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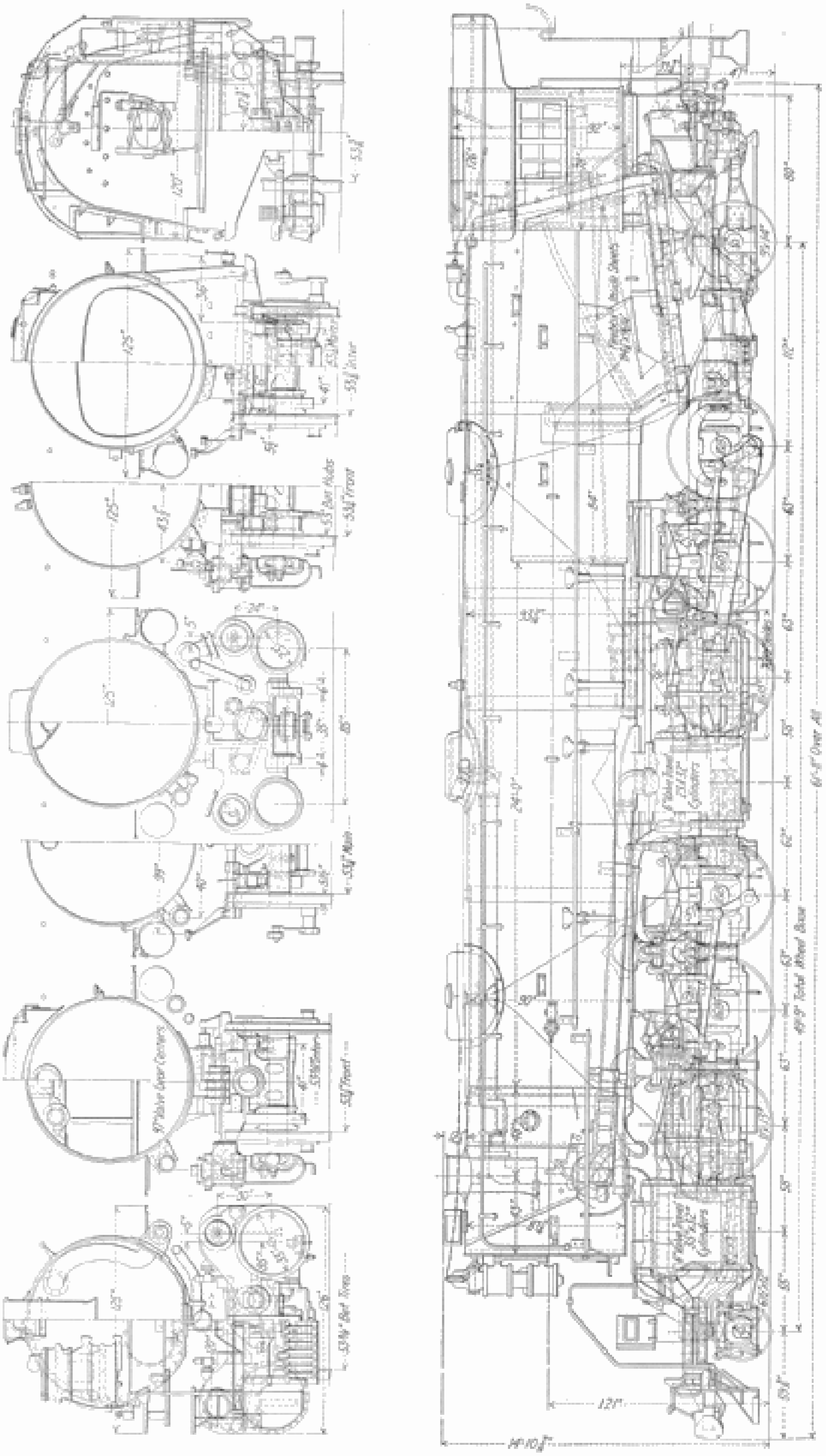


Elevation and Sections of the United States Railroad Administration Standard 2-6-6-2 Type Locomotive

Standard 2-6-6-2 Type Locomotive

Weights: Total 448,000 lb., Drivers 358,000 lb.;
Tractive Effort Compound 80,000 lb., Simple 96,000 lb.

