This one failed when the tar leaked out through the oakum, but this was prevented to a great extent by the use of sand above the oakum. At first the joints were water tight, but the jar and slight working about of the slabs loosened the oakum, letting the sand and tar escape. The joint at the abutment also leaked very badly. In addition to this the water found its way through two of the slabs themselves.

These methods had been tried during 1906 and 1707, and in 1908 it was thought best to waterproof the whole surface of the bridge and to aid the water in running off by a system of drain pipes.

The method shown on the right-hand side of Fig. 8 was the one adopted. The slabs were built with a ½-in. batter on the sides instead of with an offset so that they could be

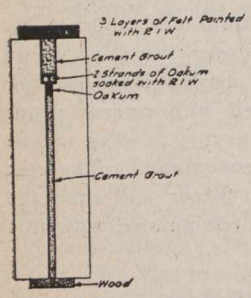

FIG. 1

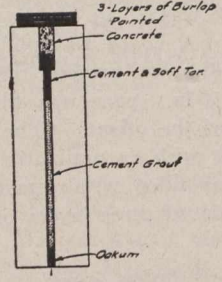

FIG. 2

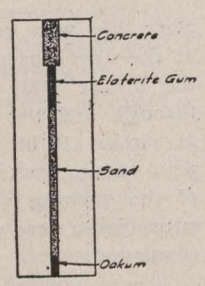

FIG. 3

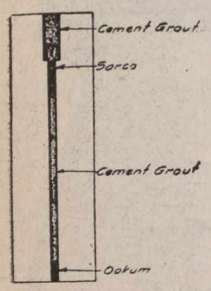

FIG. 4

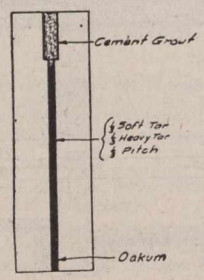

FIG. 5

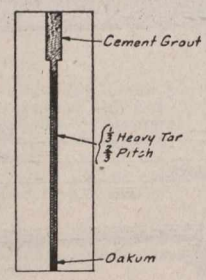

FIG. 6

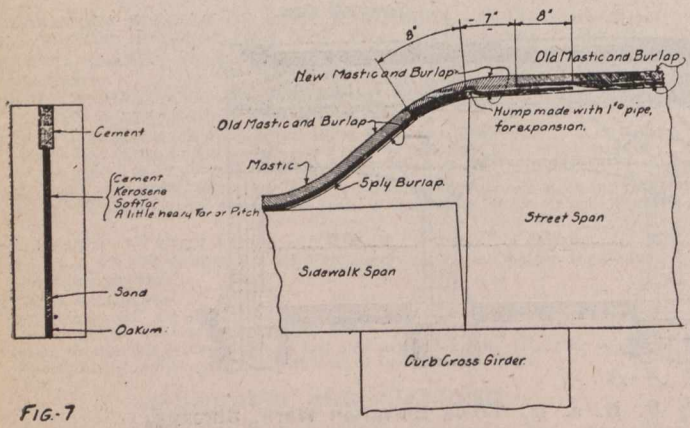

FIG. 7

FIG. 9

calked from above. After calking the cracks with oakum they were filled with cement grout. The vertical offset of 12½ in. over the curb cross girder was rounded off by a fillet of concrete. The abutment back of the bridge seat was built up to the level of the top of the sidewalk slab. The lifting stirrups or hook bolts by means of which the slabs were placed were cut off at the top of the concrete and the surface of the bridge swept clean. As a rule only one track or a width of 14 ft. could be waterproofed at one time because of operating conditions and the fact that the force used was of such size that this was one day's work. A strip about 4 ft. wide was mopped with a coat of asphalt which had been heated to the melting point. Four kinds of asphalt were used at different times, Sarco No. 6 and No. 651, melting point 160 deg., Barber Asphalt Company's positive deal "A," melting points 140 deg. Texaco and Warren Chemical Company's asphalt cement. On this was put a strip of 8-oz. open-mesh, first quality burlap, 42 in. wide. This came in 2,000-yd. bundles and was made into rolls coiled on a 1½-in. gas pipe 7 ft. long. It was applied by starting at one end of the bridge and rolling it across. A man followed the roll and swept out any wrinkles so as to give a smooth surface and bond it to the asphalt below. The top of this burlap and a strip of concrete about 15 in. wide on one side of it was then painted with hot asphalt and another layer of burlap laid, covering two-thirds of the first layer, the rest lapping over on the concrete. This burlap and the adjacent concrete were then painted and another strip laid covering one-third of the first and two-thirds of the second strip. In this way the burlap was made three-ply. Care had been taken that the temperature of the asphalt was not high enough to burn the burlap. A melting point of 160 deg. Fahrenheit gave the best results, as asphalt with a higher melting point burns the burlap and it becomes more brittle at low temperatures. After three-ply of burlap had been laid the whole surface was again mopped with asphalt and a protecting layer of mastic put on. This layer consisted of one part of asphalt and four parts of dry engine sand. The asphalt was heated to the melting point in one kettle and the engine sand heated over an iron plate. They were mixed and stirred in another kettle until of the right consistency, a slow fire under the kettle keeping the mixture plastic. This mastic was dipped into iron wheelbarrows, wheeled on broad runways laid on the burlap, dumped, and finished with wooden trowels to a thickness of 1 in. The top of this mastic was mopped with asphalt. This 1-in. layer was not intended to aid in waterproofing, but was put on to protect the burlap from the ballast and the track tools.

The drainage system consisted of inverted 8-in. half-tiles laid between each track leading from the hump over the curb cross girder to the back of the abutment. Back of the abutment and about 1 ft. below the bridge seat a board was placed on which rested another 8-in. half-tile. The end of the burlap rested in this and another 4-in. tile was laid in it. The tiling was given a slope of about 1 per cent. toward down-pipes. These down-pipes were 50 ft. apart and ran down the back of the abutment to the sidewalk level, then through it and under the sidewalk to the gutter. The mastic was protected by ¾ in. of roofing gravel to keep the sharp edges of the crushed stone ballast from cutting into it. The crushed stone ranged from ½ in. to 2½ in. and was used to allow free movement of the water through it.

It was not long, however, before the boards and tiling crushed down into the newly made fill, giving no means of escape for the water which ran off the bridge, causing it to back up above the level of the bridge seat and find its way down the face of the abutment. This was prevented by building the concrete so as to overhang the back of the abutment about 1 ft. and letting it run down the back about the same distance. The top of the abutment was painted with a heavy coat of tar paint before setting the slabs. This effectually sealed the joint. In all abutments built after this experience a notch was left in the top, as shown on the left-hand side of Fig. 8, in which to place the tile and prevent its crushing down.

After the first year's experience with this waterproofing, it was thought advisable to increase the thickness of burlap to five-ply. Many leaks had developed over the curb cross