Correspondence.

Ignition of Charge in Ordnance and Erosion.

To the Editor of the SCIENTIFIC AMERICAN:

My attention is drawn to an article by Henry B. Griffe, of Dubuque, Ia., suggesting that to prevent erosion of the bore in guns, the charge be ignited at base of projectile.

This was done in the needle gun, used in the Franco-German war by the German soldiers. The recoil was so severe that they were speedily condemned.

The method applied to a 12-inch gun would doubtless dismount the piece. Muskets used in the civil war were found to kick in proportion as careless boring placed the point of ignition in advance of base of charge. W. B. WILLIAMSON.

Ames, Okla.

Signals for Power Boats.

To the Editor of the SCIENTIFIC AMERICAN:

I desire to call your attention to several misstatements in the article published on page 66 of your issue of July 27, entitled "Whistle Signals for Power Boats." The statement that if the pilot of any craft, when signaled to pass to starboard, deems it inexpedient to do so, he can give two blasts and signify his desire to pass to port, is altogether wrong, as can readily be seen from Rule III. of Article 181 (Act of June 7, 1897), which is as follows, and the second paragraph of which should be especially noted:

"Rule III. If, when steam vessels are approaching each other, either vessel fails to understand the course or intention of the other, from any cause, the vessel so in doubt shall immediately signify the same by giving several short and rapid blasts, not less than four, of the steam whistle; and if the vessels shall have approached within half a mile of each other, both shall be immediately slowed to a speed barely sufficient for steerage way until the proper signals are given, answered and understood, or until the vessels shall have passed each other.

"Vessels approaching each other from opposite directions are forbidden to use what has become technically known among pilots as 'cross signals'—that is, answering one whistle with two, and answering two whistles with one. In all cases, under all circumstances, a pilot receiving either of the whistle signals provided in the rules, which for any reason he deems injudicious to comply with, instead of answering it with a cross signal, must at once observe the provisions of this rule."

There are four situations in which two vessels can be found when approaching each other. The first of these is head-on, so that, in the daytime, the masts of the two vessels are practically in line, or that, at night, the red and green lights of each boat are visible from the bow of the other. In this case the vessels must each give one blast of their whistles, thus signifying their intention of passing to the right of each other.

The second situation is where the two boats are to the left of each other as they approach. At night their green or starboard lights only will be visible. In this case they will pass at the left after first each giving two short blasts.

In the third situation the boats are to the right of each other. They will keep to their respective courses, and pass to the right after first giving one blast of their whistles.

In the fourth situation the boats are approaching at an oblique angle. In this case, the vessel which has the other on her own right-hand or starboard side must keep out of the way of the other, and must slacken her speed or stop and reverse if necessary, at the same time indicating her intention by one or two blasts of the whistle as the circumstances may require.

These four situations are the chief ones which can occur, and if the power-boat users will remember the simple rules which govern the control of craft encountering them, there will not be the danger of collision that now frequently occurs. The motor boatmen should remember that the main "rule of the road" is the same on land or sea, namely, "keep to the right"; while when one boat is overtaking another, it is proper for her to give the other warning as to which side she will pass, by blowing one short blast when passing on the right, or two short ones when passing on the left. The overtaken vessel should repeat the signal if there is room for the overtaking boat to pass. If there is not room, she should give four or more sharp blasts, which should cause the overtaking boat to hold back until such time as she receives the signal (one or two short blasts) from the vessel ahead, allowing her to pass.

Motor boatmen should have their attention called to the fact that all open power boats under 10 tons gross are obliged to carry a single combination light showing green and red on the right and left hand sides respectively; to have a suitable whistle or siren; and to carry a 6-inch bell of good tone and quality for use as a fog bell in bad weather. In fog, mist, snow, or heavy rainstorms, a prolonged blast of the whistle must be given at intervals of not more than a minute, while the boat is under way, and when at anchor the bell must be rung rapidly at similar intervals for about five seconds. PILOT.

New York, August 10, 1907.

A New Type of Bullet.

A noticeable feature at the Bisley rifle meet in England this year has been the all-round decided improvement in the scoring. This result is attributable to a new type of bullet, with which experiments are being conducted, the advantages of which are not only an increase in range, but a marked improvement in accuracy, due to the fact that it has a flatter trajectory, and does not require such allowances for wind as are now requisite, since it offers a lesser area of resistance. The present service bullet has a flat conical head, but in the new missile the head is carried to as fine and thin a point as is possible in view of the metal employed in its construction.

