basis: Saxby & Farmer, Ltd., England; McKenzie & Holland, Ltd.; Saxby & Farmer (India), Ltd.; the McKenzie, Holland & Westinghouse Power Signal Co., Ltd.; the Railway Signal Company, Ltd.; Compagnie Generale de Signalisation of Paris, having works in Worcester and Chippenham, England; Calcutta, India; and Melbourne and Brisbane, Australia.

On account of the difficulty in establishing a value for the holdings of the Westinghouse Brake Company, Limited, in the German and Russian companies under existing conditions, they were eliminated from the Brake Company's assets prior to the amalgamation and turned over to a new company, the Westinghouse Brake Subsidiaries, Limited, organized for the purpose of holding these interests, and the capital stock of the Subsidiaries Company was distributed pro rata to the shareholders of the Westinghouse Brake Company, Limited.

In exchanging the holdings in the Westinghouse Brake Company, Limited, for shares of the Westinghouse Brake & Saxby Signal Company, Limited, and of Westinghouse Brake Subsidiaries, Limited, the company retains a substantial interest in each of these companies, and the Board of Directors feel that with the association of the brake and signal companies in Europe as in the United States, the interest of the company has been conserved. The Compagnie des Freins Westinghouse, of Paris, has enjoyed an especially prosperous year. The necessity, however, of carrying larger values in inventories and accounts receivable has required new financing, which is now well under way.

During the year under review the volume of orders received and product shipped was satisfactory. The year closed with a fair amount of unfilled orders on hand, but owing to the unprecedented condition of the railroads of the country and their necessary policy of curtailing purchases, current orders show a marked falling off as compared with the same period of previous years. Manufacturing operations thus far this year have been at an almost normal rate, but obviously they must be materially reduced unless there is a marked increase in new business. The financial results of the year's operations, after providing from earnings for dividends and adequate reserves, show a net addition to surplus of $1,249,122.09. The increase in accounts and bills payable for the year of approximately $8,300,000 as compared with the previous year, is accounted for by the increase in accounts and bills receivable of almost $8,000,000 and $2,800,000 in inventory. It is hoped that the remedial legislation recently enacted by Congress, known as the Winslow Bill, will result in payments that will reduce outstanding accounts to normal proportions.

The Westinghouse Union Battery Company was organized to engage in the manufacture and sale of storage batteries for automobile and general use, its operations being carried on at the works of the Union Switch & Signal Company, Swissvale, Pa., where an efficient organization has been perfected and is placing on the market a battery of superior quality.

The detailed financial statements reflect the united operations of the following companies: Westinghouse Traction Brake Company, Westinghouse Friction Draft Gear Company, Westinghouse Pacific Coast Brake Company, Westinghouse Air Brake Home Building Company, Union Switch & Signal Company, Union Signal Construction Company, the American Brake Company, National Brake & Electric Company, National Steel Foundries, Milwaukee Locomotive Manufacturing Company, Safety Car Devices Company, Locomotive Stoker Company, National Utilities Corporation and Westinghouse Union Battery Company.

The total assets, according to certified inventories, amount to $61,390,916.54, with a surplus balanced of date December 31, 1920, amounting to $16,140,579.56.

National Scale Men's Association

The National Scale Men's Association held its sixth annual meeting at Chicago, on March 15-17 inclusive coincident with the meetings of the Railway Engineering Association, and the National Railway Appliance Association. Among other business papers on the following subjects were presented. "The Testing and Inspection of Industry-Owned Scales," by C. W. Mann, superintendent of scales, Southern railway. "Scales and Weighing from the Viewpoint of a Railroad Engineer," by R. Hayes, structural engineer, Southern railway. "Design of Weight Bridges," by James L. Miller, engineer of bridges, New York Central. "Waterproof Decks for Railroad Truck Scales," by John E. Armstrong, assistant engineer, Canadian Pacific. "Waterproof Pits and Scale Drainage," by T. O. Dean, superintendent of scales, Texas & Pacific.

The attendance was unusually large, and the discussions of noteworthy interest.

The Air Brake Association

Preparations are nearly completed for holding the annual convention of the Air Brake Association at the Hotel Sherman, Chicago, Ill., beginning May 3 and continuing for four days. In addition to the general routine business, special committees will present reports on the following subjects:

(1) Auxiliary Devices Test Code and Instructions.
(2) Empty and Load Brake.
(3) Hand Brakes.
(4) Brake Pipe Vent Valve, Its Purpose, Operation, Installation and Maintenance.
(5) Triple Valve Repairs.
(6) Steam Heat Installation and Maintenance of Passenger Trains.
(7) Should not the Present Terminal Test be Modified to Insure an Effective Grade Brake as well as an Operative Brake.
(8) Recommended Practice.

Coincidently the Air Brake Appliance Association will furnish an exhibit of air brake appliances. Special arrangements are being made to accommodate the members and guests in the Sherman Hotel, and a large attendance is expected.

American Railway Tool Foremen's Association

The eleventh annual convention of the American Railway Tool Foremen's Association will be held at the Hotel Sherman, Chicago, Ill., on August 9, 10 and 11, 1921. Announcement of subjects to be discussed and other details is being prepared by the Secretary R. D. Fletcher, 1145 Marquette Road, Chicago, Ill., to where all enquiries should be addressed.

Domestic Exports from the United States by Countries During February, 1921

Steam Locomotives

Countries	*Number*	*Dollars*
Costa Rica	4	54,909
Honduras	2	33,600
Mexico	31	831,980
Newfoundland and Labrador	6	221,700
Cuba	13	325,180
Virgin Islands of U. S.	1	7,574
Dominican Republic	4	61,265
Brazil	3	97,386
Dutch Guiana	1	6,046
China	7	205,000
Dutch East Indies	1	7,200
Hongkong	1	14,112
Japan	8	60,230
New Zealand	4	21,261
Philippine Islands	7	301,400
British West Africa	1	18,771
British South Africa	3	87,726
Total	97	2,355,295

Books, Bulletins, Catalogues, Etc.

OIL FUEL: ITS SUPPLY, COMPOSITION AND APPLICATION. By Edward Butler, M. I. M. E. Fourth Edition. Published by J. B. Lippincott Company, Philadelphia. 310 pages, 155 illustrations; cloth.

This is recognized the standard book on the subject of which it treats, and its great popularity during the war period has induced the author to make considerable enlargement besides completely revising the work, so that those who may have earlier copies will find much that is the result of the latest experience in the revised work.

The work is divided into thirteen chapters, each treating of separate phases of the subject beginning with the sources of supply and taking up in succession the heat value, the chemical composition, combustion in furnaces, variations in land and marine boilers, including the appliances and methods used in locomotive practice both European and American, also road vehicles, metallurgical and other purposes embracing lighting and domestic uses.

THE STEAM LOCOMOTIVE. By E. L. Ahrons. Published by Sir Isaac Pitman & Sons, London, England. 116 pages, illustrated.

This is an elementary work giving a description of the modern steam locomotive, and intended for those who are not fully familiar with the mechanism of the modern, high-powered steam locomotive. It is written with great clearness, and while it is largely confined to British or European Continental practice, it is a valuable contribution to railroad literature, much of the matter being of a general kind common to all steam locomotives.

Lubrication of Steam Turbines

The subject of lubrication of steam turbines is exhaustively treated in No. 2 of the current volume of *Lubrication* published by the Texas Company. The article is a fine illustration of how minutely the engineering staff of the enterprising company has analysed the subject. As is well known: metallic surfaces, however finely polished, are microscopically rough and the projections, however minute, tend to interlock. A lubricant allows the projections to pass each other. This is simple enough, but when we come to consider the effect of speed, the weight, the kind of bearing, it will be readily understood that viscosity of the lubricant is an important factor, not speaking of the evaporation and decomposition and what is known as emulsification or the tendency of the oil to mix with water. Any oil to be suitable for turbine use must have a high resistance to emulsification. This quality depends on the character of the oil and the treatment which it has undergone in refining. All this and more than this is clarified in the article referred to, and copies may be had on application to the company, 17 Battery Place, New York.

The Commonwealther

Among the house organs that reach us the Commonwealth Steel Company's monthly periodical is a model in what may be termed the fellowship spirit. The welfare of the employees seems to engross the attention of the management as much, if not more, than the products for which the company has earned a highly deserved reputation. This is as it should be. The human element should should come first. Social justice leads to economic justice.

Sulphur in Coal

The United States Bureau of Mines announces the issuance of Technical Paper 254, "The analysis of sulphur forms in coal," by Alfred R. Powell, organic chemist. This paper describes and elaborates the method for the determination of the various forms of sulphur.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV — 114 Liberty Street, New York, May, 1921 — No. 5

The 120-Ton Coal Cars of the Virginian Railroad

Details of the Buckeye Truck

For a number of years the Virginian Railroad has been known for the heavy tonnage trains which have been hauled over its rails from the mines of West Virginia to its tidewater terminal at Sewall's Point, near Norfolk, Virginia. The originating points for the traffic are located among the mountains between Deepwater and Princeton, and this is a region of heavy grades. Princeton, West Virginia is the assembling point for the traffic, and from that point to tidewater, with the exception of the climb up the western slope of the Allegheny mountains, the controlling grade is only 0.2 per cent. On this grade up the mountains a pusher service is maintained. In the development of its tonnage trains it has had built some of the heaviest, if not the heaviest locomotives in the country.

Until recently its cars were of 50 tons maximum capacity. About four years ago. the road had four sample cars of 120-tons capacity built. These were placed in service and about a year ago an order was placed with the Pressed Steel Car Company for 1,000 cars of this capacity, with the expectation and intention of increasing the net tonnage of the trains.

With the old type of 50-ton hopper bottom and gondola cars, the train lengths were limited to eighty-five cars, as being about the limit that one engine could handle down the grades from Princeton to the New River and down the eastern slope of the Allegheny Mountains, where there is a grade of 1.5 per cent, the distances being about 12 and 7 miles respectively.

The cars are carried on six-wheeled trucks of two types. One made by the American Steel Foundries and the other by the Buckeye Steel Castings Company. In the illustration presented herewith, it is the Buckeye truck that is shown. The truck of the American Steel Foundries will be illustrated in a future issue.

120-TON CAR ON THE VIRGINIAN RAILROAD

The car illustrated, was built by the Pressed Steel Car Company. The framing of the car uses 13 in. channels weighing 37 lbs. to the foot for the center sills, which extend for the full length of the car. The length over the striking plates in 50 ft. 8¾ in. and these project 7⅛ in. beyond the end sills. This gives an inside length of 49 ft. 6 in. and a width of 10 ft. 2¾ in. The sides and bottom slope down at the center, so that an increase of depth of something more than a foot is obtained at that point. The actual depth at the center is 8 ft. 5⅛ in. while at the end it is 7 ft. 4¼ in. These dimensions give it a capacity of 3850 cu. ft. when level full and 4450 cu. ft. when heaped up to an angle of 30 degrees. It is upon this latter condition of loading that the capacity of the car is estimated. With coal weighing 54 lbs. to the cubic foot, and the car loaded to the 30° heap angle, the weight of coal will be a trifle more than 240,000 lbs. While the nominal capacity of the car is 240,000 lbs., this is also intended as the maximum and the cars are stenciled as of 210,000 lbs. capacity so as to admit of the usual 10 per cent overload that is allowed in practice.

The size of the car coupled to the fact that it is deeper at the center, gives it the general appearance of a quadruple hopper car. It is not, however, a hopper car and has no hoppers, drop doors or any means of discharge except as the load is dumped over the top by the dumping machine, installed at Sewall's Point. This makes it necessary that it shall be operated only over the lines of the Virginian Railroad, as there are no other dumping machines, except on the Norfolk & Western, capable of handling cars of this size and capacity.

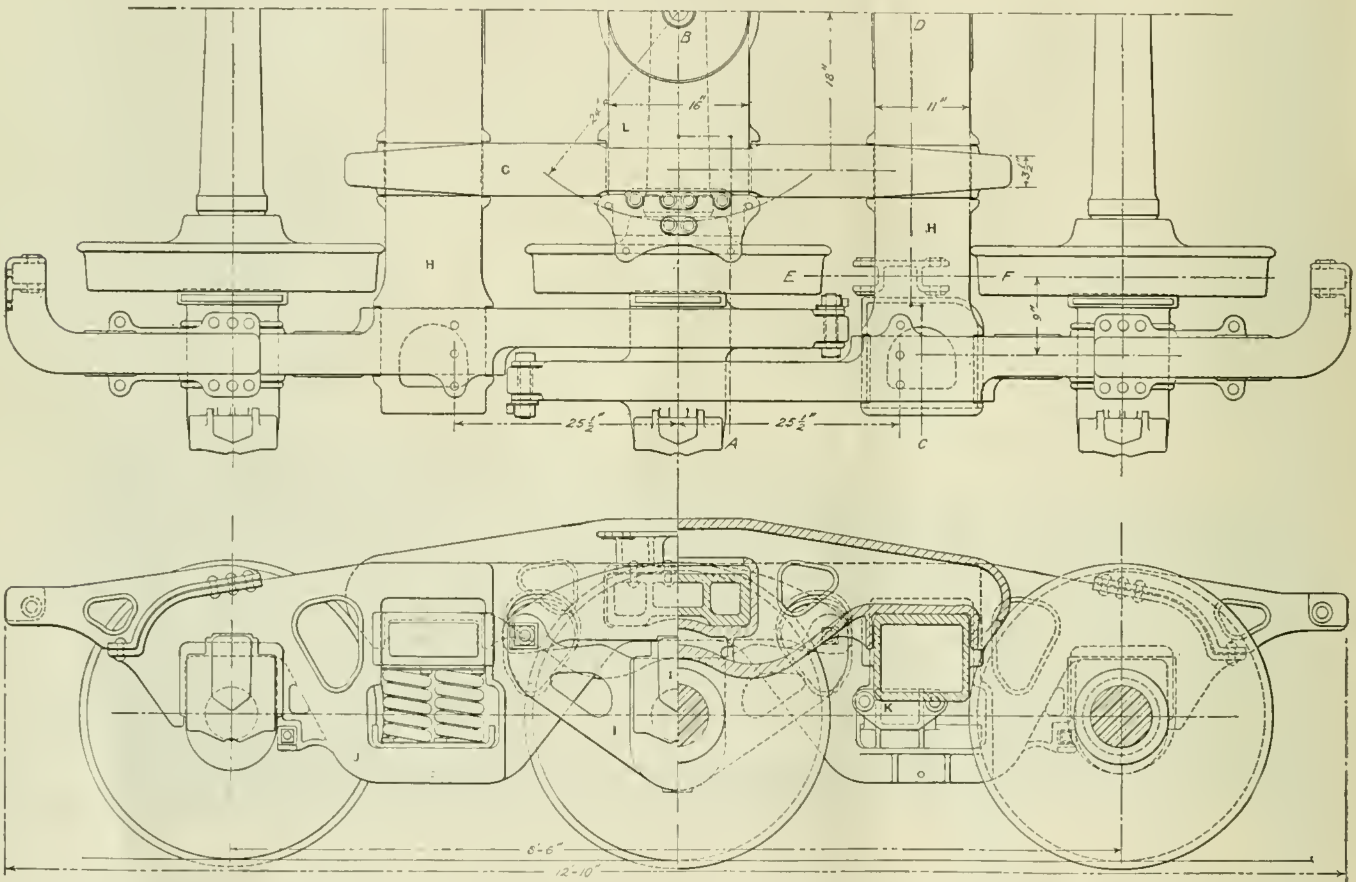
The reproduction of the photograph of the car shows it to be entirely free from outside side stakes or other projections on the outer surface, so that it presents a smooth, straight surface throughout the whole length and depth of the body at all points. This serves the purpose of engaging the clamps in the car dumpers and avoids a concentration of stresses on the side stakes, top angles or other projections while the car is being dumped. It also makes it possible to use practically all of the clearance width of the road for the inside or available loading width of the car, thus providing for the required cubic capacity in a minimum of length and height. The sides are formed of ¼-in. plates, sloped in near the top at an angle of about 15° and then flanged out, overlapping the horizontal leg of the top angle to which they are riveted. The angles extend to within approximately 2 ft. 4 in. from either end. At these points the plane of the side sheets is dropped back into the car so as to bring the ladders inside of the clearance limits and also to afford them a certain amount of protection in the car dumpers, and elsewhere where they would be apt to be struck.

The assembled side construction forms a girder of sufficient strength to carry the whole load of the car as well as its dead weight and do this at a low fiber stress and thus leave the center sills free to take the buffing strains without being called upon to carry the load at the same time, thus making them a stayed column of maximum resistance.

the center sills are spaced 18½ in. apart while on the cars with the Cardwell gear they are spaced 12⅞ in. apart, this difference being made because of the difference in the dimensions of the gears.

The center sills develop an effective buffing area of more than 30 sq. in. and the ratio of stress to strain calculated according to the rules of the American Railroad Association practice is below .05.

The ends of the cars are formed of ¼-in. plates like the bottom and sides and are reinforced at the top by 5-in. by 3½-in. by ⅜-in. rolled steel bulb angles and intermediately by two pressed steel braces which extend the full width of the car. Again, at the bottom they are reinforced by the floor sheets which are



SIDE ELEVATION, LONGITUDINAL SECTION AND PLAN—BUCKEYE TRUCK FOR VIRGINIAN RAILROAD 120-TON CARS

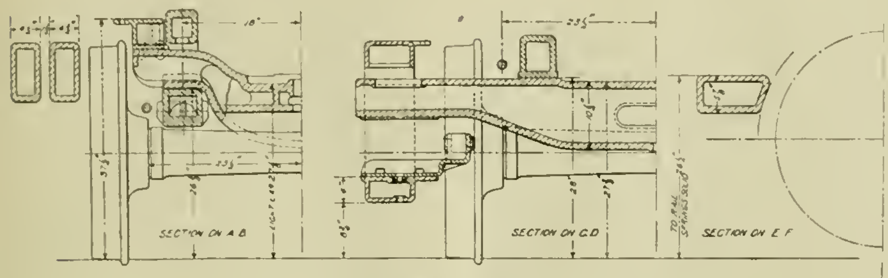
top angles are the standard 4 in. by 4 in. by ½ in. rolled steel angles with the vertical flange on the outside and in line with the plane of the side sheets. Fourteen stakes are provided on the inside of the side construction, on each side and the connection between these stakes and the side top angle is effected through malleable iron castings. The side stakes consist of reinforced triangular gussets and 5-in. rolled bulb angles all directly connected to the bolster, cross bearers and floor supports, all of which are located inside of the car body.

The sides are reinforced along the bottom by a 3½ in. by 3½ in. by ⅜-in. angle which also supports the floor. The center sills are reinforced by a top cover plate and, at the bottom by a 4-in. by 3½-in. by ⅜-in. angle.

Five hundred of the cars are equipped with the Westinghouse draft gear and the Lewis truck as made by the American Steel Foundries and the other five hundred have the Cardwell Duplex draft gear and the Buckeye trucks and it is with this latter equipment that the car is shown in the accompanying illustrations. While the whole of the thousand cars are equipped with the latest form of empty and load brake as made by the Westinghouse Air Brake Co.

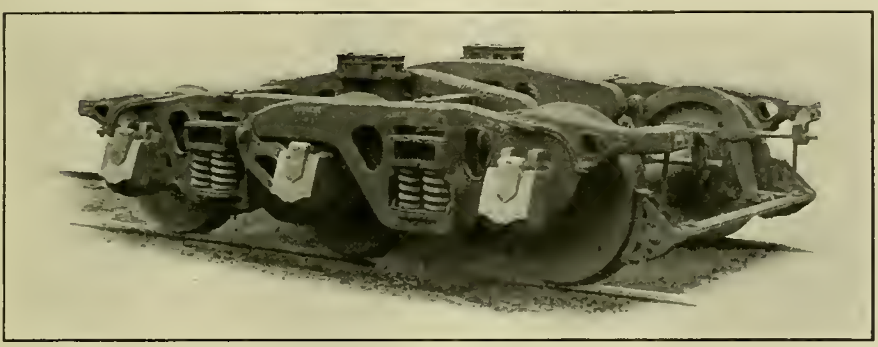
On the cars equipped with the Lewis trucks and the Westinghouse draft gear flanged up to engage the ends and are riveted thereto. As intimated, the floor sheets are ¼ in. thick and they, with the floor supports, including bolsters and crossbearers are of the built-up construction.

The trucks illustrated in this connection are the Buckeye trucks and they are of cast steel, being carried on six wheels and are equipped with the standard American Railroad Association 6 in. by 11 in. axles and 33 in. rolled steel wheels, Stucki side bearings and clasp brakes. It was considered advisable to use the clasp brake on these cars because of the high brake-shoe pressure that is involved in the use of the empty and load brake as applied to these cars. This brake is intended to apply, when in the load position a pressure equal to 40 per cent of the loaded weight of the car. When distributed over



CROSS SECTION—BUCKEYE TRUCK

the twelve wheels of the car this puts about 10,750 lbs. of brakeshoe pressure on each wheel, and this was considerad too

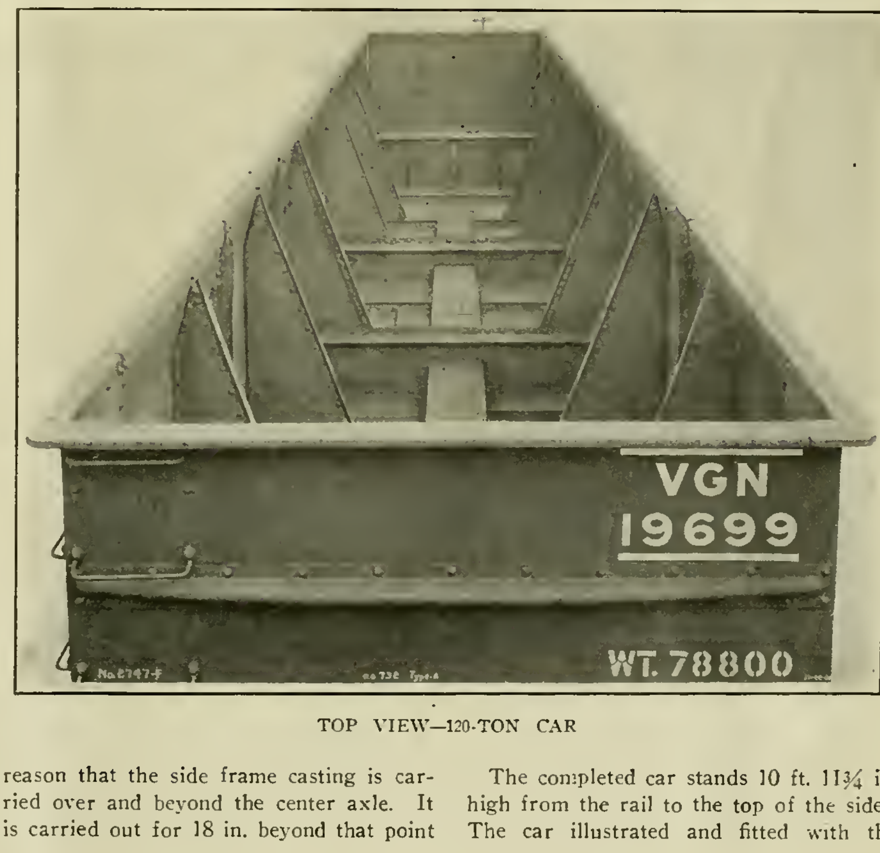


THE BUCKEYE TRUCK

much to be used on a single shoe and for that reason the clasp brake was used.

The Buckeye truck, which is here illustrated is formed almost entirely of steel castings. These castings are so arranged that they are readily assembled and equalize the load on the three pair of wheels, and, at the same time, give perfect vertical flexibility when passing over inequalities in the track.

The weight of the car is carried on centerplates that are cast solid with the center bolster casting *L* and it is to this that the sidebearing blocks *M* are riveted. The center bolster casting is carried at either end by the longitudinal bolsters *G* which are spaced 36 in. from center to center or 18 in. on each side of the center line of the truck. These longitudinal bolsters, in turn, rest on the transverse bolsters *H* which are carried at each end by the springs. The ends of the transverse bolsters project through an opening in the side frame castings *J* in which the spring seats are located. These side frame castings are fitted with an emergency fastening for the journal boxes and with right and left brake hanger brackets, which are riveted in place. The side frame castings rest directly upon the outside journal boxes and have their other end projecting over and beyond the center of the center axle. The distance between the axles is 4 ft. 3 in. making the total wheel base of the truck 8 ft. 6 in. The distance of the center of the spring seat from the center of the outer axle is 23 in. leaving 28 in. to the center of the center axle. It is evident that, in order that the weight may be equally distributed over the three pair of wheels the distance between the bearing point of the side frame casting where it rests on the center axle must be twice that to the point where it rests on the end axle. It is for that



TOP VIEW—120-TON CAR

reason that the side frame casting is carried over and beyond the center axle. It is carried out for 18 in. beyond that point and is there fitted with a bearing bolt as shown. This bearing bolt serves to attach it to the journal box equalizer casting *I* which includes the journal box and which rests on the center axle journal. This casting terminates in jaws at each end which straddle the ends of the side frame castings and to which they are bolted.

It is evident, from this construction, that the truck is quite flexible both laterally and longitudinally and that it can accommodate itself to any inequalities of the track, for the side frame castings can turn on the end axles and the journal box equalizer castings can turn quite as freely on the center axle.

The trucks have now been in service for several months and are giving excellent service. The truck made by the American Steel Foundries and which is used on five hundred of these cars will be illustrated and described in a future issue.

In addition to the air brakes that are operated by the new empty and load brake, a special screw type of hand brake is provided for braking the cars by hand. This has been applied because the ordinary hand brake would not be suitable for spotting these cars on the dumpers and in handling them about the mines where it is sometimes necessary to drop them down steep grades after loading.

The couplers used are of special design having American Railroad Association type *D* heads and slots for connecting to draft gear with 2 in. by 6 in. forged keys and cast steel yokes.

The completed car stands 10 ft. 11¾ in. high from the rail to the top of the sides. The car illustrated and fitted with the

Buckeye trucks weighs 78,800 lbs., of which 41,600 lbs. represents the weight of the body and 37,200 lbs. the weight of the Buckeye trucks. The other car fitted with the Lewis trucks weighs 78,900 lbs., the body weighing 43,200 lbs. and the Lewis trucks 35,700 lbs. These dead weights make a ratio of revenue earning load to total dead weight hauled of 75.3 per cent.

Revised Locomotive Boiler Code

What is considered as an important step in engineering standardization was taken at the Boston meeting of the Council of the American Society of Mechanical Engineers, when it adopted in its final form that portion of the A. S. M. E. Boiler Code, known as the Locomotive Boiler Code. This code contains the rules for the construction of locomotive boilers which are not subject to Federal inspection and control.

The necessity for such an addition to the Boiler Code arose from the fact that, while the boilers of locomotives operated on railways engaged in interstate service are covered by the construction and inspection rules of the Interstate Commerce Commission, there was found to be a vast mileage of industrial and short-line railroads in operation in the various states, which, by virtue of their location, are not subject to the interstate requirements.

As a result of calls for a Code to cover the construction of boilers of this class, the Sub-Committee on Railway Locomotive Boilers was appointed in 1916. This committee consisted of F. H. Clark, chairman; F. J. Cole, chief construction engineer of the American Locomotive Co., Schenectady; A. L. Humphrey, vice-president and general manager of the Westinghouse Air Brake Co., Wilmerding, Pa.; S. F. Jeter, chief engineer of the Hartford Steam Boiler Inspection & Insurance Co., Hartford; William F. Kiesel, Jr., mechanical engineer of the Pennsylvania Railroad, Altoona, Pa.; and H. H. Vaughan, vice-president of the Dominion Copper Products Co., Montreal. The work of this sub-committee was interrupted somewhat by the war, but its preliminary report was submitted to the Boiler Code Committee in April, 1919.

The preliminary report was printed and distributed at the spring meeting in Detroit, where it was accepted by the meeting. The sub-committee has been coordinating the points of view of all who would be affected by such a Code and the final result approved by the Main Committee and the Council is now ready for use. H. V. Willie, assistant to the vice-president of The Baldwin Locomotive Works, Philadelphia, and Kenneth Rushton, chief mechanical engineer of The Baldwin Locomotive Works, were brought into the Committee and with Mr. Cole and James Partington, estimating engineer of the American Locomotive Co., New York, appointed in place of Mr. Humphrey, resigned, represented the locomotive manufacturers.

Constructive assistance was given by the mechanical division of the American Railway Association, through its representatives, A. W. Gibbs, mechanical engineer of the Pennsylvania Railroad; W. I. Cantley, of the Lehigh Valley Railroad, and N. A. Ferrier, of the New York Central Railroad. A. G. Pack, chief mechanical engineer of the Interstate Commerce Commission at Washington, has expressed great interest in the Code, and, with his staff of engineers, has been in frequent attendance at meetings of the sub-committee.

During the past two years Mr. Clark, the original chairman of the Committee, has been in China as Technical Adviser to the Ministry of Communications at Pekin. Mr. Vaughan has carried on the work of the Committee as acting chairman.

The Code, itself, follows the general form of the Code for stationary boilers. The materials to be used and methods of construction of the various braced and stayed surfaces are very carefully specified. Attention is given to the desire of the locomotive builders to maintain the lowest possible weight consistent with strength. As compared with stationary boilers with a safety factor of five, the allowable factor for locomotive shells is four. Requirements in the use of safety valves and their method of test are rigid as are the hydrostatic tests specified.

The principle additions appear in Section ninety-one, and is amended to read as follows:

Section 91. The commission shall cause to be inspected at least once each year, all boilers used for generating steam or heat which carry a steam pressure of more than fifteen pounds to the square inch, except where a certificate is filed with such commission by a duly authorized insurance company, in conformity with the rules and regulations of the commission, and certifying that upon such inspection such boilers have been found to comply with the rules and regulations adopted by the commission and to be in a safe condition. Every such insurance company shall report to the commission all boilers insured by them coming within the provisions of this section including those rejected, together with the reasons therefor. A fee of five dollars shall be charged the owner or lessee of the Consolidated Laws, as added by chapter three hundred and internal inspection made by the inspector of the commission, but not more than the sum of seven dollars shall be collected for the inspection of any one boiler for any year. Such fee shall be payable within thirty days from the date of such inspection. If a certificate of inspection filed in the office of the commission shows a boiler to be in need of repairs or in an unsafe or dangerous condition, the commission shall order such repairs to be made to such boiler as in its judgment may be necessary and it shall order the use of such boiler discontinued until such repairs are made or such dangerous and unsafe conditions remedied. Such order shall be served upon the owner or lessee of the boiler, personally or by mail, and any owner or lessee failing to comply with such order within a time to be specified therein, which shall be not less than ten days from the service of the order if served personally and not less than fifteen days from the mailing thereof if served by mail, shall be liable to a penalty of fifty dollars for each day's neglect thereafter. Every owner or lessee of any such boiler who shall use or allow a boiler to be used by anyone in his employ after receiving notice that such boiler is in an unsafe or dangerous condition shall be subject to a penalty of not to exceed five dollars for each day on which such boiler is used after receipt of such notice. Owners and lessees of boilers shall attach to such boilers the numbers assigned by the commission under a penalty of five dollars for each day's failure so to do after such numbers have been assigned.

The provisions of this section shall not apply to cities in which boilers are regularly inspected by competent inspectors acting under the authority of local laws or ordinances. Said cities shall enforce the boiler code as adopted by the commission.

Boilers subject to inspection by the public service commission, inspectors of steam vessels under the State superintendent of public work and United States Government are exempted.

Removing Buckles in Plates

When a section of a steel plate is heated with the oxy-acetylene torch, expansion of the heated metal is restrained by the surrounding cold metal, the result being that the hot metal is slightly upset and made a little thicker. When the metal cools it shrinks. Advantage of this is taken to remove buckles from plates. Buckles can be eliminated very nicely with the torch by operators who understand the mechanics of the trick. The buckle should be located closely and circled with chalk. Three or four spots should be marked, depending on the size of the buckle and the thickness of the metal. Heating the spots results in the complete disappearance of the buckle, due to the upsetting and subsequent contraction of the metal. It might be explained that a buckle in a plate is simply a result of excess metal at that place. When the metal is shrunk the buckle lies flat.

The operation has been found to be easy in accomplishment, and invariably satisfactory in the desired result.

The Manufacture of High Speed Steel

Inception and Progress Towards a High Degree of Utility

At the May meeting of the Central Railway Club held at Buffalo, N. Y., Felix Kremp, metallurgist of the Atlas Crucible Steel Company, Dunkirk, N. Y., presented a paper on the manufacture of high speed steel, which was both interesting and instructive. There are so many volumes published on this subject that while they are of value to those who have opportunity to study them, it is gratifying to find in Mr. Kremp's paper not only the details of the general means and methods used in the manufacture of high speed steel, but also a brief and reliable historical account of its inception and improvement from time to time in the hands of many ingenious metallurgists, to whose labors we are indebted for the high degree of utility to which high speed has attained at the present time. Mr. Kremp does not venture into the realm of what may be accomplished in the future in the way of further scientific experiment, but confines himself like a practical working engineer to the product as it is today. The following is the chief part of the paper as presented:

Probably the simplest definition of a high speed steel is that a tool made from such a steel will retain its cutting edge when heated to a visible red heat, such heat being produced by the friction of cutting. The chemical composition of such a steel at the present day has been fairly well standardized and we find that the approximate analysis will be about as follows:

	Per Cent.
Carbon	.60 to .70
Manganese	.25
Phosphorus and sulphur under	.035
Silicon	.20
Chromium	3.50
Vanadium	1.00
Tungsten	18.00

Some manufacturers have attempted the use of other elements such as cobalt, but this has never been used as a substitute for any of the alloying elements mentioned above. On some tests where a tool containing cobalt has won out it is very probable that it would have been quite as successful without the addition of cobalt. Uranium has also been used to a slight extent as an alloy in high speed steel, but the objection to its use is that it is easily oxidized and the relatively great weight of its oxide prevents its elimination from the molten steel into the slag. There is on the market at the present time, however, a low carbon ferro-uranium which has been more successfully used as an additional alloy. Zirconium, molybdenum and cerium have all been used in various attempts to improve the quality of high speed steel, but at the present time, we cannot say they have been proven successful.

At the present time high speed steel is being manufactured by both the crucible and electric furnace process. I do not wish to belittle the electric furnace process in any way, as it certainly provides means of controlling and refining a steel that are not at hand in the crucible process; the process which I will describe, however, will be the crucible process, as we do not feel that the electric furnace process has as yet proven its worth for the manufacture of the highest quality steel.

The forerunner of our present day high speed steel was the invention of Mushet in 1868, of what was known as Mushet Air Hardening Steel. This was a steel high in carbon and manganese and with a low percentage of tungsten. The invention of modern high speed steel is generally credited to Messrs. Taylor and White, although they were denied patents; scientific and technical societies have accorded to them honors which were denied by the courts. Most of their work was developed at the Bethlehem Steel Company about 1898, and the steel was first demonstrated to the public in Paris in 1900. The full result of their investigation, however, did not become public until 1906, at which time Mr. Taylor published his paper on the "Art of Cutting Metals." The original Taylor and White steel was a high carbon steel and with a tungsten content of about 9 per cent and a chromium content of 3 per cent. This was quickly followed by a steel of about 60 per cent carbon, same percentage of chromium, but a higher percentage of tungsten. Probably their greatest contribution to the science was the development of the proper hardening heat for such a steel.

The only generally accepted improvement in high speed steel since the introduction of the original steel was in 1905, when Dr. Mathews was granted patents for the addition of vanadium. It was first thought that this acted only as a scavenger but it was later shown that it greatly increased the cutting efficiency of tools. While there have been no generally accepted improvements in the chemical composition since 1905, there have been great improvements in the quality. This has been brought about by improvements in the method of manufacture and also in the very great improvement in the quality and purity of the ferro alloys which make up the steel.

We now proceed to the manufacture of the steel and as stated above we will deal only with the crucible process. The crucible process for the manufacture of steel was invented by Huntsman in 1740, and since that time there have been practically no improvements in the process itself, what improvements there have been being confined to the furnace, dealing with the construction and method of heating. The crucible process is essentially a melting process, or in other words, we get out what we put in, and for this reason it is necessary to use the highest grades of raw materials and also to know their exact chemical composition.

What is known as the base of crucible steel is pig iron that has been puddled and rolled into muck bars. It is essential that this be of the highest quality, that is low in phosphorus and sulphur. To this is added a high grade scrap, that is, scrap from scrap ends of ingots, billets and bars. Muck bar and scrap are carefully weighed out in a pan where the ferro alloys, such as ferro-tungsten and ferro-chronium, are weighed out in a small bucket; this makes up the charge for a crucible; the total weight being approximately 90 or 100 pounds. The crucibles are packed by placing part of the charge of muck bar and scrap in the bottom and the ferro alloys in the center, and then the remainder of the charge on top. The crucibles used are made of a mixture of graphite and clay. On being charged the crucibles are covered with a cap from the bottom of an old crucible, and are ready to be placed in the furnaces.

The crucible furnaces are of the regeneration type and consist of a number of pits; each pit being made to hold six crucibles. The crucibles are lowered into the pits by being grasped by a pair of tongs made especially for the purpose, and bearing in mind that the crucibles are very fragile. The temperature of the furnace is maintained at 2,700 to 3,000 Fah., and it requires from 2½ to 3½ hours to completely melt the steel and when it is fully melted the steel is "killed," that is, the molten steel is allowed to stay in the furnace until the ebullition of the gases within the molten metal has ceased. The pots are now removed from the furnace and their contents poured into a ladle; it is at this point that some manufacturers differ in their handling of the steel, as it is a practice of some to pour the contents of individual pots into separate moulds. By this method we are likely to have a great variation in the carbon contents of the ingots which make up a heat of steel as it is practically impossible to obtain the same carbon content from different pots. The better practice appears to be to pour the contents of all the pots into a ladle which contains a nozzle at the bottom and from this ladle the steel is poured into the moulds, this allows a complete mixing of the steel from the various pots. The moulds are of the split type and are generally made of cast iron and vary in size from 4½ to 16 inches square. It has been found to be impractical to make a larger ingot of high speed steel than the latter size mentioned.

Steel solidifies in the form of crystals which are at right angles to the vertical axis of the moulds, and freezing proceeds from the outside to the center, and as it freezes the steel contracts which causes an opening or "pipe" in the center of the ingot. In order to overcome this pipe to some extent, hot tops, which are made of clay, are placed on the top of the ingot. These hot tops will retain molten metal longer than the mould itself, which will flow down into the pipe or opening and fill it up. It might be well also to allude to the fact that the ingot is larger at the top than at the bottom, this allows freezing from the bottom up and also decreases the amount of "pipeage."

High speed ingots as cast are comparatively weak, and they must first be annealed before any work can be done on them. After this annealing operation drillings are obtained for chemical analysis from a certain number of ingots from each heat of steel and until the chemist has reported the complete analysis it is important that the ingots should not be allowed to proceed in process of manufacture, as very often the wished for chemical composition is not obtained, and it is therefore necessary to scrap the entire heat. The surface of the ingots are now carefully inspected for any defects and these are all removed by grinding. The ingots are now ready for the cogging hammers.

It is important that the reduction in the size of the ingot should be done on hammers as it has been found that presses and large rolling mills, particularly the latter will not give the desired internal structure of the steel. The ingots are heated for the cogging operation by preheating very slowly and then bringing quickly to the desired cogging temperature in another furnace. We have found it expedient to control both the cogging and rolling temperatures by means of an optical pyrometer.

The reduction in area of the ingot under the hammers varies from 65 to 80 per cent. The ingots after this operation are in the form of billets and it is again necessary to anneal them and re-inspect them for surface defects. After this the billets are either re-cogged under the hammer or rolled to the desired bar size.

A rolling mill consists of a number of stands, the first being the roughing, through which the billet is first rolled and then through the leader and finishing rolls. The rolling mill is known as a 10 or 14 inch mill, depending on the diameter of the rolls and the size of the rolls governs the size of the bar which can be rolled. Rolling mill practice is a complete science in itself as the shape and succession of the grooves in the rolls govern the quality of the bar stock. The important elements in rolling mill practice are the heating and finishing temperatures, the draft and speed of the mill.

The rolled bars are now sent to the annealing department to be annealed. This is done by packing the bars in tubes with coal dust and coke, placing in the annealing furnace and bringing them slowly to the desired temperature, which is about 1,650 degrees Fahrenheit. The furnace is held at this temperature for a certain length of time and then allowed to cool very slowly to a black heat before the tubes can be removed from the furnace. The annealing process not only removes the strains that are in the steel from rolling but also makes the bars of uniform hardness.

After annealing the bars are taken to the inspection department, which is one of the most important departments in a tool steel mill, ranking with the chemical and metallurgical departments in the control and quality of the product. The end of each bar must be broken off or in mill parlance "cropped" and the fracture examined. It is often necessary to examine large bars of high speed steel microscopically as this is a much better gauge of the internal structure than the eye. It might be well to add here, that if the steel does not have the proper structure at this point it would be practically useless to the ultimate user and must be turned back into scrap. The inspection department also makes a very careful examination of each bar, for seams, laps and other surface defects and also tests the bars for Brinell hardness as they must be sufficiently soft to machine readily.

Bars are now ready to be sent out to the customer and as the value of the steel to the customer lies in the proper heat treatment, I feel that I should say a word about this.

It has been found that high speed steel must be heated considerably above its critical point in order to develop its full possibilities. This will generally be about 2,200 to 2,400 degrees Fahrenheit. At this temperature the various complex tungstides and carbides are thrown into solution and this solution is maintained at atmospheric temperatures by quenching into the proper medium, which in most cases is oil. Then by drawing or in other words, reheating at a temperature of 1,000 to 1,100 degrees Fahrenheit the steel undergoes a change in internal structure which makes it harder than in the original quenched condition and ready to do its best work.

In railroad shops particularly it has been the custom to test various types of high speed steel by a cutting test and it might be of interest to know what Mr. Taylor said in regard to this. "This test requires so much expensive apparatus, consumes so much time and is so slow that a simpler index or guide which will indicate correctly the quality of high speed tools is much needed." Up to the present, however, no simple method for the testing of a high speed steel has been devised. I do not believe that a high speed steel should be judged solely by the cutting test alone, neither should it be purchased on chemical composition. The user should first obtain some idea as to quality by determining the methods of manufacture and quality of raw material put into the steel, or as Dr. Mathews has very ably put it, "steel making rather than chemical analysis is the first consideration." When several steels have been selected with the above idea of quality in mind the test should approximate shop methods as closely as possible, as it has often been the experience of many users that a steel which did excellent work on a test was a miserable failure when working under actual shop conditions.

Tank Steel

Tank steel has, at last, been defined by the Association of American Steel Manufacturers "as a grade to be used for ordinary fabrications or for structural purposes where no particular stresses are required. It should be free from surface defects." The reason for making this definition lies in the fact that, since the outbreak of the war a great deal of "tank steel" has been specified for purposes for which such steel was unsuited and then has had attached to it requirements that would throw the material into a higher classification, without, of course, expecting to pay the extras required by such higher classification. The ruling of the committee is further that if the buyers' specifications stipulate a tensile test from each plate as rolled, a material shall be classified as flange steel. Further, that if a flange steel purchase specifies a homogeneity test in addition to naming chemical and physical properties, the material becomes fire-box steel. Again, that if the steel plate order carries specifications with regard to phosphorous and sulphur limits equivalent to the fire-box grade, the steel shall be regarded as fire-box steel unless the chemical tests are modified.

Master Boiler Makers' Association Convention Postponed

The annual Convention of the Master Boiler Makers' Association which was to have been held on May 23 to 26, inclusive, 1921, at the Planters' Hotel, St. Louis, Mo., has, on account of business depression, been postponed indefinitely. The Secretary's office is now located at 26 Cortlandt Street, New York City, instead of 95 Liberty Street, as formerly.

The Design of Large Locomotives

Features Which Keep an Engine in Service a Maximum Length of Time, Reduce Maintenance and Repair Costs, and Increase Revenue-Earning Power

By M. H. HAIG,[1] TOPEKA, KAN.

The design of a large locomotive depends on the service to which it is to be assigned. The service varies with the weight of the train to be hauled and the number of cars in the train, and is affected by the topography of territory on which it is to operate, ruling grades in each direction, length of grades, average speed between terminals, method of dispatching, whether single or double track between terminals, etc. This information being available, it is a reasonably simple matter to determine upon the leading features of a locomotive to meet the requirements.

Restrictions and Limitations Imposed

For a locomotive to give practically 100 per cent service, its design and construction must not be restricted by personal opinion or by physical limitations of the road. If the weight needed for adhesion in starting a given train is restricted by an opinion that certain wheel loads should not be exceeded or because bridges and track are not capable of carrying the necessary weight, then the capacity of the locomotive is restricted and the train must be adjusted to the locomotive, instead of the locomotive being built to suit the train. This in turn has a tendency to limit a division or a railroad as a whole. Limitations such as these, together with clearances of bridges and structures, obstructions along the right of way, etc., affect the locomotive design and construction. The locomotive as a whole is dwarfed, or some of its vital or essential parts are so dwarfed as to cripple the machine as a whole.

A railroad is a plant, establishment or organization for manufacturing transportation. The locomotive is a very important part of the plant and is one of the most direct earners of revenue from which the transportation-manufacturing plant obtains its income. As such, it is a matter of business and economical principle to adjust some of the physical conditions of the road to meet the requirements of the locomotive, to prevent dwarfing it and to prevent sacrificing its power. Meeting these requirements of the locomotive amounts to meeting the necessary requirements of traffic. No turntable installed at a principal roundhouse should be less than 100 ft. long, and in many cases the length should be 125 ft. The distance between the walls of a modern roundhouse should be great enough to permit closing the door behind the tender of a Santa Fe or Mikado type locomotive and have ample room for trucking between the locomotive pilot and the outer wall of the roundhouse. Passing tracks should be long enough to take trains justified by the business and traffic of the division or territory. Bridges, rail and roadbed should be capable of carrying a static wheel load of at least 65,000 lb. per pair and of permitting the additional stresses resulting from a freight speed of at least 45 miles per hour. In meeting the requirements of rail stresses particular attention should be given to the employment of heavy rails on curves.

Unless these physical conditions are provided, a locomotive cannot be designed and constructed without restriction and proper power cannot be furnished to meet requirements. The only governing factors should be the size of train and the traffic of the territory.

Leading Features of Locomotive Construction

Leading features of locomotive construction such as relative size of cylinders, length of stroke, total heating surface, superheating surface, grate area, etc., have been well covered by handbooks and pamphlets issued by locomotive builders and by reports to the various associations, as well as by articles in the technical press. Tables of principal dimensions of large locomotives are obtainable from the same sources, together with detailed descriptions of features of design and construction which have met with general favor and some which have been short-lived. A discussion or comment on these features would therefore be largely a repetition of facts already presented and easily available.

Features which have not been so generally discussed and exploited are those which keep a locomotive in service a maximum length of time, reduce engine failures to a minimum, reduce cost of maintenance and repairs and increase revenue-earning power. Among these, durability of material and accessibility of parts are important factors. The latter implies arrangements by which a locomotive is made free from complications in construction, inexpensive to repair, easy to maintain, and so put together that needed repairs can be made handily and quickly.

Almost as important as providing a locomotive that will meet the requirements of trains to be hauled and traffic conditions is providing one that requires minimum repairs—a locomotive that after one trip is ready to be turned for the next trip.

A locomotive is in revenue-earning service only when it is hauling trains. Any road can make a study and determine what proportion of its locomotives are unserviceable and what percentage of the time its serviceable locomotives are on the road. Such information will show what percentage of the time its engines are earning revenue.

To maintain the advantages of designs already existing and to develop these still further requires the unlimited cooperation not only of the mechanical, civil-engineering and operating forces of the railroads, but also of the locomotive builders, and particularly of the manufacturers of material.

The necessity for unlimited cooperation by manufacturers of material is evident from the study of failures of parts both large and small. On the principle of encouraging further consideration of such cooperation by all concerned and for the purpose of arousing interest in those details of locomotive construction which are not always given the attention to which they are entitled, a number of details which seldom appear among "leading dimensions" will be discussed.

Counterbalance

Important among such details and one which is affected particularly by designers and manufacturers of material, is the counterbalance. The blow from the counterbalance is caused by the differerence between the weight of the revolving parts carried by the pins and the total weight in the wheel to balance both the revolving and reciprocating weights. In other words, it is the weight in the wheel to balance reciprocating weight that causes the hammer blow.

Weight of reciprocating parts therefore affects hammer blow of driving wheels, riding qualities of locomotives, possible damage to track and bridges and total weight of locomotive. It is particularly essential to make these parts as light as possible, and to make them light the material must be durable.

Due to the increase in weight of locomotives and to the hammer blow on rails when reciprocating parts are heavy, the 1915 Committee of the American Railway Master Mechanics' Association made the following recommendation:

Keep total weight of reciprocating parts on each side of locomotive below 1/160 part of total weight of locomotive in

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Abstract of a paper to be presented at the Spring Meeting, Chicago, May 23 to 26, 1921, of The American Society of Mechanical Engineers.

working order and then balance ½ weight of reciprocating parts.

An attempt to counterbalance large locomotives in both freight and passenger service according to this recommendation has demonstrated its merit, but has further demonstrated that the durability of both cast and forged steel must be improved if the method is to be continued.

Crossheads

The Laird type of crosshead is lighter than several other designs, its performance is very satisfactory in service, and it therefore has advantages in designing for light reciprocating parts. A crosshead of this type used interchangeably on large freight and passenger locomotives is shown in Fig. 1.

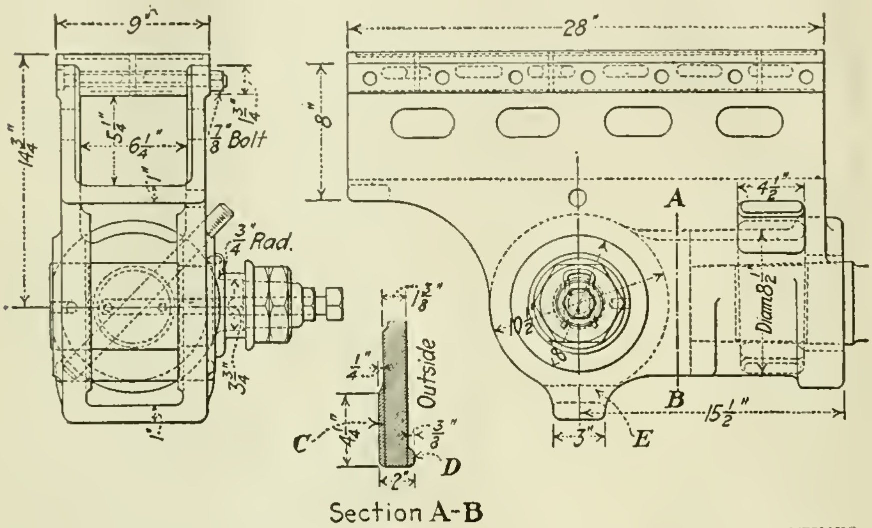


FIG. 1. LAIRD CROSSHEAD USED ON VARIOUS TYPES OF LARGE LOCOMOTIVES

The construction originally employed is shown by the figure, with the exception of later reinforcement at *C*, *D* and *E*. After about a year's service these crossheads began to break, the weakness appearing in the relatively thin wall between the hub around the piston rod and the lighter hub around the crosshead pin. The same weakness developed in crossheads of similar general design among locomotives of three or four different classes. The defects which proved common to these different crossheads are shown in Fig. 2.

By breaking up these crossheads in order to investigate the nature of the metal, it was found that in most cases each fracture had its origin in a shrinkage crack. The metal in most of the broken crossheads was found to be porous and to contain blowholes or gas holes, or shrinkage cracks, cold shuts or pipes. In some cases all of these defects were present.

Fig. 2 shows very clearly the difference in cross-section of the metal at and near the break. This difference is no doubt largely responsible for the defects in the metal which have caused an epidemic of failures. Crossheads of this general design have been used for many years, and as it appears impossible to modify the shape to advantage, the question, then, is whether foundries can adjust their practices to cast such irregular sections without blowholes, shrinkage cracks and other defects. This is one of the opportunities for manufacturers of material to cooperate with the locomotive designer.

Driving Wheels

Another irregular section which causes shrinkage cracks is the cast-steel driving-wheel center. Rims and spokes are of much lighter section than the hub and counterbalance, and shrinkage cracks are not unusual at the juncture of these light and heavy sections. Foundries which cast locomotive parts have these conditions to meet and it is believed that foundry practices can be adjusted to meet them.

Crosshead Pins

In the development of locomotive construction within recent years the union link of outside valve gears has been connected direct to the crosshead pin. This reduces weight by eliminating the crosshead arm and by shortening the length of the combination lever, thus lessening reciprocating as well as total weight. A further advantage is in eliminating connection between the crosshead and arm.

In eliminating the crosshead arm the duty of the crosshead pin is increased. A broken crosshead pin is more serious than a broken crosshead arm. When a pin breaks there is a possibility of something else being broken and a very great probability of a cylinder head being knocked out and carrying a part of the cylinder wall with it. It is therefore absolutely necessary that the material in the crosshead pin shall be of a good quality, and the steel used should contain about 0.50 per cent carbon and have a tensile strength of 80,000 lb. per sq. in.

By reference to Fig. 1 it will be observed that the diameter of the union link shank of the crosshead pin is 3¾ inches. This is believed to be considerably larger than usual in locomotive design. Even though the stresses in the crosshead pin are low, this large size appears to be a necessary precaution against the uncertainty in quality of material. As a further precaution there is a ¾-inch fillet at the end of the shank.

Piston Rods

The greater number of breaks in piston rods of at least one railroad have been through the keyway. Next in order is the location in the crosshead fit adjacent to the collar. Breaks in the body are usually adjacent to the collar at the crosshead fit and occasionally at the collar adjacent to the piston-head fit.

The mechanical fit between the rod and the crosshead is often responsible for the breakage of the former. If there is not a good bearing throughout the length of the fit or at both ends of it, there is opportunity for a slight movement of the rod in the crosshead. This starts a crack which gradually progresses into a fracture. To facilitate making a good bearing at both ends of a piston-rod fit in a crosshead, the diameter is reduced 1/16 inch for a length a little greater than the keyway and about midway between ends of the fit. To prevent cracks starting in sharp corners at edges of the keyway, these edges are chamfered at both ends of the keyway and entirely around.

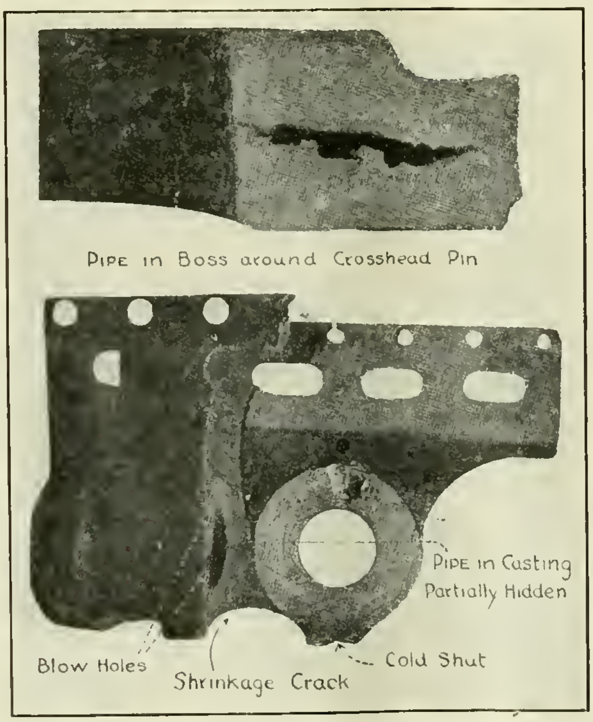


FIG. 2. LOCATION AND NATURE OF DEFECTS IN A POORLY CAST CROSSHEAD

Rods with comparatively low stresses sometimes fail in such a manner that it is difficult to attribute a cause unless quality of material is responsible. This is true of rods of ordinary carbon steel as well as those of specially refined steel and of alloy steels. In this is another opportunity for the assistance and co-operation of manufacturers of material.

Cylinders

Failures of parts such as those described in preceding paragraphs, quality of material, uncertainty of cylinder cocks being operated, extreme variation in temperature due to use of superheated steam, foundry practices, etc., all affect the design of cylinders. Consideration of these and other features has resulted in the development of the design shown in Fig. 3, which is that of the cylinder of a Mikado locomotive. Except for modifications in dimensions this represents cylinders used also on Santa Fe, Mountain, Pacific and other locomotive types. The principal features of this cylinder are:

Simplicity in construction.

Uniform thickness of metal.

Absence of heavy metal sections at junctions of walls.

Walls and parts of ample thickness for strength, well ribbed, well braced and arranged with easy curves and generous fillets.

Uniform sectional area throughout length of steam and exhaust passages.

Short steam ports.

Small steam clearance.

Sections of metal, fillets and other features arranged to eliminate internal stresses set up in metal when cooling.

Double row of splice bolts holding halves of cylinder saddle together.

Double row of bolts at smoke arch.

Triple row of horizontal bolts securing cylinder casting to frame.

Depth of saddle casting directly above frame forming a box section and providing strength where shallow castings used with double-frame rail failed in the past.

Location of valve close to cylinder, permitting short ports, straight valve gear without offsets, and application of nearly straight steam pipe.

Large openings to cylinder cocks.

The steam and exhaust channels are free from obstructions and restrictions which will interfere with free flow of steam. The exhaust channels are gradually reduced in area from valve bushing to base of exhaust pipe in such a manner that the cross-sectional area of any point in the channel is not larger than any area through which exhaust steam has previously passed.

A weakness in castings of some large cylinders has been in the wall around the live-steam port. As shown in Fig. 3, this wall is made 2 inches thick and the distance across the port below the valve bushing is 24 inches. To reduce stresses in this wall it has been made thicker than most other walls of the casting and, compared with former practice, width across port has been reduced about 4 inches. The bridges in the live-steam port are 2 inches thick. They were formerly but 1 inch in thickness and it was not unusual to find them cracked clear through. The change was made to increase the cross-section of the bridges in relation to the adjacent walls and thereby reduce tendency to shrinkage cracks.

To obtain a good cylinder casting from any design, it is necessary to have proper co-operation of the pattern shop and the foundry. Patterns must be well built and carefully checked. The checker should exercise especial care to see that pattern-makers apply all the fillets called for. The foundry should so arrange the mold as to obtain uniform sections of metal. To insure this, careful measurements should be taken when cores are being set and a drop light should be let down into the mold when taking measurements.

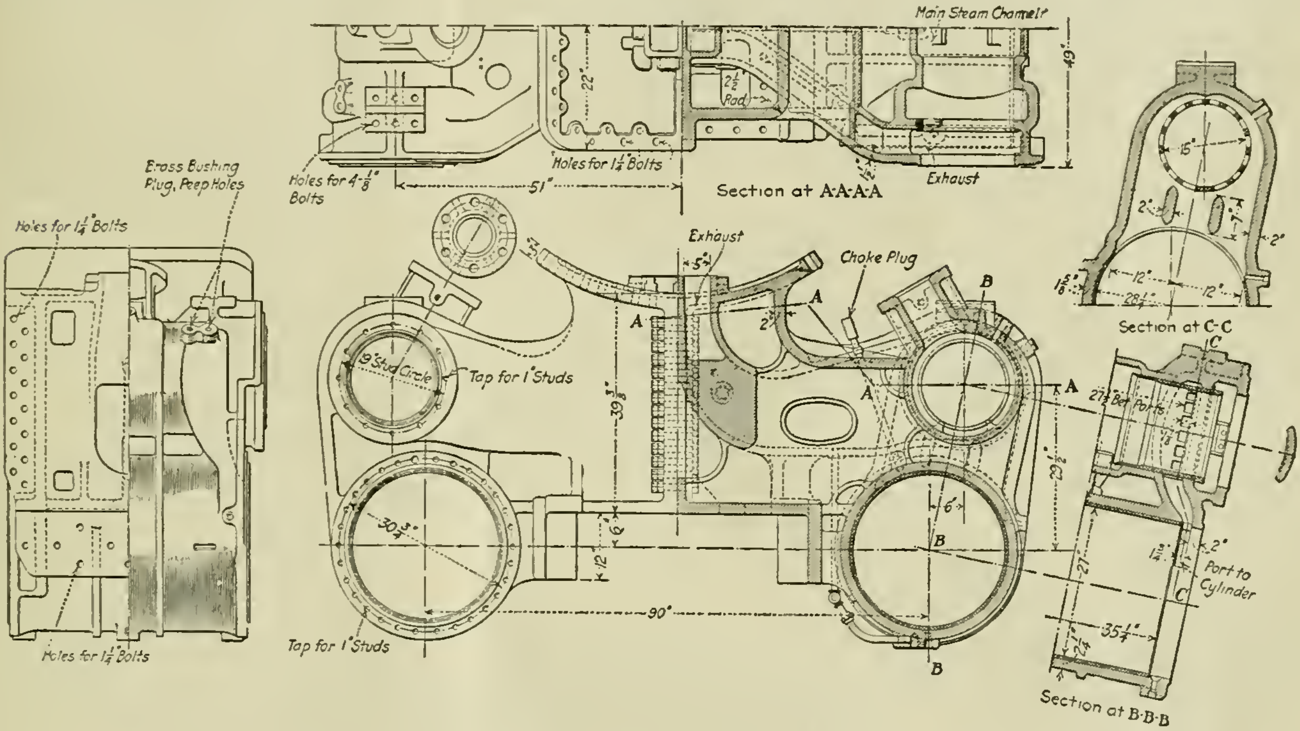


FIG. 3. CYLINDER FOR LARGE LOCOMOTIVE

Frame Braces

Locomotive frames are subjected to repeated lateral and twisting stresses, as well as to various other stresses, which will gradually break a single frame, but which can be withstood indefinitely by the application of substantial braces. An example of a pair of strong frames substantially braced is shown in Fig. 4, the arrangement illustrated being for a Santa Fe type locomotive. Bracing in the manner shown has been used for a number of years very successfully, and with very little modification is applicable to any locomotive class with outside valve gear.

Braces must be bolted to frames securely. Where braces or castings of other parts are bolted to a frame, the bolts should be applied with the head end bearing in these parts and not the thread end. This will provide for bearing on the bolt through the full thickness of the part bolted to the frame.

Boiler Cracks

In using the boiler to supplement the

frames in forming a backbone or foundation from which to brace machinery parts, the boiler shell is subjected to additional stresses which result in cracks in the sheets. The most frequent causes of these cracks are guide-yoke braces, valve-motion braces and the ordinary belly braces to frames. Guide-yoke and valve-motion braces are often very stiff and are bolted securely to the frames and studded to the boiler. When the boiler expands the braces and connections are held rigidly by the frame and there is a tendency for the boiler to tear itself loose from these fastenings. This sets up strains in the metal which are aggravated by the vibration and pounding to which braces are subjected.

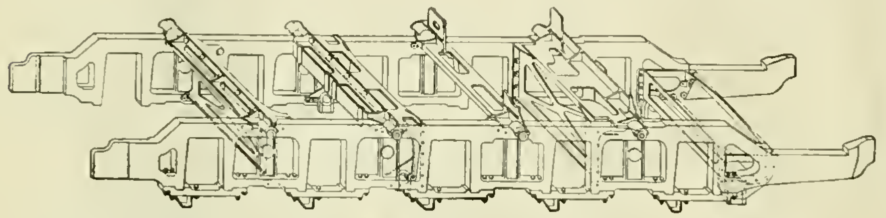


FIG. 4. FRAMES AND FRAME BRACING OF A LARGE LOCOMOTIVE

In an effort to overcome these cracks, outside welt plates have been riveted to the boiler to reinforce it where the brace pads are studded on. Experiments have been made with flexible, or partially flexible, braces, some of which have so far been successful.

On engines where breakage of braces has occurred, some of them are being replaced by braces with a pin connection at the lower as well as upper end. Where the use of pins is not favored, however, a thin plate in connection with a cast-steel brace should provide sufficient flexibility for expansion of the boiler and proper stiffness for bracing machinery parts.

The Back Flue Sheet

Boiler back flue sheets of large locomotives are renewed and patched more frequently on account of cracks in the knuckle near the top flange than from any other cause. On at least one road the average life of flue-sheet knuckles is 3 years and 3 months, the maximum and minimum varying within rather a large range.

A minimum limit of distance of top flue holes from top of flue sheet that is considered practical is shown in Fig. 5. To omit flues near the top of the flue sheet sacrifices heating surface. To raise the top of the flue sheet above the usual location of flues increases the weight in the firebox, adds to the amount of water necessary to cover the crown sheet, and by requiring increase in diameter of boiler to maintain steam space above the crown sheet, increases the weight of the boiler and consequently the weight of the locomotive as a whole.

Considering the stresses and the peculiar punishment to which flue-sheet knuckles are subjected, it is important to specify this material carefully. The following limits have been demonstrated by experience as practical:

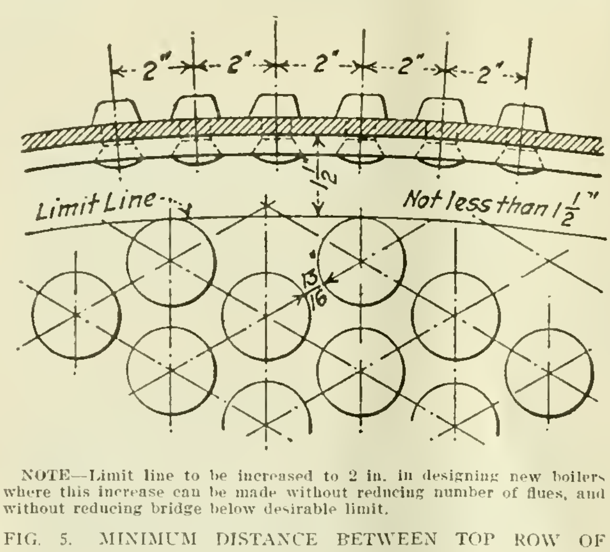
Tensile strength: 52,000 to 60,000 pounds per square inch.
Elongation: Not less than 25 per cent.
Carbon: 0.12 to 0.25 per cent.
Sulphur: Not over 0.025 per cent.

The Ashpan

Various details at the rear of a locomotive should be arranged to permit a large ashpan with smooth slope sheets at an angle that will permit cinders to fall to the hopper without obstruction, and its design should be decided on before the designs of surrounding parts have progressed too far. Equally as important is area between the ashpan and mud ring or through parts of the pan, to admit air to support combustion. This area should be at least equal to the area through the boiler flues, and preferably a little greater.

The Grate Rigging

The place for grate rods, which operate the grates, is near the center of the grates and above the deep portion of the ashpan. On locomotives without stokers this arrangement is not diffcult to provide for. With some stokers, however, grate rods in this position are interfered with, and this has resulted in some grate rods being located along the sides of pans, in certain cases very close to the flat portion or shelf of the pan under the mud ring. In this position the rods collect cinders close to the air openings and obstruct the admission of air for combustion. With steam grate-shaker equipment and stoker the grate rods can be located near the center of grates by applying a set of intermediate rockers.



NOTE—Limit line to be increased to 2 in. in designing new boilers where this increase can be made without reducing number of flues, and without reducing bridge below desirable limit.

FIG. 5. MINIMUM DISTANCE BETWEEN TOP ROW OF FLUES AND FLANGE OF BACK FLUE SHEET

Water Columns

A very thorough investigation into conditions affecting the performance of water columns indicates that the most satisfactory service is obtained with a column and connections conforming with the following specifications:

Inside diameter of water column.. 3½ in.
Inside diameter of top steam pipe.. 2 in.
Inside diameter of connection of column to top steam pipe..Not less than 2 in.
Inside diameter of bottom connection to boiler..¾ in.
Top steam pipe as short as possible consistent with required location forward of boiler back head flange.
Minimum number of bends in top steam pipe to column. This pipe to be lagged.
No valves between water column and boiler either in top steam pipe or in bottom connection.
Water-column bottom connection should extend into boiler far enough to clear nearby T-irons or other obstructions, approximately 4½ in. from inside of sheet.

Cab Equipment

The back wall of the cab should be far enough away from the boiler back head to give room for a satisfactory seat, for the application of the required equipment, and for a man to pull freely the throttle open without striking his arm against it. A distance of 46 in. from the face of back head at the center of fire door to the back wall of cab will meet these requirements.

Engineers' and firemen's seats should be located where the men can see ahead and their vision should not be obstructed by air pumps located too high, classification lamps misplaced, running boards too high at the front, or other obstructions that might interfere with their seeing semaphores, switch stands, etc.

Blow-off cock handles should be so located that they can be operated by a man in position where he can see the water glass, and preferably without leaving his seat. The water glass, steam gage, air gages, etc., should be so located that they can be seen by the engineer when in usual position on his seat.

The throttle lever, power reverse lever, cylinder-cock lever, sander valves, brake valves, etc., should be located where the engineer can reach them handily when sitting in usual position on his seat or sitting with his head out of the window. It appears like a small detail, but it is a worth-while one to locate the straight air valve where it can be reached easily by an engineer when in such a position that he can see a man at the back of the tank giving signals for coupling to a train.

The lubricator must be at such a height that a man can see the feeds, and it must be high enough to avoid pockets in the oil pipes.

The use of clear-vision windows has made it somewhat difficult to arrange the seats so that either seat or window will be a height to suit different men. This problem, however, has been solved for one road by its motive-power department chief, who has developed an adjustable seat made of steel and having a spring cushion and an upholstered back. The back being secured to the seat and independent of the back of the cab prevents any vibrations resulting from shaking of the cab wall.

Tender Capacity

Tender capacity should be arranged so as to reduce to a minimum the time a locomotive is detained from the productive work of hauling trains for the purpose of taking water and fuel. This implies large fuel and water capacities, but in arranging for suitable tender capacity care must be taken to avoid unnecessary weight, as any increase in the weight of the tender produces an equal decrease in the weight of train that can be hauled behind the tender.

Tender fuel space should be arranged so as to enable the locomotive to handle a full train with as few stops for fuel as may be feasible.

On territories equipped for water to be taken on the run or when stops for purposes other than taking fuel or water are made regularly at stations where water may be taken, the water capacity should be only sufficient to supply the locomotive when handling a full train, between water stations, with a moderate surplus for unusual delays.

On territories handling a large percentage of through trains with few stops, tenders of large capacity are desirable as they permit keeping locomotives more continuously at work. Where water is scarce and the supply has to be hauled to water tanks, tenders of large capacity are desirable as they reduce the number of water stations that must be maintained as well as the number of locomotives, cars, and men employed in hauling and handling water at these stations.

In addition to reducing time consumed by trains on the road, together with overtime pay to train and engine crews, large-capacity tenders effect a substantial saving by reducing the fuel consumed in starting and accelerating trains as well as the damage to locomotive machinery, draft rigging, tires and rail which frequently results from stopping and starting long freight trains. Train dispatching is simplified and the movements of superior and opposing trains are expedited, as a train which keeps moving interferes less with the movements of other trains than one which must stop frequently, thereby introducing uncertainty as to how long it will be detained.

United States Labor Board Decides That National Agreements Will Close on the First of July

Basic Principles Promulgated—Railroad Executives and Employees Representatives Present Data

On April 14, while the discussion was going on in regard to the justness and reasonableness of the existing rules and regulations in relation to the national enactments affecting the rates of wages of the great body of railroad employees the United States Labor Board announced its decision abrogating the agreements affecting working conditions, effective July 1, 1921. The decision conveys an order calling upon the officers and system organizations of employees of each railroad to select representatives to confer and decide as much of the rules controversy as possible, such controversy to begin at as early a date as possible. The decision affected all railroad employees except those in train service who are under separate agreements between the individual railroads and the four big brotherhoods.

It will be recalled that the momentous controversy was begun immediately after the return of the railroads to private ownership on March 1, 1920, but the consideration of the rules and regulations was postponed by the Labor Board when it was formed on April 15, 1920, because of the pressing urgency of the wage question at that time. When the board began to function it divided the whole railroad controversy into a question of wages and of working conditions. The hearings on wages resulted in what was known as decision No. 2, the $600,000,000 wage award of July 20, 1920, and the rules dispute was deferred until January, 1921. In setting July 1, as the date for terminating the national agreements, the board reserves the right to terminate its direction of decision No. 2 at an earlier date than July 1, 1921, with regard to any class of employees if it shall have reason to believe that such class of employees is unduly delaying the progress of the negotiations to be entered into by the conference of managements and employees. It also reserves the right to stay the termination of the agreements if it believes any carrier is unduly delaying negotiations. While placing the chief responsibility for drawing up a new set of rules agreed upon in conference and the rules promulgated by the board itself would play, respectively, in forming a new national aide. Under the transportation act, provision is made for agreements between the roads and the employees and any such agreements would probably form the backbone of a new set of rules. Such other rules as the board considered just and reasonable would then, it was stated, be added.

Meanwhile a set of sixteen principles outlined by the board and drawn up by Henry T. Hunt of the public group has been promulgated as a foundation for any rules that may be agreed to in the conference. The sixteen principles outlined are as follows:

"1. An obligation rests upon management, upon each organization of employees and upon each employee to render honest, efficient and economical service.

"2. The spirit of co-operation between management and employees being essential to efficient operation, both parties will so conduct themselves as to promote this spirit.

"3. Management having the responsibility for safe, efficient and economical operation, the rules will not be subversive of necessary discipline.

"4. The right of railway employees to organize for lawful objects shall not be denied, interfered with or obstructed.

"5. The right of such lawful organization to act toward lawful objects through representatives of its own choice, whether employees of a particular carrier or otherwise, shall be agreed to by the management.

"6. No discrimination shall be practised by management as between members and non-members of organizations or as between members of different organizations, nor shall members of organizations discriminate against non-members or use other methods than lawful persuasion to secure their membership. Espionage by carriers on the legitimate activities of labor organizations or by labor organizations on the legitimate activities of carriers should not be practised.

"7. The right of employees to be consulted prior to a decision of management adversely affecting their wages or working conditions shall be agreed to by management. This right of participation shall be deemed adequately complied with if and when the representatives of a majority of the employees of the several classes directly affected shall have conferred with the management.

"8. No employee should be disciplined without a fair hearing by a designated officer of the carrier. Suspension in proper cases pending a hearing, which shall be prompt, shall not be deemed a violation of this principle. At a reasonable time, prior to the hearing, he is entitled to be apprised of the principal charge against him. He shall have a reasonable opportunity to secure the presence of necessary witnesses and shall have the right to be there represented by counsel of his choosing. If the judgment be in his favor he shall be compensated for the wage loss, if any, suffered by him.

"9. Proper classification of employees and a reasonable definition of the work to be done by each class, for which just and reasonable wages are to be paid, is necessary, but shall not unduly impose uneconomical conditions upon the carriers.

"10. Regularity of hours or days during which the employee is to serve or hold himself in readiness to serve is desirable.

"11. The principle of seniority, long applied to the railroad service, is sound and should be adhered to. It should be so applied as not to cause undue impairment of the service.

"12. The board approves the principle of the eight-hour day, but believes it should be limited to work requiring practically continuous application during eight hours. For eight hours' pay eight hours' work should be performed by all railroad employees, except engine and train service employees, regulated by the Adamson act, who are paid generally on a mileage basis as well as an hourly basis.

"13. The health and safety of employees should be reasonably protected.

"14. The carriers and the several crafts and classes of railroad employees have a substantial interest in the competence of apprentices or persons under training. Opportunity to learn any craft or occupation shall not be unduly restricted.

"15. The majority of any craft or class of employees shall have the right to determine what organization shall represent members of such craft or class. Such organization shall have the right to make an agreement which shall apply to all employees in such craft or class. No such agreement shall infringe, however, upon the right of employees not members of the organization representing the majority to present grievances either in person or by representatives of their own choice.

"16. Employees called or required to report for work and reporting, but not used should be paid reasonable compensation therefor."

The labor board itself expressed satisfaction over the fact that the decision apparently had met with some approval from both sides, declaring this indicated it had at least opened the way to permanent industrial peace between railroad employees and employers.

The decision of the board to permit individual conferences between each road and its employees, instead of granting request for one national conference, was said by board members to have been the only course open.

The statement issued by the Executive Council of the shop men was as follows:

"Railway employees can accept the decision because it involves no impairment of their economic or social status. Indeed, to have this code promulgated by a Governmental agency, such as the United States Railroad Labor Board, means more to organized labor than any code that has ever been established in any industry. It is a vindication of the fundamental principles for which we have contended consistently and persistently, and its acceptance in good faith by railroad managements will mean that the public interest will be fully conserved.

"We believe that the decision marks a new era in industrial freedom. We have been fighting for human rights and the fundamental economic rights of railway employees. The Labor Board has more than vindicated our position. It has to a great extent established by its decision the bill of rights for which we have been contending.

"This decision of the Labor Board will not only have a very strong and beneficial effect upon the transportation industry but it will mark the beginning of industrial law, so to speak, and of a code of principles which will be used as a basis of proceeding in all our basic industries."

The statement issued by E. T. Whiter, Chairman of the Association of Railway Executives' Conference Committee, was as follows:

"While the representatives of the railways would have preferred that all the questions involved should be referred to individual conferences, the decision has given opportunity for arrangements between individual roads and their employees which can be made much more reasonable than the present national agreements, and which, in a large measure, can be adapted to the local conditions of each carrier."

"Principles laid down by the board clearly indicate its disapproval of rules which the railways have shown result in employees being paid for time greatly in excess of that actually worked. The entire tenor of the decision is that the railways should be economically operated; that employees should render efficient labor for all the time for which they are paid—that the artificial 'pyramiding' of wages, which under the present rules has resulted in large waste, should cease."

In the variety of views regarding the decision of the Labor board, the consensus of opinion seems to be that the roads gain in the substitution of the new set of sixteen principles for the old rigid agreements.

The whole of the principles are drawn up so broadly as to reduce the opportunity for harrying the employers with exacting demands for application in extreme cases. The roads gain the power to arrange each one with its own employees or their agents for such modifications of working conditions as the local situation may necessitate. The principles sanction regulations needful to proper discipline for safe railroad operation; the sixth in number virtually forbids some of the practices of the closed shop; the employees gain the right to be consulted prior to decisions affecting their wages or working conditions—and here appears the most significant bearing of the sixteen principles on the wage question; limits are put in Section 9 on the opportunity to use elaborate employee classifications as means to impose on the carriers excessive wage requirements or a multiplication of the number of workers; even as to the eight hour day, the Board, in Section 12, insists on eight practically full hours of application, except for the train crews, specially provided for in the Adamson act of 1916.

In several respects then the Board's action renders the operation of railroads a less trying and wasteful task, even with the question of wages left aside. The estimate that the abrogation will of itself save the roads $300,000,000 a year does not exceed the conceivably possible, when one thinks of the uneconomic practices that a superabundance of rules may render needful.

In another way the roads gain. The decision shows the Board to have a keen understanding of the need to keep the railroad companies out of disaster. Likewise friendly to the railroad employees the action taken shows a knowledge of where the employees' true welfare lies. The men who drew up these sixteen principles knew that when railroads became utterly destitute their employees would not prosper. This attitude justifies hope of a return to sound railroading facilitated by sound Government supervision.

As may be expected the representatives of the labor unions claimed the right to be heard before the United States Labor Board and W. Jett Lauck, economist for the unions which are against any wage reduction, presented a document extending to about 125,000 words prepared by the American Federation of Labor Bureau of Research, railway employees department, claiming that about one hundred men through interlocking directorships centered in about a dozen institutions a control of the majority of the country's important railroads, and basic raw materials, and that the railroads, Mr. Lauck asserted, were the chosen vehicle for this labor drive. Lay-offs of repair men in recent months, he charged, were made deliberately, while much of the repair work was let to outside companies, who charged the roads about twice what the same repairs would have cost in their own shops. One purpose, he said, was to get this portion of railroad labor out of government jurisdiction by forcing it to work for the outside concerns. These concerns, he added, were largely under this same financial control as the roads.

A dozen New York financial institutions were named, and Mr. Lauck charged that these banks had directors in ninety-two Class One railroads, and in twenty railroad equipment companies, that their directorships reached twenty-four coal railroads and coal companies, and that through non-banking directors this alleged combine was still further interlocked. Mr. Lauck summarized the report as follows:

"The evidence shows there is a capital combine consisting of the major banks, the railroads, and the industries controlling basic materials, and that this combine has and exercises a power over the economic destiny of the United States. It shows that within the identical capitalist group lies the power to adjust or misadjust relative prices in a manner that will stimulate or supprees industrial activity. It points out that this focal capitalist group has deliberately maintained high prices of steel, coal, cement and other basic materials and that the railroads, financed by the same interests, have refused to place the orders for plant maintenance, or even the orders necessary to prevent plant and equipment deterioration.

"The exhibit shows that the greater factors in American industry, the railway equipment producers, the railway repair works, the steel interests, the coal, cement, and other basic material producers—all are closely bound together by intercapital relations and interlocking directorates. The railroad employees made no issue as to the propriety of a centralized system of economic control. The employees call attention to the national responsibility which the possession of such power entails and note that this responsibility in the case of the railway industry has been recognized and written into the federal laws of the United States, and the employees specifically point out that this responsibility is being unscrupulously evaded. The railroads are pleading poverty. The banks are making unprecedented profits and declaring unprecedented dividends, and the same applies to steel, coal, railway equipment, and similarly situated concerns. The capital combine, in preparing to precipitate unemployment, adopted the policy that the railroads 'should do it first.' Railway improvement programmes were deferred; railway maintenance was reduced below minimum legal requirement.

"The report brings into clear relief the fact that there is no foundation for opinion which the employers' publicity machinery would popularize that the railways and the other great industries are the victims of some misfortune of the times."

Taking up first the lay-off charges, the report presented by Mr. Lauck said that the numbers laid off exceeded, in the last nine months, 103,000.

The report charged that the roads' new policy is to sub-contract in order to remove from government control many of their men. Numerous repair companies, many of them said to be new concerns, were named as taking over railroad repairs. Figures were presented which, Mr. Lauck said, showed that the total excess cost of equipment repairs made under contract by outside concerns has been sufficient to have paid all the shop employees laid off throughout the country for full-time work.

The Labor Board adjourned in April 20, after the unions had presented an array of figures which, they claimed, showed the kind of management, or mismanagement, under which the roads suffered. Among these were charges of deficiencies in the tractive power of the roads because of failure to modernize locomotives by demonstrated improvements, $272,500,000; waste in locomotive operation which could be obviated by better methods of coal purchase. inspection and more efficient firing, $50,000,000; inadequacy of out-of-date shop equipment, $17,000,000; wasted fuel in obsolete power plants, $10,000,000; waste in maintenance of way and water consumption, $12,600,000; unnecessary expenditure for supplies, $75,000,000; inefficient methods of shop cost accounting, $10,900,000; wastes incident to a too great labor turnover, $40,000,000; preventable losses and damage, $90,000,000.

The exhibit gives as the sources of its information the reports of engineers and technicians in the railway industry, the judgment of various executive officers of large roads, the reports of technical societies and Government investigations and various experts. The results were reached also by comparison of the average road with the well-managed, efficient ones.

The exhibit concludes with the statement that wastes complained of can only be done away with by close co-operation between the management and the employees. Besides an increase in managerial efficiency, there must be an increase in the efficiency of the workers, the unions claim, and this can be brought about only by co-operation.

In a whirlwind finish by way of rebuttal more than thirty railroads laid their pleas for wage reductions before the Labor Board in the final day's presentation of the carriers' evidence. All of the roads predicted receiverships and bankruptcies, and introduced exhibit after exhibit showing decreases in outside industry wages and the cost of living since the present railroad wage scale was made effective.

The adjournment, which was indefinitely postponed, it was claimed was made so that the board could give its uninterrupted attention to the wage controversy.

Meanwhile, the unions were not disposed to sit down and wait for developments. On April 24, they submitted an additional statement to the Labor Board claiming that financial mismanagement involving the dissipation of tremendous sums in bonuses to stockholders, unnecessary cuts of marketing securities, interest and dividends in excess capitalization and other losses could have been avoided.

The exhibit took up the history of twenty roads in an effort to show that they issued fictitious capitalization during the period 1910-1919 totalling $692,000,000. During this time it was also claimed that they issued bonuses or stock dividends amounting to $233,559,000, and through other forms of financial mismanagement sustained losses amounting to $123,000,000. In addition, it was claimed that thirteen representative roads during the period referred to dissipated, through improper methods of marketing their securities, the sum of $51,456,878.

It was claimed that during the period from 1910 to 1919 thirteen railroads gave away in bonuses to stockholders the sum of $27,546,051, according to the report available.

Marked Improvement in Railroad Revenues

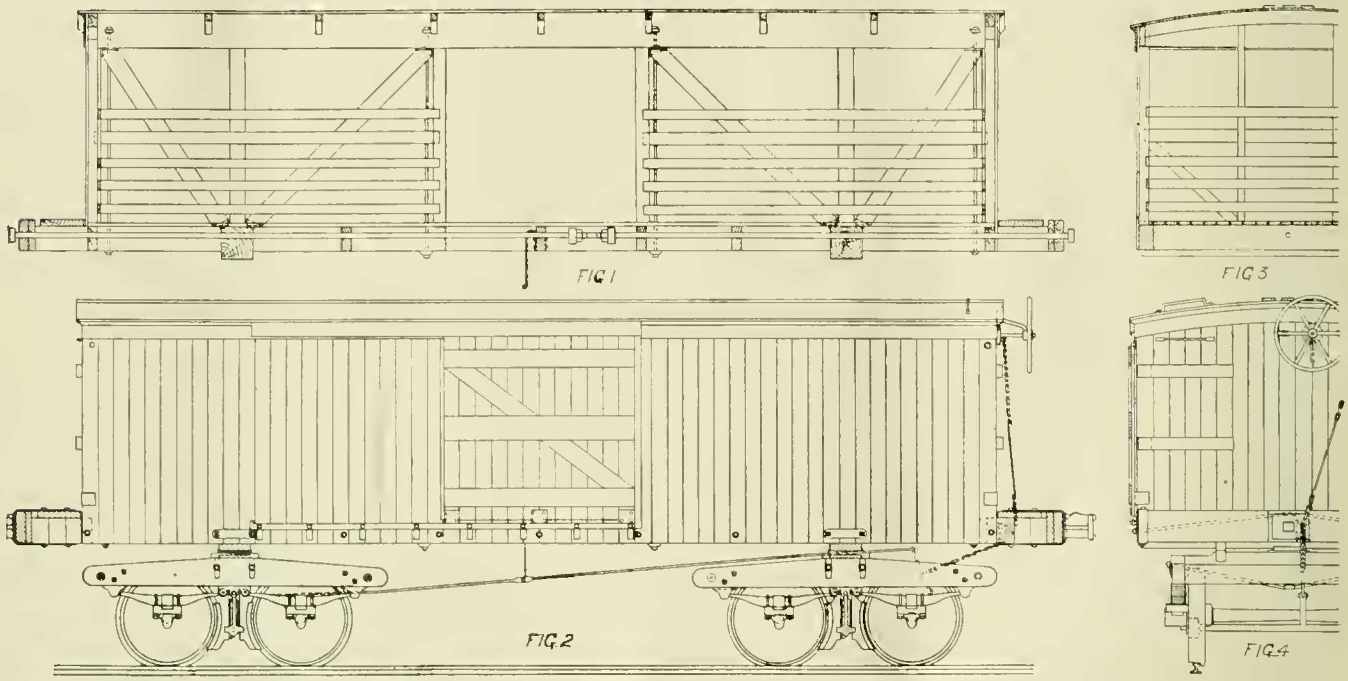
It is gratifying to learn that a considerable increase has already been made in both passenger and freight movement, as shown by the revenues as reported to the Interstate Commerce Commission for the month. On May 5, the published reports showing the net revenue for 181 of the principal carriers of the United States representing more than 220,000 miles of railroads, for the month of March will be in excess of $28,000,000. For the month of February of the present year this same number of railroads showed a deficit of $7,000,000, and for January a deficit of more than $3,000,000.

Early Cars of the Baltimore & Ohio Railroad

By J. SNOWDEN BELL

No. 4. Eight Wheel Wooden Box Car, 1856.

The earliest representation of a Baltimore & Ohio eight-wheel freight car



DETAILS OF FREIGHT CAR FOR THE BALTIMORE & OHIO RAILROAD, 1856

which the writer has been able to develop, which is probably the earliest in existence, is that shown in B. & O. blue print 0262, No. 14, 68, Case R, which is entitled "Freight car for Balt. & Ohio Railroad, as arranged Aug., 1856. Scale 1 in. 1 ft.," and bears the autographed inscription, "Henry Tyson, M. of Mchy., Aug. 18, '56." This was at that time the standard wooden box car of the road.

The construction of the car is very clearly shown in longitudinal section, side

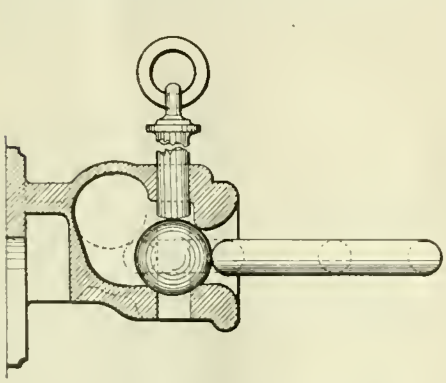


FIG. 5

view, transverse section and end view, by Figs. 1, 2, 3 and 4, and, except in being of much smaller dimensions, and having end platforms and hand brake rigging only, the car body does not materially differ from those of present practice. Dimensions are not figured on the blue print, but according to its scale, the car body was 24 feet long, 8 feet wide and 6 feet 2 inches high at centre. The length between coupler heads was 28 feet 8 inches. The special design of trucks, the continuous draw bar and the couplers, which are relics of old practice, need be only briefly referred to.

The trucks, the wheels of which were cast iron with chilled treads, 30 inches in diameter, had rectangular wooden frames, and, as shown in the side view, had no pedestals, the axle boxes being connected to the side members of the frame by leaf springs. This was, at that time, common practice, and in the locomotive trucks of several builders, notably the New Castle Manufacturing Co., the axle boxes on each side were bolted to the ends of long leaf springs, the middles of which were attached to the truck transom, the springs themselves forming the side members of the truck frame.

The couplers, which are shown in section and plan by Figs. 5 and 6, were, as will be seen, of peculiar and ingenious design, and were made under the patent of Joseph T. England, of Baltimore, Md., No. 13369, dated December 4, 1855. The coupler is very clearly stated, in the claim of the patent, as consisting of "a ball so arranged in the buffer head as to support, at its lowest position, the pin, and to be pushed away and allow the pin to fall on the introduction of the link." The writer has, in his youthful days, seen many of the England couplers on Baltimore & Ohio freight cars.

After stating that the England coupler "effects the coupling of the cars without the danger of accident now existing to the hand or arm of an attendant," and calling attention to the complication of other couplers "in which springs, bolts and other devices are used," the specification of the patent makes the following statement of the advantages of the England coupler, which were undoubtedly substantial ones at the early date of its appearance in railroad service:

"The simplicity of my invention stands prominently forward in its recommendation, while its cost is the merest trifle over that of the most ordinary bumper in use. The advantages are the certainty of a free rolling ball, always finding its place in the slight recess formed by the lower pin hole in the floor of the bumper, the

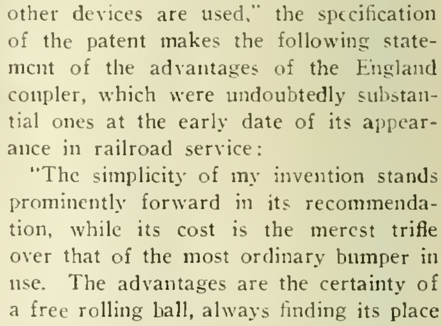


FIG. 6

facility by which any number of cars may be coupled without an attendant, simply by the backing of the locomotive. All that is necessary is to draw up the coupling bolt, when the ball seeks its place under it, and thus sustains it until tripped by the links displacing the ball, as before observed.

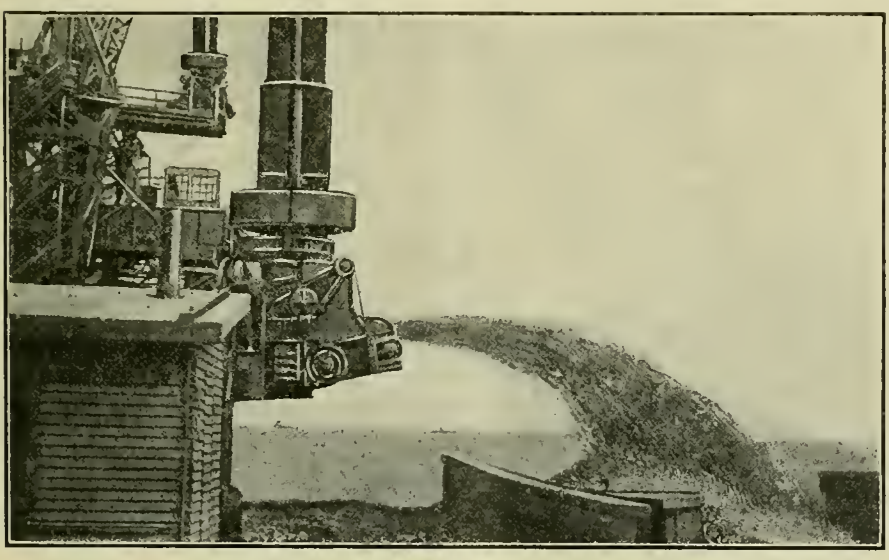
"Most, if not all, the self-couplers require the cars to be in line in the act of coupling, whereas mine, under all circumstances, will operate as coupling from a switch or at an angle or curve such as are allowable in railroads. Another advantage is that the weight of the ball and the position it assumes is sufficient to retain the link B in a horizontal position suitable for the proper coupling thereof, and the ball, moreover, sustains it in an angular position so as to admit of side coupling."

The curved top wall of the recess in the coupler head, or "bumper" as it is termed in the specification, in which the ball rests when the car is coupled, appears in the bumper shown at the right hand end of the car.

The continuous draw bar is similar to that of the Winans coal hopper, described in the April issue of RAILWAY AND LOCOMOTIVE ENGINEERING, consisting of two 2-inch rods, extending longitudinally under the car body, and connected, at the middle of its length, by a turnbuckle and keys.

Mechanical Coal Trimmers Installed on the Baltimore & Ohio Railroad at Curtis Bay, Maryland

Coal trimming devices on the Baltimore & Ohio, at Curtis Bay, Md., have reached such a degree of perfection by the application of conveyor belts and other devices that in actual work accomplished the amount is nearly trebled. The development at this great coal terminal marks a distinct chapter in the history of intercontinental trade, by the steady replacement of hand labor by mechanical equipment. Trimming coal cargoes by hand meant that a large portion of the potential working time at the pier was absorbed in periods of enforced idleness, because it was impossible for hand trimming, no matter how many laborers were employed, to keep pace with mechanical delivery.



LANE-GALLOWAY MECHANICAL TRIMMER IN OPERATION AT CURTIS BAY, MD.

H. A. Lane, chief engineer, was instructed to inaugurate studies, with a view to evolving some practical mechanical devices. This work was assigned to the office of the engineer of bridges, and the direct supervision of the development, construction and installation devolved upon Philip G. Lang, Jr., assistant engineer of bridges. Under his supervision the success of the machines installed for practically eliminating hand trimming has exceeded the most sanguine expectations. The record of 1,342 tons per working hour placed in vessels is believed to be the world's maximum. It must further be borne in mind that this amount of coal tonnage was placed in all classes of ocean-going ships.

We have previously described the construction of the immense concrete and steel conveyor-belt coal pier whose four moving towers attract the attention of all who visit the power plant. The facilities at Curtis Bay represent an investment of approximately $3,000,000, and the results have surpassed the expectations of the enterprising company. Among the most recent mechanical developments of our time must be marked the Lane-Galloway Mechanical Trimmer, which, as shown in the accompanying illustration, has a capacity of throwing coal a maximum distance of 50 feet, the incredible volume of 25 tons per minute, or 1,500 tons per hour. This operation is continued with practically no breakage, the only complaint heard of being made by the crews of the boats that the mechanical trimmers load the boats so fast that the crews do not have time for shore leave as formerly.

In the constant cry for more production this surely leads the way as far as the handling of a product is concerned and reflects great credit on the enterprise of the Baltimore & Ohio Railroad Company, as well as on the accomplished engineers who have made such hitherto unheard of results possible of accomplishment.

Electric Locomotive Performance

The *Electrical World* recently stated that a saving of over two-thirds of fuel burned may be effected by conversion to electric traction and even with the very latest steam locomotives this saving will be over 50 per cent. In spite of the higher cost of the electric by 50 per cent, the smaller number required to haul the same tonnage offsets this handicap, and, in addition, various indirect benefits are derived such as the appreciation of real estate values.

Railway Extension in Bolivia

A contract has been signed between the Bolivian Government and an American firm for the financing and construction of the railway from La Quiaca, on the Argentine border, to Atocha, Bolivia, a distance of 126½ miles, the only link needed to give La Paz, Bolivia, an all-rail route to Buenos Aires, Argentina. The American company engages to negotiate a loan of $7,000,000 in favor of the Bolivian Government to cover the expense of construction and equipment of this railroad, and to complete the road by August 1, 1925.

The construction of this line will mark the completion of the second trans-Andean railway in South America, the other being the railway connecting Valparaiso and Santiago, Chile, with Buenos Aires, Argentina. The latter line, however, is not serviceable for several weeks in the year, on account of severe snowstorms and snowslides which occur occasionally on the route, whereas the La Quiaca-Atocha line will be serviceable all the year round. By means of this new railway the trip from New York to Buenos Aires via Arica or Mollendo, Chile, can be made in 18 days, and by way of Antofagasta, Chile, in 19 days.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

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JAMES KENNEDY, Managing Editor.
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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $3.50 or fifteen shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

The Railroad Labor Question

The overwhelming mass of evidence presented to the United States Labor Board at its meetings last month from the railroads and labor unions gives us at least a vision of the monumental task that the Board has on its hands. The decision of the Board in setting aside the rules and agreements was inevitable, and has been tacitly accepted. Under the pressure of the circumstances from which they arose it was not to be expected that they would have the enduring quality of continuation. No more will the agreements that may arise as the result of the present controversy. The establishment of the eight-hour law may be said to have reached the character of a basic principle, but the humane measure may be said to have been fairly well established before the aftermath of the great war was dreamed of. All that this law requires is an honest enforcement in seeing that eight hours' work has been done.

As in all heated disagreements it is natural to expect that both sides are apt to overstate their cases. That the condition of the railroads is owing to mismanagement is a strong statement. It may be true in spots. So it is with the charge that employes are derelict except at piece-work. Our experience with skilled mechanics has been that they will work well if they are well treated. Good treatment reaches deeper than the exact amount of wages paid. A clever mechanic does not require to be praised for his work, he feels it in his bones, but a ready appreciation from a competent source is an encouragement of the highest kind, and costs nothing.

We will not assume the mantle of prophecy in regard to the undiscovered future. If any vision is given to us at all, it is the cheering hope that governmental operation will be avoided, and that a better spirit of co-operation between employer and employee will be established, and that the day is near when governmental control as exemplified in the work of the various commissions and boards will be such that the members of these controlling bodies will be able to say that their yoke is easy and their burden is light.

Suspension of the Railway Supply Manufacturers' Exhibit

As will be noted elsewhere in our pages, the Railway Supply Manufacturers' Association, after due deliberation, has decided to postpone the Exhibit, and will in no way be officially represented at the meetings of the Mechanical Division and Purchasing & Stores Division of the American Railway Association.

This is not to be wondered at, as the present condition of the Railway Supply business does not justify the outlay of the very considerable expense in preparing such an exhibit, and while it is universally expected that improved conditions will arise before mid-summer, such hopes have failed of realization before, and some higher degree of stability must be established before the railway supply manufacturers can be expected to undertake vast expenditures in the face of the present existing conditions.

The Supply Manufacturers' exhibit will be greatly missed, as it was the real object lesson at these meetings, finely educational as furnishing a concrete illustration of whatever real progress was being made in mechanical appliances used on railways, not speaking of the improved methods of operation in production and maintenance, while at the same time it kindled a strong desire in the minds of the leading railway men engaged in the mechanical departments to introduce the improved appliances that had thus come under their observation and then adopt the new and improved means and methods calculated to obtain a greater degree of efficiency and economy in their own separate spheres of activity.

It will be recalled, however, that this is not the first time that the Railway Supply Manufacturers' Exhibit, and other meetings, have been temporarily suspended. During the war period it was deemed proper to suspend the meetings on the just assumption that every railroad man was required to be at his post, and in the absence of those who were called into the service of the country on the battlefields of Europe, there were no men to spare from the work that had to be done. The present emergency brings an excuse equally justifiable, and when the associations are all encouraged by the renewal of business, as they shall be, before another year the instructive and interesting exhibits will be all the more welcome and beneficial.

Machinists' Apprentices

The apprentice system has been the subject of inquiry by the Industrial Board of the Merchants' Association of New York, and among other industries it was claimed that information was obtained from about 5,000 machine shops in Greater New York, showing that of definite training of apprentices there is little, as the survey revealed only four establishments having regular indentured apprentices. In eleven other establishments visited, employing 4,477 machinists and machinists' helpers, there were only 164 apprentices, or boys who were more or less thoroughly trained in the trade. Turning to the railroads the Pennsylvania furnishes a good illustration. A regular apprenticeship system was started in 1910 and in 1917 had grown to ten schools with several hundred apprentices. Equipment and instructors are furnished by the company, and all instruction is carried on on the company's premises. There are three classes of apprentices—regular apprentices, who are admitted upon examination and interview and whose period of apprenticeship is four years; first-class apprentices, chosen from regular apprentices showing exceptional ability after the first year, and specials, consisting of graduates of technical colleges and occasionally first-class apprentices of extraordinary ability.

The courses of instruction for regular and first class apprentices in addition to the regular shop work consist of four hours per day during working hours and on company time for forty-two weeks each year during the first three years. Apprentices move by definite schedules from one shop to another. Written instruction and text book material are prepared by the instructors and supplied in mimeograph or blueprint form. The results of the system have been better trained men, the creation of media for selective material, and a definite creation of a higher class of apprentices.

The Testing Department In Extremis

The practical man, who has built himself up from the ranks, and who has had nothing of the theoretical in his training, frequently has great difficulty in persuading himself or permitting others to persuade him that an investigation, which does not have dollars and cents written all over it, can be made to be a paying proposition. It is this that has been the principal hindrance to the establishment and continuation of the test department and testing laboratory on a railroad. It is the test department without a laboratory that seems to have the hardest struggle for existence.

The recent drastic cutting in the shop and road forces has been felt in many test departments, where the organization has been so broken up by the decimation of its forces that little or nothing remains. Where such a disruption is a positive necessity, nothing in the way of protest can be said, but if there is a pecuniary possibility of holding to together, it should be one of the last to be interfered with. For, while it is not a money earner in itself, its functions are such that nothing else upon a railway can so surely point the way in which money can be saved as can it. And it is those roads that have been most liberal towards their test departments that are effecting the greatest economies in their many lines of activity.

It is the almost universal testimony of mechanical officers that the test department is a paying institution and yet when the matter of requisitions for expensive instruments come before a practical general manager they are too apt to be refused because he wants immediate and tangible results. So of what use is an investigation into the character of the flue gases of the stationary plants as a means of saving coal? Why measure the vacuums in the locomotive smokebox in order to determine the interacting effects of drafts and combustion and back pressures? Yet it would not be difficult to put one's finger on exhaustive investigations lasting for months, filled with baffling disappointments that finally develop results that paid all the costs an hundred fold.

The difficulty that the engineer of tests labors under is that he can never promise definite dividends in advance on any investigation. He thinks that there is a possibility of saving in a certain field. He thinks a proposed investigation will yield results of value. He thinks that an improvement can be made in the working of a certain class of locomotives. He thinks this, that and the other thing but he does not know. And yet his practical superior thinks that he and all other members of the mechanical department should know, intuitively, what is best, though he, himself, usually bases every decision on the lessons of past experience, and is decidedly disinclined to commit himself to untried paths. It is difficult, in these days of financial distress, to resist the impulse to curtail the expenditures of a non-productive department. But, as a matter of fact, it is at just such a time that the testing department should be driven to do all it can towards the finding out of ways and means of reducing costs and saving expense, and this it cannot do if its forces are dissipated and a mere remnant only left to do the work.

And closely allied to the department of tests is that of the mechanical engineer. He has a certain amount of routine work to do, but his most important work is that of keeping his plans well worked up in advance of the requirements of his railroad, so that when the demand comes for something bigger or better than has been known he will be in a position to supply it, and can be the first in the field with a new design and not have to ask his employers to wait until he can work it up.

But when the cutting of forces begins, the drawing room is apt to feel the full force of the order at an early date and the railroad is thus cut off from a source of supply that may cost it dearly in delay in the months to come.

Well! What can be done about it? Almost nothing except to say to the managers in the words of the apostle: "Whatsoever of these things are lovely, whatsoever are of good report; if there be any virtue and if there be any praise, think on these things. The things which ye both learned and received and heard and saw, these things do: and peace shall be with you."

Canadian Railway Board of Adjustment

The Minister of Labor stated at a conference of the Canadian Railway Board of Adjustment held at Ottawa last month that in July, 1918, great difficulties were looming on the railways with respect to wage matters, because from 1914 to 1918 the railway men had carried on very loyally without an increase in wages commensurate with the increase in the cost of living. A meeting was held and seventy-nine representatives of the railway employees, and twenty-four representatives of the railway companies met together and reached a decision that there should be no interruption of transportation during the war, no matter what difficulties may have to be met with. In order to provide machinery, with this in view, a board consisting of six men representing the employees and six representing the railway companies was established, and since that time, notwithstanding the fact that the war has been over for two and a half years, any questions arising which were not possible of solution between the individual railways and their employees, were referred to this board and thereby satisfactorily and unanimously disposed of, and there has never been occasion to resort to the Industrial Disputes Investigation Act on our railways since that time, with one exception. The arrangement has been an unqualified success; and while the agreement was entered into only for the duration of the war, it is still in effect. I am convinced that this general principle is absolutely sound, and I am delighted that so many of our larger employers are giving attention to it.

Demand for Cars Increases

The car service division of the American Railway Association authorizes the following:

"An improvement in the demand for cars during the week which ended on April 15 is shown by reports just received from the railroads of the United States by the car service division of the American Railway Association. The number of surplus or idle freight cars on American railroads for the week was 499,479, or a decrease of 7,948, compared with that for the previous week when a new high record in the number of idle cars was shown.

"This reduction in the number of cars for which there is no freight was due entirely to an increase in the demand for coal cars, the number of surplus coal cars being 252,010, or a decrease of 9,284, compared with the previous week. Reports showed, however, that the number of idle box cars remained virtually unchanged, there being 176,805 on April 15, compared with 176,916 on April 8.

"Compared by districts decreases in the number of surplus cars were shown in the Allegheny, Pocahontas, Southern, Central Western and Sothwestern regions, while increases were reported only in the Eastern and Northwestern."

The President's Views on the Railroad Problem

President Harding has spoken definitely in his determination to let the Labor Board alone in solving the questions at issue between the railroad executives and the employes, but he ventures to remark that, "It is little to be wondered that ill-considered legislation, the war strain, Government operation in heedlessness of cost and the conflicting programs, or the lack of them, for restoration have brought about a most difficult situation, made doubly difficult by the low tide of business. All are so intimately related that no improvement will be permanent until the railways are operated efficiently at a cost within that which the traffic can bear. If we can have it understood that Congress has no sanction for Government ownership, that Congress does not levy taxes upon the people to cover deficits in a service which should be self-sustaining, there will be an avowed foundation on which to rebuild."

These are wise words, and it is a matter of satisfaction to observe that the President knows his place and assumes no dictatorial attituded affecting the questions that have arisen and that require expert investigation and undisturbed consideration to arrive at just conclusions that may be accepted by all concerned.

Snap Shots—By the Wanderer

I have been thinking some recently as to why I should continue to exert myself, for really in the course of my career I have done some exerting. Why exert myself for myself, my family, my country or the world at large? Of what use? Why not adopt the seniority method for everything? I am born. For a brief interval of time I am the youngest inhabitant of the earth. I am at the bottom of the list, the very lowest in the line of promotion. But if I live until all who were alive at the time I was born are dead I shall have reached the summit of this world's greatness. I get there not because of any great intellectual ability; not because of my efforts in behalf of the rest of mankind; not because of any notable achievements, but solely as a tribute to the stomach that has sustained me through a long and uneventful life, and the lusty heart and lungs that are within me, a magnificent exemplification of the old adage that all things come to him who waits. Why not? Isn't it just the carrying out of the principle of seniority that holds such complete sway in the selection of men for promotion in the railroad world?

Why should a man exert himself? No possible amount of exertion will enable a man to outstrip his fellows in the race. The path in which they are all running is a single track, single file affair, with no passing tracks. It is eminently fitted to kill ambition and destroy imitiative; and, if we may believe the stories as to present day efficiency, it has pretty well succeeded. Men stand in line as at a ticket office, each awaiting his turn, and if one steps out even for a time, the others close in behind him and he loses his place and must come in again, if at all, at the tail of the queue. Small wonder that the railroads have difficulty in enlisting and holding good men.

And what has it done for the individual?

A good many years ago Carlisle brought the wrath of England down about his ears by his well-known statement that "England is inhabited by forty million people, mostly fools." And, if we consider the matter carefully, it can hardly seem that England has a monopoly in the character of the majority of its population. But, as we are committed to the principle of the absolute rule of the majority with no minority representation why criticise the dictum of the majority which has decreed this seniority rule upon us, with all of its detrimental and demoralizing effects. Some day, perhaps, but not likely, there will be a change in the spirit of the dreams of those who control those things and the first entering wedge will be driven that will make for the betterment of the morale, the efficiency and the ambitions of the rank and file who now follow so blindly the leaders who have elected themselves into positions of authority.

The good men of the rank and file are "cabined, cribbed, confined" by the rulers under which they are permitted to work and live however much they may chafe and fret. But we live in the days of a majority sway, and woe betide the man who kicks against the pricks.

Finally, in discussing this matter one feels like paraphrasing that famous passage in the epistle of St. Paul to the Corinthians, so as to make it read:

"If I speak with the tongues of men and of angels, but have not *seniority*, I am become sounding brass, or a clanging cymbal. And if I have the gift of prophecy, and know all mysteries and all knowledge; and if I have all faith, so as to remove mountains, but have not *seniority*, I am nothing. And if I bestow all my goods to feed the poor, and if I give my body to be burned, but have not *seniority*, it profiteth me nothing. *Seniority* causeth me to suffer long and is unkind; *seniority* envieth much; *seniority* vaunteth much unto itself and is much puffed up, it doth behave itself unseemly, it continually seeketh for its own, it is easily provoked, it taketh not account of evil: it rejoiceth in unrighteousness, but rejoiceth not in the truth; beareth nothing, believeth all things, hopeth all things, endureth all things. *Seniority* never faileth; but whether there be prophesies for a brilliant career, they shall be done away; whether there be tongues, they shall never cease; whether there be knowledge, it shall be done away. For we know in part, and we prophesy in part; but when the *seniority* is come that which ought to be shall be done away. When I was a child, I spake as a child, I felt as a child, I thought as a child, now that I am become a man, I have put away childish things and childish ambitions. For now we see in a mirror darkly, but then face to face; now I am permitted to know only in part and to do only in part; but then I thought I knew fully, even as I also was fully known. But now abideth faith, hope *seniority*, these three; and the greatest of these is *seniority*."

I believe that I have told the story of the Irishman, who, when asked years ago, during the construction of the Hoosac Tunnel, what he thought of it, replied: "Well, it'll be of no use, but it'll be a great arnimint to society." The tunnel has proven itself to be something more than an ornament, though it has never quite fulfilled the extravagant predictions to its value that were made by its original promoters.

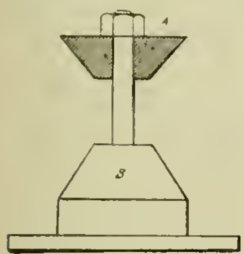
It seems probable that the valuation of American railroads will follow in the footsteps of the tunnel. It was to be the great and only means of regulating railroad rates. It was an absolute and useless waste of the moneys of the public and the railroads. It was to be the great asset in the adjustment of the relations of the public to the railroads. It would be worthless when finished and of no use whatever. Probably the truth lies between these two extremes. There is one thing certain, however, and that is that the careful surveys that have been made, cannot fail to be of some value to the roads. Where these surveys are duplicates of those already existing, and those existing were known to be correct; well then perhaps,——. But, strange as it may seem, there were more roads than one that had no survey and no maps of their own alinement. No survey and no maps of abutting property nor the names of its owners, and no means of determining rights and privileges. Roads where no two mileposts are the same distance apart and where the marked miles vary from 200 ft. short to 600 ft. long. Where two consecutive mileposts are marked as being several miles apart though really less than the standard 5,280 feet. Where levels and profile had not been checked, so that the engineering department made no pretense of calling them accurate. Then comes the valuation commission and proceeds to survey and make the line in such a manner that even the veriest tyro of an engineer can read, take notes and locate each and every object along and adjacent to the right of way. Perhaps this may have no monetary value, but it puts the railroad managers in a position to answer questions regarding their own property that they could not have answered before. It puts the railroad on a difficult plane. Perhaps it may be like a man's cash account. He has spent his money, and that only tells him what he did with it. The road is there and has been paid for, and every engineer knows its every curve and sag and hump and bridge and trestle. So why put these down on paper? Well, sometimes outsiders or even the managers may want a bit of information that only such a map can give. At any rate, while the surveys and maps may not be worth their cost, they are more than mere ornaments and have a value most decidedly real and practical. And it is only when one learns of the dearth of the information which they contain, as it existed on many roads, that the reason and value of the work can be fully appreciated.

Some Ingenious Shop and Road Kinks

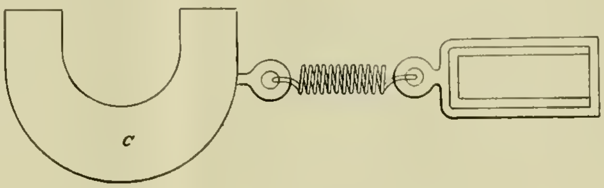
In Use on the Delaware & Hudson—Norfolk & Western and Virginian Railroads

SPRING SUSPENDED DOLLY BAR

It has been found that, in pressing wheels on their axles, the inequality in the pressures on the tail piece of the press, puts such a stress on the dolly bar that carries the load that it is apt to break the rod by which it is carried. This is usually a small bar, so as to reduce weight and make handling easy. It has been found in the shops of the Delaware & Hudson at Watervliet, that if the dolly bar is supported by a spring, it can yield to the variation in stress and adapt itself to the requirements of the press and the wheel and thus breakage be avoided. Accordingly the construction shown in the engraving is used. It consists of a loop or hook to hang over the upper bar of the press and a spring upon which the U-shaped dolly *C* is hung. This instead of the solid bar usually used in that place.



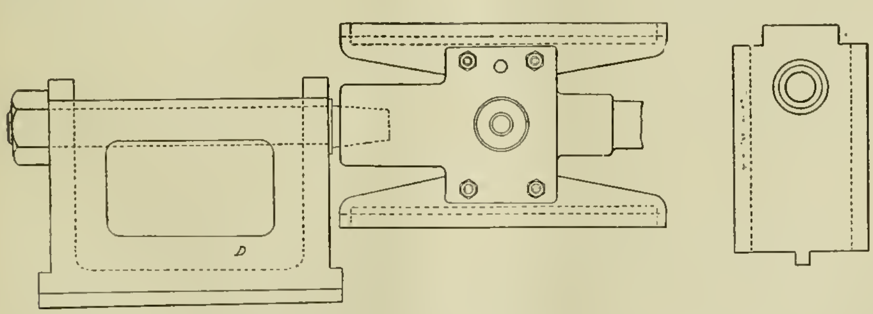
CHUCK FOR TURNING SIDE ROD BRASS



SPRING SUSPENDED DOLLY BAR FOR CAR WHEEL BRASSES

CHUCK FOR TURNING SIDE ROD BRASSES

Side rod brasses are turned in a small boring and turning machine with great rapidity by the use of the chuck shown herewith. This chuck consists of a base *B* which is bolted to the table of the machine and has a tapered portion in the form of a truncated cone over which the brass is slipped. A similar conical piece *A* slips down over the bolt and when the two are drawn together by the nut the brass is centered and can be turned. It has been found that the work can be done far more rapidly with this arrangement than is possible in a lathe.



CHUCK FOR PLANING CROSSHEADS—NORFOLK WESTERN RAILROAD

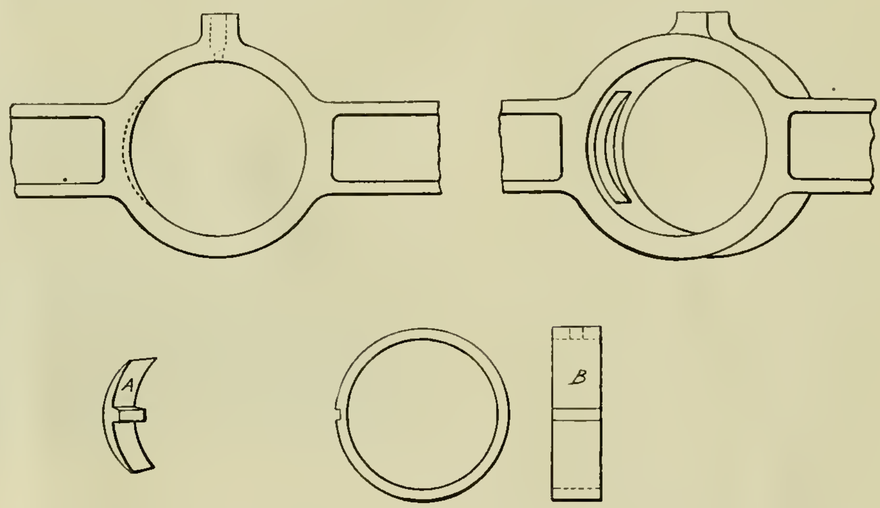
CHUCK FOR PLANING CROSSHEADS

The arrangement shown is a very substantial chuck for holding crossheads for planing the slides. It consists of a heavy castiron base *D* which is bolted to the platen of the planer and into the upper portion of which a heavy bar is fastened. This bar has a collar near one end that is brought up solidly against the face of the chuck by the bolt. The projecting portion is tapered to the same taper as the piston rod and the crosshead is slipped on over it and keyed in place. The nut can, then, be slackened off and the crosshead turned so that the surface to be planed is square with the platen of the machine and the work be quickly done. When one surface has been finished the nut is again slackened and the crosshead given a half turn to bring the other surface into line. This avoids the necessity of squaring up each crosshead separately on the machine, and insures that the two faces of the bearing surfaces against the guides are parallel with each other.

METHOD OF HOLDING SIDE ROD BRASSES

Mr. G. H. Langton, superintendent of shops of the Virginian Railroad at Princeton, West Virginia, has patented a method of preventing brasses that may become loose in the side rod from turning. Instead of turning, the device not only holds the brass in place, but tightens it and prevents any increase in the looseness from occurring.

To use it a crescent-shaped groove is cut in the seat of the brass in the side rod and into this a filler *A* is placed. This filler is made to fit closely into the groove so that except for the projection of the key on one side it is flush with the hole in the rod. The brass *B* is turned to a pressing fit in the rod as usual and is identical with the ordinary brass except for the keyway cut in it to match the key on the filler. The brass is then pressed in as usual.



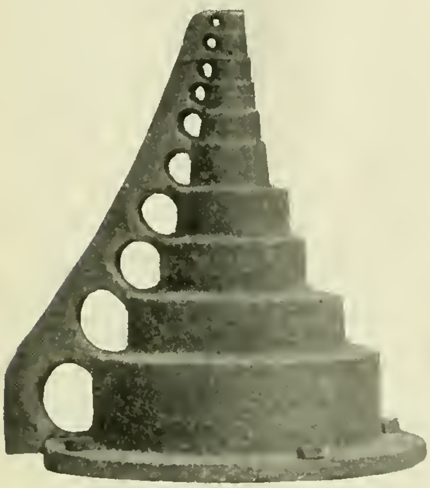
METHOD OF FASTENING SIDE ROD BRASSES—VIRGINIAN RAILROAD

In case it is pounded loose and tends to turn, it can do so for a short distance only, as the filler turns with it and as it turns, it is forced out against the brass by the eccentricity of the groove, so that the more it tends to turn, the tighter it becomes. Even though the engine were to be reversed and the brass slipped from its tightened position, it instantly becomes tightened again by the reversal of the movement of the filler.

The arrangement has been used on a number of locomotives on the Virginian Railroad with great success.

PIPE BENDING MACHINE

A very simple pipe bending machine, so simple, in fact, as to be hardly worthy of the name of a machine, is in use in the shops of the Norfolk & Western Ry., at Roanoke, Va. It is shown in the accompanying engraving and consists of a casting made up of a series of cylinders of different diameters arranged above one another in the form of a stack, and each having a loop cast on one side of it to take the various diameters of pipe that it is desired to bend. These holes or loops vary from about 1 in. to 2½ in. in diameter. The method of using is simply to push the end of the pipe which it is



PIPE BENDING MACHINE—NORFOLK & WESTERN RAILROAD

desired to bend, through the proper hole and carry the other end around the machine thus effectively and quickly making the bend to any desired angle.

Railway Statistics of Canada

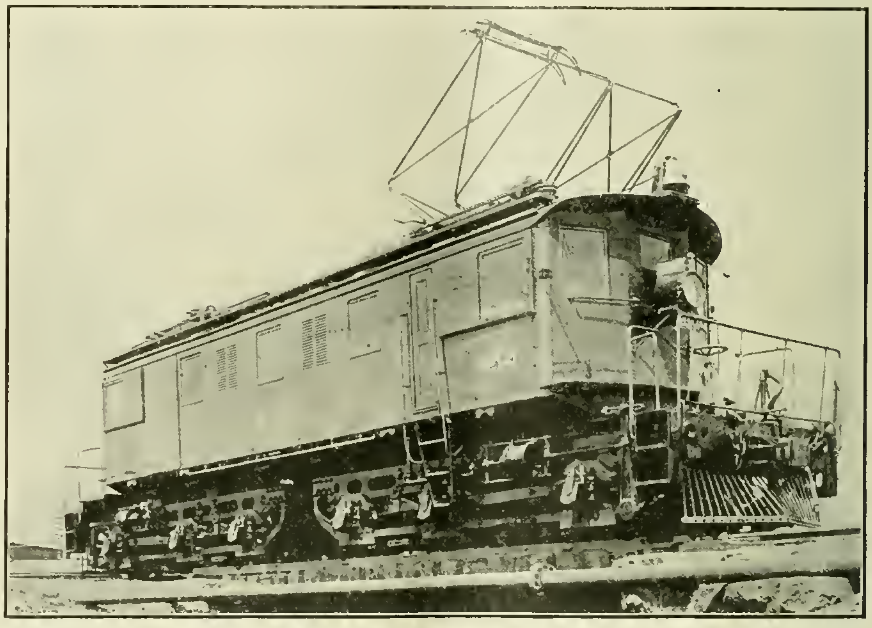
Recent reports show that the following statistics for 1920 have been derived in regard to Government-owned railways in Canada: In 1920 there was a total deficit of $70,331,734, as compared with a total deficit of $48,242,536 in 1919. The foregoing figures do not take into consideration interest or fixed charges on transcontinental or intercolonial railways. The increased loss is attributed to increased expenditures in pay rolls and fuel. It was pointed out that the cost of many materials and supplies had increased very much over 1919. Prices of equipment also advanced. It was stated that out of every dollar earned the railways had to pay 75 cents for operating wages and 20 cents for fuel, leaving 5 cents for all other requirements, which totaled 29 cents.

The mileage operated by the Canadian national management last year was as follows: Canadian Northern, 9,859.78 miles; Intercolonial Railway and branches, 2,221.86 miles; Quebec & Saguenay and St. Johns & Quebec, 234.07; Grand Trunk Pacific, 2,732.40 miles. The amount of new track laid in 1920 amounted to 147.6 miles.

American Electric Locomotives for Brazil

The first Baldwin-Westinghouse freight locomotive for the Paulista Railway Company in Brazil has been completed and tested. The passenger locomotives are nearing completion. This marks a milestone in the electrification of one of the most important lines in all South America. This is the initial step toward the broad application of natural resources of Brazil to the replacement of imported coal for power development.

These locomotives are to be used in main line freight service on the Paulista Railway which is the main broad gauge trunk line of the most prosperous and productive part of the state of Sao Paulo. These freight locomotives weigh 105 metric tons, and have six driving axles each equipped with one 280-H. P. direct-current motor, arranged for operation with two motors in series on the 3,000-volt line. They are designed to handle trailing loads up to 700 metric tons over a line having a maximum grade of approximately 2 per cent. The locomotive is equipped with M. C. B. couplers for testing purposes but will later be equipped with Continental draft gear, and arranged for vacuum train brakes.



BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVE FOR PAULISTA RAILWAY, BRAZIL

Enormous quantities of the coffee, beans, rice, cereals, and cattle are transported over this line by thoroughly modern and efficient railroading methods. Electrification is the latest step in the growth and progress of this notable railway.

American Railway Association, Mechanical Division

As previously announced in our pages the General Committee, because of the financial stress and serious business conditions, has determined that it is necessary to defer the annual convention scheduled for Atlantic City in June. It has been decided to hold a strictly business meeting at the Drake Hotel, Chicago, on Wednesday and Thursday, June 15 and 16, 1921. All members of the Division are invited to attend. The sessions will convene at 10:00 A. M., city time, which is 9:00 A. M., Central Standard time, and continue all of each day with luncheon period 12:30 to 2:00 P. M.

Reports from the following committees will be considered: Wednesday, June 15,—General Committee. Committee on Nominations. Arbitration Committee. Committee on Prices for Labor and Material. Committee on Loading Rules. Committee on Standard Method of Packing Journal Boxes.

Thursday, June 16,—Committee on Car Construction. Committee on Brake Shoe and Brake Beam Equipment. Committee on Train Brake and Signal Equipment. Committee on Tank Cars. Committee on Specifications and Tests for Materials. Election of Officers will be held Wednesday, immediately after report of Nominating Committee is presented. Advance copies of the reports to be considered will be mailed to the members before the meeting.

Reservations for rooms should be made promptly, requests being sent direct to the Drake Hotel, Chicago, Ill.

Mexico Places Equipment Contract

The Mexican government through the Minister of Communications and Public Works has signed a contract with Mr. Otto Kafka, president of the Argos Steel Products Corporation, 170 Broadway, New York City, involving $20,000,000 for railroad equipment. The material covered by the contract includes 200 locomotives, 300 passenger cars and about 50,000 tons of steel rails. Payment on the contract is guaranteed both by a trust on the equipment itself and by all the revenue of the National Railways of Mexico.

Repairs on Maintenance of Steel Freight Cars

Importance of Construction and Inspection by Leading Experts

The gifted Herbert Hoover in a recent address before the members of the American Engineers pointed out with much force that in a period of depression, like the present, if any thing like the present was ever seen before,—was the opportune time to make needed repairs on railroad equipment, so that when the inevitable change for the better came, the wave of prosperity could be met with that degree of readiness essential to mastering the situation. Mr. Hoover did not venture to say where the money was going to come from to pay the skilled workmen who would necessarily be engaged in the work of reconstruction. If there be any railroad on the American continent that has surplus funds we would like to know where it is located, not that we have any desire to lay hold of its honest earnings, but that we might herald its name as a shining example of what forethought crystallized with economic management can accomplish. That such a thing might have been possible is not beyond belief, but wealth, however acquired, seems to create a vacuum instead of a compression, and the more that the average man, or set of men, gets, the more they seem to need. If we prayed as earnestly for more sense as we do for a more liberal supply of means, our supplications might reach the throne of grace. As a rule we seem to find means for our vanities but are frequently short of necessities. Mr. Hoover's advice is ill-timed, and, in case we fall into the same category we will better switch off this side track and get back on the main line.

Wise words come to us from all kinds of sources, if we could only remember them when the opportunity comes to put them in force, but when the prosperous days come—as they shall come— we get a swelling of the head and coincidently a contraction of the heart, and we travel the old road again wise in our own conceit. These reflections come to us in scanning a paper recently presented by S Lynn, master car builder on the Pittsburgh & Lake Erie on the subject of "Repairs, or Maintenance of Steel Freight Cars," and while we have not space for his entire production, it has so much of merit that we take the opportunity to make such extracts as seem to us to be well worth remembering.

The history of the steel freight car is modern history, as it has been known in general service for less than 25 years. Its development has been gradual starting with self-clearing hoppers and drop bottom gondolas of 80,000 lb. capacity, and extending at the present time to every type of railway service. Heavier motive power, with greatly increased train tonnage, has created a demand for cars of increased capacity. The limit of capacity apparently has not yet been reached, since one of the large car companies has, within the year, built cars of 120 tons capacity.

While no accurate figures are available, it is estimated that approximately 75 per cent of the 2,500,000 freight cars in service in North America are either of all steel, steel underframe or steel concrete construction. As this number of cars represents an investment of over three billions of dollars, the importance of keeping them in good repair and in service is self evident.

Repairs to steel cars are necessitated by the following causes: deterioration caused by age and ordinary wear and tear; and abuse, caused by rough handling and damage done in loading and unloading. The latter of these causes will not be discussed in this paper since such damage varies greatly with the locality, and with the service in which the cars are used, and is a matter for correction by individual roads and shippers.

Freight cars should be designed of sufficient strength to withstand the shocks incident to modern service, such as the starting and stopping of trains, and necessary handling in yard switching. Some of the earlier cars were designed with a view of decreasing the dead weight, and our experience has proved that the weight had been reduced too low to be consistent with satisfactory service. The tendency for a number of years past has been to increase somewhat the weight of the cars, not by using heavier steel plate for the sides of floors, but by strengthening the sills, and also the sides, by the application of angles along the top of the sides of the cars, and by the application of heavier draft gear.

Cars with wooden center sills and draft timbers have proved inadequate and this has led to the various reinforcement programmes now in use on many railways as a means of continuing their cars in service. The center sills, draft sills, and draft gears should have sufficient strength to withstand the shocks to which they are subjected, or they will be broken, bent or buckled, with consequent extensive damage to the superstructure.

A casual inspection in almost any classification yard will reveal the fact that repairs to steel cars have been badly neglected during the past few years. Large numbers of cars may be seen with floor, hopper and side sheets badly corroded, and, in many cases, rusted and worn entirely through. A close inspection will usually develop the fact that center sills are buckled, either in front of, or between, the body bolsters. This condition is due either to faulty construction, sills of insufficient area, abuse in service, or neglected maintenance. Conditions existing during the recent world war imposed many hardships upon the railroads generally, making it almost impossible for them to keep the maintenance of their freight equipment up to pre-war standards. Shortage of labor and materials, coupled with the pooling of equipment, had a tendency toward deferred maintenance, which resulted in merely patching up worn out cars and keeping them in service long after they would have been shopped for rebuilding under a normal maintenance programme. The large percentage of home cars on foreign roads resulted in neglect, since proper material for repairs of foreign cars was not generally carried in stock. This resulted in makeshift repairs, most roads doing only enough work on foreign equipment so that it would haul one more load, in the hope that it would carry that one load off the line and never return. The results of this practice are now most evident, when cars are being returned to the home roads in large numbers and in universal bad order.

In the matter of painting, steel cars have also suffered from neglect. While it may be a debatable question as to whether or not it pays to keep the bodies of open top steel cars well painted, all will agree that it is at least necessary to preserve the ideantity of the car. The writer believes that the exterior of steel cars should be kept well painted, as by this process at least one side of the steel is protected against corrosion, and, in addition to this, well painted equipment is a good advertisement for any road. It is obviously impractical to attempt painting the interior of open top steel cars, since the commodities usually carried in such cars consist of coal, coke, iron ore, limestone, furnace slag and mill products, which, in the process of loading and unloading, so badly damage the paint that it would serve no purpose as a protective coating. The interior of steel equipment is where corrosion is the most evident, and is probably due to moisture laden with acids from the products of the mines and mills, or to electrolysis caused by impurities existing in the steel itself.

There is also a difference of opinion among mechanical officers as to the maintenance of steel cars. Some recommend patching up the holes and repairing the damage caused by wear and corrosion, as long as practicable, and when deterioration becomes too extensive to warrant further patching, the car body is cut up and scrapped, and new bodies built and placed on the old trucks, or, if the trucks are of insufficient capacity, or poorly designed, the entire car is scrapped and replaced with a new unit of equipment. Others maintain that it is better to give the car current repairs, by renewing the parts as fast as they become defective, thereby prolonging the life of the car indefinitely.

Up to this point the steel car has been dealt with in general terms and I would like now to state a few things that in my opinion are necessary to maintain steel car equipment properly and economically. Shops should be provided at points where heavy repair steel car work is to be performed. They should be well lighted and ventilated, and, in the colder sections of the country, should be properly heated. Overhead crane service is desirable, and, by proper arrangement, eliminates the necessity for material tracks between the working tracks, thereby decreasing floor space. Small wall or jib cranes should be installed to handle yoke riveters, etc. The money expended for shops will repay the investment many times over in a few years and it is a fallacy not to provide them. While I would not say that a steel car cannot be repaired outside, under adverse weather conditions, I believe that the work can be carried on more successfully where shops are provided.

Shops should be well equipped with suitable machinery, properly located, so that repair parts may be made economically, without any lost motion or backward movement. It is a question whether or not it pays to attempt the manufacture of all steel car parts in the average railway shop. Some of the larger roads buy most of their car repair parts, already punched and pressed into the proper shape ready for application. However, it is necessary to have sufficient machinery to make odd parts, or to extend the supply when exhausted, as it is almost impossible to keep sufficient parts on hand to meet all conditions. Punches, shears, hydraulic presses heating furnaces, and a good supply of efficient pneumatic tools, are indispensable in the modern shop and will soon repay the initial cost of installation. Sufficient compressor capacity, with facilities for supplying dry air at all times, is necessary for the economic use of pneumatic tools. Proper facilities should also be provided to take care of the scrap parts that will accumulate, and the shop and surroundings should be kept clean at all times. While this may not seem important to some, nevertheless it has a certain moral effect on the workman which should not be underestimated.

Another and probably one of the most important factors in repairs to steel cars, is the quality and quantity of supervision. Sufficient intelligent supervision must be furnished, or the work will lag, and both the quality and quantity of the output will suffer. The gang foreman who comes into daily personal contact with every man under him is the keystone of any organization. He forms the contact point between the management and the men, and when the contact is broken the current ceases to flow. These men should be selected from the ranks, if possible, and should be men who have developed ability and initiative in their work and they should also have ability to handle the workmen. While a thorough knowledge of how to perform the work is necessary, this is not the first requisite, as ability to handle men, and personality, stand above this qualification. Foremen should be intelligent, and fairly well educated, in order that they may read the rules, blueprints and instructions, and apply them intelligently, and also that they may be eligible for promotion to high positions as vacancies occur.

Another important feature is the personnel of the shops. Wages paid, and working conditions, should be such that they attract capable young men to seek employment in railway shops. Unless this is done, there is a tendency for skilled mechanics to seek more remunerative employment in industrial work. This is particularly true in the large industrial centers. The tendency prior to Federal control, in some sections of the United States, due to shortage of mechanics and inability to induce young men to enter the service, has been to hire foreigners from central and southern Europe, men who have never had any mechanical training, and to try to make mechanics out of them. These men come to us wholly unacquainted with our language, our customs, and our laws, and must be assimilated into our organizations. While at first a rather costly proposition, with proper and tactful handling, they usually learn very rapidly, and have become the mainstay of some of our car shop organizations. It is very important that those charged with the handling of these men should by careful and tactful treatment, instil in them the principle of loyalty to their employers, and with proper encouragement and fair dealing on the part of their foreman, the majority of them readily become acquainted with our methods of work. The nationalization of foreigners has become an important subject and it is very generally conceded that they are more easily reached in the shops than in their homes. However, any tendency toward radicalism should be carefully watched, and immediate steps taken to circumvent it.

In the actual work of repairs it is suggested that draft attachments and center construction be sufficiently strengthened, so that the shocks incident to modern service will be absorbed and distributed throughout the car, without causing extensive damage to the superstructure. Center and draft sills should have sufficient area, and should be protected against buckling by the use of cover plates. A common cause of failure is due to bodies of hopper cars not being securely fastened to center sills. A few rivets are driven in inside hopper sheets, to hold the body of the sills, and the heads corrode and wear off the rivets, allowing them to pull through the sheets. This results in the whole strain being thrown on the body bolsters, which are usually of a wide single plate type, with the result that they are unable to stand up under the strain. The sills start moving back and forth under the car, and it soon gets in such condition that permanent repairs become a rather expensive proposition. Sides and ends of steel equipment should be properly reinforced, to prevent bulging out under load. Drop door equipment should be kept in proper working order to facilitate unloading. Care should be taken, in repairing trucks, to provide side bearing clearance, and to see that brakes and all running gear are kept in good condition.

A well defined programme of reinforcement should be outlined and put into practice on all roads. The cost of such additions and betterments is usually insignificant, when the future life and productive service of the car are considered. Money appropriated for such features is a good, sound investment, when judiciously used, and should pay large dividends. Many roads make the mistake of repairing their older equipment in kind, as they did not have exacting conditions on their lines. Such equipment should either be reinforced or kept on their own lines and not offered in interchange, where there is a possibility of it getting out into the large industrial centers and in heavy tonnage trains, when it is almost an impossibility to keep it off the repair tracks. This places an unnecessary burden of expense on both the owner and the handling line. As cars come into the shop for general repairs, a careful inspection should be made, and if the car has not deteriorated to the extent that it is felt advisable to scrap it, it should be repaired in accordance with a well defined reinforcement programme, as outlined. Otherwise, if this is not done, after considerable money has been spent on the car, it will again, due to inherent weakness, be back on the shop track.

In conclusion, if the railways were provided with the facilities, and a maintenance programme similar to that suggested in this paper was adopted by all roads, and an honest effort was made to maintain the cars in accordance with that programme, the steel cars in the country would give the owner a better return for the money invested, in the way of better service and in increased life of the cars.

In the course of the discussion that followed an interesting personal experience in car repair work was presented by H. C. Oviatt, superintendent of motive power of the New York, New Haven & Hartford railroad, in which he stated that they "had on the New Haven, a total of approximately 37,000 freight train cars, 8,800 of which are all steel open top cars, the remainder being principally steel underframe box cars. At the time that the railroads were taken over by the Government, the New Haven railroad was exceedingly fortunate in having all of their equipment in first class condition.

It is well known that freight cars during the last two and a half years have been pooled, and the owning roads have seen very little of their equipment, the New Haven operating as low as 8 per cent of the total home equipment to the cars on the line.

Not long after the roads were returned to the owners, freight cars began to return, and with the depression of business, such equipment returned in increased numbers, either under the car service rule, or specially marked home for general repairs. While the facilities on the New Haven road are adequate under normal conditions to take care of the box car equipment, it had not provided for the general repair to all-steel cars.

From the fact that many of the open top cars were purchased as early at 1906, 1907 and 1908, it was realized that provision must be made for making repairs to these cars. Our General Car Inspector and Shop Superintendent were delegated to investigate shop equipment of other roads, for the purpose of gathering such information as would assist us in selecting the best shop arrangement and tools for doing this class of work, but little information was obtained, as few of the roads visited were properly equipped for repairing this type of car. The financial condition of the New Haven Road, like many others, was such that it could not make an appropriation for the erection of new shops of a capacity to meet the requirements. After further study of the situation it was decided to open one of the recently abandoned roundhouses and a building formerly occupied as locomotive and car shop, making necessary alterations and installing in same equipment and tools for handling steel work.

An appropriation of $170,000 was approved for repairs and alterations and the purchase of tools, which included, in addition to pneumatic and other small hand tools, such machine tools as McCabe flanger, press, straightening rolls, flange clamp, bolt cutters, steam hammers, journal truing machines, punch and shears, oil furnaces and blacksmith forges, electric tractors, air compressors, etc., together with overhead air hoist and jib crane for handling the work through the shop.

Each shop was organized with a competent foreman and sufficient forces to operate at full capacity, and being located at extreme ends of the line, as well as under different management, a considerable rivalry sprang up between the two organizations, resulting in increased efficiency and minimum cost of production.

The operation at each point is so arranged that inspection is made of the equipment before going into the shop, and each part that is to be removed, marked. At the same time, an order blank is filled describing sheet numbers that will be required, and the cars are then placed on stripping pits, where a stripping gang removes sheets by use of oxy-acetylene torches, pneumatic guns, etc. Scrap sheets are then unloaded by the use of air hoist, and immediately removed by tractor truck equipped with one ton crane. The new sheets are returned by the same truck and placed in car. Cars are then removed to another section of the shop, where assembling alone takes place. By this method scrap is kept out of the shop, permitting work to proceed with minimum interference, and having material close at hand when assembling begins.

Material used in repairs is fabricated at the mills when purchased, as it could not be done at the company's shops. On this basis each shop is turning out five cars a day, with repairs to superstructure that will extend the life of same to a minimum of five years, and in many cases, a much longer time. The car also receives a general overhauling of trucks, draft gear, couplers, and necessary repairs to bolsters, undersills, etc., at the approximate cost of $863 each, covering labor, material and overhead.

With the assistance of small orders given to outside contractors, we have been able to not only reduce the number of bad order open top cars on the line, but are taking care of those returned currently. My explaining the above operations is simply to illustrate results that can be obtained by the use of facilities already at hand, with a small outlay to cover proper equipment, together with efficient organization, making large capital expenditures unnecessary.

Unlike repairs to locomotives, the handling of repairs to freight train cars by designating cars requiring various classes of repairs to individual shops, has never been considered. In order to handle this subject in a more systematic way a thorough canvass was made of our system to determine the number of each class of repairs turned out daily, the forces engaged, material in stock, and adequacy of means for handling.

Our investigation showed that while we were prepared for handling light repairs, we were not equipped to handle heavy repairs advantageously. I therefore decided to organize forces to take care of a particular class of work, and arranged accordingly, supplying the material necessary for the class of work that would be carried on at each point and with necessary forces. On this basis, our heaviest repairs, including classes 1 and 2, are ordered to the point where they can be economically handled. Lighter repairs, such as 3, 4 and 5, are likewise handled at points which do not require tools for heavy class of work. With this arrangement it is possible to assemble at each point, material required for the particular class of repairs. At the same time, the forces become familiar with the routine work, increasing production at minimum cost.

Each class of repair is considered on the man hour basis, permitting of a close check of the efficiency of each plant, also allowing the supervising officers to determine the efficiency of the forces as a whole. The question of supervising forces should be decided by the railroad company alone, and the educating of such men should be given careful consideration in the future, as it is too important a matter to be overlooked."

G. M. Basford, president of the G. M. Basford Company, New York, also made a valuable contribution to the discussion, in the course of which he pointed out that "cars and locomotives must be regarded as an enormous investment the earnings from which increase in exact ratio to the percentage available for service. There is no problem now before railroads as important as the production problem in maintenance.

"Until we compare the steel car of today and the improved locomotive of today with the car and the locomotive of, say, twenty-five years ago, until we compare the loads they take and the loads they haul we do not give credit to improvements justly due to them. Some years ago I had the honor to be present at a demonstration in one of the largest terminals on the other side of the line of an engine starting and hauling a train of 600 tons. Newspaper men were much impressed with the performance although the engine involved had to have help from an unseen switcher to get the train going. How insignificant does a train of 600 tons seem now? For many years cars and locomotives grew bigger and heavier and more efficient. Steel cars revolutionized the handling of freight and improvements increased the capacity of the locomotive. Announcement is made of the construction for a railroad in Virginia of 1,000 120-ton cars. This road has highly specialized conditions of operation and has increased its train loads from 7,950 to 13,200 tons. It is given to but very few roads to haul such trains, but this case turns our thought to the remarkable improvements which have been made, improvements in which the steel car is fundamentally a part. Other roads with other conditions have increased their train loads tremendously though not as much as this. If we were called upon today to handle traffic when business is good, with the equipment of a generation ago, or before Canadian Pacific took the lead in superheating, the public would understand much that is not now understood concerning the improvements railroads have made.

"The next thought is that big large capacity steel cars and locomotives that are not merely big and heavy, but are also highly efficient, have made it possible to meet the transportation needs when those needs were greatest—couldst thou both eat thy cake and have it? We therefore must face the problems that these improvements have brought. We must maintain and keep in good condition the equipment that has done so much for transportation. Big expensive cars and big expensive locomotives must not be kept idle for lack of adequate shops, machinery and facilities for quick repairs. No other business could stand it. The railroad business cannot stand it long. It has always been easier to get new cars and new locomotives than to supply facilities for maintaining those we already have and for improvements in operating them. Today transportation faces new conditions. New methods are called for and what is needed most of all is to improve the equipment now in use and get more use out of it. Maintenance facilities are the most desperate need of railroads on the other side of the line. I know that Canada is different from the United States but perhaps this expression may do no harm in Canada. If cars and locomotives were like bridges as to maintenance this question would not arise. Bridges must be kept up for safety, whereas cars, also locomotives, will usually make another trip before falling apart.

"It is fair to say that no structure designed by engineers was ever so well adapted to hard, rough, uncompromising service as is the modern steel car. These structures are a tribute to engineering guided by experience. They earn the money for the road and therefore they merit the care necessary to keep them to their work.

"This calls for facilities for shops, machinery, appliances, cranes, hoists that few if any roads have supplied to sufficient extent. We cannot effect the savings from more economical rolling stock unless we take care of it. We cannot always 'take out' on a bank account. We must also 'put in.'

"You know your proportion of bad order cars. I do not. You know whether the number is above or below the average, but it is perfectly safe to say that the proportion may be reduced on every road by additional facilities that will put cars back on the road in a shorter time. It is well to remember the impressive statement now made, indicating the loss of 4 per cent bad order cars to be $100,000 per day.

"Then comes the question of the men. It is my opinion that car repair forces are remarkably well organized. The cars and reliability of car inspection forces would surprise the public if the facts were better understood. They know the standards and report most intelligently on what the car needs.

"Then comes the repair question. Because quick, thorough repairs saves the building of many new cars, and the same thing is true of locomotives, repair facilities should be most generally supplied out of funds that otherwise must go for new rolling stock. Will you have more cars to increase what is already an overload on shops or will you have more shops and more machinery to get more service out of the money already spent?

"As to men, Cardinal Gibbons said in a recent interview: 'Expect great things of your fellow man and of yourself. For great opportunities are ahead, greater than any that came before. But only those who have the courage and vision to expect them will profit when they come.'

"As to supervision, and that is the important factor in car and also in locomotive repairs, let us bear in mind the fact that 'the foreman is the top sergeant of industry,' and that he must be selected and trained accordingly. Is it not pitiful to see how a great many men, when promoted to positions of importance, get out of touch and out of sympathy with the men in the ranks. Foremen need a helping hand and strong influence over them to provide the efficiency in a large organization that is easy to secure in a small one. Writing in the *Nation's Business,* James B. Morrow gives an inspiring picture of the Hon. E. E. Clark, chairman of the Interstate Commerce Commission, who was a brakeman, then a conductor, and until recently was the only railroad man on the Commission. He once said to a friend, 'If a brakeman walks to a switch to let a train on the siding, or walks back so as to flag any train that may be approaching, he is not of much account. If he runs make him a conductor as soon as you can.' Herein is a fundamental idea in the selection of a foreman.

"Let us remember that busy days will come again and that goods will be waiting for cars. Let us get car repair facilities in order. A quick and easy way to save barrels of money is to bring the shop up to date, up to the efficiency of the best locomotives, the best cars and the best men, to protect an investment of over three billion dollars in steel cars."

Condition of the New Haven

According to President E. J. Pearson of the New York, New Haven and Hartford, the present situation of the New England railroads is developing closely in accordance with the information and forecast which have been furnished to the Federal authorities and the commissions appointed by the New England governors. The public has been receiving transportation from the New Haven system at less than cost. This is indicated by the inadequacy of revenues for meeting operating costs, taxes and charges, but not including any dividends which should be paid and could be considered if the road is placed into a position to earn six per cent on its tentative valuation. Such deficits for the New Haven and Central New England, excluding Federal guarantees, were $8,000,000 in 1918; $8,900,000 in 1919; $30,000,000 in 1920; and $7,675,000 for the three months of January, February and March, 1921; a total for such period of $54,575,000.

Adjustment of Brake Power on Tank Cars

Requests having been received from a majority of the owners and operators of tank cars for an extension of the effective date for complying with the provisions of Circular S III—11, issued May 15, 1919, and the Tank Car Specifications for the Adjustment of Brake Power on Existing Cars. It is stated that this request is due to the present general business conditions and also to the fact that so many of the cars are scattered throughout the country, many of them being stored on railroad sidings, making it difficult, if not impracticable, for the owners to complete the work in the time limit set, which is July 1, 1921.

The request has been granted by the General Committee, and the effective date for complying with the requirement of the Tank Car Specifications in the matter of Adjustment of Brake Power on existing tank cars has been extended to July 1, 1922.

Air Brake Association

The executive committee of the Air Brake Association decided to cancel the annual convention which was announced to be held at Chicago, May 3-6, 1921. A business meeting of the committee will be held at the Hotel Sherman, Chicago, on May 3 and 4, at which reports of committees will be received. The meeting will be open to all members. The action of the executive committee is in keeping with other associated bodies who are hopeful that better business conditions will prevail in the near future, and this will be the last annual meeting which they expect to postpone.

Authenic Record Run

On April 18, 1921, a special train of two cars was hauled over the Philadelphia & Reading and the Central of New Jersey, a distance of ninety miles, at an average speed of 67.5 miles an hour, covering the distance between Philadelphia and Jersey City in one hour and twenty minutes.

Explosion in a Medium Pressure Compressed Air Line

At the Eddystone Plant of The Baldwin Locomotive Works, there occurred several years ago, in November, 1918, to be exact, an explosion in the compressed air system which for extent and violence exceeded anything of the kind that has ever happened, as far as we have been able to learn. The explosion occurred in that portion of the plant known as Section "A", where are located the shop and storehouses for the assembly and erection of locomotives. The explosion happened at about 4 a. m. on a Sunday morning at a time when there was very little air being used, and was not presaged by any unusual action as far as was observable at the compressor. In fact the engineer in charge of the machine stated that he had just filled the lubricator and was walking back to the discharge end of the compressor, when the pipe-line outside the powerhouse blew up with a tremendous roar. Investigation showed that the pipe line twelve inches in diameter, and buried three feet under ground had exploded with the utmost violence for a length of 700 feet. For about one-half this distance the pipe was under a wide roadway paved over with six inches of concrete and on top of that two inches of Amiesite. Notwithstanding the heavy cover the energy let loose by the explosion was sufficient to open up a trench from six to ten feet wide the entire length. There was considerable damage doue to the adjacent buildings by the flying debris, heavy blocks of concrete being propelled as if by dynamite. The pipe itself, twelve-inch extra heavy, was literally torn into shreds. See the illustration for a view of one average section. Most fortunately at the time of the accident there were very few men around, and no one was injured. The compressor itself was not damaged by the explosion in any way nor was the receiver which is located close to the compressor but outside the power house, except for one of the two safety valves, which was blown out bodily, landing on top of a re-enforced concrete roof seventy feet high with sufficient force to go right through.

The compressor was of modern type two stage with intercooler. It had a capacity of 4,700 cu. ft. of free air per minute, and was driven by a direct connected synchronous motor of about 600 K. W. capacity. There was no after cooler, the compressor discharging through a short pipe line into a cylindrical receiver of about 400 cu. ft. capacity. The pipe line is buried three feet under ground and running from the air receiver around the building to the point where it connected with the ten-inch underground line connection. At this point another ten-inch line led off at right angles to feed the Erecting Shop. There were no drips in this pipe line nor anywhere in the system except at the bottom of the air receiver. The investigation following the accident disclosed that there was considerably more lubricating oil fed into the air compressor than had been instructed. The instructions were that five drops per minute were to be fed through each of the lubricator pipes. The probability is that this was greatly exceeded and further that the drip at the bottom of the air receiver had not been blown down regularly.

It is practically certain therefore that there was a pool of oil lying in the bottom of the twelve-inch pipe not less than one-inch deep dammed in place by the receiver at one end and at the other by the ridge formed by the junction of the twelve-inch pipe with the 10-inch pipe. The compressor had for some months been running night and day no matter what the load owing to the fact that the power contract under which we were at that time operating included a heavy penalty for low power factor, and the continuous operation of the synchronous motor particularly under light load had a beneficial effect on this power factor. As a matter of fact, however, for many months previous the plant had been working day and night under war time conditions turning out locomotives for the use of General Pershing in France, and even on Saturday and Sunday nights there were many men working about the plant and considerable power being used. At the time when this accident occurred then, which was very shortly following the armistice, things had begun to slacken a little and on this particular night for the first time there were very few working in the shops, and the air compressor which in common with machines of the motor-driven type unloaded by stages was running a large part of the time with all stages unloaded.

The two important factors in causing this explosion seem to have been the presence of lubricating oil in the pipe and the fact that the compressor was not discharging air; that is, the velocity of flow through the pipe was practically nil. Theoretically, of course, the air compressed at each stroke into the unloading pockets of the compressor when it expanded from the pockets would reabsorb exactly the same amount of heat which it had given up during the work of compression. Actually, however, we find that the temperature will rise somewhat in this action whether due to friction of the moving air or from whatever cause. In all air compressors carbon will be found around the discharged valves resulting from the decomposition of the lubricating oil in greater or less amount and it seems probable therefore that particles of this carbon may have been heated to incandescence and then when flow was started through the pipe portions of this incandesent carbon may have been carried out into the pipe line starting very possibly a slow combustion of the oil or oil vapor therein. The heat thus generated would tend to raise gradually the temperature inside the pipe and it would seem that a critical combination had been reached practically simultaneously along the whole length of this pipe between the pressure and the temperature of such a character that the oil was as it is called "cracked," and its hydro carbons had reassociated themselves into a volatile gas which became mixed with just the correct portions of air to form an explosive mixture which, of course, immediately detonated. There have been many explosions in compressed lines similar in character to this one if

VIEW SHOWING RESULTS OF EXPLOSION IN COMPRESSED AIR LINE not so considerable in extent and very little of a definite nature seems to be understood of the changing conditions within a compressor or pipe leading to such explosions. There is a good field for study along this line by investigators who have the opportunity and time to devote to it and the results of such investigation should be most valuable as making possible the prevention of such accidents in the future.

This explosion, of course, caused us to go over all of our air compressor installations with a critical eye and the following recommendations made at that time were adopted and have been carried out:

Lubricating oil: Providing that a good grade of mineral oil with a flash point not below 400 F. is used, we felt that quantity more important than quality, therefore recommendations were that the oil previously used should be continued but its rate of feed to the cylinder should be absolutely restricted to from one to five drops per minute depending upon the size of the cylinder.

Safety valves: That safety valves of liberal size be placed on all intercoolers and on discharge pipes as near the machine as practicable.

Fusible plugs: That fusible plugs be installed with a blowing point of 500 F. in the discharge line close to each machine.

Check valves: That check valves be installed in discharge line close to each compressor.

Drips and blowoffs: That drips be installed at all points where there is a pocket in the line. Where it is possible receivers or after-coolers should be drained to a small tank below them and the blow-off valve should be placed on the small tank. This would not allow oil which had accumulated to be revaporized and carried into the pipe line by its contact with a stream of warm air at high velocity.

After coolers: That after coolers be installed at each machine as far as possible in cases where several small compressors are grouped close together one after cooler may do for all.

Cleaning: That in order to dissolve and wash out the accumulations of carbon once each week two to three quarts of a solution of castile soap in water should be fed through each cylinder lubricator.

Instructions for operations: That the following instructions be printed and hung up in plain view in every power house:

RULES GOVERNING OPERATION AND INSPECTION OF AIR COMPRESSORS.

Explosions in Air Compressors and Receivers occur with sufficient frequency to demand careful attention, and in order to guard against these and to insure efficient operation of the compressors, the following must be observed:

Poor working conditions of the compressor, such as leaking valves, hot and dirty inlet air, insufficient cooling water, carbon deposit in cylinders or connections, all assist in producing dangerously high temperatures of the compressed air, which are sufficient to ignite the volatile constituents of the lubricating oil, and produce violent explosions, therefore—

1. Keep the temperature of the compressed air, during compression as low as possible.

2. Keep the pistons and valves tight and in good working condition.

3. Use plenty of cold water, and have it visible at discharge from cylinders or coolers.

4. Do not use kerosene, gasoline or other volatile substances in the cylinders, tanks or any connections.

5. Use mechanical or sight feed oilers for the compressor cylinders, and watch their operation carefully.

6. Use the least amount practicable of the air cylinder oil specified by your Chief Engineer. Use no other kind. Air cylinders require much less oil than steam cylinders.

7. Keep the cylinders, tanks and connections free from carbon, accumulated oil and deposits.

8. All main air receivers, and also drip tanks at compressors, shall be drained twice daily. Drip cocks, under cylinders, shall be opened and drained twice daily. All drip tanks on lines throughout distributing system shall be drained once each day.

9. Test the unloader frequently on motor-driven compressors to see if the unloading valves work freely. Should the unloader "throw out" frequently, it indicates that more air is being compressed than is used, and you should notify your Chief.

10. Watch the thermometer on the discharge line of the compressor. If the temperature rises above normal, examine into the cause. Should it rise above 350, shut down the compressor and notify your Chief.

11. In the discharge line of each compressor there is a fusible plug which will melt out when the temperature of the compressed air reaches a dangerous point. If this occurs shut down immediately, notify your Chief, and do not start machine again except on his orders.

12. Test safety valves once every day, or oftener by raising the disc from its seat. Test once every week with air pressure.

13. Careful inspection to be made weekly on every compressor. Valves to be tested for leakage each week. All valves must be removed and examined once each month, and an internal inspection of the cylinders made. Remove all oil, carbon and residue, and replace all defective valves, springs, etc.

14. Once each week on all air compressor units, use a solution of soap and water for about four hours, through the lubricators feeding the cylinders.

15. Inspect the interior of each air receiver every two weeks, and clean out all oil and carbon.

16. Watch the operation of your machine carefully and learn to know it—its length of service and its efficiency depends upon you. See that necessary adjustments are made properly and when needed. Check up carefully on inspections. Keep the oil clean and the lubricators filled, and keep your Chief informed on any needed repairs or supplies.

Allowable Load on "D" Axle

In the report of the Committee on Car Construction as submitted by letter ballot at the annual meeting of the Mechanical Division of the American Railway Association last year there was a recommendation that the capacity of the "D" axle with 5½ inches by 10 inches journal be increased from 38,000 lbs. to 40,000 lbs., the present dimensions being such that the allowable stresses will not be exceeded.

The foregoing recommendation of the Committee on Car Construction was approved by the necessary two-thirds majority in the Mechanical Division and was formally approved by the Association at its session, November 17, 1920. The Committee on Car Wheels has considered this matter in its relation to chilled iron car wheels and has decided that the wheel formerly designated for cars of maximum gross weight not to exceed 161,000 pounds can take this increased load without any change in weight being necessary. The proposition to increase the capacity of the "D" axle having 5½ inch by 10 inch journals, and the cast iron wheel for use with this axle to 40,000 pounds and 169,000 pounds, respectively, is approved. The Committee desires to note that no existing cars should be marked up in capacity on account of this increased rating of axle "D" with 5½ inch by 10 inch journals until they have received permission to do so from the American Railway Association. When asking permission for this increased marking they shall present evidence that the trucks and cars are of a strength commensurate with the proposed increase in the load of the axle. In no case shall cars be changed by other than the owner.

Valve Handles

The Railway Association of Canada has issued the following in regard to valve handles of water gauge mountings. Attention has been called to the desirability of having valve handles of water gauge mountings on locomotives so located as to permit of manipulation without danger of operator being scalded in event of water glass breaking. It is recommended to member lines that where the top mounting of the water gauge is located on the top of the boiler, instead of in the face plate, the valve handle should be extended beyond the face plate, so as to be easy of access in case of water gauge breaking.

Items of Personal Interest

R. D. Stewart has been appointed chief engineer of the Denver & Salt Lake, with headquarters at Denver, Colo.

George F. Heise has been appointed toolroom foreman of the El Paso & Southwestern shops at El Paso, Tex.

W. Arthur Birch, gang foreman on the Atchison, Topeka & Santa Fe, at Needles, Cal., has been transferred to Staples, Minn.

J. E. Blasie has been appointed district storekeeper of the New York Central at Depew, N. Y., succeeding H. L. Grandy, transferred.

R. W. Barnes has been appointed construction engineer of the Southern Pacific Lines, succeeding S. B. Moore, granted leave of absence.

Frank G. Fischer has been appointed master mechanic on the Southern division of the St. Louis-San Francisco, with office at Memphis, Tenn.

L. J. Green, formerly assistant general storekeeper on the New York Central at West Albany, N. Y., has been appointed storekeeper at Otis, N. Y.

A. J. Litwin, car foreman of the Northern Pacific at Paradise, Mont., has been transferred to Staples, Minn., succeeding F. M. Weseman, deceased.

W. H. King, Jr., has been appointed general purchasing agent of the Seaboard Air Line, with headquarters at Norfolk, Va., succeeding H. C. Pearce, resigned.

E. S. Huffman, assistant general storekeeper on the New York Central at West Albany, N. Y., has been appointed district storekeeper, with headquarters at West Albany.

J. Graham has been appointed division foreman of the Santa Fe, with office at Amarillo, Tex., succeeding W. B. Perkins, transferred to Slaton, Tex., as division foreman.

W. A. Duff, assistant chief engineer of the Moncton Division of the Canadian National Railways, has been appointed engineer of standards with headquarters at Toronto, Ont.

