See Purchasing Agents' Guide on page 329 :: :: :: ::

See Alphabetical Index to Advertisements on page 291

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An Experimental Mallet Articulated Locomotive.

By G. I. Evans, Chief Draughtsman, Locomotive Department, C.P.R., Montreal.

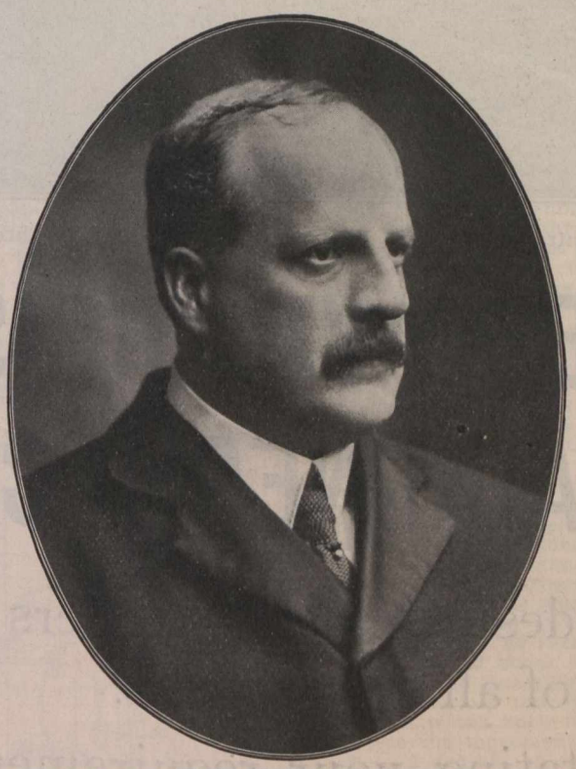
A Mallet articulated locomotive was designed and constructed by the C.P.R. during 1909, and embodied some original features which, in addition to its being the first of its kind on this road, made it an experimental locomotive. The object of this paper is to describe briefly some of its details, tests made on it, and finally what it is doing in regular service.

For the benefit of those who have not had a very close acquaintance with the Mallet articulated, it may be said that a Frenchman named Mallet was the first to successfully design and construct a jointed or articulated locomotive, that is, one which is so arranged as to permit of part of the wheel base moving sideways independently of the remainder, thus enabling a locomotive with a long wheel base to better adapt itself to sharp curves. As the locomotive was to be used in pushing service in the Rocky Mountains, it was necessary that it should traverse curves of at least 15 degrees and have comparatively high tractive power. The following table gives the general dimensions:

Type	0-6-6-0
Gauge	4′ 8½″
Service	Pusher
Fuel	Bituminous Coal
Tractive power	57,400
Weight on drivers, working order	262,000
Weight, total in working order	262,000
Weight of engine and tender, working order	391,000
Wheel base, front engine	10′ 4″
Wheel base, rear engine	10′ 4″
Wheel base, total engine	35′ 2″
Wheel base, engine and tender	60′ 7″
Weight on drivers÷tractive effort	4.57
Tractive effort × dia. drivers÷equivalent heating surface	975
Equivalent heating surface÷grate area	.59
Weight on drivers÷equivalent heating surface	77
Cylinders, dia. and stroke h.p.	23¼″ x 26″
Cylinders, dia. and stroke l.p.	34″ x 26″
Valves, dia. and kind h.p.	11″ Piston
Valves, dia. and kind l.p.	12″ Piston
ving wheels, dia.	58″
Driving axles, size. Main	9½x12, others 9x12
Boiler, kind	Radial stayed, wagon top
Pressure	200 lbs.
Firebox, length and width	120″ x 69⅞″
Firebox, thickness of sheets. 5-16″, ⅜″, ½″,	7-16″
Firebox, water spaces	Sides, 4½″; throat, 5″; back, 3½″
Tubes, number and dia. in front section	281, 2″ O.D., and 12, 2¼″ O.D.
Tubes, length in front section	96″
Tubes, number and diameter in rear section	289, 2″ O.D.
Tubes, length in rear section	109″
Heating surface, tubes	2,605 sq. ft.
Heating surface, firebox	180 sq. ft.
Heating surface, total	2,785 sq. ft.
Superheating surface	420 sq. ft.
Equivalent heating surface*	3,415 sq. ft.
Grate area	58 sq.ft.
Tender tank, kind	Semi-water bottom
Tender frame sills	Centre, 13″; sides, 10″
Tender trucks, kind	Equalizer
Tender wheels, size	34″ dia.
Tender axles	5½″ x 10″
Water capacity	5,000 Imp. Gals.
Coal	12 tons

*Equals total heating surface + superheating surface × 1.5.

CONSTRUCTION, GENERAL.—The outline of the locomotive is shown by the line drawing, fig. 1, and the half-tone engraving, and reference to these shows that there is considerable difference between this design and other locomotives recently put into service on American railways. For convenience of comparison, a line drawing of a Mallet locomotive, designed and built by the Baldwin Locomotive Works, is reproduced in fig. 2. The most striking difference between the two designs is in the arrangement of the cylinders, the shortness of the front bumper or footplate, and the position of the superheater. The absence of front and back guiding trucks is also noticed, but these are not in general use, being advocated by practically only the Baldwin Locomotive Works. This arrangement of cylinders, whereby the two pairs are brought together near the centre of the locomotive, permits of an extremely simple pipe arrangement, cutting out a number of packed expansion joints, everyone of which is a continual source of trouble through leakage. The removal of the cylinders from the front also permits of shortening the overall length of the locomotive, and, as locomotives of this type are very long, every foot possible must be saved to permit of their being taken into existing roundhouses. Provision has been made for changing piston packing rings by simply removing the front cylinder heads, disconnecting the main rod from the crosshead, and pushing the piston out into the space between the two cylinders. The piston valves have also been taken care of in a similar manner, so there can be no objection to this arrangement on account of inaccessibility.



GEORGE McL. BROWN
European Manager, Canadian Pacific Railway.

BOILER AND SUPERHEATER.—This is of the wagon top type, as shown by fig. 3, is radially stayed, and has an unusually small front ring and smokebox. There are three separate compartments in the barrel, the front of which is practically a feed-water heater, and, owing to its small diameter, is full of water all the time. The injectors discharge into this compartment, which is connected to the boiler proper by two equalizing pipes 4″ in diameter, one of which is located on the side centre line and the other on the top.

The second or middle compartment is for the superheater, which consists of double loops of 1¼″ seamless steel tubing dropped down into the path of the hot gases from the firebox. There are 69 of these superheater elements. One end of each connects to the saturated header, which takes steam from the boiler, and the other connects to and discharges into the superheated header, which is connected direct to the h.p. cylinders. When the locomotive was first turned out the superheater was connected to the l.p. cylinders, but, from tests made subsequently, it was changed as described. The reasons for this are explained further on. Two ¾″ blower pipes having nozzles are so located as to blow jets of steam diagonally across the superheater compartment, through the tubes, to bring down any soot which may collect.

There is no steam in the superheater pipes when the throttle is closed, but no cases of burning out have developed after about four months' service, nor is any trouble anticipated, as this condition applies, although to a lesser degree, to other types of superheaters which are giving good service. The superheater pipes are secured to the headers by union nuts, and are readily removable for repairs, one element at a time, through the opening at the top of the boiler, which is closed by a flanged steel door. If necessary, the complete superheater, header, and tubes may be lifted out bodily.

The back compartment is the boiler proper or steam generating section, and the construction is similar to ordinary boilers, except that the radii on the cor-