The British experiments in this direction were influenced by the tests that have been conducted in European military circles with the Spitzer projectile, which is a light-weight bullet of 150 grains. Military experts who have witnessed the trials therewith were somewhat dubious of its "effective stopping power," considering its light weight. The well-known British ammunition manufacturers, Kynochs Limited, continued private investigations upon the lines of the Spitzer bullet, and as a result of their numerous tests and researches evolved this latest type of projectile, which it is anticipated will revolutionize musketry as much as did the invention of smokeless powder, especially when used in conjunction with the service arm of the British army, the Lee-Enfield rifle, since therewith a point-blank range up to 800 yards is possible. Precisely what this means may be readily grasped, since up to this distance no time need be lost in adjusting sights, it being only necessary to take direct aim and then fire.

The new bullet is similar in construction and weight to that already in use. It is formed of a cupro-nickel envelope containing the softer metal, and weighs 225 grains. The service bullet is similarly built up, measures 1.25 inch in length, is of the same weight, and has a bluff round head. The latest projectile is somewhat longer, due to its being carried to a thin and fine point. With the special ammunition that is used therewith it has, when fired with the Lee-Enfield rifle, a muzzle velocity of 2,400 foot seconds, which is 400 foot seconds in excess of the older type. The results of the trials at Bisley have demonstrated the fact that the resistance which it offers to the wind is fifty per cent of that of the snub-nosed bullet, the wind allowance being as much as 20 deg. less at 1,000 yards, while even at the maximum ranges the difference is equally striking. The scoring at Bisley with this type of bullet has been unparalleled in regard to "highest possibilities," the contrast being emphasized by comparisons under precisely the same conditions with the service bullet; and the level of marksmanship has been raised to an unprecedented degree, especially at the 1,000 and 1,100 yards ranges. It is realized that this remarkable success has been achieved by the combination of the pointed shape with the most suitable weight, a factor which has been resolved after a long series of experimental investigation.

The Largest Cave in the West.

Two gold-prospectors recently discovered in the Santa Susanna Mountains, about fifty miles from Los Angeles, Cal., the largest and most remarkable cave in western America. While looking for indications of gold, they found an opening which they entered. The opening led to a great cavern, consisting of many passages, some of them wide, but most of them narrow and lofty. The passages lead into great halls, some containing an acre, studded with stalagmites and stalactites, in some cases so thickly that it is difficult to get through. The walls of one of these halls are covered with rude drawings, some almost obliterated, but others still clear. The drawings represent incidents of the chase, showing Indians on foot pursuing bear, deer and other animals. One wall-painting shows the bear pursuing the hunter. The work is done with a soft, red stone much used by the Indians for that purpose.

A new gem has been discovered by prospectors in San Benito County, Cal. It is described as a clear, transparent, blue stone with violet tints in the deeper colored portion. It surpasses the sapphire in brilliancy and rivals it in color, though it is not so hard; being about as hard as chrysolite and harder than moonstone or opal. Under heat it turns a bright red but on cooling resumes its normal color. It has been given the name of Benito, from the county in which it was found.

THE LARGEST LOCOMOTIVE EVER CONSTRUCTED.

There has just been completed at the Schenectady Works of the American Locomotive Company a freight locomotive, which, among many other novel and characteristic features, is distinguished by being considerably the largest and most powerful locomotive ever constructed. We give herewith, in addition to the views of the various parts, a photograph of the completed engine, taken as soon as it had been run out from the erecting shop. This truly mammoth locomotive is the first of three which are being built by this company for the Erie Railroad.

To understand the conditions which call for the production of such a monster piece of mechanism, it is necessary to familiarize ourselves with that particular stretch of the Erie Railroad on which the work of the new locomotive will be done. The object of building a part of the motive power in such large units as this is to be found in certain economic principles, by the observance of which it has become possible to haul freight in the United States at a cost per ton very much lower than the rate obtained in other countries.

The three locomotives will be used as helpers on a stretch of up-grade, 8 miles in length, which is encountered by east-bound trains running from Susquehanna to Gulf Summit. The grade is located at the west end of the Delaware division, which is 104 miles in length, and at the east end of the Susquehanna division, which is 140 miles long. The amount of load which a freight locomotive can haul over a given division is determined by the maximum grade on that division; that is to say, as many cars are coupled up behind an engine as it can, unassisted, pull over this grade. The determining maximum grade on each of the two above-mentioned divisions is two-tenths of one per cent; or two-tenths of a foot in 100 feet. At present, the heaviest freight engine of the Erie, weighing 184,000 pounds, can haul a train weighing 3,400 tons from Cornell, at the west end of the Susquehanna division, to Port Jervis, at the east end of the Delaware division, provided it is assisted over the 8-mile stretch of road above referred to containing a one and three-tenths per cent grade. Up to the present time, these freight trains have been assisted over the grade by two and sometimes even three of the heaviest of the Erie helper engines; or if that were not done, it was necessary to cut the train in two. This entailed trouble and delay, and also involved the use of extra engineers, firemen, etc. In order to solve the problem, it was suggested by the American Locomotive Company to concentrate the helping power in one engine of exceptional weight and power, thus placing the whole of the auxiliary power in the hands of a single crew.

