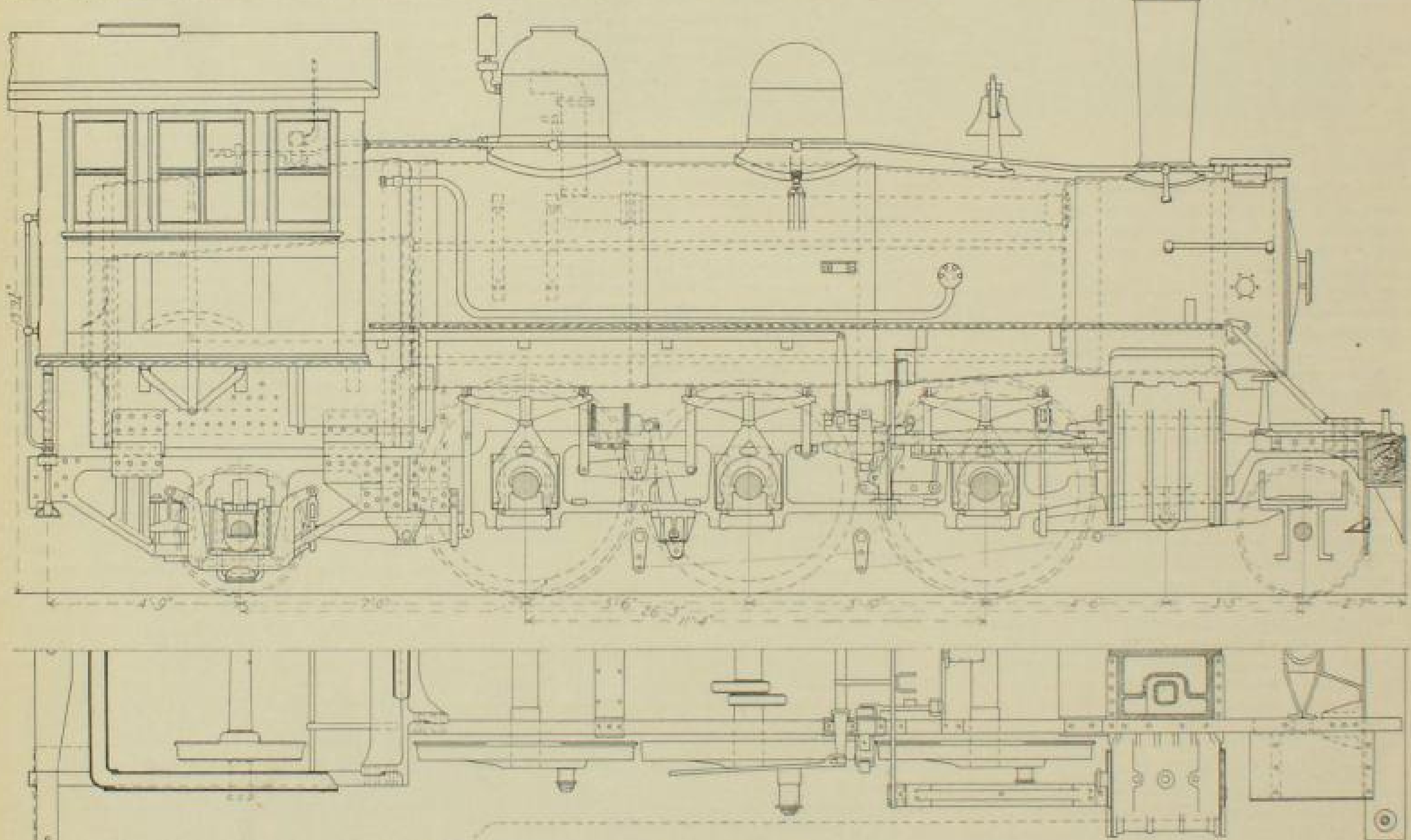
and they must not put in rates to Hampton which prohibit its citizens from the transaction of business in competition with Palatka. . . . . Held, that the present Hampton rates are in violation of both the fourth and third sections of the act to regulate commerce, but that Hampton rates may properly be made higher than the Palatka rates by the differentials now existing between the Palatka and Jacksonville rates. . . . The defendants are given until May 1, 1900, to readjust their rates to Hampton and Palatka in accordance with the conclusion above stated, and if at that date this has not been done, an order will issue in the premises."

Double Heading in Texas.

At the continuation of the hearing on double heading before the Texas Railway Commission this week at Austin, two Southern Pacific engineers announced that they did not believe "double heading" dangerous to life, and said the practice was advantageous to employes. They were the first to side with the railroads among the many employes examined. One of the engineers testified that in his opinion there are no dangers in double heading as compared with single headers, and that he and other men prefer the double header runs; that they are out on the road less time relatively than single headers; never hauled more than thirty loaded cars with a double header; used automatic couplers and never heard of any being broken.



PRAIRIE TYPE LOCOMOTIVE, C., B. & Q. RY. ELEVATION AND PLAN.—FIG. 1.

Took the position that the strain is not caused so much by the power ahead, but depends on the weight behind. He also said that both engineers can apply the air successfully in an emergency, and that the second engineer can see ahead except for 100 feet, and that on account of "straight shot" smoke-stacks the second engineer is not bothered by cinders or smoke, and that the first engineer looks out as carefully as if there was only one engine on the train. In his opinion there is an element of safety in double heading, because two engineers would not forget orders as quick as one. The witness related how one engine could haul the train where the other engine is temporarily disabled. Was aware that the brakemen had complained, but none of the other employees.

The other engineer testified substantially as the preceding witness did. He said that he prefers double headers because of the speed and because there is not extra hazard. Is a member of the El Paso lodge which passed a resolution against double-headers, but said it was in the nature of sympathy for the conductors and brakemen thrown out of employment.

The hearing was concluded this week, and the decision of the commission will probably be made public in a few days. If the Commission attempts to force the railroads to abandon the practice of running of "double headers" the matter will probably be taken into court.

Mr. Mudge says he thinks it was shown conclusively that "double-heading" does not increase the hazard to life, and that the employees are making the fight solely because the practice reduces the number of men employed.

The last testimony taken at the hearing was that of General Manager Van Vleck of the Southern Pacific. The testimony was given by proxy, and was in effect that the Southern Pacific is running double-headers to compete for transcontinental freight; that for many years other lines, secured most of the business across the continent and that after diligent investigation he found they used double-headers altogether, and that on account of their economy, speed and ability to keep large shipments intact and not splitting them in several trains the double-headers were found to be indispensable, and that in order for the Southern Pacific to get a part of the through business and not go bankrupt, it is absolutely necessary to run double-headers; and further, he does not believe it extra hazardous as compared with single heading.

The defense then announced that it rested for the present. Mr. Campbell, attorney for the employees, stated that the complainants had several other witnesses and could get 1,000 others to corroborate testimony already offered, but as so much time has been consumed and willing to curtail the matter, it had been decided to close the case. As to arguments, Mr. Campbell said if the commission desired to hear arguments they would argue the case, if not, it would be agreeable to submit the case without argument. Mr. Terry, one of the railroad attorneys, said there were several important points to which he desired to call the commission's attention, and that if agreeable he would like to submit a brief, at the same time furnishing the opposing counsel with copies. This was agreed to by both parties, and the case will be completed by the filing of briefs by both parties. The commission then announced the hearing at an end.

The Coal Supply.

The present coal famine in Germany has started Swedish capitalists in search of new fields of supply. They have been successful in discovering seams in Spitzbergen. The coal fields on Bear Island are mostly in the hands of a German company. Preparations for the operation of these arctic coal fields were begun last summer, and it is expected that when resumed this season the output will be remunerative. In this connection a Pittsburg, Pa., paper states that "within the next year local railroads will have connection with coal beds sufficient to supply abundant traffic for 300 years. It has been estimated that branch lines now being constructed within 50 miles of Pittsburg will develop over 4500 square miles of territory underlaid with the famous Pittsburg coal bed. This bed is 11 feet thick on the average, and as each square miles of a coal bed of one foot in thickness contains 1,000,000 tons, we find that in the region named there are 9,900,000,000 tons of bitumen."

A NEW TYPE OF LOCOMOTIVE, C., B. & Q. RY.

Any marked departure from the existing types, or in the larger details of locomotive design, is of exceptional interest to motive power officials for the very good reason that the present type of locomotives embody what might be termed the concrete ideas of a vast number of men whose experience has well qualified them to cope with the problems of locomotive design. The introduction of the Wootten type of firebox into service where anthracite coal was used was a departure. This type of boiler has since proved itself so very great a success with that character of fuel that spasmodic attempts were made to use the Wootten boiler with bituminous coal in the endeavor to obtain the greater evaporative efficiency that would accrue with soft coal burning at the rate of 90 or 100 lbs. per sq. ft. of grate surface per hour instead of at the rate of something like 180 lbs. per hour.

The result of such attempts did not give the results that were anticipated. This for several reasons. Bituminous coal is a long flaming fuel. During the process of combustion it gives off a great quantity of volatile gases. These gases are a part of its fuel value—contains many of the heat units existent in the coal. These volatile products or gases must be ignited in order to complete the process of combustion and give off the heat units latent therein; otherwise the gases will pass out through the stack in the black smoke of imperfect, wasteful combustion. In order for the gases to become ignited it is necessary to have some sort of a "combustion" chamber, wherein the gases can have time to properly absorb a sufficient amount of air in the presence of a high temperature, so that combustion will have reached as advanced a stage as possible before entering the tubes. After once entering the tubes very little further combustion takes place.

