24. Powdered Coal, C. H. Hogan (N. Y. C.), chairman.
25. Specifications and Tests for Materials (A. R. M. M.), F. M. Waring (Pennsylvania), chairman.
26. Design and Maintenance of Locomotive Boilers, C. E. Fuller (Union Pacific), chairman.
27. Locomotive Headlights, H. T. Bentley (C. & N. W.), chairman.
28. Superheater Locomotives, W. J. Tollerton (C. R. I. & P.), chairman.
29. Design, Maintenance and Operation of Electric Rolling Stock, C. H. Quereau (N. Y. C.), chairman.
30. Train Resistance and Tonnage Rating, O. P. Reese (Pennsylvania Lines West), chairman.
31. Subjects, M. K. Barnum (B. & O.), chairman.

# STANDARD 2-8-8-2 TYPE LOCOMOTIVES

## First of Government Order for Over 100 of These Engines Delivered to the Norfolk & Western

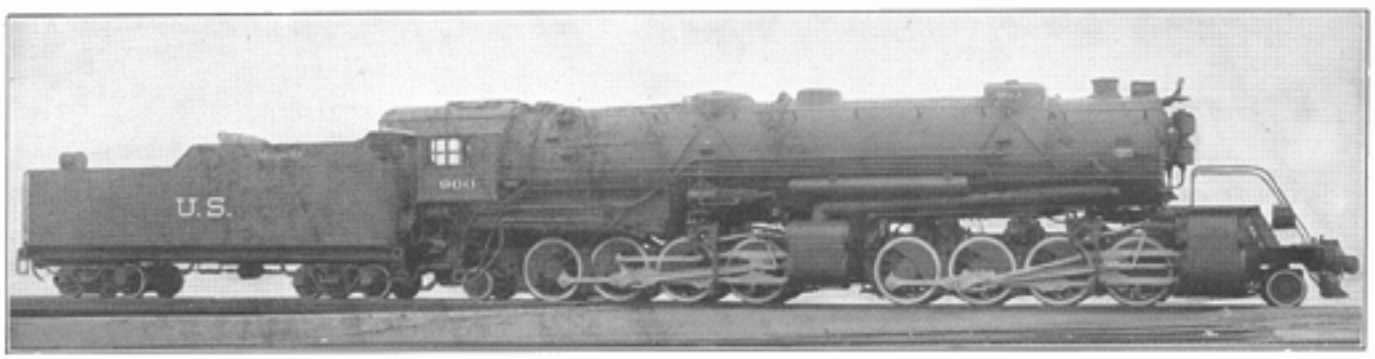
THE first order of 1,025 locomotives placed by the United States Railroad Administration included an order of 20 heavy (2-8-8-2) standard Mallets. This was later increased to over 100, 65 to be built by the American Locomotive Company and 41 by the Baldwin Locomotive Works. The American Locomotive Company has within the past month made the first delivery of these locomotives. While they were scheduled and lettered for the Virginian Railway they have been assigned for duty on the Norfolk & Western. These engines are the largest of the standard locomotives built for the Railroad Administration and represent the limit to which a locomotive can be built to come within the maximum clearance limitations set by the Railroad Administration (15 ft. 9 in. high and 10 ft. 9 in. over cylinders). These locomotives are smaller than those which can be used on the Virginian Railway, as evidenced by the 2-10-10-2 type Mallet locomotives which were recently built for that road by the American Locomotive Company. These latter engines have a width clearance of 12 ft. and a height clearance of 16 ft. 7½ in. On the other hand, the clearance limitations of these standard engines compare very favorably with the 2-8-8-2 Mallets recently built by the Norfolk & Western to that company's own design. Being limited by these clearance restrictions a very careful design had to be made to provide a locomotive of the power required.

In the matter of power these standard engines may be compared with locomotives of similar wheel arrangement built by the Norfolk & Western in its own shops, and for the Western Maryland by the Lima Locomotive Company. A table comparing the principal dimensions of these two locomotives is included. A description of the Norfolk & Western locomotive was published in the *Railway Mechanical Engineer* of August, 1918, page 445. From this table of comparison it will be seen that the standard locomotive is 6,000 lb. heavier than that built by the Norfolk & Western, and 3,300 lb. heavier than that built for the Western Maryland. The working pressure on the standard locomotive is also 10 lb. greater than that of the Norfolk & Western locomotive and 30 lb. higher than that used on the Western Maryland locomotive. The boiler proportions of the standard locomotive and those of the Norfolk & Western compare very favorably. However, the Norfolk & Western design provides about 200 sq. ft. more heating surface and about 35 sq. ft. greater superheating surface. While these two engines are very nearly alike in proportions, they are of an entirely different class as far as the construction details are concerned, which will necessitate a different line of repair parts and illustrates one of chief objections to standardization.