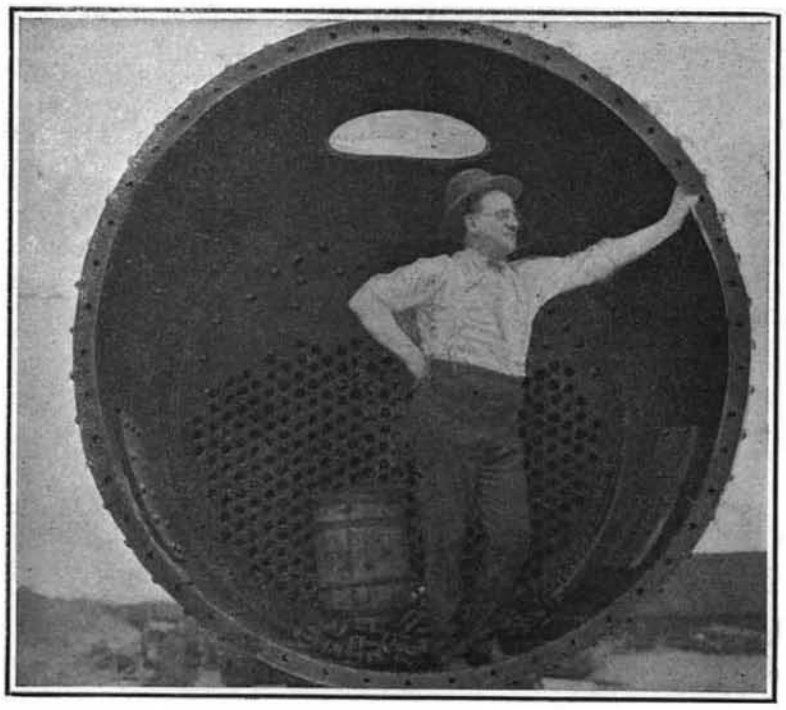
The construction of an engine of the necessary tractive power was rendered possible by making use of the Mallet type of articulated compound locomotive, in which one huge boiler is mounted upon two separate engines, one high-pressure and the other low-pressure, each pair of cylinders being carried upon a separate truck and operating its own set of driving wheels. The first locomotive of this type to be constructed in this country was built by the company for the Baltimore and Ohio mountain service; and in the few years it has been at work, it has given most excellent service, hauling even greater loads than were anticipated, and all the parts functioning satisfactorily. This was followed by a still larger engine for the same class of service, built by the Baldwin Locomotive Company for the Great Northern Company. The third to be built is the huge locomotive which forms the subject of the present article. By a study of the accompanying table showing relative weights and dimensions, it will be seen that the Erie locomotive

COMPARISON OF THREE MALLET COMPOUNDS.