An anthracite coal contains a very small quantity of such volatile gases and consequently there is

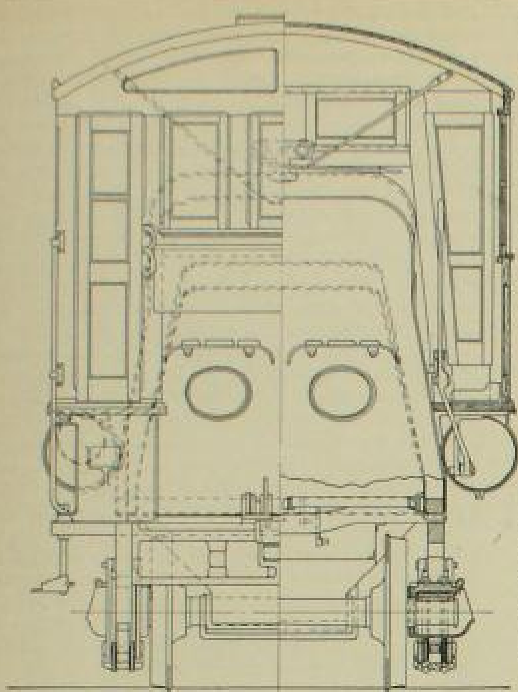


FIG. 2.—REAR CROSS SECTION.

necessity for but very little combustion chamber capacity. What benefit was expected to be derived from the introduction of a combustion chamber into the barrel of a Wootten boiler for use with anthracite coal we cannot conceive. There was no necessity for such provision, and it decreased the tube length so desirable to have in order to extract the heat from the passing gases, and this without any equivalent gain through an extended firebox heating surface. In addition to this it developed such structural weaknesses and operative difficulties as to cause it to be discarded before any extended effort was made to use a boiler of this form of construction in bituminous coal burning service. The idea of a combustion chamber was all right for soft coal burning, but we believe that the needless provision of it for anthracite burning has retarded many years the ideas which have given form to the example of advance in locomotive design we here present.

Now, since bituminous coal demands a combustion chamber, and since a combustion chamber placed in the barrel of the boiler is unsatisfactory for the reasons already mentioned, we can evidently obtain the same results by increasing the firebox capacity so that it, with a brick arch, forms a virtual combustion chamber, or, in other words, return to the deep firebox. In doing this much advantage is gained. The gases have an opportunity to unite with the air in the presence of a high temperature; in fact, by putting in the brick arch which the deep firebox permits we have an incandescent mass for

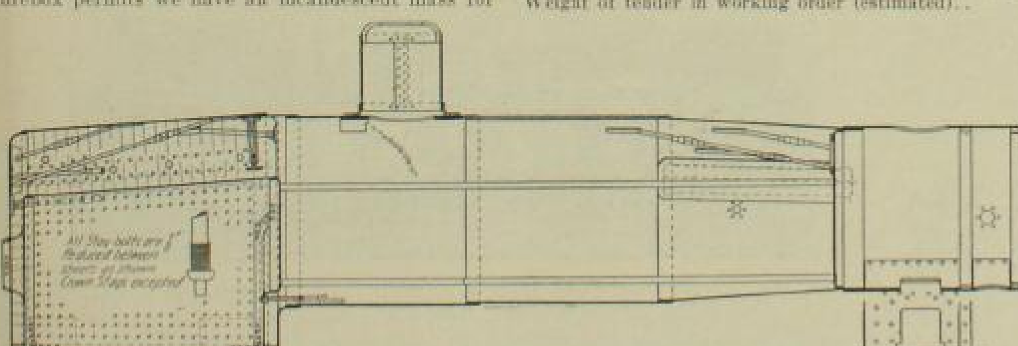


FIG. 3.—WIDE FIREBOX BOILER, PRAIRIE TYPE LOCOMOTIVE—ELEVATION.

them to impinge upon and ignite, while their rapidity of exit is delayed by this impinging; at the same time the space above the arch offers what is really a combustion chamber. We also gain heating surface in the most desirable part of the boiler, and have long boiler tubes to absorb the heat from the passing gases.

But we cannot gain a deep firebox in a Wootten boiler on account of its already great hight. The difficulties in the way of obtaining a deep and at the same time a wide firebox for the burning of bituminous coal has led designers hitherto to be content with the narrow firebox, and endeavor to in some measure retrieve the wastefulness of a small grate area by increasing the length of the box. This has been but a poor compromise, for the limits in this direction are such that for any given weight of engine an entirely insufficient grate area is obtained for any but the very best quality of soft coal, and, of course, it is entirely out of the question for the majority of roads to furnish any such fuel. These facts have received the consideration of the more thoughtful class of motive power men for a long time, but discussion upon the subject looking to an actual endeavor to attempt a practical solution of the difficulties in the way of the desired design has recently taken a decided advance.

The satisfactory service evidenced by locomotives with trailing wheels, as in the Atlantic and Columbian types, gave a clue to Mr. F. A. Delano, superintendent of motive power for the Chicago, Burlington & Quincy Ry. Co., which has led to the excellent solution of the problem which, through his courtesy in the matter of blue prints, we are enabled to present in this issue. Several of these locomotives are now being constructed at the West Burlington shops of this company, and one of them has been in service for a short time with results of which we shall speak further on. The several hard nuts which were necessary to be cracked in order to give practical shape to the design will readily be appreciated by those who have given the subject even the most casual attention and the entire absence of precedent presented some considerations which are well understood by many. All this renders of peculiar interest this bold step toward the provision of a grate area and type of firebox which is adapted to the character of fuel used. That this boiler and its firebox is exactly what is needed, no one who has studied the subject will deny, while that the construction adopted to provide for such a boiler gives promise of success we think will be admitted after giving the design sufficient study.

As will be seen in the illustrations, the locomotive is a mogul to which a pair of trailing wheels have been added in order to allow of a frame construction suitable for the reception of a wide and comparatively deep firebox. The new type thus formed has been designated "Prairie type" and in the present example is of the following leading dimensions:

Cylinders	19 x 24 ins.
Driving wheel centers	56 ins.
Thickness of tires	4 ins.
Engine truck wheels	37 ins.
Trailing wheels	37 ins.
Driving wheel base	11 ft. 4 ins.
Firebox, inside	7 ft. x 6 ft.
Boiler pressure	190 lbs.
Boiler, diameter at front end	56 ins.
Boiler, diameter at throat sheet	66 ins.
Heating surface, tubes	1827 sq. ft.
Heating surface, firebox	131 sq. ft.
Heating surface, total	1958 sq. ft.
Grate area	42 sq. ft.
Weight of engine in working order (estimated)	138,000 lbs.
Weight on drivers (estimated)	94,000 lbs.
Weight of tender in working order (estimated)	96,000 lbs.
Tender, water capacity	5000 gals.
Tender, coal capacity	8 tons
Extreme width	10 ft.
Extreme hight above rail	14 ft. 9 ins.
Tractive effort	22,500 lbs.

There are a good many features of interest about this locomotive entirely aside from those consequent upon the adoption of the wide firebox, and to one of which we here desire to call attention. It will be seen that the center line of the boiler is only 7 ft. 10 ins. from the top of the rail, which fact will appeal to one as offering so very low a center of gravity that the rolling lurch should be noticeably small. In addition to this it will be seen that except for a break in rear of front driver the spring equalization is continuous along both sides and joins by a cross equalizer at the trailing wheel as well as at the pony truck. The engine thus setting virtually in a cradle, should, with the other point mentioned, be an exceptionally smooth riding machine over even very bad track.

In the boiler, Figs. 2, 3 and 4, it will be seen that the firebox has a grate surface 6 ft. wide and 7 ft. long, so that the resulting grate area of 42 sq. ft. (which bears a relation to the cylinder volume of 10.6, excelling the association's recommendations by 7.6), is disposed in a form which enables the fireman to most easily control the condition of his fire—two fire doors being provided for his further convenience. The firebox is of the Belpaire type. It may be well in this connection to give the reasons which caused the adoption of this type of firebox in the present case, which would also permit the use of the arched box, as in the Wootten type. In the present box all

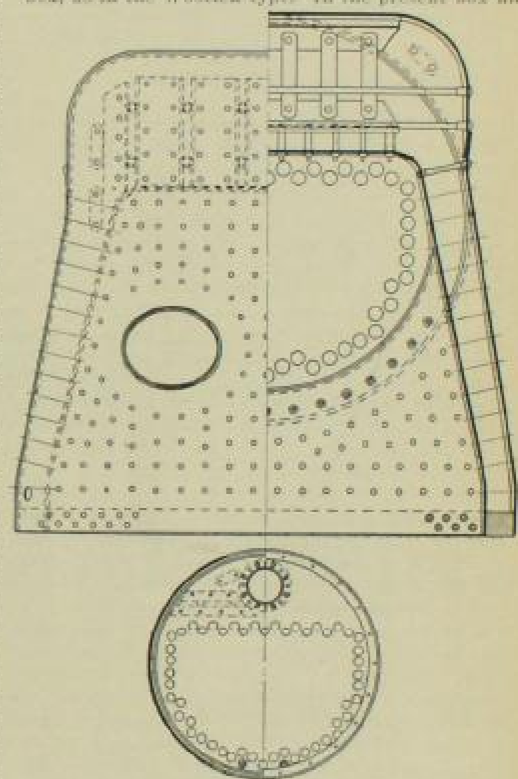


FIG. 4.—CROSS SECTION OF BOILER.

stays are enabled to be placed practically at right angles with both sheets, while the flat crown sheet permits a button head stay to be used under the favorable condition of a flat surface against which to bed. In bad water districts the side sheets can be renewed more easily and the box can be (as it is) tapered off both on the top and on the sides—a desirable feature in the cab.

