The LOCOMOTIVE WORLD

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LOGGING PLANTATION MINING
INDUSTRIAL AND
STANDARD RAILROAD MOTIVE POWER

THE LOCOMOTIVE WORLD

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THE LOCOMOTIVE WORLD

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THE FRANKLIN TYPE AND PRINTING COMPANY

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FEDERAL BOILER INSPECTION

Methods of Filling Out Boiler Forms Nos. 1, 2 and 3.

In order to avoid confusion and obtain uniformity, the Chief Inspector of the Division of Locomotive Boiler Inspection has requested that the methods following be used in filling out the various forms, taking first the Monthly Boiler Inspection and Repair Report:

The month for which the report is filed should be inserted in the upper left hand corner of report and the number of the locomotive and the initials should be given in the upper right hand corner. The initials will be those of the owning railroad, and not of the operating railroad. The name of the company operating the locomotive should appear on the line at the top of the report; the initials of the company are not satisfactory, the full name being required on this line. The date that the inspection and repairs are completed should be filled in on line 2 of the body of report. The place where inspection was made and the locomotive number should be filled in on line 3. The locomotive number should correspond with that given in the upper right hand corner of report. The name of the operating company should be filled in on line 4, and the working steam pressure should be filled in on line 6.

Question No. 1 should show the pressure at which each safety valve is set to pop. If the locomotive is equipped with only two safety valves, the space on report for the third safety valve should be filled in with the word "none." The date of setting should be given.

Question No. 2 should show the date on which steam gauges were tested and left in good condition. The steam gauges should be tested immediately before the safety valves are set or any changes made in the setting.

Question No. 3 should be answered "yes" or "no." If the boiler is not equipped with a water glass, a line should be drawn through the words "water glass cocks."

Question No. 4 should be answered "yes" or "no,"

Question No. 5 should be answered "yes" or "no."

Question No. 6 requires two answers; first, showing the condition of the flues, and, second the condition of the firebox sheets, thus; If the flues are fair and the firebox good, say "fair," "good"; or "good," "good," if both are good.

Question No. 7 requires two answers; one showing condition of staybolts, the other showing condition of crown stays. These answers should show the number found broken at the time of inspection, thus: If three staybolts are found broken and crown stays are all intact, the answer should be "three bad" (indicating three broken staybolts), and "good," indicating that crown stays are good. If any of the crown stays are also found broken, the answer should indicate the number. If none of the staybolts or crown stays are broken, the answer should be "good," "good"

Question No. 8 should give the number of crown stays and staybolts which were renewed at time of inspection and repair, thus: If, in the inspection, three staybolts were found broken and all three renewed and no crown stays were broken, the answer should be "three," "none." If none of the broken staybolts were renewed, it should be so stated, and the location of the broken bolts should be given on the diagram on the reverse side of Boiler Form No. 1. We might here call attention to the fact the relative positions of the words, 'staybolts' and 'crown stays' in questions 7 and 8 are reversed; and it is, therefore, necessary to be careful in indicating the number of each found broken and the number shown as renewed in reply to Question No. 8.

Question No. 9 requires two answers, giving the condition of arch and water bar tubes, if used; if either is not used, the answers should be "not used," thus: If the boiler is fitted with arch tubes but no water bar tubes, the answers would be "good," "fair," or "bad," as the case may be, covering the arch bar tubes, and "not used" covering the water bar tubes. Or, if neither is used, "not used."

Question No. 10. If date of previous hydrostatic test is known, it should be given; otherwise, the answer should be "no record." "No record" will not be considered as a proper answer to Question No. 10, after July 1, 1912.

If boilers are equipped with fusible plugs, they shall be removed and cleaned of scale at least once every month. Their removal must be noted on the report of inspection. This item should be noted as Item 11. For example: "Were fusible plugs removed and cleaned?"—"yes" or "no."

QUARTERLY REPORT

This report is filled out the same as the monthly report, except that in Question No. 1, the date that the safety valves were set must be given; and in the answer to Question No. 2, the date steam gauges were tested and left in good condition, must also be given. These dates must correspond, and also correspond with the date shown on line No. 2. You will understand that these dates will then hold good in filling out Boiler Form No. 1 for the next three months. Every third month, however, safety valves and steam gauges must again be tested.

BOILER FORM NO. 2.

It is understood that Boiler Form No. 2, or Quarterly Inspection Card for Locomotive Cab, can not legally be filled out and posted in the cab until all the provisions in Boiler Form No. 1 have been complied with, as the Quarterly Inspection Card indicates this. In filling out this card, the name of the operating railroad should appear on the first line. The number of the locomotive on the second line. The date safety valves and steam gauges were tested on the third line; and the date last hydrostatic test was made, on the fourth line. On the fifth line, the place or name of the division point where tests and inspections were made should appear. The next line shows the name of the inspector, and the last line the expiration of the card, which is three months from date of card.

ANNUAL REPORT—BOILER FORM NO. 3

The name of the company operating the locomotive should appear in the upper left hand corner of the report; the initials of the company are not satisfactory, the full name being required on the line. The number of the locomotive must be inserted in the upper right hand corner, and also where it is called for on the third line of the report. The initial of the locomotive must be given in the upper right hand corner, and the initial will be the initial of the owning railroad and not the initial of the operating railroad. The date that the inspection and repairs are completed should be filled in on line 2. The place where inspection was made should be filled in on line 3. The name of the operating company should be filled in on line 4, and the working steam pressure should be filled in on line 6.

Question No. 1. If date of previous hydrostatic test is known, it should be given; otherwise, the answer should be "no record."

"No record " will not be considered as a proper answer to Question No. 1 after July 1, 1912.

Question No. 2. If date of previous removal of flues is known, it should be given; otherwise, the answer should be "no record."

Question No. 3. If date of previous removal of lagging from barrel of boiler is known, it should be given; otherwise, the answer should be "no record."

Question No. 4. If the date of previous removal of caps from flexible staybolts is known, it should be given; otherwise, the answer should be "no record." "No record" will not be accepted as a proper answer to this question after January 1, 1913. If flexible staybolts are not used, the answer should be "not used." If bolts of the "breakless type" are used, the following note in addition to the above answer should be made—"Special 18mo. examination of Breakless bolts made ....19...." All of the above questions refer to the past, and answers to the following questions refer to the present:

Question No. 5 should be answered "yes or no."

Question No. 6. The total number of flues removed should be given.

Question No. 7 should be answered "yes or "no."

Question No. 8 should be answered "yes" or "no."