THE first of the standard Mallet type locomotives designed by the United States Railroad Administration has recently been turned out by the Schenectady works of the American Locomotive Company, for delivery to the Chesapeake & Ohio. The locomotive is of the 2-6-6-2 type, the lighter of the two standard Mallet types, and orders were placed for 30 of these locomotives.

The locomotive has a weight on drivers of 358,000 lb., 2,000 lb. less than the maximum permissible within the axle load limit of 60,000 lb. The cylinders are 23 in. and 35 in. in diameter by 32 in. stroke and the locomotive is designed to deliver a tractive effort of 96,000 lb. simple and 80,000 lb. compound. In the table will be found a comparison of the principal dimensions and data for a number of Mallet locomotives of the 2-6-6-2 wheel arrangement, of which the standard locomotive is the heaviest both on drivers and in total weight.

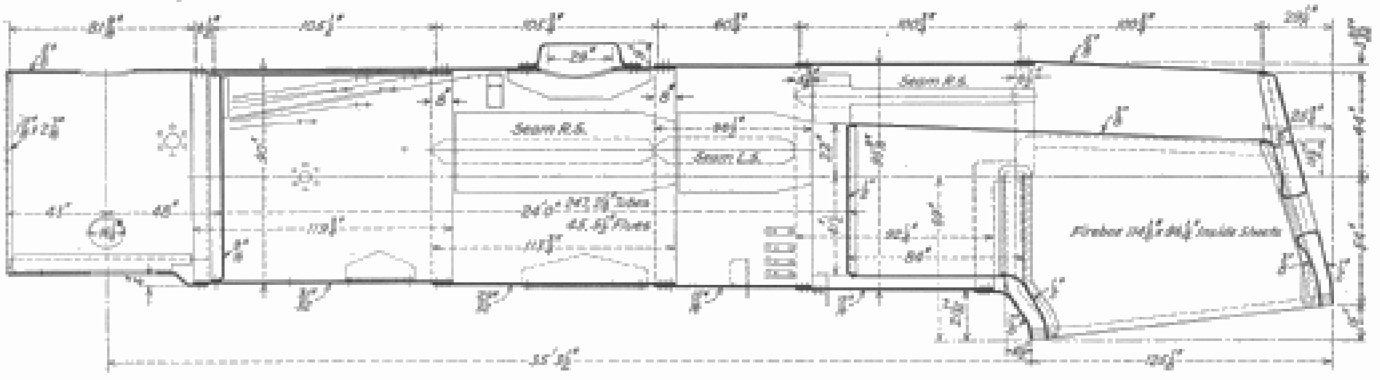
The boiler has an outside diameter at the first ring of 90 in., increasing to 95 9/16 in. at the fourth ring just forward of the firebox. The dome is located on the second ring from the front and is 9 in. high.

The firebox has a combustion chamber extending forward into the barrel of the boiler 84 in. from the throat sheet, making the tubes 24 ft. long. It is fitted with a Security brick arch carried on five arch tubes and is fired by a Standard stoker. The fire door is of the Shoemaker power operated type and the grates are operated by Franklin power grate shakers. The boiler is fitted with the Locomotive Superheater Company's Type A superheater with 45 units.