A noticeable feature of the boiler is the very large water spaces that have been provided between the side sheets and also between the tubes and the shell. The water space is 4¼ ins. at the mud ring and spreads wider as the sheets rise from the mud ring. The telescopic barrel of the boiler is 56 ins. in diameter at the front end and 66 ins. in diameter at the junction with the throat sheet. The main taper is made in the first ring, so that there is considerable space between the tubes and the shell. This appeals to one as affording a free space which will particularly assist in keeping the boiler free of mud or scale deposits. There are 194 boiler tubes 2¼ ins. in diameter. This may seem at first to be a small number of tubes, but these tubes are 16 ft. 1 in. in length and it must also be remembered that the more perfect firebox combustion will not give need for so much flue heating surface, and also that a slow escape of the gases through the long tubes will render them much more efficient as heat extractors. These tubes could easily have been made considerably longer, owing to the length of barrel necessary to accommodate the driving wheels between the cylinder and the firebox, but since any greater length of tube would render their length out of advisable proportion to the diameter it was deemed better to set in the front tube sheet about 10 ins. Advantage was also taken of these facts to introduce a form of back tube sheet that has given very good results in the Wootten type of boiler. That is, that the tube sheet proper is set in away from the front sheet about 4 ins. and joined there by flanges. This throws the flue heads further from the flames, and, besides adding a trifle to the firebox heating surface, much facilitates flue sheet renewals.

It will be noticed that the box is 18 ins. deep at the throat. This allows a brick arch to be placed in the box, which is extremely desirable for reasons mentioned further back. Attention is called to the longitudinal bracing in the boiler, in which the turn buckles are introduced in order to render certain a uniform fitting in of the braces. A peculiarity is also noticeable in the throat stays in which button head staybolts are screwed through from the box sheet on into suitable lugs on the barrel.

The engine itself differs in no important detail (with the exception of the engine truck, of which

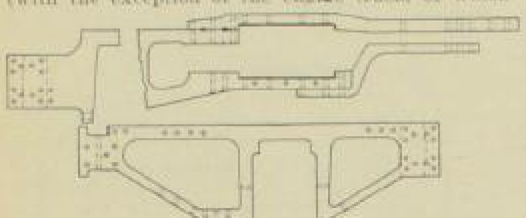


FIG. 6.—FRAME DETAIL.

we will speak later) from the ordinary mogul engine until we get back of the rear pedestal jaw at the rear wheel. At this point, in Fig. 1, it will be seen that the frame drops 7½ ins., and it is also seen that the main engine frame on other side butts up to and splices with a ribbed wing upon a very heavy cast steel cross piece, which is shown in detail in Fig. 5. As to the stability of this joint, attention may be called to its construction and manner of placing the keys, and to the fact that the joint is 16 ins. in hight and 12 ins. in length, and that there are 12 bolts 1⅛ ins. in diameter holding the joint together. Fig. 5 will show that the cross-piece is designed of sufficient strength to sustain all the varying stresses to which it may be subjected. Referring again to Fig. 1, we see that this cross-piece is immediately below the front end of the firebox, and that it extends upon either side in such a manner that the short, trailer frames upon being attached thereto will stand 6 ft. 2 ins. apart, which will bring them directly beneath the mud ring, as seen in Fig. 2. This throws the trailer pedestal jaws exactly right for the use of an outside journal upon the trailing axle.

Attention is called particularly to the working out of the various details resulting from the use of this outside journal trailer. The last driving spring hangers extend down to below the main frames, where they engage with equalizers upon either side which are fulcrumed at a point, Fig. 1, which favors the trailers in load distribution. Both of these equalizers engage at their trailer ends with a cross equalizer, plan in Fig. 1, whose ends engage in turn with the trailer equalizer hangers. In Figs. 1 and 2 it will be seen that a pair of slings carry a pocket for receiving the trailer journal box equalizers upon each side—the hangers at the rear end of these equalizers carrying a seat for the reception of a pair of coil springs. This arrangement would seem to promise a very steady riding back end, on account of the weight being carried to journals upon the outside of the frames, and with the cross-equalizing forms a sort of cradle.

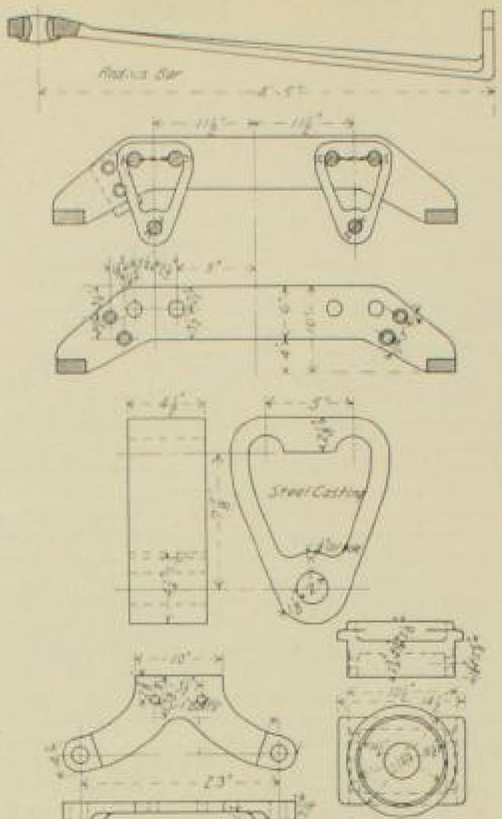


FIG. 7.—PONY TRUCK DETAILS.

In the lower detail in Fig. 5 is shown the tail piece or draw casting to which the trailer frames are attached at the rear. The benefits accruing from such a short rear overhang is readily understood. The spread of the trailer frames enables the ash pan of course to fit in quite readily. In Fig. 6 will be seen, in the larger detail, the method of frame construction, an observable point of which is noticed in the forming of the lower chord where it passes around the cylinder—the splice being placed at the front, which, in case of collision, facilitates repairs. The cylinders are cast with an incorporated piston valve chamber and the valve used is the patented one devised by Mr. F. H. Clark, mechanical engineer for this line, which was illustrated in our issue of Feb. 24, and has given excellent results in an extended service upon this road. The main rods will be seen to be quite short, but the effect of the increase in angularity due to this has been to some extent retrieved by lengthening the link radius through the introduction of a motion rod.

In Fig. 7 is shown details of a truck which is constructed in a somewhat novel manner and in which we think much interest will be taken in regarding the method of hanging the center or swing casting. The usual style of eye-head hangers having been abandoned in favor of what might be termed a heart-shaped hanger. This, while not original with this road, has been in service for over a year upon a great many mogul engines, and has given such marked results that it is regarded with great favor by the motive power men of this line. It is well known that in a pony truck fitted with the usual style of swing hangers, although such hangers are inclined to each other at a considerable angle, does not have the guiding effect to a degree that would be very desirable to have. This is easily noticed on a curve—the engine running at an apparent tangent and then being thrown over, in other words "nosing." In the present truck the hangers are discarded in favor of what might be termed a "heart-shaped" hanger. The center, or swing casting is but 14 ins. in width and has bolted to it the wrought swing frame shown in the figure. The upset ends at the end of this frame take the case hardened swing pins. Now, the hangers are formed as seen in the figure, of cast steel, and to hang, each upon two pins. It will be readily appreciated that the force tending to swing in either direction will have to raise each hanger from off one or the other of the supporting pins, which of course, will be at the expense of a considerable greater force tending to throw the engine over central than is the case with the ordinary inclined hangers, as a result of which this pony truck approaches the four-wheel truck in guiding efficiency.

This locomotive has been in service for a week and although put out without lagging has in its preliminary breaking so justified the hopes of the designers that striking results are expected to be shown in the tests which are to follow as soon as the machine is well broken in. The locomotive has been called upon to haul a slight excess of her rated capacity and on one of the hardest pulls was allowed to run low in water and to drop considerably in steam pressure. Then while still working at full capacity, both injectors were applied and an effort to gain steam at the same time was made. By the time the three gages of water had been obtained, the pressure has picked up so that the engine popped a moment after the injectors were shut off. The engine is now in the shop for lagging, and we hope to have the pleasure of presenting the results of a careful test upon its conclusion.

ASH DUMP, PHILADELPHIA & READING RY.

At Reading, Pa., there is a substantially-built ash dump recently constructed for the Philadelphia & Reading Ry. which affords a good example of a modern structure of this kind where the ashes are disposed of by hand loading. The pits into which the ashes are dumped from the locomotives are arranged under a track elevated to such a hight that 6 ft. of clear headroom remains between the floor of the pit and the under side of the girders supporting the rails, while the floor of the pit is on a level with the top of a gondola car standing upon the loading track, at the side of the dump. The retaining wall for the elevated track is 444 ft. long, of rubble masonry laid in cement mortar. The dump is approached at each end with grades of 5 per cent, eased by vertical curves at the points where the grade changes. The top of rail over the dump is 8 ft. above top of rail on main tracks, while the loading track is depressed to bring the top of rail 5 ft. 6 ins. below top of rail for main track. The dump is 72 ft. in length, divided into eight pits, each 9 ft. in length, between centers of partition piers. The length of the dump was designed with reference to the possibility of dumping simultaneously the ash pans of two of the standard passenger locomotives of the road standing over the dump, tender to tender, as shown in the accompanying half-tone view.