Question No. 9 should be answered "yes" or "no." If flexible staybolts are not used, the question should be answered "not used."

Question No. 10 should be answered "yes" or "no." The dome cap is required to be removed whenever the hydrostatic test is made. If throttle standpipe is not removed when hydrostatic test is made, a note should be made that "boiler was entered without removing standpipe," and a line should be drawn through the words "and throttle standpipe." If the boiler is entered by removing the throttle box only, the word "standpipe" should be erased and the word "box" inserted.

Question No. 11 should show the pressure applied when hydrostatic test was given.

Question No. 12 should be answered "yes" or "no."

Question No. 13 should be answered "yes" or "no."

Question No. 14 should show the pressure at which each safety valve is set to pop.

Question No. 15 should be answered "yes" or "no." If the boiler is not equipped with a water glass, a line should be drawn through the words "water glass cocks."

Question No. 16 should be answered "yes" or "no."

Question No. 17 should give the number of crown stays and staybolts which were renewed at the inspection and repair. The total number of staybolts renewed from the time the locomotive was taken out of service, until the inspection and repairs are completed, should be given. If the boiler is given a new firebox, this question may be answered with the words "new firebox."

Question No. 18 should give the condition of the exterior of the barrel of the boiler if one-third or more of the lagging is removed from the barrel. If less than one-third of the lagging is removed, the answer should be "not inspected." All of the lagging must be removed at least once every five years and a thorough inspection made of the entire exterior of the boiler at that time.

Question No. 19 should give the condition of the interior of the barrel of boiler if a sufficient number of flues are removed to allow a thorough examination of the belly of boiler. If such a number of flues are not removed, but the interior of the barrel above the flues is examined, this item should give the condition of the interior of the barrel above the flues. For example: "Good above flues." The entire set of flues must be removed at least once every three years and a thorough examination made of the entire interior of the boiler.

Question No. 20 requires two answers; first, showing condition of firebox sheets; and, second, showing condition of flues.

The answer to Question No. 21 should give the condition of arch tubes, if used. If not used, the answer should be "not used."

The answer to Question No. 22 should give the condition of water-bar tubes, if used. If not used, the answer should be "not used."

Question No. 23 should give condition of cross-stays, if used. If not used, the answer should be "not used."

The answer to Question No. 24 should give the condition of throat stays, if inspected. If not inspected, the answer should be "not inspected." By "inspected" is meant a visual inspection; as it is claimed that defective throat stays can not be detected under the hammer tests the same as defective staybolts. Therefore, unless visually inspected, the answer should be "not inspected."

The answer to Question No. 25 should give the condition of sling stays, if used. If not used, answer should be "not used."

The answer to Question No. 26 should give the condition of crown bars, braces and bolts, if used. If not used, the answer should be "not used." If radial stays are used, their condition may be indicated by erasing the words "bars, braces and," the answer thus giving condition of crown bolts. T-bars, such as are used in connection with radial stayed boilers, will be included under the heading of "bars."

The answer to Question No. 27 should give the condition of dome braces, if used. If not used, the answer should be "not used."

The answer to Question No. 28 should give the condition of back head braces whenever it is possible, for these braces to be inspected. If not inspected, the answer should be "not inspected."

The answer to Question No. 29 should give the condition of front flue sheet braces whenever it is possible for these braces to be inspected. If not inspected, the answer should be "not inspected."

If boilers are equipped with fusible plugs, they shall be removed and cleaned of scale at least once every month. Their removal must be noted on the report of inspection. This item should be noted as Item 30. For example: Were fusible plugs removed and cleaned?—"yes" or "no."

OUT-OF-SERVICE REPORTS

In regard to the out-of-service report referred to in the last paragraph of the general instructions, applicable to both monthly and annual reports, the following should be added:

If a locomotive is in service at any time during the last fifteen days of any month, and an inspection report has not already been filed for that month, a report of inspection of Boiler Form No. 1 should be filed, showing the condition in which the locomotive was found immediately prior to being removed from service, and also bearing a notation to that effect that no repairs had been made, but before the locomotive went into service again all the repairs would be made and an inspection and repair report on either Boiler Forms 1 or 3 would be filed therefor. The out-of-service report need not be filed until the end of the month for which it is to cover.

The out-of-service report is made on Form No. 1. In making this report, the month it is intended to cover appears in the upper left hand corner. The number of the locomotive and the initial in the upper right hand corner. The name of the operating company on the first line. Then, diagonally across the face of the report should be written "Out of service from.............." (giving dates) "For................" (state whether repairs, sold, scrapped, etc.) "And will not be used until inspection report is filed." "Dated at................ at................" This report should be sworn to by the officer in charge, who must sign it. All other reports must be signed and sworn to by the inspector or inspectors, and certified to by the officer in charge.

Where two men make the various tests or where the inspector is not in position to certify to such work as has been done by the machinist, both men making the tests and inspections must swear to the reports. In this case, the Boiler Form No. 1 should show before each of the questions the initial indicating the mechanic who made the various inspections, as, for instance—before Questions Nos. 1, 2, 3, and 4, "setting of safety valves," "testing gauges," "cleaning gauge cocks," "testing injectors," etc., the letter "M" indicating that the machinist looked after this part of the work, should be used. Before Question No. 5, where a part of the steam leaks were repaired by the machinist and the others by the boilermaker, the letters "M" and "B" should be used; and before Questions

Nos. 6, 7, 8, 9, and 10, the letter "B," indicating that the boilermaker or inspector looked after this part of the work, should be used.

In connection with filling out the above reports, it might be well to state that the latest instructions from the office of the General Boiler Inspector with regard to the setting of safety valves, as referred to in paragraph 35 on page 9 of the Order of the Commission, are that two steam gauges must be employed during the time the safety valves are being set. One of these gauges to be visible to the man adjusting the safety valves. Both gauges must be tested and must correspond. The safety valves, however, must be set to the correct pressure to be carried, as indicated by the gauge permanently employed on the boiler. The second or temporary gauge—that is, the one that must be visible to the man setting the safety valves—is simply to be used as a check to guard against over pressure in case the man in the cab, whose duty it is to inform the man on the boiler of the pressure indicated by the safety valves, should have his attention momentarily detracted from his duties. It will also be necessary, hereafter, although not so stated in the Order of the Commisssion, to see that the syphon pipe connected to the steam gauge, together with the cock leading to the boiler and the shut-off cock are fully open, and that the pressure is not in any way obstructed by short kinks in the pipe or partial stoppage of the cock or cocks. And where two cocks are used, both handles must point in the same direction when the cocks are open or closed, preferably in line with the pipe when open and crosswise closed. This latter order has been brought about through an explosion occurring on one of our railroads while the safety valves were being adjusted.—*F. P. Roesch in Locomotive Firemen and Enginemen's Magazine.*

PORTLAND CEMENT PRODUCTION

During the last thirteen years the production of Portland cement in the United States has shown an annual increase and the growth of the industry has been enormous. This is indicated by the fact that the two-million barrel increase in production in 1911 was the smallest that has been recorded within the period named above.