TABLE OF COMPARISON OF 2-8-8-2 TYPE LOCOMOTIVES

| Name of road | U. S. Std. | Norfolk & Western | Western Maryland |
|---|---|---|---|
| When built | 1919 | 1918 | 1915 |
| Tractive effort, compound, lb. | 106,000 | 104,300 | 106,000 |
| Weight, total, lb. | 531,000 | 535,000 | 495,000 |
| Weight on drivers, lb. | 57 | 56 | 52 |
| Diameter of drivers, in. | 478,000 | 472,000 | 445,000 |
| Cylinders, diameter and stroke, in. | 25 and 39 by 32 | 24½ and 38 by 32 | 26 and 40 by 30 |
| Steam pressure, lb., per sq. in. | 240 | 230 | 210 |
| Total heating surface, sq. ft. | 6,320 | 6,316 | 5,669 |
| Superheater heating surface, sq. ft. | 1,475 | 1,510 | 1,264 |
| Grate area, sq. ft. | 196 | 96 | 80 |
| Weight on drivers ÷ tractive effort (compound) | 4.7 | 4.5 | 4.2 |
| Tractive effort × diameter drivers ÷ equivalent heating surface* | 695. | 680.6 | 726.3 |
| Equivalent heating surface* ÷ grate area | 86.6 | 89.4 | 94.9 |

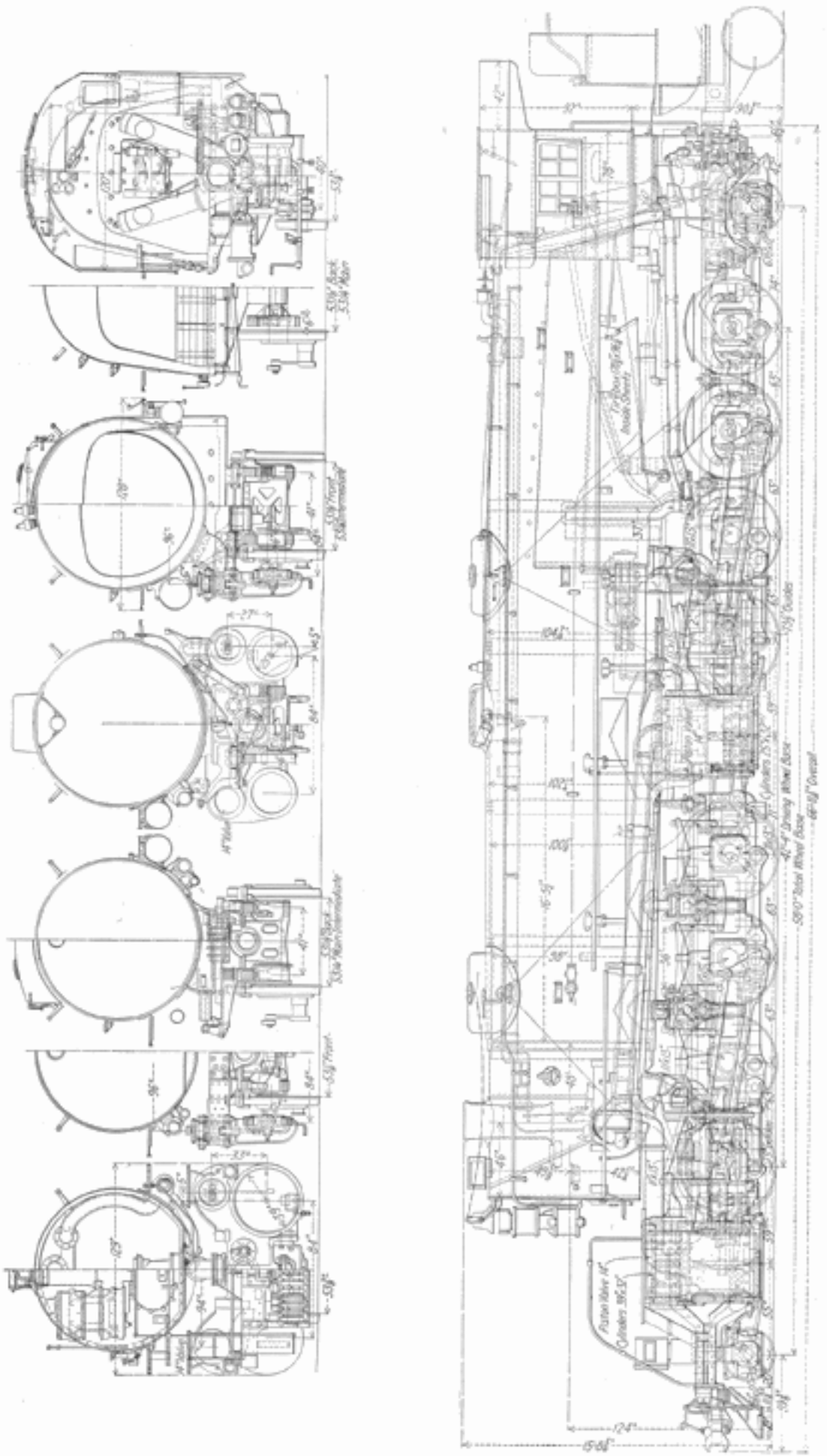
*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
†Gaines combustion chamber is used on this locomotive.