The line engraving herewith shows a side elevation of three of the pits composing the dump, and also a side elevation of one of the brick piers or partitions, and a cross section of the track. Each track rail rests directly upon the top flange of a 12-in. 170-lb. I-beam, in lengths of 17 ft. 11½ ins., or long enough to extend over two panels and leave ½ in.

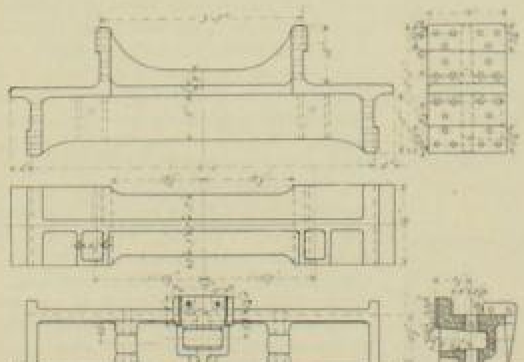
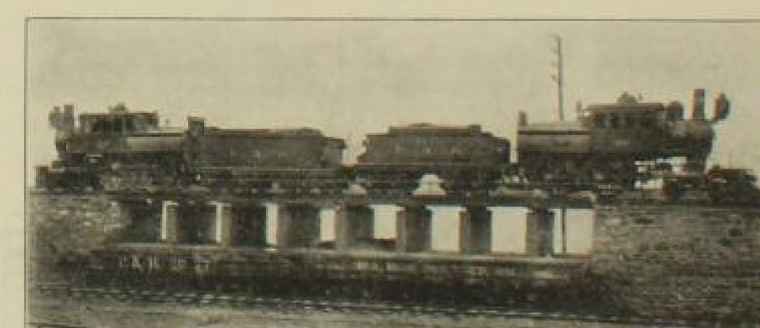


FIG. 5.—CROSS CASTING AND TAIL PIECE.



ASH DUMP, PHILADELPHIA & READING RY., AT READING, PA.

New Locomotives of the Chicago, Burlington & Quincy.

[WITH AN INSET.]

In this issue are shown the new freight locomotives and six-wheel switchers of the Chicago, Burlington & Quincy, four of each having recently been built in the company's shops at Aurora and West Burlington. For the drawings and other data we are indebted to the designers, Mr. F. A. Delano, Superintendent of Motive Power, and Mr. F. H. Clark, Mechanical Engineer of that road.

Freight Locomotives.

For a number of years the standard freight locomotive of the Chicago, Burlington & Quincy has been the class "H" mogul and the latest engines of this class have 2,048 sq. ft. of heating surface, 30 sq. ft. of grate area, 121,500 lbs. weight on the driving wheels, and a total weight of 142,000 lbs.; the firebox is 3 ft. 4 in. wide by 9 ft. long. These engines have given good service, but to meet the requirements for greater boiler capacity, economy of fuel consumption and simplicity of firebox design a new freight locomotive has been designed which in several respects differs from engines built heretofore. As stated, four of these are now about completed and will be known as the class "R," or "Prairie" type, in contradistinction to the Atlantic type. They are particularly interesting as an application of a wide and deep firebox suitable for bituminous lump coal.

The modified Wootten firebox used with low-grade anthracite coal has never been considered favorably by Western roads burning hard bituminous coals, and they appear unnecessarily wide and entirely too shallow. It may be said that the chief object in the design of the class "R" engines was to get a fair increase in grate area, a deep firebox, and a low-hung engine which would ride safely over any kind of track. Such a firebox makes necessary certain modifications in the wheel arrangement and frame construction which would not be advisable if tractive effort were the chief requirement, the engine having been designed for low grades. The class "R" engines have a single or pony truck, in front, three coupled drivers and a pair of trailing wheels, a combination which has been named the "Prairie" type to distinguish it from other wheel arrangements. In this instance the middle drivers have no flanges.

The principal features are shown in Figs. 1 and 2, being respectively an elevation and sections. The total weight of the engine in working order is estimated at 140,000 lbs., of which about 96,000 lbs. is on the drivers, 20,000 lbs. on the leading and 24,000 lbs. on the trailing wheels. The cylinders are 19 x 24 in., the steam pressure is 190 lbs. and the driving wheels are 64 in. in diameter, making the maximum theoretical tractive power about 21,700 lbs. or 22.6 per cent. of the adhesive weight. It will be seen that the engine is best suited for fast freight service on fairly level track where the boiler capacity governs the train load.

The boiler is of the Belpaire type, and has 139 sq. ft. of firebox heating surface and 1,937 sq. ft. of tube heating surface, or a total of 2,076 sq. ft. The grate is 6 ft. wide and only 7 ft. long, making an area of 42 sq. ft., but it is proposed to start the brick arch from a low wall in the front of the firebox, which plan, if carried out, will reduce somewhat the grate area. The depth of the firebox is 62¼ in. at the front and 56 in. at the rear.

The novel features of the firebox are shown in Fig. 3, and attention may be called to the water legs which slope outward. The side sheets are straight to within a few inches of the mud ring, where the water spaces are 4½ in., gradually increasing to 7 in. at the top. The unusually large water spaces will doubtless prolong the life of staybolts and side sheets, and it is anticipated that in these respects better results will be obtained than with former engines. The boiler is not so wide at the rear that the cab has to be placed forward. Two fire doors are provided and considering the short grates, it is reasonable to suppose that the work of firing will be better done, which together with the lower rates of combustion should result in economies. Although a very short extension front is used, the smokebox is 5 ft. 5 in. long. This became necessary as the length of the barrel was determined by the driving wheels clearing the firebox at one end, and the cylinders at the other, and the fact that it was not considered advisable to make the tubes longer than 16 ft. 1 in.

The cylinder arrangement is apparent from Fig. 4 and the details of the piston valves are shown in Fig. 5. In this valve the number of parts is much less than in the first ones used. It consists essentially of the valve body, a single casting through which the valve rod extends, two bull rings and the packing rings, all being held in place by a single nut and cotter on the end of the valve rod. This arrangement of piston valve is doubtless the best so far brought out, and weighs about 40 per cent. less than a similar Allen slide valve. The link motion has been modified, as shown in Fig. 1, so that longer eccentric rods can be used. This modification consists in an extension bar connecting the link block and the rocker shaft, the extension bar being attached to the rocker shaft at the rear and suspended at the forward end by a hanger. Laird cast steel crossheads are used, the upper guide bar being of cast iron, while the lower bar is made of forged steel, so that the depth of the crosshead may be as little as possible. The piston rods, 3¼ in. in diameter, are steel with a 3¾-in. collar at the piston and a 4-in. collar at the crosshead, large fillets being used where there are changes in diameter. Where the rods enter the piston and crosshead the taper is ¼ in. in 5 in., and a single nut is used at either end.

The only changes in the frame construction are at the firebox end where there is an offset of 16½ in. From Figs. 1 and 6, it will be seen that a heavy cast steel cross bar is used at the front of the firebox to which both sections of the frame are attached; a somewhat similar cross bar forms the connection at the rear. The journal boxes of the trailing wheels work in pedestals and the bearings of that axle are outside the wheels. This gets the rear journals well away from the heat and dirt of the ash pan, and where they can be easily inspected. The front pair of drivers and the leading wheels are equalized together in the usual manner, and the main and rear drivers and the trailing wheels form another group. A cross bar is placed just forward of the trailing wheels, to which are connected the equalizers in front and back of that point as shown in Fig. 1. The seat of the rear equalizers is supported by two stirrups made of round steel which extend up and end in eyes; a rod passes through the eyes of each stirrup and transmits the load to the top of the journal box. The trailing axle is given 1 in. play, which, if required, can be increased to 2 in.

The details of the expansion pads are clearly shown in Fig. 7, and Fig. 1 gives the arrangement of the brake gear, the brake cylinder being placed under the boiler barrel and between the two rear drivers. The principal dimensions are given below along with those of the new six-wheel switchers.

Six-Wheel Switching Locomotives.

Fig. 8 shows the construction of these engines, which are estimated to weigh, in working order, 122,000 lbs. The cylinders are 20 x 24 in., the driving wheels 52 in., and the steam pressure 180 lbs., which makes the maximum theoretical tractive effort about 26,500 lbs., or 22 per cent. of the tractive weight. The novel feature of this class of engines, the "G3," is the boiler, Fig. 9, which has a firebox extending outside the frames, but differing from the class "R" boiler in that it is of the straight top, radial stay type, with vertical side sheets. Also, on account of the different service requirements, the firebox is made shorter and narrower, being only 6 ft. long, 4 ft. 6¼ in. wide and 58½ in. deep; the grate area is 27 sq. ft. There are 1,732 sq. ft. of tube heating surface and 106 sq. ft. of firebox heating surface, a total of 1,838 sq. ft., which is very large for a switch engine. In these engines the frames are not offset, but the firebox is carried on expansion pads which rest on brackets bolted to the frame as shown by Fig. 10.

The same design of piston valves is used as in the class "R" engines and the cylinder arrangement, guides, crossheads and piston rods are also similar. The pistons, however, are "Z" shape, Fig. 11, and made of cast iron. The advantage of this form is that in casting no cores are needed, and it is easily determined whether the piston is of the required thickness. With some styles of box pistons there is more or less uncertainty about the thickness of the walls.