The total production of Portland cement in the United States in 1911, according to Ernest F. Burchard, of the United States Geological Survey, was 78,528,637 barrels, valued at $66,248,817. Although the increase over the production of 1910 was 1,978,686 barrels, or 2.58 per cent, the total value decreased $1,956,983, or 2,87 per cent. The average price per barrel in 1911 was a little over 84 cents which was five cents per barrel less than the price of 1910.

The average price of cement at the Pacific Coast mills was $1.40½, while the price in the Lehigh district was 71¾ cents per barrel.

It is reported by Mr. Burchard that many mills in the East and the Middle West sold cement as low as 65 cents a barrel.

Nine additional plants reported production during 1911 over the number in 1910, bringing the total plants in operation in the United States up to 115.

There were 926,091 barrels of natural cement produced during 1911, valued at $378,533. Of puzzolan cement there were 93,230 barrels valued at $77,786. Add these to the Portland cement and the grand total of barrels is 79,547,958 which were valued at $66,705,136.

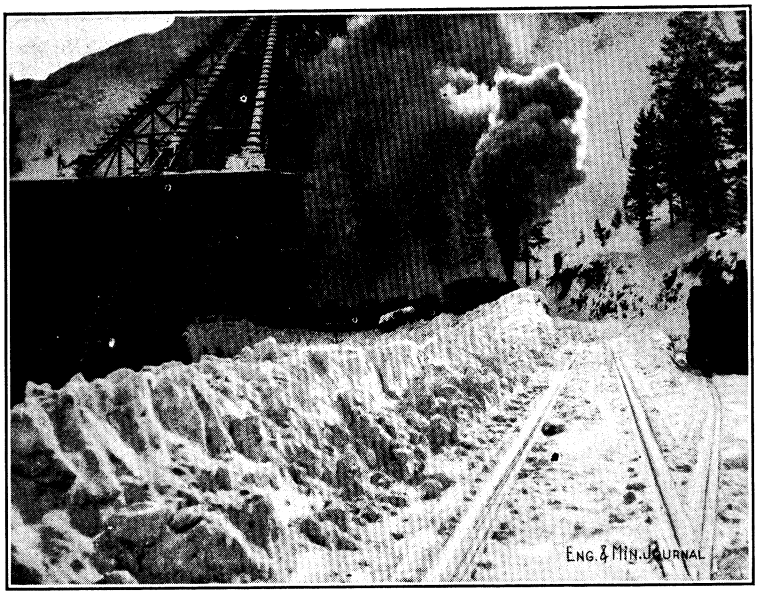
Three new plants, the International near Spokane, the Olympic near Bellingham, Washington, and the Portland plant near Portland, Oregon, promise to add three more productive plants during this year. At least their cement will be ready for the 1913 market.

Muscular and Horse Power

Glibly as everyone now talks of horsepower there are few things concerning which the average man knows so very little as he does of what strength the human or the animal is capable of exerting. Some idea of this has come to light through a series of interesting tests recently made to determine the respective pulling power of horses, men and elephants. Two horses weighing 1,600 pounds each, together pulled 3,750 pounds or 550 pounds more than their combined weight. One elephant weighing 12,000 pounds pulled 8,750 pounds or 3,250 pounds less than its weight. Fifty men, aggregating 7,500 pounds in weight, pulled 8,750 pounds, or just as much as the single elephant; but, like the horses, they pulled more than their own weight. One hundred men pulled 12,000 pounds.—*Ideal Power.*

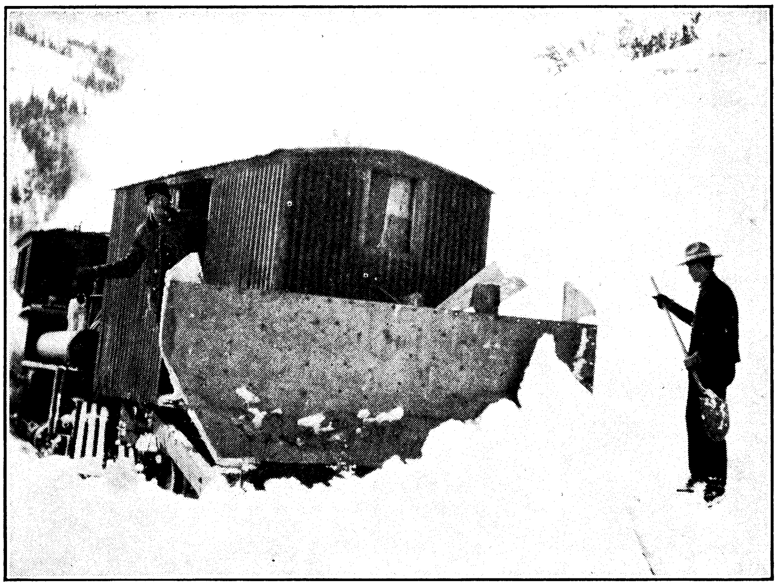
Some Interesting Views

When the warm Summer days come and the sun beats down upon us, it is pleasing to the eye to gaze on a Winter scene. The views herein illustrated have been loaned to us by the Engineering and Mining Journal and show operations of the Empire Copper Company, Mackay, Idaho. These views show difficulties encountered on a mining railroad during winter months. The road is operated by Shay geared locomotives, which are equal to the demands, and Mr. LELAND, president of the above company, states that they are able to keep road open for traffic at all times. They have some very heavy grades to overcome; some of the grades being 6 per cent combined with 34 degree curves.



Shay Engine bringing up a train load of mine timbers, complete and ready to "go" in. A heavy load for a little engine.

Large Ore Bin, where the Shay road cars are loaded. The tramway down which ore is brought is shown in background.