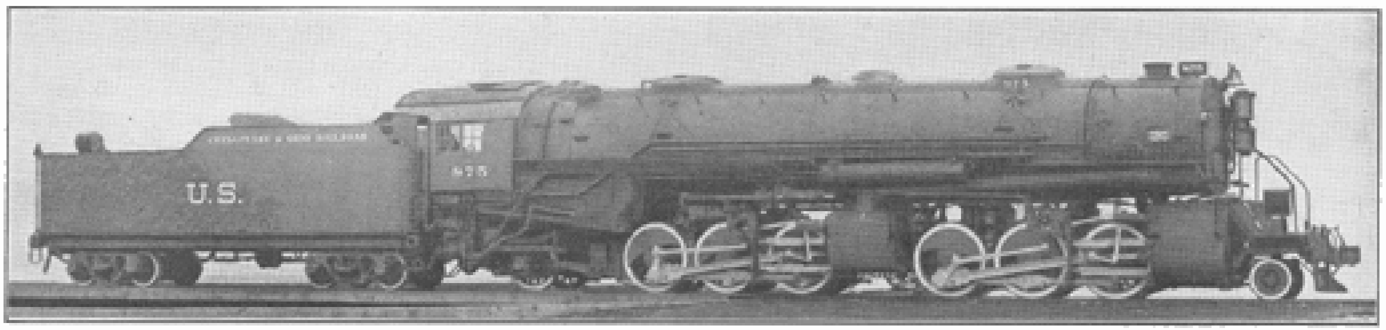
In general the detail design of the frames follows that of all the other standard type locomotives which have been built. The top rails for both high and low pressure units are 6 in. wide, with a maximum thickness of 5 in. over the pedestals and a minimum thickness of 4½ in. The lower rails have a maximum and minimum thickness of 3½ in. and 3 in. respectively. The high pressure frames are designed with splice joints at the rear for attachment to a Commonwealth frame cradle which includes in one casting the frames, rear deck plate and trailer equalizer fulcrums. The high pressure cylinders are supported on a single front rail which is cast integral with the main frames.

The low pressure frames are designed to receive the articulation joint, which is of the Baldwin universal type, hinged for movement about a horizontal axis transverse to the center line of the locomotive and provided with a ball joint pin connection at the high pressure unit end. The low pressure cylinders are supported by double rails, both of which are bolted to the main frame. The frames of both units are spaced 41 in. from center to center, while the cylinders have a spread of 85 in. Owing to the size of the low pressure cylinders the face of the lower rail bolting flange is only 20½ in. from the center line of the locomotive, thus requiring an offset in the front frame rail. This is provided by bolting the front rail to the inside face of the lower rail extension of the main frame and reducing the lateral thickness of this section to 3 in. where it is joined under the cylinder to the front rail. The section of the extension under the cylinders is 11 in. deep, while that of the front rail has a vertical thickness of 7 in. The upper front rail is bolted and keyed to the top of the main frame over the front pedestal. The section of the main frame here is 13 in. deep with horizontal slots for the splice bolt nuts over the pedestal.

The cylinders and valve chambers throughout are bushed with Hunt-Spiller gun iron. In the design of the high pres-



Boiler for the Standard 2-6-6-2 Type Locomotive



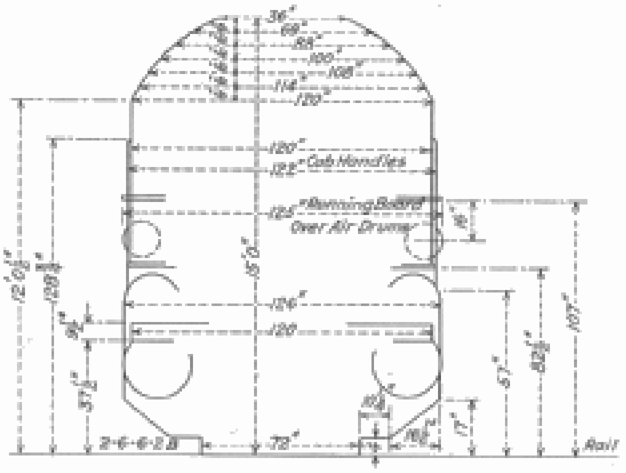
The Railroad Administration Standard 2-6-6-2 Type Locomotive sure cylinders is incorporated the Mellin intercepting valve which completely controls the admission of steam, either exhaust from the high pressure cylinders or steam direct from the boiler, to the low pressure receiver pipe. Piston valves