The principal dimensions of the class "R." Prairie type, and the class "G3,"' six-wheeler switcher, are as follows:

Type	Prairie.	Six-wheel.
Class	R.	G3.
Name of builder	Chicago, Burlington & Quincy	
" operating road	" " "	
Gage	4 ft. 8½ in.	
Simple or compound (both)	Simple.	
Kind of fuel to be used (both)	Bituminous coal.	
Weight on drivers	96,000 lbs.	122,000 lbs.
" truck wheels	20,000 lbs.	....
" trailer wheels	24,000 lbs.	...
Weight, total	140,000 lbs.	122,000 lbs.
" tender loaded	96,000 lbs.	75,000 lbs.
Wheel base, total, of engine	26 ft. 3 in.	10 ft. 10 in.
" driving	11 ft. 4 in.	10 ft. 10 in.
" total (engine and tender)	51 ft. 4 in.	38 ft. 9¼ in.
Length over all, engine	37 ft. 11 in.	....
" " total, engine and tender	60 ft. 6¼ in.	....
Height, center of boiler above rails	7 ft. 10 in.	7 ft. 10½ in.
" of stack above rails	15 ft.	14 ft. 6¾ in.
Heating surface, firebox	139 sq. ft.	106 sq. ft.
" " tubes	1,937 sq. ft.	1,732 sq. ft.
" " total	2,076 sq. ft.	1,838 sq. ft.
Grate area	42 sq. ft.	27 sq. ft.
Drivers, diameter	64 in.	52 in.
" material of centers (both)	Cast iron.	
Truck and trailer wheels, diameter	37 in.	....
Journals, driving axle, size	8½x9½ in.	9x10½ in.
" truck " "	5½x9 in.	....
Cylinders, diameter	19 in.	20 in.
Piston, stroke	24 in.	24 in.
" rod diameter (both)	3¼ in.	
Kind of piston rod packing (both)	Metallic.	
Main rod, length center to center	6 ft. 3¼ in.	6 ft. 1¼ in.
Steam ports, area (both)	35 sq. in.	
" width (both)	1½ in.	
Exhaust ports, area (both)	69.5 sq. in.	
" width (both)	3 in.	
Bridge, width (both)	1¾ in.	
Valves, kind of (both)	10-in. piston.	
" greatest travel (both)	6 in.	
" outside lap	1 in.	¾ in.
" clearance	$\frac{1}{16}$ in.	0 in.
" lead in full gear	....	....
Boiler, type of	Belpaire.	Straight top. Radial stay.
" working steam pressure	190 lbs.	180 lbs.
" material in barrel (both)	Steel.	
" thickness of material in barrel	⅝ in.	$\frac{9}{16}$ in.
Boiler, diameter of barrel	56 in.	60 in.
Seams, kind of horizontal (both)	Butt.	
" " circumferential (both)	Lap.	
Thickness of tube sheets (both)	½ in.	
" crown sheets (both)	⅜ in.	
Crown sheet stayed with (both)	Radial stay.	
Dome, diameter (both)	28¼ in.	
Firebox, length	7 ft.	6 ft. 0 in.
" width	6 ft.	4 ft. 6¼ in.
" depth, front	62¼ in.	58½ in.
" " back	56 in.	58½ in.
" material (both)	Steel.	
" thickness of sheets (both)	⅜ in.	
" brick arch? (both)	Yes.	
" water space, width (both)	Front, 4½ in.; sides, 4½ in.; back, 4½ in.	
Grate, kind of (both)	Shaking and rocking.	
Tubes, number	194	204
" material (both)	Wrought iron.	
" outside diameter (both)	2¼ in.	
" length over sheets	16 ft. 1 in.	14 ft. 6 in.
Smokebox, diameter	57½ in.	61½ in.
" length (both)	65 in.	
Exhaust nozzle (both)	Single.	
" " "	Permanent.	
Netting (both)	Wire.	
" size of mesh (both)	2½x2½ in.	
Stack (both)	Taper.	
" least diameter (both)	14 in.	
" greatest diameter (both)	19½ in.	
" height above smokebox	....	4 ft. 2 in.
Tender.		
Type (both)	Swivel truck.	
Tank capacity for water	5,000 gals.	3,900 gals.
Coal capacity	8 tons.	6 tons.
Kind of material in tank (both)	Steel.	
Thickness of tank sheets (both)	$\frac{3}{16}$ and ¼ in.	
Type of under-frame	Wood with steel center sills.	Composite.
Type of truck (both)	Diamond frame.	
Truck with swinging motion or rigid bolster (both)	Rigid.	
Type of truck spring (both)	Elliptic.	
Diameter of truck wheels	36 in.	33 in.
Diam. and length of axle journals	5x9 in.	4¼x8 in.
Distance between centers of "	5 ft. 6 in.	6 ft. 3 in.
Type of truck bolster	....	Steel.
Type of truck transom	....	Channel.
Length of tank	19 ft.	....
Width of tank	9 ft. 6 in.	....
Height of tank, not including collar	4 ft. 10½ in.	....
Type of back drawhead (both)	M. C. B. coupler.	
With or without water scoop (both)	Without.	
Special Equipment.		
Sight-feed lubricators (both)	Michigan.	
Bell ringer	Plattsmouth.	Crandall.
Couplers	Leeds pilot at front.	Chicago.
Muffler	....	Consolidated S. V. Co.
Sanding devices	"She."	Leach.
Driver brake equipment (both)	Westinghouse.	
Tender " " "	Westinghouse.	
" " beam (both)	Monarch.	
Driver " shoe "	Ross-Mehan.	
Piston rod packings (both)	C. C. Jerome.	
Valve "	Dunbar.	C. C. Jerome.

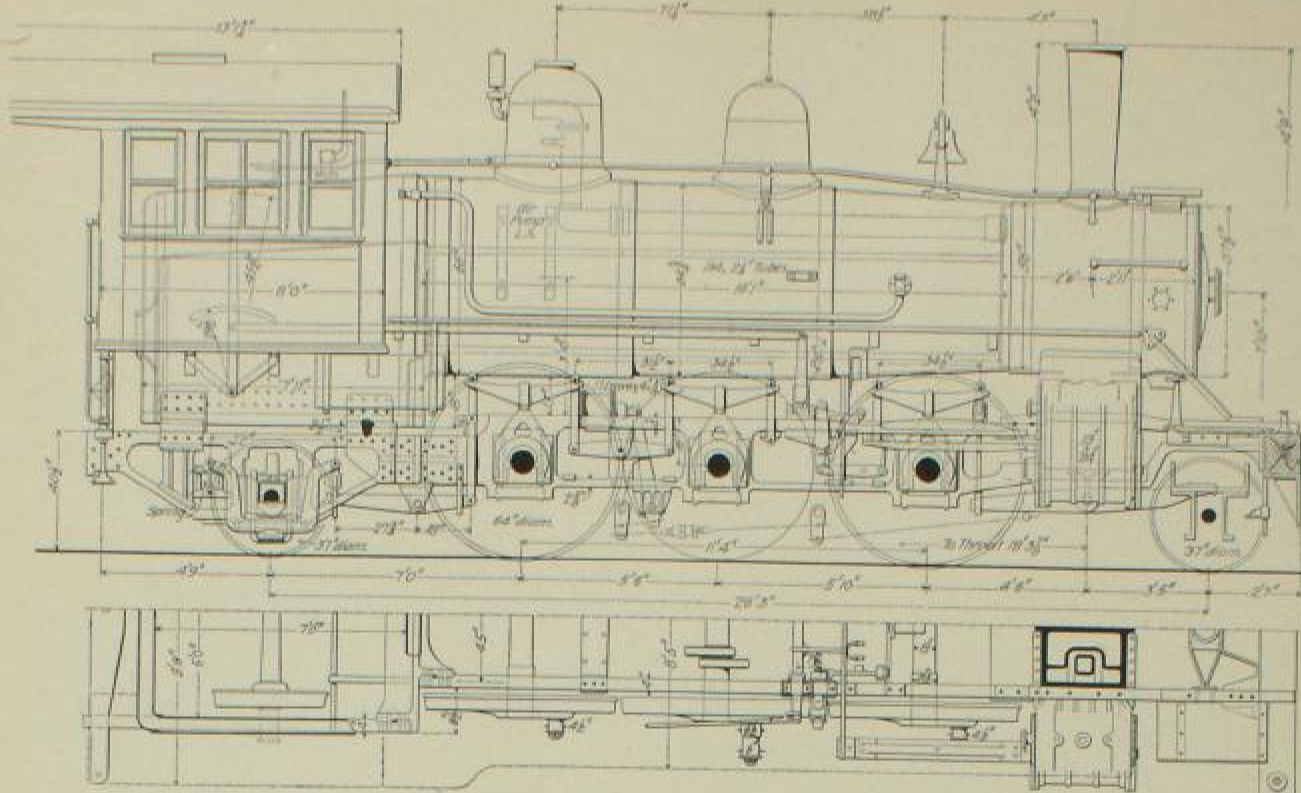


Fig. 1.— New Class R " Prairie Type " Locomotive—Chicago, Burlington & Quincy Railroad.