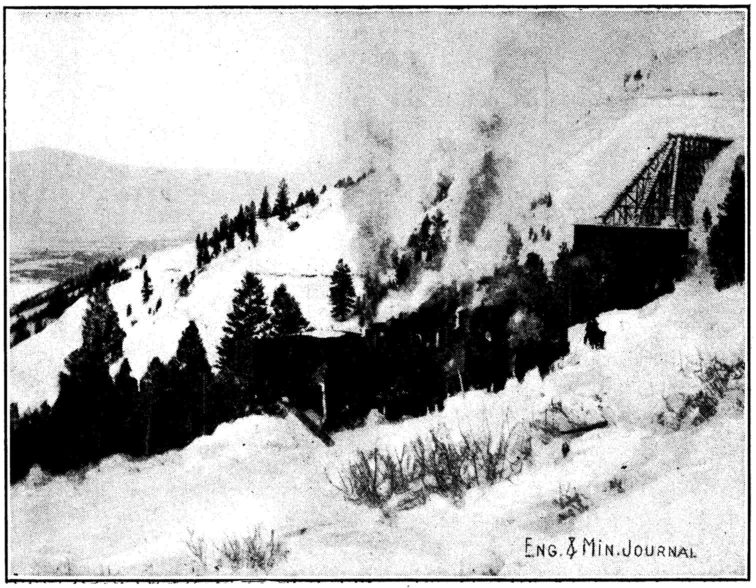


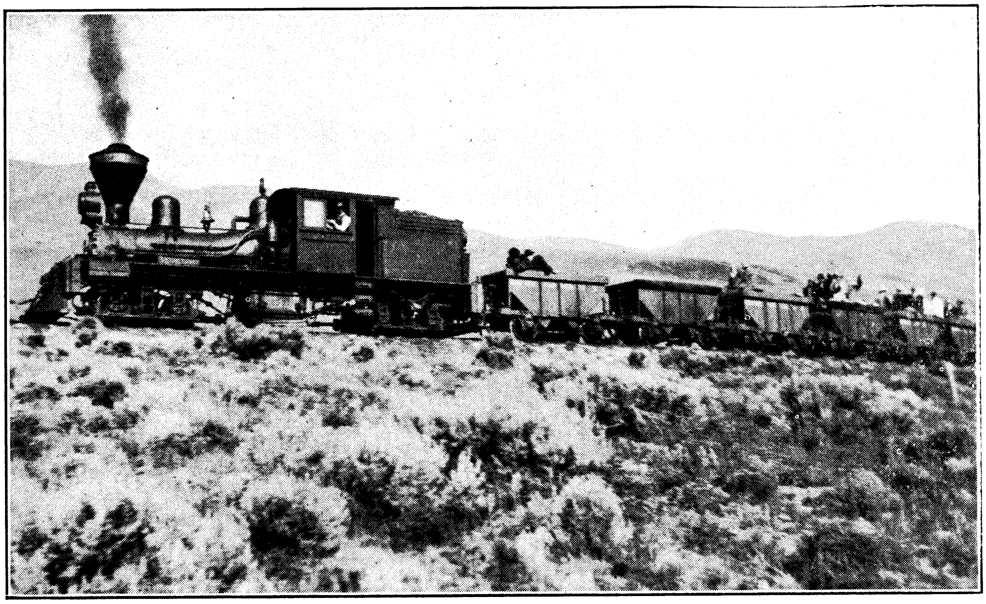
Views of Home-made Snow Plow

Coupled to two 24-ton Shay locomotives

USED BY

Empire Copper Company, Mackay, Idaho.





Shay Locomotive with Lima R. & H. Stack, on Empire Copper Company Railroad.

THE LOCOMOTIVE

RECENT IMPROVEMENTS

Most important of all changes in the science of railroading since the invention of the locomotive by Stevenson are those that are under way today. The general public knows little about them, yet without the improvements introduced transportation rates would have to be raised, the drain on the coal fields of the world would be increased and the cost of living would be even higher than it is today.

The locomotive has been going through and still is in a period of evolution. Its efficiency has been increased amazingly. It is conservative to estimate this increased power at from twenty to twenty-five per cent.

Three inventions play a part in this—the superheater, the brick arch and the mechanical stoker. Of these the superheater is of first importance, the brick arch second and the mechanical stoker third.

The superheater is the creation of Wilhelm Schmidt, who was a farm boy in Germany and who worked as a blacksmith's helper and a blacksmith in Dresden. Through his invention he is likely to be known to fame as one of the great benefactors of mankind. The brick arch is old. It was used forty or more years ago, abandoned, revived, dropped again, and now, in a much improved and more effective form, it is doing excellent service. The demand for maximum capacity from the fire-boxes because of the introduction of the superheater made the arch more of a necessity than in former days.

A RADICAL DEPARTURE

Like the arch, there is nothing particularly new in the mechanical stoker idea. In development, however, it is a radical departure from the "dummy fireman" of years ago. The mechanical stoker is here to stay, although comparatively few railroads are using it yet. How much a part it plays in increasing the efficiency of a locomotive is a matter of dispute. Its use today is confined almost exclusively to the mammoth locomotives of the Mountain and Mikado types on the great coal-carrying railroads, such as C. & O., the Norfolk & Western and the Virginian, where the locomotives are so big that two firemen have to shovel coal if the mechanical stoker is not on the job.

The locomotive has been and is yet one of the most wasteful mechanical devices in man's serivce. Despite all he has been able to do heretofore, man has been able to get only about five or seven per cent of the energy that is in the coal used in a locomotive. There is waste, too, in steam. There has been a loss of about fifteen per cent in the transmission of steam from its creation to its use. It is in wiping out this waste in the transmission of steam that Wilhelm Schmidt has done his great work.

At the age of 18 Schmidt was a blacksmith in Germany, and is now about 50 years old. He has, to a high degree, the painstaking, earnest methods characteristic of the German. While he worked at the forge he thought out several mechanical improvements in connection with the use of steam, and one in particular which applied to steam boilers and engines used in steamships. He might never have been heard of, however, and his genius never found vent but for chance.

DISCOVERY BY ACCIDENT

One day, while at work, he was sent by his foreman to repair a lock in the door of the home of Prof. Zeuner of the University of Dresden. When Schmidt finished the job, Prof. Zeuner complimented his workmanship and asked him some questions about himself. The boy was so encouraged by the kindly manner of the professor that he summoned up courage to speak on his ideas and the improvements that he had thought out. Schmidt had drawn out roughly on sheets of wrapping paper some of the ideas that were in his mind.

The professor recognized in these rough drawings the spark of genius. The drawings were very crude, for Schmidt was without technical mechanical training.