Standard 2-8-8-2 Type Locomotive for the U. S. Railroad Administration

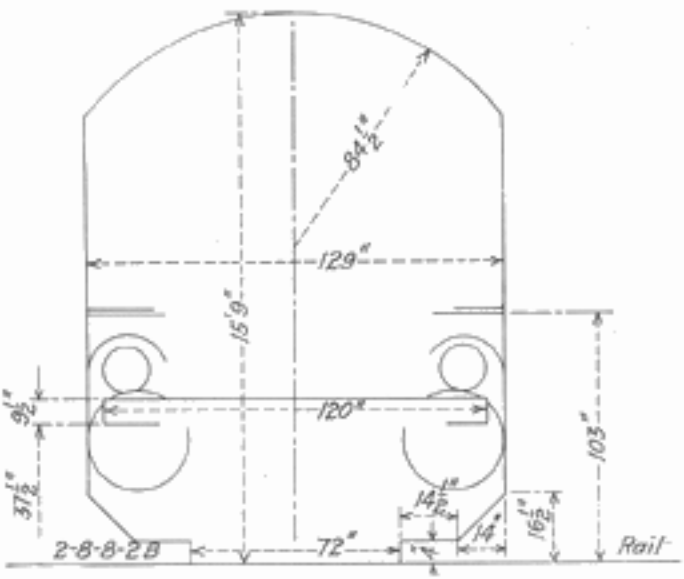
The standard 2-8-8-2 Mallet locomotive has a total engine weight of 531,000 lb., of which 28,000 lb. is on the leading truck, 237,000 lb. on the front or low pressure unit, 241,000 lb. on the high pressure unit and 25,000 lb. on the trailing truck. It is built for a permissible axle load of 60,000 lb., which is the same limit prescribed for the standard 2-6-6-2 locomotive. The cylinders are 25 in. and 39 in. by 32 in., and a working pressure of 240 lb. is carried on the boiler. The distribution of the weights amongst the various drivers is shown in the weight diagram, which was prepared by F. P. Pfahler, chief mechanical engineer of the Mechanical Department, United States Railroad Administration. The clearance diagram, also prepared by Mr. Pfahler, is included in the illustrations.

The boiler of these locomotives has an outside diameter



Elevation and Sections of the Standard Heavy Mallet Type Locomotive

at the first ring of 98 in. It is of the straight barrel type and has shell plates 1 1/16 in. thick. The dome is located on the third course and on account of the clearance limitation is only nine inches high. The boiler is equipped with a Gaines combustion chamber. The length of tubes is 24 ft. There are 274 2¼-in. tubes and 53 5½-in. flues, which are of No. 8 gage, being one gage heavier than the general standard practice in the construction of Mallet locomotives, due to the fact that a working pressure of 240 lb. is carried on the boiler. The firebox is 170⅛ in. by 96¼ in., having an effective grate area of 96.2 sq. ft. The firebox sheets are ⅜ in. thick and the back tube sheet is ½ in. thick. The tube




Clearance Diagram

spacing is similar to that used on the standard 2-6-6-2 type Mallets.