Comparison of Recent Mallet Locomotives of the 2-6-6-2 Type

Name of road	U.S. Std.	B.R. & P.	N. & W.	C. & O.
Year built	1919	1914	1912	1911
Builder	American	American	American	American
Tractive effort, lb.	80,000	80,000	72,800	72,800
Total weight, lb.	448,000	429,000	405,000	400,000
Weight on drivers, lb.	358,000	355,000	337,000	337,500
Diameter drivers, in.	57	57	56	56
Cylinder diameter and stroke, in.	23 & 35 x 32	23½ & 37 x 32	22 & 35 x 32	22 & 35 x 32
Steam pressure, lb. per sq. in.	275	200	200	200
Heating surface, total evap., sq. ft.	5,443	4,935	5,003	5,064
Heating surface, equivalent,* sq. ft.	7,381	6,473	6,485	6,430
Grate area, sq. ft.	76.3	72.2	72.2	72.2
Tractive effort × dia. drivers ÷ equivalent heating surface*	617.8	704.5	628.6	634.0
Firebox heating surface ÷ equivalent heating surface,* per cent	5.6	6.0	5.3	6.1

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

are employed with both the high and low pressure cylinders. These valves are 12 in. in diameter and have a maximum travel of 6 in. The valves for the low pressure cylinders are



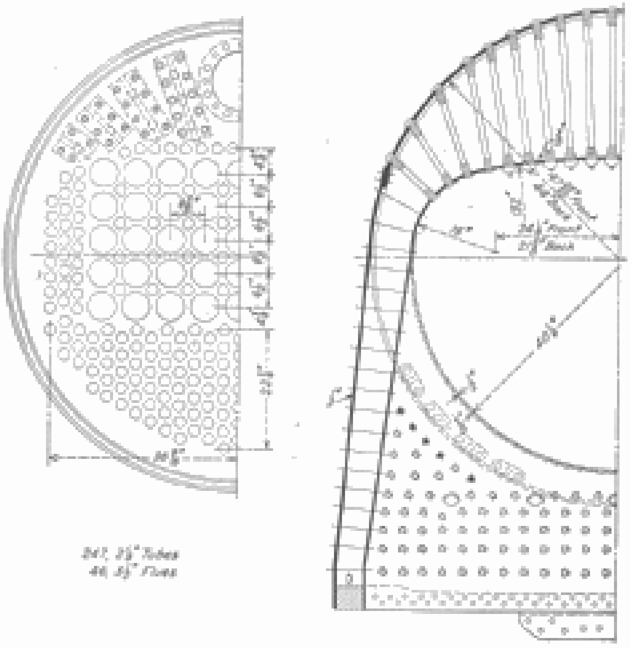
Clearance Diagram for the Standard 2-6-6-2 Type Locomotive

double ported while those for the high pressure cylinders are the same as are used on the 0-6-0 type switchers.

The high pressure piston specifications call for either rolled or cast steel of dished section, while for the low pressure pistons the center of which has a diameter of 30¾ in., exclusive of the bull ring, cast steel only is specified. Hunt-Spiller gun iron bull rings and packing rings are used

distribution is controlled by the Baker valve gear and the Chambers back head type throttle. The locomotive is fitted with a Lewis power reverse gear.

The driving journals throughout have a diameter of 11 in. and are 13 in. long. The driving boxes are interchangeable on all journals, except that the crown brass for the main journals is finished with a clearance of 1/100 in. instead of 1/32 in. The same driving box is also used on the heavy Mountain type locomotive, with the exception of the main journals, and on the main journals of the