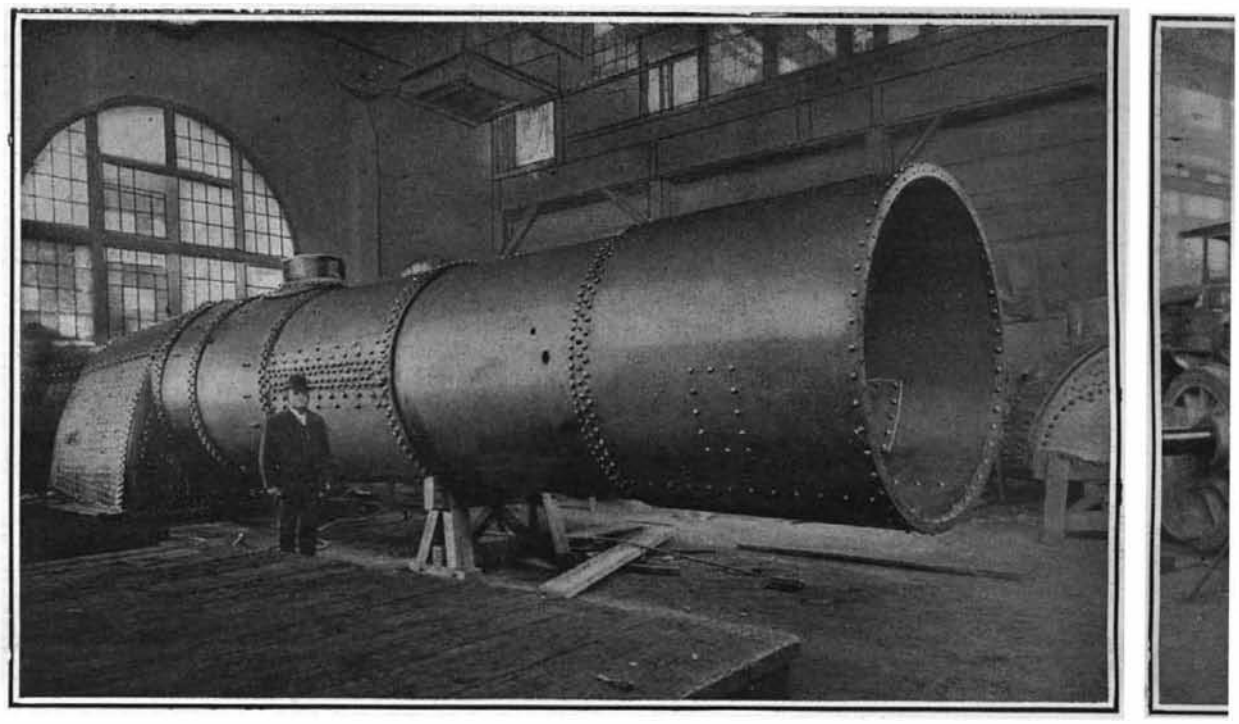
Road	Baltimore and Ohio.	Great Northern.	Erie.
Builder	American Locomotive Co.	Baldwin.	American Locomotive Co.
Total weight.	334,500 lb.	355,000 lb.	410,000 lb.
Wt. on drivers	334,500 lb.	316,000 lb.	410,000 lb.
Size cylinders.	20 & 33 x 32 in.	21½ & 32 x 32 in.	25 & 39 x 28 in.
Diam. drivers	56 in.	55 in.	51 in.
Tr'ctive effort (compound).	71,500 lb.	71,600 lb.	98,000 lb.
Steam pressure	235 lb.	200 lb.	215 lb.
Total wheel base	30 ft. 8 in.	44 ft. 10 in.	39 ft. 2 in.
Driving wheel base, rigid	10 ft.	10 ft.	14 ft. 3 in.
Total heating surface	5,585 sq. ft.	5,658 sq. ft.	5,314 sq. ft.

marks a great advance upon the other two, the total weight of the engine having gone up from 355,000 pounds in the Great Northern to 410,000 pounds in the Erie locomotive, and the tractive effort from 71,600 pounds to 98,000 pounds.

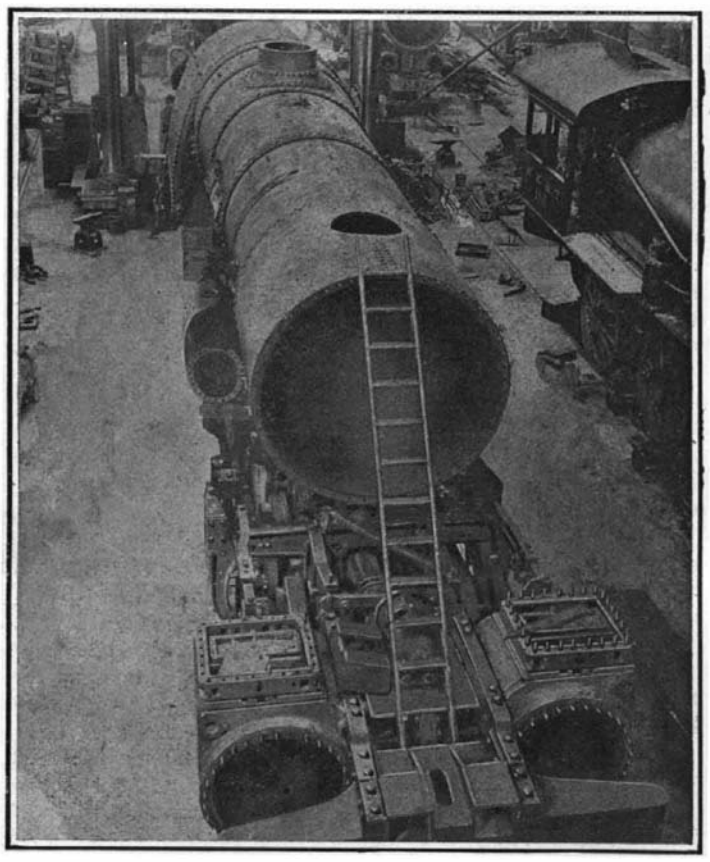
The high-pressure cylinders are 25 inches, the low-pressure 39 inches diameter, and both have a stroke of 28 inches. The tractive effort of 98,000 pounds will be developed when the engine is working compound; but an intercepting valve is provided, by which



View Looking Into Smokebox, Whose Diameter is 8 Feet.