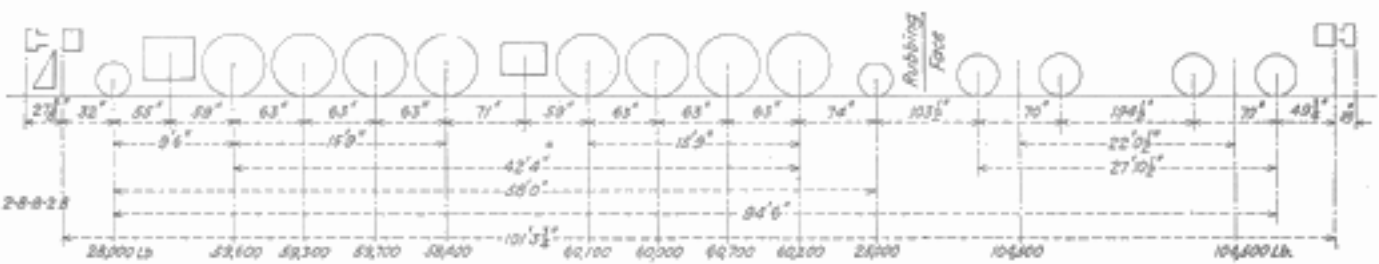
The frames for these locomotives are 6 in. in width, the same as for the 2-6-6-2 locomotives and are 6¾ in. deep over the pedestals, having a minimum thickness of 5½ in. The lower rails are 4½ in. deep, with a minimum thickness of 4 in. The frames for the high and low pressure engines are connected with the Baldwin type of frame hinged casting. From the standpoint of design they are, with the exception of differences in dimensions, practically exact duplicates of the frames built for the standard 2-6-6-2 locomotive.

As in the case of the 2-6-6-2 standard locomotive, both the high and low pressure cylinders are provided with piston valves. A larger diameter of valve is used, however, it being 14 in. The travel of the valve for the high pressure cylinders is 6½ in. and it is given a lap of 1 in., a lead of ⅛ in. and an exhaust clearance of ¼ in. In the low pressure cylinders the valve is double ported and has a travel of 6 in. with a lap of 1⅛ in., a lead of 3/16 in. and an exhaust clearance of 7/16 in. As in the case of all the standard locomotives the valves and cylinders are bushed with Hunt-Spiller gun iron. Both cylinders are spaced 84 in. between centers, whereas in the lighter Mallets the spacing is 85 in. As in the case of the 2-6-6-2 Mallet the Mellin type of by-pass and intercepting valve is used to control the simpling and compounding of the locomotive.

In the matter of general design the crosshead for the 2-8-8-2 locomotive is the same as that of all standard locomotives. The dimensions are also practically the same, with the exception of the piston fit, the diameter of the boss in the body of the crosshead being made eight inches instead of seven, on account of the heavier piston rod, which is 4½ in. in diameter for the 2-8-8-2 locomotive and 3¾ in. in diameter for the 2-6-6-2 locomotive. The pistons have a dished section and those for the high pressure cylinders are interchangeable with those used on the light standard Pacific and the eight-wheel switchers. The specifications require that they be made of rolled steel or cast steel. They are provided with packing rings of Hunt-Spiller gun iron. The pistons for the low pressure cylinders are, of course, not interchangeable with any others used on the standard locomotives, although they are of the same general standard design. They are made of cast steel and are of dished section, having, as in the case of the high pressure cylinders, two packing rings of Hunt-Spiller gun iron. The piston rods for both the high and low pressure units of the heavy Mallet type locomotive are 4½ in. in diameter. Paxton-Mitchell piston and valve rod packing is used on these locomotives.

The main rods of both the high and low pressure cylinders are precisely the same. They are 118 in. long from center to center and are of I-section, being 3 in. wide and 6 in. deep, with 1½-in. flanges and a ½-in. web. They are of the same design as the main rods used on the 2-6-6-2 standard locomotive, the only difference being that they are one inch longer between centers and the flange is ½ in. deeper. Thus it will be seen that rods for both these locomotives can be manufactured from exactly the same size of stock material. The design of the strap end is exactly the same, the only difference being that the rods for the 2-8-8-2 type are a little heavier than for the 2-6-6-2 type locomotive.