Prof. Zeuner was deeply interested and informed some of his associates that he had discovered a youth of promise. They arranged to give private lessons to Schmidt, preparing him especially in the subject of steam engineering. Schmidt proved so apt a student that at the age of 25 he was recognized throughout Germany as an authority. Not only that, but he had become one of the leading inventors of appliances which tended to utilize more completely the power contained in steam. This recognition was emphasized when the honorary degree of doctor of engineering was bestowed upon him by the University of Carlsruhe.

Steam is a highly compressible and elastic vapor generated from water at a temperature of 212 degrees Fahrenheit. In a closed vessel such as a locomotive boiler it is necessary that the water be raised to a much higher temperature which, at 200 pounds pressure equals 388 degrees. The steam passes through the valve called the throttle valve, thence through pipes to the steam chest. The expansive force of the steam moves the pistons, piston rods and cross-heads back and forth. The passage of the steam is effected through many winding pipes. Steam has a tendency to return to water. In its comparatively long course about 15 per cent of the power is lost through this tendency to return to water.

About twenty years ago Dr. Schmidt was employed in perfecting a type of engine, using a mixture of hot air and steam, by which he expected to obtain a great improvement over the ordinary steam engine. His tests convinced him that it was possible to use steam up to 660 degrees Fahrenheit and he also came to the conclusion that superheated steam was the best medium by which to overcome the losses due to condensation. In other words, his plan was to heat the steam to a degree of dryness, increase its expansive power and rid it of its waste.

THE SUPERHEATER HIS LIFE WORK

From the time Dr. Schmidt first experimented with superheated steam he made his life work the development of a superheater to produce and carry setam to the cylinders in a satisfactory manner. He designed various types of superheaters, each of which was constructed to furnish steam at very high temperature and the present superheater is the result of all these years of work.

The Prussian State Railways were the first to test the Schmidt type of superheater in locomotives. The first two superheater locomotives on the Prussian lines were put to work in 1898 and still are in regular express service. A lot of difficulties were encountered in the construction of these engines, and special forms of pistons, piston-valves and stuffing boxes had to be designed to stand the high temperature of the steam. These two locomotives marked the beginning of the use of superheated steam in railroad service.

The growth of the superheater is evidenced by the fact that more than 12,000 superheater locomotives are in service now on European railroads, principally in Germany, France, England and Russia.

This continent did not know the superheaters until 1900. Then they were tried experimentally on the Canadian Pacific. For nine years other railroads looked upon the Schmidt superheater largely as an experiment. Then, all of a sudden, it came into great favor. From 1909 up to the present time there have been installed in American locomotives nearly 7,000 superheaters of this type. They are distributed among more than 100 railroads. Recently the extension of the use of the superheater has included Africa, South America, Japan and Australia, so that the use of the Schmidt superheaters is worldwide now, more than 20,000 being in service.

It effects a wonderful economy. By its use a locomotive burns one-quarter less coal than under the old system. Locomotives use five per cent of the total production of coal in the United States. What a bearing a saving of 25 per cent of locomotive fuel has on the conservation of the coal resources of the country is a simple problem.

It also has made possible the increase in the size of locomotive and thereby made the operation of longer trains and faster schedules possible. It has reduced the congestion of railroads because longer trains mean fewer doubleheaders, By increasing the number of ton miles the locomotive is capable of producing there is a reduction in the number of train miles necessary to the transfer of freight. In this period of agitation against the railroads, and the legislation adverse to them, the superheater has been a means of keeping within bounds the operating cost of many a railroad that would not have been possible had the high cost of operation continued that existed when saturated steam locomotives were used exclusively.

What the superheater does to the steam the arch does to the gases in the firebox. Because of the tremendous activity of combustion on the grate of the modern locomotive an infinitesimal time is available for the combustion of the gases given out by the coal. These gases move with great velocity and the distance through which they must pass while burning is extremely short. These gases must burn before they reach the tubes.

The fire-brick arch forms a sort of slanted hurdle in the firebox compelling the flame to double over it, thus increasing the length of the flame. The arch increases the temperature of the fire, drives the hotter flame to the back and crown sheets and compels every pound of coal to give up more heat.

The revival of the arch is due to the fact that locomotives had reached the point where clearances and weight had reached the limit and it was necessary to crowd greater boiler capacity into the limits already reached. The arch adds to the boiler capacity by making each square foot of heating surface count to the fullest. By increasing the combustion it lessens the amount of smoke and cinders. It is claimed for the brick arch that it produces as complete combustion in a locomotive as is obtained in the average stationary engine.

Many men have been concerned in the development of the brick arch. It is difficult to say to whom most of the credit is due. The value of the arch is appreciated more today than ever in the history of the locomotive, and it is likely, before long, that all locomotives except those of small size, will be equipped with it. Tests have shown that it saves nearly 12 per cent in coal and 40 per cent in the abatement of smoke.

THE MECHANICAL STOKER

To the public at large the mechanical stoker probably is more interesting than either the superheater or the arch. It is older than either. Way back in 1855 the old Ross Winans camelback engines had a sort of mechanical stoker. The first real automatic stoker, however, was the Day-Kincaid, afterward known as the Victor. The firemen laughed at it. As a matter of fact, it had not become a necessity, but on some railroads it is a necessity today.

Not so many years ago the average locomotive did not burn more than six or seven tons of coal on a run of 100 miles. Today the average is nearly double that amount. On some railroads where trains of 80 or 100 cars are hauled and mammoth locomotives are used, it is a physical impossibility for one fireman to shovel enough coal into the firebox to keep the fires up to requirements. Two firemen have to be employed. Every time the firebox door is opened there is a loss of radiation. The efficiency of the fire depends in part upon the physical condition of the fireman. If he distributes the coal evenly andw ell, the fire will burn evenly and well, If he becomes tired he is not likely to throw as much coal to the far end and corners of the firebox as he should, and is apt to dump more coal near the door than is good for the fire.

There are various forms of mechanical stokers. One of them consists of a crusher and elevator and a distributer. The crusher is located on the tender. It takes the coal and crushes it to a size which will pass through a slot about one and one-half inches in width. Then it is taken in a conveyor or elevator to the boiler-head and the deck-plate. The coal falls into a main distributer hopper, thence into three other distributers, one of which is located centrally and each of the other two on the side. Each distributer is fitted with a steam nozzle, through which a blast of steam is admitted for driving the coal into the firebox. Literally the coal is sprayed over the flaming mass of stuff in the firebox.