The Boiler, 8 Ft. Diam., 35 Ft. Long, Weighs 50 Tons. Has 5,314 Sq. Ft. Heating Surface.



Bird's Eye View Showing the Forward Engines.

the engineer can turn live steam into the low-pressure cylinders, in which case about 45 per cent of the boiler pressure will be realized in them and the tractive effort proportionally increased, rising to a maximum of about 120,000 pounds. Under these conditions, it is curious to note that the locomotive could haul on the level 250 loaded freight cars, or, say, 10,000 tons of freight, and that the train would be nearly two miles in length. It could pull this load, moreover, at a speed of 8 or 10 miles an hour. If such a train were loaded with wheat, it would represent the product of twenty-six square miles of wheat land.

In a huge locomotive like this, in fact in any locomotive, "the" boiler's "the thing"; and to supply steam to engines of such great capacity, it became necessary to design a locomotive boiler far larger than any in existence. The outside diameter of the largest ring is 98¼ inches; the heaviest ring of the shell being 1 3/16 inches thick. The tubes, of which there are 404, are 21 feet long and 2¼ inches in diameter The firebox, which is of the Wootten type, is 114¼ inches wide by 126⅛ inches long. The weight of the boiler itself, empty, is 100,000 pounds, and the water alone in the boiler weighs over 40,000 pounds. The total heating surface is 5,314 square feet, of which 4,971 is in the tubes and 343 in the firebox, the grate area being 100 square feet.

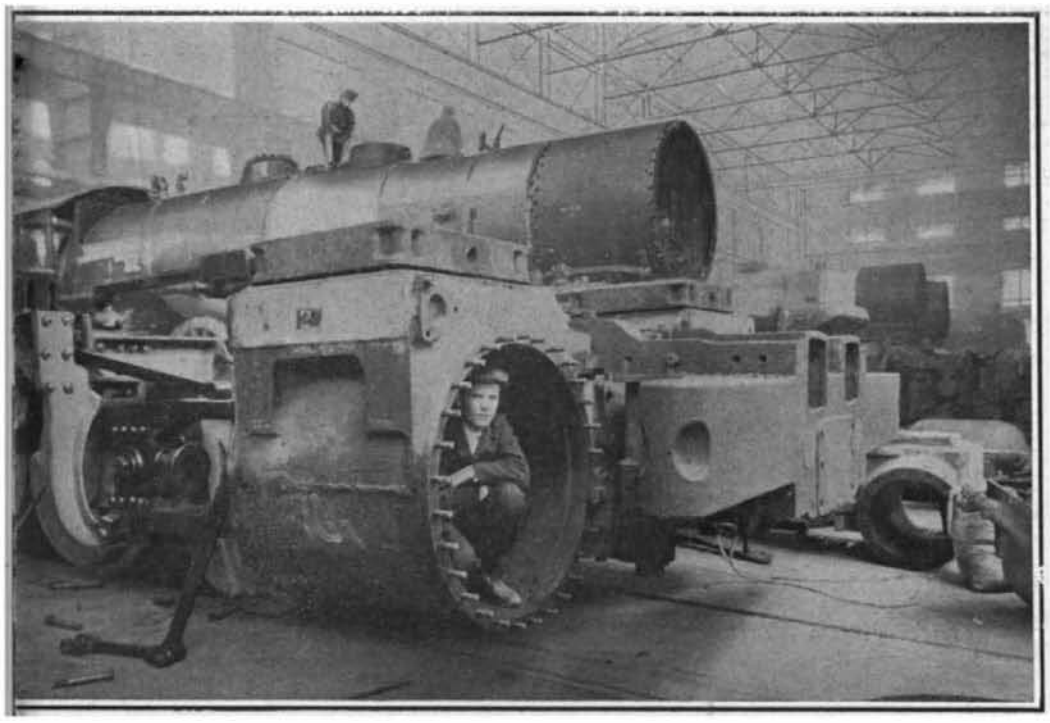
That the heating surface has not increased in proportion to the other elements of this locomotive, is due to the fact that a 4-foot combustion chamber has been introduced which, of course, reduces the tube heating surface. Were it not for the fact that four feet of the barrel is taken up by the combustion chamber, the total heating surface would be over 6,000 square feet.