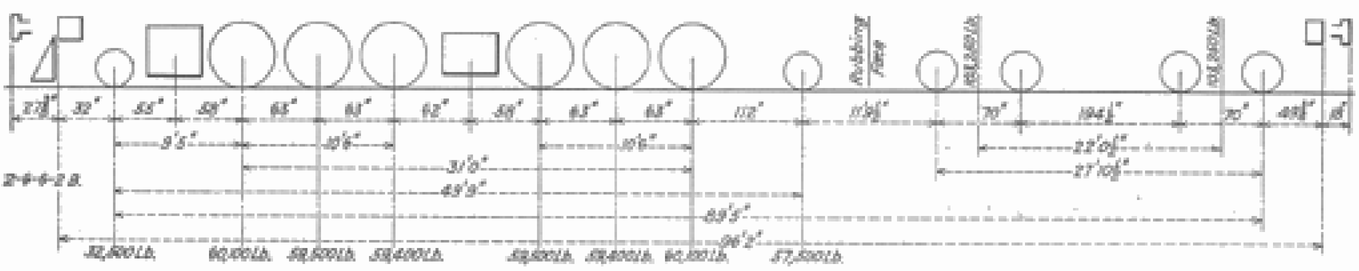


Tube Layout and Firebox Section—Standard Light Mallet Type Locomotive

light Mikado type locomotive. The engine truck is of the constant resistance type and the trailer truck is of the Cole-Scoville type.

The tender tank has a water capacity of 12,000 gallons and a coal capacity of 16 tons. It is carried on a Commonwealth cast steel frame, and is one of the three standard types which have been designed to meet the requirements of all of the standard locomotives. The trucks have cast steel side frames and are of a design which is used on all the standard freight locomotives. The Unit Safety drawbar and Radial buffers are used between the engine and tender.

Among the specialties with which these locomotives are equipped are four Coale three-inch open safety valves, No.



Weight Distribution Diagram for the Standard Light Mallet Type Locomotive

on both high and low pressure pistons. The design of the crossheads is the same in detail as that employed on all previously built standard locomotives, and is interchangeable with that on the 0-6-0 switchers. Paxton-Mitchell packing is fitted both on the valve stems and piston rods. Steam

13 Nathan non-lifting injectors, Nathan bull's-eye lubricators, Ashton steam gages, Okadee flanged blow-off cocks and Barco flexible pipe joints.

On the diagrams, prepared by F. P. Pfahler, chief mechanical engineer, Division of Operation of the Railroad Administration, will be found the clearances and actual wheel load distribution for these locomotives. Other dimensions and data are as follows:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort, compound	80,000 lb.
Tractive effort, simple	96,000 lb.
Weight in working order	448,000 lb.
Weight on drivers	358,000 lb.
Weight on leading truck	32,500 lb.
Weight on trailing truck	57,500 lb.
Weight of engine and tender in working order	654,000 lb.
Wheel base, driving	31 ft.
Wheel base, rigid	10 ft. 6 in.
Wheel base, total	49 ft. 9 in.
Wheel base, engine and tender	89 ft. 5 in.

Ratios

Weight on drivers ÷ tractive effort, simple	3.7
Total weight ÷ tractive effort, simple	4.7
Tractive effort, compound × diam. drivers ÷ equivalent heating surface*	617.8
Equivalent heating surface* ÷ grate area	100.3
Firebox heating surface ÷ equivalent heating surface,* per cent	5.6
Weight on drivers ÷ equivalent heating surface*	48.5
Total weight ÷ equivalent heating surface*	60.7
Volume equivalent simple cylinders	21.7 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	340.5
Grate area ÷ vol. cylinders	3.4

Cylinders

Kind	Compound
Diameter and stroke	23 in. and 35 in. by 32 in.

Valves

Kind	Piston
Diameter	12 in.
Greatest travel	6 in.
Outside lap	1 in.
Inside clearance	H. P., ⅜ in.; L. P., 1/16 in.
Lead in full gear	¼ in.

Wheels.

Driving, diameter over tires	57 in.
Driving journals, main, diameter and length	11 in. by 13 in.
Driving journals, others, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	30 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	Straight top
Working pressure	225 lb. per sq. in.
Outside diameter of first ring	90 in.
Firebox, length and width	114⅛ in. by 96¼ in.
Firebox plates, thickness	Sides, back and crown, ⅜ in.; tube, ½ in.
Firebox, water space	Sides and back, 5 in.; front, 6 in.
Tubes, number and outside diameter	247—2¼ in.
Flues, number and outside diameter	45—5½ in.
Tubes and flues, length	24 ft.
Heating surface, tubes	3,478 sq. ft.
Heating surface, flues	1,549 sq. ft.
Heating surface, firebox and arch tubes	416 sq. ft.
Heating surface, total	5,443 sq. ft.
Superheater heating surface	1,292 sq. ft.
Equivalent heating surface*	7,381 sq. ft.
Grate area	76.3 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	206,500 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.