A. L. Prentice has been appointed district storekeeper of the New York Central, with headquarters at Elkhart, Ind., succeeding C. F. Heidenrich, transferred to Collinwood, Ohio.

J. F. Spiegle has been appointed assistant master mechanic on the Canadian National, with headquarters at Horneypayne, Ont., succeeding W. G. Strachan, transferred to Capreol, Ont.

O. P. Reese, superintendent of motive power of the Pennsylvania, Northwest region, with headquarters at Toledo, Ohio, has been transferred to Chicago, Ill., succeeding O. C. Wright.

T. A. Roussin has been appointed master mechanic of the Missouri-Illinois, which was organized to take control and operation of the Illinois Southern, with headquarters at Bonne Terre, Mo.

B. B. Greer, vice-president of the Chicago, Milwaukee & St. Paul, has been elected president of the Des Moines Union railroad in addition to his other duties, succeeding F. C. Hubbell, resigned.

A. W. Newton, chief engineer of the Chicago, Burlington & Quincy, has been appointed an engineering member of the joint committee on automatic train control, succeeding H. R. Safford, resigned.

C. J. McCue has been appointed general roundhouse foreman of the Santa Fe, Coast Lines, with office at Needles, Calif., and J. A. Woods has been appointed foreman at Bagdad, Calif., succeeding Mr. McCue.

G. T. DePue, mechanical superintendent of the Erie, with headquarters at Chicago, Ill., has been appointed shop superintendent at Galion, Ohio, and the office of mechanical superintendent at Chicago has been abolished.

Robert Eldridge has been appointed general foreman of the Chicago, Rock Island & Pacific, with office at Sayre, Okla., and William D. Oakford has been appointed night roundhouse foreman, with office at Haleyville, Oak.

J. M. R. Fairbairn, chief engineer of the Canadian railway company, and R. A. Ross, member of the administration commission of Montreal, have had the degree of Doctor of Science conferred on them by the Senate of the University of Toronto.

J. J. Connors, formerly superintendent of motive power of the Denver & Salt Lake, has resigned to become associated with the Lowe Brothers Company, Dayton, Ohio, as railway representative with offices at 1243 Monadnock Building, Chicago, Ill.

F. T. Knight, locomotive foreman of the Canadian National railways, with offices at Port Arthur, Ont., has been appointed locomotive foreman of the Grand Trunk Pacific, with office at Sioux Lookout, Ont., succeeding W. H. Fletcher, transferred.

J. E. Wharton, division storekeeper of the Pennsylvania, with headquarters at Toledo, Ohio, has been appointed storekeeper of maintenance of equipment department, with headquarters at Toledo, and the position of division storekeeper has been abolished.

Paul J. Schenck has been appointed general foreman of the Chicago, Rock Island & Pacific, with office at Dalhart, Tex., succeeding James McLeod; and David M. Rankin has been appointed car foreman with office also to Dalhart, succeeding Robert L. Riding, resigned.

Henry C. Nutt has been elected president of the Monongahela and the Pittsburgh, Chartiers & Youghiogheny. Mr. Nutt was in charge of the transportation office of the American army of occupation at Coblenz, Germany, and had the rank of Colonel in the United States army.

E. W. Scheer has been appointed general manager, Eastern Lines, of the Baltimore & Ohio. Mr. Scheer has been thirty years in the employ of the company, chiefly in the transportation department, his latest position being that of superintendent of the Maryland district.

William T. Lane, district manager of the Pacific Coast territory of the Franklin Railway Supply Company, Inc., New York, has been transferred to Cleveland, Ohio, as district manager of the Cleveland territory, and James McLaughlin, assistant to the vice-president at Chicago, has been transferred to San Francisco as district manager of the Pacific Coast territory, succeeding Mr. Lane.

Thomas E. Robertson, for many years active in the work of the American Patent Law Association, of which he was at one time president, has been appointed by President Harding to be Commissioner of Patents. Mr. Robertson is a graduate of the National University Law School, and is a member of the bar of the United States Supreme Court. His appointment meets with general approval.

Percy W. Jones, formerly in the employ of the Chicago & North Western, has been appointed signal engineer examiner in the Bureau of Safety, Interstate Commerce Commission, Washington, D. C. Mr. Jones has had a wide experience as a signal engineering expert on several of the Western roads, and during the war period served in the construction division of the United States Army with the rank of lieutenant.

W. H. Noble has been appointed district manager, railway sales department, of the Texas Company, with offices in Chicago, Ill. Offices have been established at 1689 Arcade Building, St. Louis, Mo., with F. E. Sheehan, representative in charge; also offices at 1206 Merchants National Bank building, Los Angeles, Cal., with J. B. Flynn, representative in charge, and at Oklahoma City, Okla., with L. R. Dallam, representative in charge.

J. A. McGrew has been appointed superintendent of maintenance of the Delaware & Hudson with headquarters at Albany, N. Y. A consolidation was effected last month in the motive power and car departments, together with the maintenance of way and structures. The superintendent of motive power, master car builder, signal engineer, efficiency engineer and the engineer of maintenance of way will all report to the superintendent of maintenance, who will report to the general manager.

O. C. Underwood, formerly signal supervisor on the Southern Railway Lines, East, and L. C. Heilman, formerly office engineer of the signal department of the Chicago, Rock Island & Pacific, have been appointed to represent the American Railway Association at the experimental tests being made on the operation of the automatic train stops on the Chicago & Eastern Illinois, and on the Chicago, Rock Island & Pacific. P. W. Jones and R. B. Johnson, recently appointed examiner, will represent the government.

G. M. Stone, master mechanic on the Chicago, Rock Island & Pacific, since the consolidation of the various divisions of the road, has been appointed general foreman, with offices at Manley, Iowa. B. H. Smith, master mechanic, has been appointed general foreman, with offices at Fairbury, Neb. W. E. Danvers, master mechanic, has been appointed road foreman of equipment with headquarters at Amarillo, Tex., and A. Hambleton, master mechanic, has been appointed general foreman, with offices at Shawnee, Okla.

John P. Kelly, inspector of safety appliances in the Bureau of Safety, Interstate Commerce Commission, has been appointed senior railway mechanical engineer for the bureau, with headquarters at Washington, D. C. Mr. Kelly began his railway career as fireman on the New Haven in 1884 and was promoted to engineman in 1887. In 1898 he was air brake instructor on the New York Central and also was for several years in the employ of the Westinghouse Air Brake Company. As a writer on technical subjects he conducted for some time the Air Brake Department in RAILWAY AND LOCOMOTIVE ENGINEERING. In 1912 he reentered the service of the New York Central as consulting air brake engineer and in 1919 entered the government service as stated above.

Obituary

Hardin L. Anderson

The death of Hardin L. Anderson, editor of the *Illinois Central Magazine* occurred on April 2, 1921, at the Illinois Central Hospital, after a brief illness. Mr. Anderson was in his 62 year and was a graduate from the Virginia Military Academy, his father having won distinction as a Colonel in the Confederate army during the Civil War. The younger "Colonel" Anderson, as he was called, after serving as postmaster in Salt Lake City during the Cleveland administration entered railroad service, and had considerable experience on several of the western railroads in the transportation departments, eventually becoming superintendent of the Wyoming division of the Union Pacific. In 1910 he entered the service of the Illinois Central, and as editor of the *Illinois Central Magazine* his work was much appreciated by the company and employees.

Lester G. French

Lester G. French, editor of "Mechanical Engineering" and assistant secretary of the American Society of Mechanical Engineers, died in New York on April 18, in the fifty-fourth year of his age. Mr. French graduated from the Massachusetts Institute of Technology in 1891 and for several years was connected with the International Correspondence Schools, Scranton, Pa., as instructor in mechanical engineering. From 1897 to 1906 he was editor-in-chief of "Machinery." In 1908 he was appointed editor of "Mechanical Engineering." He was the author of several engineering text-books, among others being a valuable treatise on the steam turbine.

Marshall M. Kirkman

Marshall M. Kirkman, former vice-president of the Chicago & Northwestern, died on April, 1921, in his 79th year. Mr. Kirkman entered railroad service as a telegraph messenger, and was in the employ of the Chicago & Northwestern 53 years. In 1881 he was appointed comptroller, and elected vice-president in 1889, retiring in 1910. He was the author of numerous books and treatises, his chief work, entitled "The Science of Railways," published in 1894, describes the methods and principles governing the location, organization, capitalization, construction, maintenance, operation and administration of railroads.

H. Kirke Porter

H. Kirke Porter, president of H. K. Porter Company, Pittsburgh, Pa., died at his home in Washington, D. C., on April 10 at the age of 81. Mr. Porter began the building of the lighter type of locomotive in 1866, and continued with marked success up to the present time, with Mr. Porter as president of the company. In addition to his marked ability as a constructing engineer, Mr. Porter took an active interest in public affairs and in 1902 was elected a member of Congress.

James Watt Memorial Fund

The executive committee who have had in hand the arrangements connected with the James Watt Memorial Fund announce the discontinuance of active propaganda as from the 31st ult. The receipts and payments account shows memorial receipts amounting to £14,518; commemoration receipts, £733; and £280 from a workers' demonstration. The total balance in hand for allocation stands at £11,407 11s. 10d., and the committee recommend that £5,000 be allocated to the Birmingham University for establishing a Chair of Research in Mechanical Science (£3,775 15s. has already been subscribed for this specific purpose); that a sum not exceeding £500 be expended on the memorial volume; that, subject to the cost of the two schemes named being met, the balance shall be invested in the names of three trustees to accumulate until sufficient funds are forthcoming to provide a permanent memorial building to the memory of James Watt, which shall serve as a meeting-place and library for technical societies and be a centre from which engineers can co-operate in spreading scientific knowledge.

American Railway Association, Division VI. Purchases and Stores

On account of the financial stress and serious business conditions, the general committee of Division VI, Purchases and Stores, has decided to defer the annual convention which was expected to be held in June at Atlantic City, N. J. A strictly business meeting will be held at the Blackstone, Chicago, Ill., on June 9, 10 and 11, 1921, at which it is announced that the general and standing committees will be in attendance. In addition, the members are requested to have such representatives of their supply departments present as can do so. Committees will present their reports, and a plan will be formulated in regard to the future activities of the division. Arrangements are being made to exhibit a series of motion pictures illustrating reclamation work on the railroads, showing marked progress in economy and efficiency.

American Society of Testing Materials

The annual meeting of the above Society will be held at the New Monterey Hotel, Asbury Park, N. J., from June 20 to 24 inclusive. Monday, June 20, will be devoted to committee meetings. An interesting programme is in course of preparation, and from present indication the meeting will be the largest the Society has ever had. Among other subjects a number of timely papers on iron, steel and non-ferrous metals are scheduled for presentation. Detailed circular may be had from C. L. Warwick, Secretary, 1315 Spruce street, Philadelphia, Pa.

Removal

The Gold Car Heating & Lighting Company announce removal of their offices and warehouses to the Bush Terminal, 220 Thirty-sixth street, Brooklyn, N. Y. The company's new quarters are much more commodious, and the well-known facilities for shipping from the Bush Terminal are of the best, and will enable the company to make prompt shipments.

Requests Canadian Pacific to Run National Railway

Administration and operation of the Canadian National Railway by the Canadian Pacific is proposed in a letter from Lord Shaughnessy, chairman of the latter road, to Premier Meighen, which was made public on April 24. Lord Shaughnessy disclaimed any attempt to create a Canadian Pacific monopoly.

The chairman said that present operations of the roads made a demand of $200,000 a day upon the government without any compensating advantage. His plan, he asserted, would eliminate all danger of political interference, and after payment of fixed charges of the entire system, including dividends of Canadian Pacific preferred stock, a total annual deficit of $51,190,000 would be arrived at. Add to this, he said, the guaranteed dividends of the Canadian Pacific common stock and it would then amount to about $80,000,000.

While he admitted that this would be little improvement on present conditions, he said that if the average operating cost of the combined system could be brought to the Canadian Pacific level it would represent a saving of $56,000,000. The remaining deficit, he declared, could be brought to eleven or twelve millions, and this would gradually be caught up with.

Pig Iron Production

Production of pig iron in the year just closed was about 36,500,000 tons, with the production of steel ingots a little over 40,000,000 tons, which, according to the production of 1919, shows a gain of about 20 per cent. Production in 1920 was light in comparison to capacity, yet it was much greater than in any past years except 1916, 1917 and 1918. In the year 1919 the production of pig iron was 31,015,364 tons, while that of steel ingots was 33,604,795 gross tons. A compilation of figures shows that the production of ingots in 1920 was one-third greater than in any year before the war. Capacity is now about one-half as much again as in 1914, or a little over 52,000,000 gross tons of steel ingots per annum.

Concreting a Railroad Tunnel

It appears that the Canadian Pacific Railway is concreting the five-mile Connaught Tunnel near Glacier, British Columbia. This tunnel is through solid rock and although this material would be supposed to be of the most lasting character, a lining of concrete is being placed against the rock to make assurance doubly sure for a clear and safe roadway for the trains. This difficult work is being done without interference to the operation of traffic. The smoke from the trains is blown out of the tunnel by giant fans set in motion after a train passes, and it only takes a few moments to clear the air the entire length of the tunnel.

Measuring Rail Wear

The *Engineer* states that the old-fashioned method of ascertaining the extent to which a rail has been worn under traffic by taking it out of the road and weighing it, is now superseded by taking a mold of the rail and calculating the weight from a tracing of the cast. The first material used for this purpose was plaster of paris, but this was found to be unsatisfactory owing to its irregular contraction. A British engineer has now introduced the use of plasticine for the making of the mold, and has patented a simple form of nut-cracker apparatus for rapidly taking rail molds in plasticine. The mold is placed with a piece of sensitized paper behind it in a printing frame and the area of the photograph produced is taken out with a planimeter, and the weight of the rail calculated.

Important Railway Supply Companies Change Location

The American Arch Company, Inc., the Superheater Company, the Franklin Railway Supply Company, Inc., the International Pulverized Fuel Corporation, Rome Iron Mills, Incorporated, Lima Locomotive Works, Inc., and the G. M. Basford Company, with offices formerly at 30 Church Street, New York, are now located in the National City Building, 17 East 42d Street, New York City.

Books, Bulletins, Etc.

THE AUTOMATIC VACUUM AIR BRAKE, by Charles L. Gilbanks. Published by the Scottish Mission Industries Co., Ajmeer, India.

This work has met with much popular favor, particularly in India and other countries where large numbers of railway men are interested in the vacuum brake system, chiefly known as Gresham's. Three extensive editions have been published, and the third edition has been carefully revised and improved. The fundamental principles of vacuum brake working are clearly described. The latter part of the book is in the catechism form with answers appended. The drawings of the details are excellent, and the work is altogether very creditable.

REPAIRING OF LOCOMOTIVES, by E. L. Ahrens M.E. Part II, published by the Locomotive Publishing Co., London, England.

The author of this work is one of the best known writers on locomotive engineering in Great Britain, and his contributions to railroad literature are highly esteemed. In condensing his life's work and preparing it for publication in parts he is making a notable contribution to the railroad literature of our time. Much of the work, as may be expected, refers to British locomotive practice, but much also is of real value to locomotive repair men generally. The parts are being finely illustrated and printed in clear letterpress.

Curtis Steam Turbines

Curtis steam turbines of 100-kw. to 3,500-kw. capacity have been developed for driving 60-cycle generators at 3,600 revolutions per minute, according to Bulletin No. 42201B, issued by the General Electric Company. This publication, entitled "Curtis Steam Turbines, 100-kw. to 3,500-kw. Capacity," supersedes Bulletin No. 42201-A. These units are considered well adapted for industrial and lighting plants requiring economical and reliable generation of electric power. As no internal lubrication is necessary, and as the oil is circulated through the bearings in a closed system, the cost of oil is very small. The cost of attendance is also small, and, on account of the simple and strong construction, the cost of repairs is very low. Under maximum working conditions, steam may be extracted from a Curtis turbine for heating and manufacturing purposes. The steam which passes through all stages of the turbine to the condenser is used at the same high efficiency as in a turbine from which no steam is extracted. This bulletin is generously illustrated by photographs of typical installations which have given excellent performance, showing them to be representative of the best turbine practice. An outline of the turbine principle, as well as a detailed description of the construction features, will be found in this instructive publication.

Commerce Commission's Accident Bulletin

In the Interstate Commerce Commission's Accident Bulletin No. 74, covering October, November, and December, 1919, and the year ended December 31, 1919, returns were included which indicated that twenty-two accidents occurred as a result of cast steel wheels breaking, ten being caused by overheating and twelve by other causes. These data were correctly compiled from monthly reports of railway accidents filed in the Bureau of Statistics by various railways throughout the United States, but it has developed that most of the companies manufacturing the wheels in question made cast iron wheels instead of cast steel wheels. Correspondence with the roads rendering the returns resulted in a correction of all the monthly reports affected. It seems proper, therefore, to call attention to these errors and to state that the returns attributed to the breaking of cast steel wheels should be transferred to cast iron wheels.

Baldwin Record No. 100.

The Walschaerts Valve Gear as described and illustrated in the latest Baldwin-Record, No. 100, leaves nothing to be desired in point of construction or adjustment. The series of hypothetical cases covers all that experience has shown likely to occur in the variations in valve opening incident to the assembling of the parts, as well as what may arise after the gear has been sometime in service. If the hypothetical illustrated cases do not exactly tally to a sixty-fourth in every instance, the directions are so clear that any intelligent mechanic may immediately see what part of the gearing should be moved, and with this valuable guide at hand no time need be lost, as so frequently occurs, in idle experiment. The illustrations are of the finest, the instructions are of the clearest, and the printing is of the best. An entirely new feature is what is known as a reproducing model. The operation of this machine, including the drawing of the ellipses, illustrating the movements of the valve, has already been recorded in moving pictures.

Superheaters for Stationary Power Plants

Bulletin No. T-7, issued by the Superheater Company, contains much information that every executive as well as every stationary engineer should know. The saving in fuel, which is the main question, has been proved beyond doubt to run from 10 to 25 per cent, the variation arising from the fact that the more wasteful the plant is the greater will be the saving brought about by the use of superheated steam. Not only so, but it is almost always more economical to install superheaters than to add additional boilers. Conclusive tests have shown that the thermal conductivity of superheated steam is much lower than that of dry saturated steam, and heat is thereby less rapidly transmitted to the pipes, hence radiation and condensation losses are much less than with saturated steam. The benefit in the case of long steam lines is very great. As the length increases condensation troubles multiply. Superheating prevents this. The same saving occurs in the cylinders of all steam engines. Condensation cannot take place until the temperature has been lowered to that of saturated steam. This cannot occur in ordinary steam engine practice, and as steam superheated to 200 or 250 degrees has from 30 to 40 per cent more specific volume than saturated steam of the same pressure, there is thus a double saving effected. Complete details with accompanying illustrations will be found in the Bulletin, copies of which may be had on application to the Company's office, 17 East 42nd street, New York.

Staybolts

The bi-monthly Digest issued by the Flannery Bolt Company, Pittsburgh, Pa., among other matter of interest in regard to new equipment and repairs on boilers, presents further details in regard to what is known as the "F. B. C." welded flexible staybolt, in the use of which a light band of metal deposited by electric arc welding, effectively seals the joint between the sleeve and the sheet, and produces permanent results at a minimum of expense. Each sleeve being provided with a specially designed copper gasket insures freedom from cap leakage. The flush sleeve neatly fills a reamed hole and is sealed with the weld, and is thereby freed from the crushing effect on the threads, the cap being readily removed with an ordinary wrench. This has been proven by very extensive service tests. It should be noted that the accuracy of the threaded sleeve is essential to securing a tight fit, as the bolt and sleeve do not depend on the weld for strength, the weld merely preventing exterior leakage.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV 114 Liberty Street, New York, June, 1921 No. 6

New Record Demonstration of Heavy Tonnage Train Handling

To Illustrate the Practicability of Handling Trains of 16,000 Gross Tons Back of Locomotive Tender on Heavy Grades in Regular Train Service

For a number of years the Virginian Railway has been pre-eminent on account of the tonnage of the coal trains which it has been hauling from the mines of West Virginia to tidewater. The road was built for the express purpose of facilitating such traffic and the requirements put upon the engineers at the outset were that there should be no adverse grades between the summit of the Alleghenies and tidewater of more than .2 per cent, and this also holds between the foot of the hills leading from the mines to the foot of the west slope of the Alleghenies. This makes but one pusher grade, namely from Whitethorne to the summit, a distance of about nine miles. On the other hand, there are two descending grades of 1.5 per cent, running from Princeton to Kellysville, a distance of about 12 miles, and from Merrimac to Fagg, a distance of about nine miles.

The limitations of train length for movements down the two grades has been 85 cars with one engine, but the increase of traffic has made it desirable that the weight of the trains be considerably increased. It is for this purpose that the 120-ton cars described in our issue for May were designed. In order to determine what could be done with cars of this capacity, a demonstration was carried into effect through the co-operation of the Westinghouse Air Brake Company and the Virginian Railway. The handling trains of this size down grades of 1.5 per cent and 8 or 10 miles in length, is naturally one of securing proper braking capacity. Hence, the demonstration consisted of a number of standing tests made with 70 of these cars in the Princeton yards, a run with a train of 100 of these cars loaded between Princeton and Roanoke, a distance of 97.2 miles, followed by a return run of 75 of the cars empty, and a final run from Princeton to Roanoke with 75 loaded cars.

As shown by the profile of the road between Princeton and Roanoke, a grade of 1.5 per cent is encountered down to Kellysville, followed by a lighter grade to New River, then adverse grade up the New River to Whitethorne, then a climb of the west slope of the Alleghenies to Merrimac and down a 1.5 per cent grade to Fagg, and from here a generally descending but undulating grade into Roanoke.

In the standing tests at Princeton the train was doubled so that the head and rear ends were together on adjacent tracks. The train was equipped with the latest design of empty and load brakes of the Westinghouse Air Brake Company, and known as their Double Capacity Brake Equipment. It was upon this brake equipment that dependence was placed for the successful execution of the demonstration.

This equipment consists of three cylinders, one to take up the slack in the foundation brake rigging and the brakeshoe, a second to apply the brakes when in the empty position, and a third which comes into action only when in the load position. It is so designed that it requires a reduction of at least twelve pounds in the brake pipe pressure before the load cylinder commences to function. This is done to provide flexibility in the equipment, so that on light reductions made by the engineman, severe brake power will not be produced on the train; and if heavier brake power is desired, it is only necessary for the engineman to make a heavier reduction. With the equipment as designed, a braking ratio of 40 per cent is obtained on the empty car when operating in empty position, instead of the usual 60 per cent, and 40 per cent on the loaded car, instead of the usual 15 to 20 per cent, when operating in load position. The release of the brake is accomplished in the usual manner, and all three brake cylinders exhaust through the same port down to the final few pounds brake cylinder pressure, which last pressure is dropped out through special vent valves. If the retaining valves on the cars are turned up, the valve of the retaining valve is retained in all three brake cylinders.

HEAVY MALLET TYPE LOCOMOTIVE OF THE VIRGINIAN RAILWAY USED IN HAULING DEMONSTRATION TRAIN.

Standing Tests

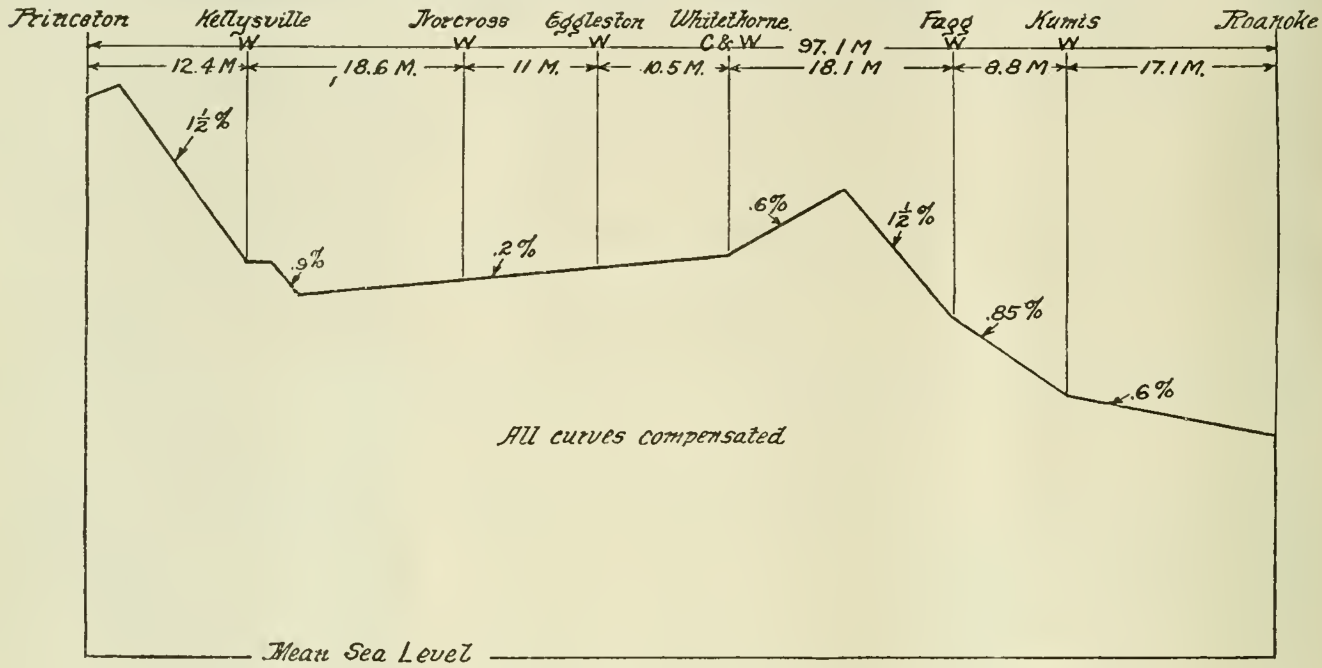
The standing tests were made in the Princeton yards on May 24, with 70 cars arranged as already stated. The length of the jumper between cars number 35 and 36, was 37 feet, so that the total length of the brake pipe for the 70 cars alone, less the branch pipes, was 4,097 feet. The tests were made with a brake pipe pressure of 70 pounds per square inch, and consisted of eight demonstrations, several of which were made at the request of visitors.

To illustrate the speed and certainty of service brake application as it occurs on cars in a train with this type of equipment, and the facility with which the brakes can be applied and released, a ten-pound service application with the brakes in empty position was made. A chronograph, provided with electrical contacts to record the time of serial action in service application from the movement of the brake valve to the start of the brake cylinder piston on the seventieth car indicated 13.9 seconds. A rate of quick service propagation of 294 feet per second. The resultant cylinder pressure on car 1 was 35 pounds, and on car 70, 25 pounds. The time from the movement of brake valve to release on car 70 was 10.5 seconds.

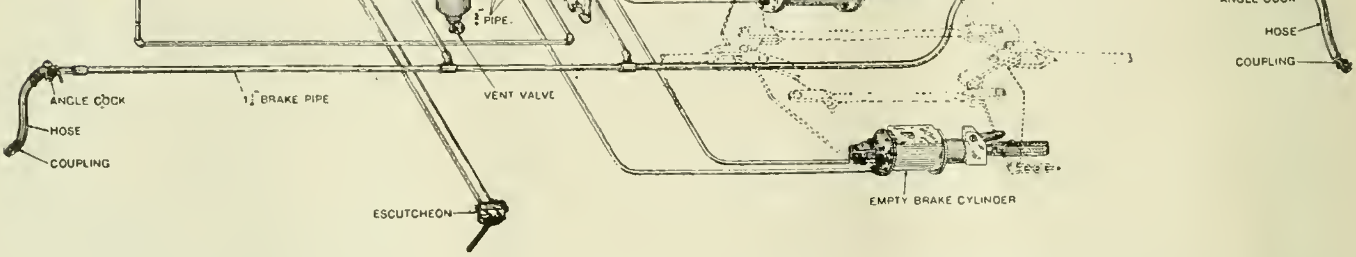
An emergency application was then made. The time from the movement of the brake valve to emergency position to the start of the piston on car 70 was 7.5 seconds. The rate of emergency propagation 547 feet per second, disregarding the length of brake pipe on locomotive and tender, and the 37 feet between cars 35 and 36. The resultant cylinder pressure on car 1, 54 pounds, and on car 70, 51 pounds.

To show the reserve safety factors of the equipment, an emergency after service application was made. The service pressure in car 1, 36 pounds; in car 70, 19 pounds. Service time, 13.8 seconds. Emergency time, brake valve to car 70, 7¾ seconds. Emergency pressure, car 1, 53 pounds; car 70, 50 pounds.

To illustrate the double capacity and air economizing features, cars 1 and 70 were placed in position to secure proper braking effort on loaded cars. A service application demonstrated that the brake cylinders operated in the intended sequence.



PROFILE OF THE DIVISION BETWEEN PRINCETON AND ROANOKE ON THE VIRGINIAN RAILWAY OVER WHICH THE DEMONSTRATIONS WERE MADE.



PIPING DIAGRAM OF THE DOUBLE CAPACITY BRAKE EQUIPMENT.

The time from the movement of the brake valve to start of release on car 70 was 21 seconds.

To demonstrate the protection afforded by the equipment against the possibility of the empty car being braked with the forces required for the loaded car after being set out from the train at a siding or terminal and unloaded, the equipment on cars 1 and 70 were shown to return automatically to empty position when the pressures were between 15 and 10 pounds.

The train was now increased to 100 cars by adding 15 cars to each of the strings on tracks 1 and 2. To demonstrate that brake cylinder leakage in any one or more than one cylinder in the train does not interfere with the proper operation of the balance of the brakes in the train, cocks having No. 8 drill (.199 in. dia.) orifices were opened on five cars adjacent to car 70, preventing the development of brake cylinder pressure on those cars, while normal pressures were developed in the remainder of the cylinders. A service application of 10 pounds, followed in 15 seconds by a second similar application, was made. That the brake cylinder leakage did not influence the pressure in the brake pipe is evidenced by the fact that the brake pipe leakage was found to be five pounds in two minutes from 61 pounds, the pressure to which the brake pipe had been reduced by the service application.

A special demonstration, brake pipe leakage corresponding to brake cylinder leakage established step by step on cars in the region of car 70 was as follows:

No. Orifices (No. 8 Drill) Open	Brake Pipe Pressure Car 1	Brake Pipe Pressure Car 100	Brake Cylinder Pressure Car 100
None	69	66*	
1	69	60	†
2	66	47	46
3	65	41	46
4	64	30	45

*Press of time prevented waiting for complete recharge of train.

†Not observed.

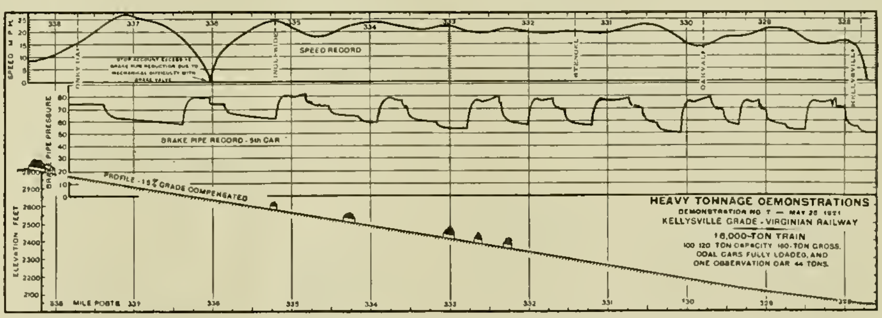
The value of a No. 8 drill orifice is 48 cu. ft. of free air per minute from 70 pounds.

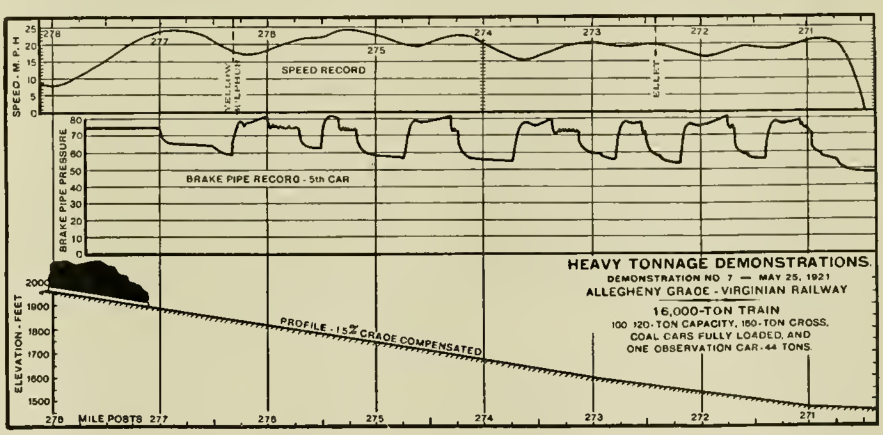
In a special demonstration of the quick action time on a 100-car train, the time from the movement of the brake valve handle to piston start on car 100 was 10.7 seconds. The total length of the brake pipe, less branch pipes and engine and tender was 5,837 feet. The rate of emergency propagation, 545 feet per second, disregarding the length of the brake pipe and no compensation for 37 ft. connection between cars 50 and 51.

120-TON CAR ON THE VIRGINIAN RAILROAD

Running Tests

The first running test was made on May 25 with 100 loaded cars of 120 ton capacity, and another car of the same type, but empty, was added at the rear end of the train, and was used for observational purposes only. The following is the general data of the weight of the train and the results indicated by the run:





Average weight per car loaded 318,800 lbs., or 159.4 tons; average weight per car empty, 79,000 lbs., or 39.5 tons; average weight of lading per car 239,800 lbs., or 120 tons; weight of engine and tender, 898,300 lbs., or 449 tons; weight of observation car, 87,100 lbs., or 44 tons; actual weight of 100 loads, 31,285,800 lbs., or 15,643 tons; weight of 100-car train behind tender, 31,372,900 lbs., or 15,686.5 tons; total weight of 100-car train, 32,271,200 lbs., or 16,136 tons; length of cars over buffer blocks, 51 ft. 5 in.; length of 1¼-in. standard brake pipe per car, angle cock to angle cock, 52 ft. 4 in.; brake pipe length from back of angle cock to hose coupling center (two) 5 ft. 8 in.; total length of brake pipe per car. 58 ft. 0 in.; length of branch pipe (1¼ in. standard) per car 4 ft. 3 in. 10 lb. pressure retaining valves used throughout train. With the locomotives, observation car and cabooses the train was over a mile and an eighth in length.

An interesting feature of the train was the locomotive by which it was hauled. It is well known that the Virginian has the heaviest locomotives in the world. A

Mallet type locomotive of the 2-10-10-2 wheel arrangement, fired by the Duplex Stoker, was used in handling the train down the grades. The total weight of the engine, including tender in working order, is 898,300 lbs. When working simple it exerts a tractive force of 176,000 lbs., and when compound 147,200 lbs. There are ten of these engines in use on the road. They are used for service on the heavy grades between Elmore and Clark's Gap, where there is an adverse grade of 2.7 per cent.

In descending the 1.5 per cent grades between the summit and Kellysville and Merrimac and Fagg, it may be stated that the wheel temperatures were uniform throughout the train, being somewhat higher at the head end than at the rear, but the wheels were not unduly warm at any point. A total absence of slack action was noted throughout the train. This was due in large measure to the brakes being purposely more active at the head end than the rear, keeping the slack together at all times. The speed down grade ranged from 20 to 24 miles per hour, except for a reduction to 16 m.p.h. when approaching Kellysville yard. Just after tipping the summit of Kellysville grade a heavier reduction than intended was made and the train was brought to a stop. After waiting twenty-two minutes the pusher engine came up to assist in starting the train. In attempting to start, the head engine broke a knuckle at the rear of the tender and an emergency brake action resulted. After this emergency brake action the train was held on the grade for 28 minutes without recourse to hand brakes before the descent was resumed.

It was noted that the seventeenth car from the head end leaked off rapidly after this emergency brake action. No measure of the brake cylinder leakage on this car was taken, but it might have been anything up to the capacity of the air compressors on the locomotive. Assuming this to be the case, however, the brake action on the remainder of the train and the margin of safety would not have been affected thereby. This occurrence served as a concrete illustration of the point emphasized in the standing demonstrations, and the Westinghouse Air Brake Company's claim that any direct communication between the main reservoir and the brake cylinders is dangerous as well as impracticable in general service.

The train performance down the Allegheny grade from Merrimac to Fagg was a duplicate of the run down the Kellysville grade in the way of total freedom from shocks, speed range and wheel temperatures.

A brake pipe pressure of 75 lbs. was used. The first demonstration that was made with this running train of 16,000 tons was on the heavy grade between Princeton and Kellysville, a distance of 9.6 miles. This was followed by a similar demonstration between Merrimac and Fagg, a distance of 8.8 miles.

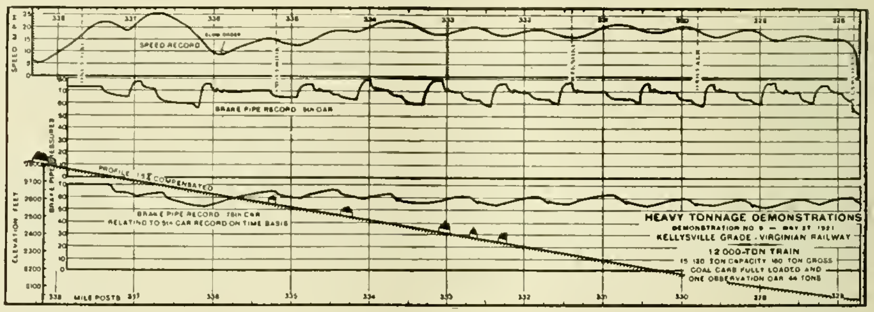
On May 26, a return trip from Roanoke to Princeton was made with a train of 75 empty 120-ton capacity cars and observation car, equipped with double capacity brakes in empty position. The total weight of train, exclusive of locomotive and tender and caboose, 6,012,100 pounds, or 3,006 tons.

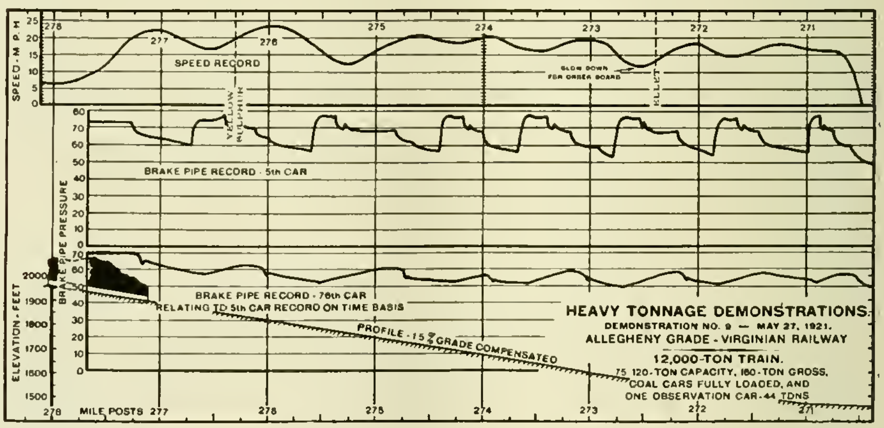
The purpose of this run was to demonstrate that with the much lower braking force on the empty cars, permissible with the use of the double capacity brake, a very considerable reduction is made in the intensity of the shocks following heavy service or full emergency applications with trains composed wholly of empty cars, and contributes materially to the elimination of shocks in mixed trains of loaded and empty cars.

having the train stretched and in the most critical condition for severe slack action.

The final demonstration was made on May 27, and consisted of a run from Princeton to Roanoke with 75 loaded cars and the observation car. The weight of the 76-car train behind the tender, 12,070 tons. Total weight of the train, 12,519 tons. A brake pipe pressure of 75 pounds was used.

Five cars in the train (15th, 30th, 45th, 60th and 74th) had open drain cocks in the cylinders, and as a result the wheels on these cars were cold. The wheel temperatures on the remainder of the train were uniform, none being unduly high. The temperatures of the wheels at the head end were somewhat higher than on those at the rear, due to the intentionally greater brake activity on the leading cars. As for slack action, the train handled as



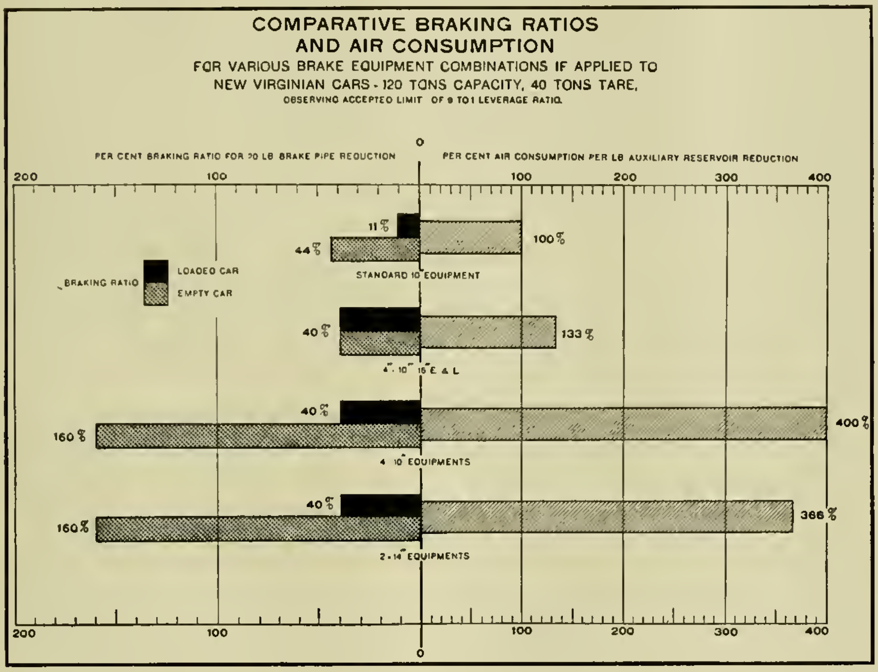


A stop was made about two miles west of Salem from an approximate speed of 20 m.p.h., using a single continuous brake pipe reduction of 15 lbs. The train was brought to a stop without shock, the slack closing in mildly at the rear end. Other service stops made at Fagg and Whitethorne, while observers were riding the rear end, were made also without shock. Between Eggleston and Pembroke stations an emergency stop was made from a speed of about 20 m.p.h. The resultant run-in of slack at the rear end was not sharp enough to be termed a shock. It was severe enough to interfere only mildly with the equilibrium of a man standing and unprepared for the occasion. In making this stop the engineer closed the throttle and immediately placed the brake valve in emergency position, thereby smoothly as a passenger train. The speed fluctuations did not exceed 5 m.p.h. for any brake cycle except on the observance of a 10 m.p.h. slow order at one point a short distance east of the summit.

Just east of Rich Creek station, on a .9 per cent descending grade, an emergency stop was made from a speed of about 27 m.p.h. As measured by rail lengths, the stop distance was 760 feet. The slack conditions and the run-in were even milder than those of the preceding day's test.

With a view to making this test under more critical conditions, a repeat was made just east of McCoy station on an ascending grade of .2 per cent. The speed was approximately 13 m.p.h., and the stop distance, according to rail lengths, 230 feet. The slack run-in at the rear end came just at the stop, and while more noticeable than in the first test, was very mild, being insufficient to move a camera in a leather case acting as an improvised slidometer on a planed board bench. The train was handled between Merrimac and Fagg with the same uniform control as on Kellysville grade, only light brake applications being used. Including a slow order, the total variation of speed was kept between a minimum of 13 m.p.h. and a maximum of 25 m.p.h.

The train arrived at Roanoke at 3.10 P. M., a total of 8½ hours elapsed time, showing the possibility of handling a 12,000-ton train in regular traffic in reasonably close to an eight-hour period.



COMPARATIVE BRAKING RATIOS AND AIR CONSUMPTION FOR VARIOUS BRAKE EQUIPMENT COMBINATIONS IF APPLIED TO NEW VIRGINIAN CARS - 120 TONS CAPACITY, 40 TONS TARE, OBSERVING ACCEPTED LIMIT OF 9 TO 1 LEVERAGE RATIO.

The 100-car train of 16,000 tons is the heaviest train that has been ever handled down a similar grade with a single engine. The train was sent unbroken through to Sewell's Point, but data in regard to this run was not taken and is not available. The train left Roanoke the morning after its arrival, and reached Sewell's Point about 36 hours after starting from Roanoke. It should be added that the train length was increased to 110 cars at Victoria for the final run to Sewell's Point, a distance of about 120 miles, so that the final run was made with the train having a weight of about 17,600 tons. The Virginian Railway bears the undisputed distinction of handling by far the heaviest tonnage trains in the history of railroading.

Mr. C. W. Huntington, President, and Mr. C. H. Hix, Vice-President, displayed the greatest courage and foresight in carrying to completion the original conception which the late Mr. H. H. Rogers had as to the possibility of the development of the railway, and the purchase of these 120 ton capacity cars in view of the market conditions then existing was an indication of the fortitude required for the successful development of such a property under the circumstances. The results of the demonstrations have undoubtedly served to illustrate the wisdom of their course.

The equipment was ordered on the assurance of the Westinghouse engineers that the double capacity brake would meet the requirements of the heaviest car that any railroad could conveniently handle from the standpoint of motive power.

The demonstration brought together about 200 men representing 36 of the leading railroads and 22 supply houses from all over the United States and Canada, as well as representatives of the Interstate Commerce Commission, and the railway press.

The party assembled at Roanoke, Virginia, on Tuesday, May 24, to take a special Pullman train, with diner, and which served as living quarters during the four days demonstration.

Mr. W. S. Bartholomew, Vice-President of the Westinghouse Air Brake Company, was in active charge of the arrangement of that company, while the elaborate plans of the Virginian Railway were carried out under the direction of Mr. C. H. Hix, Vice-President and General Manager; Mr. W. A. Gore, Superintendent at Princeton, aud J. W. Sasser, Superintendent of motive power.

We will publish a more detailed description of the double capacity brake equipment in an early issue of RAILWAY AND LOCOMOTIVE ENGINEERING.

The most important and, perhaps, the most lasting impression gathered from the demonstrations was the apparent ease with which the operations were conducted in transporting commodity traffic of a low grade kind in such magnitude of bulk over such insuperable natural difficulties. In these days of sharp economies, it is surely an example of high courage in procuring equipment of such capacity, involving enormous costs, and subjecting the outlay to the result of processes already adopted previous to trial, and crowned as it is with triumph, it is only another proof that in the atmosphere of American enterprise, there is no limit to possibilities. The constructors seemed to have vied with each other in meeting the requirements of the situation, and the result is a marked advance in bulk of delivery of material, saving in time, and safety and reliability in operation, to all of which the various manufacturers of railroad equipment and appliances have contributed their best, and marks a special advance in the railroad operation of our time.

Exports of Steam Locomotives from United States in 1920.

[Prepared by the Division of Statistics, Bureau of Foreign and Domestic Commerce]

Our exports of steam locomotives increased from 491 in number, valued at $4,475,429, in 1913, the last pre-war year, to 959, valued at $30,275,728, in 1919, the first peace year, and to 1,711 in number, with a value of $53,629,847, in 1920. Over one-half of last year's value, or $27,376,079 for 721 engines, was sold to European countries, mostly to Belgium, Poland, France and Italy. Outside of Europe our best customers were Cuba, Brazil, China and British Africa.

The details by countries in 1920 are shown in the following table:

Countries	Number	Value
Azores and Madeira Islands	3	$75,300
Belgium	155	8,764,188
Denmark	16	619,680
France	162	3,859,417
Italy	175	4,184,947
Poland and Danzig	139	6,548,050
Rumania	25	1,625,000
Spain	45	1,680,505
Sweden	1	18,992
Canada	78	786,108
Honduras	7	21,281
Nicaragua	1	7,400
Panama	5	8,541
Salvador	4	84,875
Mexico	65	866,054
Newfoundland and Labrador	2	39,735
Jamaica	7	191,010
Trinidad and Tobago	6	98,646
Other British West Indies	1	5,785
Cuba	288	8,369,082
Dutch West Indies	1	3,114
French West Indies	2	11,130
Dominican Republic	8	99,340
Argentina	33	1,131,070
Bolivia	1	21,410
Brazil	147	4,277,713
Chile	24	445,669
Colombia	18	417,081
Ecuador	3	98,025
British Guiana	1	22,700
Peru	13	199,291
Venezuela	2	24,465
China	86	3,370,510
Kwantung	11	478,435
Chosen	4	118,900
British India	15	363,921
Dutch East Indies	23	682,996
Japan	26	234,149
Australia	2	82,600
New Zealand	2	22,450
Philippine Islands	30	298,959
British West Africa	2	53,662
British South Africa	33	1,811,740
French Africa	10	368,000
Portuguese Africa	4	83,200
Egypt	25	1,054,721
Total	1,711	$53,629,847

Labor Board Submits Reasons for Its Decisions

Railroad Representatives and Employees Continue the Discussion. Sensational Enquiry Into the Railroad Situation

As previously announced, the United States Railroad Labor Board, after prolonged sessions lasting over two months, and the consideration of voluminous evidence, rendered a decision on June 1 affecting the wages of various classes of employes on 104 railroads. The decision involves a reduction in the scale of wages averaging 12 per cent, and is calculated on estimates of the present cost of operation to effect a saving of about $400,000,000 a year. The reduction will go into effect on July 1, 1921. It is on this date also that the national working agreements will be abrogated.

It is noted that men classed as engine service employes will be reduced more than those engaged in other departments of railroad service. Freight engineers, motormen, firemen and helpers, will be reduced 64 cents per day; passenger engineers and firemen 48 cents. The board's decision sets up new scales for all groups of employes, from track repairers to engineers and conductors. The board continues its sessions, hearing evidence affecting the other roads, whose complaints are already filed, and it is expected that the reduction will be generally the same as that already announced in regard to the 104 roads primarily affected. Of these there are over 100, and the same schedules will likely be applied to them.

The reduced costs of living and reductions in other industries were the main factors on which the wage reductions were based by the board. The decision as published points out that the adjustment period has produced conditions in whose burden all have to share.

In a supplemental memorandum, the board points out that during government control the wages of railway employes were increased from an average of $78 a month in December, 1917, to $116 in January, 1920, or about 20 per cent. The board's decision last year, effective May 1, 1920, increased wages 22 per cent, or to an average of $141 a month. After this increase the workers, according to the findings, were receiving an average increase of 81 per cent more than they were getting before Federal control and about 10 per cent of the number, chiefly the lower paid unskilled workers, had received increases in excess of 100 per cent. The board estimates that the cuts of 12 per cent would "mean an average monthly wage of about $125 for all employes, but such an average means, of course, that while some workers would earn a sum considerably in excess of this, many thousands would fall far short of that figure."

In its decision the board sets forth some of the conclusions on which it acted, as follows:

"It finds that since the rendition of its decision No. 2 (last year's wage increase) there has been a decrease in the cost of living. What that decrease has been it is impossible to state with mathematical accuracy, or even what the general average for the United States has been up to and on any given date. The machinery for procuring and stating with accuracy the date to fix this is by no means perfect. The decreases vary greatly according to the locality, and affect different persons in different degrees. In the cities the general decreases in some lines have been offset to some extent by the high rents. In some of the items in the cost of living the fall in prices has been great, in others much less.

"In a decision of this character it is not practical to fix rates applying with exact ratio to each individual employe and each separate locality, for the reason that necessity compels the board to accept certain standardizations of pay for railroad employees. But these standards are now somewhat different in different regions, and so the decreases will have relatively the same general effect.

"There are certain facts and conditions known to all and which can neither be disputed nor ignored. Whatever may be said as to the origin or contributing causes there has been and is a marked and to some extent distressing and disastrous depression in business and industry affecting the entire country and some lines of production most seriously. As a result, heavy financial losses have been suffered and many hundreds of thousands thrown out of employment and deprived of all wages, and this loss of purchasing power by them has in turn accelerated the general depression by reducing the demand for the products they would otherwise have purchased.

"While it has been argued that the fall in prices has not reached to any large extent the consumer it has without question most disastrously reached and affected the producers, especially some lines of manufacture and the agricultural classes. It should be recognized by all that the problem before us is chiefly an economic one, and we are all confronted by adverse and troublesome conditions which every one must help to solve."

As might have been expected, the action of the Labor Board in rendering its decision did not call forth immediate expressions of opinion by the interested parties. Large bodies move slowly. Conferences among the executives, and meetings among delegates representing the employees were necessary to obtain some concrete opinion, and after a week of quiet consideration the situation broke into new activities in three widely separated official bodies.

On June 6, representatives of 150 railroads declared before the Railroad Labor Board here their determination not to rest on the 12 per cent wage reduction in certain classes of railway labor, but to stand squarely on their request for a cut which would wipe out the entire $600,000,000 increase granted last year.

A referendum vote was begun by 250,000 maintenance of way employes and members of the six shop crafts brotherhoods on whether or not the men would accept wage reduction orders issued on ninety-three railroads last week by the Railroad Labor Board. The results will be made known late this month. The wage reductions are scheduled to go into effect July 1.

Over the objection of W. S. Carter, head of the enginemen and firemen, John G. Walber, representing the Eastern railroads, asked for substitution of pro rata payment instead of time and one-half pay, the present rate, for overtime in freight and yard service. Carter declared such a proposition was a matter of rules rather than wages, and had no place in the present hearing. Walber, however, insisted that time and one-half was "injected into the wage schedules as a pay increase measure" and the railroads felt that it should receive attention now.

"The standardization of wages for all classes of railroad employes which disregard local conditions is a serious violation of economic laws," Walber continued. "Continuation of such a policy would be in violation of the transportation act. In any circumstances the largest area to be considered by the Labor Board in determining wage scales should be the rate regions as established by the Interstate Commerce Commission."

Walber presented brief statements on behalf of the Ann Arbor, Bangor & Aroostook, Baltimore & Ohio, Boston & Albany, Buffalo & Susquehanna, Central of New Jersey and the Bessemer & Lake Erie, Buffalo, Rochester & Pittsburgh and Central of Vermont, which asked that the wage increases granted by the board in July, 1920, be wiped out and that overtime in many classes be paid on a prorata basis.

Harry Smith, chairman of the Pullman system federation, announced that a strike ballot now being taken probably would result in a tie-up of the sleeping car service. The St. Louis shop workers are already out, he said, and the enormous shops at the south end of Chicago may be closed.

"The strike ballot was ordered," said Smith, "because the Pullman Company would not obey the decision of the Railroad Labor Board, which ordered the company and the employes to confer with a view to an agreement on rules and working conditions to take the place of the national agreement. The company simply refused to engage in such a conference. That leaves us nothing to do but strike."

Smith, in his statement, accused the railroad wage board of holding up its decisions until the company could smash its labor organizations.

"The Pullman Company has laid off 65 per cent of its mechanical employes since January 1," he said. "Cars are rotting in the shop for want of repairmen. Every time a Pullman car returns from a trip it must be repaired. The result of neglect is accidents."

The projected strike will affect locksmiths, machinists, sheet metal workers, electric men, car men, helpers, apprentices and car cleaners in some eighty shops throughout the country, according to Mr. Smith.

American Society for Testing Materials

The twenty-fourth annual meeting of the above Society will be held at Asbury Park, N. J. June 20-24, 1921. The headquarters will be at the Monterey Hotel. Provisional programmes furnished by C. L. Warwick, secretary-treasurer, 1135 Spruce street, Philadelphia, Pa.

Senatorial Inquiry Into the Railroad Situation

Last month at the Capitol at Washington the Senate Committee on Interstate Commerce began an enquiry into the present railroad situation with a view to developing the following matters:

First. The operating revenues and expenses of the railroads of the country which under the law make reports to the Interstate Commerce Commission, comparing these revenues and expenses with like revenues and expenses (including the period of Federal control) since 1921.

Second. The reasons which led to the extraordinary cost of maintenance and operation from March 1, 1920, to March 1, 1921.

Third. The reasons which induced the diminished volume of traffic in the latter part of the year 1920 and the first two months of 1921, and in that connection the influence of the increased freight and passenger rates prevailing during that period.

Fourth. The efficiency or inefficiency of railroad management during Federal control, during the year beginning March 1, 1920, and the efficiency or inefficiency of labor employed by the management during the same periods.

Fifth. The best means of bringing about a condition that will warrant the Interstate Commerce Commission in reducing freight and passenger rates.

Senator Albert B. Cummins, Iowa, chairman of the committee, is presiding over the meetings. After a short statement, in which he presented some operating statistics of the railroads for the last four years, Mr. Cummins called as witnesses the railroad executives.

The witnesses who have testified this far are: Mr. Julius Kruttschnitt, chairman of the executive committee of the board of directors of the Southern Pacific; Mr. Daniel Willard, president of the Baltimore & Ohio; Mr. A. H. Smith, president of the New York Central; Mr. Howard Elliott, chairman of the board of the Northern Pacific.

These executives, and others who will follow, presented evidence to the Committee on the causes and remedies for the present situation of the railroads in their operation prior to and under the Transportation Act.

It should be noted, however, that while the results of the Senatorial enquiry will be awaited with interest, it will not in any way interfere with the work of the United States Labor Board. As has been clearly stated, the Labor Board has been empowered to take up and settle disputes about wages, and about rules, if a dispute about rules threatens strikes. It is a tribunal set up by Congress for the purpose of handling any labor disputes, and prompt action is very necessary. It is generally conceded that the hands of the Labor Board should not be tied by a mandatory law, and coincidentally the railroad managements and the representatives of the railroad men should meet together and make a reasonable effort to settle their differences, and it is likely that the rates of pay and working conditions could be amicably agreed upon, and if not, a review by the Labor Board would likely adjust any outstanding difficulties that might arise.

Vitalizing Locomotives

An Array of Proofs That a Combination of Devices Will Increase the Power of a Locomotive From 27 to 80 Per Cent

By GEORGE M. BASFORD

Mr. George M. Basford has been an ardent advocate for the improvement of locomotive practice by the addition of whatever makes for economy of operation, and in a paper on "Vitalizing Locomotives," read before the New York Railroad Club on the evening of May 20, he presented the arguments for his belief. The basis of his argument rested upon an elaborate series of tests made by Mr. Harry Linton, of the Lima Locomotive Works, and the diagrams that he presented makes a strong case for the several improvements, the adoption of which he advocates. The special things which are brought to the front in the paper are the brick arch, the superheater, the feed-water heater and the booster.

He presented a series of diagrams showing the effect of each of these, when taken alone, in comparison with an engine using saturated steam, and then a composite diagram, which is here reproduced, showing the combined effect of all four.

These curves show a practicable method of increasing the capacity of a plain saturated steam locomotive from 27 to nearly 80 per cent by applying to the locomotive four vitalizing factors, the combined weight of which does not exceed 18,000 pounds. This increase in capacity is obtained with no increase in coal consumption, simply by utilizing more of the heat units in the fuel. The figures given have been substantiated by tests or in every-day operation of an actual modern locomotive.

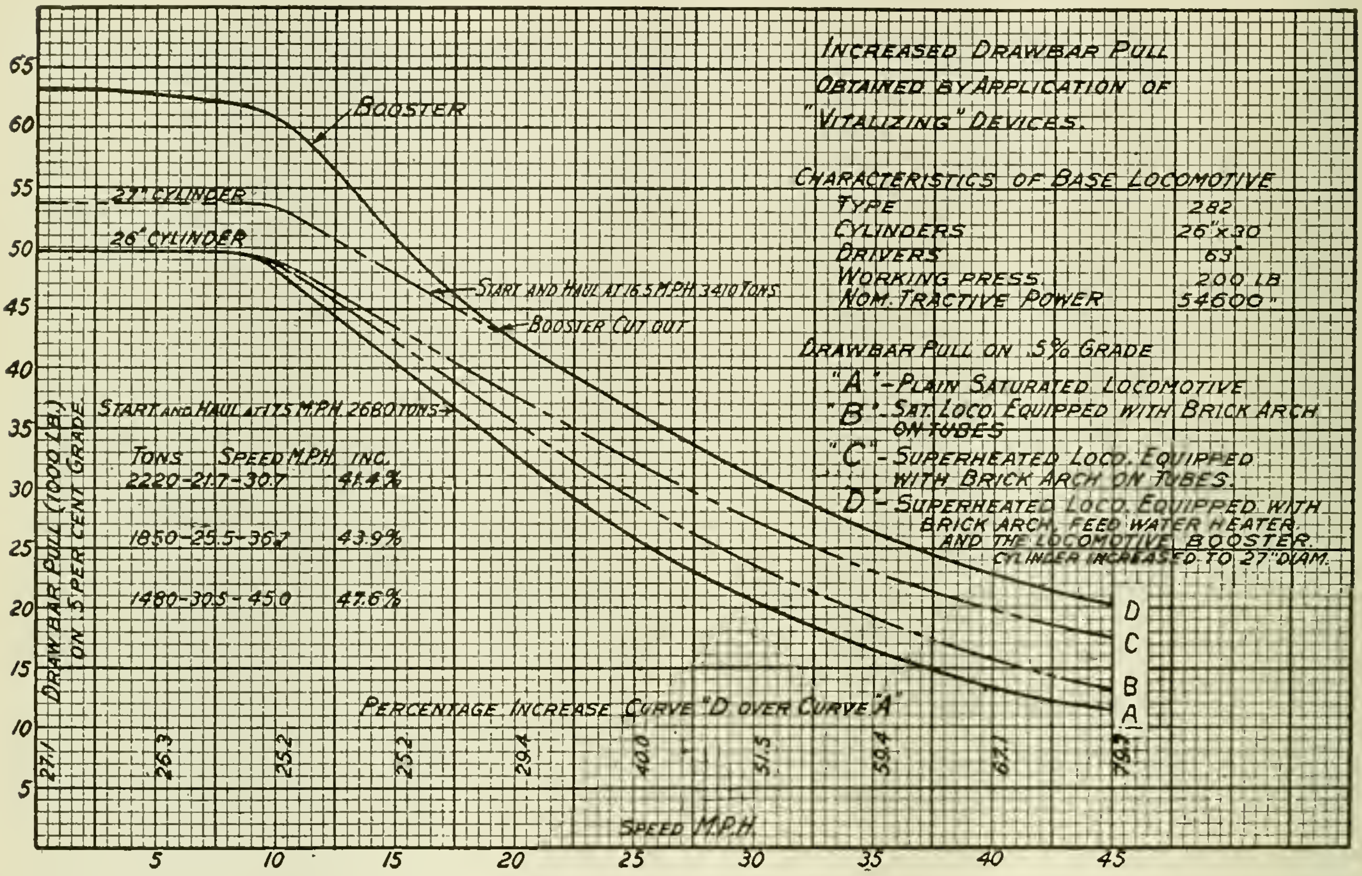
Curve A represents the drawbar pull on 0.5 per cent grade obtainable from a plain saturated locomotive having the principal characteristics of the U. S. R. A. class 2-8-2 A, but without any of the capacity increasing devices.

Curve B shows the result achieved through the application of the fire brick arch on tubes.

Curve C shows the improvement brought about through the addition of a brick arch and a high temperature superheater.

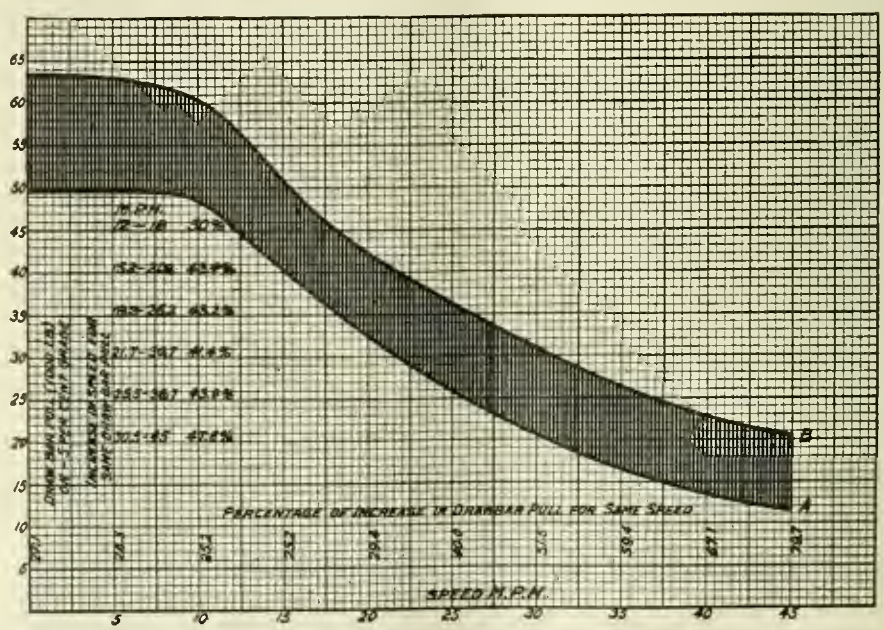
Curve D shows the final result achieved through the application of fire brick arch, a high temperature superheater, feed water heater and the locomotive booster.

The brick arch and superheater may be applied to the plain engine without increasing the size of the cylinders, although a better result is obtained if the cylinders are enlarged. When the feed water heater is added the possible economy at relatively low speed can only be obtained with an enlarged cylinder. Curve D is based on an increase of one inch in diameter of the cylinder.



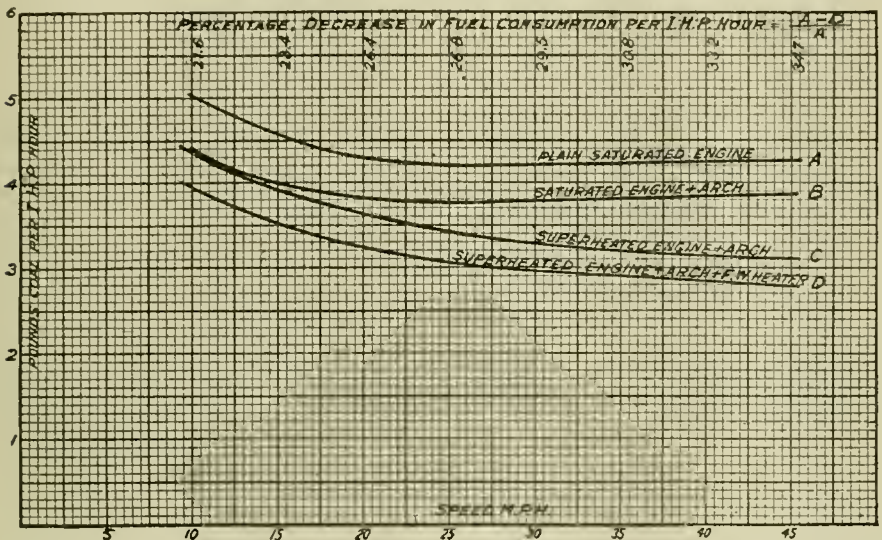
With a combination of all the factors the total increase in capacity is greater than the sum of that obtained from the separate devices. An examination of the sources of the economies will show that this is to be expected. The fire brick arch increases the evaporation and power output by the economical consumption of the fuel; its field of operation is in the firebox only. On the other hand, the superheater utilizes this increased evaporation by the prevention of cylinder condensation and by increasing the volume of the steam at working pressure. The feed water heater utilizes the heat in the exhaust steam, which otherwise would be wasted, and the booster utilizes the potential energy of the boiler at a time when the locomotive cylinders cannot develop the full boiler output, that is at starting and at a comparatively slow speed. It will be seen, therefore, that the economy of the feed water heater is based not on the saturated engine, but on the increased volume of steam produced by the arch and the augmented temperature of the steam, which is the product of superheating. Below a speed of 25 miles per hour, the increased capacity shown by Curve D is not all attributable to the feed water heater, but is due to the greater potential capacity of the boiler, which can only be utilized when a larger cylinder is applied.

Then from this curve there were obtained two others: One showing the combination of drawbar pull and speed converted into terms of drawbar horsepower, and shows the increase in horsepower obtainable by a combination of the capacity increasing factors. The second is a further development showing the pounds of coal used per indicated horsepower hour at a wide range of speeds. It illustrates the relative coal consumption per horsepower hour of a plain saturated locomotive and the same engine equipped with available power increasing factors.



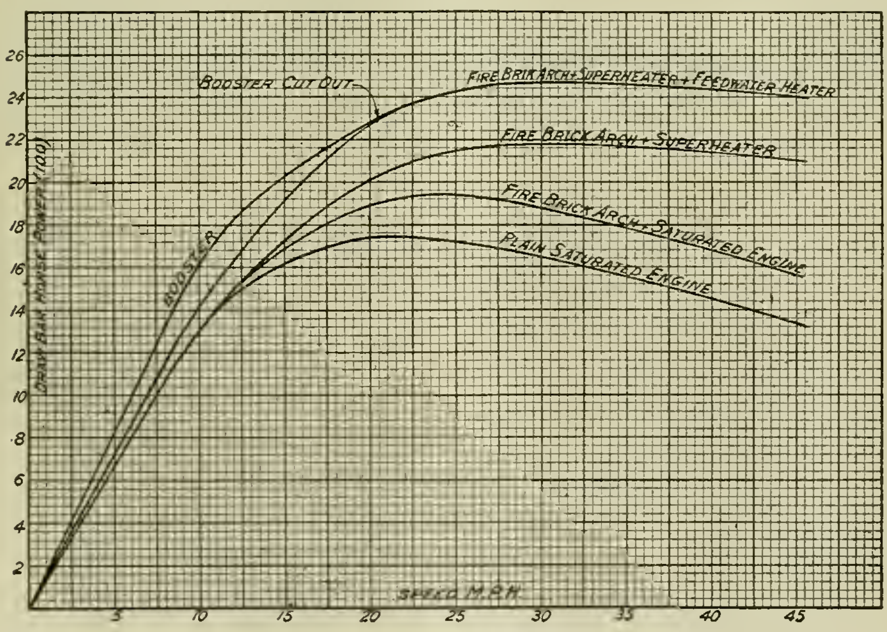
It should be borne in mind that the fuel rates shown are those which would obtain when the locomotive is delivering its rated power, and burning fuel at the rate of from 120 to 130 pounds per square foot of grate per hour. Better fuel rates have been obtained on testing plants where the fuel consumption per square foot of grate area per hour was low.

These curves are based on the locomotive consuming the same weight of fuel per hour under all conditions of equipment and illustrates the fact that the greatest conservation of fuel can only be obtained when advantage is taken of capacity increasing factors which derive their power from a more efficient utilization of the heat units in the fuel. These curves represent the same engine the United States Railway Administration light 2-8-2



type which formed the basis of the other curves.

The paper also touched upon the advantages to be derived from the use of high quality steel for the reciprocating parts and showed that if applied to the reciprocating parts of a U. S. Railway Administration Mikado locomotive, it was possessed of interesting possibilities. He took a light and heavy Administration Mikado, both of which were actually built with reciprocating parts of open hearth steel. The results in rail pressures which would be obtained if the heavy Adminis-



tration engine had been built with high quality steel reciprocating parts of light weight are shown, while the light Mikado puts less stress upon the track up to 40 miles per hour, the conditions are reversed when 45 miles per hour is reached. In other words, at all speeds where the engines are likely to damage the track the heavy Mikados with light parts are safer engines than the light Mikados with heavy parts. In this comparison, it should be borne in mind that the heavy Mikado has 10 per cent more tractive power than the light one and 14 per cent more heating surface. The total weight of the heavy Mikado is 9.5 per cent greater than the light one and has from 10 per cent to 15 per cent greater capacity. It should be self-evident as to which should be chosen for efficient service.

Liquid Coal

The news comes from Germany that the chemists of the country have at last solved the problem of liquifying coal and that a commercial application of the process is about to be made. Two plants have been placed at the disposal of the chemists and they are said to be already working to repeat in the factories what they have achieved in the laboratory.

There are two methods by which this liquification is accomplished. One of them is that already employed in the making of dyestuffs, to convert coal to a gas, mix it with other gases, pass it over certain metals and finally condense it into all possible components. This method is being improved by bringing on condensation with electrical charges and with violet rays. The other method is to convert coal to a fluid, and with the latest method a tar is obtainable which has the glow of Burgundy wine.

The liquification of coal is not a new idea, but has been the dream of chemists for many years. A Frenchman, Berthelot, first liquefied coal almost seventy years ago. He treated it with chemicals and melted it in sealed glass tubes at 275 degrees centigrade. It became crude oil with 40 per cent waste. A Russian, Ipatieff, improved the process by using rare metals, like nickel and platinum, and employing gas instead of chemicals, and by having the process work under a pressure of 200 atmospheres.

In 1919 a German, Prof. Bergius, patented a process for liquefying bituminous coal, lignite, peat and even wood. He succeeded in producing a thin fluid with almost no waste, a fluid which can be refined to petroleum of any desired grade. The process requires a temperature of 400 degrees centigrade and is not expensive.

If such a process can be developed so as to be a commercial possibility and success, its value to the industrial world would be beyond estimate.

Latvian Rolling Stock

The rolling stock of the Latvian railways now consists of about 200 locomotives and something over 3,000 freight cars, which are reported in working order. At the present time wood is used almost exclusively for fuel on the locomotives; but the rapidly increasing cost of the wood is forcing the government railway authorities to consider the purchase of coal for transportation purposes. The Latvian peace treaty with Soviet Russia stipulated that the latter was to deliver 110 locomotives to the Latvian government; thus far 40 have been forthcoming.

Electric Service Supply Company

The Electric Service Supplies Company, Philadelphia, will act as exclusive selling agent for the Peerless Equipment Company of Hanover, Pa., manufacturers of Peerless Armature Repair Machinery and Segur Coil Winding Tools. Heretofore Peerless Armature Tools were manufactured by the Manley Manufacturing Company, York, Pa., and Segur Coil Winding Tools were manufactured by the Electrical Manufacturers Equipment Company, whose headquarters are in Chicago.

Development of Coal Cars on the Norfolk & Western

Details of Construction of the 100-Ton Coal Car

For a number of years the mechanical department of the Norfolk & Western Ry. and the builders have been engaged in the development of the coal car for the traffic between the mines of West Virginia and the tidewater wharves at Lambert's Point near Norfolk. In this development the car has passed through the several stages from the all-wooden structure, the composite, all-steel and, in the latter, has risen steadily in capacity until the latest design is that of a car of 200,000 lbs. capacity, carried on six-wheeled trucks of special design.

In this development the proportion of paying to dead load has risen with the capacity, until the car under consideration, has an empty weight of but 53,500 lbs., or a little more than 21 per cent of the weight of the car when loaded to its stenciled capacity; while, if loaded with the permissible 10 per cent overload, this percentage drops to about 19.5 per cent. This is, we believe, the lowest percentage of empty to loaded car weight that has thus far been obtained.

The general dimensions of the car are as follows: Length over striking plates, 43 ft. 9 in.; coupled length, 46 ft. 2 in.; center to center of trucks, 31 ft. 8 in.; truck wheel base, 8 ft. 6 in.; height of top of car side from rail, 11 ft.; height of center of gravity, loaded with 200,000 lbs. of coal, 6 ft. 9 in.; inside length, 42 ft. 7 in.; inside width, 9 ft. 6 in.; cubical capacity level full, 3,122.5 cu. ft.; cubical capacity with 30° heap, 3,636 cu. ft.; nominal capacity, 200,000 lbs.; weight of empty car, 53,500 lbs.; weight per foot of coupled length, 5,491 lbs.; weight of one truck, 12,240 lbs.

The calculated weight of the coal in the above dimensions is based on a density giving 55 lbs. per cu. ft.

The car has a very symmetrical appearance and, when in a train, has a smoothness of running that is very unusual in freight car construction. The general appearance of the car is well presented by the accompanying illustration of the side view. The line engraving illustrates the construction of the body in detail. The center sills are formed of 12-in. channels which extend to points just outside the bolsters as will be discussed later. The bolsters are built into and form an essential portion of the body of the car, and are formed of a pressed steel arch extending across the car and riveted to the side-sheets at each end and stiffened at the top by two 2½ in. by 2½ in. by ¼ in. angles. The ends of the arch are fastened to the sides by 3 in. by 2½ in. by 5/16 in. angles. This bolster has sufficient stiffness to carry the loaded car if it is desired to raise it either by jacks or hooks from an overhead crane, with or without the trucks. Spaced at intervals of 7 ft. 11 in. between the bolsters there are three cross ties formed of 4 in. by 3½ in. by 5/16 in. angles extending across the car, between which there is riveted the triangular gusset to stiffen the side sheets to which it is riveted by means of an angle, with an outside special I.

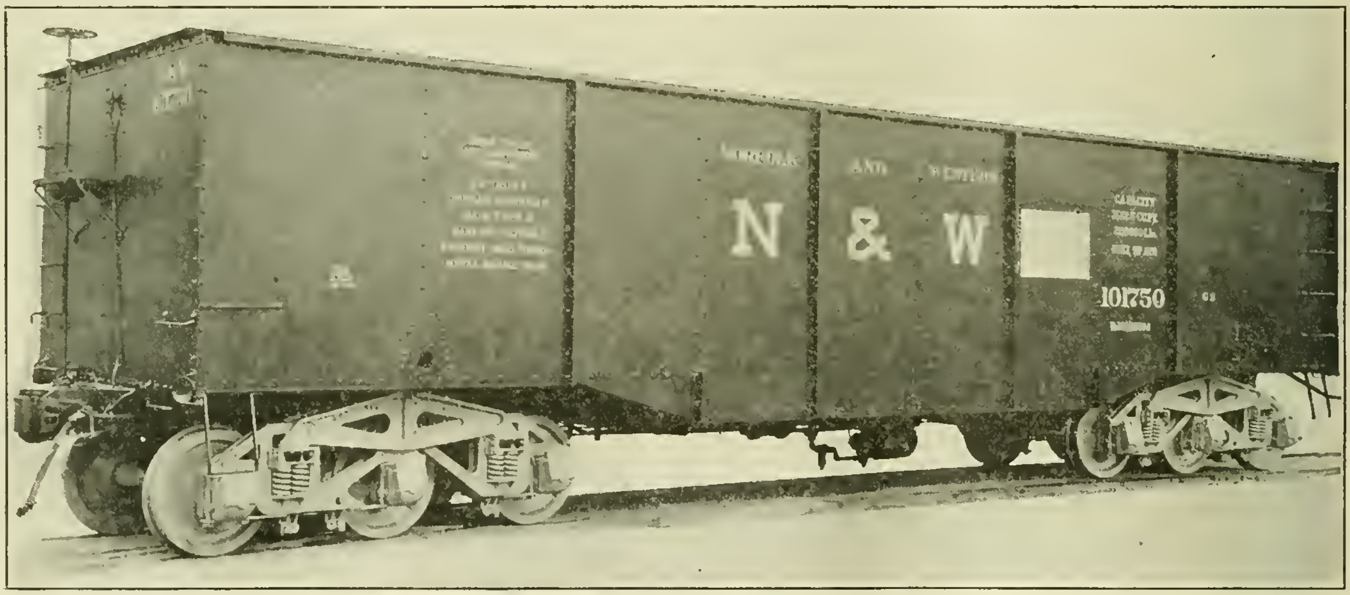
Between these main cross-ties and the bolsters there are four minor cross-ties reaching from the center sills to the sides of the car.

The top of the car is stiffened by a special angle to take the loaded car in the dumping machine at Lambert's Point, for these cars are lifted, turned over and dumped, in the manner that has been in use for a number of years with the cars of lighter capacity.

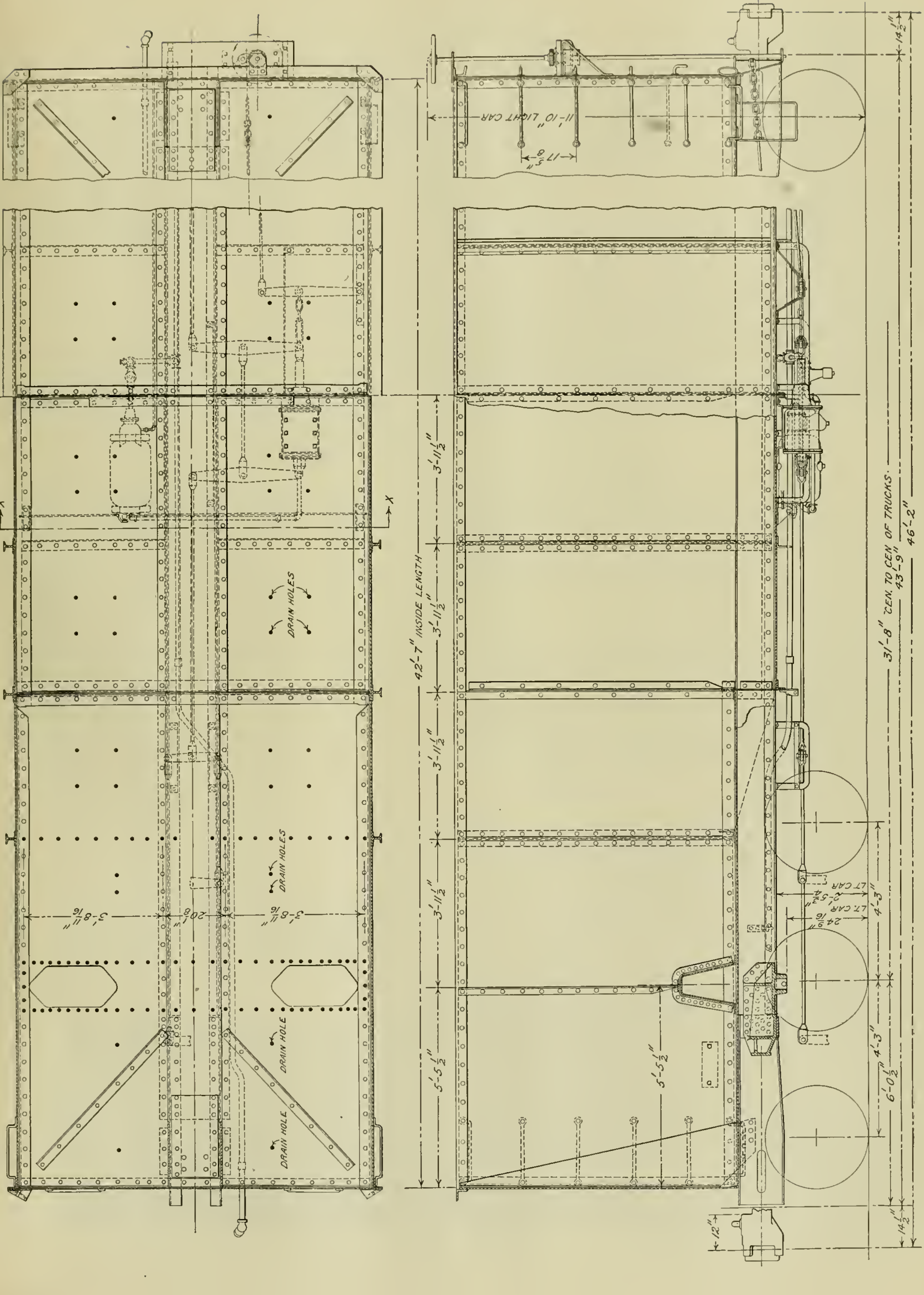
The gusset plate, furthermore, not only serves to stiffen the side of the car but to transfer the load to the center sills.

One of the novel features of the car is the method of supporting the body on the trucks. The usual method of carrying the whole load on the center plates and depending upon the side bearings to balance the body, with the usual tendency to bind, has been abandoned and a four-point support substituted therefor, with no weight at all carried on the center plates. This is an innovation that was only adopted after a trial of several months had been made with some heavy tenders, where the effects and working could be carefully watched. It was found that, with a car of the dimensions of this one, there was yield enough to the metal of the body to permit the necessary movement of the trucks without straining the metal of the body beyond its elastic limit.

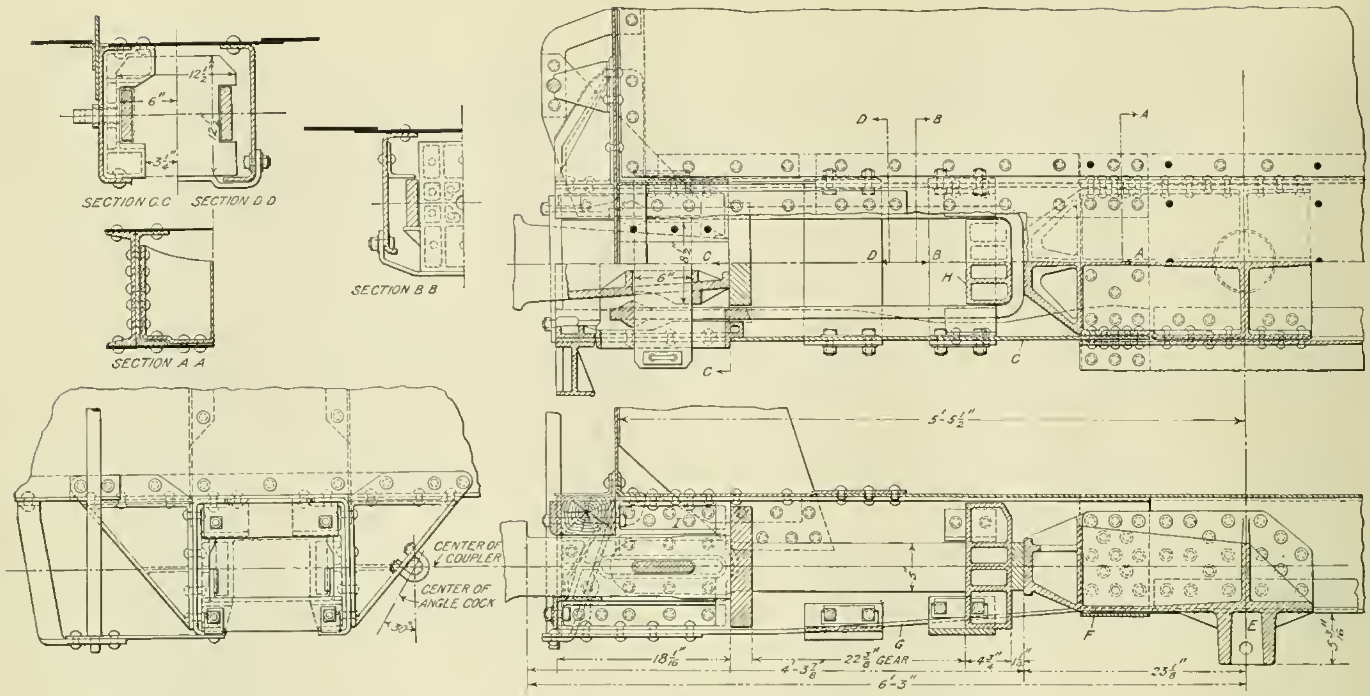
The tests, upon which these conclusions were based, consisted of supporting a car on four calibrated springs at its four corners and then raising and lowering one corner out of the plane of the other three, and noting the loads on these other three



100-TON COAL CAR ON THE NORFOLK & WESTERN



PLAN AND SIDE ELEVATION OF 100-TON CAR ON THE NOROLK & WESTERN

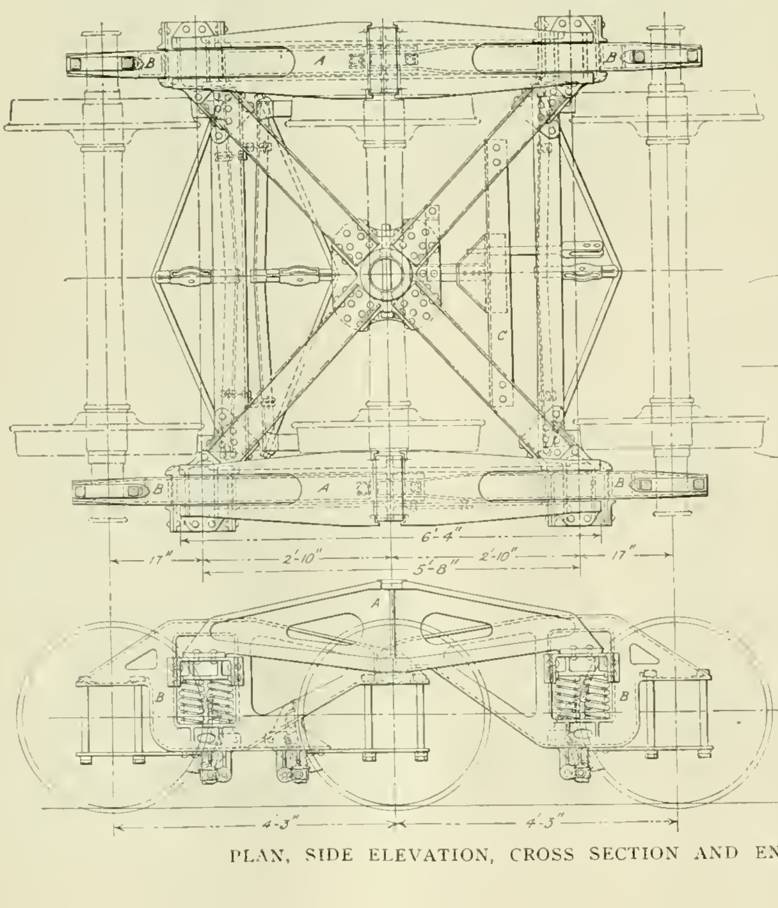


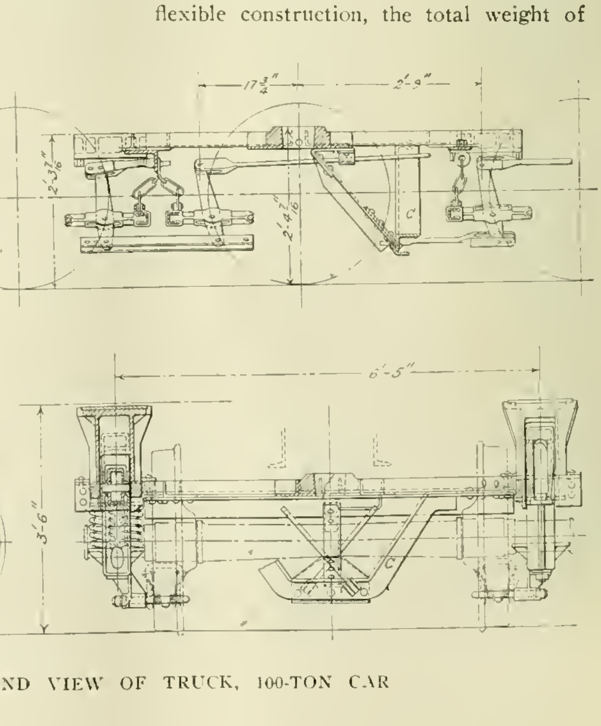
DRAFT RIGGING, 100-TON CAR NORFOLK & WESTERN RY.

corners, as indicated by the heights of the springs. The maximum warp given, in this way, to the body of an empty car was 3 in. and 2½ in. to a loaded car. The change in load, by this process, amounted to a little more than 10 per cent of the static load at that point. This showed, conclusively, that an open car of this description could be safely carried by four points of support. The truck was accordingly designed to work in this manner.

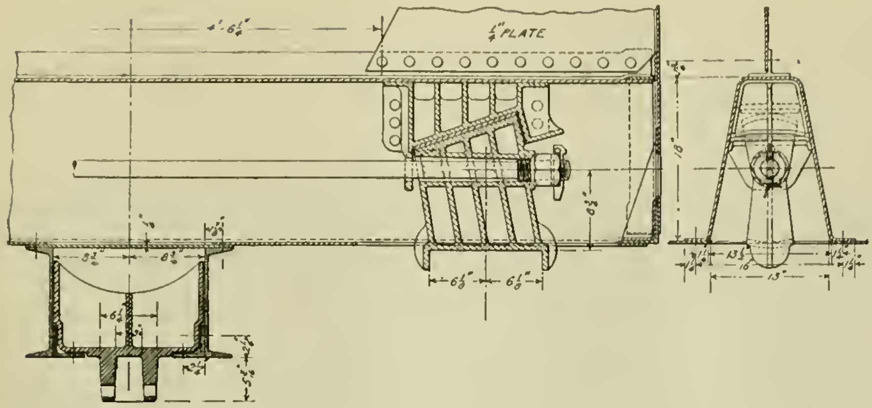
The method of support is shown by the engraving of the section and details of the body bolster. Reference to the car drawing shows the bolster to be an inverted U-shaped structure, the central portion of which is reinforced by 4 in. by 3 in. by 5/16 in. tee weighing 4 lbs. to the foot. To the vertical leg of the tee there is riveted a triangular gusset sheet ¼ in. thick, by which the load is transferred from the sides to the bolster. This gusset extends out over the side bearing which forms one of the four supports. The body bearing consists of a steel casting, fitted with a liner, as shown, which forms the bearing for the conical roller. The upper surface of this roller is inclined, while the lower is horizontal, the two lines meeting at the center of the car. The two rollers on either side of the car are held together by a 2 in. bolt with a nut and cotter at each end. This prevents the rollers from spreading and putting a side thrust upon the side bearings of either the body or the truck. The rollers and bearings have a length of bearing sufficient to permit of negotiating a 35-degree curve.

The truck itself is of a very light and flexible construction, the total weight of





PLAN, SIDE ELEVATION, CROSS SECTION AND END VIEW OF TRUCK, 100-TON CAR



CENTER PIN AND FOUR-POINT SUPPORT, 100-TON CAR, NORFOLK & WESTERN RY.

one truck being 12,240 lbs. and is fitted with the standard 5½ in. by 10 in. axle and steel wheels.

As already explained, no load is carried on the center plate. The body center plate is merely a pin, that can work up and down in the truck center plate. This is a steel casting carried by four diagonal 6 in. by 2½ in. channels that are riveted to the equalizing beam *A* and thus serve to transmit the lateral thrust of the car to the truck.

The transmission of the vertical and horizontal stresses from the body to the truck are thus separated. The vertical load is carried by the side bearings on the four-point support, and the lateral stresses are transmitted through the diagonal braces from the center plate.

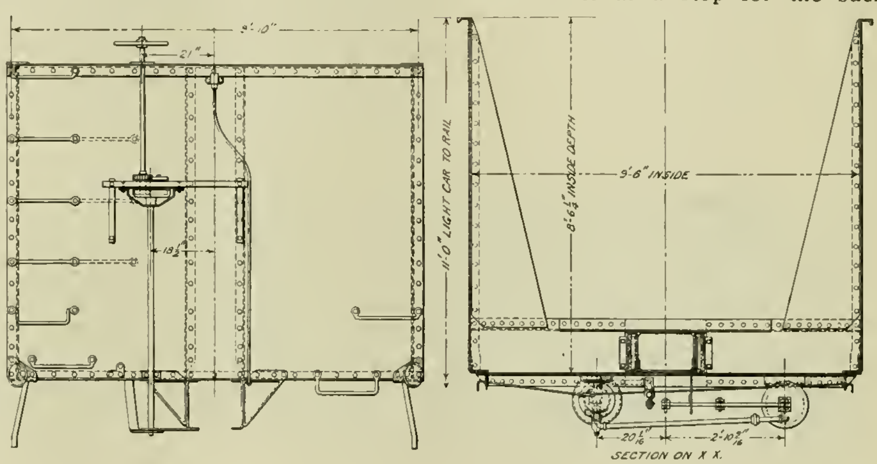
The equalizing beams rest on the spring caps. The springs are carried in a pocket in the flexible side frames *B* and are so adjusted that the same weight is carried by each of the wheels. The journal boxes of the outside axles are bolted to the outer end of the flexible side frames. The center box is bolted to the inner end of one of the frames to which the corresponding end of the other frame is pivotally bolted.

There are three brake beams applying brakes to one side of each wheel, and these are operated by two pull rods from the cylinders on opposite sides of the truck, thus avoiding any turning movement on the same. It also makes a separate brake-shoe adjustment possible and eliminates all possibility of an accumulation of an excessive angularity of the levers.

A cable guard *C* is placed beneath the lever system in order to protect it from the cable used to haul the cars up the incline to the dumping machine. This is made of 4 in. by 3½ in. by ⅜ in. angles riveted to the diagonal braces as shown.

Four hundred of these cars are equipped with the Westinghouse K-2 triple valves and one hundred with the Automatic Straight Air triple, the details of the test of which on a seventy-car train were published in the April issue of this paper.

For such cars it has been necessary to make the draft gear of the most substantial character. It has, therefore, been designed not only to provide ample strength to resist all stresses that may be put upon it, but to take in any type of draft rigging that it may be desirable to use.

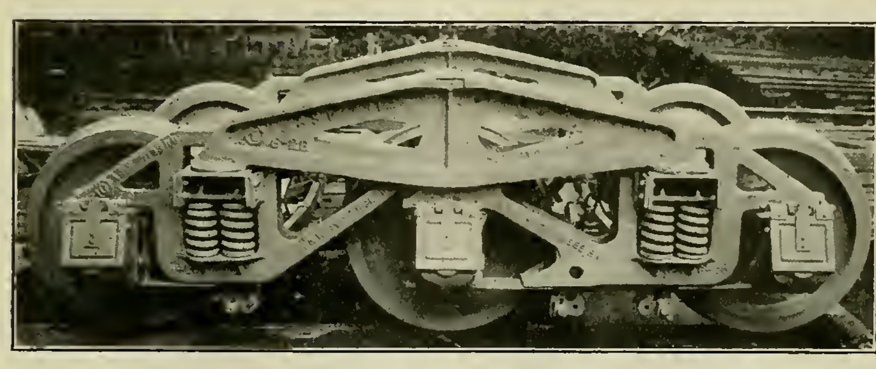


END ELEVATION AND CROSS SECTION OF BODY, 100-TON CAR, NORFOLK & WESTERN RY.

The channels, forming the center sills, end 17¼ inches outside the center pin; and, at their ends the space between is filled by a steel filler casting *E* of which the center pin forms an integral part. This fits into the center plate or bearing of the truck and serves not only to haul the truck but to transmit to the latter any longitudinal or lateral thrusts that may be put upon it by the car body.

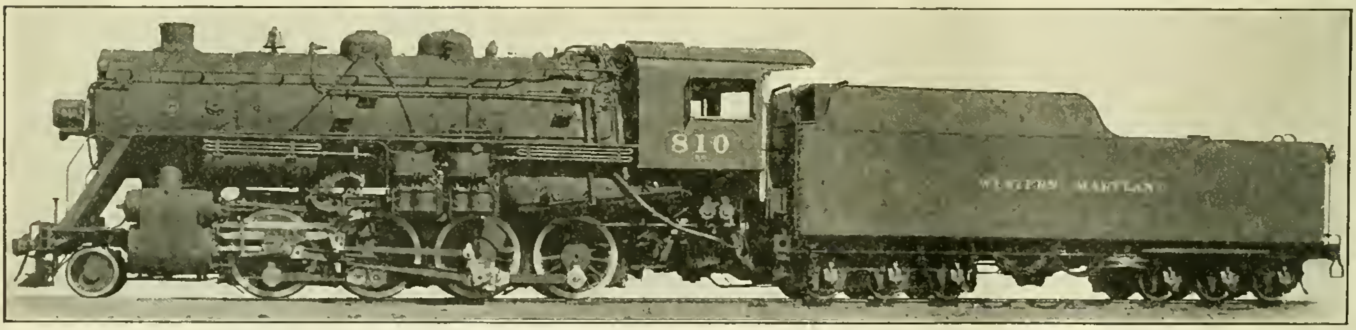
As will be seen from the engraving this casting is securely riveted in between the center sills both to the webs and the tie plate, which is made of 7¼ in. by 3/16 in. In order to protect the sills and, at the same time give ample buffing and pulling strength to the end of the car, a pressed steel extension *C* is used, running from the rear of the tie plate *B* to the face of the buffer block. This is of channel section and lies between the webs of the center sills and the filler or center casting *A*. This casting has a projection at the front which serves as a stop for the back end of the yoke and the follower. The follower *D* is a steel casting and is here shown as 4¾ in. thick. This extraordinary thickness is so as to allow sufficient distance between the inside of the yoke and the back end of the coupler shank so as to allow for any length of draft gear that may be used, which can be done by a change in the thickness of the follower.

The front follower is the usual flat plate and is 2¼ in. thick. A single key 1½ in. by 6 in, is used to hold the yoke to the coupler. The yoke is slotted so that the key has a play in it and can move back with the coupler shank under buffing stresses. On each side of the pin the coupler shank is widened so as to give an additional bearing for the key. There is, thus, no rear follower stop, and the front follower stop is cast integral with the front casting *E* which also serves as a separator and tie between the two pressed steel draft sills, and to which it is securely riveted.


6-WHEEL TRUCK, 100-TON CAR, NORFOLK & WESTERN RY.

Consolidation Type Locomotives for the Western Maryland Railway

Comparison With Others of Heavy Consolidation Type Built by Baldwin Locomotive Works



CONSOLIDATION 2-8-0 TYPE LOCOMOTIVE FOR THE WESTERN MARYLAND RAILWAY—BALDWIN LOCOMOTIVE WORKS, BUILDERS

During the past ten or twelve years locomotives of the Mikado type have, to a large extent, displaced Consolidations in heavy main line freight service. The Consolidation, however, is still used to a considerable extent, especially for heavy drag service where slow speeds will suffice, and where fuel conditions do not require the boiler and firebox proportions that can be obtained in the Mikado type. With driving wheels of the size that are suitable for work of this kind, it is possible, in a Consolidation design, to use a firebox throat of sufficient depth to install a brick arch, without raising the boiler to an excessive height. Such a locomotive, with a high percentage of total weight on driving-wheels, is well fitted for heavy slow speed service.

The Baldwin Locomotive Works are now building, for the Western Maryland Railway, a group of Consolidation locomotives which are notable because of their great weight and hauling power. These locomotives are designed to traverse curves of 22 degrees, and are operating on 90 pound rails and grades of 3½ per cent. The total weight is 294,900 lbs.; while the weight on drivers (268,200 lbs.) and tractive force (68,200 lbs.) exceed those reached in any Mikado or Consolidation type locomotives heretofore constructed by the builders. The ratio of adhesion is 3.93, indicating that the weight on drivers is utilized for tractive purposes to the fullest possible extent. The chief business of the Western Maryland is handling a heavy coal traffic, and the new Consolidations represent the latest development in a series of locomotives which for years have proved successful in this work.

As compared with a design of heavy Consolidation built for the Western Maryland in 1910, and using saturated steam, these new locomotives show an increase in total weight of 31 per cent, and in tractive force of 40 per cent.

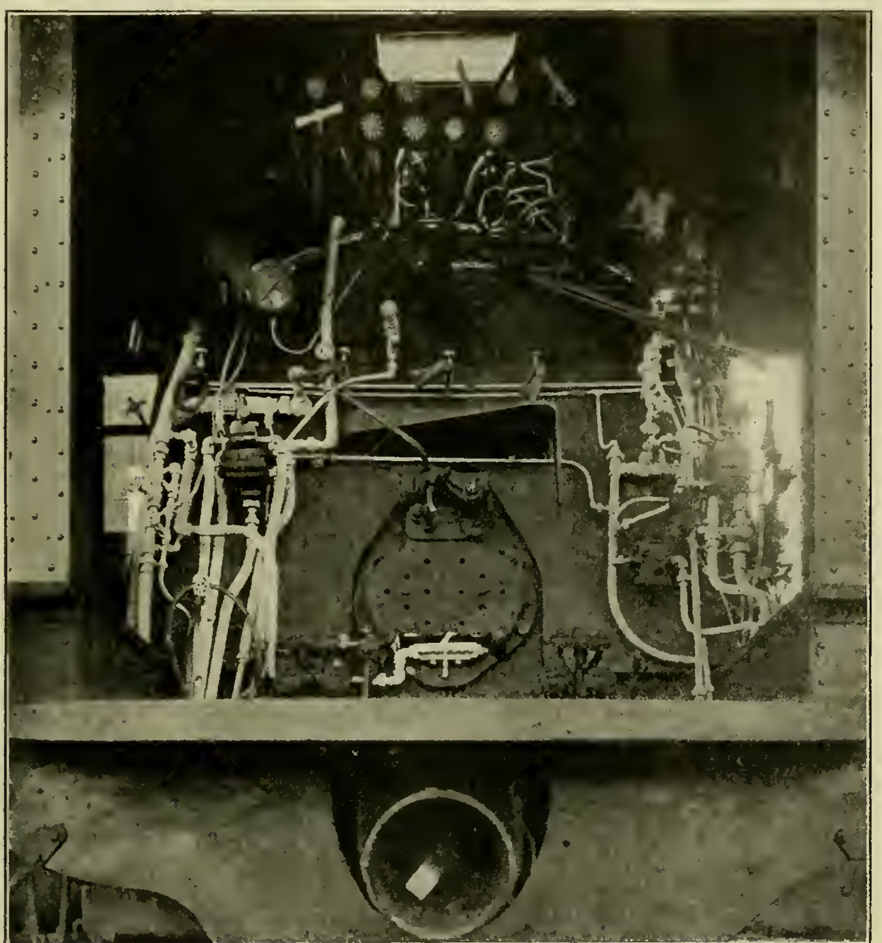
The cylinders of the new locomotives are fitted with gun-iron bushings, and the steam distribution is controlled by 14-inch piston valves. Walschaerts valve motion is used, and the gears are controlled by the Pittsburgh power reverse mechanism. The equipment includes automatically operated drifting valves designed by the railway company. The links are carried on longitudinal supports of cast steel, which are bolted in front to the guide bearers, and at the rear to a crosstie placed between the second and third pairs of drivers. The reverse shaft is located immediately in front of the links, and the lifting arms extend in a backward direction, each radius rod being suspended at its rear end. The valve motion is so designed that the link blocks are down when running ahead. The valve rod is provided with two slots, through one of which the key passes attaching the rod to the crosshead. The second slot is located partly outside of the crosshead, so that when a tapered piece is driven into it, the crosshead can be forced off the rod; the key being of course first removed. Other machinery details include cast steel piston heads of dished section, with cast iron bull rings and packing rings. The guides and crossheads are of the Laird type. The main rod stubs are of the open end type which permits renewing the brasses without removing the eccentric cranks.

The frames are 6 in. wide, spaced 41 in. between centers; and each frame is cast in one piece with a single front rail to which the cylinders are bolted. The transverse bracing calls for special attention. A most substantial steel casting, placed just back of the cylinders, extends the full length of the leading driving pedestals and serves as a fulcrum for the driving brake shaft. The guide yoke crosstie is also of cast steel, and it is extended back sufficiently far to brace the second driving pedestals. This crosstie also serves as a support for the driving brake cylinders, one of which, because of the lack of room, is placed in a horizontal, and the other in a vertical position. The two brake shaft arms are placed at right angles to each other, the horizontal cylinder being connected to the vertical arm by means of pull rods, while the vertical cylinder is directly connected to the horizontal arm. The frame braces further include a steel casting at the main driving pedestals, and a casting, placed between the main and rear pedestals, which is bolted to both the top and bottom frame rails and serves as a support for the forward end of the firebox.

The driving boxes are of cast steel, and are fitted with bronze hub faces and brass lined pedestal faces. Cast iron shoes and wedges are used, the latter being of the self-adjusting type. The driving axles and engine truck axle are of heat treated steel, and flanged tires are used on all the wheels. Flange oilers are applied to the front and back drivers.

The truck is of the Economy constant resistance type, and is equalized with the first and second pairs of driving-wheels. Dolphin beams are placed over the boxes on the third and fourth pairs of drivers, and are connected, on each side of the locomotive, with three inverted leaf springs which are placed below the upper frame rail. Limited clearance space under the firebox did not permit placing the springs over the boxes of the two rear pairs of wheels.

The boiler is of the straight top type, with horizontal roof sheet and sloping throat and back head. The throat has a depth of 19 13/16 in., measured from the under side of the barrel to the bottom of the mud ring. The firebox is supported, at the front and back, on vertical plates. The front end of the crown is supported on three rows of expansion stays, and about 550 flexible stay-bolts are applied in the breaking zones in the sides, throat and back. The safety valves are placed just forward of the firebox and, as the clearance is limited, they are tapped directly into the boiler shell instead of being mounted on an auxiliary dome.



BACK BOILER HEAD AND CAB EQUIPMENT OF CONSOLIDATION LOCOMOTIVE FOR WESTERN MARYLAND RAILWAY

The firebox equipment includes a brick arch, power operated fire-door and grate shakers and Standard stoker. The drop-plates are at the back of the grate. The ash pan has two hoppers with swing bottoms, both of which are controlled by one handle. Flushing pipes are applied for washing ashes from the slopes of the pan.

The cab is unusually roomy and comfortable with all fittings placed within convenient reach of the crew. The injectors and steam turret are placed outside the cab and have extension handles identified by small aluminum plates with raised letters. The equipment includes a breather pipe for providing fresh air while passing through tunnels. This arrangement consists of a ½-inch pipe placed across the boiler back head, and having five ¼-inch globe valves equally spaced, each fitted with 3 feet of ½-inch hose. The air supply is drawn from the brake system.

An interesting detail is the arrangement of the hand rail columns, which are in the form of clamps, so that the hand rail can be readily taken down without removing the columns. The headlight dynamo is placed on the right-hand side of the boiler, forward of the cab, and the wiring is run through the hand rail. The pilots are adjustable as to height above the rail and are of short design so that two locomotives can be coupled end on without interference.

The frames are of one-piece construction made of cast steel by the Commonwealth Steel Company. The total length is 38′ 8″ and the width over outside sills is 8′ 11¼″. The distance between truck centers is 22′ 11¾″.

The trucks are of the six-wheel type, manufactured by the Commonwealth Steel Company. The truck frames are constructed with longitudinal and transverse members of steel, cast in one piece. The pedestals are bolted to the frames and the wheel loads are equalized on each side. Swing bolsters are used, and are hung on three-point suspension links. The brakes are of the clasp type with brake shoes on both sides of the truck wheels. It is found in practice that these tenders take curves smoothly and are very easy riding.

These locomotives have a height of 15′ 10″, a width over cab boards of 11′ 4″, and a total length of engine and tender, measured from face to face of bumpers, of 80′ 4¾″. Their leading dimensions, in comparison with those of a number of heavy Consolidation type locomotives built during the past few years by The Baldwin Locomotive Works, are given in the following table:

	Pennsylvania Lines	Union Railroad Company	Bessemer & Lake Erie Railroad Co.	Lake Superior & Ishpeming Ry.	Philadelphia & Reading Ry.	Western Maryland Ry.
Cylinders	26 ins. x 28 ins.	25 ins. x 32 ins.	26 ins. x 30 ins.	26 ins. x 30 ins.	25 ins. x 32 ins.	27 ins. x 32 ins.
Valves	Piston 14 ins. diam.	Piston 12 ins. diam.	Piston 14 ins. diam.	Piston 14 ins. diam.	Piston 13 ins. diam.	Piston 14 ins. diam.
Boiler type	Belpaire	Straight top	Straight Top	Straight Top	Wootten con.	Straight Top
Diameter	78½ ins.	84 ins.	84 ins.	88 ins.	79¼ ins.	88 ins.
Working pressure	205 lbs.	190 lbs.	190 lbs.	185 lbs.	200 lbs.	210 lbs.
Firebox—length	110¼ ins.	111½ ins.	120⅛ ins.	108⅞ ins.	126¼ ins.	112 ins.
Width	72 ins.	70¼ ins.	70¼ lbs.	78¼ ins.	108¼ ins.	96¼ ins.
Tubes—diameter	5⅜ ins. & 2 ins.	5½ ins. & 2¼ ins.	5½ ins. & 2¼ ins.	5⅜ ins. x 2 ins.	5⅜ ins. & 2 ins.	5½ ins. & 2¼ ins.
Number	5⅜ ins., 36; 2 ins., 265	5½ ins., 36; 2¼ ins., 200	5½ ins., 36 ins.; 2¼ ins., 200	5⅜ ins., 45; 2 ins., 300	5⅜ ins., 36; 2 ins., 239	5½ ins., 50; 2¼ ins., 240
Length	15 ft. 1 in.	15 ft. 0 in.	15 ft. 0 in.	15 ft. 6 ins.	13 ft. 6 ins.	15 ft. 3 ins.
Heating surface—firebox	175 sq. ft.	214 sq. ft.	207 sq. ft.	216 sq. ft.	225 sq. ft.	232 sq. ft.
Combustion chambers	....	....	....	....	71 sq. ft.	....
Tubes	2,841 sq. ft.	2,530 sq. ft.	2,530 sq. ft.	3,390 sq. ft.	2,359 sq. ft.	3,236 sq. ft.
Firebrick tubes	....	27 sq. ft.	....	29 sq. ft.	....	30 sq. ft.
Total	3,016 sq. ft.	2,771 sq. ft.	2,737 sq. ft.	3,643 sq. ft.	2,655 sq. ft.	3,498 sq. ft.
Superheater	623 sq. ft.	654 sq. ft.	634 sq. ft.	844 sq. ft.	575 sq. ft.	945 sq. ft.
Grate area	55 sq. ft.	54.4 sq. ft.	58.6 sq. ft.	58.7 sq. ft.	94.9 sq. ft.	74.9 sq. ft.
Driving wheels—diameter	62 ins.	55 ins.	54 ins.	57 ins.	55½ ins.	61 ins.
Journals	10½ ins. x 13 ins.	Main 11 ins. x 13 ins. Others 9½ ins. x 13 ins.	Main 11 ins. x 13 ins. Others 10½ ins. x 13 ins.	11 ins. x 13 ins.	11 ins. x 13 ins.	Main 12 ins. x 13 ins. Others 11 ins. x 13 ins.
Engine truck wheels—diameter	33 ins.	30 ins.	30 ins.	30 ins.	33 ins.	33 ins.
Journals	5½ ins. x 10 ins.	6 ins. x 12 ins.	6 ins. x 12 ins.	6½ ins. x 12 ins.	7 ins. x 11 ins.	6 ins. x 12 ins.
Wheel-base—driving	17 ft. 0½ in.	16 ft. 4 ins.	15 ft. 7 ins.	16 ft. 0 ins.	17 ft. 6 ins.	17 ft. 6 ins.
Total engine	25 ft. 9½ ins.	25 ft. 1 in.	24 ft. 4 ins.	26 ft. 0 ins.	27 ft. 0 ins.	27 ft. 3 ins.
Total engine and tender	62 ft. 5⅛ ins.	60 ft. 1½ ins.	61 ft. 4 ins.	60 ft. 11½ ins.	63 ft. 11 ins.	74 ft. 1¼ ins.
Weight—on drivers	226,800 lbs.	240,320 lbs.	242,300 lbs.	238,000 lbs.	250,800 lbs.	268,200 lbs.
On truck	22,600 lbs.	19,940 lbs.	20,050 lbs.	30,000 lbs.	30,300 lbs.	26,700 lbs.
Total engine	249,500 lbs.	260,260 lbs.	262,350 lbs.	268,000 lbs.	281,100 lbs.	294,900 lbs.
Total engine and tender	431,000 lbs.	404,000 lbs.	410,000 lbs.	425,000 lbs.	462,000 lbs.	565,000 lbs.
Tractive force	53,300 lbs.	58,700 lbs.	60,600 lbs.	56,000 lbs.	61,500 lbs.	68,200 lbs.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:
JAMES KENNEDY, Managing Editor.
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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd.,
3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $3.50 or fifteen shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

The Quadruple and Triple-Cranked Locomotives

The Spring meeting of the American Society of Mechanical Engineers has called forth a number of able literary productions looking towards further improvement in the design and operation of locomotives. The problems involved may be said to be second only to the financial questions so particularly prominent at the present time, and the improvement of the locomotives may properly be said to be a part of the financial problem, because unless the improvement lessens the cost of operation it can hardly be called an improvement at all. Indeed the most of the improvements are of a kind that have grown out of the growth of the engine itself rather than any radical change in construction, just as new branches will grow out of a sapling oak and in the course of time expand into the king of the forest, defying the storms and resplendent in green and gold.

Not only do improvements grow out of the larger necessities, but it is a curious fact in engineering generally and locomotives particularly that many experiments that were full of promise and cast aside have afterwards been found to be of enduring merit when applied on a larger scale to meet the enlarged requirements. Hence many modern improvements look to us like old acquaintances who have blossomed into larger being—the same but not the same. In the long ago they seemed unstable and erratic. Now we meet them clothed with the dignity of success and in their right mind and proper place.

Others again, full of promise, disappear, as if gone to seek their fortunes in another planet, like Einstein's deflected rays of light that bend into a wandering epicycle through the luminiferous ether and if the theory is correct they will be back some day whether we are here to meet them or not. We could name quite a number of these things, but one will suffice as an illustration. We recall the time when we had hopes of living to see the perfected three-cylinder locomotive. Our hopes might as well be dead, and our grief is calm. None of the clever essayists have thought it worth mentioning for a long time, and yet it had the elements of merit in it because it was based on a correctly balanced division of the impelling forces striking a blow at regular intervals of 120 degrees instead of the present eccentric division of two blows, 90 degrees apart, with a supervening blank of 270 degrees. With a fly-wheel loaded with a mass of acquired momentum the eccentricity is not particularly felt, but there is no space for fly-wheels on the modern locomotive. We have even made bold to ask several accomplished engineers why we have not a perfected three-cylinder locomotive?

The answer has invariably been—the necessity for a cranked axle—the bad arrangement of cylinders as to connecting-rod lengths, if the crank axle is the forward one, or the necessity for inclined cylinders or forked rods if the cranked axle is not the forward one. Some honest claims are made that they have been through the crank axle period. There have been at least four types of locomotives with cranked axles—the original Webb compound, which has been convicted and condemned for general debility; the De Glehn four-cylinder compound, which was a fine machine but of insufficient power; the four-cylinder balanced compound designed by the Baldwin Locomotive Works, and a nearly similar design by the American Locomotive Company, there being several engines built to each of these latter designs.

Their history is, by general consensus of opinion, that the crank axle construction required too much care to maintain and operate. All inside cylinders are necessarily less accessible than those attached outside and the engineers in America do not care to go underneath the locomotives to attend to any defect when it arises in such parts. The result was, as may be expected, that when anything happened to any of these cranked locomotives, no matter how trifling, the locomotive was placed in the shop, and unless specially expedited at all hours and under all conditions costly delays were inevitable.

It is to be assumed that the finely-constructed three-cylinder locomotives which were placed in operation on the Philadelphia & Reading some years ago, were all reconstructed, or converted to two-cylinder locomotives, for the same reasons that affected the costly operation of the four-cylinder engines.

In regard to the outstanding merits of the three-cylinder locomotive, there can be no question as to an improved over-lapping of the power torque curves, but in the inevitable limited space it almost of necessity involves a short main rod, which results in intense pressures on the cross-heads, which are already one of the most troublesome parts to maintain, the wear being exceedingly rapid, and the effect of the wear very serious.

It need hardly be pointed out that while in European railroad practice, the cranked axles are largely in use on the locomotives, their diminutive size renders them in no way comparable in the details of equipment to the American locomotive, unless it were possible to extend the width of the latter in the same ratio as the variation in weight and power, and this under existing conditions is impossible.

However, as we have already stated, we are not without hope of hearing some thing of our triply equipped locomotive again after its cycle of silence has been run, and some engineering essayist calls it from the vasty deep.

Railroad Men's Wages

It would be premature to pronounce on the effect of the decision of the Labor Board in ordering a general reduction of about 12 per cent on the wages of railroad employes. As the increase in wages was made to meet the high cost of living, and as the price of many commodities has been reduced, some reduction in wages was to be expected. In the very nature of things, it is experimental, and the chief value of the work of the Labor Board is not in the immediate hope of meeting the involved approach to disaster that confronts the railroads but in the assurance that a real change has come in regard to the treatment of the railroads by the government. For many years it has been the almost universal opinion that the railroad executives were not to be trusted. The period of governmental operation dispelled this opinion, and this was not the only good result. It was also clearly demonstrated that many railroad men were poorly paid, and it is not likely that these two gross errors will even be so rampantly manifested again. Railroad men deserve liberal treatment, and out of the controversy there is at least the promise of the dawn of a better day.

That the increases in wages allowed to men engaged in many branches of railroad service were abnormal and irregular is the general opinion which we do not care to dispute. We do know that they had long been underpaid, and if any employes in some instances have been overpaid for a short period, there has been no grievous error committed. The absence of rancor about the decrease in wages is the best proof that the employes are not unreasoning, but are disposed to take their fair share in the depression that has fallen so heavily on the railroads, and the work of the Labor Board is being received in a far kindlier spirit of appreciation as compared with the work of the various commissions that have been a real hindrance to railroad development for many years. It seems strange that it has taken such a long time to learn that it does not pay to shackle enterprises. It is generally conceded that the government has been guilty of violating a natural law, and the evil result cannot be cured in a day.

At the same time, it must be admitted that many railroad managers in the past used corrupt methods to advance their own interests. The drastic measures adopted by the government overshot the mark and the result is before us. At the present time it is not too much to say that, generally speaking, there never were men more sincerely in earnest than the railroad men of the present, and never were they so well qualified by education and experience, and all that is needed is a restoration of public confidence, and a hearty cooperation among all classes engaged in the work of transportation which is the leading industry of our country.

Large Locomotives.

The papers presented to the Railroad Section of the American Society of Mechanical Engineers at the Spring meeting in Chicago were devoted to the presentation of the case of the large locomotive from different angles. One of these papers, that by Mr. Haig, was published in RAILWAY AND LOCOMOTIVE ENGINEERING for May and another, that of Mr. Snyder, appears in this issue. The third dealt with the economic advantages of large locomotives and was mainly devoted to calling attention to matters deserving of careful study, and these seemed to cover about every point connected with the locomotive. The two papers of which abstracts are published in this and the last issue deal with the details of design, with especial reference to those of the boiler and its fastening. Attention is called to the necessity for combined firmness and flexibility, which is a point that cannot be too strongly emphasized. We have traveled far from the old days when the back head was rigidly braced to the frame whereby the boiler was prevented from expanding while the firebox was carried on expansion plates in order that it might be permitted to expand. And so the papers very forcibly point out that connections between the frame and the boiler barrel should permit the boiler to move under the influence of changes in temperature. Again the cracks in the flue sheet seem to be regarded almost as unavoidable, and perhaps they are, for the sheet is subjected to a constant movement due to the action of the tubes and sides of the firebox which are pushing upon the tubesheet in opposite directions.

In the matter of staybolt stresses considerable emphasis is placed upon the desirability of using flexible bolts, but one statement is made by Mr. Snyder that comes somewhat as a surprise. He says: "It has been proved by experiment that if flexible stays are properly applied to the boiler when built, while they may make a slight movement during the firing up of the locomotive, after the boiler has become completely heated and steam pressure raised these stays assume their original position."

This is evidently a point upon which the doctors disagree. In the November 1919 issue of this paper there was published an article on the deflection of staybolts, giving the details of an elaborate investigation conducted on the Lake Shore & Michigan Southern and Delaware & Hudson railroads. According to this investigation the staybolt starts to deflect the moment the fire is kindled and continues in constant motion during the whole period that the boiler is under steam, only returning to its original position when the boiler had become cold again. The care with which this work was done and the delicacy of the apparatus employed led to a general acceptance of the result. It is, therefore, something of a surprise to learn that this investigation which seemed so conclusive and consistent has been overthrown and a return to the old idea that the staybolts are always straight when the engine is under steam has been demonstrated to be the correct one. An attempt will be made to obtain the data upon which the statement in the paper is based, and if obtainable it will be made public later.

These papers on design are worthy of most careful consideration. We have been very busy in improving the efficiency of our locomotives and have made wonderful strides during the past two decades, but we are here shown that much more remains to be done. The brick arch and the mechanical stoker have done much for economy of operation, and utilization of coal, and the cry is raised as to why we are not doing more towards the development of the feed-water heater and why we are not following more closely on the heels of our European colleagues in its introduction. Then what with the variable exhaust, improved rods, better material, one emerges from the reading of these papers with the conviction that there is work enough ahead to keep another generation of locomotive designers busy.

Powdered Coal a Fuel Saver

The *Scientific American* states that there is nothing new in the suggestion to employ powdered coal, but of late the methods of using such fuel have been developed to such an extent that many large users of coal can with considerable profit turn their attention to powdered coal. It is claimed by certain manufacturers of powdered coal equipment that a decided gain in steam generating economy with increased boiler capacity follows the more perfect combustion of the lower priced fuels that is obtained by burning powdered coal. The higher furnace temperature and simplicity of control with very great flexibility to swing the furnace output with the load makes this established combustion method ideal for the modern industrial plant and central station.

According to tests recently performed by two fuel experts with Illinois coal, it is learned that contrary to the customary specifications, it is not necessary to pulverize the coal to the extreme fineness of 85 per cent through a 200-mesh screen in order to obtain good combustion and good efficiency. This ability to burn coarser coal means increased capacity of the pulverizing mills and decreased cost of coal preparation. The results also show that it is not necessary to dry coal to about 1 per cent moisture in order to burn it successfully in pulverized form, and it is stated that with most Eastern coals drying is not at all necessary. Good results can be obtained when the coal is burned at rates varying from 0.5 lb. to 2 lb. per cubic foot of combustion space per hour, and the best results at a rate of 1 to 1.5 lb.

Fortunately for the industrialist who wishes to give some thought to pulverized coal, there are specialists in this field who are prepared to give specifications and costs for the conversion of an existing plant or for the erection of a new plant. In either event the pulverized coal idea is no longer an untried one, and it is worthy of serious thought.

In this connection it may be stated that but for the occurrence of the war period, with its paralyzing influences, the use of powdered coal on the railroads would have been much further advanced than it is at the present time.

Snap Shots—By the Wanderer

Of course, it's heresy. A disagreement with popular ideas is always heresy. Quite in accord with the old definition that "orthodoxy" is my doxy, and "heterodoxy" is your doxy. But if no one disagreed with popular ideas, or disagreeing failed to voice the disagreement, what a dreary, monotonous, to say nothing of its unprogressiveness, this poor old world would be. So quite prepared to be proven in the wrong, I am going to stand up in meeting and ask, "Why the traveling fireman?" Now, please, oh, please, hear me, or rather hear me out, before you say "pish," or some other word like the one that so shocked the sensibilities of the visitors and officers on board H.M.S. *Pinafore*.

The traveling fireman is not so very old. Most of us old uns can remember his birth. He seems, however, to have grown lustily and to have given a fairly—yes, we'll say, a very good account of himself. But why "traveling fireman"? As such, his duties are confined to the left-hand side of the engine. He can go into the minutest details of instruction as to how the fireman should place his feet; how he should grasp his shovel; how he should bend and unbend his back, and where and how he should place the coal in the firebox, if he is one of those unfortunates who has still to shovel coal into the firebox instead of supervising the operations of a piece of mechanism. All this can he do, and more. But let him cross by so much as the breadth of a hair towards the other side, and his authority becomes as naught and his importance as a bubble that has burst. He may show how the coal should be placed with the most scientific thoroughness, and explain the laws of combustion with chemical exactness, but all will be as nothing should the magnate at the throttle so decree. He would not be much of an engineer who could not so handle the engine that the finest of firing would fail to keep her hot. The reverse lever might "trail the links along the ties," as John Hill used to say, or the injector might choke her with water on a pull; and other things, too numerous to mention, might happen against which there would be no redress. Fortunately, these things seldom do happen, for engineers are not usually men of that kind. But they might. The traveling fireman has justified his existence, of which there is no gainsaying. But, still I ask, "Why, fireman."

He was not the original traveling instructor or supervisor, or whatever else you may choose to call it. The traveling engineer preceded him and gave such a good account of himself that the fireman was born shortly after him. Now, the traveling engineer is supreme. His word is law and there is none to gainsay him. He can relegate the engineer to the left-hand side for the time being. He can take the levers and show how they should be manipulated. He can tell the fireman to scatter his coal or heap it in the back corners, and he can "show how." If he can't, his position becomes a joke and his instructions the subject of mockery and scoffing, and the duration of hs official life will be short. But, he, too, is in danger. He grasps at the authority above him, and before we know it, he is acting as a sort of trainmaster, first telling and then reporting to the superintendent about train handling to the neglect of the engine, because the new work is cleaner and pleasanter than the old; while the engine is left to the traveling fireman of limited authority.

Of course, it is very easy for an old maid to tell the mother of nine as to how children should be reared. Yet, as an outside observer, her suggestions may be of value. So I presume on a suggestion or two. If the traveling fireman is to do his best work and get the best results, give him the authority to do and get. Let his duties be the same as now, if you wish, but make him a traveling engineer; "assistant," if you like, but let him be able to boss the throttle opening as well as that of the fire door. And he can't do it as a traveling fireman. "A rose by any other name may smell as sweet." But a man as "traveling fireman," cannot command attention and get the results that he could as "assistant traveling engineer." Then, if the real traveling engineer is to be pulled out of his sphere, add "assistant trainmaster" to his other title and give him the authority that goes with it. The traveling fireman, as such, is "cabined, cribbed, confined," in his activities, and the possibilities of his usefulness are limited. So why not take the same man and give him a chance?

And this is my heresy for the time. I will, however, let you into a secret. It was not my very own, but I was inoculated with it by a number of railroad men whom I have heard discussing the subject.

There is an old economic law of price being governed by the relation existing between supply and demand. A law that meets with much opposition in some quarters, such as labor headquarters and dining cars. The first is a little too much of a proposition to be handled in an offhand discussion in Snap Shots, but the latter can be made to fall within our range of thought, whether it really belongs there or not. And the reason for some of the prices charged but rarely received in dining cars, is difficult for an outsider bent on gain to fully understand. Now, with the more or less perfect understanding that the dining car is somewhat of a charitable institution, in that it is not a paying proposition as far as the railroad is concerned from the standpoint of moneys paid out and received, it is possible to understand the reason for some of the prices on the bill of fare. There is the effort to make the thing pay. Passengers, on through trains, are more or less at the mercy of the road. In time they get hungry. The dining car is the only place to relieve it. So, being hungry, and there being a monopolistic supply of food available, they pay the monopolistic prices until they are no longer hungry and then stop. They don't stuff and gorge. Appetite satisfied and pocketbook depleted, they stop. To paraphrase: *Parvum sapienti sufficit*. A little is enough for the wise.

I look at my own modest order, and then at the table spread for the diners about me. I see that I and they have been eating real food, and that desserts and frills rarely appear. Then I look at the menu, and think I see the reason. I dislike, and so do they, to pay fifteen cents for an orange that could be bought for five at a stand. So, if I think I shall want fruit on the train I buy before starting, and so do they. If I forget, I go without, and so do they. Now, the question comes up, would it not pay the dining car to sell fruit at five cents to stuff the passengers, rather than not sell it at all? So with other little dainties that are not necessities but luxuries. People, that is, some people, even most people, would like to top off with a little dessert, but we don't like to pay thirty-five cents for ten cents' worth of honey. It is bad enough to pay five for the small biscuit on which to put it. Biscuits that sell for ten cents a dozen in a shop, do seem rather expensive at sixty on a car. But they may be classed as a necessity, with bread at five cents a slice, and the monopoly having the bread and we having the hunger, there is nothing for us to do but to capitulate and pay. But we don't buy oranges at fifteen cents or honey at thirty-five cents a spoonful.

Now, that being the case, why would it not be good business that would lead to big business, to cut the price of luxuries to what people will pay for the satisfaction of the palate, pure and simple, and hold the prices of necessities where the hungry man will take them, though it make of him a financial wreck. Isn't it more profitable to sell twenty oranges at five cents than none at fifteen, and lose their cost through rotting? I have never run a dining car, and I may be all wrong, but I think it to be a safe gamble, that if the prices of these little after-the-meal luxuries were to be reduced, demand would meet the price, and they would move in a way unknown before. I only wish that some dare-devil of a dining car superintendent would try it for a month, and let me know the result.

Those of us who have passed the years that are supposed to bring discretion and have arrived at those which are sometimes contemptuously referred to as those of reminiscence, cannot fail to have observed, if that kind of observation lay in our trend of thought, that the valve setting of locomotives of the present time is much better and squarer than it was in the old days when the setting of the valves of the Stephenson gear was regarded as an occult art and guarded from the knowledge of the profane, with a care that was as ridiculous as it was successful. Whether it is because the Walschaerts gear is less likely to disarrangement or is more carefully designed, or the men in charge are more competent, it is difficult to say, but I suspect that all three elements have contributed to the result. For the fact is that lame engines are much rarer than they used to be, though—— Well, of all things! Is it the cussedness of inanimate things, or are the gods eager to show that it is the exception that proves the rule? But just as I was in the full glow of that sentence, it was interrupted by the passage of a locomotive of the most pronounced mama-papa type. One exhaust was prominent and more prominent above its fellows, as if to say: "*Listen* to this, *listen* to this, *listen* to this." Well you couldn't help but listen. But as I was about to say—*though* exceptions are *not* unknown, it is always best to make a guarded statement.

Still to revert, I will maintain my thesis that valves are set better than they were, for my reminiscence does not go back to the days of old that were perfection. I attribute it to greater skill and care in design. Designers really design. I remember once, when working out the valve gear for a switching locomotive for one of the best known superintendents of motive power in the country, I was instructed to use the link of a big passenger locomotive, because they had a template for it. The eccentric rods of the passenger locomotive were six feet long and those of the switcher were three, with a corresponding difference in the throw of the eccentrics. If you think the exhaust of that switcher wasn't lame, you know little of the requirements of the Stephenson gear. It was a nightmare, and the time spent by the valve setters in trying to square it would have paid for twenty templates. Strange that that man never learned of the sensitiveness of the old gear. He was at the head of a big railroad—a very big railroad—and it is almost safe to say that he did not have a single locomotive which was not limping over the road with the most pronounced "*Listen* to this." And the pranks that we have seen played with that gear, and the efforts to square engines that couldn't be squared by men who didn't know would fill a book. Perhaps I will tell of some of them some day. But I don't want to reminisce any more just now. I simply maintain my thesis that something or somebody is responsible for a much better state of valve construction and operation than prevailed when I—well, years ago. And it is due, I believe, as I have already stated, to more careful designing and a higher class of men at the head of the mechanical departments, and not altogether to a change in gear, for the Stephenson gear could be made so square that no ear could detect a variation in the intervals of the exhaust, if you knew how. But you had to know how, and then live up to what you knew. Well, you have to do that in any thing, if you are to make a success of it.

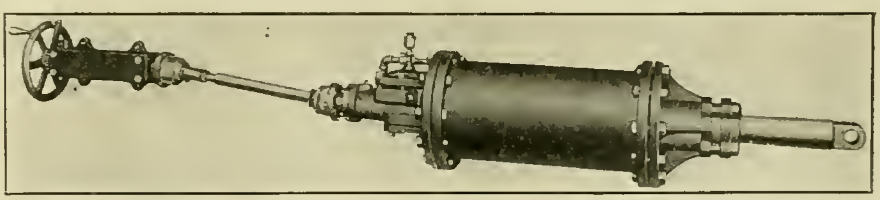
New Design of Power Reverse Gear

Severe Tests Demonstrate Its Absolute Reliability

Since the introduction of power reverse gears on high-powered locomotives considerable discussion has arisen from time to time as to the reliability of the gear to retain its exact position at all points of cut-off. As may be expected, the inevitable wear of any mechanism, particularly in joints or other parts subjected to shocks and constant friction, will, in the course of time slightly affect the exact position of any moving part at the extreme end of the connections. This may be particularly noted in the Stephenson valve gear, where the movement of the valve is effected after passing through an involved number of bearings or joints.

A new reverse gear, known as the Franklin Precision power reverse gear, and manufactured by the Franklin Railway Supply Company, New York, has already met with much favor among leading railroad engineers, and a series of interesting tests were recently made at Franklin, Pa., in the presence of many leading experts, the object aimed at being to subject the appliance to such shocks as would occur as if the device was in actual service on a locomotive in operation, and by increasing the shocks to even a greater degree of intensity than would arise in actual service. The new reverse gear, as its name implies, is particularly designed for precise adjustment of cut-off. It consists of a 10 in. by 18 in. cylinder, with all parts enclosed, being of the best material and sufficiently heavy for the hardest service. The operating valve is attached to the rear end of the cylinder and is controlled by a hand wheel located in the cab, the wheel being provided with an indicator showing the point of cut-off, and is connected to the gear by an operating rod. The wheel and rod are not in any way affected by the stresses or shocks incidental to the functioning of the gear. No guides or crosshead is used in this new type of reverse gear, the thrust being through the piston. Rods and levers are also eliminated and there are no pins or bushings to wear and gradually affect the accuracy of the operation of the valve, no adjustment being provided, as none is required.

The apparatus used in testing the appliance consisted of substantial frame work, so that the reverse gear may be said to have been secured in the same way as if applied to a locomotive. Application of the cab control wheel and opearting rod was made in the same relative position as actual service requires, and the cut-off indicator set at its proper relation to the gear. Compressed air at a pressure of 105 lbs. per square inch was applied to the cylinder. A set of gauges was attached to the cylinder compartment for pressure reading, bleed cocks being installed at each gauge, to subject the reverse gear to stresses similar to those received from the valve gear when a locomotive is running an extended rod was attached to the gear piston rod. This rod passed through an adjustable friction clutch by means of which varying and very heavy resistances could be applied.



VIEW OF THE NEW "PRECISION" POWER REVERSE GEAR FOR HIGH POWERED LOCOMOTIVES.

To the friction clutch was attached a connecting rod, which was operated by an eccentric with one-inch travel, driven by an electric motor. The eccentric served to reciprocate the clutch on the extended piston rod, subjecting the gear to shock and reversal of stresses equaling those occurring in actual service.

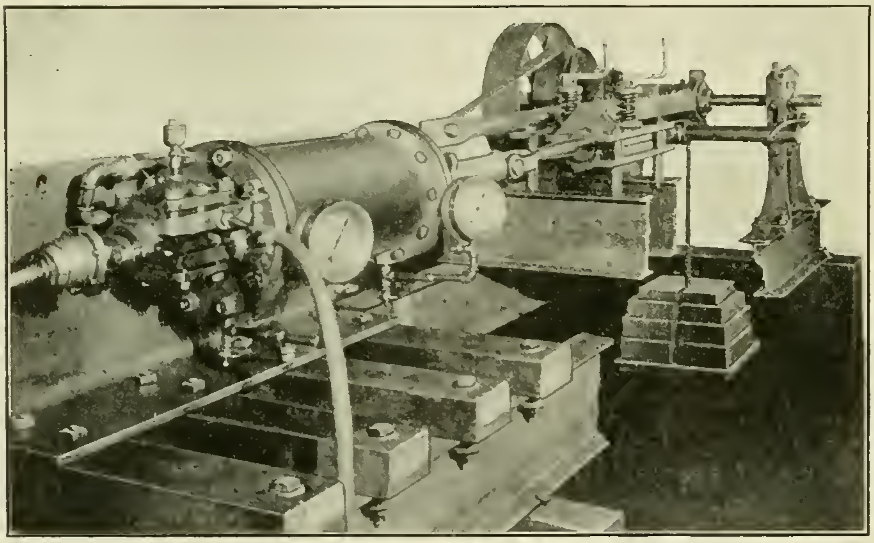
Frictional resistance between the adjustable clutch and extended piston rod was obtained by tightening the clutch. These frictional resistances were calibrated by hanging known weights on a cable which passed over a pulley and was hooked on the extended piston rod. When the friction of the clutch stopped the weight from moving, the frictional resistance equaled the load on the cable. This weight arrangement was used to establish a known frictional resistance.

Two conditions were considered, the first where the force acting on the gear piston was the same in both directions, the second an unbalanced force acting in one direction only. In the first case the desired frictional resistance between the clutch and rod was obtained as outlined above, and the cable and weights were disconnected from the rod. The motor was then started, and the clutch forced to travel back and forth on the piston rod 320 times per minute. Observations were taken on ten separate tests, each test being run without a stop for 30 minutes.

To duplicate the condition of an unbalanced force acting on the gear in one direction only the frictional resistance of the clutch was first set to equal the weight hung on the rod and the weight not disconnected.

In starting these tests observations were taken with no load on the gear in order to establish the position of the cab indicator relative to the actual point of cut-off. Moving the indicator from corner to corner and setting to any desired cut-off the relative positions of the indicator and piston checked in every case within 1/32 in.

Seven separate running tests were made with the clutch operating against the gear in each direction. The first test was run with 500 lb. frictional resistance between clutch and piston rod and the resistance was increased 500 lb. for each test until a load of 3,500 lb. was reached. With the motor reciprocating the clutch 320 times per minute there was absolutely no movement of the piston. The gear was moved from corner to corner slowly or as rapidly as desired and the cut-off always checked with the position shown by the cab indicator. While under load the force required to adjust the cut-off was so small that the operating rod could be rotated by hand without using the cab control wheel. The gear absorbed all shocks, no vibration or stresses being transmitted to the cab control wheel or indicator.



TESTING THE NEW "PRECISION" POWER REVERSE GEAR MOUNTED ON A SPECIALLY CONSTRUCTED MACHINE.

To demonstrate the operation in case of leaks the pressure in the cylinder was bled down approximately 15 per cent. Under these conditions the piston moved .005 in. each way under load. When the leakage cock was closed the pressure automatically rose and stopped entirely all movement of the piston.

To determine the effect of an unbalanced load in one direction only the clutch was set for 2,000 lb. and weights left attached, the clutch and weight equaling 4,000 lb. one way and zero the other. Under these conditions the gear immediately set up the differential pressure in the cylinder required to absorb the shocks. There was no movement of the piston and bleeding of each cylinder compartment by hand had no effect.

To further unbalance the load the clutch pressure was increased to 2,500 lb., making a load of 5,000 lb. acting on the gear in one direction only. No movement of the gear was perceptible, the cut-off being held as rigidly as it was in the previous test.

The result of the tests clearly demonstrated the accurate micrometer adjustment of cut-off; the complete stability of cut-off and absolutely no trace of creeping; pressure automatically set up to resist sudden unbalanced forces and maintain stability of adjustment; all shocks absorbed by air; minimum air consumption; adjustment of cut-off with minimum physical effort; when air is cut off, the gear remains positioned corresponding to the last indicator and cannot be changed until air or steam is again used.

Reinforced Concrete Railway Wagons

In a recent issue of the *Verkehrstechnik,* A. Kleinfigs, in an illustrated lengthy article claims that the chief advantages of reinforced concrete for wagon construction lie in their reduced maintenance costs, their being fireproof, and cheaper initial cost when compared with all-steel wagons. Where timber and steel or timber construction alone is employed, there is very little advantage. The rapid corrosion of steel wagons, particularly when used for coal traffic, can only be avoided by the frequent use of anti-rust paint, which, at the present time is expensive. The tare weight of a concrete as against all-steel wagon, is greater by about 20 per cent. in the case of a 20-ton wagon, and its gross weight some 6 or 7 per cent. greater. In both cases the initial cost of the running gear, buffers, fittings, etc., is alike, but with concrete the underframe and body is cheaper than in the case of either steel or timber construction. An open goods wagon of 20 tons capacity, can, at the present time, be bought for 42,000 marks, whilst a similar all-steel wagon costs 54,000 marks. In the case of passenger coaches, the use of concrete is undesirable on account of its being cold and damp, and also its increased weight and cost of construction. Reinforced concrete is particularly useful for open mineral wagons, timber and rail trucks and refrigerator vans.

Electrification of the Italian Railroads

A message from Rome says that Italy has decided to electrify 5,000 miles of her railways, and a mission, including many well-known Italian experts in electrical science, will study the best systems of railway electrification in the United States.

New Rail Motive Power Tried in Roumania

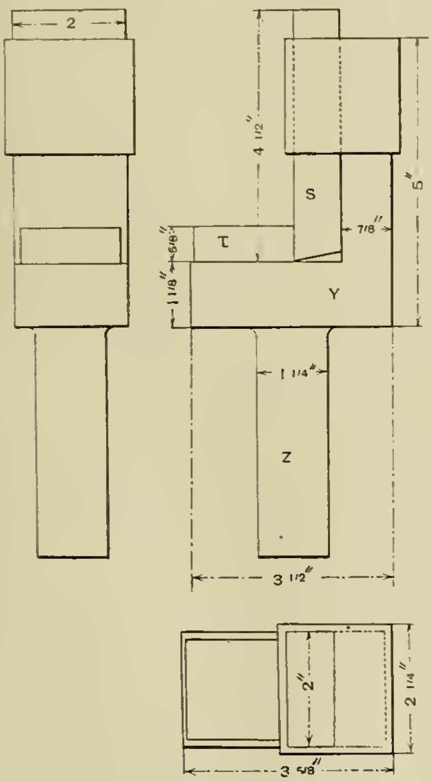
Airplane motors and propellers are being tried out at Bucharest, Roumania, as motive power for the hauling of freight cars along railroad tracks. In trials at an aviation field a few miles from Bucharest, April 26, one motor with shaft and propeller installed on a flat car pulled two empty freight cars at a speed of thirty-three miles an hour.

Ingenious Labor Saving Devices in Use

In Some of the Leading Railroad Shops

Machine for Trimming Cold Chisels

There is a handy little tool in the blacksmith shop of the Erie Railroad at Marion, Ohio, for trimming the ends of cold chisels. It is a one-man affair. Ordinarily, when a blacksmith has dressed a chisel he needs a helper to strike while he holds the trimmer and the chisel. With this device he can dispense with the helper. It consists of an L-shaped forging *Y* having a square stem *Z* that fits into the hole



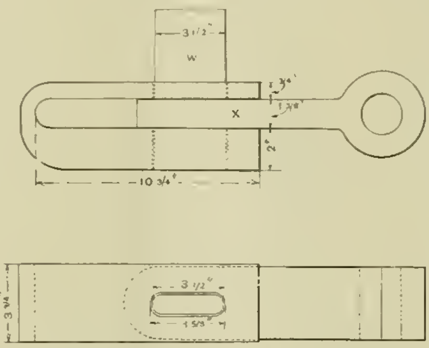
DEVICE FOR TRIMMING COLD CHISELS IN USE ON THE ERIE.

in the anvil. The upright portion of the forging has a band welded about it which serves as a pocket and guide for the cutter *S*. This last is of tool steel hardened and shaped like a shear knife at the lower end. A small square anvil *I* with a square stem fits into a hole in the horizontal portion of the forging, just as the stem *B* fits into the anvil.

After the chisel has been forged to shape, it is laid on the anvil *D* and the cutter *C* dropped down on it. A blow of the hammer causes the cutter to trim the chisel.

Punch for Spring Hangers

There is also a punch for spring hangers that is used under a steam hammer for punching the key holes in spring hangers. It consists of a U-shaped forging with one leg considerably thicker than the other. An oblong hole is cut through the two holes into which a hardened steel punch *W* is loosely fitted. The spring



PUNCH FOR SPRING HANGERS IN USE ON THE ERIE.

hanger *X* is heated and slipped between the two legs, and the punch driven through by the steam hammer.

Seat for Dressing Sledges

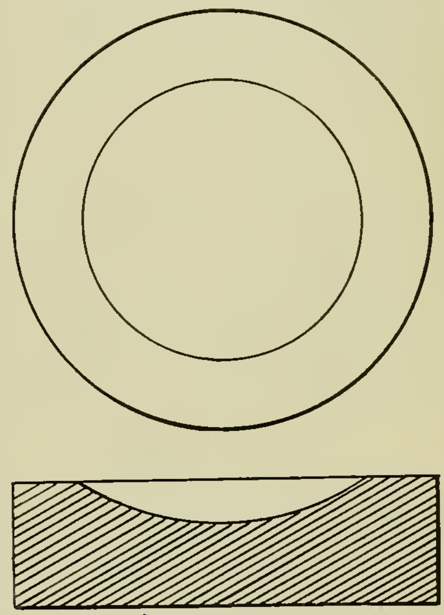
It is a rather long and difficult job for a blacksmith to redress the face of a sledge hammer and give it a properly rounded surface. The simple die, shown herewith, enables the work to be done very quickly under a steam hammer. It consists of a disc about 6 in. in diameter and 1¾ in. thick, into the upper face of which a spherical pocket is sunk. This pocket is about 4 in. in diameter and ⅝ in. deep, struck with a radius of about 3 9/16 in. After the hammer has been dressed, the face end is heated and set on the pocket, when a few blows of the steam hammer on the upturned pene drives it home and gives the face the rounded surface that is desired.

Boring Air Brake Cylinders on a Wheel Borer

It has been the practice to rebore and bush the cylinders of the Westinghouse air pumps for the whole road at the Meadville, Pa., shops. The volume of this work at last became so great that the department was swamped and the output did not keep up with the demand. In reboring and bushing the pumps a bushing ⅜ in. thick is used. The work was done in a lathe but this was found to be too slow. Accordingly the method now in use was devised.

The machine used is an ordinary car wheel boring machine, fitted with a Davis micrometer boring bar.

The set up for boring the cylinder is shown in Fig. 1. In this *N* represents a base plate which is held central on the table of the machine by means of the jaws *O* of the universal chuck. The cylinder is placed on this base and centered by means of the plug *Q* which is bored out to slip over the boring bar *R*. The conical surface is dropped into the cylinder and by pressing down on it with the roughing tool *V*, it is squared and the cylinder drawn to the center; it being understood that the tools used in the boring bar are squared on both sides, so that as the lower one is pressed down on the plug *Q* the latter is moved so as to be square with the bar. The plug thus centers the cylinder with the bar, when it is clamped to the base plate with the straps as shown. The plug is then removed and it is bored out to a standard diameter, the tools being set to micrometer measure-

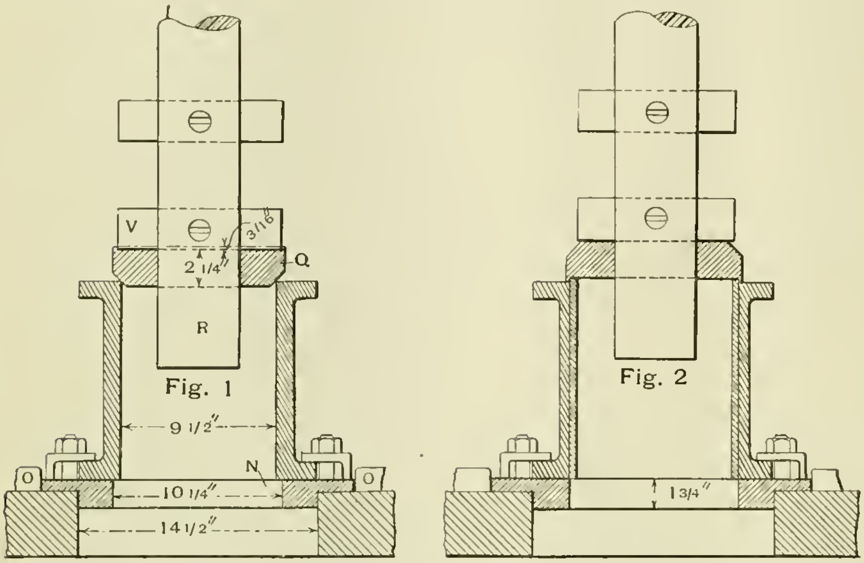


DISC FOR FORMING FACE ON DRIVING SLEDGES IN USE ON THE ERIE.

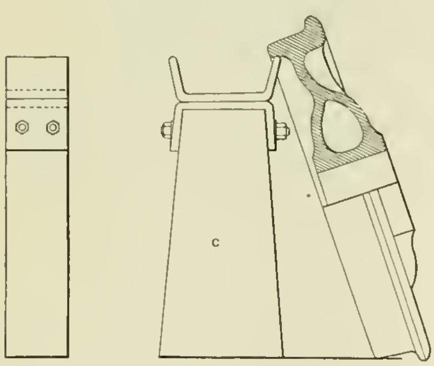
ments in the boring bar. This makes it possible to turn the bushings to a standard diameter by a micrometer gauge so as to insure a uniformity of pressure in putting them in place. They are made a trifle long so as to project beyond the end of the cylinder when in place as shown in Fig. 2. The cylinder is placed on the base as before and the plug reversed and set over it. It will be noticed that the upper side in Fig. 1, has a lip around the outer edge. This lip sets down over the end of the bushing and, when the boring bar is run through the hole in the plug, the cylinder is centered. When this is done the cylinder is again clamped to the base and the bushing bored and faced off. It is a unique use for a wheel borer and one that has served to greatly decrease the time required for this class of repairs.

Wheel Support

In connection with the wheel borer in the shops of the Delaware & Hudson at Watervliet, New York, there is a very simple and handy wheel support to hold the wheel in an upright position after it has been rolled up to the machine and before the lifting tackle to place it in the machine has been adjusted. It consists of a substantial block *C* bolted to the floor and capped by a U-shaped piece of flat steel the upper end of whose legs are of the proper height from the floor to catch under the rim of the wheel as it is leaned against it as shown in the illustration. This avoids throwing the wheel to the floor and holds it in a convenient position for the adjustment of the tackle.



DEVICE FOR REBORING AND BUSHING CYLINDERS OF WESTINGHOUSE AIR PUMPS. IN USE ON THE ERIE



WHEEL SUPPORT AS USED AT THE DELAWARE AND HUDSON SHOPS.

Oil Fuel on French Railways

Details collected from French sources are given of the experiments carried out by the Orleans Railway with Mazout, a residual oil obtained from petroleum, in the endeavor to find a fuel which would minimize the consumption of coal, now so scarce and dear in France.

A 1909 Pacific type engine was adapted for the purposes of the trials, carried out in the large locomotive shed in the rue du Chevaleret, Paris. A tender fitted with an oil reservoir was attached to the engine, and a fire was started in the latter. As the oil only becomes semi-fluid at 20-25° it is brought to this temperature by means of a steam coil. The oil mixed with steam taken from the engine boiler passes into the distributor, and is sprayed into the firebox. Inflammation of the oil starts up the heating, and maintains it. The intensity of the fire is controlled by the distributor cocks regulating the steam and air pressure. Steam was raised at the trial in 45 minutes against 3 hours with coal. Only one burner per engine is necessary, and the conversion of a locomotive from coal to oil firing can be carried out under three days at a cost of between 40,000 and 50,000 frs.

A trial run with two saloon carriages was made between Paris-Austerlitz-Aubrais, the journey being completed in 1 hr. 48 mins. in a manner satisfactory to everyone concerned. The advantages noted were: Reduction in labor, absence of clinker, quicker control of heating power, complete absence of cinders and smoke.

The heating efficiency is shown by the following figures, taking 100 units as a basis:—

Loss through incomplete combustion	.9
Loss through smoke	14.0
Loss through steam to atomizer	1.2
Used up by surplus air	3.2
Loss through radiation	5.7
Available for steam raising in boiler	74.7

The consumption per 100 ton/kg., including engine and tender, amounts to 4.200 kg. with coal, and only 2.160 kg. with oil fuel.

Mazout is already in use at the Paris Waterworks, also in central heating plants in Paris and on the Riviera. The conversion of 400 locomotives to oil firing has been decided upon.

Electrification of the Gothard Railway

Through the electrification of the 45-km. stretch, Erstfeld—Airolo, of the Gothard Railway, no reduction in running time has been achieved. Whilst with steam locomotive speeds of 90 km. per hour (55.8 m.p.h.) upon a grade of 2/1,000 were obtained, the electric locomotives are designed for a maximum speed of only 75 k.m. per hour (46.5 m.p.h.). Through electrification the greatest advantages lie in the mitigation of smoke and economy in operating costs owing to the great coal saving effected.

The latest type of electric locomotive to be placed in operation during this year is of the 2—4—2+2—4—2 type, having a maximum speed of 75 km. per hour upon the level with 300-ton trains; 50 km. per hour on a grade of 26/1,000. Adhesive weight 74 T. Total weight 113 T. Four motors (single phase), each of 300 h.p. hourly rating, and 1,020 r.p.m.

Work is proceeding with the electrification of the 61-km. stretch of line between Lucerne and Erstfeld as also the 120 km. of the southern main line, so that it is hoped shortly to have over 422 km. electrically operated, which represents 7 per cent of the whole of the main lines of the Swiss Railways.

Ball-Bearings for Railway Service

Roller and ball-bearings on railway have been experimented with for many years, both on American and European railroads. While the reports have been more or less of a favorable kind, it would appear that it has been left to the Swedish railways to put the experiments into practice. Trials have been conducted on the Swedish State railways and very satisfactory results obtained. A train of 26 wagons fitted with ordinary bearings was increased to 30 wagons or 15 per cent with ball-bearings upon a road having grades of 1 per cent 5 kms. long. The train fitted with ball-bearings was stopped and started without difficulty upon these grades. This could not be done with ordinary bearings.

In another trial, a load of 29 wagons of total weight about 1,300 tons (ordinary bearings) could be increased to 39 wagons or 1,800 tons when fitted with ball-bearings, and no increase in fuel consumption was noted. Upon the result of these trials, the Swedish State Railways have decided to equip the whole of their goods stock with ball-bearings, and with this end in view, have associated themselves with the Skefko Co. of Gothenburg.

The Necessity for Improvement in the Design and Operation of Present-Day Locomotives*

By W. H. Snyder, M. E., Lima Locomotive Works

No one it is believed will dispute the fact that present-day operation of high-power locomotives is one of the most vital questions with which our railroads are concerned. The demands of constantly increasing passenger and freight traffic have brought about a constant increase in size and power of our locomotives. It has not been so many years since an engine of 25,000 or 35,000 lb. tractive power was sufficient to take care of all requirements. Twenty years ago cylinders 22 or 23 in. in diameter were considered as about the limit in size. Constantly increasing demands on motive power since that time have brought us to the hugh Mallet engines with tractive powers of from approximately 150,000 to 175,000 lb. Our simple engines have increased from 20-in. or 21-in. diameter cylinders up to 31-in. cylinders, with a tractive power ranging from around 35,000 lb. to 83,000 lb. In view of the rapid strides that have taken place in increasing the size and power of locomotives within the last few years, it seems rather out of place to predict that the maximum has been reached. It is also true that the use of improved devices has made possible the satisfactory operation of the large locomotives of today. Everything seems to indicate that we have not reached the maximum capacity of the locomotive even within the present limits of clearance and rail load, and we may expect to see these same engines made far more powerful and economical by the application of devices which are now available or which are already being given serious attention.

In view of the foregoing, the most vital matter which confronts locomotive designers and operating officials is that of increasing the capacity as well as the efficiency of the locomotives which we have today. In many ways these problems have already been attacked and great improvements are continually being made. In the following paragraphs an attempt will be made to draw attention to some of the problems which our present-day locomotives bring forth and upon the proper solution of which depends their success.

Combustion and Steam Generation

In order that large engines may operate properly, it is of course necessary that a sufficient supply of steam be furnished to cylinders so that they can be made to produce their maximum horsepower. It is not enough to provide a given number of square feet of heating surface in the firebox and the tubes so that we may be reasonably certain that sufficient water will be evaporated to supply the cylinders. It is, however, necessary that we take into account proper construction of the boiler necessary firebox volume to produce the best possible combustion of fuel, and the design of grates so that fuel will be economically burned to such an extent only as required by the maximum evaporation of the boiler.

In producing heavy motive power it has been necessary on account of prohibitive axle loads to apply a sufficient number of axles under the engine to reduce the individual axle load to within reasonable limitations. This has lengthened out the engine to such an extent that boiler design and maintenance has become a serious problem. In the first place, it is necessary to design a boiler that will properly function with the other vital parts of a locomotive. At the same time the length has become such that the use of combustion chambers is a necessity to avoid a prohibitive length of tube. Large engines have been constructed with a tube length of 25 ft. and it seems that no definite rule has been established as to what the limit of length of tube of a given size should be. Experiments have been made on this subject and it has been said that the maximum length in inches of a tube of a given size should be approximately 100 times its diameter in inches. It would seem that this is as nearly correct as any general rule which has been devised and one which can be readily followed.

The author does not feel that any definite rule should be made in regard to length of tubes, for this might bring about a condition whereby other vital features of the engine would be involved in order to abide strictly to the length as noted above. Tubes 2 or 2¼ in. in diameter in excess of 20 ft. in length are questionable, and this feature should be looked into carefully before a decision is reached.

The advent of long combustion chambers has brought along with it the necessity for increased attention to boilers. The application of a long combustion chamber requires a large number of additional staybolts and it would naturally be expected that a boiler of this kind would require more staybolt attention. For this reason, if for nothing else, there is no doubt that a proper installation of flexible stays in the firebox and combustion chamber will prevent a great deal of the staybolt trouble which has been experienced in the past.

Complete as well as partial installation of flexible staybolts has met with considerable degrees of success in many railroads, and the consensus of opinion seems to be that their application goes a long way toward overcoming staybolt trouble. The extreme length of firebox sheets due to the application of a combustion chamber, naturally increases the relative amount of expansion and contraction of the boiler It has been found by experiment that if flexible stays are properly applied to the boiler when built, while they may make a slight movement during the firing up of the locomotive, after the locomotive has become completely heated and steam pressure raised, these stays assume their original position. The fact that movement of the staybolt can be shown while the boiler is being fired up shows that something of this kind is necessary, for if rigid stays were applied, this movement would have to be taken care of in some other manner, which would be detrimental to the boiler. Although long combustion chambers require more attention in maintenance, this will be offset by the increased firebox volume and the resulting better combustion.

On account of height limitations, the height of the dome as well as the steam space in the boiler has been reduced to such an extent that difficulties are being encountered with the proper life and maintenance of superheater equipment, because too much water is drawn over through the throttle into the superheater. This is a question requiring experiment to determine as nearly as possible the minimum steam space which should be provided for boilers working on various grades. Cole in his bulletin on locomotive ratios, has given figures for the minimum height of crown for different grades and lengths of firebox. This, it is believed, is the first effort made to tabulate this information and get it in shape so that it could be followed. It is thought that in most cases the minimum height that he gives will work out satisfactorily. There is, however, one point which is not taken into consideration, namely, the height of the dome. This has a great deal to do with obtaining dry steam, and in the opinion of the author, consideration should also be given to the height of the throttle above the water line as well as to the steam space in the boiler. Considerable development on this subject is now well under way, and we can confidently expect results of value in the near future.

*Abstract of a paper presented at the Spring meeting of the American Society of Mechanical Engineers, held in Chicago, Ill., May 23 to 26, 1921.

