

Canadian Pacific Railway Mallet Articulated Locomotive.

extension  $1\frac{1}{8}$ ", which would necessitate the use of two universal ball joints with packing and a packed expansion joint instead of two simple ball rings, which are sufficient to take up both the rotary movement and extension. The receiver pipe movement would be the same, provided the connection to the h.p. cylinders was directly over or close to the frame connection pin. This pipe is usually given flexibility by a packed universal ball joint and a packed expansion joint.

From the above it will be seen that, with the l.p. cylinders at the front, and following the usual pipe construction, five packed joints would have been used, but with the arrangement adopted there is only one packed joint and two ball rings.

**CYLINDERS, VALVES AND VALVE MOTION.**  
—The cylinders are of the piston valve type, with inside admission on the h.p. and outside on the l.p., which permits of the most satisfactory arrangement of steam pipes. The diameters are: h.p.,  $23\frac{1}{4}$ " x 26" stroke; l.p., 34" x 26" stroke. All four are cast separately, without saddles, and are bolted together by vertical flanges in the usual manner. The h.p. have a cast-steel saddle which is common to both cylinders, and which bolts rigidly to them and to the boiler. This connection to the boiler is a very important one, the barrel being under pressure at this point, and the saddle is secured with  $1\frac{1}{4}$ " bolts, having a taper of 1-16" in 12", driven into holes reamed from the pressure side. The l.p. cylinders have no saddle, as there is a move-

ment between the boiler and truck at this point. A small steadying casting has, however, been applied, which slides across the flat surface on the top of the cylinders, but no weight is transmitted to the truck by it. The main frames are slabbled to a section 15" deep x 3" wide at the cylinder fits, and are braced laterally by the frame connection castings which join the two engines together. The arrangement of the cylinders and their fastening is shown by fig. 5.

Walschaert's valve motion is used. The design varies but slightly from that used on other C.P.R. locomotives, except in the radius bar lifting link on the l.p. engine, which, of course, must have flexible connections to permit of movement between the boiler, to which the reversing arm is attached, and the truck. It must also be made as long as possible, as, when the locomotive is rounding a sharp curve, the boiler will swing about 9" off the centre line of the truck at this point, and the angle taken by the lifting link causes the radius bar to raise in the radius link, thus shortening the travel of the valve when the engine is in forward gear and lengthening it when in backward, the radius bar being down for forward and up for backward gear. This applies to all Mallet locomotives having the radius bar suspension arranged in this manner, but is comparatively unimportant if sufficient clearance is allowed between the radius link and block at the top.

Provision has also been made for varying the cut-off in the l.p. cylinders inde-

pendently of the h.p. That is, the l.p. cut-off may be lengthened without affecting the h.p.

Reference to fig. 1 shows that the h.p. reverse shaft has two arms on the right-hand side. One of these is  $11\frac{1}{2}$ " long, and is connected to the power reverse cylinder, the stroke of which is 12", and as the h.p. radius bar lifting arm is forged to the same shaft, the lift or fall of the radius bar is always proportional to the travel of the power cylinder piston. The arm on this shaft, to which the l.p. reach rod connects, has a slotted upper end with a sliding block, to which the reach rod pin connects. This block is held in any desired position by means of a screw adjustment. The shortest length of the arm is  $12\frac{1}{2}$ ", and with the longest power piston travel of 12", the

movement of the reach rod is  $\frac{12}{11.5} \times 12.5$ ",

or 13" nearly. If, by means of the screw, the reach rod block is moved up to 14" from the shaft, the movement of the

reach rod becomes  $\frac{12}{11.5} \times 14$ ", or 14.6",

with a consequent increase in the rise or fall of the l.p. radius bar, which will increase the travel of the valve.

A simple form of power reverse gear is used, consisting of a 6" steam cylinder, with its piston rod connected to the reach rod shaft as described above. Rapid movement is prevented by an oil dash pot, the piston of which is connect-

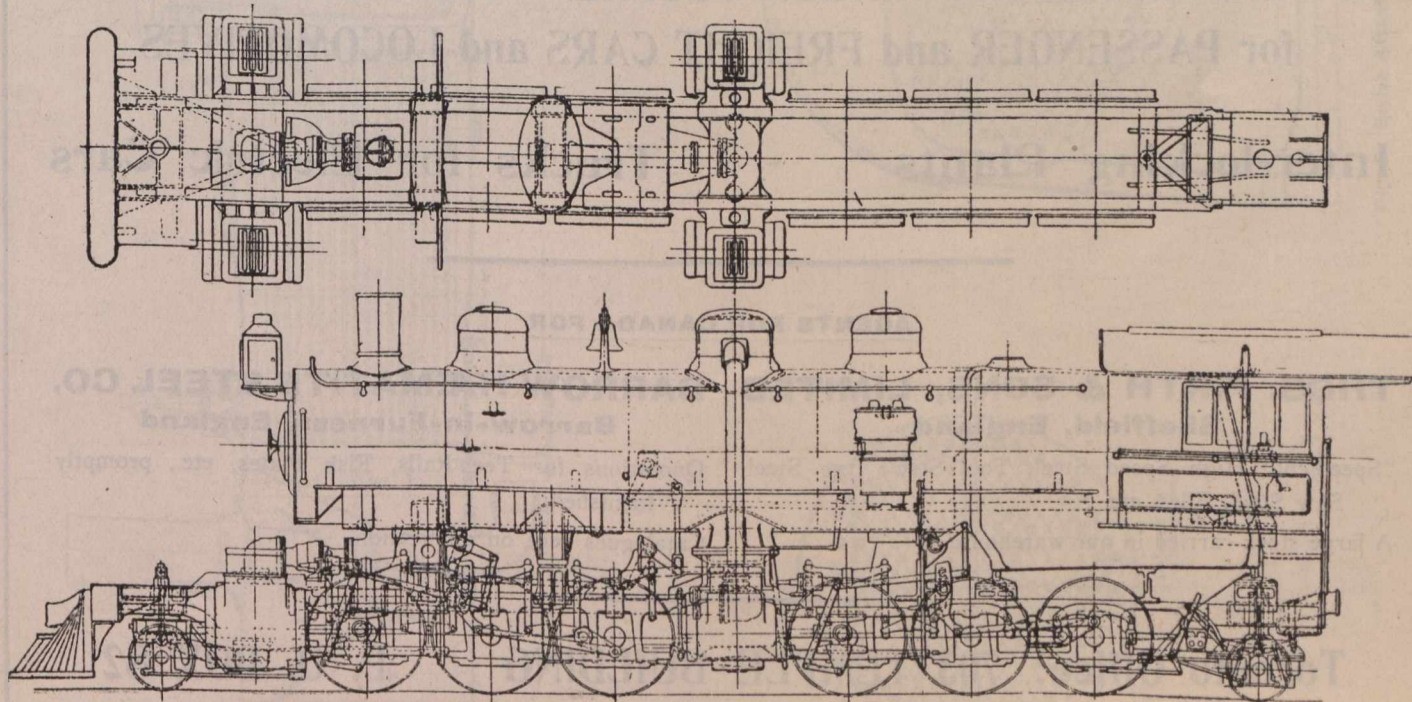


Fig. 2. Side Elevation C.P.R. Mallet Articulated Locomotive.