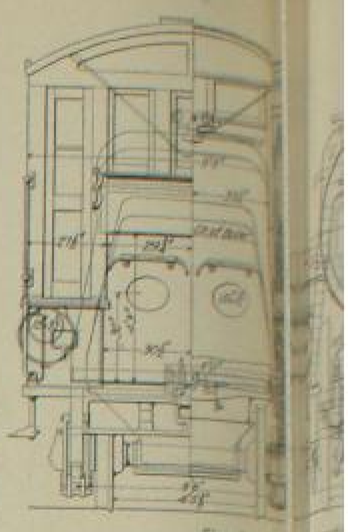
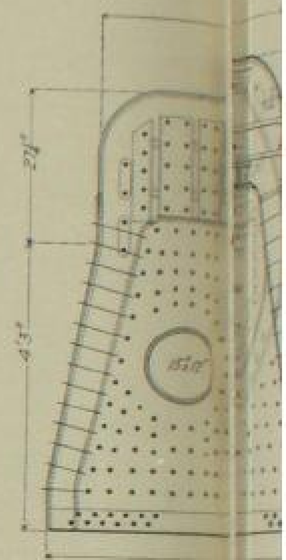


Fig. 2.—Se



Cross Secti Boiler

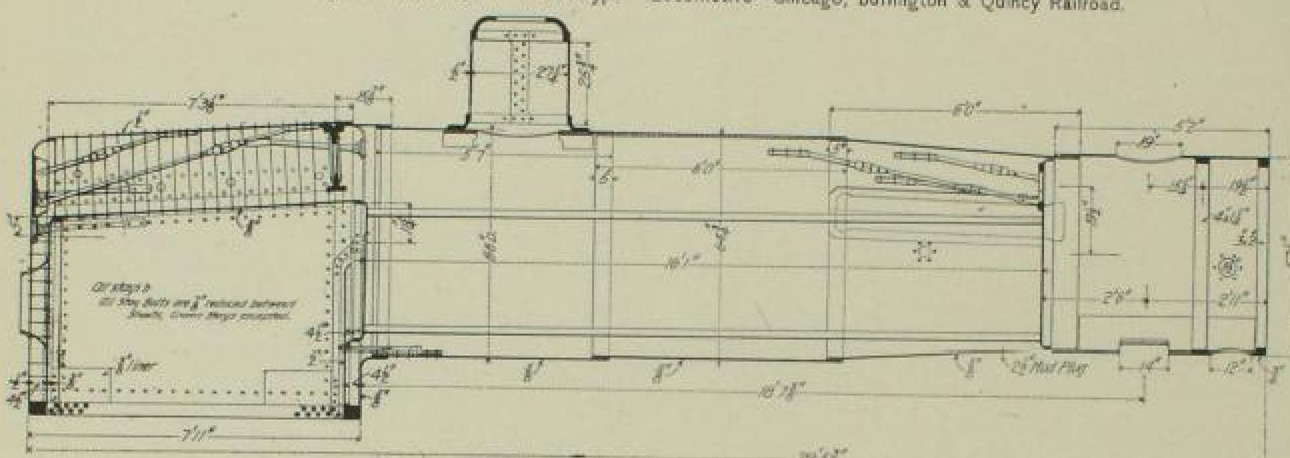


Fig. 3.—Boiler, Class R Locomotive.

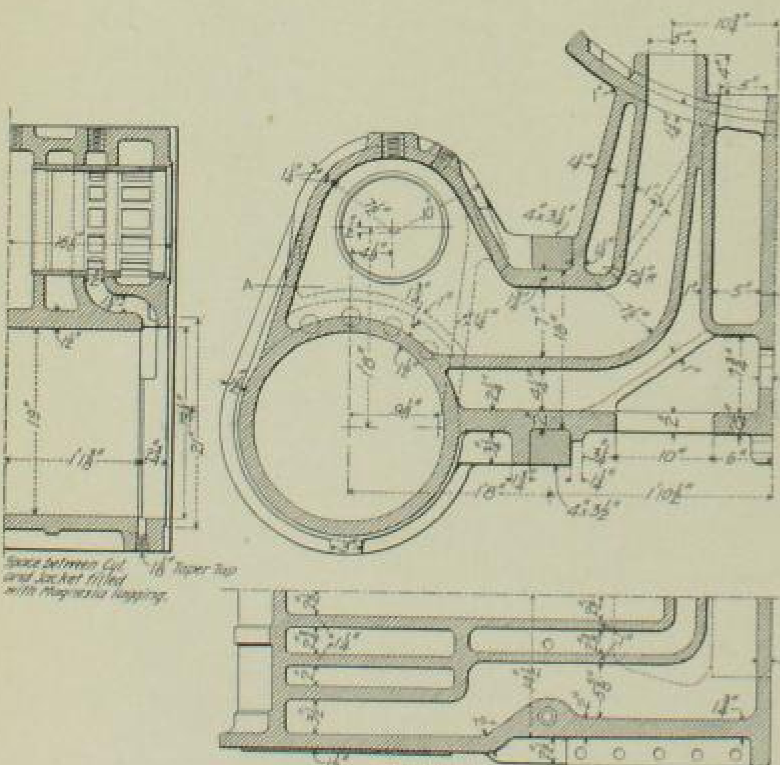


Fig. 4.—Cylinder, Class R Locomotive.

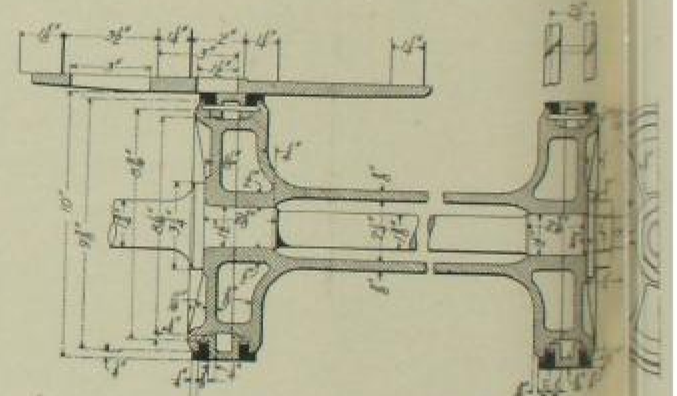
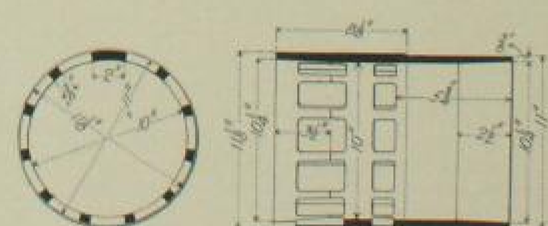


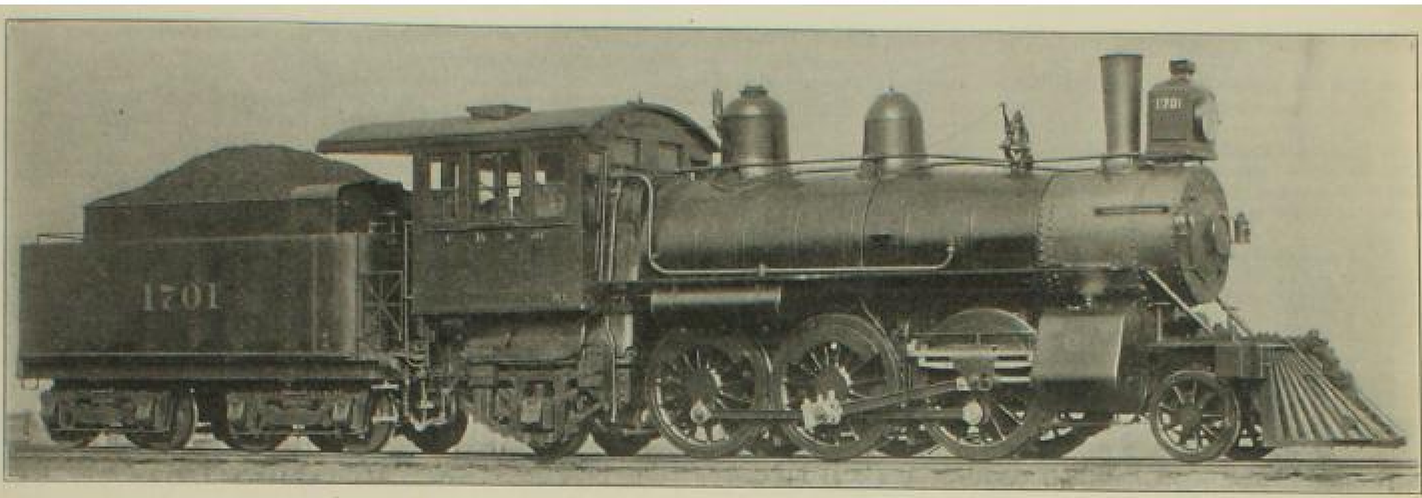
Fig. 5.—Piston Valves for Class R and G3 Locomo



Steam Chest Bushing, Class R Locomotive.