As noted above, it seems that we have about reached the limit of size of cylinders and size of boiler due to road clearances. To undertake to provide additional road clearance on practically all of the main lines today would mean a total expenditure of money entirely out of proportion to the benefits that would accrue.

On account of the apparent limitations of piston thrust and road clearances, the greatest problem we have with our large locomotives today is to increase their capacity without exceeding greatly our present sizes. Anything to increase the hauling capacity of the locomotive without increasing the height and width limitations under which the locomotive must work might be called an essential capacity-increasing device. A few of these with which we are most familiar and which have proved beyond doubt their desirability are the superheater, the brick arch and the mechanical stoker. There are possibilities of still increasing the efficiency of the superheater without increasing the size of the boiler in which it must operate. There are also possibilities and constant improvements in the design of brick arches which lend to higher evaporation and better combustion of fuel. It has been stated that when a locomotive requires as much as 6,000 lb. of coal per hour it has gone beyond the limits of the ordinary fireman. Automatic stokers have been in use so long that their dependability for heavy power is no longer in question. Many men are studying this particular feature of locomotive design and operation, and we may confidently expect in the future a gradual increase in the efficiency of these mechanisms. As they stand today they are an unqualified success, and time and study will bring about the necessary refinements so that better combustion and less coal per horsepower will be used.

We have not as yet gone very extensively into the use of feedwater heaters. It has been proved without a doubt in foreign countries that the feedwater heater is an essential capacity-increasing device as well as an economical addition to the locomotive. In this respect, then, it would seem that we are somewhat behind the Europeans, and there is no doubt that in the near future when the economies that can be effected by the use of feedwater heater are realized it will become almost as general as the superheater today.

Another small item which has received only passing attention in this country is the variable exhaust. As is well known, a variable exhaust that can be properly operated and which will not require much maintenance attention will have a great tendency to relieve back pressure at high speeds, and its operation will also provide the necessary draft at slow speeds. It is one of the small things that deserves consideration and study and something which it is felt will be worked out satisfactorily for the future.

The Engine Proper

There have been no radical changes in the general design of cylinders. The use of outside steam pipes has resulted in advantages both from a casting and maintenance standpoint. It would seem well worth while to consider a design of cylinder by means of which the weight could be reduced to a great extent, permitting of additional weight of other parts and thereby increasing the capacity of the locomotive.

The design of valve gears has received a great amount of attention, and many accepted types are now available. In all of these every effort has been to better the steam distribution. In maintenance we are far ahead of engines used twenty years ago. There is yet, however, much to be desired in steam distribution, and this subject will bear as careful study in the future as it has in the past.

Power Transmission

When we consider that as much as 150,000 lb. piston thrust is being transferred through a single main rod and from this into the driving wheels of a locomotive, it is not difficult to understand why troubles are experienced with main crankpins and particularly side rod bearings at the main pin. In order to provide the proper strength to take care of this tremendous piston thrust, it has been necessary to design extremely heavy main and side rods. The piston thrust is not the only consideration in this connection. The inertia forces, particularly in drifting, at times reach figures that are even greater than the piston thrust. Practically all of this must be taken care of through the main crankpin and the necessary connections to the side rods at this point.

All are familiar with the large number of experiments which have been carried on to produce a steel that would give a higher elastic limit than the ordinary high-carbon open-hearth steel which was successfully used until engines reached their present proportions. The use of such steel for side rods, main rods and piston rods has been principally confined to heat-treated and quenched forgings, which permitted the use of sections which were considerably lighter than what could be used with the ordinary open-hearth annealed forgings. Steel has also been produced which gives a high elastic limit and which can be successfully used with ordinary annealing, permitting very considerable reductions in weight compared to the ordinary open-hearth steel formerly employed. The use of such a steel does away with quenched forgings and permits of rods being heated for closing in straps and similar work without destroying the quality of the material as is the case with quenched forgings.

Main and side rods have been produced and have been in successful operation for the past few years in which the piston thrust is carried directly from the main rods to the side rods back of the main wheel. This does not in any way reduce the piston thrust that must necessarily come on the main rods. At the same time, however, it does reduce very considerably the piston thrust that must be transferred through the main crank pin into the side rods, thereby alleviating to a very great extent the troubles that have been experienced with large side rod connections at the main pin. Such a design does not increase the total weight of the rods to an extent likely to cause any appreciable increased difficulties from a counter-balance standpoint.

The design of main and side rods as well as main crank pins will always be a vital question in the construction of locomotives. It has been necessary and always will be in designing the rods for locomotives to assume certain arbitrary limits of fiber stress based principally upon past experience. It is impossible to take into account all the stresses produced in rods when a locomotive is in operation, and for this reason the allowable fiber stresses in tension, compression and bending must be taken comparatively small in comparison to the elastic limit obtained in such forgings.

Rod design is a study in itself and presents a subject, the details of which cannot be covered in a paper of this nature. There has already been a great deal written and a number of experiments conducted regarding the proper design of rods to successfully stand up under severe usage and at the same time reduce to a minimum the ordinary difficulties presented from the standpoint of counterbalance. Hollow bored piston rods, light designs of crosshead and piston, the use of high-tension steel for side and main rods, as well as the use of hollow-bored crankpins, are familiar to all. More careful attention should be paid to the quality and upkeep of rod bearings, and every endeavor should be made to provide bearings of such quality and design that renewals will be reduced to a minimum.

Before the advent of our present-day large locomotives with their tremendous piston thrust, it was not a particularly difficult matter to design a suitable main crankpin. The size of the main pin was made to a great extent to accommodate the cylinder centers and other parts of the locomotive, and so long as the bearing pressure per square inch of projected area based upon maximum piston thrust was within a limit of 1,600 or 1,700 lb. the main pins would work satisfactorily. The ordinary design of smaller locomotives was such that the main side pin would also be sufficient. It has been found in comparatively recent years, however, that the old rule would no longer apply. In order for the main crankpin to be of sufficient size to withstand heavier piston thrust and still maintain the fiber stress within workable limits, it was necessary of course to increase the diameter proportionately. This brought up the question of rubbing speed. It is a well-known fact that if the rubbing speed is too high, bearings will heat and wear very rapidly regardless of the bearing pressure. A main pin designed properly for heavy piston thrust must therefore be so proportioned that the length will bear a certain relation to the diameter within very close limits. On account of the necessity for keeping cylinder centers as close together as possible because of road clearances, if a proper length of main pin is obtained, its proper size presents a difficult proposition. This is one of the great difficulties which the author is confident will be overcome in the future by the proper application of a design previously mentioned, wherein a large part of the piston thrust is transmitted directly from the main rod into the side rod, thus reducing the force that previously has been taken through the comparatively short and large-diameter main side pin. It is not sufficient to establish a definite set of cylinder centers and frame centers for a given diameter of cylinder. In the design of large locomotives different conditions and problems are confronted which make this point a particular study in itself and which should be gone into thoroughly before a decision in regard to the design is reached.

Counterbalance

It is a very difficult matter to separate the question of counterbalance from the design of connecting rods and reciprocating parts. There is a great diversity of opinion in regard to the proper amount of counterbalance which should be applied to locomotives. It is easier to state the counterbalance result desired than to tell exactly how it is to be obtained. We generally think of a locomotive being counterbalanced properly when it will ride satisfactorily and without excessive vibration, and it seems that this is the only rule by which counterbalance is judged. There are in operation heavy Santa Fe type locomotives which have between 35 and 40 per cent of the reciprocating weights counterbalanced and they are said by traveling engineers to ride easily. The author believes that with our present heavy engines with long wheelbase, it is not necessary to balance as much as 50 or 55 per cent of the reciprocating weight. In fact, it is quite possible that we may be able to counterbalance a smaller percentage of reciprocating weight than has heretofore been attempted, especially for long, heavy engines, provided the revolving weights at the main pin can be properly taken care of. Every effort, however, should be made to balance all of the revolving weights on the main pin. If, for example, we lack 400 lb. of balancing the revolving weight on the main pin, the effect on the track is exactly the same as if we had 400 lb. of counterweight on any of the other wheels to balance reciprocating parts.

There is an added difficulty to this problem, because the action of the counterweight in wheels other than the main is exactly opposite to the force produced by the weight on the main pin, which is not counterbalanced. This condition results in increased track stresses in frames and other parts of the locomotive. There is also a tendency at high speeds when a condition like this exists for the main wheel to lift from the rail, while the wheels other than the main are exerting their maximum force on the rail. This reduction of weight on the main wheel at the time when the other wheels are exerting their maximum force on the rail provides a tendency for the main wheel to slip when it is impossible to slip the remaining wheels. No one, it is believed, can give any idea of the stresses which are produced in side rods, frames and other parts of the locomotive due to a condition of this kind. In fact, there have been instances when the rods were torn off and crankpins loosened for this reason alone.

On account of the extremely heavy weight required at the main pin in order to have the proper strength of parts, particularly for large freight locomotives, it is a difficult matter to balance very much—if any—more than the revolving weights at this point. This being the case, if as much as 50 or 55 per cent of the reciprocating weights is to be balanced, it is easily seen that all the counterweight for reciprocating parts must be added to the counterweight in the wheels other than the main. Thus, in order to balance a high percentage of reciprocating weights on engines of this class, it is necessary to add counterweight to the wheels other than the main to such an extent that track stresses and riding of the locomotive at comparatively high speeds become a very serious question.

The author is of the opinion that no definite set rule can be established in this regard, but that each particular design is a study in itself, and wherever revolving weights at the main pin are encountered such that they cannot be properly counterbalanced, steps should be taken to provide the best means possible of reducing revolving weights at this point as well as providing reciprocating parts as light as possible consistent with strength. This of course has been accomplished in the past by hollow-boring the main pins and piston rods and by using a light design of piston head, which indicates that a steel having a high elastic limit with the proper elongation and reduction of area should be employed. The use of such steel has already proved that it can be depended upon. One of the principal fundamentals in counterbalance is to keep the reciprocating weight as light as possible.

The Running Gear

On account of the large increase in the size of cylinders of present-day heavy locomotives over those used several years ago, the cylinder centers have been spread until they have reached practically the clearance limitations of the railroads; and the necessity for larger journals to carry properly the increased axle loads has caused the frame centers to be brought nearer together.

This condition increases very materially the distance from the center of the cylinder to the center of the frame, which of itself produces greater strain in the frame and at the same time increased pressures on the driving-box bearings as well as on shoes and wedges. In addition to the above, piston thrusts have increased from approximately 65,000 lb. to approximately 150,000 lb., and means must be provided to properly take care of the increased piston thrust along with the increased overhang.

The accompanying diagram, it is believed, shows very clearly the increased forces that a frame must stand in order to properly take care of the tremendous increases in piston thrust as well as the increased leverage caused by the very considerable lengthening of the distance between the cylinder centers and the frame centers.

While discussing the subject of frames it is hardly proper to ignore the vital question of frame cross-bracing. Substantial and sufficient cross-braces should be applied between the frames and rigidly bolted thereto to form a rugged structure which will not rattle to pieces. Sufficient bearing for bolts and adequate bolting

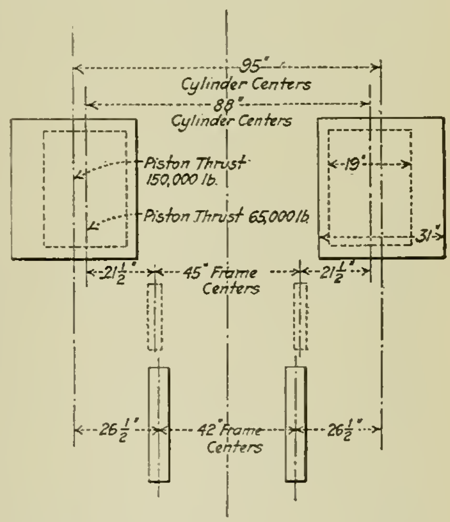


DIAGRAM SHOWING INCREASE OF OVERHANG OF CYLINDERS IN PRESENT-DAY LOCOMOTIVES.

flanges are a very important feature. At the same time it must be borne in mind that there is a possibility of tying up the frames so rigidly that there will be a tendency for failures ahead of the front pedestal and just back of the cylinder fit at a point where it is practically impossible to obtain sufficient reinforcement.

It seems as though the design of driving-boxes, driving-box brasses had not successfully kept pace with the rapid increase of piston thrust. We have in almost general use the same type of driving-box brass that has been standard on locomotives for years. The design is such that the brass extends about half-way down over the journal. Inasmuch as the brass must take up the piston thrust, it is very evident that we shall have trouble in taking care of driving-box brasses until a suitable design is produced—one in which the brass will cover much more of the front and back projected area of the journal than is now the case. In the heavy engines of today the main driving-box brasses in particular wear rapidly, due to the tremendous thrust which they are forced to stand up against. It is true that some work has been done along this line and designs produced which will help at least to overcome the difficulty. There is, however, a wide field for improvement, and this particular subject alone warrants the study and investigation of all who are concerned in the design and operation of locomotives.

Many experiments have been tried, and in many cases they have gone beyond the experimental stage and have proved to be very satisfactory. Among these are driving-box brasses cast into the driving-box. Many boxes are in use today where the brasses are keyed into the box, making them rapidly removable for replacement. However, the author feels that none of these has approached the solution to the problem, which lies in producing a design that will surround the journal with a bearing as completely as possible and still lend itself to comparatively easy maintenance and reasonable cost of application.

Guiding and Trailing Trucks in Connection With Long Wheelbase

With our present heavy Mikado and Santa Fe type locomotives the length of rigid wheelbase is almost if not quite double the rigid wheelbase in ordinary service twenty years ago. It is unnecessary to comment upon the fact that it is a difficult matter to operate such engines around curves of even comparatively small degree and at the same time prevent the rapid wear of hub liners and driving-box faces, thus increasing quickly the lateral play to a prohibitive point and necessitating work in the shop to overcome it.

Santa Fe type engines with 22-ft. rigid wheelbase are not uncommon. Engines of this type and of this size will weigh in the neighborhood of 400,000 to 420,000 lb. When we stop to think that to move this tremendous mass of material around a 16 or 18 degree curve, a force of many thousand pounds is required, is it any wonder that we obtain rapid flange wear and the necessity for returning tires before the proper amount of mileage has been obtained? In the majority of cases, it is believed the force necessary to properly curve an engine of this kind has been applied at the front truck and the first driver. In most cases types of leading trucks have been used which produce a very small resistance on curves of small degree. In order to prevent rapid flange wear as well as to overcome the development of lateral play unnecessarily, designs have been produced which will give a high initial resistance of the front truck and provide a lateral motion for the front driver, with adequate resistance so that some of the guiding force is transferred back to the second pair of drivers.

Since locomotives operate the greater part of the time on tangent track, it is necessary to have a high initial guiding resistance which will not be increased when curving. In other words, a flexible wheelbase is produced which has all the requisites of the ordinary rigid wheelbase, but at the same time will overcome many of the difficulties now encountered in an attempt to operate engines of this size and length. Many designs of trailing trucks have been produced with the idea in mind of helping to remedy the conditions which have been noted above. These of course have met in a way the conditions which it was necessary to overcome. There is much yet to be done in producing a trailing truck which will have the proper facilities for equalization of spring rigging and at the same time produce an initial guiding force which can be kept nearly constant, thus avoiding the high final lateral resistance which is found in a good many of the trailing trucks now in use. The use of friction plates to produce the necessary resistance is undesirable on account of the uncertainty of the resistance obtained. What is needed is a positive centering device whose resistance will be adequate initially, can be always depended upon, and which will not mount up to prohibitive figures under the maximum swing of the trailing truck.

In addition to the foregoing, some work has been done in the way of producing a design by means of which the lateral play in locomotive driving wheels can be taken up without removing the wheels from under the engine or taking the boxes off from the axles. No doubt in the near future a practical device of this kind will be produced. This is another one of the many problems which can be worked out which will enable the railroads to keep their locomotives in service.

The advent some years ago of the power reverse gear overcame one of the great objections that engineers had to large locomotives. It is a fact that it is almost impossible for one man to reverse one of our large locomotives equipped with the ordinary hand reverse lever. Power reverse has come to be an essential part of engine equipment and has been found to be economical even though it may be used on a locomotive which could be comparatively easily reversed by hand.

Probably no one thing contributes more to the failure of side rods than the improper adjustment of shoes and wedges. If these are allowed to run loose, stresses in the side rods will amount to a very high figure and it is impossible to determine to what extent they may go. If the shoes and wedges are improperly set up, the driving wheels are very likely to be out of tram. This in itself brings undue stresses on the rods, which in time will unquestionably produce failures. The author feels that there are many cases where in attempting to overcome the failure of side rods we have deliberately increased their sections without giving due consideration to the cause of failure. Consideration of the foregoing brings us to the point of providing an adequate automatic adjustment of the wedge so that the difficulties mentioned will not be encountered. A satisfactory automatic wedge if properly applied and maintained will, no doubt, go a long way toward preventing side-rod failures.

Means for Increasing Nominal Tractive Power

All railroads have points on certain divisions where there is a critical grade or the necessity of starting a heavy load under adverse conditions. At such places increased tractive power is required which is not needed elsewhere. We are therefore confronted with the problem of producing a device which can be set to work to increase the tractive power of a locomotive to such an extent that the critical grade or the necessity for increased tractive power to start a train under adverse conditions will be overcome, thus enabling the engine to take its full tonnage over the entire division. This device should be so made that it can be applied when necessary and thrown out when the additional tractive power is not required. Designs have already been produced wherein an additional tractive power of 8,000 or 10,000 lb. has been applied to the trailing trucks of large locomotives. There is also a possibility of applying such a device to the tender truck, thus availing ourselves of the adhesive weight of the tender to help boost the engine over the critical points in a division. There is always present a possible potential boiler capacity which can be brought out by the use of a variable exhaust or other device sufficient to obtain rapid combustion at slow speeds.

What has already been done along this line may be taken as a start in the right direction. A certain amount of development work must be done in order that these necessary improvements may be made to operate satisfactorily. These problems require the co-operation of the railroads to provide the necessary means for trying out such devices which, after having been carefully considered, show that they have possibilities for future use.

The Ash Pan

The question of ash pans is also one needing serious consideration. With the large increase in size of locomotives in many cases we have evidently lost sight of the importance of this necessity. There are in use a number of rules stating what the proper air opening in the ash pan should be, some saying that the ash pan air opening should be equal to the net gas area of the tubes and others that it should be a certain percentage of the opening through the grates. While many of these rules have in a way proven satisfactory, at the same time it would seem that to get at the question logically we should determine the amount of coal that can be burned economically per square foot of grate and then on this basis provide an ash pan air opening that will give the required amount of air to burn satisfactorily the maximum amount of coal which is expected to be consumed. The amount of air that will flow through a given opening in the ash pan, it is believed, can be very closely approximated from the vacuum produced in the smokebox. This, of course, is only a suggestion, and it may be that when the question is looked into more carefully a more desirable and accurate method of determining the required ash pan air opening for proper combustion may present itself.

Lubrication

Lubrication is a subject which has received much attention and a great number of combinations and experiments have been made to determine the most satisfactory method. With our present high superheat the proper introduction of oil into the cylinders and valves of a locomotive is worth serious consideration. In many cases oil has been provided to both the cylinder barrel and the steam chest of superheater locomotive, and in other cases it has been provided to the steam chest alone. Both methods have given apparent satisfaction, but it is a difficult matter to state which is the better. It seems that if it has not already been done, experimental work should be undertaken to determine just how this best can be accomplished. For instance, one railroad may seem to get good results with one method, while another may use an entirely different method and both operate their engines satisfactorily. We do not know how much oil is used and it is difficult to obtain a direct comparison, due to the fact that no accurate data are kept in regard to the amount of oil supplied to either the valves or the cylinders.

It is common practice in European countries to provide a force-feed lubricator located very close to the cylinder. The ordinary method which they use in connecting up this lubricator is to provide a pipe to each end of the piston-valve steam chest. This oil supply opens directly over each end of the valve when it is in central position. In addition an oil pipe is supplied to the cylinder at its center. It is reported that by this method there is less carbonization of the oil than when it is fed into the steam pipes or into the center of the piston-valve steam chest. Whether or not this is so the author has no means of proving, but it seems logical.

In order to increase the tonnage which a locomotive can haul it is just as vital to decrease the resistance as to increase the power. Now it is not an impossibility to provide roller bearings for passenger cars, and there seems to be no reason why they cannot be used on freight cars. Of course this would mean very radical changes in design and a gradual displacement of present equipment, but the reduction of rolling resistance and the better facilities for lubrication which would be provided would be sufficient in time to overcome the necessary expense. All this may seem rather far-fetched, but it is at least worthy of consideration.

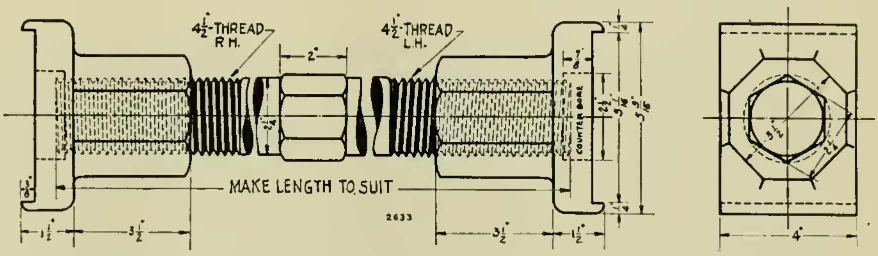
This question of lubrication may as well apply to other parts of the locomotive. The proper grooving of side-rod and main-rod brasses, or the use of babbitt inserts, are questions that should be taken up in connection with lubrication of these parts. A variety of opinions can be obtained from men operating locomotives in regard to the advisability of a number of methods which are in use at present and apparently giving satisfaction.

Conclusion

In summing up the situation, it may be said that the use of the superheater alone has increased the capacity of locomotives when compared with saturated engines of the same design to such an extent that no one would think of building a large locomotive for up-to-date railroad service without the application of superheat. This is one of the greatest strides that has been made in the construction of locomotives in the past few years. We must not content ourselves, however, with what has been done with this one device. The large locomotive of today has become a necessity and is here to stay. What we need to do now is to avail ourselves of the opportunities offered in the application of many of the labor-saving and capacity-increasing devices which have already been worked out and are giving satisfactory service, and at the same time look forward to the possibilities of applying other devices which are yet in their infancy, but which have proved beyond doubt that they are well worth our consideration and are of sufficient importance to warrant their adoption. There are many improvements yet to be made in locomotives and it behooves the operating officials of railroads as well as the leading minds in locomotive operation and design to get together and to continue to produce locomotives which in the next 20 years will be as far ahead of our present engines as our present locomotives are ahead of the locomotives that were built 20 years ago. Without the capacity-increasing devices which have been mentioned the large locomotive of today would be impossible—it could not be operated satisfactorily. Our large engines are an absolute justification of these improvements. Further developments are ready at hand and in their use lie the possibilities of still more powerful and economical transportation units built to operate within our present limitations of clearance and permissible rail loads.

Device for Spreading Locomotive Frames for Thermit Welding

The illustration shows a device for spreading locomotive frames for Thermit welding, developed by William Banks, Blacksmith Foreman, Yazoo & Mississippi Valley Railroad, Vicksburg, Miss. It can be used between pedestals or long sections of frames by applying different length screws. The device is very simple and inexpensive and can be manufactured in any railroad shop.



DETAILS OF ADJUSTABLE BRACE USED FOR THERMIT WELDING OF LOCOMOTIVE FRAMES.

Precision Device for Ordinary Lathes

In order to obtain the requisite pitch variation when using an ordinary lathe, the Precision and Thread Grinder Manufacturing Company of Philadelphia, U. S. A., have brought out a device by which the saddle of the lathe can be advanced by the required amount. An adjustable bracket bolted fast to the lathe bed, carries a short section of a wide rack, the rack being so arranged that it can be swiveled about a bolt in the bracket opposite the centre of the lead screw. A clasp-nut embracing the lead screw, has teeth on its circumference which engage with those of the rack. It is evident that as the clasp-nut travels along in contact with the rack it will be given a certain rotation proportionate to the inclination of the rack and so will cause the saddle to travel faster or slower thus increasing or diminishing the pitch of the thread being cut.

Items of Personal Interest

I. C. Climo, water master of the Burlington & Quincy at Beardstown, Ill., has been transferred to Centerville, Iowa.

C. C. Reynolds has been appointed road foreman of engines on the Santa Fe Rodendo Junction, Cal., succeeding F. A. Gibbs.

Harry E. Wells has been appointed general foreman of the Santa Fe, with office at Marceline, Mo., succeeding J. Banker, retired.

Minden McGee has been appointed shop foreman of the Atchison, Topeka & Santa Fe, with headquarters at Lamy, N. M.

Edward Rickerton has been appointed general foreman of the Canadian National Railways, with office at Port Arthur, Ont.

L. W. Gilbert has been appointed road foreman of engines of the Atchison, Topeka & Santa Fe, with office at La Junta, Colo.

F. A. Gibbs has been appointed terminal road foreman of engines of the Atchison, Topeka & Santa Fe, with office at Rodondo, Cal.

Fred S. Powers has been appointed road foreman of engines on the Toledo & Ohio, with office at Bucyrus, Ohio, succeeding W. A. Jex, promoted.

E. E. Chapman has been appointed engineer of tests of the Santa Fe system, with office at Topeka, Kan., succeeding H. B. MacFarland, resigned.

C. A. Dougherty, assistant district storekeeper of the New York Central at Elkhart, Ind., has been apointed storekeeper at Englewood, Ill.

C. M. Newman has been appointed master mechanic on the Baltimore & Ohio, with headquarters at Washington, Ind., succeeding E. J. McSweeny, transferred.

P. G. Lang, Jr., assistant engineer of bridges of the Baltimore & Ohio, with headquarters at Baltimore, Md., has been promoted to engineer of bridges, succeeding W. S. Bouton.

E. J. McSweeny, division master mechanic of the Baltimore & Ohio, with headquarters at Washington, Ind., has been transferred to Garrett, Ind., succeeding W. F. Moran, resigned.

B. W. Griffith, formerly assistant general storekeeper of the New York Central at Collinwood, Ohio, has been appointed district storekeeper, third district, with headquarters at Collinwood.

H. Modaff, assistant superintendent of motive power of the Chicago, Burlington & Quincy, with headquarters at Lincoln, Neb., has been appointed master mechanic, with headquarters at Ottumwa, Iowa.

Clement F. Street, formerly vice-president of the Locomotive Stoker Company, has opened an office in the Smith building, Greenwich, Conn., for the purpose of placing on the market the Street locomotive starter for application to locomotive trailer trucks and tenders.

T. E. Paradise, assistant superintendent of motive power of the Chicago, Burlington & Quincy, with headquarters at Lincoln, Neb., has been appointed master mechanic with headquarters at Hannibal, Mo., the position of asistant superintendent of motive power being abolished.

Harry W. Finnell has become connected with the sales department of the Automatic Straight Air Brake Company, with headquarters at the company's general offices, 210 Eleventh avenue, New York. Mr. Finnell has had a wide experience in the railway supply business and was attached to the War Industries Board during the war.

W. A. Jex, assistant road foreman of engines on the Toledo & Ohio Central, at Bucyrus, Ohio, has been appointed supervisor of air brake equipment, with offices at Broad Street Station, Columbus, Ohio. Mr. Jex will also have supervision of the air brake work on the Zanesville & Western, Kanawha & Michigan, and the Kanawha & West Virginia.

John E. Mahaney, general storekeeper on the Norfolk Southern, has been appointed superintendent of stores on the Chesapeake & Ohio. Mr. Mahaney has had a wide experience in railroad service, particularly in the stores department of some of the leading western roads, and during the Federal control period was supervisor of stores of the Northwestern region.

Frank S. Robbins, formerly master mechanic of the Pennsylvania at Pittsburgh, Pa., has been appointed mechanical adviser to the Chinese Eastern railway, which is a part of the Trans-Siberian System. Mr. Robbins entered the war service as captain of Company D of the 19th Engineers, and on being appointed superintendent of motive power of "D" line was promoted to the rank of major of engineers. Mr. Robbins' headquarters will be at Harbin, Manchuria.

Dexter S. Kimball, Dean of the College of Engineering of Cornell University, has been nominated president of the American Society of Mechanical Engineers at the meeting of the society held in Chicago last month. Three vice-presidents were also nominated. They are Col. E. A. Leeds, Dayton, Ohio; Robert Sibley, San Francisco, and L. E. Strothman, Milwaukee. Sherwood F. Jeter, Hartford; Horace P. Liverridge, Philadelphia, and Hollis P. Porter, Tulsa, have been nominated as managers. William H. Wiley, New York City, has been again nominated as treasurer. The nominations will be voted on by the members of the society through a letter ballot and the election will take place at the annual meeting of the society next December.

N. P. Kershner, master mechanic of the International & Great Northern, with office at Palestine, Texas, has been promoted to superintendent of motive power with headquarters at Palestine. Mr. Kershner served an apprenticeship as a machinist in the Philadelphia & Reading, and after working a short time as a machinist entered the University of Pennsylvania, from which he graduated with honors in 1908. Moving west, he held many positions in the mechanical departments of several of the leading roads in the west and southwest. At the outbreak of the war he entered the service as lieutenant of engineers and was a year and a half in France, retiring with the rank of major. After his discharge he was appointed mechanical inspector on the Texas & Pacific, and latterly shop superintendent. From thence he was called to the International & Great Northern, as noted above.

Y. Z. Caracristi, recently a member of the Railway and Industrial Engineers, Inc., has opened consulting offices at 43 Broad street, New York. Mr. Caracristi has had an extensive practice as a consulting engineer, particularly in railroad supervision, equipment and betterment. He was associated as designer and constructor of the Union Station, Washington, D. C., and as assistant to the general superintendent of motive power of the Baltimore & Ohio, was in charge of shop additions, and the improvement of design and construction of locomotives and cars, including the design and construction of the first mallet type of locomotive. He was also engaged in making extensive improvements in shops of many of the leading railroads and supervised the layout, design and equipment of extensions in the plant of the Lima locomotive works. For many years Mr. Caracristi has been also engaged in consulting work for banking interests, and associated with J. M. Muhlfeld and other engineering experts in introducing the first successful burning of pulverized fuel in suspension. Mr. Caracristi will continue in the consulting field, specializing in railroad and shop design, operation and betterment.

Alba B. Johnson, president of the

Railway Business Association, announces the election of the other officers and members of the Executive Committee, as follows: Honorary vice-president, Geo. A. Post, New York. Vice-presidents: W. W. Salmon, Rochester, N. Y.; W. W. Willits, Chicago; Knox Taylor, High Bridge, N. J.; W. H. Woodin, New York; S. G. Allen, New York; Stephen C. Mason, Pittsburgh; Charles J. Symington, New York. Secretary, Frank W. Noxon, Liberty Building, Philadelphia, Pa. Executive members: V. C. Armstrong, New York; J. C. Bradley, Buffalo; S. P. Bush, Columbus, O.; Robert F. Carr, Chicago; J. S. Coffin, New York; S. M. Curwen, Philadelphia; G. F. Downs, Buffalo; Andrew Fletcher, New York; Howard A. Gray, Chicago; Irving T. Hartz, Chicago; A. L. Humphrey, Pittsburgh; E. J. Kearney, Milwaukee; R. P. Lamont, Chicago; Frank J. Lanahan, Pittsburgh; E. B. Leigh, Chicago; Herbert I. Lord, Detroit; Burton W. Mudge, Chicago; A. H. Mulliken, Chicago; W. G. Pearce, New York; J. G. Platt, Boston; F. A. Poor, Chicago; William E. Sharp, Chicago; S. L. Smith, Cleveland; Alexander Turner, New York; E. H. Walker, New York; H. H. Westinghouse, New York; W. E. Clow, Chicago.

The Westinghouse Electric & Manufacturing Company

The report showing the gross earnings and manufacturing and selling cost of the products of the Westinghouse Electric & Manufacturing Company of the year ending March 31, 1921, has been issued. During the year, the position of the company was greatly strengthened by the acquisition of exclusive rights under the important patents owned by the International Radio Telegraph Company. The earnings for the year amounted to $150,980,000, an increase of $15,000,000 over the previous year. There is available for dividends of over $12,000,000 or 16.8 per cent on the Company's capital stock.

Domestic Exports from the United States by Countries During April, 1921

STEAM LOCOMOTIVES

Countries	No.	Dollars
Malta, Gozo, and Cyprus Is.	1	14,548
Canada	1	3,750
Honduras	1	17,550
Mexico	18	422,362
Cuba	5	162,430
Brazil	20	567,610
Peru	4	128,430
China	2	70,800
Hongkong	4	75,200
New Zealand	1	14,957
Philippine Islands	5	268,500
Egypt	4	176,350
Total	66	1,922,487

New Forty-five Ton Locomotive to Handle Car Load Freight Business on the Youngstown & Suburban Railway

The Youngstown and Suburban Railway has recently placed in service a standard Class B, 45-ton, Baldwin-Westinghouse locomotive. This locomotive is equipped with four-type 562-D-5, 600-volt, 100 hp. field control motors and HLF control.

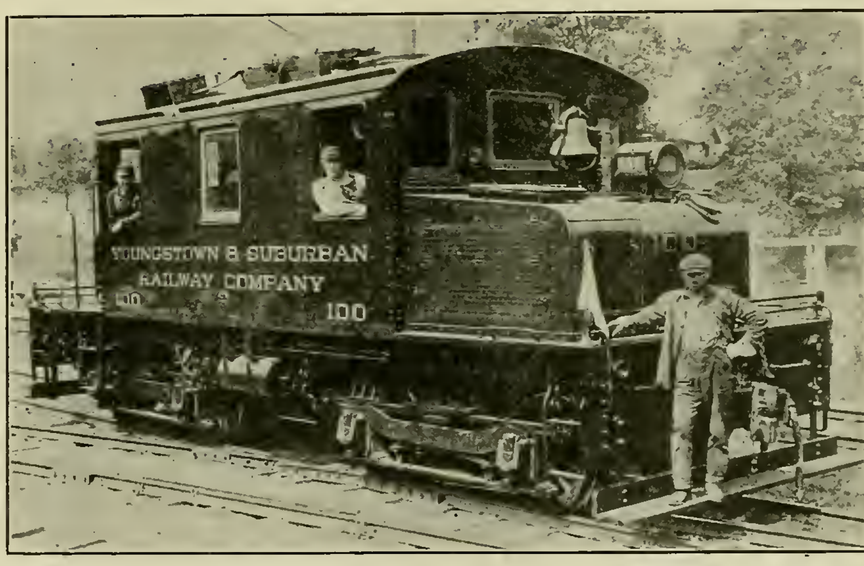
The new locomotive is subjected to rather severe service, as the maximum grade on this property is 2.05 per cent, and on this grade the engine will handle five loaded 100,000 lb. capacity cars or a train of fifteen empties. The maximum gear reduction permits this without the danger of drawing excessive power from the substation.

The increase in car load freight business due to the constantly growing industries tributary to the right-of-way of the company made necessary the purchase of motive power capable of handling steam road equipment. A large part of this business is made up of building materials handled to the new tripple of a construction company. An idea of the quantity of this business is given in an article which appeared, before the tripple was completed, in the company publication, published by Day & Zimmerman, engineers, who own and operate the Youngstown and Suburban Railway. It says:

"The total trackage from the switch to the end of the tripple will be over 1,000 feet and the total length of the tripple itself will be 540 feet with bins having a capacity of approximately 3,000 tons of materials. The various bins under this tripple are for the storage of sand and gravel and other building materials and will be arranged so that a 4½ ton truck can be loaded in two minutes. Directly opposite the tripple there is to be constructed 1,100 feet of track with a clear space of 900 feet which will be used for handling brick, tile, sewer pipe and similar material. At the right will be constructed garage and barns for 35 motor trucks and wagons and 15 horses, and on the left will be warehouse, office buildings, etc."

The general characteristics of this locomotive are as follows:

Weight 45 tons. Maximum tractive effort (25 per cent adhesion) 22,500 lb. Normal tractive effort at 9.7 mph. (full field) (1 hour) 15,200 lb. Continuous tractive effort with forced ventilation (short field) 9,000 lb. Maximum trailing load starting on ½ per cent grade 780 tons. Balancing speed (short field at 600 volts) on level with 500 ton load 17.5 mph. Balancing speed (short field at 600 volts) on 2.05 per cent grade with 350 ton load 10.2 mph.



NEW FREIGHT LOCOMOTIVE FOR THE YOUNGSTOWN & SUBURBAN RAILWAY.

It is reported that during the first months of operation the new engine has proved most satisfactory.

Removals

A number of railway supply manufacturers have removed their New York offices, among which are the R. W. Benson Company, who will remove its offices from 50 Church Street, New York City, to the Liggett building, Madison Avenue and 42d Street, on June 1.

The American Flexible Bolt Company will remove their sales offices from 50 Church Street, New York City, to the Liggett building, corner of 42d Street and Madison Avenue, on June 1.

Warning Reckless Automobilists

The Baltimore & Ohio Railroad Company is to be commended for its persistent determination to inculcate common sense in the minds of automobile drivers. Vice-president Galloway, in charge of operation and maintenance, makes the startling statement that only one in every four automobile drivers uses the necessary precautions for safety at grade crossings. This estimate is taken from actual observations made at crossings at various times. As may be expected the casualties are increasing. In the four-year period from 1917 to 1920, inclusive, on all the railroads of the United States there were 4,250 persons killed at grade crossings and 12,750 persons injured in automobile accidents.

Since November, 1919, the company began a direct and persistent mailing campaign to bring graphically to the attention of automobilists their neglect to heed warning signals. Those who failed to take precautions before crossing had their license numbers taken down by the railway employes and the drivers were communicated with, setting down the date, place and time of their negligence, and urging them to exercise care in the future. Doubtless but for this and other expensive precautionary work the accidents would have been greater, and it is to the great credit of the company that at a time of great financial stress this humane work should be persistently maintained, and it is amazing that in the face of casualty lists it should continue to be necessary.

National Purchase of the British Railways

There has been introduced in the British Parliament a bill for the naturalization of the railways of Great Britain. The bill provides for their purchase by the State, and their subsequent management in the public interest under the direction of the Minister of Transport, in whom, six months after the passing of the act, all the property of the companies would pass into the hands of the Government. It will be interesting to watch the progress of the bill, which is backed by the Labor party, now numbering nearly one-sixth of the parliament.

Automatic Straight Air Brake

The Automatic Straight Air Brake Company has replaced the brakes which they put on the Chicago & Eastern Illinois passenger trains last September, which was the first installation of their brakes commercially. These brakes, which have just been put in service, embody slight adjustments which experience demonstrated were desirable.

The company also reports progress in the installation of the Automatic Straight Air Brake for passenger service on the Erie Railroad. Several trains are now fully equipped.

Another interesting development is their "All Service" triple valve.

Catalogues, Bulletins, Etc.

Light Torches

The Westinghouse Lamp Company has issued Vol. 1, No. 1, of Light Torches, and its purpose is to discuss problems relating to the sale, installation and use of modern lighting units. It is admirably edited and gives promise of taking a high place among the house organs. It is issued from the New York office.

Air Consumption of Locomotive Auxiliary Devices

The Air Brake Association has issued a report on the above subject extending to seventy pages, which contains the most complete and representative data hitherto attainable concerning the air consumption of locomotive auxiliary devices, such as air operated fire doors, bell ringers, reverse gears, sanders, water scoops, coal pushers, etc. The work of the committee preparing the report has largely been in the direction of determining by the use of the test code the weak points with a view to suggestions for revision of its methods on the limits imposed. The work of the committee as embodied in the report is one of the most important contributions of its kind made to the association.

Canadian Railway Statistics for 1919

The Dominion Bureau of Statistics has issued a report on railway statistics for the year ending December 31, 1919, from which it appears that the average number of employees were 173,728; salaries and wages $233,323,074. The ratio of wages to operating expenses amounted to 62 per cent, and the ratio of wages to gross earnings 57 per cent. The average wages per hour were $0.523. On the electric railways there were employed 16,940, with salaries and wages amounting to $20,211,576.

Accident Bulletin No. 77.

The Interstate Commerce Commission, Bureau of Statistics, has issued Bulletin No. 77, showing collisions, derailments and other accidents resulting in injury to persons, equipment or roadbed, arising from the operation of steam roads in interstate commerce during the months of July, August and September, 1920, from which it appears that the total number of train accidents during the period specified showed a considerable increase over that of 1919, the previous year showing a total of 7,091 accidents, resulting in damaging railway property to the extent of $6,403,750, and for the same period in 1920 the report shows that 10,292 train accidents occurred, with a consequent loss amounting to $9,982,870. Of injuries to persons, the report showed that in 1919 the number killed were 1,763 and 14,738 injured, while in 1920 2,044 were killed and 17,947 were injured. In the locomotive boiler accidents it is noteworthy that in the case of crown-sheet explosion, where low water was no contributing cause, the number was 17, while in crown-sheet explosions where low water was shown to be the contributing cause, only 2 cases are reported.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV 114 Liberty Street, New York, July, 1921 No. 7

The Virginian Railway 120-Ton Coal Cars

A Description of Their Construction, With Details of the Lewis Truck

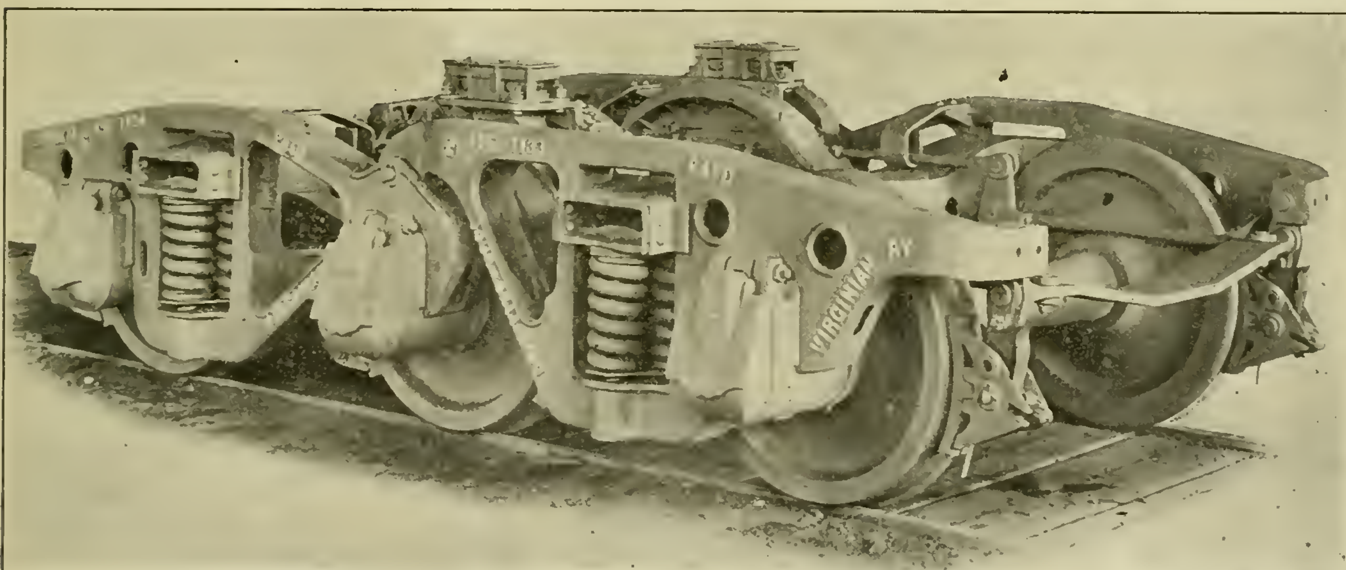
In our issue for May there was published a general description of the 120-ton coal cars of the Virginian Ry. together with the details of the Buckeye truck which is used under a portion of this equipment. That article is here supplemented with a description of the details of the construction of these cars together with that of the Lewis truck, as made by the American Steel Foundries, and which is used under the balance of the cars.

These cars have the largest capacity of any cars operating in regular service on American railroads. In order to obtain this capacity and build the cars as short as possible they have been made very wide and high. The car body is 49 ft. 6 in. long and 10 ft. 2¾ in. wide, with a depth, at the center of 8 ft. 5⅛ in., and at the ends of 7 ft. 4¼ in. The cubical capacity of the body is 3,850 cu. ft. up to the level of the top; but, when the load is heaped on an angle of 30° the volume of the same is 4,450 cu. ft. and will weigh about 240,000 lbs.

The car is so well proportioned that, while it is readily seen to be large, it does not impress one, at first sight, as having the great capacity that it has.

Their size and design is such that they cannot be run off from the home road because of the impossibility of unloading them without unloading machines such as have been installed at Sewall's Point, in which the whole car is picked up and dumped. This is the only means of unloading as there are no hoppers in the floor.

As appeared in the reproduction of the photograph of the car that was published in the May issue, there are no outside projections, such as stakes or braces along the side of the car, except at the top, where the side sheets are bent in from a point 1 ft. 8 in. below the top. This slope carries the sheet in for a distance of 4 in., when it turns up straight again and is brought out flush with the outside, where it is reinforced by a 4 in. by 4 in. angle riveted between the horizontal portion. This forms the bearing face for the clamps of the dumping machine. It is braced on the under side by fourteen pressed steel braces that fit in beneath the angle and fill the space formed by the inclination of sheet and the top. This relieves the side sheets of any bending stresses that would otherwise be imposed by the clamps of and handling in the dumping machines.

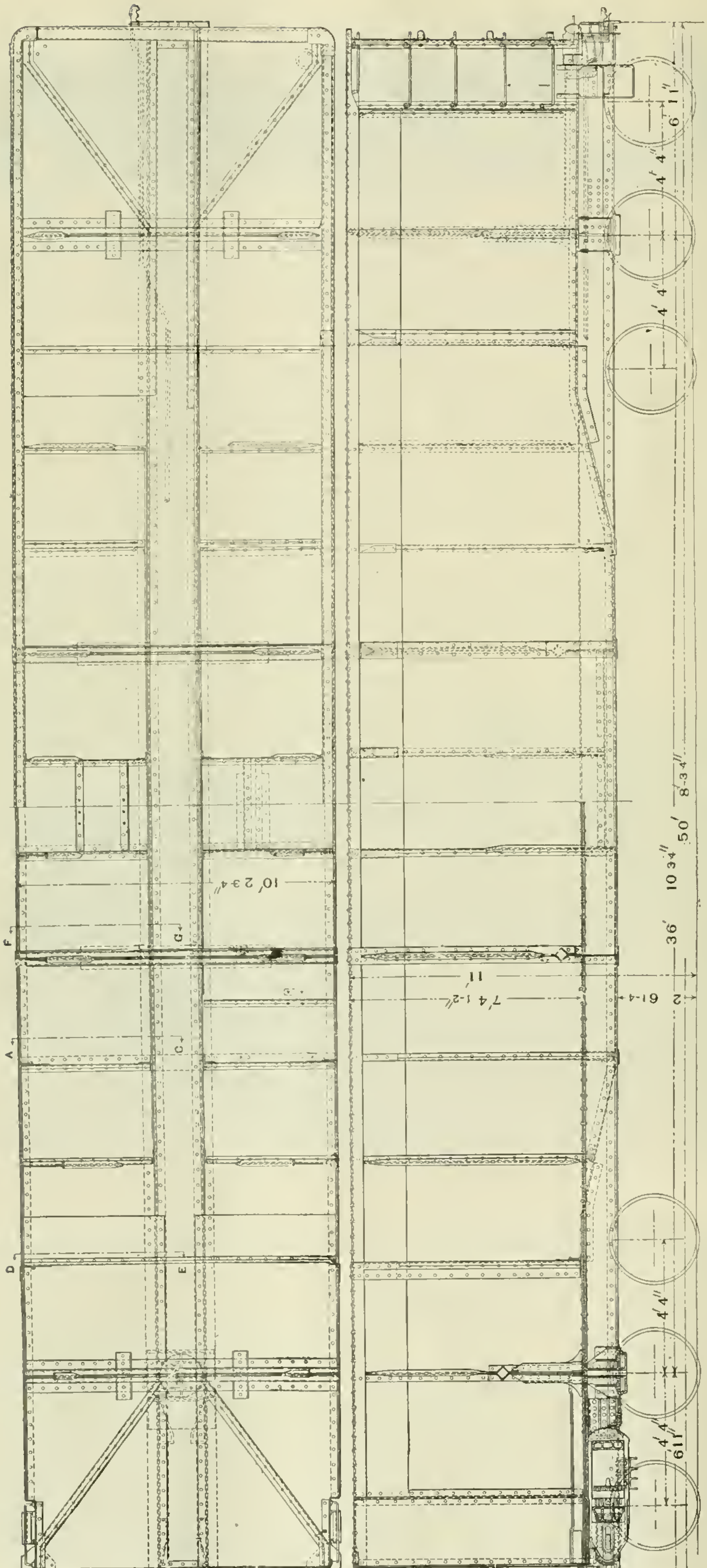


LEWIS SIX-WHEELED TRUCK OF THE 120-TON COAL CARS ON THE VIRGINIAN RAILWAY

The construction of the sides of the car is clearly shown by the cross sections on the lines *A C*, *D E* and *F G*.

The section at *A C* is taken, as indicated on the full length plan of the car, at a point near the end of the center section, where the depth of the side plates is the greatest. This, at first glance, may not appear to be so, because the upright portion of the section is broken in the engraving, for which an allowance should be made in studying it.

This section shows the side sheets to be made of ¼ in. plate, bent and braced at the top, as already described, and rivetted



PLAN AND ELEVATION 120-TON CAR VIRGINIAN RAILWAY, MANUFACTURED BY PRESSED STEEL CAR CO.

at the bottom to a 3½ in. by 3½ in. by ⅜ in. angle, which runs the whole length of the car. There also appears an inside stake made of a 5 in. rolled bulb angle which is rivetted to the side sheet, and bent at the top to conform to the angle of the sheet, which is 15°. The bent part is cut off flush with the line of the straight part of the head or bulb. This brings the inside line of the stake nearly flush with the inside face of the offset portion of the side sheet.

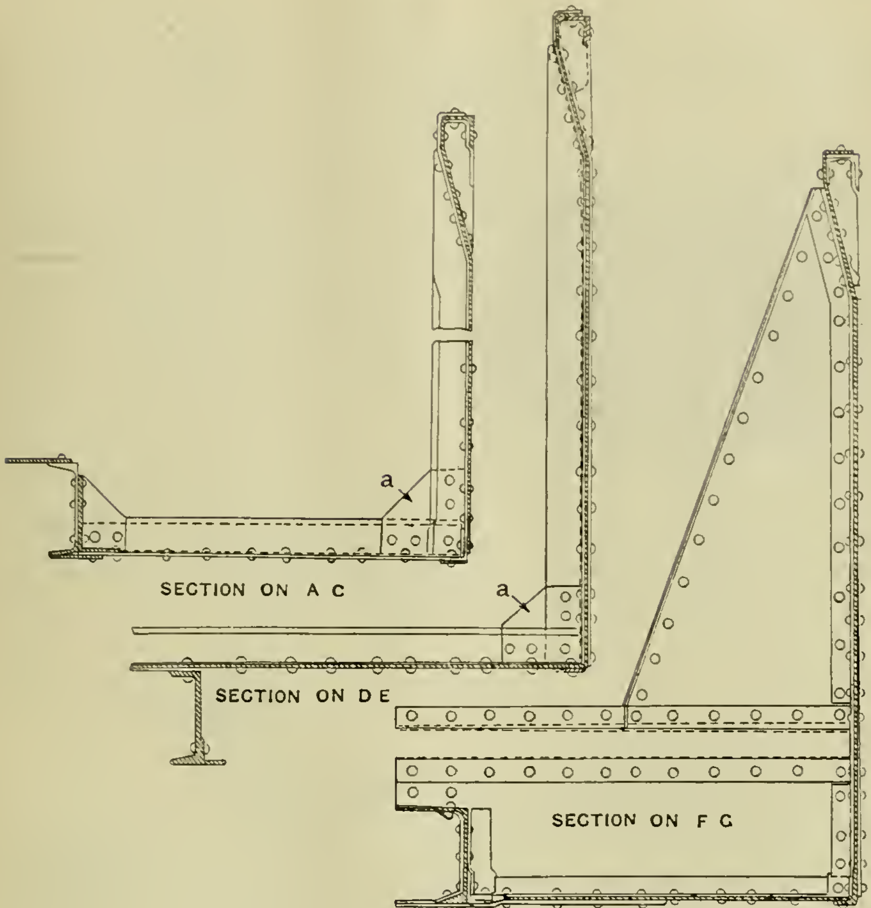
At the bottom the floor is rivetted to the top of the flanges of the bottom side angle and to a similar angle riveted to the bottom of the center sills. It is stiffened by a cross bearer made of a 5 in. bulb angle, which lies on top of the floor and is riveted, with it, to the angle at the bottom of the center sill.

At the outside the two bulb angles are connected by the gusset *a* and, at the inner end, a similar gusset stiffens the connection between the cross bearer and the center sill.

The center sills are made of 13 in. channels of standard section and weighing 37 lbs. to the foot. They are built in with the flanges towards each other and in addition to the bottom reinforcement of the 3½ in. by 3½ in. by ⅜ in. angles, are provided with a cover plate ¼ in. thick. This gives a total sectional area of the center sills, for the resistance to buffing stresses of a little more than 31 sq. in. The sills run the full length of the car.

The section *D E* is taken at a point back of the bolster where the height of the side is only 7 ft. 4¼ in. As far as the side of the car itself is concerned at this section, with the exception of the height, the construction is the same. There is a difference, however, in the floor construction. Instead of being rivetted to the reinforcing angle at the bottom of the center sills, the floor plate is carried over the top of the cover plate and the cross-bearer bulb angle lies on top of the floor. There is the same gusset connection at the outside, while that at the center sill is omitted.

In addition to the inside stakes referred to, there are six inside stakes formed of an angle riveted to the side sheet with a triangular gusset 30 in. wide at the bottom, which, in turn, has a reinforcing angle riveted to its inclined edge. This construction is clearly shown in the section at *F G*. At this point the floor construction is the same as that described in connection with the section on *A C*, except that, instead of a bulb angle to act as a stiffener there is an angle running from the side sheet to the center sill, to which a vertical plate is rivetted. This plate rises to the top of the center sills and above that the cross bearer is formed of two pressed steel plates with a stiffening rib as shown at *b* in the longitudinal section of the end of the car. There are



SECTIONS OF SIDE CONNECTIONS OF 120-TON CARS.

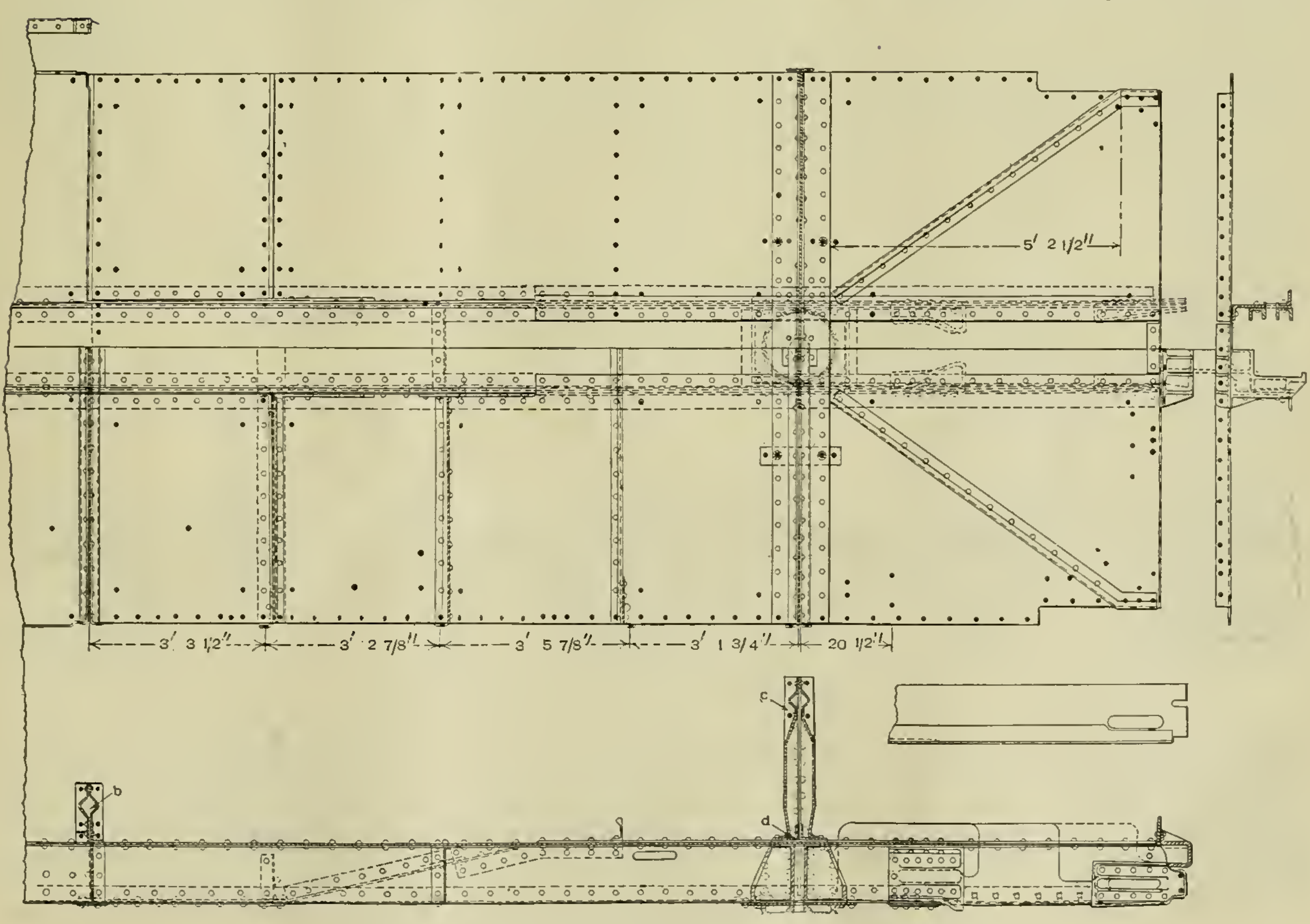
four of these gusset stakes between the bolsters, but only two of them have the cross-bearer construction shown at *b*. These two are spaced 4 ft. 10⅞ in. on each side of the center, and the other two are located about midway between these and the bolsters. Where the stiffened cross-bearer construction is not used, there is a simple angle connection similar to that shown in the section *D E*.

At the bolsters there is a similar gusset form of stake so that the vertical and transverse stiffness of the car at this point is very great. The construction of the bolster is clearly shown in the longitudinal section and plan of the end of the car. It will be remembered that the floor of the car lies above the center sills at this point. The bolster truss lies above the floor. It is built up in connection with two angles *d* with unequal legs that are rivetted to the floor. Between these angles a plate is riveted that rises to a height of 2 ft. 3 in. above the floor, and above this there are two stiffened plates running across the car similar to that used in the cross bearer at *b*.

At the center there is a cast filler between the channels of the sills and this serves as a seat for the body center plate.

As already stated the sills run to the end of the car, and the follower stops are riveted to their inner faces as shown on the plan.

At the end of the carrier for the draw-bar is a steel casting with a cast carrier



LONGITUDINAL SECTION AND PLAN OF END 120-TON CARS.

bar that sets upon a lip on either side of the opening and is held in place by a 1¼ in. bolt.

The corners are fitted with poling pockets, and are braced by diagonals.

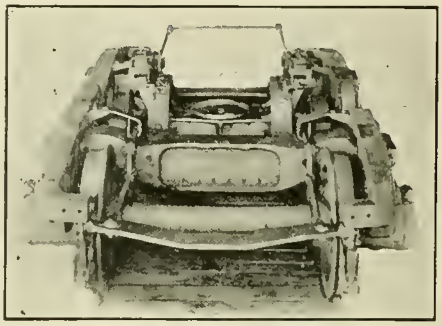
The smooth surface of the exterior of the car is broken only at the ends where there is an inset of the sheets to permit the ladder rounds to be made inside the general surface of the car. The inset is 4½ in. and the ladder rounds project 3 in. from the surface thus formed so that they are well out of the way of the bearing surface of the dumping machine. The rounds are spaced 17¾ in. apart.

The sheets of the end of the car are stiffened by being bumped with a U-shaped rib extending across the car. These ribs are tapered and have the greatest depth at the center, where it is 4 in. The gap between the sides of the rib is 2¾ in. and it is tapered from a depth of 4 in. at the center to 1½ in. at the side of the car. There are two of these ribs spaced 26¼ in. apart between centers and with the lower one set 3 ft. 1 in. above the top of the center sill.

It will be seen that the car is so braced that the sides act as girders to carry the major portion of the load which is brought back to the center plates through the very stiff bolsters.

THE LEWIS TRUCK

Five hundred of these cars are equipped with the Westinghouse N-12-A draft gear and the Lewis truck as made by the American Steel Foundries. The trucks are of the six-wheeled type and are fitted with clasp brakes.



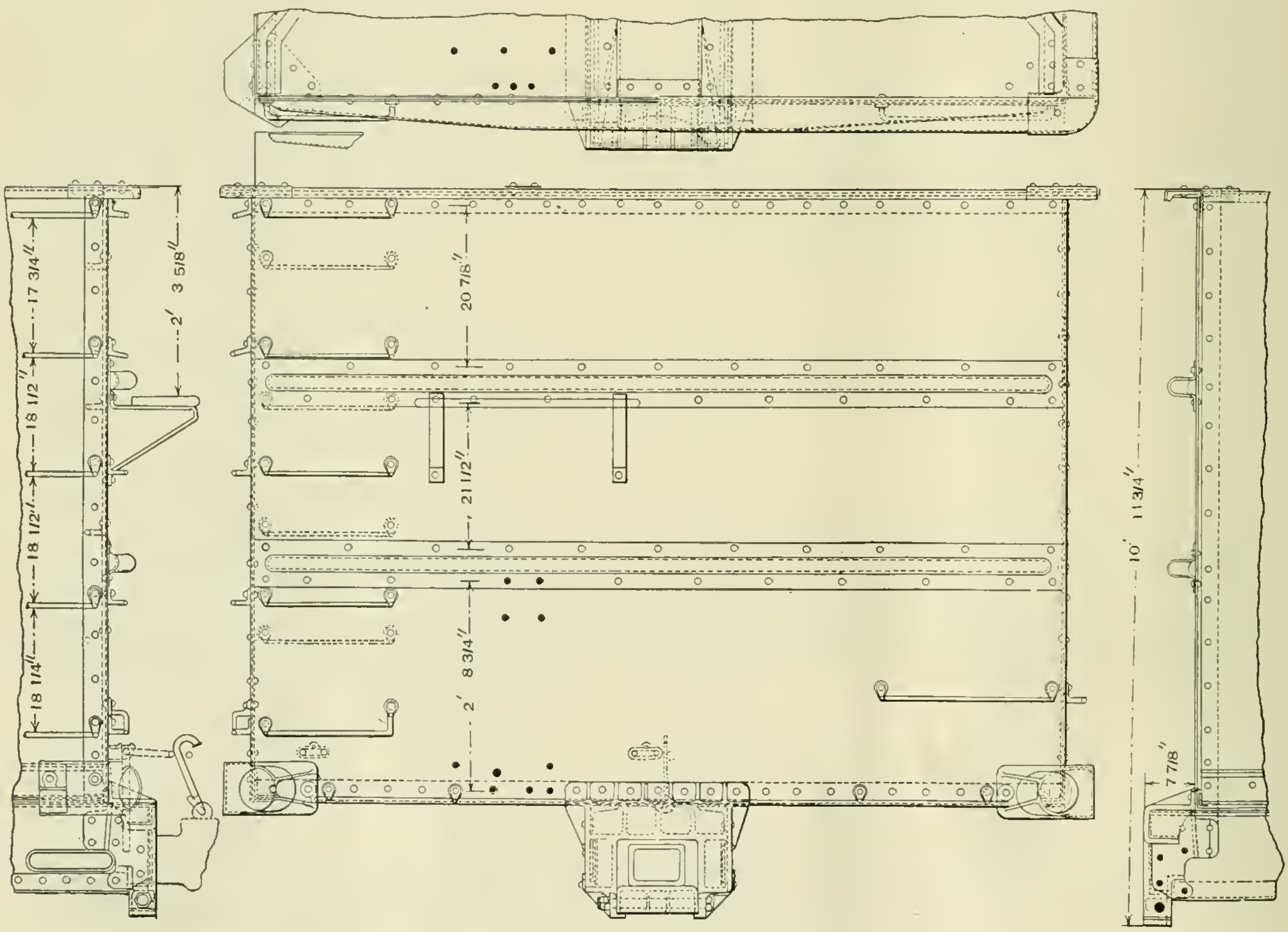
VIEW OF LEWIS SIX-WHEELED TRUCK.

The side frames are formed of two steel castings; one of which has pedestal jaws to take the journal boxes of the center and one of the end pair of wheels. The other casting has the pedestal jaws for the third set of oil boxes and is connected to the first or main casting by a 1½ in. pin. The static load on each wheel, barring the weight of the truck, is about 23,300 lbs., of which one-half is carried by this pin. If 50 per cent, be added to the static load for running stresses, it puts the shear on these pins at almost exactly 10,000 lbs. per sq. in. of section.

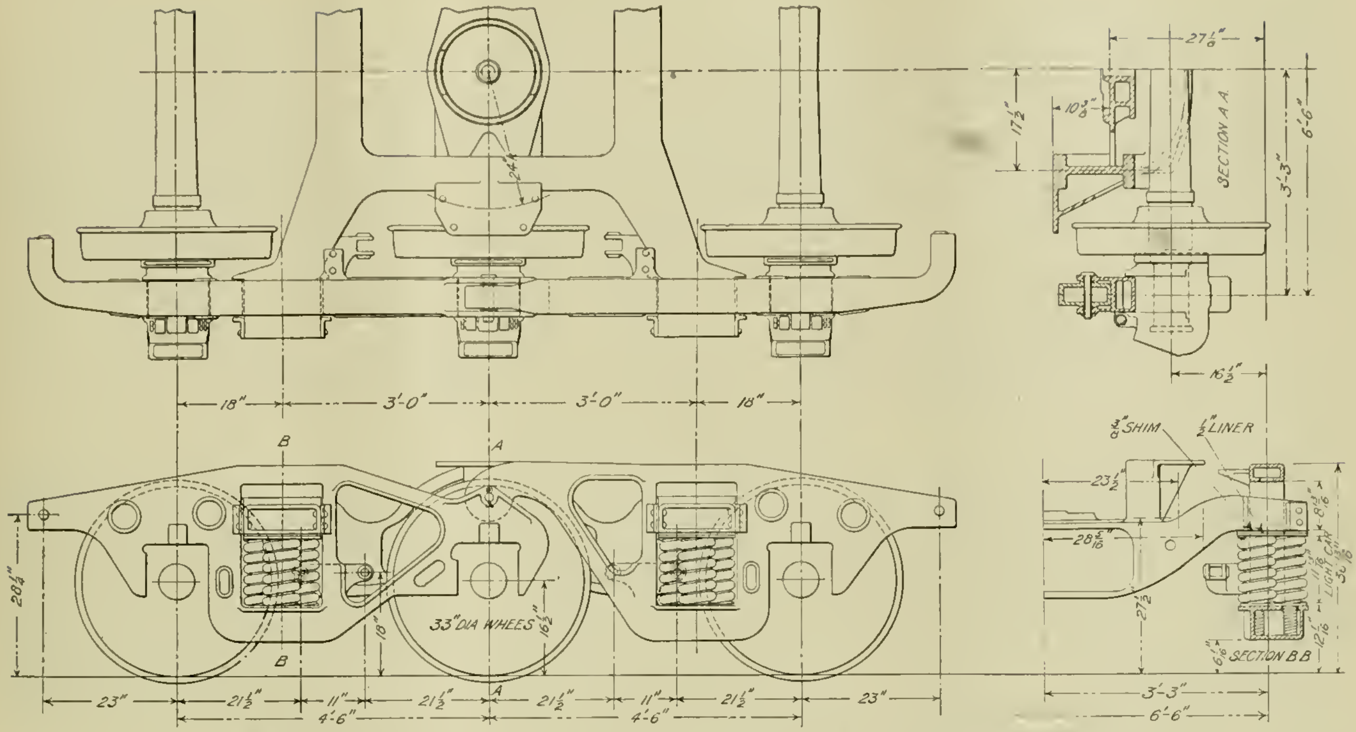
Each casting has a spring seat with its center 18 in. from the end axle. The total wheel base is 9 ft. This arrangement of the side frames makes for perfect vertical flexibility and adaptation to any inequalities of the track.

The bolsters are all united in a single casting which has the central equalizing bolster and the two cross bolsters, whose ends rest on the springs. The sections of the several cross pieces are U-shaped, inverted, and the longitudinal or wheel piece is a single plate. The equalizing bolster chops down close to axle so that it is 10⅜ in. below the face of the side bearing seat. This makes it possible to lower the whole body of the car. The wheels are 33 in. in diameter and each truck weighs 17,850 lbs.

Owing to the heavy braking power used in connection with the empty-and-load brake on these cars, whereby a total braking pressure equal to 40 per cent. of the total weight of the loaded car is put upon the brakeshoes, it is necessary to use a clasp brake with two shoes for each wheel.



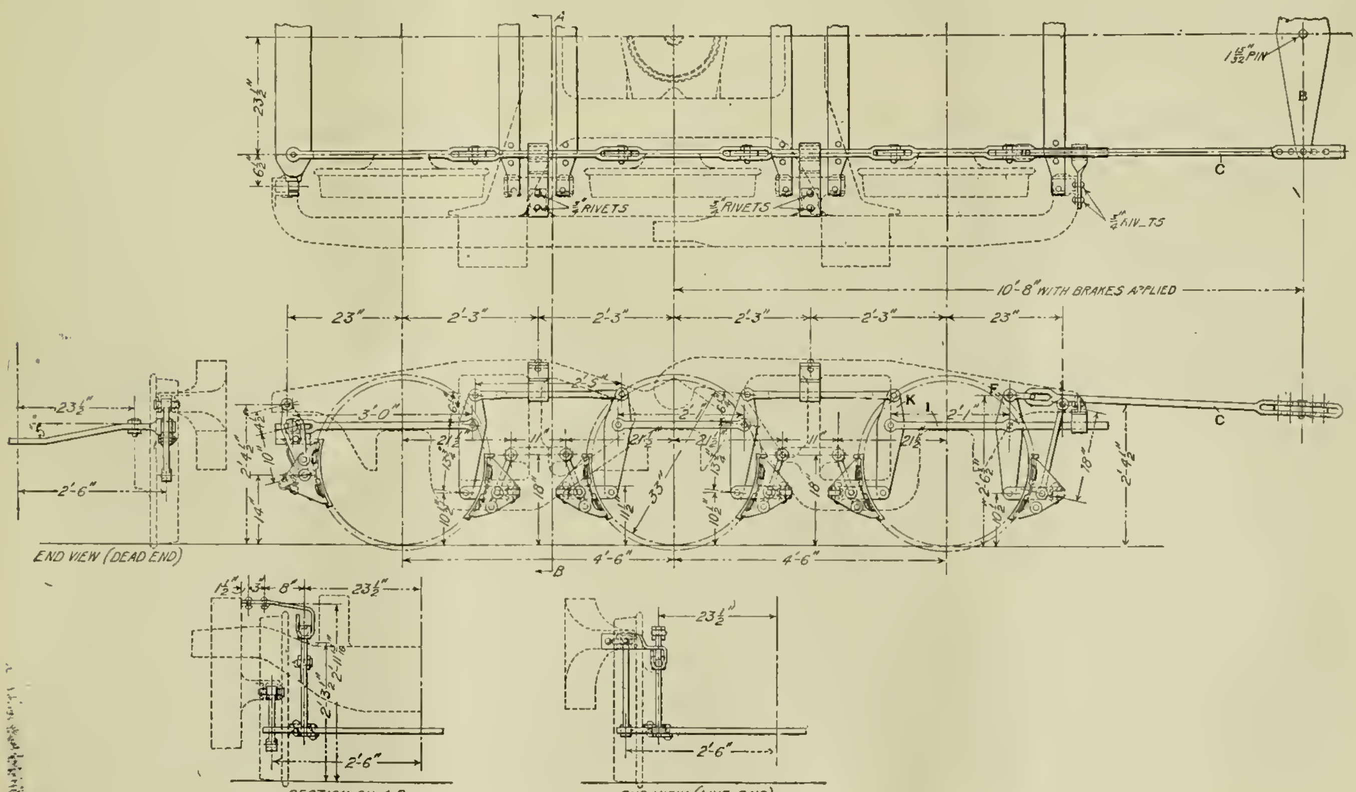
END ELEVATION 120-TON CAR VIRGINIAN RAILWAY.



LEWIS TRUCK FOR 120-TON CAR, MANUFACTURED BY AMERICAN STEEL FOUNDRIES.

The method of application is interesting in that it marks the reappearance on cars of the principle of brake leverages that sure on each brakeshoe is the same and there is no increase of stress on the foundation rigging from the last shoe to the point of application of the power; since the pull on all rods of the same class is the same, and all connections are in tension.

The pull of the brake connection is applied to the center of the horizontal equalizer *B*. One half of this pull is transmitted to the connection *C* and, by it, to the upper end of the brake lever *F*. This lever is 20 in. long, and has the pin for the pull rod *I* set 6¼ in. from the upper end, leaving the lower end 13¾ in. long. With these proportions, about 45.5 per cent of the pull on *C* is applied to the brakeshoe and the pull on the connection *I* becomes 145.5 per cent of that on *C*. As the proportions of *K* are the same as those of *F*, the same brakeshoe pressure is applied as on the shoe at the bottom of *F*, while the pull on the rod leading off from the top of the lever *K* is the same as that transmitted to *F* by *C*. This is carried on through the whole series of levers putting the same pressure on each



CLASP BRAKE FOR LEWIS TRUCK, 120-TON CARS.

brakeshoe and the same stress on each connection of the same class.

As this system of levers is placed upon each side of the truck, and the vertical levers like *F*, *K*, *etc.*, are attached directly to the brakeheads, there is no need of the ordinary brakebeam, but, in its stead, simple flat tie beams are used that serve to hold the brakeshoes in place and have no braking stresses put upon them.

This system of brake levers has been thoroughly tried and can hardly fail to be as effective here as it has been elsewhere.

In the construction of these cars the Virginian has followed along the lines laid down at the time it was built, namely, the handling of the heaviest possible tonnage from the mines to tidewater, in cars built especially for the traffic which would remain on its own line. Such a car is, of course, unsuited for general interchange traffic, as it could not be profitably used except where it can be handled in an unloading machine. But, where such facilities are available, it affords a means for the economical handling of maximum loads and has already demonstrated the fact that they meet the requirements of the situation admirably.

Practical Mechanical Suggestions

By JOHN MITCHELL

The average railroad man has suggestions to offer to solve most any problem that may arise, and no doubt many unsolved problems could be disposed of if more of their suggestions were formally presented and acted upon. There are given herein several suggestions gathered from various sources.

LUBRICATION.—This always has been, still is, and will continue to be a live issue, as the life of a machine is dependent on it to a considerable degree. Force feed or mechanical lubricators are doing their part in making each drop of oil reach the right spot in order to perform its function and no doubt greater things than we imagine are in store. The hydrostatic lubricator, however, is in quite general use on locomotives and it is often surprising how little attention is given to their performance. Some time since one of the first-class roads undertook to find out how many of their tallow pipes were applied so that oil would flow from the lubricator to the steam chest, without any being retained in sags of the pipes. A special can, holding one quart, was designed, the pipes disconnected at the lubricator and at the steam chest. One man then poured a quart of oil in the pipe at the lubricator and another caught it in a similar can at the steam chest. If the full quantity did not flow through, it was a sure indication that the pipe was not properly applied, as sags or pockets were retaining the oil, which would necessarily prevent a uniform flow of oil to the valves and cylinders when lubricator was working. This is something that should be checked, at least as often as engines receive heavy repairs, as cutting of any parts from lack of lubrication is a very expensive, as well as embarrassing condition to contend with.

A leaky lubricator throttle valve is a common occurrence and each one necessarily wastes some oil whenever the filling plug is removed, and the hot oil escaping causes some accidents that should be avoided. As a rule, lubricators are filled by men who do not regularly report defects on engines, consequently, unless the valve is leaking too bad to be able to fill the lubricator, it will not be reported and therefore not repaired. These valves should be reground at regular intervals, whether reported or not, say, once a month and in addition a standard valve should be used, care being taken to adopt the best the market affords.

DRIVING BOXES.—The driving boxes in use today are very similar to the ones in use on the earliest locomotives and the principle is exactly the same.

There is a very wide field here for the inventor and it seems that the past fifty years should have brought forward more on this item than has been developed. Practically all mechanical men admit the wisdom of cutting out a driving box brass in the crown, that the journal may not have a bearing in the crown for several inches. This enables the brass to wear to a perfect bearing before the box gets pivoted, which will cause it to wear and pound on the sides. Most roads follow this practice, but they do not carry the principle far enough. It is entirely possible to cut enough out of the crown of the brass to control the wear and cause the wear to be uniform over the entire bearing surface. No rule can be laid down, as it is necessary to experiment with different classes of engines to find out what the width of the slot in the crown should be—the heavier the engine the wider the slot. This slot should extend to within one-half or three-quarters of an inch of the ends of the brass, and should be deep enough to prevent the journal ever having a bearing on this surface, or, in other words, extend in depth to the condemning thickness of the brass. After the proper width of slot is determined from tests, the brasses can be cast with the slot cored in them. In some instances, on heavy power, it is necessary to have this slot three inches or more in width.

As long as there is grease in the cellar, the revolving journal will carry with it enough grease to keep this slot filled at all times and this is a distinct advantage as it increases the area of the journal coming in contact with the lubricant, which reduces wear and hot boxes. Journal, or driving box, pound is one of the greatest known detriments to a locomotive, and if the wear is compensated by reducing the bearing surface in the crown, a driving box brass can be worn down to the condemning thickness, without the diameter of the brass being appreciably larger than that of the journal. This is a simple remedy, but it is certainly efficacious in eliminating journal, or driving box, pound.

In some instances it has been found advantageous to drill a 3/16-inch hole from the hub side of the crown brass into the grease slot or pocket, which permits grease to be forced through this hole and thus lubricate the hubs. This is not effective, however, on engines that are run with excessive lateral, as too much grease escapes.

REVERSING GEARS.—The modern heavy power has, to a great extent, necessitated the adoption of power reverse mechanisms, but in addition it is an economical addition to any engine for several reasons; namely, it saves the time of the engineman, as well as his strength, both of which can be used to better advantage in other ways. This is especially true in switching service. It offers greater assurance that the engineman will use a more proper cut-off, by hooking the engine up, due to the greater ease with which it can be done. It is much more positive in action, invaluable in case of emergency and a good all-around safety device.

The power reverses in use have their faults, of course, among them being the tendency to creep unless properly maintained—the tendency to freeze—the necessity of a steam, as well as an air, connection and the absense of flexibility in not being subject to manual operation. A screw reverse, with a small air motor attached, to drive it, would overcome all these weaknesses, by permitting of closer adjustments of cut-off, obviating the necessity of a steam connection, do away with creeping, simplify the mechanism and be a real safety device, as it could be operated instantly by hand under any conditions. It is really strange that the railway supply companies have not developed this mechanism instead of pushing the ones now on the market, to such an extent.

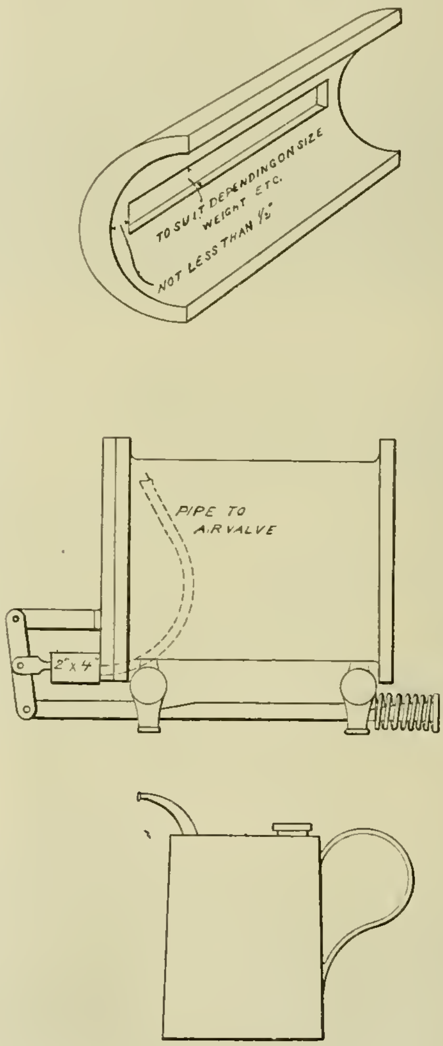
The screw reverse is in use and all that is necessary is to attach a suitable air motor to drive the screw, retaining the wheel with an arrangement to throw it out when the motor is being used.

CYLINDER COCKS.—The water of condensation is removed from the cylinders by a very simple device, to which little attention is given, but the railroads lose many dollars on account of this lack of maintenance. In the first place we are still using cylinder cocks that at best do not have a discharge greater than one-half inch in diameter, which is entirely inadequate to discharge the water, from an 18-inch or larger, cylinder, in anything like the time that operating conditions permit for this operation. A cylinder cock should have sufficient opening, so that all water would be discharged in one revolution, if the engine is moved off slowly. Instead of a half-inch opening, we need something like two inch openings to accomplish this, and in order to secure such a large opening it will probably be necessary to perfect an arrangement with a gate or quick opening valve attached to the cylinder, or cylinder heads. We hear great stress laid on the opening of cylinder cocks and the necessity of permitting all water to escape before they are closed, which is entirely correct, but it is well nigh impossible with the modern engines as the time required is prohibitive, and if the instructions were carried out literally, most trains would be delayed some ten minutes or more while the engineer was getting the water out. As a consequence cylinder heads are knocked out each day, cylinders cracked and broken, cylinder packing broken, lubrication destroyed, rod packing cut and steam leaks initiated or aggravated. These troubles will not be obviated until cylinder cocks of larger discharge capacity are used.

The operating mechanism of cylinder cocks is sorely neglected as the importance of maintaining it is not properly presented. On Mallet power it is especially hard to maintain the air operated mechanism in good working order. This mechanism generally consists of four air cylinders, one located under each bottom guide, and the vibration of the guide, as well as the close proximity to the ground, frequently make them inoperative. On such a simple device as cylinder cock rigging, it is certainly an easy matter to design it so that it will need no repairs, except at infrequent intervals. Any device that requires repairs practically each trip is inviting neglect and generally gets it in good measure.

To improve the conditions referred to on Mallet power one road has developed an arrangement, which consists of only two cylinders made of 3-inch pipe. These cylinders are located midway between the frames on a suitable brace, one for the high pressure engine and one for the low pressure. The power from these cylinders is transmitted to the cylinder cock slides, through a substantial shaft, to each end of which is attached an arm or lever, and the center arm or fulcrum can be designed to give any degree of power desired to move the slides. On account of the location these cylinders are not subject to fouling, they can be securely fastened to cross-brace and should never work loose, they assure positive action on account of the additional power and require hardly one-fifth the maintenance due to more substantial design and fewer parts.

As an improvement, on hand operated cylinder cocks, on other than Mallets, there



DRIVING BOX—CYLINDER COCKS—OIL CAN.

has been designed and used an air operated cylinder cock which is held open by a coil spring and closed by admission of air to the operating cylinder. This is a simple device, the coil spring being attached to the back end of the cylinder cock slide and, being held in a state of compression between a lug at the end of the slide and the cylinder cock, it forces the slide back at all times which opens the cylinder cock valve, and this valve does not close until air is admitted to the operating cylinder by someone in the cab. This device might be called semi-automatic and it is a great improvement over the ordinary riggings as it will save trouble from a great many sins of "omission" even if it cannot prevent trouble from the sins of "commission."

It is hard to impress upon shop forces the necessity of exerting *extra* effort in maintaining a device, which they may feel or know is of poor or faulty design or inefficient, and while there is no good reason for this attitude, the best way to overcome it is to devise and install the best that can be had. It will pay any road handsomely to go over their cylinder cock rigging, with these suggestions in mind and improve or perfect it.

PERSONAL EFFORTS.—It is hardly necessary to repeat that "self preservation is the first law of Nature," but it seems that there are a lot of railroad men who do not fully realize this law. How often we find a man who has been demoted or asked to resign, who feels that he has been treated very, very badly, or in other words been given a "raw" deal, without just cause, after faithful service. Everybody is looking for results these days and unless one can produce, sooner or later he is going to get what he may consider a "raw" deal. It is necessary, therefore, that we get the full benefit of the other fellow's experience and ideas and while a great deal is accomplished through the numerous organizations of officials, and, even more through our trade papers, we do not get the full benefit of all railroad experience by any means as yet. It appears that a very good way to diffuse such information more is to follow the practice recently adopted on some roads, of sending their mechanical officials—minor as well as major—to other roads for at least two weeks each year to act as observers and profit thereby. This of course is in addition to the regular vacation, as it can hardly be expected that a hard working railroader would be in a proper state of mind to obtain ideas if he were required to use these precious days sizing up the other fellow in order to gain knowledge. There is no man who cannot spare the time and it will certainly get many of us out of the rut to observe the other fellow as much as possible, and in most cases we may be able to help the man in the "foreign" shop on some items that are worrying him, which makes it doubly worth while. Get some new ideas every day and if you do not have authority to put them in effect, keep kicking until this authority is given.

Words of Wisdom

Time, whose tooth gnaws away everything else, is powerless against truth.

Life is like walking along a street—there always seem to be fewer obstacles to getting along on the opposite pavement; and yet, if one crosses over, matters are rarely mended.

The Application of Superheaters to Light Locomotives

Some Examples of Recent Construction in Which Installations Have Been Made

That the superheater is a marked success in locomotive work is evidenced by the thousands of applications that have been made and the golden opinions that the device has won. But, up to the present these applications have been made on road engines, and especially on those of the heavier classes, where the actual saving in fuel made a goodly figure, and one worthy of consideration for itself alone.

Now, having demonstrated the value for locomotives in road service, the applications of the superheater are being extended to those small locomotives which are used about industrial plants, at mines and by contractors, where the personnel in direct charge are not as skilled as in railroad work, and where the same care and attention are not given to maintenance.

There seems to be no good reason, however, why superheated steam should not show the same relative saving over saturated steam when worked in a small cylinder as when used in a large one. And, if that be so, a saving of from 20 to 30 per cent in steam on a contractor's locomotive looks to be quite worth while from the standpoint of actual saving. These small locomotives are intended to include those weighing 30 tons or less, and operating upon all gauges of track.

The operation of this class of locomotive differs in one important respect from locomotives used in railway service, in that these small locomotives are not operated for revenue, whereas, railway locomotive operation costs are chargeable directly to freight and passenger transportation. Small locomotives are a necessity for the service in which they are used, but their costs of maintenance and operation, which cannot be offset by revenue, must be charged as an expense and included in the overhead of the industry or service in which they are used. With fixed charges already high, it is more important today than ever before to give thought and study to ways and means to reduce operating expenses. And one practical way to reduce the operating costs of small locomotives is to equip them with superheaters. To the owners and operators of small locomotives the subject of superheated steam is, therefore, one of timely interest to consider. This is true not only because of the probable savings to be effected, but because it not only involves no change in design, nor does it add any appreciable weight to the locomotive, a matter of great importance where the engine is to be operated over temporary trestles, where the weight on the driving wheels is limited.

The properties of superheated steam, which make it more effective on small locomotives, are identical with those that have its use so efficient on road locomotives, and there is no reason why this should not give the same increase of capacity, saving in fuel and reduction in the amount of water used. This may even show better results than on the large locomotives because the ordinary condensation of saturated steam in small cylinders is greater, in proportion to the amount used, than in large cylinders.

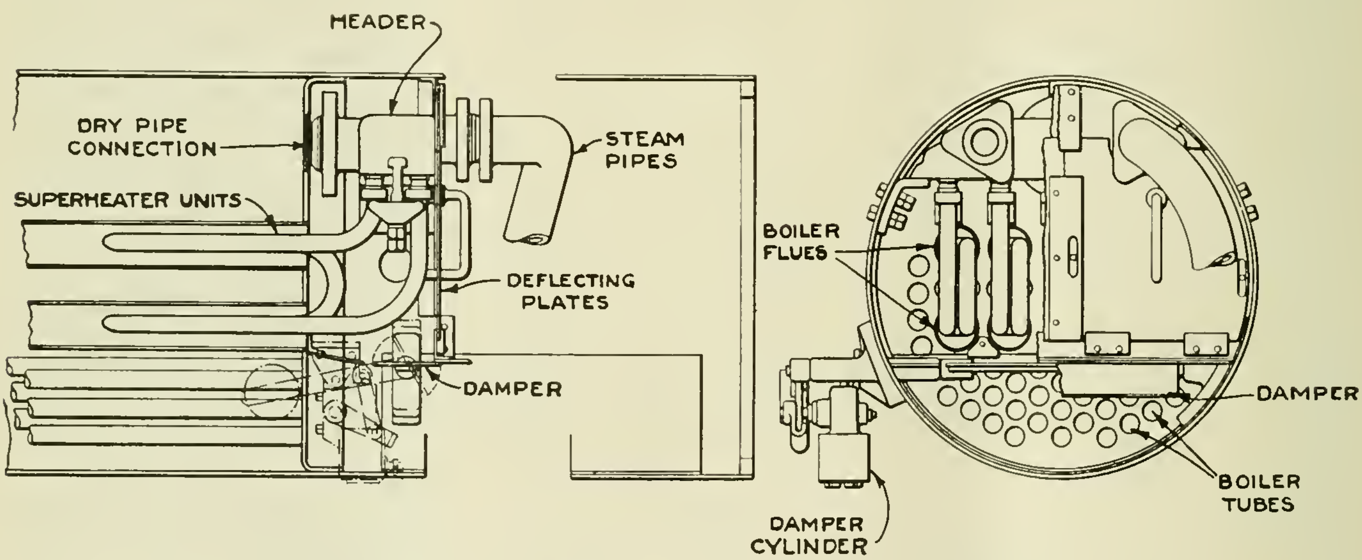
When this is applied to saddle tank engines the advantage is, at once, apparent in that there is a reduction in the delays incident to going after coal and water, or in the cost of hauling these two commodities to the scene of operation when this has to be done.

Further, small engines are frequently operated at full capacity. With the cylinders taking steam full stroke, boiler capacity is insufficient to supply the necessary steam. Operating superheated locomotives at full capacity is advantageous, because when boilers are worked hard, fire-box temperatures are high, resulting in high degrees of superheat.

As these small locomotives are usually worked on short runs, where stopping and starting is of frequent occurrence, there is another advantage in that the superheater locomotive is "smarter," that it gets under way quicker and saves time in doing its work. It will be observed also that the superheated locomotive operates with less smoke than the saturated locomotive, due to a reduction in the fuel consumed. This fact is an obvious advantage where locomotives operate in or near large cities where stringent smoke laws are enforced.

To manufacturers of small steam locomotives, the superheater is of particular interest and value. The application of the superheater places the small steam locomotive on an advantageous competitive basis in point of economy with other types of small motive power. This fact should be borne in mind also by the prospective user of small locomotives and should be carefully considered in the selection of the type of locomotive power best adapted to the service requirements.

The accompanying illustrations show a number of these light locomotives of var-



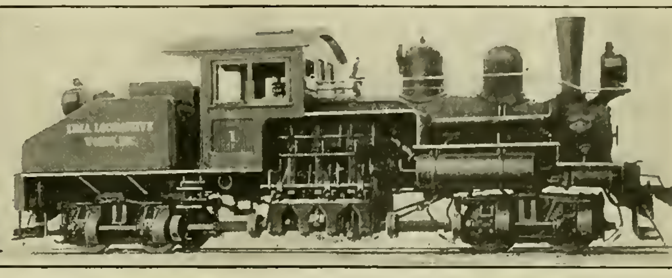
SUPERHEATER ARRANGEMENT FOR SMALLER CLASSES OF LOCOMOTIVES ious designs which have been equipped with superheaters. They embrace types covering the Mogul, Shay, Climax and saddle tank.

In making these applications, the amount of heating surface will appear to be almost ridiculously small, as shown by the line engraving of such an installation. From this it appears that but four superheater units are used in the boiler illustrated, but with boilers of approximately only 30 in. in diameter this has been found to be quite sufficient to attain and maintain a superheat of 150° Fahr., and this will effect the usual saving in coal and water.

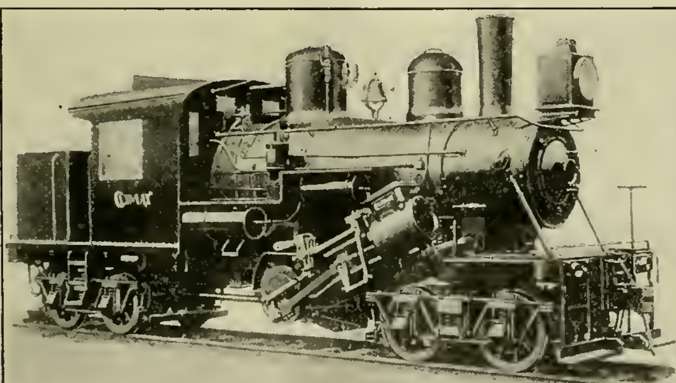
As to the cost of maintenance, there is no reason to think that this expense will be relatively any higher with four units than it would be with a dozen or more. So that there is every reason to expect that the savings will more than meet the cost of installation and the slight increase in maintenance charges. So that, broadly speaking, the advantages of superheated steam in small locomotives may be summarized as follows:

A reduction of from 20 to 30 per cent in fuel consumption, with a corresponding reduction of from 25 to 35 per cent in water used; an increase of about 30 per cent in the capacity of the locomotive; an engine that will do its work more quickly and handle a greater tonnage at one time, and one that will probably produce less smoke, all of which is worthy of the attention of the owners of this class of power.

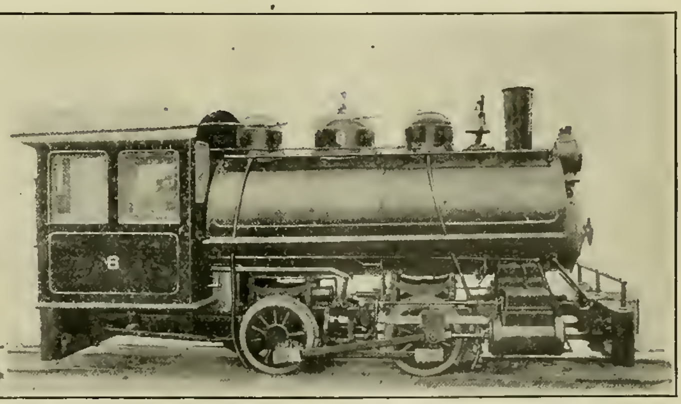
2-6-0 TYPE LOCOMOTIVE BUILT BY H. K. PORTER CO.



SHAY GEARED LOCOMOTIVE BUILT BY LIMA LOCOMOTIVE WORKS.



GEARED LOCOMOTIVE BUILT BY CLIMAX MFG. CO.



SADDLE TANK LOCOMOTIVE BUILT BY VULCAN IRON WORKS.

The Detroit-Windsor Bridge

Announcement has been made that the plans for the Detroit-Windsor suspension bridge are now submitted to a board of consulting engineers. The preliminary work on the design of the bridge has been completed. It will have the longest and heaviest span of any suspension bridge in the world. The span will be 1,805 ft., and there will be two roadways each 28 ft. in width, paved with concrete; two 7-ft. sidewalks also paved with concrete, and the two trolley tracks over which it is proposed to arrange for the operation alternately of Detroit and Windsor street cars, thus making it possible to give transfers to all parts of both cities. The current for the operation has been promised on a reasonable basis by the Hydro as soon as the new Niagara plant is completed.

The foundations for the bridge will be sunk to bedrock at a depth of 100 ft. by the pneumatic process, and this work will be done by the bridge company. The contract for the steelwork will be made as soon as the plans are fully developed, but arrangements have already been consummated whereby the wire for the cables will be furnished by the Roebling Company, who made the cables for the three great suspension bridges over the East River at New York City. Each cable will consist of approximately 10,000 separate wires, with ultimate strength of 240,000 lb. per sq. in.

The contract has already been signed between the American Transit Company, which has the authority from Congress to span the river, and the Canadian Transit Company, chartered by Parliament for joint action in financing and building the bridge. The joint board of directors of eleven members will be elected in August.

The railway deck is planned to have four tracks, with the approaches on 1½ per cent grades, and connect with the Essex Terminal Railway in Windsor, thus affording access to the Grand Trunk, Pere Marquette and Canadian Pacific railways and on the American side with all the railways entering Detroit. The operation would be by electric locomotives weighing about 120 tons each, which will haul from 30 to 50 freight cars.

The preliminary work as has been stated is finished, and the details are rapidly approaching completion and the growing necessity of such a structure is universally conceded in the interests of growing transportation.

Material of Safety Valves

In reply to inquiries as to what material it is necessary to use under the requirements of the Boiler Code for the Y-fitting, also for the safety-valve body, for safety valves to be operated at a pressure of 225 lbs., it is the opinion of the committee that the valve referred to may be made of cast iron, provided the temperature does not exceed 450 deg. Fahr. The safety-valve body need not be of steel unless it is to operate with superheated steam, in which case cast steel should be used.

Hearings Before the Senate Committee on the Railroad Problem

Aftermath of the Labor Board's Decision—Views of the Executives

The hearings before a committee of the United States Senate continued at intervals during the last month, and a mass of evidence submitted, the larger portion of which was already familiar to the public. Among the most important statements made was that of S. Davies Warfield, president of the National Association of Owners of Railroad Securities. He said that only through far-reaching economical methods for conducting transportation and through the wiping out of old-time prejudices could rates and fares be made satisfactory to the people and compete with the rates of other forms of transportation while producing returns sufficient to enable the roads to finance obligations. With proper economies, however, and the return of normal business conditions, he predicted that the railroads could earn a 6 per cent return and also reduce rates.

Transportation could not be maintained, he said, on a return on railroad property in the aggregate less than that provided in the Esch-Cummins act. He said any attempt to impair that act would menace successful operation, in the public interest, of the transportation system.

"The question for the moment," said Mr. Warfield, "is whether sufficient revenue can be obtained from rates and fares that will be considered reasonable by the public and the shippers, and will these rates bear a relation to the price obtainable for the articles transported that will not impede commerce; or will part of the money required to meet the necessities of transportation have to be supplied, in the public interest, by taxation? The latter means government operation and eventual government ownership, and unless effective railroad organization is consummated to introduce rigid economies this cannot be avoided."

He contended the increase in railroad rates could not be held accountable for the contraction in business from which the railroads had suffered acutely. The unprecedented and unforeseen era of business readjustment, he said, was the real cause of the loss of business to the railroads.

Mr. Warfield presented as an economy measure the plan which he has heretofore announced for an organization of the officials of the railroads as grouped in each of the four territories now established by the Interstate Commerce Commission.

Another plan was to provide for a central agency or corporation to supply equipment to the railroads without profit to the corporation and to perform other services under the supervision of the Interstate Commerce Commission.

He said the commission has laid out the country in four districts, with the carriers already grouped in those districts. He would have the carriers of each group organize themselves. A group railway board, of not less than five members, would be selected by each group of carriers, according to his plan. From among the carriers of the groups men would be selected to report on advanced methods for producing economies.

These officials, he said, were to be selected from each of the four group boards, twelve in all, to serve on a national board, with twelve additional members selected from the trustees of the National Railway Service Corporation. This national board would be composed of practical railroad officials and men trained in finance and general business administration. This board would determine questions of legislation and public policy. The group boards and their committees would be advisory and would not interfere with the boards of directors of railroads.

Wage reductions, Mr. Warfield said, cannot entirely supply the means through which to meet the constant demands of the shippers for decreased rates, which can be secured through economies possible of attainment.

"It has been made apparent," said Mr. Warfield, "that the country cannot look to a thousand or so executives of railroads, nearly 200 alone representing the great systems, to reach agreements and conclusions among themselves respecting the co-ordination of facilities and service and the introduction of economies to the extent essential to guarantee the most economical administration and methods of transportation under the system that is at present observed. Unless these conditions are recognized, and relieved through definite organization, then transportation through private operation must fail."

Mr. Warfield outlined the plan of the board of economics and engineering appointed by his association as the only instrumentality free from entangling alliances which could look into the subject of economies in the interest of the public. This board is now engaged in a broad inquiry into railroad questions. It is composed of John F. Stevens, F. A. Moliter, John F. Wallace, W. L. Darling, L. B. Stillwell and W. J. Colpitts.

Views of the Trainmen's Chief

"If time and one-half pay and other working rules and conditions are eliminated and wage reductions are ordered as well, no power on earth can hold the railroad men of this country." W. G. Lee, president of the Brotherhood of Railroad Trainmen, one of the "Big Four" organizations of train service employes, made this statement on June 23, when asked his opinion of the attitude of railroad men generally toward the recent decision of the United States Railway Labor Board reducing wages of 2,000,000 rail men an average of 12 per cent.

A further decision of the board, covering railroads not included in the hearing which ended in the board's order of June 1, is to be given within the next week. Both orders became effective July 1.

Heads of the "Big Four" brotherhoods and of the Switchmen's Union of North America, late in May, joined in calling a conference in Chicago July 1 of 600 general chairmen of the organization to "consider and pass upon the award." A similar conference was held a year ago, when the board announced its famous wage increase order.

"Our men will not stand for elimination of time and a half pay and such things, and wage reductions, too," President Lee said, speaking not only for his own organization, but indicating that he expressed the sentiment of the members of the other brotherhoods. "In fact, they'll fight quicker against the loss of such things than on the matter of wages," he continued.

"If the general chairmen do not want to assume the responsibility of accepting the award, they will probably order it submitted to a referendum of the members," Mr. Lee said. "If the members accept it, all right, but it would be fifteen days anyhow, perhaps thirty, before we would know the result.

"Some of the chairmen will be fully instructed by the members of the lines they represent," he went on. "I am already receiving protests against acceptances of any such an award, but these, of course, are only the expression of individual lodges.

"I don't think our fellows would object to the 12 per cent reduction if they felt sure the railroads were not coming right back for more. That is, they are inclined not to make any serious protest if they can be assured the railroads will not go before the board again and ask further reductions.

"Everything depends upon the railroads. We hope, by the time of the conference to have some indication of what they propose to do. If they are going to ask for more, then our men may pass up this award, wait for the later decisions and vote on the whole thing at one time. Under the law the new rates go into effect

July 1, you know, whether they are accepted by the men or not."

President Lee's statement was the first given by the head of any of the sixteen recognized railway unions indicating the probable attitude of railroad men of the country toward the wage reductions ordered by the Railway Labor Board.

Erie Adopts a Simple Plan

E. D. Underwood, president of the Erie railroad, announces the establishment of a local labor board this month whose function will be to settle all differences on matters relating to rules and working conditions. Mr. Underwood explains that to refer such matters to the Labor Board is impracticable and fails to get results within a reasonable time. The plan evolved by the Erie provides that the officers and employes shall join in the selection of a committee of four, two from each class, and that if the committee is unable to agree on any question coming before them, they will jointly choose a representative from the public.

Mr. Underwood is of the opinion that regulating working relations by law is a bad way. The employes have everything to gain by the new plan and nothing to lose, because no prejudice will be felt against the employe taking a case to the local board. The way to settle the differences will be to settle them on the ground where they occur, and through men who are acquainted with the conditions. When this is done, and not until then, Mr. Underwood claims, a feeling of mutual good will will arise and loyalty be established.

Contentions of the Brotherhoods

Among the complaints submitted to the Railroad Labor Board, showing the feeling among train service employes as expressed by brotherhood executives, much complaint has been made over the interpretation of the rules and the decision abrogating the agreement in force under the authority of the United States Railroad Administration. Speaking on the subject W. S. Carter, president of the Brotherhood of Locomotive Firemen and Enginemen, stated that many roads have interpreted the decision to mean that the schedules held by the train service employes should be abrogated on July 1, and that the employes will fight ten times as hard against the abrogation of these schedules as they will against a moderate reduction in wages.

The decision given by the Labor Board in the conference states that the board did not, nor could it under the provisions of the Transportation Act of 1920, include in its decision any matter which was not properly before it as a dispute. The decision did not, therefore, terminate the existing schedules or agreements of the train, engine and yard employes in the service of the carriers. Changes in such schedules or agreements, however, may be made after the required notice either by agreement of the parties or by decision of the board after conference between the parties and proper references in accordance with the provisions of the Transportation Act and the rules of the Board. The act will not have been complied with until the carriers shall have met in conference the duly designated representatives of the employes directly interested in the dispute, and, in case of a disagreement, shall have properly certified the dispute to the Labor Board.

A further decision of the Board was to the effect that the majority of any craft or class of employes shall have the right to determine what organization shall represent members of such craft or class. Such organization shall have the right to make an agreement which shall apply to all employes in such craft or class.

Present Condition of the Railroads

In a statement made before the Committee of the Senate, Samuel Rea, president of the Pennsylvania Railroad Company, claimed that in many particulars the present condition of the railroad companies and their lack of traffic was due to the world-wide conditions which prevail also in other industries as well as in the railroad business. But the difference between these industries and the railroads in meeting these conditions is that the industries had the advantage of sharing in the high prices and profits of the war period, and at present the industries have the power to fix their prices and wages and to shut down their plants if the business, or profits, do not warrant their operation. The railroads, however, were in the war period restricted to the returns of the test period, and even under the Transportation Act are not allowed to retain the profits made under reasonable rates if in excess of 6 per cent on their property investment—if they happen to be so fortunate as to obtain that result—but are required by law to divide the so-called excess with the government, and hence are largely prevented from fortifying themselves to the fullest extent to meet depressions. Although the railroads were granted higher rates effective August 26, 1920, yet since that date they have proved to be insufficient to cover their costs, and yield a fair return. Though many railroads are facing financial difficulties, they cannot promptly reduce wages nor change the wasteful working conditions, to the level of the going wages and working conditions of the industries, through the territories they serve. That must be done by the Labor Board. By Federal law the rates were to be fixed to produce a fair return, yet the railroads are apparently unable to insist upon compliance with that law so long as supply and demand restrict production and consumption, and reduce the volume of traffic.

The railroads must, therefore, get the requisite financial results to allow them to exist, by postponing all capital expenditures, by curtailing employment, by shutting down all possible activities on the road and in the shops and offices, by stopping the purchase and use of supplies, by postponing for the present, even though they will cost more later, all maintenance and replacement expenditures except those requisite for safety.

Order Reducing Wages Is Extended

On June 27 the United States Labor Board extended its wage reduction order to practically every large railroad in the country. The average 12 per cent reduction granted 104 carriers on June 1 now covers 210 more roads. It involves virtually all classes of employes on practically every railroad known as Class 1 carriers which was not included in the board's original reduction order. The Class 1 group includes every big road in the country. Rates of reduction for several minor classes of employes were also added to the order. Dining car employes and porters were named in added sections of the decision. The new decision is looked upon as making a reality of the estimated $400,000,000 annual savings expected when the board's 12 per cent cut is applied to all employes in the Class 1 carriers.

National working agreements binding railways and their employes will not terminate on July 1, as directed by the United States Labor Board in its original decision. Indications are that they will continue in force at least another month and possibly for an indefinite period. Many of the roads were unable to reach agreements with employes at the time specified by the board, and the board itself lacked time to draft a set of rules to which it had intended to give effect on lines that would be found agreeable to the railroad unions. Some of the railroads, a majority, it is said, either have failed to carry out the board's instructions to get together with employes on new working agreements or have not yet completed the task. A few of the roads, according to reports, have made no attempt to meet employes' representatives in this matter.

Alba B. Johnson Confers with the President

Alba B. Johnson, of Philadelphia, and a group representing the Railway Business Association presented to the President at Washington on June 27, a statement in behalf of concerns selling goods or service to railroads, claiming that the problem of industrial employment is the first and most vital obstacle concerning the roads, and the situation was aggravated by inability of the roads to pay bills of railway supply manufacturers or to order necessaries. He charged that depletion of railway treasuries is due to delay in reaching an adjustment of railway accounts with the government. Railroad orders being held to the minimum many plants are on part time or closed down, throwing their forces out of work. In Mr. Johnson's opinion rehabilitation of railways and subsequently their maintenance and operation will depend upon the foresight and business judgment applied to the regulation of rates.

The President informed the delegation that he was in accord with many of the ideas advocated. He intimated that the reason he has not taken up the question of obtaining sufficient funds to meet railroad adjustment claims has been due to the fact that in his opinion public sentiment in that direction has not been crystallized. The President gave the delegation the impression that he does not feel yet that the time is ripe to ask for such an appropriation, and that early readjustment claims will be paid from the fund of $225,000,000 on hand for that purpose.

Vote of the Railway Men on Wage Reduction

It need not have been a matter of such surprise as seemed to be to the editors of the daily press that the vote to reject the pay reduction, when it became known in the last days of June that shop employes over the country had voted overwhelmingly to reject the 12 per cent reduction in wages ordered by the United States Labor Board beginning July 1.

The result of the referendum taken among shopmen and forwarded to the national headquarters of the railroad department of the American Federation of Labor at Chicago, showed for the decrease about 48,000; against the decrease, 235,000. The decided opposition of the shop employes came as a surprise to the public generally, and the labor leaders particularly, who, it was said, believed that the reduction in wages would be accepted by a small margin. There are 600,000 men who belong to the Railroad Department of the American Federation of Labor. These men are employed on every railroad in the country.

Leaders of the labor unions, who will not allow themselves to be quoted, are apparently in earnest against any strike at this time. They will, it is said, conduct post vote negotiations with the various union branches to try to induce the men to accept the reduction which is already in effect. They plan, in case of a final vote decision, to make a final effort to negotiate with individual employes, the general impression among the leaders being that they could not expect public sympathy to be on the side of the employes in the event of a strike at this time. Not only so, but as there are thousands of railway men out of work, and it is not unlikely that these men would be willing to take the positions vacated by the strikers. The leaders, however, seem to know that their place is to represent the demands of the majority.

Question Going Back to Members

Early this month, after several days' discussion among the representatives of the unions, the opinion seemed to gather strength that there would be no strike at this time. After repeated conferences it was decided that the question that brought 1,500 railroad labor representatives to Chicago would be sent back to the membership of such organizations as had not already taken a referendum on it. Indications gave promise that the result of further voting would be largely dictated by the leaders, who, apparently, are convinced of the futility of a general walkout.

Radicals in the ranks of the union chiefs were won to conservatism chiefly because of the recent change in the main issue. Contrary to general opinion, this is not primarily the 12 per cent reduction in wages. Working rules are a more important factor.

While the wage reduction order has been a source of dissatisfaction to the 1,500,000 railway employes, the leaders evidently accepted it as inevitable. They believe that wages will be increased again when traffic picks up.

But the unions are making a last ditch fight on working rules. When in April the Labor Board issued an order directing that the national agreements which had been in force since the Government took over the roads should end July 1, organized labor lost a hard fought battle. It was this order and not the wage reduction that caused most of the dissatisfaction that started strike talk.

As is well known when the Labor Board ruled that where no substitute code had been agreed upon by the railways and their employes the national rules, excepting those applying to pay for overtime, should remain in force indefinitely. Thus the rail workers temporarily retrieved something of what they had lost.

But the ruling favored the railways in one important respect. It provided that, pending further action of the board, overtime should be paid for at the regular rate, excepting in cases of employes whose unions had special agreements with railroads prior to Government control. The 500,000 shop craft employes benefit by the exception. Few others do.

But the modification of the original order is said to have given union men new hope for ultimate success in their effort to gain satisfactory working conditions.

"If it had been merely the wage question," said one of the leading union chiefs, "the delegates to these conferences would have disposed of that with a formal protest at the most. In fact, I don't think there would have been occasion for conferences. But the working rules are another story. They represented thirty years of fighting by railway union labor."

Reports are said to indicate that, in view of the crisis just passed, railroad officials are showing more inclination to nogotiate on new working agreements.

Proposes Solution of the Railroad Problem

S. G. Blythe in an article in the *Saturday Evening Post,* discussing the railroad problem, states, in part, that the principle of governmental supervision and control of interstate commerce is well established and essential, but governmental supervision and control must be progressive and not reactionary, must be businesslike and not academic and theoretical, if the realroads are to cease to be a taxable expense and are to come back to their former status.

Admitting all just contentions as to abuses and derelictions in railroad management in the past, the fact remains that, as the railroads could not operate at a profit for themselves or for the Government, there is something wrong in the system.

When the period of depression came, after the boom had gone and when there was a vast decrease in work for the railroads, the rates were raised by and with the consent of the Government, on the theory, perhaps, that a raise then would decrease prices. The bars were taken down after the fields were empty.

That is an illustration of the Government in commercial business. That is why every man who has given attention to the matter insists that the Government must get out of commercial business. If higher rates were justified when the roads finally did get them they were justified when they would have been profitable instead of restrictive.

The real solution of the question and the real way to relieve the taxpayers of this railroad burden is to grant to the railroads the ordinary flexibility of business operation that the private business enterprise has. It is not argued that the Government should abandon supervision of rates, but it is held that the railroads should have the opportunity that any business man has of adjusting his prices to conditions as the conditions arise instead of being compelled to wait for a year for the action of a governmental body.

If the railroads had a flexibility of operation they would be in far better case, and the rates they might make could be subject to review and rebate if excessive. The point is, as held by students of the question, that the roads are strangled now by the restrictions upon them which preclude their taking advantage of business conditions as they arise instead of waiting until those conditions have passed.

The thing seems reasonable. A great deal of the prosperity of the country depends on the prosperity of the railroads. As the situation is at present, relief must be given or the Government must take over the railroads again to prevent paralysis of transportation. Taxpayers who have even a remote idea of what the recent Government experiment with the railroads cost them—the taxpayers—will shudder at the prospect of this.

New Mikados for the Baltimore & Ohio Railroad

The Baltimore & Ohio Railroad was among the first trunk lines in this country to recognize the advantages of the Mikado type for heavy freight service and in 1911 ordered 40 locomotives of this type from the Baldwin Locomotive Works. These locomotives used saturated steam with a working pressure of 205 pounds and the cylinders were 24 inches in diameter by 32 inches stroke. With drivers 64 inches in diameter the maximum tractive force was 50,200 pounds.

Using this original design as a base, a large number of additional Mikados were subsequently built; improvements being introduced wherever it was possible to better fit the locomotives for the special conditions existing on this railroad system. Including fifty Mikados now being built, the total number of this type thus far constructed by the Baldwin Locomotive Works for the Baltimore and Ohio, is 420. This includes 100 standard light Mikados ordered by the United States Railroad Administration.

The new locomotives are designated as Class Q-4, and have cylinders 25¾ inches in diameter by 32 inches stroke.

The steam distribution is controlled by 14 inch piston valves. Forty-five of these locomotives are equipped with Baker valve motion and five with Young valve motion. Both types of gears are controlled by the Ragonnet type B power reverse mechanism.

In the locomotives equipped with Baker gear, the valve travel is 7 inches, the steam lap 1 inch and the lead ¼ inch. The locomotives with the Young gear have the same lead, but the travel is increased to 9 inches and the steam lap to 1⅜ inches.

The boiler is of the extended wagon top type, equipped with a superheater and brick arch and carrying a steam pressure of 220 pounds. Its general dimensions are closely similar to those of the boilers used in the first Mikados built for this road. The installation of a superheater has necessarily changed the arrangement of the tubes and caused a reduction in the tube length of from 21 feet to 20 feet 5 inches. The new locomotives are fired with Duplex stokers and are equipped with one piece cast-steel ash pans having single hoppers with swing bottoms. The pans are designed to give sufficient clearance for a "booster" should it be decided to install this device at any time in the future.

The arrangement of the frames and spring rigging presents several interesting features. The main frames are 6 inches in width and each is cast in one piece with a single front rail which passes under the cylinder saddle and extends forward to the bumper beam. In addition, there is an upper frame rail of heavy construction which is bolted to the main frames back of the cylinders and extends forward to the bumper. Above the leading truck is placed a substantial steel deck casting, which is bolted to the cylinders, bumper and upper and lower frame sections; while the brake fulcrum casting braces the frames most effectively back of the cylinders. This arrangement provides an exceedingly strong construction at a point where stresses are severe. The rear frame is of the Commonwealth cradle pattern.

The driving spring hangers are connected to the equalizing beams by keys instead of pins and prevented from wearing the frames by chafing plates which are electrically welded into place.

The rear truck is of the Delta type and the method of equalizing it with the driving springs should be noted. The rear driving spring hangers instead of being attached directly to the truck frame, transfer their loads to equalizing beams which are fulcrumed on the truck frame.

The locomotives have steam heat equipment so that in cases of emergency, they may be used in passenger traffic.

The tenders of these locomotives are of the Vanderbilt type with a capacity for 12,000 gallons of water and 20 tons of coal. The tender frames are of the built up type with cast steel bumpers. The trucks have cast steel side frames and bolsters and rolled steel wheels.

The total weight of tender with water and fuel is 213,600 pounds and the light weight is 74,000 pounds.

The following are the leading dimensions of these Mikado type locomotives:

Gauge, 4 ft. 8½ ins.; cylinders, 25¾ ins. x 32 ins.; valves, piston, 14 ins. diam.

Boiler.—Type, extended wagon top; diameter, 78 ins.; thickness of barrel sheets, ¾ in., 13/16 in.; working pressure, 220 lbs.; fuel, soft coal.

Firebox.—Material, steel; staying, radial; length, 120 ins.; width, 84 ins.; depth, front, 81½ ins.; depth, back, 72 ins.; 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, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Diameter, 5½ ins. and 2¼ ins.; material, steel and steel; thickness, .148 in. and .125 in.; number, 40 and 200; length, 20 ft. 5 ins. and 20 ft. 5 ins.

Heating Surface.—Firebox, 228 sq. ft.; tubes, 3,566 sq. ft.; firebrick tubes, 28 sq. ft.; total, 3,822 sq. ft.; superheater, 1,010 sq. ft.; grate area, 70 sq. ft.

Driving Wheels.—Diameter, outside, 64 ins.; diameter, center, 56 ins.; journals, main, 12 ins. x 13 ins.; journals, others, 10½ ins. x 13 ins.

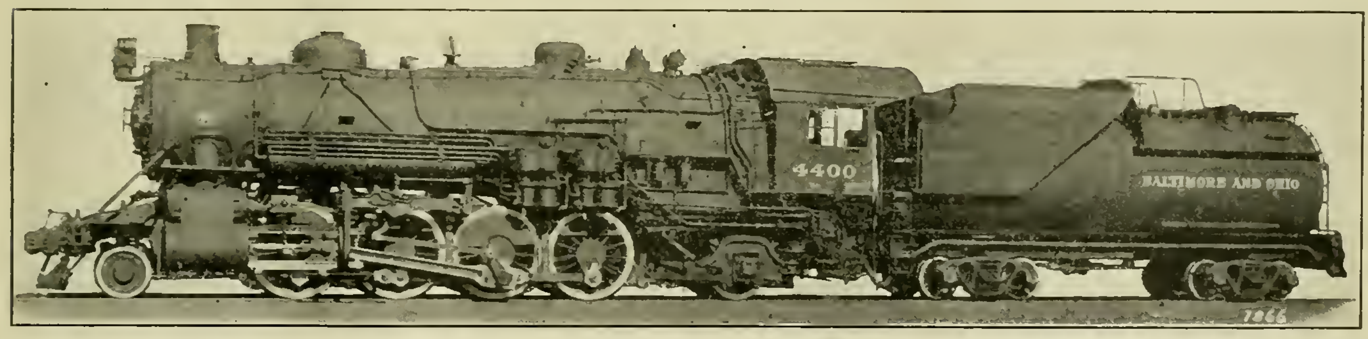
Engine Truck Wheels.—Diameter, front, 33 ins.; journals, 6 ins. x 10 ins.; diameter, back, 46 ins.; journals, 9 ins. x 14 ins.

Wheel Base.—Driving, 16 ft. 9 ins.; rigid, 16 ft. 9 ins.; total engine, 35 ft. 1 in; total engine and tender, 74 ft. 2¾ ins.

Weight.—On driving wheels, 247,000 lbs.; on truck, front, 22,700 lbs; on truck, back, 57,700 lbs.; total engine, 327,400 lbs.; total engine and tender, 541,400 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 12,000 U. S. gals.; fuel capacity, 20 tons.

Tractive force, 62,000 lbs.; service, heavy freight.



MIKADO 2-8-2 TYPE LOCOMOTIVE FOR THE BALTIMORE & OHIO RAILROAD.
Baldwin Locomotive Works, Builders.

Some Features of the Design of Locomotives Introduced for the Purpose of Modifying the Effect on the Track

By FRANK WILLIAMS, A. M. E. I. C.*

The destructive forces exerted by a locomotive on one rail may be roughly classified under the following headings: static load, dynamic augment, impact, lateral flange thrust and abrasion.

Static Load

The static load is merely the dead weight of the locomotive on the rail, and in order that a correct distribution of weight may be maintained at all times the locomotive is suspended on a system of equalizers and springs that have the effect of compensating for any slight irregularity of track such as low rail joints, etc. Nearly all locomotives in North America are hung with what is virtually a three point suspension, that is to say there are three separate systems of equalizing beams and springs. For example, in the Mikado freight engines the engine truck and the first and second drivers are equalized together, the third and fourth drivers and the trailing truck on the right side are covered by another set of equalizers and the third and fourth drivers and the trailing truck on the left side by an exactly similar arrangement. The centers of equilibrium of these three systems of levers are the three theoretical points of suspension, and when designing a locomotive, the center of gravity of the line weights has to be so located as to distribute the proper proportion of weight to each of these three points; the weight is then distributed to the different pairs of wheels by means of the equalizers according to the desired axle loading.

Fig. 1 is a sketch showing the springs and equalizers of the locomotive in question. It will be noticed that there is a transverse equalizer at "A" which allows any excess load to be distributed to both sides of the locomotive and connects the front arrangement into one system. The two back systems are separate from each other, as the so-called transverse equalizers at "B" is not really an equalizer in any sense of the word, but merely a very convenient mechanical arrangement for connecting the trailing equalizer, which is set slightly diagonally, to the back driving spring hanger.

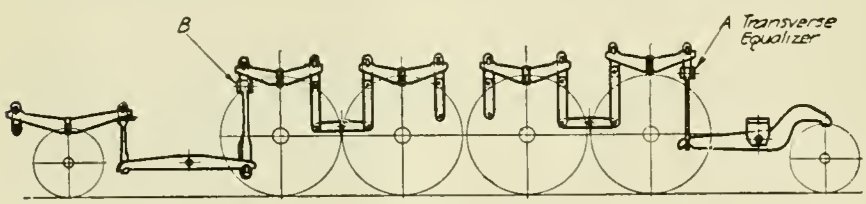


FIG. 1

In case there may be any who do not understand the advantages of a three-point suspension, let them consider a four-legged table standing on an uneven floor so that only three legs come in contact with the floor. If this table is slightly rocked until the fourth leg touches the floor it can be seen that all the time the table is in motion the load is carried on only two legs. A three-legged table, on the other hand, will accommodate itself to an uneven floor and each leg bears its fair share of the load.

The arrangement of the spring rigging varies on different classes of locomotives to suit the wheel arrangements, but the three point idea is always adhered to and a correct weight distribution maintained even though the track may be in bad shape.

Dynamic Augment

This is a term usually applied to the excess load which comes on the rail at every revolution of the driving wheels as the result of the centrifugal force of the over-balance in the wheels. It is a matter of impossibility to balance perfectly all the forces which distribute the smooth running of a two cylinder engine at high speed. The side rods, crank pins, crank hubs, back ends of the main rods and the effect of the eccentric crank when used are rotating weights, and are all completely balanced in the particular wheels which carry them; the distributing forces which cause all the trouble are due to the reciprocating movement of the pistons, piston rods, crossheads and the front end of the main rods.

In order to obtain a perfect balance, these reciprocating weights would need to be balanced by other reciprocating weights and this can be very conveniently done in a four-cylinder balanced engine, but with the ordinary two cylinder engine this is out of the question, and we have to resort to the expedient of increasing the balance weight in each driving wheel a certain amount in order to counteract the fore and aft vibration imparted to the locomotive by the rapid movement of the reciprocating parts.

The bone of contention for many years was how much of this reciprocating weight should be balanced and how much left unbalanced. If we balance too great a proportion of this weight the effect of the overbalance on the track may be severe and if on the other hand we balance too small a proportion, it will be impossible for the crew to ride on the footplate at high speeds owing to the excessive vibration, moreover the engine would soon go to pieces in service.

In the early days of locomotive building various proportions of the reciprocating weights were balanced with varying success; the proportion varied from 50 per cent to 75 per cent of the total, 66 per cent being the proportion adopted by most railroads. Later the engineers realized that the weight of the locomotive itself was a factor which should enter into the question, as it is self evident that a light engine with comparatively heavy reciprocating parts will be more subject to this fore and aft vibration than a heavy engine with comparatively light reciprocating parts.

The method then adopted was to take one four-hundredth of the total weight of the locomotive from the weight of the reciprocating parts on each side separately and then balance the remainder, this amount of counterbalance being evenly distributed between all the driving wheels.

The results obtained by this method were very good in the great majority of cases but experience proved that at very high running speeds it still left something to be desired and in 1915 counterbalancing methods underwent a radical change as the result of a report submitted by a committee appointed by the American Railway Master Mechanics Association to investigate the matter.

The chief point established by this committee was that reciprocating parts were usually heavier than necessary and that the total weight of these parts should not exceed a certain definite ratio to the total weight of the locomotive.

As a result of the conclusions arrived at by the committee the rule generally adopted by locomotive designers today is to keep the total weight of the reciprocating parts on each side of the locomotive below 1/160 part of the total weight of the locomotive in working order and then balance one half the weight of these parts, distributing this overbalance evenly between all the driving wheels.

*Abstract of a paper read before the Moncton Branch of the Engineering Institute of Canada.

The dynamic augment caused by the centrifugal force of the overbalance is then checked in order to make sure that it will not exceed one half the static load on the rail when the locomotive is running at a speed in miles per hour equal to the diameter of the driving wheel in inches.

If the centrifugal force of the overbalance were to exceed the static load on the rail at any particular speed the wheel would actually lift clear of the rail every time the counterbalance weight went over the top centre, or if the centrifugal force were only slightly less than the static load and the locomotive happened to be rolling a little, it might lighten the static load at the instant when the counterbalance weight was passing the top centre and the same condition would obtain; but when the locomotive is balanced in accordance with the present day method it will be agreed that there is no chance of the wheel lifting under any service conditions.

It is generally conceded by engineers who have made the closest study of these matters that dynamic augment is not in itself specially destructive to the track, but if it should be great enough to lift the wheel it will be accompanied by impact and in this case it might be very serious.

Impact

The term "Impact" is applied only to a sharp hammer blow delivered directly on the rail in order to distinguish clearly between this and the dynamic augment. If the dynamic augment is destructive, it is only mildly so, but impact is one of the most destructive forces with which the track maintenance department is troubled.

It has been pointed out that it is possible to cause impact by using an excessive amount of overbalance in the driving wheels. The most common use of impact is a flat spot in a tire. This may be the result of a skidded wheel or the shelling out of a piece of the tread of the tire. This condition is rigidly covered by our Maintenance Regulations and the locomotive is immediately taken out of service if a flat spot is found 2½ inches long.

Lateral Flange Thrust

For many years the fact has been recognized that a locomotive in road service must be guided, or the alignment of the rails will be seriously disturbed by the wheel flanges. This guiding is the duty of the engine truck.

Speaking generally, passenger engines are equipped with four wheeled trucks and freight engines with two wheeled trucks. A freight engine having a higher tractive effort than a passenger engine, therefore needs more adhesive weight and on this account less weight is carried on the truck. The high speeds at which the passenger engine operates make the four-wheeled truck desirable for this class of service although the two-wheeled truck has excellent guiding qualities even at comparatively high rates of speed.

On the early designs of engine truck the centering arrangement was merely a flat slide with a couple of light springs one on each side, working in opposition to each other. This arrangement gave very good satisfaction on the locomotives of that period, but would be useless on the locomotives of today as the truck has to swing quite a distance off the centre before any considerable centering thrust could be exerted by the spring.

This service was superseded many years ago by the swing link. In this type of truck the swing bolster was suspended

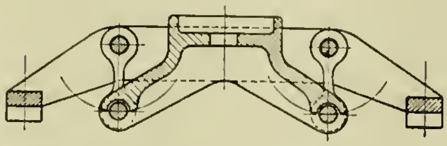


Fig. 2.

from the swing frame by four straight links as shown in Fig. 2. This truck was a distinct improvement on the earlier type but it had the same inherent disadvantages in a milder degree. The initial centering effect is nil and therefore this truck could do very little guiding when the locomotive was running on a straight track.

Although it may not seem reasonable to the uninitiated, it is just as important that a locomotive should be guided on a straight track as on a curve, and for this reason the swing links were changed to a two point suspension as shown in Fig. 3.

It will readily be seen from this sketch that in whichever direction the truck

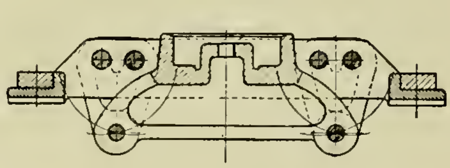


Fig. 3.

swings off the central position there is an immediate centering effect, and by properly proportioning the links this may be fixed at the desired percentage of the weight on the truck. It is common practice to make the initial centering effect about twenty per cent of the weight on the truck.

This type of truck has excellent steadying and guiding qualities on straight track and moderate curves, but it is not well suited to very sharp turnouts where a wide swing of the truck is required, as the resistance to side swing or the centering effect increases very rapidly as the truck gets further off the center, owing to the sharp angle which the swing links assume under these conditions.

In order to design a truck of this type for very sharp curves it is generally found necessary to cut down the initial resistance to prevent the possibility of the outside wheel being lifted from the rail by the pull of the swing links at their greatest angle and this of course is detrimental to the steadying qualities of the truck.

It can be seen from this that a truck with a constant resistance is greatly to be desired and many attempts were made to

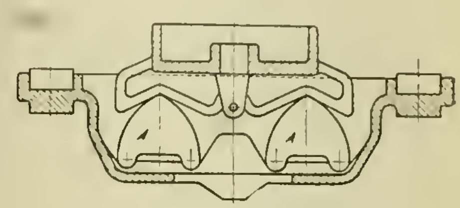


Fig. 4.

develop such a truck. Eventually the "Woodward" truck, which was first manufactured by the American Locomotive Company, was placed on the market and this design appears to meet with all requirements.

It will seen from Fig. 4 that the centering arrangement of this truck is a radical departure from previous practice, the swing links are discarded and the swing bolster rests on the rocking pieces "AA" in such a way that in whichever direction the truck swings, the swing bolster has to roll up an inclined plane. These inclined planes, the height of the rocking pieces and the spacing of their pivot points may be so arranged as to make the centering effect of the truck equal to any desired percentage of the weight on the truck and, whatever this percentage may be, it remains the same even though the truck may swing to its extreme travel.

By using a truck of this type it is possible to increase the initial resistance to side swing to about fifty per cent of the weight on the truck and this gives it a great advantage in steadying and guiding qualities over the swinging link type.

When a trailing truck is used on a locomotive it is given only a very moderate centering effect, for although this resistance to side swing has a beneficial effect in steadying the locomotive on a straight track, it will negative a certain amount of the guiding action of the engine truck when rounding a curve. The only object of giving side play to the trailing truck is to provide a flexible wheel base for rounding curves.

When five pairs of driving wheels are used as on our Santa Fe locomotives the front pair of drivers is given lateral play in order to cut down the rigid wheel base and give greater flexibility, and on extremely heavy power articulating is resorted to for the same reason.

Abrasion

The most rapid abrasion is probably caused by the grinding of the wheel flanges against the side of the rail on curves and turn-outs and this evil is mitigated as far as possible by making the wheel base flexible as is practicable by the methods mentioned before when dealing with lateral flange thrust.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:
JAMES KENNEDY, Managing Editor.
GEORGE L. FOWLER, Associate Editor.
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A. J. MANSON, Associate Editor.

London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd.,
3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $3.50 *or fifteen shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

The Postponement of the Mechanical Conventions

Whatever feeling of regret may be expressed at the indefinite postponement of the meeting of Division V Mechanical-American Railroad Administration and other meetings it must not be imagined for a moment that the various officers and committees to whom many matters of importance were entrusted, and from whom reports were expected, were in any way remiss in the duties imposed upon them. The work has been going on, and we are well aware that much progress involving many needed revisions in rules and regulations, and many advances on standardization and improvements in details of equipment have been discussed and decided upon by the experienced men to whose charge the matters were committed and this work will in due time be submitted for the approval or amendment by the members generally.

In some respects the present time is worse than the war time as far as allowing any considerable number of the leading men in the mechanical department of railroads to leave their posts of duty, even in the interests of the common betterment of the work in which they are engaged. The shortage of men and material, the lack of means, the delay in effecting settlements of disputed questions, the spirit of unrest, the complaints and threatenings, the acrimonious accusations, the airing of bitter truths arising out of a false governmental oppression, or suppression, of all that tended toward the well-being of the railroads and their development as an essential national necessity—could not be much worse than it has been and still continues to be.

Under such conditions the best course is to remain at work, like a beleagured army standing to its arms when surrounded by danger and difficulty. The situation, dark as it has been, cannot last forever. As soon as the railroads are permitted to manage their own affairs, like any other enterprise, there will be peace, and the associated bodies will function harmoniously as in the past, and the best and the brightest will again feel at liberty to meet together to exchange opinions in regard to the great and good work in which they are engaged, to the end that progress may move forward and not backward, and that we may "rise on stepping stones of our dead selves to nobler things."

The Heated Season

It will not be considered amiss to remind the engine men that in the summer season, in addition to the greater heat of the atmosphere there is also a marked increase in the amount of dust incident to all vehicular travel. The particles of grit and other abrasive substances are apt to get in between the rubbing surfaces of the bearings. These superinduce cutting and heating of the bearings, and may be impossible to discover and remove without taking the bearing apart. A liberal supply of oil, and if water pipes are attached, water should be poured upon the heated parts. If the trouble is in a driving box, it should be examined to ascertain if the wedge is jammed in the driving box. The slight expansion of the box and wedges, owing to the increased degree of temperature, may be sufficient to bind the box in the wedges, in which case the wedge should be slightly loosened, care being taken not to loosen the wedge too much, which may lead to frame breakages and other troubles, and it should also be remembered to set the wedge up again in its proper place when the box has sufficiently cooled. It will be found that where the self-adjustable wedge has been introduced the real value of the clever device will manifest itself particularly at this season of the year by remaining cool. Every locomotive might have been equipped with self-adjusting wedges by this time but for the multiplicity of causes that have hindered the adoption of this and other valuable devices.

On the locomotives not thoroughly equipped with the latest appliances in lubrication, if cold water and wedge-loosening do not have a permanent effect in cooling the box, a remedy may be found in relieving the bearing of some of the load resting upon the box. Hard wood wedges, suitably formed, should be carried on the locomotive so as to be readily driven into the space between the frame and spring saddle. A slight raising of the saddle will considerably diminish the weight on the bearing and lessen the tendency to heating.

In the case of the rod brasses becoming overheated the trouble may be more easily remedied, but there is an added difficulty in the readiness with which babbitt metal will melt in the brasses before any evidence of heating may be observed by the locomotive engine men. Under such circustances it is generally advisable to keep the engine running until the babbitt is all melted out. Any attempt at cooling while the babbitt is melting rarely fails to close up the oil holes and adds to the work to be done. A loosening of the rod key and judicious lubrication generally have the desired effect, and the addition of graphite may be relied upon as a sure safeguard against, as well as a remedy, in the case of the heating of bearings generally.

In regard to the heating of eccentric straps on the older types of locomotives equipped with the Stephenson valve gear it is not good practice to suddenly cool a heated cast iron eccentric strap with water. The tendency to crack the eccentric strap is very great. The best method is to slacken the bolts holding the two halves of the eccentric together and insert one or more thin liners. Lubricate well and do not move the reverse lever until the eccentric strap is fairly cooled.

In the case of car box journals heating, if it should become necessary to apply water to a heated journal, it is good practice to take the weight of the car off the journal. Waste should be placed along the sides and under the journal, and the water poured into the box instead of upon the journal. In this way the water is partially warmed before it comes to the journal and the journal is cooled gradually. In applying a new brass a block of hard wood should be placed between the top of the wheel and the sills of the car. The lifting jack should be placed on a block of wood across the ends of the ties. A small block of wood placed between the top of the jack and the box will keep the jack from slipping. The jack should be raised sufficiently to relieve any weight on the brass so that it may be readily removed and the new brass applied, taking particular care that both brass and bearing are perfectly clean.

These suggestions may be looked upon as unnecessary, as it may be taken for granted that experienced railway men come well prepared for any emergency but a reminder is never out of place.

Fuel Oil

One pound of fuel oil will average 17,000 to 20,000 British thermal units. Assuming an average of 18,500, the equivalent evaporation, from and at 212 degrees, will vary from 14.3 pounds of water, with a boiler efficiency of 75 per cent, to 7.6 pounds of water with a boiler efficiency of 40 per cent. The fuel losses when burning oil are not as great as when burning coal, and it is safe to assume that taking everything into consideration, one pound of oil possesses as much fuel as 1¾ to 2 pounds of average coal. The equipment necessary for burning fuel oil is comparatively simple, and locomotives originally designed for burning coal or wood can readily be changed to oil burners.

Not only so, but oil possesses many advantages as a fuel for locomotives. Among these are ease of handling and firing, absence of sparks, ashes and cinders, and the ability to work the locomotive at maximum capacity for sustained periods, regardless of the physical limitations of the fireman.

While these facts have been well known for many years in America, and have been fully taken advantage of in the districts where oil is plentiful and coal scarce, the British with their proverbial slowness in adopting new means and methods, seem to be just finding it out. The prolonged strike of the coal miners, beginning as it did on April 1, has compelled the railway men to look for other sources of fuel supply, and the change from coal burning locomotives to fuel burners are said to number as many as forty per day. We do not know the ratio of comparative costs of coal and oil in Great Britain, but at a time when coal cannot be had except from America, it resolves itself into a question whether coal from Virginia or oil from Persia is the cheapest, and in the undiscovered future, we would not be surprised to learn that when the coal industry again becomes normal, the demand for coal on the railways in Britain will be found to be considerably lessened and many of the miners may find that their occupation is gone.

Rail Joints.

It is interesting to note that among other mechanical devices that have been experimented with on railroads in the last century and passed into quiesence, the cutting of rail ends diagonally across the heads is receiving revived attention among some European engineers. As is well known the rail joint has always been looked upon as the weakest part of the permanent way, and many curiosities in interlocking, dovetailing, and other costly variations were tried and after the usual noisy demonstration that sounded to the inexperienced ear like a note of triumph, were found wanting. The hammer blows of the heavy locomotive wheels are not calculated to deal gently with complicated rail joints. At the first glance the diagonally cut rail head seems theoretically to meet the situation as far as relieving the intermittent shock of the wheels passing over the joints, and which, on a square cut rail end cannot be avoided. In the experiments with the diagonally cut rail end it was found that trouble was experienced when creeping took place. The angle at which the rails were cut at the joint superinduced a weakening or overflowing at the points with the result that the gradually lengthened points pushed over the inner sides of the attached rail and as a consequence affected the exact alignment of the gauge, tightening the gauge at the joint and slowly but surely widening the gauge immediately beyond the joint. The trouble was increased when trains running backward caught the overlapping points on the wheel flanges.

Rails are heavier in these days, and material is more durable, but as artillery seems to keep a little ahead of armor, so does heavier service keep ahead of heavier rails. In any event there can be no great harm in giving the old, forgotten inventions a new birth of experiment under new conditions. It has been said that trial is better than triumph. It teaches us the limit of possibilities. The revival of obsolete devices should be encouraged, and the skew-cut rail joint may some day come into vogue. The device, simple as it is, is capable of variety in the angle of the skew. The angular points might be rounded into obtuseness and tempered into indestructible resistance. The field is open and whoever gets rid of the repercussions of rail-joint shocks will deserve a distinguished service medal much more than many survivors of the late war who succeeded in holding down swivel chairs during the entire period, and whose real triumph was not so much in their contribution to winning the war as to their successful attack on the National treasury.

The Saving Habit

If there is one thing in the world that the American people need more than another it is the saving habit. Speaking of thrift, Rudyard Kipling, the Anglo-Indian *literateur* says: "All the money in the world is no use to a man or his country if he spends it as fast as he makes it. All he has left is his bills and the reputation of being a fool, which he can get much more cheaply in other ways. There's nothing fine or funny in throwing away cash on things you don't want merely because the cash is there. We've all done it in our time, and we've all had to pay for it. The man who says he never worries about money is the man who has to worry about it most in the long run, and goodness knows there's enough worry in the world already without our going out of our way to add to it. Any fool can waste, any fool can muddle; but it takes something of a man to save, and the more he saves the more of a man does it make of him. Waste and extravagance unsettle a man's mind for every crisis; thrift, which means some form of self-restraint and continence, steadies it."

There is only one weak point in Mr. Kipling's discourse. The money that a man spends foolishly may fall into the hands of men that can save, so it is not altogether lost. It is certain that a man, who cannot save money, if any of it comes his way, will never make any headway. We meet many railroad men who claim that they were better off in pre-war times, but we also meet a chosen few who have built houses within the last few years. It is in ourselves that we are thus or thus. The average man has more need of more sense than more money, and if common sense be denied him, what he needs are trustees to manage his finances.

Electric Locomotive Drives

A. Marshall, an eminent European authority in electric traction claims that the parallel crank drive has been most used in Central Europe of recent years for large locomotives. Recent experience in America, however, has been trending in favor of a modification of the older and well-known tramcar type of drive, in which the motor pinion drives a fixed gear wheel in the axle, the motor frame having on one side lug bearings through which the axle passes and on the other side spring suspension from the car frame. The main draw-back of the parallel crank drive in the uneven working, with consequent shocks and vibration, which takes place when resonance occurs with the oscillation of the rolling stock or with the single-phase current periodicity.

The construction with motor armature direct on the driving axle, as in the new Chicago-Milwaukee-St. Paul locomotives, is dismissed as not being ripe for discussion under German conditions, and two new drives are described which have for some time been under test on the Swiss railways. One is the Brown-Boveri drive, having two swinging eccentric toothed cranks to transmit the power from the pinion-driven gear wheel (with which they rotate bodily) to the track wheel. This drive has given two years' service without wear or any incentive to revision. The other is the Tschanz system, in which the drive is transmitted through a set of intermediate concentric gearing to a gear wheel concentric with the track wheel.

Snap Shots—By the Wanderer

In the clever play of Rollo's Wild Oat, there is a wealthy old codger who made his money in air brakes, and in the course of the dialogue the following piece of technical information is given:

Goldie. Tell me about your grandfather.

Rollo. Oh! he's a terror. He wants everyone to do what he wants.

Goldie. What does he want you to do?

Rollo. He'd like to have me interested in air brakes.

Goldie. Air brakes? Tell me about them.

Rollo. Well, you know when you are in a train and it gives a lurch and everyone who is sitting down is thrown on the floor, and everyone who is standing up is thrown on top of them? Well, that's the air brake working.

Goldie. I always wondered what it was. I should think you'd want to do something about it if you could.

Most of us would want to do something but limit ourselves to an abuse of the engineer or his superiors for the inconveniences that we experience. The question arises why this rough handling here and not there. I spend nights on sleeping cars with more frequency than is altogether agreeable, and on one road which I patronize extensively I know that I am to be jerked about during the night by rough train handling. It is of such ordinary occurrence as to be of common knowledge and yet nothing seems to be done by the management to relieve these disagreeables. It might be thought to be a necessity, were it not that, on a parallel and competing line, the brake handling is ideal. Trains run into stations and seem to drift to a stop, so smooth is their operation. And we who rejoice in the smoothness and make remarks about the bumping, often speculate, in our innocent way, as to why A bumps us and B stops without perceptible shock. I am going to try and find out what sort of training B gives the engineers and, if I find out, I will tell you all about it.

And speaking of sleeping cars reminds me that the Pullman Company have at last done something that you and I and thousands of others have been wishing they would do for more years than one. That is, they have taken a very courteous, and I hope effective way, to eliminate the morning nuisance of the smoking room. He usually gets up early and then sits himself down to smoke or watch his fellow travelers dress or just think of nothing. From the expression of his face the last seems to be the true explanation of his presence. For, if he did think, even for one minute, he would see that he is in the way, not wanted and a positive nuisance. And what he can find interesting or even tolerable in the spectacle of a mass of men crowded into a stuffy room in their various stages of negligee surpasses the power of the average thinking man to fathom. I have often asked the porters about it and they say: "What can I do? If I says anything to them they only gits mad." So now the owners, in appreciation of the condition, have had a nice little notice printed, framed and posted on some of their cars. It reads:

"To avoid congestion, passengers are requested to refrain from using this as a smoking room in the morning, until after passengers have made their toilet."

It has not been in service long enough to have any noticeable effect as yet. We have hopes. Perhaps if it fails, it might be well to have it printed in larger type.

And while on this subject it might be permitted to suggest that a good way to secure proper attention to the notice would be to issue orders to the porters that, as soon as a section is vacated in the morning, it shall be made up regardless of the close proximity to a terminal. As it goes now, if a train is due to arrive late, the porter usually clears the sections with great promptness and there is little or no excuse for the smoking room loafer to be one. But where the train ends its run at eight or earlier, the porter is so eager to hold up his passengers, brush them off and secure his tip that he neglects their real comfort for the problematical one of having had the satisfaction of having a whisk broom shaken at them. So meanwhile we sit around on berths and are generally disgruntled with the whole order of things and the Pullman Company in particular. It has always seemed to me that if he would jump in and clear the berths and give his people a chance to be comfortable for the last half or quarter of an hour of the trip, he would be quite as sure of his tip as though he followed the whisk-broom method and that what he did receive would be given far more willingly than it is now, by the man who ends a night run by sitting on the edge of his or somebody else's berth, as he does when he has drawn an upper. Perhaps this, too, can be corrected. If it is, all excuse for the smoking room loafer of the morning is demolished.

Superheated steam is responsible for some changes in the manipulation of locomotives, and it may be for one that often attracts my attention. I am old enough to remember the toy machine of earlier days; and in those days we always instructed the engineers to open their cylinder cocks on leaving a terminal, and above all to never fail to have them open when they were taking their engines out of the roundhouse. Our cylinder heads were not as strong as they are now, and the condensation of steam at 140 lbs. boiler pressure was more than a little. So to avoid broken cylinder heads or possibly a bent main rod, much reliance was placed on an open cylinder cock.

Now I seldom see or hear an open cylinder cock when a train is pulling out of a terminal, and they are not always open when the engine is moved out of the roundhouse. High steam pressure cuts down the actual amount of condensation and superheating helps still more. Disked cylinder heads of cast steel bolted to steel cylinders with 1 in. studs spaced from 3 in. to 3½ in. apart, makes a pretty strong construction and that with short ports makes a breakage unlikely. But, when there is water in the cylinders, the stresses set up are tremendous, and I venture a guess that it is the cause of more than one bent main rod. Just look at it. The rod is made to sustain the steam pressure with more than a little to spare. Its proportions are such as to amply care for all vertical stresses. It often weighs nearly a ton. And yet it comes in bent. Why and how? Too much water seems a reasonable reason.

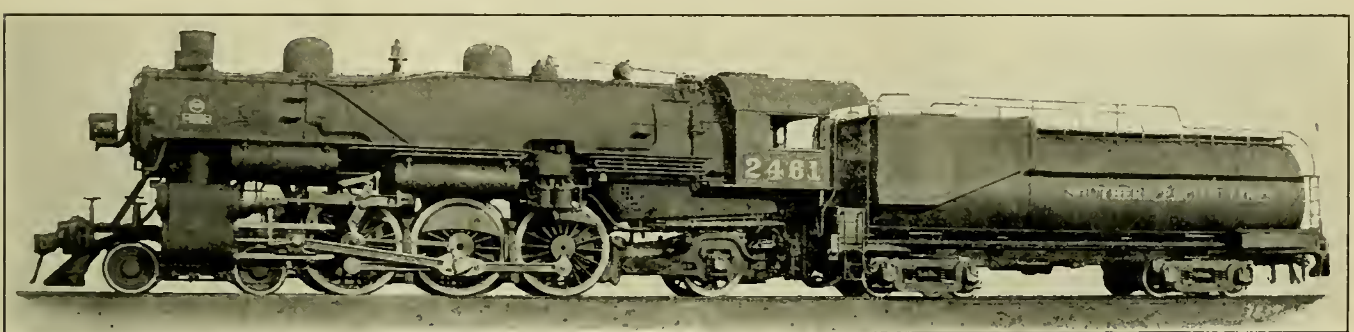
Saturated steam at 650° Fahr. does not obtain at the first opening of the throttle and if my senses have not altogether deceived me I have seen a deal of moisture coming out of the stack at a start. Heavy rods and substantial heads go a long ways to prevent breakage, but why overstrain even these? Why not resort to and practice that simple preventive of bent rods and cracked cylinders that was so effective when parts were weaker and steam moister than it is today?

Did you ever hear of a car being blown out of a siding to the main line? With these facts of experience facing you, would it not be worth the cost of a little time, paper and pencil to calculate the extra foot pounds of energy required to haul an empty freight car, with an open door, over a division? If you should do it, you would find that the foot pounds would be more easily expressed in horsepower hours and that these figures would be somewhat staggering. Horsepower costs coal, and may cost time, and both add to the cost of transportation. So why not shut that car door before that horsepower is stolen or lost? The difference between this horsepower and the simple horse in the unlocked barn being, that the horse may be recovered but the horsepower cannot. So when I see a string of empties rolling through the country with their doors wide open, I only wish that I could have half of what I could save by closing them. If you are a superintendent, why don't you order them closed and then see that it is obeyed?

New Pacific, Santa Fe and Switching Locomotives for the Southern Pacific Lines

Marked Increase in Weight and Tractive Power

In spite of the business depression affecting the purchase of much needed new equipment, it is gratifying to note that among recent additions to motive power the Baldwin Locomotive Works has recently completed forty locomotives for the Southern Pacific Company. These represent three types as follows: Fifteen Pacifics for passenger service, 15 Santa Fes for heavy freight traffic and 10 six-wheel switchers. In accordance with Southern Pacific practice these locomotives burn oil for fuel. They all use superheated steam and have tenders of the Vanderbilt type.

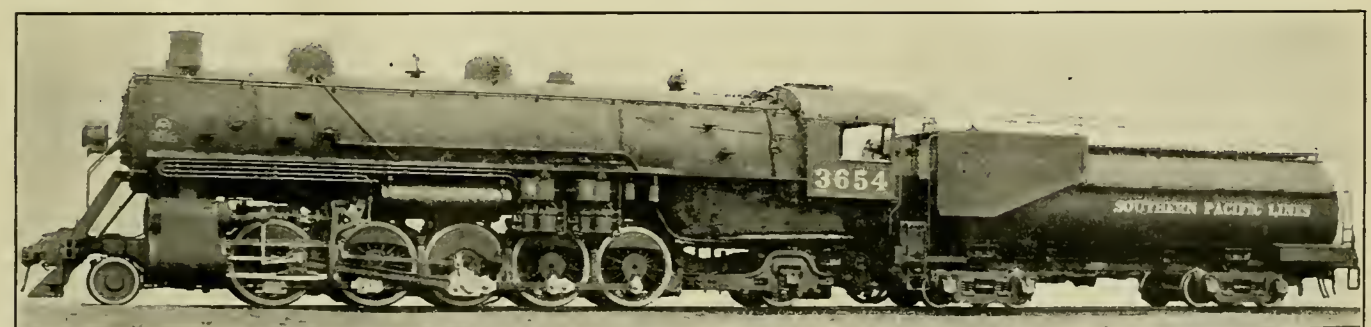


PACIFIC 4-6-2 TYPE LOCOMOTIVE FOR THE SOUTHERN PACIFIC LINES—BALDWIN LOCOMOTIVE WORKS, BUILDERS.

The first Pacific type locomotives built by the Baldwin Locomotive Works for the Southern Pacific Company that were equipped with superheaters were completed in 1912. A brief comparison of their dimensions with those of the new engines will be of interest as showing the increase in weight and capacity since that time. Such a comparison is as follows:

PACIFIC TYPE LOCOMOTIVES

	1912	1920
Cylinders	22 x 28 ins.	25 x 30 ins.
Driving wheels, diameter	77 ins.	73½ ins.
Steam pressure	200 lbs.	200 lbs.
Grate area	49.5 sq. ft.	70.4 sq. ft.
Evaporating surface	2,658 sq. ft.	3,352 sq. ft.
Superheating surface	580 sq. ft.	867 sq. ft.
Weight in drivers	141,500 lbs.	180,000 lbs.
Total weight	221,000 lbs.	297,800 lbs.
Tractive force	29,800 lbs.	43,600 lbs.
Tender capacity	12,000 gals. (water)	5,000 gals. (oil)



SANTA FE 2-10-2 TYPE LOCOMOTIVE FOR THE SOUTHERN PACIFIC LINES—BALDWIN LOCOMOTIVE WORKS, BUILDERS.

The new Pacific type locomotives have main frames 6 inches wide with Commonwealth rear frame cradles and Delta trailing trucks. The trailing truck is equalized with the drivers by means of equalizing beams which in this case are fulcrumed on the truck frame. With this arrangement the load is transferred to the truck frame at the radius bar pin and through two sliding bearings placed right and left back of the truck wheels. The front truck is of the Economy constant resistance type. The cylinder barrels are bushed and the pistons have open hearth cast steel centers fitted with cast-iron bull rings.

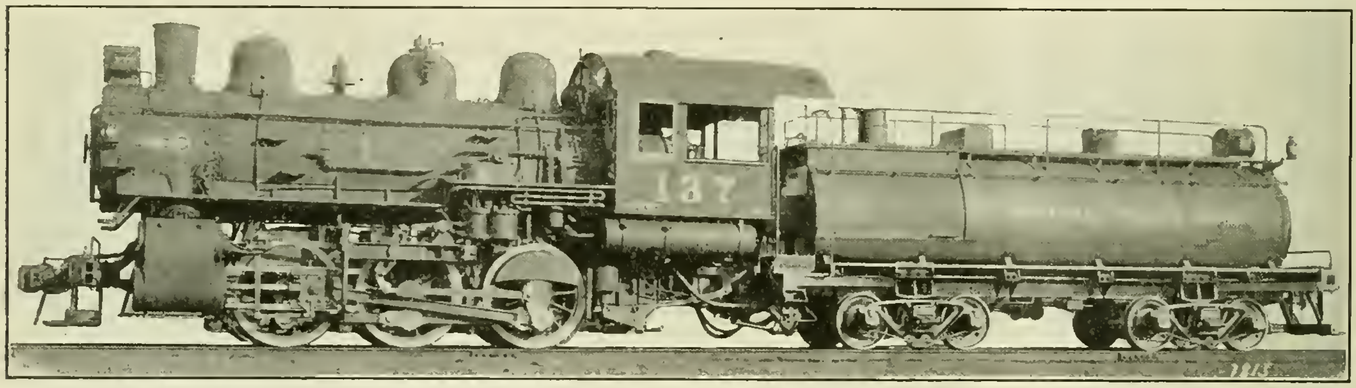
The driving axles, main crank pins and piston rods are hollow-bored and heat-treated. The main driving boxes are extended and Walschaerts valve motion is used, controlled by the Ragonnet type "B" power reverse mechanism. The boiler is of the extended wagon top type with a combustion chamber 36 inches in length. A Rushton throttle with auxiliary drifting valve is applied. The tender trucks are of the equalized type with journals 6½ ins. by 12 ins.

SANTA FE TYPE LOCOMOTIVES

The Santa Fe type locomotives are similar to the Pacific in many respects, and in a general way conform to the already established standards in service on the Southern Pacific System, but are a considerable advance in many leading details, being over 30 per cent heavier and about 50 per cent greater in tractive power as shown in the comparative table in relation to the Pacific type. In the Santa Fe type the boiler presents a difference in construction in that it has a straight top, with a combustion chamber 64 in. in length and tubes 21 ft. long. The machinery details of the two types are generally similar and the trailer trucks are interchangeable. Lateral motion driving boxes are used on the leading drivers of the Santa Fe type. The tenders are duplicates of those used with the passenger locomotives.

Switching Locomotives

In regard to the switching locomotives it may be said briefly that they represent a conservative design as far as the weight and capacity are concerned, but their equipment is in accordance with the most recent practice for power of this type. The engine wheelbase of 11 ft. is relatively short, and the main rods are connected to the rear pair of drivers. The valve motion is of the Walschaerts type. An interesting detail is the oil tank in the tender, which is so designed that the engine crew have an unobstructed view when running backwards. It will be noted in the accompanying illustrations that the tenders of the Pacific and Santa Fe type locomotives are of the Vanderbilt type, a cylindrical form in which a rectangular space is provided in which an oil tank is placed. This may readily be converted to accommodate coal should a change from oil be desirable. The switching engines have the tenders constructed, as has been already stated, so as to afford an unobstructed view in the rear of the locomotive. The tender trucks are of the archbar type with cast steel frames. The material throughout is of the best.



0-6-0 TYPE SWITCHING LOCOMOTIVE FOR THE SOUTHERN PACIFIC LINES. BALDWIN LOCOMOTIVE WORKS, BUILDERS.

Failure of Cast Iron Wheels.

In a paper read before the American Society for Testing Materials last month, Mr. H. J. Force, the chemist and engineer of tests of the Delaware, Lackawanna & Western R. R., made a strong recommendation for the use of a chemical formula for the manufacture of cast iron wheels. This is quite in accord with the practice of most foundries, where, for a number of years, the selections of metals and the proportions used in charging have been based upon the chemical composition, the old method of selection by fracture having been almost if not entirely discarded.

With an annual production of nearly three million wheels, that are used for all kinds of service, in all climates and over all conditions of track, it is small wonder that there are failures; and if a complete record of all of these failures could be gathered and studied it would probably be a most valuable contribution towards a means of bettering the wheel as a whole.

Mr. Force called attention to the fact that "the cast iron wheel is about the only part of railway equipment which is not purchased to a chemical specification; yet it is the most important part of such equipment." And then follows a tabulation of the analyses of a number of wheels that have failed. In this table fifteen analyses are given in which the average of the silicon is 79 per cent. This is undoubtedly high, but the specific causes of the failures are not given, although the author states that "the composition as to phosphorus and especially silicon is fairly satisfactory." It is pointed out that the wheel with the lowest sulphur and lowest phosphorus apparently gave the best service. The higher silicon wheels in all cases showed more wear than the lower silicon wheels. On the other hand it is believed that the combined carbon content, which in one case is as high as 0.99 per cent, is outside the limit for a cast iron wheel which would give the best results.

While urging the use of a chemical specification, "it is not contended that a chemical requirement will at once eliminate all wheel failures"; but it will serve to reduce them. It is on this basis that the following specification is recommended:

Total carbon, 3.00 to 3.65 per cent.
Combined carbon, .45 to .85 per cent.
Manganese, .50 to .75 per cent.
Phosphorus, not over .32 per cent.
Sulphur, not over .17 per cent.
Silicon, .45 to .75 per cent.

This varies somewhat from the composition aimed at in some of the larger foundries.

In some places the points that are especially watched in making up charges are the silicon and manganese content. In others it is the silicon and combined carbon. While it may be acknowledged that the combined carbon is of great importance, it is exceedingly difficult to control, and owing to the influence of the sulphur, it will take care of itself.

But the softening effect of the silicon makes it necessary that it should be very carefully watched, while the hardening effect of an excess of manganese, or even of its absence, in the extreme, makes it necessary that it should be confined in thin rather than narrow limits. It is well known that both the manganese and the silicon helps to cut into the sulphur, while the former also has an important influence in steadying the shrinkage and keeping the strength up to the proper point.

With these matters in consideration the irons and coke are so selected and the charges so made up that an approximation to a desired analysis is usually obtained. Such an analysis may be taken to be about as follows:

Silicon, from .55 to .70 per cent.
Manganese, from .45 to .52 per cent.
Phosphorus, from .28 to .33 per cent.
Sulphur, not over .17 per cent.

In the matter of phosphorus and sulphur this composition is almost identical with that suggested by Mr. Force. But both the upper and lower limits of the manganese are lower while there is a permissible range of only seven points as against twenty-five in the proposed specification. In the matter of silicon Mr. Force allows a range of thirty points as against fifteen in the range of practice. If, then, we take into consideration the fact that the limits found possible in actual practice give good results, it would hardly seem advisable to increase the ranges allowable for the impurities.

In the tabulation of the paper the failed wheels average a silicon content of .79 per cent. It would hardly seem advisable, then, to run so close to that average as .75 per cent in a specification.

But to establish a specification for cast iron wheels that does not include a wide range in its limitations would probably be impossible, because of the real delicacy of the chemical operations in the cupola, and the effects not only of the iron mixtures and fuel used but of the actual foundry practice.

Difficult as this may be, this great advance has been made over the practices of the old school, in that a chemical analyisis is now the basis of work in all foundries instead of the purchase of iron by brand and the mixing by the appearance of the fracture, and then melting with a certain coke that may vary widely in its composition.

Engineering Aspects of Signaling

By A. H. BUDD, Chief Signal Engineer, Pennsylvania Railroad

At a recent joint meeting of the Engineering Section, Safety Council and the Philadelphia Section of the American Society of Mechanical Engineers, A. H. Budd, presented an interesting paper on Signalling, from which we make the following abstracts. Railroad signalling is based on the proposition that any failure should be on the safe side. All apparatus is, therefore, designed so that, as far as possible, any failure will cause the signal to display its most restrictive indication. This means that semaphore arms are counterweighted to go to the stop or caution position should the power fail or apparatus be deranged; that signal circuits are all designed on the closed-circuit principle; that power must be properly applied to give a "Proceed" or "Clear" indication.

