For first-class work, British Standard Tested Salt-glazed Ware Pipes should be used. Each pipe is subjected to an internal hydraulic test at the works and should withstand a pressure of 20-lb. per sq. in. without showing signs of injury or leakage. The specification also includes an absorption test.

SETTING OUT AND EXCAVATION OF DRAIN TRENCHES

A drain must be laid to an adequate inclination or gradient. This is expressed as a ratio between the total fall (or difference in level between the upper and lower ends of the drain) and the horizontal length of the drain. Thus, if the fall is 2-ft. and the horizontal length is 60-ft., the gradient is 1 in 30. A 4-in. drain should have a minimum fall of 1 in 40 and a 6-in. drain a minimum fall of 1 in 60, *i.e.*, the diameter in inches is multiplied by 10.

Before deciding upon the gradient to which a drain is to be laid, it is necessary to obtain the depth of the public sewer (or existing drain or cesspool) and the level of the ground. The depth of the sewer below the ground level at the proposed point of connection may be obtained by inspection on the site, such as at a convenient manhole or chamber (see p. 80), or from the surveyor to the local authority; the level of the ground along the proposed line of the drain is determined by using a dumpy level and levelling staff or the straight edge and spirit level. The longitudinal section, such as is shown at E, Fig. 30, can then be plotted. Besides having an adequate fall, the drain should be laid to a uniform gradient up to the boundary of the site, or from chamber to chamber (see p. 80), after which the fall may be increased up to the connection. Thus, at E the drain has a uniform inclination of 1 in 32 up to the intercepting chamber M, from which point the gradient is increased. In this example it would be uneconomical to maintain a uniform gradient from the gully to the sewer because of the additional excavation which would be entailed.

Unless the drain is a short one the setting out of the trench is performed in the following manner: A wood peg is driven in on the proposed centre line of the drain at each point where it changes direction. The sides are pegged out, pegs being inserted at half of the width from each centre peg; a cord is stretched taut and tied to one pair of side pegs, the side is marked with a pick or spade, and the opposite side is similarly marked after the line has been transferred to the corresponding pegs.

The correct level of the bottom of the trench is obtained and a uniform fall maintained by the use of two *sight rails* and a *boning rod*. A sight rail is a wood board, having straight edges, and about 1½-in. thick. It is fixed to a pair of 4-in. by 2 or 3-in. wood posts, having pointed ends, which are securely driven into the ground at one end and clear of the proposed trench; each post is sometimes packed with earth, gravel, etc., within a 6 or 9-in. drain pipe placed vertically with its flange resting on the ground. The sight rail is nailed to the two posts at any convenient height and with its upper edge horizontal as tested by a spirit level. The second sight rail is fixed at the correct level in a similar manner at the opposite end of the trench; the level of the top edge of this rail must be such that an imaginary line, called the *line of sight*, drawn from it to that of the other is parallel to the proposed gradient of the drain; a dumpy level and levelling staff should be used to fix the height of this second sight rail to ensure that the difference in level between the two rails is that decided upon. An application of sight rails is illustrated at A, C and D, Fig. 29, where the inclination of the line of sight is 1 in 40 and is 7-ft. 6-in. above the bottom of the proposed trench. The required gradient of the trench bottom is maintained by use of the boning rod. This rod resembles an elongated tee-square having a wood blade with cross head attached (see A, B, C and D). The height of the rod must equal the vertical distance between the line of sight and the predetermined level of the trench bottom, *i.e.*, 7-ft. 6-in. in this example.

The excavation is proceeded with until the level of the bottom of the trench is reached as determined by "sighting through." Thus, the foreman standing immediately behind one of the sight rails looks towards the far sight rail so that he can just see the top edges of both rails, and the required depth is indicated when the top of the boning rod, resting upon the bottom of the excavation and held vertically by an assistant, coincides with the line of sight. This is repeated the rod being held at intervals along the trench. The boning rod W at D, Fig. 29, shows that the required level of the trench at that point has been reached and that additional excavation is necessary further up if, when sighting through as the rod is held in turn at positions U and V, its head appears above the line of sight as indicated. Excavation of the last one or two inches may be deferred until just prior to the laying of the drain, when the earth is trimmed off and the bottom rammed solid.

Timbering, as required, is provided as a temporary support to the sides of the trench (see Fig. 42, Vol. I, and Fig. 19, Vol. III).

JOINTS.—These must be airtight and watertight; none of the jointing material must remain within the bore of the pipes, and the invert must be in true alignment throughout. The jointing material used for ware pipes is (1) cement and (2) bitumen.

1. *Cement Joint* (see G, Fig. 29).—This is the joint most commonly employed. The composition of the mortar recommended is 2 parts cement, 1 part sand and 2 per cent. of waterproof compound (see p. 27); sometimes neat cement is used, but this has been known to crack the pipe sockets owing to the expansion of the cement (probably of indifferent quality) when setting; another mixture, often used, consists of equal parts of cement and sand. In addition, it is customary to use a piece of *yarn* (also known as *hemp*, *gaskin*, *gasket*, *jute* and *rope*) at each joint.

The joint is formed in the following manner: The spigot of a pipe is placed within the socket of the last laid pipe and closely butted against the shoulder. A piece of yarn, after being dipped into a pail of cement grout to preserve it (unless it has been previously tarred) is wrapped two or three times round the spigot and well caulked against the shoulder by means of a blunt chisel, cement