It is possible for the fireman to inspect his fire at any time, rake the fire or supplement the work of the stoker by hand firing. Should the mechanical stoker fail, or anything go wrong with it, hand firing can be resorted to immediately. It seldom is necessary to open the fire door at all, and complete round trips over a division or more than 100 miles without this being done is common. In fact ,the mechanical stoker is almost human in doing its work.

Of the men responsible for the development of the mechanical stoker as it is today, Clement F. Street, of Cleveland, Ohio, and D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines west of Pittsburgh, are pre-eminent. Street has developed what is known as the overhead feed and Crawford the underfeed.

What any improvement in the locomotive means may be gathered from the fact that in the United States alone there are 63,000 locomotives, and an average of nearly 4,500 locomotives are built each year. Locomotives cost a great deal of money. A switch engine costs approximately $17,500; a large Mikado locomotive costs $27,500 —*The Railway Record.*

QUESTIONS AND ANSWERS.

Position of Valves at Different Positions of Crank Pin.—"With engine on dead center, in what position will valves be with lever in forward gear, back gear and center notch, lower forward eighth, lower quarter, lower back eighth, back center, upper back eighth, top quarter, and top forward eighth? Give position of valves on both sides. Stephenson link motion outside admission valves."—T. E. G.

Answer.—Starting with the right side of the locomotive on forward center, if the engine is a right lead engine, as is commonly the case, the left crank pin will be on the upper quarter; with the reverse lever in full gear forward the right valve will be just uncovering the front steam port to the amount of the lead, while the left valve will be moved ahead and have the back steam port fully uncovered; with the reverse lever in the center the right valve will be practically in the same position as with the lever in the corner, while the left valve will be on the center of its seat and covering both ports; with the lever in full back gear the right valve will still be in the same position, that is, just beginning to open the front steam port, but the left valve will have been moved back so as to fully uncover the front steam port on that side.

Right Side on Lower Forward Eighth.—Rotating the wheels of the engine so that the right crank pin is on the lower forward eighth, the left crank pin will be on the upper forward eighth; in this position with the reverse lever in full forward gear, the valve on the right side will have moved back, partially uncovering the front steam port, while the valve on the left side will be moved back and in the act of closing the back steam port on that side; with the reverse lever in the center of the quadrant the right valve will be a little ahead of its central position on the seat but covering both ports, while the left valve will be a little back of its central position, but also covering both ports; with the reverse lever in full back gear the right valve will have been moved ahead so that the back port is partially open, but the valve will be in the act of closing the back steam port on the right side, while on the left side the valve will be moved back and the front steam port will be partially opened and the valve will be in the act of further opening this port.

Right Side on Lower Quarter.—Moving the engine further so that the right crank pin may occupy a position on the lower quarter, the left crank pin will be at its forward center. In this position with the reverse lever in full forward gear the right valve will be pulled back so that the front steam port on that side is fully opened, and the left valve will also be pulled back so that the front steam port on the left side is opened by the smount of the lead; with the reverse lever in center of quadrant the right valve will occupy the center of its seat with both ports covered, while the left valve will be practically in the same position as with the lever in full forward gear, that is, the front steam port will be open to the amount of the lead; with the lever in full back gear the right valve will have been moved forward and the back steam port on the right side be fully opened or uncovered, while the left valve will be in the same position as with the lever in full forward gear, that is, the front steam port on that side will be open to the amount of the lead.

Crank Pin on Lower Back Eighth.—Advancing the engine further so that the right crank pin will occupy a position at the lower back eighth, the left crank pin will now be on its lower forward eighth. In this position with the reverse lever in full forward gear the right valve will have the front port slightly open but be in the act of closing it, while the left valve will have the front port on the left side about one-half uncovered, and will be in the act of opening the port fully; with the reverse lever in the center of the quadrant the right valve will have been moved ahead so as to cover both ports, but will not be in the center of its seat, being a little back of the center, and the left valve will have been moved ahead so as to cover both ports, but it also will not occupy the center of the seat, but will be a little ahead of the center; with the reverse lever in full back gear the right valve will be moved ahead so as to partially cover the back steam port and will be in the act of further opening this port; the left valve will have been moved ahead so that the back steam port is partially opened but the valve will be in the act of closing this port.

Right Crank Pin on Back Center.—Advancing the engine further, so that the right crank pin will be on the back center, the left crank pin will now be on the bottom quarter. With the engine in this position and the reverse lever in full forward gear the right valve will have been moved ahead and be in the act of opening the back steam port by the amount of the lead, while the left valve will have been moved back so that the front steam port on that side is entirely uncovered, or, in other words, is wide open. With the lever in the center of the quadrant the right valve will not have materially changed its position, but will still have the back steam port open by the amount of the lead; the left valve, however, will now be on the center of its seat with both ports covered; with the reverse lever in full back gear the right valve will still be moved ahead so as to uncover the back steam port the amount of the lead and be in the act of further opening this port; the left valve, however, will have been moved ahead so as to fully uncover the back steam port on the left side.

Right Crank Pin on Uppfr Back Eighth.—Advancing the engine further so that the right crank pin will occupy a position at the upper back eighth, the left crank pin will be on the lower back eighth. With the engine in this position and the reverse lever in full forward gear the right valve will have the back steam port partially uncovered and be in the act of further opening it, while the left valve will be pulled back so as to partially uncover the front steam port on the left side, but will be in the act of closing it; with the reverse lever in the center of the quadrant the right valve will occupy a position a little back of the center of the seat, but will have both ports covered, and the left valve will occupy a position a little ahead of the center of the seat, but will also have both ports covered; with the reverse lever in full back gear the right valve will be moved back so as to partially uncover the front steam port, but will be in the act of closing it; the left valve will be moved ahead and have the back steam port on the left side partially uncovered and will be in the act of further opening it.

Right Crank Pin on Top Quarter.—Moving the engine further so that the right

(Continued on page 15.)

QUESTIONS AND ANSWERS.

(Continued from page 12.)

crank pin will be at the top quarter, the left crank pin will now be on the back center. With the engine in this position and the reverse lever in full forward gear the right valve will have been moved ahead so as to fully uncover the back steam port, while the left valve will also have been moved ahead and have the back steam port on the left side uncovered to the amount of the lead and will be in the act of opening this port; with the reverse lever in the center of the quadrant the right valve will be on the center of its seat and have both ports covered; the left valve will not have changed its position, however, but will have the back port open the amount of the lead; with the reverse lever in full back gear the right valve will have been pulled back and have the front steam port fully uncovered, while the left valve will not have changed its position, but will still have the left back steam port open by the amount of the lead and be in the act of further opening this port.