Recognizing that even then we may have what we call false- "Clear" failures, or that lights may be extinguished, we have a rule which it would be difficult to enforce in industrial plants, that the absence of a signal where one is usually displayed, or an imperfectly displayed signal, must be regarded as the most restrictive indication which that signal can display, and the failure reported to the Superintendent.

Light Signals Versus Position-Light Signals

The signals in general use are semaphore arms for day and colored lights for night. On some parts of some roads, colored lights are used both day and night and, within the past five years, the Pennsylvania has used rows of slightly yellowish lights to simulate the positions of the arms, knowns as position-light signals.

The advantage of light signals is that they have no moving parts; that of position-light signals, that there is no chance of a color-blind man's mistaking them. On account of their simplicity and lack of moving parts, light signals are becoming more and more popular. Of course, the lights may fail.

It will probably be hard in industrial plants to establish a rule that lights shall be displayed when it is safe to proceed and that no lights shall indicate a dangerous condition. This, however, is a correct principle. As shop employes are rarely examined for color-blindness, it would appear that indications given by position might be better than colored lights.

Reliability of Signal Essential

If the signal is depended upon to indicate danger, it must be absolutely reliable, as otherwise, since employes grow to depend upon these signals as a warning, in the event of a signal's failure they are encouraged to take chances. So that signals, if installed at all, should be arranged so that failure of power or breakage of power transmission line will still result in the display of some signal.

One of the most desirable features in protection of any kind is uniformity, so that employes will know what to expect when a certain signal is displayed. This is particularly true in the protection of highway grade crossings where the interest of the public and the railroads in the protection is identical, and uniformity all over the country at such crossings is most desirable. The American Railway Association has made a number of recommendations which have, in a large measure, been carried out throughout the country: (1) Striping in black and white of crossing gates; (2) Placing of "Stop" signs of uniform appearance in the hands of the watchmen; (3) Display of red lights on crossing gates or in the hands of the watchmen toward team traffic at night; and (4) Placing of white disc with black cross and the letters RR at the side of the highway 300 ft. to 500 ft. from the railroad crossing, indicating to vehicle drivers that they are approaching a railroad; this is required by law or by order of the Public Service Commission in some of the States.

It is my personal opinion that drivers owe something to themselves in the way of protection and that a sign indicating they are approaching a railroad should cause them to exercise proper care, just as a sign indicating a sharp curve or heavy grade on the public highway requires similar action. There are many automatic devices in the market for the protection of such crossings usually located at the crossing and operated by the approach of the train; among these are bells, wig-wags, flashing lights, etc, all of which have moving parts.

The simpler a device of this kind is the more reliable it is and the less chance of failure. The absence of such a device where one is usually displayed might lead drivers to feel that no train was approaching.

Day and Night Light Signal

We have designed a signal for use on the Pennsylvania System in States where its use is approved by the Public Service Commission consisting of two vertical red lights, visible day and night, operated by the train, the operating track circuit being on the closed circuit principle so arranged that, if one of the lights burns out the other will still be displayed; as this signal has no moving parts except the track delay armature which is common to all automatic devices, motors, flashes, etc., are eliminated.

In view of the possible failure of all automatic devices, their use is not recommended at the ordinary open crossing, it being felt that the sign 500 ft. away, warning drivers that they are approaching a railroad is sufficient, where there is good view of the track in both directions; but where the view is shut off by buildings, etc., and an automatic device is to be used it is recommended that the one described above be installed so that in a short time, the public will be educated to the fact that certain signs indicate approach to a railroad and other devices indicate that a train is coming, the absence of such devices not indicating that it is safe to cross, but their presence being an additional warning that there is danger ahead.

If some such uniform protection could be attained it is fair to suppose that a good many of the highway crossing accidents might be avoided, even though there are some drivers who are so reckless that regardless of what is displayed they will take chances. In my opinion, devices of this kind should be installed where necessary at existing crossings, not as an absolute remedy, but as the best that can be provided short of separating the grade, which separation, under the present financial condition, is absolutely impossible for some years to come, though it will eventually be made.

Shattered Zones in Steel Rails.

Recent investigations show that shattered zones in steel rails represent thermal effects, shrinkage cracks. They are usually located along the middle of the head, and at the junction of the web and base; the period in which they form is considered to be at the time of cooling after the last pass of the roll mill. The shattered zones thus far examined have been confined to hard or medium hard steels. In respect to the association of transverse fissures with shattered rails, transverse fissures have been found in rails both with and without shattered heads, and shattered heads have been found without transverse fissures. Thus it appears that a shattered state of the metal is not a necessary precursor to the formation of a transverse fissure. It is generally conceded that rails are not regarded as permanent members in engineering structures by reason of the cold-rolling motion of the wheels, which strains the zone of metal next to the top of the head beyond its elastic limit.

The British Government Railway Bill

A Comprehensive Measure Establishing an Amalgamation Tribunal

The railway bill, which has been fully discussed in the British Parliament, is a comprehensive document covering the original purposes setting up a new tribunal with power to fix actual rates and to control deviations therefrom. No limit has been placed on the maximum to which the new rates must conform, and it does not follow, therefore, that they will be lower than those now existing. In introducing the bill Sir Eric Geddes, Minister of Transport, stated that it was unnecessary to refer at length to the present condition of the railways, a condition which is at once the outcome of war, a reflex of trade conditions, and a result of great change in the economic handling of all great industrial undertakings. It will be apparent to one and all that provision is absolutely necessary to meet the changes that must ensue when control lapses in August next; it is equally apparent that these changes should follow the lines of a greater efficiency in service, a large economy in management, and a gradual extension of the public facilities that have been reduced by the abnormal conditions already referred to.

It has been decided in the first instance that the proper line of progress lies through the establishment of larger and better operating units. In order to abolish as far as possible competitive services for the same traffic and a system of competition that exhausts competing railway lines without ultimate advantage to those they serve, it has been decided to bring about a wide measure of co-operation by organizing the railways of Great Britain into six groups; amalgamating the principal lines, absorbing the smaller ones, and giving each group a strong incentive to develop the special area which it serves. In arranging these groups, operating economies and the financial position have been the determining causes.

The railway bill proposes to leave companies in the six groups to arrange their own amalgamation scheme, but if they can not agree between themselves a Railway Amalgamation Tribunal will be set up to take the responsibilties they are unwilling or unable to assume. A very large measure of assent has been obtained through prolonged and patient negotiation with all the interests concerned, and at the time of bringing the bill before the House of Commons only a few railways, including the Scottish companies, will be found in opposition to the principles which it follows. The position of the Scottish railways is a difficult one. They appear to have gone a little outside their usual practice in the matter of expenditure and are undoubtedly rather uncertain about their own future. Scottish railway rates are on a lower basis than those obtaining in England, but the opinion is held that, with a return to normal trade conditions, they are at least sufficiently high to enable the Scottish railway companies to maintain a standard of prosperity and efficiency. In these circumstances it would be manifestly unfair to raise the level of Scottish charges to the level obtaining in England, where conditions are different. That would be penalizing the user to benefit the owner.

The railway companies obtain certain definite advantages from the new bill. They obtain security of tenure and a large freedom from competition, though not at the expense of the public. The Railway and Canal Commission is charged to look after the national interest in matters of service and minor extensions. At the same time, the Minister of Transport, on the advice of a committee of experts, can order common user of railway stock and give directions as to other essential matters with which the rights of those who use the railways are bound up. Companies within the six groups will not be permitted without sanction to combine or to make joint-purse arrangements.

Hitherto the principle on which rates have been regulated has been the establishment of maxima by statute. This has left the actual rates within the maxima to the discretion of the companies (subject, of course, to the act of 1894), but it would be unreasonable to maintain this condition after the amalgamations outlined by the bill come into force. Moreover, the jurisdiction of the Railway and Canal Commissioners, to whom all appeals lay hitherto, is limited. These commissioners will retain very considerable power. They will continue to act as arbitrators for the Ministry of Transport or the Board of Trade. They will exercise jurisdiction in public or private acts, and decide the services and facilities due from the railway companies in return for the advantages conferred upon them.

But for the purpose of deciding the incidence of rating, a new Rates Tribunal is set up under the bill, and the tribunal will seek in general terms to impose upon each class of merchandise a fair share of the burden that railway companies must carry. The basis on which rates are to be fixed will be one designed to secure for each company a standard revenue, based upon that obtained in 1913, together with 5 per cent upon capital expenditure made under Government control, and a further allowance in respect of large capital expenditures not fully remunerative in 1913. It is obvious that rates established in the immediate future will be upon the basis of existing conditions, which can not be regarded as stable; consequently, these rates must be modified as conditions permit.

The proposed relations between the boards of management and the employes of the railway companies have undergone a change. The original intention of the Government was that workers should be represented on the boards of the various new groups. In the light of this decision, which was of definite value as a basis for bargaining, the National Union of Railwaymen, the Associated Society of Locomotive Engineers and Firemen and the Railway Clerks' Association—the three largest unions connected with the railway service—entered into direct negotiations with the railway companies, and arrived at an agreement which was recently communicated to the Government. This agreement is conditional as to its principal provisions on the understanding that the railway bill shall contain no other references to management or conditions of service than those to which the parties chiefly concerned have agreed.

The workers have withdrawn their original demand for representation on boards of directors, and in place they have accepted a scheme of joint councils of officers and elected employes. These councils will function along the lines of clause 16 of the Whitley report. The agreement maintains the Central and National Wages Boards, subject to a 12 months' notice, which may not be given before January 1 next (1922). Each of the parties to the agreement will have several representatives on the boards, and in default of agreement between the unions and individual railway companies on questions relating to payment and to hours and conditions of service, reference will be made to the Central and National Wages Boards. Provision is made for the setting up of a committee consisting of six representatives of the companies and six representatives of the unions to prepare schemes for carrying this new agreement into effect.

Provision is made for payment by the treasury to the railway companies in Great Britain of £60,000,000 in settlement of the claims of the companies for compensation arising out of the agreements and arrangements made during the period of control. One-half of this sum will be paid at the end of 1921 and one-half at the end of 1922. The compensation is based on the 1913 revenue of the companies, with allowances for increased expenses and arrears of maintenance that may have arisen.

Practicability of Automatic Train Control

Recent governmental reports state that out of fifty-three collisions investigated by the Interstate Commerce Commission during one year, twenty-eight, it was found, occurred where some sort of the block system was in use. Theoretically this system is perfect. Its principle is that on a given space, usually a mile, only one train may be at one time. When a train is on the block ahead, automatically the danger signal is set. Originally time was the controlling element in train operation. The great advance made in the substitution of a unit of space for a unit of time is apparent. But this improvement emphasizes more prominently the gap of danger that remains between the system of protection at the side of the track and the engineer in the cab. Of the twenty-eight wrecks which the Interstate Commerce Commission investigated in the year referred to, eleven were due to the failure of the engineer to observe and obey signals.

The question as to whether this danger can be bridged has been met by the Interstate Commerce Commission by an unqualified affirmative. Acting under the authority of a new section of the railroad law, the commission has just taken a momentous step in this direction, the practical testing out on important railroads of devices to bridge the gap. This action is considered to mark the beginning of the greatest advance in safety of train operation since the installation of the block system. That has now resulted in automatic signaling reaching a high state of perfection. The next step is automatic train control, to link up closely with automatic signaling; that is a device that will step in and enforce the signal when the engineer fails to heed it.

This is no dream of today or yesterday. For years inventors, inspired by the vast opportunity, have been at work on various devices to accomplish this end. There are more than 200 such devices in various states of development. Some are far advanced. Three have for some time been in practical use on limited section of railroads, the Regan Safety Device on twenty-two miles of double track of the Chicago, Rock Island & Pacific, the Miller Train Control on 106 miles of double track of the Chicago & Eastern Illinois and the American Train Control on twenty-one miles of single track of the Chesapeake & Ohio.

The problem involved is one of the stiffest inventors have faced. Literally stated, the problem is that an arm of some sort shall reach up from the track and set the brake of the train when the engineer has failed to respond to the automatic signal of danger. The solution has been approached in different ways, by an electrically charged ramp at the side of the track, by a magnet in the center of the track, by induction, and by the use of wireless. The necessity for the use of such devices has been pointed out by W. P. Borland, Chief of the Bureau of Safety of the Interstate Commerce Commission, in the report on the collision at Porter, Ind. Mr. Borland said in his report on this disaster:

"This accident again calls attention to the necessity for an automatic train-control device to be used in connection with existing signal equipment for the purpose of automatically controlling the speed of a train in case the engineman for any reason fails properly to observe signal indications and to operate his train accordingly. Signal Engineer Wiegand of the New York Central Railroad, in response to an inquiry as to what means could be provided to prevent similar accidents, stated that in this case, as far as signaling was concerned, ample protection had been provided, and the only thing he knew of that would provide further protection was the installation of an automatic stop or train-control system; he stated, however, that he was not at present prepared to recommend any particular device of this character."

One of the leaders in Congress who urged the adoption of an automatic train-control device was John Esch, now a member of the Interstate Commerce Commission, and recently stated,—"We shall proceed under the authority given by the new provision of the railroad law. Already noteworthy steps have been taken in this direction. We have recently assigned expert observers to each of the three roads that are trying out automatic stop devices. Two other train control devices are now being installed on the New York Central and the Southern Pacific on selected parts of these roads. Other installations are to follow. To each of these testing places a trained observer will be sent. We are now receiving daily reports where automatic control devices are in practical service, and this will continue as new demonstrations are added.

"These reports will supply us with data for ordering more automatic train control devices that meet our specifications on the heavier trunk lines. We shall proceed reasonably, and on the basis of tests. We have to consider the state of railroad finances in ordering installations. Even after we have data to go ahead on, I do not think initial installations will extend above 100 miles, and this will be on that part of a trunk line where most needed. The railroads have two years in which to carry out our orders.

"In the administration of this section of the law the commission has invited the co-operation of the American Railway Association, and a joint committee on automatic train control consisting of representatives of the Operating Division, the Engineering Division, Signal Section and Mechanical Division, has been appointed by the association. The testing of the automatic train control devices will be conducted jointly by the Bureau of Safety of the commission and the American Railway Association Committee. The selection of devices for these tests will be made in each case by the Joint Committee of the A. R. A., and the railroad company on whose line the installation is to be made, subject to the approval of the Interstate Commerce Commission.

"We have additional authority under this new provision of the law to which little attention has so far been given. This authority comes under that phrase in the law which reads 'or other safety devices.' This gives us the right, I think, to order in the block system. Some of the train control devices, according to their owners, do not require the block system as a basis, but it will be found generally true that automatic train control is superimposed on some kind of a block system. Therefore, in addition to the protection from collisions which the block system itself affords, it is a step in preparation for the extension of automatic train control.

Train control devices may be divided into two general classes, contact and non-contact, the distinction being that in one class physical contact between the roadside apparatus and the train in accomplishing the purpose. The Regan, the Miller and the American Train Control device all belong to this type. The ramp is a third-rail placed alongside the track at breaking distance from each block signal. The name comes from the fact that there is an incline from the ends to the centre. On the locomotive is a shoe for contact with the ramp at the given intervals. Through the apparatus on the locomotive that controls the shoe runs the current that governs the brakes on the train. Through the third rail section at the side of the track runs the current of the electric circuit of that particular block.

When the shoe strikes the ramp it rises to the high point at the centre and at this elevation the electric current on the locomotive controlling the brake valves is broken. If the block is clear and the device is functioning properly the shoe picks up the current, and this current, for the instant of contact, takes the place of the broken current on the locomotive and the brake valves are held in place. If the block is occupied and the signal is at danger, no current is supplied to the ramp to keep the brake valve in place, the air brake device on the locomotive is at once operated and the brake is set. The train is brought to a standstill. This is what happens if the engineer has failed to observe and act on a danger signal. It is the automatic stop. The device may be so set as to reduce the speed of the train when it has risen above the danger point instead of bringing it to a standstill. The ramp type of device varies in particulars. Some have a ramp on each side of the track, the second one being to give readings on a dial in the engine cab.

The induction and magnetic types require no physical contact between the engine and the roadside apparatus. The principle here is control by a magnetic impulse from the track to the locomotive. Permanent magnets located in the tracks are used to produce approach and stop signals, reflecting the signals of the block system. In some devices collecting coils on the train perform the same function as a transformer, being controlled by special electric circuits in the track rails to stop the train when the signal is at danger or to reduce speed when speed restriction is imposed. There are several variations in this type. It has been slower in development than the ramp type, but two are now being installed for try-out by the Interstate Commerce Commission. Claims made by inventors of this type are that it is independent of such untoward weather conditions as snow and ice, and the problem of clearance, with which the ramp type has to deal, is completely overcome.

Electrification of the Indian Railways

It is officially reported that as many of the Indian railways have long and steep gradients electrification would ensure the following advantages: (1) Electric locomotives of much greater power than existing steam locomotives can be placed on these lines without increase of axle weight; (2) it is possible to design electric locomotives to give twice the h. p. of steam locomotives with the same adhesive weight, hence heavier loads could be handled at faster speeds, resulting in greater carrying capacity of the line or decreasing of the rolling stock; (3) electric locomotives require less power to propel their own weight than steam; (4) owing to the power station "reserve of power" electric locomotives are always able to haul a load at the critical speed—provided the motors are not overloaded; (5) energy is produced under far more economic conditions at a central power station than in a steam locomotive boiler; (6) with electric control, trains can be taken down gradients at higher speed and with greater safety than with a steam locomotive, and the wear on wheels and brakes is less; (7) due to light weight and absence of vibration the destructive influence of electric locomotives on permanent ways and bridges is less than with steam; (8) increase of passenger comfort with electric traction; (9) steam traction efficiency is less in winter due to radiation, electric traction efficiency improves in cold weather; (10) with electric locomotives double heading of trains presents little difficulty of control as compared with steam locomotives; (11) owing to simplicity of electric locomotives the maintenance cost is less than in steam locomotives.

Improved Railway Situation in Mexico

It is reported that the night trains from Mexico City to Vera Cruz have been suspended so that the locomotives can be employed in moving merchandise and cars from that port to the capitol. Strict orders have been issued against seizing any oil-tank cars belonging to individual corporations, and this fact will help the fuel situation. Since the new locomotives purchased by the National Railways began entering the country, traffic on the northern divisions has been materially improved. It is reported that in one week more than a thousand cars of merchandise were moved from Tampico, Monterey, Monclova, and Nuevo Laredo. Up to the present only about 35 locomotives have passed over the Mexican border, and if the noticeable improvements effected have been the result of this addition to the rolling stock, it is believed that with the entry of the total number of over a hundred locomotives, the railway service will be greatly improved.

Colloidal Fuel in Japan

The newly invented colloidal fuel, which is now under investigation by the Government of Japan as a substitute for coal and heavy oil, is expected to give Japanese shipping a most efficient fuel at a low price and to remedy the alarming decrease of the supply of coal and petroleum, states *Shipping and Engineering*.

Railroad Officers' Salaries Reduced

It is officially stated that the salaries of the Pennsylvania railroad officers will be reduced to conform with the cut in wages of the employes ordered by the Railroad Labor Board, both reductions becoming due on and after July 1, and be on a similar basis—applicable to increases received since January 1, 1918. It is stated that formal action to this effect was taken on June 23 by the board of directors of the Pennsylvania. A resolution passed by the board instructed executive officers to take proper steps to put such reductions in effect for all concerned. The action of the board followed the adoption of a policy outlined at a meeting held last March, when a resolution was adopted stating that in making a readjustment of salaries and wages it was only fair and proper that the burden should be borne by all officers as well as employes.

International Chamber of Commerce Review the Railroad Situation

In a review of economic and financial conditions in the United States presented at the first general meeting of the International Chamber of Commerce recently in session in London, it is stated that: Since the first of April, there have been developments which promise relief from excessive labor costs on the railroads.

It is a serious defect of our methods of regulating public utilities that relief from intolerable conditions can seldom be secured before deterioration of service and actual or impending bankruptcies force our regulating bodies to appropriate action. The present situation is that the country does not want government ownership of railroads, and that relief from exorbitant wage demands must be had if government ownership and operation (at a huge deficit) is to be averted. Recent developments indicate that relief may be at hand and justify a more hopeful view of the situation than it would have been reasonable to entertain a few months ago. If the next six months can bring a solution of the problem, they will dispel one of the most ominous clouds that now darken a difficult business situation.

Commonwealth Devices Going to Europe

If you cannot find work near home go further and look for it. President Howard of the Commonwealth Steel Company while on a recent trip to Europe, closed an initial contract with the International Sleeping Car Company for 150 cast steel four-wheel trucks to be used on 75 new sleeping cars which the company was ordering for its European continental service, and as an order for 300 cars is in contemplation, additional orders for the Commonwealth may be expected in the near future. A portion of the order has already been filled, the consignment being made to M. Hautot, Director General of the Compagnie Generale de Construction de St. Denis, Seine, France.

Bureau of Foreign and Domestic Commerce

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES DURING MAY, 1921.

STEAM LOCOMOTIVES

Countries—	Number	Dollars
Canada	1	5,115
Mexico	62	1,433,208
Cuba	7	193,891
Argentina	6	226,500
Peru	1	26,837
Chosen	2	27,060
Straits Settlements	20	496,000
Dutch East Indies	3	30,850
Japan	1	12,875
New Zealand	1	14,958
Philippine Islands	5	180,075
Total	109	2,647,441

Items of Personal Interest

Edgar E. Clark, chairman of the Interstate Commerce Commission, has been reelected chairman for another year.

Clarence White has been appointed general foreman of the Atchison, Topeka & Santa Fe, with office at Newton, Kan.

Lee Stanford has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe, with office at Gallup, N. M.

F. L. Wheaton, division engineer of the Delaware, Lackawanna, has been transferred from Binghamton to Buffalo, N. Y., succeeding G. E. Boyd.

P. G. Lang, Jr., has been appointed engineer of bridges of the Baltimore & Ohio, with headquarters at Baltimore, succeeding W. S. Benton, retired.

Homer C. Johnstone, formerly with the Midvale Steel Company, has been appointed representative of the Gould Coupler Company, with headquarters in New York City.

H. D. Turner, master mechanic of the Chicago, Burlington & Quincy at Ottumwa, Iowa, has been appointed road foreman of engines, with headquarters at Burlington, Iowa.

R. M. Nelson, purchasing agent of the Chesapeake & Ohio, has been appointed assistant to the director of purchases and stores, with headquarters at Richmond, Va., and the position of purchasing agent has been abolished.

W. L. Conwell has been elected president of the Safety Car Heating & Lighting Company; J. A. Dixon, R. Parmly and James P. Soper, vice-presidents; C. W. Walton has been elected secretary and treasurer, and William Stewart, assistant secretary and assistant treasurer.

C. M. Hoffman, superintendent of machinery of the Verde Tunnel & Smelter Railroad, with headquarters at Clarkdale, Ariz., has been appointed superintendent of motive power and machinery of the Los Angeles & Salt Lake, with headquarters at Los Angeles, Cal., succeeding D. P. Kellogg, resigned.

Charles A. Kothe has been appointed mechanical superintendent of the American Automatic Connecter Company, Cleveland, Ohio, succeeding N. M. Barker, resigned. Mr. Kothe was master mechanic on the Erie, his appointment being made in 1913, when he took charge of the company's shops at Marion, Ohio, and latterly was transferred to Port Jervis, N. Y.

H. C. Pearce, general purchasing agent of the Seaboard Air Line, has been appointed director of purchases of the Chesapeake & Ohio, and the Hocking Valley, with headquarters at Richmond, Va. Mr. Pearce has had a wide experience particularly in the purchasing department of railways, and is chairman of the division of purchases and stores of the American Railway Association.

Colonel Washington A. Roebling, vice-president of John A. Roebling's Sons Company, Trenton, N. J., has been elected president, succeeding his nephew, Karl G. Roebling, who died recently. Colonel Roebling has been prominently identified with the firm for many years, and with his brother Charles G. Roebling, completed the construction of the Brooklyn bridge which was opened in 1883.

C. E. Davies has been appointed managing editor of *Mechanical Engineering*, succeeding the late L. G. French. Mr. Davies is a graduate of Rensselaer Polytechnic Institute with a degree of M. E. During the war period he was in the service of the Ordnance Department at the Frankford Arsenal, engaged as assistant production superintendent of the artillery ammunition division. He left the service with the rank of captain. Mr. Davies joined the editorial staff of the Society in March, 1920, as associate editor, and is thus specially fitted for the position for which he has been appointed.

Frank H. Cunningham has been appointed special engineer with the Franklin Railway Supply Company, Inc., New York. He served an apprenticeship as machinist on the Norfolk & Western and afterwards attended the University of Virginia. Following his graduation with the degree of Mechanical Engineer he returned to the Norfolk & Western as machinist, subsequently becoming material inspector, mechanical inspector, assistant engineer of tests and supervisor of locomotive stokers. In 1914 he went with the Standard Stoker Company as fuel engineer, being appointed later to plant manager at Erie, Pa., and assistant general manager, a position which he filled at the time of his resignation to enter the services of the Franklin Railway Supply Company, Inc., as above noted.

C. J. Burkholder has been appointed special engineer of Franklin Railway Supply Company, Inc., with offices in New York. Mr. Burkholder started his railroad work at Tyrone, Pa. He later became a locomotive fireman and locomotive engineer on the Union Pacific. Leaving the Union Pacific he went with the Kansas City Southern as locomotive engineer, then traveling engineer, trainmaster, general road foreman of engines and division superintendent. He resigned from the Kansas City Southern to become mechanical representative of the Economy Devices Corporation, which later merged into the Franklin Railway Supply Company, Inc. In November, 1918, he resigned from the position of western sales manager of the Franklin Railway Supply Company to become master mechanic of the Kansas City Southern, which position he held at the time of his appointment above noted.

The presidents of the eastern railways at a recent meeting appointed a special committee of eleven prominent engineers to co-operate with the Jersey Port authorities in formulating plans toward the solution of the port and terminal problems of New York. The committee appointed embrace the following: R. C. Falconer, assistant to the president and chief engineer, Erie; Edward Gagel, chief engineer, N. Y., N. H. & H.; G. T. Hand, chief engineer, L. V.; G. W. Kittredge, chief engineer, N. Y. C. Lines East; H. A. Lane, chief engineer, B. & O.; L. V. Morris, chief engineer, L. I.; J. H. Nuelle, general manager, N. Y. O. & W.; A. E. Owen, chief engineer, C. of N. J.; G. J. Ray, chief engineer, D., L. & W.; E. B. Temple, assistant chief engineer, Pennsylvania; and S. T. Wagner, chief engineer, P. & R.

American Railway Association Mechanical Division

Owing to the present unusual conditions and the inability of the members to attend the meeting of the Mechanical Division, American Railway Association, called to be held in Chicago, June 15-16, 1921, the meeting was, by order of the officers of the Division issued June 10, postponed to June 29-30. A second order dated June 21, stating that owing to the inability of the members to attend the postponed meeting of the Mechanical Division, the meeting has again been postponed. It is further stated that in view of the uncertainty as to the conditions for the next few weeks no date has been set for the postponed meeting.

Scholarships at Stevens Institute

The Mechanical Division of the American Railway Association has four scholarships at Stevens Institute of Technology, two of which are now open, and are available for sons of members of the Division, and cover the regular tuition charges for a four-year course, leading to the degree of Mechanical Engineer. The course offered also includes instruction in electrical, civil and other branches of engineering. Full information as to course of study, entrance requirements, etc., will be supplied by the Secretary, 1426 Manhattan Building, 431 South Dearborn street, Chicago, Ill., upon application.

Joseph T. Ryerson & Son Scholarships

One of the Joseph T. Ryerson & Son Scholarships of the Mechanical Division, American Railway Association, is now vacant. The scholarships provide an annual stipend of $300, and shall be confined for a period of four years for each beneficiary. Candidates must have had at least twelve months' practical experience in the mechanical department of an American railroad. Circular containing full particulars in regard to the examinations of candidates may be had on application to V. R. Hawthorne, Secretary, 1426 Manhattan Building, 431 South Dearborn street, Chicago, Ill.

Conventions Postponed

The convention of the American Railway Tool Foremen's Association which was announced to be held in Chicago on August 9, 10 and 11, has been indefinitely postponed. The Executive Committee of the International Master Blacksmith's Association has also decided on postponing the convention which was to have been held at Chicago, August 16, 17 and 18. The Secretary of the International Railway General Foremen's Association has issued a notice to the members that owing to the unsettled condition of the railways and other conditions, the call for the 1921 convention has been cancelled.

Vocational Classes in Railway Shops for Disabled Workmen

The Federal Board for Vocational Education reports that classes in railway shop-work with an enrollment of 800 or 900 men are being conducted in 27 localities and in thirteen states. The subjects taught are arranged in unit courses and there are included blueprint reading, mechanical drawing, shop drafting, mathematics, boiler makers' layout, electricity, locomotive assembly and repair, acetylene welding and car building.

American Institute of Electric Engineers Standards

The American Institute of Electric Engineers has submitted its Standards, 1921 edition, to the American Engineering Standards Committee for approval of an American Standard. The standards submitted represent the latest revision of Institute's standardization rules. The work is issued in a 172-page book in flexible cloth binding. Copies may be obtained from the American Engineering Standards Committee, 29 West Thirty-ninth Street, New York.

Code of Rules—M. C. B.

A code of rules governing the condition of, and repairs to, freight and passenger cars for the interchange of traffic adopted by the American Railway Association, Mechanical Division, 1920 Code, Supplement No. 1, has just been issued by the American Railway Associaton, 75 Church street, New York. The supplement extends to 16 pages and contains numerous important details effective this month. The clear interpretation of many of the rules is of real value, and copies of the Code should be in the hands of all engaged or interested in the repair of freight and passenger cars.

Curtis Steam Turbines for Mechanical Drive

The application of the Curtis steam turbine for driving circulating and boiler feed pumps, as well as centrifugal pumps for all purposes, fans and blowers and other apparatus has been successfully developed by the General Electric Company. The turbine may be designed for either condensing or non-condensing operation. It may be adapted for any steam pressure from 60 to 250 pounds, for either dry or super-heated steam, and for speeds from 1,200 to 5,000 r. p. m. It may be arranged with either one, two or three stages, depending upon the operating conditions.

According to Bulletin No. 42019, issued by the company, this turbine represents the best type of design and construction, based on practical experience gained in building Curtis steam turbines. Every detail has been worked out so as to make all parts as simple as possible and of ample size and strength. A description of the principle involved in this turbine, and a careful summary of its several parts, including wheel, shaft and buckets, wheel casing, bearings, packing, governor, governor valve, emergency governor and other elements, is included.

Advice to Boiler Attendants

The annual memorandum of the Manchester Steam Users' Association has just been issued, and under the heading "Advice to Boiler Attendants," fuel economy and related subjects are simply and carefully explained. The most important item in the memorandum is the painstaking analysis of reported boiler explosions which can throw light on the vexed engineering question as to the value of hydraulic tests in preventing boiler explosions. It is interesting to find that, contrary to a very popular belief, many explosions of boilers have occurred shortly after they had successfully withstood hydraulic tests of much higher pressures. This rather surprising evidence fully confirms the policy of the Manchester Steam Users' Association, for the prevention of steam boiler explosions, as laid down by their founder, the late Sir William Fairbairn, F.R.S., that the only effective means for preventing boiler explosions was to have boilers thoroughly inspected every year by carefully trained boiler inspectors. The gratifying result of steadfastly adhering to this policy has been that during the sixty-five years of the association's existence, no explosion has occurred of any boiler bearing its guarantee and certificate of safety which could have been prevented by inspection, though during the last thirty-three years over 140 boilers, outside the ranks of the association, have exploded, which, according to the Board of Trade inquiries, had been inspected but not efficiently.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV 114 Liberty Street, New York. August, 1921 No. 8

Pacific Locomotive for the Madrid, Saragossa & Alicante Railway of Spain

Details of Its Construction and Unusual Elegance of Finish

About ten months ago the American Locomotive Co. shipped fifteen Pacific locomotives to the Madrid, Saragossa & Alicante Ry. of Spain. The line runs in a general southeasterly direction from Madrid to Alicante on the Mediterranean and from Madrid northeasterly to Saragossa on the Ebro river, which skirts and cuts through the mountains of northern Spain.

They were shipped to Alicante and set up in the shops at that point.

The service into which these engines have been put have been the express service between Madrid and Barcelona; between Madrid and Santa Cruz on the Andalusia line; between Alicante and Madrid and during holy week they hauled the fast expresses between Madrid and Cordoba.

When the engines were first put into service, the engine crews had some difficulty in mastering the details, many of which had been designed in accordance with American practice. But these, once learned, they handled the machines with all of the facility of the other locomotives belonging to the company.

Although these engines are somewhat smaller than some of the other types of engines in use, they have given very satisfactory service in the hauling of corresponding loads, in all of the services mentioned above, and at speeds touching the allowable limits, which permits the making up of time lost on the regular schedule. Their ease of motion and stability is very marked on curves, which is attributed by the officials to the excellent design of the trailing truck, which is in accord with established American practice.

A notable feature of the engines is the high degree of finish put upon the working parts and the evident care taken in painting. This latter was done under the following specifications: After testing the boiler, under steam, the shell and firebox were cleaned with gasoline in order to eliminate all traces of oxide, by which the adhesion of the paint would be prevented. They were then painted with a coating of a mixture of iron ochre, turpentine and boiled linseed oil. The inside of the jacket was also painted in the same way. The lower portion of the firebox, which is exposed to view below the running board is painted black.

The outside of the engine was given four coats of paint and a puttying. First there was a priming coat of grey paint, followed by a puttying with putty varnish; then, in succession, coats of dull black, black varnish and varnish. The frames and all unpolished parts were given a priming coat of iron ochre paint, and then one of black paint. The wheels were given a priming coat of grey, and were then puttied, rubbed down and given a coating of black followed by one of varnish.

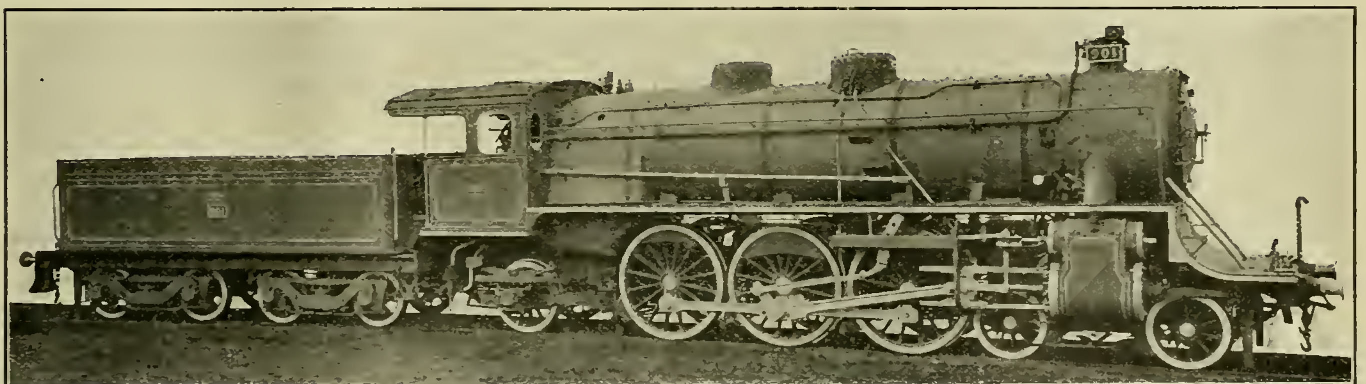
The ends of the axles were painted red and varnished.

The outside surfaces of the tender plates were washed with gasoline to move the rust and were then painted in the same way as the boiler except that the puttying was done with paint putty instead of varnish putty; and then, before the application of the first coat of black, the surface was rubbed down with glass paper.

The inside of the tanks were painted with the same mixture as that used for the boiler.

The frames and all iron work on the tender were painted in the same way as the iron work of the engine. And the wheels were given the same treatment as that accorded to those of the locomotive.

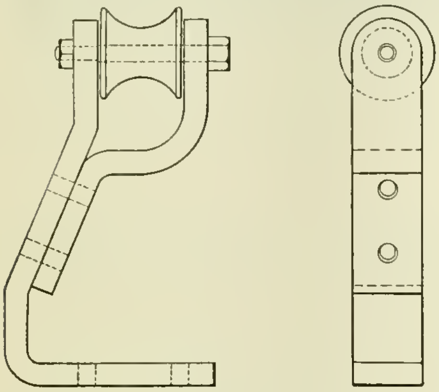
As for details of the finish, the cylinder heads and steam chest casings are polished instead of being painted. The main and side rods are polished except in the channels, which are painted black. All motion



PACIFIC 4-6-2 TYPE LOCOMOTIVE FOR THE MADRID, SARAGOSSA & ALICANTE RAILWAY OF SPAIN
AMERICAN LOCOMOTIVE COMPANY, BUILDERS.

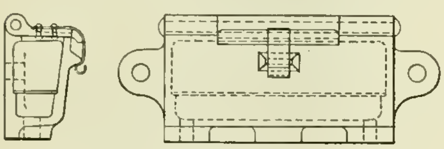
work, except the crossheads, is also finished. The crossheads after being finished were painted black and varnished. The polishing also extends to the handrails and posts.

The result of all this care in painting, combined with the high finish of the working parts, was to produce a machine of an exceedingly rich and elegant appearance.



ROLLER SUPPORT FOR REACH ROD

What this will count for in Spanish reals (that is, dollars and cents) can only be told when the engines are brought in for their first general repairs. But up to the present, the impression made by these engines is excellent and they are giving a first-class account of themselves.

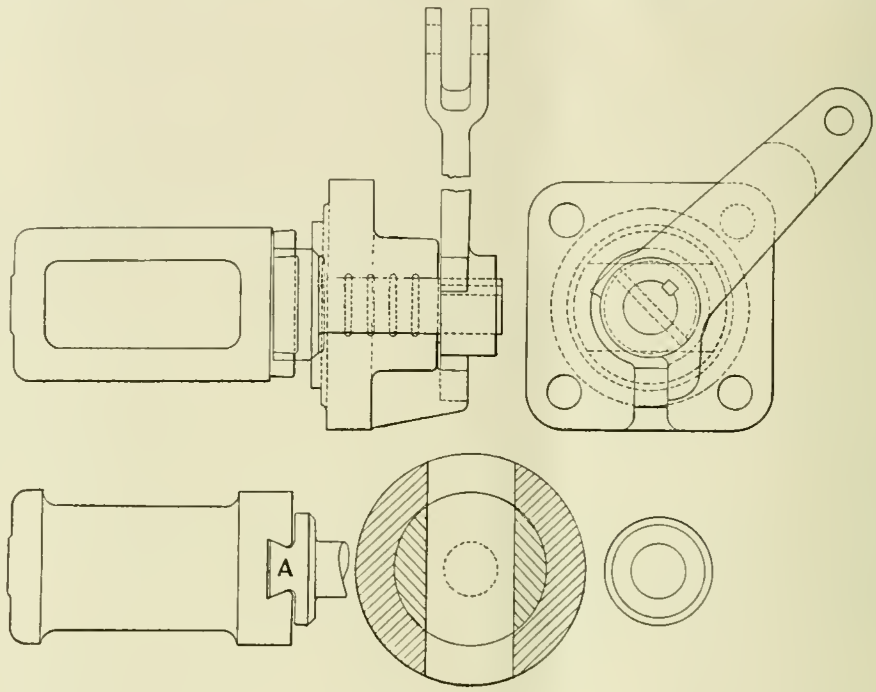


OIL CUP FOR DRIVING BOXES

Turning to the details of the engine there are a few that are deserving of attention.

They are fitted with superheaters and, according to the reports received, the high degree of superheat obtained was the cause of some trouble at first in the form of scored valves. With other engines the temperature of the superheated steam ran from 625 degs. to 660 degs. Fahr. But, with these engines, this temperature ranges from 710 degs. to 750 degs. Fahr. A temperature so high that a special oil and great care on the part of the engineer is required, in order to prevent cutting. And it was this lack of experience that led to the early troubles, which have now been entirely done away with.

The engines are fitted with the vacuum brake and it is the pipe from the ejector that is shown leading along the side of the boiler below the hand rail with its discharge back of the smoke stack.

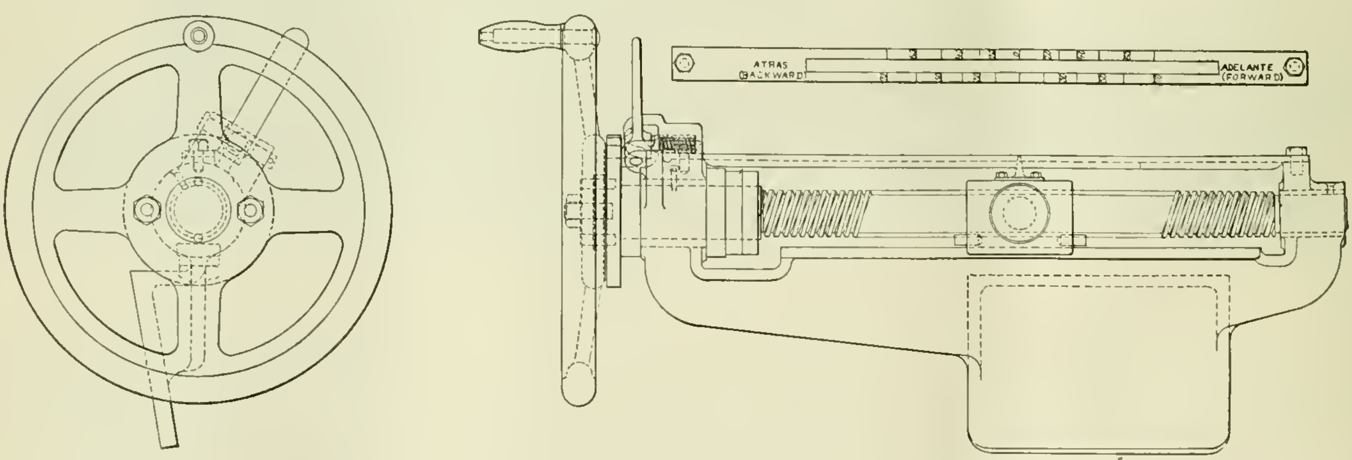


BY-PASS VALVE

One minor detail of value that is not often seen on American locomotives is the reach rod guide that is shown about midway the length of the rod above the running board. This is a mere bracket with a roller for carrying the rod. But, as the latter is of considerable length, it serves to prevent excessive vibrations due to the motion of the engine.

Another detail is that of the oil cups or boxes that are set on top of the running board in order to lubricate the driving boxes. These are simple cast iron boxes about 7 ins. long by 1¾ in. wide by a little less than 2 ins. deep inside. The cover is held in place by a spring latch lipping in beneath a projection on the body of the box, as shown. In the bottom there is a brass perforated plate having perforations about 1/16 in. in diameter and spaced eight to the linear inch. From the bottom pipes are led to the top of the axle boxes.

In accordance with the general European practice these engines are fitted with a screw reverse gear of the type shown. This is a gear that has been applied to a large number of engines by the American Locomotive Co. with very satisfactory results.



SCREW REVERSE GEAR

The screw is double-threaded and is turned by the hand wheel at the rear. Collars are fastened to it on each side of the bearing in the supporting bracket to take the thrust of the screw. The head carries a pointer that rises between two plates of the quadrant or index plate, on which is marked the percentage of the point of cut-off.

At the back end of the screw and in front of the operating wheel there is a latch wheel A into which the latch B is dropped to lock it in place and take up any tendency to rotate caused by a pressure of the head. This is, in turn, locked or pressed down in place by the screw shown in front of it.

One more detail may be noted and that is the rotating by-pass valve. This, too, is a design of the American Locomotive Co. and is very simple and efficient.

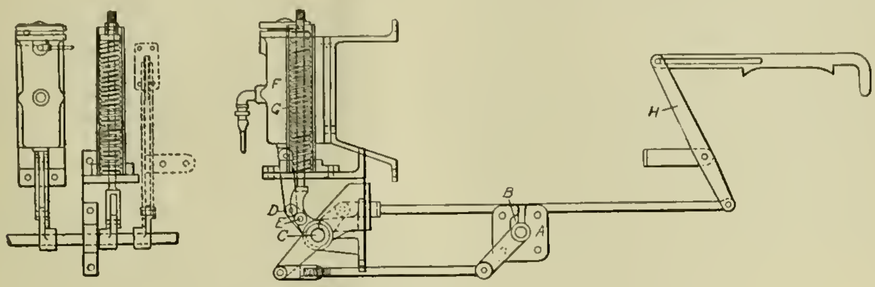
The valve itself is a simple plug valve of straight cylindrical shape. It has no packing rings but is made a steam-tight fit in its seat or casing. A dovetail connection, as shown in the plan at A, serves to attach it to an operating stem that passes through the outside gland and in which it is packed by four water grooves spaced about ½ in. apart. The valve is given a throw through 90 degs. The operation is very simple. When in the position shown in the cross section, there is a direct connection through the valve from one end of the cylinder to the other. Then when turned through 90 degs. the two passages in the casing are closed and the connection is cut off.

The valve is made to operate automatically as well as manually.

The valve is set in the casing A and a lever is keyed to its stem by which a motion of 90 degs. is communicated to it. It will be seen that, when the valve lever is in the open position there is a shoulder B which bears against a lug on the casing cover and prevents further movement in that direction. An excess of movement in the direction of closure is prevented by the piston of an operating cylinder.

A connection runs from the lower end of the stem lever to a lever keyed to a shaft C, to which other operating levers are attached.

One of these is a lever D, which is connected to the piston rod of a piston in the cylinder F. This cylinder has a pipe connection leading to the steam pipe of the locomotive; and, when the throttle is open, live steam is admitted to the space above the piston, forcing the latter down, and with it, through the combination of levers and connections, the stem lever of the valve into the closed position.



MECHANISM FOR OPERATING BY-PASS VALVE

When the throttle is closed the pressure falls and the spring, whose cap is attached to the stem leading down to the lever E, forces the latter up and draws the stem lever to the open position, thus permitting a free flow of gases between the two ends of the cylinder.

The valve may be manually operated by the connections and handle as shown.

When, however, this handle is locked the pin connection at the upper end of the lever H can move to and fro in the slot of the handle under the influence of the automatic operation.

Among the accessories are the Heintz system of steam heat connections; Lambert single water sander to front driving wheels and hand sander for second drivers; A. L. Company's standard cast iron smokestack with cover plate and hood; vacuum brake, cylinders 21 ins. diameter; hand brake in addition to vacuum; Alco flexible expansion stays; Walschaerts valve gear; screw reverse gear, right hand drive, ashpan, closed type with suitable dampers,—no air openings around the mud ring; Nathan non-lifting injectors; one backhead combination injector, check and stop valve with internal delivery pipe; cinder pocket at bottom of smokebox; washout flanges used instead of screw washout plugs throughout the boiler with the exception of the two plugs at the bottom of the front tube sheet, which are screw plugs; extended piston rods and valve rods; operating portion of the vacuum brake ordered from the Vacuum Brake Company, London, —two sets being shipped in advance to the Brooks Works for application and the remainder direct to the railway company.

The boiler is of the straight top variety with sloping backhead and throat sheet; copper firebox, and copper staybolts; Locomotive Superheater Company's superheater; Everlasting blow-off cock; Coale safety valves; grate,—close finger spacing, —dump at front end; front bumper,—steel plate; Railway Company's standard automatic type water gauge; couplers,—Railway Company's standard screw link type with two opening buffers; auxiliary handbrake on tender.

The following are the principal dimensions of these locomotives:

Cylinder diameter	0.584 meter (23 ins.)
Piston stroke	0.660 meter (26 ins.)
Distance center to center of cylinders	2.310 meters (90.94 ins.)
Diameter driving wheels (3 in. tires)	1.750 meters (68.90 ins.)
Diameter truck wheels	0.975 meter (38.40 ins.)
Diameter trailing wheels	1.150 meters (45.28 ins.)
Inside diameter of boiler	1.651 meters (65.00 ins.)
Distance between tube sheets	5.791 meters (19 ft.)
Diameter superheater flues	0.136 meter (5.35 ins.)
Diameter tubes	0.050 meter (2.00 ins.)
Number tubes	148
Number superheater flues	28
Heating surface firebox	13.8 sq. meters (148.47 sq. ft.)
Tubes (inside)	121.2 sq. meters (1303.92 sq. ft.)
Superheating flues	65.5 sq. meters (704.68 sq. ft.)
Arch tubes	1.2 sq. meters (12.91 sq. ft.)
Total	201.7 sq. meters (2,169.98 sq. ft.)
Grate area	4.09 sq. meters (44.00 sq. ft.)
Weight of engine light	76,600 kg. (168,520 lbs.)
Weight of engine working order	85,500 kg. (188,100 lbs.)
Weight on drivers	48,000 kg. (105,600 lbs.)
Boiler pressure	12 kg. per sq. cm. (170 lbs. per sq. in.)
Tractive effort $\frac{0.65 \times p \times d^2 \times l}{D}$	10,267 kg. (22,061 lbs.)

The tractive effort is based on a thickness of tires of 55.5 millimeters (2 3/16 ins.).

In the formula:

d = diameter of cylinder in meters and inches.

p = boiler pressure in kilograms and pounds.

l = stroke in meters and inches.

D = diameter drivers in meters and inches.

Tender:

Diameter wheels. 0.975 meter (38,375 ins.)
Water capacit 20 cu. meters (5,300 gals.)
Coal capacity.... 5,000 kg. (5.5 tons)
Weight light ....22,700 kg. (49,940 lbs.)

During the months of January, February and March, 1921, these engines made an average of 4,244.5 kilometers or 2,632 miles and used .0355 kilograms of oil per kilometer or about ⅛ gill per mile. The coal consumption was 23.83 kilograms per train kilometer or about 87.7 lbs. per train mile.

Priming in Locomotives

Priming is water carried away with the steam from the boiler to the cylinders. It was found that in every case of priming investigated the cause was the foaming of the water in the boiler. Foaming is the phenomenon exhibited by some waters of producing a very large number of small bubbles when boiled. The bubbles occupy a large volume of the steam space, and in extreme cases take up the whole space previously occupied by the liquid as well, so that there is no liquid, as such, left. These bubbles are about one-sixth inch diameter. Both foaming and priming are highly dangerous; the foam may be so bad as to leave little liquid in the boiler, thus risking overheating and collapse of crown plate or tubes.

Again, the foam tends to fill the gauge glasses and prevent the driver from ascertaining just how much water is in the boiler.

Priming washes the lubrication off the valves and cylinders, wastes fuel and water, and sometimes fractures cylinder covers; to prevent such fractures the cylinder cocks should be opened.

The first indication that priming is likely to occur is usually given by the water in the gauge glass becoming turbid; priming may be detected by a spray at the funnel and by the sound of the exhaust.

Sudden changes in pressure increase the tendency to foam. Therefore the throttle should be opened gradually. If too much water is carried in the boiler it reduces the steam space and thereby increases the tendency to prime.

It is known that priming can be stopped by a dessert-spoonful of castor oil placed in the gauge glass or in the tender, but its use is not officially sanctioned.

Foaming is not caused by matter held in suspension in the boiler water, but by mineral salts or organic matter (nearly always the former) held in solution. The salts that cause foaming consist of (1) an active salt which need only be present in small quantity, say 3 grains per gallon; (2) a passive salt which enables the active one to cause foaming. The passive salt must be present in large quantity, say, 200 grains per gallon; but this condition will be satisfied sooner or later by the concentration due to the continued evaporation of water in the boiler. Magnesium carbonate is an active salt, sodium chloride (common salt) is a passive salt; there are many others of course, but these are examples of a numerous class.

When the concentration of the passive salt becomes great enough to cause priming, the boiler should be blown down to expel some of the concentrated solution.

Another remedy suggested is that the water should be first softened and then made neutral with sulphuric acid. This treated water should be used in a boiler from which all scale has been removed, and should not be mixed with other water. It will be seen that this is a remedy that must not be attempted by enginemen, and one that requires some arrangement whereby the engine using it will not leave the district where the treated water is available.

Judge Gary and Labor

A labor contemporary states that it fails to see in the statement made by Judge Elbert H. Gary, chairman of the United States Steel Corporation, the great constructive ideas which should characterize any pronunciamento emanating from such distinguished lips. Boiled down to its very essentials, his plan asks for more Government regulation. That in this instance regulation of capital and labor, the Nation's fundamental and creative assets, are involved, does not alter the fact at all. If anything, we have too much Government guidance, too many of the hindrances which, under the mask of beneficial direction, conceal the sneering features of official intrusion into private affairs. True, labor is at present exempt from some of the restrictions which fetter capital; true, also, labor is forever asking for more exemptions along the same lines. But this is no argument for more chains. Nor is, we think, the creation of more of them in accord with what may prove the ultimate remedy.

After all, what is enlarged Government regulation but the stepping stone to the Socialist doctrine of complete Government control? Are we to seek the healing ointment in what we now know has produced the greatest sores on Europe's economic body? The temporary relief that may come to so-called capitalistic enterprises under a system such as Judge Gary advocates, would of necessity produce the contrary result just so soon as a change in Government were to place the administrative power into the hands of those it is now sought to restrain. In a lesser degree, this applies also to the agencies who, in the final analysis, interpret the law. Such a thing as absolute legislation, legislation which leaves no chance for two opinions, is unknown. Human justice seems unable to devise it. The minority opinions in our highest court bear witness to this. A mere chance turn in any election could make them the majority's rule. The eyes of the "liberal" and the "conservative" judge have never yet been able to see the same lights and shadows.

No, the test to which Judge Gary challenges organized labor, is no test at all, it is merely a demand to recede from a position which has become organized labor's very platform. There will be no acquiescence to it. Nor do we think that "capital" should make it its motto. What we believe is, that the removal of the Governmental screws from the thumbs of the business man will place him in a better position to fight whatever battle may be ahead. Labor is entitled to keep its free hands. And capital must be made free.

Locomotive Design

An eminent engineering authority claims that most of the earlier formulae for the calculation of train resistance make no distinction betwen engines and car resistance. Consideration shows that for equal weights a locomotive has a different resistance to an open freight car, a two cylinder 4-4-0 type passenger engine moves more freely than an 0-8-0 freight locomotive. Frank has evolved an equation which very closely approximates to the resistance of the large American freight car trucks, and this equation has been somewhat simplified by Strahl, who, in collaboration with Sanzin, carried out a large amount of experimental work upon locomotive resistance and their results are recognized as a close approximation to the truth.

For the calculation of boiler sizes, it has been universal to use the rates of horsepower per unit of heating surface, but here, also, it is obvious that if the heating surface be doubled, the boiler horsepower is not nearly increased in the same ratio. This, however, is more nearly true if the grate area be taken as a basis. Strahl's formula is used for calculating the boiler output. Strahl's investigations are based upon modern locomotives and are the most valuable contribution to the subject.

Discussion on Repair of Locomotives at Outside Shops

Hearings on the question of sending locomotives to outside shops for repairs were discussed before a representative of the Interstate Commerce Commission by representatives of the leading Northwestern roads, who claimed that owing to the roads having at that time more business than they could handle, it was a matter of absolute necessity, and not with any intention to punish the employees. The extra cost of such repairs were, it was claimed owing to the increased overhead and other expenses including the difference in new materials and locomotive appliances. Not only so, but in the case of the C. M. & St. P., 50 compound locomotives were converted to simple locomotives, which was not, properly speaking, repair work, but partially new, adding greatly to the tractive power of the locomotives. This enhanced the cost of the co-called repairs, besides which the overhead expenses of the company's own shops were claimed to be negligible.

A Model Profile of a Railroad

Used for Showing Complete Details of a Section of the Erie

The profile of a railroad, as it is usually drawn, shows merely the profile with the alignment drawn in diagrammatically. Sometimes, but not always, there is a diagrammatic track lay-out. This will serve the needs of a man whose needs do not go beyond the information contained in the "profile." But there is hardly an officer on any road who will not be called upon to use or furnish information that is not usually given on the "profile" sheets.

A profile sheet issued by the Erie Railroad, a sample of a small section of which is presented, herewith seems to contain about all of the information that is likely to be required by anyone regarding the roadway and track.

There are two lines at the top, which, by the character of their cross-hatching, indicate the kind of ballast that is used under the two lines of rails in the double track, whether gravel, granulated slag, cinder, crushed slag or crushed stone. The date at which the stone ballast was introduced is also shown.

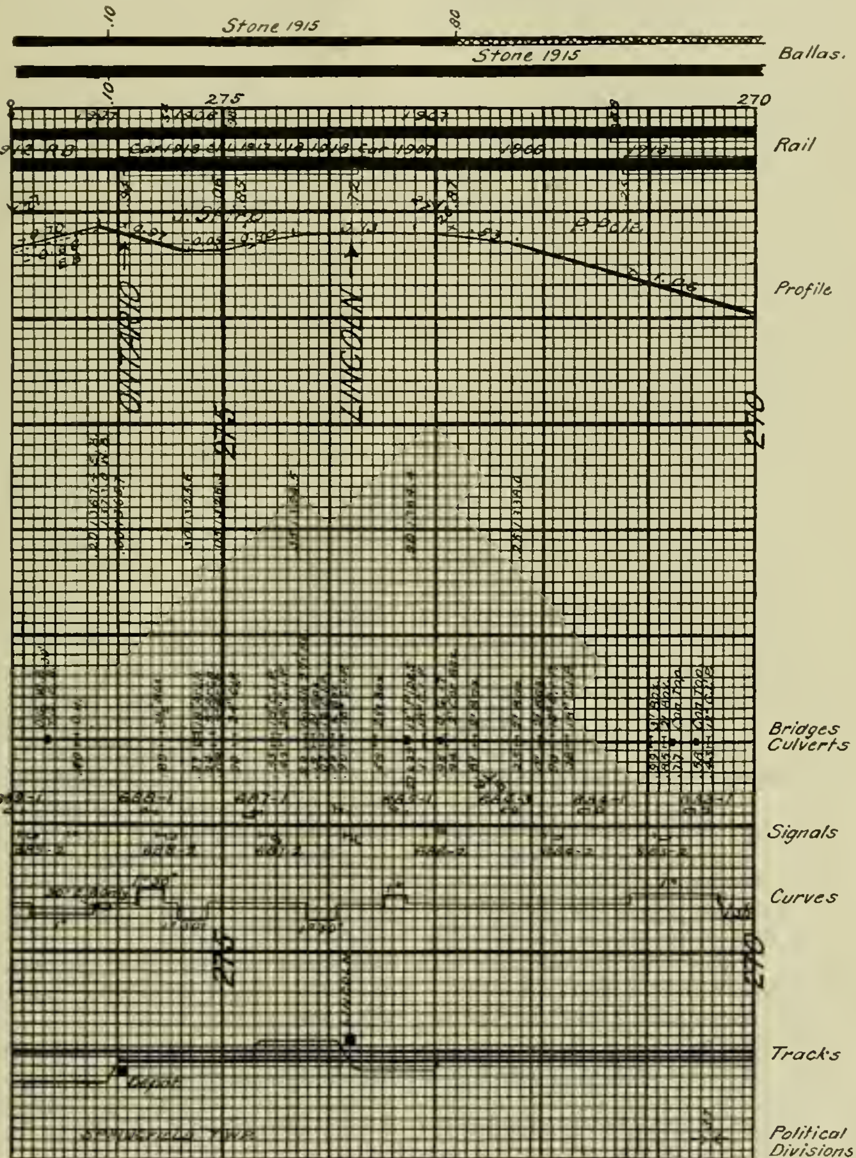
Below this two more heavy black lines show the weight of the rail whether of 90 or 100 pounds in weight, while index figures show the makers name and the date of laying.

The profile and stations follow. On the profile the percentage of the grade is marked, while the name of the owner of the abuting property is given next to it. On either side of the third heavy horizontal line below the profile there are figures. The figures above the line indicate the number of feet that each change of grade is above the datum line of the profile; while the figures below the line show the fraction of a mile at which the change of grade occurs beyond the last preceding milepost. For example, coming from right to left, the first indication shows that the change from the 1.06 per cent up grade occurs at mile 272.25 at an elevation above datum line of 1338.0 feet.

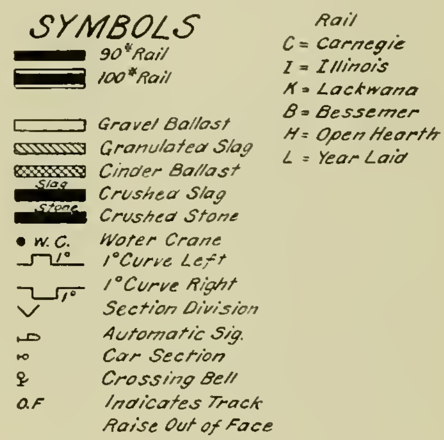
Next in order come the location of bridges and culverts. Each is marked as to its location in fraction of a mile beyond the last milepost with its character, whether box, concrete top, cast iron pipe, etc.

The signals are marked and located in a similar manner, and the curves are laid out in the usual conventional manner. Near the bottom the layout of the sidings and location of station buildings is given, while at the very bottom arrow heads indicate the line of demarkation of the several political divisions through which the road passes, such as township and county boundary lines.

It will be seen that there is hardly a question that can arise in the course of ordinary railroad operation connected with the track, which cannot be answered by reference to this diagram, and as such and for its completeness it is recommended to the attention of those officials upon whom there may devolve the duty of preparing data and diagrams of this kind. It was found to be a sure and safe guide when first used, and the style has since been adopted.



PROFILE DETAILS USED IN THE CONSTRUCTION OF A SECTION OF THE ERIE RAILROAD



Continued Efforts in Solving the Railroad Problem

Labor Leaders Warn the Men Against Unauthorized Strikes—The Pennsylvania's Plan—Hearings Before the Senate Committee—Government Expected to Come to the Rescue

In the first week of July the union leaders prepared a referendum affecting all the unions. It took the form of a resolution accepting the wage reduction under protest and demanding that wages be raised again when the railroad business returns to normal. The 1,500 union representatives advised the railroad men that there is no hope of winning a strike if called at present, because the sentiment of the country is decidedly against strikes. The workers are warned that launching a walk-out that is lost before it starts would involve the disruption of the unions. Under these circumstances the men are advised to make the best of the situation, and bide their time to gain the concessions they desire. Belief was general that the workers, with memories of last year's outlaw strike still vivid, would follow their leaders' advice. The agitation for the retention of the national agreements or working conditions or something equally as good would be continued.

The railroads are warned that a limit has been reached, and that no further encroachments on wages or working conditions, some of which have been in force for many years, will be tolerated. Warning was also sent to all members of the shop crafts unions on all railroads to so conduct themselves that they will not become involved in a stoppage of work. The circular letter pointed out that the shop crafts compose only 22 per cent of the two millions of railroad employees in the country, and that no action on the wage cut ordered by the United States Labor Board, and which went into effect on July 1, should be taken without authority of the railway employees' department. All employees were asked to refrain from any action which might lead to an unauthorized strike.

The National Agreements Controversy

As already announced the Pennsylvania railroad officials submitted a plan to the employees proposing the selection of delegates by ballot to meet an equal number of representatives of the railroad company for the purpose of discussing working agreements with a view to a reasonable working settlement of the questions involved. Complaints against the Pennsylvania were made to the United States Labor Board, in which it was claimed that the officials of the Pennsylvania system had violated their agreement with the men, in negotiating with them individually instead of through their unions. Similar charges were made against the Long Island railroad, and it is reported the Pullman Company was ordered by the Labor Board to deal with its men through their unions instead of dealing with individuals. It is also reported that the Labor Board had abrogated the agreements ordering the roads and the employees to get together and draw up new agreements, and when it became apparent that many of the railroads had failed to deal with their men, definite action was said to have been taken restoring the agreements.

The representatives of the shop crafts of the Pennsylvania charged before the Labor Board that its orders had been defied by the railroad company, in refusing to deal with the union representatives and that instead had negotiated in their own way with representatives of employees selected in accordance with the road's own plan. In a later statement made by officials of the Pennsylvania it is claimed that the employees were explicitly told that the election machinery which was proposed was solely to receive an accurate expression of the desires of the employees and that the management would recognize the men thus selected as empowered to speak for the men by whom they were chosen, whether they were union men or non-union men. It is the hope of the management that the men thus chosen as representatives may serve as a nucleus of committees which shall frequently confer with the officers on all matters not only affecting their own welfare, but also the welfare of the railroad, and of the public which the railroad serves.

It appears from reports that outside of Altoona, a majority of the shop crafts have declined to vote, and the management feels that it can assume no other course than to deal with the committee chosen by those who did vote, and that notwithstanding the endeavors to reach a satisfactory settlement over the national agreements, the Labor Board and the public will have this problem before them for some time to come, unless it be determined that these national agreements will not continue to be imposed upon the railroads under some other form.

Hearing Before the United States Senate Committee

In connection with the hearing before the Senate Committee on Interstate Commerce in Washington, the following statement by Mr. T. DeWitt Cuyler, chairman of the Association of Railway Executives was presented: The transportation service of this country is passing through a crisis. It is not a crisis peculiar to the railroads of the United States. It is a situation of world-wide incidence arising from perfectly understandable causes, most of them having their origin in the world war. The Transportation Act has not broken down. The present difficulties of the railroads are not due to the Transportation Act, and the Act provides effective machinery for remedying, in so far as it may be done by national legislation, the difficulties in which the railroad men find themselves.

The railroad managers regret that the operation of inexorable economic laws makes it necessary that railroad wages should be reduced. But the railroad managers have no fight with their employes, and the supreme aim of every railroad management in America today is to establish its relationship with its employes on a basis of friendliness and co-operation which will result in work at satisfactory wages for the largest possible number of men in an efficient and economical service to the public. Railroad managements are fully aware of the feeling in many quarters that certain railroad rates are excessive, and the unremitting efforts of the railroad managements of this country is to provide service of such economy and efficiency that it can be rendered at a rate which will promote the movement of the largest possible amount of traffic.

The public and the Congress may rest assured that the railroad managers are straining every nerve so to reduce their expenses that they may be able at the earliest moment to adjust rates to changed economic conditions, and certainly to the end that no individual rate shall be so high as to interfere with the normal movement of a commodity. The railroads have just emerged from a year of extraordinary expenditures that were so large that even with greatly increased freight revenues they were unable to earn an appreciable sum upon the actual investment in American railroad property. The railroads are rapidly surmounting their difficulties, and from now on will realize a progressively improving situation.

Rigid Rules Claimed to be Unreasonable

Mr. John G. Walber, Secretary of the Bureau of Information of the Eastern railroads states that in the opinion of the railroad managers the rigid rules are neither just nor reasonable. In a diversified country as large as the United States, the establishment of rigid and inflexible rules which cannot take into consideration those diversified conditions must to a large extent fall far short of meeting the requirements of justice and reasonableness. The extent of the relief to be obtained from the oppressive conditions inherited from Federal control will very largely depend upon the recognition given to these provisions by the Labor Board on the disputes now pending concerning reductions in the wage scales and also appeals which will probably be made concerning rules, in the event of labor organizations adhering to certain of their principles as in the past.

Officers Salaries Reduced

Coincident with the reduced rates of wages in accordance with the decision of the Labor Board, several of the leading railroads arranged to reduce in like manner, the compensation of those general, division and other officers and monthly employes who in the light of the higher cost of living were granted increases in their compensation at or since May 1, 1920. While the wages of such officers and employes do not come under the decision of the Labor Board, it was deemed necessary, because of the general conditions which so adversely affect the revenues of transportation companies that such action be taken, notwithstanding it is recognized that during the period of inflation the officers did not receive increases in their salaries at the times or to the extent generally granted to any classes of officers and employes of industrial organizations nor in proportion to the increases granted from time to time to other classes of railroad employes generally.

Still Harping on the National Agreements

E. T. Whiter, who represented the railways before the U. S. Railroad Labor Board in the hearings leading to the abolition of the national agreements, as between railways and their employes, outlined to the senators the effects of these agreements in increasing operating expenses. He showed that the U. S. Railroad Administration made these agreements shortly before the railways were handed back to their owners. That with the shop crafts four months before; that with the maintenance of way employes two and one-half months before; that with the clerks two months before; that with the firemen and oilers six weeks before, and that with the signalmen only one month before the properties were returned. In the classes of employment covered by the national agreement, there were employed in 1917, 1,206,520 men, whereas in 1920 there were employed 1,436,488. He showed how the abolition of piecework brought about an immediate reduction in efficiency, ranging from 10 to 40 per cent. He doubted very much whether the abolition of the national agreements will help the railways in their financial trouble. If employes meet the individual managements in the spirit intended by the decision ending the agreements, much will be accomplished, but if, on the other hand, the organizations maintain a position contending for that which in effect would be a continuation of the agreements, thus ignoring the principles laid down in the decision, little or no progress would be made, and the whole question would again be thrown back to the Labor Board, in the form of innumerable disputes, for decision as to what constitutes reasonable rules.

Government Expected to Pay What It Owes the Railroads

Acting on recommendations of its steering committee, member roads of the Association of Railway Executives approved recently the tentative plans worked out by representatives of the Harding Administration railway officials and bankers to fund the $500,000,000 owed by the carriers for capital expenditures made during Government operation of railroads and settle claims of the roads against the United States Railroad Administration for undermaintenance, balances due on materials and supplies, depreciation, unpaid compensation and all accounts arising out of twenty-six months of Federal control. The action was taken at a meeting in the board room of the New Haven Railroad at Grand Central Terminal, at which practically the entire membership of the association was represented.

Although the official statement issued at the close of the session by T. De Witt Cuyler, chairman of the association, said that "further statement on the situation must come from the President of the United States," it is known that the proposal provided for an extension of the powers of the War Finance Corporation to finance the settlement without an appropriation by the Congress and with as little strain as possible on the credit of the Government in connection with the sale of securities which will be made to provide the necessary cash.

The first steps looked for in the execution of the plan will be a proposal to the Congress to amend the War Finance Corporation act and permit the transfer to that corporation of certain assets in the Government Treasury. Those securities are about $1,180,000,000 and include $250,000,000 in railroad securities turned over to the Treasury against approximately $210,000,000 in loans made from the Government's revolving fund; approximately $430,000,000 indebtedness funded for additions and betterments to equipment, way and structures, and bonds of about $500,000,000 to be issued by the railroads to fund the remaining capital expenditures made by the Railroad Administration.

Against that collateral it is expected that the corporation will be able to issue a sufficient amount of debentures for sale to the public to supply adequate funds for payment of claims of railroads allowed against the Railroad Administration. In view of substantial concessions insisted on by the Administration it is probable that the undermaintenance claims will be scaled down about $500,000,000 or $600,000,000. Claims for compensation unpaid for the period of Government operation aggregate $500,000,000. Unpaid guarantee for the six months following the relinquishment of Federal control, amounting to about $200,000,000, is provided for by an appropriation in the transportation act of 1920 and thus will require no provision in the present settlement.

Although the final announcement by the President may reveal some changes, the admission of rail executives that no further conferences on that subject with Administration officials were expected was taken to mean that all essential principles of the arrangement had been determined.

The Government and the Railroads

It must not be imagined that the Government is placing half a billion dollars into the hands of the railroad executives without taking the money out of the pockets of the people. The money cannot be taken out of the earth or out of the waters under the earth. As should be well known during the period of government control of the railroads, two sets of claims were established; government claims against the roads, and the claims of the roads against the government. The government claims amount to about $763,, 000,000 for improvements, and must be finally paid by the railroads. The claims of the railroads against the government would exceed this, but the bills are being trimmed down to something a good deal less. Probably the amounts due and payable by both sides will be nearly equalized. It would not be unusual in business transactions to call it square and let it go at that, but the railroads need the money in the worst way, and the exact amount owing by both the railroads and the government will not be satisfactorily computed for some time.

It is a generous and kindly act, whatever way one looks at it to advance half a billion dollars to the railroads in the meantime. It means existence to the railroads, but the government can afford to wait for a final settlement. If the railroads get a fair chance the debt will be cancelled sooner than some of us imagine. Not only so but the War Finance Committee can readily produce the amount proposed to be furnished to the railroads without increasing the present appalling total of national taxes. The plan proposed by the government is to take over a sufficient amount of railway securities, discount them, and sell them in the open market, the government guaranteeing repayment. It looks to be the best plan available. The government will literally be compelled to take a paternal interest in the railroads, and the iron grip on the throats of the railroad executives may be changed to something akin to a friendly partnership, as it should be, and the years wherein we grief have seen may be changed to a live and let live policy that will lead us in the ways of pleasantness along the paths of peace.

Railroad Labor Board Orders New Ballot to Obtain Committees

On July 30 the United States Labor Board, in session at Chicago, issued an official notice declaring elections of employees' committees held by the Pennsylvania railroad and by the Pennsylvania shop crafts union illegal and void, the Board ordering a new ballot to select a committee on negotiation of rules covering working conditions to replace agreements established during Federal control.

The decision also canceled rules now in force as a result of agreements reached by the railroad with the committee elected on the Pennsylvania ballot.

The shop crafts unions are fully recognized in the board's decision, although non-union men were declared to have full and equal rights. In a form ballot drafted for use in the new election employees are allowed their choice of representation by the Pennsylvania System Federation, affiliated with the railway employees' department of the American Federation of Labor, the American Federation of Railroad Workers or by any other organization or individual for whom a majority vote is cast.

The Labor Board refused to be drawn into a discussion of the open shop, for which the Pennsylvania has openly contended. It was on this principle that the railroad refused recently to recognize the unions' claims to representation of the majority of shop employees and proceeded to hold a general election. The board, however, said the dispute which arose over the unions' claim was "merely one of procedure."

Neither the Pennsylvania's general election nor a ballot conducted by the system federation was fair or legal, the board said, and the employees have consequently "been denied their legal right to select representatives for this important conference on rules."

The board's decision declared the dispute one of technicalities, adding that "at a time when the nation is slowly and painfully progressing through the conditions of industrial depression, unemployment and unrest, it is almost treasonable for any employer or employee to stubbornly haggle over non-essentials at the risk of social chaos."

The board's ruling orders a conference on or before August 10, between representatives of the road, the Pennsylvania System Federation, or any other organization having shop crafts members and established to function as a labor organization, as set forth in the transportation act, and any other representative carrying the signed authorization of one hundred unorganized employees. This conference is to determine the method of holding the new election and the general committee will also have charge of the election.

As has been already stated, when the Labor Board, last April, directed the railroads to negotiate working rules to succeed those established by the railroad administration and continued by the board pending their replacement, the Pennsylvania System Federation, comprising the six shop crafts unions, authorized its general chairmen to conduct the negotiations. The carriers, however, refused to negotiate with this committee and a ballot was sent out by the road.

This ballot did not provide for designating any organization requiring votes to be cast for individuals. Upon refusal of the company to amend the ballot allowing votes for organizations the union men refused to vote the company ballot and issued one of their own.

The Pennsylvania recognized only the committees named by its ballot, conferred with them and subsequently put into effect rules negotiated with those committees. It is these rules which the board has declared void.

The dispute, as the Labor Board viewed it, was entirely one of who should represent the employees. The transportation act, however, does not prescribe the method by which employees shall select their representatives and "both parties correctly concluded that an election by ballot would be necessary," the decision said. There the dispute arose.

"The carrier had no more right to undertake to assume control of the selection of representatives of the employees than the employees would have had in supervising the naming of the carrier representatives," the decision said. "In this sophisticated land of popular elections no political party would submit to having its primary held and managed by the opposing party."

As has also been already published, the Pullman Company was involved in a similar dispute and after holding a general election, disregarding the unions, was ordered by the board to negotiate with the union committee. The Pennsylvania, however, is given the opportunity of a new election, by which it is expected both union and non-union employees will be satisfied.

Will Tide the Roads Over

Secretary Mellon of the United States Treasury announces that the Government is preparing to loan the railways of the country $500,000,000, and that additional legislation will be necessary to carry this plan into effect.

The loans will tide the roads over until the railway business so improves that roads can float private bonds and thus repay the Government. The $500,000,000 is to be in no sense a gift to the railways of the country, and this fact should be kept clearly in mind. Settlements must be made within five years.

With the return of national prosperity, to which adequate transportation service will contribute to a large extent, the roads will be able to meet their obligations promptly and repay the Government at the end of the five-year period.

Put the Railroads to Work

Transportation is the backbone of the nation's business life. It is idle, therefore, for the Government to split hairs as to the method of paying to the roads the sum notoriously due them, and it is madness to insist that the roads remit what they owe to the Government at a time when the securing of money is costly and almost impossible. A Government that can postpone payment of interest on ten billions owed it by foreign nations most certainly can afford to fund for ten years one-tenth the sum due to it by its own legal corporations, particularly as they are ready and able to pay interest on the amount involved.

Prices for Transportation in Italy

In the States just now the people are kicking about the high fares, but they should pay what an Italian is obliged to and they would stop complaining. For instance, an Italian, to travel a distance of two hundred and thirty miles, about as far as from Boston to New York, pays something over forty dollars. This is first class, second is about eight dollars less, and if he cares to sit for ten hours on the board seats in the third class, it comes to only about twenty-nine dollars. Everything is proportionate and yet the travelers in the States can't see why they have to pay the railroads such a lot of money to get from New York to Philadelphia.

Yes, Government ownership of railroads is a great thing, all right. For some one. But that some one isn't the government, it isn't the travelers, and it's a safe bet it isn't the railroad.

Engineer's Opportunity

Thoroughly trained enginemen can do much to help reduce the cost of railroad operation, and it is difficult to determine where the responsibility for fuel waste begins and ends. Today this fact is realized more than ever before, owing to the high cost of nearly every article a railroad has to purchase, and dividends may be paid from.

Eminent Engineers Offer Suggestions Looking to Improvements in Locomotive Design

The excellent paper by W. H. Snyder, M. E., presented before the spring meeting of the American Society of Mechanical Engineers and which appeared in our issue of June, 1921, has been the subject of much discussion among leading engineers generally and particularly among those who were present at the meeting. Among others, A. W. Bruce, of the American Locomotive Company, stated that the so-called floating bushing had been used on heavy power engines on the main pin for both main and side rods, and when properly lubricated this loose bushing gave good satisfaction. The use of special steel for light parts, while desirable, was questionable until assurance could be had that the same steel would be carried in stock and used to replace parts.

W. B. Oatley, chief engineer, The Superheater Company, expressed his opinion that probably less attention had been paid to the more economic production of front-end draft than to any other detail connected with locomotive design, and that intensive work along this line was eminently desirable. There seemed to be no reason why 2¼ in. boiler tubes should be the upper limit in practical use. Long, small-diameter tubes unduly increased the resistance to flow of gases and would nullify to some extent the evaporative capacity unless the front end draft was greatly increased. He had for several years advocated using 2 in. tubes when the length was from 15 to 17 ft., and up to 2¼ in. for 30 to 33 ft. lengths, the shorter lengths being for soft coal and the longer for anthracite, oil and pulverized fuel. Domes had been gradually growing smaller and smaller. The absence of a dome, however, did not mean that practically dry steam could not be delivered to the superheater proper, but that the throttle, superheater (if any), dry pipe, etc., must be so arranged as to take care of the conditions. With long boilers on grades the rolling and surging would often cause slugs of water to splash up into the dome and pass to the superheater where they would deposit scale and produce deterioration.

C. J. Mellin, constructing engineer of the American Locomotive Company, Schenectady, N. Y., has given his opinion that in regard to the matter of counterbalancing, the best method available appeared to be to use three cylinders and a single internal crank on the driving axle, which was a simple construction and provided room for parts of ample strength and bearings of ample size. While not giving as good a balancing effect as four cylinders, the method had the greater advantage of affording a better turning effect than any other means that might be used as far as experiments show.

J. E. Muhlfeld, vice-president of the Railway and Industrial Engineers, Inc., New York, states that practically all of 65,000 locomotives in the United States today were primarily improved enlargements and rearrangements of Stephenson's pioneer "Rocket," built in 1829. To improve their performance and efficiencies one of the simplest and most expedient means was to increase the boiler pressure and thus reduce the factor of adhesion. Superheaters, brick arches, feed heaters, etc., would increase sustained horsepower and promote fuel economy, but they did not materially affect the true capacity value of the locomotive, which was its starting power. With existing driving-wheel load limitations there was no reason for the factor of adhesion in freight locomotives to exceed 4 or 4.1 as a maximum when the limiting friction for dry sanded rail would allow a factor of 3 and for dry rail 4. Due to improper gas-area ratios, too few elements, or location of the superheater element rear return bends too far from the firebox flue sheet, many locomotives were being run with 50 to 100 deg. less superheat than would otherwise be obtainable. The use of 350 lb. steam pressure and 300 deg. superheat together with a more efficient boiler, improved combustion, better steam distribution and utilization of waste heat, would put the steam locomotive in a class by itself as the most effective and economical self-contained mobile power plant for the movement of fast and heavy rail tonnage.

Max Toltz, of M. E. Toltz, King & Day, Inc., St. Paul, Minn., stated that the water tube boiler had been used by the French since 1903, particularly in Algeria. They were now used on ships when in heavy seas the foundations similarly lacked rigidity. The simple engine was to be preferred to the compound, but steam pressures should be increased and superheaters employed.

W. E. Woodward, of the Lima Locomotive Works, said 20 years ago 70 h. p. developed for five tons of locomotive weight was good practice. Now, however, 100 h. p. for the same weight was common. The 3500-h. p. engine at present used to pull fast, heavy trains weighing about 350,000 lb. If designed according to practice in 1900 to 1905 it would weigh at least 500,000 lb., could not be run on railroads, and would have a boiler so large that it could not be fired properly.

C. T. Ripley, Railway Exchange, Chicago, stated that he thought that in future development work on the locomotive, the manufacturers, railroads, members of the mechanical societies and the universities with their faculties and equipment should be brought together, for their cooperative work would surely produce results quickly and at much lower costs.

In closing the discussion Mr. Snyder said that from his viewpoint the most economical railroad operation consisted in hauling the largest load possible. Capacity should be increased as it had been in marine practice, where no one would care to go back to the caravels of Columbus from the huge ocean liners of the present day.

Corrosion of Boiler Tubes

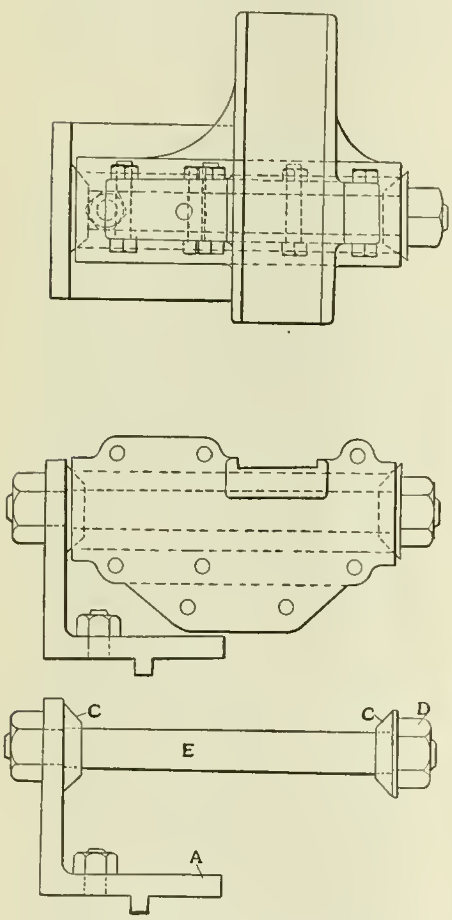
B. G. Worth presented to the thirtieth general meeting of the American Electro-Chemical Society a paper describing an unusual corrosion of a steam boiler. All attempts to control the action by electrolytic means failed. The chemist at the plant found that a notable quantity of ferrous carbonate was held in solution by excess of carbonic acid, which is a not-infrequent condition in ground waters. It is rather remarkable that the water-softening plant was not originally adapted to deal with this condition, as it is generally evident by the change of the water from clear to a reddish turbidity on standing a short time exposed to the air, and still more quickly if aerated. Corrosion of metals by natural waters has been a subject of extensive study, and among other conditions a water containing much dissolved air, with very little scale-forming material will often produce notable corrosion, especially if the feed water is introduced by a tube terminating at the boiler wall. The corrosion is generally less if the tube is prolonged to, or near, the center of the water-mass. In such unusual conditions a change of water, if possible, that may be found on the surface of the earth is generally found to be more nearly free from minerals held in solution.

Heat from Locomotive Ashes

Owing to the large amount of unburned coal in locomotive ashes and smoke-box cinders, they have comparatively good calorific value, and, it is claimed, that when collected, they can be burned in stationary boilers for the generation of electricity. For the clearing of ashes out of the smoke-box, a vacuum pump is most useful; and for the cleaning away of the ash and clinker which have been dumped in the ash pit, a bucket conveyor is used. This conveyor is driven by an electric motor, and the process is an aid in fuel economy.

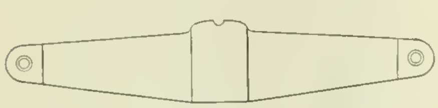
Handy Shop Devices in Use on the Delaware & Hudson and the Southern Railway

Among the handy shop kinks in use in the Watervliet shops of the Delaware & Hudson Co. is a very simple chuck for holding rocker boxes for planing on a planer or shaper. It consists of a base *A* having a lug fitting into the slot in the platen of the machine, by which it is squared and prevented from slipping. The



CHUCK FOR PLANING ROCKER BOXES. DELAWARE & HUDSON CO.

vertical portion of the base carries a 2½ in. bolt *E* over which the two conical washers *C C* are slipped. The bolt is rigidly attached to the base, and, after the rocker box has been fitted and the two



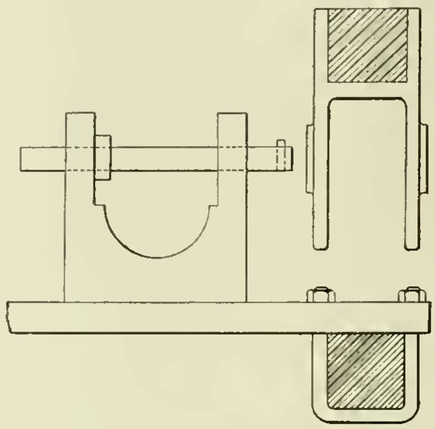
EQUALIZER WITH BUSHED PIN HOLES. SOUTHERN RAILWAY

parts bolted together, it is slipped over the bolt and squared and held by the conical washers, which enter the hole of the rocker bearing.

In setting up the work it is merely necessary to level the frame seat to be planed and tighten the nut *D*.

* * *

Equalizer pins and equalizer pin holes



BORING BAR FOR EQUALIZER BRACKETS. SOUTHERN RAILWAY

wear, and when they wear the pins must be renewed and the holes should be repaired in some way to save the expense of a new equalizer. The problem has been solved in a very efficient manner at the Somerset, Ky., shops of the Southern Ry. by simply making a new pin of the original dimensions and then boring out the holes in the equalizer that have worn oblong. The holes are bored out to a standard size and then bushed back to their original dimensions. This is done by the simple method of using steel tubing cut to length and casehardened and then driving home, no machine work being done on them. When the bushings become worn, in turn, they are simply driven out and new ones put in their place; so that, when the bars have once been bored they are done with for the balance of their life.

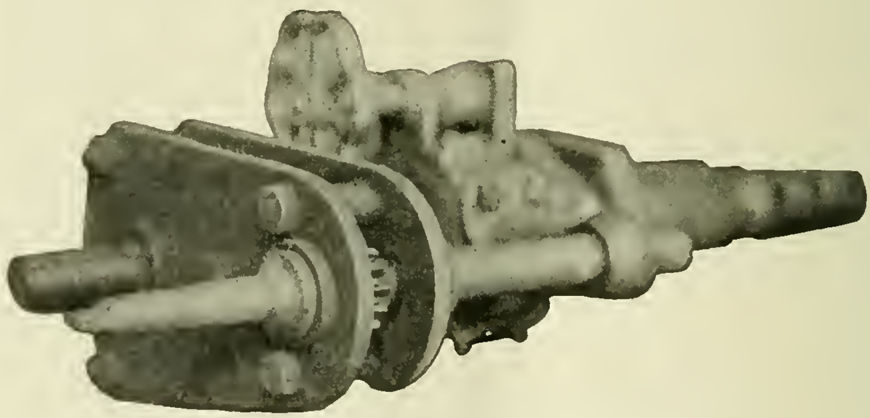
These bushings always last from one shopping to the next and frequently through two shoppings for general repairs.

In like manner the holes for the pins in the equalizer brackets are bored out and bushed when worn. This work is done without removing the brackets from the engine when the latter is in for general repairs.

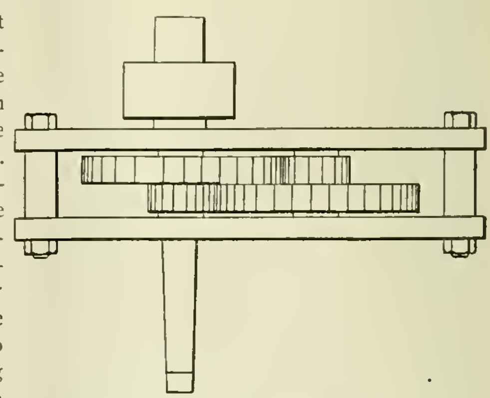
A specially designed tool is used for the purpose.

A heavy bar measuring about 6 in. by 2 in. is bolted across the engine from frame to frame in line with the holes to be bored. To this is bolted the frame of the machine, which is made from an old engine truck oil box, the two legs of which are bored to carry the boring bar. One leg is faced off to take the thrust.

Outside of this is the feed consisting of a worm and gearing, as shown in the illustrations. This has a pinion meshing into teeth cut on the sleeve of the boring bar. The bar is driven through a train of gears by an ordinary air drill, fitting on the taper shank of the spindle of the last gear of the train.



GEARING FOR DRIVING BORING BAR FOR EQUALIZER BRACKETS. SOUTHERN RAILWAY



REDUCING GEAR FOR MOTOR DRIVE

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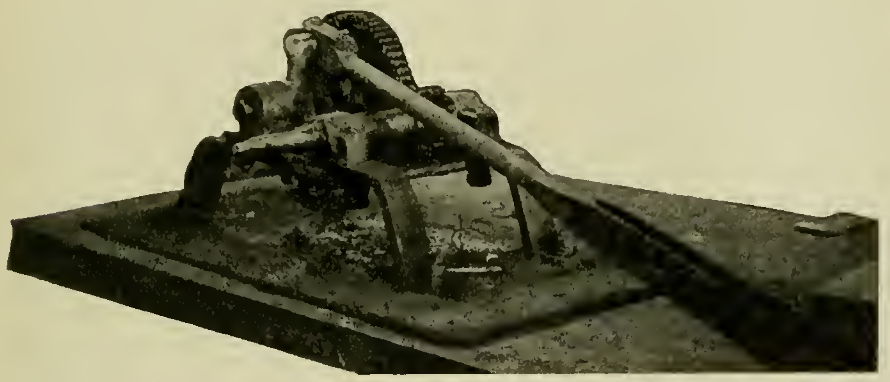
The air motor is being extensively used for all sorts of purposes. One is the grinding of the joints between the cylinders and their heads.

The arrangement used for this consists of a spindle having a taper shank, for taking the air motor, and a pinion driving a



GEARING FOR GRINDING CYLINDER HEADS. SOUTHERN RAILWAY

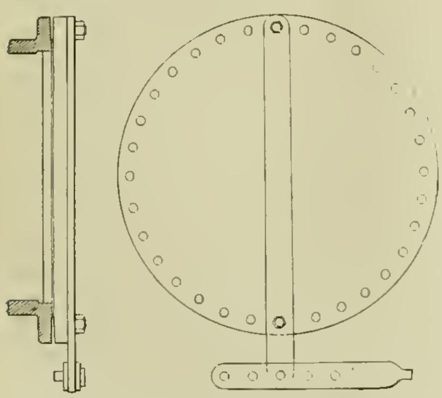
spur gear which is keyed to a crankshaft. The crank drives a connecting rod that is coupled to the head.

The head, to be ground, is put in place and a crossbar or arm is bolted to it as shown on the engraving. The connecting rod is attached to the projecting end of the crossbar and gives it an oscillating motion which is continued until the seat is ground.

* * *

Another use is that of pulling cylinder bushings into place.

The bushing is entered at one end of the cylinder and a crossbar or plate is put across the outer end. The center of the plate is threaded to take a screw of 2¼ in. diameter. The other end of the screw passes through a head at the far end of the cylinder and has a collar which takes the thrust against the head. The screw is

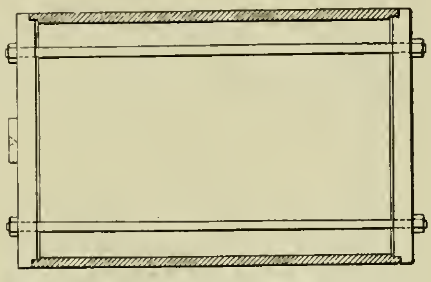


METHOD OF GRINDING CYLINDER HEADS. SOUTHERN RAILWAY

driven by a chain of gears like that illustrated in connection with the boring of equalizer brackets, under the motive power of an air motor.

* * *

The bushings for the cylinders of large engines are now so long that it is frequently impossible to bore them out on the largest boring mill available. In the Somerset, Ky., shops of the Southern Ry. this condition was encountered where bushings 27 in. in diameter and 42 in. long had to be bored, and the largest boring



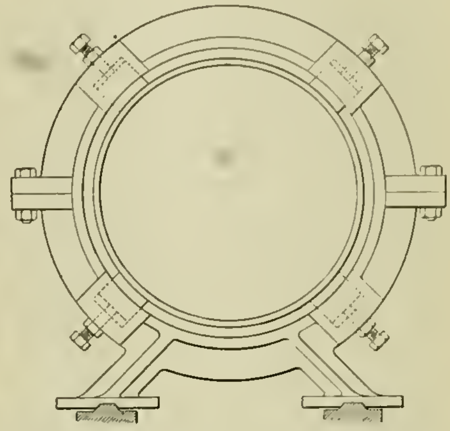
METHOD OF HOLDING CYLINDER BUSHINGS FOR TURNING. SOUTHERN RAILWAY

mill had a table 84 in. in diameter with a feed of only 38½ in.

The problem was solved by using a special chuck for boring and then turning, both operations being performed in a lathe.

The boring chuck consists of two rests, similar to the ordinary center rest, which are bolted to the bed plate of the machine. These rests are made in halves, and each half has two dogs, like those shown in the engraving, having teeth on the inner edge. They fit into sockets in the rim of the chuck, and are forced against the bushing when it is in place by the set screw at the back, and so may be made to serve, both for centering and holding the work.

The boring is done with a bar of the usual design, having a traveling head and the feed is accomplished by the usual star and screw. The bushing is first bored and counterbored on a lathe to which this chuck is fitted. The two ends are then closed with two cylinder heads that are

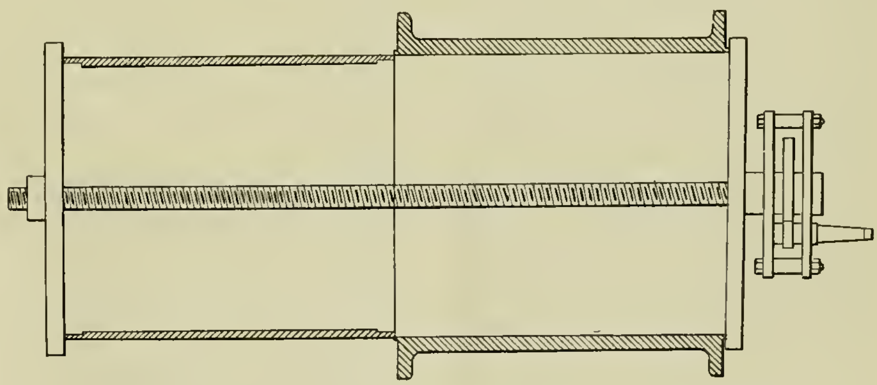


CHUCK FOR HOLDING CYLINDER BUSHINGS FOR BORING. SOUTHERN RAILWAY

bolted in place, as shown on the engraving. These heads are fitted with centers for the lathe. This combination is then swung into an ordinary lathe and the outside turned.

Safety on the B. & O.

The safety report just compiled by the Baltimore Division of the Pennsylvania Railroad for the month of June shows that among a total of 5,602 employes



MOTOR DRIVEN SCREW FOR PUTTING BUSHINGS IN CYLINDERS

there were only 20 accidents resulting in disability of more than three days. This is a marked improvement over June, 1920, when the accident total was 36.

A hundred per cent safety record was maintained last month by the following 12 of the 21 departments in the Baltimore Division: York Shop, Electricians, Foreman Car Cleaners, Foreman Car Inspectors, Supervisor No. 87, Supervisor No. 89, Supervisor No. 90, Supervisor of Signals, Master Carpenter, Other Station Employes, Division Operator and Captain of Police.

Only one accident was reported for each of the Supervising Agents, Supervisor No. 86, Mt. Vernon Shop, Yard Forces, Benning Shop and Canton Shop departments.

Steam Cylinder Lubrication

The current issue of *Lubrication* has an interesting and instructive article bearing on the subject of lubrication with which we not only cordially agree but as the matter is so clearly presented we take pleasure in making some brief abstracts. The author justly claims that it is far more difficult to ascertain whether a steam cylinder is efficiently and economically lubricated or not than it is to determine the same condition with bearings because the inside surface of the cylinder cannot be seen or felt while the engine is running. Wear in a cylinder cannot be usually detected except on examination when the cylinder head is removed. Cylinders and valves cannot be examined every day, so the tendency is to use an excess of oil in order to be sure of getting enough. A cylinder oil is required to lubricate every sliding surface which comes in contact with the steam. In reality this includes not only such surfaces as may actually be touched by the steam, but those moving parts which are heated by it or are under its pressure. The principal parts that must be lubricated are: The admission or controlling valve and valve rod, the cylinder walls, the piston and piston rings, the piston rod, and the exhaust valve if different from the admission valve. In addition the oil generally must lubricate the main stop valve and throttle. When various surfaces are usually under different pressure and temperature conditions in the same machines, and the lubricant must take care of their varying conditions equally satisfactorily, the slide valve, operating, as it does, with an excess pressure on one side, is exceedingly difficult to lubricate, as the tendency is to continuously scrape the oil away from the valve seat, giving a maximum opportunity for wear and leakage. This, of course, could be somewhat prevented if the edges of the valve and its seat could be chamfered, but while this procedure would assist in the lubrication it would result in poor steam economy and hence is unthinkable. To produce satisfactory lubrication of the slide valve, therefore, the oil film must be continually renewed. On account of this difficulty it has been found impractical to operate slide valves at a pressure much over 125 pounds per square inch.

Piston valves, being balanced as to steam pressure on the sliding surface, are not subjected to the tendency of squeezing the oil from between the bearing surfaces, but a seal must be maintained between the different parts of the valves to prevent leakage of steam and loss of power. The valve rods are usually comparatively small with little friction, but quite serious trouble may result in the running of the engine if they are not properly lubricated. When adjustment is very exact, any overheating may cause a change of alignment with a possible sticking of the valve and a waste of power.

While the nominal duty of the oil within the cylinder is to lubricate the cylinder walls, the proper lubrication of the piston rings and the piston rod is equally as important. Horizontal engines, on account of the weight of the piston, require greater care in the selection of a lubricant than do vertical cylinders, and it is considered the best practice in the horizontal type of engine to have the piston supported by a tail rod so that its weight is not carried by the cylinder wall directly. This allows the piston rings to function in producing a seal and not in carrying a load. Piston rings should be rounded on the edges so as to prevent the scraping off of the oil from the cylinder walls, and the rings also should be so designed as to float freely around the piston, thus taking up any misalignment due to unequal expansions or otherwise.

LUBRICATORS

There are two general types of lubricators used in steam cylinder lubrication: The hydrostatic type and the mechanical type. In some cases of direct application, small sight feed cups or similar devices are used.

The hydrostatic type of lubricator, working on the principle of forcing the oil into the lubricating line by means of a head of water produced by condensed steam, is somewhat erratic. Conditions may change the amount and temperature of the water and hence the head, and changes in temperature may vary the viscosity of the oil so that a constant and regular flow is not maintained. The amount of oil flowing into the lubricating line will be independent of the load or speed of the engine, and hence the lubricated parts will not receive the varying amounts of oil required to take care of the changing speed conditions.

In the mechanical type of lubricator, as it is generally geared directly to the engine, the oil is forced into the line at a rate which varies directly with the speed of the engine, thus giving a lubrication more commensurate with the requirements. When the engine stops, the lubricator also stops feeding, thus avoiding waste by flooding the engine with oil when it is not in operation. Most mechanical lubricators have sight feed cups so that the rate at which the oil is fed to the line can be ascertained at any time. In the multiple type of lubricator where one piece of apparatus feeds a number of lines, sight feeds with separate regulating devices should be installed in each line. The best types of lubricator will feed the same amount of oil regardless of temperature, viscosity or amount of oil in the receiver. Some types keep the feed pipes full by means of spring check valves, which also are vacuum proof. This causes oil to be fed the instant the engine is started. The mechanical lubricator can be used either with the direct system of application or with the atomization system, but the hydrostatic type is generally only used on the latter.

SUPERHEATED CONDITIONS

In engines with high superheat it has been the general practice to use heavy-bodied pure mineral oils, and as a result good lubrication has not always been obtained, and it has been the general opinion that such machines are very hard to lubricate. This use of a pure mineral oil is no doubt due to the fact that cylinder oils were too often used which were not properly refined or compounded with such fatty oils as would withstand the carbonizing effect at the high temperature of superheated steam. Unless very high superheat is used, steam at the exhaust will show some moisture, and as we must lubricate the cylinder on the exhaust stroke as well as on the expansion stroke, we must use a slightly compounded oil that will take care of slightly wet conditions. Even if the exhaust from the high pressure cylinder remains dry, that of the low pressure will be wet. This, of course, can be taken care of by using a different oil on the high and low pressure cylinders, but this is not necessary as oils are now made which will take care of both conditions satisfactorily.

DETERMINATION OF PROPER LUBRICATION

The real test of a cylinder oil is the condition of the rubbing surfaces after it has been used. In making an examination of a cylinder running on a certain oil, too hasty a conclusion as to its value should not be reached. It takes time to form a film surface on a cylinder wall, and if possible several weeks should elapse before the action of the oil is finally judged. A perfectly lubricated cylinder should be highly polished and have a glaze over its surface. It should have no rough or dull spots, and there should be no sign of rust if examined immediately after stopping the engine. The color should vary from a bright iron-white to a light brown or steel blue. If the cylinder head is removed immediately after stopping the engine there should be a film of oil all over the surface sufficiently thick to saturate three or four thicknesses of cigarette papers. Even when the engine has stood for several hours there should still be a film upon the cylinder walls, though not necessarily as thick as if examined immediately after stopping the engine. The stain on the paper should be brown. If it is black or has black particles or streaks, the cylinder or rings are probably wearing or the oil is carbonizing. If there are pools of oil lying in the bottom of the cylinder or in the counterbore, too much oil is being fed and the quantity should be reduced. If the cylinder walls are dry in spots or show signs of wear, either too little oil is being fed or the wrong kind of oil is being used. Lack of lubrication will sometimes be shown when the engine is running, by sticky valves or groaning sounds from the cylinder.

Economy of lubrication can be checked up by examining the exhaust steam or piston rod leakage. If the condensed steam shows considerable quantities of liquid oil, either too much oil is being fed or it is not properly atomized. If it shows minute drops of oil and is milky in color it is probable that atomization is complete and the feed is correct. If the piston rod shows a film of oil on it and there is no oil fed directly to the piston rod it can be taken as an indication that the atomization is satisfactory, or at least that the surfaces are receiving sufficient oil.

Rail Terminals

The International Chamber of Commerce in reviewing the American economic situation during its recent sessions had under consideration the transshipment agency composed of the major elements quite distinctly and yet inseparably interlocked. These were the shipping facilities outside the bulkhead, and rail facilities inside of the bulkhead.

In the past, the great tendency has been for shipping men and port authorities to concentrate their efforts entirely towards the water-side facilities, too often with scant attention to the equally important rail facilities on the land side, and owing to the intense railroad competition for marine business, these rail terminal facilities were too often left to the railroads for individual development as best suited their particular purpose. As a result, the rail terminal development in many ports, especially the larger and most congested ones, has become so highly individualistic as to introduce entirely needless complexity in terminal operations, the duplication of investment, the increase in terminal costs and an unfortunate absence of co-operative administration and efficient procedure which should obviously be inaugurated in every great port.

This system has, in some cases, necessarily resulted from national encouragement of the competitive system, not only as between overland carriers, but also in their terminals. But the lessons learned from the intense operations of the war are now being reviewed during the less strenuous period of reconstruction and there is a widespread demand that more economic methods should be instituted in port terminal procedure for securing greater flexibility of operations, unified control and development and neutrality in relations of the shippers to the carriers, both rail and water.

The rail terminal operations of the Port of New York, including New Jersey, the most important railhead of the country, are a case in point and important investigations with supporting legislative action are now being brought to fruition with the specific object of securing promptly that degree of co-ordination between rail and marine operations so greatly desired. The second port of the nation, New Orleans, likewise requires equally intensive study to the same end. And emphasis is laid upon these very necessary measures because the Transportation Act, under which the one-quarter million miles of American railroads are now operated, specifically voices this policy, although no comprehensive procedure or direct mandate has as yet been promulgated. But, even in view of the great magnitude of the problem in its financial, political and constructive phases, it may truthfully be recorded here that America is striving for that fortunate solution which will be of the greatest assistance to international trade. Were America confronted by the development of only a few ports the problem would be infinitely less difficult.

The Testing of Welds

The question of testing welds has been discussed since welding first came into use, and especially during the last five years, the present importance of the question being very considerable. Since the matter was taken up from a scientific aspect every conceivable method of testing has been suggested, but some of these are beyond the capacity of the welding shop, though of great value. The American Welding Society, says the *Technical Review*, proposes to put the testing of welds and welded structures on a sound foundation.

While no one method of testing can give all the information desired, the microscope, in the case of welds as with metals, is probably the most powerful single method of investigation. It is a recognized fact that welding becomes increasingly difficult as the carbon content of the steel rises, and in considering tests it must not be overlooked that, apart from the strength of the weld, the strength of the original material and of that used in making the weld are limiting factors. The author has obtained informative results from making tensile tests, and calculating the elongation for each half-inch of the test piece on each side of the rupture, and is of the opinion that in many cases the alternating stress test would yield valuable information. In his opinion, however, the best test quickly to determine the general character of a weld is to grind it off level with the surface of the original material, clamp it on an anvil with the weld level with the edge, and open end of the V uppermost, and then to bend the projecting end by blows from a sledge hammer. The number of blows withstood or the angle to which the piece bends before cracking is a reliable guide as to the quality of the weld. In certain cases it is informative to perform this test at a bright orange heat. A 90 deg. cold bend in steel 2 in. by ½ in. is considered satisfactory. Electric welds will not prove as strong as those made by the oxy-acetylene method, except possibly those made with covered electrodes. Defects visible to the naked eye naturally indicate poor welding, but the author is of the opinion that the minor invisible defects are of greater importance. He advocates microscopic investigation after the polished sections have been etched for 30 minutes to an hour in a warm 25 per cent aqueous solution of hydrochloric acid, a method which has proved effective in the investigation of hidden defects in rails. The treatment results in the acid eating away the edges of any defects, which consequently show up as wide channels on subsequent microscopic examination. Some of the defects in welds are not visible under the microscope until the material is strained and a small bending machine which can be used on the microscopic stage to deform the etched specimen while it is under observation is very useful.

The author also believes that the tensile and alternating stress tests will prove very valuable, but no standard figures are yet available. The appearance of a weld is a very good guide as to its character, and though the characteristics of a good weld cannot be described, they are easily recognized after a little practice. Since the serious defects in welds are occasioned by the presence of oxide, the size of the tip should be restricted in gas welding, and the amount of current in electric, though this means slower working. Overheating of the metal increases the readiness with which it takes up oxygen. The regular use of the bending test described above has been found to effect great improvement in the quality of the work in many cases.

A New Tube Expander

A new design of flue expander is claimed to be meeting with favor among French railway men. The tool is described as consisting of two units, a tube-expander of more or less normal construction, and a chuck adapted to operate it. The chuck is electrically driven, and a flexible connection between the chuck and the expander prevents the application of too great a pressure and withdraws the expander when the operation is completed. In order to enable sufficient pressure to be applied the flexible connection can be changed for one giving the desired resistance. The apparatus is entirely automatic in action, and does not demand any special skill for successful operation, and is said to be satisfactory and effective in avoiding the tendency to superinduce annoying leaks that are difficult to stop.

Autogenous Welding in the Railroad Shops

In addition to the excellent work done by the firms engaged in the manufacture of welding apparatus in the publication from time to time of instructive pamphlets setting forth in details the best means and methods of obtaining satisfactory results in the great and growing industry of autogenous welding, it is interesting to peruse contributions to the general information furnished occasionally by the skilled mechanics engaged in the actual work. As voices from the ranks are sometimes as well worth listening to as the reports of generals usually several miles in the rear of the battle line, so are the records of mechanics themselves worthy of attention as far as their personal experience has enabled them to observe the actualities of service expected from them.

In this regard Mr. Edward Eldridge, discussing the subject of electric and acetylene welding at the Elizabeth shops of the Central Railroad of New Jersey, at a recent meeting of the Metropolitan branch of the Welding Society in New York, stated that they had wonderful success in both boiler and locomotive work. Mr. Eldridge stated that in the erecting shops "we weld frames, cylinders and castings of all kinds, both with the electric arc and acetylene. We also weld superheater units. In the machine shop department we are welding crossheads, valves, driving wheels and building up worn parts that are too numerous to mention. The boiler department comes in for its share and here we are welding whole fire boxes, one-half fire boxes, one-half throat sheets, backheads, door-rings, patches, large cracks, flues and patches in tanks.

Frame Welding

"When welding broken engine frames the frame is trammed and leveled, after which it is V'd out about 45 deg. on both sides with the acetylene cutter. It is then chipped to remove all scale and burned material. The next step is to expand the frame about ⅛ in. in order to take care of contraction. To get this expansion we use a charcoal fire on the rail that is not broken, and as this expands, it will open the one in which the break is located. Two welders are then put on to weld, one on either side. When they get one layer welded on, they take an air hammer and bob it to get the scale and dirt off before starting another layer and continue in this way until the frame is welded flush. The welded joint in the frame is then reinforced by the use of ⅝ in. or ¾ in. round mild steel bars which are put across the weld and extend 2 ins. on either side of it. These bars are spaced from 1 in. to 1¼ ins. apart and are welded in solid where possible. Bars placed in this manner greatly increase the tensile strength of the frame at the welded joint. In welding single rail frame, the rail is expanded on the opposite end to get the expansion where the break is located. Afterward the weld is made in the same manner as in the case of the two welded rail frames.

Cylinder Welding

"In welding engine cylinders that are cracked or broken we are doing it with both the electric arc and acetylene. When welding with acetylene, the crack or broken cylinder is V'd out to a 45 deg. angle and the opening left from ⅛ in. to 3/16 in. on the bottom of the crack. A frame is then built around the cylinder which is heated to a cherry red heat with a charcoal fire before starting to weld. In using an alloy cast iron rod for filler, care must be taken not to chill the iron or it will be hard. After the weld has been completed and has cooled, the furnace is taken away and the cylinders bored or trued up.

"In welding engine cylinders, with electric metallic arc, all cracks or broken parts are V'd out or beveled to a 45 deg. angle and studs applied. The size of stud is used according to the thickness of the casting. Where the casting is 1 in. or over we use a ¾ in. or a ⅞ in. stud. These are placed about 2 ins. apart, using one row in the crack and two rows outside, one row being on either side of the crack. Wherever a new piece is set in to replace a piece broken out, we use forged steel, with studding applied only to the cast iron. In making the weld, a light layer is placed around each stud first. Then the layer is put on where the weld is going to be applied, after which you have steel to steel to weld. After the weld is finished, white lead is put on the inside of the cylinder to do away with leaks or pin holes which form next to the cast iron. When a joint comes in the weld, we braze 'Tobin' bronze so as to leave a soft joint to machine. This bronze is brazed on with acetylene. If no acetylene is used, a small piece of copper is dove-tailed at the joint.

Steel Casting and Other Pieces

"In welding broken or cracked iron, steel or cast steel castings, the casting must be V'd to about a 45 deg. angle, and the crack extended through to a feather edge so that the weld will get all the way through. Care must be taken to get all grease or dirt off, as this will get into the weld and weaken it. If a casting is warped out of shape, it will not spring if it is welded from both sides, a little welding being done on each side alternately until the weld is completed.

"Bars of steel for reinforcing are always used as the grain runs across the weld in all directions. In welding superheater units we found the acetylene weld was better than the electric. Where the unit is cracked on the return end, the proper way is to cut off the end about one inch in order to get into good material. A cap made of ¼ in. material is then welded on. By using a cap the weld will be on the side of the unit instead of on the end and the greatest heat will strike the cap, which is the thinnest part, and will stand this heat as the steam passing through will keep it cooler.

Machine Department

"In repairing crossheads where the flanges are worn down we are welding on a ⅝ in. strip. The strip is beveled on both sides of one edge on the planer, after which it is taken and welded on both sides, bringing it back to its original size. The guides which are worn on the side are built up to the original size. By applying strips 1 in. to 1¼ ins. wide, beveled from both edges and welded through the sides of the guide, the guides are brought up above standard size, after which they are planed down to the proper dimensions. In building up worn castings which are to be machined down, great care must be taken not to over-lap the layers as this is the cause of black or hard spots in welding.

Fire Box Welding

"In welding complete fire boxes, we use a butt weld. The sheets are beveled on the inside and set in place on the mud-ring, then tacked in the water space. All fire boxes are welded on the floor. Starting in the center of the flue sheet at the bottom, the weld is made up to the ear or lap. The fire box is then turned over and the welding continues from the center of the crown sheet to the mud-ring, giving ⅛ in. reinforcing. After completing the weld on this side, the box is again turned and with a round nose chisel, a groove about 3/16 in. deep is cut in the seam in order to get all the scale and dirt off. This groove is then reinforced with ⅛ in. or 1 in. layer of welding metal. On the flue sheet we put ½ in. by 3 ins. round mild steel bars and weld around it. On the throat sheet five bars are used in the same way. The reason for putting on these bars is to stiffen the flue sheet when the flues are rolled. In welding half throat sheets and backheads, the sheets are beveled the same as the fire box side and welded before rivets are put in, giving about 3/16 in. by ⅛ in. reinforcing.

"In welding mud-ring corners we put a fillet weld on the inside through plug holes and reinforce ½ by 1¼ ins. by 12 ins. on the outside.

"In welding one-half fire boxes we use a staggered seam, starting the cut back from the throat sheet two staybolts, then up one staybolt. The seam then goes back two staybolts, down one, back two and so the length of the fire box. By staggering seams expansion and contraction is scattered in all directions.

"In welding patches in fire boxes we use an oval patch so there will be no sharp corners. The patch has a 3/16 in. radio so that there will not be any strain after the weld has been made. In applying the patch after the top and sides have been tacked on, the weld is begun at one end of the patch and continued across the top. The ends of the patch are welded from the top down, first welding about 3 ins. on one end and then the same amount on the other, until the ends are completely welded. The patch welding is then completed by beginning at one end at the bottom and continuing to the other end, and re-enforcing about 3/16 in. By welding this way the heat from the welding travels up into the patch and the contraction will straighten out the patch.

"In welding cracks in fire boxes where they are over 4 ins. long, the creck is V'd out to a feather edge. The welding is begun 3 ins. from the top and the weld continues to the top. Welding is then begun about 3 ins. further down and continues upward as before and so on until the crack is filled up. The next step is to take a welding hammer and bob up the welding material that has been applied and put on 2/16 in. reinforcing. Cracks welded in this manner we have had for two or three years.

"In welding door-holes we weld some with the lap and some with butt weld. In welding a lap weld care must be taken to keep the sheet laid up tight at all times and a fillet weld is applied on the edge. Care must also be exercised to see that the weld is as thick as the sheet in all places. A thin spot is an element of danger.

"In welding flues in the fire box, we put the flues in the same as before welding was practised. The boiler is then filled with warm water so that it will not sweat, and with a roughing tool all dirt and scale was cleaned from the sheet. With an acetylene torch or blowpipe all grease and oil are burned from the flue and sheet. The work is begun at the top of the flue sheet and progresses across so that the smoke will get on the flues that are already welded and not on the ones to be welded. Always start to weld a flue at the bottom, welding up each side to the top. Care must be taken that there is no copper sticking out of the sheet as this will cause blow holes in the weld."

Approved Methods of Cooling Refrigerator Cars

During the heated and, indeed, during all seasons the problem of keeping at a low temperature the so-called refrigerator is a problem which in these days of shortage of funds and delays in transportation, is more serious than is generally known.

The advantages of mechanical refrigeration against ice and salt mixture are well known. For hauling long distances it is undoubtedly a fact that by means of ice and salt it is impossible to get a low enough temperature that will safeguard such commodities as frozen fish. For hygienic purposes it is necessary that milk should not go above 50 degrees, and it is impossible to guarantee that this will not be exceeded with the ordinary ice and salt cooling. The dissipation of the ice means varying temperature, which in itself is detrimental. There is a great saving in weight, as the approximate weight of the ice and salt bunkers, connections, buffles, screens and drip tanks amounts to about 5,870 pounds, as against a complete weight of Clothel refrigeration plant of about 3,780 pounds. The saving in haul alone is quite an item, and as regards the costs, actual test made upon the Southern Pacific Railway demonstrated that the cost of icing for 10 days amounted to $60, as against $20, the cost of the operation of Clothel refrigeration plant.

Serious damage is caused by the waste of the melting ice and salt, resulting in injurious effect upon the steel bridges, and it has been found necessary to fit collecting tanks to prevent this trouble. With mechanical refrigeration it will be noted air circulation is obtained by means of a fan, which, of course, results in better condition of the goods. One of the results of mechanical refrigeration became apparent only after the installation and trial. It was found that with a mechanical refrigeration and air circulation system the refrigerator cars when unloading were so dry and sweet that they could be used immediately for return freight of the most delicate description. With the ice refrigeration cars, however, it was found impossible to use these cars for delicate freight before they had been thoroughly dried and sweetened. This meant a greater earning capacity for the available stock. Another gain was the avoidance of stopping for re-icing or re-cooling at the cooling plants established along the long haul lines. For the carriage of fruit from California to Chicago, for instance, it was demonstrated that a saving of 24 hours each way could be effected, which gave another considerable increase in freight-earning capacity. To provide against a long stoppage due to serious breakdown a small gasoline engine was fitted to operate the plant, which, under ordinary conditions, was driven by the axle.

Numerous arrangements have been made in an attempt to maintain uniform temperature throughout when cooling by ice, but in spite of all efforts it was found that there was a great difference in the ends of the cars, near the refrigerator tanks, and the center. It is, of course, impossible to place the ice tanks overhead and, therefore, there can be but a very small amount of air circulation, and, furthermore, all parties will admit the importance of uniformity of temperature, which is impossible of achievement without mechanical equipment of some description. It was found a matter of very convenient service, as the mechanically-cooled car could be pre-cooled in a few hours to a safe temperature to receive the goods, whereas the iced car was not available for service for a considerable time, and the saving in this respect was about 40 hours. As regards convenience, of course, there is no comparison as the Clothel system admitted of the car being pre-cooled at any point where freight was available, whereas it was necessary to shunt the ordinary car to certain fixed points where ice and salt were available. The actual trials and records were made upon a refrigerating car working over a distance of 150,000 miles, working in all kinds of climatic conditions with the ordinary rough handling and carrying all kinds of perishable produce so that the records are fairly conclusive.

British Locomotives Burn Coal and Oil Together

It is reported that the North Staffordshire Railway of England, in common with many other British railways, has adopted oil-burning for locomotives. Three 0-6-2 engines have been fitted and six more are getting ready. The system adopted is said to be that in vogue on the Midland railway, which was chosen on account of its extreme simplicity and the ease and cheapness of fitting, requiring, as it needs, no structural alteration in the firebox or ash pan, and allowing for oil or coal, or both combined, to be burned without any further alteration. The burner is placed in the firebox, and is supplied from a tank of 450 gallons capacity which is fixed on the top of the coal bunker. Steam is supplied to the coal burner from a stop valve on the boiler, and the supply of oil is regulated by a simple cock. With a little practice regulation of the supply of oil and steam is easily acquired. The engine works without smoke and maintains steam well both in passenger and freight service. The tank is of sufficient capacity to last more than a full day's work.

The rapid introduction of oil as fuel in British railway service has already been seriously commented on, not only by the mine owners but by the miners themselves. A strike lasting three or four months affecting any staple commodity sets people thinking, and something new should not surprise us.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:
JAMES KENNEDY, Managing Editor.
GEORGE L. FOWLER, Associate Editor.
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A. J. MANSON, Associate Editor.

London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

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Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

Industrial Depression and The Steel Corporation

The June issue of *Industrial Management* contained three articles on the present industrial depression that are deserving of more than a passing glance. Two were contributed articles by Roger W. Babson and George Huntington Hull, respectively, and the third was an editorial comment on the others in which certain deductions were made that places the burden of the present industrial depression upon the shoulders of the United States Steel Corporation.

The point made in the first article is "that steel has not played its usual part in the current economic cycle" in that its price has not fallen in proportion to other commodities, or, rather, using the pre-war prices as a basis, its present advance above those prices is greater than other commodities. In order to prove this, seven commodities are cited, to wit: cotton, silk, wool, wheat, corn, sugar and potatoes, the average of whose present prices is 33 per cent above those obtaining before the war. He then quotes six others, steel billets, petroleum, newsroll paper, coal, window glass and aluminum, and picks out steel for the statement quoted above, whereas the average price of the five commodities, besides steel billets, is 124.6 per cent above pre-war rates, while steel is but 95 per cent above those rates. And yet the excuse is made that the huge taxes put upon the product "has been a great factor in keeping up the price," with the prediction that lower prices will be possible during the current year.

The second article is an abstract from two chapters of Mr. Hull's book, "Industrial Depressions, or Iron, the Barometer of Trade."

The gist of this is that when prices are so high that people will not pay them, there is industrial depression, which seems so axiomatic as to bar discussion. It is on this foundation that the editor makes his final statement that "orders will be withheld, until the buyers of steel know that prices have been equitably and fairly adjusted."

It is a very simple and regretably popular thing to put the responsibility for disagreeable burdens or experiences on those who are doing big things, and when the enormous sums involved in the transactions of the Steel Corporation are set forth by themselves they stagger the average man by their very immensity and he loses sight of their relative value. As, for example, in the Interchurch report the total surplus of the corporation was presented in such a way as to lead the casual reader, and most men read casually, to infer that it was the surplus of a single year, and as such might readily appear as an instance of outrageous profiteering. But, as a matter of fact, it was the accumulation of nearly twenty years and represented less than five per cent of the value of the properties.

Now, let us look at the part played by the Steel Corporation since 1914 in the economics of our national life.

First, it may be stated without fear of successful contradiction, that the very magnitude of the Corporation and its resources saved our government from failure to meet the demands that were put upon it. It is not probable or even possible that had the great steel industries been acting as individual units there could have been that unity of action that was necessitated by the exigencies of the war.

In the matter of prices these were fixed by the Federal Trade Board during the war. And it was on the profits made under these prices that all expansion work of the Steel Corporation was done. In short, the government did not contribute towards this enlargement.

After the armistice, the War Industrial Board reduced prices on March 25, 1919, reductions that the Corporation accepted though capital is made, in the editorial under discussion, of the fact that, in the following May, Director General Hines refused to pay the prices for rails so fixed. In the meantime, under the stress of the demand for steel, some of the independent makers were exacting premiums of from ten to fifty dollars a ton. But in all of this flurry the Corporation never received a cent of premium and the fact that it consistently held its prices and those awarded tended towards a stabilization of the industry which without that stabilization would have seen its prices skyrocketing to unheard-of heights. It is estimated that the independents received at least $600,000,000 in premiums during and since the war.

Now let us look at some of the prices in detail: During the war the prices fixed were for, bars, $2.90 per hundred; shapes, $3; plates, $3.25.

The prices fixed by the War Industrial Board in March, 1919, were, bars, $2.35 per hundred; shapes. $2.45; plates, $2.65.

Present prices are: bars, $1.75 per hundred; shapes and plates, $1.85.

The award of $47 per ton for rails still holds and there is an interesting fact in connection therewith. The orders for rails for 1921 were placed last fall without price or a price to be fixed by the Corporation in December. Railroad officials expected a rise but there was none.

It is this $47 per ton for rails that seems to stick in the crop of the critics. We are told that it is too much, but no analysis is offered to prove the statement and comparisons are made with pre-war prices. Let us see!

Wages were advanced to 140 per cent above pre-war rates, and have since suffered two reductions so that they are now about 91 per cent above those rates. Transportation has advanced about 38 per cent. Then inasmuch as the makers must haul 7 tons of raw material for each shipment of 4 tons, this increased rate adds about $4 to the cost of each ton of steel. Add to this, the increased cost of limestone and coal with the Federal tax burden on top of that and there is probably not much of a margin left in the $47. This is a surmise, but it does seem reasonable.

Now in the matter of wages, the Corporation is between the devil and the deep sea. One party decries it for not cutting wages; the other for not raising them. As a matter of fact, it is following the middle course of not reducing wages faster than the drop in the cost of living will warrant, and reductions thus far made, have not affected those receiving the lowest wage, so that according to the report of the Labor Board in Washington, the unskilled laborer in the employ of the Steel Corporation is the best paid man of his class in the country.

In short, since the armistice was signed, the Corporation has made four reductions in the prices of its products, totaling approximately $23 per ton. In the meantime wages have not been reduced correspondingly; freight rates have increased about 40 per cent. and coal, ore, limestone and other materials entering into the manufacture of steel have increased nearly $8 per ton. All of these items show an increase, over pre-war costs, of more than $20 per ton, and that, therefore, relatively speaking, prices are really lower than they have been at almost any time in the last twenty years.

This is in accord with a statement made by Mr. Eugene G. Grace, president of the Bethlehem Steel Corporation that:

"With steel prices relatively at the lowest point in 20 years, it is evident that the steel interests have done their full share in liquidating values to a point where business should go forward, provided other conditions are similarly adjusted."

With these conditions before us, and while we may wish for lower prices and feel confident that they will come, it does not seem that the articles in *Industrial Management* warrant us in placing much, if any, of the burden of the present depression on the Steel Corporation.

What Is the Matter with the Patent Office?

Attention has been called time and time again to the deplorable condition of affairs in the Patent Office. It seems a singular anomaly that this important branch of governmental service, and one of the very few that produces a considerable financial surplus, should be, generally speaking, several years behind with its work. Everybody admits that the trouble arises from a shortage of employees. The surplus money is needed for other purposes, and the inventors must wait. There is a bill before Congress this year and it will likely be passed. It is similar to a bill passed in the lower house last year. The fault must consequently be in the Senate. Too much thought is said to be fatal to action. It seems to us that too much talk is also deadly. But both houses invariably find time and money also to appoint innumerable and costly commissions overlapping each other and producing next to nothing.

Whatever the reason for the utter neglect of the crying needs of the Patent Office may be, certain it is that none of this is in the slightest degree the fault of the Patent Office. On the contrary, the inadequate and ill-paid staff is doing more than can fairly be asked to deal with an overwhelming mass of difficult work. About 50,000 applications for patents are awaiting action by the Patent Office at the present time. In 38 out of the 47 divisions of the applications filed during the year 1920, not one has been reached for action. Since nearly all patent applications must be acted on several times before determined by the grant of the patent or final rejection, the delays thus indicated are serious. In addition to injustice to the inventor, it is becoming not uncommon for those who have made investments to find that they have unwittingly become infringers of a patent which has long been delayed on an application in the Patent Office. And the effort of the office to handle with an inadequate staff an overwhelming mass of work necessarily results in grants after insufficient investigation, or unwarranted rejections, with the consequent unnecessary litigations and injustices.

Referring again to the bill reported on favorably in the lower House, and known as the Lampert bill, it is gratifying to observe that the Federal Trade Commission section which was incorporated in the Nolan bill and which prevented its passage in the Senate in the last session, has been omitted from the present bill, which otherwise closely parallels the Nolan bill.

The Lampert bill provides for about fifty additional employees in the Patent Office at Washington and for an increase of approximately $500,000 in the Patent Office appropriation. This will greatly relieve the serious condition due to the resignation, on account of inadequate compensation, of over 100 examiners and over 150 of the clerical force in the past sixteen months.

Under the Lampert bill there will be increases in the salaries of the examiners, commissioners, and clerks ranging all the way from $150 to $2,300, according to the character of the work performed, and there will also be various modifications in procedure made necessary by changing conditions during the last few years.

The National Agreements

The National Disagreements would be a better title for the rules and regulations affecting much of the duties expected of railroad men generally and those employed in the mechanical department particularly. Many of the agreements were made in the last century, and in the more recent closing days of Federal control of the railroads a conglomeration of ill-digested details were added. The new regulations are, however, not without merit. An attempt was made to point out what a railroad man should do as well as what he should not do. They were repudiated by the Labor Board and then the Board changed its decision and re-established them again. Vacillation of this kind, to say the least, is tantalizing. The question naturally arises —what are we to expect next? In all likelihood the same Board will reverse itself again. Somersaults may be entertaining in a circus, but they are out of place when performed by a judicial body.

Not only so, but the established regulations of many years standing cannot be lightly set aside in a moment, neither can a new and strange variety of regulations be added in a day and assume a concrete place until they are fairly tried during a probationary period, and if some new and untried regulations are found to be a menace to that spirit of good-will that should exist between employer and employee, they should either be modified or abolished altogether.

There has been, as we have pointed out before, an over-statement or exaggeration of both sides of the case before the Labor Board. The railroads can command the services of lawyers more accomplished than the members of the Labor Board will ever likely become. The labor unions have also masterly representatives who have accomplished much in the past and who are sharpened by experience, and who having come through trial to a certain amount of triumph, may be relied upon as being able to hold their own in any controversy regarding the things which they know.

Like interested spectators, while we are endeavoring to sense the situation, we would deem it presumptuous to offer advice. We know that the representatives appearing before the judicial bodies are in deadly earnest. So is the expectant public. Our hope is that the railroads will soon be in the position promised by legislation enactment when a liberal profit will not be a rainbow promise vanishing in a storm, but a necessary and tangible fulfillment. And to this we might add another hope, that has become crystallized into an assurance, that we will never again see railroad men living and moving and having their perilous being in muffled misery as the result of ill-requited toil.

New Railroad Labor Agreements

The *New York Journal of Commerce*, commenting on the labor problem, states that the current advices to the effect that important preliminary progress has been made by the railroads in the matter of negotiating individual agreements with their men will be received with approval by the business community. Selection by the workmen of individuals to represent them in the conference with officials of the carriers is apparently progressing smoothly. The managements, too, are reported to have drawn up definite plans of procedure which should serve to expedite the work of actual negotiation. Large tasks lie ahead, however. The formulation of contracts which will at once assure labor a square deal and the roads economic conditions of operation is likely to prove a difficult task.

Only about thirty days remain for the completion of this work. Whether or not it can be accomplished in a satisfactory manner in that length of time will depend in no small measure upon the spirit of good will and moderation with which each side enters negotiation. Unreasonable demands by either party would result in lengthy disputes and probably in further wrangle before the Labor Board. The occasion is one which calls for frank and full co-operation.

The Canadian Northern

Lord Shaughnessy, chairman of the Canadian Pacific System, expressing his personal view of the railway problem in Canada, and declaring for a consolidation of all of the Canadian railroads into one big system, in the portion of his statement referring to the Canadian Northern System, said that it was by over-expansion made a hopeless proposition. Without wishing to criticize the policy pursued by the company it is evident that the future of the property was founded on the assumption that the prosperity and expansion which Canada enjoyed for a period of eight or ten years would continue indefinitely, and the mileage of the system was increased year by year until the annual interest charges of the company reached a sum out of all proportion to present or prospective revenue. Had the promoters confined themselves to the territory between Lake Superior and Edmonton their venture would have been of advantage to the country and profitable to themselves, but their exploits east of Port Arthur and west of Edmonton were untimely and disastrous. It became clear that the company must collapse unless kept alive by very large grants from the public treasury. For this there could be no justification, and the only other alternatives for the Government were to permit default and liquidation or to take the property over under the terms of the Act of 1914. The Dominion Government, having become a partner in the enterprise by accepting 40 per cent of the share capital at a cost to the country of $57,000,000 in subsidies and guarantees, and being guarantor of the company's securities to a large amount, default and a receivership would have had their disadvantages. While it is probable that in the circumstances the country's interests were best served by the acquisition of the property, it strikes one that the legislation relating to the transaction would have been the subject of less criticism had provision been made for the payment of a very substantial honorarium to the men who had devoted nearly twenty years of their lives to the establishment and development of the enterprise instead of the creation of a tribunal to determine the value of something that in the minds of the large section of the public was valueless.

With the ownership or control of the Intercolonial, National Transcontinental, Canadian Northern, and Grand Trunk Pacific lines vested in the Dominion Government, the Canadian people are now the proprietors of about 17,000 miles of railway, with a capital investment of say $850,000,000, and an annual interest charge of something like $34,000,000. In the annual interest charges nothing is included for the Intercolonial and Prince Edward Island Railways, because these have been with us for so long a period as unproductive and expensive property, nor for the National Transcontinental absorbed in the Consolidated Fund.

There is no rolling stock equipment nor are there terminal yards, freight facilities, repair shops or other requirements commensurate with a system of this magnitude, and the cost of providing them will be very great indeed.

Testing Locomotive Slide Valves

All that is necessary is for the valve to be placed over the steam port faces and the throttle opened; if no steam issues from the cylinder release locks the valve may be considered steam tight.

As the side valves have ⅞ in. of lap there is ample margin in placing the valve to cover the ports without having to resort to any fine movements.

In full gear the valve closes when the piston has travelled 75 per cent of its stroke; therefore the valve will close when the driving crank pin has reached what it is known as the "angle," either front or back, according to the direction that the engine is traveling.

This gives four recognized points or angles where the valve can be tested for steam-tightness, with the reversing lever in full gear.

At the half stroke of the piston the valve is central over the ports in mid-year; this gives two more recognized points, making six in all.

As it is possible to close the valve of a locomotive in any position when the driving crank pin is between the two top angles or the two bottom angles by manipulating the reversing lever, the six recognized points need not be adhered to.

It is considered, however, if there is any preferred position, the angle is the better one than on the top or bottom quarter, for the reason that by reversing the lever each valve is closed in turn and any defect can more readily be recognized, should same exist.

Scored valve faces are the commonest causes of slide valves blowing through. When this occurs a distinct squeal is heard in the steam chest and the only point then to determine is to which chest contains the defect.

In practice an engineman can easily distinguish a slide valve blowing through when the locomotive is at work, and testing is only necessary for confirmation purposes.

In testing piston valves for steam tightness a little more is necessary. The valve being constructed in the form of circular discs working in a cylindrical steam chest, has rings sunk into the valve heads to render them steam tight. There are two rings on each head, commonly known as the admission ring and the exhaust ring, the former being on the side of the admitted steam and forms the valve lap, the latter being on the side of the exhaust steam.

When testing the valve for steam tightness in the ordinary way with the valve central over the ports, the admission ring only is being tested. As there is no internal lap on locomotive slide valves when the valve is central, the exhaust ring is standing over the steam port and the edge of the ring and the edge of the port are line and line. Therefore to test the exhaust ring it must be placed over the steam port bridge. This is done by placing the engine into gear on the top or bottom quarter and applying steam. If defective the steam will pass through to the exhaust and steam would issue from the cylinder cock at the opposite end to that which live steam was being admitted.

In running a defective exhaust ring would cause a blow through to the exhaust from the point of admission to the point of cut off, which is an easy matter to detect.

The Government's Plan

The plan to empower the War Finance Corporation to invest somewhere near $500,000,000 in the funded obligations of railroads, held by the Federal Railway Administration, aims to supply from the proceeds of this investment money needful to the payment of sums owing to roads on various scores under the Government war lease. President Harding presents this plan, and asks Congress to authorize it, as a simple means of settling the Government's debts to the roads. Its simplicity consists in its making use only of means which stand ready at hand. It adds ease to simplicity, since it obviates the need of raising extra money to pay the roads with. All is to come out of a sum of money already in the War Finance Corporation's control.

Like many simple and easy ways out of difficulty, this one presupposes a correct judgment on intricate matters. It requires that the War Finance Corporation have the requisite millions at its actual disposal in cash form. It demands that the obligations of the railroads bear the character that permits of the placement of this corporation's money in them, without too wide diversion from the money's original or now controlling purposes.

If it needs only authorization by Congress, and nothing else obstructs the transaction, the Administration deserves credit for devising a most effectual plan for dealing with the roads. Many had reckoned it likely that the Government would have to raise new revenue in order to meet its railroad bills. Wherever it was to come from, an appropriation, at the least, seemed needful. The scheme of pouring the Railroad Administration's holdings of railway obligations into the War Finance Corporation's vaults, and the money from those vaults reversely into the Railroad Administration's hands and thence to its creditors, does away with revenue bills and appropriations.

Snap Shots—By the Wanderer

Who is right? Who is following the proper course? When the doctors disagree, who is to decide? Hardly the layman who, familiar as he may be with conditions in general, cannot possibly know all the ins and outs, the by-ways and the influences that go into the formulation of a decision. This much is purely speculative. The grasping of a puzzled mind. But the layman comes back to the question of why there should be such a wide difference in the policies of railroads in matters that do not involve any great amount of risk. For example, I know of two roads, competitors; having terminals in the same cities that are as different as black and white in all matters relating to little things, whether they differ at all as to big things I cannot say. But to take a very little thing as an example. If an employe of the A. B. C. railroad designs any special contrivance or tool and it is put into a satisfactory use in any shop of the road, its construction and use, with the name of its designer is sent to every other shop. It is shown to every caller and should that caller be, even as you or I, an occasional scribe, he is invited to make it public and show its merits to the world. Publicity, great publicity is the cry. It shows that we are awake, that we are trying to do our little best for the betterment of the service, and the more we cry it from the housetops and show what we are trying to do the better it will be for us. And if we name names and tell who is responsible for the device or scheme, the more the individual employe will be encouraged to help and use what initiative they have for the general betterment of the service and interests of the road.

At the X. Y. Z. everything is placed at our disposal quite as much and with the same apparent freedom as on the A. B. C. Drawings of everything, to the last detail, are furnished on request; but, and this is a but with large and flaming letters, it is with the distinct understanding that it is for our personal information. We are quite welcome to all that has been given, but, under no consideration, must the name of the road be mentioned or the source from which the information was obtained. The name of the originator is to be buried and forgotten in the archives of the company and his sole reward is to be in the consciousness of a deed well done.

Which is the better way? Which productive of the best results? As an interested party, I am in no position to decide. I leave it an open question to those who ought to know.

There was once an old saying, now grown into disuse in these days of advanced youth and skirtless bathing suits, that it was line upon line and precept upon precept that should serve to guide the young and inexperienced in the way that they should go. But the person who persists in applying this line upon line policy is apt to be voted a bore, and when once voted a bore your period of usefulness is at an end. But the spirit of reform is so strong upon me that I must talk, even at the terrible risk noted above. Years ago Mr. Appleyard put the long wide parcel rack on the New Haven. It was modeled after the big luggage racks of European cars and had a capacity almost equal to the reception of a steamer trunk, and many is the traveler who has risen up to call him blessed even though his name is unknown. Its adoption has been slow, very slow. For thirty years or more it has been a shining example to car builders' of what ought to be. And my plaintive cry is, why isn't it? It has become an almost, if not quite a personal, plea. The man with a large satchel in the ordinary coach is an unmitigated nuisance in the absence of the big rack. To him who travels much and where parlor cars are not available, the big rack is a necessity to mental and physical comfort. A man put himself beside me the other day with a big, black satchel and a dress suit case. He couldn't help it; the car was full. So we each sat with doubled knees because the parcel racks were too small to take a lady's reticule. We were both as uncomfortable as possible and I, at least, was wondering why this great railroad, so progressive in all other matters, should have so overlooked the parcel rack. I have known roads where the big rack was used on all cars except those assigned to commuter trains. May heaven forgive such an error of judgment. If ever there was a car that needed luggage accommodation, it is the commuter's car.

There is an old proverb about giving a dog a bad name that seems to stick and hang to the railroads despite all efforts to do away with it. Surely the sins of the past must have been very great, or it is only that the hue and cry has been so loud and persistent as to drown all other sounds, and leave the culprit running for his life and freedom and no chance to defend himself. It really looks that way. But the strangest cry that I have yet heard is that accusing the railroads of a deliberate attempt to ruin competing canals. It is probably axiomatic that the canals have been ruined because of railroad competition. They simply could not meet it. But it so happens that I have traveled and lived along the lines of a number of abandoned canals and have listened to the tirades, of the dwellers in those parts, against the railroads. Take for example the Chenango, Morris & Essex, Delaware and Hudson and James River, to say nothing of the Erie that would have been utterly abandoned by now had not the good people of New York been hypnotized by the desire for a great waterway to the lakes and built the barge canal.

But all along the lines of these relics of the past there are more men than a few who long for the good old days of the mule, the raging waters of the long ditch and the gentle ripple of the passing barge and vehemently declaim and prove, though I have never been quite able to follow their line of reasoning, that by some chicanery business has been taken from the canals so that the railroads might rob the public for the benefit of the controlling magnates. It is not quite clear how this piece of commercial legerdemain was accomplished and it matters little so long as there is a numerous and talkative element of the community that believes it.

It is not much and if it were the only thing, it could be disregarded, but it is one and a festering element in the anti-railroad agitation. Just remind yourself of the old rhyme of little drops of water and little grains of sand and then remember that this is still a troublesome and, for a drop, a turbulent one. And it persists in spite of the fact that, under ordinary commercial conditions, water communications cannot compete with rail.

Witness, for example: The Hudson, Ohio and Mississippi. There was a time when the Hudson was crowded with steam and sailing craft. The shores were lined with the homes of river boatmen who owned and sailed a fleet of sloops and schooners that numbered hundreds. They gave way first to the towed barge and now the latter is becoming a rarity in the face of railroad competition on each bank. Here is a deep navigable tidal estuary, one hundred and fifty miles long, whose traffic is mostly tourist traffic. Of course it handles some freight, but compare its tonnage or passenger lists with those of the railroads! The latter have undoubtedly killed the river trade and I have even heard it urged that it was through underhanded methods that this was done.

Ye who sow the wind will reap the whirlwind, and we of the enlightened United States of America are reaping a whirlwind of ignorant and unreasoning prejudice as a result of the windy anti-railroad agitation of the last two decades.

It is a decrease that is very readily diagnosed as to cause, but the finding of the remedy or preventative for the recurrence of the trouble is quite another matter and may well tax the ability of all right-thinking men to the utmost and for some time to come.

New Powerful Switching Locomotives for the Illinois Central Railroad

Among locomotive orders recently completed, one of the most interesting calls for 25 switchers of the 0-8-0 type, which have been built for the Illinois Central Railroad by the Baldwin Locomotive Works.

These locomotives are closely similar to the United States Railroad Administration standard 0-8-0 A type, the principal difference being the width of the firebox which in the United States Railroad Administration locomotives is 66¼ ins. and in the Illinois Central's 72 ins. This necessarily increases the firebox heating surface and the grate area which in the new engines are 195 sq. ft. and 51.2 sq ft., respectively, as compared with 190 sq. ft. and 47 sq. ft. in the U. S. R. A. design.

The new switcher has a straight top boiler equipped with a superheater of 36 elements, having a heating surface of 658 sq. ft. An arch is installed in the firebox on three 3-in. tubes. The ash-pan has a single hopper of large capacity with a sliding bottom. The slide is a substantial casting that will not warp out of shape and the sides of the pan are sloped sufficiently to render it self-cleaning.

Baker valve motion, with bushings of bronze, is applied and controlled by a Ragonnet type "A" power reverse gear.

The main frames are five inches wide, with double front rails of forged iron. These rails are secured to the front bumper by a short deck plate of steel, which is cast in one piece with the bumper brackets.

The gibs and wedges, piston packing rings, cross-head gibs and cylinder bushings are made of gun-iron.

The cab is of steel construction with a roomy deck and large side windows and is equipped with steam heat.

The tender has a capacity for 8,000 gallons of water and 12 tons of coal. The tender trucks are of the 4-wheeled type with cast steel side frames.

The principal dimensions of these locomotives are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 25 ins. x 28 ins.; valves, piston, 14 ins. diam.

Boiler.—Type, straight top; diameter, 80 ins.; thickness of barrel sheets, 23/32 in.; working pressure, 175 lbs.; fuel, soft coal.

Firebox.—Material, steel; staying, radial; length, 102⅛ ins.; width, 72 ins.; depth, front, 75½ ins.; depth, back, 73½ ins.; trickness 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, 5 ins.; sides, 4½ ins.; back, 4½ ins.

Tubes.—Diameter, 5½ ins.; material, steel; thickness, .148 in.; number, 36; length, 15 ft. 0 ins.; diameter, 2 ins.; material, steel; thickness, .125 in.; number, 230; length, 15 ft. 0 ins.

Heating surface.—Firebox, 195 sq. ft.; tubes, 2,569 sq. ft.; firebrick tubes, 18 sq. ft.; total, 2,782 sq. ft.; superheater, 658 sq. ft.; grate area, 51.2 sq. ft.

Driving wheels.—Diameter, outside, 51 ins.; diameter, center, 44 ins.; journals, main, 10 ins. x 12 ins.; journals, others, 9 ins. x 12 ins.

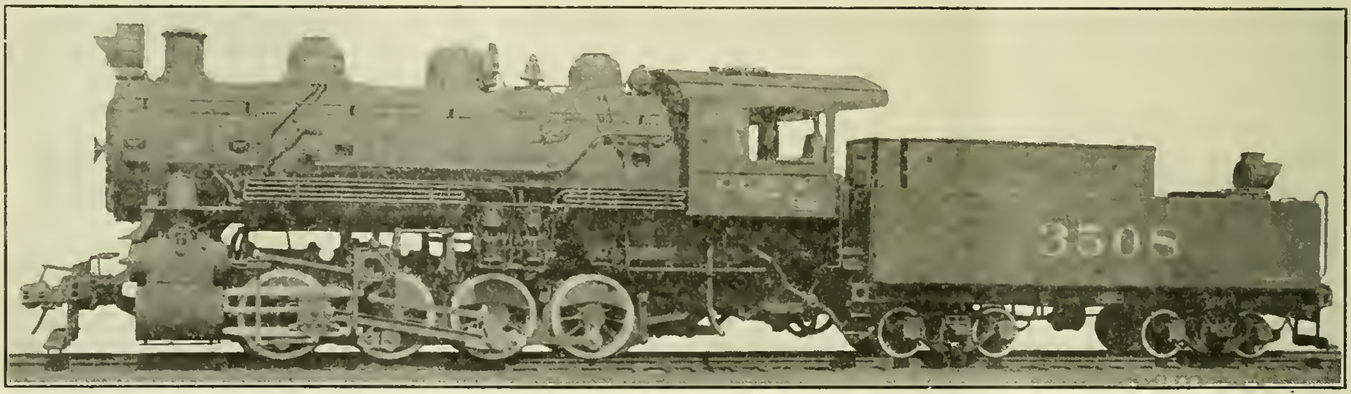
Wheel base.—Driving, 15 ft. 0 ins.; rigid, 15 ft. 0 ins.; total engine, 15 ft. 0 ins.; total engine and tender, 53 ft. 3½ ins.

Weight.—On driving wheels, 221,700 lbs.; total engine, 221,700 lbs.; total engine and tender, 380,000 lbs.

Tender.—Wheels, number 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 8,000 U. S. gals.; fuel capacity, 12 tons.

Tractive force, 51,000 lbs.; service, switching.

The engines are among the most powerful of their class, and their services are said to be a great improvement both in the important element of economy in operation as well as in the saving of time in the constantly varying kinds of service.



SWITCHER 0-8-0 TYPE LOCOMOTIVE FOR THE ILLINOIS CENTRAL RAILROAD—BALDWIN LOCOMOTIVE WORKS, BUILDERS

Electro-Mechanical Train Stop

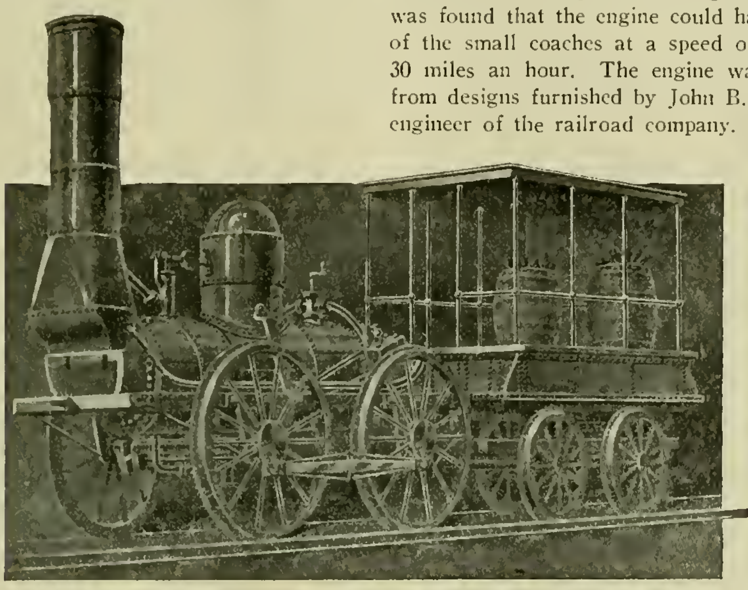
Experimenting with electro mechanical train stops among British engineers has developed something nearly the same as is already in use in America. A shoe under the engine is raised by contact with a ramp on the track and by mechanical connections moves a stop which normally holds the brake valve, which is thus released to apply the brakes. In the connections is a toggle lever, one arm of which is under the influence of an electric solenoid, and if electric current is also collected from the ramp, as should be the case if the signal is clear, the solenoid is energized to stiffen the toggle, and thus to hold the stop in opposition to the brake valve, notwithstanding that it would otherwise be moved out of the way. Consequently, though the brakes tend to be applied mechanically at every ramp, they are held off if electric current is also received. This is at distant signals, but at a stop signal a higher lift, or the striking of a trigger by wings on the ramp, causes the brakes to be applied without possibility of release until the train has stopped. Here also the passing of an electric current prevents the brakes being applied.

Aluminum in Car Construction

The many uses to which sheet aluminum may be put has been the subject of recent engineering experiments. It is pointed out that the metal's outstanding properties are, of course, its lightness, its virtues in chemical action, its durability and malleability. These characteristics render aluminum suitable for various parts in car construction, including panels, nosing and beading, window frames, ventilators and other appliances. Some progress has already been made in the directions referred to, and an extensive development in the near future may be confidently looked for in railroad and other service.

The Locomotive "De Witt Clinton" Runs Again

The first locomotive operated in New York State, drawing its original train of three old-fashioned coaches, and in the presence of thousands of spectators, after being taken from its exhibition platform at the Grand Central Station, made a run of about a mile from 96th street to 116th street, New York. With seats on the roof of the coaches, each coach held nine persons. The men and women passengers wore the costumes of 1831, and the "De Witt Clinton" made about the same speed as it did ninety years ago, traversing the one mile in nine minutes.



THE "DE WITT CLINTON" LOCOMOTIVE BUILT IN 1831

In marked contrast to the interesting relic of the last century, and for the purpose of drawing attention to the great advance in railroad equipment, a modern high-powered Mogul, built in 1916 and longer by several feet than the entire train of the relic, made the run on a track parallel to the one used by the De Witt Clinton. The occasion for the display was the official starting of the earliest railroad train of New York to Chicago, where it is now on exhibition at the Pageant of Progress, being held from July 30 to August 14.

As is well known among railway men the De Witt Clinton was built at the West Point Foundry and was conveyed by towboat to Albany on July 25, 1931. On July 27 it was placed on the road, then recently completed and known at that time as the Mohawk & Hudson River Railroad, which later became part of the Hudson River Railroad. The locomotive weighs four tons, and is a four-wheel engine, the drivers being 4½ ft. in diameter, with cast iron hubs, spokes turned and polished, with wrought iron tires. The two cylinders are 5½ in. by 16 in. set at the sides of the firebox at an angle of about 30 deg. to inside cranked axles on the leading pair of wheels. The wheels are connected by side rods in the form of double trusses.

The boiler is of the horizontal type and has a large dome that overshadows the rest of the engine. The boiler had 30 copper tubes 2½ in. in diameter and 6 ft. long, and was fed by pumps operated vertically by a bell crank. The firebox had two doors, one above the other. The steam pressure was set at 50 lbs. per square inch. When in good working order it was found that the engine could haul five of the small coaches at a speed of about 30 miles an hour. The engine was built from designs furnished by John B. Jervis, engineer of the railroad company.

One-Man Cars in America

A notable step in the development of the one-man principle on street railway electric cars in the United States has been taken at Seattle. In this city, where one-man operation had previously been confined to "safety cars," this method of working has now been extended, on the municipal system, to large, double-truck cars hitherto worked by two men.

According to an article in the *Electric Railway Journal,* of New York, this plan of operating some of the larger vehicles has been adopted with only slight changes in the arrangement of the cars, costing about $100 per car. These changes included permanently closing the rear entrance door and connecting the rear exit door in such a manner that the operator at the forward end has control of it. This was accomplished by running a rod the entire length of the car just under the left-hand sill and making proper connections with the door levers underneath the car step. The motorman's cab on the left-hand side of the front platform was removed, and the sand-box formerly located there was moved inside the car and placed under a seat. The bulkhead door at the front end was widened to 44 ins. The controller, operator's seat, and air valves were rearranged, and air sanders, rear door operating mechanism, and a gear-wheeled type of hand brake installed at the left of the operator.

In general, the *Journal* says, the plan embodied the changing of the single-end, rear entrance, and rear and front exit two-man car into a front entrance, rear exit, single-end, one-man car. The over-all length of this type of car is 49 ft. and the width 8 ft. 7 ins. There is a seating capacity of 60. The motors are two Westinghouse 310-C. Twenty-seven cars of this class have been converted for one-man operation, and have been running since March 1. The trainmen are said to be well pleased with the arrangement, and no complaints from the public have been received.

New Design of Steam Tractor.

A new design of truck or tractor, the work of Dr. H. O. Baker, is in operation, and is applicable to any 2-ton capacity vehicle. The engine, which is housed in a casing extending forward from the back axle, operates on the uniflow principle. Slide valves are worked by link motion, and the feed water pumps are driven off the engine shaft, so that when the engine is free, water supply can be maintained when the car is stationary. The condenser is placed at the front of the bonnet as is the radiator in a petrol car, and is instrumental in the prevention of scale formation. The boiler, which is placed at the front under the bonnet, consists practically of a series of coils of drawn steel tubing.

Employment Bureau of the Federated American Engineering Societies

The wide and varied field of engineering activity has created the need of some great clearing house of engineering services from which engineers of any specific qualifications may be obtained. In recognition of this want, the Federated American Engineering Societies, has established at 29 West 39th street, New York, an employment bureau for engineers of every variety of training and experience. Applicants must be members and submit a complete educational and professional record which is carefully classified, so that as the special requirements of any position are received. The relatively large number of men with whom the Bureau is in touch, the comprehensive classification of records, and the fact that the services of the Bureau are free to employer and member alike, renders possible the selection of the right man for the service required. Negotiations may be confidential if desired. The high standards required for membership in any of the member societies insure the quality of men available and the Bureau will welcome inquiries from those seeking to build up or expand their engineering organizations in preparation for the increased activity now manifest.

Battery Locomotives

At the conference of British Civil Engineers, held recently, the subject of electric locomotives was discussed at great length, and among other views the opinion was strongly expressed that the quill type of electric locomotive was that which best met the problem of the high-speed electric locomotive. The quill type utilized the space available between the wheel flanges quite as fully as would ever be necessary for locomotives such as were required in that country. It was thought that this type also made the center of gravity sufficiently high, perhaps not as high as might be desirable but sufficiently high.

The New York Central armature type of engine they were that not so sure about. They thought it involved too many axles, and presented difficulties in connection with the spacing of the axles and the framing of the engine. Also the wheels seemed too small for good driving, and the center of gravity was distinctly too low. The rod locomotive seemed to be an inversion of progress. Its advantage was that it put, as Sir John Aspinall said, the motors upstairs, and made them more accessible, and raised the center of gravity, but it had the disadvantage of transferring reciprocating motion to rotating motion and back again. There was no doubt this type of locomotive could be made to operate, but the rods tended to lock each other, and to impose heavy stresses, which were bound to be a disadvantage both as regards maintenance and consumption.

In regard to electric shunting locomotives it was claimed that they may be either operated from overhead wires or from a self-contained battery. Certain limitations imposed by the battery roughly define the respective spheres. Generally speaking, battery operation is most suitable for yards where the work is moderate and fairly uniform, especially where fairly long lengths of infrequently worked siding are involved. In such cases battery locomotives will economically replace horse or capstan shunting. A probable field for battery traction on electrified main lines is that of working way-side sidings with a battery tender to supply the main line locomotive. Some branch lines may be worked economically with battery locomotives. Shunting in large goods yards will probably be best effected by locomotives combining overhead conductor with battery supply, the battery dealing with the lightly worked sidings. Where the obstruction of an overhead wire is objectionable, as on quay sides, battery operation is the only form of electric traction possible.

Supply by battery alters for the worse the operating characteristics of an electric locomotive, especially as regards overload capacity. Straight battery working is not suitable for heavily worked sidings, or those out of which an occasional heavy lift has to be made, and the same applies to lines having heavy gradients, or that at certain hours require specially heavy trains to be handled. In such cases overhead conductors should be used; undue increase in battery capacity and weight, or the provision of special types, prohibitively enhances costs. Mid-day boosting charges are adverse to the life of all batteries of whatever type.

Many existing sidings where locomotive operation may be contemplated are equipped with turntables. If it is, as it may be, impossible to substitute points for these, a capstan may be fitted to the locomotive, so as to enable it to pass over such turntables and into the sidings they serve.

A Universal Moulding Machine

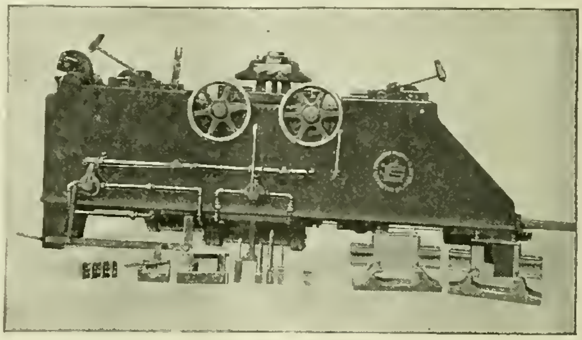
The use of moulding machines has become standard practice where large quantities of the same type of castings are required, but it is not so well adapted to the ordinary foundry where a wide range of work has to be carried out. In such cases a series of several machines may be necessary to meet all the conditions; and this expense is not justified except in large foundries. To meet the needs of the small foundry with a varied demand, an adaptable moulding machine has been introduced which can be quickly and easily adjusted to take moulding boxes and pattern plates of any size within a comparatively wide range. The machine is portable, and is operated entirely by hand power, so that even the smallest foundry would find it a good investment.

Improved Arc Welding

A new arc system of welding is now being employed by several companies who report that it effects maximum savings in the cost and time of manufacture and repair of metal parts. Uniform success is said to attend the welding of metals of various characteristics, such as cast, malleable and wrought iron, cast and rolled steel, bronze and brass, etc. The new system is the only one, so it is claimed, producing constant heat per unit area in the weld due to the following points: 1. A limited low voltage output from the generator which prevents injury from high voltage and assures a short arc. 2. Maintained constant current supply to the welder. The current flowing through the electrode is the same whether the current is short-circuited or flowing in the form of an electric arc. 3. Welding metals so designed that they furnish the required ductility and tensile strength within practical limits of metallurgy which is so much to be desired.

Air Brake Signal and Steam Hose Dismantling and Assembling Machine

The accompanying illustration shows a new development in railroad shop appliances for dismantling and assembling hose. Many railroad shops are not so well equipped as they should be with appliances for this work. With ordinary shop tools very frequently clamps are distorted, strained, cracked or broken. The "Covington" machine eliminates any possibility of injury to the attachments, and all hose fittings including the clamps are recovered, and a much better assembling job is turned out than can be done by hand assembling, besides the labor saving in comparison with other methods. In this regard it may be stated that on a test one man dismantled 100 air hose within an hour and assembled 25 air hose ready for service in one hour. Any man of average intelligence can become expert in the use of machine within ten days.



AIR HOSE DISMANTLING AND ASSEMBLING MACHINE

The entire equipment of tools for the complete range of work is shown in the illustration. To change from one operation to another requires less than two minutes. The operator naturally would dismantle all air and signal hose before commencing on other kinds of hose. Air and signal hose are handled by the same tools, except the nipple puller, which can be applied in ten seconds. To change from air and signal dismantling to steam hose dismantler requires less than one minute; to equip machine to strip short ends of air signal hose, less than three minutes; from air and signal to steam short ends, less than one-half minute. To change from dismantling to assembling requires less than one-half minute. Any hose in any condition can be dismantled even if cut off close up to fitting, bursted steam hose, cut or torn hose, any and all can be successfully handled with the "Covington." In assembling fittings into new hose no possible injury can result as hose are held rigid without clamping ready to receive fittings as shown in illustration.

The machine is manufactured by the Covington Machine Company, Covington, Virginia. The materials and construction are of the best and the reports in regard to its operation are of the most gratifying kind.