NEW CLASS R " PRAIRIE TYPE " LOCOMOTIVE, AND CLASS G3

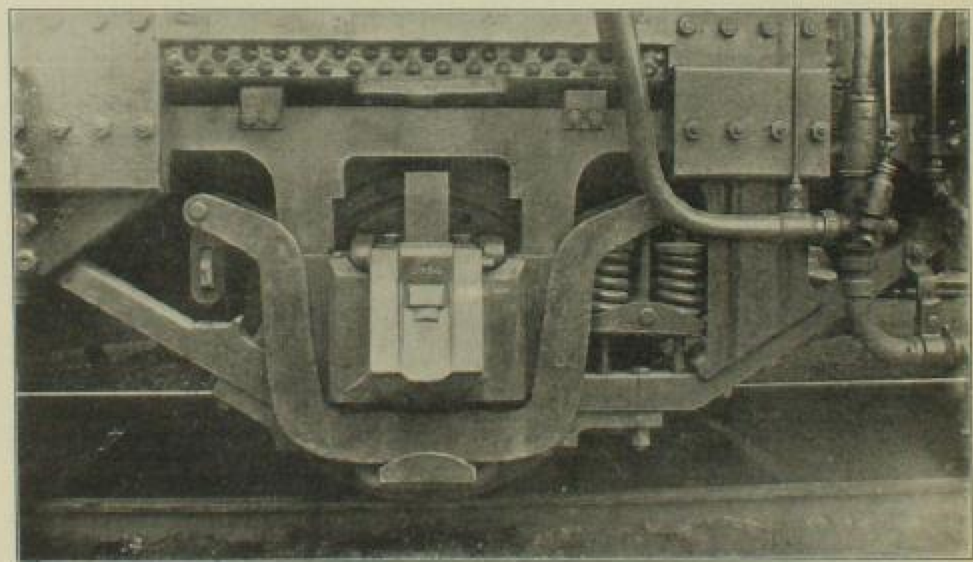
Designed by Mr. F. A. Delano, *Superintendent of Motive P*



New Class R "Prairie Type" Locomotive—Chicago, Burlington & Quincy R. R.

"Prairie" Type Freight Locomotives of the Chicago, Burlington & Quincy.

In our issue of March 30 last, the drawings of the new "Prairie" type freight locomotives of the Chicago, Burlington & Quincy were published, together with a very full description of the novel features. These engines are for fast freight service on a fairly level road and have attracted much attention. They represent a successful attempt to design a sufficiently wide fire box for bituminous coal, and at the same time the cab is so placed that the engineman and fireman are together. Since our first publication these locomotives have been put in service and the engravings are from photographs of the completed engines, furnished by Mr. Delano. The notable features may be briefly stated.



Trailing Truck Journal Boxes of "Prairie Type" Locomotive.

There are three pairs of driving wheels and a single pair of leading and trailing wheels; the middle drivers have plain tires. The trailing axle has outside bearings, as clearly shown in the engravings, and this promises to be used in future designs as the journals and boxes are removed from the heat and dirt of the ash pan, a steadier riding engine is obtained and the journals can be readily inspected. The boiler is of the Belpaire type with the water legs sloping outward beyond the lines of the main frames; the use of trailing wheels also permits of a deep fire box. The boiler, valve motion, piston valves and other details were illustrated March 30. The principal dimensions are:

Cylinders, size	19 x 24 in.
Driving wheels, diameter	64 in.
Working steam pressure	190 lbs.
Total weight	140,000 lbs.
Weight on drivers	96,000 lbs.
Heating surface, firebox	139 sq. ft.
Heating surface, tubes	1,937 sq. ft.
Heating surface, total	2,076 sq. ft.
Grate area	42 sq. ft.
Firebox, length	7 ft.
Firebox, width	6 ft.
Firebox, depth, front	62½ in.
Firebox, depth, back	56 in.
Tubes, number	194
Tubes, diameter	2¼ in.
Tubes, length	16 ft. 1 in.
Tender, water capacity	5,000 gallons
Tender, coal, capacity	8 tons

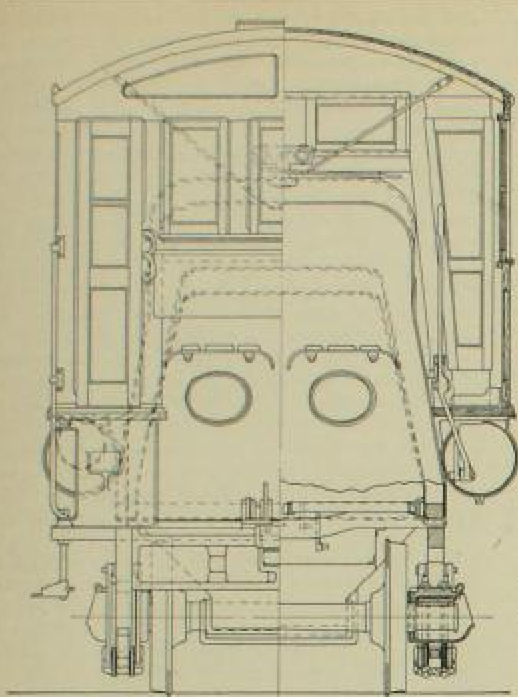


FIG. 2.—REAR CROSS SECTION.

necessity for but very little combustion chamber capacity. What benefit was expected to be derived from the introduction of a combustion chamber into the barrel of a Wootten boiler for use with anthracite coal we cannot conceive. There was no necessity for such provision, and it decreased the tube length so desirable to have in order to extract the heat from the passing gases, and this without any equivalent gain through an extended firebox heating surface. In addition to this it developed such structural weaknesses and operative difficulties as to cause it to be discarded before any extended effort was made to use a boiler of this form of construction in bituminous coal burning service. The idea of a combustion chamber was all right for soft coal burning, but we believe that the needless provision of it for anthracite burning has retarded many years the ideas which have given form to the example of advance in locomotive design we here present.

Now, since bituminous coal demands a combustion chamber, and since a combustion chamber placed in the barrel of the boiler is unsatisfactory for the reasons already mentioned, we can evidently obtain the same results by increasing the firebox capacity so that it, with a brick arch, forms a virtual combustion chamber, or, in other words, return to the deep firebox. In doing this much advantage is gained. The gases have an opportunity to unite with the air in the presence of a high temperature; in fact, by putting in the brick arch which the deep firebox permits we have an incandescent mass for

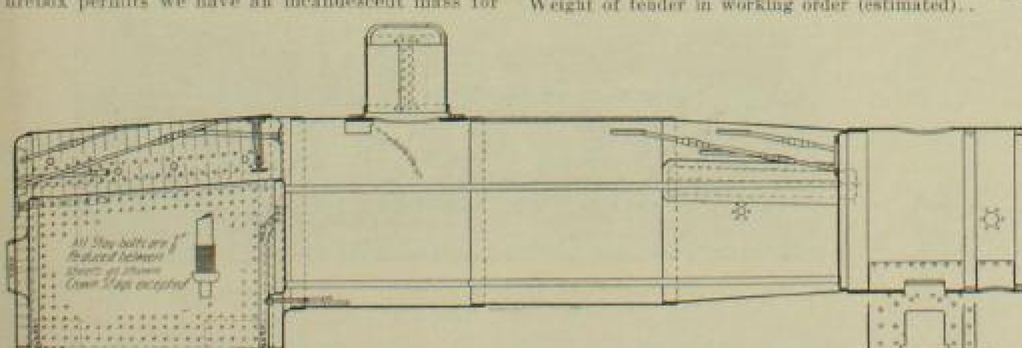


FIG. 3.—WIDE FIREBOX BOILER, PRAIRIE TYPE LOCOMOTIVE—ELEVATION.

them to impinge upon and ignite, while their rapidity of exit is delayed by this impinging; at the same time the space above the arch offers what is really a combustion chamber. We also gain heating surface in the most desirable part of the boiler, and have long boiler tubes to absorb the heat from the passing gases.

But we cannot gain a deep firebox in a Wootten boiler on account of its already great hight. The difficulties in the way of obtaining a deep and at the same time a wide firebox for the burning of bituminous coal has led designers hitherto to be content with the narrow firebox, and endeavor to in some measure retrieve the wastefulness of a small grate area by increasing the length of the box. This has been but a poor compromise, for the limits in this direction are such that for any given weight of engine an entirely insufficient grate area is obtained for any but the very best quality of soft coal, and, of course, it is entirely out of the question for the majority of roads to furnish any such fuel. These facts have received the consideration of the more thoughtful class of motive power men for a long time, but discussion upon the subject looking to an actual endeavor to attempt a practical solution of the difficulties in the way of the desired design has recently taken a decided advance.

The satisfactory service evidenced by locomotives with trailing wheels, as in the Atlantic and Columbian types, gave a clue to Mr. F. A. Delano, superintendent of motive power for the Chicago, Burlington & Quincy Ry. Co., which has led to the excellent solution of the problem which, through his courtesy in the matter of blue prints, we are enabled to present in this issue. Several of these locomotives are now being constructed at the West Burlington shops of this company, and one of them has been in service for a short time with results of which we shall speak further on. The several hard nuts which were necessary to be cracked in order to give practical shape to the design will readily be appreciated by those who have given the subject even the most casual attention and the entire absence of precedent presented some considerations which are well understood by many. All this renders of peculiar interest this bold step toward the provision of a grate area and type of firebox which is adapted to the character of fuel used. That this boiler and its firebox is exactly what is needed, no one who has studied the subject will deny, while that the construction adopted to provide for such a boiler gives promise of success we think will be admitted after giving the design sufficient study.

As will be seen in the illustrations, the locomotive is a mogul to which a pair of trailing wheels have been added in order to allow of a frame construction suitable for the reception of a wide and comparatively deep firebox. The new type thus formed has been designated "Prairie type" and in the present example is of the following leading dimensions:

Cylinders	19 x 24 ins.
Driving wheel centers	56 ins.
Thickness of tires	4 ins.
Engine truck wheels	37 ins.
Trailing wheels	37 ins.
Driving wheel base	11 ft. 4 ins.
Firebox, inside	7 ft. x 6 ft.
Boiler pressure	190 lbs.
Boiler, diameter at front end	56 ins.
Boiler, diameter at throat sheet	66 ins.
Heating surface, tubes	1827 sq. ft.
Heating surface, firebox	131 sq. ft.
Heating surface, total	1958 sq. ft.
Grate area	42 sq. ft.
Weight of engine in working order (estimated)	138,000 lbs.
Weight on drivers (estimated)	94,000 lbs.
Weight of tender in working order (estimated)	96,000 lbs.
Tender, water capacity	5000 gals.
Tender, coal capacity	8 tons
Extreme width	10 ft.
Extreme hight above rail	14 ft. 9 ins.
Tractive effort	22,500 lbs.