Right Crank Pin on Upper Forward Eighth.—Advancing the engine so that the right crank pin will occupy a position on the upper forward eighth, the left crank pin will be on the upper back eighth. With the engine in this position and the reverse lever in full forward gear the right valve will have been moved ahead so as to partially uncover the back steam port' but will be in the act of closing this port, while the left valve will also have been moved ahead so as to partially uncover the back steam port on the left side, but will be in the act of further opening this port; with the reverse lever in the center of the quadrant the right valve will occupy a position a little ahead of the center of its seat, but will have both ports covered, while the left valve will occupy a position a little back of the center of its seat and will also have both ports covered; with the reverse lever in full back gear the right valve will have been moved back so as to partially uncover the front steam port and will be in the act of further opening this port, while the left valve will have been moved back also, so as to partially uncover the front steam port on the left side, but will be in the act of closing this port.—*Locomotive Firemen and Enginemen's Magazine.*

RAIL PRODUCTION IN 1912

Statistical Bulletin No. 2, of the Bureau of Statistics of the American Iron and Steel Institute, Philadelphia, Pa., shows that the production of all kinds of rails in the United States in 1912 amounted to 3,327,915 tons, against 2,822,790 tons in 1911, an increase of 505,125 tons, or over 17.8 per cent. Included in the total for 1912 are 174,004 tons of girder and high T steel rails for electric and street railways, as compared with an output of 205,409 tons of similar rails in 1911.

Of the total production of rails in 1912 3,165,939 tons were rolled from Bessemer, open-hearth, and electric steel blooms or billets; 42,586 tons were rolled from new seconds, defective new rails, and steel crop ends; and 119,390 tons were rerolled from old steel rails or were renewed steel rails. No iron rails are reported for 1912.

The production of Bessemer rails in 1912 amounted to 1,099,926 tons, against 1,053,420 tons in 1911, an increase of 46,506 tons. Of the total in 1912, 1,070,480 tons were rolled from ingots and 29,446 tons were rolled from new seconds, defective new rails, crop ends, etc. The maximum production of Bessemer rails was reached in 1906, when 3,791,459 tons were produced.

The production of open-hearth rails in 1912 amounted to 2,105,144 tons, against 1,676,923 tons in 1911, an increase of 428,221 tons, or over 25.5 per cent. Of the total in 1912, 2,092,004 tons were rolled from ingots and 13,140 tons were rolled from new seconds, defective new rails, crop ends, etc. Almost all were rolled from basic steel. The maximum production was reached in 1912. It will be noticed that the production of open-hearth rails in 1912 was almost twice that of Bessemer rails in the same year.

In 1912 the production of rails rolled from steel made in electric furnaces amounted to 3,455 tons, as compared with 462 tons in 1911. In 1909 and 1910 small quantities of rails were also rolled from electric steel, but these rails were included with the Bessemer and open-hearth rails reported for these years.

In 1912 the production of steel rails rolled from new seconds, defective new rails, crop ends, old steel rails, etc., including renewed rails, amounted to 161,976 tons, of which 42,586 tons were rolled from new seconds, etc., and 119,390 tons were renewed rails or were rerolled from old steel rails. Of the 42,596 tons rolled from new seconds, etc., 29,446 tons were rolled from Bessemer steel and 13,140 tons were rolled from open-hearth steel, and are therefore included in the totals given for Bessemer and open-hearth rails for that year. But, as the 119,390 tons of rails rolled from old steel rails in 1912, and the renewed rails as well, could not be classified by the manufacturers they are not included in the Bessemer or open-hearth rail output for that year, but are grouped under the general heading of electric and rerolled steel rails. Prior to 1911 all rails of this class are included with Bessemer or open-hearth steel rails.

No iron rails were rolled in 1912. In 1911 the production was 234 tons, all rolled in Illinois, and all weighing less than 45 pounds to the yard, against 230 tons in 1910.

The table on the following page gives the production of all kinds of rails in 1912, classified according to their weight per yard, and totals according to weight since 1902.

Kind of rails —Gross tons.	Under 45 lbs.	45 lbs. and less than 85	85 lbs. and over	Total Gross tons
Open-hearth steel rails	75,203	488,695	1,541,246	2,105,144
Bessemer steel rails	103,826	591,744	404,356	1,099,926
Electric and other steel rails	69,643	38,153	15,049	122,845
Iron rails	None	None	None	None
Total for 1912	248,672	1,118,592	1,960,651	3,327,915

Years—Gross tons.				
Total for 1911	218,758	1,067,696	1,536,336	2,822,790
Total for 1910	260,709	1,275,339	2,099,983	3,636,031
Total for 1909	255,726	1,024,856	1,743,623	3,023,845
Total for 1908	183,869	687,632	1,049,514	1,921,015
Total for 1907	295,838	1,569,985	1,767,831	3,633,654
Total for 1906	284,612	1,749,650	1,943,625	3,977,887
Total for 1905	228,252	1,601,624	1,546,053	3,375,929
Total for 1904	291,883	1,320,677	672,151	2,284,711
Total for 1903	221,262	1,603,088	1,168,127	2,992,477

The production in 1912 of rails weighing under 45 pounds to the yard shows and increase of 29,914 tons as compared with 1911; rails weighing 45 pounds and less than 85 pounds show an increase of 50,896 tons; and rails weighing 85 pounds and over show an increase of 424,315 tons. In 1912 over 41 per cent. of the rails weighing less than 45 pounds to the yard, nearly 53 per cent. of the rails weighing 45 pounds and less than 85 pounds, and over 20 per cent. of the rails weighing over 85 pounds were rolled from Bessemer steel, while in the same year over 30 per cent. of the rails weighing less than 45 pounds per yard, over 43 per cent. of the rails weighing 45 pounds and less than 85 pounds, and over 78 per cent. of the rails weighing 85 pounds and over were rolled from open-hearth steel.

In the following table the production of all kinds of rails from 1903 to 1912 is given by processes. Of the total production of rails in 1912 about 33.05 per cent. were rolled from Bessemer steel, about 63.25 per cent. were rolled from acid and basic open-hearth steel and about 3.70 per cent. were rolled from electric steel and from old steel rails. As previously stated no iron rails were rolled in 1912.