Notes of Interest on Foreign Railways

Steam Turbine Driven Locomotives

Latest advices report that, on the Swiss Federal Railways, trials are now being made with a steam turbine-driven locomotive. The turbine is located transversely across the front end of the boiler and drives through a suitable reducing gear upon an idler-shaft located above the bogey and connected to the coupled axles by means of coupling rods. The speed of the turbine is 8,000 revolutions per minute, the gear reduction being such that the speed of the locomotive on the track is as high as 50 miles per hour. The boiler is provided with a super-heater and a condenser is fitted below the boiler. The water is conducted back again to the tender of the machine which is arranged in such a way that the water can trickle down from the roof of the tender in fine streams, thus providing for an effective cooling of the water. The locomotive is not provided with a blast pipe and for this reason induced draft has been provided by means of special ventilators. It is reported that this locomotive showed a fuel economy of 25 per cent as compared with compound locomotives of similar size.

Railway Development in Japan.

The survey work preparatory to the long contemplated plan of constructing a submarine railway tunnel between Shimonoseki and Moji is completed and the tunnel will be opened to traffic within seven years, but under the present unsettled labor conditions of the world, including that of Japan, this estimate can be but vague. According to the latest investigations, the total mileage of the State railways in Japan is 6,040 miles. In addition, there are 127 private lines, including 126 light railways and one standard gauge steam railway. Their total mileage is 1,820 miles. Thus, the total mileage of railway lines in Japan is 7,860 miles. It is stated that government railway extensions in the near future will include eight new sections, 130 miles in length, to be completed this fiscal year, which will bring the total mileage of the State lines to about 7,990 miles.

Railway Work in Germany

Reports from Germany state that while a large number of locomotives are in bad order there is considerable railroad reconstruction under way, and also new canal construction. In the great locomotive shop of the Krupp Works at Essen, heavy locomotives are turned out complete at the rate of one a day. In another shop wagons, or cars, are manufactured at the rate of eight a day. In still another building near by, five-ton motor lorries were being manufactured alongside of small motor scooters. At Dusseldorf there is located the Rhein Metall Fabrik. This plant has readjusted its operations from a war to a peace basis and today ranks as one of the first railroad rolling stock industries in Germany. In less than a year it turned out 1,000 locomotives and 1,000 freight cars, and its monthly production at the present time is 30 locomotives and 300 freight cars. This concern also has more men on its payroll today than before the war and, like Krupp's, is executing a large volume of foreign orders.

French Railway Places Order with Westinghouse

An order for electrical equipment amounting to $1,200,000 has been received by the Westinghouse Electric International Company from the Midi Railway of France. The order includes transformers, synchronous condensers, lightning arresters and other substation equipment.

The Midi Railway operates an extensive system starting from Bordeaux, running through Toulouse to Cette, with many branches. The section on which the Westinghouse equipment will be used extends from Pau to Toulouse in the Pyrenees Mountains near the Spanish border. The line passes through Tarbes and St. Gaudens, and has a total length of over 100 miles.

Germany Utilizing Peat.

The scarcity of coal in Germany has called into notice the available deposits of peat as a substitute for fuel. The scheme involves building five large electricity generating stations for peat firing, situated along the north coast of Germany, and connected to a 150,000-volt power distribution network extending over the whole of Germany. It is assumed that the peat is burned under boilers, as its utilization for producing gas for driving gas engines has not been found to be economical, owing to the large percentage of moisture contained in the peat. It is estimated that the deposits of peat in Germany would suffice to run all the public electricity works for 150 years or the railways of Germany for 220 years.

Electrification of the National Railway of Jamaica

A bill authorizing the electrification of 127 miles of the government railway in the island of Jamaica has been passed by the government, and proposals are on foot to borrow $7,000,000 for the purpose of purchasing the necessary equipment, besides taking over the traction and lighting system of Kingston, now owned by a corporation.

Railway Extension in China

A new railway has been opened in China, and known as the Pekin-Suiynan railway. It extends from Pekin 403 miles with projected extensions to the Yellow river district on one side, and the trans-Siberian on the other, and furnishes an opening through the rich districts of Kauru and Mayolia.

New Railway in Mexico

A new railway in Mexico is authorized by the Mexican Government running from Mazatlan, Sinaola, to Llano Grande, Durango, with a view to a more ready line of communication from Mexico to the Far East. It will unite the lines in the interior to the North Pacific Coast, and will be administered by the Government.

Electrification of the Chilean State Railway

Announcement has been made that the contract for the electrification of the Chilean State Railway between Santiago and Valparaiso, has been awarded to the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. The construction and installation will cost approximately four million dollars.

Switzerland Purchasing Electric Equipment

It is reported that the Swiss Railway Administration has approved the purchasing of 32 electric locomotives, and 24,000,000 francs has been voted as the limit available for the purpose. Considerable progress has already been made in the electrication of the railways, and it is expected that it will shortly embrace the entire national railway system.

Domestic Exports from the United States by Countries During June, 1921

Steam Locomotives

Countries	Number	Dollars
Canada	1	3,000
Honduras	2	10,000
Mexico	66	1,833,847
Cuba	1	31,436
Argentina	2	85,290
Brazil	18	406,665
Colombia	1	28,000
Peru	4	49,790
China	30	1,585,000
Japan	4	38,900
New Zealand	1	11,685
Philippine Islands	6	170,861
Total	136	4,254,474

The Traveling Engineer's Association

The Executive Committee of the Traveling Engineers' Association, has considered it necessary to defer annual convention scheduled to be held in Chicago, Ill., on September 6-9, inclusive. The general financial stress and serious business condition confronting the Country generally and the railroads particularly, has induced the propriety of postponement at this time.

It is arranged, however, that there will be a business meeting held at the Hotel Sherman, Chicago, beginning on Tuesday, September 6th, at 10 a. m., and special reports from the following committees will be considered:

1. Distribution of power and its effect on operating costs—Chairman, Robert Collett; D. Meadows, W. R. Garber, J. E. Ingling, C. A. Fisher.

2. Recommended practice for conservation of locomotive appurtenances and supplies.—Chairman, J. P. Russel; J. A. Mitchell, W. J. Fee, H. E. Reynolds, E. Von Bergen.

3. What are the advantages of the self-adjusting wedges, the feed water heater and devices for increasing the tractive power of the locomotive in starting and at slow speed.—Chairman, T. F. Howley, Frederick Kerby, Jno. P. Stewart, John Draney, J. A. Talty.

4. The best method of operating stoker-fired locomotives to obtain the greatest efficiency at the least expense.—Chairman, Joseph Keller; A. L. Bartz, William Lowney, James Fahey, F. L. Stockwell.

5. A comprehensive standard method of employing, educating, and examining engineers and firemen.—Chairman, J. B. Hurley; F. P. Roesch, J. C. Simino, Andrew Wheeler, C. W. Stark.

6. Operation and maintenance of oil-burning engines.—Chairman, J. N. Clark; J. C. Harris, H. H. Kane, E. F. Boyle, E. E. Cornish.

7. Committee on Revision of Progressive Examination for Firemen for Promotion and New Men for Employment.—Chairman, W. H. Corbett; T. F. Lyons, C. W. Corning, F. R. McShane, F. R. Melcher.

8. Committee on Subjects for Discussion at the 1922 Meeting.—Chairman, J. H. DeSalis; G. A. Kell, E. R. Bowen, F. P. Roesch, J. D. Heyburn.

9. Committee on Change of Constitution and By-Laws.—Chairman, B. J. Feeney; P. J. Miller, J. C. Petty, E. Hartenstein, S. V. Sproul.

10. Committee on Arrangements for Next Annual Meeting.—Chairman, W. O. Thompson; W. H. Corbett, G. H. Travis, J. W. Fogg, B. J. Feeny, L. R. Pyle, F. P. Roesch.

It is expected that W. E. Preston, president of the Association, will be present at the business meeting and that all of the above mentioned committees will have their papers in the hands of the Secretary, W. O. Thompson, General Offices, N. Y. C. R. R., Cleveland, Ohio, in ample time to have them printed and ready for action at the meeting, and that all other committees attend and be ready to submit their various reports.

President Rea, of the Pennsylvania, Celebrates His Fiftieth Anniversary

July 17 marked the fiftieth anniversary of the date when Samuel Rea, president of the Pennsylvania, entered the service of the company. He was then in his fifteenth year, and was engaged in engineering work in Morrison's Cove, Williamsburg and Bloomfield branches of the Pennsylvania. Latterly he was promoted to assistant engineer in charge of the construction of the chain suspension bridge over the Monongahela river at Pittsburgh, and from 1883 to 1888 principal assistant engineer, from 1888 to 1889 assistant to the second vice-president. In the early nineties he was appointed first assistant to the president, followed by election to the fourth vice-presidency, succeeding to the third, second and first vice-presidencies. In January, 1913, he assumed the duties of president of the Pennsylvania.

Mr. Rea has had charge of some of the largest railroad construction works, among others the Pennsylvania tunnels under the Hudson, the bridge over the East river at Hell Gate, and the Pennsylvania Station in New York City.

Electrification of Railways in France

The work of electrification of some of the French railways is reported to be progressing rapidly, the Midi company having ordered 50 new electric locomotives similar to those in use on the Chicago, Milwaukee & St. Paul Railway. The Orleans and Paris, Lyons & Mediterranean lines are also establishing electric equipment the power for which will be furnished by the waterfalls of the French Alps. Both projects are said to embrace track lines of over 2,000 miles.

Harnessing Tidal Power

In a recent issue of *Engineer*, there appears an analysis of the various methods of using tidal power, in which the author, Norman Davey, considers: (1) Single basin systems subdivided into (*a*) outward flow type, (*b*) inward flow type, (*c*) outward and inward flow type; and (2) two-basin systems consisting of (*a*) double basin type, (*b*) sump type. All these systems are of the water storage type. The float system is dismissed as having only theoretical interest, being a producer of small power only.

A Record Run

A special train running on the Missouri, Kansas & Texas regularly, hauled by locomotive No. 392, made a recent continuous trip of 1,024 miles from Waco, Tex., to Kansas City, Mo. The average speed of the train was about 40 miles per hour, and the engine was reported to be in excellent condition on arriving at Kansas City. The occasion was the movement of a special train carrying delegates and guests to the Shriners' convention at Des Moines, Iowa. The locomotive and train could have proceeded toward Des Moines, but the connecting line was not deemed as adapted to so heavy a train. The locomotive was a Pacific 4-6-2 type, having a tractive effort of 41,000 lbs.

English Changing Signals

The English railways are replacing the red roundels with yellow roundels in most distant signals, in order to remove the inconsistency now existing in the signalling systems that certain red lights do not indicate "stop." It is also expected that the new requirements in regard to new railways will lay down the rule that the front of the arm be painted in accord with the yellow light.

Locomotive Construction in France

In addition to the construction of our 600 locomotives necessary to maintain the equipment on the French railways, it is expected that by the end of the year, the quantity of new locomotives will be more than doubled, orders being on hand from South America and other countries, formerly largely supplied from British locomotive works.

Cypress Most Durable Wood

Cypress has the reputation of being the most durable of woods. It was much used by the ancients, and was employed in the original doors of St. Peter's, at Rome, which, on being removed after 600 years, were found to be perfectly free from decay.

New Re-chargeable Dry Battery for Hand Lanterns

Electric hand lanterns have not been heretofore more generally used by the railroads because of their high cost of maintenance, but a recent improvement, a rechargeable dry battery points to their more general adoption. This battery is designed for use in connection with the lantern manufactured by the Federal Electric Company of Chicago, cuts down the cost of maintenance and operation and gives trainmen or other night workmen a perfect light with absolute safety. The federal electric lantern after a test covering two years has proven its safety, dependability and durability, and the new rechargeable battery meets the requirements of those who would furnish their men a safe fool-proof light at a low cost.

Items of Personal Interest

Ernest O. Cook has been appointed storekeeper of the Santa Fe, with headquarters at Riverbank, Cal.

C. S. Roe has been appointed general manager of the Ocklawha Valley, with offices at Rodman, Fla., succeeding T. B. Bernard, resigned.

J. W. Johnston has been appointed general foreman of the Chicago & Rock Island shops at Ft. Worth, Tex., succeeding A. F. Davis, resigned.

G. E. Pryor has been appointed master mechanic of the Quanah, Acme & Pacific, with office at Quanah, Tex., succeeding L. E. Wingfield, resigned.

C. B. Daily has been appointed master mechanic of the Chicago & Rock Island, with office at Cedar Rapids, Iowa, succeeding G. M. Stone, transferred.

D. M. Swobe has been elected president and traffic manager of the McCloud River, with headquarters at San Francisco, Cal., succeeding J. H. Queal, deceased.

D. D. Briggs has been appointed master mechanic in charge of the mechanical department of the Alabama, Tennessee & Northern, with headquarters at Mobile, Ala.

G. H. Pinion, assistant purchasing agent of the Texas & Pacific, has been appointed general storekeeper with headquarters at Marshall, Tex., succeeding A. D. Walther.

J. S. Allen has been appointed division master mechanic of the Brownsville division of the Canadian Pacific, with office at Brownsville Junction, Me., succeeding E. Bowie, transferred.

J. W. Finch has been appointed general foreman of the Chicago & Rock Island, with office at Reno, Okla., succeeding F. D. Buckley, who has been appointed round house foreman at Elden, Mo.

F. T. Knight, locomotive foreman of the Canadian National Railways at Port Arthur, Ont., has been appointed locomotive foreman of the Grand Trunk Pacific at Sioux Lookout, Ont., succeeding W. H. Fletcher, transferred.

Ernesto Ocarranza Llano has been appointed director-general of the National Railway Lines at Mexico and assumed the duties of the position last month, succeeding Nicholas Procel, who had been filling the position temporarily.

J. E. Mailer, master mechanic of the Fort Smith & Western, with headquarters at Fort Smith, Ark., has been appointed superintendent of motive power with the same headquarters, and the position of master mechanic has been abolished.

J. McDonough, master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Fort Madison, Iowa, has been transferred to the Illinois division, with headquarters at Chicago, succeeding A. L. Beardsley, resigned on account of failing health.

J. Kornatser has been appointed road foreman of engines on the Chicago & Rock Island, with office at Shawnee, Okla., and appointments to similar positions on the same road are that of W. C. McCullough, at Pratt, Kan.; B. J. Bonner at Elden, Mo.; S. F. Hanchett at Des Moines, Iowa; H. T. Demsey at Estherville, Iowa; B. Strauss at Cedar Rapids, Iowa, and J. C. Rhodes at Trenton, Mo.

OBITUARY

John Findley Wallace

John F. Wallace, the eminent engineer, died at Washington, D. C., on July 3. Mr. Wallace was born in 1852, and educated in Monmouth College, Ill., Wooster University, and Armour Institute of Technology. Joining the United States Engineer Corps in 1876, he rapidly developed a remarkable ability in construction work, and was called into railroad service as engineer in charge of design and construction of the principal railroads in the West. Among his constructions were the Fort Madison bridge over the Mississippi River, the bridge over the Missouri River at Sibley, Mo., the design and construction of joint terminals of the Santa Fe and Illinois Central. From 1891 to 1904 Mr. Wallace was chief engineer and later general manager of the Illinois Central, during which period the road may be said to have been reconstructed, over $100,000,000 having been expended on improvements during 14 years. The first track elevation in the city of Chicago was designed and superintended by Mr. Wallace. During 1904-5, he was chief engineer of the Panama Canal, and designed the plans of the canal work, and assisted on the sanitary engineering plans in connection with General Goethals. Later Mr. Wallace was appointed a member of the Isthmian Canal Commission, and also general manager of the Panama Railroad and Steamship lines. His later years were occupied in designing various terminals, and as chairman and part of time active president of Westinghouse, Church, Kerr & Co., from 1906 to 1916, designed and superintended the contruction of many engineering works. He was a member of many engineering societies, and past president of nearly all of the societies to which he was attached.

Charles A. Prouty

Charles A. Prouty, director of valuation of the Interstate Commerce Commission, died on July 8, in the 68th year of his life. He was a native of Vermont and was admitted to the bar in that State in 1882, and practiced law there until 1896, when he was appointed a member of the Interstate Commerce Commission. In 1912 he was appointed chairman of the Commission, and in 1914 became director of valuation. In 1918 he was appointed director of the division of public service and accounting on the staff of the United States Railroad Administration at Washington, D. C. Charles F. Staples, who has been connected with the valuation work for several years, has been appointed acting director and the work which has been so successfully carried on under Mr. Prouty's supervision will, it is expected, soon be brought to a satisfactory completion. Mr. Prouty is universally recognized as having accomplished conspicuous and enduring public service.

Henry S. Manning

Henry S. Manning, who retired in 1905 as senior partner of Manning, Maxwell & Moore, manufacturers of railway supplies, died on July 9, in New York City, in the 76th year of his age. Mr. Manning, while a student at Yale University in 1862, left to join the Union army, and rose to the command of a regiment. In the Spanish-American war the firm of which he was senior partner fitted out a special floating repair shop, under a special Act of Congress, and rendered valuable service to the American fleet.

Emerson Bristol Biggar

Mr. Emerson B. Biggar died at his home in Toronto, Canada, last month, in his 69th year. He was a pioneer in trade journals in Canada, particularly in the field of engineering, founding "The Canadian Engineer," "The Canadian Woodworker," and other periodicals. For many years Mr. Biggar was a regular contributor to the leading magazines of the United States and Canada, and a writer on public questions of interest. Two books of particular interest to engineers written by him were "The Canadian Railway Problem," and his last published book, "The History of Hydro-Electric Development in Ontario."

Albert Taylor

The death is announced of Albert Taylor, manager of the Electric Storage Battery Company, Philadelphia, Pa. Mr. Taylor was born in England in 1864 and in 1884 was graduated from Princeton University. Entering electric service with the Edison, he rapidly rose to eminence in his profession.

Tests on Lubricating Oils.

The chemical engineering and agricultural engineering department of the A. and M. College of Texas have started an experiment to determine the properties of asphaltic base and paraffin base lubricating oils and the qualities that recommend them for use as lubricating oils in internal combustion engines. Several oil manufacturers have contributed samples of their products for experimental material, specimen automobile and tractor motors of different makes and types have been obtained from manufacturers, and the various kinds of oil will be subjected to a practical test in these engines. Before and after the oils are used the chemical engineering department will make various tests to ascertain the physical and chemical qualities, and to determine the relation between the laboratory tests and the actual value of the oil.

Transportation the Problem of Soft Coal

The National Coal Association, Washington, D. C., has issued a sixteen-page pamphlet briefly but convincingly pointing out that to obtain even distribution of output so that the railroads will not be jammed under the strain of unusual demand is the outstanding factor in the bituminous industry's effort to meet the nation's coal needs. The consumer can aid in keeping coal cars moving all the year round by ordering coal months in advance. To attempt to crowd the hauling of the bulk of the nation's coal into the Fall and Winter months is admittedly hazardous from every viewpoint. Facilities for storing coal at the mines does not exist. Usually they could not store coal there if they would. There is literally no physical room to store the output. Even if there were the coal would have to be handled twice. The coal is shipped away when mined. If the cars are not there the work stops, but the overhead expense goes on with the inevitable rise in price. In brief, by taking the coal away when it is mined and storing it away, the public can help itself in a way that the mines are unable to do.

New Turbo-Generator

A small turbo-generator having a rated capacity of half a kilowatt at 32 volts, has been designed by the Westinghouse Electric Company of East Pittsburgh, Pa. It was devised primarily for locomotive head-lights, but may also find applications where steam is available and a very small power is wanted. The total steam consumption at full load varies from 120 lb. per hour with steam at 150 lb. per square inch to 115 lb. per hour with steam at 250 lb. At no load the consumption is about 50 lb. per hour. The generator can be wound to develop 110 volts to 120 volts if desired.

The Illinois Central

Another interesting historical book in regard to American railroads has just been issued by the Illinois Central, entitled, "What Every Employe Should Know." The sixty-year history of the development of the railroad from the short strip between Chicago and Calumet, Ill., to the 6,186 miles of track now in operation forms an admirable illustration of what enterprise has accomplished in opening up one of the richest sections of the continent. The book should have a wider circulation than among the employes. It might be truly said that the original constructors builded better than they knew, as the road is now the main artery of commerce in fifteen States, some of which are larger and of more real value than several European principalities.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV. 114 Liberty Street, New York, September, 1921 No. 9

Physical and Operating Conditions on the Denver & Salt Lake Railroad

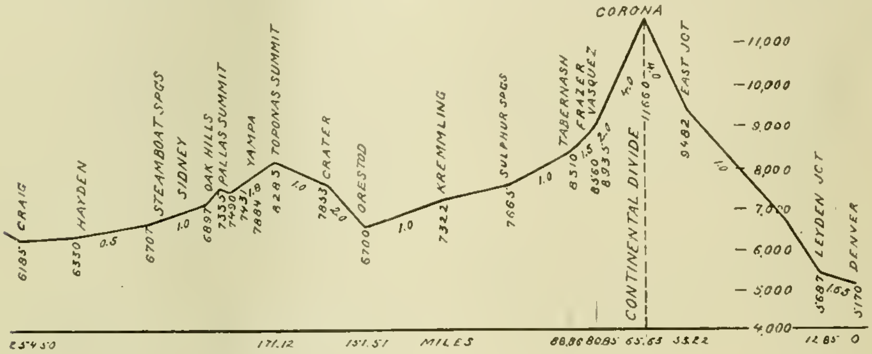
The Traffic Hauled and Results of a Recent Demonstration of the Automatic Straight Air Brake

The Denver & Salt Lake Railroad was projected to run from Denver, Colo., to Salt Lake, Utah. The construction was begun 18 years ago, but was halted at Craig, Colo., about 255 miles from Denver, but only 165 miles in an air line. The line runs in a general northwesterly direction from Denver and crosses the continental divide of the Rocky Mountains at Corona, at a distance of about 65.63 miles from Denver.

The line is in mountainous country throughout its whole extent and there is practically no level line between the termini.

The altitude of Denver is 5,170 feet and the grade westward is ascending at the rate of 1.65 per cent for 12.85 miles, then follows a run of 40.37 miles on a rise of 2 per cent, after which there is a grade of 4 per cent for 12.41 miles to the summit which stands at 11,660 feet, making a rise of 6,490 feet in the 65.63 miles. On leaving the summit the road drops over a 4

VIEW IN JAMES PARK AT YANKEE DOODLE LAKE ON THE DENVER & SALT LAKE RAILROAD per cent grade for 15.22 miles, to be followed by a 2 per cent grade for 4.27 miles as on the eastern slope, after which there is a run down 1.80 and 1 per cent grades for 66.39 miles to Orestod. This covers the crossing of the continental divide; beyond which there is a climb to another summit at Topenas and a drop down to



PROFILE DENVER & SALT LAKE RAILROAD

Craig, as shown on the profile, over grades ranging from 1 to 2 per cent, with a final run of 40.34 miles into Craig over a gentle decline of .05 per cent.

Not only is the line one of heavy gradients but it is exceedingly crooked, as will be seen from the map. In fact, 127.42 miles, or 50.073 per cent, of the total is in curvature, and these curves vary from 0 deg. 30 mins. to 16 degs.; that is, from radii of 11,459 ft. to 359.3 ft. And, further, there are 16.92 miles of curves in excess of 10 degrees, all of which will be eliminated, except 5.71 miles of 12 degs. curve, by the construction of a tunnel under the continental divide.

Finally, there are fifty-eight tunnels on the line, aggregating 24,763 ft., about thirty of which are located on the eastern slope of the continental divide.

It is proposed to drive a tunnel through the mountains from the foot of the 4 per cent grade on each side; that is, from near Common Point towards Vasquez, a distance of 6.04 miles, by which the distance will be shortened 22.62 miles and the whole of the haul over the 4 per cent grade done away with. The difference in elevation between the two portals is only 90 ft., the lower being 9,100 ft. above sea level. As it stands the road at Corona is believed to be the highest piece of standard gauge track in the world.

As for the scenic features of the line, it can hardly be surpassed, as may be partially appreciated from the reproduction of a photograph taken near Newcomb looking toward Tolland and Common Point on the eastern slope, from which it is proposed to drive the tunnel under the divide.

It is on this portion of the line on the eastern slope of the mountains that a considerable tourist traffic is carried during the summer months. But, as the summit is about 1,500 ft. above the timber line the trouble experienced from snow blockades in the winter is exceedingly serious, and it has been necessary to place the summit under the protecting shelter of large snow sheds. The snowfall is not excessive, but during the three months of December, January and February, it is almost invariably accompanied by winds of high velocity, frequently reaching 90 miles an hour. Under the drift of these winds a fall of one or two inches of snow is sufficient to fill the cuts within a few minutes. This taken in conjunction with the unusually low temperatures experienced, which sometimes fall to 50 degs. Fahr. below zero, a total cessation of traffic is often brought about, which may last for three consecutive days, while during this period of three months practically every train passing over the crest must be preceded by a rotary snow plow.

Such are the physical conditions under which the road must be operated.

The question naturally arises as to the reason for the construction of such a road through such difficult territory. The answer is that it was to reach and render available to the market the rich coal fields of the basin immediately west of the mountains.

It is not generally appreciated that the Yampa coal fields in Routt County, Colorado, are among the richest in the country, both as to quantity and quality.

In a report on the road made in 1916 by Mr. E. W. McKenna, an estimate is made that this coal field embraces 1,200 square miles of territory, and the deposit, as thus far explored, contains from six to ten workable veins from 4 ft. to 20 ft. in thickness or from 60 to 120 cu. ft. of coal per square foot of surface. If the workable coal is estimated at a thickness of 60 ft. this field contains 50 billion tons of coal. The coal is bituminous and exceptionably free from impurities and the operations established have shown that the mining conditions are unusually favorable

This coal comes into competition with the lignite coals from Boulder and Jefferson counties, Colorado, with the low grade bituminous coal from Rock Springs, Fremont County, Colorado, which is on the main line of the Union Pacific Railway and the Walsenburg field in El Paso County, Colorado, which belongs to the Colorado Fuel & Iron Company. As a fuel it is superior to any of the others.

The lignites cited contain 79.12 per cent of combustible and 20.88 per cent of noncombustible matter. The Fremont coals have 84.30 per cent combustible and 15.7 per cent non-combustible matter and contain 11,919 British thermal units. The corresponding figures for the Walsenburg coals are 84.98 per cent, 15.02 per cent and 12,293 heat units; while the coals of the Yampa field, according to the McKenna report, show 86.6 per cent; 13.4 per cent and 13,686 heat units, respectively.

There are some lignite fields that would naturally be tributary to the road, but the main body of the Yampa field, which is in touch with the railroad for a distance of about 40 miles, contains only bituminous and higher grades of coal. The lignites being restricted to the Laramie formation in the region northwest of Craig.

MAP OF DENVER & SALT LAKE RAILROAD

An average analysis of seven samples of coal, taken from as many operations in this field, is as follows:

	Per Cent
Moisture	9.63
Volatile combustible	35.11
Fixed carbon	49.93
Ash	5.33
Total	100.00

The average of sulphur was 0.704 per cent, with an average fuel ratio of 8 to 21, which is the fixed carbon divided by the volatile combustible matter.

COAL SEAM INTERIOR OF YAMPA COAL FIELD MINE. DENVER AND SALT LAKE RAILROAD

According to a report of the United States Geological Survey, the following are the heat equivalents of some of the more prominent coals:

	B. T. U.
Pocahontas, West Virginia...	15,800
Pittsburgh, Connellsville	15,500
Horse Creek, Ala.	14,800
Belleville, Ill.	13,200
Yampa, Colo.	12,447
Lafayette, Colo.	11,500
Sheridan, Wyo.	10,800

Anthracite Coal

At the northeastern corner of the field there is a bed of anthracite, which is especially well adapted to domestic use, the average analysis from two operations being as follows:

	Per Cent
Fixed carbon	79.09
Volatile combustible	6.98
Moisture	2.83
Ash	11.10
Total	100.00

The seams from which the analyses of bituminous coal were taken ran from 5 ft. to 15 ft. in thickness, which surpasses that of the great Pocahontas seam in West Virginia.

The coals of the Yampa field thus show a fairly low percentage of ash, only two of the bituminous coals carrying more than 10 per cent as taken from the mine, while the percentages found in the other samples run from four to six.

The sulphur is low, being generally less than one per cent. The greatest sulphur content noted in the geological survey was 1.67 per cent, while the average of all analyses made was only 0.71 per cent.

The utilization of this coal will, of course, depend upon its character. The anthracite of this field, although of a somewhat limited extent, will doubtless be used largely as a domestic fuel. The bituminous coals serve well for both domestic and steam purposes.

Thus far, the interest has centered about the Yampa field which contains the bituminous and anthracite coals, while the poorer grades farther west have been considered unworthy of notice.

GILSONITE VEIN ON DENVER & SALT LAKE RAILROAD

Oil

In addition to the coal fields which are the source of supply of the present tonnage to the road, the presence of oil has been suspected in various parts of the area traversed by the road, especially in the prairie southwest of Hayden, sixteen miles from Craig, and in the Yampa river valley.

The chief indication of oil consists of a well known seepage or oil spring in the canyon of Tow Creek, three or four miles north of the Yampa river. The oil from this spring is in constant use as a lubricant and is regularly gathered by the ranchmen and miners. It issues from the rock in globules with the water of the spring and, when allowed to accumulate for some hours, is found as a sheet on the surface of the small pool of water. This sheet may attain a thickness of one-eighth of an inch. When the spring is kept clean, the daily flow of oil is approximately one bucketful. The oil is black and heavy and has an agreeable odor.

This is one of the possibilities or probabilities of the territory that has not yet been developed sufficiently to warrant exact statements.

Gilsonite

Finally, there are well developed veins of gilsonite that run from 6 ft. to 20 ft. in width. They stand vertically and extend to unknown depths. Excavations have been carried on to depths of 300 ft. and more with no indication of reaching or even approaching the bottom.

Gilsonite is an almost pure asphalt. It is a solid that breaks with a lustrous fracture and does not soil the hands. It is of a better quality than the Trinidad article, as it contains 95 per cent of asphalt with but 5 per cent of impurity, while that from Trinidad contains about 43 per cent of sand.

It is already mined in considerable quantities. The work is very simple, as the side walls require no timbering.

At present it is carried out to the north over a narrow gauge road operating over a 7 per cent grade. But the property can be readily reached by a spur on easier grades from the Denver & Salt Lake R. R.

There is a great deal of prospecting for precious ores along the line of the road, and there are one or two small gold mines, one copper mine and one tungsten mine in operation. This latter is a very valuable find, and the ore has been proven to be in sufficient quantity to become valuable as a traffic producer.

There is no doubt that other discoveries will be made, which will bring in an increase of population, and stimulate westbound tonnage.

Equipment

The freight equipment of the road consists of cars of 60,000 lbs., 80,000 lbs. and 100,000 lbs. capacity, the latter amounting to about 60 per cent of the whole.

The coal cars are of the drop bottom

gondola type, carrying 50 tons, as shown in the illustration.

The road engines are Consolidations, Mikados and Mallets; the general dimensions being as follows:

For the Consolidations they are:

Cylinder diameter	22 ins.
Piston stroke	28 ins.
Steam pressure	210 lbs.
Heating surface	3,511 sq. ft.
Diameter, drivers	55 ins.
Weight on drivers	195,000 lbs.
Total weight of engine	219,000 lbs.
Tractive effort	44,000 lbs.
Weight of tender	60,600 lbs.
Coal capacity	15 tons
Water capacity	8,000 gals.

For the Mikados the dimensions are:

Cylinder diameter	26 ins.
Piston stroke	30 ins.
Steam pressure	185 lbs.
Heating surface	4,175 sq. ft.
Diameter, drivers	55 ins.
Weight on drivers	232,000 lbs.
Total weight of engine	306,000 lbs.
Tractive effort	58,000 lbs.
Weight of tender	61,500 lbs.
Coal capacity	15 tons
Water capacity	8,500 gals.

The dimensions of the Mallets are:

Cylinder diameter	21 & 33½ ins.
Piston stroke	32 ins.
Steam pressure	225 lbs.
Heating surface	5,237 sq. ft.
Diameter, drivers	55 ins.
Weight on drivers	352,000 lbs.
Total weight of engine	362,000 lbs.
Tractive effort	78,000 lbs.
Weight of tender	61,300 lbs.
Coal capacity	12 tons
Water capacity	9,000 gals.

The extraordinary grades from the east and west to Corona, impose conditions upon which the future of the property, for the present, depends.

To negotiate these grades with a train of 1,250 tons requires two Consolidation and two Mallet locomotives having a combined tractive effort of 244,000 lbs.

"A train on the descending grade has been limited to this tonnage on account of the great risk of runaways on the descending plane."

This has been the limiting factor in the operation between Corona and Denver.

FIFTY-TON COAL CAR, DENVER & SALT LAKE RAILROAD

A. S. A. Brake Demonstration

In order to determine whether a train equal in length to the number of empty cars that the engine could haul back, could be taken down the grade, a train of 34 cars and weighing 2,431 tons, was equipped with the Automatic Straight Air Brake for demonstration on this grade. This was an increase of nearly 95 per cent above the standard load.

To handle this train out of Tabernash and up to the foot of the 4 per cent ascending grade required 3 Mallet type locomotives, each having a tractive effort of 78,000 lbs., and two Consolidation locomotives each having a tractive effort of 44,000 pounds.

At Irvings, the foot of the 4 per cent grade, two more Mallet engines were added, each having the same tractive effort as the other Mallets (seven locomotives in all); there was, therefore, 478,000 lbs. tractive effort used to lift the engines themselves and the 2,431-ton train up the 4 per cent grade.

The illustration shows the demonstration train being hauled by seven locomotives up the 4 per cent grade on the western slope of the Rocky mountains.

The trip up the grade was without incident.

At Corona the triple valves in the entire train were put in graduated release position, the piston travel was adjusted to not more than six inches the brake pipe pressure previously having been raised to 100 lbs. as is the usual practice.

AUTOMATIC STRAIGHT AIR BRAKE EQUIPMENT USED ON DENVER & SALT LAKE RAILROAD. (The White rod denotes the connection for operating the graduated release valve)

The trip down the descending grade was without incident, except that the train was stalled at mile post 62½, due to too heavy reduction in approaching a 16 deg. reverse curve. Three minutes after the train stopped it was again in motion. This because no retainers are used with this type of brake, and release is entirely in the hands of the engineer.

At Dixie Lake, 4½ miles from the summit, the regular inspection stop was made, and wheel temperatures noted; the temperature was very uniform, there being two or three cars in the train with wheel temperature slightly higher than the average of the others, but any wheel in the train could be touched with the fingers without discomfort. The caboose brake, which did not have the A. S. A. equipment, only applied once in service on the entire run, and its wheels were cold.

The train left Dixie Lake at 5.41 P. M. and reached Antelope, the second inspection point, at 6.08 P. M., where the wheels were again examined and found in the same condition as at Dixie Lake, hardly a noticeable increase in temperature, except that the heat had radiated more toward the hub, but the back of the hand could be held against the plate continuously at a point 3 inches below the tread.

This is considered a matter of great importance by the railroad officials, as hot wheels due to brake application constitute one of the troubles of operation.

At Antelope it was found that a brake head on one car was broken, due to an old crack, and a bottom rod on another was bent so badly that the piston was allowed to come into contact with the non-pressure head so the brakes on these two cars were cut out, and as the brakes on the caboose were not working the remaining 2½ miles of 4 per cent grade was made with 32 brakes holding 35 cars which weighed gross 2,431 tons, or slightly less than 76 tons per brake.

The observers on the rear reported the slack action as nil.

After finishing the 4 per cent grade and following a 15 lb. service reduction, an intentional emergency application was made, for the double purpose of "spotting" the train for a picture, and shaking up the rear end if possible. The observers reported that the stop was as smooth as any service stop, there being no slack action on the rear and there was none felt on the engine.

The train arrived at Tolland at 7.20 P. M. and after changing crews, departed with the same locomotive and caboose for Denver, leaving Tolland at 7.50 P. M.

The triple valves were left in graduated release all the way to Denver, the wheels were examined at each of two regular cooling and inspection points and found to be in the same condition as on the 4 per cent grade, this because the speed limit on the 2 per cent grade is higher.

The slack action on the 2 per cent grade can best be described by the fact that two men sat at the desk in the caboose and compared notes of the trip and checked over the weights on waybills, writing at the desk almost continuously for the first hour out of Tolland.

No particular observations were taken on the 2 per cent grade and the train reached Denver (Utah Junction) at 12.15 A. M.

It may be added that the train was handled down the grade from Corona to Denver by a single Consolidation locomotive. The result showing that the tonnage down the grade can be doubled and operating expenses per ton mile halved.

The engine was equipped with the No. 6 E. T. equipment, one cross compound and one 9½-in. compressor, but only the cross compound was used descending the grade.

The main reservoirs had a nominal capacity of 70,000 cu. in. and the maximum pressure used was 140 lbs. per square inch. The intermediate main reservoir pressure was 130 lbs. in running position.

Maximum brake pipe pressure 100 lbs.

Minimum brake pipe pressure at any time 65 lbs. (Following two applications and two releases without recharging.)

Maximum brake pipe reduction at any one time 25 lbs.

Minimum brake pipe reduction at any one time 7 lbs.

Number of brake cycles, Corona to Dixie Lake, 4½ miles, 12 cycles.

Number of brake cycles, Dixie Lake to Antelope, 5.1 miles, 17 cycles.

Number of brake cycles, Antelope to end of 4 per cent grade, 2½ miles, 6 cycles.

Total number of brake cycles on 4 per cent grade, 35 cycles.

Total elapsed time on 4 per cent grade, 2 hrs. 7 mins.

Total time standing still, 47 mins.

Actual running time on 4 per cent grade, 1 hr. 40 mins.

Actual length of 4 per cent grade, 12.5 miles.

Average running time, 9.4 miles per hour.

DEMONSTRATION TRAIN ON THE DENVER & SALT LAKE RAILROAD EQUIPPED WITH AUTOMATIC STRAIGHT AIR BRAKES

Maximum speed reached, estimated, 15 miles per hour.

Minimum speed, estimated, 6 miles per hour.

Wheel temperature, practically uniform, and normal for an A. S. A. train on 4 per cent grade.

Slack action reported as nil by observers on caboose.

The operation of the brakes was entirely satisfactory throughout the run.

The caboose wheels were found stone cold on all inspections, hence its weight of 20 tons are accredited to the 34 A. S. A. brakes, which had to handle its weight.

Total tons behind tender, 2,431 tons.

Tons per brake, Corona to Antelope, 71.5 tons.

Tons per brake, Antelope to end of 4 per cent grade, 75.97 tons.

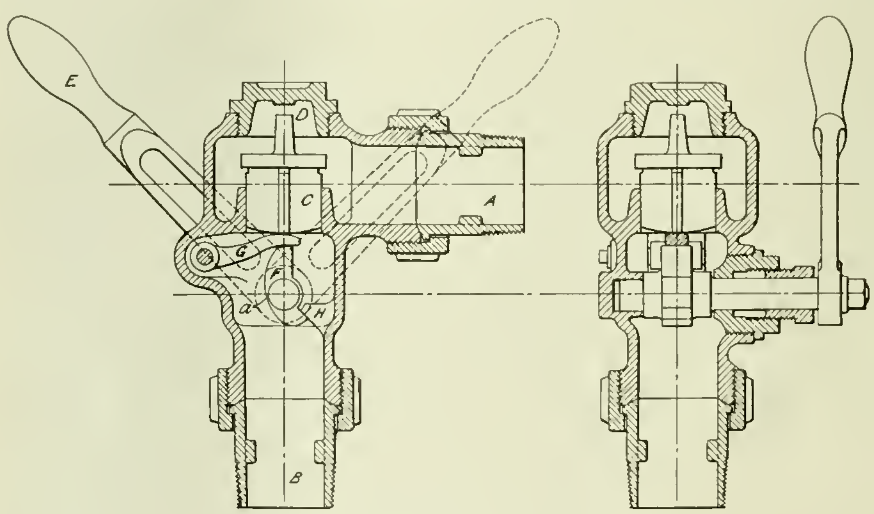
The brake pipe leakage was at the rate of 4 lbs. per minute from 70 lbs.

As for the number of brake cycles used it was about 50 per cent of those usually used with the standard 1,250-ton train, and equipment.

It became evident during the run that a much longer train could be handled down the grade with a single engine, as only one air compressor was used.

Sellers' Drifting Valve

Wm. Sellers & Co., Inc., of Philadelphia, have developed an exceedingly simple drifting valve which can be easily opened against any steam pressure, and which will open automatically should an excessive pressure be developed in the steam chest. The connection to the boiler is at *A*, and that to the steam chest is at *B*. The valve *C* is a flat seated wing valve that fits loosely in its guide and can be lifted out and reground by removing the cap *D* in the casing without removing any of the pipe connections.



DETAILS OF SELLERS' DRIFTING VALVE

The handle *E* turns a shaft to which a cam *F* is attached, which operates through a loosely pivoted lever *G*. When the handle is in the position indicated, by the dotted lines, the valve is down upon its seat and the lever *G* rests upon that portion of the cam marked *a*. In this position the greatest amount of leverage may be exerted in order to lift the valve, so that it can be raised against any steam pressure. Then as the lever is moved over toward the position, shown by the full lines, a more rapid movement is given to it, until when, in the position shown, the cam stands vertically beneath the lever *G* and the valve is held in its open position and there is a free flow of steam from the boiler to the steam chest, and with no liability of closing until the handle is moved toward the dotted position, as it will be seen that the point of support is off center and the cam itself is resting against a stop *H* cast on the casing. On the other hand, when the handle is in the dotted position, the valve is held to its seat by the steam pressure above it, but is able to lift, in case an excess pressure should be developed beneath it, returning immediately to its seat as soon as the pressure drops.

As the operating lever has but two positions, there is never any danger of an insufficient steam supply when it is open.

The Slipping of Locomotive Wheels

It is a common thing for locomotive wheels to slip, that is, for the coupled wheels to revolve more rapidly than they otherwise would, from the movement obtained by rolling.

This action is caused by the power exerted by the steam on the pistons being greater than the resistance of the wheels on the rails. This frequently causes difficulty to engine-drivers and calls for careful manipulation of the engine to enable full loads being hauled, particularly on rising grades.

In the early days of locomotives it was thought that the adhesion or friction of the coupled wheels on the rails would not be sufficient to enable locomotives to exert their full power, and many contrivances, such as tooth wheels and racks, were devised and experimented with.

It was soon found possible, however, to design a locomotive and place sufficient weight on the driving or coupled wheels to get sufficient adhesion to resist the power obtained from the cylinders.

Pambour, in his "Treatise on Locomotive Engines," written in the early stages of locomotive practice, wrote: "Two conditions are necessary in order that an engine may draw a given load. First, that the dimensions and proportions of the engine and its boiler enable it to produce on its piston, by means of its steam, the necessary pressure which constitutes what is properly termed the power of the engine; and, second, that the weight of the engine be such as to give a sufficient adhesion to the wheels on the rails. These two conditions of power and weight must be in accordance with each other, for if there be a great power of steam and little adhesion the latter will limit the effect of the engine and there will be steam lost; if, on the other hand, there be too much weight for the steam, that weight will be a useless burden, the limit of the load in that case being marked by the steam."

D. K. Clark, the English authority, writes as the result of experiments conducted: "At speeds under 20 miles per hour it appears that when the rails are dry the co-efficient of friction or the adhesion is one-fifth of the weight, and that on very dry rails it is one-fourth. As the speed is increased the adhesion is reduced. These data are corroborative of the results of the author's experiments on the ultimate tractive force of locomotives on dry rails, from which he obtained a co-efficient equal to one-fifth of the weight at speeds of about 10 miles per hour."

Every locomotive engine-driver knows that after an engine begins to slip it will not exert as much power as it did before it began to slip. In other words, the adhesion of the wheels is much less when they slip than when they roll without slipping. Experiments conducted show the great difference between the two kinds of friction, and that one at least is very much affected by the speed and also by the time. That is, it has been found that at a high speed the friction is much less than at a slow one, and is considerably less after some seconds than it was at the beginning.

The Railroad Problem Before the President and Congress

Railroad Executives and Labor Representatives Keep the United States Labor Board Busy —More Balloting

Last month President Harding renewed his request to the leaders in Congress to make every effort to pass legislation for the relief of the railroads before the coming recess, maintaining that delay in the enactment would prevent a resumption of activity this year in industries dependent on the railroads. He pointed out the desirability of providing for the government's payments to the railroads as quickly as possible, and expressed the fear that failure to dispose of the legislation until Congress reconvenes in October might retard general prosperity and would certainly work against the return of the railroads to a sound basis.

It is understood the President may not insist that the legislation shall be rushed through both branches until after he learns more fully the nature of the expected opposition in the Senate. Those who conferred with him gained the impression that he would like to see the measure put through the House at least before recess and possibly an effort made to pass it in the Senate.

The leaders left the White House feeling that the President may reverse his position on agreeing to the thirty day recess if the railroad bill is not acted on. They failed to get his definite approval for a recess without final action on the bill but believe he will make no objection to a recess after an earnest effort has been made to get action on it.

It was hoped that the House might speed up its program sufficiently to pass the relief bill under a special clause, but it was apparent that if the President actually insisted on final disposal the hope of a recess would disappear, as there appeared to be no chance of getting the measure through the Senate, except after a lengthened debate, as amendments will certainly be offered when the bill is reported to the Senate by the Interstate Commerce Commission. The President has received such general approval throughout the country for his so-called interferences in legislative action that many expect to see him call for action on the railroad bill which will place the recess plans in the far distance.

Lowering Railroad Rates

Among other important phases of the railroad problem the American Farm Bureau Federation, claiming a membership of 1,250,000, petitioned the President and the Interstate Commerce Commission for a reduction of "all the railway rate advances intended to increase their net income above the war guarantee." There are several reasons why that petition was improper, and why even the farmers have reason to be better pleased with the announced reduction of railway rates on grain for export than they would have been if their request last month had been granted. It is particularly welcome that the reduction of rates in the farmers' interest results from an agreement rather than compulsion. The Administration, through Secretary Hoover, undertook to adjust favorably the claims of the railways against the Government in consideration of the railways waiving their claim to be compensated for the inefficiency of labor employed for the railways by the Government, and reducing rates on grain for export by one-quarter. During the recent weeks when total car loadings were falling by nearly a million cars, grain loadings increased 30 per cent. For the last week in July, the grain movement was the unprecedented maximum of 64,919 cars, a gain of almost double 1920. The railways and farmers together are thawing out frozen loans. The movement may be expected to grow when rates are made still more attractive.

Responsible officers of railways say that rates on steel for export also are under arrangements nearly concluded. Another betterment of railway conditions lies in the fact that the troublesome question of the division of rates between New England roads and trunk lines was referred back to the railways for adjustment by themselves. The Interstate Commerce Commission disapproved the present division, but declined to order any change until the railways report themselves unable to agree. Reduction of specific rates by agreement is the proper way to correct the dislocation of rates by the horizontal advance, regardless of the relation of rates to commodity prices or to competitive market.

It is generally conceded that the increased earnings of the railroads for the last three months sound a new note of optimism for the nation's industries. Apparently the great carriers are slowly getting upon a sounder basis, and reports that certain lines might go into the hands of receivers are less frequently heard. The net earnings for June of more than fifty millions, for July of nearly fifty-four millions, show the extent of the change for the better.

The railways are the arteries of the nation, the channels through which circulates the life blood of trade. They furnish, therefore, an excellent means of taking the industrial pulse, of determining whether business is to continue in a state of depression or whether before it lies a period of renewed health and activity. The railways prosper only when there is a large volume of traffic, and there is a large volume of traffic only when business booms. The renewed activity, then, of the principal lines can mean but one thing —the industry of the nation is reviving.

For the railways themselves the turn for the better is most opportune. The long series of misfortunes—unwise regulation, Government control, industrial depression —have told upon their efficiency and vitality. Even under the most favorable circumstances many months must pass before a complete recovery may be expected. But the corner has been turned, optimism has taken the place of depression, and from now on their position should gradually grow stronger.

In turn, nothing can contribute more to the industrial revival than this fact. Prosperity is impossible with weakened, inefficient carriers; with a well managed, adequate system of transportation the entire business life of the country is stimulated and quickened. That the finances of the roads are showing marked improvement is welcome news to the nation, will create renewed hope and optimism.

Movement Among Railroad Men

It is interesting to abserve the continued activity and resourcefulness of the railroad executives and employes in the ever-changing kaleidoscope in the great problem in which their vital interests are so largely involved. Among these, it is reported that the Railway Service Company, a corporation organized by manufacturers, bankers and business men in Marion, Ohio, took over operation of the Erie railroad shops and roundhouse at that point. The service company leased the buildings and equipment of the railroad company and has contracted to do all repair and other work heretofore done by the employes of the railroad. While this idea is not new it will be watched with a renewed interest. The procedure so far has been to offer employment to all employes of the Erie company in the service, each man to take his former position and receive the same pay as that received from the railroad company.

Since the Railroad Service Company is not a "common carrier," it was pointed out that it would not be subject to supervision by the Railroad Labor Board and would not come under the provisions of the Esch-Cummins railroad act.

Appeal Made by Erie Employes

B. M. Jewell, head of the railway employes department of the American Federation of Labor, requested the Labor Board for a definition of the status of employes of the Erie railroad shops who have not accepted employment with the Railway Service Company, which took over operation of the shops. The men who would be affected by the ruling, according to Erie officials, are those who walked out when the ten-hour day was resumed and Sunday overtime pay refused and who, according to the unions, were "sent home" by the company for refusal to comply with the new order of the railroad. The unions state that 500 of these men have refused to accept employment with the Railway Service Company.

The President of the Erie Presents His Views

F. D. Underwood, president of the Erie railroad, claims that it is a misnomer to call the plant at Marion a shop. The actual shop is at Galion, twenty miles east of Marion, which is a transfer point, with a roundhouse force which in normal times numbers more than 600 men, and which now has a reduced force of about 400 men. Neither physical ability or capacity was tested during war times, but recently certain classes were required to take examinations. Some shopmen objected to the conditions or output for Sunday work without penalized overtime. When the time given elapsed their places were filled. Those who failed to report for service were mostly those who have come into the Erie since January, 1918. Of 3,125 men examined, 59 were rejected for physical reasons.

Announcement by the Pennsylvania

The following order was issued by the president of the Pennsylvania: "By direction of the United States Labor Board the request is granted for fifteen days extension of time provided for in decision No. 219. The purpose of this request was to enable the company to take such steps as might be necessary in the interest of all its employes. Announcement was made on May 20, 1921, that all employes would be given an opportunity to have a voice in the management in matters affecting the welfare through representatives of their own selection, whether union or non-union men. A majority of our employes want to deal with the management through employe representatives. About 175,000 employes are interested in rules governing working conditions. About 117,000 of these employes have expressed a desire to negotiate rules through employe representatives. The employe representatives who have been elected have acted in good faith with the management. The management has acted in good faith with them. The rights and interests of these representatives and the employes whom they represent must be recognized and protected. Inasmuch, therefore, as this decision,—No. 218,—of the Labor Board vitally affects the welfare of all our employes, and, in accordance with the announcement made by the company on May 20, 1921, the management will confer with representatives of all classes on the Pennsylvania System. Meetings for this purpose are being arranged for all classes of employes."

Labor Union Officials Issue a Statement

The union officials stated that the present situation was a life and death struggle in which the principle of unionism, not only at Marion, but wherever shop employes is at stake. "We will not strike," the statement continued, "nor is there any danger of an extended strike over the entire system until the decision of the Labor Board is received.

"If we can be deprived of the benefits of our existing agreement with the railroad company and the benefits of the Esch-Cummins act by such a maneuver, then, following a systematic plan of elimination, the railroads can gradually convert shop after shop from a railway department to a private enterprise and can by so doing abrogate all agreements by which their operations are at present regulated.

"We are not fighting the new service company. Our fight is for the same conditions which prevailed under Labor Board control. If we are given time and a half for work on Sunday and extra pay for time over eight hours we will have no further objections to offer."

Telegrams from shop crafts unions all over the country offering support to the local unions in any step they deem necessary have been received by local union officials, they announced.

Union leaders are aroused over the Erie's move, which they consider a plan to defeat the purposes of the Railroad Labor Board and Transportation act.

"The action of the Erie only affects the shopmen, but we will take it up while in our conference here," said Timothy Shea, assistant president of the Brotherhood of Locomotive Firemen. "What action we will take I cannot say."

The Labor Board Issues A Decision

The Labor Board lost no time in rendering a decision on some of the questions at issue in the railroad problem which will have an important effect upon the action of the labor unions, who called a series of general meetings, which began in Chicago in the last week in August.

An exception—one denying the time and one-half rate to men regularly assigned to necessary Sunday and holiday work—provoked the first dissenting opinion that has been made public since the board was formed a year and one-half ago.

A. O. Wharton, former president of the railway employes' department of the American Federation of Labor, submitted the minority opinion. He is one of three labor representatives on the board.

The decision embodies the first of the rules the labor board will prescribe to replace the national working agreements established during Federal control of the roads. The order applies only to the 137 railroads involved in the overtime controversy with the six federated shop crafts, but it will bind all other roads, it is said, as soon as their cases come before the board.

All railways reaching independent agreements with their employes, however, are free to disregard the board's rules.

Seven rules, covering the same ground as the same number in the National agreements, were laid down, all dealing with overtime pay. They are effective as of August 16. The board will publish others as soon as they are drafted.

In addition to adhering, in general, to the established overtime rate, the board recognized the eight-hour day standard, as it has done in an earlier decision.

Objecting to the majority opinion as one which "does not appear either just or reasonable," Mr. Wharton took particular exception to a provision cutting the pay of employes regularly assigned to road work and paid on a monthly basis. This stipulated that such employes should compute their salaries on the basis of 243 hours a month, instead of the present 263 hours, allowing no overtime for hours worked in excess of eight per day, nor deductions for less than eight hours' work, unless the employe deliberately lays off.

Cases in which existing rules will be modified by the board's decision include:

Employes may now be required to work two hours overtime, instead of one, before being released for meals.

Employes called for work and not working, or working two hours and forty minutes or less, will receive four hours' overtime, instead of five.

Instead of five hours' pay, employes called one hour or less before their regular time will receive time and one-half for the overtime.

If allowed at least five hours off during every twenty-four workers called from home will not be paid overtime for time spent in sleeping.

The concluding paragraph of Mr. Wharton's dissenting opinion reads:

"It does not appear either just or reasonable that conditions which have been in effect from ten to twenty years and even longer, established as a result of negotiation and mutual agreement between employers and employes and not infrequently established where no organization of employes existed, can now be decided as unjust or unreasonable."

The majority opinion was written by Chairman R. M. Barton and concurred in by Albert Phillips and Walter L. McMenimen, members representing the unions; G. W. Hanger and Ben W. Hooper, who, with Judge Barton, represent the public, and Horace Baker, J. H. Elliott and Samuel Higgins, representing the railroads.

The following is an excerpt from an explanatory statement accompanying the new rules:

"There was a wide diversity of rules among the numerous railroads of this country prior to the standardization that took place during Federal control. It is therefore possible to cite precedents for almost any rule that may be advocated. Such precedents at best are persuasive, but not controlling. The fact that a given rule may once have existed by agreement on a road is not conclusive of its reasonableness and justness, for it may have been imposed on the employes by unavoidable necessity or on the carrier by economic pressure. The board has therefore felt constrained to consider the principles of right and wrong involved in the proposals and counter proposals submitted to it in the light of present conditions and industrial history.

"Throughout these rules the soundness of the principle of punitive pay for overtime work has been recognized, but not to the extreme extent embodied in the national agreement.

"The eight-hour day has also been given full recognition. The policy of paying time and one-half for work performed on Sundays and holidays is also approved in rule six, but an important exception is provided. Certain kinds of work, which are unavoidably and regularly performed on Sundays and holidays and which are absolutely essential to the continuous operation of the railroad to meet the requirements of the public, are not treated as overtime work. The carrier has no choice as to the performance of this work, and does not arbitrarily require it. It is not just to penalize the carrier for that which it cannot escape. Manufacturing plants can, as a rule, control or eliminate Sunday and holiday work, therefore, a comparison of such plants with a railroad is unfair, except in so far as the 'back shop' is concerned, and the method of paying for overtime in the back shop has not been disturbed by these rules.

"There are other classes of employment in which Sunday and holiday work is regular and necessary and those engaged in it are not paid overtime; for example, engineers, firemen, conductors and trainmen, and, going outside of railroad service, police and fire department employes, and street car conductors and motormen.

Relic of Ten-Hour Day

"The practice of allowing five hours for a call is a relic of the time when ten hours constituted a day's work and it was thought just and reasonable to allow one-half day, or five hours, for a call. Now that the hours have been reduced to eight by the same principle it is just and reasonable to make the allowance one-half day or four hours.

"Employes usually commence work between 7 and 7.30 a. m., with a lunch period in the neighborhood of 12 o'clock noon, and finish their regular eight hour period at 4 p. m. Certainly there is no hardship in asking employes to continue on to 6 p. m. (if their services are required) before they go to a meal, and in many cases workingmen would prefer to work the additional two hours in order to complete their work and go home without having to return.

"If men are called after regular hours for some emergency work, it is fair and reasonable to use these men only on other emergency work which may have developed after they were called without being obliged to call them again or to call other men.

"When men are sent out on the road for emergency service, or to fill temporary vacancies, it is certainly just and reasonable to pay them straight time for all time traveling or waiting, and for all time worked, straight time for straight time hours and overtime for overtime hours in accordance with the practice at the home station or at the point where they are temporarily employed.

"It is just and reasonable that men assigned to road service on a monthly basis should be paid eight hours per day, 365 days per year without any allowance for overtime."

Passage of the Railroad Bill Expected

It is gratifying to learn that Congress is taking action likely to insure the passage of the railroad bill before the recess. Majority Floor Leader Mendell states that the bill might defer adjournment of vacation several days longer than had been expected. Any question as to whether the bill can pass before recess or at an early date was removed by remarks of Senators. It became obvious that the bill cannot be passed without considerable debate.

In a conference with President Harding, John E. Edgerton, president of the National Association of Manufacturers, gave the President the unqualified indorsement by the manufacturers of his recommendation that Congress immediately make available $500,000,000 for the rehabilitation of the railroads. Relief to the railroads would give immediate employment to 200,000 idle mechanics and about 1,000,000 other unemployed should alone be sufficient influence to provide the needed relief.

An amendment dealing with the question of the inefficiency of labor is as follows: "In using any funds or moneys available under this or any other act no payments of allowances shall be made to any carrier on account of the so-called inefficiency of labor during the period of Federal control; such funds and moneys shall not be used in making any settlement between the United States and any carrier, which does not forever bar such carrier from setting up any further claims, right or demands of any kind or character against the United States growing out of or connected with the possession, use or operation of such carrier's property by the United States during the period of Federal control."

Union Leaders Dissatisfied With the Outlook

At a conference held in Cleveland beginning on August 23, the railroad labor leaders decided to distribute strike ballots to the 409,000 members of the unions, including the Brotherhood of Locomotive Engineers, the Brotherhood of Railway Trainmen, the order of Railway Conductors, the Brotherhood of Locomotive Firemen and Enginemen and the Switchmen's Union of North America. It was reported that it would take at least a month before the decision of the members of the various unions will be known. Railroad labor chiefs are said to be dissatisfied with the wage and working condition outlook. They have attempted to place the railroad managements of the country on record against more cuts in wages and changed working conditions.

After the recent 12 per cent cut in wages was ordered by the United States Labor Board at Chicago, the railroad managements were given to understand by labor leaders that the 12 per cent probably would be acceptable if the men could be assured other slices would not be sought, and that the time and a half pay for overtime would be kept. The answers of the railroads to these questions are reported to have been unsatisfactory. That brought the executive conference to Cleveland. It was to decide what was now to be done in view of the uncertain outlook. The preparation of the ballot was said to have involved considerable discussion, as it was desirous to present the whole outlook to the men and it will be up to them to decide what action will be taken.

Interstate Commerce Commission Offers a Proposition

Coincidentally with the various conflicting opinions that have characterized the actions of all interested in the solution of the railroad problem, a tentative plan upon which consolidation of the country's railroads may be carried out, has been prepared by the Interstate Commerce Commission, which is not mandatory, but comes in the form of recommendations from the commission. It will likely be modified, after public hearings have been held, before being adopted. It embraces a scheme whereby twenty possible systems are in the commission's plan, but in certain cases these systems are alternative, and the proposition may be said to await discussion. The railroad officials are reported not to be favorably inclined toward any consolidation plan at this time. Any such attempt would seriously affect the value of railroad securities, and add much to the already numerous problems of the railroads which are yet unsolved, but when the roads are on a steady earning basis, it would then be proper to make several consolidations.

New Mountain, Pacific and Switching Locomotives for the Missouri Pacific Railroad

Details of Dimensions and Appliances

The American Locomotive Company have recently built a number of locomotives for the Missouri Pacific Railroad. Among them there were fifteen (0-6-0) switching engines, five (4-8-2) mountain type and five (4-6-2) Pacifics.

The general dimensions of the mountain type were as follows:

Track gauge, 4 ft. 8½ ins.; cylinder diameter, 27 ins.; stroke, 30 ins.; tractive power, simple, 53,500 lbs.; factor of adhesion, 4.22.

Wheel Base—Driving, 19 ft. 7 ins.; rigid, 12 ft. 8 ins.; total, 41 ft. 4 ins.; total engine and tender, 77 ft. 2 ins.

Weight—In working order, 335,000 lbs.; on drivers, 226,000 lbs.; on trailer, 56,500 lbs.; on engine truck, 52,500 lbs.; engine and tender, 527,800 lbs.

Boiler—I. D. first ring, 76⅝ ins.; working pressure, 210 lbs.

Firebox—Length, 114⅛ ins.; width, 84¼ ins.; combustion chamber, length, 59 ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; throat, ½ in.; water space, front, 5½ ins.; sides, 4½ ins.; back, 4½ ins.

Crown staying, 1 in. Radial.

Tubes—Material, Seamless Steel; number, 182; diameter, 2¼ ins.

Flues—Material, Seamless Steel; number 40; diameter, 5½ ins.; thickness tubes, No. 11; flues, No. 9; tube length, 22 ft. 0 in.; spacing, 11/16 in.

Heating Surface—Tubes, 2,346 sq. ft.; flues, 1,261 sq. ft.; firebox, 300 sq. ft.; arch tubes, 27 sq. ft.; total, 3,934 sq. ft.

Superheater surface, 1,084 sq. ft.

Grate area, 67 sq. ft.

Wheels—Driving diameter, outside tire, 73 ins.; material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, rolled steel; trailing truck, diameter, 43 ins.; kind, cast steel; tender truck, diameter, 36 ins.; kind, rolled steel; front, 10 ins. x 19 ins.

Axles—Driving journals, main, 12 ins. x 13 ins.; other, 10 ins. x 13 ins.; engine truck journals, 6½ ins. x 12 ins.; trailing truck journals, 9 ins. x 14 ins.; tender truck journals, 6 ins. x 11 ins..

Boxes—Driving, main, cast steel; others, cast steel.

Brake—Operating, Westinghouse; driver, American; truck, American; trailer, American; tender, Westinghouse; air signal, Westinghouse; pump, 1—8½ cross-compound; reservoir, 1—22½ ins. x 84 ins., 1—22½ ins. x 102 ins.

Truck—Engine, Woodward; trailing, Delta.

Exhaust pipe, single; nozzles, 6 ins., 6⅛ ins., 6¼ ins.

Grate style, rocking.

Piston rod, diameter, 4¾ ins.; piston packing, Snap Ring.

Smokestack—Diameter, 18 ins.; top above rail, 15 ft. 0 in.

Tender frame, cast steel.

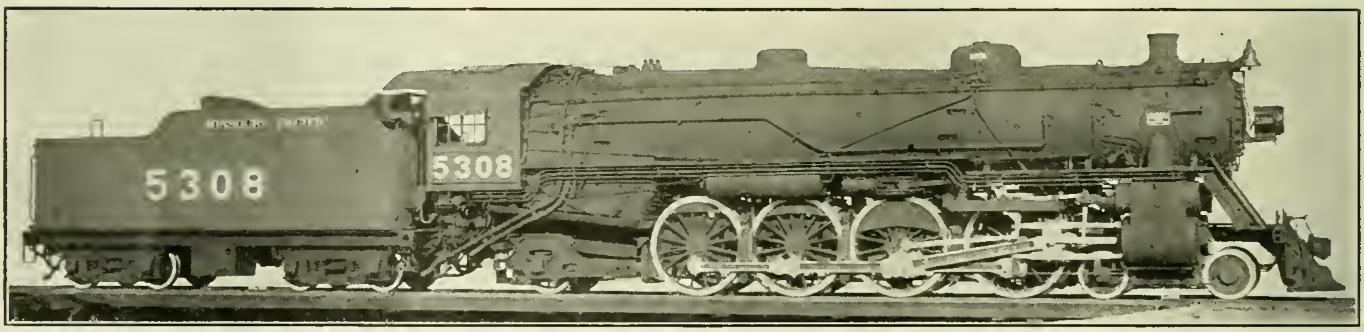
Tank—Style, water leg; capacity, 10,000 gals.; capacity, fuel, 16 tons.

Valves—Type, 14 ins.; piston travel, 7 ins.; outside lap, 1¼ in.; clearance, 3/16 in.; lead in full gear, 3/16 in.

The mountain engines were equipped with the following specialties which were not common to the other engines:

Woodward-Riegel driving box spacer device applied in connection with the lateral motion front driving box; back cylinder heads arranged with the Hoke safety guide lug; valve travel 7 ins. and steam lap 1¼ in.; Commonwealth C. S. engine truck frame with pedestal cast integral; combustion tubes—5 ins. right side and 4 ins. left side of firebox; guide yoke and frame fulcrum casting combined into a box-shaped cross-tie; lateral motion driving box; Franklin radial buffer; Duplex stoker, and constant resistance type engine truck.

In addition to these the following specialties were common to the 4-8-2 and 4-6-2 locomotives: Radial stays and expansion stays first 16 rows from flue sheet are expansion stays, 18 rows wide with 10 center rows of button heads, 17th and 18th rows are radial stays with 10 center rows of tapered threads in crown riveted over. The remaining rows are radial stays with 10 center rows of button heads; all radial and expansion stays outside of the 10 center rows have straight threads in crown, riveted over; valve setting exhaust clearance and lead 3/16 in.; ash pan is arranged so that booster can be applied later without changes—air opening is 16 per cent of grate area; National dust guards; Woods side bearings; capable of taking 16 deg. maximum curve; Edna coal sprinkler; Chicago flange oilers; Ashton steam gauges; Gold Car Heating & Lighting Co. steam heat equipment complete; Pyle National Headlight equipment, including headlight case; King metallic packing; Commonwealth rear frame cradle; Commonwealth Delta trailing and tender trucks; American Arch Co.'s firebox, and Chambers throttle valve.



MOUNTAIN 4-8-2 TYPE LOCOMOTIVE FOR THE MISSOURI PACIFIC RAILROAD
AMERICAN LOCOMOTIVE COMPANY, BUILDERS

The following specialties are used in common on all three types of engines:

Twenty per cent of tubes beaded at front end—tubes and flues welded in firebox sheet; No. 5 Reflex water glasses; O'Connor firedoor flange; Madden ashpan; Unity safety drawbar; Commonwealth tender truck, bottom equalized type; steam pipes—Cole outside packed type; Franklin adjustable wedges; Superheater Co.'s superheater—latest practice, including return bends and damper cylinder; Vilco AL 110 lead lined double sanders, with Viloco duplex engineer's sander valve, together with hand sander; Franklin grate shaker; Sargent Co.'s "Renu" gauge cocks; Okadee Co.'s blow-off cocks; Lindstrom siphons; Vissering & Co.'s bell ringer; Buffalo tender brake beams; Jemco unity spark arrester; Barco flexible joints; Consolidated safety valves, including bushing; Hancock injector checks;

Franklin No. 9 pneumatic firedoor; Elvin driving box lubricator; Miner draft gear on tender; Nathan & Co.'s injector, lubricators and reflex water glasses; Commonwealth engine bumper and tender frame; Johns-Manville boiler and cylinder lagging; National Malleable Castings Co.'s engine coupler, pocket, tender coupler and journal boxes; Alco type "E" reverse gear; Alco flexible staybolts and flexible expansion stays and Harter circulating arrangement.

The general dimensions of the Pacific locomotives are as follows:

Cylinder—Type, piston valve; diameter, 26 ins.; stroke, 26 ins.

Tractive power, simple, 39,500 lbs.

Factor of adhesion, simple, 4.21.

Wheel Base—Driving, 13 ft. 0 in.; rigid, 13 ft. 0 in.; total, 33 ft. 7 ins.; total, engine and tender, 67 ft. 3/4 in.

Weight—Working order, 267,500 lbs.; on drivers, 166,500 lbs.; on trailer, 52,000 lbs.; on engine truck, 49,000 lbs.; engine and tender, 435,700 lbs.

Crown staying, 1 in. Radial.

Tubes—Material, Seamless Steel.; number, 207; diameter, 2 ins.

Flues—Material, Seamless Steel; number, 32; diameter, 5 3/8 in.; thickness tubes, No. 11; flues, No. 9; tube length, 20 ft. 0 ins.; spacing, 7/8 in.

Heating Surface—Tubes, 2,155 sq. ft.; flues, 895 sq. ft.; firebox, 207 sq. ft.; arch tubes, 26 sq. ft.; total, 3,283 sq. ft.

Superheater surface, 778 sq. ft.

Grate area, 49.5 sq. ft.

Wheels—Driving diameter outside tire, 73 ins.; center diameter, 66 ins.; material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, rolled steel; trailing, 43 ins., cast steel; tender, 36 ins., rolled steel.

Axles—Driving journals, main, 10 1/2 ins. x 12 ins.; other, 10 ins. x 12 ins.; engine truck journals, 6 ins. x 12 ins.; trailing, 9 ins. x 14 ins.; tender, 6 ins. x 11 ins.

Boxes—Driving, main, cast steel; others, cast steel.

Brake—Operating, Westinghouse; driver, American; trailer, American; tender, Westinghouse; air signal, Westinghouse; pump 1—8 1/2 in. Cross-compound; reservoir, 2—22 1/2 x 84 ins.

Engine—Truck, Woodward; trailing, Delta.

Exhaust pipe, single; nozzles, 5 3/4 ins., 5 7/8 ins., 6 ins.

Grate style, rocking.

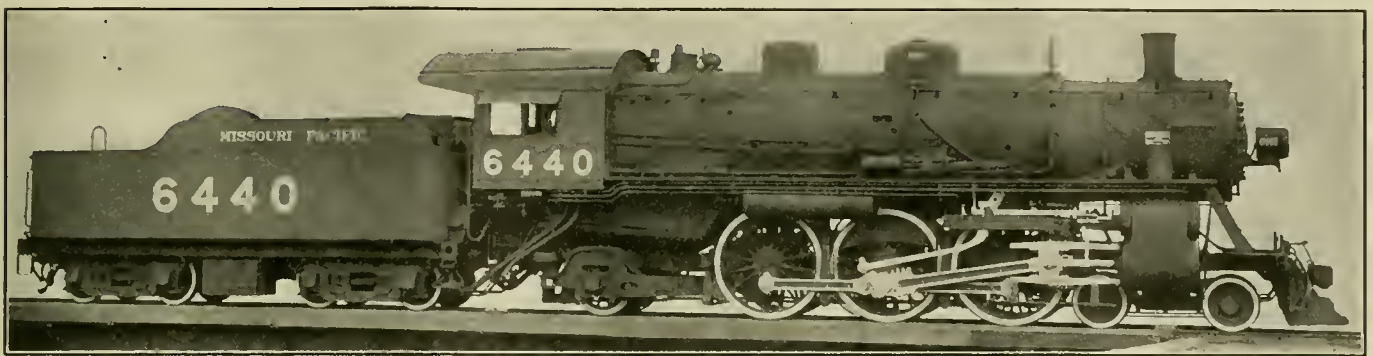
Piston rod, diameter, 4 1/2 ins.; piston packing, Snap Ring.

Smokestack—Diameter, 18 ins.; top above rail, 15 ft. 5 ins.

Tender frame, cast steel.

Tank—Style, Water Leg; capacity, 8,000 gals.; fuel, 14 tons.

Valves—Type, 14 in. piston; travel, 6 1/2 ins.; outside lap, 1 1/8 in.; clearance, 3/16 in; lead in full gear, 3/16 in.

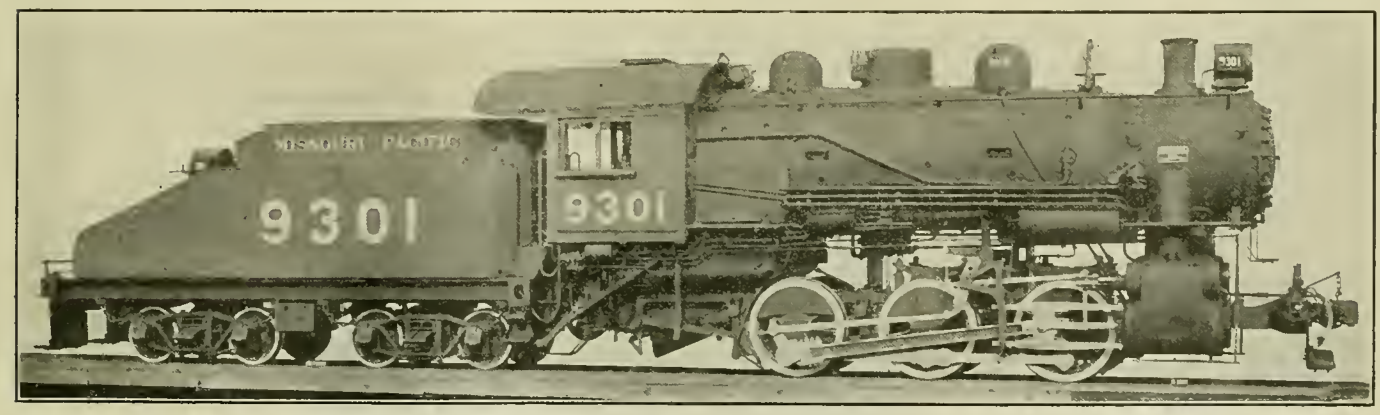


PACIFIC 4-6-2 TYPE LOCOMOTIVE FOR THE MISSOURI PACIFIC RAILROAD.
AMERICAN LOCOMOTIVE COMPANY, BUILDERS

The Pacific engines were equipped with the following specialties, which were not common to the others: The valve travel 6 1/2 ins. and the steam lap 1 1/8 in.; frame bracing—combined guide yoke and brake fulcrum casting making a box-shaped casting to strengthen frame ahead of first driver; cast iron solid piston head; steam pipe bolts at superheater header and at cylinders made of heat-treated steel.

The only specialty used in common by the Pacific and switching engines, other than those mentioned, is the Edwin S. Woods tender side bearings.

On the switching engines the National Malleable Castings Co.'s tender journal boxes and Sunbeam electric headlight equipment complete are used. In addition to this the Stanforge gear has been applied to one tender.



SWITCHING 0-6-0 TYPE LOCOMOTIVE FOR THE MISSOURI PACIFIC RAILROAD.
AMERICAN LOCOMOTIVE COMPANY, BUILDERS

Boiler—Type, Ext. Wagon Top; I. D. first ring, 72 3/8 ins.; working pressure, 193 lbs.

Firebox—Type, wide; length, 108 ins.; width, 66 ins.; thickness of crown, 3/8 in.; tube, 5/8 in.; sides, 3/8 in.; back, 3/8 in.; water space, front, 4 1/2 ins.; sides, 4 1/2 ins.; back, 4 ins.; depth (top of grate to center of lowest tube), 24 1/2 ins.

The following are the principal dimensions of these switching engines:

Cylinder—Type, Piston V.; diameter, 21 ins.; stroke, 28 ins.

Tractive power, simple, 39,100 lbs.

Factor of adhesion, 4.16.

Wheel Base—Driving, 11 ft. 6 ins.; rigid, 11 ft. 6 ins.; total, 11 ft. 6 ins.; total, engine and tender, 43 ft. 10½ ins.

Weight—Working order, 163,000 lbs.; on drivers, 163,000 lbs.; engine and tender, 287,800 lbs.

Boiler—Type, Ext. Wagon Top; I. D. first ring, 64 11/16 ins.; working pressure, 190 lbs.

Firebox—Type, wide; length, 78 ins.; width, 70¼ ins.; thickness of crown, ⅛ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4½ ins.; sides, 4 ins.; back, 4 ins.; depth (top of grate to center of lowest tube), 21½ ins.

Crown staying, 1 in. Radial.

Tubes—Material, Seamless Steel; number, 158; diameter, 2 ins.

Flues—Material, Seamless Steel; number, 24; diameter, 5½ ins.; thickness tubes, No. 11; flues, No. 9; tube length, 14 ft. 0 in.; spacing, ¾ in.

Heating Surface—Tubes, 1,149 sq. ft.; flues, 480 sq. ft.; firebox, 145 sq. ft.; total, 1,774 sq. ft.

Superheater surface, 393 sq. ft.

Grate area, 38 sq. ft.

Wheels—Driving diameter outside tire, 51 ins.; center diameter, 44 ins.; material, main, cast steel; others, cast steel; tender, 33 ins., cast iron plate.

Axles—Driving journals, main, 9½ ins. x 12 ins.; other, 9 ins. x 12 ins.; tender, 5½ ins. x 10 ins.

Boxes—Driving, main, cast steel; others, cast steel.

Brake—Operating, Westinghouse; driver, American; tender, Westinghouse; pump, 1—8½ in. C. C.; reservoir, 1—22½ x 72 ins., 1—22½ x 48 ins.

Exhaust pipe, single; nozzles, 4⅝ ins., 4¾ ins., 4⅞ ins.

Grate style, rocking.

Piston rod, diameter, 3½ ins.; piston packing, Snap Ring.

Smokestack—Diameter, 14 ins.; top above rail, 14 ft. 3¼ ins.

Tender frame, cast steel.

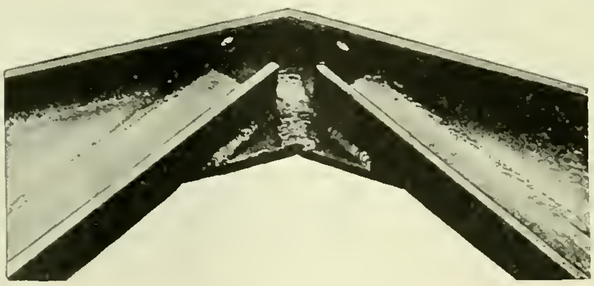
Tank—Style, Water Leg; capacity, 6,000 gals.; fuel, 10 tons.

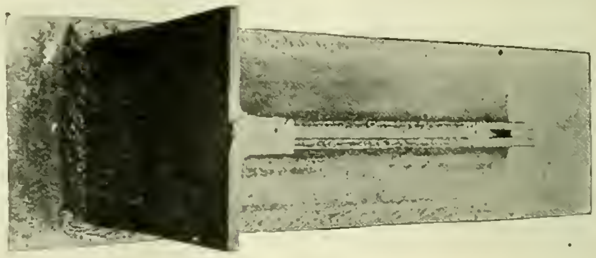
Valves—Type, 10 ins.; piston travel, 6 ins.; outside lap, 1 in.; lap or clearance, 0 in.; lead in full gear, 1/16 in.

In a later issue there will be published a description of the Mikado engines forming a part of this order, which will include the more interesting features peculiar to them.

Arc Welding Supplants Rivets for Structural Work in New and Important Industrial Structures

That arc welding is continually finding new and important industrial applications is being demonstrated by numerous reports of successful welding. In a recent publication issued by the Westinghouse Electric & Manufacturing Company, entitled "Arc Welding Applications," many interesting and novel uses of arc welding are explained and illustrated.

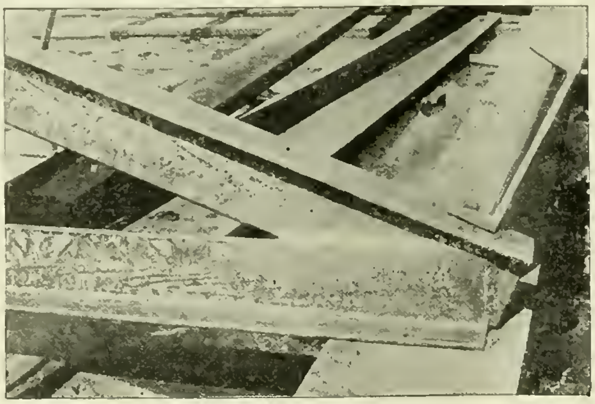




One of the applications shown is the first structural steel building ever erected without the use of rivets. The electric ars was employed throughout the entire construction to unite the structural steel members. Inasmuch as the entire construction was tested and approved by the New York Bureau of Buildings, the arc welding process for this line of work has passed from the experimental stage to the practical commercial stage. The trusses are designed for a live weight of 40 pounds per square foot, each truss supporting a panel of 800 square feet. They were tested at a load of 120 pounds to the square foot, or a total load of 48 tons on the two trusses.

The main advantages of arc welding, for this work, are the elimination of the necessity for fabricating the steel parts and the saving of time in waiting for the girders to be fabricated. Another decided advantage of the arc welding method over that of riveting is that it does away with the noise of riveting and makes it possible to work day and night without causing any disturbance.

This unique example of the use of arc welding has aroused a great deal of interest in the building trades and industrial plants. Although no extended use of this principle has been made as yet, it is quite possible that great development may be made in the near future.



Testing of Welds

A number of ideas have been suggested for the testing of welds. Some shops require their welders to make sample welds each month, which are tested and the results posted on a blackboard for all the shop men to read. This has both its advantages and disadvantages. Another plan is to cut out a section of a weld, where it is practicable, and examine it for fusion and porosity. If the welder does not know just when his work is to be tested, he is likely to be forced to constant care. We know of some cases where welders are being required, after making a good sized weld, to stamp their initials and the date alongside of the job so that there can be no question as to responsibility for workmanship, if the weld fails. The testing of welds is of vital importance and it will be of interest to many to learn that a special committee of the American Welding Society is devoting considerable attention to the question.

Federated American Engineering Societies Reports on Elimination of Waste in Industry

The Committee on Elimination of Waste in Industry of the Federated American Engineering Societies have performed a notable service in preparing and issuing a comprehensive report, and which has just been released for publication. It will be recalled that in November last year, Herbert Hoover was elected the first president, and among his first acts suggested a study into the restrictions and wastes in industry. On November 20 the executive board authorized the appointment of a committee to make such an investigation and immediately thereafter the general plans were drafted and a small preliminary committee selected. On January 12, 1921, Mr. Hoover named fifteen engineers as the Committee on Elimination of Waste in Industry and added two others at a later date, making the membership eighteen in all.

The essence of the plan was to gather quickly such concrete information as might be used to stimulate action and to lay the foundation for other studies. It was believed that a limited, yet carefully studied volume of findings obtained through a rapid, intensive study would not impair the value of the facts disclosed or the validity of the recommendations based upon them. So within less than five months the committee completed an assay or analysis of waste in six typical branches of industry, and presented a summary of its findings to the American Engineering Council. This took place on June 3, 1921, in St. Louis, at which time a condensed news abstract was given to the press. The final report is now presented in the name of the committee.

The original plan contemplated ten investigations in the field, including transportation and coal mining. The studies of transportation and bituminous coal mining have not yet been completed to be included in the report before us. A considerable investigation was made in both cases but it was found that these two fields were of such large proportions and the situation inherently so intricate that adequate studies could not be made with the time and funds available.

The industries selected for specific study are of great public interest and importance, for their operation directly affects the daily life of everyone. The work of the investigation has been carried through at cost or less. The engineering firms which made the investigation have been reimbursed only for the actual salaries of the men in the field and for their traveling and clerical expenses. The report is the first work undertaken by the Federated American Engineering Societies in rendering public service. It discloses losses and wastes due to the restraint and dissipation of the creative power of those who work in industry. It lays the foundation for knowledge of the destructive influences which have too much controlled in the past. From this knowledge will grow the conviction that mental and moral forces must be added in a much larger degree, to the physical resources now employed if industry is to serve all who are dependent upon its continuous and effective operation

The general observations embodied in the report are of a kind that applies to almost every industry, and while, as we have stated the involved problem of transportation generally and railroads particularly has not yet been completed, much of the report that is so far published applies to the railroads as well as other industries. In referring to materials and equipment the committee recommend that materials should be standardized to the fewest practicable kinds, sizes and grades and that the details of equipment including machines and tools, should be standardized so as to permit of the widest interchangeability and maximum usefulness consistent with improvements and inventions.

Performance standards should be developed as a valuable aid to planning and production control. Under the week-work system such standards are the basis of a just measurement of the individual workers' performance and of the adjustment of his wage rate to his capacity. Under the piece-rate system they are the basis of just rates. Without standardization of appliances, conditions, work content and method, no valid performance standard can be maintained.

By constantly comparing actual performance with the standards and promptly investigating the causes of the departure from standards, the manufacturer can quickly detect adverse conditions as they creep in, and rectify them. Performance standards, in fact, will enable him to plan the size of his plant and operating force for a given volume of business for continuous operation.

Experience indicates that the best results can be obtained when employment and personnel direction develops a sense of mutual interest in production on the part of management and workers. To accomplish this management should stimulate the interest of workers, individually and collectively, in creation, in craftsmanship and in the contribution of their experience and knowledge to the productive processes. "Industrial relations" to be effective should be closely allied to production and concern itself with educating the workman in the science of process, recording his accomplishment and enabling him to become conscious of the relationship of his work to the whole.

During the past few years, there has been a widespread advance and extension of employment and personnel methods in industry and many of the accruing advantages are now generally known. Among these is a means whereby the worker has a direct avenue of approach to his employer, and the employer has a means for communicating organization policies to the employee.

Such industrial education and training as has been conducted by certain leading manufacturers has obtained beneficial results, and it is believed that further developments along these lines is desirable.

Management has a definite responsibility to prevent industrial accidents. Systematic preventive measures can and should be inauugurated. With regard to methods there is already an abundance of information.

In regard to industrial research it should be consistently carried on, both in the individual plant and by associations. The seed for knowledge obtained by such research is manifest in every industry studied. Although comparatively new in this country, the success of research laboratories conducted by a few large industrial firms and trade associations is well known.

In discharging its responsibility for eliminating waste in industry, labor should cooperate to increase production. The need for facts instead of opinions stands out everywhere in the assay of waste from intentional restrictions of output. All concerned need to remember that science is an ally and not an enemy, and that no policy can be soundly based which ignores economic principles. Ignorance of these principles lies at the root of most of labor's restriction of output. The engineers who made the field assays unite in pointing out that this attitude is beginning to change. The change should be agressively led; not allowed to drift. Labor organizations have an opportunity today which may not soon occur again to draft for themselves a new bill of rights and responsibilities. Unions are now great organizations with such funds and personel at their disposal as would have seemed fantastic even a quarter of a century ago. Their influence permeates the whole of American industry, unionized or not. No service which they can render can be socially more valuable than that of studying the needs of the industries in which they earn a livelihood, and allying themselves with the technicians who serve with them to increase production, which will inure to the ultimate benefit of all.

Labor should cooperate to prepare for and even demand the determination and use of performance standards. The unions rightly insist on reasonable hours and the best pay obtainable but to discharge a responsibility in eliminating waste they should lend themselves to the greatest flexibility in the utilization and economy of the services of their members. It is the worker's interest rather than to his detriment that his services should not only be efficient but definitely recorded and evaluated.

Labor should change its rules regarding restriction of output, unreasonable jurisdictional classifications and wasteful methods of work, thereby removing some sources of waste.

Certain restrictions probably have seemed necessary to labor as a basis for trading with employers. This report is concerned with restrictions only in their relation to waste. It recommends a revision in the light of the strength and standing of organized labor today. The trading basis is not sufficient justification for union rules.

Labor is responsible no less than management for improving the health of the workers and for preventing accidents in industry. Unions have accomplished much in protecting their members through educational work in health and safety, but there is still much to be done, in cooperation with management and community organizations.

Periodical physical examinations and medical advice have resulted in a number of instances in substantial improvement in the health and well-being of workmen. In many cases, however, there exists a strong prejudice against such examinations. As a result of this unfortunate attitude many workers live in subnormal health when their condition is easily remediable.

Inasmuch as the organization of personnel relationships in industry can only be accomplished through the cooperation of both employer and employee, labor should assist in such work of organization and in maintaining and utilizing the structure developed. Among the most important causes of industrial discontentment are those connected with waste in industry; intermittent employment, fear of unemployment, lack of scientific and accepted methods of determining wages and hours, inequalities of opportunity, ill health and industrial accidents as well as those caused by backward management and restrictions of output.

Public and semi-public agencies can assist by definitely encouraging and supporting the efforts for elimination of waste. Bodies such as local chambers of commerce and other civic and community associations can bring influence to bear through local conferences with the different branches of industry. In particular such effort might be directed toward the construction of dwellings, the furtherance of public health and the prevention of non-industrial accidents.

During the past seven years the U. S. Bureau of Labor Statistics has gathered statistics of strikes and lockouts from various sources and has published them in the *Monthly Labor Review*. These figures are not comparable with the statistics contained in the earlier reports either in completeness or in accuracy. The bureau has not undertaken any special field investigations, and it has no authority "to require reports relative to strikes from anyone."

As the extent of seasonal employment and temporary shutdowns and lay-offs has not been subjected to a general statistical measurement, the resulting industrial waste cannot be determined with any degree of accuracy. There are no employment figures comparable, for instance, to those collected in England by the Board of Trade.

A body of principles for the adjustment of labor disputes should be accepted which can be developed with experience.

Thus far American legislation for the settlement of these problems presents almost as many varieties as there are states. The nomenclature of the bodies created to deal with controversies between employer and employee may in many cases be the same, but their duties and manner of appointment differ widely. Almost the only consolation to be drawn from this legislation is the fact that it recognizes a need. In no state has the existing machinery shown itself capable of meeting a great crisis.

No federal legislation has resulted from the recommendations of the Second Industrial Conference (1919)—the most comprehensive attempt yet made in America to meet this pressing problem. In view of the waste resulting directly and indirectly from labor disputes, there is obvious need for wisdom to create and operate successfully agencies endowed with sufficient power and vision to adjust or to stop the destructive and needless controversies over labor questions.

The largest area of waste lies in the periods of slack production and unemployment, due to the ebb and flow of economic tides between booms and slumps. Studies of industries as a whole show that we usually expand our equipment at the periods of maximum demand for products instead of doing our plant expansion during periods of slack consumption. While it cannot be expected that all industry could be so stabilized as to do its capital construction in slack periods, there are some industries which could be led in this direction by cooperation with the government and cooperation among themselves. This applies particularly to railways, telephones, telegraphs, power concerns and other public utilities, and to expenditure upon our municipal, state and national public works.

The duty of engineers is a part of all the responsibilities previously stated in different recommendations. Engineers come in contact with and influence every activity in industry and as a body possess an intimate and peculiar understanding of intricate industrial problems. They are in a position to render disinterested service and their peculiar responsibility is to give expert judgment wherever engineering training and technical skill are needed to reach a just decision.

This report brings forward certain pressing problems concerning the solution of which engineers should hasten to assist. The assays of waste show first the need of definite and quantitative industrial information on a multitude of points. Science has pushed ahead in some directions; it lags behind in others. The duty of the engineer is preeminently a duty to enlarge the boundaries of knowledge. His lifelong training in quantitative thought, his intimate experience with industrial life, leading to an objective and detached point of view, his strategic position as a party of the third part with reference to many of the conflicting economic groups, and above all his practical emphasis on construction and production, place upon him the duty to make his point of view effective.

Nickel-Chrome Steel Bridge

It appears that the Germans constructed a bridge of nickel-chrome steel instead of mild steel, some nine years ago. This bridge has been in constant use and has proved satisfactory, no repairs having been necessary. The nickel-chrome steel used has thus fulfilled expectations, and proved to be a suitable material in cases in which low weight without loss of safety is essential. The bridge is a single-track railroad bridge, the main girders, which are of nickel-chrome steel, weighing 35 per cent less than if mild steel had been used.

Cars in Increasing Demand

The Car Service Division of the American Railway Association reports that so far as are obtainable the number of surplus freight cars on American railroads are rapidly lessening in number, the total in the last week in June being 4,266 greater than that reported in the second week in July. The number of surplus coal cars was also reported to be lessened. Greater demand for stock cars was also reported, while the reports so far received for August show the same increasing demand.

The Necessity of Raising Timber for Railroad Ties

In the growing assurance of an early revival of improved conditions in all matters affecting the welfare of the railroads, it is well to remember that there is, perhaps, no larger subject than the conservation of timber. It is a national subject. A trip through the wooded districts, particularly in the mountainous regions of the west, teaches us something of the depletion of timber areas. That full provision has not been made for the supply of timber for railroad ties, and for which there will be a generous demand in the coming years, is already well known to railroad men. When we realize the fact that nearly three thousand ties are used in each mile of railroad track, and that even the best available timber does not last more than from six to twelve years, some idea of the vast amount of timber required becomes apparent. Not only so, but in the very nature of things, it is one of the growing necessities, and while some of the leading railroads have given considerable attention to the subject by making provision for planting trees, the greater number have given the matter little or no attention. It is well known that the forests, particularly in the north, cannot stand the drain for any considerable length of time, nor can it hardly be hoped by any reasonable effort in reforestation to keep abreast of the demand. The timbers used are mostly slow-growing ones, with the exception of some kinds of pine, and even those take from thirty to forty years to attain sufficient size.

As is well known the street railways have tried various means of saving their ties, and as it is, the practice to use concrete over them, there is difficulty in getting at them when repairs require to be made, they are generally allowed to remain untouched until the track requires to be taken up. Ties have been tried which are made of concrete, reinforced, and having a small pocket into which a wooden plug is inserted after having been treated with preservative, the object being to give greater resiliencey to the rail, so that there is a combination of wood and concrete. The preserving process has been proved to be an excellent thing in prolonging the life of ties, provided it does not cost too much, but the railways generally are at a disadvantage, as they either have to buy the ties from the firms treating the ties, or transport them to the treating plant, besides the cost of creosoting and the cost of freight rates when the ties are returned, so that it makes this creosoting process very expensive, at least doubling the cost of the tie, making in many cases, the concrete ties with the wooden insert cheaper, depending, of course, of how much it would now cost for a sufficient supply of concrete. The concrete tie with the wooden insert has, for some years, been used to some extent on the Pennsylvania and New York railroads, and in many instances the creosoted wooden plug has been used.

The present, or at least the impending necessity, can only be met in two ways, one by increasing the life of the timber tie and the other by using some other material, such as steel or concrete. Many experiments have been made in the latter expedient, and it is generally claimed that they have not been altogether satisfactory from an economical point of view, and at a time when steel and concrete could be procured at much less cost than at present.

The first expedient is the only one which has come into any considerable use on this continent and it has usually taken the form of injection of creosote into the pores of the wood. This acts as an antiseptic, preventing the bacterial growth which results in decay through what we are accustomed to call "rot." The creosoting process, while a great advance on the use of raw woods, is by no means a perfect cure; first, because it is expensive, nearly doubling the cost of the tie; second, the timber is somewhat weakened in the process, owing principally to the high temperatures to which the wood is subjected; third, to be at all effective the timber should be thoroughly seasoned or dried, and this is hardly practicable by existing means except by the consumption of a large amount of time and space and the locking up of a considerable amount of capital for that time. In some European countries, ties are stacked and air-dried for eighteen months or more, before treatment, and even then do not get a dry tie or perfect product, and in America it seems to be seldom that more than one-third to one-half of this time is allowed.

According to notable chemists, dry woods or cellulose are almost indestructible by any ordinary agency such as the tie is exposed to. The bacterial growth requires moisture and oxygen for its development. It would appear, therefore, that if we thoroughly dry a piece of timber, and keep it dry, it will last indefinitely. We know from actual experience that this is so. Everyone has used or seen old timber in the form of beams and joists taken from buildings two or three centuries old and perfectly sound. In these cases moisture has been excluded. Again, every one has seen or at any rate read of piles and foundation timbers many centuries old in a perfect state of preservation. In these cases oxygen has been excluded. We all know that exposed timber will generally last longer when coated with paint or tar or some waterproofing material. The exceptions are where the timber has been waterproofed before it was seasoned, with the effect of retaining the moisture already in the stick and preventing its evaporation. Timber, even when air-dried for a considerable length of time, still contains fifteen per cent or more of moisture, the percentage varying with the nature of the material and the size of the stick.

One of the main reasons for much of the substitution of steel for timber in the recent past has been the growing scarcity of the latter and the cheapness of the former, but still more recently the conditions have been reversed and steel has become very difficult to obtain while timber has not increased in price in the same ratio. These, of course, are largely temporary conditions brought about by the exigencies of the late war, but it seems that they are not going to readjust themselves as speedily as might have been expected.

Practically all of our dimension timber has come from the Northwestern or the Southern States, and the cost is largely a matter of freight rates. Freight rates are based chiefly on weight. If thirty or forty per cent of moisture, which many of our timbers contain, can be removed and at the same time increased strength be added by proper treatment before the timber starts on the journey, it follows that smaller quantities will often answer the purpose, and that these quantities will be lighter in weight and cost less per cubic foot, so that there is a double gain that in the aggregate will be an important consideration.

In regard to the drying of timber, one of the principal items of cost is for fuel for drying, and the price of coal is high at present. Then follows the problem as to whether the ties can be successfully waterproofed and kept dry. Asphalt and coal-tar pitch have been tried and asphalt failed in many cases. The pitch has a penetrating quality which the asphalt does not possess. Birch is a very durable timber when dried through and through. Lignum Vitae is of great endurance, but except in a limited degree in Central America is not available, the supply commanding prices for other purposes than being laid in the earth. The growing problem has received some attention in the past, and if the same degree of activity had been given to the planting of trees the situation would be less serious than it is. It can hardly be said to be a case where the sins of the fathers are being visited upon their children. It is rather an instance of the children indulging in more wanton destruction of the resources of nature than their fathers, in their pressing necessities, ever dreamed of in their fiercest onslaught on the primeval forests.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $3.50 or fifteen shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

The Debilitating Effect of Government Control of the Railroads

It seems to be generally agreed among statisticians and others that men commonly drop at least one-third of their former energy and efficiency after even a short season on the government pay roll. The commentators, perhaps, do not make allowance for the effort that it requires to get there. In many governmental situations this is the hardest task, and the place being once secured a counterbalance of relaxation naturally sets in. Not only so but many governmental places are the reward of activity not directly connected with the place secured. The lucky appointee has also to project his mind into the undiscovered future as to the ways and means of holding his "job" or securing something equally as good. An experienced office-holder becomes a chronic office-seeker. He has no hesitation in accepting anything that turns up from a dog-catchership to a fat commissionership. Usually, also, his expenses are mysteriously increased, and it is not all fodder that comes to his crib.

A microscopic investigation, however, shows that the cause of the inefficiency of the government employe lies deeper than this. It is generally conceded that the railroads have had the same experience while under governmental control, and it cannot be said that the officers or employes lost any sleep in securing their positions. They were there already. There is something relaxing in governmental service. The weakening influence affected the managers as well as the managed, or, rather, the mismanaged. They all seem to lie down together. There was a good excuse for the managers. The men who had formerly been accustomed to settle affairs on their own responsibility found that they had to pass all questions of any importance to Washington. At first they naturally resented this, but they soon found it to be a convenient and thought-saving practice. Had the system continued a few years more these men would have changed their mental make-up to something new and strange. They would have learned to evade any kind of responsibility and become mere place holders. As it is they could not be expected to recover their mental resiliency all of a sudden. In some cases the rest has done them good, in others it is doubtful whether they will ever be the same men again. A good man generally grows in a ratio to the responsibility that is put upon him. In government service nobody may properly be said ever to be responsible for anything, except, perhaps, the outward veneer of party allegiance, and even that is easily brushed aside if the other party offers sufficient inducements.

The falling off of the real workers should, therefore, not be wondered at. They are not blind. They can see where the money comes from, and it is folly to expect that men will work as hard under the guarantee of an overflowing public treasury as they will do under a strictly-managed corporation on the brink of bankruptcy.

Spare Time Study

We are constantly in receipt of letters from young men asking advice in regard to securing employment on railroads, and while, perhaps, there has never been a period in our experience when the opportunities were so limited, we deem it our duty to try to keep the lamp of hope burning because in the past, as well as in the good time coming, the ambitious, intelligent railway men had, and will have many advantages. Among these it might justly be claimed that there is a continuity of employment. They are not, generally speaking seriously affected by slumps in trade, by bad weather, or by tightness in the money market. Most also have a provision for their old age. There are facilities for free and cheap traveling. There is opportunity for promotion and increase of earning capacity. There is a constitutional course for the redress of grievances, and the management is always ready to listen and give sympathetic consideration to any honest representation. After the great upheaval of a war of unprecedented magnitude brought about by the warring blood of Europe, and which is not yet entirely rid of its war-breeding monarchies and socialistic absurdities, it would be idle to expect an immediate return to normal conditions. This is no reason why young men should lapse into despondency, but should rather take every possible means to acquaint themselves with an elementary knowledge which is so essential to a fair start in any calling above that of simple manual labor. Knowledge comes by reading, and reading should not be rapid and perfunctory, otherwise it is mere literary dissipation, and is of no more benefit than the bewildering balderdash of the ephemeral fiction that floats, sewer-like, into utter oblivion. The young railroad aspirant should procure elementary books bearing on the direction in which he desires to develop his mental and physical activity. He should not borrow books. Borrowing is a species of petty larceny that is annoying to the lender and degrading to the borrower. The engineering press also furnishes many valuable details that do not pass into books. Some of them have courses of study that are even ahead of the older matter in book form. At any rate he should read all he can afford to lay his hands honestly upon, and then read some more.

In addition to this, if at all possible, and if the mind is settled in full sincerity, a course of study should be taken up with a correspondence school of established reputation. A solitary student is apt to run into error or graitvate into indifference. A correspondence with master minds polished by education and grounded in practical experience is a real safeguard. In this regard we know of nothing better than the International Correspondence School at Scranton, Pa. The institution is now serving no less than 300 railroads, and their graduates are marked men. The intellectual growth arising from the educational work of this institution is incalculable. Those who have observed the phenomena of nature in a green field, a portion of which was purposely left to the unaided operations of nature and another portion to the scientific application of some approved method of fertilizing can judge at a glance the amazing effect. The studious railroad man may not be so quickly recognized, but his superiority cannot remain hidden under any cloud of favoritism for any length of time.

Not only so but the leading railroad executives have shown a laudable enterprise in encouraging the development of the educational institution to which we have referred, and the studious, quiet railroad man will find when the opportunity comes to enter the service, and the instructions cars of the institution are opened to him he will be able to say that his yoke is easy and his burden is light.

The Annual Report of Section III Mechanical

Owing to conditions with which everyone is familiar, there was no meeting of Section III Mechanical of the American Railway Association this year, but the several committees rendered very full reports which have been made public and their recommendations have been acted upon by the executive committee.

It would seem to the outsider that many of the topics dealt with should have been settled years ago, but the high-capacity car and heavy trains are bringing so many new problems to the fore, that the end is not yet.

This is especially brought out in the report of the committee on car construction, where attention is called to the unsatisfactory service rendered by helical springs as they are manufactured at the present time, for which there does not seem to be any good excuse, except possibly that of the difficulty of obtaining material of a suitable quality. But the charge that the process of manufacture is unsatisfactory would seem to spell negligence. With the furnaces now available and the possibility of accurate control and determination of temperatures, there should be no trouble in so regulating the process of manufacture that the best possible results obtainable with the material available should be secured. The recommendation that alloy steel be used is in a direct line with its adoption in other fields where stresses have been increased and weights reduced. It seems strange that the railroads should have waited for the committee to make these recommendations because it would seem to be a case where each individual could control the character of the springs delivered. For example, the recommendation that the springs should be ground so that at least two-thirds of the circumference should present a flat bearing surface at right angles to the axis of the spring, is something that any road could have specified. And because this has not been done, it is probable that much unnecessary truck and car deterioration has resulted.

The brakeshoe and brakebeam equipment also receives its due need of attention, for the head, shoe, key and beam all need attention. The fact that keys are so made that they can be driven down and still remain a loose fit leads to the recommendation that they be thickened at the center. Then the fact that the load is not always restricted to the central lugs, makes it necessary to test the heads for strength, when it was found that, in numerous cases, the strength of the head was not in proportion to the capacity of the beams. Under loads for which the beams were designed the deflection of the head amounted to a thirty-second of an inch in addition to the deflection of the beam itself. But whether this is sufficient to disturb existing brake rigging standards is a matter yet to be determined. It is interesting, in this connection, to recall the criticisms that were made a few years ago when the first brakebeam testing machine was exhibited at the June convention. It received a good deal of attention as a novelty but most visitors thought it an unnecessary refinement that would never receive really serious attention. And now the committee illustrates two machines for this purpose of 50,000 and 75,000 lbs. capacity respectively, and the testing of brakebeams has come to be as essential as that of boiler plate.

In the matter of specifications the committee on tests for materials makes one recommendation that will probably meet with hearty approval on all sides. "The frequent revision of specifications has been severely criticised by both purchasers and manufacturers" and is acknowledged to be a most undesirable state of affairs. To prevent this, the committee recommends that a definite time limit should be established within which no revising shall be made except for reasons important to the interests of the association and that this time limit should be placed at three years.

With the care that is usually exercised in the adoption of a standard, it certainly ought to have sufficient merit and be so founded on good practice, that it can stand unchanged for three years without being affected seriously by the improvements and changes that may be made in methods and practices in that time. It might not, perhaps, be well to make a Medes and Persians affair out of it for even the three years, but with the proviso suggested by the committee, a standard ought certainly to be left alone for as long a time as possible.

In the case of the report of the tank car committee we have another example of how things may not be as simple as they look. It seems passing strange that, with all the experience the world has had for a hundred years in the making of safety valves, there should be any difficulty in making one that would be tight when subjected to the pressure developed by the evaporation of volatile oils, and yet such is the case. The committee is still looking for a suitable safety valve that will remain tight up to a popping point of 25 lbs. to the square inch.

In the matter of dome covers, too, the committee is having its troubles. One paragraph of its report is an interesting comment on the failure of the average man to take thought. It seems that the Bureau of Explosives has taken a decided stand against the ordinary screw type of cover, because of the accidents that have occurred when an attempt has been made to remove it when there was a pressure in the tank. The report in commenting on this says: "It was expected that the escape of gas through the vent holes at the top of the screw portion of the cover would give adequate warning to a man of ordinary intelligence that internal pressure existed and that the dome cover should not be removed until this pressure had been relieved. The numerous casualties which have occurred because of the removal of the cover in spite of this warning show that a better form of cover is necessary." Which, being translated, simply means that men do not use intelligence in doing this class of work, for ordinary intelligence seems to be the equivalent of "no intellegence." So a fool proof cover is needed. It is something of a disappointment to learn from this same report that the welding of the sheets of the tank has cost so much as to be prohibitive. During the whole development of welding, this has been looked upon as a field where its successful application would be most probable. It does not appear that the forge welding is unsatisfactory, but is merely expensive. As for autogenous welding, the committee takes the position that it is not prepared to "recommend the acceptance of such tanks in advance of definite proof of the reliability of this method of welding." The simple solution of such a situation would appear to be the making of half a dozen or more tanks by those interested in autogenous welding, and put them in service until they have shown the reliability or unreliability of that method of manufacture.

These are some of the outstanding features of the reports, most of which may be regarded as reports of progress, and it is to be hoped that by another year, there will be such an improvement over present conditions, that the regular convention, with its discussions will be held.

Meanwhile the reports are of such a character that a full reproduction of them as they stand would not be of any great value when stripped of the reasons for the recommendations and without the elucidation that usually comes from the discussion in open convention. The presentation of the reports in abstract will be made in our next issue, and in a way that will present the gist of their matter without using the full text of the reports as they stand. This will place their substance before our readers without necessitating the reading of the full report.

Official Data on the Suspension of Railroad Employes

Between August, 1920, and March, 1921, no less than 604,756 employes on railroads were "laid off." At the first mentioned date there were 2,197,824 employes; at the latter date there remained in employment 1,503,068, showing a decrease of 24.5 per cent, being the largest reduction in the railroad service of which there is any authentic record. The greatest reduction occurred in the ranks of employes engaged in construction work, 71 per cent having been laid off. Approximately 49 per cent of the maintenance of way employes were suspended.

Apprenticeships in the Motive Power Department of the Grand Trunk Railway

It may not be generally known that the Motive power department of the Grand Trunk railway system has been a pioneer in the modern development of apprenticeship systems, which are now part of the educational features of a large railroad in North America. From a small beginning about sixteen years ago, in a few of the main shops, the system now in use has spread out to include instruction by a capable instructor at every shop and roundhouse where three or more apprentices are employed. There are a few places where less than that number are employed, but arrangements are such that these can be reached by correspondence lessons and periodical visits by a teacher, so that no apprentice working for the Grand Trunk railway in the motive power department is without the opportunity of improving himself along lines best suited to his advancement.

The wide range of work conducted in the motive power department makes it possible for the company to offer regular courses of apprenticeship in the following variety of trades: machinists, boilermakers, patternmakers, tinsmiths, coppersmiths, moulders, blacksmiths, pipefitters and electricians. All of these are available at the three main shops, located at Montreal, Stratford, Ont., and Battle Creek, Mich. The majority are available also at the shops at Ottawa, Ont., and Deering, Me. Machinists' apprentices are employed at all roundhouses, and their training is specialized on running repairs to locomotives. This line of work covers a great field, and affords the roundhouse apprentice a large variety of work and opportunity for study. A part of their time is given to machine shop practice.

Increases in the rate of pay are made regularly each year. The apprentice is required to try an examination each year, which will show the Master Mechanic and the superintendent of Motive Power that he has been diligent in his studies and that he has applied himself to his work. At each of the main shops there is an apprentice instructor, whose duty it is to supervise the education of the boys individually and to show by demonstration how machines should be run.

Each week every apprentice must attend class studies in mechanical drawing, mathematics, sketching, blueprint reading and points concerning machinery, locomotive parts and shop operations. Such portions of these subjects are taught as are needful for the particular education of the apprentice. These classes are under a capable instructor who also sees that every boy has regular shifts, so that he will be given an all-round education, and not simply learn how to work one machine or perform one operation. Later on, after his apprenticeship period is completed, he can specialize in one department if he desires.

An apprentice having satisfactorily completed his four years in the shop as a machinist, blacksmith, pipefitter, patternmaker, electrician or boilermaker, receives a bonus from the company. Roundhouse apprentices, who also serve four years, receive a bonus from the company upon satisfactory completion of their term. While no restriction is placed upon an apprentice to continue in the service of the company after the completion of apprenticeship, nevertheless the management prefers that all apprentices who have served their time remain with them, and appreciate their continued service.

The Exhaustless Supply of Coal

Now and then we hear an alarmist come forth with startling warnings of the fast diminishing of our coal resources. Recently a well-known geologist surprised the public with an array of figures along lines of scientific investigation. He brought out the fact that if the present wasteful methods of coal mining are not improved and if the consumption increases in the same ratio as it has during the past few years, by 1940 at least one-eighth of the country's available supply of fuel will be exhausted; and if there is not a careful husbanding or revolutionizing invention in the meantime, that the greater part of the original heritage of coal will be used or wasted by the middle of the next century, or at the most 200 years hence.

But many propositions involving a mathematical progression strike snags, so to speak, before going far. It is well that it is so, for mathematical progression soon runs into absurd figures. So, while there is perhaps no imminent danger of an early exhaustion of our coal resources, there must in the future be substitutes for coal to some extent to save us from plunging into a veritable debauch of coal exploitation. It is within a comparatively short time, the lifetime of men still living, that the demand for coal has increased from practically nothing to over six and a half tons per capita. Consider what such steps of future progress would attain! Is there any wonder that even scientists should become alarmed to some extent?

But, lucky for future generations, everybody does not see the coal situation in the same gloomy light. In a report from the Secretary of the Interior, Franklin K. Lane, in 1914 a diagram was shown illustrating the coal resurces of the United States. (*National Geographic Magazine*, February, 1914). Our total supply of coal was represented by a block of coal ten miles high, ten miles wide and ten miles thick. In other words, a block of coal of 1,000 cubic miles would equal our resources. Of this supply of coal only about two cubic miles had been extracted, a mere corner of the mighty cube.

Great Britain and Ireland are said to have a great store of coal. Belgium, France, Germany, Austria and Russia have a much greater supply. The deposits in Asia are so vast that even an approximation is not possible. China is supposed to have inexhaustible veins. Geologists have estimated the deposits of the province of Shansi, with an area less than that of the State of Missouri, at 1,200,000,000,000 tons. Siberia is also credited with deposits of inestimable extent.

With such vast deposits one would suppose that all of the coal of the world could never be used up, or at least not until all of our institutions of today have crumbled into dust.

The British Railways

Government control of the railways of Great Britain, which has existed during the past seven years, ceased on August 15. The financial reports show that while their net income has been doubled the expenditures have been trebled. Treasury grants have made up the deficit. Coincidently the Railways Bill has passed the House of Commons, and it is expected that the roads will be placed in the position of self-supporting commercial undertakings. The bill may be said to be a half-way measure between unfettered private operation of the railways and nationalization of the entire railway system, and is an earnest effort to obviate the objectionable features of both of these forms of operation. Charges are not to be determined by the operating companies, but by what are known as Rates Tribunals, whose aim is directed to afford an annual revenue equal to that of 1913 when the financial condition of the roads were considered to be eminently satisfactory. Meanwhile the government has agreed to pay about $250,000,000 for the restoration of the roads to the physical condition they were in when the government assumed control.

Satisfaction over the terms of the new railway bill is expressed throughout the United Kingdom, as it is felt that both the railway companies and the trade-unions have gotten what they asked for, and at the same time the general public is protected by the tribunal which establishes maximum traffic charges. This Act, coming immediately after de-control, substitutes forms of regulation which are more far-reaching than anything known to the experience of the country, since it takes from the various companies the prerogative to make their own rates and settle differences with their own workmen.

For purposes of administration and to secure greater economies as to personnel, improvement in traffic, and general co-ordination in service the railway systems in the United Kingdom—composed of 27 great constituent and 96 subsidiary companies—are to be amalgamated into four main groups.

Snap Shots—By the Wanderer

In the good old days that were so bad when we were living in them, cars were smashed and more or less damage done by bad handling and there was some pressure, a little, put on yard crews to hurry their work. Still there was a limitation to this hurry by the fact that a man was always between cars that were being coupled together and that fingers and hands and arms were apt to be crushed by the link-and-pin arrangement then in common use. A little carelessness, a little anger, on the part of the engineer; a little delay or awkwardness on the part of the switchman meant disablement, and so many were the accidents due to car coupling that a loud and insistent demand was made by the public for something better than we had known and the automatic coupler came into being. Then, with the danger to the man removed, we immediately began to speed up our processes, and the cry came for stronger and stronger cars, because of the greater speeds of impact in making up trains and coupling cars. Damage to lading, and injury to cars increased about as the square of the speed, and claim agents were clamoring for more cars.

It is strange, this departmental view of railroad operation. Men in private life would not let an engineer burn oats in order to cut down coal bills, while his trucking costs had to pay for the oats. So why not let the cost of car handling and yard expenses go up a dollar if car repairs can be cut twice as much. But no, the hump track and the hustling conductor drives cars together at high speeds while the repairs mount up and the claims are staggering. And for what? The saving of a little time in the yard. And in the saving of this time, let us remember that impact increases about as the square of the speed, so that the blow at four miles an hour is four times that delivered at two.

I believe that the Rochester investigations showed that the spring draft gear would about close under the impact of a loaded car at two miles an hour. So why not cut down coupling speeds to that figure, waste a little time, and save couplers, draft rigging and car bodies to say nothing of lading damages and perishable freight lost through delay to bad order cars?

It takes a car about 11 seconds to run over a 33-foot rail at two miles and half that time at four miles an hour. So that in switching 250 cuts a day, the time lost would be about an hour and a half. It looks very much to an outsider as though that lost time would be time well spent.

So we are coming back to our old regime are we? And piecework has not been banished from our shops forever? Word comes that it has been re-established at Altoona on a basis that will enable a man to make more than the hourly wage, subject to readjustment as that hourly wage may vary. This puts the man on his own footing and cuts out that leveling down process by which equality is gained by making the best man as good and no better than the worst. Of course, it is not popular with the advocates of equality, but actual equality is a thing that does not exist, however much we may prate to the contrary.

This opposition to piecework often reminds me of a little scene that occurred at the Meadows shops of the Pennsylvania railroad, years ago, when piecework was being introduced.

The hourly rate for machinists was 28 cents and the piecework rate for men turning axles was made so that a little better than this could be made. Two men were working side by side on lathes of the same kind. On piecework the wages of one rose to 35 cents and those of the other dropped to 24 cents. So the latter went to the master mechanic and asked for a raise in the rate on the ground that he could not make day pay, and that it was not right to cut him like that.

His attention was called to the fact that his mate was making 35 cents. The man still demurred on the ground that he was not being treated fairly, when the master mechanic said: "Now see here, you have come to the wrong person in this matter. You ought to go to God. He did not make you as smart as that other fellow and your complaint should be to him and not to me."

It looks that way. So long as natural ability varies as it does, it seems a rather hopeless task for mere humans to try and level it.

An engineer friend of mine insists that there are very few fundamental principles in nature, and that if we could only have a complete understanding of them, our problems would be readily solved. For example, it is seemingly a far cry from a piano string to the tension bars of a testing machine, but they act alike, just the same. If the tone of a piano is allowed to fall and remain down for some time, and is then brought up to concert pitch at a single tuning, the tone will flatten or fall almost at once. Whereas, if the tone is dropped, it will sharpen, that is, rise. The reason is that when the string is stretched and compelled to yield, it will continue to yield after the pulling movement has stopped. This later yielding causes it to loosen and so drop in tone. In like manner, when a string has been under a stiff tension for a long time and that tension is relieved, it will continue to try and shorten after the actual movement has ceased and so will tighten and its tone will rise.

Some time ago an attempt was made in a testing laboratory to calibrate two testing machines and it was found that the indications varied under load. The columns of this machine were 5½ in. in diameter and 6 ft. 6 in. long and were made of from .24 to .28 carbon steel. There were four columns in all.

The machine was left under a load of 600,000 lbs., for seven days, before the columns stopped yielding. The variation in temperature had some influence on this, but it was found to be necessary to add about 2,000 lbs. to the load in order to take up the stretch of the columns.

When 100,000 lbs. had been removed and left for a time, the machine was again out of balance and the load, as indicated, kept increasing for ten hours. That is, it paralleled the piano string that sharpens after the tension has been relaxed. The next day 300,000 were removed and the same thing happened; that is to say, the apparent load kept on increasing.

We have known this about the piano string for years, and there is no reason why we should not have argued back that the same thing would happen to the big tension members of testing machine, except that we have had no occasion to notice it. Of course, these were heavy loads that were used, but where is the limit to this action? Is there any limit? Why should there be? If there is no limit, then aside from the motion caused by variations of temperature there must be this constant change of dimension and stress in all structures, and nothing can ever be in a state of perfect rest.

There is always more or less of tension between different departments of a railroad because each is trying to make a good showing even at the expense of some other one. But it does seem as though the mechanical department had a case against the transportation if complaints that I hear in the roundhouse have any basis in fact and there is good reason to think that they have.

It is said that reports of train delays are not made out with all of the impartiality, that true justice demands. For example if a locomotive is ordered for a certain hour and fails to be delivered at that hour to the minute there is apt to be a delay registered against the mechanical department for not having the engine ready. Whereas, the engine may be delivered on time to the second and then go out into the yard and wait for a hour or more for the train that is not ready, and yet headquarters hears of no delay on that account. Or it may happen that, due to slack inspection, a defective car may have been put in a train and has to be cut out after the train is made up and no report is made of this delay. Well! None of these things may amount to much, but they leave an unpleasant taste in the mouth and the men don't feel that they are being fairly treated.

And when men do not feel that they are being fairly treated, loyalty is not to be found. So in these days of strenuous endeavor to make things go smoothly, and increase efficiency, it looks as though some decrease in inter-departmental friction might not be a bad thing to look after. And for this a spirit of "I am at fault" to take the place of "Thou art the man" on the part of officials would be a very good one to cultivate. A fair field and no favor even to me, and you will be apt to get a long pull, a strong pull and a pull all together.

Improved Railroad Earnings Due to Deferring of Maintenance of Cars

Official reports show that the total revenue freight car ownership of Class 1 railroads of the United Staes,—those listed by the Interstate Commerce Commission as having gross annual revenue in excess of $1,000,000,—was on July 1, 1921, 2,342,823 cars. The corresponding ownership on July 1, 1920, was 2,369,871, or a net loss of 27,048 units during the year.

This apparent loss is further offset by an increase in the number of locomotives available for service during the year. There were owned by the Class 1 roads in the United States as of July 1, 1921, 65,-591 locomotives, while the corresponding figure for July 1, 1920, was 64,475, or a net gain during the year of 1,116 in number of locomotives available for service.

This gain represents not only increased capacity per locomotive available, but also fills the greater need, as compared with cars, for increasing transportation capacity of the railroads. Increased power will handle with greater efficiency the cars which are available for service, while to increase the number of cars without increasing the number of engines will but add to confusion in times of abnormal activity.

That the railroads are continuing to re-equip themselves with freight cars and locomotives is evidenced by the records that they are, as of July 1, 1921, 11,821 freight cars and 194 locomotives "on order," the majority of the latter being intended for freight service.

Deducting an arbitrary of 7 per cent allowance as a normal number of cars awaiting repairs under prevailing conditions, we would have a figure very close to 24 per cent of the available equipment now idle and awaiting commercial demands of the country—in round numbers, 567,000 cars, of which 373,000 are already for immediate loading and 194,000 are held in bad order conditions until demand arises for their use.

The current reports of revenue freight cars loaded indicate a total of about 775,-000 per week. The greatest average car loading heretofore reported in the last four years under the most favorable operating conditions and during a period of car shortage has been just over 1,000,000 cars per week. That is, the railroads are now loading and handling approximately 77.5 per cent of the carriers,—expressed in cars,—that they have shown that they are capable of doing.

Solving Railroad Transportation Problems

The transportation department of the University of Illinois College of Engineering has set out to solve railroad transportation problems. In some of the experimental work the college authorities are working in co-operation with the American Society of Civil Engineers and the American Railroad Engineers' Association, while in others the Illinois institution is doing free lance research work. Some of the railroad track studies have been in progress for some time, and are more comprehensive than anything of their kind hitheto attempted.

The question of how heavy rails should be laid to withstand the traffic of different weights and types of locomotives has been covered and an intensive investigation of all types of rail joints, to ascertain the proper length and shape, has been completed.

The railroad ties have not been neglected as they have been carefully scrutinized from all possible angles regarding their bend, their bearing in ballast, what happens if the ties are not tamped thoroughly or are tamped too much in one spot. Complete data have been obtained concerning the most efficient designs for steel and reinforced, concrete ties. Scientific observation of the ballast have included how the pressure is distributed downward from the tie through the ballast and laterally through the roadbed foundation so as to decide the exact amount of ballast essential for best results, particularly in cases where the roadbed is soft. For ordinary light traffic, gravel and cinders generally constitute satisfactory ballast, but where the traffic is heavy, crushed rock and broken stone are preferable. These tests will be continued and carefully re-checked until absolutely reliable data are obtained in conclusive amounts.

Idle Freight Cars.

The Associated Railway Executives report that 30 per cent of the freight cars of the country were idle in July. This, perhaps, may be considered more as a product of a trade depression that is passing than as an indication of a serious present stagnation in production. The slump in retail buying, of course, eventuated in factory inactivity; the recovery now taking place presages an early return to normal sales and manufacture.

The fact that the number of idle cars on July 1, 728,000, had been reduced by August 8 to 513,040, may be taken as a definite indication of accelerating industrial activity. It is confidently predicted that the railways will show aggregate net earnings of $500,000,000 for 1921, so that beyond doubt a real revival of industry has begun.

Of the cars listed as earning nothing on July 1, 15 per cent were in repair shops. As long as shipments remain at an abnormally low figure the railway managers may have reason to allow the replacing of the disabled cars to proceed at a leisurely rate. The repairing and installation of new equipment ought not be allowed to lag to a point where the roads might find themselves ill prepared to meet the demands of a revived trade. It appears evident that the tide has turned. It would be a serious mistake for the railways not to prepare for the change.

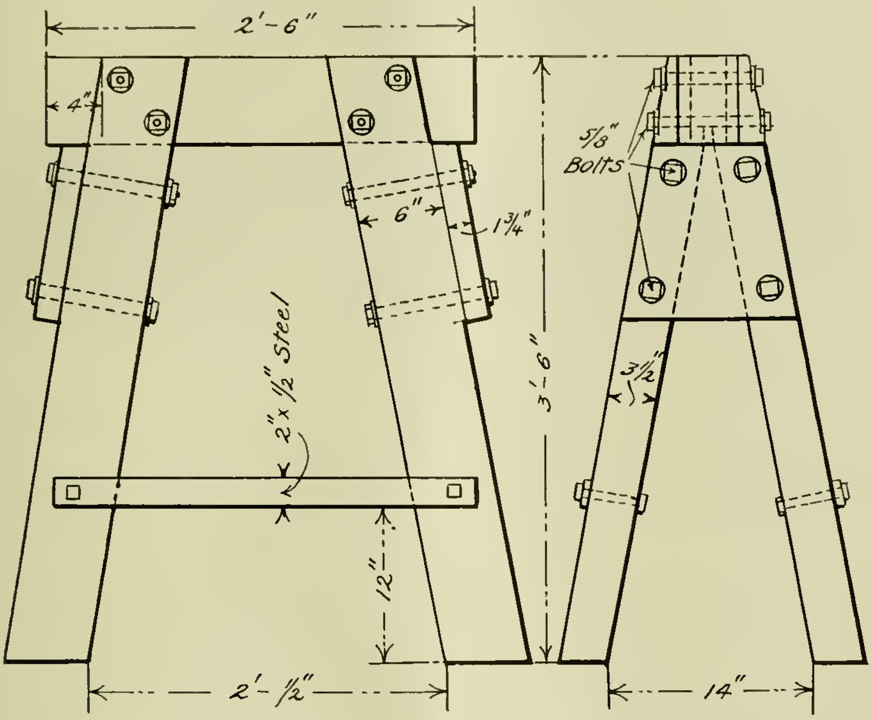
American Locomotive Company

In the report to the stockholders of the American Locomotive Company for the first six months of 1921, President Andrew Fletcher stated that the total unfilled orders for locomotives, reconditioning of old locomotives and for miscellaneous work on June 30, 1921, was $4,595,-598, of which domestic business was 11.5 per cent and foreign business 88.5 per cent, the foreign business being mostly for Japan, China and South Africa. Mr. Fletcher further stated that it is difficult to forecast the future business of the company for the next six to twelve months. At the present time there are but few orders for new locomotives, either for domestic or foreign use, but there is encouragement in the fact that the administration of our government is working on many different problems affecting the prosperity of the country, and we are hopeful that the railroad and transportation matters, so vital and far-reaching in effect on the general business of the country, and particularly to the business of the equipment companies, will be adjusted in the near future on a sound business basis.

In regard to the gross earnings of the company during the period under consideration, they amounted to $25,990,000 and the expenses including maintenance and $685,000 depreciation, were $21,391,000, and after paying taxes amounting to $655,-000 and some other unimportant items there was $3,901,000 available for dividends, and after the payment of the usual dividends $2,270,000 was added to the balance sheet surplus. No money will be spent on the proposed new plant at St. Louis until business improves.

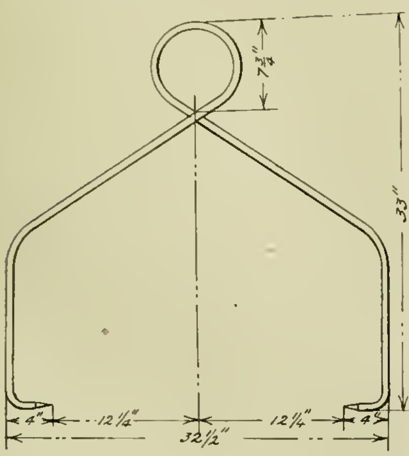
Handy Shop Tools Designed and Used by the Mechanics On the Erie Railroad

In the several shops of the Erie Railroad there are a number of handy devices that have been designed by the men either in charge of or doing the actual work of car and locomotive repairing. Some of them have been standardized for use in all shops, while others were designed to meet local conditions.



SHORT CAR HORSE IN USE ON THE ERIE RAILROAD

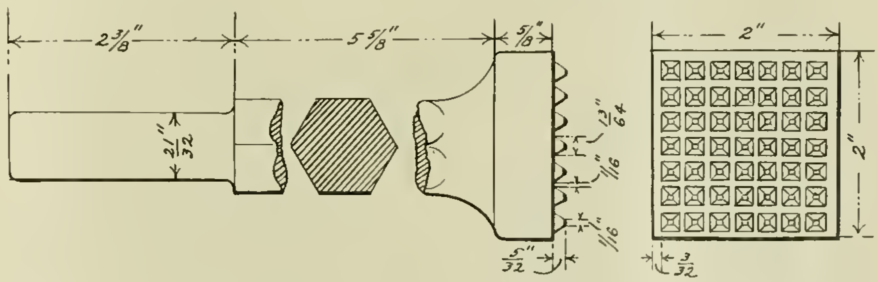
A number are merely shop conveniences common everywhere, but which have here been put in standard form for ready duplication. Such a case is found, for example, in the short car horses for holding cars in the repair shops when the trucks have been removed. They are substantially made and bolted together with a leg base measured on the outside of about 1 ft. 8 in. by 3 ft.



BARRELL HOOK USED ON ERIE RAILROAD

Another handy device is a barrel hook for transferring wooden oil barrels. It is made of round spring steel ⅝ in. in diameter of the dimensions given in the engraving. Its action is very simple: the points are sprung over the barrel and then, when lifted at the eye, they are pressed into the wood and the barrel can be safely lifted.

A boiler scaling tool for use in an air hammer consists of a shank fitted to enter the socket of the hammer and an enlarged square, the face of which is covered with a series of truncated pyramids 5/32 in. high and 49 in number. The shank connecting the two parts is made of 1 in. hexagon. It will be seen that, under the action of the air hammer, the impinging of the truncated pyramids on the scale will serve to remove it very rapidly.



BOILER SCALING TOOL IN USE ON THE ERIE RAILROAD

Among the many gauges and methods that have been devised for determining the depth of cut to be taken when turning steel wheels for sharp flanges, here is one that possesses the combined advantages of simplicity and accuracy. It consists of a thin plate gauge of the shape shown in *A*. On the horizontal arm a scale is ruled, as shown, and so set that, when placed on the tread of a new wheel, the extreme end of the scale at *B* will be in line with a straight edge placed against the back of the wheel.

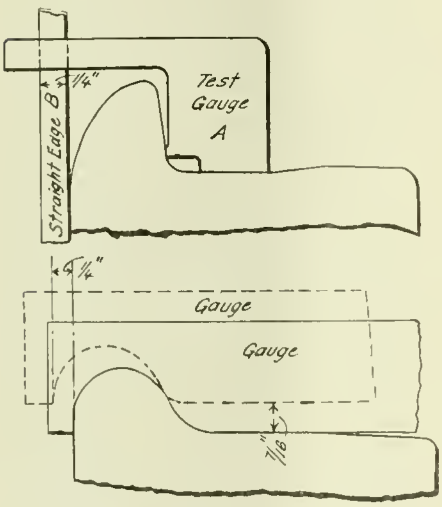
If the flange is worn the point *C* of the gauge will move towards the back of the wheel, carrying the scale with it. The distance that the straight edge moves in from the line *B* on the scale is an index of the depth of cut that is to be taken from the tread in order to build up a full flange. A table drawn up for use with the gauge gives this depth of cut and is as follows:

A Flange Worn	B Depth of Cut	C Diam. Reduced
1/32 in.	1/16 in.	1/8 in.
1/16 in.	1/8 in.	1/4 in.
3/32 in.	3/16 in.	3/8 in.
1/8 in.	1/4 in.	1/2 in.
5/32 in.	5/16 in.	5/8 in.
3/16 in.	11/32 in.	11/16 in.
7/32 in.	3/8 in.	3/4 in.
1/4 in.	7/16 in.	7/8 in.
9/32 in.	1/2 in.	1 in.
5/16 in.	17/32 in.	1 1/16 in.

In the illustration the straight edge is moved ¼ in. from the line *B*, which, according to the table means that, in order to build up the flange, it is necessary to take a cut 7/16 in. deep, thus reducing the diameter by ⅞ in.

The design of a very simple post jib crane is shown. It has a radius of swing of 20 ft. and a capacity of 2,500 lbs. The hoisting is done by means of a chain tackle hooked over the bar separating the two sides of the trolley.

This trolley is formed of two plates ⅝ in. thick of the shape and dimensions shown. The wheels are flanged and 4 in. in diameter and run loosely on 1½ in. axles. These axles are simply 4-in. lengths of shafts passing through the side plates of the trolley and held in place by split cotters. The boom is of 4½ in. by 1¼ in. flat iron, swelled at the end to take the 3-in. vertical pin on which it is pivoted. The pin is held by two heavy castings bolted to the post or column, one above and the other below the boom. These castings are made from the same pattern. The stay is of 1½-in. round steel and is held at the top by two castings iden-



GAUGE FOR TURNING WHEELS WITH SHARP FLANGES

tical with those used for the boom. At the outer end, the boom and the stay are connected by a 2-in. pin. The vertical distance from center to center of the boom and stay at the post is 6 ft.

The interesting feature of the design is its great simplicity. It requires but one casting, the pattern for which could be made by any carpenter; the forging can all be done in any blacksmith shop and the machine work where a drill and a hacksaw are available.

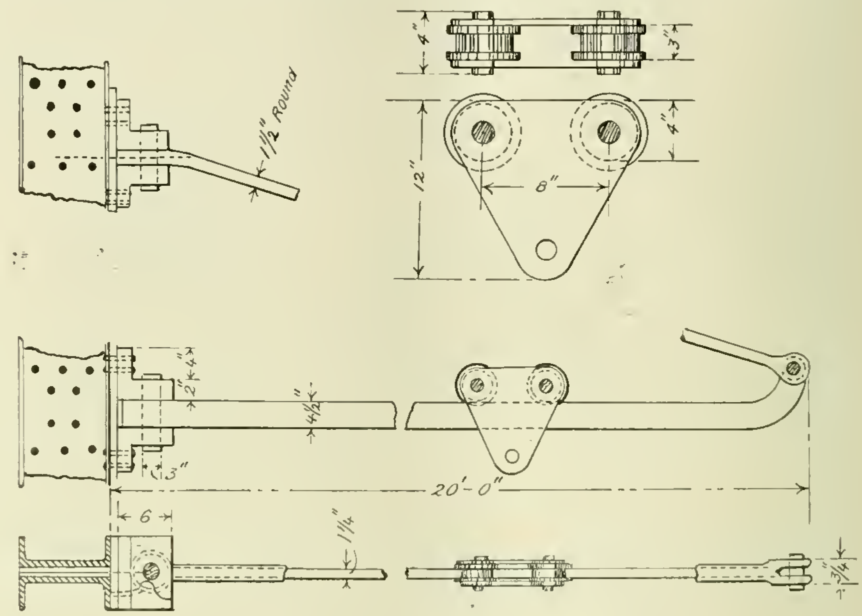
Another device of the same character is a tool room rack for bar tools: or it may be modified in the distance between slots and used for carrying air or other motors which are provided with operating handles extending out on each side.

It stands 6 ft. high and is formed of 3 in. by 1 in. iron. The spread of the legs is 3 ft., 9 in. Starting from a height of 14½ in. above the floor, the receiving slots are cut at intervals of 4¾ in. between centers and are 1¾ in. wide; a distance and opening that can be varied to meet any local requirements. It is cross-braced with 2½ in. by ⅝ in. iron and the whole riveted with ½-in. rivets.

It is simply a good, substantially built rack and is offered as a suggestion to those in need of a similar convenience.

Electrification of Italian Railways

Work on the general electrification of Italian railways is proceeding actively. At the end of last August, 10 roads, comprising a total of 797 kilometers, had been electrified. From September 1, 1920, to June 30, 1921, 5 additional roads, comprising a total of 234 kilometers, were electrified. During the current year, 434 kilometers of road will be electrified.

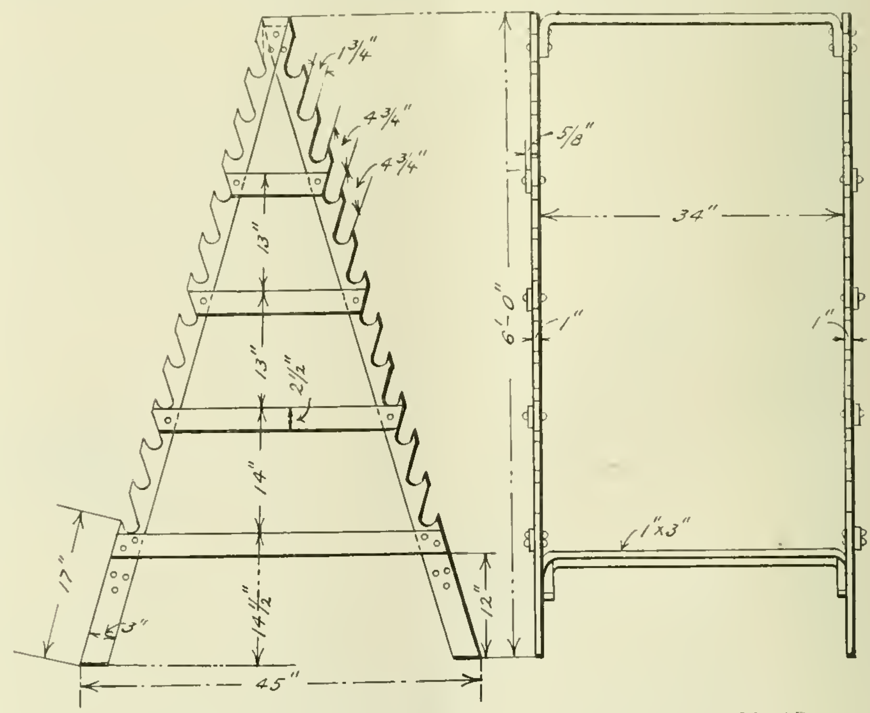


POST JIB CRANE USED ON ERIE RAILROAD

The saving in coal resulting from these electrifications amounted, at the end of June, to 160,000 tons. By July 1, 1922, it is calculated, the saving in coal will reach 1,000 tons a day, causing a daily saving of 200,000 lire, or 70,000,000 lire annually.

At the end of August, 1920, the sole generating plant worked by the railways of the State was that of Mordegno, with a capacity of about 5,000 horsepower and normally working with about 3,800.

Various works have now been begun and are being carried on and finished by means of designs and contracts approved recently by the second section of the Superior Council of Waters, and which will soon be submitted for the financial approval of the Council of Administration of the railways.



TOOL ROOM RACK FOR BAR TOOLS IN USE ON THE ERIE RAILROAD

New Method of Making Hollow Drill Steel

There are various methods of making hollow drill steel. That in general use in the country is to use a drilled billet with a sand filled core. Another system, which is that generally used in Sweden, is to roll the drilled or pierced billet over a projectile or ball as in ordinary pipe manufacture.

In the Swedish material, a peculiar condition is present. The hole is badly decarbonized by the method of manufacture.

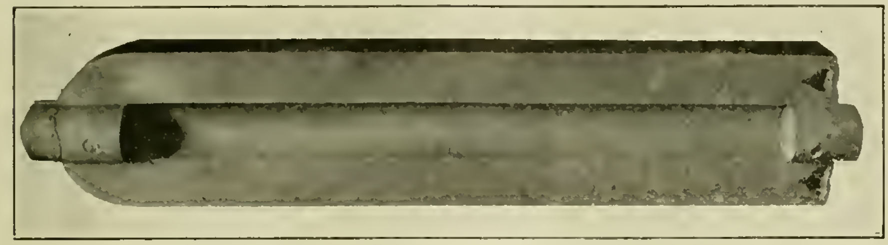
A question that seems worthy of deep consideration is this: Is this decarbonized core an advantage or disadvantage? If it is an advantage, why not duplicate this by controlled practice and not haphazard means of manufacture? If it is a disadvantage, why then is it that steel of this character has such a good reputation for being a good grade hollow drill steel? There is nothing in the steel that can be discerned microscopically or by analysis that proves it to be superior to hollow drill steel of good manufacture made by methods that prevent decarbonization of the hole. Therefore it is fair to assume that the decarbonized wall of the hole is an advantage. On investigating this subject it was found that hardened bars with this decarbonized hole do not become so intensely hard on the inside, neither are they so prone to cracking. Bars with radial cracks are of course bad, no matter what the system of manufacture.

The Ludlum Steel Co., of Watervliet, N. Y., have recently developed a method of making hollow drill steel that is giving excellent results, but without meeting the disadvantage of the Swedish method.

It consists in inserting a high-grade low-carbon mild steel tube suitably cleaned by a sand-blast, into an ingot mould and casting the hot metal around the tube. The tube is filled with an air excluding material so as to prevent oxidization and scaling of the inside of the tube. The material generally used is a high-grade sand.

The ingots, as cast, measure 4 ft. by 8 in. square and the tube is about 2½ ins. in diameter. They are first plugged at each end, as shown in the engraving and then cogged down to billets about 2½ ins. square. They are then cleaned, chipped and reheated and rolled to the size of the finished bar. In the case of a 1-in. hexagon, for example, this leaves a hole 5/16 in. in diameter.

After rolling, the bars are cut to the required length and the sand extracted by means of a sand blast working at a high velocity, the general appearance of which is shown in the engraving.



PLUGGED HOLLOW INGOT READY FOR ROLLING

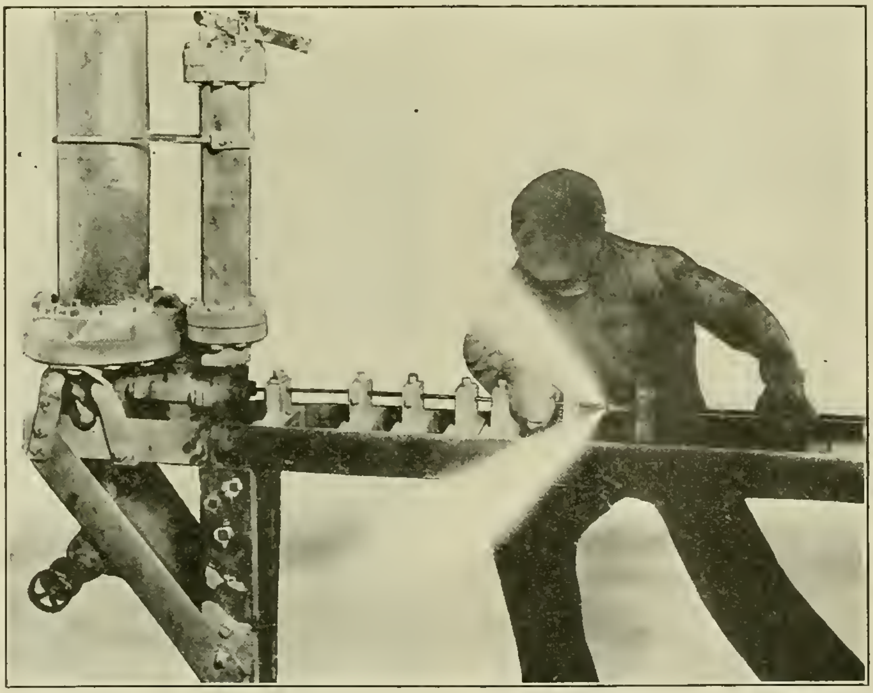
Hollow drill steel made in this way will have an artificially produced equivalent decarbonized core which will be free from any such tendency towards splitting and driving in radial cracks as noted above. The surface of the inside of the tube will be comparatively smooth, giving a uniform cooling rate to the inside of the bar, again reducing the tendency for a radial crack to start.

One of the reasons why the carbonless walls of the tube of the bars made by this method do not crack in manufacture is because the mild steel tube is not the result of a decarbonized steel highly impregnated by oxygen and oxides and having a number of microscopical holes where the carbon of the carbides last resided. These holes are places of weakness which may or may not weld up, depending on whether the interior of these microscopical cavities is coated by an oxide layer or filled with gas, either from the gas occluded in this steel or that which has penetrated from the furnace atmosphere.

Decarbonized steel produced from a metal of originally high carbon content, is probably weaker than a low carbon mild steel that has been worked down to the required size.

In the making of steel segregation is to avoided as far as possible, but it is a thing which must happen in all steel solidification and this is responsible for a certain mechanical weakness in the finished bar. If the segregation can be so located as to have a very little mechanical effect, it would be desirable to make the ingots in that manner.

Casting hollow ingots by the tube method is particularly fortunate in this respect. As the segregation which is bound to occur will be concentric with the hole and its maximum occurrence is about midway between the exterior of the ingot and the tube wall, this area is very large in circumference, comparatively speaking, and the segregation is comparatively small because the distance between the tube and the ingot mould is small. This thin layer of segregation will be most noticeable at the top of the ingot. It can have no effect or at most very little effect upon the bar,



CLEANING FINISHED HOLLOW DRILLED STEEL WITH SAND BLAST as the segregates do not, under any circumstance, creep through to either the exterior or the interior wall of the ingot. Segregation is not removed at all in the pierced billets from solid ingots and is only very indifferently removed in the case of the drilled billet. Furthermore, even if segregated impurities are removed by using only the butts of the ingots, and drilling the billets, there is still carbide segregation to contend with. This will run in straight or nearly straight lines, parallel with the wall of the ingot or the line of freezing.

The inside of the hole of a drilled billet must, therefore, necessarily be the weakest place in the billet, resulting in a weak bar. Progressive fracture is easily started from one of these many sources of weakness.

The smaller the ingot the less will be the tendency to develop surface seams or cracks. Steel will shrink about 3/16 to ¼ in. to 1 ft. and the steel as poured into the ingot mould will immediately freeze and contract to, say, one-half of the total shrinkage. As the inside of the ingot then begins to cool at a later time, the solid surface is trying to maintain a larger area than is demanded by the lower layers. The exterior of the ingot must then be crushed or the walls sink in, in which case it is under tension in a direction normal to the surface. If the ingot mold wall is concave the ingot when cooling will come practically straight, therefore the surface of the ingot must be under tremendous compression and just beneath the skin of the ingot or the depth of the first frozen layer the steel must be under tension, being held under constraint by the outermost layers, already in high compression. When the ingot is reheated it does not completely remove these strains, and when subjected to mechanical work the ingot will proceed to "let go" in various places, an action which will readily be conceded as being responsible in some measures for seams, cracks and defects of the character under construction. The smaller the ingot the less the actual amount of shrinkage.

Demonstration Heavy Tonnage Handling — Virginian Railway — by Westinghouse Air Brake Company

In the June, 1921, issue of this paper there was published a description of the test, conducted on the Virginian Ry. conjointly by the railway and the Westinghouse Air Brake Co., to demonstrate the efficiency of the double capacity brake made by that company.

The data there presented has been compiled and issued in the form of a handsome volume of 85 pages.

The book contains, in addition to the data given in the report of the tests above referred to, a description of the conception, development and equipment of the Virginian Ry.

The second section deals with fundamental principles underlying the development of the air brake equipment.

The third section deals with the features of the double capacity brake and its special functions.

These are:

The provision of a braking force sufficient for loaded cars;

The avoidance of enough retardation on empty cars to produce shocks;

To restrict the air consumption to the capacity of a 1¼ in. pipe;

To so arrange it that, in the event of the failure of a piston packing, it is only the individual car that will be affected;

The working in harmony with the brake equipment already in use.

In order to obtain this required amount of braking force for these extremely heavy cars, three cylinders are used whose diameters are 4 in., 10 in., and 16 in. respectively. And "in order to permit all of these cylinders to operate, it is necessary to manually unlock and move to 'load' position the handle of the operating mechanism." This is the movement of the "change-over-valve" handle to the load position.

"The change-over valve being in load position and the equipment charged up, when a single reduction, say, four pounds of brake pipe pressure is made, air pressure from the auxiliary reservoir is permitted to flow in to the 4-in. cylinder only. This is designated as the "take-up cylinder"—which is within the 10-in. cylinder piston, and is incorporated in the equipment for the purpose of taking up the free slack in the foundation brake gear and pulling the brake shoes against the wheels.

"When the reduction is sufficient to permit the auxiliary reservoir and the take-up cylinder to almost equalize, the transfer piston in the change-over valve will shift by spring action, and pressure will then be admitted on the face of the 10-in. piston. It will be noted that the take-up piston has a notched push rod, while the piston rod of the 10-in. piston carries on it a latch box containing a pawl. When the take-up piston has been forced out, carrying with it the notched push rod, as soon as the 10-in. piston has been forced outward 1 in., the pawl, being released, grips the notched push rod and the 10-in. piston delivers its force to the cylinder lever through the notched push rod.

"As in the case of the take-up piston, when the reduction is sufficient to almost equalize the pressure in the auxiliary reservoir and the empty cylinder, which will have only a very short travel on account of the action of the take-up piston, the load cylinder transfer valve will shift by spring action, and permit air pressure to flow to the 16-in. load cylinder. As in the case of the take-up piston, the load cylinder has a notched push rod which is pulled out by the action of the 10-in. empty cylinder, and similar to the empty cylinder the 16-in. load cylinder has a latch box and pawl, which on 1-in. movement will grip the notched push rod and the stress of the 16-in. load cylinder will be transmitted through its notched push rod. It will be apparent that the 10-in. "empty" and 16-in. "load" cylinders will each in their turn, in the "load" position of the equipment, apply their force with very slight piston travel, and, therefore, require but slight additional amount of air to secure the greatly augmented braking force required for such heavy cars when fully loaded.

"The equipment is so designed that it requires a reduction of about 10 pounds in brake pipe pressure before the load cylinder commences to function. This provides flexibility in the equipment so that with light reductions by the engineman, severe brake action will not be applied in the train; and if heavier brake action is desired, it is only necessary for the engineman to make a heavier reduction. With the equipment as designed, a braking ratio of 40 per cent. is obtained on the empty car when operating in empty position, instead of the usual 60 per cent. and 40 per cent. on the loaded car, instead of the usual 15 per cent. to 20 per cent. when operating in load position.

"The release of the brake in loaded position is accomplished in the usual manner and all three brake cylinders exhaust through the same port.

"If the retaining valves are turned up, the value of the retaining valve is retained in all three brake cylinders.

"The equipment is designed in the manner indicated so as to utilize to the fullest extent piston area, and by the use of the take-up piston and the notched push rods on both the empty and load pistons to reduce the piston travel, without interfering with shoe clearance and thereby reduce the volume of air required for the application. In addition to this, where retaining valves are used, in grade service, after the first reduction is made bringing the load cylinder into operation, all succeeding reductions required to bring the load cylinder into operation are much lighter."

The remainder of the book is taken up in the details of the demonstration with which our readers are already familiar. The book is copiously illustrated throughout with half-tone engravings of scenes along the route from Princeton to the sea, pictures of the equipment and other matters pertaining to the demonstration.

Items of Personal Interest

William J. Sheppard, car foreman of the Canadian Pacific at Revelstone, B. C., has been transferred to Nelson, B. C.

H. M. Righter has been appointed division engineer on the Erie, with headquarters at Susquehanna, Pa., succeeding Charles M. Lewis.

J. F. Streib, formerly assistant chief engineer of the Pressed Steel Car Company, Pittsburgh, Pa., has been appointed chief engineer, succeeding B. D. Lockwood.

Charles Copeland, assistant treasurer of E. I. duPont de Nemours & Co., Inc., Wilmington, Del., has been elected secretary, succeeding the late Alexis I. du Pont.

George L. Ernstrom, engineman on the Northern Pacific, has been appointed road foreman of engines of the Yellowstone division, with headquarters at Manden, Minn.

J. S. Allen has been appointed master mechanic of the Brownsville division of the Canadian Pacific, with office at Brownsville, Me., succeeding E. G. Bowie, transferred.

Thomas Allison has been appointed road foreman of the Pasco division of the Northern Pacific, with headquarters at Pasco, Wash., succeeding R. F. Wilkinson, granted leave of absence.

J. C. Garden has been appointed superintendent of motive power and car departments of the Grand Trunk, lines east of Detroit and St. Clair river, with headquarters at Montreal, Que.

E. J. Brennan, formerly superintendent of motive power of the Chicago, Milwaukee & St. Paul, Lines East, has accepted the position of sales manager of the Rogotchoff Company, Baltimore, Md.

Edward G. Bowie, master mechanic of the Brownsville division of the Canadian Pacific at Brownsville Junction, Me., has been transferred to the Schreiber division, Algoma district, with office at Schreiber, Ont.

G. H. Laycock, locomotive fireman, Canadian National Grand Trunk Pacific, Jasper, Alta., has been transferred to Edmonton, Alta., and J. E. Lewis, formerly locomotive foreman at Edmonton, has been transferred to Jasper.

C. H. Chambers has been appointed road foreman of engines on the Santa Fe, with jurisdiction on the second and third divisions of the New Mexico division, with headquarters at Las Vegas, N. M., succeeding J. D. Stewart.

John R. Leighty, assistant chief engineer of the Missouri Pacific, has been appointed chairman of the western group engineering committee on federal valuation of railroads, with headquarters at Chicago, succeeding H. C. Phillips, resigned, to engage in consulting engineering practice.

Col. J. N. Williams, chief engineer of the Northwestern Pacific, has resigned to become chief engineer of the Western Pacific. President W. S. Palmer and the leading officials of the Northwestern Pacific tendered a banquet to Col. Williams who feelingly expressed his regret at his departure.

W. L. Manning has been appointed assistant superintendent of stores of the Chesapeake & Ohio, with headquarters at Huntington, W. Va., and W. S. McDonald has been appointed general storekeeper of the Western division, and R. L. Morris, storekeeper, also with headquarters at Huntington.

Jesse B. Snow has been appointed engineer in charge of the construction of the freight and passenger tunnel in New York harbor between Staten Island and Brooklyn, and Charles B. Drew has been appointed principal assistant engineer. Col. W. J. Wilgus and John F. Sullivan are chosen as consulting engineers. Arthur S. Tuttle, chief engineer of the board of estimate and apportionment will have general supervision of the construction work.

OBITUARY

Henry F. Colvin.

Henry F. Colvin, eminent railroad engineer and manufacturer, died at his home in Philadelphia, on August 4. He was born in Plainfield, Conn., July 6, 1838, and entered railroad service as a fireman on the Delaware, Lackawanna & Western railroad in 1856, and was promoted to engineer in 1859. In a few years he was called to the Rhode Island Locomotive Works in Providence, R. I., as an expert in testing new locomotives in service. In this work he was eminently successful, and became widely acquainted with the leading railroad men of his time. Among his intimate associates were M. N. Forney, John A. Hill, Angus Sinclair, D. A. Wightman, J. Snowden Bell and many others. Much of their literary work was submitted to Mr. Colvin for approval or correction. His memory was looked upon as almost uncanny in its unerring accuracy, and he became much sought after as an authority on the development of the locomotive.

HENRY F. COLVIN

In 1876 he became identified with the Rue Manufacturing Company of Philadelphia, makers of the Rue injectors, and in 1878 was made general manager of the company, remaining in the position over thirty years. During this period he patented several improvements in injectors and steam jet apparatus. He was an active member of the Franklin Institute and contributed much notable work on the Committee of Science and the Arts of that institution, serving 29 years on this committee. Among other engineering works he patented the two-cylinder cross compound and the tandem compound locomotives built by the Pittsburgh Locomotive Works. His only son, Fred H. Colvin, is editor of the *American Machinist*.

Thomas S. Howland

Thomas S. Howland, vice-president of the Chicago, Burlington & Quincy Railroad, died in Boston, Mass., August 8. He was born in 1844, at North Dartmouth, Mass., and fought in the Civil War, and was mustered out at the age of nineteen as a second lieutenant. He graduated from the Lawrence School of Harvard University in 1868, and entered railroad service in the same year. He occupied many positions on the Burlington, beginning in the civil engineering department, and in a few years was transferred to the executive department. In 1883 he became secretary of the company, and latterly, in addition, vice-president and treasurer, his period of service with the Burlington extending over 53 years.

Henry C. Adams

Professor Henry C. Adams, University of Michigan, died at Ann Arbor, Mich., on August 11. Mr. Adams was born at Davenport, Iowa, in 1854, and graduated from the Johns Hopkins and Heidelberg Universities. In 1887 he was appointed statistician of the Interstate Commerce Commission and served continuously until 1911. He also served as advisor to the Chinese government as an expert on the standardization of railway accounts, and was the author of several treatises and books on financial and railroad subjects.

Epes Randolph.

Epes Randolph, president of the Southern Pacific of Mexico, and the Arizona Eastern, died at Tucson, Ariz., on August 22. Mr. Randolph was born in Lunenbery, W. Va., and entered railway service in the engineering department of some of the eastern railways, but his life work may be said to have been accomplished in the Southwest, where he was rapidly advanced to important positions on the development of the chief railroads in that region. Under Mr. Harriman, Mr. Huntington and other railroad builders his constructive ability was highly appreciated. Among other positions he was president of the California Development Company, where his engineering ability was said to have saved the entire valley when threatened by the overflowing of the Colorado river in 1906.

Franklin Manufacturing Company

Announcement has been made that General Charles Miller has assumed entire charge of the Franklin Manufacturing Company, Franklin, Pa. E. R. Rayburn, vice-president, will have charge of the sales department, with offices at 20 East Jackson Boulevard, Chicago, Ill. Among the specialties manufactured by the company are wool and cotton journal box packing, magnesia boiler lagging and pipe covering, train pipe covering, asbestos, millboard and cements.

Westinghouse Electric & Manufacturing Company

A ten per cent reduction in prices of motors, motor control apparatus, direct current generators and motor generators has been announced by the Westinghouse Electric & Manufacturing Company, on all sales in the Canadian market. Among other extensive orders recently received by the company is the manufacture of a large part of the electric equipment of the Midi Railway of France.

Q. & C. Company

The Q. & C. Company, New York, Chicago and St. Louis, has taken over the exclusive agency in the railway field for the Century steel fence posts manufactured by the Funk Brothers Manufacturing Company, Chicago Heights, Ill. The Century posts are manufactured of high carbon steel and dipped in a special preservative preparation.

July Rail Net Income

The net income of the 203 Class 1 railroads and terminals and switching companies of the country in July is reported to be approximately $75,000,000, as estimated by the Association of Railway Executives. This figure is based on the reports of 149 roads for the month, which show net operating income of $50,724,000, against a deficit of $5,196,000 in the same month a year ago. This would be an increase of about 50 per cent.

The progress during the month was attributed mainly to benefits derived from reductions in wages. It was estimated that the net income in July was at the rate of slightly more than 4 per cent per annum, against 6 per cent provided for in the transportation act. Final figures for the first six months of the year show that the Class 1 roads earned a net income of $141,758,307, approximately 1.8 per cent, falling short of 6 per cent by $335,497,693.