As will be seen from the illustrations, the locomotive is carried upon two sets of eight driving wheels each, all of the eight in each case being coupled, so that the whole of the weight of 210,000 pounds of the engine is available for adhesion. The boiler is mounted rigidly upon the main or after frame of the locomotive, and its weight is borne partly upon this and partly upon the forward radial frame, on the front end of which the low-pressure cylinders are mounted. That part of the weight of the boiler, about 90,000 pounds, which is carried on the forward engines, is supported on a self-adjusting sliding bearing, located between the third and fourth driving wheels, a brass bearing plate being introduced between the boiler bearing-casting and a wrought-iron plate carried on the forward engine frame. There is another sliding support located between the second and third pairs of driving wheels, which is provided with a floating balance device that serves to take some of the load off the main boiler bearing. The forward engine frame is pivoted at its after end to the forward end of the main frame of the engine. When the locomotive enters a curve, the forward engine is free to swing to right or left, as the case may be, the sliding bearing plate and other devices allowing it to do this with comparatively little resistance. As a matter of fact, because of the flexibility of the wheel base, the lateral wrenching effects of this engine upon curves will be less than that of much smaller engines. Moreover, the load being distributed among sixteen wheels, the concentrated wheel load of 51,250 pounds per wheel is considerably less than that of some locomotives of far less total weight. The total weight of the engine is 210,000 pounds, and of the engine and tender 572,800 pounds. The length over all is 80 feet.

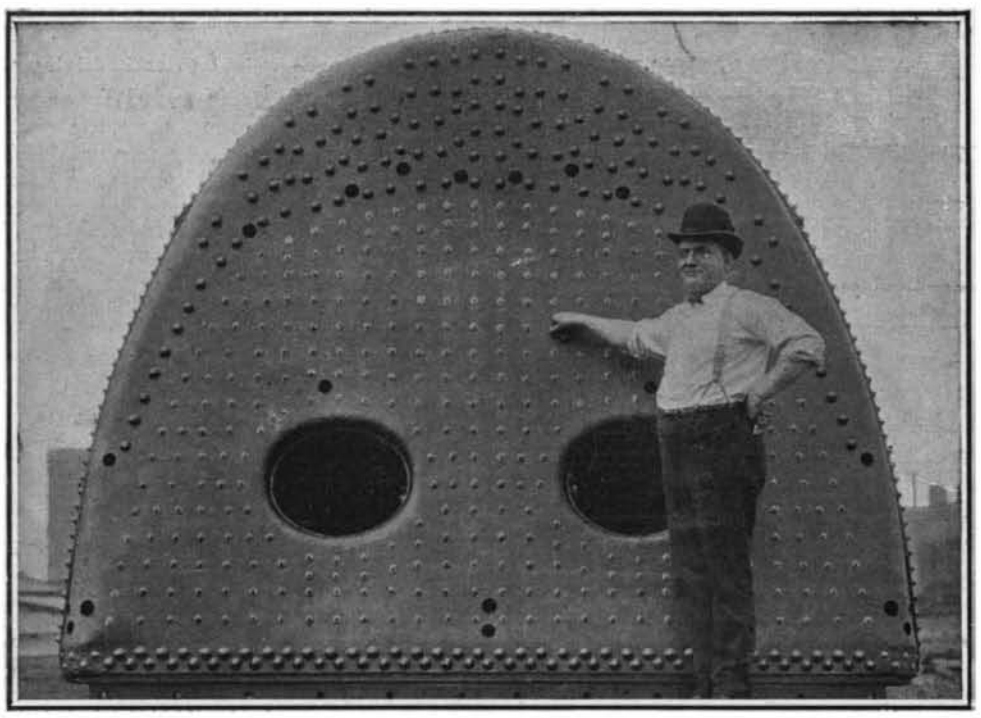
The operation of the locomotive is as follows: Steam

Length, 80 feet. **Weight of Engine,** 205 tons. **Weight of Tender,** 81½ tons. **Boiler,** diameter, 8 feet; length, 36½ feet. **Weight of Boiler,** 50 tons. **Heating Surface,** 5,314 square feet. **Steam Pressure,** 2
working compound, 49 tons; working simple (live steam in low-pressure cylinders) 60 tons. Working simple, this engine could haul, at 8 mi

THE LATEST "MOST POWERFUL LOCOMOTIVE IN THE WORLI



he Diam. (89 In.) of Low-Press. Cylinders Exceeds That of Many Locomotive Boilers.