ENGINE FAILURES—CAUSES AND REMEDIES*

It has been said that the engine failure reports form one of the best barometers of the efficiency of the mechanical department, and this is indeed the case where all detentions and reported failures are carefully investigated *before* they are recorded. Where the engine failures charged depend, however, on the reports of conductors or on interpretations of the rules by the despatcher's or trainmaster's clerk, the accuracy of the charge is often open to question.

An engine failure on the line of road is an expensive proposition, more far reaching in its effects on the movement of trains than is generally believed by mechanical men who have had no road experience, often so upsetting the despatcher's pre-arranged schedule that we cannot be surprised if he loses his temper and feels like charging every delay, regardless of cause, as an engine failure.

*Abstract of a committee report presented at the 1918 convention of the Traveling Engineers' Association.

DEFINITION OF WHAT CONSTITUTES AN ENGINE FAILURE

1. All delays waiting for an engine at an initial terminal, except in cases where an engine must be turned and does not arrive in time to be cared for before leaving time.

2. All delays on account of engines breaking down, running hot, not steaming well, or having to reduce tonnage on account of defective engine, making a delay at a terminal, a meeting point, a junction connection, or to other traffic.

DELAYS THAT SHOULD NOT BE CONSIDERED AN ENGINE FAILURE

1. Do not report cases where engines lose time and afterwards regain it without delay to connections or other traffic.

2. In cases where a passenger or scheduled freight train is delayed from other causes, and an engine (having a defect) makes up more time than she loses on her own account, should not be called an engine failure.

3. Do not report delays to passenger trains when they are less than five minutes late at terminals or junction points.

4. Do not report delays to scheduled freight trains when less than 20 minutes late at terminals or junctions.

5. Do not report delays when an engine is given excess of tonnage and stalls on a hill, provided the engine is working and steaming well.

6. Do not report delays on extra dead freight trains if the run is made in less hours than the miles divided by ten.

7. Do not report engine failures on account of engines steaming poorly, or flues leaking, on any run where the engine has been delayed on side-tracks other than by defects of engine, or on the road an unreasonable length of time—say, 15 hr. or more per 100 miles.

8. Do not report an engine failure for reasonable delays in cleaning fires and ash-pans on the road.

9. Do not report failures against engines that are coming from outside points to the shops for repairs.

10. Do not report cases where an engine is held in the roundhouse for needed repairs and called for by the operating department, they being informed that the engine will not be ready until a stated time. Failure to provide that engine before the stated time should not be called an engine failure.

11. Do not report broken draft rigging on engines and tenders caused by air being set on train, account of bursted hose or breaking in two.

12. Do not report delays to fast schedule trains when the weather conditions are such that it is impossible to make the time, provided that the engine is working and steaming well.

13. Do not report delays when an engine gets out of coal and water, caused by being held between coal and water stations an unreasonable length of time.

If rule No. 2 is correctly interpreted there is no need for the 13 qualifying rules. However, if an engine apparently fails on the line of road, it is charged as an engine failure, although the engine may be in perfect condition and the delay due entirely to other causes, such as mishandling on the part of the crew, either engineer or fireman, excessive tonnage, weather conditions, or any of a hundred possible causes, any of which may result in a poor engine performance and for which the engine or its condition is least of all responsible.

The true cause of the poor performance should be determined by a full investigation, which, however, may not be possible immediately and, consequently, when determined several days may have elapsed before the cancellation of the charge is requested. This being the case, it appears to this committee, in justice to the mechanical department, it would be much more equitable were all doubtful cases simply shown as delays on the "morning report" and these delays then promptly investigated and where the failure is established it be so reported on a subsequent report, or else a monthly report compiled, showing all failures and delays.

Any criticism to be of value must be constructive; therefore, as a first step toward the elimination of engine failures, we