Railway and Locomotive Engineering

A practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV 114 Liberty Street, New York, October, 1921 No. 10

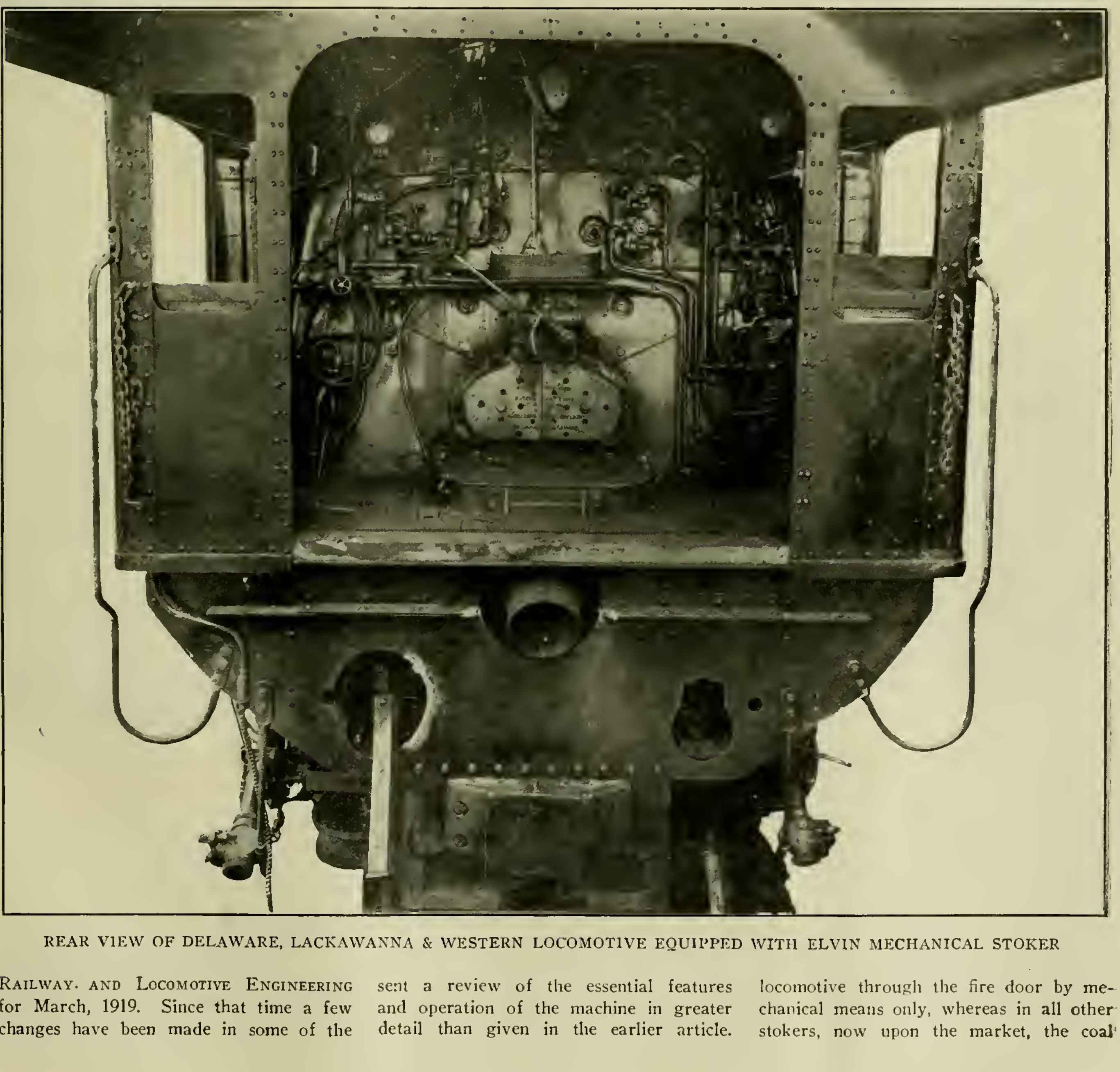
Distinctive Features of the Elvin Mechanical Stoker

Details of Its Construction and Operation, and Improvements Made Without Changing the Fundamental Principles of Its Design

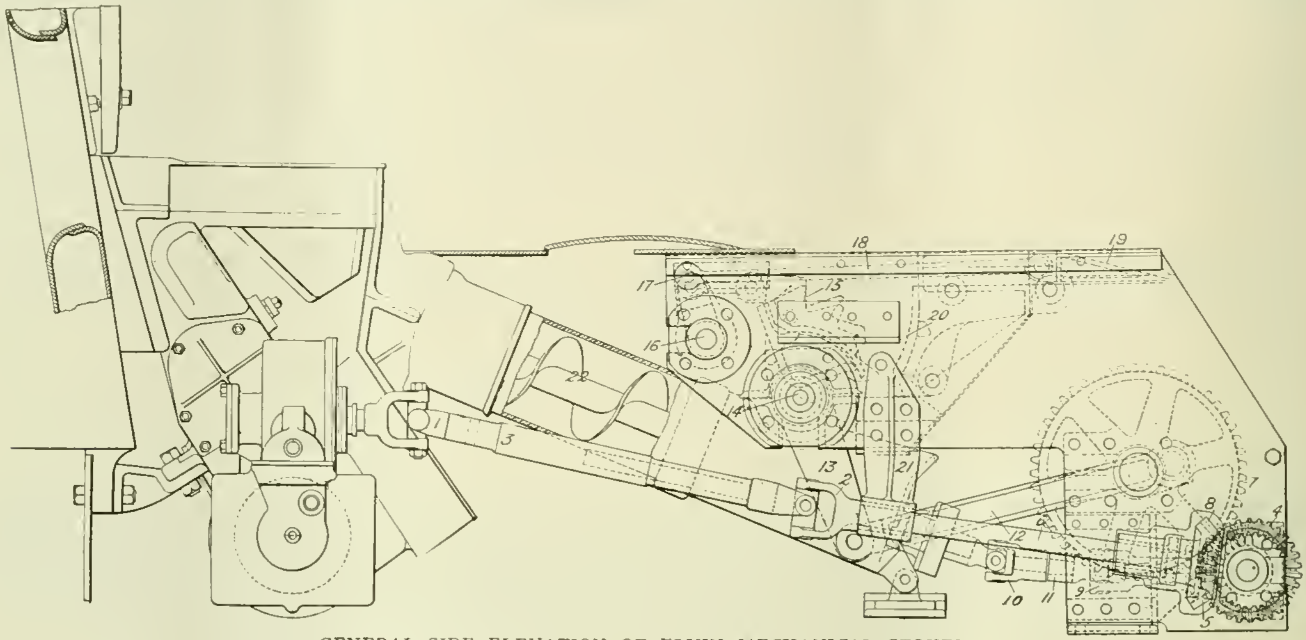
A description of the Elvin mechanical stoker as applied to a number of locomotives on the Erie R. R. was published in Railway and Locomotive Engineering for March, 1919. Since that time a few changes have been made in some of the details without changing the fundamental principles of its operation.

It is the purpose of this article to present a review of the essential features and operation of the machine in greater detail than given in the earlier article.

The machine is essentially a mechanical stoker in that coal is taken from the tender and put into the firebox of the locomotive through the fire door by mechanical means only, whereas in all other stokers, now upon the market, the coal

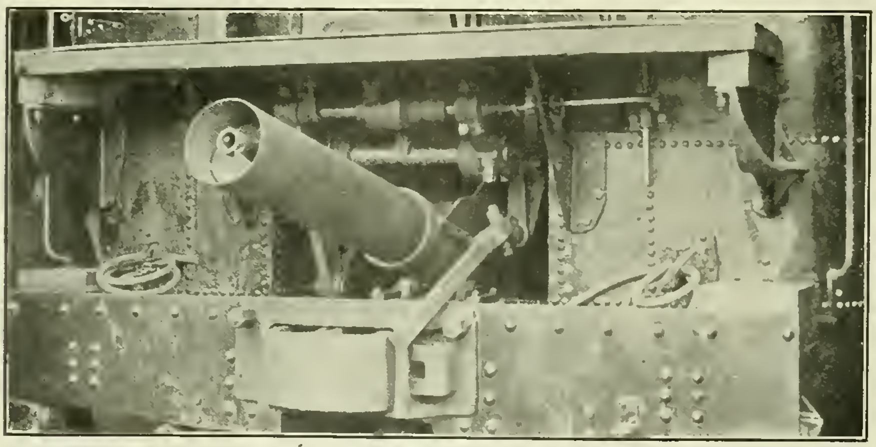


REAR VIEW OF DELAWARE, LACKAWANNA & WESTERN LOCOMOTIVE EQUIPPED WITH ELVIN MECHANICAL STOKER is distributed over the surface of the grates by means of a steam blast.

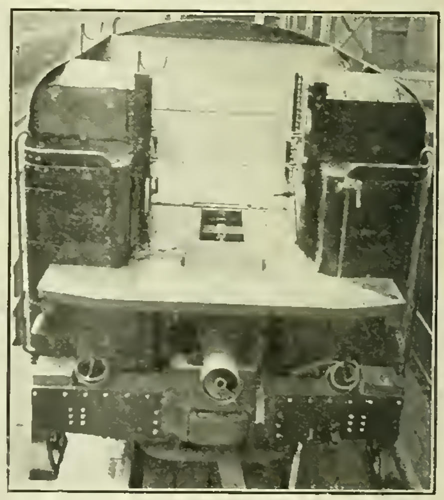


GENERAL SIDE ELEVATION OF ELVIN MECHANICAL STOKER

In the adaptation of mechanical means to the distribution of the coal in the firebox the purpose has been to imitate skilled hand-firing as nearly as possible. This involves the scattering of the coal over the surface of the bed in a uniform shower with especial attention to the placing of suitable quantities in the rear corners and along the back and side sheets. In order to do this the design of the shovels by which the coal is thrown into the firebox, as well as their motion, had to be carefully studied.



FRONT VIEW OF TENDER SHOWING CONNECTION OF ELVIN MECHANICAL STOKER



TENDER EQUIPPED WITH ELVIN MECHANICAL STOKER

The form of the shovel is clearly shown in the engraving illustrating the relative positions of the shovel and elevator when the latter is near the upper end of its stroke. The shovel is pivoted at one end and swings with a vertical shaft set just outside the firedoor, and has an arc of action through about 145°. In plan the shovel has a gradually widening base with a vertical backing which follows the back contour with its full height of about 4 ins. for nearly the whole length, and then has a lower ridge, about 1½ in. high, following well around the curve. These shovels pick up the coal from the top of the elevator and throw it into the firebox in a manner that will be described later.

Taking up the design of the stoker in detail, its operation begins at the floor of the tender where the coal is delivered to it through long and narrow openings in the same.

Power is taken from a worm on the engine shaft on the locomotive and delivered to the mechanism on the tender through a pair of gimbel universal joints, 1 and 2, connected by a shaft having a slip joint, 3. This construction permits a wide range of movement, both laterally and longitudinally, between the engine and tender and still maintains a nearly uniform motion of the tender parts. Beyond the joint 2 there is a length of shafting 6 to which a beveled pinion 5 is keyed. This pinion drives a train of gearing, the details of which it is unnecessary to describe, which includes the spur gear 7 and the beveled gear 8. The latter is keyed to a shaft driving the conveyor worm through the universal gimbel joints 9 and 10, and the shaft carrying the slip joint 11.

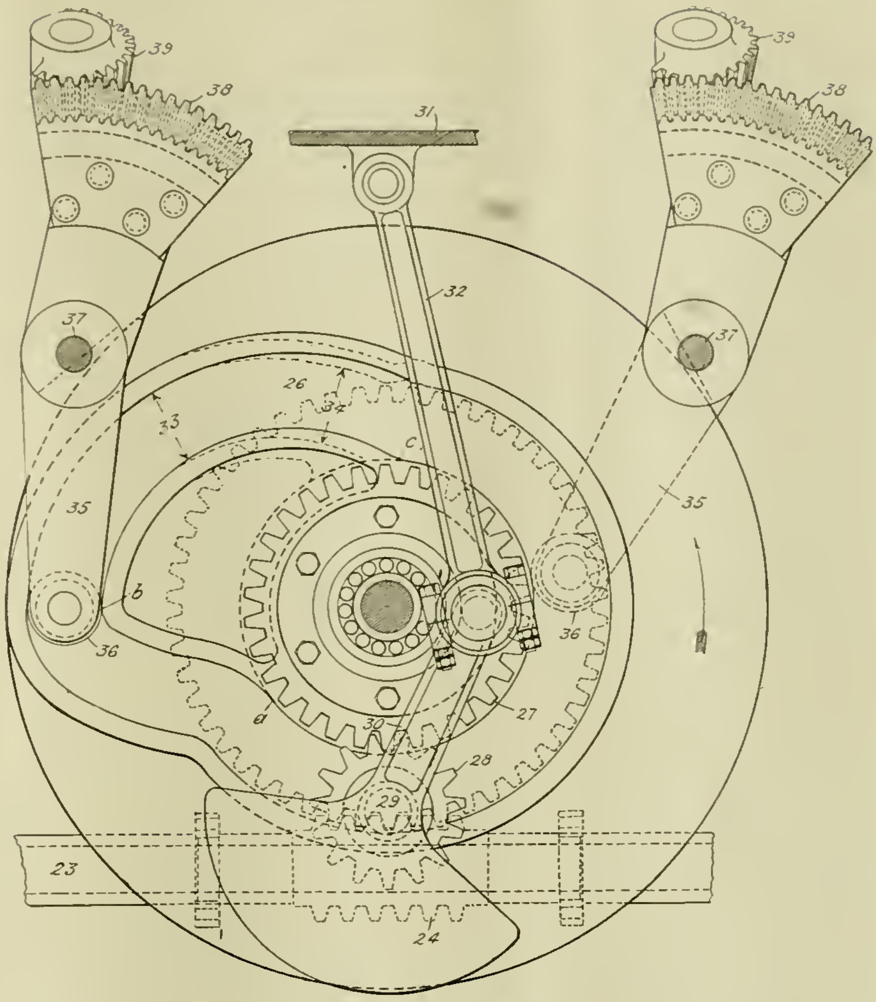
The spur gear 7 carries a crankpin, by which the connecting rod 12 is made to oscillate the lever arm 13. This lever arm 13 is keyed to the shaft 14, which runs transversely to the center line of the tender and to which the coal crusher jaw 15 is also keyed. A rocking motion is thus given to the crusher.

A pin connection on the crusher casting serves for the attachment of a connecting rod running ahead to a rocker arm on the shaft 16 to which a second rocker arm 17 is also keyed. From the upper end of this last arm a connection 18 runs back to the coal feeding device 19 and gives it a slow forward and backward movement with a travel of about 4 inches. It will be seen that these coal feeders have a gentle inclination to the rear with a vertical face at the front, so that, as they move to and fro, they slip back beneath the coal on their backward motion and carry it with them as they move forward. This produces an intermittent forward movement of the coal towards the opening between the moving crusher jaw 15 and the stationary plate 20. The lumps of coal falling into this space that are too large to drop on down between the moving and stationary jaws are crushed until they are in pieces small enough to so pass through.

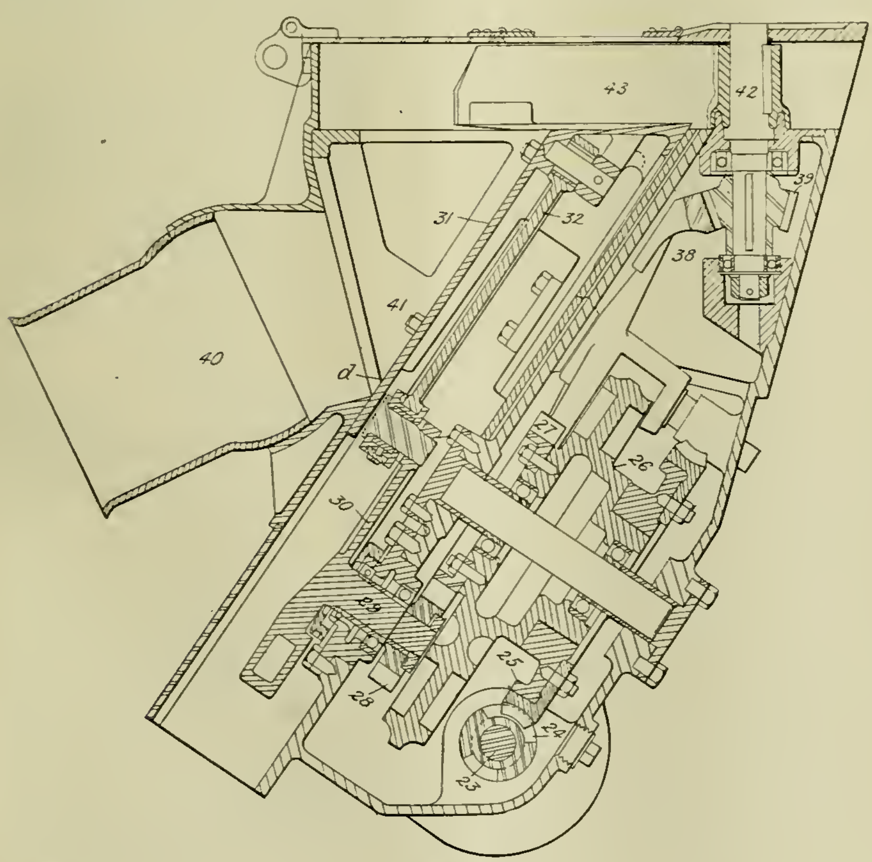
The coal as it leaves the crusher drops into the hopper 21 above the conveyor screw 22 and then the latter carries it forward from the tender and delivers it to the elevator on the engine, which forms a part of true stoker mechanism.

This is shown by two engravings illustrating a section on a line with the center line of the engine and a rear elevation, both of the operating and distributing mechanism.

This portion of the machinery is driven direct from the engine shaft 23. This shaft in addition to the worm driving the tender mechanism also carries a worm 24 that meshes with and drives the wheel 25. The latter is rigidly attached to a cam disk 26 in which the cams are located for the operation of the shovels. This disk also carries the spur gear 27, that meshes with a pinion 28 of one-half its own diameter, so that the revolutions per minute of the latter are twice those of the gear. The pinion is keyed to the shaft 29 to which the crank arm 30 with its counter balance is keyed. This crank drives the elevator 31 through the connecting rod 32.



REAR ELEVATION OF OPERATING MECHANISM OF ELVIN MECHANICAL STOKER



LONGITUDINAL SECTION OF OPERATING MECHANISM, ELVIN MECHANICAL STOKER

From the longitudinal section of the machine it will be seen that the elevator rises on an angle of 34° with the vertical, while the top, on which the coal rests, is always horizontal.

All this is very simple. The shovel movement, however, needs a little more careful study, and can be best understood from a study of the rear elevation.

The cam disk carries two similar cams on its opposite (front and rear) faces. These are indicated, in the engraving, by the spaces 33 and 34 outlined by full and dotted lines respectively. The cams impart an oscillating movement to the lever arms 35 through the rollers 36 attached to the ends of the same and which run in the cam grooves. The lever arms 35 are pivoted on the horizontal shafts 37. The outer ends of the levers carry sections of beveled gears 38. These mesh with the sections of beveled pinions 39 which are keyed to the vertical shafts to which the shovels are attached. The oscillating movement of the arms 35 is thus communicated to the beveled gear segments, and these are so proportioned that they oscillate the pinions and shovels to and fro through an angle of 145°, as already stated.

The two cams, it will be seen, are almost identical in shape and location, the difference between them being due to the difference in the angles at which the shafts 37 stand from the main central shaft about which the cam rotates. The direction of cam rotation is indicated by the arrow and is contrariwise to the movements of the hands of a clock.

While the rollers are against that portion of the cam which is concentric with the center of the cam disc, they are, of course, stationary, which is the condition of the right hand roller in the illustration, in which position the shovel is drawn back to the side of the elevator waiting for the latter to come up with a load of coal. As the cam revolves, the roller and shovel remain stationary until the point *a* is reached. The roller is then moved rapidly outward while passing over that portion of the cam between *a* and *b*. At *b* it has reached the extreme of its throw as shown by the left hand lever and the shovel has swept through the 145° of its movement. Then, as the cam advances the roller is drawn towards the center and the shovel back away from the elevator, until, at *c*, both are again at rest.

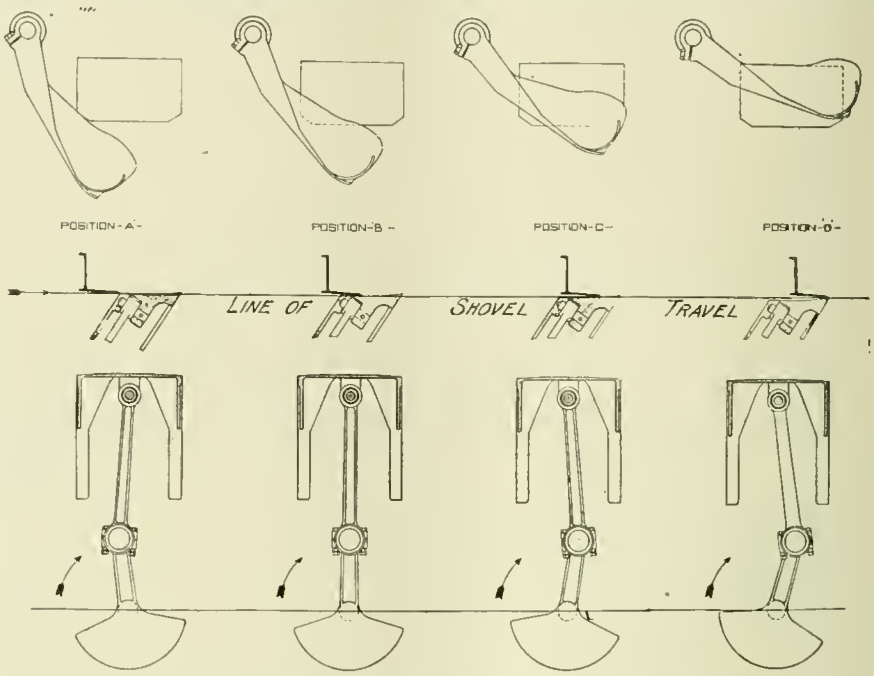
The movement of the two shovels thus alternates, first one and then the other throwing coal into the firebox. Meanwhile the elevator, making two strokes to each revolution of the cams, offers a load of coal to each shovel as it is swung forward.

It is here that the resemblance to hand firing comes in. The coal is picked up from the top of the elevator by the shovel as it swings forward and it is carried upon the bottom surface of the same. The rib at the back prevents it from sliding off the shovel and the centrifugal action gives it a tendency to slide out towards the end. This, combined with the movement of the shovel itself, scatters it in a sort of shower over the surface of the bed of coal on the grate. But the low, hook-shaped rib, at the outer end, catches some of the coal as it slides over the surface of the bottom and holds it until the end of the shovel travel is reached, when it is thrown into the back corner of the firebox, as the end of the shovel is, then, well inside the door. One shovel, therefore, feeds the back right and the other the back left hand corner of the firebox.

The movement of the coal is, then, as follows:

It is dragged forward by the feed conveyor 19, until it drops into the crusher and thence into the hopper 21, from which it is carried forward by the screw conveyor 22 and discharged through the tube 40 into a triangular terminal of the conveyor casing 41. The coal moves continuously forward across this space to the top of the elevator. The elevator, in its motion up and down, descends so that its upper surface comes down flush with the bottom of the conveyor tube at *d*. In this position coal is delivered direct and, as the elevator rises, it moves forward over the space and, as it descends again, the coal moves rapidly over on to the top of the elevator.

At the upper end of the stroke of the elevator there is a very close adjustment between its movements and that of the shovels. It is evidently necessary that, with the elevator driven by a crank it is in constant motion, and that the coal must be removed during a brief period of its near approach to and recession from its highest position.



LINE OF SHOVEL TRAVEL OF ELVIN MECHANICAL STOKER

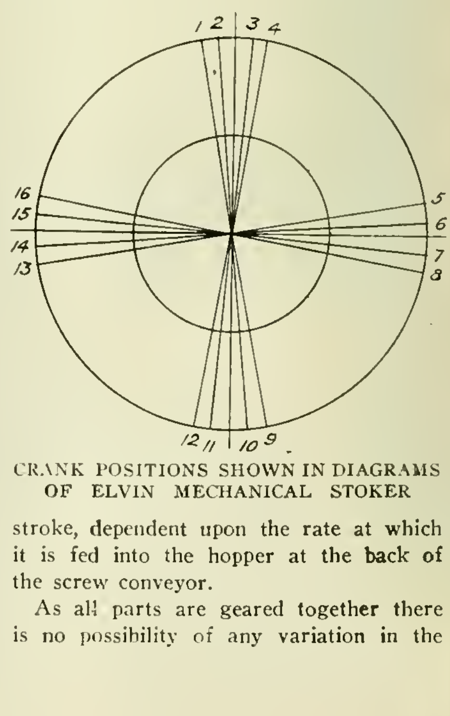
The relative movements of elevator and the shovels also require that the two shall be so shaped that they may come into close proximity with each other and yet not touch. These shapes and the adjustment are shown in the series of engravings over the caption: "Relative Position of One Shovel and Elevator at Various Points Near Top of Stroke."

The crank, which drives the elevator, is shown as rotating in the direction of the hands of a clock. Before the elevator reaches the upper end of its stroke, the shovel starts to move forward from its stationary position; and, when the crank is in position *A*, the shovel has moved forward to the point indicated. That is it has just started to cross over the surface of top of the elevator. At this point the elevator is still rising and the crank lacks 8° of being at the center. In position *B* the elevator is at the extreme upper limit of its throw, which is ¼-inch above the line of shovel travel, and the shovel has advanced well over its upper surface. In order that the two parts may not come in contact the heel or back side of the shovel is higher than the front on the under surface and the top of the elevator is cut away so as to make it slightly concave.

From this point the elevator is falling, and so, in order that it may not get too far away from the bottom of the shovel, its front side is raised above the center, and, in position *C*, with the crank 8° beyond the center and the shovel edge at about the center of the elevator, the two are still close together. In position *D*, the crank has advanced to 14° beyond the center, the elevator has dropped to the level of the line of shovel action and the shovel has moved across the whole face of the elevator and picked up all of the coal from its surface.

Then, as the empty elevator moves down, the shovel advances through the door of the firebox, distributes the coal and returns to its stationary position, as already described.

Under ordinary working conditions, the elevator makes about 40 strokes per minute and delivers from 3 pounds to 5 pounds of coal to the shovels at each stroke, dependent upon the rate at which it is fed into the hopper at the back of the screw conveyor.



CRANK POSITIONS SHOWN IN DIAGRAMS OF ELVIN MECHANICAL STOKER

As all parts are geared together there is no possibility of any variation in the synchronism of their action and the shovels are housed in a box which protects them from accident and prevents any one from being struck by them or by chance flying particles of coal. This box has a floor about ¼-inch below the line of travel of the shovels, and is closed by a hinged cover by which the flow of air through the door openings into the firebox is cut off.

One of the most interesting features of the stoker mechanism is the engine which is used to drive it. It is of unique design and of a remarkably compact construction.

Its working parts consist of two pistons, one working within the other and with movements at right angles to each other. The engraving shows a side elevation of the cylinder or box with the cover removed. The outline of the interior of the box is marked by the lines *a*, *b*, *c*, *d*. The space between the lines *b* and *c* is filled by a liner so that the line *c* becomes the working face for the piston. The sides of the box are flat, and form the bearing surfaces for the pistons, the sectional areas of which are rectangles.

The outline of the main piston is marked by the lines *e*, *f*, *d*, *g*, and it reciprocates to and fro in the box from right to left and left to right.

Steam is admitted to and exhausted from the ends of the pistons through the ports in the end walls marked *h* and *i*. The steam enters and leaves through the ports at the center which are shown in black.

The main piston 1, forms a box or cylinder in which the second piston, 2, reciprocates vertically. The outline of this interior box is indicated by the lines *k*, *l*, *m*, *n*, and the top and bottom of the piston by the lines *o* and *p*, above and below which are curved portions rising and dropping into domes in the main piston.

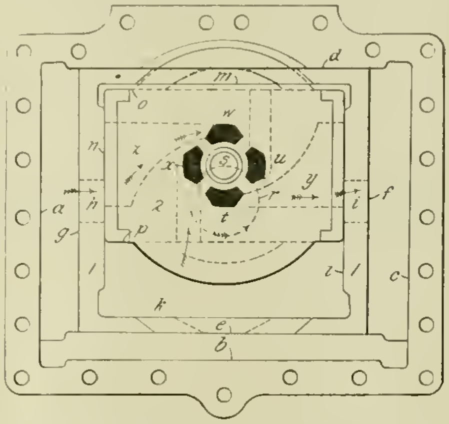
The shaft enters at the rear of the box and carries the crank pin *s* which enters a bearing in the inner piston and describes the crank circle *r*, which is 2½ inches in diameter; the speed being at the rate of about 500 revolutions per minute.

In the engraving the outer piston is shown at the center of its stroke and the inner piston at the extreme upper end of its stroke. In this position the crank is turning in the direction indicated by the arrow on the crank circle, and steam admitted at the port *t* follows the line of arrows through the passage *y* in the inner piston through the port *i* in the outer piston to the right hand end of the box, thus pushing the piston to the left. At the same time the port *w* is open to the exhaust and steam is flowing to it from the left hand end of the box through the port *h* in the outer piston and the port *z* in the inner.

The port *x* of the inner piston is also open to the exhaust which is flowing to it through the port leading down therefrom, as indicated by the arrow. The port *u*, which serves the upper side of the inner piston has not yet opened, but does so, shortly after the crank has passed the center.

The crank is thus acted upon by two pistons moving at right angles to each other, and in what is virtually a double Scotch yoke, so that it will always start.

The detail of the valve action of this engine can be readily followed from the diagrams presented. In these the view is



SIDE ELEVATION OF ELVIN STOKER ENGINE WITH COVER REMOVED

taken from a direction opposite to that used for the engine itself, so that the crank *B* is represented as turning in the direction of the curved arrow *A*.

The various positions of the crank in the diagrams are numbered from 1 to 16 consecutively. The ports in the inner piston are lettered *C*, *D*, *E* and *F*. The port *C* serves the top of the inner piston; *D* serves the right hand side (as viewed in the diagram of the outer piston; *E*, the bottom of the inner piston and *F* the left hand side of the outer piston. In the diagrams the space enclosed by the circle *G* is the opening of the steam admission port in the box; the circle *H* is the crank circle, and the space between the circles *I* and *K* is the exhaust opening in the box. The double cross-hatched portions of the ports in the inner piston represent the portions of those ports that are opened to the admission or exhaust ports in the box.

In position No. 1, the crank *B* is about 10° from and is approaching the upper center. At this point, the port *D* is fully open to the exhaust and steam is flowing into it from the right hand side of the outer piston, while the admission port *F* is admitting a full flow of steam to the left hand side of the same piston. The port *C* is still slightly open to the exhaust from the top of the inner cylinder, while the port *C* is at the point of cut-off for the lower side of the inner piston.

In position No. 2 the crank still lacks about 5° of reaching its upper center, and the same condition prevails as before in the case of ports *D* and *F* serving the outer piston and both ports of the inner piston are closed; the exhaust port *C* serving the top of the inner cylinder is just at the closing point of the exhaust.

In position No. 3, the crank has passed about 5° beyond its upper center and the two ports *D* and *F* serving the outer piston are still functioning as before; the ports *C* and *E* are closed but the port *E* is on the line to open the exhaust to the bottom of the inner piston.

In position No. 4, the crank has passed to about 10° beyond its upper center, with the ports *D* and *F* still open to the exhaust and admission. The port *E* has opened the exhaust from the bottom of the inner piston to a slight extent, and the port *C* is just opening the admission to the top of the inner piston.

Immediately upon passing position No. 4, all four ports are open; *D* and *E* to the exhaust and *C* and *G* to the steam. This condition prevails until position No. 5 is reached.

In position No. 5 the crank has reached a position about 10° from the right hand center; the ports *C* and *E* serving the top and bottom of the inner piston are wide open to the admission and exhaust ports respectively; the cut-off of the port *F* to the left hand end of the outer piston has just taken place and the port *D* has nearly closed the exhaust from the right hand side of the outer piston.

In position No. 6, the crank is about 5° from the right hand center and both ports serving the inner piston are closed, the exhaust *D* from the right hand side having just closed, both ports serving the inner piston being open to the admission and exhaust as before in No. 5. At the same time the port *F* is on the line to open the exhaust from the left hand side of the outer piston.

In position No. 8 the ports *C* and *E* are still open to the admission and exhaust; the port *F* has opened the exhaust from the left hand side of the outer piston and the port *D* is on the line to open the admission to the right hand side of the outer piston. In this position the crank has passed about 10° beyond the right hand center.

Between this and position No. 9 all ports are open. Ports *C* and *D* to the admission and *E* and *F* to the exhaust.

In position No. 9 the ports *D* and *F* serving the outer piston are open as before; the port *E* has nearly closed the exhaust from the bottom of the inner piston and the port *C* is on the line of cut-off for the top of the inner piston. At this point the crank is approaching the lower center and is about 10° therefrom.

In position No. 11, the ports serving the outer piston are still open as before, and both ports serving the inner piston are closed, the port *E* being on the line of the exhaust closure for the bottom of the inner piston. The crank is about 5° from and approaching the lower center.

In position No. 11, the same condition prevails as in position No. 10 except that the crank has passed to about 5° beyond the lower center and the port *C* is on the line to open the exhaust from the top of the inner piston.

In position No. 12, the crank has passed to a point about 10° beyond the lower center, the two ports serving the outer piston are still wide open; the exhaust from the top of the inner piston has been slightly opened through the port *C* and the port *E* is on the line to open the admission to the bottom of the inner piston.

Between this and position No. 13, all ports are open as indicated in No. 12.

piston are wide open and both ports serving with the outer piston are closed; the port *F* being at the point of closure of the exhaust from the left hand side of the outer piston.

In position No. 15, the crank has passed to a point about 5° beyond the left hand center. Both ports serving the inner piston are wide open and both serving the outer piston are closed with the port *D* just opening the exhaust from the right hand side of the outer piston.

open when the crank is about 10° beyond the center and the cut-off occurs at about 10° before the crank reaches the opposite center. The exhaust opening occurs about 5° after the crank has passed its center and closes about 5° before it has reached the opposite center. Therefore, the admission is open through 160° of the revolution of the crank, and the exhaust is open through 170°, leaving about 15° of travel at each end where both ports are closed. But, when one set of ports for one piston

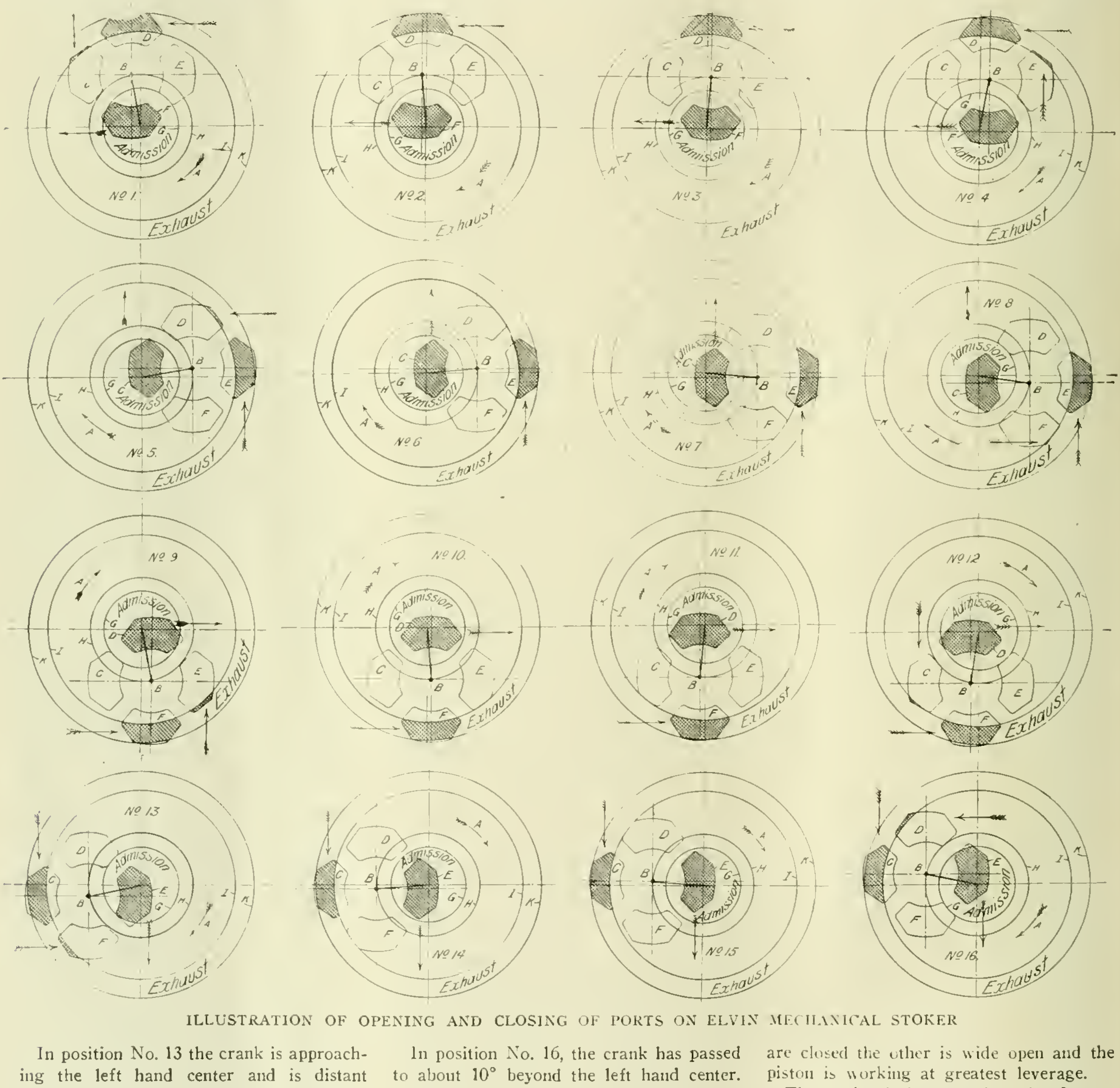


ILLUSTRATION OF OPENING AND CLOSING OF PORTS ON ELVIN MECHANICAL STOKER

In position No. 13 the crank is approaching the left hand center and is distant about 10° from it. The ports serving the inner piston are wide open to the admission to the bottom and the exhaust from the top. The port *F* has nearly closed the exhaust from the left hand side of the outer piston and the port *D* is on the point of cut-off from the right hand side.

In position No. 14, the crank lacks 5° of reaching the left hand center. The ports serving the top and bottom of the inner

In position No. 16, the crank has passed to about 10° beyond the left hand center. The ports serving the inner piston are open as before in No. 15. The port *D* has opened the exhaust from the right hand side of the outer piston to a slight extent and the point of admission has been reached for the port *F* serving the left hand end of the outer piston.

From this to position No. 1, all ports are open.

Thus it appears that the admission ports are closed the other is wide open and the piston is working at greatest leverage.

The engine is beneath the cab. Its action is smooth and it develops sufficient power with a very small space to run the stoker up to speed with any variety of coal.

The stoker in the form that is here described has recently been applied to a number of Mallet locomotives built for the Chinese Railway which are the largest Mallets ever exported from this country.

Traveling Engineers Present Valuable Reports

Details of Meeting of Executive Committee at Chicago

As previously announced in our pages the Traveling Engineers' Association postponed the holding of the annual convention this year, but in the meantime the various committees had proceeded with the preparation of the reports on the various subjects assigned to them, and the Executive Committee deemed it proper to call an informal meeting, which was held on September 7 and 8, 1921, at the Hotel Sherman, Chicago, at which the reports of the committees were read and discussed, reports of officers were received, and officers were elected.

In opening the proceedings the president, W. F. Preston, in an eloquent address, referred to the disastrous effects of the great war, and pointed out that the problem of to-day is to replace that which had been destroyed, in order that the comfort and security of civilization may be passed on to future generations, that which was destroyed was the product of labor of hands and brains, and was saved through centuries of economy. It is our task to work and save, and real wealth is only created when men work and save.

The contribution of the Traveling Engineers' Association is to supply at minimum cost an article which the modern world stands in great need of—transportation. The world is far short of its demands. Ocean transportation was nearly swept from the seas by the great war. Transportation by highways is growing by leaps and bounds, but will never replace the service that was rendered by the railroads. During the past ten years our population has increased more than 15 per cent, but from the day the world was plunged into war the railroads have been unable to increase terminals, to better their road beds or to improve rolling stock. Members of our organization occupy the positions in supplying this sorely needed commodity — transportation. We are always on the firing line, in the front line trenches. But back of us is a great army of loyal engineers and firemen, trained for their jobs, strong, ready, capable.

The great world need is that men in all walks of life shall work harder and save more of what they produce. The world needs that every locomotive shall work to its full capacity the maximum number of hours each year at the minimum cost of operation. Not only for this year, but for years to come, must we continue to contribute our big share to replace that which has been destroyed.

Now is the time to stick close to the rigid rules of common honesty. The honest man will not accept a day's pay until he has done a day's work. There must be the same honesty in dealing with the corporation as with the individual. The measure of a man must be not how much wealth has he taken into his own safety vaults, but how much has he done in his generation to quiet the unrest, to put right the wrong, to house and feed and give comfort to a world whose civilization has been strained near the breaking point.

The world looks to us in America to safeguard the sacred right of man to own property, secure against all interference except by due process of law. It is the law that makes us free. Can you picture a railroad whose trains run at random, at the mere whim of the engineer, who might claim that because this is a free country he had the liberty to run his train how, when and where he pleased? It is because he and all engineers obey the law that he becomes a free man. He has the freedom of the road when all obey the law.

Secretary's Report and Reports of Committees.

From the report of the Secretary it appears that there is at present a membership of 1,546, being a gain of 87 members during the year. In spite of the general financial depression the finances of the association were shown to be in a very satisfactory condition.

The reports of committees embraced a variety of subjects, and all showed a painstaking and illuminating analysis of the subjects treated, and all of which together with the discussions arising for the presentation of the reports will be published in the annual volume recording in permanent form the transactions of the association, and which, it is expected, will be ready before the end of the year. Meanwhile we are pleased to furnish abstracts of the leading features of the valuable reports as we can afford space in our pages.

A Comprehensive Method of Employing, Educating and Examining Engineers and Firemen.

In commenting on the human organization the report set forth the fact that systematic development of the labor material available will do much in remedying labor conditions on railroads at the time of year when men are needed. The employing officer should have regular days in his office to confer with applicants for positions, and this information should be given on the circulars posted. This officer should be a responsible man and carefully selected. The first impression made on the applicant is usually a lasting impression. It will be claimed that no one has time to converse with all the men who apply for jobs. This may be true, but might it not be cheaper in the end to have some capable person or organization responsible for handling all applicants with the occasional chance of getting the right man at the time of need instead of finally having to take whoever comes?

The best practical training to fit a fireman to meet the variable conditions always present in locomotive operation is on the deck of the engine in the midst of those variable conditions; in other words, the training should be more practical than that which can be obtained by any other method. The real practical training starts when the new man makes his first trip on an engine and under personal instructions by a competent instructor works to keep the engine hot without wasting steam at the pop valve, strives to save coal without starving his fire too much and tries to prepare his fire to meet a sudden change in working of steam without making black smoke.

The first trips of a new man on the engine are his habit-forming trips. They are more important in their effect on the direction of his habitual attitude toward his work and toward the welfare of the company, and in the effect on his sense of duty and responsibility on his character than any other number of trips of his life. He should be instructed by the traveling fireman or traveling engineer or sent out with the best crew on the division if the traveling fireman or traveling engineer are not available.

We believe that railroads should establish a system of progressive examinations when a man is employed as a fireman. He will be given the questions on which he will be examined at the end of the first year. Having answered these questions satisfactorily, he will then be given questions for the following year. Having passed this examination, he will be given a third and final set of questions, on which he will be examined before being promoted to engineman.

It is not expected that a man will answer these questions without assistance and in order that he may understand them properly, there should be established a school of instructions in the use of the air brake and all other locomotive appurtenances, and all employes invited to attend. He should also be invited to ask the master mechanic, traveling engineer or air brake instructors or any other official for such information as may be required on any points in connection with his work.

Operation and Maintenance of Oil Burning Locomotives

The committee in opening its report pointed out that the first attempt in the United States to burn crude oil in the firebox of a locomotive was made at Santa Paula, Cal., in 1894. The subsequent study of combustion soon led to a better understanding of the firebox and boiler design and realizing the many advantages to be gained by the use of oil as fuel, every effort was made to develop the most efficient burner and drafting arrangement. Most obstacles were overcome and in a comparatively short time a high degree of efficiency was attained.

Crude oil possesses many advantages over other fuels and in the West its use soon became widespread, being employed in steam making in power plants and floating equipments until the degree of popular interest grew to such proportions that the economic need of the fuel oil situation became quite apparent. At no time during the past few years has the production of crude oil in the United States been sufficient to meet requirements and records for June, 1921, show the consumption of 81,000 barrels per day in excess of production, which deficit was and is being supplied from the Mexican fields.

	Bbls.
Daily production, United States, June, 1921	1,346,833
Imports from Mexico	340,175
Total	1,687,008
Daily consumption	1,427,367
Amount placed in storage daily	259,641

At the present rate of consumption we are told by geologists that the crude oil supply in the United States will be exhausted within a few years as there now remains but about 60 per cent of the original supply underground. With this prospect is it small wonder that strenuous efforts are being exerted to conserve the remaining supply by maintaining and operating oil burning locomotives as economically as possible? At the present time there are about 41 railroads operating in 21 states which burn oil for fuel.

The maintenance of the locomotive rests largely with the enginemen. The medium through which the maintenance is accomplished is the work report and its correct rendition. This means that if the locomotive is to perform economically at its maximum capacity specific information must be given to the roundhouse force as to just what defects were noted under actual operation. Maintaining an oil burning locomotive would be a very simple task if a thorough and accurate report of defects noted by engine crews were reported at the end of each trip. "Don't Steam" covers a multitude of sins, but the worst sinner of all is the man who writes it on his work report, with no further detail, and then has writer's paralysis.

Generally speaking there are but few points of difference in maintaining an oil burning locomotive as compared with a coal burner and these points of difference affect the design of tender, oil piping and firebox arrangement. The fuel oil tank is constructed of ⅜-inch material and the capacity is approximately 3,000 gallons—a coal equivalent of about seventeen tons on the basis of 42 gallons per barrel and four barrels of oil equal to one ton of coal. On filling the square tank two-inch space is left in top on semi-cylindrical six inches to allow for expansion when oil is heated. The ratio of expansion is one per cent for each 25 degrees increase in temperature. Fuel tanks are provided with a measuring rod designed to show inches on one side and gallons on the other so that accurate measurements may be obtained at all times. Oil flows to burner by gravity on all types of locomotives except the Mallet, in the tender of which is used six pounds air pressure. The oil piping arrangement conveys the oil from the tank to the burner, from which it is sprayed into firebox by steam. This conduit is two inches in diameter and passes through a superheater four inches in diameter which is used, in addition to the tank heater, to heat the oil before it reaches the firebox.

The tank heater should be so constructed and maintained as to keep oil at proper temperature, the oil feed line should be free from leaks, with as few elbow joints as possible, metal with flexible joints is preferable to rubber; cut-out or safety valve on tender, blow-back valve, superheater and firing valve should all be in perfect working condition. Burner should be of suitable size, varying from one inch to three inches according to size of firebox, clean and lined up about 60 inches from flash wall to insure perfect combustion. Six to nine and one-half inches—depending on draft arrangement—is the correct distance from burner to fire pan floor and particular attention should be given to see that burner is so placed that oil strikes flash wall in center. Care must also be exercised to see that fire pan is free from air leaks with no obstruction on floor and all damper controls are in perfect working order.

There are two ways of drafting an oil burning engine; one, the horizontal draft and the other the vertical. Both are in general use on oil burning roads. The arrangement of the brick work on both drafts is practically the same. The horizontal draft, by which air is admitted through the door, is the most economical, but in poor water district, from the standpoint of boiler maintenance, the vertical draft arrangement with the flat door by which air passes to the rear of the firebox, prevents cold air from reaching the staybolts, thus reducing boiler maintenance. The horizontal draft in good water districts has proven very successful both from the standpoint of boiler maintenance and fuel consumption.

Air openings from firepan should vary, depending on size of firebox. From sixteen square inches air admission around burner and 85 square inches at rear of firebox to 225 square inches around burner to 224 in rear. It has been found that the best results obtained on an oil burning engine, with respect to front end arrangement, is the use of an extension stack extending down to center line of boiler, being 12 to 16 inches in diameter. In order to insure economical fuel performance firepan must be maintained in good condition. To secure the best results the firepan should be welded to the mud ring and rigidly secured so as to obviate all possibility of air leaks at sides and front—also behind the brick work. The maintenance of firepans on oil burning locomotives is a very important feature and too much attention cannot be given them.

Front end leaks and outside steam leaks should not be tolerated. In the roundhouse organization one man should be assigned to make torch tests and repair all air leaks into front end and around outside steam pipes. There are many recommended practices for the elimination of air leaks around outside steam pipes, the best one in use is the application of a casting made of ¼-inch steel plate with a welded seam. This casting is riveted permanently to the smoke box and then caulked or welded around the edge to make it perfectly air tight. It is large enough in diameter to allow removal of the steam pipes without disturbing it. The lower end of the casting is flanged outward and to it is riveted a wrought iron ring. A cast iron flange made in halves is fitted together and bolted roughly around the steam pipe, which is machined true at this point. The cast iron flange is secured to the wrought iron ring on the bottom of the casing with eight studs and a copper wire gasket used between them to obtain an air-tight joint. A copper gasket is then caulked into a dovetailed groove in the cast iron flange around the steam pipe.

The operation of oil-burning locomotives call for the same attention from the engineer as on a coal burner but the fireman has no manual labor to perform in delivering the fuel to the firebox. He has to be alert at all times, for there is no bank of burning oil to aid him in keeping an even firebox temperature when the engineer is working a light throttle or drifting after having forced the locomotive to its capacity. The closest team work between the engineer and fireman is necessary for the fire must be changed to meet the operation of the throttle and reverse lever.

A supply of clean, gritty sand should

be used in the sand box of the locomotive with sand scoop so that the fireman can clean soot from the flues. The flues should be sanded while running by placing a small quantity of sand in the scoop and by inserting it through opening in the fire door while the engine is working hard, allowing the exhaust to draw the sand through the flues, thus cutting the soot in its passage and discharging it from the stack. It is good practice to sand frequently in order to remove soot which is a non-conductor of heat and causes steam pressure to drop rapidly. Engineers should take care to give the valve sufficient travel, opening throttle far enough so that exhaust will carry sand through the flues and do the work for which it is intended. The sand scoop should be held as far in fire door as possible in order to prevent sand from falling on brickwork or flash wall.

Firemen should watch the temperature of oil and endeavor to keep it just warm enough to insure an even flow to the burner—this temperature will vary from 100 degrees for light California or Texas oil to 180 degrees for heavy Mexican oil. The fireman has direct control of amount of steam used to heat oil in tender and unless he is careful he may not only damage the oil by overheating it so that it loses its lighter gases, but also increase the hazard of explosions from the escaping gas. Where excessive steam is turned into tender there is excessive condensation and unless this water is drained off it will go to the burner, causing trouble and often putting the fire out.

Heating oil in tender is not for the purpose of aiding in burning it but to cause it to flow in a steady, even stream from tender to oil feed line, where it passes through a superheater box or joint before it reaches burner. The purpose of the superheater is to raise the oil to a temperature where it will be easily broken up by atomizer as it goes from burner tip into firebox. Since it takes less than one-fifth of a second for a particle of burning oil to travel from burner tip to flue sheet it is of utmost importance to have oil so atomized that no time is lost in burning it.

The use of the blower is to create sufficient draft to keep the firebox clear of smoke and gases and to produce artificial draft. The misuse of the blower causes waste of fuel and damage to the boiler. Very light applications should be indulged in under all conditions. The strong use of blower draws cold air into firebox damaging flues and flue sheets, causing them to leak. A slight color of smoke at the stack is better than no smoke at all, for a clear stack indicates too great an amount of air. Losses from too much air are frequently three times as great as from insufficient supply. Firemen should avoid black smoke at all times if possible; it is a loss of fuel and should not be tolerated. Black smoke is either the result of faulty firing or the condition of the engine.

Firing valve by which the flow of oil to the burner is regulated requires constant attention. Lost motion frequently occurs in this apparatus and much fuel is wasted due to the fact that fireman loses the correct adjustment of this valve account too much play either in the rods or in the valve itself. When an engine is worked to full capacity on long grades and has been fired heavily it requires very careful attention to prevent flues from leaking as the small tongue of flame does not fill firebox sufficiently to keep out the cold air. Engineers cannot be too careful at such times, they should start gradually to ease off on throttle, allowing fireman plenty of time to adjust his firing valve, injectors should be shut off at once, if only for a short time, and then work at short intervals. In most cases engines start leaking while descending grades after having been worked hard. Careful teamwork between the engineer and fireman will prevent black smoke when shutting off or pulling out of the station.

What are the Advantages of the Self-adjusting Wedges, the Feed Water Heater, and Devices for Increasing the Tractive Power of the Locomotive in Starting and at Low Speed?

The important questions submitted to the committee were categorically answered in an exhaustive report, and referring to the present standard wedge it was referred to as being of the usually adjusted style, so-called because adjustments are made by hand-operated methods and is designed for the purpose of taking up the wear which occurs to a more or less extent in service between the driving boxes and the shoes and wedges brought about in part by the up and down movement of the frame on the boxes caused by vibratory motion of the boiler structure and in part by up and down movement of the boxes in the frame jaw due to uneven trackage.

Pounding of loose boxes tends to loosen bolts and nuts, to break wedge bolts, to loosen wheels, to crystalize the metal in wheel axles and perhaps bring about their breakage and brings about a general tendency to weaken the frames and running gear of the locomotive. That these possible consequences resulting from failure to prevent undue lost motion of the driving boxes in the box jaws of the frame are frequently the cause of locomotive failures and always a source of increased maintenance cost is too well known to require dwelling upon.

The engineman has always been held responsible for allowing any such undue lost motion to exist in the fit of the driving boxes in the frame jaws of the locomotive of which he is in charge and until within the past few years usually himself assumed the duties of taking care of such lost motion and in a large measure attended personally to the setting up of the adjusting wedges. Due to changing conditions, however, this practice of the engineman himself taking up the wedge has largely become a habit of the past and the most that is looked for from him today in this connection is that he shall report any looseness or pounding of the driving box parts, the actual work of setting up the wedges, etc., now largely devolving on the roundhouse forces. This condition has not brought about a change for the better.

When the engineman himself took care of this work it was his practice to so spot the locomotive that the driving boxes were forced up against the shoes, thus giving all possible free play between the driving boxes and the wedges and permitting the wedges to be forced up to the extent necessary to eliminate all lost motion; the wedge was then slightly pulled down to provide the required freedom of movement of the box and to prevent it sticking. It is now not uncommon practice in roundhouses for employes assigned to this work upon report of the engineman to undertake to adjust the wedges without moving the locomotive at all, thus frequently not fully accomplishing the object desired and thereby permitting the locomotive to return to service in a condition detrimental to itself and the railroad.

The value of a self-adjusting wedge, simple in its design and non-erratic in its action, will readily appeal to all who have to do with either the handling of the locomotive or its maintenance. To the engineman it would mean a more efficient and satisfying machine, to the mechanical department an incalculable benefit in the savings effected in maintenance cost through the tendency to prevent the many troubles arising through failure to properly keep up the wedges and through the reduction of locomotion failures due to those causes as well as a very considerable saving in the cost of roundhouse labor now required to do the adjusting of wedges, and doing it none too efficiently. In which direction the saving would lay, would, of course, depend largely upon the previously existing conditions.

At first glance, the designing of such a wedge seems quite simple and easily brought about through the placing of a suitably arranged spring underneath the adjusting wedge and operating it in such manner as to gradually force up the wedge as lost motion develops in the driving box parts. It is understood that this method, without any change in the adjusting wedge other than adding to it of such a spring and the small parts necessary to give the required spring tension, has been tried out on at least one large railroad. In giving this method a second thought, however, we are likely to look for what we understand actually occurs, that of the wedge being gradually tightened until it grips the box, causing a hard riding locomotive and possible rough usage of the rail as a consequence. This, of course, means the curing of one evil at the expense of acquiring another one practically as bad.

A method of preventing this gripping of the box has been brought forward in a self-adjusting wedge now being used to an increasing extent on many of our railroads. In this device the adjusting wedge is made in two parts which might appropriately be referred to as an adjustable wedge and a floating wedge. The adjustable wedge is tapered on one side to suit the taper of the frame jaw with a reverse taper on its opposite face. The floating member is also tapered, its thickest part being at its upper end, and it fits between the adjusting wedge and the driving box. A wedge bolt, attached to the adjusting wedge as usual, passes down through the pedestal binder and has attached to it below the binder the adjusting spring and the parts necessary to give this spring the required tension. The floating wedge is made of such length that when fitted into the driving box jaw, there is not less than 3/16 in. nor more than 5/16 in. clearance or play for it to move up and down between the pedestal binder and the frame. With this arrangement, if the driving box should move up in the frame jaw, there would be a tendency for it to carry the floating wedge with it in case there was any clearance between the top of the floating wedge and the top of the frame jaw. On account of the tapers of the two wedge parts this would tend to bring about a loosening of the driving box between the shoe and wedge. Before this could be effected, however, the small clearance given the floating wedge between the pedestal binder and the top of the frame jaw would bring the top of the floating wedge up against the top of the jaw, checking any further tendency to cause undue freedom of the box as the floating wedge would then be held stationary even if the box continued to rise in the frame jaw. If the driving box should move down in the frame jaw the tendency would be to carry the floating wedge with it and at the same time there would be a tendency to force down the adjusting wedge against the spring tension. This would bring about a loosening of the driving box between the shoe and wedge. The limited clearance space of the floating wedge in the frame jaw, however, would cause the lower end of the floating wedge to strike the binder and prevent further tendency to cause undue freedom of the box, as the floating wedge would then be held stationery even if the box continued its downward movement.

Reports from several of our members located on roads having this device in use and who have had actual experience with it, as well as from several mechanical superintendents on roads having it in use, state that it gives excellent results.

While any type of self-adjusting wedge is supposedly automatic in its action, it must be remembered that none are automatic in maintenance. Like all mechanical devices they require a certain amount of attention, the labor required, for such attention being, of course, considerably less than is necessary for looking after manually adjusted wedges. The principal attention to self-adjusting wedges should be for regular lubrication, absolutely necessary with any type of wedge, and the adjustment of the adjusting spring.

It is impossible to give accurate figures on the savings in cost of upkeep of the frame, box parts and running gears as between engines having manually adjusted wedges and ones with self-adjusting wedges for the reason that many troubles with these parts which could be caused by poorly maintained driving box parts might also be due to other causes.

In regard to feed water heaters it was claimed that more earnest consideration should be given to this important subject. It should be borne in mind that from 55 per cent to 58 per cent of all heat generated in the firebox is lost in exhaust steam. This great loss of heat is due to the necessity of exhausting steam from the steam cylinders while still in its gaseous form and to the fact that it requires about 970 heat units simply to hold water in the form of steam, all of which, together with such additional heat units as may be in the exhaust steam, is allowed to pass out of the locomotive stack without doing any additional work other than acting as a draft on the fire.

Considerable success has been achieved in heating feed water for boiler use by means of exhaust steam. It is our understanding that this practice has long been successfully made use of in connection with stationary boilers; also, that it is used to a considerable extent in European countries on locomotives. Germany alone is said to have 10,000 locomotives equipped and to be adding this equipment at the rate of 2,000 feed water heaters per year. That this method has not received more consideration in this country in the past has probably been due to cheap fuel and lack of an efficiently developed device for the object in view.

Generally speaking, feed water heaters making use of exhaust steam are of two kinds known as the closed type and the open type. In the open type the exhaust steam either goes directly into the feed water, and in condensing gives up its heat to the water or goes through tubes surrounded by the feed water, heating this water while being itself condensed in the tubes. When it goes directly into the water it is found advisable to pass the exhaust steam through an oil separator en route to the feed water heater to prevent lubricating oil contained in exhaust steam from entering the locomotive boiler. In this type the heater is open to atmospheric pressure and the pump is placed between the heater and the boiler check. In the closed type the water is forced through tubes in an enclosed heater, these tubes being surrounded with exhaust steam which heats the water as it passes through the tubes. In this type the heater is between the pump and the boiler check and is subject to boiler pressure.

In the open type on account of the heater being open to atmospheric pressure the feed water can be heated only to the normal boiler temperature of 212 deg. F. In the closed type it is possible to heat the water to within 10 to 15 deg. of the temperature of the exhaust steam, which may run as high as 250 deg. F.

About one-sixth or 15 per cent of the exhaust steam which would ordinarily go out through the locomotive stack is diverted to the use of the feed water heater.

One type of heater which has been applied to probably one-half of the American locomotives so far equipped has an arrangement whereby after the exhaust steam going to the heater has been condensed, this water can be filtered, freeing it of any lubricating oil that it may contain and returned either to the locomotive tender or into the suction pipe of the pump carrying the feed water to the heater. By this means it is claimed that the tender water capacity is in effect increased 10 to 15 per cent.

As the savings are in proportion to the amount of fuel used, they are naturally greater on freight locomotives than on passenger engines, on account of the greater amount of fuel used, and the greater savings are obtained on divisions where it is required to use steam constantly when the train is in motion. On divisions with alternately rising and falling gradients the savings are not so apparent.

Our information is that some eighteen of our American railroads are today using or experimenting with feed water heaters, although not to exceed seventy-five locomotives all told are equipped, and that five different types of feed water heaters are being tried out.

For the benefit of those interested, a summary is attached covering a number of runs made with a freight locomotive on the New York division of the Erie Railroad equipped with a feed water heater of the "closed" type, showing results of four runs made with the feed water heater, as compared with the same number of runs using the feed injector. Also, a summary of runs made in passenger service with a locomotive on the D. L. & W. Railroad, equipped with the same type of feed water heater.

In regard to the locomotive booster the report pointed out that except where arrangement is made for the setting off of part of the cars at certain points, or for the use of helping locomotives under certain conditions, it is usual to assign to the locomotive only such tonnage as it can of itself start from any point between ter-

Summary of Results, Erie R. R. Freight Locomotive

Test	Heater	Injector	Heater	Injector
Direction of runs	West	West	East	East
Length of runs, miles	88.3	88.59	89.22	89.44
Actual running time—Dec. hours	4.75	54.36	5,658	5,699
Number of cars, incl. dynamometer car	70	74	80	87
Actual tons, incl. engine and tender	1,957	1,988	5,029	4,943
Coal fired per locomotive mile	211	245	203	241
Average steam pressure	173	172.0	173.1	172.7
Average superheat	579	597	571	600
Maximum superheat	606	641	604	640
Water evap. per pound of coal as fired, running time	7.917	6.867	7.697	6.529
Water evap. per pound dry coal, R. T.	7.965	6.909	7.735	6.609
Equiv. evap. per pound dry coal, R. T.	9.270	8.070	9.007	7.772
Total coal fired, running time	18,635	21,705	18,151	21,574
B. T. U. per pound coal as fired	13,279	13,702	31,357	13,225
Boiler effic. based on dry coal, per cent	67.34	57.0	65.1	56.3
Coal fired running time to operate feed water pump	231	...	225	...
Water evap. per pound coal as fired, running time, based on equal B. T. U.'s (13,225)	7.885	6.628	7.621	6.529
Per cent saving in coal as fired running time in favor of feed water heater	18.96	...	16.72	...
Per cent total coal fired to operate feed water pump	1.24	...	1.24	...
Per cent net saving in coal as fired R. T. in favor of feed water heater	17.72	...	15.48	...
Average feed water temperature	71	65	71	60
Average temperature of feed water leaving heater	209	...	193	...
Average temperature of feed water leaving injector	...	178	...	169.5
Maximum temperature of feed water leaving heater	231	...	239	...
Maximum temperature of feed water leaving injector	...	199	...	190

Average of Tests With D. L. & W. Pacific Type Passenger Locomotive No. 1135, Train No. 6

	Heater	Injector	% Difference for Heater
Tonnage	527	535	1.5% Less tonnage
Running time	193	189	2.2% More running time
Total coal, pounds	9,760	12,460	21.6% Less coal per run
Total water, pounds	97,919	95,493	2.27% More water per run
Lbs. water per lb. coal	9.97	7.79	28.0% More water per pd. coal
Coal per ton train	18.4	23.3	21.0% Less coal per ton train
Water per ton train	186	180	1.67% More water, ton train

minals where it may chance to be stopped.

Usually, to attach the locomotive to such tonnage as it could keep moving, once the train was in motion, would mean that assistance would be required to start it from all points not down grade, where it might chance to be stopped, and would likewise in all probability be required to get the train up not only low per cent grades, but even ordinary so-called "knolls." Presuming that practically full steam piston power is necessary to handle the train when once started, this would frequently mean the aid of another locomotive to get such train over the road as with the ordinary locomotive no other means of helping it is available.

The locomotive booster, which is a name by which this device is known, is designed with the purpose in view of assisting in starting such standing trains as the locomotive is capable of hauling on a level track when once in motion without the aid of such device, but which it would otherwise be unable to start without assistance of some kind and for helping it to haul such trains over ordinary grades encountered between terminals; to assist in starting trains out of places where stops are necessary, as at stations, towers, water plugs, switches, etc., or where made necessary by locomotive or train troubles, and which on account of curvature or grade, are bad places to start from and ordinarily would likely require the taking of the train slack, perhaps backing up to a place from which a start could be made, setting off of cars, doubling of grade, or the obtaining of the assistance of another locomotive.

While the addition of a booster increases the tractive effort of the locomotive and thereby makes possible the starting of additional cars, and to that extent serves to increase the tonnage which can be hauled under normal conditions, or serves to assist in getting heavy trains over the road without delays or grades and at bad starting places, it is in no sense intended as an aid in permitting the overloading of the locomotive to a point beyond what its normal capacity would be when in motion on a level track without this device, as such practice would require the device to be operated continuously on the level track, which is not the intention and would make additional aid again necessary in starting from terminals, bad starting places en route, and on ascending grades.

The booster cuts out automatically when the reverse lever is moved back from the corner, which is at a speed of approximately twelve or fifteen miles per hour, or it may be cut out instantly by the engineman knocking the booster latch down, which is similar to knocking out an electric switch. The claims made for the booster are that it puts any locomotive with trailing wheels into the next class above in starting effort, because the trailing wheels act as an additional pair of drivers; that on freight trains this means more tons handled annually because of greater starting effort and acceleration, and avoids damage to machinery and equipment because of a smooth, steady start; that on passenger trains it means smooth starting and quick acceleration to road speed, protects the equipment from damage and renders schedules more easily maintained by avoiding delays in starting; that it reduces by one-half the time required to get trains to speed, and that it pays its own fixed and maintenance charges several times in doing this through reduced wear and tear on rods, pins, crosshead keys, tires and other parts of the main machinery of a locomotive that would ordinarily be caused by slipping in the effort to start, but which are minimized, if not wholly eliminated, by the superior acceleration with the booster in service, and that when the train is up to road speed it has no more effect on the locomotive's operation than so much coal on the tender.

The Best Method of Operating Stoker-Fired Locomotives to Obtain the Greatest Efficiency at the Least Expense

The committee's report on the above subject contained many valuable hints in regard to stoker operation and among other practices often in vogue claimed that operating the present type stokers about the yard to prepare fire to be out of place. Hand firing is better and should be practiced. The old saying that a fireman is known by the color of his smoke is more true now with the stoker than in hand firing. With a stoker, if fireman and engineer are working together or co-operating, they should be able to keep a uniform color of smoke at the stack. Why should there not be a uniform color of smoke, as the feeding of coal can be at the will of the crew and placed in the firebox with the steady and uniform air supply? With skill and interest on the part of the crew, why should the firing not be uniform?

Fuel for stoker engines should receive the same consideration; i.e., good coal for economy, and a good grade of coal selected should be assigned to a district or division and kept there; draft arranged to suit, and get the men acquainted with the same. Stoker fires should be light, in accordance with the grate opening, which permits the proper amount of oxygen to perfect combustion. The more perfect the combustion the greater the saving.

Fuel for stoker-fired engines should not be pulverized or have an excessive amount of very fine size, as too much waste exits from the stack and an excessive consumption is experienced. Coal of a hard nature or at least fairly hard in nature or strata, is much more economical than a very friable coal that will crumble up almost to dust between the mining and the time the coal is to be placed into the firebox.

Recommended Practice for Conservation of Locomotive Appurtenances and Supplies.

The report stated that the subject of the conservation of supplies is logically divided into two parts; first the conservation at the terminal, and second, conservation on the road. A suitable building located at the point where all engines arrive and depart, materially affects the conservation of supplies at the terminal. This is where all equipment is checked to the engine crews prior to their departure, and checked in again upon their arrival. This facilitates the keeping of a complete record at all times and enables the party in charge of equipment to account for it if any should be lost or destroyed. If the engine crews know they will be held responsible for the use of supplies upon their arrival at terminals, it will act as an incentive for them to take better care of the equipment. Where the engines are in pool service, the engineer going out should have an opportunity of seeing the work reported by the incoming engineer. This will give the outgoing man the information that is essential for the proper care of any work that has been done. He will also have a knowledge of defects that have been reported, which the shop forces were unable to attend to and he will thus be able to protect himself and the company from injury.

The adequate supply of lubricant for the trip should be considered highly essential to the conservation of machinery, and appurtenances on the engine. Worn cylinders and valve bushings can often be charged to improper lubrication. However, this is seldom due to the fact that an insufficient amount of oil has been furnished. It is more often caused by defects that have not been reported or defects that have been reported and repairs not made. Also, instructions are not always carefully followed as to the right method of lubricating the machine, or perhaps the man in charge is indifferent.

In order to conserve supplies on the road it is imperative that engines be equipped with proper receptacles so that the different articles, such as oil, waste, lanterns, flags, water glasses, fuses and torpedoes, will not be wasted and damaged if not used. If all concerned were advised as to the cost of supplies or the enormous amount of money involved, it would be an incentive to all concerned for their judicious use and care. The co-operation of the employes is paramount. Carry no equipment on the engine that is not required. All surplus equipment should be promptly reported and removed at the home terminal.

Overloaded tenders are dangerous and extravagant, and overflowing tanks at water plugs are wasteful and expensive, for in freezing weather the water often overflows the tracks, which is very dangerous indeed, as well as expensive to clear away.

Enginemen should make intelligent reports as to locomotive conditions; that is, reports by means of which the enginehouse organization is capable of locating the precise defects. Reporting defects in a general way should not be tolerated, and enginemen should be encouraged to make proper reports by having the work done promptly or if the work cannot be done on this trip the engineman should be so advised and the work followed up and done for the next trip. This will encourage enginemen not to grow lax in making detailed reports.

The report particularly pointed out the air losses of the power reverse gear. In many instances adequate fuels have not been furnished to properly maintain this appliance and there are heavy air losses as a result of improper care. With the necessary care this device would result in a saving of fuel and water, as the engineer can adjust the cut-off with so much less exertion. However, with heavy air losses around the rotary and by the cylinder packing, it is next to impossible to regulate the cut-off at short valve travel, which results in the engine being worked at a longer cut-off, with a corresponding excess of consumption of fuel.

Once the steam has been used instead of the air for operating the gear it is of no more use until the piston is repacked.

Piston packing rings improperly cut, and failing to lap properly cause creeping. Also, if they are too tight and hardened, the rubber having lost its resiliency, they will not keep tight contact with the cylinder wall.

Hardened packing in the piston gland, scored rod or worn parts—any blow here will cause creeping.

Leaky drain cocks or cylinder oil cups will cause creeping.

On some gears there are cone-shaped valves for the distribution of air to the power reverse and these valves cause considerable trouble because of leaks, which will cause creeping when the reverse lever is hooked up. Leaky rotary valve will also cause this trouble; however, this seldom gives any trouble. Cases have been found where the stop pin is broken off and wedged between the rotary faces, damaging them; but under ordinary wear the rotary stands up well.

When the reverse gear valve assembly is changed, it is absolutely necessary to check the length of the long connection rod to the cylinder lapping lever. In some cases it had to be changed in length as much as 1½ in. Failing to do this the links will touch bottom at one end and have too short maximum cut-off in the other end.

Lost motion in pins and connecting rods of the reverse should not be tolerated.

Owing to the fact that the gear receives most of its wear in hook-up position, in time the cylinder increases in diameter at that part of the stroke and the piston rod decreases in diameter at the corresponding place. A gear that is worn this way will be a constant source of trouble from creeping and jumping.

Rotary, cylinder and connecting rod pins should be well oiled. Make sure that the steam shut-off valve is not leaking condensation into the reverse.

Cases have been found where the long connecting rod had several bends in it. This rod should be of sufficient size to avoid bending.

Any engineer operating locomotives equipped with electric headlights should make this a part of his study, in connection with his other duties. He should see before leaving the terminal that the dynamo has been well oiled and cared for and that his headlight is equipped with incandescent globes, also that he has sufficient lights placed in proper position in the cab, in order to furnish light to all the equipment he has to handle. He should bear in mind that the dynamo is the most vital part of the equipment and that he should pay particular attention to the condition of this machine at all times, keeping constantly in mind that all the bearings should be kept oiled. The governor will get out of order once in a while and will not control the speed of the machine as it should. When this condition develops, if the engineer does not take notice, it will result in the cab lights being burned out, especially if the headlight is cut out from the switch in the cab. In order to handle this situation, the engineer should throttle the machine down by the throttle in the cab. The engineer should bear in mind that if his hours are long in making the run over the devision, at night, the machine should be lubricated between terminals. He should also see that his headlight is properly focused. There is no one who has a better opportunity of keeping the headlight properly focused than the engineer. After completing the trip, if there are any conditions about this equipment causing it not to function properly, he should make an intelligent report and have conditions properly cared for at the terminal before the engine is allowed to go out again.

Referring to the proper use of the superheater appliance the report urged that enginemen should be taught the disastrous effects of carrying high water with this device. It not only converts the appliance into a steam dryer, but is very apt to cause the unit joints to leak and also to form a coat of lime or sediment on the inside of the tube, which substantially affects the degree of superheat obtained. It has been discovered that in extreme cases of carrying water too high in the boiler the superheat units have become completely clogged. Moreover, superheater headers have been broken, due to an excessive amount of water or filling the boiler too full while the engine was laying up at terminals.

Enginemen should receive instructions to closely observe the operation of the damper, for if the damper does not close when the throttle is closed, the superheater units will become overheated and will not only cause the unit joints to leak, but will have a tendency to crack the return bends and thus cause a complete engine failure.

Miscellaneous Reports.

Committee on Revision of Progressive Examination for Firemen for Promotion and New Men for Employment.

Committee on Subjects for Discussion at the 1922 Meeting.

Committee on Change of Constitution and By-Laws.

Committee on Arrangements for Next Annual Meeting.

Discussions

While the discussions arising from the presentation of the reports were all of an interesting kind, it may be stated briefly that in almost every instance the personal experiences of those participating in the discussions tended to emphasize the justness of the conclusions arrived at by the various committees, and the reports may be said to have been unanimously endorsed by the members of the association who had the opportunity of being present.

Election of Officers

The result of the election of officers was as follows: President, J. H. De Salis, New York Central; first vice-president, Frederick Kirby, Baltimore & Ohio; second vice-president, T. F. Howley, Erie; third vice-president, W. J. Fee, Grand Trunk; fourth vice-president, J. B. Hurley, Wabash; secretary, W. O. Thompson, New York Central; treasurer, David Meadows, Michigan Central. W. F. Preston of the Southern railroad, whose term as president of the association expires, was added to the membership of the executive committee.

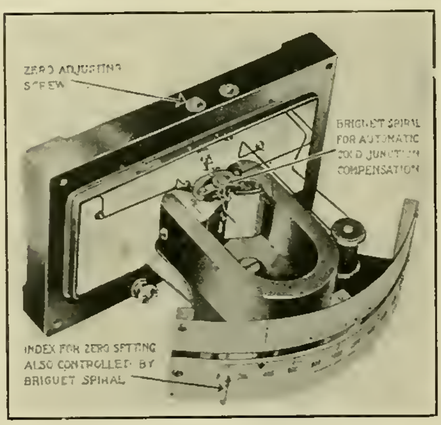
Brown Compensated Pyrometer

The pyrometer has now become such a thing of every-day use that all who have anything to do with the measurement of those higher temperatures that lie above the range of the ordinary forms of thermometers, are familiar with its construction and operation. For accurate work, such as the determination of the temperature of superheated steam, there is always the trouble and frequently the uncertainty of determining the temperature of the cold junction of the couple.

As the thermo-couple generates a voltage that is dependent upon the difference in temperature between its hot and cold ends, it is of great importance, for accurate work, that the temperature of the cold junction should be known at all times; that it should be maintained at a constant temperature, or that any variations to which it may be subjected should be automatically compensated. The first of these requirements is almost impossible of attainment, as the cold junction temperature will always lag behind any changes in the surrounding atmosphere. Of the other two, the automatic compensation for changes is the more desirable from the standpoint of the observer, as it obviates all the trouble of maintaining a constant temperature.

The Brown Instrument Company, of Philadelphia, Pa., has recently developed a thermo-electric pyrometer, in which the variations in the cold junction temperature are automatically compensated for in the instrument, which also has the usual means of setting the pointer of the instrument to zero.

The method employed is the use of what is called a Briguet spiral, which is a compound strip of two metals having different co-efficients of expansion. This spiral is made to operate upon the springs controlling the movement of the galvanometer, so that the indicator is set ahead or back, according as the cold junction temperature rises or falls. For example, suppose the cold junction temperature is 75 deg. Fahr. and the hot junction be 1,500 deg. Then the millivoltage developed would be that of the difference between the two and would indicate a temperature of 1,425 deg., to which the 75 deg. must be added in order to get the true hot junction temperature. Suppose now the cold junction temperature rises to 90 deg. Fahr. Then the indicated temperature would be 1,410 deg. If it is not known that the cold junction temperature had risen to 90 deg., and if the original temperature were to be added to that indicated, the result would be 15 deg. too low. With the compensated pyrometer, the instrument itself would indicate the difference in temperature between the two junctions, to which the Briguet spiral adds the cold junction temperature, so that the instrument pointer indicates, at all times, the actual temperature of the hot junction.



INTERIOR VIEW OF THE BROWN COMPENSATED PYROMETER

In the illustration the pointer leading out from the Briguet cold junction compensation is the instrument indicator, showing the actual hot junction temperature. The pointer for zero setting coming up from beneath the scale is operated by a Briguet spiral and is merely a thermometer index, indicating the temperature existing at the instrument or the cold junction. It is not adjustable and is set by the makers, and serves as the zero setting for the main pointer. When the couple is cut off from the main pointer that pointer is still under the control of the spiral of thermostatic metal and will swing back to register with the lower or temperature pointer. So that, when working, this thermometer reading is simply added to the temperature reading that would otherwise be obtained from the millivoltage obtained from the current generated by the difference in temperature between the hot and cold junctions.

The great advantage to be obtained by this automatic compensation for variations in cold junction temperatures, especially on locomotives where these variations are apt to be sudden and of considerable magnitude, are too apparent to need any comment.

Some Shop Appliances in Use in the Delaware & Hudson Company's Shops at Watervliet, New York

The setting of the return crank of a Walschaerts gear is sometimes difficult because of the lack of any definite point from which to take a measurement. The crank itself is usually laid out in the drawing room and made in the shop, but the trouble begins when it is to be placed on the crankpin and the keyway cut so as to locate it in the proper place.

A very simple and accurate gauge has been devised for this work and is in use in the shops of the Delaware & Hudson at Watervliet, New York. It consists of a heavy base *A* with stem B sliding through it and held by a thumbscrew. This stem carries a two-way slide, in which another stem *C* is fastened, like the indicating stem of a surface gauge, except that the two stems *B* and *C* are always held at right angles to each other.

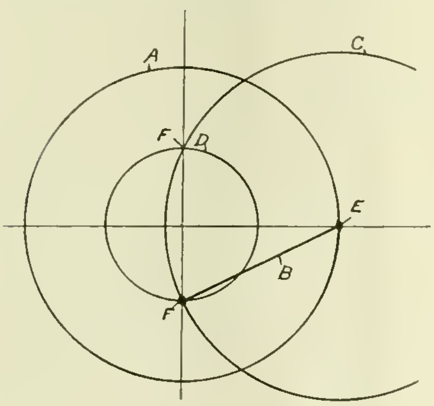


DIAGRAM OF GAUGE FOR SETTING ECCENTRIC CRANK ARM OF WALSCHAERTS VALVE GEAR, DELAWARE & HUDSON CO.

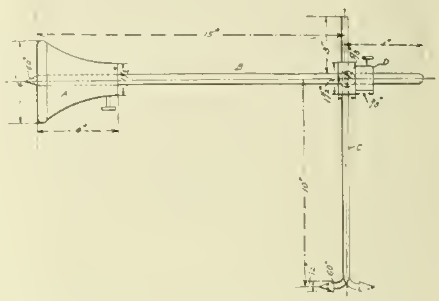
The main stem *B* terminates in a 60° center beneath the base, suited to fit into the center at the end of the main driving axle. The outer end of the stem *C* is turned at right angles and also terminates in a 60° center.

The method of using the device is first to set the stem *C* so that the distance from the 60° center to the center of the stem *B* is equal to the radius of the throw of the eccentric arm. The 60° center may be used turned in as shown in the full lines or out as shown by the dotted lines. In either case the principle of operation is the same.

The crank arm is slipped over the crank pin, and the eccentric rod pin put in place. The center of the stem *B* is then placed in the main driving wheel center and the eccentric arm is turned until the center on the stem *C* can enter the center in the eccentric rod pin. When this can be done the eccentric arm is in its proper position and can be marked for the keyway.

If the stem *C* is turned with the center in, as in the full lines, it enters the eccentric rod pin from the outside. If it is turned outward, as in the dotted lines, it enters from the inside. It is merely a matter of convenience as to the way in which it is used.

The principle upon which it works is



GAUGE FOR SETTING ECCENTRIC CRANK ARM OF WALSCHAERTS VALVE GEAR, DELAWARE & HUDSON CO.

shown by the diagram. In this the circle *A* represents the path of the crank pin, and the circle *D* that of the eccentric pin. It is also the circle that would be described by the center on the stem *C* if the whole device were to be turned with the center on *B* set in the axle center.

If, now, the point *E* indicates the crankpin and the heavy line *B* represents the eccentric arm, it is evident that if that arm be turned about the crank pin, the center of the eccentric pin will swing through the circle *C* and will cut the circle *D* at the points *F* and *F'*, one of which will be the proper location of the eccentric arm, and will be located by the coincidence of the center on *C* with the center in the eccentric pin.

Hydraulic Testing Machine

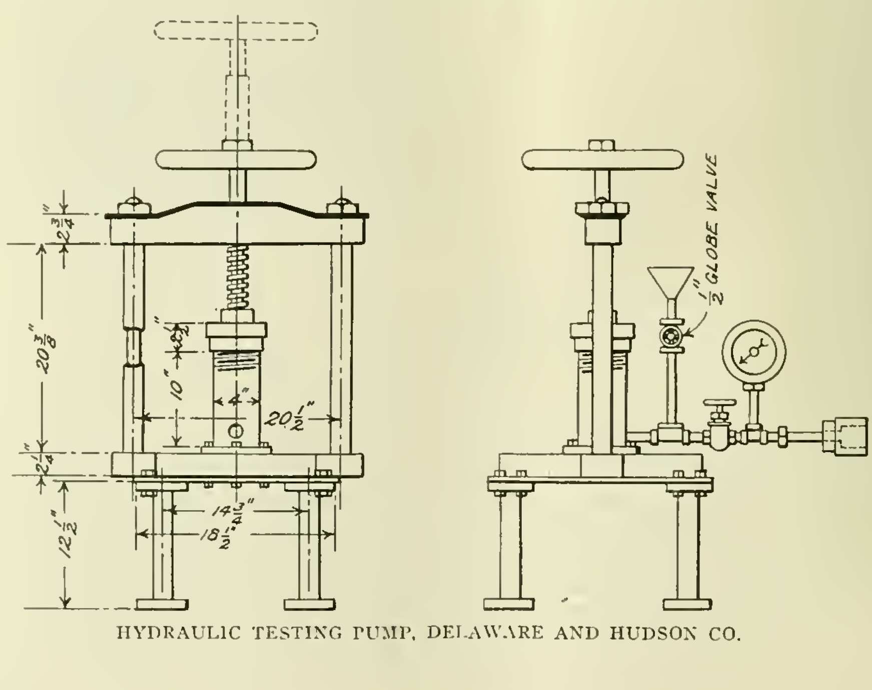
In air brake department of the shop there is a small hand-operated, home-made hydraulic testing machine for testing air hose, pop valves and other items to which it is desired to apply an hydraulic pressure.

The original was an old screw letter press with the uprights lengthened so as to afford room for placing a small cylinder beneath the yoke. This cylinder contains a plunger, packed in the usual way to the upper and outer end of which, the screw is attached. There are no check valves used. The single pipe leading from the bottom of the cylinder is fitted with a globe valve, and between this valve and the cylinder there is a tee, from which another pipe rises in which there is a second globe valve and which ends in a filling funnel.

To operate the device, the piece to be tested is attached to the outer end of the horizontal pipe and the globe valve in that pipe closed. With the plunger in its lowest position the globe valve in the vertical pipe is opened and the system filled with liquid. Then as the plunger is raised more liquid is poured in at the funnel until the upper position is reached, when the globe valve in the vertical pipe is closed and that in the horizontal opened. Then as the plunger is pushed down the liquid is forced out through the horizontal pipe, and any pressure that may be applied to the piece to be tested is indicated by the gang.

Plan of Waste Reclamation Room.

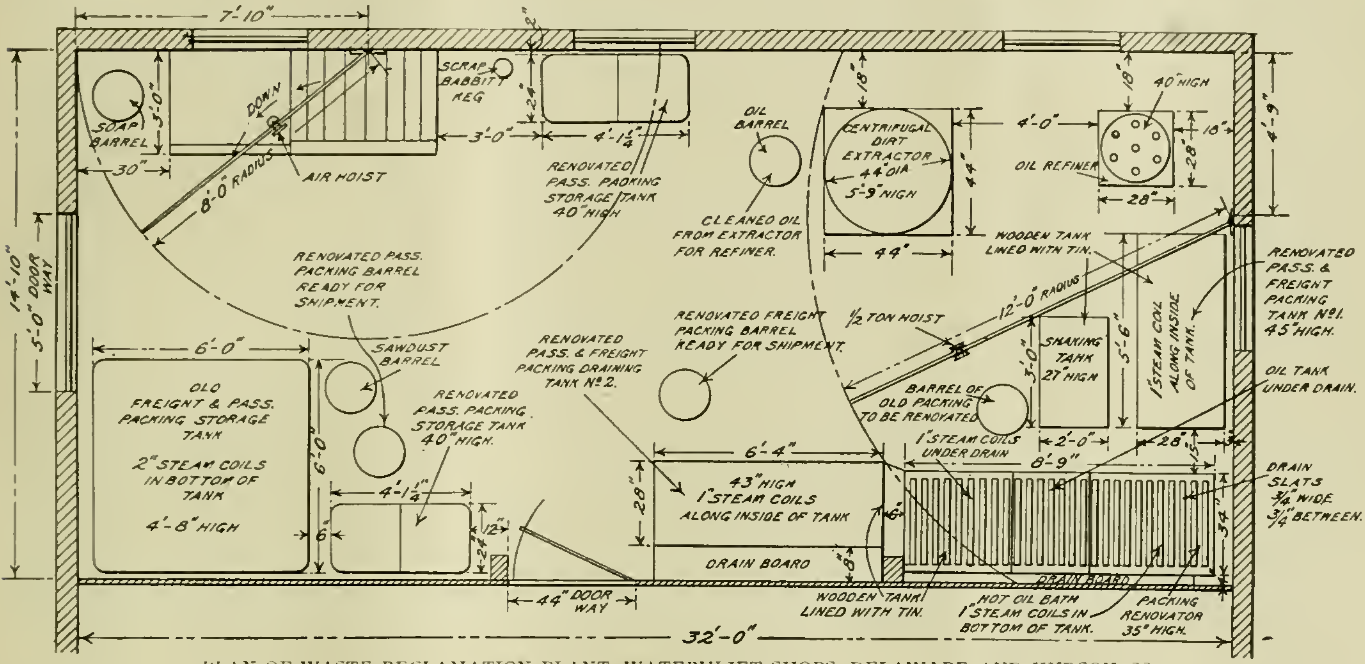
In our issue for March, 1921, we illustrated a number of the tanks that are used in the waste reclamation department of



HYDRAULIC TESTING PUMP, DELAWARE AND HUDSON CO.

the Watervliet shops of the Delaware & Hudson Co. A plan of the layout of the room is here shown. This room is 14 ft. wide and 32 ft. long. The dirty waste is received and thrown into the 6 ft. square tank at the left. From there it goes to the 8 ft. 9 in. tank.in the right-hand corner. Thence it goes to the two tanks having lengths of 6 ft. 4 in. and 5 ft. 6 in., which are fitted with steam coils, and finally it goes to the storage vat for renovated packing.

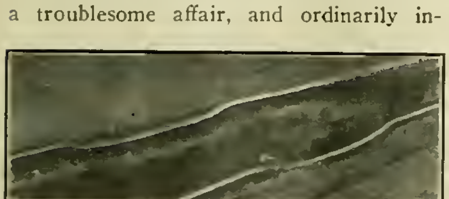
The room is served by two post cranes. It also contains a centrifugal dirt extractor, an oil refiner or cleanser and a shaking tank for loosening the waste. The general method of use having been described in our issues for January and March, 1921.



PLAN OF WASTE RECLAMATION PLANT, WATERVLIET SHOPS, DELAWARE AND HUDSON CO.

Depressed Track for Spring Renewals.

The renewal of driver springs is usually a troublesome affair, and ordinarily involves running the wheels up on wedges with more or less prying with bars to get the keys out of the hangers. This is done away with in the roundhouse at Watervliet by depressing the tracks about 3 in. and for a distance of about 6 ft. at one of the pits. This is used for spring renewals and removals. The engine is run into the stall having the depressed rails and the wheels with defective springs spotted on the depressed section, when the removal is easily made.


DEPRESSED RAILS FOR DRIVING SPRING RENEWALS, WATERVLIET SHOPS, DELAWARE & HUDSON CO.

Improvement in Tie Plates

The New York Central lines have conducted a series of tests to determine the relative loss of metal in the plates of various compositions, including those containing a small percentage of copper. The length of time over which the tests were conducted varied from two years to a maximum of six years, and some of the tests are still in progress. In all cases the maximum corrosion developed on the bottom or under side of the plates, contrary to the generally accepted theory of most engineers and maintenance of way men that the maximum corrosion takes place on the top or exposed portion. The percentage of copper ranged between 0.25 per cent as a minimum and 0.5 per cent as a maximum. In comparing the data, the results reported from the copper-treated plates was a loss of 0.59 per cent for high carbon open-hearth steel, too hard to punch. Iron plate came next, with 1.17 per cent. The standard steel plates varied from 4.70 to 6.60 per cent, showing a loss 8 or 10 times more than that of the copper-treated plates.

Foaming and Priming

Foaming is largely a surface effect and is caused by certain types of organic matter, saponifiable oils in the presence of caustic soda or sodium carbonate and matter in suspension. On the other hand, priming may be defined as a condition whereby the steam is liberated in slugs as compared against even ebullition under normal conditions. The cause usually assigned for the effect is increased surface tension of the water as the result of concentration of the sodium salts. All sodium salts being soluble have a tendency to increase the surface tension of the water, thereby disturbing evenness of ebullition. In other words, when the concentration of sodium salts is high, on account of associated increased surface tension, the water tends to liberate its steam in slugs, the consequence of which is a spray which is carried over with the steam and is apt to create trouble in valve and piston rings, and affect the packing of the piston very materially.

Standard Dimensions and Repairs of Box Cars Adopted

At the convention of 1920, the committee on Car Construction, recommended for standard fundamentals for future designs of box cars that the inside dimensions should be:

Length	40 ft. 6 in.
Width	8 ft. 6 in.
Height	8 ft. 6 in.

These dimensions have been submitted to letter ballot and have been approved.

At the same time, the committee recommended that when the ends of cars were broken, they should be replaced with ends specified for new cars. Owing to an evident misunderstanding of the meaning of the recommendation as substituted to letter ballot it was lost. The general committee, therefore, ordered a special letter ballot to be taken, restating the proposition and recommending an affirmative vote. The proposition as restated was as follows:

"On house cars (other than refrigerator cars) with steel underframes or steel center sills having a center sill area of not less than 24 sq. in., when an end requires repairs consisting of new posts and braces, the ends shall be replaced with ends specified for new cars, *this to be done by or under the direction of the car owners.*"

This has now been adopted as a standard and is effective as of the date of the Rules of Interchange of 1921.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:
JAMES KENNEDY, Managing Editor.
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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 *per year*, $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world*, $3.50 *or fifteen shillings. Single copies*, 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

Economy in Pulverized Coal

The increase in the use of pulverized coal is the best proof of its economic importance. It is generally admitted that by the use of pulverized coal a saving of 20 per cent. in heating efficiency and from 20 to 30 per cent. in consumption may be obtained. The fundamental economic advantage lies in the complete stage to which combustion is carried on in the furnace. The contact surface between coal and air is greatly increased by splitting the coal into numerous particles of small size. The second advantage in the pulverization of solid fuel is the fact that it floats in the air, spreads, and is carried off by even small air currents. This makes the intimate mixture of coal and air very easy. It simplifies the construction of burners, and guarantees economical combustion. The finer the coal power, the more nearly ideal conditions for complete combustion are approached.

Where proper apparatus and methods are in use, however, other more tangible economies are effected by the use of powdered fuel. The labor cost of firing is materially lowered, and losses during short periods when steam pressure is not required are reduced to a minimum. No air is allowed to pass through the furnace when firing operations stop, so that the radiant heat of the furnace is absorbed by the boiler, avoiding the losses which occur with grates or stokers through the constant burning up of fuel and incomplete combustion of the gases generated from banked fires. The time necessary to get up steam is reduced by half when pulverized coal is substituted for the same fuel in lump form. Until very recently the impression has prevailed that only certain grades of bituminous coal was suitable for powdering. High volatile coal gives the best results, but mixtures of such a grade of coal with anthracite culm have proved entirely satisfactory, and pulverization may be applied to any solid fuel, peat, lignite, or bituminous coals of any grade, as well as anthracite and coke. For a time fuel oil seemed destined to replace coal in many industrial uses, and it has done so to a considerable extent; but the great increase in the output of fuel oil in recent years has been through the discovery of new sources of supply. Many of the early discovered fields have begun to exhibit a decided decrease in production, due to the exhaustion of the available supply, and the increased cost of fuel oil in the districts supplied from these fields has in some cases made it necessary for industrial consumers to turn again to coal.

Working Steam Expansively on the Locomotive

Candidates for locomotive engineer are required to explain the advantages of working steam expansively. This might also be included in the examination for firemen, because unless the fireman maintains a high pressure of steam it is impossible for the engineer to use it expansively. Two firemen were discussing the pressure of steam necessary to negotiate a certain grade. One of them remarked that 100 lbs. pressure was sufficient for the purpose. No doubt the train could be got over the grade with that pressure, but it would be at the expense of working the steam at a very long "cut off." This means that the boiler would be called upon to supply more steam than would be the case if the steam were kept close up to the working pressure to enable the engineer to work it expansively.

A theoretical comparison may be made as follows: To work steam of 70 lbs. pressure "full stroke" in cylinder 21 ins. x 26 ins. would require for each stroke .857 lb. weight of steam, taking 982 heat units for its generation; whereas to work steam of 100 lbs. pressure in a 9-in. "cut off," the expansion of the steam in the cylinder would result in an average pressure on the piston of approximately 70 lbs., and would therefore do the same amount of work as in the previous case. But for each piston stroke we now require only .416 lb. weight of steam, taking 480 heat units for its generation. Thus it would take more than twice as many heat units to do the same work when using steam of 70 lbs. pressure "full stroke" as when using steam of 100 lbs. pressure in a 9-in. "cut off."

The economy in working expansively has also been demonstrated by practical tests on the testing plant at Purdue University.

Some results of those tests are shown in the following table:

Boiler Pressure.	Pounds Weight of Steam Per Horsepower Hour.	Heat Units Per Horsepower Minute.
240	24.7	483
200	25.5	498
160	26.6	517
120	29.1	563

Whilst stressing the need for keeping the boiler pressure close up to the working pressure (without any blowing off) in order to work in a short "cut off," it is desirable to utter a warning against working the engine at too short a "cut off." This causes the engine to work against "back pressure" owing to the excessive compression, and also involves heat losses from condensation and reevaporation in the cylinder. Therefore, when the lever is already fairly close to the center and it is necessary to still further reduce the horsepower, this should be done by throttling, rather than by "notching up" too close to the center.

New Safety Warning on the New Haven

A flashing, red electric light signal adapted to highway crossings approaching nearer the ideal to meet the requirements of safety warning than any other form of signal now in service has been established at grade crossings on the New York, New Haven & Hartford Railroad. This lamp consists of a parabolic reflector equipped with a standard Edison socket, which is held in place by an adjusting device so arranged that it can be centered at any point within certain limits in both the horizontal and vertical planes. The reflector is of mirrored glass and is permanently fastened in the lantern.

In place of the usual lens or glass of the standard lantern, a drum 8 ins. deep and 24 ins. in diameter is mounted. The center of this drum is equipped with a high transmission glass, red roundel, which is concentric with the reflector. Around the upper part of the drum, above the red center, the words "When Red" have been cut, while underneath, the word "Stop" is cut. Light from the lantern illuminating the interior of the drum shines through transparent letters, making these words plainly seen by anyone approaching the crossing.

The circuits for the operation of the lamp are simple, being connected with the track in such a way that when energy is applied, 30 flashes of the lamp per minute are produced and this is considered most suitable and effective. The mechanism is so adjusted that 75 per cent of the time the lamp is brightly illuminated, while during the remainder it has a dull red glow. Thus at no time while a train is approaching the crossing is the lamp entirely out. During practically all abnormal or failure conditions, either a constant red light or a flashing red light is provided.

As a train approaches the crossing the signal flashes out its high-powered electric warning light in both directions on the highway in much the same manner as our silent beacons along the coast warn the mariner of his danger. Many years of experience with the same apparatus in signals governing train operation on the principal railroads of the country show that failures are almost unknown. The crossing signals are in service day and night thus providing constant warning for the twenty-four hours and their light is so intense that it can be seen a considerable distance in bright sunlight. Travelers on the highway must stop when the signal is flashing its warning of danger, and after a train has passed over the crossing, should it continue to flash its red light, it is indicating the approach of another train, either on the same track or the one adjoining.

Apprenticeship

While the question of standardizing apprenticeships in electric and other industries are being discussed, and plans on projects tried and rejected, it is gratifying to observe that many of the leading manufacturing companies have met with eminent success and seem ready to adopt changes in their systems of apprenticeships when the change is deemed necessary. The records furnished in every case speak for themselves.

The American Locomotive Company has had apprentice training for eleven years, and 53 per cent of those trained remained with the company. An apprentice club is maintained to provide social life for the boys.

The Westinghouse Air Brake Company have conducted apprentice courses since 1902. Since then 81 apprentices have graduated out of 155 indentured, 50 of the indentures being cancelled for various reasons. Twenty-eight graduates remain with the company, six holding executive positions. The course is always full, 24 being the largest class allowed. Practically all graduates are assigned to tool-room work for which recruits are otherwise hard to obtain.

The Atchison, Topeka and Santa Fé Railway established apprentice schools over 13 years ago. Since that time 1,539 skilled mechanics have been graduated for the shops and roundhouses, fully two-thirds of this number and 90 per cent of last year's graduates being still with the company. Some 220 have been promoted to positions as foremen and master mechanics.

The Western Electric Company train tool-making apprentices from 15 to 18 years of age. Of these 80 per cent were reported to remain with the company, and 20 per cent of those who remain fill supervisory positions.

The Westinghouse Electric and Manufacturing Company, Lester, Pa., have conducted apprentice courses for about thirty years, most of the graduates remaining with the company.

Freight Cars Just as Necessary as Locomotive

A freight car is not an object of great beauty, but it is tremendously useful. It is a thing of service and, when it is not in place or broken down, what an ado there is! In the city there is a shortage of coal or sugar or flour, or others of the thousand and one things that are carried from producer to consumer. In the country there is complaint that wheat or corn or other products of the farm are ready for shipment and cannot be got to the market. The freight car is the burden-carrier of the nation, for the most part unappreciated except when it is not at work.

A locomotive is much more interesting. It is a triumph of mechanism, a thing of speed and power and beauty, it also serves, but in a more inspiring way, for as it travels over the country it leads a long line of burden-bearing freight cars. How much better, it may be said, to be a locomotive and compel than to be just a freight car and endure. That is a natural but rather a superficial thought. While it is true that, if all of a railroad's rolling stock were freight cars, the farms and factories would not be emptied and the market would not be supplied, there would be precisely the same result if all the rolling stock were locomotives. It is only when the locomotive and the cars are put together that there is satisfactory service.

The Hostler

It is claimed that no engineer undertakes to tell the hostler how he should handle the engine, for the hostler is the representative of the master mechanic, and a law unto himself. It would do no good to complain of him to the average round-house foreman, as he usually has enough other troubles and besides that he might not take kindly to your interfering with "his men" or methods. Engineers know this and don't butt in, but such samples of indifference and ignorance of the simplest rules of handling a locomotive at terminals have their effect on the enginemen, who, after a while, also forget to exercise the usual careful methods of handling and say, "What's the use?"

We read and hear much about the efforts of the mechanical officials to improve locomotive hauling, but they are wasting much of their energy trying to tell the engineers and firemen how to do things when they could accomplish more by correcting faults nearer home.

Locomotive Design

One of the principal aims in designing and running locomotives is that of assuring the necessary tractive force and drawbar efficiency without at the same time introducing excessive coal consumption in the endeavor to maintain the steam supply. It is desired that the boiler should steam freely and that the task of applying the steam to the work of propelling the train should be done as economically as possible, and whilst it is only natural that increased work should be reflected in a higher steam consumption, the ratio between the two must, if economy is to be observed, be kept as close as possible. The modern locomotive with superheater boiler is placed in a more favorable position for steam production than formerly was the case, and with carefully designed cylinders in which the steam ports and passages are of the best shape and proportions the most advantageous use of the steam in the boiler may be anticipated. It is not sufficient in itself to produce the steam, but also to use it to the best advantage.

Locomotive Operating

Since the performance of the locomotive depends on the proper combustion of the coal in the firebox, co-operation between the engineer and fireman is essential to successful working. This co-operation may include the following:

The engineer to advise the fireman how he is likely to work the engine at certain places. For instance, when a freight train is blocking an important passenger train, the engineer will generally work the engine a little heavier than is usual for that particular section. If he warns the fireman of his intention to do so, the fireman will know to increase the amount of fuel supplied to the fire in order to suit these conditions. Then, again, a fireman who is not familiar with the road will be greatly helped if the engineer takes care to advise him when approaching a momentum grade, so that he can get a good fire on ready for it, or when approaching a grade where the engine can roll without steam, so that he can get the fire burned down and thus avoid black smoke and "blowing off."

When starting away from a station the boiler should not have much more than ¾-glass of water (or its equivalent, after allowing for standing on an up grade or a down grade), and the engineer should effect a proper compromise between the need of the engine for generating momentum quickly and the need of the boiler to have a fire put on before a very strong draught is created.

In short both enginemen should not be thinking of the requirements of the engine alone, nor of the boiler alone, but of the locomotive as a whole.

Snap Shots—By the Wanderer

I was talking with the buyer for a large concern of horse dealers the other day, and, to my surprise, he told me that the automobile had not injured their business the slightest, and that, furthermore, they had an order on their books for 2,000 horses for a big company; that said big company had kept careful account of costs and found that for deliveries within a radius of ten miles horses were cheaper than automobile trucks. To check the statement I repeated it to the manager of a firm of automobile truck manufacturers. He rather demurred at the ten-mile radius, but was quite willing to grant the economy of using horses within a radius of five or six miles. But whether it is six or ten miles, the horse can evidently underbid the automobile for short distances.

For some time manufacturers near large cities have found the automobile cheaper and quicker for the transportation of goods between city warehouses and factory than the railroad. If this is true for the individual manufacturer, why should it not be for the public at large and miscellaneous freight in general. The automobile has the advantage of saving four transfers and of making a direct delivery from shipper to consignee, with the elimination of the possibility of damage during these four transfers. The four are from truck to station platform; from station platform to car, at the shipping end, and a reverse movement at the receiving end.

The point to be determined is the distance at which the saving effected by the automobile transportation ends and balances with that of the railroad, which will, of course, be determined by local conditions.

Incidental savings will be the track warehouse room saved by the elimination of these short distance shipments. It seems worth investigating.

As to the profitableness of short railroad hauls, an elaborate investigation on one road a few years ago showed that the cost of transfer from truck to station platform and from platform to car, plus that of checking in and out, with the reversal at the other end of the route, cost more than could be charged for any haul less than sixty miles, leaving nothing at all for the cost of hauling. Then, when attention is turned to the cost of delays caused by local freight trains blocking the track and interfering with through traffic, the losses on this class of freight are still further increased. It may be set down as an axiom that way freight trains never get over a division which they cover without a charge for overtime.

And this is an important item in their losses. In fact on one road at least the way-freight is so expensive and troublesome to operate that daily service has been abandoned and it is run only every other day. That is, one crew running out one day and in the next does all the local freight work.

So it does look as though the case of the motor truck *versus* short railroad haulage was a pretty good one.

But the status of the motor truck is not likely to remain as it is indefinitely. At the present the truck has the benefit of a road built without expense and maintained free of charge, except for the small license tax. It is highly probably that this will be changed in the near future. There is a movement already on foot to impose an operating license upon all motor trucks, the amount to depend on the capacity; the receipts thereof to be devoted to road maintenance, on the ground that there is no good reason why the public should maintain roads for the benefit of trucking companies. When this has been done, it remains to be seen as to whether the truck can compete with the railroad for short hauls. The end is not yet, but as it stands there is little doubt that the short haul freight is not only unprofitable but involves an actual loss to the railroad company.

And the old Tweed question comes to the front: "What are you going to do about it."

There is one thing in which I share a certain mystification with the Pullman porter. I have asked many of them why, and they always say, "Boss, I certainly doan know, and they always acts insulted if you say anything to them about it. So nachuly we done say nothing." And I wouldn't if I was in the porter's place. But sometimes in my capacity of an inconvenienced and somewhat disgusted passenger, I do express my wonderment that any man in his sense or possessed of the faintest modicum of common sense, should want to sit in the smoking room of a sleeping car, doing nothing but being in the way and making a nuisance of himself generally, during the dressing hours of the morning. If he is a smoker and must have a cigarette, I can appreciate his standpoint, for the smoker seems to be willing to inhabit anything from a pig sty down in order to get his smoke. So, though he may be an infernal nuisance, we will probably have to continue to tolerate and pity him because of his weakness. But how the casual visitor can abide the smells and the rather disgusting displays that many passengers of an unnamed persuasion make of themselves in the morning hour, for no apparent reason on earth, surpasses the powers of comprehension of the Pullman porter and myself. Our disgust is shared, of course, by a goodly number of passengers who use the dressing room by force of necessity. And as neither we nor the porter can say anything without giving offence, I take this occasion to make this suggestion for the consideration of the officials of the Pullman Company. Let them have a notice printed of which the porter shall hang three or four copies in the dressing room in the early hours of the morning, the said notice to have a character, viz., to repeat my commendation of the notice recently posted by the Pullman Company requesting that the room be not used as a lounging room during the dressing hour. And, then, if it is not heeded, to post something strong enough to put these nuisances to shame and drive them out.

There are frequent academic discussions as to what may be the most useful invention in railroad work. While I don't exactly like to use the superlative "most" in connection with the brake cylinder of the air brake equipment, that piece of mechanism has certainly been devoted to a very great variety of uses wherever it is desired to use an air pressure. And that reminds me of the first uses. It is not so many years ago that John Henney, at that time superintendent of motive power of the New York, New Haven & Hartford, took some pieces of cast iron pipe, put heads on them, and installing a Westinghouse compressor to furnish the air, used the combination for lifting work on and off the machines in the New Haven shops. He was very proud of his adaptation and, as far as I know, he was the first to use compressed air for hoisting purposes. His example was soon copied, however, and the locomotive air pump was used for a long time in many places because of the impossibility of getting appropriations to buy an economical compressor. The old air pump as a source of supply has long since disappeared, but the brake cylinder is still with us as the motive power for a great mass of home-made handy devices.

A certain fairly well-known engineer whom I could mention, but won't, is in the habit of congratulating himself that his early mechanical training, in the shop, was obtained in a repair shop, where it was thoroughly impressed upon him that the principal duty of a designing engineer was to do his work in such a way that when his mechanism went to the repair shop the various parts would be accessible to the man who has to do the work. This is brought to the front by the contemplation of the modern locomotive. Things have been so piled upon the machine within the past few years, it is small wonder that they are so heaped over each other, that those last applied have to be removed to get access to the ones first put on. Sometimes things have the appearance of having "just growed," like Topsy, especially on the back head. The point is whether it would not be a paying investment for the world if a little more real designing were sometimes done on that head. I know that it is a tangling, maddening, brain-confusing thing to do, that designing of the full layout of piping on the back head of a modern locomotive boiler. It is so much easier to locate the door opener, the blower valve, the lubricator, and all of the other etceteras, and then let the pipe fitters loose to make the connections according to their own ideas. This gets there in the easiest possible way for the builders, makes the engine look rather jumbled at the back, and puts up a problem, like the unraveling of a tangled mass of string, to the repairman. I don't wonder that the designer dodges. But should he?

I had become so accustomed to this twisted method that I had forgotten that anything else were possible, until I recently saw an engine, having all the appurtenances that go with the latest up-to-date, and with a back head as clean as clean could be. There was not a piece of pipe that could not be removed without disturbing any other piece. It all lay neatly flat against the back head. The cab seemed empty. It looked as though the spirit of order had taken possession and entered into his own. And when that engine gets into the back shop for repairs there is more than one man who will rise up and call that man blessed who designed the layout for that piping.

To which attention is respectfully called.

Economic Aspects of the Electric Locomotive

By L. E. Lynde, Railway Department, Westinghouse Electric & Manufacturing Co.

Among the important reasons for the use of electric locomotives in place of steam, is that of economy. The saving in operating expense and improved service over previous steam engine operation, on many roads has warranted the change over. The conservation of fuel resources, as well as the increased cost of fuel, and the inherent limits of steam operation in tunnels and terminals have in some cases made it practically essential that roads be electrified.

The item of fuel uses up a large part of the earnings of a railroad company. Coal is hauled from the mines to the railroad round houses, and in many instances retraces its path in the tender of the locomotive, thereby calling for a vast amount of car equipment and motive power necessary for the hauling of this tonnage, and this produces no revenue to the company! Locomotives burn 25 per cent of all the coal that is mined, and of all the freight handled, 12 per cent is coal hauled for the railroad's use. It is said that one-third of all the coal burned in locomotives is wasted in so-called stand-by losses. The hauling capacity of a steam locomotive is decreased due to the weight of the tender with its water and coal. With an electric locomotive, this is devoted to revenue tonnage. Statistics show that a saving of over 123,000,000 tons is possible by the use of electric locomotives.

The rapid growth of traffic in and out of the large terminals has made the electric locomotive a necessity. The use of electricity in terminals makes it possible to double the capacity by the use of different elevations. It also permits the construction of revenue producing buildings over the yard and terminal tracks. Much time is lost in waiting for smoke and steam to clear from terminals, besides the danger involved in operating trains due to the impossibility of determining their location. The rapid acceleration offered by the electric locomotive allows the speeding up of the departure of trains, which is an important item in the now congested terminals.

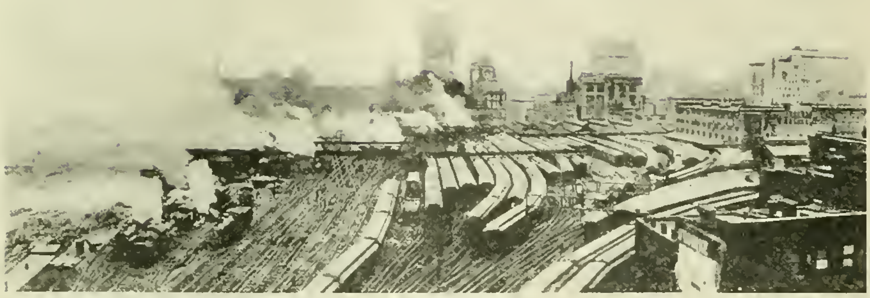
STEAM LOCOMOTIVES BURN 25 PER CENT OF ALL COAL MINED AND 18 PER CENT OF ALL FREIGHT HANDLED IS COAL FOR RAILROAD USE

The safety and comfort afforded passengers, as well as the ease with which large trains can descend grades by means of the regenerative system of braking, points to the superiority of the electric over the steam locomotive. Regeneration allows complete control of the train on down grades, leaving the air brakes to be used in case of emergency, as well as returning power to the system. There is also a saving in wear and tear on brake equipment, and a reduction in the grinding and noise. In starting, the slack of the train is taken up gradually, thus preventing shocks, drawbar pullouts, and accident to passengers. The electric locomotive offers the engineer a clear view of the track ahead, which is more or less impossible with a steam locomotive, due to smoke and steam.

Relief for congested territories can be secured with less capital expenditure by electrifying, than by adding more tracks, grades and tunnels, at a large expense. Longer and heavier trains can be hauled at a higher speed on the ruling grades, thus increasing the headway of the trains while at the same time, stops for water and coal are eliminated. Freight trains as hauled by steam locomotives are of such weight and length, that it is frequently necessary that an extra engine be used to push the train in order to reduce the chances of drawbar pullouts. The speed with which the electric locomotive delivers the train, reduces the length of the trains and the necessity of an extra locomotive. Delays to passenger trains caused by freight trains shifting to sidings, is reduced to a minimum, due to the increase in speed of the freight.

The electric locomotive has proved its worth during the winter storms. There are no delays due to freezing and failure to get up steam, thus allowing a continuous fight to be made against the elements. This is of extreme importance, since a few hours' delay in fighting snow may mean a week's cessation of service, due to drifts On certain electrified sections during the winter of 1917-1918 steam trains were turned over to electric locomotives many hours late, and brought into the terminals on time. Cold weather increases the efficiency of the electric and decreases that of the steam locomotive.

Continuity of service of a locomotive reduces the expenses and increases service. In the use of the electric locomotive there are eliminated many division points which were used by the steam locomotive as exchange points. On the electrified division of the Chicago, Milwaukee & St. Paul



SCENE BEFORE ELECTRIFICATION PERMITTED USE OF MORE THAN ONE TERMINAL LEVEL

Railway, a run of over 440 miles is now covered without changing electric locomotives, where previously four steam locomotives were used. On the New York, New Haven & Hartford Railroad, a switching locomotive operated 24 hours a day for thirty days, a record with which a steam locomotive could never compete. On the Norfolk & Western Railway, six electrics replace twenty Mallet type locomotives.

With the electric locomotive no time is lost in cleaning fires and securing supplies of coal and water, while the fires on the steam locomotive must be maintained in order to insure its prompt use. A steam locomotive's capacity is limited by its boilers, while the electric has unlimited capacity, due to its ability to operate in multiple with other units. The electric locomotive is a translating engine and not a generating engine, and is ready for service at any time and any place.

The electric locomotive reduces the personnel of the road, due to the elimination of turntables, since it is operated from either end. Shop and roundhouse labor is reduced, as the majority of repairs to a steam locomotive are due to boiler troubles. Statistics show that steam locomotives are in for repairs more often and for a longer period than electric locomotives. The boiler water in many instances has to be treated, thereby involving extra expense. Repairs to freight cars, caused by the abuse they receive at the hands of a steam locomotive, are greatly reduced on account of the ease with which the electric picks up the slack, and the cost of starting and stopping heavy trains is greatly reduced.

A marked economy effected by the electric locomotive is the reduction in trainmen and enginemen expense, due to the increased ton-miles per train-mile, and per engine-mile. Extra men must be employed to keep the fires on the locomotives in the yards burning to insure their prompt use, while the electric draws no power except in actual operation, and can be started on a moment's notice. Engineers of steam locomotives are taking over the electric locomotives after a few days' instruction, and proving very efficient, thus eliminating the necessity of breaking in new men. The electric locomotive has established very low maintenance costs, and with its reliability and flexibility in meeting all kinds of service has greatly reduced operating expenses.

Many claims are made against the railroad company for damages, resulting from fires caused by the sparks from the steam locomotives. Claims are made for accidents to passengers through the sudden starting and stopping of trains. The electric locomotive tends to eliminate both of these claims, and hence decreases the damage suits. The chance of danger signals being passed is greatly reduced, since the duties of the firemen or engineer's helper are not such as to prevent him from observing, as in the case of a steam locomotive fireman, who is firing most of the time. Most electrified roads employ the double check, the engineer calling the signals to the fireman, who verifies them.

SCENE AFTER ELECTRIFICATION WITH MORE THAN ONE TERMINAL LEVEL, PERMITTING THE USE OF REVENUE PRODUCING BUILDINGS

From installations in service, it is found that the electric locomotive is a conserver of fuel, has proved to be more economical than the steam engine, increased the safety and comfort of travel, decreased the delays encountered in winter, increased the speed of transportation and undoubtedly will decrease the cost of transportation.

VIEW OF HEAVIER TRAINS ON STEEPER GRADES AFTER ELECTRIFICATION

A Notable Steel Bridge in Alaska

The fifty-million-dollar Government Railway in Alaska has involved some very heavy work. The line is not expected to pay until the land it traverses has been fully developed as well as the ocean port. The most important bridge is that over the River Susitna, 264 miles north of Seward.

Result of Balloting on the Railroad Labor Questions

Attitude of the Pennsylvania—Decision of the Labor Board

During September, as stated in last month's discussion of the questions involved in the national controversy involving the future of the railroad, balloting on the question of a strike among the employes was proceeded with, and on September 26, the leaders of the Big Four brotherhoods and affiliated unions met in Chicago and the consensus of opinion was that there was little doubt but that the railway employes had voted for a general strike rather than accept a wage reduction, but announced that the conservation council of the leaders might prevail against a walk-out. Of the 186,000 ballots on hand at the date referred to the indications were that the result would be overwhelmingly in favor of a strike.

"Our past experience has been that 98 per cent of the men always vote to strike," is attributed as being a statement made by Vice-president James Murdock. All the railroad union leaders expect that substantial majorities will be cast for a strike. The affiliated shop crafts voted by a majority estimated at 325,000 to 48,000 to walk out, and are only waiting to see what action the other unions will take and for the United States Labor Board to dispose of the pending working rule agreements. Reports of the general chairmen of the trainmen were plainly disappointing to the union leaders, the trainmen had voted on a separate ballot because their leaders did not approve of the joint ballot prepared by the other unions. President W. G. Lee had addressed a circular letter to the men, in which he pointed out five reasons why he though a strike would be unwise at this time and why the men might expect some wage reduction. He asked them to consider the fact that wages and working conditions of all classes established since 1918 were the result of a world war; that 5,000,000 of men are now unemployed; that nearly all classes of labor have been forced by mediation, arbitration, strikes or lockouts to accept reduced rates of pay during the past year; that the increased wages granted railroad men last year were based on increased cost of living and that government reports indicate a 16 per cent cut in living costs since July, 1920.

The letter, however, apparently failed to influence the voting as shown by the returns so far examined. The strike vote, however, does not necessarily mean the immediate calling of a strike. The question as submitted carried a vote for or against "a strike unless the wage reduction question can be settled in a manner satisfactory to the general grievance committee representing the class of service in which the voter is engaged." "It has been frequently charged," Mr. Lee states, "that officers of the brotherhood have prevented the membership from engaging in a strike after a vote was canvassed in favor thereof, and it is admitted that in years gone by officers of the brotherhood with general committees, have accepted a partial fulfillment of the requests, in some instances rather than report a strike." As regards the reduction of pay of July 1, 1921, it has been decided to permit general grievance committees to determine for themselves whether they desire the membership on their systems to be withdrawn from service, regardless of the action taken by any other railroad by the membership of any or all the sister organizations." The general chairman on any railroad system where the men vote to strike will be given authority to call out his followers, Mr. Lee claimed. The men will not strike until called to do so.

The Attitude of the Pennsylvania

Circumstances have brought the Pennsylvania into sharp conflict with the United States Labor Board. It is one of those clashes which were bound to come in the process of applying the transportation act. There is a difference of opinion which ought to be settled in the courts. The Labor Board called on the Pennsylvania to negotiate with its employes regarding working conditions. The road held elections at which the employes were to choose representatives. The ballots apparently did not afford union members an opportunity to vote for representatives through their organizations, that were not employes. The Labor Board held that this limitation on the choice of representatives was improper and ordered the road to hold a new election. This the executives of the road declined to do, stating that of the 176,000 employes interested in and affected by rules covering working conditions 117,176 had indicated a desire to negotiate through employes representatives. Contracts have been entered into with 149,918 employes. The management claims that the great majority of the employes are satisfied with the direct method of adjusting differences, and denies the Labor Board's right to insist on the indirect method.

The Labor Board has no coercive power, but if it can get a test of the validity of its order with the courts both the Board and the railroad will be doing a public service. It is of the highest importance to the future of railroad operation that this point should be decided.

Opinion of the Labor Board

In reviewing the attitude of the Pennsylvania, the United States Labor Board holds that it knows of no law in this country which prevents or limits a man in selecting his own representation, and the Board has no power to prescribe a limitation which the law does not, and has no disposition to do so. The organizations are repeatedly and expressly recognized in the transportation act and shown to have the right to represent the employes in these matters if elected to do so. Of the hundreds of disputes brought before the Board probably less than five have been brought by and for unorganized employes. Congress contemplated that the organizations would largely represent the employes, and made it the imperative duty of the Board to hear them.

This presents the real crux of the controversy in this case. Here was an organization to which many, if not a majority, of the employes in the shop craft class of this company belong. It is strongly insisted that a majority of this class on this road desired and had authorized this organization to represent them in the conferences and negotiations to be held. For reasons and motives that are immaterial to this Board, it is evident that the management was not willing, if it could be avoided, that this organization, its officials, agents and committees should represent these men, and it evidently formed its plans to prevent this if it could. Anyway, it was unwilling to agree, or did not agree, with this organization on a plan to fairly ascertain the wishes of this class of employes on the road. Both of the contending parties adopted and carried out their own separate plans, both of which were held by this Board to be faulty and unfair. The Board endeavored to prescribe a plan and method that would fairly obtain and accurately express the wishes of the majority of the employes of this class. This decision the carrier rejects and refuses to abide by, and arrogates to itself the sole function and power to decide these matters. If a majority of this class of employes on this road has an absolute right under the law to select their own representatives—and this is the clearly expressed will of Congress—this Board in its proceedings and decisions must obey the mandate of Congress. If the carrier refuses, it is an attack not so much on this Board as on Congress. It is nothing more or less than a denial and repudiation of the sovereign will of the United States as expressed by Congress.

If the members of any class wish to join a union they have that right. If they desire to remain out of or leave such a union at any time, they have that right. If they or a majority of any class want a union or its officers to represent them, they have that right. If they, whether union men or not, want other individuals to represent them, they have that right. Neither this board nor the management of the Pennsylvania System has the right by any kind of plan or movement to dictate as to who shall be their representatives. Any attempt to do so is an authorized assumption of power.

The carrier suggests that the employes who are not parties to the alleged contracts and who do not want to be bound by them may invoke the aid of the board.

The purpose of the Transportation Act was to enable the parties to meet in conference, and when unable to compose their differences, for the Labor Board to prescribe conditions under which they should act. It is pointed out in the decision above referred to that there are two possible views as to the present state of the law on this subject: One is that the decisions of this board are merely persuasive with only a moral obligation resting upon the parties. The other is that Congress in the exercise of paramount police power necessary for the preservation, safety, and progress of the country, has, as to these common carriers and their employes, for the benefit of the public, limited the exercise of their hitherto unquestioned legal rights in such matters. But, as stated in that decision, whatever view may be taken, the duty of the Labor Board remains the same; that is, to decide what is just, fair and reasonable as between the parties and the public.

If Congress should enact a law prohibiting recognition of labor organizations of railway employes, or authorizing carriers to establish rules in the interest of the public prohibiting railroad employes from belonging to such unions, this Board would obey the law. But on the contrary, Congress has recognized as lawful and directed this Board to recognize them in the railway service, and this Board in this decision is only obeying the obvious direction of Congress. Its decisions on this subject do not tend to a closed shop and have no bearing whatever on the very bitterly debated question of the open and closed shops in other industries. Any representations or statements to the contrary are not only misleading, but can only work public harm.

This Board can only to the best of its ability decide the disputes brought before it according to the provisions, purposes and spirit of the Transportation Act, seeking to do all it reasonably can to secure industrial peace along these lines and to prevent an interruption of traffic so disastrous to public interests. If either party to such disputes sees proper to disregard its decisions and thus contribute to or cause the public misfortune which Congress sought to prevent, the responsibility is with those guilty of such action.

While the Board regrets such action, not so much because it is an attack more or less direct on the power and effectiveness of the Board, but because it, in the opinion of the Board, is in effect a deliberate attempt to ignore the power and defeat the will and purpose of Congress plainly expressed, and Congress in these matters represents the dignity, power and sovereignty of the United States. The remedy lies with the public, or possibly with Congress or the courts.

American Railway Association Establishes Safety Section

Carrying out the recommendation of Daniel Willard, president of the Baltimore and Ohio Railroad, which was approved by the board of directors of the American Railway Association, of which he is chairman, a safety section of that organization has been created, under whose auspices railroad safety work will be conducted. This action grew out of a meeting here between R. H. Aishton, president of the Association, and 25 safety representatives of the leading railroads of the country.

Through this affiliation with the American Railroad Association, regarded as the premier organization of its kind in the country, railroad safety men anticipate that their work for the preservation of life and the elimination of accidents will be greatly stimulated. Co-ordination of methods now in use on various individual roads will be the prime object of the new safety section, under whose direction unified plans will be carried out on the railroads.

Although permanent officers for the safety section of the Association will not be elected until the next meeting in Boston on September 26, temporary officers have been chosen. E. M. Switzer, of the Chicago, Burlington and Quincy Railroad, was named chairman; John T. Broderick, superintendent of safety on the Baltimore and Ohio Railroad, first vice-chairman, and Isaiah Hale, of the Santa Fe Railroad, second vice-chairman. A board of direction and committees to map out a program for preliminary work were also appointed.

Apprenticeship System

The American Electric Railway Engineering Association, at its convention held in the first week of October, 1921, at Atlantic City, N. J., among other reports received a comprehensive report on the apprenticeship system, or rather the lack of a standardized apprentice system. The report also stated that an insufficient number of young men of suitable character, training and ability have entered the electric railway service in recent years, but efforts are being made to overcome this undesirable condition. The apprenticeship systems on many of the steam railways are pointed to in the report as well adapted to the requirements of the service, and could be modified to suit the peculiar needs of the electric railway business. Many of the universities have organized co-operation training courses. This plan, probably, offers the best means by which the industry may secure recruits for its engineering personnel. Outlines for a four years' course were suggested, which it is hoped will serve as a foundation upon which a plan of apprenticeship training may be adopted by the Association.

A Bold Britisher

Sir. F. Banbury, chairman of the Great Northern Railway of England, speaking in support of his motion for rejection of the Railway Bill, recently passed by the House of Lords, said that there was no warrant for believing that the bill would bring about savings in the operation of the railways, and that in the future the railways would be managed by the Rates Tribunal, the Amalgamation Tribunal, the Railway and Canal Commission, the National Wages Board, and the Minister of Transport. If that was not to attempt bureaucratic control from London, he did not know what was. What business could be successfully managed if the management was taken out of the hands of the partners and placed in the hands of bodies set up by the State? What was left to the representatives of the shareholders to do, unless it might be to smooth over friction between these various bodies? The only matter he could see left to the sole responsibility of the directors was finding the money which other people were to spend. A straightforward attempt to nationalize the railways would result in some compensation being paid for the property taken away. But by this bill the property was to all intents and purposes taken away, and not only was no compensation paid to the owners but actually they had to find the money to pay the expenses and salaries of these bodies. It was the unfortunate shareholders who had to pay.

Apprenticeship on the Railways

It is claimed that among other changes effected in the management of railways during the period of government control, some companies were compelled to discontinue their school work. Shop training was continued, but with the necessity for a reduction in working forces many graduate apprentices were laid off and the results of training were thus nullified. Since the return of the roads to their owners there has been an attempt to return to normal conditions, but since the companies are required to recognize seniority in making reduction of forces, and since apprentices are not given seniority before gradution, it results that the first men to be laid off during trade depression are the recent apprentice graduates. Another rule limits the number of apprentices to one for each five mechanics. When forces are reduced apprentices also must be laid off, and training which should be a continuous process is greatly impeded, much to the detriment of the service.

Railway Conditions in Russia

Out of a total of 19,100 locomotives in good condition before the war, there are at present from 5,500 to 7,650 reported in working order by different authorities, or a decrease of motive power by 60 to 75 per cent. Of that number approximately 1,000 are idle owing to lack of fuel. Serviceable cars are reported at from 150,000 to 286,000, or a decrease of from 48 to 70 per cent of the pre-war number.

The roadbeds are reported in very bad condition, and if large repairs are not made in the next few months considerable sections will have to be closed to traffic. According to the latest estimate at least 25,000,000 ties must be replaced and the present program calls for only 5,000,000 replacements. A considerable mileage of branch lines has been removed and used for repair material.

The fuel situation is very serious. Cessation in production of coal by 80 per cent and the deterioration of the mines has forced the railways to depend much more upon wood. Such wood must come from the forests of northern Russia, and the haul is too long for supply to southern Russian railways. An effort has been made to change the locomotives on the southern railways into oil burners, but the gradual decline of oil production has limited this transformation.

In the course of construction there were 88 auxiliary railroad lines for the forest work, including 38 of narrow gauge and 50 of broad gauge. There were at the beginning of the year in course of construction 626 miles of railroads, 250 miles narrow gauge, and broad gauge 366 miles. About 70 per cent of the roadbed was completed and rails were laid to a length of 142 miles. The construction of these auxiliary railroads are handicapped by the shortage of workmen, as they were constantly leaving, and the work often temporarily abandoned.

Wireless Control of Locomotives

According to the *Revue Generale des Chemin de Fer,* a series of tests on electrical intercommunication between two electric locomotives driving the same train is now in progress between Paris and Juvisy. The system, which was patented in 1917 by the Orleans Railway Company, consists of an arrangement whereby the locomotive at the head of the train produces a periodical secondary current of low voltage and relatively high frequency. This current is superimposed on the power current and is transmitted to the ordinary circuits which supply the two locomotives. In the locomotive at the end of the train selective receivers are installed which allow different effects to be obtained according to the form of the current transmitted. These secondary currents are used principally for operating the contactor and breaking equipment and, of course, avoid the use of a driver at the tail of the train. The arrangement is, obviously, more useful on mountain sections where locomotives are used at both ends of the train than for motor trains operated by an ordinary multiple-control system.

Electrification of Japanese Railways

The official system for the electrification of the railways of Japan has recently been revised and a new electric bureau established, states an issue of the Yokohama *Chamber of Commerce Journal.* According to the plan now being worked out by the Department of Railways, the first steps will be to electrify the entire Tokaido line, whose traffic has been increasing enormously each year, from Tokyo to Kobe, and a part of the Central line between Iidamachi station in Tokyo and Kofu, in the rear of Mount Fuji, where many tunnels make transportation slow. Electric trains will be used exclusively for passengers, freight trains being propelled by steam as at present.

German Proposal to Supply Italy with Locomotives

The following is a translation of an article which appeared in a daily newspaper of Venice, the *Gazzetta di Venezia,* August 17, 1921, regarding a proposal made by the German Government to the Italian Reparations Commission whereby Germany would supply 300 locomotives to the Italian State Railways instead of the equivalent reparations in money; that is, about 300,000,000 lire. It appears from the article that the offer has been rejected by the Italian Government, this decision having been arrived at through the conference between the government offices and the representatives of Italian industry.

Improved Railway Service for Rumania

Representatives from the Ministry of Railways for Rumania have arrived in Prague to discuss the means of establishing rapid train service between Czechoslovakia, Rumania, and other southeastern European countries, says a report from Consul C. S. Winans, Prague, Czechoslovakia. A general conference on this question is to be held at Prague in October, 1921. The negotiations now going on at Budapest between Czechoslovakia and Hungary regarding the rates to be charged on merchandise sent to Rumania by way of Hungary are said to have reached a favorable conclusion.

Progress of Electrification in Italy

It is reported that Italy's electrification of her State railways is progressing rapidly. When the task is completed Italy will have taken her first definite step towards freeing herself from virtual slavery to whatever foreign country can supply her with coal—to say nothing of greatly improving her financial situation by diminishing one of her biggest and most expensive items of importation.

Following the electrification of her railways, Italy plans to electrify nearly all of her industries, utilizing the almost inexhaustible water power resources of her mountains and streams.

A New Canadian Railroad

Construction work will be commenced at an early date on a logging railroad northward from Squamish, British Columbia, to the vicinity of Lake Alice. According to estimates upward of 2,000,000,000 feet of logs will become available for transportation by this means, and it is anticipated that something like the activity of former years will again be in evidence. The new undertaking will have incorporated with it the booming grounds formerly operated by the Howe Sound & Northern Railway, making possible the handling of unlimited shipments.

Gets Large Locomotive Order

S. M. Vauclain, president of the Baldwin Locomotive Works, who has returned to Philadelphia from a trip to Mexico City, where he conferred with President Obregon, stated recently, according to a Philadelphia wire, that he had arranged for a credit of $2,500,000 to the Mexican Government for the purchase of locomotives, and also that he gave that government the privilege of an additional credit of $2,500,000. Under the first credit Mexico has ordered forty-five locomotives, and also ordered twenty engines under a separate condition of payment.

Purchase of American Locomotives by Mexican Government

The number of locomotives purchased in the United States by the Mexican Government has been reported to Assistant Trade Commissioner Connell from official sources as 130. Of these 85 have been obtained on a rental basis with a view of ultimate purchase, and the other 45 have been purchased outright and a cash payment of from 15 to 20 per cent already made. Further purchases are expected.

Drill Steel

Recently an entirely new and novel method of producing hollow drill steel has been developed by P. A. Armstrong, vice-president of the Ludlum Steel Company. The method employed is to insert a very mild steel tube into an ingot mould and cast the hot steel around it. The tube is previously sand-blasted, and filled with refractory material—usually a high-grade sand. The filling remains during the rolling operation and is ejected by compressed air. The whole method of manufacture appears to be effected with the object of producing a steel capable of extreme surface hardening with a soft "backing," which appears a reasonable and sound proposition.

Items of Personal Interest

H. Schmidt has been appointed roundhouse foreman of the Erie, with office at Cleveland, Ohio.

S. T. Depue has been appointed master mechanic of the Kent division of the Erie, succeeding R. W. Blacker, resigned.

R. E. Detrick has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific with office at El Reno, Okla.

George Canfield has been appointed locomotive foreman of the Canadian Northern, with office at Jelicoe, Ont.

M. J. Manion has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific, with office at Pratt, Kans.

J. R. Sanderstrom has been appointed assistant car foreman of the Chicago, Rock Island & Pacific, with office at Herington, Kans.

William W. Wilson has been appointed shop foreman of the Chicago, Rock Island & Pacific, with office at Pratt, Kans.

H. W. Sasser has been appointed shop superintendent of the Erie, with office at Galion, Ohio, succeeding S. T. Depue, promoted.

John Wren has been appointed night roundhouse foreman of the Chicago, Rock Island & Pacific, with office at Kansas City, Kans.

E. P. Eich has been appointed day roundhouse foreman of the Chicago, Rock Island & Pacific, with office at Kansas City, Kans.

W. B. Smith has been appointed general foreman of the Rock Island shops at Sayre, Okla., succeeding Robert E. Detrick, transferred.

C. C. Kyle has been appointed acting general storekeeper of the Northern Pacific, with headquarters at St. Paul, Minn., succeeding O. C. Wakefield.

W. Wilcox has been appointed roundhouse foreman of the Illinois Central, with office at Jackson, Tenn., succeeding C. B. Thompson, transferred to Birmingham, Ala.

M. McKernan has been appointed superintendent of safety of the Missouri Pacific, with headquarters at St. Louis, Mo., succeeding R. H. Dwyer, assigned to other duties.

J. D. McCarthy has been appointed purchasing agent of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., succeeding W. G. Manchester, resigned.

H. C. Turner has been appointed master mechanic of the Ottumwa division of the Chicago, Burlington & Quincy, with headquarters at Ottumwa, Iowa, succeeding H. Modaff.

J. A. Carney, superintendent of shops of the Chicago, Burlington & Quincy, at Aurora, Ill., has been appointed supervisor of fuel economy, with headquarters at Chicago.

B. A. Orland has been appointed master mechanic of the Mobile & Ohio, with headquarters at Murphysboro, Ill., and with jurisdiction extending from East St. Louis, Ill., to Tomms, Ill.

E. O. Brower has been appointed general foreman of the car department of the southern division of the St. Louis-San Francisco, with headquarters at Memphis, Tenn., succeeding W. A. Johnston, resigned.

H. Modaff, master mechanic of the Ottumwa division of the Chicago, Burlington & Quincy, with office at Ottumwa, Iowa, has been appointed superintendent of shops at Aurora, Ill., succeeding J. A. Carney.

J. C. Nolan, superintendent of the Texas division of the Gulf Coast Lines with headquarters at Kingsville, Tex., has been appointed mechanical superintendent with the same headquarters, succeeding J. L. Lavallee, resigned.

G. C. Seidel, master mechanic of the Minneapolis & St. Louis, at Marshalltown, Iowa, has been appointed mechanical engineer of the Chicago & Alton, with headquarters at Bloomington, Ill., succeeding J. H. Leyonmarck, deceased.

J. M. Velasco, assistant general purchasing agent at the National Railways, of Mexico, with headquarters at New York, has been appointed purchasing agent with headquarters at Mexico City, and W. L. Wibel succeeds Mr. Velasco at New York.

W. C. Kelly, electrical foreman of the St. Louis division of the Illinois Central, with headquarters at Centralia, Ill., has resigned to accept the appointment as assistant electrical engineer of the Central of Georgia, with headquarters at Macon, Ga.

J. H. Moore, signal supervisor of the Rochester division of the Buffalo, Rochester & Pittsburgh, has had his jurisdiction extended to include the Buffalo division, with headquarters at East Salamanca, N. Y., succeeding A. J. Darrow, assigned to other duties.

Charles M. Lewis, division engineer of the Erie, with headquarters at Susquehanna, Pa., has been transferred to Jersey City, N. J., with jurisdiction over the New York division and side lines, including a part of the New York, Susquehanna & Western division.

H. B. Titcomb, vice-president of the Pacific Electric, with headquarters at Los Angeles, Cal., has been elected president of the Southern Pacific of Mexico and the Arizona Eastern, succeeding Eber Randolph, deceased. Mr. Titcomb has had a wide experience and made an excellent record on several of the southwestern railroads.

Max R. Brockman, foreman of the Southern, with headquarters at Selma, N. C., has been appointed general foreman at Greensville, S. C., succeeding J. C. Dunham, deceased, and W. C. Horne, foreman at Charlotte, N. C., has been appointed foreman at Selma, N. C., and J. H. Woody, machinist at the Spencer shops, has been appointed night foreman, with office at Charlotte, N. C.

John Callaghan, of Calgary, Alta., has been appointed as Deputy Minister of Railways and Telephones by Hon. V. W. Smith, minister of that department in the new Alberta Government. Mr. Callaghan will also act as manager of the Alberta Government's railway lines. At one time he was chief engineer of construction for the Pacific & Great Eastern Railway, and recently has been with the C. P. R. in Calgary.

Edward Charles Schmidt has been appointed professor of railway engineering in the University of Illinois. Mr. Schmidt is a graduate of the Stevens Institute, and since his graduation as mechanical engineer has had considerable experience in the service of some of the leading construction companies. Among others he was engaged for some time with the American Stoker Company, the Edison Electric Company, the American Hoist and Derrick company. During the war he served as major of ordnance and later transferred to the Railway Administration. In this connection he prepared a number of valuable bulletins which are extensively used by the railways of the country.

OBITUARY

Frederick F. Gaines

F. F Gaines, superintendent of motive power of the Central of Georgia Railway from 1906 to 1917, died at Washington, D. C., on August 26, in the fifty-first year of his age. Mr. Gaines was born at Hawley, Pa., and was graduated from Cornell University, and in 1895 he became draughtsman on the Lehigh Valley and in a short time was promoted to engineer of tests, and in 1897 to mechanical engineer, and in 1902 to master mechanic. In 1904 he was appointed mechanical engineer of the Philadelphia & Reading, and later accepted the appointment on the Central of Georgia as noted above, from which position he resigned on account of failing health. In 1918 he was appointed a member of the committee of standards of the Railroad Administration, and in 1919 was elected chairman of the Board of Wages and Working Conditions, and subsequently served as a member of the Railway Board of Adjustment, No. 3. Mr. Gaines was a member of several of the engineering clubs and societies and was president of the American Railway Master Mechanics' Association in 1914 and 1915. Mr. Gaines was an accomplished constructing engineer, a fluent and graceful speaker and an occasional contributor to railroad periodicals. His improvement on locomotive fire boxes known as the Gaines combustion chamber, has been warmly endorsed by eminent authorities.

Kenneth Rushton

Kenneth Rushton, vice-president in charge of Engineering, The Baldwin Locomotive Works, died September 2, 1921, at the age of sixty years. Mr. Rushton was born in Philadelphia, Pa., and was educated in the city schools and Episcopal Academy. He served an apprenticeship, as machinist, under Hugo Bilgram, of Philadelphia, and afterward entered the employ of The Baldwin Locomotive Works, in April, 1881. Mr. Rushton's association with The Baldwin Locomotive Works continued uninterruptedly until the time of his death; first as a draftsman, and later as designer, chief mechanical engineer, and finally as vice-president. He was the inventor of many appliances used in the construction of locomotives, and was closely associated with S. M. Vauclain in the development of the four-cylinder compound that bears the name of the latter. While Mr. Rushton did not travel extensively in the prosecution of his business, he represented Baldwin's abroad in some important missions. In 1913, he was sent to Chile, visiting various points of railroad interest on

KENNETH RUSHTON

the west coast of South America, and in 1918, went to France, in connection with the design of railway transport for artillery. Mr. Rushton became a member of the American Society of Mechanical Engineers, in 1920, and served on the Locomotive Boiler Sub-Committee of the American Society of Mechanical Engineers' Boiler Code Committee. He was also a member of the American Society for Testing Materials.

Edward Armstrong Craig

Edward A. Craig, manager of the Export Department of the Westinghouse Air

EDWARD ARMSTRONG CRAIG

Brake Company and the Westinghouse Traction Brake Company, Pittsburgh, Pa., died at Edgewood, Pa., on August 28. Mr. Craig was connected with the Westinghouse organization for thirty years and was widely known in railway circles throughout the country. At an early age he became an expert in shorthand and became secretary to the general superintendent of the works. There he developed exceptional business ability. In 1906 the company established the Southwestern district with headquarters at Pittsburgh, Pa., and Mr. Craig was appointed manager, and in 1920 he was placed at the head of the Export Department, and only a few days before his death he was advised of his appointment as president of an important subsidiary company. Mr. Craig was a man of remarkable business activity, as well as of much popular esteem among fraternal and other associations.

Canadian Locomotive Company

At the annual meeting of the Canadian Locomotive Company, held September 8, all of the members of the Board were reelected and also the following new officers: chairman of the board, Aemilius Jarvis, Toronto; president, F. G. Wallace, Pittsburgh; vice-president, J. L. Whiting, Kingston; vice-president and general manager, William Casey, Kingston; secretary, William Harty, Jr.; treasurer, J. H. Birkett, Kingston.

Car Service Organization

The car service division of the American Railway Association has been reorganized, with M. J. Gormley as chairman. He will have general supervision over the activities of the division and will report to the president of the American Railway Association.

Car service managers are W. C. Kendall, A. G. Gutheim, W. J. McGarry and L. M. Betts. J. J. Pelley is manager of the refrigerator department, with headquarters in the Manhattan Building, Chicago. C. F. Stewart is manager of the troop movement department and C. A. Buch is secretary. The manager of the refrigerator department will also act as district manager in Chicago. The car service managers are assigned, as follows: W. C. Kendall to the railroad relations section, A. C. Gutheim to the public relations section, L. M. Betts to the closed car section, and W. J. McGarry to the open car section.

New Train Service Board of Adjustment

Representatives of the Baltimore and Ohio, and the New York Central, and representatives of engineers, firemen, conductors and trainmen employed by these two companies, have agreed to form a Train Service Board of Adjustment. Four members will represent the railroads, and four the train service organizations.

When disputes arise, the settlement of which by the usual method of direct conference has failed, they shall be passed upon by the new regional board whose decisions will be final and binding on both the railroads' management and train service employes. It will not come within the province of this board, however, to hear any disputes arising from proposed changes in rules, working conditions or rates of pay, such matters being handled by the United States Labor Board.

It is hoped and believed that the new plan will be helpful in adjusting differences which naturally arise on large systems of railroads, and that it will result in more harmonious working relations, with consequent steadier and more effective operations.

A Notable Triumvirate

When a syndicate was formed in 1880 to build the C. P. R., says the London *Free Press*, the chief members were three remarkable Scotchmen, all of whom had come to Canada as boys and by sheer grit and ability made their way up the ladder of success. Of the three only one is dead, Lord Strathcona; he was well over 90 when he passed away. The others, Lord Mount Stephen and Richard B. Angus of Montreal, are also nonagenarians. Lord Mount Stephen celebrates this month his ninety-second birthday, while Mr. Angus passed his 90 mark recently and looks as if he would round out more than the century.

Railway System Lighting

J. H. Kurlander, of the Lighting Service Department of the Edison Lamp Works of General Electric Company, Harrison, N. J., has produced a notable contribution to railroad literature in compiling information on the lighting of buildings and yards in connection with railroad service. The special Bulletin L. D. 128, extends to 32 pages and is illustrated by 26 illustrations. The descriptive matter is of real value combining as it does data in current practices obtained from some of the leading railroads in the east presented in an orderly and logical manner. The photographs of actual installations supplemented by diagrams render the subject clear and concise. The suggestions contained are not theoretical, as nearly all of them have been extensively and successfully applied in actual service. The subject is one of special importance as the period of daylight decreases. It may not be generally known that increases of from ten to thirty-five per cent in the production of machine shops have been obtained by actual test where illumination has been raised from what is ordinarily regarded as good practice to higher levels, with an operating cost of less than five per cent of the pay-roll expense. The publication of the special Bulletin is timely and on the important subject of which it treats may properly be said to be complete and copies should be in the hands of those interested in the best and most economic methods of Railway System Lighting. Copies may be had from the General office, Harrison, N. J.

The Railroad Question Before Congress

A 50-page pamphlet containing the testimony of the Railroad Executives at the hearings on "Railroad Revenues and Expenses," before the Senate Committee on Interstate Commerce from May 10 to June 18, 1921, has been published by the Department of Transportation and Communication. The testimony has been arranged specifically with reference to the five questions propounded by the Senate Committee. The questions were:

First. The operating revenues and expenses of the railroads of the country which under the law make reports to the Interstate Commerce Commission, comparing these revenues and expenses with like revenues and expenses (including the period of federal control) since 1912.

Second. The reasons which led to the extraordinary cost of maintenance and operation from March 1, 1920, to March 1, 1921.

Third. The reasons which induced the diminished volume of traffic in the latter part of the year 1920 and the first two months of 1921, and in that connection the influence of the increased freight and passenger rates prevailing during that period.

Fourth. The efficiency or inefficiency of railroad management during federal control, during the year beginning March 1, 1920, and the efficiency or inefficiency of labor employed by the management during the same periods.

Fifth. The best means of bringing about a condition that will warrant the Interstate Commerce Commission in reducing freight and passenger rates.

The summary of the testimony given by the leading railroad executives of the country is complete, and the publication, copies of which may be procured on application to the Chamber of Commerce of the United States, Washington, D. C., presents in a compact form reliable financial data appertaining to the railroads of the United States during the last twelve years.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV | 114 Liberty Street, New York, November, 1921 | No. 11

Three Economically Successful Locomotives In Passenger and Freight Service

In a paper to be presented at the annual meeting of the American Society of Mechanical Engineers in December, Mr. James Partington, the estimating engineer of the American Locomotive Company, gives the details of the general construction and performance of three locomotives that have shown themselves to have been particularly well adapted to the performance of the work for which they were designed. They are: A Pacific that is running on the Erie; the half-stroke cut-off Decaprod locomotive of the Pennsylvania, the tests with which were described in Railway & Locomotive Engineering for February, 1920, and the 2-10-10-2 Mallet of the Virginian R. R.

Pacific Locomotive No. 50,000

The Pacific locomotive was the No. 50,000 of the builder's consecutive numbering. It was designed and constructed at the builder's expense to demonstrate the maximum tractive power with adequate boiler capacity that could be obtained while keeping the adhesive weight below 60,000 lbs. per driving axle.

Many of the large Pacific type locomotives with drivers 75" in diameter and over in operation today greatly exceed locomotive 50,000 in total weight.

An average of all of the important engines of this type including locomotive 50,000 shows approximately 1,000 lbs. less tractive power with an increase of 17,400 lbs. in weight with the very slight advantage of only 1½ per cent in boiler capacity.

Locomotive 50,000 delivers one cylinder horse power for every 110.8 pounds of weight and one boiler horse power for every 120.3 pounds of weight.

In actual tests it developed:

An average of 2.21 lb. of coal per I.H.P. hour.

A low rate on one test of 2.12 lb. of coal per I.H.P. hour.

An average rate of 16.85 lb. of steam per I.H.P. hour.

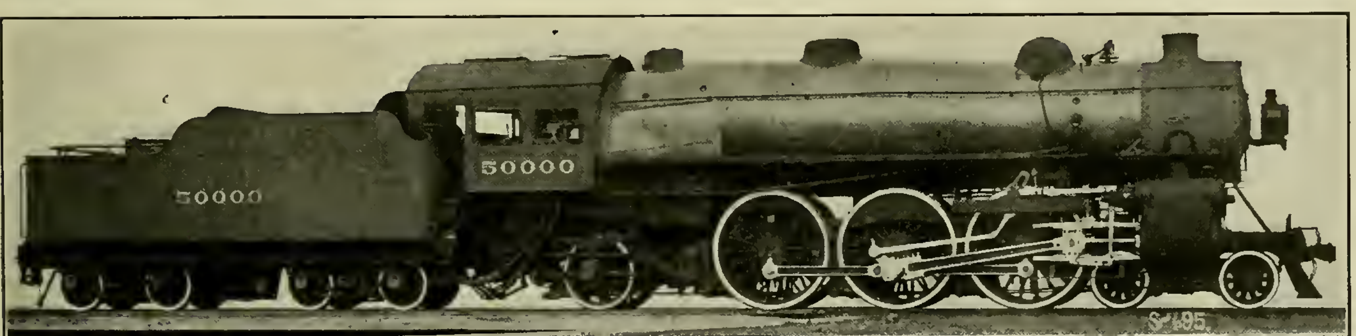
A low rate on one test of 16.5 lb. of steam per I.H.P. hour.

A maximum indicated horse power of 2,216 or one horse power for every 121.4 lbs. of weight.

The thought occurred that possibly 50,000 was built too light and that later on in order to keep the engine in service many of the parts might require strengthening.

Locomotive 50,000 was purchased by the Erie Railroad and numbered 2509. Mr. Wm. Schlafge, mechanical manager of the Erie, states that since the locomotive was received it has been necessary to make very few changes. The guide yoke was reinforced on account of working. Guide yoke blocks were also made solid on the guide yokes. The trailer spring sliding block was changed to the same type as used on their K-4 Pacific type locomotives. No other changes or alterations have been made. Yet from the time this locomotive was placed in service on the Erie R. R. up to March 1, 1920, it had made a total mileage of 351,800.

Ten years of service coupled with 350,000 miles of running demonstrate the strength of the design and the figures given indicate remarkable performance.



FIFTIETH THOUSAND LOCOMOTIVE BUILT BY THE AMERICAN LOCOMOTIVE COMPANY

Pennsylvania Railroad Decapod

While the design of engine "50,000" represents the best practice of the present day as measured by the economical operation of passenger locomotives, the development of heavy freight power involves the consideration of other factors that materially affect the design. In 1915 the Pennsylvania R. R. found that for the economical operation of their line a tractive power about 25 per cent in excess of the Milkadoes than in use was desirable. In working on the design for such an engine, an attempt was made to obtain better economy in performance by a radical departure in cylinder proportions. The accepted practice in proportioning cylinders is to arrange for a cut off of nearly 90 per cent of the stroke, so that the starting torque may be as uniform as possible.

As the adhesive weight limits the cylinder diameter if excessive slipping is to be avoided it is obvious that on long grades, where the maximum tractive effort is required, the long cut offs use steam in a most uneconomical manner. As the Pennsylvania R. R. has several such long grades on its line, the new design adopted involved a limitation of the cut off to about 50 per cent in place of 90 per cent and an increase in the cylinder diameter to give sufficient torque at this cut off to fully utilize the adhesive weight. The expected increase in economy of coal and water due to the shorter cut off has been fully realized.

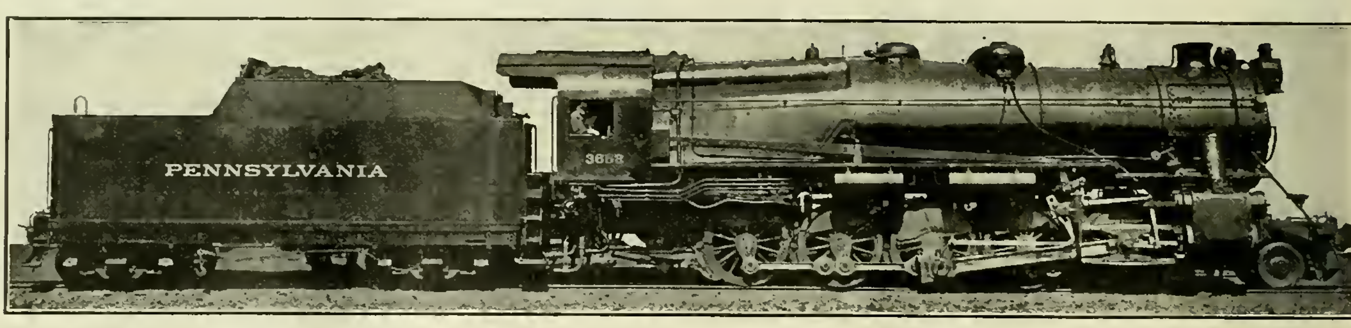
Not only has the engine shown remarkable efficiency, but the economy under wide ranges of load is especially remarkable.

We are fortunate in having available a very complete test of this engine, made on the testing plant at Altoona. (RAILWAY & LOCOMOTIVE ENGINEERING, February, 1920). This test shows a water rate of 15.4 lbs. per I.H.P. with a total I.H.P. of 3,080 at 40 per cent cut off and a coal consumption of 2.9 lbs. The lowest coal consumption recorded is 2.00 lbs. per I.H.P., obtained at an output of 1,777 I.H.P. and a cut off of 30 lbs.

The thermal efficiency of the locomotive is also high and well sustained over a large range, a maximum of 8.1 being attained at an output of 1,777 I.H.P., and the range being from 6.1 per cent at 776 I. H. P. to 5.3 per cent at 3,486 I. H. P. with an average of over 7 per cent for the usual operating conditions.

The highest drawbar pull recorded in these tests is 76,211 at a speed of 7.4 miles per hour, but in road service a pull of 80,640 lbs. has been recorded at 7.2 miles per hour. The indicated tractive effort plotted from a card taken at 7.4 miles per hour at 55 per cent cut off is slightly over 90,000 lbs.

This design gives a calculated figure of 88.9 lbs. per cylinder horse power, the lowest record. During the tests an indicated horse power of 3,486 was developed, giving a weight of 106.2 lbs. per horse power.



DECAPOD 2-10-0 TYPE LOCOMOTIVE, PENNSYLVANIA RAILROAD, BUILT AT COMPANY'S SHOPS, ALTOONA, PA.

VIRGINIAN 2-10-10-2 TYPE LOCOMOTIVES

The large 2-10-10-2 Mallet engines for the Virginian Railway were designed to meet their unique conditions. This road was built as an outlet to certain bituminous coal fields of West Virginia.

The tonnage to be handled increased rapidly, rising from 2,141,009 in 1911 to 7,621,555 in 1920, and in order to handle the business at a profit the maximum attainable capacity in motive power was demanded. Having fixed on 100 cars as the maximum number that could safely be handled in a single train, the car capacity increased to 120 tons, it was estimated that a locomotive of 147,000 lbs. tractive power would be needed to haul the train from Princeton to tidewater, a helper being used for a grade of .6 per cent ten miles long over the Alleghenies. The 2-10-10-2 Mallets were designed to meet these conditions and their operation has been very successful. They have

2-10-10-2 MALLET TYPE LOCOMOTIVE OF THE VIRGINIAN RAILWAY, BUILT BY AMERICAN LOCOMOTIVE COMPANY

MODERN MAXIMUM EFFICIENCY LOCOMOTIVES

Road	No. 50,000 Erie	Virginian	Pennsylvania
Type	4—6—2	2—10—10—2	2—10—0
Fuel	Bituminous coal	Bituminous Coal	Bituminous coal
Boiler type	Conical connect.	Ext. wagon top	Conical connect.
Boiler diameter	76¼"—87"	105½"—118½"	87—90½"
Weight on drivers	172,500	617,000	342,050
Weight on truck	49,000	32,000	29,750
Weight on trailer	47,000	35,000	......
Weight, total	269,000	684,000	371,800
Driving wheel diameter	79"	56"	62"
Cylinders	27"x28"	30" and 48"x32"	30½"x32"
Boiler pressure	185	215	250
Tractive power	40,600	147,200	90,000
Factor of adhesion	4.25	4.08	3.80
Cylinder horse-power	2,427	5,040	4,182
Grate, length and width	114"x75¼"	144"x108¼"	126"x80"
Grate area, sq. ft	59.7	108.7	70.01
Tubes, number	207	381	244
Tubes, length	22' 0"	25' 0"	19' 1"
Tubes, spacing	¾"	7.8"	⅝"
Tubes, thickness	No. 11 B.W.G.	No. 11 B.W.G.	.125
Tubes, diameter	2¼"	2¼"	2¼"
Flues, number	36	70	48
Flues diameter	5½"	5½"	5½"
Flues thickness	3/16"	No. 9 B.W.G.	.18
Combustion chamber—length	None	36"	42"
Brick arch	Security	Gaines	Security
Heating surface—firebox	248	532	290
Heating surface tubes—water side	2,672	5,592	2,731
Heating surface tubes—water side	1,136	2,511	1,313
Heating surface—total	4,056	8,635	4,334
Boiler horse-power	2,250	4800	2,553
Steam rate, lbs. per h.p. hr	20.8	19.7	20.8
Coal rate, lbs. per h.p. hr	3.25	3.1	3.25
Superheater—Number of units	36	70	42
Superheater—diameter	1½"	1½"	1½"
Superheater—heating surface	879	2,120	1,418
Tender weight in running order	161,500	214,300	182,000
Tender capacity coal, tons	14	12	17½
Tender water, gallons	8,000	13,000	9,000
Weight of locomotive in lbs., per cylinder h.p.	110.6	135.7	88.9
Weight of locomotive in lbs. per boiler h.p.	119.6	142.5	145.4
Best Actual Performance—			
Steam rate—lbs. per h.p. hr	16.5	......	15.4
Coal rate—lbs. per h.p. hr	2.12	......	2.0

handled trains of 16,000 tons on a .2 per cent grade with the lowest consumption of coal per ton mile ever recorded.

However, on May 25 a train of 15,725 tons behind the tender was hauled from Princeton to Roanoke at a rate of 26.9 lbs. of coal per 1,000 ton miles, and on May 27th a 75 car train of 12,070 tons showed the same figure for coal per thousand ton miles.

One of these engines has hauled a train of 110 cars weighing 17,250 tons from Victoria to Sewall's point which is believed to be the heaviest train ever handled by one engine. The ruling adverse grade was .2 per cent.

The principal dimensions of the three locomotives cited and a comparison of the horse power characteristics—calculated by the American Locomotive Company's method—are embodied in the table:

Engine	No. 50,000												Average
Cylinder	27x28	27x28	25x28	25x30	27x28	26x28	26x28	23½x26	26x28	25x28	25x28	25x28	25.6x28
Drivers, dia	79	80	79	75	77	79	75	79	75	77	80	75	77.5
Boiler, dia	76⅜	78½	76⅜	79⅞	75 7/16	78	78 9/16	70⅝	76	74	72	69	....
Pressure	185	205	210	200	185	210	200	200	190	200	200	185	197.5
Firebox, length	114⅛	126	126	111⅛	114 1/16	126⅛	114⅝	108⅛	110	120⅝	126¼	108⅛	....
Firebox, width	75¼	80	108¼	84⅜	84	108¼	84¼	75¼	72	84	108¼	70¼	....
Tube, length	22.0	19.0	17.3	18.6	22.0	19.0	20.6	21.6	20.0	22.0	19.0	20.0	....
Wheel base driving	14.0	13.10	14.0	13.2	14.0	13.10	13.0	14.0	13.0	13.4	13.10	13.6	....
Wheel base engine	35.7	36.6	36.0	34.9	36.2	35.8	34.11	36.6	34.4	35.8	35.7	34.9	....
Weight on drivers	172,500	201,800	192,500	181,500	178,000	181,400	194,000	184,500	169,500	165,000	176,900	168,500	180,500
Weight of engine	269,000	308,900	302,000	299,000	295,000	291,400	287,000	282,000	280,000	279,500	273,600	269,000	286,400
Heat. surf. tubes and flues	3,808	3,746.8	2,830	3,232	2,534.7	3,454	3,939	3,193	3,380	3,720.9	2,644	2,970	....
Heat. surf. firebox	248	288.6	351	297.6	239.8	303	259.6	231	240	266.4	282	230	....
Heat. surf., total	4,056	4,035.4	3,181	3,529.6	3,774.5	3,757	4,198.6	3,424	3,620	3,987.3	2,926	3,200	3,640.8
Superheating surface	897	1,154	645	803	962	816	970	838	830	783.5	652	778	....
Grate area	59.8	70.0	95.0	65.0	66.5	94.8	67	56.5	55	70.4	94.5	52.7	61.6* 70.6
Tractive power	40,600	41,845	39,500	42,600	41,700	42,770	42,900	30,900	40,700	38,600	37,200	36,700	39,670
Cylinder H.P.	2,427	2,690	2,365	2,252	2,427	2,556	2,434	1,990	2,312	2,252	2,252	2,083	2,336
Boiler H.P.	2,235	2,467	2,244	2,282	2,104	2,311	2,398	1,958	2,112	2,267	1,950	1,869	2,186
Weight per cyl. H.P.	110.8	114.8	127.7	132.8	121.5	114.0	117.9	141.7	121.1	124.1	121.5	129.1	122.8
Weight per boiler H.P.	120.3	125.2	134.6	131.4	140.2	126.1	119.7	144.0	132.6	123.3	140.3	143.9	131.8
Boiler percentage	92.0	91.7	95.0	101.0	86.7	90.5	98.5	98.2	91.5	100.5	86.8	90.0	93.5

The figure 70.6 is the average for all the engines, including the hard coal burners.
*Figure in red is an average of the soft coal burning engines only.

In connection with the Pacific locomotive No. 50,000 that is running upon the Erie, the above table gives the dimensions and characteristic features of it and eleven other large Pacific locomotives that are now in operation in the United States.

