

with a bar of section shown in fig. 7, they finally adopted the simpler rectangular shape (fig. 15.). We may here note that the early designers made no attempt to transmit their power through a parallel motion, and we shall presently see that they were justified in sacrificing force for the sake of simplicity of construction.

MODERN FORMS.

Locomotive crossheads, the world over, belong to three classes: namely, the two-bar, the four-bar, and the single bar types. It is true that there are many heads that do not come under the above classification, but they are special designs and not standard. The two-bar type, as seen in figs 8, 9, 10, 11, is the most common head seen on the American Continent. The guide bars are equi-distant top and bottom from the piston rod and are central with the vertical plane of the cylinders. The pin is always separate, and lies under the centre of the slipper block. The heads are usually made in cast steel with brass shoes top and bottom, and steel pin, as seen in fig. 8.

A cast iron type (fig. 9) is common in which the socket is reinforced by ribs cast between it and the shoe supports—see "a, a" in fig.

It is usual on this type to use brass liners on the sliding surfaces, with a cast iron flange bolted on as shown at "b, b." This head is not as simple as that seen in fig. 8, and is being supplanted by the latter on many of the large American Railway Systems. The four-bar type, seen in figs. 13, 14, and 16, consists of two blocks which run on either side of the piston and connecting rods, and are joined in one casting which forms connection for piston rod and also the pin around which the connecting rod end oscillates. The casting is made of good wheel C.I. or cast steel. Although the crosshead pins are usually part of the casting, on some roads separate pins are used. The weak features of this design are that the pin does not always lie under the centre of the slipper block, giving uneven distribution of pressure on it; when the pin is cast, it is always a difficult operation to machine it and keep it in order; also four sliding surfaces are more difficult to deal with than two. When made in C.I. this type is weak at points "a, a," "b, b" and "c, c." To prevent breaking some roads have ordered W. I. bands to be shrunk around the flanges next to the inside of the bars.

The guide bars are made of W. I., case-hardened, and ground with emery wheel to the proper surface.

A crosshead which belongs to this class is seen in fig. 14, which represents the head used on the Vaucrain compound made by Baldwins, of Philadelphia. In this the high and low pressure