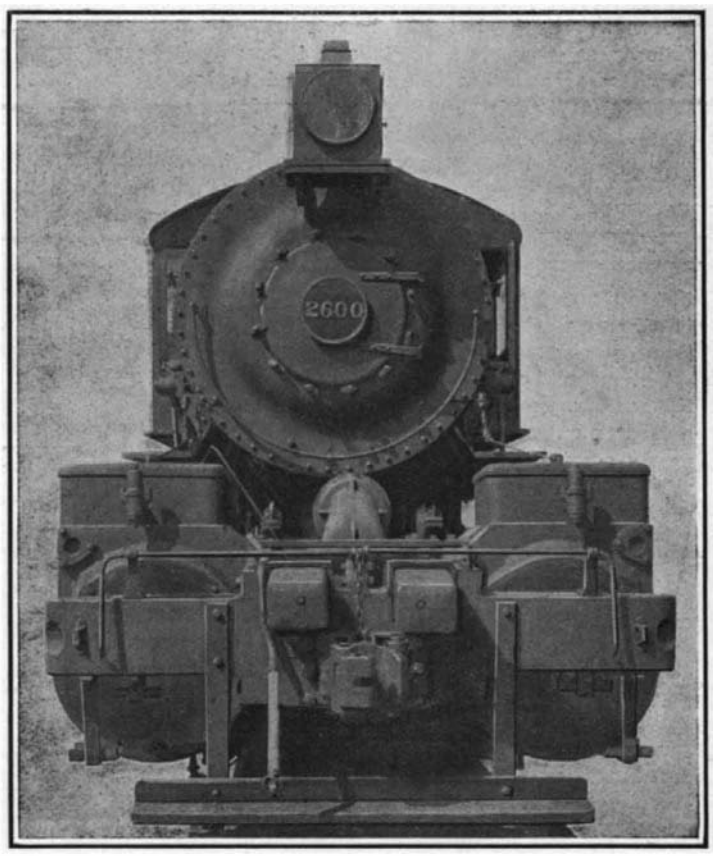
The Enormous Wootten Firebox, Containing 100 Sq. Ft. of Grate Surface.

is taken from a dome, placed at the top of the boiler, through a throttle, which is so designed as to act as a steam drier. It passes through steam pipes on each side of the boiler to two high-pressure cylinders, each of which is 25 inches in diameter, with a stroke of 28 inches. The valves are of the piston type operated by a Walschaert gear. From the high-pressure cylinders the steam is led through a pipe placed centrally between the frames, and provided with universal and sliding joints, to a pair of low-pressure cylinders 39 inches in diameter by 28-inch stroke, located far out beyond the front end of the smokebox, as shown in the accompanying illustration. The steam distribution is effected by means of D-valves operated by a Walschaert gear. From the low-pressure cylinders the steam exhausts through the smokebox to the stack. It is an interesting fact that in spite of its great power the operation of this engine is rendered easier than that of an ordinary road engine. This has been made possible by the addition of pneumatic reversing cylinders to the ordinary reversing gear, with provision for positive automatic locking in any desired position.