There are a good many features of interest about this locomotive entirely aside from those consequent upon the adoption of the wide firebox, and to one of which we here desire to call attention. It will be seen that the center line of the boiler is only 7 ft. 10 ins. from the top of the rail, which fact will appeal to one as offering so very low a center of gravity that the rolling lurch should be noticeably small. In addition to this it will be seen that except for a break in rear of front driver the spring equalization is continuous along both sides and joins by a cross equalizer at the trailing wheel as well as at the pony truck. The engine thus setting virtually in a cradle, should, with the other point mentioned, be an exceptionally smooth riding machine over even very bad track.

In the boiler, Figs. 2, 3 and 4, it will be seen that the firebox has a grate surface 6 ft. wide and 7 ft. long, so that the resulting grate area of 42 sq. ft. (which bears a relation to the cylinder volume of 10.6, excelling the association's recommendations by 7.6), is disposed in a form which enables the fireman to most easily control the condition of his fire—two fire doors being provided for his further convenience. The firebox is of the Belpaire type. It may be well in this connection to give the reasons which caused the adoption of this type of firebox in the present case, which would also permit the use of the arched box, as in the Wootten type. In the present box all

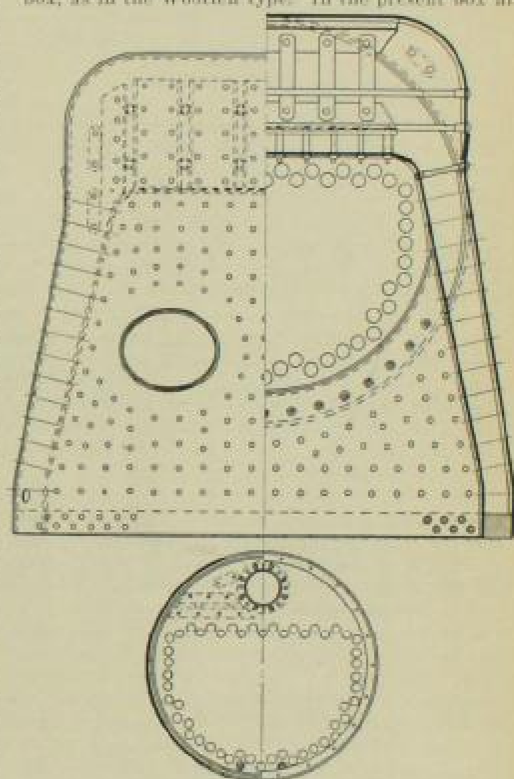


FIG. 4.—CROSS SECTION OF BOILER.

stays are enabled to be placed practically at right angles with both sheets, while the flat crown sheet permits a button head stay to be used under the favorable condition of a flat surface against which to bed. In bad water districts the side sheets can be renewed more easily and the box can be (as it is) tapered off both on the top and on the sides—a desirable feature in the cab.

A noticeable feature of the boiler is the very large water spaces that have been provided between the side sheets and also between the tubes and the shell. The water space is 4¼ ins. at the mud ring and spreads wider as the sheets rise from the mud ring. The telescopic barrel of the boiler is 56 ins. in diameter at the front end and 66 ins. in diameter at the junction with the throat sheet. The main taper is made in the first ring, so that there is considerable space between the tubes and the shell. This appeals to one as affording a free space which will particularly assist in keeping the boiler free of mud or scale deposits. There are 194 boiler tubes 2¼ ins. in diameter. This may seem at first to be a small number of tubes, but these tubes are 16 ft. 1 in. in length and it must also be remembered that the more perfect firebox combustion will not give need for so much flue heating surface, and also that a slow escape of the gases through the long tubes will render them much more efficient as heat extractors. These tubes could easily have been made considerably longer, owing to the length of barrel necessary to accommodate the driving wheels between the cylinder and the firebox, but since any greater length of tube would render their length out of advisable proportion to the diameter it was

THE RAILROAD GAZETTE

The Prairie type freight locomotives of the Chicago, Burlington & Quincy have now been in service about six months, and are a success. They have not only met the expectations of the designers and builders, but that road has probably never had a new design of locomotive which has met with so little adverse criticism. The essential features of the design have already been adopted by other roads that have apparently anticipated favorable reports of performance, and the Burlington itself is now preparing to order twenty or thirty more Prairie type engines. These will weigh about 150,000 pounds, have 20 in. by 24 in. cylinders, and boilers 68 in. in diameter at the front. Of course, in these it is desired to correct any faults in the first design, but although the performance has been watched closely, it has been really difficult to find where improvements can be made. The new engines will probably be a little larger, but essentially the same as the first, which means a good deal, as this design involved many new features. The six months' experience has confirmed Mr. Delano's opinion that the wide, deep fire-box is the proper one for burning bituminous coal, and the present records of the new engines indicate at least 15 per cent. economy over other engines running in the same pool; no attempt has been made to favor the new engines. It seems quite clear, also, that coal can be burned with these engines, making steam freely, which cannot be used with narrow fire-box engines. One of the Prairie type engines used on the Burlington & Missouri River is now running with fair success on lignite coal, and it is thought that if it is found impracticable to burn clear lignite, at least half lignite can be used. The use of inferor grades of coal is doubtless one of the most important results attained with wide, deep fire-boxes, and offers the greatest opportunity for saving.

Notes on the Prairie Type Locomotives.

We recently had an opportunity to ride on one of the notable Prairie type engines, now running out of Chicago, on the Chicago, Burlington & Quincy. These engines have wide, deep fire-boxes and have been referred to so often as to need no description here; last week we published a brief account of their satisfactory performance. From observation and inquiry it is evident that the new Burlington engines are well adapted to the fast freight service in which they are used and besides showing a saving of at least 15 per cent. of fuel over other engines in the same pool, the wide fire-boxes are held in high favor by enginemen and firemen. On this particular trip a good quality of lump coal was used, but inferior coal can be burned. With but one wide fire-box engine on a division it is impracticable in regular working to supply that engine with a poorer grade of coal than other engines will burn, but engines of the Prairie type are burning lignite coal on the Burlington & Missouri River.

With a train of 37 loaded cars, an average speed of 30 miles an hour was easily maintained and the engine steamed freely at all times. There was a noticeable absence of black smoke, although the engine was fired in the usual way; that is, three or four shovels of coal were put in at a time and the smoke would be brown for a few moments, but the discharge from the stack quickly cleared. There can be no doubt that the work of the fireman is materially lightened by using the short, wide grates.

There seems to be some difference of opinion among the enginemen as to the necessity of using two fire doors with these engines. Some prefer two doors, the same as now used, but others hold that one door somewhat wider than is the common practice is all that is needed. In support of the latter view, it can be said that some firemen charge most of the coal through one door, although it is situated well to one side, and even then they appear to have no difficulty in distributing the coal over the grates. If such an engine can be fired satisfactorily through one door it would seem to be of little use to complicate the construction of the boiler with the second door where the fire-box is deep and about 6 ft. wide.

The working of the piston valves and valve gear is all that could be expected and it is thought that without the free movement of the reverse lever given by the piston valves it would be difficult to handle these engines in the narrow space left for the engineman between the side of the boiler and the cab. In the new Prairie type engines now ordered from the Baldwin Locomotive Works, the cabs will be set further back, and there will be more room for the engineman.

There is practically no rolling of these engines from side to side, due probably to the effect of the outside bearings of the trailing wheels. With a light train, however, and running at speeds above 20 or 25 miles an hour, the rear of the engine with the present arrangement has a decided movement from side to side on straight track, most of which it is thought can be prevented by modifications in the trailing truck rigging. The driving wheel base is 11 ft. 4 in., the front truck wheels and truck drivers are 7 ft. 11 in. center to center, and the rear drivers and trailing wheels are 7 ft. centers, making the total wheel base 26 ft. 3 in. To allow for sharp curves considerable play is given at the rear journal boxes, and this permits of a side movement of the rear of the engines at high speeds. As now arranged the load on either side at the rear is carried on a plate resting on rollers and the rollers are free to move on a concave plate on top of each trailing journal box. When certain modifications are made the engines will doubtless ride very easily and still curve freely.

The main frames and the frames of the trailing wheels, which are off-set, are both connected to a heavy cast steel cross bar just ahead of the fire-box. Some designers have thought that these joints in the frame would be difficult to maintain, as they receive all the pulling and bufing forces, but no trouble of this kind has been experienced and the joints remain perfectly tight after six months of hard service.

A part of the new Prairie type engines of the Burlington are replacing old 20 x 24-in. consolidation engines which weigh about 110,000 lbs. These consolidation engines are no longer suited to the service and have been withdrawn from road service. They are now being converted into six-wheel switchers, and the change is made in an interesting way. The pilot, leading truck wheels, the rear drivers and boxes and back rods are removed and the rear flanged tires are put in place of the blind tires of the main drivers. Then a plate is bolted to the frames at the rear covering the rear pedestals, and the equalizers are re-adjusted. The result is a very good six-wheel switcher, weighing about 98,000 lbs., and the value of the scrap material is just about equal to the cost of making the alterations.