Reporting by Engineman on Arriving at Terminals

The Central Railway Club gives indications of maintaining its intellectual and social activity by opening its fall and winter sessions with a dinner served in the Fort Erie Beach Hotel on August 25. A large attendance was present and the occasion was made very enjoyable by a display of oratorical and musical talent among the members and guests. The occasion was not allowed to pass without a contribution to the real work of the Club which has become distinguished by the presentation of papers on vital subjects affecting the welfare of some department or other of the work in which the members are engaged. These papers generally have had the merit of brevity, allowing full scope for discussion, and on this occasion the president, Mr. Walter H. Flynn, called on Mr. T. J. Hartnett, road foreman of engines of the Delaware, Lackawanna Railroad, who presented a paper on "The proper inspection and reporting of work by enginemen on arrival at terminals—with relation to enginehouse repairs." The following extracts from Mr. Hartnett's paper will show that he has a thorough familiarity with the subject.

"One of the most important duties of an engineman to my mind on his arrival at terminals is the making of a proper inspection and work report. This is very necessary in order to give the enginehouse repair staff the best possible information regarding any existing defects that have been brought to his notice from operating the locomotive on the road, so that the enginehouse mechanics can prepare to make these repairs which aids in the quick turning of the power from the terminal.

Since the pooling of power has been adopted by most modern railroads, the engineman seldom gets the same locomotive more than one trip, unless it is in passenger service where a locomotive is assigned to two men or groups of men alternately. Therefore, the interest that was once taken by a locomotive engineer in making a thorough inspection of his locomotive on arrival at a terminal seems to have waned, to the extent at least, that he does not take time or interest in making proper tests for blows, pounds, knocks, etc. which was once characteristic of him when regularly assigned to a regular locomotive. Unless the engineman can be prevailed upon to make a proper inspection on his arrival at a terminal, this loss must now be counteracted in some other manner.

On modern or Class A railroads where heavy superheated power is used, railroad companies have installed outside inspection pits and inspectors have been employed to aid the engineman in making an underneath inspection on arrival at the ash track, so that a proper report can be made of the necessary work required on the locomotive. This system greatly aids the enginehouse staff in making quick repairs, and this in turn makes the locomotive available for service sooner than if such aid were not given. This is especially necessary when fires are drawn and steam is not avaliable for making tests by the enginehouse staff when defects have not been properly located by the inbound engineman.

If the locomotive is reported "not steaming," an effort should be made by the engineman to assign a direct cause. It has been my experience that this usually can be done if the engineman does his part in giving proper information regarding the performance of the locomotive while in his charge, such as steam leaks in fire and smoke boxes, superheater units, large and small fire tubes being plugged, air leaks around smokebox door, door ring, etc. If this information were given by the enginemen on arrival it would aid materially in making repairs and correspondingly reduce the liability of engine failures and aid in the interest of a greater degree of economy.

While the duties of the outbound engineman may not be as important as those of the inbound engineman, from the enginehouse staff point of view, nevertheless, upon their performance depends the success of the run over the division. Some of these duties as I see them are as follows: Inspection of work report by the inbound engineman and inspector; the work that has been completed by the mechanics and that not completed but which was reported by both engineman and inspector. If in his opinion the work reported and signed as completed is liable to fail or cause trouble, the enginehouse foreman's attention should be called to it; and if in the latter's judgment the locomotive is in condition to perform satisfactorily, no time should be lost in arguing the point. Another important duty that the outbound engineman must always bear in mind and upon which depends the success of his trip, is the oiling he has given the locomotive before leaving and proper and consistent lubrication while en route. If this practice is looked after in a haphazard way, break-downs and short mileage between general shopping is the result, as one drop of oil reaching a bearing in need of it will avoid overheating of such parts and thus decrease the liability of delays and criticism of the engineman by his supervising officials."

Debate on the Railroad Wage Dispute Comes to a Close

Strike Called and Recalled by the Employees' Representatives—A Mass of Conflicting Views Harmonized

During the last month developments in the attempts to solve the railroad problem have had a startling effect on the public mind. The result of the balloting on the question of declaring a general strike among the organized railroad men assumed such an overwhelming majority that it was looked upon as if the employees were really in earnest, and while the press and public showed much alarm, as might have been expected, the feeling was very strongly manifested against such extreme measures. Those who were more familiar with the questions at issue, and the forcible methods of presenting the views of railroad men reserved their judgment on the assurance that some kind of comprimise would be found to meet the difficulty.

It would be impossible to present even in a condensed form the history of the meetings and conferences, the calling of the battalions of chairmen and experts, the blasts and counterblasts, much of which appeared in the daily press, but most of which spent itself in the desert air. Chicago was the storm center. Cleveland may be said to have been the base of supplies of the employees, while the railroad executives seemed to hold their chief council of war in New York. Of course, Washington political circles were disturbed, but it must be admitted that President Harding, as might be expected, acted like one who had passed through the fiery furnace of experience. Beyond an assurance on the part of the government to sustain the United States Labor Board in its decisions he did not venture into the realm of discussion. Attorney-General Daugherty showed less poise and called to his aid the district attorneys of some of the principal cities, and, like a board of aldermen discussing the paving of a street, they laid their heads together and the thing was done. We were guaranteed that the mails, the transportation of the necessities of life and fuel would be continued. We might get along with less mail matter, especially in the way of governmental printed reports, but it was cheering to know, according to Mr. Daugherty, that our bread and water will be sure.

Glancing briefly at the multitudinous comments of the daily press, and even at some of the journals that should be better informed, it is deplorable to observe that many gross errors have been made, intentionally or otherwise, in regard to the exact amount to which the transportation rates and scales of wages have been raised during and since the war period. The exact data can be easily secured by all who desire the truth, but it is painfully evident that the truth is not always desirable by those who see with one eye only.

The following tables furnish the data, according to governmental reports, and may safely be considered as reliable:

Advances in Rates and Wages Since 1915

A compilation by the Bureau of Railway Economico shows that since 1915 there has been an increase in rates amounting to 78 per cent, while the wage scale has advanced 119 per cent.

The rate increases were as follows: June 27, 1917, 3.7 per cent; March 15, 1918, 2 per cent; June 25, 1918, 25 per cent, and September 1, 1920, 34 per cent.

Increases in pay to workers were as follows: 1916-17, 7 per cent over 1915; 1917, 13 per cent over 1916; 1918 41 per cent over 1917; 1919, 5 per cent over 1918; and 1920, 22 per cent over 1919.

Number of Railway Employees and Average Wages

The annexed table compiled by the Bureau of Labor Statistics of the United States Department of Labor, covering the years 1915 to 1921, shows the probable number of railroad employees, with their classification and average yearly earnings, and also the successive wage increases in each classification and the average wages and increases of all employees:

	Employees Jan. 1	Yearly Wage					
	1921	1915	1916	1917	1918	1919	1920
Clerks, $900 per an. and upward	243,965	$1,136	$1,190	$1,277	$1,445	$1,379	$1,758
Clerks, below $900	1,879	650	682	681	689	693	830
Messengers	11,533	434	471	514	759	861	1,093
M. W. & S. foremen	8,449	1,107	1,132	1,197	1,676	1,859	2,335
Section foremen	42,776	772	816	885	1,255	1,320	1,767
Gang foremen	26,091	1,167	1,232	1,352	2,308	2,415	2,883
Machinists	63,364	1,030	1,205	1,394	2,358	1,878	2,297
Boilermakers	20,887	1,076	1,230	1,425	2,395	1,950	2,369
Blacksmiths	10,997	927	1,083	1,258	2,100	1,759	2,166
Carpenters	52,459	768	858	939	1,492	1,482	1,885
Painters	13,201	758	857	950	1,573	1,551	1,911
Electricians	15,247	941	957	1,030	1,728	1,922	2,310
Car inspectors	26,923	887	973	1,141	2,204	1,959	2,442
Car repairers	93,478	751	826	993	1,718	1,699	2,070
Other skilled laborers	60,526	855	936	1,065	1,737	1,764	2,173
Mechanics' helpers	159,298	607	676	822	1,406	1,240	1,629
Section men	276,820	454	509	601	864	944	1,182
Other unskilled laborers	121,197	560	609	695	1,040	1,085	1,371
Construction men	25,623	516	556	625	915	969	1,367
Train dispatchers	6,144	1,606	1,721	1,801	2,389	2,745	3,134
Telegraphers	22,206	800	859	917	1,223	1,594	1,879
Agent telegraphers	19,730	828	860	948	1,319	1,754	1,978
Station agents	13,806	937	952	1,039	1,334	1,752	2,073
Station employees	116,968	605	657	710	996	1,138	1,438
Yard Engineers	23,242	1,528	1,613	1,791	2,050	2,108	2,750
Yard firemen	23,577	916	988	1,094	1,368	1,510	2,107
Yard conductors	22,831	1,358	1,423	1,585	1,911	1,902	2,604
Yard brakemen	57,380	1,169	1,198	1,327	1,673	1,686	2,319
Engine house	76,972	684	722	835	1,258	1,314	1,624
Freight engineers	35,280	1,846	1,852	2,108	2,494	2,658	3,564
Freight firemen	37,962	1,136	1,126	1,275	1,686	1,840	2,560
Freight conductors	28,411	1,589	1,617	1,855	2,269	2,314	3,156
Freight brakemen	71,093	1,036	1,052	1,202	1,646	1,727	2,458
Passenger engineers	13,219	2,141	2,124	2,233	2,527	2,999	3,427
Passenger firemen	12,816	1,287	1,297	1,354	1,737	2,154	2,600
Passenger conductors	11,073	1,850	1,877	1,966	2,273	2,648	3,098
Passenger baggagemen	5,883	1,049	1,098	1,175	1,577	1,881	2,359
Passenger brakemen	16,300	1,026	1,031	1,094	1,512	1,789	2,212
Marine employees	11,513	775	892	928	1,268	1,607	1,825
Average all employees	*2,060,368	830	892	1,004	1,419	1,482	1,908

*Total employees.

Additional Data in 1921

It will be readily seen by those familiar with governmental reports that however reliable they may be they are always months and even years behind the time that they reach the journalists or general public. The above table of rates of wages consequently does not include the 12½ per cent reduction in wages which went into effect on July 1, 1921, nor should the fact be overlooked that many adjustments have been made, and are being made, as promised by the carriers. These have been reductions subtracting from railroad net income. Among others, rates on livestock have been reduced 25 per cent, and on copper bullion 25 per cent. On lumber from the Pacific Coast, approximately 10 per cent; from New Orleans and Galveston to New York, from 35 to 40 per cent; on cotton from Gulf ports to New York, from 20 to 25 per cent.

It should also be borne in mind that the rates of wages paid to the great body of railroad men previous to the dates enumerated in the table were such, to say the least, as makes any comparison unfair, because they were considerably below that of other occupations for many years.

Reduction of Wages or Rates

Early in October the railroad union leaders armed with a vote showing over 80 per cent of railroad men favoring a strike against any wage reductions. It was assumed that they would consider themselves victorious if they could maintain wages at the present level. It was believed that a reduction in freight rates would be made if wages of workers can be reduced. Announcements that railroad executives were to meet union men induced the idea that the possibility of a strike was remote. It was expected that the two sides would get together and settle their differences, which arose when the United States Labor Board ordered a 12 per cent reduction for railroad employees in July.

Question of Rates

In regard to the question of reducing the rates on railroads coincidently with a further reduction of wages it was the general opinion in Washington that a proper system of railroad regulation can never be established until the roads are consolidated into a few compact systems so that rates may be intelligently made. Under the present situation the Interstate Commerce Commission in its efforts to determine what are just rates for everybody It was like groping blindly and experimenting with one rate or other. It is considered by many to be impossible to fix a rate that would be fair to all alike. It is claimed that if the roads were consolidated in a small number of groups it might be possible to make rates that would result in virtually equivalent returns to all railroads alike. Under the present system a rate that would bring one road a large return of profit might force another road to ask for a receiver. It is hoped that a reduction of rates, particularly on certain classes of commodities, would stimulate business on a scale that will solve the unemployment problem and start a boom in building and other industries. Official action ordering the general rate reduction and authorizing an application to the Interstate Commerce Commission for reduced schedules was expected to be taken by the Association of Railway Executives. The association's executive committee already has approved the reductions on the ground that more than 400,000 freight cars are idle, due to present rates. It was even stated that a decision had been arrived at by a conference of railroad presidents, merchants and big manufacturers, who contended that lower charges were all that were needed to create a business boom. If the association fails to ratify the recommendation of the executive council, it is said, many of the roads are prepared to reduce the rates on their own initiative.

It is claimed that the reductions have been worked out carefully by the executive committee of the association, consisting of General W. W. Atterbury, vice-president of the Pennsylvania Railroad, chairman, and Presidents Elliott and Storey of the Northern Pacific and Santa Fe lines respectively. These three men, one of whom at first opposed the idea, have advocated its adoption.

This is the first time in the history of American railroading that the transportation agencies of the country, acting virtually as a unit, will petition the government to allow them to lower rates instead of increase them.

It is well that the carriers are preparing to file such tariffs of their own volition. Should the roads decide against the proposal of their executive committee, there are a veritable host of shippers' organizations ready to deluge the commission with petitions for lower rates.

Strike Order Issued

On October 15 more than half a million railroad men were ordered to initiate a strike on October 30, while other unions whose membership make the total about two millions, announced unofficially that they were preparing to follow suit and make the walkout general. Under this programme the tieup would be complete by November 2. The strike orders were issued to what are known as the Big Five brotherhoods, the oldest and most powerful of the railway unions, and they specifically included mail trains in the walkout. Their provisions instructed strikers to keep away from railroad property, with a warning that "violence of any nature will not be tolerated by the organizations." It was claimed that no further orders would be necessary to call out railroad workers on every big line in the country.

Proposed Cut in Wages

It was claimed that two days previous to the calling of the strike the carriers notified the employees that they would ask the Labor Board of a further wage cut of 10 per cent, at the same time assuring the public that the shippers and the people should have the benefit of this wage reduction in the form of reduced freight rates. To this proposition the employees replied that no general reduction of freight rates followed the $400,000,000 wage reduction of July 1; that the cost of living has not been sufficiently lowered since July 1 to justify another wage reduction, and that they will strike without even awaiting a decision of the Labor Board as to whether another wage reduction is just and reasonable.

Experts Put to Work

No sooner was the strike order issued than President Harding had two sets of experts at work gathering information as the basis of proposals which he purposed making to the railroads and their employees. It was expected that the proposals will tend to force both the railroad executives and the employees to accept them. Meanwhile, both sides had before them proposals put forth by the "public group" of the Railway Labor Board in which the railroads were urged to make a rate reduction at once on the ground that wages have already been reduced by the board and before they are cut again the rates should come down. It was said that the Labor Board favored the carriers giving immediately a general rate reduction, measured by the July wage reduction, and the benefits derived from the new rules and devised under the supervision of the Interstate Commerce Commission to afford the greatest degree of relief to the public, and the request for further wages be withdrawn until the rate reductions has been completed.

This plan, the board pointed out, would provide time for everybody to "cool off" and would be an advance toward solution of the railroad problem, rather than a simple throwing of the whole matter into the chaos attendant on a strike.

The experts put to work by President Harding were members of the Labor Board and of the Interstate Commerce Commission. The Labor Board members were studying figures on living costs and railroad workers' wages, with a view to determining whether wages could safely be further reduced. The Interstate Commerce Commission was studying the rate reduction angle.

Work of the Labor Board

The Railroad Labor Board has functioned for more than eighteen months, settling hundreds of controversies between carriers and their employees, and its decisions with but few exceptions have been respected by both sides. There would have been a strike long ago if the two parties had undertaken to settle without intervention or supervision the manifold disputes they inherited from the war period. There is absolutely nothing in existing conditions that justifies the carriers and their employees in inflicting the ruinous results of a strike on themselves and on the public. There is no amount of propaganda that can convince the people that either side is entirely blameless.

On the first day of July the Railroad Labor Board made effective a decision which reduced the wages of railway employees 12 per cent, aggregating about $400,000,000 per annum, basing the estimate on the normal number of employees. Since then by a revision of only a part of the working rules of only one class of employees, the carriers have received further benefits amounting to many millions of dollars.

Unemployment a Big Factor

Railroad officials lay some of their hopes for breaking up any walkout if it should be started on unemployment. There is, at the present time, about one skilled railroad worker out of work for every man now employed. Some of these men have been out of work for as much as a year. The hold on these men by the unions is practically negligible and, it is predicted, there would be a rush of these men to fill the jobs left vacant by the strikers.

As a result of the present slack movement of freight the unions do not possess as powerful weapons as they have had in the last few years when the mere rattle of the saber has brought immediate conformation to the union leaders' demands. If some of the railroads make aggressive fights against the striking unions and employ strikebreakers the organization heads, the railroad officials believe, will be helpless to prevent them.

As seen by the officials, the union officials in promising their followers to ward off any wage cut have burned their bridges behind them. Their replacement would result in any withdrawal from the strike order. As a result but few of the leaders could submit to a "peace without victory" agreement. Instead of offering any concessions which might permit a peaceful settlement the railroads were planning to press the application for the 10 per cent reduction, the officials said.

Some executives believed if there must be a strike to thresh out the differences between the roads and their employees it had best come at this time, so that the differences could be settled definitely.

On the other hand, there is a belief among union men here that despite the slow freight movement the time was opportune for a test of strength, and that now is the time for delivering a vital blow. Any national strike would result in a starve out policy, which now, at the beginning of winter, would have serious effects.

The Strike Line Weakens

In the beginning of the last week of October the apparently united part of the railroad men to strike on October 30 began to weaken. It was claimed that at a meeting held in Chicago, the officials of the Brotherhood of Railway and Steamship Clerks, Freight Handlers, Express and Station Employees, representing 350,000 men, voted not to authorize a walk-out by their members for the time being. The vote was taken in a meeting that lasted several hours, and in which some of the officials at first favored, but finally swung over to a "no strike now" policy, but the question will be taken up after the Labor Board renders a decision on the rules and working conditions now before it. The action taken left the signalmen and the eleven "standard" rail unions which may join the conductors, firemen, engineers, trainmen and switchmen in the strike they had called.

Other union leaders said that it was by no means certain that a majority of the eleven organizations would walk out. It became known that the meetings of the conference committee of the six shop craft unions, numbering 476,000 men, have been decidedly stormy. When leaders of these groups a few days previous admitted they could not hold back their men, they now appeared more confident of keeping them from joining a strike.

The President believes, it is understood, that the public, which would suffer most because of a strike at the beginning of winter, will force both sides to accept some reasonable compromise and has, therefore, set himself to frame such a compromise. President Harding is determined there shall be no interruption of the deliveries of coal and foodstuffs if it can be prevented. At the same time, he is trying to safeguard the interests of all the parties to the controversy.

Reduction in Wages Cannot Be Entertained at This Time

The United States Labor Board, on October 25, turned to the railroads in its attempt to avert the rail strike scheduled for October 30, suggesting that the roads temporarily postpone seeking further wage reductions because the board's docket was so crowded that wage decisions for all classes of employees could not be rendered before July, 1922. The carriers, however, informed the board that they were "powerless to take any other position" than their present one.

In a formal statement the board informed the carriers that it would not consider any petitions for wage cuts until the questions of rules and working conditions now before it were fully settled. The board then unofficially let the carriers know, it was learned, that since a ruling on wages for all classes could not be handed down before July, 1922, it would like the roads formally to announce postponement of their plans to seek further pay cuts, taking the attitude that such an announcement might avert a walk-out.

The committee of the Association of Railway Executives which conferred with the board announced, however, that the carriers would stand pat on their plans to seek the new pay cuts on the ground that wages must be reduced before freight rates could be lowered, and that since the strike was called technically in protest of wage cuts already authorized by the board, there was no necessity for the roads to take other than an inactive part in the strike controversy between the board and the unions.

Strike Order Withdrawn

A final announcement was made after a conference held in Chicago on October 27, of leaders of the switchmen, conductors, engineers and firemen, that resolutions had been adopted withdrawing authorization of a walk-out, and officials of the telegraphers' organization announced that they would take similar action. They were said to be the only unions which had authorized a strike. The official wording of the resolution adopted was that the "strike be declared not effective."

In discussing the resolution annulling the strike orders, the union presidents declared that its outstanding feature was that it "was based on the statements made to the unions by the Labor Board that wage reductions would not be considered by the board for any employees until the rules and working conditions for these employees had been settled." It was further pointed out that the strike "absolutely was off," and that a walk-out could not now be called until a new vote had been taken. The consensus of opinion seemed to be that the unions had decided to call off the strike because of the growing public opinion that the strike would be against the Labor Board, and consequently the government, and not against the railroads.

Peace With Honor

The representatives of the carriers and the representatives of the employees have announced their intention and purpose to conform to the law and abide by the orders of the board. The board does not deem it necessary to make any further orders on or about the matter, but are moved to congratulate the parties interested and the public on the return to industrial peace, and what is regarded as a triumph of law and an escape from what would have been a national disaster, and to express a hope that no such serious threat will again come before the United States Labor Board."

New Locomotives for the National Railways of Mexico and the Mexican Railway

Details of Dimensions and Appliances

The Baldwin Locomotive Works has recently completed a group of locomotives of various types for the railways of Mexico which are of interest, not only from an engineering standpoint but also because their construction represents an important item in the plans now being carried out for the rehabilitation of these lines. The locomotives referred to include eighty-three for the National Railways of Mexico and eleven for the Mexican Railway, besides a number of others built for industrial companies.

The locomotives for the Natioanl Railways are of three types, viz:—20 Pacifics (4-6-2) for passenger service, 23 Mikados (2-8-2) for heavy freight service, and 40 Consolidations (2-8-0) for lighter freight service. These locomotives all use a heavy grade of Mexican oil for fuel, and are of standard gauge, with the exception of 20 of the Consolidations, which are of three feet gauge.

The Pacific and Mikado type locomotives are naturally of special interst because of their weight and capacity, and also because they have been designed with an exceptionally large number of interchangeable detail parts. The passenger locomotives are operating on curves of 16 degrees (10 degrees metric) and grades of 2.2 per cent; and the freight locomotives on curves of approximately 23 degrees (14.3 degrees metric), and grades of 3 per cent. Ten of the Pacific type locomotives and fifteen of the Mikados are equipped with the Young valve gear, and the remaining ten Pacifics and eight Mikados with the Baker gear. The Ragonnet power reverse mechanism is used on all these locomotives.

With the exception of such changes as are necessitated by the differences in wheel arrangement, the Pacific and Mikado type locomotives are practically duplicates. The following are among the parts that interchange:

The boilers, with principal internal and external fittings, including oil-burning equipment and firepans.

Machinery details: Cylinders, piston valves, valve rods and valve-rod crossheads, pistons and piston rods, crossheads, main rod straps, keys and brasses, and valve gear details, excepting the lengths of certain members.

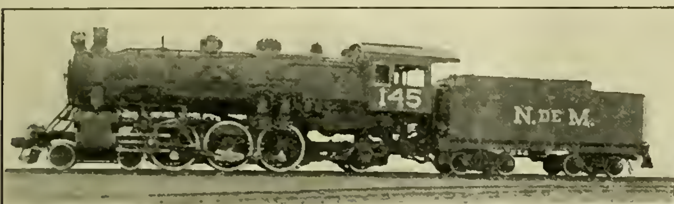
Running gear and frame details: Driving axles, boxes, shoes and wedges, driving and engine truck wheel hub liners, front engine truck boxes, wheels and axles, trailer trucks complete, frame pedestal binders and crossties, frame filling pieces for brake hangers, back foot plates, back equalizing beams, front bumpers and pilots, driving springs and spring saddles.

Other parts: Cabs, running boards and brackets, air reservoirs and supports, air pumps and supports, hand rails and columns, steps and step hangers, cab fittings, furniture and tenders complete.

The boilers are of the extended wagontop type, having an outside diameter of 76″ at the front end and 86″ at the dome ring. The firebox is of the radial stay type, with flexible bolts in the breaking zones and three rows of Baldwin expansion stays supporting the front end of the crown. All the tubes are welded into the back tube sheet, and the crown-bolts are flush on the inside of the firebox, in view of the use of oil for fuel.

The rear trucks are of the Hodges type, with cast steel boxes. The wheels have cast steel centers, fitted with bronze hub liners. The front engine truck wheels are of rolled steel.

The tractive force of the Pacific type is 40,000 pounds and of the Mikado type 53,000 pounds, the ratio of adhesion being practically 4 in each case, while the average load per pair of driving wheels is very nearly the same in the two designs. The similarity of these two locomotives shows clearly the extent to which interchangeable details can be used in certain types carrying approximately equal wheel loads.

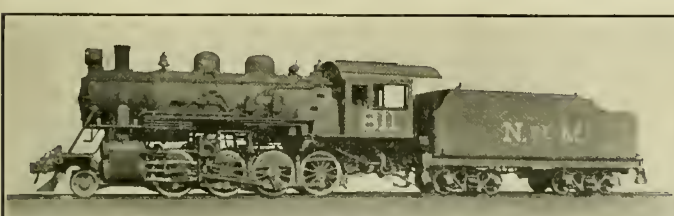


PACIFIC TYPE LOCOMOTIVE 4-6-2 FOR THE NATIONAL RAILWAYS OF MEXICO

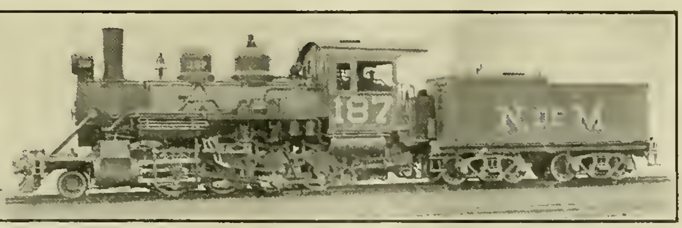
MIKADO TYPE LOCOMOTIVE 2-8-2 FOR THE NATIONAL RAILWAYS OF MEXICO

The standard gauge Consolidation type locomotives develop a tractive force of 34,300 pounds and carry an average weight of 39,500 pounds per pair of driving wheels, the ratio of adhesion being 4.6. These locomotives are specified for operation on the same grades and curves as the Mikado type engines. They have straight top, wide firebox boilers and are equipped with superheaters. The firebox is stayed with flexible bolts in the breakage zones, and the tubes are welded in the back tubesheet. The steam distribution is controlled by 11-inch piston valves, and the valve motion is of the Baker type, controlled by the Ragonnet power reverse mechanism.

The tenders, as far as trucks and frames are concerned, are practically duplicates of those used with the Pacific and Mikado type locomotives, although the tank capacity is less.



HEAVY CONSOLIDATION TYPE LOCOMOTIVE 2-8-2 FOR THE NATIONAL RAILWAYS OF MEXICO



LIGHT CONSOLIDATION TYPE LOCOMOTIVE 2-8-2 FOR THE NATIONAL RAILWAYS OF MEXICO

The light Consolidation type locomotives are of three feet gauge, and develop a tractive force of 26,600 pounds, with a ratio of adhesion of very nearly four. They are operating on grades as steep as 4.53 per cent and curves of approximately 21 degrees (13°—40′ metric).

These locomotives are so designed that they can, if desired, be subsequently rebuilt for standard gauge track; and with this end in view, and also to provide sufficient stability in a narrow gauge locomotive of this size, the frames are placed outside the wheels. Each main frame is cast in one piece with a slabbed rear section, and has double front rails bolted to it. The equalization is arranged in the usual manner, the front pair of drivers being equalized with the leading truck, while the remaining pairs are equalized together on each side of the locomotive. The frames are braced transversely between adjacent pairs of drivers.

The boiler has a straight top and a wide firebox, which is placed back of the drivers and over the slab frames. This construction necessarily involves a considerable overhang, which, however, is kept within a reasonable length by placing the cab forward over the firebox. The latter is supported on each side by a sliding bearing of ample length.

Saturated steam is used, and the steam distribution is controlled by balanced slide valves operated by Walschaerts' motion. The links are placed outside the second pair of driving wheels and are supported on longitudinal bearers of cast steel, which also serve to strengthen the frame bracing. Each driving crank has a counterbalance weight cast in one piece with it.

Should it be necessary at any time to rebuild these locomotives for standard gauge, the wheels will be mounted on longer axles, thus bringing them outside the frames, which are so spaced transversely as to make this possible. As now built, the locomotives have a maximum width of 9′ 11″, and a height over-all of 12′ 9½″. In view of the severe grades on which they operate, they are fitted with the Le Chatelier cylinder water brake in addition to air-brake equipment.

Consolidation Type Locomotive of the Mexican Railway

The Consolidation type locomotives for the Mexican Railway are of special interest because of the character of the line on which they are used. The main line of this railway extends from Vera Cruz on the coast to Mexico City, a distance of 264 miles; and abounds in curves and grades. One of the most difficult sections occurs in a tunnel, where there is a curve of 100 meters radius (328 feet or 17½ degrees) in combination with a grade of 3 per cent, uncompensated; while the maximum grades on which the locomotives are used are of 4½ per cent. To facilitate free curving, the two middle pairs of driving wheels have plain tires; and the Le Chatelier water brake is applied to supplement the air brakes when operating on steep grades.

These locomotives develop a tractive force of 43,000 pounds, with a ratio of adhesion of very nearly four. They have straight top, wide firebox boilers, and are equipped with superheaters. The piston valves are 14 inches in diameter, and are operated by Walschaert's motion. The cab fittings include a "breather pipe," which is conected with the air-brake system and has several outlets for the purpose of supplying air to the crew when passing through tunnels. A similar device was applied to the heavy Consolidation type locomotives for the Western Maryland Railway, which were built early in 1921 by the Baldwin Locomotive Works.

These locomotives were urgently needed and were built in a remarkably short space of time, as the order was received on May 23, 1921, and the last of the eleven engines was shipped on July first.

This was perhaps the most rapidly filled order on record, with the exception of some engines of a lighter type that were built during the war period under extraordinary conditions.

The annexed table gives further details in regard to the locomotives described above.

	National Railways of Mexico				
	Pacific Type	Mikado Type	Standard Consolidation Type	Light Consolidation Type	Mexican Ry. Consolidation Company Type
Gauge	4′ 8½″	4′ 8½″	4′ 8½″	3′ 0″	4′ 8½″
Cylinders	25″ x 28″	25″ x 30″	21″ x 28″	18″ x 22″	22″ x 28″
Valves, piston, diam.	14″	14″	11″	Bal. slide	14″
Boiler					
Type	Wagon top	Wagon top	Straight	Straight	Straight
Diameter	76″	76″	68⅜″	60″	76″
Working pressure	180 lbs.	190 lbs.	180 lbs.	180 lbs.	190 lbs.
Fuel	Oil	Oil	Oil	Oil	Oil
Firebox					
Material	Steel	Steel	Steel	Steel	Steel
Staying	Radial	Radial	Radial	Radial	Radial
Length	114⅛″	114⅛″	95⅛″	53 13/16″	108⅛″
Width	84¼″	84¼″	75¼″	49⅞″	66¼″
Depth, front	84½″	84½″	67¾″	58″	74¾″
Depth, back	66″	66″	55⅝″	47½″	59¾″
Tubes					
Diameter	5⅜″ and 2″	5⅜″ and 2″	5⅜″ and 2″	2¼″	5⅜″ and 2″
Number	36–231	36–231	24–156	180″	32–226
Length	19′ 3″	19′ 3″	14′ 6″	15′0″	13′ 10″
Heating Surface					
Firebox	228 sq. ft.	228 sq. ft.	144 sq. ft.	79 sq. ft.	179 sq. ft.
Tubes	3,289 sq. ft.	3,289 sq. ft.	1,664 sq. ft.	1,582 sq. ft.	2,246 sq. ft.
Total	3,517 sq. ft.	3,517 sq. ft.	1,808 sq. ft.	1,661 sq. ft.	2,425 sq. ft.
Superheater	828 sq. ft.	828 sq. ft.	409 sq. ft.	....	511 sq. ft.
Grate area	66.6 sq. ft.	66.6 sq. ft.	49.8 sq. ft.	18.7 sq. ft.	49.5 sq. ft.
Driving Wheels					
Diameter	67″	57″	55″	41″	51″
Journals, main	10½ x 12″	10½″ x 12″	9″ x 10″	7½″ x 7″	9½″ x 12″
Journals, others	9½″ x 12″	9½″ x 12″	8″ x 10″	....	9″ x 12″
Engine Truck Wheels					
Diameter, front	33″	33″	30″	24″	30″
Journals	6″ x 12″	6″ x 12″	5½ x 10″	4¼″ x 8″	6″ x 10″
Diameter, back	40″	40″	....	....	....
Journals	8″ x 14″	8″ x 14″	....	11′ 6″	....
Wheel Base					
Driving	12′ 0″	15′ 0″	15′ 0″	11′ 6″	14′ 3″
Rigid	12′ 0″	15′ 0″	15′ 0″	11′ 6″	14′ 3″
Total engine	33′ 2″	33′ 7″	23′ 5″	18′ 11″	23′ 4″
Total engine and tender	66′ 4½″	66′ 9½″	58′ 5″	47′ 0¼″	56′ 0″
Weight					
On driving wheels	159,280 lbs.	210,000 lbs.	158,100 lbs.	103,000 lbs.	169,000 lbs.
On truck, front	46,770 lbs.	20,000 lbs.	16,860 lbs.	10,200 lbs.	22,700 lbs.
On truck, back	44,820 lbs.	40,000 lbs.	....	....	....
Total engine	250,870 lbs.	270,000 lbs.	174,960 lbs.	113,200 lbs.	191,700 lbs.
Total engine and tender	420,000 lbs.	439,000 lbs.	329,200 lbs.	192,500 lbs.	311,700 lbs.
Tender					
Wheels, number	8	8	8	8	8
Wheel, diameter	33″	33″	33″	30″	33″
Journals	5½″ x 10″	5½″ x 10″	5½″ x 10″	4¼ x 8″	5½″ x 10″
Tank capacity, water	8,500 gals.*	8,500 gals.*	7,000 gals.*	3,600 gals.*	6,000 gals.*
Tank capacity, oil	3,500 gals.*	3,500 gals.*	....	1,511 gals.*	2,500 gals.*
Tractive force	40,000 lbs.	53,000 lbs.	34,300 lbs.	26,600 lbs.	43,000 lbs.
Service	Passenger	Freight	Freight	Freight	Freight

* U. S. gallons.

CONSOLIDATION TYPE LOCOMOTIVE 2-8-0 FOR THE MEXICAN RAILWAY

The Development of the American Passenger Car

Nineteenth and Twentieth Century Appliances Compared

There is probably no one thing connected with the American Railroads that, to the casual observer, has changed so little during the past thirty years as the passenger car. It has the same long body with the monitor roof, with platforms at the ends, and cross seats with an isle down the center that it had at the beginning of the period mentioned. To go back a little earlier we find the car mounted on bogie trucks, but without the monitor and low ceiling and small windows that would not be tolerated today in a freight caboose. The great step in advance from this construction was in the use of the monitor or clere story with the side ventilators. This added greatly to the comfort and convenience of the cars, and since that time the changes have been mostly those of detail. In reviewing what has been done in this respect we should start at a consideration of the car as it stood in the early seventies.

At that time it was about fifty feet long and had accommodations for about fifty-six passengers. The trucks were of the four-wheeled type: the spring arrangement consisted of elliptics beneath the bolsters and a wide variety of designs at the equalizers; the windows were small; the brakes were applied by hand; the couplers were of the old link-and-pin type, and the heating arrangements were stoves bolted to the floor. The changes that have been made, have come in so gradually and the discomforts were so far from being realized at the time, that it is only by an exercise of the recollection and imagination that the true condition of railroad travel at the time can be appreciated.

Early in the seventies the link-and-pin coupler was being rapidly replaced by the Miller coupler, buffer and platform. This improvement consisted in raising the platform up to the top of the sills, and taking off all buffing stresses in a line with the same. In the older construction the platform timbers had been bolted beneath the sills so that there could be no direct thrust and very little was needed to turn the platform down and telescope the cars. In fact a more unmechanical construction can hardly be conceived. In addition to this the Miller couplers were hooks that required a slight compression of the independent buffer springs in order to bring them together, so that the play or slack between the cars was entirely obviated. This brought the faces of the platforms close together and made the passage from car to car, while the train was in motion, comparatively safe and easy. In contrast with the new arrangement was that of the old where the platforms were frequently twenty inches or more apart, with a slack in the couplers that permitted even this distance to vary by 4 or 5 inches; with nothing to steady the cars, and with each free to swing throughout the whole of its liberal side motion, until the adjacent car looked and acted like a cockle-shell on a choppy sea.

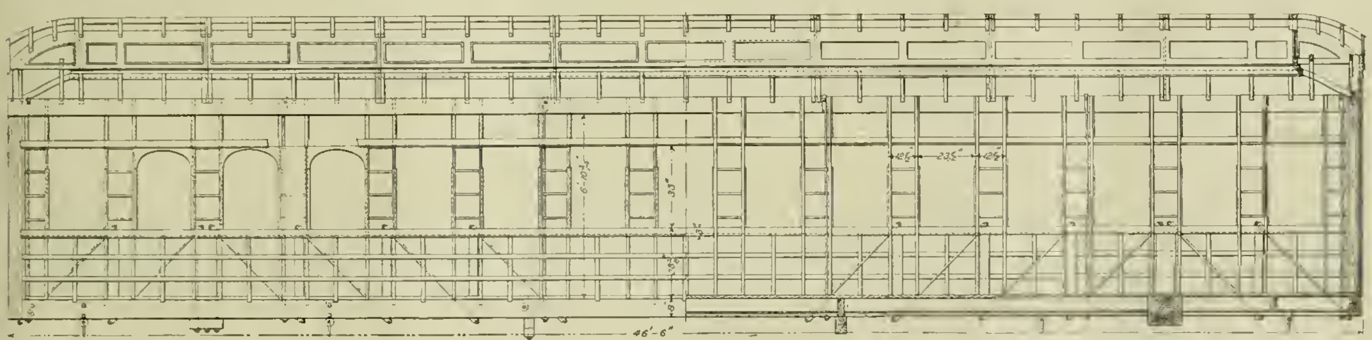
In the matter of brakes, the Cramer spring emergency brake had been extensively applied, but as it was not used for service applications, dependence being placed entirely upon hand work, it was beyond the pale of consideration so far as increase of schedule time or the comfort of the passengers was concerned. The first step in the improvement of this feature was in the introduction of the straight air brake. This placed the control of the train in the hands of the engineer and the brakeman, as such, ceased to exist, although the name still clings to the train hand. Before the straight air brake had become universal practice a great improvement was made and it was rendered automatic. The railroads were quick to adopt it and by 1880 every passenger car in the country was probably equipped with the automatic air brake, and afterwards with the quick acting brake that was a still further improvement on the same.

As the track of thirty years ago was not up to the high standard that is now considered essential, the jar upon the cars was very much in excess of what we experience today, and this was still further increased by the faulty spring suspension. The elliptics beneath the bolsters were much stiffer than we use at present, while rubber at the equalizers served to give a cushion and but very little real spring action. The improvement of this point, however, consists almost solely of a change in the proportions and a general substitution of the round bar helical for the rubber and helicals that were made of every conceivable shape of steel for the equalizers, that the ingenuity of man could devise and the patent office be persuaded into protecting.

Next to the introduction of the air brake, the discarding of the stove has contributed as much to the safety and probably more to the comfort of the passenger than any other one thing that has been done. In the cold climate of the northern states, the intense heat near the stove and the freezing temperature at the remote corners of the car rendered winter travel a fruitful source of lung diseases and general discomfort. The hot water heater was a luxury indeed after what had gone before. This was located in the corner of the car and by means of pipes distributed the heat evenly, throughout the vehicle. This was a satisfactory method of heating and, is in fact, still considered by many to be the best that has ever been devised. In 1885 and 1886, however, there was a strong agitation against the use of fire in a car and a law was passed prohibiting their use in a car running in interstate traffic, so that, at present, the almost universal method of car heating is by means of steam taken from the locomotive.

It is a curious fact that, in the introduction of all of these improvements the railroad man had comparatively little to do. While the inventors and promotors of the devices that were put upon the market, may have had some railroad experience, they rarely occupied official positions at the time and so the credit for the advance really belongs to outsiders.

In the matter of construction and internal arrangement, the car builder has had a great deal to do, and while very



46 FT. 6 IN. PASSENGER CAR BODY OF THE PENNSYLVANIA RAILROAD DESIGN OF 1875.

few roads build their own passenger cars, they do make their own repairs, and the officers are therefore well fitted for analyzing defects and applying the remedy to guard against similar ones on new equipment.

It is to the railroads, too, that is due the transformation of the interior from the rather gaudy system of cheap oil painting decoration to the simple wood finish of the present day. Formerly the headlinings were most lavishly painted with impossible flowers and fruits, while the panels at the ends of the cars and over the windows were filled with oil paintings of every imaginable subject. This work was all done on a thin cotton canvas.

The advent of the wood veneer was the death blow to the head lining industry and we will know it no more.

With a width of from 9½ to 10 feet the traveling public is satisfied with the accommodations, and the single first-class ticket that obtains on all roads entitling the holder to a passage in an ordinary coach meets the requirements of the country, while for those who desire a greater comfort or luxury, the parlor and sleeping cars are available at an increased cost.

These are a few of the visible changes that have been made and of which an observant layman might be expected to be cognizant. But the real changes in the passenger car that have brought it to its high state of development, are out of sight and cannot be seen in photographs or pictures. Of course these relate to the framing and stiffening of the body. In the early days, with which a comparison is being made, a great deal of dependence was placed upon the truss plank to secure vertical stiffness. This was a heavy plank, set on edge, running the whole length of the car and located on either side just inside the framing. The latter was light and trussed by small bolts running diagonally from the sill to the belt rail.

As the speed of trains was increased and the heavy sleeping cars were introduced, these light cars that frequently weighed no more than twenty tons were quickly racked and rendered so loose-jointed as to be unfit for service. The result was that there have been continued efforts to strengthen the framing until now a strong and substantial car that frequently has a length of 70 feet is built.

It would greatly exceed the limits of this article to enter upon a description of the steps that have been taken in the development of the modern car. Steel was introduced wherever it could be advantageously used, as in carlines, and braces. The vertical stiffening of the frame has been accomplished by successive changes, involving many types of trussing and bracing below the window rail. In some cases a steel plate girder was placed alongside the wooden framing from end to end of the car. This was effective to an extent that possessed the inherent disadvantages of a composite wood and steel construction. While no absolute standard was established or could be, the general run of such framing had a diagonal truss rising from the ends to the belt rail near the center with diagonal braces below, and with the spaces between the framing filled with blocks glued in, so that the whole space beneath the windows partook of the character of a plate girder. The outer surface of the space was smoothly finished and the panelling was glued on so that the whole offered, when completed, an exceedingly strong construction and one not easily racked or destroyed.

One more change that has done much for the comfort of passengers is the introduction of the vestibule. This consists of the enclosing of the platforms, so that a passage from one car to another is as safe as the movement about the interior of a single car. This improvement was first introduced on high speed through express trains but has now become common, though not universal practice. It may be said to be used on all trains where dining cars are used where it is necessary for women and children to pass from car to car while the train is in motion. Of course this has no counterpart on the earlier cars.

Such cars were built 70 feet or more in length over the end sills and would seat from seventy-five to eighty passengers.

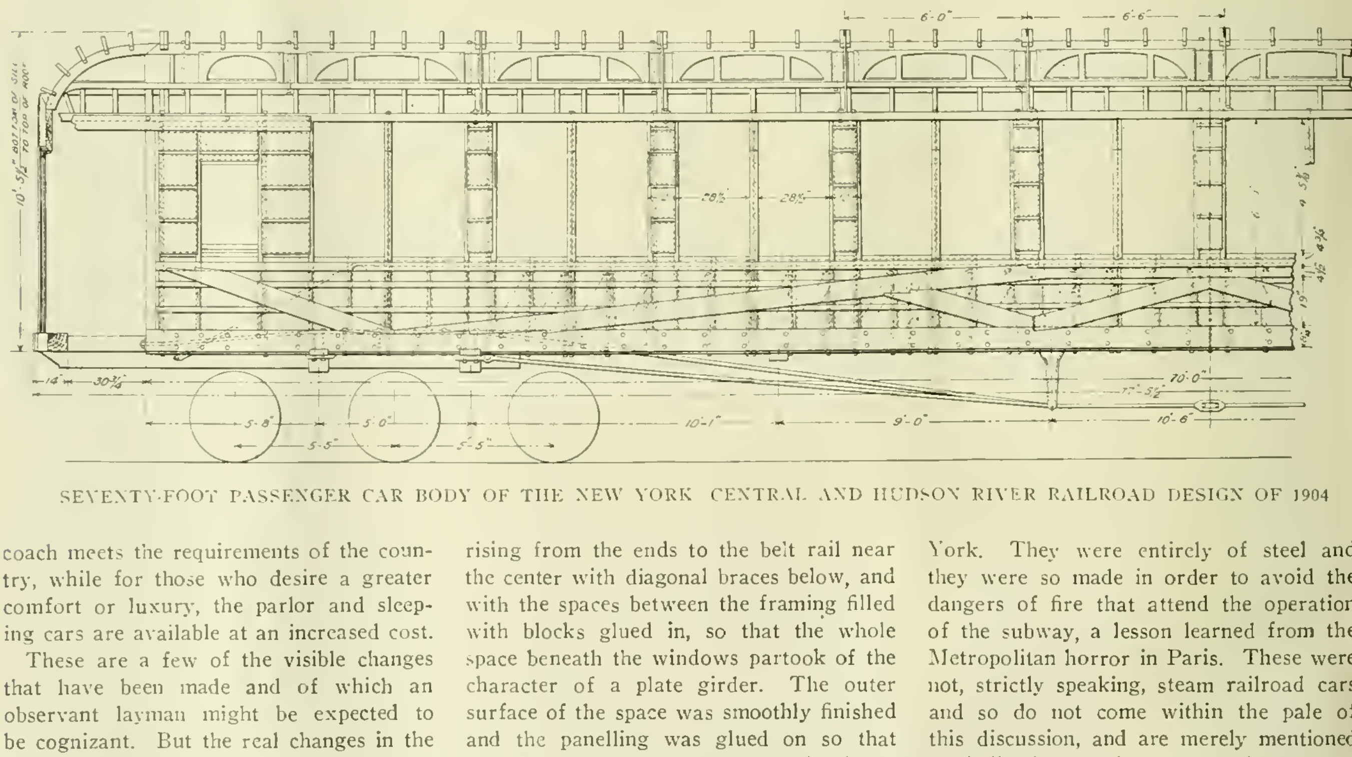
The trucks upon which the passenger cars were carried have for many years been of the four or six-wheeled type, according to the weight of the body. The frames and bolsters were at first of wood, with cast iron and steel for fittings. Afterwards the side frames were plated with steel and, then, a few steel trucks made their appearance, used at first tentatively, then frequently, until now they are almost universal on new equipment.

Steel at first seemed to be making very slow progress as a material for upper framing. A few cars were built for some western lines in which rolled shapes were used for the sills, which were stayed by truss rods in the same manner as wooden cars.

Then came the steel cars put into service on the Interborough lines in New York. They were entirely of steel and they were so made in order to avoid the dangers of fire that attend the operation of the subway, a lesson learned from the Metropolitan horror in Paris. These were not, strictly speaking, steam railroad cars and so do not come within the pale of this discussion, and are merely mentioned as indicating tendency towards the use of steel that, soon afterwards, developed along the lines of steam railroad practice.

In what has been said no attention has been paid to the development of the parlor and sleeping car; as that could well afford a subject by itself for a longer article than space permits for this.

In the work that was done on the ordinary first class American passenger car during the twenty-five years ending about 1910, in the matter of mere dimensions, it was increased from a length of about 50 feet to from 70 to 75 feet, and that the weight rose from 40,000 lbs. to 70,000 lbs. Then great improvements were made in



SEVENTY-FOOT PASSENGER CAR BODY OF THE NEW YORK CENTRAL AND HUDSON RIVER RAILROAD DESIGN OF 1904 the roof, framing, platforms, couplers, brakes, interior decorations and heating and some in ventillation, but not much. But since then the ventillation has been so greatly improved as to leave little to be desired.

Then came a rapid development of the all-steel car. The first great move in the use of the car of this description was in the equipment of the Pennsylvania R. R. for use into the New York terminal. Almost before these cars were put into service, this type of construction took a leap ahead and became practically the only class of car built, until now the all-steel car is the one in almost universal use for new work.

There are, of course, variations in the details of construction and internal arrangements, such as parcel racks and the like, according to the ideas of the officers in charge, and these are subject to constant improvement. As much room as can be afforded is given to each passenger and this is about 4½ square feet of floor space, and there is little prospect of it being increased.

For airiness and comfort, and ease of riding the present steel car is unsurpassed by any similar vehicle in the world. They are now built to a length of nearly 75 feet overall and have a weight of 135,000 lbs., with a seating capacity for 88 passengers. Such cars being carried on six-wheeled trucks. It is, of course, dangerous to predict that any final limit has been reached, yet the prospects of any further increase of size and weight seems to be remote.

Triplex Locomotive Sand Trap

The illustration presented herewith shows the internal construction of a new sand trap that has recently been put upon the market by the Triplex Sand Trap Co., of 1327 Patterson avenue, Roanoke, Va. It contains no nozzles in the body that can give any trouble by working loose. There are two nozzles as shown (1 and 2), and these are screwed in from the outside and can be readily removed for inspection or renewal. These stand in line with the delivery ports, which are of two sizes, so as to vary the amount of sand delivered to the pipes, and they are of such size as to handle all of the sand that may be required; the diameter of the nozzles being proportional to suit that of the delivery nozzles. The use of the two nozzles is for the purpose of providing a heavy as well as a light feed of the sand, the heavy being supplied from the jet (1) and the light from the jet (2). It is the intention that the jet (1) should be used when starting and after the locomotive is under way the jet (2) which will supply only about half the quantity of (1) can be used to prevent the wheels from slipping. And as the delivery from this nozzle is sufficient for that purpose, there is an avoidance of the use of the excessive amount that is usually poured down upon the rail, with the corresponding saving, both in sand and train resistance.

The trap is also provided with a pipe and trap cleaner. This is effected by connecting an air pipe at the openings 3 and 4.

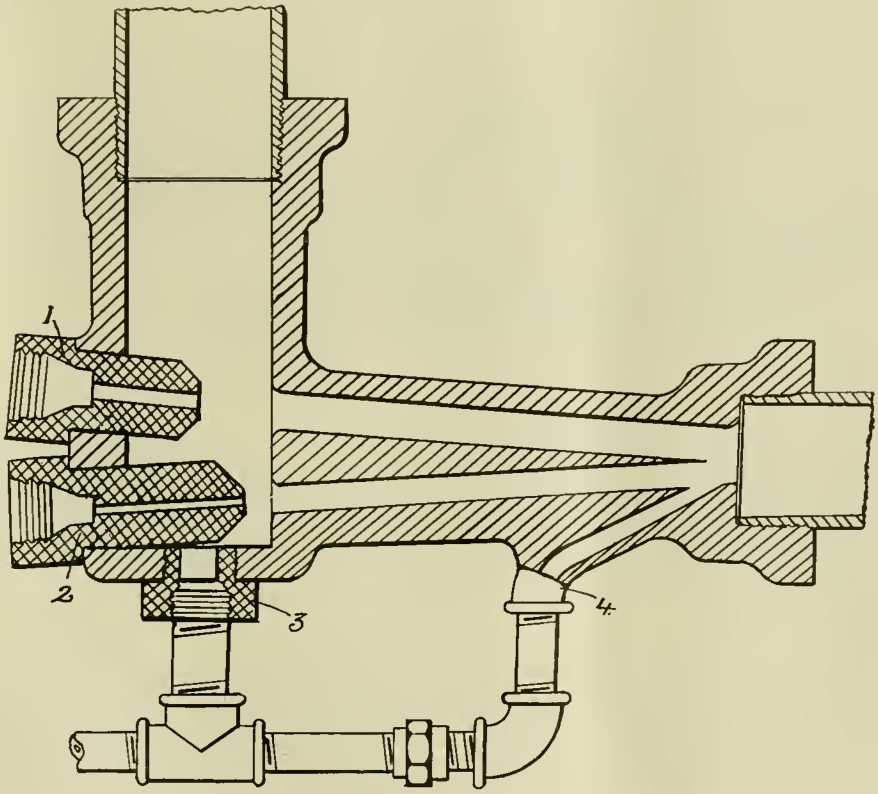
When air is admitted at 3, it enters the trap beneath the body of sand and loosens it by agitating it so that it will flow freely while that at 4, serves to blow out any foreign matter that might find its way down and interfere with the proper delivery from the nozzles 1 and 2. A plug at the point of connection at 3 makes it possible to clean the trap of any foreign matter that may work down, such as cinders, stone or waste.

The air valve in the cab is provided with three ports. As the handle is moved from the closed position it first opens the port leading to the connections at 3 and 4. This admits a blast of air at each of these two points. One at 3 serves to agitate and loosen the sand in the body of the trap and the other 4 to blow out the delivery pipe. Then, as the handle of the valve is advanced, the port to 3 and 4 is closed and the one to 1 is opened. As long as it is held in this position the heavy blast and the heavy delivery of sand continues.

The next advance opens the port 2 and the maximum delivery takes place. Finally in the extreme position of the valve, the port to 1 is closed and that to 2 left open, thus cutting down the delivery to a minimum and effecting a considerable saving.

As the valve is closed the reverse process takes place and at the end there is a repeated agitation of the sand and a blowing out of the delivery pipe.

The trap can be placed at any convenient point on the boiler to which the sand will blow by gravity from the box. It necessitates three pipes from the cab. Each of these divides into two branches, one to the trap on either side of the engine as in the usual manner.



TRIPLEX LOCOMOTIVE SANDER

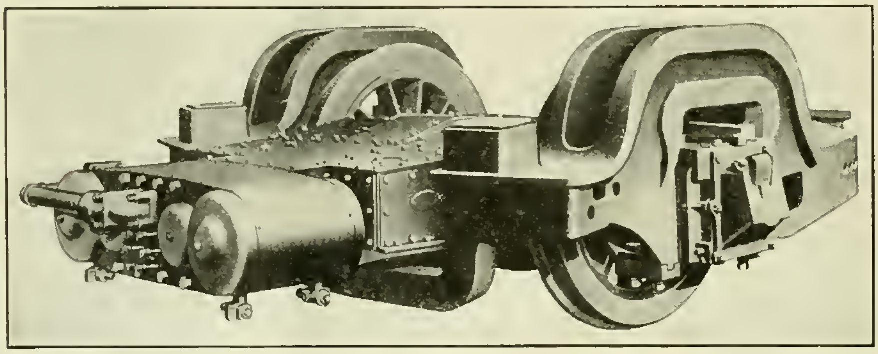
Bolivian Government Contracts for Rail Construction

The Bolivian Government is said to have placed a contract with the Ulen Contracting Corporation, 120 Broadway, New York, for the construction of a new railroad line in that country, extending from Villabon to Atoche, 128 miles, at a cost estimated at $10,000,000. The contract is to be completed in five years. The specifications call for the installation of American type of track equipment, with similar motive power. Railroad shops and other features are included. The financing of the proposition is now under discussion by the government and the prospects of an early beginning of the work is assured.

Result of Application of Locomotive Booster to Locomotive of Temiskaming and Northern Railway

The Booster in Operation

It is interesting to observe that the Canadian railway executives have not been slow in appreciating the introduction of the Locomotive Booster, the merits of which were pointed out in our pages, culminating in a full description of the extensive tests made on the New York Central Lines last year. Since that time numerous applications of the important appliance has been made, and all with gratifying results in point of economy. Among the most recent is an application and special tests of a booster-equipped locomotive on the Temiskaming and Northern Railway of Canada.



THE BOOSTER APPLIED TO THE TRAILING TRUCK OF A LOCOMOTIVE

Extension of the T. & N. O. and an increase in passenger and freight transportation imposed demands that could not be met satisfactorily with present power. Weight of existing rail and difficulty of maintaining roadbed in a country where it is almost impossible to make track repairs during six or seven months of the year mitigated against the use of heavier engines.

After a careful study of the new device and its possibilities, the T. & N. O. applied boosters to four new light Pacifics and one Mikado. The results are indicative of what may be expected from the booster as a factor in meeting conditions such as confronted the T. & N. O. The booster-equipped Pacifics are now hauling thirteen steel cars over a 1.29 per cent grade uncompensated for curvature, while the Mikado booster engine is handling more than 200 tons per train in excess of the load formerly taken by the same type of locomotive unequipped.

The booster, aptly named, is an additional power unit which imparts greater starting and accelerating power to any locomotive with trailing wheels. It consists of a simple, two-cylinder engine upon a special design cast steel bed plate. The bed plate also forms the axle bearing and truck support. Control valves are air-operated, designed and manufactured by the Westinghouse Air Brake Company.

Utilizing spare steam from the locomotive boiler the booster turns otherwise idle trailing wheels into driving wheels, greatly increasing the starting power of a locomotive and helping it over steep grades. Weighing but 3,500 pounds, the booster adds 25% to 40% to the draw-bar pull, an increase equivalent to that which could otherwise be obtained only by the addition of 50,000 pounds of engine weight.

An outstanding feature of the booster is the simplicity of its operation. Connected to the usual starting and reversing lever, the booster is thrown into gear as the engineer starts the locomotive. When the locomotive reaches road speed and the engineman links up the reverse lever, the booster automatically cuts off. It can be thrown in on grades or whenever additional power is desired.

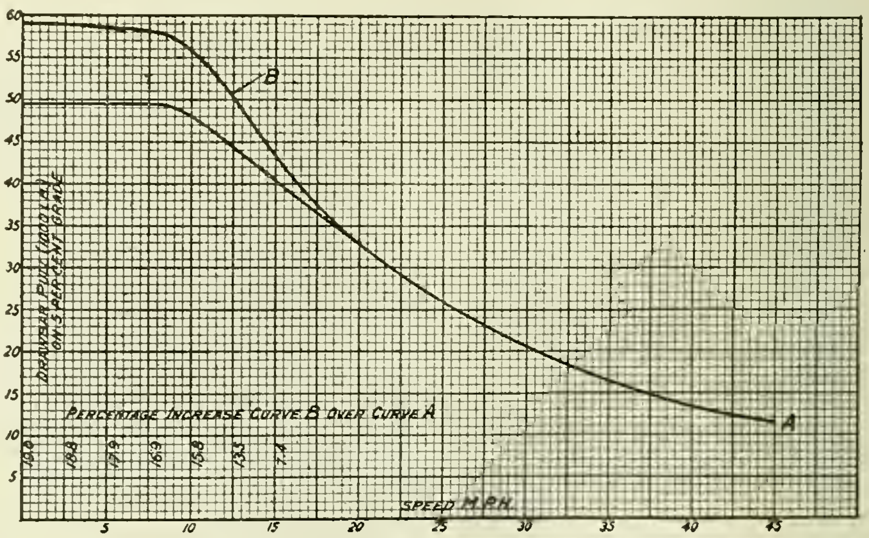
The booster-equipped locomotive will take a steep grade with a shorter cut-off, thereby reducing the steam consumption, saving fuel and avoiding tearing the fire with the heavy exhaust resulting from a long cut-off.

The development and perfection of the booster comes at a very opportune time.

Railroads, by equipping existing power with boosters may avoid or at least defer the purchase of more powerful, expensive locomotives demanded by road or traffic conditions. Forty booster-equipped engines being equal to fifty non-equipped locomotives, as accurate records indicate, railroads may materially lessen the number of new locomotives purchased in accordance with annual retirement policies. To such a reduction in engine purchases should also be credited the elimination of the fuel, upkeep and wage of crews which would be required to operate the locomotives whose purchase was avoided by the application of boosters.

With a booster-equipped passenger engine, additional cars may be added to a train without loss of time in starting or on grades. Schedules are maintained, and the starting jerks so discomforting to passengers and so destructive to equipment are large eliminated.

By increasing the load of booster-equipped freight engines, operating expenses may be spread over more tonnage, thus reducing the hauling cost per mile.



EFFECT OF BOOSTER ON LOCOMOTIVE CAPACITY

Curve A represents the drawbar pull on 0.5 percent grade of a 26x30 in. Mikado Locomotive. Curve B is the additional power obtained by applying the locomotive booster.

Booster engines are taking heavy freights up grades that formerly necessitated the use of a pusher.

On one American railroad a booster used for only seven miles eliminates over seventy pusher miles.

When a block is set against a heavy

tonnage train on a ruling grade, it is open necessary to cut the train and double over the hill, an interference with schedule which may be avoided by the booster.

Atlantic type locomotives with boosters are capable of handling heavy suburban trains heretofore hauled by Pacifics and ten wheelers. The booster reduces by one-half the time required to get engines to road speed and makes it possible for local trains to maintain schedules without hammering the locomotive at excessive speed between stations.

In mountainous country, where the weight of locomotives is governed largely by the strength of bridges and trestles the booster offers a valuable opportunity to increase the hauling capacity of a light locomotive without adding to its weight.

A by no means negligible benefit of the booster is a reduction in tire wear, estimated by one road at 50%.

By its successful, every-day performance on the T. & N. O. and American railroads, the locomotive booster steps out of the experimental stage and assumes an important place as an operating factor, a factor that will contribute materially to the solution of locomotive problems confronting the railroads.

New Pacific and Mikado Type Locomotives

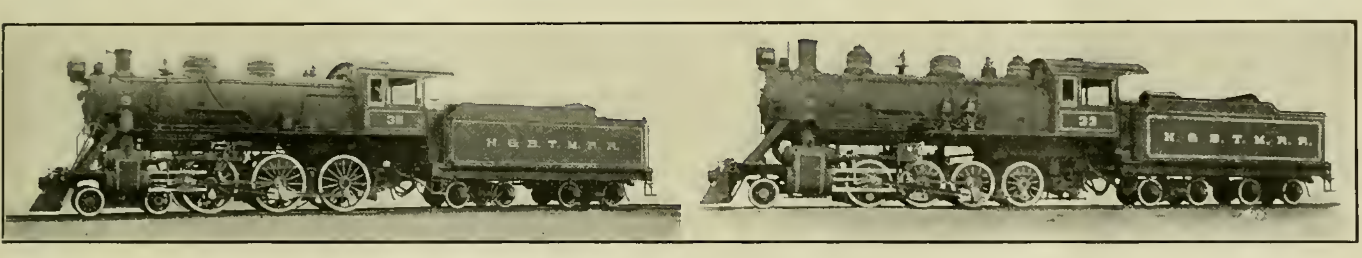
Constructed by the Baldwin Locomotive Works for the Huntington & Broad Top Mountain Railroad

The Huntingdon & Broad Top Mountain Railroad is a coal carrier, whose main line extends from Huntingdon to Bedford, Pa., a distance of 52 miles, connecting at the former point with the main line of the Pennsylvania System. During the year 1921 this road received four locomotives from the Baldwin Locomotive Works; two of the Consolidation (2-8-0) type for freight service, which were built in the Spring of the year, and two of the Ten-Wheeled (4-6-0) type for passenger service, which were completed in the Fall. These locomotives are built for operation on 85-pound rails, 18-degree curves, and grades of 1.86 per cent; and are designed and equipped in accordance with the most approved practice for motive power of their respective types.

The design of the freight locomotives is based on that of two Consolidation type engines which were built for this road in 1910. These locomotives used saturated steam, and with 22" x 28" cylinders, 51" driving wheels and a pressure of 180 pounds, they developed a tractive force of 40,600 pounds. They were equipped with balanced slide valves and Walschaert's gear. The new design retains the same sized cylinders and wheels, but the pressure has been raised to 190 pounds, increasing the tractive force to 43,000 pounds. The boiler is, in general dimensions, closely similar to that of the previous locomotives, but the new design includes a superheater and brick arch. The steam distribution is controlled by piston valves. These changes have resulted in a slight increase in weight; and the ratio of adhesion is very nearly 4, showing that the weight on drivers is fully utilized.

The locomotives that arouse the greatest interest are naturally those that are built for heavy trunk line service; but lighter motive power that is also worthy of attention is built, from time to time, for short line railways. These railways often have difficult operating problems, due to such features as light rails, steep grades, sharp curves, etc.; and while the locomotives used may be of moderate size, this is no reason why they should not be designed to give high efficiency and to develop maximum capacity in proportion to their weight. Those features of design which have proved of special value in raising the efficiency of heavy motive power, can be applied to locomotives of moderate size with equal results; and advantage has been taken of this opportunity.

The passenger locomotives are in many respects similar to the freight and, where practicable, interchangeable details are used in the two types. Schedules on this road allow approximately two hours for the 52-mile run, making twenty intermediate stops; hence a prompt get-away from stations is necessary. The new locomotives develop a tractive force of 28,000 pounds, with a ratio of adhesion of 4.5; so that, with a train of moderate weight, they can accelerate rapidly without slipping under ordinary rail conditions.



PACIFIC, 4-6-2 TYPE LOCOMOTIVE. CONSOLIDATION, 2-8-0 TYPE LOCOMOTIVE.
Biult by the Baldwin Locomotive Works.

The illustrations clearly show the principal features of both types of locomotives, and their principal dimensions are as follows:

	2-8-0 Type	4-6-0 Type
Cylinders	22" x 28"	21" x 26"
Piston valves, diameter	12"	12"
Boiler, diameter	74"	68"
Steam pressure, pounds	190	190
Firebox, length	102 3/16"	100⅜"
Firebox, width	66"	66"
Water heating surface, sq. ft.	2,237	1,987
Superheating surface, sq. ft.	503	489
Grate area. sq. ft.	46.7	42.5
Drivers, diameter	51"	66"
Truck wheels, diameter	30"	30"
Driving wheel, base	14' 8"	13' 6"
Wheel base, total engine	23' 8"	24' 3"
Wheel base, total engine and tender	55'-0 ¼"	56'-0 ½"
Weight on drivers, pounds	170,100	132,000
Weight, total engine, pounds	190,700	175,000
Weight, total engine and tender, pounds	314,700	312,500
Tank capacity, gallons	6,000	7,000
Fuel capacity, tons	10	10

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.
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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd.,
3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $2.50. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

The Threatened Strike Averted

It will be recalled that when the Government turned back the railroads to their owners, the provision made in the law then enacted would prevent all future danger of the interruption of transportation by strikes or lockouts. In order to prevent such interruption, Congress created the Railroad Labor Board in which the public, the railroad owners and the employees have equal representation. The law provides that in case of disagreement between the managers of transportation lines and their employees, the two parties to the controversy shall attempt to reach a settlement and, failing that, shall lay their case before the Railroad Labor Board, which shall hear both sides and make a decision which shall be binding and from which there can be no appeal.

The railroad managers last Spring asked for a reduction of wages. The employees refused to accept it. The case went in due course to the Railroad Labor Board, which made an order providing for a reduction of approximately 12 per cent, or a little more than half the increase that was made in wages by the Government when it relinquished the railroads. The railroad managers accepted the award but the employees proceeded to take a vote as to whether they should accept it or go on strike against it. The result was a very heavy majority in favor of a strike and the brotherhood officials were empowered by this vote to call a strike if they should so desire.

Coincidently the managers called for a further reduction in wages, and doubtless this demand had its effect on the minds of the employees in the course of balloting on the strike question. It should be borne in mind, however, that the call for a strike was against the award made by the United States Labor Board reducing wages, which took effect July 1. In the face of this decision the vote was cast and the officials of the brotherhoods issued an order for what might be called a general walk out on October 30.

The President and Federal authorities announced that the authority of the Labor Board would be upheld and that its orders would be enforced, and an earnest hope was expressed by the press and public that the proposed strike would be averted. The controversy before the Labor Board attracted the widest attention, and while the result has been that the strike order is withdrawn, neither side can claim a victory, because the Labor Board announced that it would be impossible that any proposal for a further reduction of wages could be entertained until all the involved questions arising out of the working agreements and other disputes were disposed of which would probably occupy nearly a year. The railroad managers therefore withdrew their new requests for the present, while the employees tacitly accept the reduction of wages which has been in force since last July.

After the smoke of battle has cleared away it must be admitted that both parties to the dispute fought heroically. As might have been expected the managers may be said to have had the largest amount of artillery and reached the public ear with echoing reverberations, but the public is not blind to the fact that in a hand to hand combat in the forum of debate the representatives of the employees showed a skill in the thrust and parry of debate that proved to the managers that they were meeting foemen worthy of their steel. It is to be hoped that both parties will realize that the United States Labor Board must be respected, and while it may in the very nature of things take some time before it assumes the dignity of the Supreme Court, it is hoped that its rulings after a fair and free discussion will meet with less acrimony than the controversy which has just closed.

Railroads and Common Roads

A week or two in the country not only brings us back to nature robed in green and gold, but reveals to us the fact that we can never entirely get away from our occupation. We look at such railroads as come our way in the passing panorama, and mark how substantial and well-kept they look in spite of the fact that the profits from their use are next to nothing. The descendants of the revolutionary family in whose antiquated colonial mansion we rest for a brief space, pocket their pride for a few months, and save enough from the heavy charges on their guests from the city to live in comparative comfort for the rest of the year. There is no Interstate or Interurban Commerce Commissing fixing their rates. They charge all the traffic will bear and more. An eighteenth century domicile with nine Doric columns in front, and a decayed orchard in the rear is a more profitable investment than a bundle of railroad bonds.

The variations between the railroads and the common highways, however, are in marked contrast. How is it that the shining pathways that glistened like monumental alabaster a few years ago are so dilapidated? The motor trucks have grown from one or two tons to ten or twelve tons. Not only have the heavy loads cut deep depressions on the roadway, but great splinters are broken off the sides. The irregular and incessant corrugations remind us of the rocky road to Dublin. Barrels of tar and other material are strewn at intervals along the roadside. The purchasing agent has been busy. The assault on the State treasury has been effectually kept up. The taxpayers, like the bewildered boarders, are in rapt wonderment. The boarders can get away from their heavy charges as soon as they please, the taxpayers—never.

It would look as if the heavy motor truck companies are having the best of it. They paid nothing for the construction of the highways and they are paying next to nothing for their maintenance. They certainly have the railroads skinned a mile, or to put it more accurately, they have the advantage of about $40,000, or more, a mile. This, to say the least, is hardly a square deal. The railroad companies built their own roads, and maintain them well. The heavy motor truck companies neither built roads nor contribute anything to speak of towards their maintenance. It is high time that this gross injustice should cease. While the motor truck adapted for heavy service may be said to have been an outgrowth from the conditions arising from the great war, it looks as if the service of heavy motor trucks has come to stay, and it is only proper that the promoters of the service should bear their fair share of the cost of the means that makes their occupation possible.

Doubtless in the coming assemblies of the legislatures, if they ever get done speaking about the railroads, something may be said about the motor trucks. If not, we may have to wait for another war when the government will assume control of them, and then our statesmen will find out the real inwardness of the situation and probably pave the way for a better equalization of the burdens under which the misguided and misused taxpayers meet their terrifying tariffs.

Accounts Between the Government and the Railroads

Much serious and critical comment has been made on the delay on the part of the Government in making the greatly needed settlement with the railroads but it should be borne in mind that there are many claims on the public treasury, and the Government safeguards itself by extending such payments over a period of years. In regard to the railroads the following memorandum shows approximately the amounts due to the railroads by the Government and how it is proposed to place the Director General in funds to pay same through sale to the War Finance Corporation of securities or obligations now held or which may be received by them for advances made by the Government for additions and betterments and equipment upon the railroad properties during Federal control.

Section 207 of the Transportation Act provides that the President may, in his discretion, fund the additions and betterments payable by the railroads over a period of ten years.

The Director General owes the railroads on account of:

Unpaid compensation	$459,609,114
Depreciation, property retired, etc	313,239,824
Total	$772,848,928
Less amount due to the Director General by the railroads in open accounts..	196,486,079
Balance	$576,362,859
In addition, the Director General estimates there will be required payment to make up the difference in inventory between the material taken over by the Director General on January 1, 1918, and that returned to the railroads at the end of Federal control	48,396,000
Making total estimated balance due the railroads of	$624,758,859

Ordinarily the railroads themselves would not undertake expenditures of such magnitude unless and until they were able to provide for the financing of the same through the issue of bonds and stock or were able to get the funds from other sources. Because their properties were in the hands of the Government, and because the money market was largely monopolized by the Government during the period of the war, the railroads were unable—and indeed were not called upon to any extent to finance expenditures for additions and betterments—and the natural assumption was that the expenditures made by the Government would be funded in accordance with the authority contained in the Transportation Act, 1920.

It is proposed now that the Director General fund these expenditures and to the extent judgment dictates accept properly secured obligations of the railroad: running for not exceeding ten years, in settlement.

Had this been done then, at the end of Federal control when the railroads were turned back to their owners the Director General would have been able at the same time to have paid over to the carriers the balance due them on account of compensation, depreciation, etc., in the approximate amount of $624,757,000.

The failure of the carriers to receive these funds has prevented them from paying currently for materials and supplies purchased since the end of Federal control, or to undertake the thorough repair of much of their equipment which was in bad condition.

Continued Cut in Maintenance

That the railroads of the United States were able during August to realize net earnings as opposed to the deficit of one year ago at the expense of the maintenance of their properties, was shown by complete returns of the carriers' earnings filed last month by the railroads of the country with the Interstate Commerce Commission. The total operating revenues for the railroads of the country amounted to $505,099,000 in August, or 8.9 per cent less than they were during the same month last year, while operating expenses amounted to $381,938,000, or a decrease of 43.9 per cent compared with the same previous month. The net operating income of $90,200,000 compares with an operating deficit of $158,539,000 in August, 1920.

For the eight months extending from January 1 to September 1, 1921, the net operating income of the railroads of the United States was $303,752,000, or at the annual rate of net earnings return of only 2.6 per cent upon the money invested in its railroad properties, as fixed by the Interstate Commerce Commission.

Mr. Vauclain on the Job

Regarding the duties of the president of a great manufacturing establishment, S. M. Vauclain, president of the Baldwin Locomotive Works, suggests that the executive whose tendency in business is to defer all his important decisions for conference with other executives is really not on the job. In spite of Mr. Vauclain's natural modesty he related the following personal experience in handling a difficult problem:

"Sometimes it does get up to me because, of course, a president must do something. I well remember one election day when a foreman came in to tell me that he had just broken the big steel head of the only hammer in the shop that could forge certain driving wheels. We were working on an export order that required drop-forged wheels. The ships to take the locomotives overseas had been chartered and were due within a few days. If we held those ships for long, we should have to pay a demurrage that would very quickly wipe out our profit. I called the builder of the hammer on the telephone. They thought they might get new heads through within 30 days. They might have said 30 years for all the good it did us. I told the foreman, and he seemed very much of the opinion that I ought to have at least one or two of those hammer heads in my vest pocket. There was no use talking to him about it, so I told him to stop blaming me and go home and vote.

"We had no steel in the shops big enough for those hammer heads. Casting over in my mind the stocks of the various steel mills in the country, I could not recall one that would have such a big chunk in stock. That night I went to the theatre—which I find is a pretty good thing to do when one is upset. During the show I remembered that a junk dealer in town had about a year before bought an old monitor from the Navy Department, and that the centers of the turrets ought to be just about what we needed. Perhaps he had not sold them. There was no way of finding the junkman that night, but by four o'clock in the morning I was out with a team on my way to his yard. There was no one there—not even a watchman—so I climbed the fence, and, burrowing through his stock, came across those big centers. They were just what we wanted. By seven o'clock I had the junkman down, had bought the centers, and had them on the way to our shops. By noon the hammers were running."

Stainless Iron

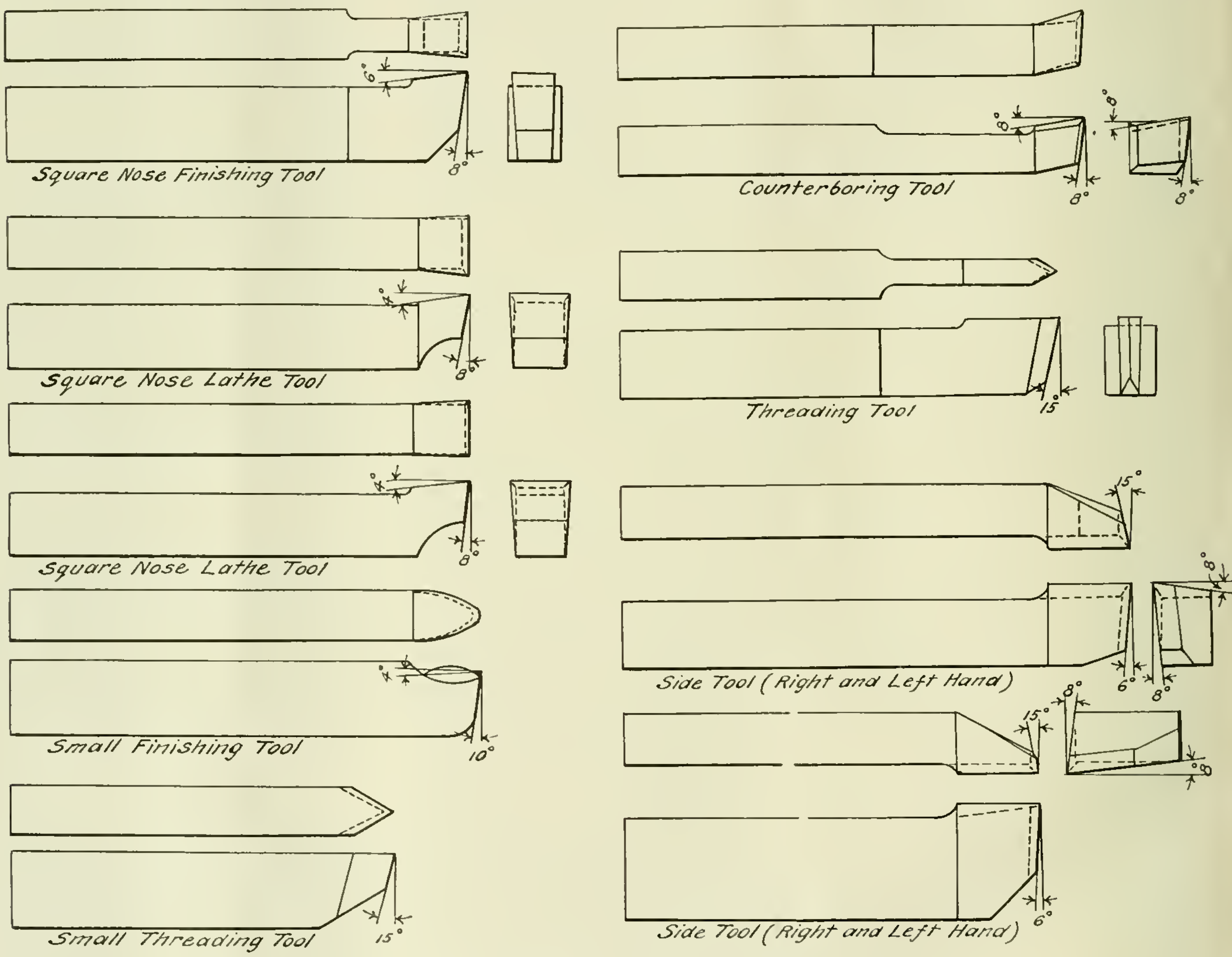
After stainless steel had been successfully manufactured, it was found that stainless iron could be produced by much the same process, with the exception that a smaller quantity of carbon-free ferrochrome was required. Stainless iron has been already largely used in the Sheffield cutlery trade and in the fittings of motor cars. Another important development in contemplation is the use of stainless iron for the furnishing of railway carriages, engines, and rolling stock generally. It is also proposed that it should replace brass for doors handles, brackets, and many other fittings. As might be expected the manufacture of stainless iron and steel is already being rapidly taken up by our American manufacturers.

Cutting Tools and Other Shop Appliances in Use on the Erie Railroad

The use of the tool grinder and of standard cutting tools has become so general in manufacturing establishments where production work is the rule, that it is taken as a matter of course. The practice is growing in railroad shops and the Erie is one among the roads that has adopted the system for the general run of work. It is, of course, impossible to provide a set of standard tools that will meet every possible requirement that may arise, but the standard shapes that have been adopted on the Erie will be found to cover such a wide range of work that the field left open to special tools will be found to be exceedingly small.

Starting with the roughing tools; the heavy round-nosed type has been found to be most efficient, and provision is made both in boring mill and lathe work for tools of this type for cutting both cast iron and steel. While the tools for both services fall under the general classification of "round-nosed" there is a marked difference in their shapes as adapted to the boring mill and the lathe. When taken in plain view, the boring mill tool has a rounder form than that of the lathe, whose contour more closely resembles that of a gothic arch. The usual difference in rake and clearance for tools intended for cutting cast iron and steel is noticed in that both the rake and clearance is less for the cast iron cutting than for the steel cutting tools. In the case of the boring tool for cast iron the rake is the same (8°) but the clearance is 2° less than for the lathe tool, these being 6° and 8° respectively. But, for cutting steel the rake is 2° less for the boring tool than it is for the lathe tool, the angles being 10° and 12° respectively, while the clearance angle (8°) is the same for both. The side rake for the boring tools is less in both instances than it is for the lathe tool, it being in the steel cutting tool only 6° as against 12° for the lathe. As these angles and shapes have been carefully studied in order to obtain the greatest efficiency of the tool, they are deserving close attention. This efficiency involves not only the possibility of the maximum speed in the cut, but the minimum of cutting resistance and consequent heating of the tool.

All of the tools above described have a side rake and are intended for what comes under the general classification of heavy work. But for lighter work roughing in either steel or cast iron but more especially for steel work there are two styles of straight roughing tools in use (A and B.) That is tools with no side rake. The two tools are of practically the same shape, that is, they have the same angles of rake and clearance, to wit: 10° and 8° respectively, and differ only that one is wider than the other and has a front face with a longer radius



CUTTING TOOLS IN USE AT THE ERIE RAILROAD SHOPS than the other so that, with the same feed it will make a smoother cut.

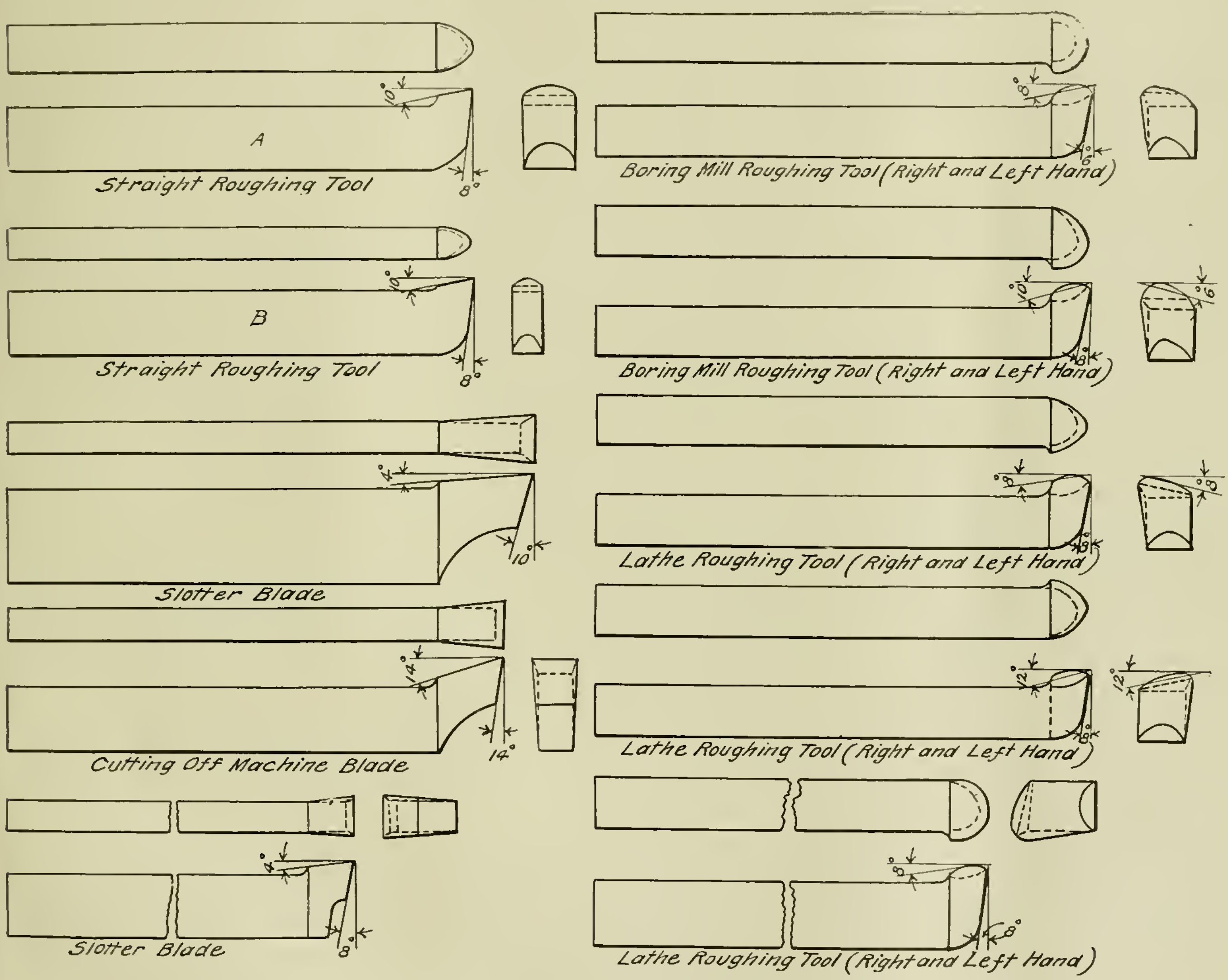
We next come to the slotter blades of which there are two forms differing only in the weight of the tool and the angle of rake which is 10° and 8° respectively. The heavier tool also has the greater width of cutting face but the angle of flare of the two is about the same.

The cutting off machine blade deserves especial attention because of the large angles of rake and clearance which it offers and the wide angle of flare and wide cutting edge presented to the work. The rake and clearance angles are the same (14°), and in this the practice differs widely from that too often found in the average machine shop, where, for that very reason, cutting off, especially of heavy bars is a piece of work that is very properly dreaded. Here we are apt to find that an attempt is made to do a cutting off job with a tool that may have no rake at all but be quite flat on the top, while the clearance is made as much as the strength of the tool will allow, so as to provide for the decreasing diameter of the surface that is cut. The result is a chattering tool and an excessive pressure put upon the upper surface by the chip as it curls up from the cutting edge.

With the large angle of rake of 14° in the tool illustrated there is no tendency to chatter and the angle of curl of the chip is so reduced that the pressure on the upper surface of the tool is greatly reduced, and with it, the power required to drive the tool through the metal. There is, on the other hand, a tendency for the tool to spring into the work, when it is raised at such an angle and cut away at the bottom, but this tendency is met by careful feeding so that the tool is held to a constant cut at all times. In this connection it is to be borne in mind that when a tool springs into the cut it turns about the front edge of its support in the tool port, so that, for a given height of cutting edge above that support, the angle at which it springs into the cut is the same regardless of the angle of rake, so that the greater the rake the less the pressure of the chip and the less the tendency to spring into the cut.

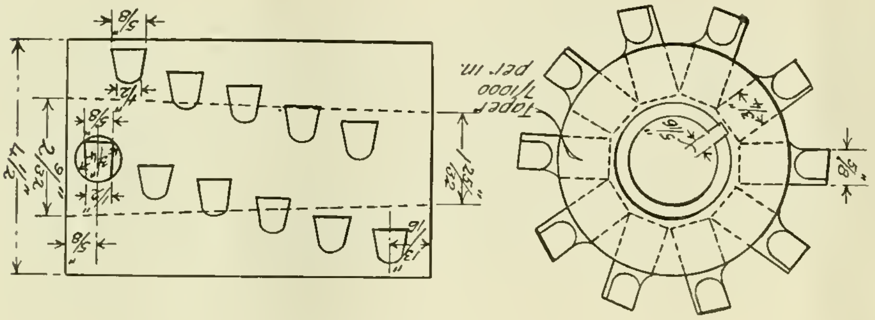
The square nose tools both for finishing and for lathe work that may require such tools are given a clearance of 8° and a rake of 6° for the finishing tool and 4° for the ordinary square-nose tool. Here again attention is called to both of these points. It is a common practice to make a square-nose tool without any rake and, then, if it scrapes off the metal instead of cutting it, to grind a notch in the top face just back of the cutting edge. This may give a rake of as much as 45° for a short distance when the chip is curved sharply upward. Such a tool will cut well while it lasts but its life is short, because of the rapid wear by grinding. The Erie practice, therefore, of giving all such tools as have thus far been touched upon a long even rake is worthy of attention. Not that it is a novel feature when attention has been paid to such things, but they do not always receive the attention that they ought.

In the case of the tools for cutting V threads attention is called to the wide angle of clearance (15°) that is allowed, and also to the fact that there is an ample side clearance. The front clearance reduces the cutting edge of the tool so that it is a real cutter and not a scraper, and the side clearance leaves a clean thread



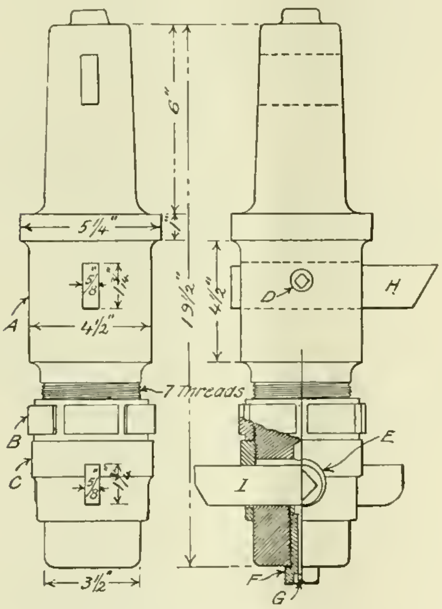
CUTTING TOOLS IN USE AT THE ERIE RAILROAD SHOPS besides adding to the side cutting qualities of the tool.

The counterboring tool has an advancing cutting edge that terminates in what



CUTTER FOR VERTICAL MILLER

closely approaches a point, but has its cutting edge protected by ample side and front clearance and back and side rake,



WHEEL BORING TOOL

an angle of 8° being used at each of these points, so that the cutting qualities are as good as possible.

The side tools are made on the same general principles as the counter boring tool, but with the variation in shape that their work requires.

Cutter Head for Vertical Miller

The very sturdy cutter head shown in the illustration is used on a vertical miller for a variety of heavy work. It carries 55 cutters set in eleven horizontal planes, with five cutters in each plane, each of whose cutting edges overlap those of the plane above and below. As will be seen from the dimensions the head sets over the tapered end of the spindle and is driven by a 5-15-in. key.

The cutters themselves are of ¾-in. round steel ground to the cutting shape shown in the side elevation, with a cutting face ⅜ in. wide and tapered back with a side clearance to a width of ½ in. at the back. They are turned to fit a tapered hole in the head which has a diameter at the face of ¾ in. and tapers back at the rate of .007 in. per inch of length. Such a cutter is capable of doing very rapid and heavy roughing work.

Wheel Boring Tool

This is a heavy tool or rather tool holder that is used for boring and chamfering cast iron wheels at one setting.

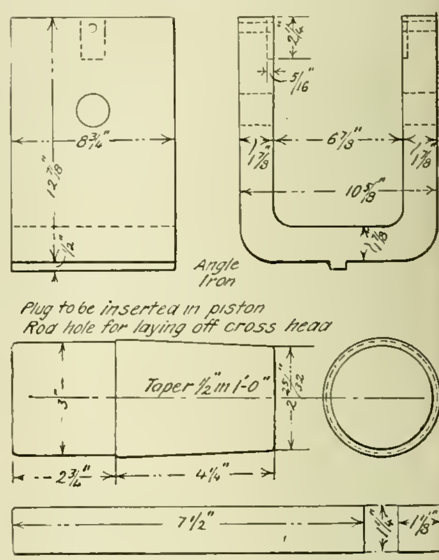
The body of the tool *A* is made to fit in the tapered hole of the spindle of the wheel borer. Just below the shoulder a slot is cut for the reception of the chamfering tool *H*, which, as its work is comparatively light is held by the setscrew *D*.

Below this the diameter of the body is reduced and it is threaded to take the nut *B*. In the smooth portion below the thread another cross slot is cut for the reception of the roughing and finishing tool *I*. A sleeve *C* is also turned to fit over the smooth portion and it is cut with a slot to match that in the body and drilled on one side to admit the setscrew *E* which is run into the body and serves to put a side pressure on the tool *I*. This tool is slipped through the slots in the body and the sleeve *C* and can be held lightly by the setscrew while being adjusted to the proper cutting distances from the center. The setscrew can then be tightened and the nut *B* run down forcing the top of the slot in the sleeve against the top of the cutting tool which is thus held firmly in place by pressure both at the top and the sides.

At the bottom there is a hollow screw *F* through which a hardened steel stem *G* is passed. This stem has a roughened face at the upper end which catches and serves to hold the tool while it is being adjusted centrally to make the correct diameter of cut, and before the nut *B* and the setscrew *E* have been turned home. The parts *D*, *E*, *F* and *G*, are all of tool steel hardened.

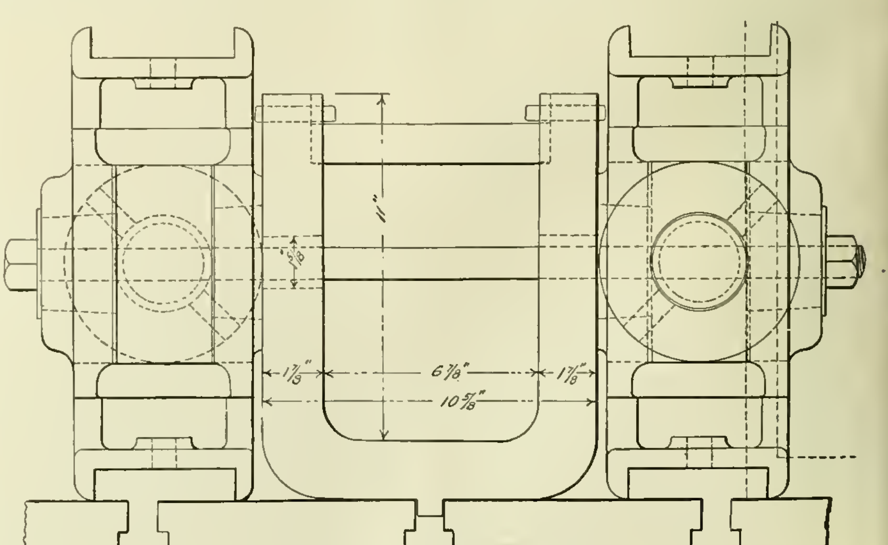
Double Angle Iron for Planing Crossheads

This is a very simple device for holding two crossheads on the planer at once, and,



DETAILS OF ANGLE FOR PLANING CROSSHEADS

at the same time laying out the ways on the crosshead.



ANGLE FOR PLANING CROSSHEADS

The main piece consists of a U-shaped piece, 1⅞ in. thick and 8¾ in. wide, having a lug ½ in. deep and 13-16 in. wide running along the under side. This latter fits loosely into the slot in the planer table and serves to steady and square the U piece, which is held down by a strap and T-headed bolts in the usual manner. The crossheads are set with the crosses of their wristpin holes against the finished outside faces of the U piece. They are held in place by a 1-in. bolt extending through from side to side as shown.

In order to prevent the top of the legs of the U piece from springing in under the pull of the bolt a 1¼-in. square bar is dropped into shallow slots on the inside of each leg, and which thus serves as a strut at the top. It is held in place by two ⅞-in. pins which slip into ½-in. holes provided for the purpose.

With the crossheads in place a tapered plug *A* turned to a taper of ½ in. to the inch is put into the piston rod hole. The part of this pin projecting beyond the hole is of a reduced size and is 3 in. in diameter. This surface serves as a base against which the edge of a square is placed, as indicated by the dotted lines. One leg of the square rests on the surface of the planer table and the other against the plug. Measurements for the laying out of the ways in the crosshead can then be made from the projecting upper end of the vertical leg.

By using this set up in a double-headed planer, two crossheads can be finished at once.

A New Way of Reducing Claims

By H. J. Force, Chemist and Engineer of Tests, Delaware, Lackawanna & Western Railroad

The purpose of this paper is to point out in a special way, and to give methods for the reduction of claims which are caused by acid and other chemicals. The total loss and damage to freight on all railroads in the United States in 1914 was approximately thirty-three million dollars, while in 1919 this jumped to over 106 million dollars. One of the very large losses is found to be on merchandise which is damaged by coming in contact with chemicals and acids. Many carloads of sugar, flour, coffee and other similar commodities have been very seriously damaged by being loaded into cars in which the floors were contaminated by various kinds of acids, with the result that in some cases not only were the lower layers of bags eaten or damaged, but also those on the side of the car were eaten with acid, with the result that the contents of the bags were spilled over the floor of the car and so made unfit for use. Cars in which strong alkalies have been shipped, in which the drums have been broken open or leaked have produced practically the same results. Car loads of machinery, in which certain parts of the machines were nickel plated or galvanized were badly corroded by the fumes of muriatic acid which penetrated the floors. Rugs, carpets, cotton goods in rolls, etc., have been in many cases eaten 1 or 2 inches, thereby practically ruining the entire roll, or making the salvage on it very small as compared with its original cost.

It is very evident that if a method could be found so that all agents and other employes could detect these acid cars that all damages due to acids could be at once eliminated. We have, therefore, found that cars which are contaminated with acid can be very easily detected. An acid car will in practically every case have the appearance of being oil soaked or wet. Cars which are thoroughly dry or dusty have been found to be free of acid in nearly all cases. Blue litmus paper when placed in contact with acid will at once turn red, and in order that the litmus paper may come in contact with the acid it is necessary to place a few drops of water upon the floor and then lay the blue paper on the damp or wet place; if acid is present the paper will at once turn red. In case the paper should not assume a reddish appearance red litmus paper should then be placed upon the floor. If the car is soaked with alkali the red litmus paper will turn blue. Cars of this kind should be placarded *"Bad Order"* either *"Acid Car"* or *"Alkali Car"* and should in no case be used for loading any commodities which could in any way be injured or damaged by acid.

If no reaction to either the blue or red paper is noted car is probably contaminated with oil and should not be used for loading such materials as sugar, coffee, flour, dry goods, or anything which would be damaged by an oily floor. Cars which are badly contaminated by acid can best be made serviceable by placing a new floor in the car, or a new lining. Where only slightly damaged this can be removed by washing well with a hose and in the case of acid sprinkling the floor with baking soda. If care is taken in the inspection of cars for the above commodities the claims on these can at once be entirely eliminated, at least so far as damage by acid or alkalies is concerned. Vegetables, such as potatoes, cabbage, onions, etc., have been found to be badly damaged on the lower layers when loaded in cars contaminated with salt. Great care should be exercised in the selection of cars for foodstuffs and no car should be loaded with these products which are contaminated with acids, alkalies or salt. Covering the floor of the car with paper or sawdust will have little effect when the car is badly contaminated with acids or alkalies.

It is gratifying to note that the efforts being made to avoid the sources of damage to freight referred to are being appreciated by the shippers.

A Reason for Good or Bad Braking

To the Wanderer:

I was greatly interested in your comments on differences in the handling of brakes on the passenger trains on two parallel roads as published in the July issue; and, when this is taken in connection with the description published of the tests on the Virginian R. R. with the empty and load brake, it has occurred to me that if you should investigate the brake adjustment on the two roads you refer to, I am sure you will find that they are using a very good grade of brake rigging adjustment on the road that handles the trains smoothly; while on the road that handles them roughly you will find that the brakes are out of proper adjustment, and that they are using, as a substitute, some sort of education in brake valve manipulation.

Fort Worth, Texas. W. D. S.

Specialties Announcement

The Pulverized Fuel Department of the Quigley Furnace Specialties Company has been acquired by the Hardinge Company, 120 Broadway, New York. There will be no change in the method of conducting the business, as the organization of the Engineering Department has been taken over intact. It is expected with the augmentation the activities will be extended. At the same time the Quigley Company will be enabled to devote its entire attention to the manufacture and sale of high temperature cement, known as Hytempite, and insulating refactory brick, known as Insulbrix, and other Insuline products, with offices at 26 Cortlandt St., New York.

Refrigerator Cars

J. E. Fairbanks, General Secretary of the American Railway Association, Mechanical Division, has issued Circular No. D. V.-216, stating that in view of the fact that all refrigerator cars with brine tanks have not yet been equipped with device for retaining the brine between icing stations, and in accordance with the recommendation from the Committee on Car Construction contained in the Report of that Committee, Circular No. D. V.-206, the effective date of Section (f) of Interchange Rule 3 is hereby extended to January 1, 1922.

Atlantic City Mechanical Conventions

The General Committee of Division 5, Mechanical American Railway Association, at a meeting held in New York on October 6, decided to hold its annual convention at Atlantic City, June 14 to 21, 1922. The Executive Committee of the Railway Supply Manufacturers' Association have also decided, after the result of a letter ballot, to hold the 1922 meeting and exhibits in Atlantic City.

The Paulista Railway Electrification

By S. B. COOPER, General Engineering Department, Westinghouse Electric & Manufacturing Company

The Companhia Paulista de Estradas de Ferro is about to begin electric operation over a 44-kilometer section of double track on their main line between Jundiahy and Campinas, Brazil. This marks the initial step in what is expected to become a broad program of electrification in Brazil, with the ultimate aim of substituting hydro-electrically developed power for expensive coal.

Brazil's supply of native coal is not abundant; it is located in Southern Brazil at some distance from the principal consuming centers, and is of comparatively poor quality. It is high in sulphur and ash, and although some experiments have been made along the lines of preliminary treatment and pulverization, railroad men there are convinced that it cannot be considered a satisfactory fuel.

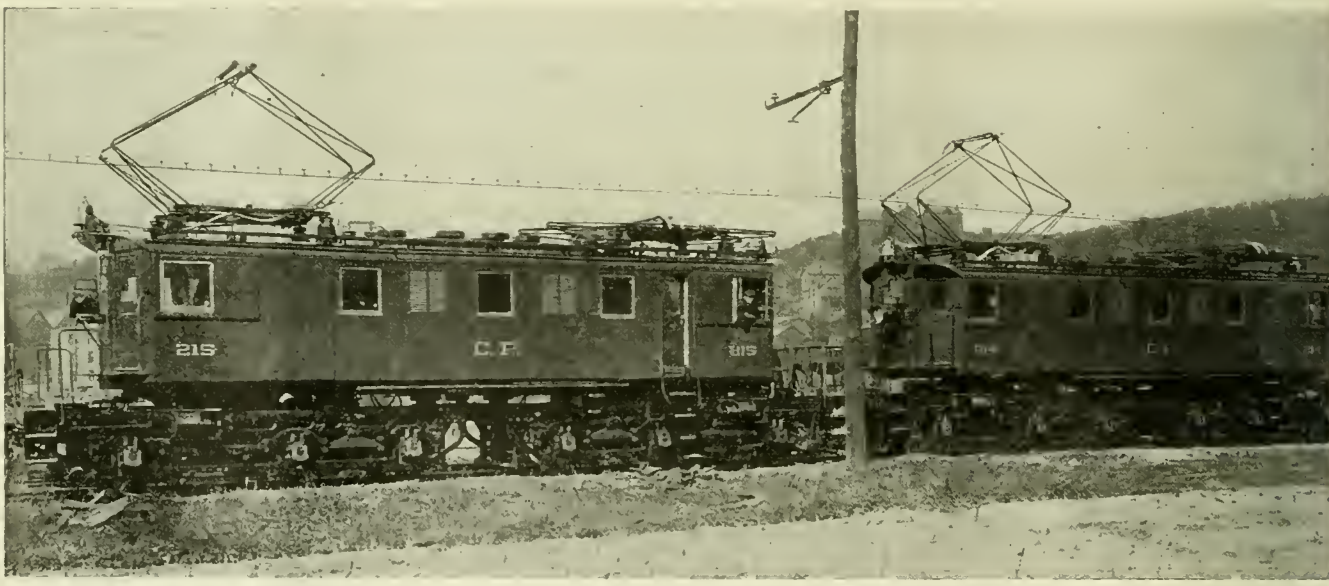
Some years ago, when the South American countries were essentially producers with a comparatively small consuming capacity, ships bound from the United States and Europe to South America for cargoes of cereals, meats, coffee, hides, etc., were able to carry coal at comparatively low rates on outbound voyages. Coal could be landed at Rio de Janeiro or Buenos Aires for $6.00 or $7.00 per ton. Since that time, however, the development of these countries has been phenomenal—their consuming capacity has increased with the development of their resources and industries, so that the high class outbound cargoes are available. The world-wide shortages of ships caused by the war has raised ocean freight rates enormously and these two factors, combined with the increased coal prices at the mines, have caused the price of coal to reach almost prohibitive figures. During the war it was almost impossible to obtain coal at all, except in very limited quantities at exorbitant prices, so that many of the Brazilian railroads, the Paulista among them, fell back on wood as locomotive fuel. Brazil has, of course, a wonderful supply of hard woods that make excellent fuel, but even Brazil could not keep up with the demand for wood fuel for her railroads, at least from sources within commercially practically distances of the lines. Furthermore, for a given calorific value, wood fuel requires a comparatively large amount of labor in its cutting, transportation, storing, handling, fire patrolling in supply yards, etc. With the rapid development of her marvelous resources, Brazil, and particularly the state of Sao Paulo, needs labor badly. I heard the statement made in 1917 that there were 15,000 men in the state of Sao Paulo engaged in getting out wood for the railways.

The topographical and climatic conditions are such as to give abundant water power. A sharp mountain range, the "Sierra do Mar," rises practically at the sea coast, reaching a height of 600 to 800 meters or more within a very short distance from the ocean. From this range the drainage is, in general, toward the northwest, with a gradual fall into the Parana River, which thence flows south, emptying into the Atlantic at the Rio Plata at Buenos Aires. The state of Sao Paulo is semi-mountainous with abundant rainfall and is crossed by several fairly large rivers with frequent falls and without excessively low water periods.

What then could be more logical than the utilization of this abundant native power instead of inferior or expensive coal? The officials of the Paulista Company have made careful studies, during the last four years, of the possibilities of electrification, and in the spring of 1920 placed their orders for the equipment necessary for the electrical operation of the 44 kilometers of double track between Jundiahy and Campinas.

Jundiahy is the southern terminus of the Paulista system, where it joins and exchanges traffic with the Sao Paulo Railway, the English owned line running to Santos. Campinas, one of the most important centers of this wonderfully rich state, is the terminus of the Mogyana Railways, an extensive meter gauge system, covering the northern portion of the state. The Mogyana traffic is transferred to Paulista broad gauge (1.6 meter) cars at Campinas, for movement over the Paulista and Sao Paulo Railway lines to Santos, so that the section now being electrified is the one of heaviest traffic on the Paulista system. It is planned to extend the electrification in the near future beyond Campinas, and it is probable that eventually the entire broad gauge main line will be electrically operated.

The Westinghouse Electric International Company is furnishing two freight and two passenger locomotives for this initial electrification. The freight locomotives are of the six-axle type, with two six-wheel articulated trucks. There are six axle-



BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVES, PAULISTA RAILWAY, BRAZIL mounted motors rating 280 H.P. at the one-hour rating; each motor is wound for 1,500 volts for operation two in series on 3,000 volts and is arranged for field control. Each motor drives its axle by a single flexible gear.

The passenger locomotives are of the 2—4—0+0—4—2 type with each driving axle equipped with a 580 H.P., 3,000 volt twin motor and quill drive.

CAMPINAS YARD AND STATION, PAULISTA RAILWAY

This arrangement was chosen because it lends itself particularly well to the requirements of this road. The passenger and freight train weights and schedule speeds are such as to require locomotive horsepower ratings in almost exact ratio of four to three, so that by using eight armatures on the passenger locomotive and six on the freight locomotive, it was possible to use the same identical motors in both services, except for the external frames. The passenger motors are in twin frames, while the freight motors are in axle and nose suspension frames, but the motors are identical electrically, and all replacement parts, coils, complete armatures, field poles, brushes, armature bearings, etc., are interchangeable throughout.

This is, of course, a tremendous operating advantage and is obtained without the sacrifice of fitness of type of each engine for its service. The freight locomotives operating at speeds up to 65 kilometers per hour (40 m.p.h.) with comparatively light axle loads, have the mechanical simplicity inherent in axle mounted motors and direct geared drive, while the passenger locomotives for speeds up to 105 kilometers per hour (65 m.p.h.) have the advantages of high center of gravity and large proportion of springborne weight given by the quill drive and so desirable in high speed service.

Mechanical practice on the Paulista, as on many South American lines, follows European rather than American practice, and their standards of mechanical workmanship and maintenance are higher than those followed on North American roads. Every effort was made in the design of these locomotives to meet these high standards of mechanical practice. The frames are of solid slab steel with the openings drilled and burned out by torch. The brake rigging and equalizer parts are fitted with case hardened pins and bushings throughout, thus minimizing wear and facilitating replacement. The pedestal shoes are of bronze and the journal boxes are arranged for grease lubrication of the hub liners.

The control equipment has been very carefully worked out to give the greatest possible degree of simplicity consistent with good engineering and the proper degree of operating flexibility. The well-known Westinghouse system of unit switches provides reliability of operation and ample circuit breaking capacity. All switches required to break heavy current are of the unit type mounted in two rows just below the main grid resistors. Motor combination circuits for motoring and regenerating are set up by cam switch groups and stabilizing resistor connections for regeneration are made by smaller unit switches without blowout coils.

The Paulista uses the Continental type of coupler with take-up screws on the passenger cars, but only open links on the freight equipment. For this reason it is particularly desirable to have a high degree of flexibility and smoothness in the control. This is accomplished by having three motor combinations of six three and two armatures in a series on the freight locomotives, giving, with field control notches, six running speeds. The main handle on the master controller has eighteen positions, giving a total of fifty-four notches. On the passenger locomotives, the armatures are connected eight, four and two in series, giving six running speeds and fifty-four notches.

Regeneration is provided for in all three combinations, with thirteen notches in each combination, giving a particularly wide range of regenerating speeds, a most desirable feature with the various classes of trains and varying grade conditions existing on the Paulista.

The auxiliary equipment is very simply arranged; a single high voltage auxiliary motor generator set furnishes power for control, lights, motor excitation during regeneration, and for the blowers, compressor and vacuum exhauster. The motors driving the exhauster and blowers are practically identical. The control and auxiliary equipment throughout is the same on the freight and passenger locomotives, excepting for such detailed differences as are required for the control of six and eight armatures respectively. The brake equipment consists of a combination of air and vacuum brakes. The space requirements for the cylinders made it impossible to use vacuum brakes on the locomotives, so they are equipped with air brakes. The control of the brakes is so arranged that air on the locomotive and vacuum brakes on the train are handled from a single valve with uniform rates of application and release. An independent straight air valve is provided for the separate control of the locomotive brakes as desired, thus making it possible to shut down the exhauster during light engine or switching movements.

TYPICAL TRACK CONSTRUCTION, PAULISTA RAILWAY, BRAZIL

The traffic on the Paulista system is growing at a very healthy rate and even with double track it will not be many years before track capacity becomes a serious consideration. It seems probable that by that time both the Sao Paulo Railway and the Paulista Company will change over to M. C. B. type couplers and therefore be able to handle much larger trains. With this end in view, these locomotives have been equipped for multiple operation so that they can be double-headed with a single crew and handle 1,400-ton trains instead of 700. The bumper castings have been so designed that M. C. B. couplers can be very easily applied to replace the Continental type.

The more important ratings and dimensions are shown in the table below. Weights are in metric tons. Ratings are on the basis of the A. I. E. E. Rules throughout, the continuous rating being based on 85 degree C. rise by thermometer, or 105 degree rise by resistance, thus giving conservative total temperatures with the high air temperatures encountered at certain seasons in Brazil.

GENERAL DIMENSIONS AND RATINGS

	Freight	*Passenger*
Type of truck	0-6-0+0-6-0 Articulated	2-4-0+0-4-2 Articulated
Rigid wheel base	14 ft. 0 in.	8 ft. 4 in.
Total wheel base	37 ft. 0 in.	41 ft. 2 in.
Length over buffers	50 ft. 2 in.	52 ft. 11 in.
Total height over cab roof	12 ft. 7 in.	12 ft. 7 in.
Total height with trolley down	14 ft. 10 in.	14 ft. 10 in.
Diameter driving wheels	40 in.	63 in.
Total weight—metric tons	106	128
Weight on drivers—metric tons	106	93.5
Motors	6—No. 350	4—No. 351
Gear ratio	16:63	28:86
One hour rating—per motor	280 h.p.	560 h.p.
Locomotive Ratings—Short Field		
One hour—h.p.	1,680	2,240
Tractive effort—Kg.	13,340	8,800
Tractive effort—Lb.	29,400	19,400
Speed—K.p.h.	34.5	69.5
Speed—M.p.h.	21.4	43.2
Continuous*—h.p.	1,350	1,800
Tractive effort—Kg.	9,800	6,490
Tractive effort—Lb.	21,600	14,300
Speed—K.p.h.	37.7	76.0
Speed—M.p.h.	[illegible]	47.2
Tractive effort at 25% adhesion—Kg.	26,500	23,100
Tractive effort at 25% adhesion—Lb.	58,500	51,000
Maximum safe speed—K.p.h.	65	105
Maximum safe speed—M.p.h.	40	65

*A.I.E.E. Std. Rules—85° C. Rise by Therm.; 105° C. Rise by Resist.

The shipment of these locomotives involved some interesting features. Each cab is completely housed in after being mounted on a heavily framed platform. The housing consists of a double lumber sheathing interlaid with heavy waterproof building paper. Each truck complete with its motors and gears mounted in place is similarly boxed and one additional box per locomotive carries the pantagraph trolleys. The truck and pantagraph boxes are loaded in the ship's hold and the two cabs are carried on deck, one on either side of the main hatch, securely bolted and lashed in place. After unloading and unboxing, it is only necessary to set the cab on the trucks, mount the pantagraphs and connect up the motor leads and brake connections and the locomotive is ready for service.

The freight locomotives are now in Brazil ready for service, and the passenger locomotives are shipped from the East Pittsburgh Works of the Westinghouse Electric & Manufacturing Company.

Early History of the Electric Locomotive

Soon after the use of electricity for single cars had proved successful, heavier operations were naturally attempted, and as early as November, 1890, a line on the South London Road which was originally designed for cable was opened, the trains being pulled by electric locomotives equipped with a pair of gearless motors having armatures mounted on the axles of the drivers. Two years later the Liverpool overhead trolley was put in operation. Here the trains were composed of two-car units, each car having one motor, the two being operated by hand control. In the spring of the same year, 1893, the Intramural Railway was constructed at the World's Fair, Chicago, where motor cars with hand control were used to pull trail-cars, and a third-rail supply with track return was adopted.

In 1895 the Metropolitan West Side Elevated Road in that city was equipped on the same general plan. In the following year the Nantasket Beach Road, a branch of the New York & New Haven Railway, was put in operation, and in September the Lake Street Elevated of Chicago. Soon afterwards electric service was instituted on the Brooklyn Bridge, motor-cars being used to handle the trains, at first at the terminals and later across the bridge.

There were few attempts, however, to replace steam operation, and only occasionally were electric locomotives used for some special reason. Among the earlier ones in the United States was one of a thousand horsepower, designed by the firm of Sprague, Duncan & Hutchison. This was provided with a pilot-lever pneumatic control, and was built in 1892-94 for Henry Villard, for experimental operation on a line out of Chicago which was never undertaken. A still larger locomotive was built by the General Electric Company for the Baltimore and Ohio tunnel in 1895.

Progress Toward Safe Conduct

It was an encouraging report which Vice-President Galloway of the Baltimore and Ohio Railroad gave to the steam railroad section of the National Safety Council. A decrease of 28 per cent in the number of casualties among employes is noteworthy, and yet the Baltimore and Ohio established that record while its train mileage increased 13 per cent. The effective decrease in casualties was, therefore, greater than 38 per cent, for it should properly be calculated by comparing the actual number of accidents under the improved conditions with the number which would have taken place if the increased traffic had been handled as carelessly as was the custom in earlier years.

Realock Grease Cup

The Flannery Bolt Company, in the Realock Grease Cup, which is being manufactured by the company, and is meeting with much popular favor, offers the Mechanical Department officials an opportunity to effect a material saving in maintenance costs, and to insure against train detention and engine failures, due to heated bearings caused by ordinary grease cups or plugs becoming lost off engines. Numerous types of cups have been designed in an effort to overcome the difficulties usually encountered, such as thread wearing rapidly and stripping, caps or plugs not properly secured and loosening out. Most of them were cumbersome and complicated, depending on the human element to properly secure the various locking devices or fastenings. Engineering experts have pronounced the Realock Grease Cup as the simplest and most effective type of cup for locomotive rod bearings, and motive power officials generally have concurred in the opinion. It is made in three standard sizes, 1½—1¾ and 2 ins. Other special sizes made to order.

French Railways Recuperating

The number of locomotives now in service in France are said to be at least 1,000 in excess of the pre-war period. Of the 600 bridges destroyed by the Germans, 565 have been rebuilt. An American signaling system has been installed, and plans for electrification have been rapidly advanced in some districts. The price of coal is diminishing as the work of reconstruction nears completion.

Railroad Ties

The American Engineering Standards Committee held a conference at Washington on October 25, on the proposed unification of the specifications of railroad ties. The matter of treating ties was not discussed.

Snap Shots—By the Wanderer

It is said that a rose by any other name would smell as sweet. Perhaps it would, but we have become so accustomed to the association of the odor of the rose with its name that most of us would be rather reluctant to have it exchange names with the stinkweed. We are all more or less tied up to our old associations and nearly all can echo the sentiments of Hardcastle in "She Stoops to Conquer," when he said: "I love everything that's old: old friends, old times, old manners, old books, old wine," and perhaps we can add old associations, old names, old customs. So perhaps it may be that the change in name, in organization, in customs, is, in part, at least responsible for the lukewarmness and indifference with which the omission of the annual meetings of the American Railway Association, Section III Mechanical, is regarded. To be sure there were very good reasons set forth as to why there should have been no meeting this year, and two years ago. The times were strenuous and hard, the members were busy and could ill be spared from their posts. But we have had hard and strenuous times before. It seems that in every decade, in the seventies, the eighties and the nineties there were times when excuses quite as valid and cogent as those made last June might have been offered for the omission of the meetings, but they were not omitted. Every year through thick and thin, in sunshine and storm, for forty years, the meetings were held; here, there and everywhere, but always somewhere.

Friendly in the interchange of the amenities of inter-association communication, each association was jealous in the guarding of its own prerogatives, and every suggestion on the part of the Master Mechanics looking towards a consolidation of the two was bitterly opposed by the Master Car Builders lest they lose their identity in the consolidation. And when the convention was anticipated or discussed in retrospect, it was the piazza convention around the court of the old Grand Union Hotel at Saratoga that was looked upon as the center of the real interest and value of the meeting.

With the removal to Atlantic City and the increase of social events, the piazza convention waned, and the assemblies on the pier and the exhibits took its place, but still there remained the feeling that the meeting and interchange of ideas with one's fellows was, after all, the thing of value that remained.

The amalgamation of the two associations with their old associations of the names of the American Railway Master Mechanics' Association and the Master Car Builders' Association, stretching back through a vista of half a century, never was and was hardly likely to have been brought about, had it not been for the compelling hand of the American Railway Association, made a little heavier, perhaps, than it would otherwise have been by the influence of federal operation. Then presto, the names and identities of the two old associations that had published the most valuable technical literature of the world vanished like the breath into the wind and they became Section III. The innocent citizen, falsely convicted of a crime, moves to a grey stone building with barred windows and becomes No. 1266. He loses interest in the world and the world loses interest in him. A member of Section III becomes as a mere figure, his old association gone, his rose with all its odor and beauty is pulled from the thorny bush in front of his cottage and put in a case labeled with a number, which any newcomer must refer to a catalogue to learn what it really was and is. Small wonder that his interest has fallen off and when due notice is given that there will be no convention, he does not raise a word of protest, but takes it as a soldier does the orders from headquarters. The point is, haven't we lost more than we have gained by this destruction of old associations and old names?

It looks very much as though some people had at last come to a realization that there are limits beyond which endurance ceases to be a virtue, and that even the worm will turn. So, when there came the threat to tie up the whole transportation system of the country, and it had permeated into the sluggish understanding of the public as to what the national agreements meant in the matter of overtime payments and payments for work that was never done, there was a revolt from the rank imposition of the thing, and the chiefs on whom the final decision for the walk-out rested promptly came to the conclusion that they would be fighting a losing battle with the whole country arrayed solidly against them, and so backed out and threw the responsibility for their failure upon the successful propaganda that the railroads had sent out against them. It is a great mistake, however, to think that this hostile public sentiment has been created since last July. It has been brewing since the passage of the Adamson bill. At that time the country was flooded with placards announcing that the threatened strike was based upon a demand for an eight-hour day, and won public sympathy because of its failure to understand that there is a wide difference between an eight-hour day and an eight-hour basic day. It is safe to say that if the Adamson bill had contained a proviso that the day's work should be limited to eight hours the promoters of the bill would not have been as enthusiastic in its support as they were. But all's well that ends well, if, indeed, it is ended. We shall see, but it is doubtful.

It seems as though the stoker was at last coming into its own. All through the early days of its development, it was acknowledged time and again that the stoker could keep the engine hot, but that it burned more coal than hand firing, and this fault was repeatedly explained and excused on the ground that this excess of consumption was due to the ease with which coal could be put into the firebox, and the fireman's idea that plenty of coal meant a plenty of steam. But, at last, he seems to have learned that a plenty of steam can be obtained without a superfluity of coal.

So in a paper to be read before the coming meeting of the Mechanical Engineers it will be stated that: "When the total coal consumption exceeds 6,000 lbs. per hour, it is generally necessary to apply an automatic stoker. These have now been so adapted to locomotive requirements that a properly designed stoker will show economy over hand firing, aside from the necessity of its use on account of coal consumption being greater than the physical capacity of one fireman if the boiler were hand fired."

It now remains to so educate the fireman in the use of the stoker that even with the demand for coal very much less than the capacity of a single fireman to supply, the stoker will effect a saving of fuel. That this can be done, those who have watched stoker operation and stoker development through a number of years, are firmly convinced.

And speaking of stoker efficiency and stoker work, and how it saves work for the fireman, there is this to be remembered. A good stoker merely transfers the labor of the fireman from his muscles to his brain. To be sure he must use his brain even to shovel coal effectively but to get the best out of a stoker, his brain must be on the alert at all times without respite.

So, with a closed door, an even draft, a steady spray of coal where it is probable that a goodly percentage of the volatile matter is distilled out before the coal strikes the grate, and that in a temperature and in an atmosphere especially suited to its combustion it is small wonder that the top of the stack can be keep clear for the greater portion of the time. And with these favorable conditions prevailing, the stoker certainly ought to make a more favorable showing than hand firing, regardless of the large or small quantity of coal that may be theoretically required in order to maintain the steam pressure and the present indications are that it can do it

Performance of the Hanna Locomotive Stoker on the Norfolk & Western Railway

Like all pieces of mechanism the Hanna locomotive stoker has been undergoing a gradual development by modifications in the details of its construction, but without change in the principles of its operation. The latest example of this development was recently placed upon engine No. 102 of the Norfolk & Western which for a time was assigned to the hauling of the fast express trains, known as the Memphis Special over the division between Roanoke and Bristol, Va., a distance of 151 miles. At present it hauls this express from Roanoke to Bristol and returns with a heavy local. The schedule running time of the westbound express from Roanoke to Bristol is four hours and fifty-five minutes, or an average of about 30.75 miles per hour including stops. On the eastbound run with the local train the running time is five hours and forty-five minutes or at an average speed of about 22.8 miles per hour.

The locomotive is of the mountain type, that was especially designed for this work and was built at the Roanoke shops of the company. Two types of tanks are used with this class of engine, one with a capacity of 9,000 and the other with 12,000 gallons. Engine 102 was a 9,000 gallon tank, and has the following principal dimensions:

Cylinder diameter	29 in.
Piston stroke	28 in.
Piston valve diameter	16 in.
Diameter driving wheels	70 in.
Diameter front truck wheels	33 in.
Diameter trailing truck wheels	42 in.
No. of 2 in. flues	233
No. of 5⅜ in. superheater flues	36
Length of flues	21 ft.
Boiler pressure	200 lbs.
Heating surface, flues	3,607 sq. ft.
Heating surface, firebox	340 sq. ft.
Heating surface, arch tubes	34 sq. ft.
Heating surface, total	3,981 sq. ft.
Heating surface, superheater	882 sq. ft.
Weight of engine, total	347,000 lbs.
Weight on driving wheels	236,000 lbs.
Weight on truck wheels	52,000 lbs.
Weight on trailing wheels	59,000 lbs.
Weight on tender wheels	167,500 lbs.
Driving wheel base	18 ft. 9 in.
Total engine wheel base	40 ft. 5 in.
Total wheel base, engine and tender	72 ft. 11 in.
Total length of engine and tender	81 ft. 10¾ in.
Tractive effort	57,200 lbs.
Tender capacity, coal	14 tons
Tender capacity, water	9,000 gals.
Firebox, length	120⅛ in.
Firebox, width	96¼ in.
Grate area	80.3 sq. ft.

The line over which the locomotive is running in going west from Roanoke, starts out over generally rising undulating grades ranging from 0.732 to 0.9 per cent for about 20 miles to the foot of the eastern slope of the Allegheny mountains. Then, there is a direct unbroken rise for about 10 miles on a 1.32 per cent grade to the summit, followed by a drop for about 6½ miles on a 1.0 per cent grade to the valley of the New River. Then there are four sharp rises on grades running from 1.19 to 1.31 per cent with intermediate drops until the summit is reached at 57 miles from Bristol, an elevation of 2,591 feet above sea level. Then comes a series of descents and undulations over grades, nearly all of which are more than one per cent into Bristol at an elevation of 1,675 feet above the sea, making a net rise of 775 feet above Roanoke, and a total rise on the up grades of 3,540 feet with a corresponding fall of 2,765 feet. The rise was made in 75.5 miles so that the horizontal distances of the two grades are the same, but the rise westbound is the more abrupt because of the greater actual rise by 775 feet.

With these physical conditions of the road and locomotive in mind, a full appreciation can be obtained of the two runs about to be described. These were made in fair weather on a dry rail, and with no preparation of the engine other than the ordinary terminal attention and no information having been given to the crew that their work was to be the object of special observation.

The westbound train of the Memphis Special consisted of eight cars with the engine and tender as follows:

Engine and tender	514,500 lbs.
1 Mail Car	131,870 lbs.
1 combination passenger and baggage car	133,400 lbs.
2 day coaches	274,800 lbs.
3 Pullman sleeping cars	450,000 lbs.
1 dining car	163,260 lbs.
8 Total weight of train	1,667,830 lbs. or about 833 tons.

The train is scheduled, as far as the time table is concerned, to run from Roanoke to Bristol without a stop, but there are seven flag stations en route and there are two necessary stops for water and one for coal, though in the case of this run, water was taken at flag station stops. As a matter of fact ten stops were made in the course of the run. Of these five were station stops; one was for coal and four were signal stops to which should be added one slow-down for track work. The actual elapsed time for the run was 4 hours and 50 minutes from which 16.5 minutes is to be deducted for the stops above mentioned, leaving an actual running time of 4 hours 33.5 minutes, giving an average running speed of about 33.1 miles per hour.

The general statement may be made that a train between stations must, at times, be run at a speed of twice its average speed, and this holds for the train in question where the speed on several occasions touched 60 miles per hour. The run up the eastern slope of the Alleghenies on a grade of 1.32 per cent was made at an average speed of a little more than 25.4 miles per hour, but between certain mile posts on a grade of 1.32 per cent the speed was over 40 miles an hour.

It was on this grade that the engineer volunteered to show what he could do. The steam pressure was 195 pound. By opening the door, dropping the reverse lever into a long cut-off and opening the throttle wide open, he cut the steam pressure down to 185 pounds in 5½ minutes. Then by closing the door to prevent the influx of cold air to the firebox and shortening the point of cut-off, he put on the injector and in 3 minutes the pressure was up to 200 pounds.

The engine could haul the train at speeds of 40 miles an hour on grades running a fraction above one per cent and did it repeatedly on the western portion of the run.

So much for the engine performance and now to the stoker.

On leaving Roanoke the fire was spread evenly over the grates to a depth of about 4 inches and was burning brightly over its whole surface, and the steam pressure was 170 pounds, a low point that was not touched again but once until the train reached Bristol; that once being just after leaving the coaling station at Vicker where a 5-minute stop was made and 3 minutes after that reading the pressure was 195 pounds. Four minutes after leaving Roanoke the pressure had risen to 190 pounds and from there on it swung up and down between 175 and 200 pounds. The average of the 109 readings that were taken was 190 pounds. So perfectly was the fire under control that the safety valve opened but once on the trip.

For the manipulation of the stoker the fireman sat on his usual seat and did not leave it for the whole run except on the three occasions when it was necessary for him to go to the tender: twice to take water and once for coal. The firedoor was opened by an observer eight times when steam was shut off and, on every occasion the bed of the fire was found to be thin and level. As the engineer remarked: "It looked as though someone had gone over it with a garden rake."

The fire was handled by observing the stack and watching the steam gauge. It was only immediately after starting that any smoke appeared, and this quickly passed away so that for nearly the whole run the space immediately above the stack was clear and transparent. So long as it remained clear and the pressure remained constant, there was no manipulation of the stoker; but if the pressure fell, an adjustment was made to throw more coal into the firebox. Then the instant a haze appeared at the top of the stack the flow of coal was checked, the stack cleared and the stoker allowed to run untouched.

There was also occasional adjustments of the steam pressure at the blast nozzles but these were slight and they were held at from 15 to 20 pounds throughout the whole run, with occasional rises of the high pressure blast to 25 pounds.

On arrival at Bristol, the fire was in the same bright level and thin condition as it was at the start.

The return trip eastward with a local train was made under the same weather conditions and with the train made up of six cars, as follows:

	Pounds
Engine	514,500
1 Mail and express car	131,800
1 Baggage car	126,600
3 Day coaches	412,200
1 Parlor car	150,000
Total weight of train	1,353,100

At East Redford an additional express car weighing 126,600 pounds was added. The train was, therefore, about 157 tons lighter than on the westbound trip to the foot of the Alleghenies, when it was only 94 tons lighter.

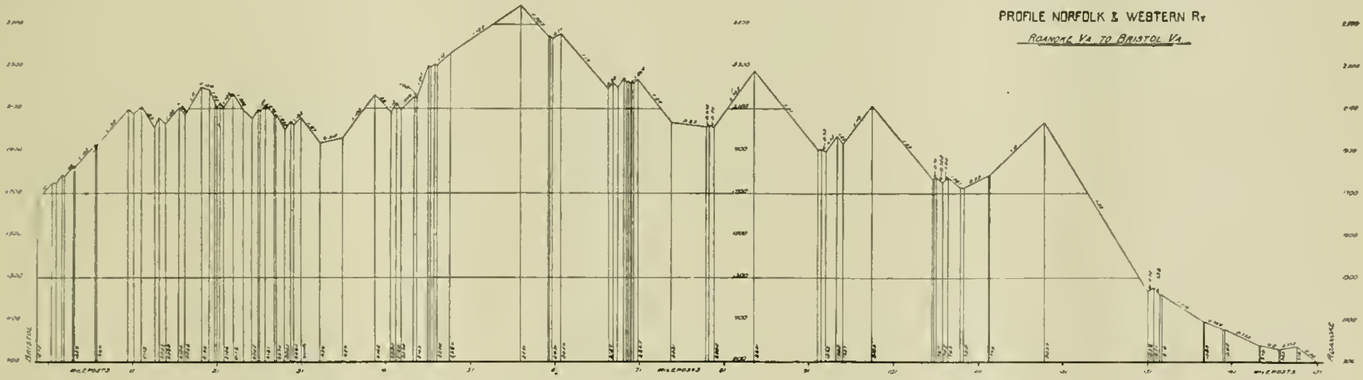
On this run the total elapsed time was five hours and 43 minutes, of which one hour and 10 minutes were occupied at station stops, leaving a running time of four hours and 33 minutes, requiring an average running speed of 33.1 miles per hour, or the same as the express train on the westbound trip. As there were 33 full stops on this run, it is evident that the maximum speeds between stations must have been high and these touched 60 miles an hour at frequent intervals.

steam pressure at the high pressure nozzles varied from 15 to 30 pounds and at the low pressure from 10 to 30 pounds.

At the start from Bristol the steam pressure was 185 pounds and this was held for 6.5 minutes. Then in 3.5 minutes more it was up to 190 pounds and 1.5 minutes later than this it touched 200 pounds, or just enough under so that the safety valves did not open. From that time until Roanoke was reached the pressure varied from 175 pounds to 200 pounds, the average of 134 readings being 192 pounds.

The ease with which steam was maintained and the engine handled the train is evidenced by the fact that on the ascent of the west slope of the Alleghenies the average steam pressure was 194 pounds as the result of seven readings taken in 10 minutes, on a run of about six miles at an average speed of 36 miles an hour, and reaching a maximum of nearly 60 miles an hour.

The firedoor was opened by an observer



PROFILE OF NORFOLK & WESTERN RAILWAY, ROANOKE TO BRISTOL, VA.

The chutes by which the distribution of coal over the surface of the firebox is controlled were untouched except for one adjustment of the right wing nine miles after leaving Roanoke, after which the levers of the distributing regulator were not moved.

The stoker, as a whole, was stopped 17 times on the run, and the total elapsed time when it was not in operation amounted to 96.5 minutes, or about one-third of the elapsed time between leaving Roanoke and arriving at Bristol. It was first stopped at the summit of the Alleghenies and was allowed to remain idle until the foot of the grade on the west slope was reached. Then, after reaching the undulating territory at the western end of the run, it was stopped very frequently at the head of the grades.

Finally, the hook was not taken from its supports, the grates were not shaken and there was not a shovelful of coal put into the firebox during the run, and the fireman had no interruptions to his long period of rest, with the exception of the occasions when he went to the tender to take coal and water.

Owing to these frequent stops the stoker required more attention than where the run was longer and the demands on the boiler more constant. As a result of this the stoker was stopped 32 times, and was idle for a total of two hours, 19.5 minutes, or nearly 41 per cent of the total elapsed time, which was to have been expected because of the greater length of time consumed in the station stops.

Again the fireman occupied his seat on the left hand side of the engine throughout the whole run, only leaving it to take coal and water, but paying constant attention to the operation of the stoker, as manifested by the steam gauge indications and the appearance of the gases issuing from the stacks. As the stoppages of the stoker were more frequent than on the westbound run, so were the adjustments of the working parts. The distributing wings were adjusted nine times. The 11 times for an examination of the bed of fuel. On leaving Bristol the bed was rough and humpy as it had been left by the burning down of the coal that had been used for banking during the night; but within 10 minutes after starting it had burned down to the smooth, thin garden-raked appearance that characterized it during the whole of the westbound run and which it held until the train ran into the Roanoke station. The firehook was not removed from its brackets and no coal was thrown into the firebox. It was, therefore, a case of 100 per cent stoker operation for the round trip.

In the equipment of the engine the main steam pipe to the stoker engine is 1¼ inch in diameter, but up to the present, the main valve has not been opened and the whole working has been accomplished through a ½-inch by-pass pipe.

The coal used is prepared for stoker operation in accordance with the practice on the Norfolk & Western Railway and is of the usual grade used, containing about 6 per cent ash and 36 per cent volatile matter.

At the end of the westbound run the engine was taken to the roundhouse and the fire banked, but not cleaned before starting on the eastbound run, and this is the usual practice with this engine. The records of the reports of the engineer show that the trip referred to was the thirteenth round trip of the locomotive since it left the shops, where the stoker had done 100 per cent of the firing and no coal had been thrown into the firebox.

As to the economy of such operation there can be little doubt, and it is the intention to make some trial runs in order to determine the exact amount of coal and water used, with dynamometer car registrations of the amount of drawbar horsepower developed.

In regard to the condition of the fire, it does not seem probable that so smooth and thin a fire could be maintained by hand firing, where the evenness of the draft is being constantly interfered with by the opening of the door.

Finally, as a side issue to the operation of the stoker, it may be well to state that it is almost noiseless in its operation. So quiet, in fact, that, when running to its full capacity, it cannot be heard even when the engine is standing.

The daily log for twenty-eight consecutive runs over this route, shows that the details of the run, as given above, are not exceptional but matters of everyday practice. This log, the runs in which total 4,228 miles, records that there was not a single shovelful of coal put in the fire box, and that, on no occasion was the hook used or the grates shaken. The cars in the trains numbered from 6 to 12 with an average of 8.25. On one occasion at the end of a trip the fire was cleaned in four minutes.

The President of the Pennsylvania Offers Suggestions for the Relief of the Railroads

Mr. Samuel Rea, president of the Pennsylvania Railroad Company, at a recent meeting of the Pennsylvania Chamber of Commerce, in submitting suggestions that would improve the railroads insisted that the first positive step that could be taken is the passage of the Funding Bill by Congress, by which the capital expenditures made by the Government on the railroads during the war period will be funded, just as part of them have already been funded through the Equipment Trust Certificates. The funding is not a gift by the Government to the railroads, but simply means that the Government loans the money for ten years instead of requiring present payment for capital expenditures made during Federal control. This of itself would be little help to the railroads, but coincidentally it will, either by direct sale, or through the help of the War Finance Corporation, enable the Railroad Administration to use its holdings of railroad securities to obtain cash and pay over to the railroads amounts due them for the use of their property and equipment during the Federal control period, but which are now held as offsets against such capital expenditures. The amounts I refer to are due for compensation, depreciation, deficiencies in the value of the stocks of materials and supplies at the end of Federal control, interest and other items, and are not at all tied up in the question of maintenance claims. I estimate that from these sources four to five hundred million dollars of current funds could be made available, from which the railroads could pay off their current obligations, and resume the necessary work connected with the upkeep of their equipment, roadway and stations, and so give additional employment. After this funding, and the release of moneys acknowledged as due the roads, will come the maintenance claims which are still undisposed of by the Government. In addition to these important matters, settlements have not yet been effected for the guaranty period by the Interstate Commerce Commission. Therefore, if our estimate of the amounts due for the Federal control and guaranty periods is correct, fully $1,000,000,000 is actually held by the Government pending such funding and settlements, that might be applied to meet current business conditions and obligations of the railroads, and enable them to carry on a fair volume of maintenance and replacement work, thus promptly giving employment and starting a cycle of improvement that would reach all of our citizens. This is not a fanciful sketch nor a bid for generosity to the railroads. The President of the United States is anxious for a final settlement but Congress has not yet shared the same convictions—although the House passed the Funding Bill and many able minds in the Senate see its great benefits. It will require speeding up by the Railroad Administration, Congress and the Interstate Commerce Commission if the funds are to be available to help out in the present depression. Meanwhile the railroads are grateful for what the President has done, and are anxious to help him in reducing unemployment.

Altoona Works Employes Association

Elisha Lee, vice-president in charge of the Eastern region of the Pennsylvania Railroad System, in an address before the annual convention of the Delaware Bankers' Association, explained in detail the company's plan for the settlement of labor differences by conferences between the management and elected representatives of the employes. Mr. Lee criticised the United States Labor Board for intervening and declaring void the recent election held under the plan, and which is referred to elsewhere in our columns. Mr. Lee stated that the company had been advised by counsel that the Labor Board had altogether exceeded its authority.

Meanwhile the employes at the four shops comprising the Altoona Works have formed themselves into a permanent organization. And in general the most important of the rules agreed to by the men and the management provide:

1. Re-establishment of piece-work under the principle previously announced by the railroad; namely, under rates set so that piece-workers can earn a rate which is higher than the day work rate which may from time to time be established for day workers.
2. A 48-hour basis week, with not more than 9 hours on any one day or less than 8 hours on any day except Saturday. This permits the men to decide themselves whether they shall work 8 hours per day or more than 8 hours on some days during the week in order to get a half-holiday on Saturdays.
3. When a reduction in expenses becomes necessary, it may be accomplished either by reduction in force or reduction of hours of work, as the employes themselves decide.
4. Overtime to be paid pro-rata for the ninth and tenth hours and time and one-half after the tenth hour.
5. Seniority based on length of service with the company rather than length of membership in a particular craft.
6. Classification of work under a wide spread of rates which permits the establishment of rates of pay based on skill required rather than a flat rate and gives a man doing more important work a higher rate of pay.

Railroads Aid in Solving Jobless Problem

The announcement from several large Eastern railroads that they are putting on all the additional men whom they can carry on their payroll is expected to be a material aid in the solution of the unemployment problem. Since July 1 the New York Central has added 21,000 men, most of whom have been put to work on repair and maintenance jobs, such as track repairing. There is danger this work will slow up during the present month, which would mean the return of some of these men to ranks of unemployed.

In the last five months the Erie has added 6,000 men for track and shop work. Increasing activity of New England manufacturers has caused the New York, New Haven & Hartford to add 3,000 in the same period to handle the increase in traffic. The Pennsylvania, with an addition of 14,000 men, stands second to the New York Central, as far as this section of the country is concerned.

Effect of the Wage Reduction

Reports to the Interstate Commerce Commission showed that the railroads earned in July $69,298,521 which would be at the annual rate of return of 4.5 per cent on their tentative valuation fixed by the commission for rate making purposes. In August it was $90,241,103 or at the annual rate of return of five per cent.

Railroading in the Caucasus

Railroading in the West in the early days had its vicissitudes that have become historical, but the tales from the East bid fair to rival, if not surpass, those western happenings with which we are all familiar. J. R. Phelps, who has charge of the transportation of the Near East Relief, tells of forwarding 350 tons of relief-supplies from the Georgian town of Tiflis to the town of Alexandropol in Armenia, a distance of 137 miles. Mr. Phelps' relation of experiences is as follows:

"After assembling my train of nineteen cars at Tiflis, we waited eight hours for an engine. Along with the engine came eight cars of government supplies, which, against my protests, were hitched to our train. As the result of this overload we broke down, an hour out of Tiflis, and waited seven hours more for the arrival of a couple of fresh locomotives. I say fresh' out of politeness, for in reality they were war-battered old things, burning wood in lack of coal. With fifteen hours of waiting and one mile of progress to our credit we jogged merrily off for Armenia.

"Five hours later one of our engines became disabled, a car-coupling broke, and twenty-seven of our wagons rolled Tiflis-ward down the steep descent whose summit we had just attained. They were brought to a standstill within a few miles, I gave first aid to two trainmen who had been injured during the accident, and we started off again with a new engine. At Sanahine there was an hour wait, and this together with the delay caused by the accident, brought our record up to thirty-two hours of waits and four hours of actual travel.

"Meanwhile we were having our troubles with refugees. Hundreds of these, perched on the car-roofs and riding on the couplings, added seriously to our already excessive load. Appeal to station-masters was unavailing. There is but one passenger-train a day in the Caucasus; practically no passenger-fares are paid, and free riding on freight-cars has become an established custom. At Koolageran, however, I found a station-master brave enough to make the attempt. While his deputies were in the act of removing my unwelcome passengers, the train started, thus endangering many of them. Seeing this, my train-guard fired his rifle to attract the engineer's attention. At the next station this shooting was exaggerated, by the remaining refugees, into an attack upon them. My train-guard was arrested, to appease the crowd, and I narrowly managed to save his life. We started out again with certainly two hundred people on the car-tops.

"We were passing through mountainous country, and the grade was severe. Suddenly, after covering one mile, the whole train, including its complement of three locomotives, rolled backward down the decline, with the result that many buffers were smashed or bent, necessitating the cutting-out of the cars thus injured. Off we went again, still higher up into the mountains until, two hours later, the whole sliding-back performance was repeated. By now my free passengers had increased enormously, rendering the situation impossible. Again I appealed to the nearest station-master, but he replied that these people were soldiers and their families, and that he would not interfere. I now searched everyone's papers and discovered, of all that big crowd of free riders, just eleven soldiers. This emboldened the railway officials to eject my traveling public, and as a result, we climbed the remaining grades and finally slid into Alexandropol. In covering 137 miles, my special relief-train had been 54 hours en route, with about 40 hours of stops, while my periods of sleep during two and a half days were practically negligible. However, when I found that my supplies had arrived just in time to replenish an exhausted larder at Alexandropol, where the Near East Relief cares for 18,000 war-orphans, I felt more than repaid for my troubles. A passenger-service has its difficulties, as does a freight-service, even at home. But running a freight-passenger train in the Caucasus is enough to qualify a man for the Carnegie medal for personal bravery."

Reduction in Freight Rates

Reduction of freight rates on hundreds of articles east and west bound and mounting in some cases to as much as 50 per cent of existing rates, were announced tonight by the Southern Pacific Company. The reductions, it was declared, average about 20 per cent and will be effective, in the case of changes made to meet competition of water-borne traffic via the Panama Canal, as soon as approved by the Interstate Commerce Commission; in the case of rates from and to points east of the Mississippi River and Chicago, as soon as Eastern roads concur in them, and in the case of rates to and from points west of Chicago and the Mississippi River as soon as the tariffs can be published.

The Grouping of the Railroads

It will be recalled that the transportation act authorized the Interstate Commerce Commission to submit a plan for railroad consolidation and to conduct hearings on the subject. A plan has been presented grouping the railroads of the country into nineteen systems. The plan was drawn up by Professor William A. Ripley, of Harvard University, and, while it cannot properly be said to be endorsed by the commission a preliminary version has been issued. It would be idle to predict the outcome of the movement, but the hearings are sure to create much interest. It is already noted that as an outcome of efficiency of the transportation problem, a great change has come over the leading railroad men. In the last century they were mostly men who rarely spoke, men of thought and men of action they were, but the flower of eloquence was of stunted growth. Now they are all speaking at once, and that with a degree of luminosity that leaves nothing further to be desired. If in the multitude of counsel there is wisdom, something great should be expected. We will continue to have our eye, or our ear rather, upon them, and endeavor to gain a reflex of the real work which sooner or later will be accomplished.

Railway Mileage

There are 740,000 miles of railways in the world, of which 266,000 are in the United States 220,000 in Europe, 70,000 in Asia, 60,000 in South America, 30,000 in Africa, and 26,000 in Australia.

Train Speeds in Europe

The European railway schedules are not yet quite up to the pre-war figures. Before the war the Northern Railway of France had an express running from Paris to St. Quentin, 95.7 miles in 95 minutes. The North Eastern of England was scheduled to cover the 44.3 miles from Darlington to York in 43 minutes, while the Great Central Railway express from Marylebone between Rugby and Leicester ran at a rate of 61.3 miles per hour.

Tips for the Tool Hardener

The Vanadium-Alloys Steel Company, Latrobe, Pa., has issued a handy reference card 6½ ins. by 11 ins., provided with a cord for hanging on the wall. On one side there are printed thirty-seven "tips," and on the other side are shown the various grades of tool steel made by the company. The suggestions are of real value, and may safely be looked upon as the results of long experience. Copies may be had on application, and also a booklet descriptive of each of the grades of tool steel to which reference is made on the card.

Australia Adopts the Standard Gauge

The Australian Railway Commission recommends the 4 ft. 8½ in. railway gauge. The estimated cost of the conversion by the roads using the narrow gauge was estimated at $115,000,000 in 1913, but the estimate at present day prices is expected to exceed $450,000,000. The state premiers will discuss the financing of the work.

Items of Personal Interest

F. S. Wilcoxen has been appointed fuel supervisor of the Chicago Great Western, with headquarters at Chicago.

A. H. Powell has been appointed superintendent of the Jeffery Shops of the Western Pacific, with office at Sacramento, Cal.

A. J. Mello has been appointed superintendent of commissary stores of the Southern Pacific, with headquarters at San Francisco, Cal.

J. E. Carr has been appointed assistant general road foreman of engines of the United railways of Havana, with headquarters at Cruees, Cuba.

D. A. Innes has been appointed locomotive foreman of the Grand Trunk Railway of Canada, with office at Stratford, Ont., succeeding H. Battley, resigned.

H. L. Traber has been elected president of the Oklahoma & Arkansas, with headquarters at Muskogee, Okla., and E. H. Foster has been elected vice-president.

W. G. McPherson, master mechanic of the Canadian Pacific, with headquarters at Regina, Sask., has been appointed master at Moose Jaw, Sask., succeeding J. Gibson.

J. Gibson, master mechanic of the Canadian Pacific, with headquarters at Moose Jaw, Sask., has been appointed general foreman, with headquarters at Revelstoke, B. C.

C. J. Burkholder, special engineer in the western territory of the Franklin Railway Supply Company, is now supervising service for all railroads dealing with the company.

J. Gallagher has been appointed deputy minister of railways and telephones for Alberta, and general manager of the Alberta & Great Waterways, with headquarters at Edmonton, Alta.

B. T. Jellison, general purchasing agent of the Chesapeake & Ohio Railway Company has been assigned to handling special matters, and the position of general purchasing agent has been abolished.

A. W. Kirkland has been appointed acting superintendent of motive power of the Atlanta, Birmingham & Atlantic, with headquarters at Atlanta, Ga., during the temporary absence of J. F. Sheahan.

Frank G. Whitney, superintendent of sub-stations of the electric division of the New York Central, has been appointed superintendent of the Dutch Point Power Station, Hartford, Conn., Electric Line Company.

M. B. McPartland, superintendent of motive power of the Denver & Salt Lake, with headquarters at Denver, Col., has been appointed superintendent of motive power of the Western Pacific, with headquarters at Sacramento. Cal.

Otis A. Vail has been appointed assistant general car foreman of the Chicago, Rock Island & Pacific, with office at Horton, Kans., and Roller W. Woodard has been appointed to a similar position at Shawnee, Okla.

C. W. Dearworth has been appointed division storekeeper of the Erie, with headquarters at Huntington, Ind., and R. H. Pauling has been appointed to a similar position on the same road with headquarters at Marion, Ohio.

H. M. Smitten, formerly engineer in the valuation department of the Southern Pacific, has been appointed brake engineer of the Western Pacific. During the war period Mr. Smitten was attached to the 37th Engineers with the rank of lieutenant colonel.

R. C. Morgan, superintendent of terminals for the Canadian Pacific, with headquarters at Winnipeg Wis., has been granted leave of absence to take charge temporarily of the Reid Newfoundland railway system with headquarters in Newfoundland.

C. K. Reaser has been appointed assistant manager of stores of the Erie, with headquarters at New York. F. J. Talbot and J. H. Sweeney have been appointed to similar positions on the same road, the former at New York, and the latter at Meadville. Pa.

SIDNEY C. DOWN

William Kennedy, a retired locomotive engineer of the Grand Trunk, who recently attained his 97th year, is to have the honor of having a medal presented to him on the occasion of the completion of his fiftieth year as a member of the Brotherhood of Locomotive Engineers. He was locomotive man for many years on the paymaster's train before division points were established.

Charles Caldwell McChord has been elected chairman of the Interstate Commerce Commission, succeeding Edgar E. Clark, resigned. Mr. McChord was engaged in the general practice of law when he was appointed a member of the Kentucky Railroad Commission in 1892. He showed much ability, particularly in handling railroad problems, and in 1910 was appointed a member of the Interstate Commerce Commission.

T. A. Hynes has been elected president of the New Jersey, Indiana & Illinois. Mr. Hynes graduated from the Union Seminary, Damascus, in 1899, and entered railway service with the Erie as telegraph operator, serving in various capacities on that road until 1913, when he accepted a position in the traffic department of the New Jersey, Indiana & Illinois, where he was rapidly promoted from general freight agent, to traffic manager, and latterly from treasurer to vice-president, which position he occupied at the time of his election as president.

V. R. Hawthorne, secretary of the American Railway Association, Mechanical Division, states that the division executive committee, after full deliberation, decided to rescind the action inviting minor mechanical organizations to amalgamate with the Mechanical Division. The minor associations of a mechanical order have done and are doing excellent work in their own way, but as the work of the Mechanical Division is already approaching congestion, it would be impossible to give proper attention to the work of the minor associations unless a prolonged series of sessions were established, which seems unlikely under present conditions.

Sidney C. Down, president of the Westinghouse Pacific Coast Brake Company, has been appointed to the newly created office of general sales manager of the Westinghouse Air Brake Company, with headquarters at Wilmerding, Pa. Mr. Down has been in the employ of the company over twenty years, coming from the Michigan Central Railroad where he was employed as general air brake instructor and inspector. His promotion in the Westinghouse company has brought him into close contact with every department of the company's activities, and as mechanical expert, resident engineer and latterly as manager and president of an important division, coupled with the opportunities of extensive foreign travel eminently qualify him for the important position he is now called upon to occupy. His personal popularity in railway circles bespeaks for his appointment a wide popular approval.

Convention of Machine Tool Builders

The National Machine Tool Builders' Association held its twentieth annual convention on October 18, 19 and 20 in New York. The value of statistical service was emphasized, and it was proposed to make this service a guide to the members of the association. Addresses were delivered by C. L. Underhill on "How Present Political Policies Affect Business," and Prof. Jorden, of New York University, on "Business Cycles," "What things should Machine Builders do and what should they avoid at various styles of the Cycle?" was ably discussed by C. L. Cameron and E. F. Du Brul.

NEW PUBLICATIONS

Statistics of Railroads in the United States

The Bureau of Statistics of the Interstate Commerce Commission published last month the thirty-third annual report of statistics of railroads in the United States. Like all of its predecessors, it has to do only with steam roads. The work extends to 83 pages, and the data furnished shows the number of operating steam railroads, which, according to the reports on file, were under Federal operation at some time during the calendar year 1919, as shown in the following table: Some roads were changed from one form of control to the other during the year.

Carriers are, for statistical purposes, separated into classes based on the amount of their annual operating revenues, as follows:

Class I.—Above $1,000,000.
Class II.—From $100,000 to $1,000,000.
Class III.—Below $100,000.

The list of Class I roads has changed slightly from year to year. The large rate increase of 1920 was likely to increase considerably the number of Class I roads, and thus disturb considerably the statistical comparisons. To avoid this result the Commission, by order dated November 22, 1920, made the revenues of the calendar year 1919 the basis for classification. In a small number of special cases departures are made from this ruling.

Strictly speaking, the term Class I carriers includes the switching and terminal companies, as well as the line haul carriers, but in this report, as in preceding volumes, switching and terminal companies are not included in the principal tables.

When the latter are included in the total that fact is indicated. The switching and terminal companies not included, 301 in number, had 2,017.51 miles of main track operated; that is, tracks kept clear for the passage of trains, and 1,749.81 miles of main track.

The total mileage of Class I, December 31, 1919, was 181,598.68; Class II, 15,507.30; Class III, 6,549.35 miles. To these are added 43,408.33 miles of track owned by non-operating companies, and 6,088.33 miles of track owned by companies not filing annual reports. The total mileage of track is thus 253,152.17.

The number of locomotives of all districts is given as 64,618, with an average tractive capacity of 35,789 lbs.; freight cars, 2,456,607; passenger cars, 56,290; company service cars, 107,280.

In regard to the number of employes, the report furnishes ample details, including all persons in the service of the reporting carrier, subject to its continuing authority to supervise and direct the manner and rendition of their service. The total is placed at 1,908,169.

The work shows a degree of thoroughness that is praiseworthy, but it continues to be a matter of regret that nearly two years must elapse before the report of the matters referred to see the light of day. In the fierce storm of the tumultuous days in which we live, the delayed publication comes like an old almanac.

Class of Operating Road	Number of Roads Reporting as— Under Private Operation	Under Federal Operation	Total
Steam roads other than switching and terminal companies:			
Class I	14	178	192
Class II	169	115	284
Class III	358	50	408
Switching and terminal companies:			
Class I	4	12	16
Class II	39	29	68
Class III	47	93	140
Total	631	477	1,108

QUESTIONS AND ANSWERS ON THE U. C. EQUIPMENT. Published by the Air Brake Association.

This is an instructive book on the U. C. (universal control) brake equipment, and is uniform in size and binding with the instruction books heretofore issued by the Air Brake Association. It is in the form of a general description of the U. C. valve, followed by a catechism in two parts: the first part deals with the general description, and the second on the methods of operation. The first contains the information that all men connected with the train service should have regarding the brake, and the second that which is necessary for an advanced study of this equipment. While the whole book is based upon a lecture given by Mr. Joseph C. McCune at the 1920 convention of the Air Brake Association.

As stated in its own foreward, it is a radical departure from the usual run of air brake literature in that it does not attempt to convey an accurate idea of all of the ports and passages that are present in the structure itself. By this method it has greatly simplified the obtaining of a general understanding of the subject. In any of the present day valves the ports and passages are so multiplex and complex that they can only be represented diagrammatically, and it is doubtful if many of those who are most familiar with the working of the air brake have a clear mental vision of the network of the passages.

The book opens with a general description of the pipe bracket and equalizing portion of the valve, and while dealing with the second of these, there is a discussion of the several functions which it is intended to perform and its method of performing them. Then follows a description of the emergency portion.

In the description of the equalizing portion emphasis is placed upon the method of operation in making a service application that the brake cylinder receives air from the auxiliary and service reservoirs only, and that the emergency reservoir is not called upon at all; so that after a full service application, there is always a sufficient supply of air held in reserve to effect a full emergency application if it should be so desired. And, further, with the 110 pounds brake pipe pressure, which, it is intended, should be carried with this equipment (it being understood that it is used only in passenger service) an emergency pressure of 100 pounds in the brake cylinder is always obtainable.

A good deal of emphasis is placed upon the means of preventing "stuck" brakes. In brief, this means consists in introducing a "resistance increasing cavity," in the face of the equalizing slide valve; whereby, by connecting it with the atmosphere or the auxiliary reservoir, the movement of the valve is given a greater frictional resistance as it moves into an application position than it has when it is moving into release. Hence, if it can move to application under a high resistance, it will surely move to release under a low.

The control of the release and the two features of direct and graduated release are dealt with at some length, and it is shown how the brake acts by permitting the brake cylinder pressure to be gradually stepped down, provided the cap over the release piston is set in the graduated release position.

It has been said that no air is taken from the emergency reservoir when a service application of the brakes is made. But on the recharge, during release, air is taken from the emergency reservoir to assist in recharging the reservoirs from which air was obtained for the service application. This arrangement results in these reservoirs becoming charged more rapidly than if all of the air needed for this purpose had to come from the brake-pipe.

In the discussion of the emergency portion some space is devoted to the subject of undesired quick action. Here it is shown that the possibility of such action is inherent in the design of the ordinary triple valve; while such action is positively prevented with the U. C. valve.

And finally there is the "protection value," which is a device for automatically bringing about an emergency application when the brake pipe pressure is reduced, for any reason, to what is considered a dangerous value, and this is placed at 35 lbs. There are ten pages of short categorical statements regarding the functioning of the valve, after which comes the catechism, already referred to, which occupies the last 27 pages of the book.

At the end there is a diagrammatic representation of the valve showing all of its ports and passages for the use of those students who are desirous of delving into the innermost recesses of the mysteries of its construction and operation.

New Locomotive Chart

A finely drawn chart has been issued by the Locomotive Publishing Company, 3 Amen Corner, London, England, showing complete details of what is known on the British railways as a six-coupled goods locomotive. In addition to the usual side section view there are also front and rear section views. The parts are named and numbered. The drawing is by W. H. Seymour, and the locomotive shown is from a type used on the Midland Railway, of which Sir Henry Fowler is chief mechanical engineer. The price of the chart, including postage, is fifty cents.

Bursting Into Song

Ten thousand copies of "Way Down Upon the Swanee River" are being distributed by the Southern Railway System as souvenirs of the "Swanee River Special," the first through train that ever ran between the Ohio River and the west coast of Florida, which was started on November 6. The special handles through sleeping cars from Detroit, Cleveland, Cincinnati and Louisville to Tampa and St. Petersburg, Fla., winter resort cities on the Gulf of Mexico Coast.

Universal Directory of Railway Officials

The Directory Publishing Company, Queen Ann's Chambers, Westminster, S. W. London, England, has issued the 27th annual edition of this book of useful information. The general style of the work is the same as in previous issues, but the amount of reliable information is much increased, as during and some time after the war the publishers were unable to include official information in regard to the personnel of some of the railways, especially in Central Europe. The index is a model of arrangement; the list of railway officials alone extends to 95 pages, and the names of the railway are given both in English and in the foreign languages where such is used. Price, $5.