Among the interchangeable details of these locomotives may be mentioned the dump grate rigging, which is the same as that used on the light and heavy Santa Fe locomotives; the pilot, which is standard for all except the switchers; tires, which are common to the 2-6-6-2 and the light Santa Fe; and engine truck and trailer axles, which are common to all of the standard locomotives. The engine truck box is the same as that used on both designs of Mikado and Santa Fe and the 2-6-6-2. The front bumper is the same as that used on all except the switchers and the frame pedestal shoe, wedge, and wedge bolt are the same on all locomotives except the switchers. In addition to this there are many other details which are interchangeable with the 2-6-6-2 type.




Wheel Spacing and Loading for the Heavy Standard Mallet

As in the case of all the standard locomotives, both the high and low pressure cylinders are provided with piston valves. A larger diameter of valve is used, however, it being 14 in. The travel of the valve for the high pressure cylinders is 6½ in. and it is given a lap of 1 in., a lead of ⅛ in. and an exhaust clearance of ¼ in. In the low pressure cylinders the valve is double ported and has a travel of 6 in. with a lap of 1⅛ in., a lead of 3/16 in. and an exhaust clearance of 7/16 in. As in the case of all the standard

The specialties used on these locomotives as well as on the other standard engines were enumerated on page 137 of

the March, 1919, issue of the *Railway Mechanical Engineer.*

The following is a list of the general dimensions of these locomotives with the principal data:

| | |
|---|---|
| *General Data* | |
| Gage | 4 ft. 8½ in. |
| Service | Freight |
| Fuel | Bit. coal |
| Tractive effort (compound) | 101,300 lb. |
| Tractive effort (simple) | 121,600 lb. |
| Weight in working order | 531,000 lb. |
| Weight on drivers | 478,000 lb. |
| Weight on leading truck | 28,000 lb. |
| Weight on trailing truck | 25,000 lb. |
| Weight of engine and tender in working order | 740,100 lb. |
| Wheel base, driving | 42 ft. 1 in. |
| Wheel base, rigid | 15 ft. 6 in. |
| Wheel base, total | 57 ft. 4 in. |
| Wheel base, engine and tender | 93 ft. 3 in. |
| *Ratios* | |
| Weight on drivers ÷ tractive effort (simple) | 3.93 |
| Total weight ÷ tractive effort (simple) | 4.37 |
| Tractive effort (compound) × diam. drivers ÷ equivalent heating surface* | 695.0 |
| Equivalent heating surface* ÷ grate area | 86.6 |
| Firebox heating surface ÷ equivalent heating surface,* per cent | 5.2 |
| Weight on drivers ÷ equivalent heating surface* | 57.5 |
| Total weight ÷ equivalent heating surface* | 63.8 |
| Volume equivalent, simple cylinders, cu. ft. | 22.2 |
| Equivalent heating surface* ÷ vol. cylinders | 375.0 |
| Grate area ÷ vol. cylinders | 4.33 |
| *Cylinders* | |
| Kind | Compound |
| Diameter and stroke | 25 in. and 39 in. by 32 in. |
| *Valves* | |
| Kind | Piston |
| Diameter | 14 in. |
| *Wheels* | |
| Driving, diameter over tires | 57 in. |
| Driving journals, diameter and length | 11 in. by 12 in. |
| Engine truck wheels, diameter | 30 in. |
| Engine truck, journals | 6½ in. by 12 in. |
| Trailing truck wheels, diameter | 36 in. |
| Trailing truck, journals | 6½ in. by 12 in. |
| *Boiler* | |
| Style | Straight top |
| Working pressure | 240 lb. per sq. in. |
| Outside diameter of first ring | 98 in. |
| Firebox, length and width | 170⅝ in. by 96¼ in. |
| Firebox plates, thickness | ⅜ in. |
| Firebox, water space | 5 in. |
| Tubes, number and outside diameter | 274—2¼ in. |
| Flues, number and outside diameter | 53—5½ in. |
| Tubes and flues, length | 24 ft. |
| Heating surface, tubes | 3,860 sq. ft. |
| Heating surface, flues | 1,815 sq. ft. |
| Heating surface, firebox | 435 sq. ft. |
| Heating surface, total | 6,120 sq. ft. |
| Superheater heating surface | 1,475 sq. ft. |
| Equivalent heating surface* | 8,333 sq. ft. |
| Grate area (with Gaines wall) | 96 sq. ft. |
| Smokestack, height above rail | 15 ft. 8⅛ in. |
| Center of boiler above rail | 10 ft. 4 in. |
| *Tender* | |
| Tank | Water bottom |
| Frame | Cast steel |
| Weight | 209,100 lb. |
| Wheels, diameter | 33 in. |
| Water capacity | 12,000 gal. |
| Coal capacity | 16 tons |

