



Fig. 1. Outline C.P.R. Mallet Articulated Locomotive.

ners of the firebox, both inside and outside, are larger than usual. This has been done to increase the rigidity of the sheets, which, it is believed, is largely responsible for staybolt breakage on the end rows.

There are four flue sheets in the boiler and two sets of flues. The front set is 96" long and the back 109", with a 63" superheater compartment between, and although cleaning holes have been applied underneath, it is seldom found necessary to use them, all cinders being carried through by the action of the draft.

As already stated, the front section of the boiler is really a feed-water heater, and has 281 tubes 2" O.D. and 12 tubes 2 1/4" O.D., giving 1,230 sq. ft. of heating surface, leaving 1,555 sq. ft. in the steam generating section (tubes and firebox).

The measure of steaming capacity of this locomotive, as expressed by the formula $\frac{T.P. (max.)}{H.S. (Total)} \times \text{dia. drivers}$, is shown

in comparison with others of a similar type in the following table, and, as the C.P.R. locomotive has a superheater, the equivalent heating surface has been used:

Road	Builder	T.P. (max.)	H.S. (total)	x dia. drivers
C.P.R.	C.P.R.	975	975	
B. & O.	A. L. Co.	715	715	
Gr. Nor. (road) ...	B. L. Co.	813	813	
Gr. Nor. (pusher) ..	B. L. Co.	690	690	
Erie	A. L. Co.	910	910	
D.N.W. & P.	A. L. Co.	775	775	
Gen. Brazil.	A. L. Co.	915	915	

In using this factor in comparisons, it must be borne in mind that the lower its value the greater will be the capacity of the boiler as a steam generator, and from the above table it might seem that the C.P.R. locomotive would not steam satisfactorily. This, however, is not the case, as an inspection of the boiler pressures in figs. 10 and 12 will show.

The injector check valve is located on the top centre line of the boiler, and consists of a cast-iron body, with connections for the right and left-hand injectors, and a third connection suitable for a pipe or hose coupling, which is used for filling or blowing off the boiler.

THROTTLE, STEAM AND EXHAUST PIPES.—The throttle valve is located on the top of the boiler outside, and consists of an iron casting, having two 5" steam-pipe connections, one on either side. The joint to the boiler is made by a brass ball ring, having an opening 12 3/4" in diameter. The throttle casting extends down through this, and connects to a cast-iron dry pipe, which takes steam from a dome set further forward on the same course. The arrangement of this is shown clearly on the boiler drawing, fig. 3.

Outside steam pipes lead from the throttle to the saturated header of the superheater, and steam, after passing through it, goes directly to the h.p. cylinders, also through outside pipes, which are heavily lagged to prevent condensation, as are also the pipes from the throttle. This portion of the piping is of course all high pressure, but no special importance attaches to it, as there is no movement in the pipes, the h.p. engine being attached rigidly to the boiler. There is therefore no chance of leakage if the joints are properly made.

The steam exhausts from both h.p. cylinders into a common header or receiver bolted over the ends of the steam chests, and this header connects by a 7" pipe to a similar one on the l.p. cylinders, which connection, however, must be flexible, as the movement of the front truck begins to affect the piping at this point, and, to minimize its effect, the connection has been placed directly over the pivot point of the front truck. The receiver pipe between the two headers extends upward about 6 ft., which was done to give sufficient volume; and this pipe, down to the point where it enters the l.p. header, is braced solidly to the boiler, and the connection which bolts to the l.p. steam chest rotates about it, due to the movement of the front engine. This rotation is about 5 degrees on a 20 degree curve, which is the greatest the locomotive will be called on to traverse. The joint is packed with alternate cast-iron and babbitt packing rings, and is the only one in the pipe system in which packing is used.

The exhaust pipe connects to the cylinder and under side of the smokebox by ball joints, and both ends have a small rotary movement, but as the angular movement is only 2' 34" on a 20 degree curve, the extension between the connections is only 3/8", which is taken up by the sliding of the pipe flanges on the flat faces of the ball rings. The flanges are held to their seats on the ball rings by 10 springs of 200 lbs. capacity each, or a total of 2,000 lbs. The extension due to the truck movement being provided for in this way, the use of the packed expansion joint is unnecessary. The arrangement of this portion of the piping, which may be called the low pressure system, is shown by fig. 4. The dotted line shows the movements of the pipes on a 20 degree curve, and the diagram underneath shows the movements of the pipes as they would have been if the l.p. cylinders were at the front of the engine. A comparison of the two arrangements shows that, with the cylinders at the front, the angular movement of the exhaust pipes would be 15 deg. 19' and its