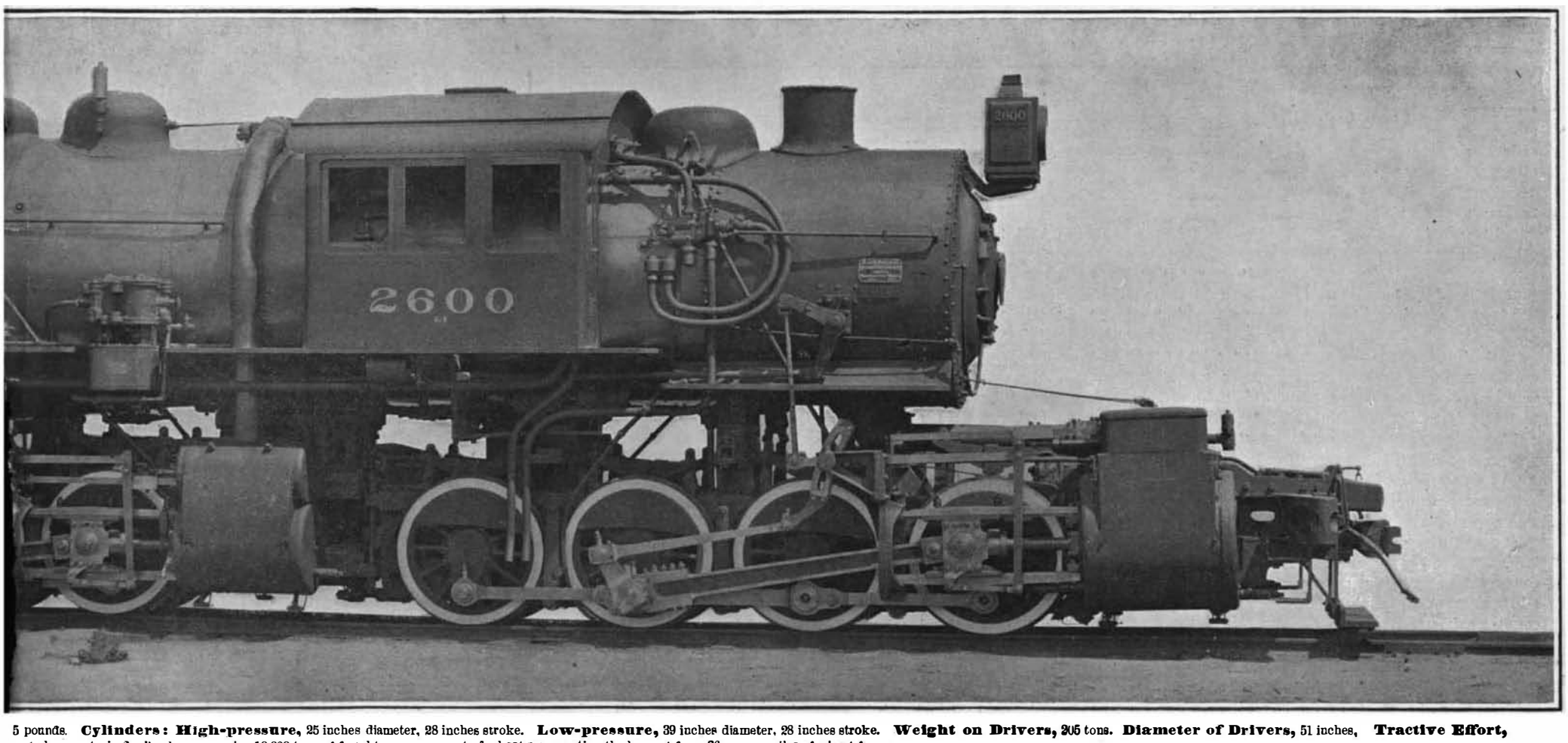
The front pair of front driving wheels are equalized together on each side, and cross-equalized in front of the forward drivers, making this system equivalent to a single supporting point. The rear engine, on the other hand, is equalized throughout on each side only, without cross-equalization. This forms a complete three-point suspended engine, which is the ideal condition for flexibility and easy action on the track. The excellent record established by the Mallet compound locomotive on the Baltimore and Ohio Railway is a guarantee of the success of this larger venture; and the American Locomotive Company is to be congratulated on having introduced the Mallet type into this country, where the conditions of modern freight service were calling for engines of exceptional weight and power.

Firing Pottery Ovens with Mond Gas.

In order to demonstrate the possibilities and efficiency of Mond producer gas as a medium for firing pottery ovens, an interesting demonstration was carried out at the Royal Victoria Pottery, Shelton, in the center of the pottery industry in Britain. The oven in which the test took place was filled with "biscuit ware," and although at full heat the temperature of the "hovel" of the oven was found to be agreeable, while it was perfectly clean and the atmosphere quite pure, owing to the entire absence of smoke. In regard to its application in this particular instance, the firm adopting the system have evolved a special method, whereby the calorific value of the gas is considerably increased, so that sufficient heat can be obtained for firing any kind of ware, both "biscuit" and "ghost." This end is accomplished by a process of regeneration, the gas and air being superheated before ignition, with the result that a temperature of 1,350 deg. C. can be easily secured, while at the same time the quantity of gas admitted within the oven can be simply controlled. Gas firing, as a result of the trials carried out at this pottery, has proved to be more economical than the systems generally in vogue, both in the cost of the fuel and also in regard to the proportion of breakages, wear and tear of the ovens, and labor. Irregular "baiting" and the imperfect distribution of the heat coincident with coal firing are perfectly overcome. Owing to the success of the experiments at these works, the utilization of producer-gas firing is to be more extensively adopted throughout the pottery district, several supply stations for this purpose now being in course of construction.



Front View Showing Great Size of Low-Pressure Cylinders.



5 pounds. **Cylinders: High-pressure,** 25 inches diameter, 28 inches stroke. **Low-pressure,** 39 inches diameter, 28 inches stroke. **Weight on Drivers,** 205 tons. **Diameter of Drivers,** 51 inches, **Tractive Effort,**
es an hour, a train 2 miles long, carrying 10,000 tons of freight, or an amount of wheat representing the harvest from 26 square miles of wheat farms.

)." WEIGHT, 286½ TONS. MAXIMUM TRACTIVE EFFORT, 60 TONS.