Railway and Locomotive Engineering

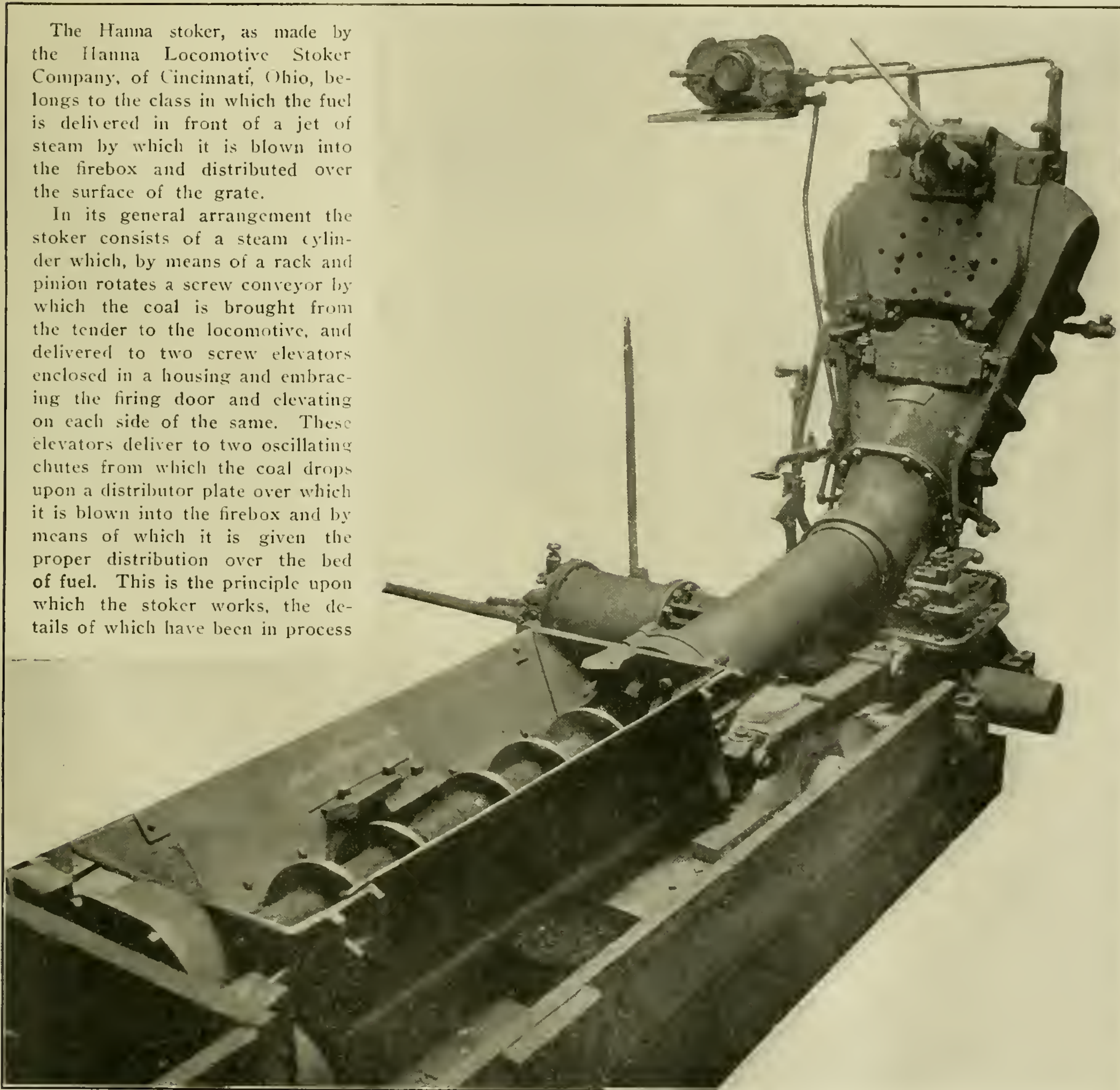
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXXIV | 114 Liberty Street, New York, December, 1921 | No. 12

The Hanna Locomotive Stoker

The Hanna stoker, as made by the Hanna Locomotive Stoker Company, of Cincinnati, Ohio, belongs to the class in which the fuel is delivered in front of a jet of steam by which it is blown into the firebox and distributed over the surface of the grate.

In its general arrangement the stoker consists of a steam cylinder which, by means of a rack and pinion rotates a screw conveyor by which the coal is brought from the tender to the locomotive, and delivered to two screw elevators enclosed in a housing and embracing the firing door and elevating on each side of the same. These elevators deliver to two oscillating chutes from which the coal drops upon a distributor plate over which it is blown into the firebox and by means of which it is given the proper distribution over the bed of fuel. This is the principle upon which the stoker works, the details of which have been in process of development for a number of years.



GENERAL VIEW OF HANNA LOCOMOTIVE STOKER

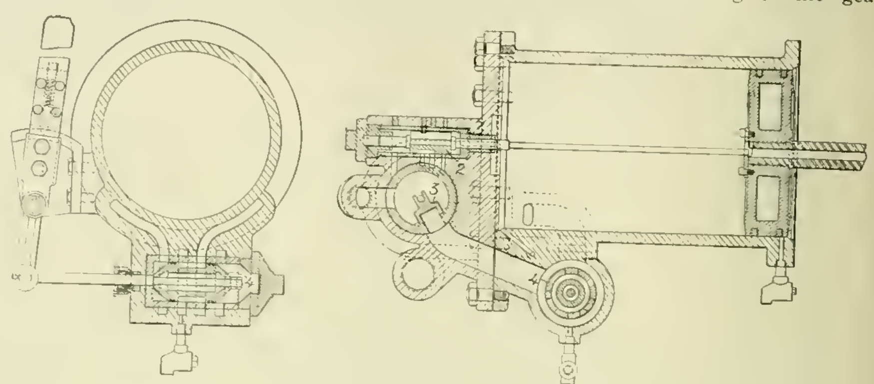
The mechanism is so arranged that the speed of the conveyor screws can be varied at the will of the fireman so as to deliver any desired quantity of fuel; or, in case of clogging or jamming, due to foreign matter such as bolts, stones, etc., the conveyor screws can be reversed by first taking the pressure off the piston by the hand manipulated reverse lever reversing the motion of the piston, which releases the tension on the clutch, at the same time putting the reverse shifter lever in the back-up position. In the distribution the coal may be scattered evenly over the surface of the grate or the delivery concentrated in one place so as to fill a hole that may have been burned in the bed, or for any other reason.

The motive power is derived from a single steam cylinder indicated by (1) on the longitudinal section of the machine. This cylinder has a diameter of 11 inches and a piston stroke of 16 inches, the reversal of which is controlled by a stem operating a pilot valve and moved by a plate on the piston after the manner of the reversing motion of an air pump. This valve is shown at (2) in the section of the engine cylinder, and as it is moved to and fro by the striking of the piston and rod against its valve stem it admits steam to one end or the other of a differential piston that moves the main slide valve (3).

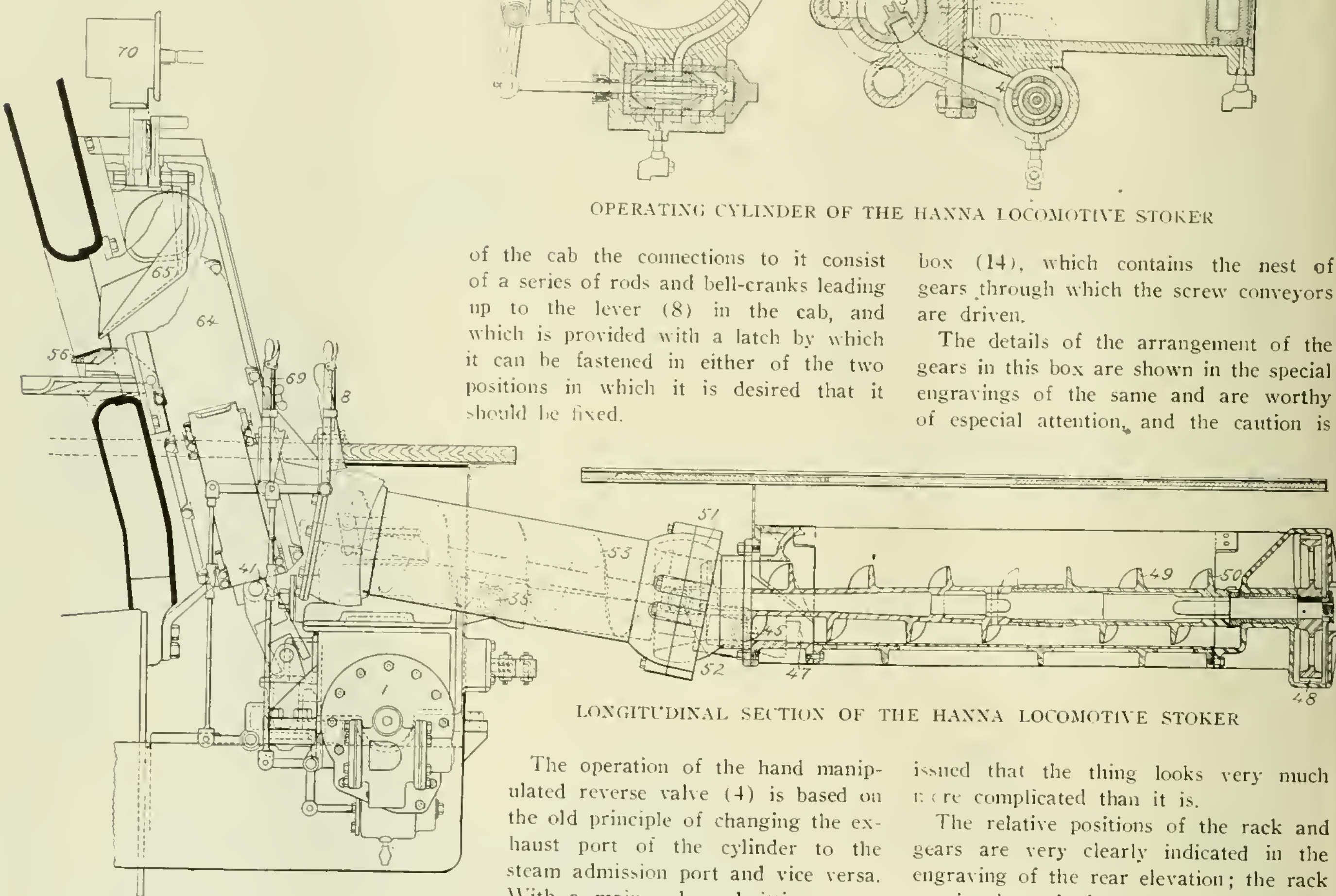
Under ordinary working conditions this arrangement needs no modification or adjusting. But, if the conveyor becomes jammed either by large lumps of coal or by foreign substances such as bolts or stone, it may be necessary to reverse the motion of the piston before it has completed its full length of stroke.

To do this the reversing valve is used. This is a hand-manipulated piston valve that is controlled and set by the lever (5) and its connections to the stem of the reversing valve.

As the valve is located below the deck of the cab the connections to it consist of a series of rods and bell-cranks leading up to the lever (8) in the cab, and which is provided with a latch by which it can be fastened in either of the two positions in which it is desired that it should be fixed.



OPERATING CYLINDER OF THE HANNA LOCOMOTIVE STOKER



LONGITUDINAL SECTION OF THE HANNA LOCOMOTIVE STOKER

The operation of the hand manipulated reverse valve (4) is based on the old principle of changing the exhaust port of the cylinder to the steam admission port and vice versa. With a main valve admitting steam to the cylinder for the full length of the stroke, this admission of steam to the existing exhaust passage and the opening of the steam port to the atmosphere will, of course, always produce a reversal of the motion of the piston. The piston is of the box type and is packed with two spring rings in the usual manner.

The piston rod, on leaving the cylinder, passes through the usual stuffing box and then across the space between the cylinder and the rack housing (6). It enters the rack housing through another stuffing box, and is keyed to the rack by the key (7). The housing is an oil tight box, which is bored out to receive the guide (9) which is fitted with a wearing and bearing strip (10) to take the downward thrust of the rack as it works the gears of the drive. The rack is cut and has a wearing key (12) let in on each side to hold it down and prevent any tendency that it might have to lift and bind against the gearing.

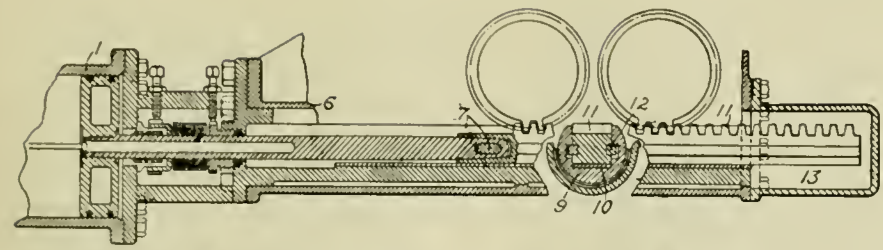
At the end of the rack housing there is a cap (13) by which the opening is closed and by the removal of which access to the rack is obtained.

Above the rack housing is the gear box (14), which contains the nest of gears through which the screw conveyors are driven.

The details of the arrangement of the gears in this box are shown in the special engravings of the same and are worthy of especial attention, and the caution is issued that the thing looks very much more complicated than it is.

The relative positions of the rack and gears are very clearly indicated in the engraving of the rear elevation; the rack running beneath the gears. The gears 16 and 17 mesh with the rack, and as will be seen from the vertical section the gears (15) and (16) mesh with each other and (17) stands clear of the others. Then, as the rack moves to and fro the gears 16 and 17 move with it, while 15 turns in the opposite direction as it is driven by 16. These gears are all loose on their shafts.

For the direct drive under normal working conditions, the gears 16 and 17 are effective. Under these conditions the rod 18, with its attached stem 27, is raised lifting the hollow bar 19 and, with it, the end of the lever 28, which is pivoted at 26. This movement lowers the other end of the lever at 20. As the stem 19 is raised, the crossbar 29 is also raised. This crossbar has two forked ends, 23 and 24, by which the clutches 21 and 22 are lifted into contact with the corresponding clutch projections on the gears


CYLINDER AND RACK HOUSING FOR THE HANNA LOCOMOTIVE STOKER

17 and 16 respectively. These clutches have a sloping back and, as they are virtually held in place by the spring 30, they can slip if there is a backward movement by the compression of the spring. The clutches are so arranged that upon one stroke of the engine piston one clutch will engage while the other will slip; while, on the reverse stroke the clutch action is also reversed.

The clutches are attached to their shafts by splines so that the latter are driven with them. On the other side of the gears 16 and 17 from the clutches the gears 32 and 31 are keyed to the shafts, so that they turn with the clutches. These gears also mesh with each other and therefore must always turn in opposite directions. It is evident, then, that as the clutch 22 receives its impulse upon one stroke of the rack and 21 receives its on the other, the gears 31 and 32 must turn at each stroke and that 32 must always turn in the same direction, receiving intermittent impulses with each stroke of the engine piston and the rack.

The gear 32, which it will be remembered, always moves in the same direction, under ordinary operating conditions, meshes with the gear 34, which is on the main driving shaft that extends back to the tender for the purpose of driving the conveyor screw; the exact arrangement of which will be explained later.

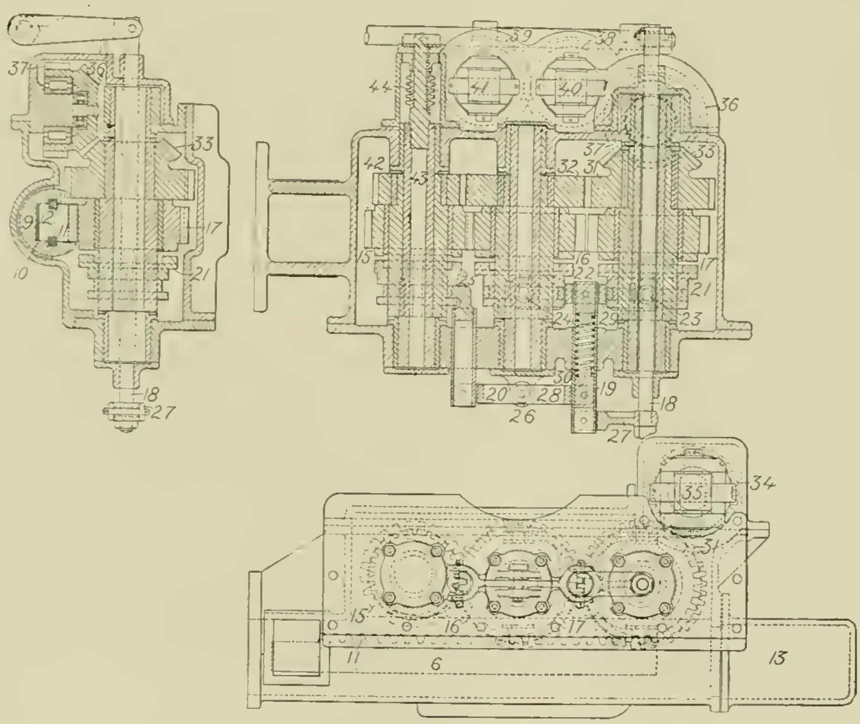
This shaft carries the gimbal connection 35, which is thus always rotated in the same direction and with the same intermittent motion as the gears 16 and 17, and the piston of the cylinder.

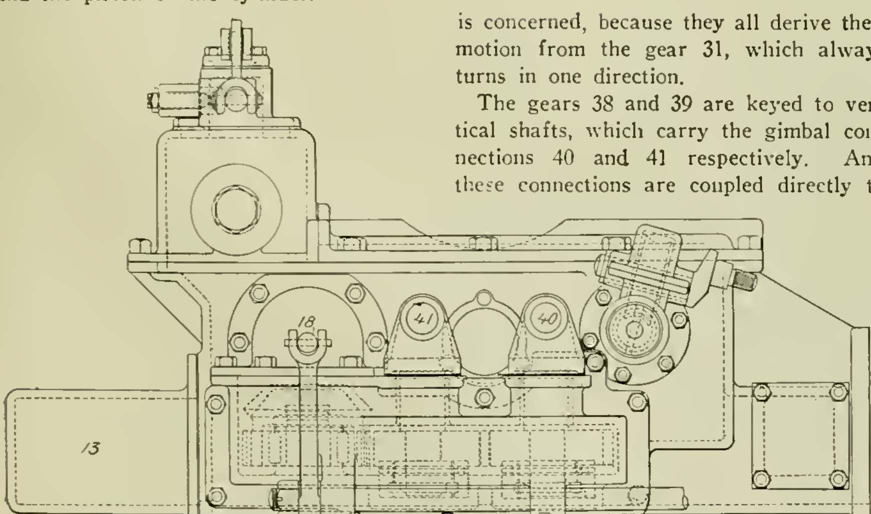
For the driving of the two inclined lifting conveyors the gear 31 has the miter gear 33 made solid with it. This miter gear 33 meshes with a similar gear 36, to which the spur gear 37 is attached. This latter gear meshes with the gear 38, and this in turn with the gear 39, so that the whole train of 37, 38 and 39 move together and always in the same direction, so far as each individual gear is concerned, because they all derive their motion from the gear 31, which always turns in one direction.

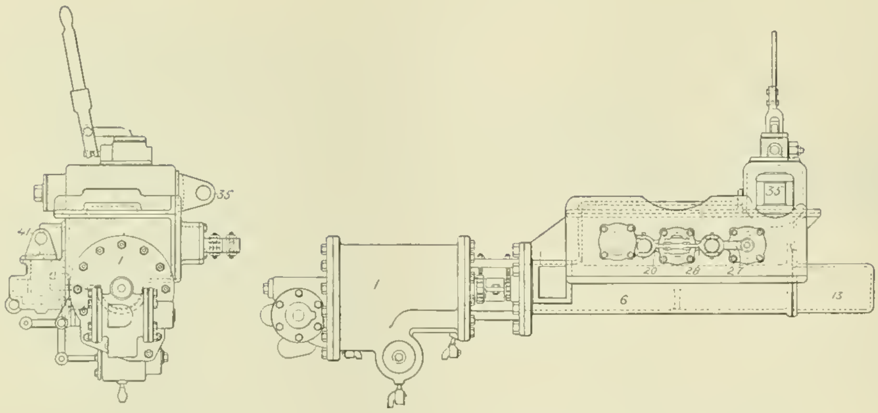
The gears 38 and 39 are keyed to vertical shafts, which carry the gimbal connections 40 and 41 respectively. And these connections are coupled directly to the lower end of the shafts of the lifting conveyors, by which the coal is raised from the discharge end of the longitudinal conveyor to the point at which it is discharged at the sides of the fire door, all having an intermittent action.

If now for any reason it is desired to reverse the action of the conveyor screws, the rod 18 is pushed out so that the clutches 21 and 22 are disengaged from their mates on the gears 17 and 16 respectively. This draws the end of the lever 28 away from the gear box and pushes the end 20 in until the clutch 25 engages its mate on the gear 15. These clutch faces are of the same shape as the others so that a slipping can take place when the motion of the gear 15 takes place. The spring 30 takes care of this also. It will be remembered that the gear 15 does not mesh with the rack, but with the gear 16, so that it moves in the opposite direction to that gear. But the teeth of the clutch 25 are so arranged that they are in action when the gear 16 is moving in the opposite direction to that in which it is moving under normal action, when driving its own clutch 22. In other words, the clutch 25 engages the gear 15 when 16 is moving in the direction the same as the normal motion of 17 and opposite to its own normal direction.

The gear 15 and with it the gear 42 on the same shaft have an active motion in the opposite direction to that of the normal direction of 17, 31 and 33. Hence the movement of all of these gears is reversed on the drive by the interposition of the gear 32 between 42 and 31. It will be seen from this that the reverse motion only takes place during one


GEAR BOX OF THE HANNA LOCOMOTIVE STOKER


FRONT ELEVATION OF THE GEAR BOX OF THE HANNA LOCOMOTIVE STOKER



ENGINE AND GEAR CASE OF THE HANNA LOCOMOTIVE STOKER

stroke of the piston and not with each stroke as in normal operation.

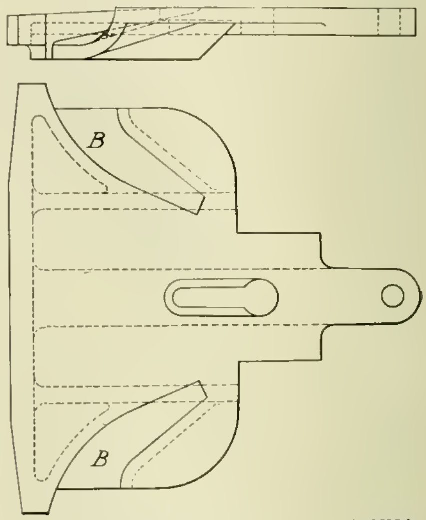
Under this normal operation the gear 42 has a movement in one direction only, and its shaft 43 partakes of it. The forward end of this shaft carries a worm 44 which drives a worm gear whose shaft projects through the forward side of the gear box, and there carries a small crank which drives a connection reaching up to the rocker arm 44 of the control box, the functions of which will appear later.

Returning now to the drive for the main conveyor from the tender to the locomotive, the longitudinal section of the stoker shows that the gimbal joint 35 on the gear box is connected to a similar joint 45 on the tender through a shaft having a telescopic connection 46. These two gimbal joints with the telescoping shaft provide for the compensation of all motion between the engine and tender.

The shaft on the tender, which is shown broken at 47, extends back to the rear end of the conveyor screw where it carries a pinion meshing in with and driving the spur gear 48, which is keyed to the shaft of the rear section of the conveyor screw 49, this shaft being provided with a suitable thrust bearing at 50.

The casing of the conveyor screw terminates at its forward end in a ball joint in which there is a gimbal connection (52) between the forward end of the tender portion of the conveyor and the inclined section 53 on the engine. The end of the inclined section 53 rests in a ball which also provides a slip joint which compensates for the movement between the engine and tender, and provides a continuous and enclosed conveyor from the tender to the point of delivery to the conveyor screws.

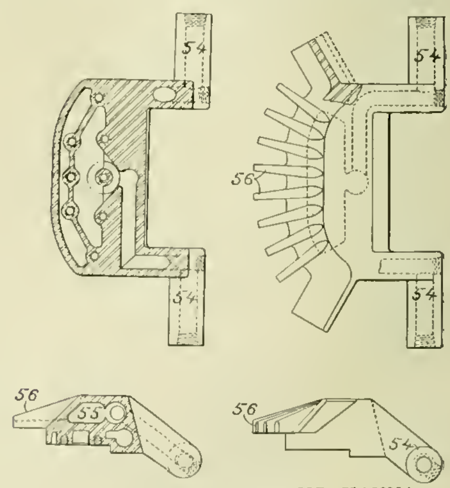
The coal is delivered from this longitudinal conveyor to the foot of the lifting conveyors, by which it carried up to the point of discharge at 64 from which it falls upon the chutes 65, which swing to



DISTRIBUTOR PLATE OF THE HANNA LOCOMOTIVE STOKER

and fro under the impulse received from the control case through the connection 66 as will be explained later.

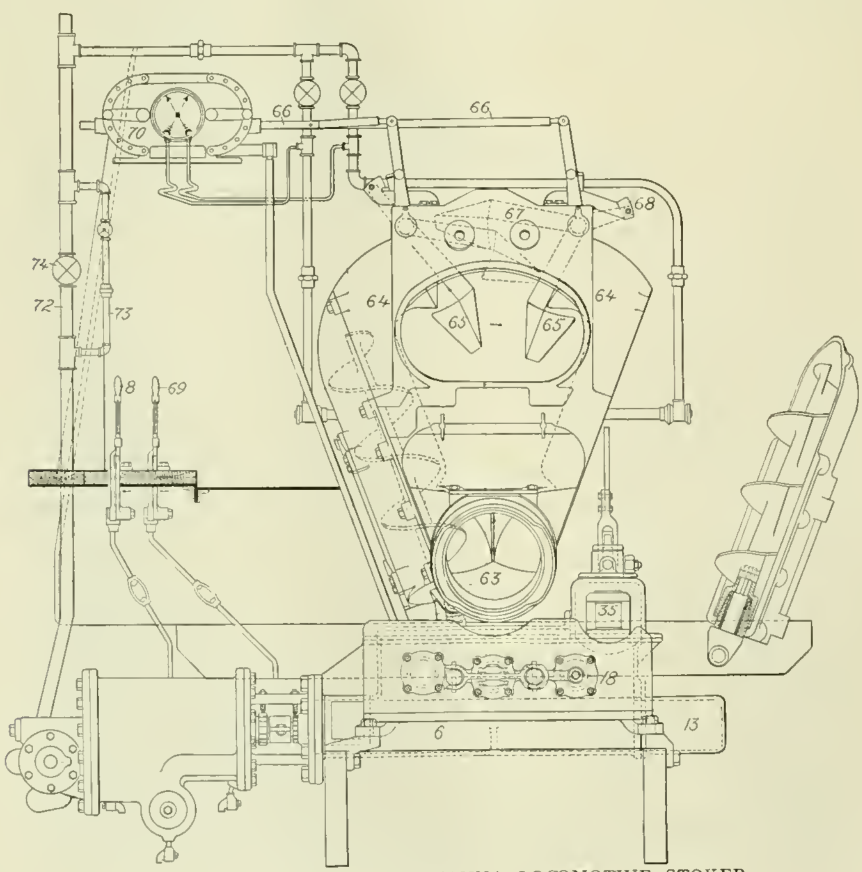
As the chutes swing to and fro they drop the coal down on the distributer plate. This plate is an important element in the operation of the stoker. It is of



BLAST CHAMBER OF THE HANNA LOCOMOTIVE STOKER

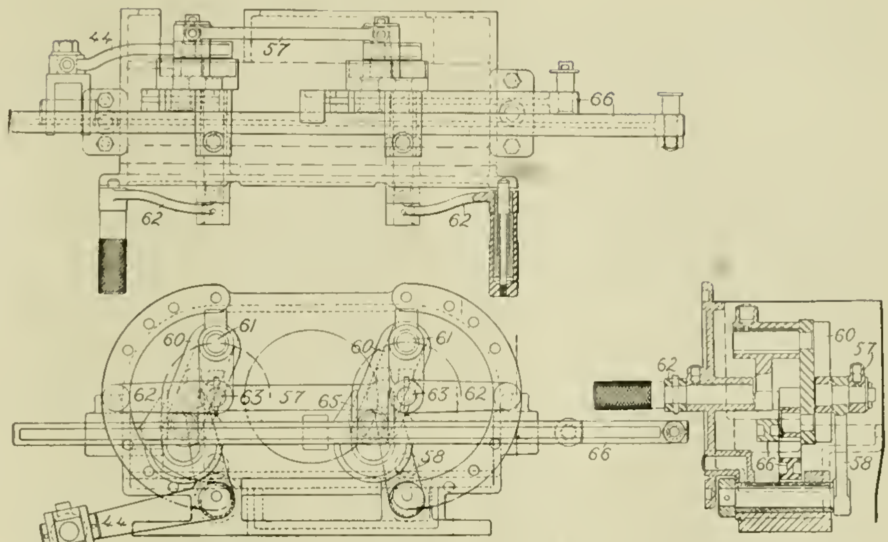
cast iron of the shape shown in the engraving and is set into a casting in the fire doors from which it can be easily removed even while the fire is burning brightly. It consists of a broad flat plate with the two diverging channels *B B* cut into its upper surface and discharging at approximately right angles to B, the center line, which corresponds to that of the engine.

The function of these channels is to catch a portion of the coal as it is blown over the upper surface of the plate and

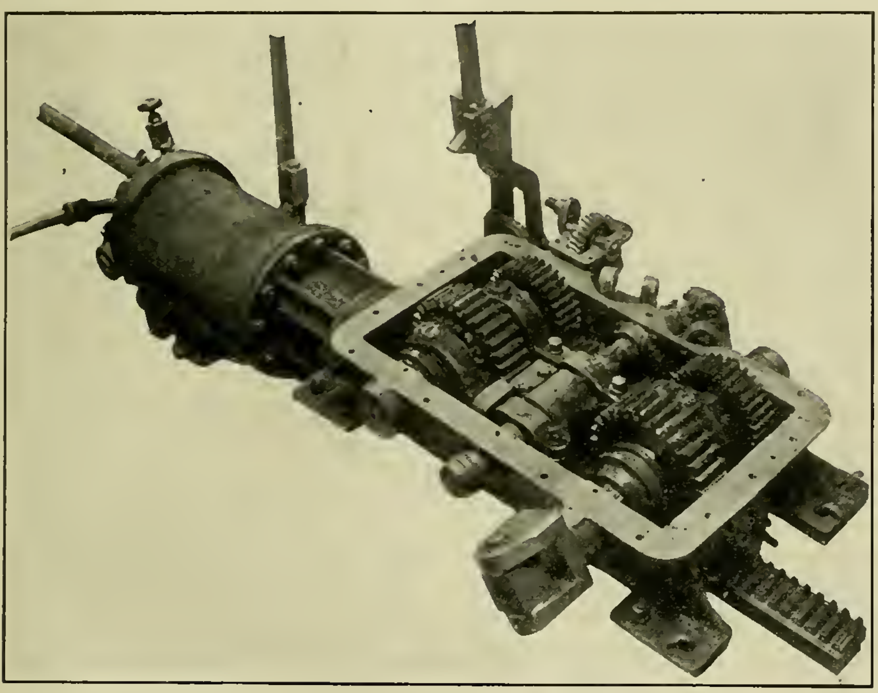


REAR ELEVATION OF THE HANNA LOCOMOTIVE STOKER divert it into the back corners of the firebox and along the back sheet.

The blast chamber is made of a steel casting and has trunnions 54, which are drilled to take the turned ends of two steam pipes. These two pipes deliver steam at different pressures to the blast changes. The high pressure going into the upper part 55, whence it is discharged into the firebox through the eight diverging nozzles 56. These nozzles are drilled with a hole 5/32 inch in diameter, which is penned down to 1/8 inch at the orifice. The low pressure steam is delivered through three orifices in the portion of the casting below the others. The combination of the two with the distributer plate serves to distribute the coal evenly over the surface of the grate. Reverting, now, to the control case by which the chutes are operated and the distribution of the coal regulated, its mechanism receives its motion from the crank on the worm gear driven by the worm 44 in the gear box.



CONTROL BOX OF THE HANNA LOCOMOTIVE STOKER

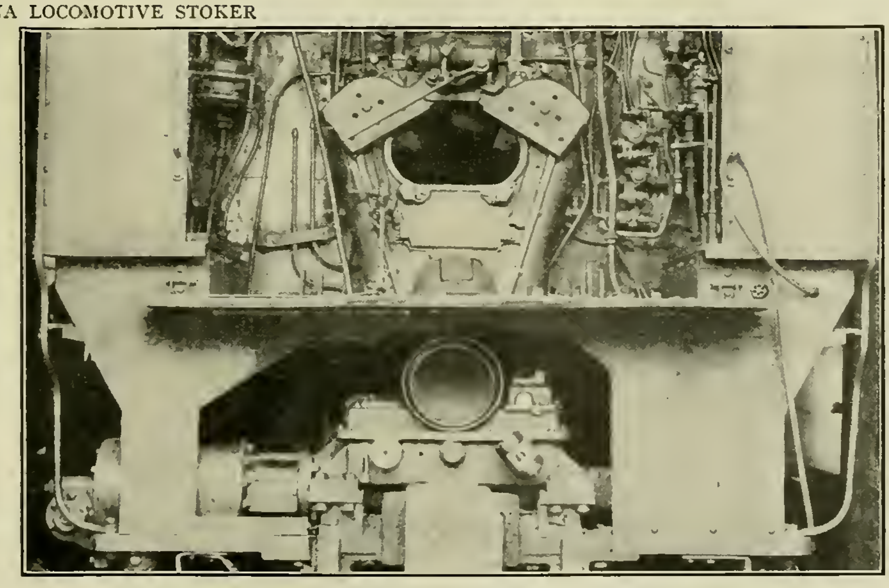

GEAR CASE OF THE HANNA LOCOMOTIVE STOKER

This crank communicates a vertical oscillating motion to the crank arm 44 of the control case. This crank arm is connected at its upper end by a connecting link 57 with the arm 58 which is pivoted on a line with the pivot of the bellcrank 44. The pin connecting 57 and 58 carries a roller 59, which runs in the slot of the tumbler block 60. This tumbler block is pivoted on the pin 61, which is fastened in the upper end of the bellcrank arm of the lever 62, which in turn is pivoted at 63. The lower end of the tumbler block carries a roller 64, which works in a Scotch yoke 65, which is fastened to the connection 66 leading out to the operating lever of the chutes.

The motion of these connections is regulated by the position in which the lever 62 is placed and pinned on its quadrant. In the position shown in the engraving the tumbler block swings about the point 61 under the influence of the connecting link 57, and its lower end communicates a corresponding motion to the Scotch yoke 63 and the connection 66.

But if the lever 62 were to be turned down so that the pin 61 were to be brought down to the center line, then the tumbler block turning also in the Scotch yoke would lie in a nearly horizontal position and the roller 59 would slide back and forth in it giving it (the tumbler block) no motion at all. Of course intermediate positions would have a corresponding influence. By raising the handle 62 the pivot 61 is moved in the opposite direction. Thus a full control can be obtained over the movement of the chutes, and each chute can be controlled independently of the other by its own handle 62.

In case of a break or stoppage of the elevator or conveyor the chutes can be

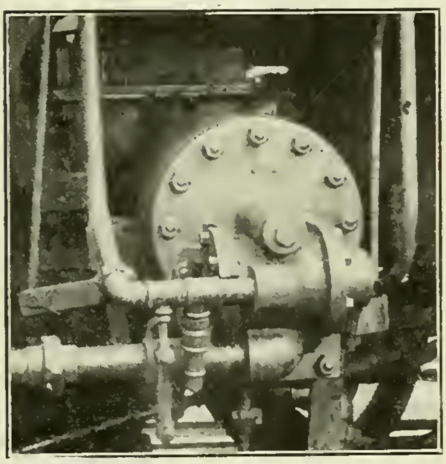

REAR VIEW OF LOCOMOTIVE SHOWING FIRE DOOR OPEN AND CHUTES BACK FOR HAND FIRING

instantly disconnected and swung up into the latched position as indicated by the dotted lines at 67 and fastened at 68. Or they may be held in any intermediate position so as to discharge the coal to any desired point in the firebox.

The general arrangement of the stoker is clearly shown by the rear elevation. In this the lever 69 indicates the lever and connection by which the reversal of the conveyor through the movement of the clutches in the gear box is obtained and the lever 8 that used for the reversal of the steam piston.

The control case is shown at 70, and in front of it is a pressure gauge with two pointers by which the steam pressure in the high- and low-pressure blast nozzles is regulated; the actual regulation of the pressure being effected by the globe valves 71.

It will be noticed that this steam is taken from the main steam pipe 72 leading to the engine, the valve in which is at



ENGINE CYLINDER OF HANNA STOKER IN POSITION

74. There is a by-pass pipe running around this valve which is ½ inch in diameter and in the ordinary operation of the stoker it has been found that the engine can be worked up to its full desired capacity by the use of the by-pass valve alone, the main valve remaining closed.

It will be seen from this description that the whole mechanism of the stoker is very accessible. The conveyor screws are driven from the tender end so that the thrust is carried on one step bearing and beyond the turning of these the engine has no work to do. The rack drive is very positive and the engine portion is of a well-known and reliable design.

In case the stoker should become inoperative due to foreign matter, the chutes can be turned up out of the way and hand firing be started at once with full stoker distribution, by simply scattering the coal on the distributer plate with a shovel.

This is rarely necessary as the appliance has been found to do its work with a degree of thoroughness that leaves little to be desired.

Railroad Net Earnings

The 12 per cent reduction, effective July 1, according to reports received by the Interstate Commerce Commission, fell far short of enabling the railroads to make net earnings of 6 per cent, which Congress authorized in the Transportation Act, as necessary to establish the credit of the roads and to assume dependable service. The deficits below the 6 per cent, for the three months referred to, were for July $53,-904,479; August, $47,758,897, and for September, $56,208,899. The actual percentages earned on the tentative valuation of the roads adopted by the Interstate Commerce Commission for rate making purposes were for July 4.5 per cent; August, 5.0 per cent, and for September, 4.6 per cent. It is claimed by the Railway Executives, however, that the above figures do not represent a normal condition because the net secured was in large part by deferring maintenance of equipment, roadbed, tracks and other items, changes which, sooner or later, must be made up.

A Voice from the Orient

It is said that all wisdom cometh from the East. *Railways*, published in Calcutta, states that "the world's credit system has broken down, and until it is restored there can be no general trade revival. That is the simple explanation of today's phenomena. The United States has ample gold, yet her wealth and her credit cannot save her from the prevailing depression, because it is not sufficient for one party to a deal to be able to deliver the goods; the other must also be in a position to give an equivalent. Expert credit schemes can only be of value in serving to set the machinery of commerce and credit in motion again. The extraordinary spectacle that the world presents today is of nations tinkering up schemes to give artificial assistance to export and simultaneously raising obstacles to import trade. In plain English, that is equivalent to endeavoring to overcome the inertia of a loaded truck with a crowbar while jamming on the brakes.

Japanese Railway Activity

An indication of the improvement in business conditions in Japan since the 1920 critical financial stress of that country is received from the recent placing of an order with the Westinghouse Electric & Manufacturing Company for substation material amounting to $76,000. This order covers the complete equipment for two substations and includes 8 rotary converters, 12 transformers, 2 complete switch gear equipments and station lighting transformers.

Telegraph and Telephone on the Railroads

The history of the telegraph and telephone was ably presented in a paper recently read before the Canadian Railway Club in Montreal, by W. J. Camp, assistant manager, Canadian Pacific railway telegraphs. Referring to controlling trains by means of telegraph and telephone generally termed dispatching, Mr. Camp stated the idea originated with Charles Minot, superintendent of the Erie railroad. This system spread rapidly, and in a short time practically all trains on this continent were controlled by telegraph. Although dispatching trains by telephone is generally regarded as of very recent origin it is a matter of fact that the long distance telephone was used for this purpose almost from its inception. For example, in the early eighties between the locomotive house and station at Quebec, nearly two miles, light locomotives were moved on "line clear" orders transmitted over a telephone circuit.

At the Association of Railway Telegraph Superintendents annual meeting in 1884, Chas. Selden, Superintendent of Telegraphs, The Baltimore & Ohio Rd., recommended the use of the telephone for train dispatching, and in 1894 he read a paper to the association on this subject and suggesting the methods to be followed, such as spelling out the words, etc. The discussion of this paper and also of papers read in succeeding years, brought out the fact that many of the railways on this continent were using the telephone to a certain extent in the handling of trains. In some cases of short terminal systems, the trains were moved entirely by telephoned orders. In 1901, the Baltimore & Ohio Railroad was using the telephone for 51 miles. A regular telephone train dispatching circuit was not, however, put into service until Oct. 2, 1907, when the New York Central opened a circuit between Albany and Fonda, 44 miles. This section of line has four tracks. On Dec. 11, 1907, the Chicago, Burlington & Quincy Railroad put in operation a circuit from Aurora, 46 miles, doubletrack. This was followed by a circuit of 106 miles, single track, of the same road on March 19, 1908.

The following shows the miles of railway operated by the two systems at the beginning of this year:

	By Telegraph	By Telephone	Per Cent by Telephone
United States....	133,317	122,022	47.8
Canada	19,720	15,956	44.7

Record of the Labor Board

Complaints have been made in regard to the delay in arriving at decisions on cases submitted to the United States Labor Board, but it may not be generally known that since the organization of the Board in April, 1920, it has disposed of over seven hundred cases. The Board is rapidly clearing the docket.

Report of the United States Labor Board Affecting Railroad Shop Agreements Completed and Promulgated and Already in Operation

The involved questions of railroad labor shop agreements which has been under consideration by the United States Labor Board for several months, and has been the subject of partial reports from time to time, were completed by a report on the remainder of the disputed points between the carriers and the shop employees and takes effect from December 1, 1921. The final report takes jurisdiction over approximately 400,000 men, and the board members believe that the decision is the most important work of the board up to the present time. It is hoped that it will provide a permanent code of shop rules to stabilize the shop crafts' part of the railroad industry. It is gratifying to note that the bulk of the rules and regulations in vogue before the war period, and which, as is well known, were effected after many years of discussion between the executives and employees, are not changed in any important degree, so that the work of the Labor Board as presented at this time may be said to be a modification of the regulations framed during the war period, and, it must be admitted, those were in the very nature of things, experimental. The same may be said of the present report of decisions, and that every detail in regard to the regulation of the work on which railroad men are engaged cannot be said to be the last word at any time. Differences of opinion should be expected, and it need not be a matter of surprise if many other changes may be found necessary from time to time.

The bulk of the changes from the old national agreement, as embodied in the decision, are changes in the classification of work to be performed by the various crafts. These classifications are made more liberal.

Machinists engaged in repair work may connect or disconnect wiring or pipe connections to repair machinery without waiting to call an electrician or sheet metal worker.

Unskilled labor may now dismantle wooden freight cars, work formerly restricted to high trained car builders.

Engineers, firemen and cranemen may make necessary repairs on the lines of the road when qualified to do the work, regardless of whether this has been considered shop work or not.

Removal or replacing of grates may be done by boilermakers' helpers, work formerly restricted to journeymen boilermakers.

An entirely new rule promulgated by the board for the first time creates a new type of apprentice to be known as "special apprentice." Previously there have been only two kinds of apprentices in the skilled shops crafts, regular and helpers' apprentices. Regular apprentices are youths entering the service between the ages of sixteen and twenty-one and serving four years' apprenticeship and helper apprentices are those apprentices selected from the ranks of the helpers. Special apprentices are to be selected from young men between the ages of eighteen and twenty-six, who have had a technical school education, and they will be required to serve only three years' apprenticeship before becoming journeymen mechanics.

The majority of the changes affected by the new rules is in the classification of the work to be performed by the various crafts. Almost without exception these classifications are made.

Large economies are expected to result from revision of the classification rules, which were made more elastic and hereafter will permit members of certain crafts to do minor jobs previously done by members of other crafts.

Provision for the representation of minorities who may have grievances is another important item of the new rules. Under the national agreement, negotiation for employees was placed almost wholly in the hands of labor organizations, with the result that the railroads and many industrial and civic institutions declared that the agreement forced a closed union shop on the roads. Non-union men found it impracticable to attempt to bring their grievances before the board, and as the rules worked out union officials handled the cases, taking their precedent from the national agreement negotiations in which union officials acted for the employees in drawing up the agreement under Federal control.

"The principal of the open shop established by the new rules," a statement by board members said, "will, in fact, be more theoretical than practical at the present time, since a large majority of the railroad shops are unionized and the existing unions are recognized by the board and by the transportation act as representative of the majority."

While most of the older working rules, sanctioned by the experience of years, are preserved in full effect, many of the more rigid rules, however, were considerably relaxed in favor of the roads, although the recognized rights of the men are fully protected and the principle of collective bargaining and union recognition is retained, as contemplated by the Transportation Act.

It will be recalled that some of the changes made earlier in the year are really of more importance than some of the changes made in the present report. Among them was the maintenance of the basic eight hour law which specified that eight hours shall constitute a day's work. All employees coming under the provisions of this agreement, except as otherwise provided in this schedule of rules, or as may hereafter be legally established between the carrier and the employees, shall be paid on the hourly basis.

This rule is intended to remove the inhibition against piece work contained in rule 1 of the shop crafts' national agreement and to permit the question to be taken up for negotiation on any individual railroad in the manner prescribed by the Transportation Act.

There may be one, two, or three shifts employed. The starting time of any shift shall be arranged by mutual understanding between the local officers and the employees' committee based on actual service requirements.

The time and length of the lunch period shall be subject to mutual agreement.

When new jobs are created or vacancies occur in the respective crafts, the oldest employees in point of service shall, if sufficient ability is shown by trial, be given preference in filling such new jobs or any vacancies that may be desirable to them. All vacancies or new jobs created will be bulletined. Bulletins must be posted five (5) days before vacancies are filled permanently. Employees desiring to avail themselves of this rule will make application to the official in charge and a copy of the application will be given to the local chairman.

An employee exercising his seniority rights under this rule will do so without expense to the carrier; he will lose his right to the job he left; and if after a fair trial he fails to qualify for the new position, he will have to take whatever position may be open in his craft.

Applicants for employment may be required to take physical examination at the expense of the carrier to determine the fitness of the applicant to reasonably perform the service required in his craft or class. They will also be required to make a statement showing address of relatives, necessary four years' experience, and name and local address of last employer.

Employees injured while at work will not be required to make accident reports before they are given medical attention, but will make them as soon as practicable thereafter. Proper medical attention will be given at the earliest possible moment and, when able, employees shall be permitted to return to work without signing a release pending final settlement of the case.

At the option of the injured party, personal injury settlements may be handled by the duly authorized representatives of the employee with the duly authorized representatives of the carrier. Where death or permanent disability results from injury, the lawful heirs of the deceased may have the case handled as herein provided.

Existing conditions in regard to shop trains will be continued unless changed by mutual agreement, or unless, after disagreement between the carrier and employees, the dispute is properly brought before the Labor Board and the board finds the continuance of existing conditions unjust and unreasonable, and orders same discontinued or modified.

The company will endeavor to keep shop trains on schedule time, properly heated and lighted, and in a safe, clean, and sanitary condition. This not to apply to temporary service provided in case of emergency.

Work of scrapping engines, boilers, tanks, and cars or other machinery will be done by crews under the direction of a mechanic.

Machinists assigned to running repairs shall not be required to work on dead work at points where dead-work forces are maintained except when there is not sufficient running repairs to keep them busy.

At points where there are ordinarily 15 or more engines tested and inspected each month, and machinists are required to swear to federal reports covering such inspections, a machinist will be assigned to handle this work in connection with other machinist's work and will be allowed five cents per hour above the machinist's minimum rate at the point employed.

At points or on shifts where no inspector is assigned and machinists are required to inspect engines and swear to federal reports, they will be paid five cents per hour above the machinist's minimum rate at the point employed for the days on which such inspections are made.

Autogenous welders shall receive five cents per hour above the minimum rate paid mechanics at the point employed.

In regard to Sunday and holiday work the ruling of the board is that instead of paying all shop employees time and one-half for Sunday and holiday work as was necessary under Rule 6 of the Shop Crafts' Agreement, the new rule prepared by the board provides that "employees necessary to the operation of power houses, mill-wright gangs, heat treating plants, train yards, running repair and inspection forces, who are regularly assigned by bulletin to work Sundays and holidays, will be compensated on the same basis as on week days." The new rule also contains the interesting phrase, "Sunday and holiday work will be required only when absolutely essential to the continuous operation of the railroad."

In regard to the rate of pay for working overtime it has been changed so instead of receiving five hours' pay for three hours and 20 minutes service or less when called to return to work the employee is to be paid a minimum of four hours for two hours and 40 minutes or less work. This four hours' pay must also be paid to employees called but not used.

During the course of hearings on the national agreements the railroads objected particularly to the provision of the old rule which allowed the employee to collect 10 or 15 hours' pay on the ground that, when he had completed the task for which he was called, his assignment to other emergency work constituted a second and sometimes a third call. To offset this the new rule says: "Employees called * * * will be required to do only such work as called for or other emergency work which may have developed after they were called and cannot be performed by the regular force in time to avoid delays to train movement."

The new rule also makes provision for paying employees time and one-half on an actual minute basis with a minimum of one hour for work performed in advance of the regularly working period. The employee who works through his lunch period receives one hour's pay and the opportunity to procure his lunch later without loss of time. The new rule gives him but straight time and the opportunity to procure his lunch later without loss of time up to thirty minutes. Straight time is allowed only for all waiting and traveling. The time of the employee for such service begins when he leaves his home station. When such emergency service is called for under the provisions of the new rule the employee is guaranteed but eight hours pay for each calendar day. The new rules also provide that when an employee is required to leave his home station during overtime hours he will be allowed one hour's pay as preparatory time.

Wrecking service employees will be paid under this rule, except that all time working, waiting or traveling on Sundays and holidays will be paid for at rate of time and one-half, and all time working, waiting or traveling on week days after the recognized straight-time hours at home station, will also be paid for at rate of time and one-half. When meals and lodging are not provided for by the company when away from home station, actual expense will be allowed.

Where employees are required to use boarding cars, the railroad will furnish sanitary cars and equip them for cooking, heating and lodging; the present practice of furnishing cooks and equipment, and maintaining and operating the cars, shall be continued.

The starting time in both the old and revised rules is set at from 6 a. m. to 8 a. m. However, the following exception is included in the new rule:

In case where the schedule of trains interferes with the starting time an agreement may be entered into by the superintendent of the department affected and the general chairman of the craft affected.

A rule of the Shop Crafts' Agreement has been changed to conform to the board's decision relative to the payment of time and one-half for work performed on Sundays and holidays inasmuch as this rule applies to employees regularly assigned to road work and paid on a monthly basis. Whereas formerly the monthly rate of these employees was determined by dividing 3,156 hours, which includes 59 Sundays and holidays at time and one-half by 12. their monthly rate is now to be deducted by dividing 2,920 hours or 365 eight-hour days, by 12.

The new rule also contains the following paragraphs which will eliminate some of the features to which the carriers have strenuously objected:

The regularly assigned road men under the provisions of this rule may be used, when at home point, to perform shop work in connection with the work of their regular assignments.

If it is found that this rule does not produce adequate compensation for certain of these positions by reason of the occupants thereof being required to work excessive hours, the salary for these positions may be taken up for adjustment.

In regard to a condition where a reduction of forces is deemed necessary, the time must be reduced to forty hours per week before reductions in the force are made. In the restoration of forces the regular hours must be restored before additional employees are engaged. Regulations are also established in cases where the railroad claimed the right to suspend an employee pending hearings, provided that if it is found that suspension was unmerited the employee will be reinstated with unimpaired seniority and pay for time lost.

Considerable modifications have been made in the regulations regarding the classification of the work of the sheet metal workers, electrical workers and carmen has been changed to allow some of the work previously performed by them exclusively to be done by their helpers and mechanics in other crafts, where the needs of the service require it. Under the national agreement carmen were exclusively assigned to wrecking crews. Under the new rules wrecking crews, exclusive of engineers, will be composed of carmen, where sufficient men are available, but when needed men of any class may be taken as additional members of wrecking crews.

Another important change affecting carmen is that which allows common laborers to dismantle wooden freight cars hereafter. Under the national agreement only qualified carpenters were allowed to do this work. About 68 per cent of the country's freight cars are built of wood. The new rule will permit employees getting $3.25 to $5 a day to do work previously required to be done by carmen receiving $5.84 a day.

In cases where the Labor Board has failed either to eliminate the old rule or formulate a new rule the point is referred to the individual carriers and their own employees for further negotiation.

As we have already stated it will be necessary to wait and watch the effect of the changes in the regulations and while the roads already claim that a saving of fifty millions a year will be made, it is not generally looked upon as a complete victory for the railroads. Intelligent and far-sighted union labor as represented on the board is in harmonious accord with nearly all of the changes made. Neither wage-rates, as a general rule, nor working conditions are disturbed. Its principal feature is the reclassification of the work pertaining to each craft. As many matters stood, no workman of a particular craft could move beyond its bounds to do a bit of collateral work he was easily able to do. Skilled labor was often given unskilled work at skilled wages, and unskilled labor was so closely restricted as to find little employment. By the revised rules, as an example, machinists on repair work may connect wiring without calling an electrician, and unskilled labor may dismantle freight cars where before it was excluded.

In such excesses of labor classification as these the rules forced upon Federal operation of the roads in the war crisis not only impaired labor efficiency but tended to reduce skill in labor to the level of the unskilled. And this is something for which labor unionism cannot afford to stand.

Axel S. Vogt

Axel S. Vogt, who, from 1887 to 1919 was mechanical engineer of the Pennsylvania R. R., died of heart disease on November 11. He was born at Christiansdad, Sweden, on January 19, 1849, and received his preliminary education in the public schools of that country, and those who knew Mr. Vogt also know that his education was progressive and continuous to the time of his death.

He entered the service of the Pennsylvania R. R. in June, 1874, and remained with that company constantly up to the time of his retirement on February 1, 1919, with the exception of about a year in 1883-84, when he was in the Shutte J. Koehrting in Philadelphia. Since his retirement from the Pennsylvania R. R. he has been engaged in an advisory capacity with the Baldwin Locomotive Works in Philadelphia.

Mr. Vogt was engineer of tests and mechanical engineer under Theo. V. Ely, who was for so many years the superintendent of motive power of the Pennsylvania Lines East. The combination of the two gave an artistic feature to the designs of the Pennsylvania equipment that stamped it with an individuality of its own, which distinguishes it from that of any other designers in the country.

As a worker Mr. Vogt was indefatigable. Apparently his only time for recreation was when he was entertaining callers in his office and that he did with a cordiality and wholesomeness that endeared him to all who had the honor and pleasure of his acquaintance. He knew no hours. In his early days on the road he broke through all of the regulations for office hours by appearing at any time that suited his convenience, and that convenience was rarely before eleven in the morning. At first his chief, Mr. Ely, was disposed to demur, but when he saw that Mr. Vogt never went home with the office force, but worked on until his average was well after midnight, he (Mr. Ely), said that he did not see that it made much difference when Vogt did his work, the one thing being that he did it and did it well.

It was always interesting to watch the development of a new design under the hands of Axel Vogt. He frequently did much of the original work with his own hands on a board in his private office. To have him lift the sheet that covered it and go over the design, and point out what he was attempting to do, was an education and a delight to the favored individual. In this development he always seemed to be working at his leisure without hurry, but somehow there was a rapidity of action that was sometimes astonishing.

It was stated above that Mr. Vogt's education was continued up to the time of his death. His technical training may have come to an end, but his reading of technical literature was omnivorous and continuous. It would be difficult to broach any topic of locomotive or car construction or operation with which he did not straightway show great familiarity. His sources of information were the technical press of all countries and his memory as to those sources was as marvelous as the range of his information itself. He could always refer and recommend the listener to look it up in Engineering · Glaser's Annalen or the Genie Civil as the case might be, and he was always correct.

As a critic of other men's work, he was always kindly in the extreme. He might not agree with the theories and practice of another designer, but his criticisms were always couched in terms of the greatest consideration and appreciation.

It seemed strange that a man of such ability, of such social instincts and of such kindliness of feeling, should never have participated in any of the public meetings of his fellows. He occasionally appeared at the conventions of the Master Car Builders' and Master Mechanics' Associations, but never participated in the discussions, and never contributed to the proceedings, though he was undoubtedly the inspiration of much that was contributed by others. This was appreciated by those who went to him for advice. He was sincere, kindly and truthful. If a device or a scheme had merit, that merit was recognized, and defects and pitfalls were pointed out with a kindness and consideration that was helpful and encouraging.

Such was Axel Vogt, a really great engineer, but so retiring in his temperament that his reputation was confined to the appreciation of his friends and his personal influence was buried beneath the outward manifestations of the great railroad that he served so well and faithfully for so many years.

The Wheel Lathe

The railway wheel lathe is, of necessity, one of the most costly machine tools required for railway work, and to justify the use of the most expensive types it is essential that a sufficiency of work should exist in the shop, otherwise it is impossible to secure an adequate measure of economy and justification for the high initial cost. The modern wheel lathe intended for the heaviest duties must be able to withstand a considerable amount of severe usage, and in the course of the working it provides a real test of the quality of modern high speed steel as applied to tool making. The cuts, as a rule, are very heavy, and every endeavor is made to speed up work on tires, many of which after use are harder in some places than others, due to slipping of the wheels and the effects produced by alternating dry and wet rails. The wheel lathe, of course, need not be confined to the one operation of turning tires, and the greatest utilization of the same machine for different operations should be made.

Avoidable Waste in Car Operation —The Container Car

By WALTER C. SANDERS,[1] NEW YORK, N. Y.

This paper describes the "container" cars which have recently been placed in service on the New York Central Lines and others having improvements on the original type which are now under construction.

The advantages claimed for the container car are that less-than-carload lots of freight, mail and express may be shipped with a material saving of time to the shipper and the railroad company, in that the container car may be rapidly unloaded and reloaded. The car will also permit the railroad to secure the maximum mileage out of rolling stock.

Valuble commodities of all kinds can be transported from consignor to consignee inviolate from damage by fire, weather, breakage or theft, also eliminating to a great extent rehandling, trucking and checking.

THE EXPRESS-TYPE CONTAINER WITH THE CONTAINERS IN PLACE. THE STEEL SIDES OF THE CAR PREVENT THE DOORS OF THE CONTAINER FROM BEING OPENED

The container car was an outcome of the railroad congestion during the war and was first put into operation last year by Mr. A. H. Smith, president of the New York Central Lines, to reduce the transportation losses due to congestion which tied up industry. This congestion was caused by the railroads being unable to get rolling stock near the platforms or places where cars could be unloaded and reloaded and put back into circulation. In some cases manufacturing plants used box cars as a storage warehouse, gladly paying the demurrage charge by the railroads. It is hoped that mail, express and freight robberies, breakage, checking and rehandling, delays to shippers, and many other railroad evils may also be materially reduced by the container-car system.

Loss of and damage to freight has grown in recent years into one of the heaviest leaks in the transportation industry and strenuous campaigns which included maintenance of extensive police and supervisory forces, together with educational campaigns among shippers and railroad employees to secure stronger packing, careful handling and suppression of theft, have failed to stop this economic waste.

The proportions of this transportation problem may be judged from the fact that in the year 1914 American railroads paid out $33,000,000 in claims for loss of and damage to freight, and for the year 1920 this mounted to a total of $125,000,000, the incidental injury to business affected being considerably greater. Under the ordinary system of handling less-than-carload lots or shipments the goods are checked and handled item by item from shipper to truck or dray, from truck to depot platform or warehouse, and from the platform to the car. They are subject to handling and checking at each stage of the journey, and when finally they reach their destination this handling and checking is all done over again. It is therefore necessary to maintain armies of employees to act as freight handlers, clerks, checkers and station overseers, as well as switchmen to shunt cars to fixed locations where loading and unloading are possible.

The container system provides that the portable container shall be loaded and locked at the shipper's own store door, conveyed by motor truck to the railroad yard, and lifted by crane aboard the container car, where steel bulkheads and sides form absolute protection against opening the container in transit. At the destination the locked container is unloaded by a crane and carried by motor truck directly to the warehouse or consignee's door, to be unloaded at his convenience. This simple system of handling goods will make it possible to greatly reduce the force of employees now necessary.

Another advantage of the container-car system expected to prove most valuable is the greatly increased use of container rolling stock in moving service, which is particularly important when traffic expands to its "peak" and the prime need is to shorten layovers of cars in yards and stations for loading and unloading, and to limit their idleness and obstruction through misuse for storage purposes. In busy times the need is to keep every wheel turning as continuously as possible to secure maximum transportation. With ample supplies of the removable containers, which in their several classes are of uniform size and interchangeable, one carload of containers may be removed and sent with their loads to consignees, and another set immediately hoisted into place and the car be ready to proceed within a matter of minutes in most instances. The locked containers may remain on station platforms or at the stores of shippers for loading or unloading at convenience without tying up costly rolling stock at points where track capacity is limited and congestion quickly obstructs the flow of traffic unless the cars are kept moving. With this rapid handling of the containers on and off the car the mileage per year made by the ordinary piece of rolling stock may be doubled, and it is predicted that the tremendous expense of maintaining box cars and other rolling

[1]Equipment Engineering Department, New York Central Lines. Assoc. Mem. Am. Soc. M. E.

[2]Abstract of a paper presented at the annual meeting of the American Society of Mechanical Engineers, held in New York, Dec. 6, 1921.

stock equal to all emergencies will be materially cut down.

The container car may make costly packing and crating unnecessary because

UNLOADING A CONTAINER FROM THE FREIGHT TYPE OF CONTAINER CAR

goods packed in flimsy pasteboard boxes or even bound with heavy paper are protected against breakage, theft and water or weather damage.

There are at present in service on the New York Central Lines, three container cars one of the mail or express type, and two that are being used for valuable freight, such as silks and woolens. Three new mail cars of improved design which are now being constructed will be equipped with an improved type of all-steel container. A new freight-type container car is being designed, and refrigerator and tank container cars are contemplated.

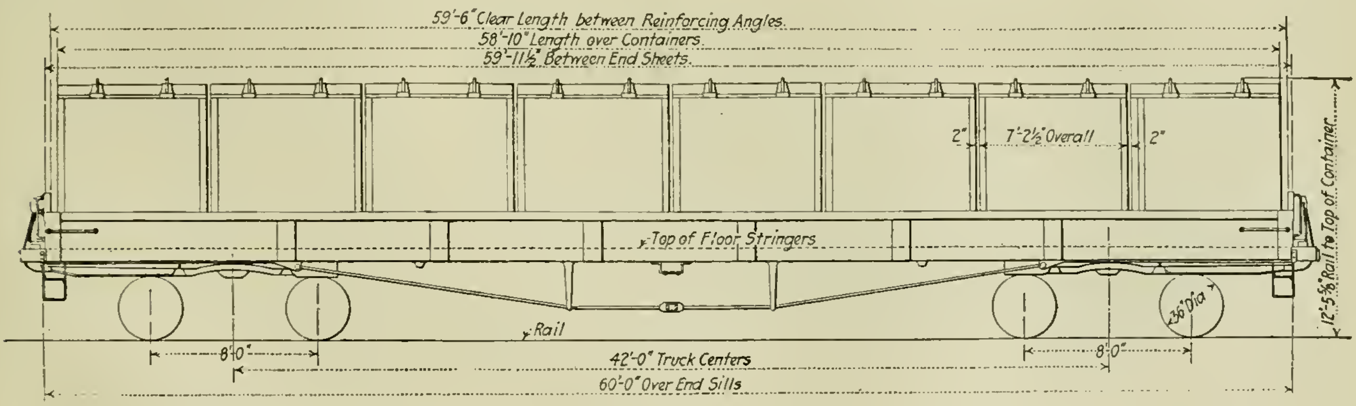
General Description of the Container Car

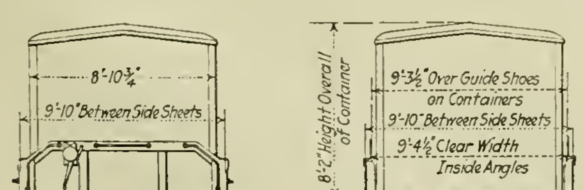
The container car is nothing more than a long car with a steel side or fence, similar to a low-side gondola, loaded with large steel safes or containers, made as light as possible, in which commodities of all kinds travel from consignor to consignee, inviolate against thieves, fire, weather and breakage. The safes or containers are lifted on and off the car by cranes or hoisting devices, permitting the "parent" rolling stock to continue in immediate transportation circulation. In appearance the loaded car seems to be a solid load of safes or steel vaults set aboard a steel underframe with a low protecting steel fence.

Express Container Cars

The present express car now in use is 61 ft. 3 in. in length, with trucks and fittings that make it interchangeable with standard passenger equipment for use in any passenger train. All modern safety appliances for a special type of car are installed, such as air brakes, hand-hold irons, sill steps, etc. This car carries nine containers, each 9 ft. wide by 6 ft. long, with an inside clear height of 7 ft. 4 in. and a door 3 ft. by 6 ft. The containers are as nearly burglar-, fire- and weather-proof as it is possible to make them, with a carrying capacity up to 7,000 lb. They have wood floors and are arranged with four eyelets or hooks, one at each top outside corner, for convenient lifting and handling. The doors are of standard refrigerator design and are arranged with a hasp and staple for the shipper's padlock, also with pin and slot for standard freight-car seal.

The steel sides of the car are spaced to suit the width of the containers, with a clearance of ½ in. on each side; the containers cannot be made as wide as the car itself because of the various state highway





GENERAL ARRANGEMENT OF IMPROVED TYPE OF MAIL CONTAINER CAR

laws which regulate the width of motor trucks. The New York State law, for instance, limits the width of an auto truck, including body, to 8 ft., the height from road to top of truck or lading to 12 ft. 6 in., and the truck and lading must not have a combined weight of over 25,000 lb. All container cars are fitted with bulkheads and steel sides 2 ft. high into which the containers fit.

In the interior of the body of the gondola part of the car are sectional guides, made of ¼-in. steel, resembling channel steel, with the laps projecting out from the open ends to enable them to be riveted to the sides of the car. There are guides at each place on the side of the car where the corner of a container will lie.

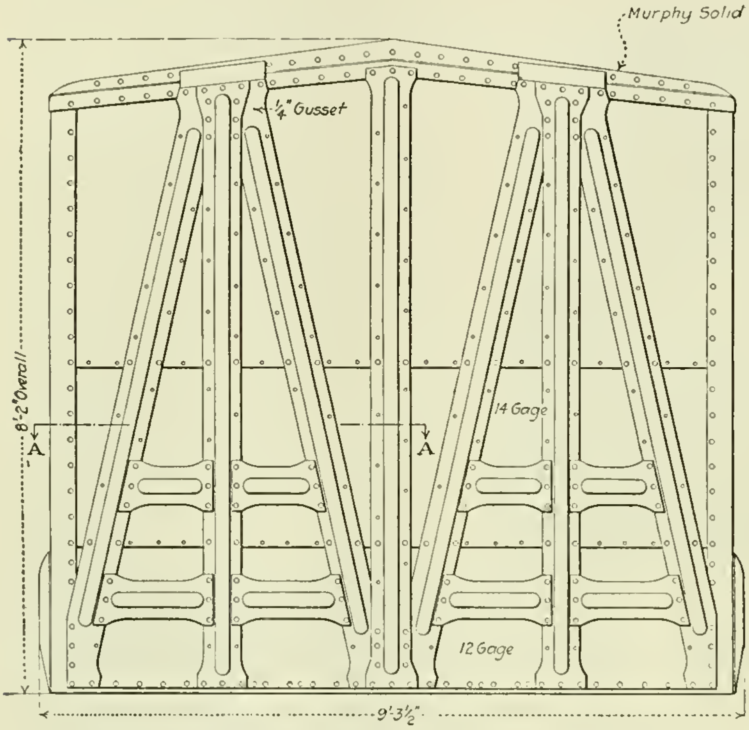
At each corner on the length side of each container there is a shoe, also of pressed steel, which will fit into the socket formed by the two guides. This arrangement guides the containers to the floor of the car and holds them in place while the car is in transit, without additional blocking or fastening. If it is found necessary to move the car over the road after one or more containers have been removed, it is unnecessary to put in any kind of blocking, because these guides and shoes are arranged to hold the containers and prevent them from shifting or falling over due to the oscillation of the car.

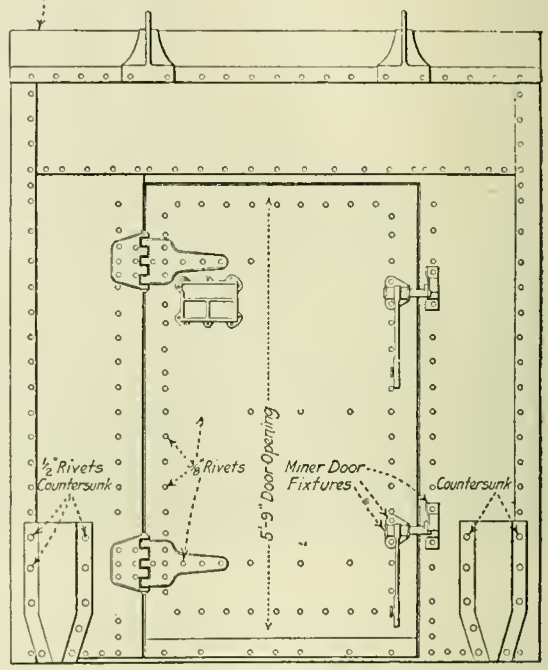
Freight Container Cars

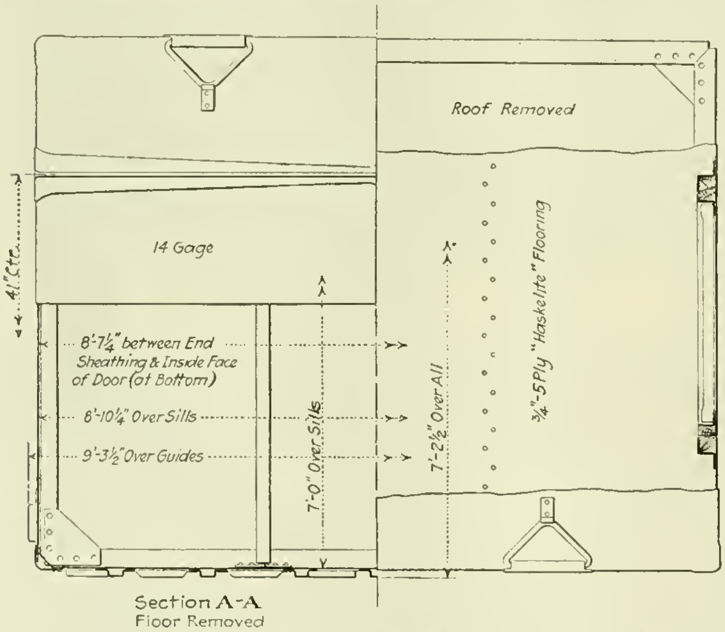
The two freight-type container cars are 50 ft. long. This is exceptionally long for a car used in freight service, being 9 ft. longer than the longest of New York Central box cars. The general construction is similar to that of the express-type container car.

The freight type carries 6 containers, length 6 ft. 7 in., width 7 ft. 1½ in. and clear height 7 ft. 7⅜ in., all inside measurements.

Each container has a steel frame, base, and roof of open-hearth steel, sides or walls of fir wood, and a radial roof so that water will shed off. All joints are double-riveted. The door in the freight type of container is located in the width side and is of standard refrigerator design. As the door is in the end or width side of the container, five 12-in. by ¼-in. steel plates are riveted to the sides of the car, extending crosswise the inside of the car, through the open clearance spaces between containers, so in case one or more containers are removed from the car, the doors of the remaining containers cannot be opened.







GENERAL ARRANGEMENT OF NEW IMPROVED TYPE OF MAIL CONTAINER CAR

Container and Container Cars Now Under Construction

The three new mail-type container cars now being built will carry 8 containers of a new, improved design, the outside measurements being, length 7 ft. 2½ in., width 9 ft. 3½ in., clear height 8 ft. 2 in., with a 5 ft. 9-in. by 3 ft. 6-in. door on the length side of the container. The cubic capacity will be 438 ft., light weight 3,000 lb. and capacity 7,000 lb.

Tests conducted in the last few months on the New York Central Lines have demonstrated that the express type of container car can be emptied of the nine containers by an ordinary crane in 21 min. and reloaded with other containers and the car put back in circulation in about the same time. This test was made with an ordinary moving track crane, since no special cranes or handling devices have as yet been constructed for use in handling the containers. With the special handling devices contemplated it will be possible to unload the containers with greater speed directly to waiting motor trucks, platforms, or on the ground.

During May, 1921, at the request of the

Postmaster General, a mail test was run from New York City to Chicago, Ill., and return with the express type of container car. Upon arrival at Chicago the nine containers, containing 37,000 lb. of mail, were unloaded onto waiting Post Office motor trucks in 21 min., which is one-fifth of the time used in unloading an ordinary mail storage car. At Chicago connections were made with western mail trains that have never been made before. Upon the arrival of the car at New York on the return trip the containers were removed from the car in 18 min.

It is believed that the use of containers in mail service (1) will prevent the loss in transit of valuable registered mail, parcels post and other mail; (2) will mean a saving to the Government in handling mail, both in trucking and checking, as well as a material saving to the railroads in the use of equipment; (3) will make possible a quick transfer at important gateway points and the maintaining of close railway connections otherwise impossible, and (4) will afford an increased weight and capacity as compared with the average load now handled in mail storage or baggage cars, the average weight of mail now carried in mail storage cars being approximately 30,000 lb.; 37,000 lb. of mail were carried on the run to Chicago.

SUMMARY

A summary of the prime advantages of the container car system is as follows:

(*a*) It will furnish a means of expediting delivery of less-than-carload lots of commodities by eliminating the time and expense of rehandling, checking and trucking.

(*b*) It will eliminate costly crating and packing.

(*c*) The immediate unloading and loading of containers at terminal points eliminates the item of demurrage, at the same time promptly releasing rolling stock, clearing the yards of cars and reducing congestion.

(*d*) It will eliminate the piecemeal loading of cars at railway sidings in exposure to all kinds of weather.

(*e*) It will tend to keep the car moving at all times, making possible double the mileage as made now by an ordinary piece of rolling stock.

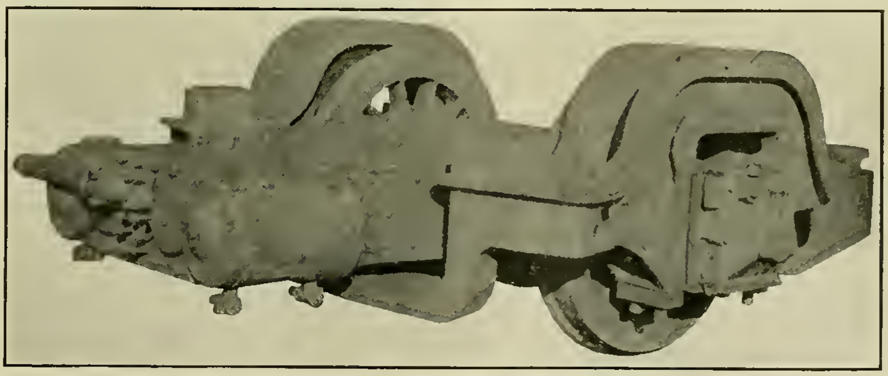
(*f*) Containers are fire- and weather-proof, and also burglar-proof in that they cannot be opened while on the car or while being transferred by handling device to and from the car.

The increased service capacity of each unit by the development of the container-car system is thought to hold far-reaching economic possibilities in railroad operation of the future, as well as in the co-ordinated use of the motor truck and the electric railway, and has already met the warm approval of both shippers and receivers and bids fair to be extended in railroad service generally as soon as the conditions assume the expected condition of normalcy.

More Favorable Reports of the Booster On a Mikado Type Locomotive for the Chicago & St. Louis Railroad

The Lima Locomotive Works recently built six Mikado type locomotives for the New York, Chicago & St. Louis Railroad, and the reports already received in regard to their performance are of the most gratifying kind. In addition to the standard features of the United States Railroad Administration light Mikado type, ten of which were allocated to the road, several new features have been added which distinctly put the recent addition to the equipment as among the best in this class of locomotives. A booster was applied to one of the locomotives furnished by the Franklin Railway Supply Company, and the prospects are that the same appliance will be attached to the remainder of the locomotives at an early date. The trailer trucks are of the Commonwealth Steel Company's outside bearing Delta type, equalized with the drivers.

These locomotives have a tractive effort of 54,700 lb. without the booster and 64,200 lb. with the booster, an addition of 17 per cent. The cylinders are 26 in. by 30 in. and the drivers 63 in. outside diameter. The total weight of the locomotive equipped with the booster is 307,000 lb., of which 226,500 lb. are on the drivers, 20,500 lb. on the front truck and 60,000 lb. on the trailing truck. The driving wheel base is 16 ft. 9 in. and the total engine wheel base 36 ft. 1 in. The frames are fitted with a cast steel cradle and Franklin automatic adjustable wedges are used on all drivers. The valve gear is of the Walschaerts' type and control is by a Ragonnet type B power reverse. Cylinder and steam chest bushings are of Hunt-Spiller metal. The front truck is of the constant resistance type. Okadee automatic cylinder cocks and White single sanders to the front drivers only are among the other specialties. The front end main rod brasses are not adjustable but are provided with solid round bushings pressed in the same as on the side rods.



FRONT VIEW OF TRAILING TRUCK SHOWING LOCOMOTIVE BOOSTER

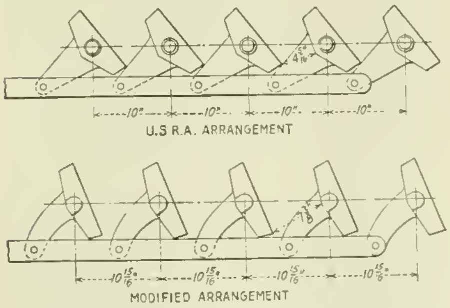
Instead of six-feed lubricators with feeds to the cylinders, these locomotives use four-feed lubricators, the cylinder feeds being omitted in accordance with the standard practice on the Nickel Plate which has been found to be entirely satisfactory.

The boiler is of the conical-connection type with combustion chamber and is equipped with type A top header superheater, Security brick arch and butterfly type firedoor. A Duplex stoker is used and particular attention was given to the cab arrangement to locate all necessary piping and fittings for the greatest convenience of the engineer and fireman. The boiler pressure is 200 lb. The firebox is 114⅛ in. long by 84¼ in. wide, which gives a grate area of 66.7 sq. ft. There are 216, 2¼ in. tubes and 40, 5½ in. flues, 19 ft. long. The heating surface of the firebox, combustion chamber and arch tubes is 280 sq. ft., the evaporative heating surface of the tubes and flues 3,497 sq. ft. and the superheating surface 882 sq. ft.

Special features include a cast steel ash pan, Woodard outside connected throttle with lever support designed to provide for expansion of the boiler, Nathan non-lifting injectors, Phillips top boiler check valves and Franklin power grate shaker.

The two center arch tube plugs in the throat sheet are located on the radius and in order to get good threads the holes in the sheet are tapped out 3½ in., steel bushings screwed in and then welded around the edge, the arch tube plugs being screwed into the bushings. This may be considered a minor detail but attention to such points can save much vexation in the roundhouse.

The grate arrangement is of an entirely different design from that used on the U. S. R. A. standard light Mikados. The U. S. R. A. box grate had a straight horn perpendicular to the grate on the longitudinal center line. With this arrangement when the grates are wide open the maximum distance between the top of one grate and the bottom of the next



GRATE ARRANGEMENT ON OLD AND NEW LOCOMOTIVES

grate is 4 5/16 in. In redesigning the grate arrangement, a curved horn was used which threw the center of the grate connection pin about 3½ in. ahead of the center. When these grates are wide open there is a maximum of 7⅜ in. from the top of one grate to the bottom of the next. The difference in design is shown plainly in one of the illustrations.

Drop gates were used on the U. S. R. A. locomotives, but these were omitted on the new Mikados which have 10 rocking grates on each side of the firebox. With the large openings it is possible to dump the fire much more quickly and easily than with the old standard arrangement of drop grates and smaller openings in the rocking grates. The curved horn grate is not original on the Nickel Plate for it is the standard on the New York Central. However, the comparison between the two designs is interesting, especially as it is in connection with such points as this that the U. S. R. A. standard designs commonly have been criticized.

As indicative of the value of the booster the record of a run made soon after the locomotive was received is of interest. This run was between Conneaut and Buffalo with a train of 50 loaded cars, 3 empty cars and 2 cabooses, the tonnage being 3.848. The regular tonnage for this class of power without a booster is 3,136. The excess tonnage handled was thus 712, or an increase of 22.7 per cent over the regular rating.

The train left Conneaut at 8:40 a. m. and arrived at Tift street yard, Buffalo, at 4:32 p. m. The time on the division was 7 hr. 52 min. and the actual running time 5 hr. 45 min., an average speed while the train was running of 19.9 miles an hour.

The booster was used eight times, as follows: Leaving Conneaut yard; on Springfield hill; pulling into and out of Girard siding; pulling into Cascade siding; pulling into and out of Pomfret siding; starting at D. A. V. & P. crossing, Dunkirk, and on Delaware hill. The approximate distance over which the booster was operated was three miles.

The maximum steam pressure was maintained over the entire division—even when the booster was operated the steam pressure did not fall and it was not necessary to lower the water level. In ascending Springfield hill the speed slackened to about seven miles an hour. The booster was then cut in and the speed was accelerated to approximately ten miles an hour before the top of the grade was reached

It was necessary to stop at the D. A. V. & P. crossing in Dunkirk. After the crossing was cleared the train, although standing on a heavy ascending grade combined with a slight curve, was started with the aid of the booster at the first attempt. This is considered one of the hardest places on the division to start a train, and demonstrated the added drawbar pull obtained from the booster.

As we have frequently stated the steam locomotive seems to be capable of more improvement from year to year, and it is already evident that among the more

SIDE VIEW OF TRAILING TRUCK WITH BOOSTER

recent improvements the booster has met with nothing but the warmest approbation. The design has been improved since its first introduction and what at first sight may seem to be an addition to the multiplex appliances used on the modern high-powered steam locomotive really requires no added work of the enginemen. Its action is automatic, and in certain types of road where helper locomotives have been required on difficult work the booster is one of the few improved appliances that pays for itself in a very short time. Every railroad man may confidently feel justified in boosting the booster.

Electrification of the Broad Gauge Lines of Chile

The total railroad mileage of Chile is 5,200, of which about 30 per cent is privately owned mainly for mining and industrial enterprises. The remainder of the mileage is divided into two general classes, the broad gauge lines and the narrow gauge lines. The former extend South from Valparaiso by way of Santiago to Paerto Montt, with numerous branches, while the latter comprise most of the northern roads with a few branch lines in the South.

The conditions that arose during the recent World War, brought very forcefully to the attention of the railroad management the necessity for electrifying the broad gauge lines, especially the Valparaiso-Santiago line with the Los Andes branch, where traffic was rapidly approaching the track capacity. In addition, fuel costs were excessive while the almost limitless water power was going to waste.

In 1918 a Commission was appointed to study the problem of electrifying the broad gauge lines. This Commission, consisting of Rafel S. Edwards and Ricardo P. Solar, made a careful analysis of electrifications all over the world. As a result of the possible economies shown in the report of this Commission, it was decided to immediately electrify the broad gauge lines beginning with the Valparaiso-Santiago and Los Andes branches, or the first zone. A loan of $10,500,000 for this purpose was authorized and was heavily over-subscribed a few hours after offering.

The awarding of the contract to the Westinghouse Company is a tribute to the exhaustive study made by its engineers in conjunction with those of the local firm, Errazuriz Simpson & Company. Every possible condition which could affect or be affected by the proposed electrification was considered, for the specifications called not only for locomotives to fit the traffic conditions but also for all substation, distribution and overhead equipment, and for all construction work; in other words, for the complete electrification of the railroad.

All locomotives will be equipped with the Westinghouse motors. The express passenger and road freight locomotives will be equipped with the Westinghouse system of regenerative braking, with its most modern development. The service in which the local passenger locomotives will operate will not require or justify the regenerative braking feature.

The fact that this contract includes only the first railroad zone indicates the magnitude of the electrification project which Chile has undertaken.

South Manchuria Buying Equipment

It is reported that South Manchuria will spend about $20,000,000 annually in the United States for railway equipment during the next few years.

Corrosion of Iron and Steel

Dr. Allerton S. Cushman, Physical Director of the Institute of Industrial Research, Washington, D. C., recently returned from an extended visit to England and France, read a paper entitled "Studies on Corrosion of Iron and Steel," at a recent meeting of the Canadian Railway Club, Montreal, Canada, in which he made a most interesting analysis of the causes of corrosion or rust of metals from which we make the following extracts:

"Briefly stated the electrolytic explanation of corrosion boils down to this: The metal cannot corrode or rust unless it first enters into solution in water or some watery solution or liquid medium. Having entered into solution, the atoms ionize and obey the laws of electrolytic dissociation. To put it in very practical language, it may be stated that iron cannot corrode or rust unless water is present to act as a medium and unless also oxygen is present to complete the oxidation of the resulting ions. Those of you who have at least a bowing acquaintance with physical chemistry, know that on entering into watery solution, the molecules of which all material substances are made up, dissociate into constituent atoms or groups of atoms which carry equal and opposite charges of static electricity. Such charged atoms are known as ions and as in the case of water taken as an example would be written H and OH. The corrosion of iron, the subject which immediately concerns us at this time, is nothing more nor less than an electrical phenomenon. There is abundant evidence to prove the truth of this statement, as all may learn who take the time and trouble to study the abundant literature of the subject. Then years ago all this sort of scientific explanation and discussion was in much the same condition as a cut-up puzzle in which the very numerous jig-saw pieces were being tediously and gradually fitted into their proper places, but the picture as a whole was far from finished and was as yet not recognizable as an ordered or purposed fact. Some pieces would not seem to fit in anywhere, and others seemed to have been jammed in anyhow, whether they fitted or not. At the present time the picture is still far from complete, but the advance of scientific knowledge in what has come to be known as the 'higher physics' seems to be making pieces fit in where only blank spaces have been hitherto discernable. I am referring now to the knowledge that has been gained of the actual constitution and configuration of the material atoms. We now know with very considerable certainty that an atom of matter is a sort of solar system in miniature, inasmuch as that it consists of a central electropositive nucleus around which are grouped electronegative satellites moving with orbital precision with reference to their nuclei and to each other. Under certain circumstances, however, these electrons are detachable from one system and attach themselves to neighboring ones with the result that the one system becomes electropositive by depletion of electronegative electrons while the other becomes electronegative by carrying for the time being a surplus of electrons. The simplest illustration that I can think of is the experiment made thousands of years ago, that eventually gave electricity its name from the yellow fossil gum amber washed up on the shores of the bleak and stormy Baltic Sea. If a piece of amber be rubbed with a cloth, it will not only pick up a bit of paper or pith or other light non-metallic substance, but the substance will actually jump across a slight gap to meet the amber as it approaches. Here was action at a distance, even if only a small distance, and such gigantic intellects as Isaac Newton and many another before and after him could make nothing of it. It now appears that many substances are composed of atoms in which the attendant electrons are only lightly held, and that they can actually be wiped off and joined up temporarily with neighboring systems. Thus we leave one body electropositive by the abstraction while the other becomes electronegative by the addition of electrons. Now, by analogy, when a surface of iron is brought into contact with a watery medium, the solution pressure of the atoms on the contact surface forces some of them to migrate, but they leave electrons behind on the parent surface, so that the iron ion in solution for an appreciable instant appears as a positively charged ion or atom devoid of its full complement of electrons. This, however, is an unstable state of affairs and the wandering oxygen molecules in the solution, in conjunction with the ever present negative hydroxyl ions (OH) become actively engaged in carrying electrons to the iron ions to make up the deficit. In the meantime, however, the negatively charged metallic surface has an excess of electrons which we might permit ourselves to say it has no use for. These electrons will move away in the direction of any atom that is deficient in electrons—in other words to any electropositive spot or area. Electrolysis is then at work and corrosion and pitting proceed apace. If the action is going on in a corroding medium in which the atomic or molecular aggregates formed by the rushing together of the positive iron ions and the negative hydroxyl ions are insoluble, the hydroxides will build and accumulate upon the corroding surface as colloidal rust. It is difficult to understand all this unless we call upon our imaginations to follow the rustless migration of electrons from one atomic system to another as the change of energies take place. It even helps if we permit ourselves to think of the electrons as living cells striving to get away from unstable and uncomfortable environments and to attach themselves to groups in which they can quietly settle down and revolve in peace and quiet. But between the solution pressure on one side attempting to make the atoms leave home and the cosmic pressure of the free ions in the watery medium trying to kick them back again they have a restless time of it. About as restless in their plane of magnitude as a football in a big game, which does not stay put in any one position very long but finds itself the plaything of contending forces continually pushing it in opposite directions. If, however, there is no oxygen present in the watery corroding medium, corrosion does not go on. Iron atoms will tend to go into solution but are pulled back by the electron they leave behind, so that they do not succeed in migrating, and the surface becomes, as we say, polarized. It is only on when the oxygen brings about precipitation of the iron ions as hydroxides that the way is cleared for more to come crowding in, so that the corroding action becomes progressive. I find it helpful to think of the contact between the metal and the corroding medium as a sort of space-lattice or grating through which the atoms have to squeeze or crowd to get into solution, incidentally wiping off and leaving behind some of their electrons in transit, and then immediately the push and pull of the opposing forces are exerted through the bars. This may seem a somewhat fanciful presentation, but to my mind it expresses something very like what actually takes place.

"I have, at all events, accomplished part of my present purposes if I have stimulated your minds to consider the corrosion of iron and steel from the standpoint of the electronic constitution of matter, in other words, as being a purely electric phenomenon. As I have pointed out, the picture is still incomplete, but the scientific knowledge which has been attained as a result of the discovery and study of radium and its congeners, is helping us to fit pieces into the puzzle, that find the appropriate vacant places waiting for them.

"Now, it must be apparent that if a metallic surface subject to corrosive attack has an unequal solution pressure at different points on its surface, due to segregation of impurities or unequal stresses and strains, or for any other contributory reason, the negative electrification of the surface will be unequal and unstable, so that the electrons are kept in an extraordinary state of movement and surging backward and forward, seeking equilibrium. Corrosion in such a system is continually being stimulated, for at no time is any stability reached. The ideal condition would be when the solution pressure was a minimum and constant for every atom making up the surface.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty St., New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.

Business Department:
JAMES KENNEDY, Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.
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London Representative:
THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E. C.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50. *Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered as second-class matter January 15, 1902, at the post office at New York, New York, under the Act of March 3, 1879.

Reduction of Rates Imminent

Towards the end of November, the investigation conducted by the Interstate Commerce Commission of the present level of national transportation rates, it was apparently decided that the latest and, perhaps, most mandatory of a series of Governmental actions will be taken forcing down railroad rates.

Negotiations between the commission and the executives of all the larger railroads have been in progress for weeks, being particularly in the open since President Harding formally took members of the Railroad Labor Board, which controls wage scales, into joint sessions with the commission.

While the railroad spokesmen, in pleadings filed with the commission, appear to have accepted the general dictum that transportation rates must be reduced, the commission's decisions and the railroad proposals are considerably at variance. Railroads have sought to make sharp reductions on Atlantic-Pacific rates to meet Panama Canal competition, but so far all of these decreases have been held in suspension by the commission to allow hearings to be held in nearly a score of cities before its examiners.

The commission has ordered a flat cut of approximately 16½ per cent on Western hay and grain rates, which the railroads have delayed putting into effect and which they have sought to compromise by offering to install a general decrease of 10 per cent on agricultural products. At the same time, the railroads have emphasized their demand that the Government through the Railroad Labor Board, allow wage payments to be reduced before seeking to reduce rates.

All of the differences between the roads and the commission center around this question, shall rates go down first, or wages? The conferences between the road executives and the commission so far have failed to bridge over or compromise the difficulty, and the order of the commission to go forward with its own investigation was taken by observers to indicate that its further proceedings will be governed by the fact that in the last analysis the commission has compulsory powers to enforce its own conclusions as to the reasonability of rates, whether the railroads voluntarily accept or not.

Railroad Electrification

The progress made in the electrification of the railroads is attracting marked attention here and elsewhere. The press, ever eager to exploit something new, is furnishing copious extracts of reports dwelling largely on its advantages. The editors seem to forget, or perhaps they do not know, that the idea is not by any means new. The progress made during the present century is by no means phenomenal, and from all appearances the steam locomotive will be in operation for several centuries yet unless new developments arise that are as yet undreamed of. The advantage of electric power in the moving of traffic at congested terminals, and in closely congested districts, is generally acknowledged. Its economy also in mountainous districts where water power is readily available can be seen at a glance. Hence it is not surprising that in Switzerland and Northern Italy and some portions of France early changes from steam to electric power may be expected.

In our own country the thirty-third annual report of the Statistics of Railways shows that from June 30, 1914, to Dec. 31, 1919, capital amounting to over 125 millions was invested on the Eastern district in steam locomotives, and one and a half millions on electric locomotives. The Western district showed a larger ratio in favor of the electric locomotives, showing an expenditure of nearly six millions for electric locomotives against ninety-four millions for steam locomotives, while in the Southern district over forty-eight millions was expended in the purchase of steam locomotives in contrast with a little over one million on electric locomotives.

Taking the Eastern district as an illustration of the progress made, and admitting that the advance made in the last century and the early part of the present century was largely experimental, the progress on electric does not exceed 1.2 per cent. The future, of course, may have marvels in store for us, but as the steam locomotive seems to be still capable of improvement, several generations will in all likelihood have reached the grand terminal before the electric motor can expect to catch up and break even with the steam horse let alone run it into the quiescence of the scrap-shed.

Future Work of the Labor Board

It is evident that the United States Labor Board, as now organized, will not likely again order any change of wages equally affecting the railroad men in all parts of the country. The variations in the cost of living in cities and less populated districts, together with the rates paid in other industries, will have a bearing on the questions that may arise in the future. It need not be feared that the Board will lack information on which to base its decisions. The high cost of talking will not likely affect the volume of facts and figures that will be furnished in any controversy that may arise. Some may imagine that it would be better to talk less and think more, but the freedom of speech is guaranteed alike to all, while the faculty of thinking has always been restricted to a chosen few. Doubtless the latter and finer quality could be improved by close application, and we have the redeeming assurance from a high source that in the multitude of counsel there is wisdom, and, we would not be surprised to learn that many well-prepared speeches, on second thought, remained unspoken. As Robert Burns said in reference to those who had fallen from grace in his day—"What's done we partly may compute but know not what's resisted."

Vauclain Predicts Prosperity

Samuel Vauclain, president of the Baldwin Locomotive Works, commenting on the outlook for business in 1922, stated that in the last month his company had received more orders than in any month during the war. This business is to a large extent from foreign countries, and much has been lost in the past because of high prices, and because deliveries were made when ready instead of keeping delivery promises, and because insistence was made in Latin-American customers that they should take the goods we recommended instead of what they wanted to buy. Mr. Vauclain further stated much damage had been done by such methods, and valuable lessons had been learned during the war period.

The Impotent Patent Office

We are pleased to note that we are not entirely alone in calling occasional attention to the deplorable condition of the United States Patent Office. The Chamber of Commerce of the City of New York joins us in expressing the feeling that it is difficult to understand what opposition there can be to the efficient operation of such governmental machinery as is represented in the Patent office. The pay of the employees in that office, who must necessarily be men of intelligence, is so far below the scale of other governmental departments that resignations have impaired the efficiency of the office until it is many thousand applications behind in its work. And it is still falling behind at the rate of several hundred applications per week.

American ingenuity is one of the intellectual manifestations of the age in which we live, and it is of the highest importance to business that the Patent office should be adequately manned. A small increase in fees, to which no patron using the office could reasonably object, would put the work once more on a sound basis. Another bill providing for this increase is now pending in Congress, but in the muddled maelstrom of multitudinous measures there is as much chance of reaching it as there is of catching the meaning of Einstein's theory on the circumjacent convolutions of the moons of Jupiter.

Superpower Plan Would Overcome Large Waste

Recent investigations by the United States Geological Survey, Department of the Interior, in what is known as thhe superpower zone—the dense industrial region between Washington and Boston—show a waste of coal used in the production of power by the industrial establishments in this zone in the year 1919 to the amount of 13,502,100 tons. In other words, the energy developed by these establishments by the burning of 19,125,900 tons of coal could have been developed in large central power plants by the burning of 5,623,800 tons. This was a waste through inefficient independent power producton of 71 per cent in coal consumption.

The industry using the largest amount of coal in the region is anthracite mining, and in this industry a coal saving of more than 75 per cent could be made if the mines were supplied from an efficient central electric power system. Many industries, it is stated, could save coal by the use of waste-heat boilers. Probably the greatest saving by this means could be made in the cement industry. It is estimated that if waste-heat boilers had been in use in 1919 in all the cement plants in the superpower zone, 540,000 tons of coal would have been saved in that single industry.

There are many blast furnaces in the superpower zone which are isolated from any steel plants or rolling mills, and approximately half their gases are wasted. These wasted gases would produce sufficient heat for boilers to generate 500,000,000 kilowatt-hours a year.

In certain plants the low-pressure steam requirements greatly exceed the power requirements, and there is no reason why such plants should not generate by-product power and sell it to the electrical distributing companies.

Railroad Cut Rates

On December 3, voluntary railroad proposals for inauguration of a ten per cent decrease in freight rates on practically all farm, range and orchard products in the United States, outside of New England, were accepted today by the Interstate Commerce Commission.

Orders were issued allowing the railroads to disregard all usual restrictions in making up the new rate schedule, as well as such violations of the long and short haul clause of the Interstate Commerce Act as might be brought about by percentage reductions.

The orders also permit the rates to be put into effect on one day's notice "on as early a date and in as inexpensive a manner as possible," for a six months' experimental period.

At the same time the commission left standing its order of October 20, requiring an approximate 16½ per cent rate decrease on grain, grain products and hay throughout the entire Trans-Mississippi district, which the railroads were later instructed to put into effect by December 27.

The railroad executives in applying to the commission last week suggested that the general 10 per cent decrease on agricultural products, which they contemplated, should apply to the Western grains and hay as well as to the other commodities and become a substitute for the 16½ per cent.

Reductions in New England territory, where the financial status of carriers is held not to justify a full 10 per cent decrease, were also contemplated in the voluntary application last week, and in the commission's orders today the roads concerned were given permission to make such decreases as they found possible, effective after a five-day notice period.

The result is that many of the railroads are making reductions of their own volition and is a proof that the managers are willing to make many reductions in rates that will likely aid in increasing traffic.

Bearing Alloys

Sir Isaac Babbitt was the first engineer who introduced an alloy containing 89.3 per cent tin, 7.1 per cent antimony and 3.6 per cent copper for the purpose of lining bearings and reducing the friction there developed. The original alloy "Genuine A-1 Babbitt," has become a valuable standard for quality among bearing alloys, as it is hard and tough, has a low melting point, very good anti-frictional qualities and is more nearly "fool proof" than any alloy in use. The price at the present time makes it almost prohibitive for this babbitt to be used in all classes of bearings, and many "so-called" babbitts or lead base alloys have been developed. Some of these have met with marked success, and have shown that good results may be obtained with lead base as well as tin base babbitts.

The principal requirements of a bearing alloy or babbitt are that it shall be composed of metals least susceptible to frictional contact, that it have sustaining qualities to carry the load, that the metals composing it shall be so united that it possess a fine, even grain and smooth surface after machining, to minimize the friction of the rubbing surfaces.

The size of the bearing, thickness of lining and speed and load conditions will be a big factor in selection of the proper babbitt or alloy and a well-made lead base babbitt will often give better service than the expensive tin-base metal.

The following are the specifications given by the American Society for Testing Materials in which they give five grades:

No.	Tin Per Cent	Antimony Per Cent	Copper Per Cent	Lead Per Cent
1........	83.33	8.33	8.33	.....
2........	89.00	7.00	4.00	.....
3........	50.00	15.00	2.00	33.00
4........	5.00	15.00	....	80.00
5........	.....	10.00	....	90.00

Foremanship

The present conditions call for the highest kind of leadership on the part of all foremen. During the rush and excitements of the past year, the foreman has felt sometimes justly, that he has not been treated right by some of the men. But a foreman ought to be a bigger man than to let some disagreeable incident of two or three years ago linger in his memory. He must feel that he is boss now, and put things through without much regard for any consideration other than production.

What is needed now more than anything else is manly, sympathetic, friendly leadership. Especially when the workman's mind is subject to worry about unemployment or part time work, the safe operation of a plant is peculiarly dependent on *right* industrial relations.

Snap Shots — By the Wanderer

It is just about a year ago that the announcement was made of the discharging of a number of ticket sellers on a certain railroad, because of their acceptance of gratuities from passengers whom they favored in the way of allotments of Pullman accommodations. But why this? There is an old myth regarding a certain monster whom Mr. Hercules undertook to slay. It had a superfluity of heads, some hundred odd, and when one was cut off another sprang up in its place. So where one grafting clerk is discharged there are others to take his place. These poor fellows who lost their places merely committed the Spartan crime of getting caught.

I may not be able to prove my case, but I can state it.

I have frequent occasion to travel between A and B. It is a night trip and I seldom if ever have any difficulty in getting accommodations at A, but at B, I have usually found everything "sold out," as far as lower berths are concerned, early in the morning.

Having a few friends at court I learned that, when everything had been sold out, I could usually get what I wanted through the friendly services of the doorman at the Exclusive Club, or even the porter at the Quality Hotel could help me out. All for a consideration of course.

So the other day, that is about a month ago, I went to the ticket office at A at about three in the afternoon, secured accommodations on a then almost empty car and made my journey. Knowing the peculiarities at B I went to the office at about eleven in the morning and was told that every lower berth on the eight or nine trains to A that night was sold. There were plenty of uppers.

I mentioned it to a friend who deeply regretted that he was not in good standing just then with the acting doorman at the Exclusive Club, but suggested that I could probably be accommodated by the porter of the Quality Hotel. I objected to that form of graft and preferred an upper to blackmail.

Then he advised that I do nothing until about fifteen minutes before train time, when the hotels and club turned in unsold accommodations, and that I apply at that time. I did so and was immediately handed a ticket for a choice lower berth. Of course this does not prove anything, but I persist in drawing inferences from the incident and so may you. Thus far, from the standpoint of my experience, the gentlemen at B are upright and worthy Spartans.

If I were asked to select some one little thing that seemed to me to present a big problem to a railroad manager, I think that I could do no better than to put my finger on the dining car. The query is can it be settled? Or at least so settled as to be satisfactory to the railroad and the passenger. It started in a desire of the general passenger agent to advertise his route. He did not expect it to pay, and it didn't. He served fine meals at a low price and did a big and unprofitable business, except for its advertising value. But when every road is running dining cars, their value as an advertisement has dropped to zero, and the failure to run them would almost damn the through traffic of the road failing.

Starting with an elaborate bill of fare on the American plan, the whole gamut of the a-la-carte table has been run; but the high prices and the rather unsatisfactory character of the food, has kept away patronage, so that passengers have been disposed to eat early before starting and late after arriving so as to avoid the excessive cost of a meal in a dining car.

And now comes another change. We are offered the choice of a table d'hote menu at a moderate (?) price. It is quite true that the price is low, that is seemingly low, but so also is the quantity of food given. It looks big to see two or three soups head the list, but the little "or" between each two of them cuts the diner down to one. Then half a dozen relishes swells the appearance of the menu, while the ever recurring "or" cuts the patron to olives or chili sauce or—. So with the meats, vegetables and deserts, so that a really hungry man would have to go through the list and then start back on another "or," and go on to the end in order to satisfy his appetite.

To the interested and unprejudiced onlooker it hardly seems probably that the solution of this troublesome little problem had been reached with this reversion to a mutilation of the American plan dinner in this meagre table d'hote.

It may be suggested that after this has been tried and failed, the hamper method of feeding travelers be tried. This seemed to be a success on European railways and might be worth trying.

In this system the traveler is given a bill of fare and orders his meal in advance. His order is telegraphed on to the restaurant station and upon the arrival of the train at that point, a hamper containing his order is given to the passenger. He eats the contents at his leisure and the hamper and dishes are returned to their owner.

It certainly is a tough problem and one wonders whether or no it should not be classed with the squaring of the circle and placed among those impossible of solution.

I believe that it was Artemus Ward who once remarked about his monkey that, "He is a most amoosin little cuss." It seems to the ordinary bystander that the same remark might be made of a certain Henry Ford of car fame. It sometimes seems as though he were working on the principle of the late P. T. Barnum, who remarked that he did not care what people said about his show, so long as they talked about it. And so with his Peace Ship and attempts to break into politics and his railroad operation, he keeps the sayings of the great showman constantly before the public. Of course he is absurd. No one ever took the Peace Ship seriously. It was a delightful junketing trip for those who went, but no one, now, seems to be particularly anxious to advertise their participation in that grand fiasco.

And now the irrepressible one comes out with magniloquent criticisms and great promises of what he proposes to do in the way of revolutionizing the railway mechanical department.

It was news to most of us that the freight train weighed several times as much as its load. Those of us whose memory harks back for more years than we like to mention in public, can remember when load and car had the same weight. But we are under the impression that the ratio of car weight to that of load had been falling for something more than forty years until now it was down to something like 35 per cent. of the load. But, of course, a little variation of a trifle of 65 per cent. or more from the fact need cause no hesitation about the making of a statement that will catch the "ear of the groundlings," provided only that it make the "unskillful laugh though it make the judicious grieve."

So Henry proposes to redesign his rolling stock and build lighter engines and cars. Mercy preserve us! Any of us can do that. Professor Langley in the course of his flying machine experiments built a working steam engine that weighed about eleven ounces to the horsepower. I am not so sure that these figures could not be paralleled in a locomotive. But Langley did not propose or dream that his engine could be used for manufacturing purposes, and the locomotive worked out on the same lines would cut a sorry figure in hauling tonnage freight. Still it will be "most amoosin" to see what will be evolved when the genius of the automobile lets himself loose in the field of locomotive and car designing. Still, who can say?

Who can say? As it is now we can only look upon the simple public that stands by with staring eyes and mouths agape and say of them as of the people of Goldsmith's Deserted Village as they looked upon the school master:

"And still they gaz'd and still the wonder grew, how one small head could carry all he knew."

The Future of Railroading is Electrification*

By W. R. STINEMETZ

Railway Department Westinghouse Electric & Manufacturing Company

From an operating standpoint electrification has reached the stage of acceptance as a desirable, reliable and economic form of motive power, and where we can couple with this a saving in natural resources, such as available water power as against coal or oil, we have the reason for the present world-wide interest in electrification.

This condition exists in France, Japan, Switzerland, Italy, Brazil, Sweden and Chile, and in all of these countries an active program is being carried out. Most of these countries had their transportation system badly crippled during the great war by scarcity of coal, and in some cases the impossibility of obtaining a supply at any price. All are now developing their hydro-electric projects, even under the present disturbed market conditions. France has estimated that by the electrification of her three principal lines, involving 5,280 miles of track, that she will effect an annual economy of 1,500,000 tons of coal. The large amount of water power available in the Alps and Appenines has caused Italy to lay out a program of electrification embracing 1,800 miles of road. In Sweden the program calls for the expenditure of approximately $12,000,000 during the next few years. Japan has a definite plan with hydro-electric power for electric operation during the next five years of from 500 to 700 miles of main line, and has already ordered trial locomotives. Last year the Paulista Railway in Brazil started an electrification program with about 73 miles of track and 16 electric locomotives. It is logical that they should arrange to utilize in the future the abundant native water power after their recent experience when compelled to go back to the burning of wood in locomotives on account of shortage of ships to import coal. The government of Chile with similar conditions has just placed a $7,000,000 order with the Westinghouse International Company for complete electrification of their important trunk line between Valparaiso and Santiago. This work will embrace about 200 miles of track and include 39 locomotives.

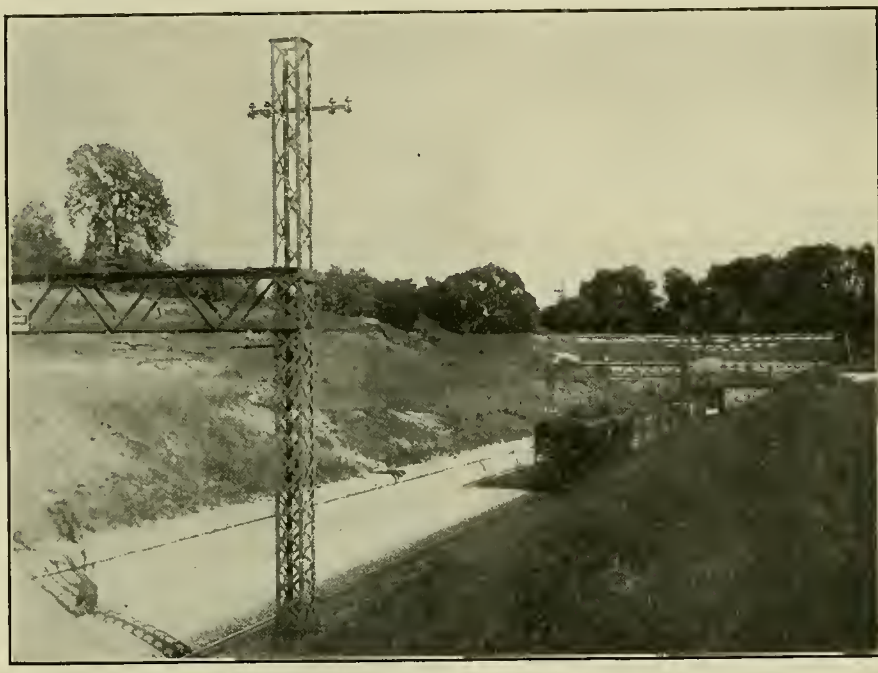
In the States this incentive is not so prevalent, due to the abundance of coal in the regions of heaviest traffic. Electrification is being studied more with the idea of improving operation and thereby eliminating the necessity of additional capital expenditures for greater trackage facilities. Its application has come where the greatest local advantages could be obtained. In many cases this application has only been partial, and the combined steam and electric operation has restricted the economies which would have resulted from complete electric operation.

Probably the most important of such applications has been the introduction of electric operation in connection with long tunnels. Here the question of ventilation was a positive restriction on the intensive use of the entire railroad plant. The Hoosac Tunnel of the Boston and Maine Railroad and the Simplon Tunnel in Switzerland are the most prominent examples of such application.

The electric locomotive can furnish unlimited power in the form of speed to expedite traffic over heavy grade sections. This characteristic of the electric locomotive has resulted in saving heavy capital expenditures for additional trackage, and coupled with regeneration, has added materially to the safety in operation when descending these grades. The Norfolk and Western Railway is now handling with electric locomotives over their heavy grade division more than double the traffic with much less congestion than they formerly experienced with steam.

The Norfolk and Western modern Mallet compound superheating steam engine, equipped with all improvements except feedwater heaters, require 5.4 lb. of coal per drawbar horsepower when operating under their road conditions, and allowing for standby losses. With electric operation about 3.3 lb. of coal are required per drawbar horsepower which gives a direct saving in fuel of 40 per cent. The saving in crew cost due to the additional work which the electric engine can perform in a given time has been stated to be between 35 and 40 per cent.

Another application has been effective in meeting the increasing requirements for terminal facilities. The use of multiple unit electric trains greatly relieves terminal congestion by eliminating switching and making up of trains, common to steam practice. It permits the more intensive and elastic use of terminal facilities, in built-up communities where real estate and trackage rights are difficult to obtain. This is best demonstrated by the results achieved by the Pennsylvania System in electrifying their main and branch line suburban service out of Broad Street Station, Philadelphia. This station was originally designed to handle 160 trains per day, but traffic has now reached a total of 600 trains daily, even though many trains have been diverted from this terminal. It would have been very expensive, though hardly practical, to have enlarged this terminal due to the valuable buildings and property surrounding it.



ELECTRIC LOCOMOTIVE AND TRAIN EMERGING FROM ST. CLAIR TUNNEL

Aside from the great capital investment saved by this electrification, the following lesser economies were cited as having been effected:

(1) Due to the less movement being required for electric M. U. trains, because steam locomotives do not have to

*Abstract of a paper presented before the Canadian Railway Club, Montreal, November 8, 1921.

be cared for and gotten to and from the round house, the capacity of the throat tracks feeding the station has been increased considerably, which increase was required by the traffic.

(2) The steam locomotives formerly handling this service have been released.

(3) The locomotive handling facilities at West Philadelphia which were overcrowded have been relieved of congestion and their necessary expansion deferred.

(4) The fireman required in steam service is not needed on the M. U. trains.

(5) There is no doubt some saving in coal.

(6) The service is more reliable, quicker, cleaner and more attractive. Schedules are more closely adhered to, all of which has helped to build up the suburban communities served, thus increasing traffic.

(7) Because suburban trains run more nearly on schedule, they do not interfere with the through trains, and a higher main line track efficiency results, with less train delays.

(8) The smoke conditions in the city district have been materially improved.

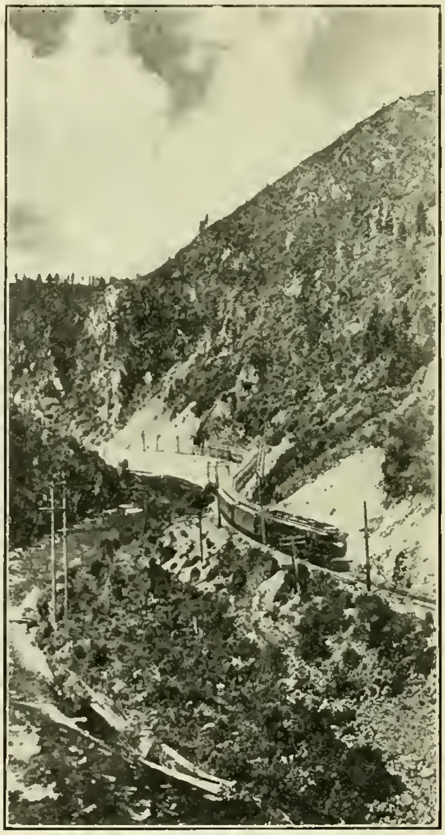
Not all of the above are readily convertible into dollars, but they nevertheless exist and amount to real economies in the broader sense.

All of our large cities, due to their rapid expansion, are now confronted with the problem of congestion in local transportation. They have built electric surface lines, elevated tracks and subways, but always the demand seems to be a little ahead of the facilities. Have the railroads done their part in solving these civic problems? Would not terminal electrification by permitting a more continuous use of local trackage not only create additional local travel, which would be profitably handled, but also relieve the congestion on the street car lines during the heavy rush hour period?

The most prominent case in America of electrification for the conservation of natural resources is that of the Chicago, Milwaukee & St. Paul Railway. It is doubtful whether electrification of this long, single track system with limited traffic would have been justified had it not been for the cheap power available from hydro-electric developments. With this saving in power cost to carry the capital expenditures, electrification has enabled this road to capitalize the many minor advantages of electric operation, such as improved service, especially in cold weather.

With the new electric passenger locomotives put in service a year ago, the Milwaukee makes a 440 mile run with one engine. During the stop at Deer Lodge, the midway point, only the engine crew and train crews are changed. The locomotives are taken off for shop inspection after mileage varying from 3,000 to 5,000 miles, which means an inspection every eight or ten trips. Under this operation these locomotives have been making records of from 10,000 to 11,000 revenue miles per month. This again is an example of intensive use of facilities.

There are two objections often advanced to electrification: one is the cost, and the other is the fact that the details of type and system have not been fully developed and standardized. Electrification is expensive, but in no case has it failed to at least carry the capital charge where applied. The situation is a parallel to industrial application where electrification has virtually supplanted all other forms of power. New tools are always expensive and electrification is a new tool, but you can get with it that which you cannot obtain with any other tools. If we are to keep abreast of the times we must spend money. The proper units must be provided for the future, regardless of cost, otherwise we shall be restricted in our industrial growth and social development, to avoid which almost any price would be cheap. Does any railroad lay its double track because it will pay for itself at once? Could some of the larger systems justify their revisions of grades and curves on the basis of savings? No terminals or change of route, or grade revisions are expected to pay for themselves on current business, but are built for the future expansion.



ELECTRIC TRAIN ON C. M. & ST. P. RY.

If we were to hesitate for the objection of final development, we would halt all progress. Standardization is a good thing after development has reached that stage which will permit of its most economical application. Standardization, however, which will retard development for some other selfish purpose is undesirable. Have the railroads standardized their steam locomotives today? They have been building them for nearly a century. We are not yet ready to handicap the developments of the future with standards which are only a measure of our present ability. Any attempt at standardization which will tend to limit this growth of the application of electricity, such as system of frequency, is not only an injustice to the coming generation of engineers, but it will in the future be swept aside if necessary by advancing science. What we should do in planning for the future is to capitalize the experience of the past and so arrange our program that we will not be handicapped by future requirements and developments.

Electrification has not yet reached its ultimate development, and the future possibilities in its use for railroads present a picture of expansion and application which could not have been visualized a few years ago. The future will no doubt bring many developments in the electric control of power to trains and in communication between trains. Radio devices will enable the dispatcher to not only communicate with, but to control the movement of the train.

One thing which is absolutely certain is that the railroads are going to live and expand. This expansion is going to be largely in the form of betterment in operation and service, rather than in physical dimensions. This will require an increase in efficiency of movement, as well as economy of operation, and a more intensive use of present facilities. The present thought seems to be that this will be accomplished largely through heavier trains and higher speed and continuous movement, using more efficiently the trackage which at present exists. This will involve the concentration of large power to constantly moving trains. Electricity is the most flexible and economic means of transmitting power yet discovered. This flexibility will permit the railroads to adjust the transfer of power to meet the constantly changing conditions, and to always adapt it economically to the growth and movement of traffic. Already industrial companies are developing this power and arranging distribution systems which will make it readily available to the railroads. Electricity has already solved the problem of the economic transmission of heavy power over great distances for all other purposes. Railroading is no different from any other type of transmission. If it is, it differs only in that it is a more difficult problem, and therefore should have use of the most flexible medium possible, namely, electrification.

Early Steel Castings

The present status of the steel casting industry gives small indication of the struggles of the pioneers. And when we consider that it is only about fifty years old the progress appears very great.

In 1871 there was built in Pittsburgh a crucible steel works, known as the Pittsburgh Steel Casting Company. It was not the first crucible steel works in this country, but it was one which marks an epoch in the steel industry for it was here, in that same year, that the first attempts were made to produce direct steel castings.

The results obtained were not encouraging, the castings were hard and brittle and had the appearance of hard white iron castings with little or no tensile strength. The production of ingots from crucible steel had been successfully carried on in the United States since 1830; in fact, up to 1867, when the Bessemer was first introduced, practically all domestic steel was forged from crucible ingots, blister steel never having been made in large quantities. Great difficulty was experienced, however, in casting small pieces of irregular shape and no immediate demand was set up for the new product owing to its uncertain properties and hidden defects.

In 1874 the Cambria Steel Company, of Johnstown, Pa., made a few castings from Bessemer steel for their own use in their works, but the violent agitation of the metal during and following the blow has always prevented the straight Bessemer process steel from being used to any great extent owing to the resulting blow holes and defects in the castings poured.

The recollection of employees and the records show that there were some small castings of comparatively simple form made at this time, but it amounted to comparatively little in tonnage and was given up owing to the fact that it naturally interfered seriously with current operations in the Bessemer converter. Mr. John E. Frye was then in charge of the plant, and in a letter, dated a number of years ago, he said:

"My recollection of the early work done at Cambria in the making of steel castings is rather hazy as to dates, which, I assume, would be the most interesting feature to record. We did some work of that character in the Cambria Bessemer shop along about the year 1876, tentatively, of course, and more in an effort to get stronger castings from our patterns made for cast iron and which proved too weak for the service demanded, and then in the direction of the development of a regular business. When the open-hearth plant was put in operation we did considerable steel-casting in moulds prepared at our iron foundry and hauled to the steel-shop. A recitation of our measure of success in the early efforts might be interesting to those now in the trade, but certainly would not be instructive for the troubles we encountered are now all set aside by later experience, and practically forgotten. A Mr. Benjamin Watkins, still a resident of Johnstown, Pa., who was my successor as the iron-foundry superintendent at Cambria, and who made the molds into which I poured the steel, might have a distinct recollection of both time and circumstances, for he naturally would give more thought, at that time, to the work, than I possibly could under the strenuous demands of steel manufacture, which kept both mind and body busy of those identified with the evolution, and I feel confident that no other person, living or dead, ever had more "worriment" over any thing in the heavens above, on the earth beneath, or in the waters under the earth, than fell to my lot in the early Bessemer days. The defects of our earliest castings were subjects of frequent consultation between Watkins and me, and the use of a highly silicious "facing" for steel molds, was suggested by me, was worked out by Watkins, and proved the most important advance the art experienced. Watkins patented the thing. My 15 years' experience in the Cambria foundry, eleven of them as superintendent, enabled me to follow the process of the art, and I made it a side line of study until it was firmly established as a special industry. After Watkins quit Cambria, he managed a steel-casting shop for the "Tom Johnson" folks, in Johnstown, using the "Mitis" Process.

About the same time (1874) experiments were being tried at several open hearth works in an endeavor to produce a sound homogeneous reliable product of direct castings. The lack of knowledge of the proper foundry practices necessary was perhaps the chief obstacle in the way of rapid development in this field. Acting on the practice in gray iron foundries invariably produced disastrous results and in consequence experiments branch out along new lines, the use of more refractory sand, more adequate allowance for shrinkage and the prevention of undue stresses in cooling and reduction of the gases liberated in the mold which form hidden blow holes. The progress was slow but steady and it was some years before the steel casting assumed its place in the arts.

In 1883 there were produced in various parts of the country 80,445 tons of crucible steel of which 1,000 tons were direct castings from the crucibles.

During the same year there were produced 133,679 tons of open hearth steel including 1,684 tons of castings. In the annual report of the Secretary Mr. James M. Swank to the American Iron and Steel Association he says, "The production of steel castings is rapidly increasing in this country." There were probably not more than 8 plants turning out castings in that year, two of which only made no other kind of steel. The Chester Steel Casting Co., at Chester, Pa., later the American Steel Casting Co. and now a part of the American Steel Foundries Co., had been making steel castings since 1871 by the McHaffey patent process, the others were using crucible or open-hearth furnaces with some slight modifications of the regular ingot pouring methods.

Further it was while in charge of the North Chicago Works in 1881 or 1882 that Mr. Robert Forsythe did some casting from the Bessemer converter, making some small pinions for the Fritz mill table gear. They were run into iron moulds with complete success.

Speeding of Grinding Wheels

A soft grinding wheel revolving rapidly permits a higher production than a hard wheel revolving more slowly. The open structure of the soft wheel provides greater clearance for the grinding chips, which results in a freer and more cooling action. A satisfactory wheel speed for cylindrical grinding of cranks, shaft pins and bearings, about 6,000 surface feet per minute; and for cutting off hardened and high speed steel tubing, and the like, the proper speed approximates 9,000 to 10,000 surface feet per minute. The following conclusions are reached regarding grinding operations: 1. The grade of hardness to be recommended for a grinding operation depends on the surface speed of the wheel. 2. The grinding wheel should be as soft as is feasible for the operation, and whenever possible operated at the high of the recommended range of speeds. 3. For a given wheel used for precision grinding operation, not much increase in production is to be expected from increasing the speed of the wheel alone. 4. The way to increase production in precision grinding operations is to increase the traverse of the work past the wheel or the depth of cut of the wheel.

Circular D. V.-220

In April, 1919, the Division of Operation, U. S. R. A. requested the Regional Directors to issue instructions to the railroads with reference to U. S. Standard Hopper and Composite Gondola cars which were built without sheave wheels on the brake shaft end of the hand brake rod, which cause considerable reduction in hand brake power.

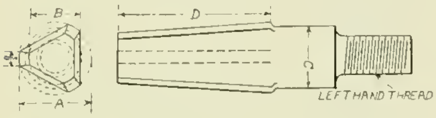
It is desirable that this work should be brought to a conclusion at the earliest possible date and the handling line should arrange to make this change on any of the cars involved which may be located on their line without the sheave wheel. Charge should be made against the car owner for the expense, for which the car owner in turn should render bill against the U. S. R. R. A.

Ingenious Labor Saving Devices

In Use on the Erie Railroad

Mandrel for Spreading the Front End of Tubes

There have been innumerable devices for spreading the front end of tubes, and here is one that is merely a tapered mandrel that is flattened on three sides so that they form an angle of 60 deg., with each other, leaving a curve on the face



MANDREL FOR FLUE SPREADER, ERIE RAILROAD

of the original circle ⅜ in. wide. The tapered portion varies, in length, from 4 in. to 4½ in., and the diameter at the large end of the taper from 1 13/16 in. to 2 1/16 in. and, at the small end from 1⅜ in. to 1⅝ in. The tabulation below shows the range of sizes that has been found convenient for ordinary use:

No.	A.	B.	C.	D.
1	1 13/16"	1⅜"	1½"	4"
2	1⅞"	1⅜"	1½"	4"
3	1 15/16"	1½"	1⅝"	4"
4	2"	1½"	1⅝"	4"
5	2 1/16"	1⅝"	1¾"	4½"

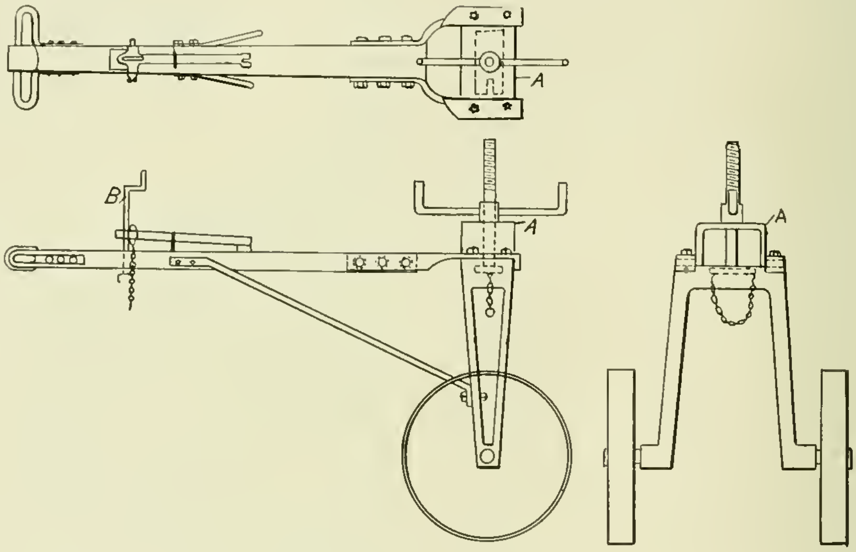
The end of the body is cut with a left-hand thread 1 in. in diameter and this is screwed into the pinion shaft of a Hartz flue welder. Facing the working end of the mandrel it is rotated in the direction of the motion of the hands of a clock, so that the work on the flue tends to run the thread in.

The flue to be spread is heated and the end pressed on over the mandrel which spreads it out to the proper diameter and taper. It will be seen that the edges of the tapered portion are not cutting edges so that no metal is cut away from the hot portion of the tube. It is simply stretched out by the outside diameter of the mandrel.

Frame Truck

The movement of engine frames about a shop is one of the things that is constantly happening and a truck for conveniently doing this work is a handy device to have. The one shown has been designed for this work and is so arranged to make it possible to pick up a frame and sling it clear of the floor. It is carried on two wheels, each 25¼ in. in diameter and having treads 4 in. wide. They run loose on their axles which are fixed in the legs of the truck frame, and have a cotter at their outer ends for holding the wheels in place. The frame is made of 1 in. by 2 in. steel, with two bars on each side which are welded to a heavy cross-bar to which the tongue is attached.

A yoke *A* spans the opening between the legs and rises to a height of 4½ in. above the top of the frame. This yoke is made of 7½ in. by ¾ in. steel and has a hole at the center of its flat face for the passage of a 1¾ in. screw. The lower end of the screw is swiveled to a short cross-bar to which a chain loop is attached. A nut, with operating levers and handles welded to it, is run down over the screw and rests on the top of the yoke thus carrying the screw and its attachments.



FRAME TRUCK, ERIE RAILROAD

The screw can thus be lowered, the chain loop passed beneath the frame and then, by raising the screw with the nut, the frame can be raised clear of the floor.

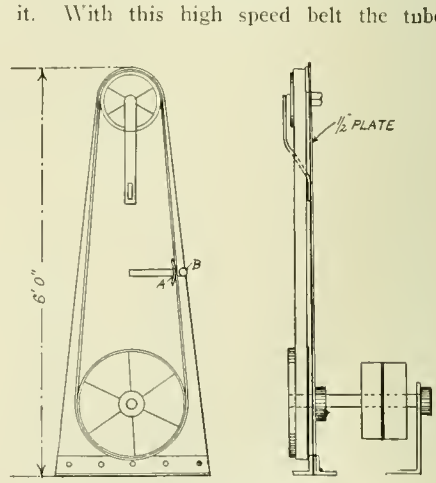
The tongue is made of wood and is held between the two straps fastened to the frame, and is braced by two ¾ in. round braces running down to the legs. The outer end is provided with a handle having straps that are bolted to the tongue.

In order to prevent the frame from tipping, as it would if it were held by a single sling at the axle, a second sling hung from the tongue is provided at a distance of about .. ft. .. in. from the axle. A bar 20 in. long, ⅞ in. thick and .. in. wide is pivoted to the top of the tongue so that it can swing vertically. A thread is cut through a hole near the end and in this a ⅝ in. screw *B* having a crank handle is run. The end of the screw has a bearing on a plate attached to the top of the tongue. A chain fastened to the swinging rod is brought down in a loop beneath the load which is raised and brought up towards the tongue by running the screw down and raising the lever. The load is thus securely balanced and may be readily moved.

Flue Grinding Machine

This machine is intended for removing rust and scale and brightening the ends of tubes to which safe ends are to be welded. The frame is formed of a ½ in. plate and, at its upper end it carries a stud upon which a loose pulley 11 in. in diameter and 3 in. face revolves. At the bottom there is a countershaft with a 20 in. driving pulley for a 2½ in. emery belt that runs over it and the overhead pulley.

There is a stop *A* 3 ft. from the floor that prevents any sagging of the belt when the tube *B*, to be ground is pressed against it. With this high speed belt the tube

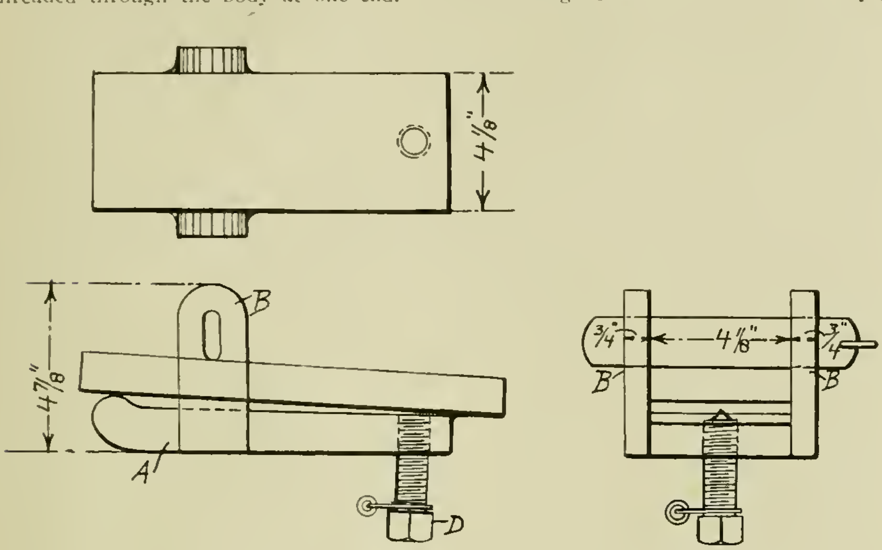


FLUE GRINDING MACHINE, ERIE RAILROAD

can be effectually cleaned of rust and brightened in a few seconds.

Device for Bending Eccentric Rods

This is an arrangement for bending eccentric rods and putting the offset in them that they so frequently require. The body *A* is made of machinery steel 4⅛ in. wide and of the shape shown in the side elevation. An upright *B* is welded to each side and these are cut for a 1½ in. by ½ in. key *C*. A set screw *D*, made of tool steel and having a hardened point, is threaded through the body at one end.



DEVICE FOR BENDING ECCENTRIC RODS; ERIE RAILROAD

The rod to be bent is heated and laid on the body, as shown, and the key driven home.

Screwing up on the set screw will then bend the rod at the key and it can be given any off-set that may be desired.

Technical Education for Trades

An able and lengthy paper was recently read before the South African Institution of Engineers by W. J. Horne, Organizer, Technical Education, Transvaal, on the above subject. Special attention was called to American systems as serving as models in advanced methods of training. Referring to the British Westinghouse Works School, Mr. Horne stated that all apprentices go through a general course, including applied arithmetic and mensuration; drawing and preliminary general workshop practice. On passing out of the general course they take up the study of mathematics, elementary science, mechanics, properties of materials as common to all apprentices, and in addition a special trade class according to the branch of the electrical or mechanical trade, testing, draughting or office work to which they happen to be apprenticed. The school hours lie between 8.30 a. m. and 5.30 p. m.; the junior apprentices attend for three hours per week in the forenoon, and the seniors for about half that time in the afternoons. The school was commenced in 1913, up to which time the Westinghouse Company had the conditions of apprenticeship prevailing generally in England. The reasons advanced were that (1) no apprentice under modern conditions could acquire a sufficient knowledge of his trade solely from his work in the shop; and (2) that the kind of instruction given in the usual type of technical school is of little value to the tradesman who intends to remain permanently in a workshop.

Referring to American machine shops, the system in vogue in the De La Vergne Machine Company, of New York, was selected. Here about 200 men and 40 apprentices are employed to produce oil-engines and ice-making machines. In this works the apprentices are employed on the company's production work, and are grouped six or so together under selected foremen; each apprentice spends a definite time in each branch, as follows:

As tool boy, up to 35 weeks (trial period).
At cold saw, up to 10 weeks (if necessary).
At power lathes, up to 40 weeks (various lathes).
At turret lathe, up to 20 weeks.
At drilling machines, up to 20 weeks.
At milling machine, up to 20 weeks (at least).
At shaping and planing, up to 10 weeks.
At bench and erecting, up to 10 to 25 weeks.
At boring mill, up to 10 weeks.
On test floor, up to 15 to 30 weeks.
In smith's shop, up to 5 weeks.
In foundry, up to 3 weeks.

Four hours' class-room tuition is given weekly, two in one period in workship mathematics and two hours in another period in drawing. A record card is kept for each apprentice on which his value is marked at the conclusion of each period on a machine tool, etc., for drawing, mathematics industry, workmanship and conduct on the following scale:—90 to 100 per cent., Excellent; 80 to 90 per cent., Good; 60 to 80 per cent., Fair; below 60 per cent., Poor.

Every three to six months each apprentice is rated for increase in pay. At the end of four years' apprenticeship his grade is determined by striking his average mark for the four years, and if he passes out he is given a certificate, a bonus of $200, and is advanced to first-class journeyman's rate.

The (*c*) class of institution of the old evening technical class type I shall not describe, as it is probably well known to many of us. It was found, both in England and America, that it did not of itself provide sufficiently for the great bulk of the average type of apprentice, while it did excellently well with the clever few. This dissatisfaction led to the establishment of specialized trades schools and of works apprenticeship schools.

Sanding Device

The improvement in sanding devices on locomotives has been one of the marked features of recent years, but James Southworth, an engineer on the Lancashire & Yorkshire railway of England, seems to have gone a step further and has invented a device which provides for the delivery on to the rails of a semi-liquid mixture of sand and water. The device is so constructed as to obviate the necessity of damp sand to arch in the sand box or to form a stoppage in the pipe. The possibility of the mixture freezing is also provided against. The water is introduced at the top of the sand box, the quantity being automatically regulated by valves so as to produce the semi-liquid mixture. There are also devices for sifting the sand in the box, and for heating the sand mixture and pipe in cold weather. It is claimed that by the use of these devices the necessity for sifting and drying the sand will be avoided and effect considerable economies. Not only so, but the mixture of sand and water can be so regulated that the sand will stay on the rails when delivered and so fulfil its purpose instead of being scattered by the four winds of heaven and the other winds from the air compressors or steam pipes.

Lubricating Steam Pipe Lines

An excellent condition of steam pipe lines may be maintained by placing a lubricator in the boiler room, and feeding a small quantity of cylinder oil into the line. There is absolutely no doubt that this expedient saves much loss at comparatively small cost. The feeding of oil tends to prevent corrosion, thereby preserving the threads of the piping, and keeps the gaskets at the joints soft, so that they do not crack and burn out. Steam lines treated in this way will last indefinitely, and stay tight.

Failure of Rails in the United States

The Interstate Commerce Commission in a recent report on an accident which occurred on a western railroad this year furnishes interesting details in the case of a passenger train that was derailed by the fracture of a rail, resulting in one death and injuries to 82 persons. The accident happened at the foot of a gradient flatter than 1 in 100, and on a curve, super elevated 2 inches of 44 chains radius, 680 feet long at a point of about 250 feet from the end. The rails were of Bessemer steel of 85 lb. weight and 33 feet long, rolled in September, 1904, and laid down during the following month; they were double spiked to an average of 18 oak ties to the rail. If these were 9 inches wide, the distance apart can only have been 14 inches. The ballast, of stone and cinders, was from 8 to 12 inches deep. They were provided with bearing plates. It is not stated whether the rails were laid upright or canted inwards, although this fact is of great importance. The general condition of the track was fairly good, but many of the rails were not in good condition. It is evident that there was nothing in the nature of the road to account for the accident, nor was the composition of the train which came to grief unusual in any respect. It consisted of two locomotives, the weight on the driving wheels not being mentioned; a mail car, baggage and smoking cars, a day coach and eight Pullman sleeping cars, 12 vehicles in all. It was traveling at a speed estimated at from 40 to 45 miles an hour, the last figure being most probably correct, as the train was over 3 hours late. The rail was broken into many pieces, 32 of which were recovered, in a length of 9 feet 6 inches from the forward end, on the left or inner side of the curve. None of the outer rails was disturbed in any way, although much of the rest of the permanent way was badly knocked about for some distance. There was every indication that the fracture was alone responsible for the derailment. The type of rupture was a split-head, nearly separating it into halves, which began 3 feet 6 inches from the fracture. This was plainly shown on numerous photographs and sulphur prints.

According to the report of the *Engineer-Physicist*, the origin of the plane of rupture is an interior one, about a quarter of an inch below the running surface. The plane of rupture extends downwards, until it reaches near the bottom of the head. Here it bifurcates towards the fillets, when complete division of the head takes place. At the upper initial edge of the plane of rupture a small V-shaped ridge of steel attached to the upper zone of metal is frequently found. This acts as a wedge to split the heads. The nature of the rail along the fractured portion was similar to that of the unbroken length. These failures are induced by certain longitudinal streaks or seams in the metal. Such seams are the incipient places whence planes of rupture extend. Owing to the narrowness of the split when it reaches the surface, it is extremely difficult of detection; this, of course, adds to the danger of the defect. A want of ductility is alleged to be the origin of the seams. No means of detecting the interior defects have yet been found. The conclusion is that, as it takes years of service to develop split-head fractures, it may safely be stated that an improvement in the structural state of the steel would measurably prolong the lives of certain rails. The result of the careful investigation in this and other similar accidents strongly corroborates the view that broken rails in the States are due to inherent defects in the manufacture, developed by the increasing weight on the driving wheels of engines.

Revolutionizing Rail Transportation

Fostered by the executives of the Northern Pacific Railroad in co-operation with W. F. Sailor, of the International Motor Company, several trial trips were recently made of a new type of passenger carrier which, it is said, may revolutionize rail transportation on branch line runs.

The vehicle which is arousing such unusual interest among leading railroad officials of the country, is a specially designed Mack gasoline rail car mounted on steel flange wheels so that it can be operated on standard railroad tracks.

The experimental trips were made over the Northern Pacific route from St. Paul to White Bear, a distance of about 12 miles. This run includes a steep and winding grade almost two miles long, one of the most severe in the Northwest. When it is understood that two locomotives are required to pull a passenger train up this ascent, some idea of the severity of the test may be ascertained.

Such great importance was attached to the first trip, that possibly the largest assemblage of big railroad men of the Northwest were present to take part in the initial try-out over the White Bear route. Prominent among these officials were Charles Donnelly, president of the Northern Pacific; Ralph Budd, president of the Great Northern; J. M. Hannaford, vice-chairman of the Northern Pacific; W. T. Tyler, vice-president of the Northern Pacific; William Genlo, of the Minneapolis & St. Louis; A. R. Kipp, of the Soo Lines; W. L. Luce, president of the Electric Short Lines, and J. J. O'Neil, general manager of the Chicago, St. Paul M. & O.

Twenty-three passengers were comfortably carried on the first trip, although the rated capacity of this motorized rail car is seventeen persons in addition to a baggage compartment. The rail car, watched by a long line of autoists who had assembled along the route, quickly climbed the steep, curved incline, and completed the run of 12 miles to the entire satisfaction of every one of the railroad officials.

After enthusiastically discussing the performance they had just witnessed, their unanimous opinion was that the experiment proved beyond doubt that motorized carriers, properly equipped, can be used to a profitable advantage in certain phases of railroad service.

When a second trip over the same route was made a few days later, the distance was covered in 29½ minutes, only 4½ minutes longer than it takes the Duluth Limited to make this run. Obviously, a small motor bus could not be expected to save time when competing with steam equipment, yet the railroad men who have carefully considered operating costs, strongly believe that gasoline rail cars will effect a more vitally necessary saving—that of operating expense. Moreover, even under the most unfavorable conditions for running a gasoline car, it has been found that the costs are much lower than those of steam operated equipment. This saving in operating costs, combined with the comparatively small capital investment required, promises to be the salvation of many branch lines, some of which have had to discontinue service.

One of the results of these tests has been a radical step away from established railroad precedent recently taken by the Northern Pacific. A number of years ago when James J. Hill, one of the foremost railroad men of his time, ran his first locomotive out of St. Paul, steam equipment was looked upon throughout the country as being the only logical answer to the transportation problem of the rapidly expanding Northwest. Today, his successor, Charles Donnelly, the present head of the Northern Pacific, is turning to the gasoline engine as an economical solution to one form of this transportation problem—short haul passenger traffic—which has never been profitably solved by the conventional railroad equipment. Convinced of the advantages of gasoline motor cars, the Northern Pacific now operates a Mack rail car in regular service on a branch line, and expects shortly to install more of these cars in like and larger capacities. Another big railroad of the West, the Great Northern, is also planning to install gas-propelled rail cars on its various branch lines.

In the East the New York, New Haven and Hartford R. R. will soon operate three such rail cars. Many of the smaller railroads, such as the Narragansett Pier R. R., Aberdeen & Rockfish R. R., Sewell Valley R. R., and Stone Harbor R. R. have been successfully using motor equipment for some time and others are in prospect.

Construction and Equipment Notes

The Erie Railroad Company purposes building an addition to the shops at Hornell, N. Y. The addition will extend to 40 by 100 feet, and with equipment will cost about $100,000.

The Lehigh Valley Railroad Company will ask for bids at an early date for the erection of a new and attached mechanical buildings at its locomotive and car shops at the foot of Chapel avenue, Jersey City, N. J. The plans are already filed, and the estimated cost will be about $150,-000.

The Missouri Pacific Railroad Company purpose building extensive additions to several of its car shops, additions to the shops at Nevada, Mo., are already in progress, and a contract awarded for construction on the additions to be made at St. Louis. The plans so far call for extensions measuring 65 by 150 feet, and consist of one storey and basement.

The Southern Pacific Railroad Company are receiving bids for the construction of a tunnel on the north side of Main street, Houston, Tex. The city and the city government will share equally in the cost, which is estimated at about $200,000.

The Louisville & Nashville Railroad Company, it is reported, are making extensive plans looking towards vast improvements in the company's works at New Orleans, La., and vicinity.

The Chicago, Burlington & Quincy Railroad Company has decided in purchasing 7,300 freight cars, including 3,000 general service cars, 1,300 refrigerator cars, 300 stock cars, and 127 passenger cars. Extensive repairs are being made on steel gondola cars by the General American Car Company, and the Western Steel Car and Foundry Company.

The Philadelphia & Reading Railroad Company are busy on plans involving the expenditure of over $2,000,000 in the construction of a new terminal and dock of reinforced concrete and steel, with concrete and wood pile foundations, in Kaighns avenue, Camden, N. J.

The United Railway Company, St. Louis, Mo., propose building a repair shop of three stories, with office buildings attached, at an estimated cost of $160,000, at St. Louis, Mo.

The Missouri, Kansas & Texas Railway Company is reported to have awarded a contract for reconstruction of its local freight station, which was destroyed by fire at Oklahoma City, Okla.

The Boston & Maine Railroad Company has finished plans for a new coaling plant, equipped with elevating and conveying machinery, to be erected at Concord, N. H.

Intensive Safety Work on the Pennsylvania

Organized safety work to emphasize the necessity of accident prevention which was inaugurated on the Pennsylvania railroad in 1910 has shown continued progress, and while the safety of the travelling public has accomplished the most gratifying results, the employees are constantly reminded to look out for themselves. An improvement of 53 per cent in the number of fatalities and 40 per cent in the number of injuries to employes of the system during the six months ending June 30, 1921 as compared with the accident record for the same period in 1920 is announced. The causes of fatal injuries enumerated and other salient features are being used as a basis for instruction by notices on bulletins, and also orally by subordinate officers, foremen and members of the various safety committees.

Railroad Construction in Canada

The Ontario Government has decided to extend the Temiskaming & Northern Railway northward about 70 miles toward its final terminus at tidewater on James Bay. This extension will involve an expenditure of about $3,500,000, and it is planned to award the work as a single contract which will provide work for the unemployed of this region.

Bids for the construction of this extension will be received by the Temiskaming & Northern Ontario Railway Commission and the data required for submitting the bids will be ready about December 1.

New Railway in Chile

Permission has been granted by the Chilean Government for the construction and operation of a new railway line between the port of Lebu and Los Sauces, connecting at the latter point with the State railways and passing through Canete, as reported by Chargé d'Affaires John F. Martin, at Santiago. The grant provides that construction shall begin within one year from September 2, 1921, and that the road shall be completed and ready for operation within four years from that date.

Gauge of Latvian Railways

The gauge of the railway line from the port of Windau east to Mitau, on the line to Moscow, will be changed from the present standard to the old Russian gauge, which is 5 feet wide, according to a report from Trade Commissioner R. Lawrence Groves, at Riga. From the port of Libau to the Russian railway system the gauge will also be widened. These changes will facilitate handling Russian trade through Latvia and will eliminate the interruption due to the freezing up of the port of Riga, as the ports of Windau and Libau are practically free from ice all winter.

Railway Activities in Chile

Four large contracts have just been awarded American firms for railway equipment, one being for 20 broad-gauge locomotives valued at $1,000,000. In all, the contracts cover 30 locomotives, 100 hopper cars, and a smaller order for refrigerators and cars of other types. Requests have been filed with the Chilean Government for permission to construct a broad-gauge railway line 22 kilometers long, from Curanilahue, Province of Aranco, to Cuyinco, to connect with the proposed railway from Lebu to Los Sauces; also to build a one-meter gauge line from Chacabuco to Camp Sorro near the Argentine frontier, a distance of 140 kilometers.

Rolling Stock on the Latvian Railroads

Official reports state that there are at present 280 locomotives on the Latvian railways, 59 for use in passenger service, 150 in freight service, and 71 in general service. Of these there are in repair shops 31 passenger, 75 freight, and 27 general service locomotives. The repairers are, apparently, unable to cope with the work. Fully 50 per cent of the locomotives are said to be old and worn out. The Latvian Government aims to establish a uniform type of locomotive, with five axles, diameter of wheel 1,450 millimeters, 70½ tons in weight, and of 14,000-kilo propelling power. To handle the normal traffic of these lines, 501 additional locomotives will be required, 286 Russian guage and 215 European gauge.

Passenger rolling stock comprises 392 cars, while there are 6,020 freight cars for the various gauges. To resume normal freight transportation 11,800 additional freight cars will be required, 6,100 Russian gauge and the remainder of European guage. The Latvian railways might offer a possible future field of endeavor for American manufacturers of locomotives and rolling stock.

Lower Freight Rates in Quebec

The Minister of Agriculture announces a reduction in the Province of Quebec of 33 per-cent on corn forwarded from Montreal or from any ports of the Great Lakes to any station in the Province of Quebec; 33⅓ per cent on grain siftings forwarded from Port Arthur, Fort William, Westfort, and Armstrong to any point in the Province; a reduction of 25 per cent on hay, thus restoring the rate in effect September, 1920. As regards transportation of hay, the reduction will apply only to points within the Province.

Only farmers and agricultural societies may benefit by these lower rates. All cars are to billed to the Provincial Department of Agriculture and will be delivered to buyers upon receipt of an order to the department.

Items of Personal Interest

H. W. Sasser has been appointed shop superintendent of the Erie at Galion, Ohio, succeeding G. T. Depue.

Harvey Grange has been appointed general foreman of the Chicago & Northwestern, with office at Clinton, Iowa.

Lee Parrens has been appointed road foreman of engines of the Atchison, Topeka & Santa Fe, with office at Needles, Cal.

O. S. Jackson has been appointed assistant superintendent of motive power of the Union Pacific, with headquarters at Omaha, Neb.

G. L. Hegberg has been appointed assistant machine shop foreman of the Chicago, Rock Island & Pacific, with office at Shawnee, Okla.

Charles F. McWilliams has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific, with office at Shawnee, Okla.

M. H. Haig, has been appointed master mechanic of the Pecos division of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M.

A. W. Kirkland has been appointed active superintendent of motive power of the Atlanta, Birmingham & Atlantic, with headquarters at Atlanta, Ga.

W. D. Hartley, master mechanic of the Atchison Topeka & Santa Fe, at Clovis, N. M., has been transferred to a similar position on the Mexico division.

James F. Deimling has been appointed Chief engineer of the Michigan Central, with headquarters at Detroit, Mich., succeeding George K. Webb, deceased.

G. W. Lillie has been appointed superintendent of motive power of the Denver & Salt Lake, with headquarters at Denver, Col., succeeding M. B. McPartland.

W. M. Anderson has been appointed master mechanic of the Northern Montana division of the Chicago, Milwaukee & St. Paul, with headquarters at Lewiston, Mont.

C. E. Brooks, traveling engineer of the Chicago, Milwaukee & St. Paul, has been promoted to master mechanic of the Bellingham division, with headquarters at Bellingham, Wash.

S. G. Kennedy, general foreman of the Atlantic Coast Line, with offices at Lakeland, Fla., has been appointed master mechanic of the Tampa district, with the same headquarters.

J. Mckenzie has been appointed shop superintendent of the Pere Marquette at Ionia, Mich., and W. F. Crowder has been appointed general car inspector, succeeding Mr. Mckenzie.

V. D. Clark has been placed in charge of the newly established branch of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., at 316 Thirteenth Street, Huntington, W. Va.

J. W. Keppel, general foreman of the Canadian Pacific with office at Vancouver, B. C., has been appointed master mechanic of the Regina division, Saskatchewan district, with headquarters at Regina, Sask.

L. E. Fletcher has been appointed acting master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Raton, N. M., succeeding T. T. Ryan, granted leave of absence on account of ill health.

F. M. Mozley, roundhouse foreman of the Gulf, Colorado & Santa Fe, with office at Gainesville, Tex., has been appointed master mechanic of the Southern division, with headquarters at Temple, Tex.

C. E. Brooks has been appointed master mechanic of the Chicago, Milwaukee & St. Paul, with headquarters at Bellingham, Wash., succeeding C. E. Cessford, assigned to other duties on account of ill health.

W. H. Dempsey has been appointed division master mechanic of the Chicago and Milwaukee division and the Milwaukee terminal of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis.

C. W. Wrenshall, general superintendent and acting general manager of sales of the central district of the Pressed Steel Car Company, Pittsburgh, Pa., has been appointed general manager of the company.

L. E. Fletcher has been appointed acting master mechanic of the New Mexico division of the Atchison, Topeka & Santa Fe, with headquarters at Raton, N. M., succeeding T. T. Ryan, absent on account of illness.

Henry P. Hoffstot has been elected vice-president of the Pressed Steel Car Company, Pittsburgh, Pa., in addition to his other duties as president of the Koppel Industrial Car & Equipment Company.

James A. Slater, manager of sales of the National Malleable Castings Company, at Chicago, Ill., has been appointed assistant sales manager, with headquarters at the Company's general offices in Cleveland, Ohio, succeeding J. H. Redhead.

F. G. Prest, purchasing agent of the Northern Pacific, with headquarters at St. Paul, Minn., has been appointed director of purchases, a newly created office, and E. J. Elliott, assistant purchasing agent, both with headquarters at St. Paul, Minn.

G. E. Passage, assistant division master mechanic of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., has been appointed master mechanic of the Terre Haute division, with headquarters at Terre Haute, Ind., succeeding J. A. Richards.

E. E. Machovec, master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Argentine, Kan., has been promoted to acting mechanical superintendent of the Northern Lines, Western district with headquarters at La Junta, Colo., succeeding J. R. Sexton, granted leave of absence.

G. H. Likert has been appointed fuel engineer of the Union Pacific, with headquarters at Omaha, Neb., and the following have been appointed fuel supervisors: B. E. O'Neill, Southern district, with headquarters at Kansas City, Kans.; A. L. Cory, Northern district, with headheadquarters at Cheyenne, Wyo., and T. C. Coats at Omaha, Neb.

George L. Bourne and Fred. A. Schaff, president and vice-president of the Superheater Company, New York, on their return from France report that they have formed as a French connection the Companie des Surschaffeurs, which has been given the rights of manufacture and sale of the Elesco superheaters and forged return bends controlled by the Superheater Company. The French Company is located at 11 Rue Scribe, Paris, France.

Ora S. Jackson has been appointed assistant superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb. Mr. Jackson was born at Huntington, Ind., and served as an apprentice machinist at the Huntington shops of the Erie, after which he served as foreman, general foreman and master mechanic on several of the leading railroads. Previous to his appointment as above he was general superintendent of the mechanical and operating departments of the Terre Haute and Southeastern.

John F. Hylan, Mayor of the City of New York, has been reelected by the largest majority ever given to any candidate for that office. The chief cause of the unusual result seems to have been a revulsion against the continued interference of the State authorities in Municipal affairs, particularly in the transit problem. Of course, it remains to be seen, whether the Transit Commission appointed by the Governor, and who are said to be making drastic inquiries into the affairs of the Interborough Rapid Transit and other companies will accomplish any needed improvement or merely effect a raising of the rates. The Mayor seems determined that in any event the rates shall not be raised, and has succeeded in establishing emergency bus routes at a low rate which have considerably relieved the congestion of traffic. Mr. Hylan still retains his active membership in the Brotherhood of Locomotive Engineers, declining to accept honorary membership in that or any other labor organization with whose activities he has been so honorably identified.

OBITUARY

George R. Henderson

George R. Henderson, consulting engineer to the Federal Fuel Administration in the Philadelphia district during the war period, and formerly, for a number of years, consulting engineer of the Baldwin Locomotive Works, died on October 19, at Media, Pa., in the sixty-first year of his age. Mr. Henderson was born in Philadelphia, and graduated from the Lauderback Academy, Philadelphia, in 1876. As draftsman, mechanical engineer, and assistant superintendent of motive power on some of the Western railroads, he became at a comparatively early age an accomplished authority in the mechanical department of railroads. He contributed occasionally to the engineering press and wrote several books appertaining to locomotive operation.

George Stephen

George Stephen, latterly known as Baron Mount Stephen, the pioneer railroad builder of Canada and first president of the Canadian Pacific Railway, died on Nov. 29, at Brockel Hall, Hatfield, Hertfordshire, England. He was born at Dufftown, Banffshire, Scotland, on June 5, 1829, and herded cattle in his early boyhood and latterly had some training in a dry goods shop in Aberdeen. Emigrating to Canada in 1850 he became the head of the largest dry goods establishment in Montreal. In the early 60's he became successively director, vice-president and president of the Bank of Montreal, and then became the foremost of the group of capitalists who financed and built the Canadian Pacific Railway. Among his associates were his cousin, Donald Smith, who became Lord Strathcona, and James J. Hill, builder of the railroads of the Northwestern United States. Mr. Stephen retired from the presidency of the Canadian Pacific Railroad in 1888, and returned to Great Britain, making his home in England, but always retained a residence at Grand Metis, Quebec. He contributed largely to educational and charitable work. He founded several hospitals and scholarships. He kept aloof from politics and confined his activities to banking, railroads and lands. He was made a Baron in the British Peerage in 1891, and received many honors and decorations. Though twice married he was childless, and his title expires with him.

Benjamin E. D. Stafford

Benjamin E. D. Stafford, vice-president and general manager of the Flannery Belt Company, died on November 30, at Atlantic City, N. J. Mr. Stafford was born February 25, 1866, in Brooklyn, N. Y. He was educated at Hopedale, Mass., and latterly in New York. He learned the machinist and tool making trade with the Hopedale Machine Company, now known as the Draper Corporation, and in a few years he had supervision of the tool department. After an extensive experience with the B. M. Jones Company, of Boston, through which he became expert in railroad work, he became associated with the Flannery Bolt Company in 1904, and became one of the leading experts on staybolt matters, and perfected many improvements on staybolts and tools used in their appliances. Mr. Stafford was a member of many of the leading engineering societies, among others the American Society for Testing Materials, American Society of Mechanical Engineers, the National Geographic Society and was past president of the Railway Supply Men's Association. He was a member of the F. & A. M. of Massachusetts.

A Successful Manufacturer Elected Mayor

Fred Atwater, Vice-President and Treasurer of the Columbia Nut & Bolt Co., Inc., Bridgeport, Conn., has been elected Mayor of the City of Bridgeport, Conn., Nov. 8th, by the largest majority ever given any candidate. Mayor Atwater carried every district in the city with a Democratic land

FRED ATWATER

slide, breaking the old Republican Machine that had been in control for ten years. Nearly every city in Connecticut went Democratic this year and there is a strong sentiment for Atwater as the next Governor of the State. Mayor Fred Atwater will still retain his connection with the Columbia Nut & Bolt Co., Inc., as Vice-President and Treasurer, where he has been in the manufacture of Lock Nuts since 1902. It is quite possible if we had more successful manufacturers in politics, it might be better for the general welfare than drawing upon the increasing supply of embryo lawyers.

DeLamater-Ericsson Committee

The DeLamater-Ericsson Committee has had a communication from the Board of Directors of the Association of Swedish Engineers, Stockholm, Sweden, stating that they will hold a celebration of the Sixtieth Anniversary of the engagement between the *Monitor* and *Merrimac* simultaneously with the celebration which will be held in New York and Washington on March 9, 1922. The Swedish committee hopes by means of these contemporaneous celebrations to still further enhance the already very cordial relations between Sweden and this country, and trusts that American engineers and other patriotic citizens will co-operate with the committee to this end.

Signal Section A. R. A.

The signal section of the American Railway Association will hold its next annual meeting on June 14, 15 and 16, 1922, at Spring Lake, N. J. This association is known as Division IV—Signal Section, and is associated with the Signal Appliance Association of which Henry Lee is chairman, Woolworth Building, New York, and F. W. Edmunds, secretary and treasurer, West Nyack, Rockland County, N. Y.

BOOKS, BULLETINS, Etc.

Life of George Westinghouse

A Life of George Westinghouse, by Col. Henry G. Prout, will be issued during the month by the American Society of Mechanical Engineers. Calvin W. Rice, secretary, has been receiving a large number of orders in advance of publication from the members of the American Engineering Societies. The price of the book in special half morocco binding is $6.00; in buckram, with gilt top, $3.50. At a later date a popular edition will be issued. The book is sure of a royal welcome from every engineer who takes a pride in the great men of his profession. Col. Prout's intimate knowledge of the subject, together with his mastery of style as a writer, may be relied upon as producing a work that will be a credit to the author and a fitting memorial to the illustrious inventor and engineer.

The Romance of the Railways, by T. W. Corbin. 310 pages, with many illustrations and diagrams, cloth binding. Published by J. B. Lippincott Company, Philadelphia.

The author states that this book is intended more for boys than anyone else, but it is hoped, nevertheless, that it may make an even wider appeal. It certainly deserves it. The story, if it may be so called, is written in a clear and engaging style and the marvels of early experiments and succeeding development are told with all the interest of the unfolding of a drama full of interesting characters and striking incidents, culminating in the splendor of modern achievements. As a work adapted to the general reading public it should meet with much popular favor, and as a compendium of bare facts we know of no better book to place in the hands of a lad who had his eye on the railroads. The author is evidently a Britisher but much of his illuminating story refers to American achievement as well as the accomplishments in other lands, and with such a breadth of vision the work should be welcome to all English speaking people.

Tentative Standards

The American Society for testing materials has issued the 1921 edition of its book of Tentative Standards. As is well known the standards and tentative standards of the Society are recognized as authoritative in the field of engineering materials. The work extends to 518 pages, and contains 127 Tentative Standards relating to steel, non-ferrous metals, cement, preservation coatings, coal and coke, imitating materials and numerous other miscellaneous materials. While much of the work relates to standards already universally adopted there is much that is new in each succeeding volume, largely added to as the result of the annual conventions. The membership of the Society exceeds three thousand, and the annual volume may be said to be a condensed edition of the accumulated engineering data in the field in which it is engaged. The book is finely printed and contains many detailed drawings of apparatus used in testing materials. Published by the Society, 1315 Spruce St., Philadelphia, Pa.

Accident Bulletin No. 79

The report of accidents on steam roads for the first quarter of 1921, shows a gratifying reduction in the number of casualties to persons, the fatalities numbering 1,604, being about 30 per cent less than the average record for many years. Of these 528 were employes. There is also a falling off in the number of accidents at grade crossings showing that the determined efforts of the railroad companies to safeguard automobile drivers—many of whom seem to be incapable of guarding themselves—are showing good results.

Electric Railway Problems

A Review of Electric Railway Problems of 1921 has been issued by the Westinghouse Electric & Manufacturing Company in Special Publication 1644. This publication is profusely illustrated as an aid to the discussions on Mass Transportation, Multiple-Unit Control, Recent Railway Motor Development, Possibilities in Interurban Service, The Value of Freight Haulage, Snow Fighting, Automatic Sub-stations, The Place of the Safety Car, The Field of the Trolley Bus, Replacement of Obsolete Equipment, Maintenance of Electric Equipment, and many other subjects.

Electrification Data

Vol. III, No. 1 of Westinghouse Electrification Data has been published and is being distributed. This issue treats of the Economics of Railroad Electrification, and includes a portion of the progress report made by the Super-power Survey to the Ex-Secretary of the Interior. Several railroads are mentioned, including the Norfolk & Western, New York, New Haven & Hartford, the Erie Railroad, the Grand Trunk Railroad, the Chicago, Milwaukee & St. Paul Railroad.