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

# CO-OPERATION

BY FRANK McMANAMY

Assistant Director, Division of Operations, U. S. Railroad Administration

It has been generally understood that the government assumed control of the railroads because of the necessity of increasing their efficiency and operating them in such a manner that the necessary transportation would be provided to enable the country to successfully conduct the war against what had come to be recognized as the enemy of civilization.

It had been demonstrated that under individual control it was not possible to obtain the degree of co-operation necessary to bring about the increased efficiency which must be obtained and that only by operating the railroads as a single system under the direction of a strong central organization could the transportation needs of the country be met.

A survey of the situation showed that one of the principal, if not the principal, needs was to improve the condition of motive power and rolling stock.

Greater efficiency in this respect could only be secured by greater efforts and closer co-operation of the army of the railroad shop employees, because with the urgent demands for men for military service and for munition factories it was not possible to increase the forces in proportion to the increased work. The results of the past year show that increased efforts and better co-operation was secured to an extent hitherto unknown. Personal convenience and comfort on the part of railroad officials and employees were alike disregarded. Sundays, holidays and vacations were unknown to most of the railroad workers for the past year or more. Every loyal man was on the job 24 hours a day and seven days a week, or as near it as was physically possible. Employees' contracts were temporarily modified with respect to shop hours and to promotions and suggestions or requests of the Railroad Administration for changes that would increase efficiency and bring about closer co-operation have been cheerfully and promptly complied with. As a result of this it is not an exaggeration to say that a degree of efficiency in operating railroad shops was reached which has never before been attained. The railroad machine has been operated at high speed and with full tonnage and the shop employees have provided the necessary equipment.

In the matter of furnishing necessary equipment to conduct transportation during the war, the railroad shop employees have gone over the top and when the records of what they have accomplished is written they will have little to regret and much to be proud of.

The war is now over and the problems incident thereto are things of the past. We have, however, confronting us problems equally important if perhaps not so urgent.

The principal requirements necessary to go from a peace basis to a war basis were, unlimited energy and unceasing effort. To change the shop organization from a war basis to a peace basis, which is the task that confronts us now, will require unlimited patience, tact and judgment. A degree of co-operation equal to that which has been exercised during the war will be required. It will require the principle of the square deal to be recognized and observed on all sides and it will require absolute confidence that the necessary reorganization will be worked out with fairness.

The railroad shop employees with the co-operation of the officials, have performed a great service in their work during the past year, but it could not have been accomplished without complete co-operation and confidence in those who were directing the work. They have before them during the reconstruction or reorganization period an opportunity of performing an equally great service and if that is to be successfully performed it will require the co-operation of all and the work must be done in a way that will inspire confidence.

During war times two points in the operation of railroads predominated; namely, safety and efficiency, and others where they in any way adversely affected these could in a measure be disregarded. In times of peace safe and efficient service must be rendered to the public at a cost commensurate with the service performed. This, of course, means readjustments of hours and reorganization of forces, but this can and should be done along reasonable lines with proper consideration for the rights of the public and of the employees. If approached in the proper spirit and carried out with absolute fairness, necessary readjustments can be made without friction and without loss of efficiency.

The spirit of co-operation and the desire for performing constructive work which has been manifest during the past year is a sufficient guarantee that this will be done.

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SWEEPINGS FROM SHOPS.—Attention has often been called to the importance of combing the sweepings which are hauled from the various shops, roundhouses, storehouses, etc., to the refuse car and taken out along the line and dumped. Yet there is reason to believe that there is much waste bound to accrue from lax methods in caring for the sweepings and an occasional inspection and renewal of instructions is worth while.—*Railway Storekeeper.*