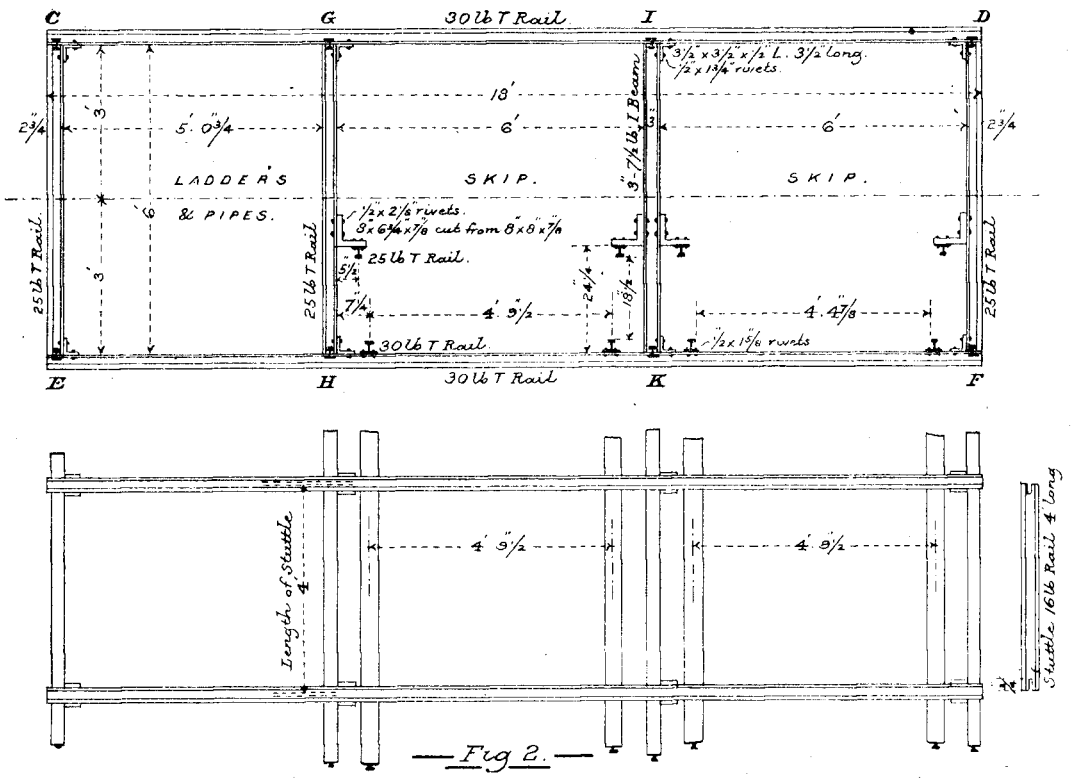

—Fig 2.—

Shaft supported by Steel Framework.

in order to avoid the necessity of pumping. Timber tubbing for this purpose may be either plank tubbing or solid wood tubbing. Plank tubbing does not differ essentially from ordinary timber lining, except that shafts so treated are generally made circular. Watertightness is secured by bevelling the edges of the planks so as to insure a good joint, and nailing them around the circular frame like the staves of a barrel. Solid timber tubbing consists of carefully shaped blocks of wood fitted together as shown in Fig. 1. Stauchness is secured by placing thin sheets of deal between the joints, which are wedged up as tightly as possible.

For some shafts a combination of iron or steel frames with timber planks has been employed; thus at Boryslaw is a circular shaft lined with timber in which each frame consists of two semi-circular rings of channel iron which are connected together by channel fishplates and bolts to form a complete circle. In this case the studdles are of timber.

The Oliver Iron-mining Company, in lining B shaft of their Pioneer Mine at Ely, Minnesota, have recently made use of the steel framework for a rectangular shaft. This lining is arranged in just the same way as ordinary timbering, only the frames are built up of steel rails, and the studdles are also of steel.

A plan and elevation of these frames is shown in Fig. 2. The wall-plates CD, EF are of 30 lb. rail, the end-pieces and the dividing-piece GH are of 25 lb. rail, and the dividing-piece KI is of 3 in. 7½ lb. I beam, this form being chosen on account of its convenient shape for that position. Beams could, of course, be used instead of rails for all the members of the frame, but it is stated that rails are more economical under conditions requiring a weight of less than 50 lb. per yard. As will be seen from the drawing, the different members are connected together by means of 3½ in. by 3½ in. by ½ in. angle cleats fastened with ½ in. rivets. The studdles are pieces of rail 4 ft. long, slotted at each end to fit on the flanges of the rails forming the frame. Sixteen-pound rails are used for studdles if bought for the purpose, but short lengths of old rails of almost any section can be employed.

In this particular shaft, which, it should be stated, was an inclined shaft, the ground was so good that little lagging was needed in the upper portions; but to prevent large portions of rock falling old wire ropes were stretched longitudinally behind the frames at 5 in. centres. Where the ground became worse ordinary 2 in. planking was employed. This planking, of course, destroyed to some extent the advantage of steel framing with regard to immunity from fire, but in order to minimise this disadvantage it has been proposed to put one 16 ft. length of metal lagging in every 100 ft. of depth. Corrugated-steel and buckled plates have been suggested as most suitable for this purpose. The weight of the lining is taken by bearers consisting of 30 lb. rails placed at intervals beneath the end-pieces and dividing-pieces. In order to give these bearers a good footing in the ground their ends are carried in cast-iron bearing-pieces. The frames are given a firm support on the bearers by means of cast-iron chairs of special form. A complete account of the lining of this shaft and of the proposed similar lining of a larger vertical shaft was given in a paper read before the Minnesota meeting of the Lake Superior Mining Institute, August, 1902.