Years— Gross tons.	Bessemer	Open hearth.	*Iron and all other.	Total.
1912	1,099,926	2,105,144	*122,845	3,327,915
1911	1,053,420	1,676,923	†92,447	2,822,790
1910	1,884,442	1,751,359	230	3,636,031
1909	1,767,171	1,256,674	......	3,023,845
1908	1,349,153	571,791	71	1,921,015
1907	3,380,025	252,704	925	3,633,654
1906	3,791,459	186,413	15	3,977,887
1905	3,192.347	183,264	318	3,375,929
1904	2,137,957	145,883	871	2,284,711
1903	2,946,756	45,054	667	2,992,477

*Iron rails only from 1903 to 1910 inclusive.

†Include 234 tons of iron rails in 1911 but none in 1912; also 462 tons in 1911 and 3,455 tons in 1912 of rails rolled from electric steel; also 91,751 tons in 1911 and 119,390 tons in 1912 of renewed rails or rails rerolled from old steel rails which the manufacturers could not classify as Bessemer or open-hearth steel rails.

Included in the 3,327,915 tonss of steel rails in 1912 are 149,267 tons of alloy rails, against 153,989 tons in 1911. The following table gives the production of titanium, manganese, and other alloy steel rails by processes from 1909 to 1912.

Alloy rails—Gross tons.	Bessemer.	Open-hearth and elec.	Total
Titanium steel rails	103,941	37,832	141,773
Manganese, copper, and nicekl	4,933	2,561	7,494
Total for 1912	108,874	40,393	149 267
Total for 1911	115,450	38,539	153,989
Total for 1910	229,935	27,389	257,324
Total for 1909	35,699	13,696	49,395

Alloy rails—Gross tons.	1909.	1910.	1911.	1912
Titanium steel rails	35,945	256,759	152,990	141,773
Manganese, copper, nickel, etc	13,450	565	999	7,491
Total	49,395	257,324	153,989	149,237

In addition to the rails rolled in 1912 we imported 3,780 tons of iron and steel rails. During the same year we exported 446,473 tons of steel rails. In 1911 our exports of rails, all steel, amounted to 420,874 tons and out imports to 3,414 tons.—*Railway Age Gazette.*

Tunnel Through the Andes

Argentina and Chile are connected by railway. Between the two South American countries rises the huge wall of the Andes, with peaks from 18,000 to 23,000 ft. above sea level.

A railway from Buenos Ayres, touching Mercedes, St. Louis and La Paz, towns to Mendoza at the eastern foot of the Andez and climbs thence up a river valley with one huge loop and many curves a full hundred miles to the summit of the pass. Thence the Chilean end of the line descends by the San Rosa River valley to Valparaiso.

British methods and machinery were used in driving the Andean tunnel, and the engineering problems presented were of unusual interest. In length the tunnel is not remarkable. The great Alpine tunnels are much longer. While the Andean tunnel is about three miles in length, the St. Gothard is over nine, the Mont Cenis nearly eight, and the Simplon about twelve. The Arlburg of Austria is nearly six and a half miles long, and the Gravenholz of Norway is about three and a third miles. The Hoosac tunnel is four and three-quarter miles, and the Tequixquiat drainage tunnel of Mexico is six miles long.

None of these tunnels, however, were driven at such an elevation as the Andean tunnel, which is nearly 10,500 feet above sea level. The only railway tunnel at such a height are some on the line leading from the coast of Peru across the crest of the Andes into Brazil and Bolivia. The Oroya Railway from Lima crosses the Andes by a pass at an elevation of more than 15,500 feet, and the railway from Mollendo to Lake Titicaca crosses the mountains at an elevation of more than 14,700 feet, and reaches the lake at an elevation of over 12,500 feet—*Railway and Locomotive Engineering.*

Car Nomenclature

For the sake of uniformity and the facilitating their business, the Association of Transportation and Car Accounting Officers at their recent meeting in New Orleans adopted the following terms relative to cars:

Home Car—A car on the road to which it belongs.

Foreign Car—A car on the road to which it does not belong.

Private Car—A car having other than railroad ownership.

Home—A location where a car is in the hands of its owner.

Home Road—The road which owns a car, or upon which the home of a private car is located.

Home Route—The line of intermediate roads over which a foreign car was moved from home.

Home Junction—A junction with the home road.

Home Route Junction—A junction on the home route.

Switching Service—The movement of a car to be loaded or unloaded or the movement of a car between railroads at a charge for the service rendered within designated switching limits, the road performing the service not participating in the freight rate.

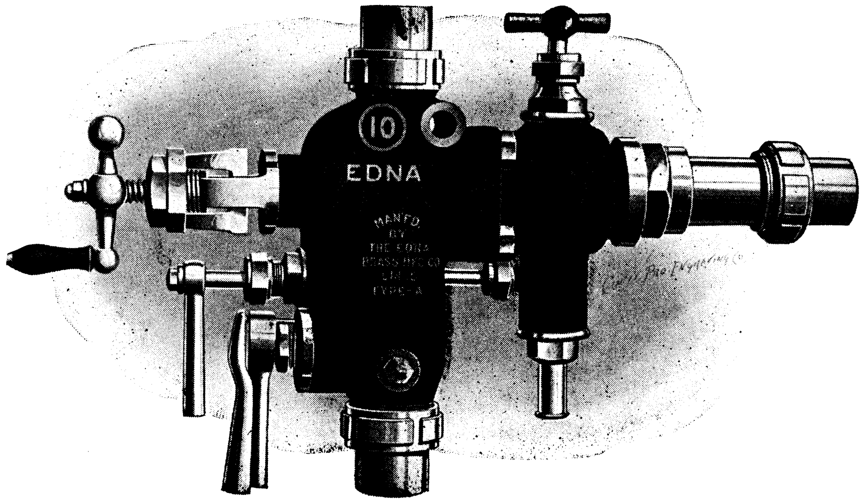
Crucibles Made of Flake Graphite

One of the oldest and most important applications of graphite is, according to the United States Geological Survey Press Bulletin, in the manufacture of crucibles for use in the steel, brass and bronze, and other industries. Such crucibles must have good tensile strength, and for their manufacture a fibrous or flaky graphite is used, the interlocking of the fibers adding to the strength. Ground Ceylon lump graphite is the material most in favor in the United States for making crucibles, although small amounts of American flake graphite are also used.

THE

EDNA BRASS MFG. Co.

Cincinnati, Ohio



MANUFACTURERS OF

Locomotive and Stationary Boiler Injectors and Lubricators, Journal and Engine Bearings, Oil Cups, Cylinder Cocks, Whistles, Pop Valves, Babbitt Metal, Main Steam and Angle Valves, Boiler Checks, Brass and Bronze Castings, Etc.

CATALOGUE AND PRICES ON APPLICATION

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