HEADING TIMBER.

The heading being ready, a rair of wall-plates were brought in, and the engineers were sont for, to superintend the placing of them. This operation is described further on. The wall-plates were 12" x 14" x 16'-0", and as the theoretical springing of the arch was at the lower side of the wall-plate, radial beds were adzed on its upper side, to make bearings for the arch timbers ; the wall-plates were jointed by halving for a foot at each end, and were made in pairs, right and left, so that the forward end when in position might always show the lower section of the half-joint, that being a material advantage in the placing of the plates. The wall-plates being in position and sceurely blocked against outward and downward movement, the joints were secured by tightening up the clamps. The detail of these clamps is shown in Fig 3. Stiffening planks 2"x 14" x 2'-0" were placed above and below the jointed plates, and drawn against them by tightening up bolts working through pairs of transverse straps. These bolts and straps are entirely outside the timber, and comprise all the permanent iron in the tunnel.



FIGI CENTRING FOR TIMBER' ARCHES

The arches were crected on the segment centres shown in Fig. 7. The arches are of 12"x12" timber, in seven segments, the segments being cut to template, and were crected by simply laying each segment in place on the centres. The centres were crected by jointing the two segments by the bolts shown in Fig. 7, and then blocking up their feet to proper position ; the long hook shown in the same Fig. was driven into the preceding arch, and served to hold the frame in position at its proper spacing; the second system of segment joint there shown proved the better in practice, being more readily handled. The arch segments being up, they were blocked solidly from the roof against all apward and outward movement, and 4" x 12" joggle-blocks with 8" shoulders were placed between consecutive arches at each joint. The centres were then withdrawn and the lagging commenced. The lagging was close-laid in lengths equal to the arch spacing and the bottom piece bore on the projecting back of the wall-plate. All voids back of the lagging were filled with broken sandstone brought into the tunnel for the purpose, and hand-laid. The use of sandstone was insisted upon because it was feared that the shale would deteriorate in time and yield under pressure if used as packing, thus giving the masses above a chance to start moving. The lagging and packing were carried up simultaneously, the packing of the crown segment being completed from between the next arches; and the timbering was completed by nailing up the two lines of 1"x6" lacing plank at each joint. These lacing planks were to protect the corners of the segments from blasts, and were torn down after the tunnel was completed. They had the demerit of hiding the condition of the joint, and were accordingly omitted in bad ground.

BENCH TIMBER.

As the bench was removed, the wall-plates were caught up on the plumb posts, due watch being kept that no length of the wall-plates was at any time left without ample support. The posts were underlaid by 4"x12"