by capillary attraction, but like the roll of similar construction, the free edge of the oversheet may be disturbed in a high gale. A second method of preventing capillary attraction is shown at U, which illustrates a " capillary groove " formed along the step and into which the undersheet is dressed ; whilst this construction is excellent in theory, it is very rarely adopted in practice.

Drips are further considered later.

(4) *Welts or Seams* are often employed for jointing sheets of lead covering vertical and steeply pitched surfaces and for jointing lead and copper damp-proof courses (see p. 18). A welt is illustrated at R, S and T, Fig. 73. Like hollow rolls, the edges of the adjacent sheets are upturned with 2-in. wide lead or copper tacks between, the tacks being fixed at from 2 to 4-ft. intervals ; after being folded as shown at R, the upturns are dressed down as closely as possible on to the flat. The spaces between the folds have been emphasized to show the construction more clearly, and the finished appearance of a welt more closely resembles the sketch at T. The width of the seam varies from 1¼ to 3-in.

Welted joints are not suitable for flats or low-pitched roofs, but like hollow rolls, they are very effective for steep or curved surfaces. Detail D, Fig. 73 shows a section through a welt which may be employed at ridges in lieu of 6-in. laps.

> The roof of the Manchester Town Hall building (see footnote on p. 142) has a 60° pitch, and the sheets of cast lead are joined at their sloping edges by welts which are 2¾-in. wide ; the horizontal joints consist of 6½-in. wide laps and the sheets are secured by turning the top edges over the boarding to which they are close copper-nailed ; each board immediately above that to which the upper edge of the sheet was nailed was removed (it being left loose for this purpose) and, after nailing the sheet, this board was replaced and nailed.

GUTTERS.—There are three forms of lead-covered gutters, *i.e.*, (*a*) parallel parapet gutters, (*b*) tapered parapet gutters and (*c*) V-gutters.

(a) *Parallel Parapet Gutters.*—As is implied, this gutter is situated behind a parapet wall and at the bottom of a flat or sloping roof ; it is also known as a *box* or *trough* gutter. The gutter is of uniform width throughout and must be at least 10-in. wide to afford adequate foot room. A long gutter is divided into sections, having a roll at the highest point, and drips at intervals not exceeding 8-ft. apart ; it is given a minimum fall of 1½-in. per 10-ft. In Fig. 71 it receives the drainage from a sloping roof, and in Fig. 72 it is associated with a lead flat.

The timber details of the gutter shown in Fig. 71 are referred to on p. 81 ; a part plan is shown at C and a longitudinal section is shown at B ; a 2-in. roll is placed at the highest point from which the gutter falls 1 in. to a 2-in. drip and the lower portion falls 1-in. to a cesspool.

A *cesspool* or *drip-box* is a lead-lined receptacle, situated at the lowest end of a gutter, from which a lead outlet pipe, suitably bent, discharges the water into a rain-water head where it is conveyed by a rain-water pipe to a gully and drain. Rain-water heads and pipes are described on pp. 153-156. The minimum depth of a cesspool should be 6-in. The wood framing, its support and the chamfered hole are detailed at O, Fig. 71. The lead lining is in one piece, two sides being turned up 12-in. against the walls, a third side being turned up 6-in. and dressed 1½-in. into a shallow rebate formed along the lower edge of the gutter boarding to which it is nailed, and the fourth side is 20-in. long, 14-in. of which is turned up vertically with the remainder dressed over the tilting fillet and roof boarding to which it is nailed. This lining is bossed to the required shape from a rectangular piece of lead before it is placed in position, and a skilled craftsman will do this without resorting to folded or " dog-eared " angles (see p. 146). It is holed and dressed over the chamfered hole formed in the wood bottom, and the outlet pipe,[1] having been formed to a swan-neck bend as described on p. 146, with its upper end enlarged by means of a tanpin or turnpin (see E, Fig. 76), is either soldered as shown or lead-burned to give a firm watertight joint. A galvanized wire or copper *balloon* or *dome* is sometimes fixed into the top of the outlet pipe to prevent it from being choked by leaves, etc. A small lead overflow or warning pipe should be provided as shown to serve as a temporary outlet for the water in the event of the pipe becoming choked. As certain mortars act chemically upon and destroy lead, it is advisable to cover the lead overflow pipe and the portion of the outlet pipe which passes through the wall with tarred felt (see B and O) ; alternatively, these pipes may be given a coating of bituminous paint.

The lower section of the gutter is covered with lead after the cesspool has been lined, the covering consisting of the *bed*, a 5 or 6-in. *upturn* or *upstand* against the wall, and an upturn against the pole plate which is continued over the tilting fillet to about 6-in. on the slope of the roof where it is open copper-nailed to the boarding along its edge. This lower end is dressed 4-in. down the cesspool, and the upper end forms the undersheet of the drip which has been described on p. 144.

The next section of the gutter has a similar covering ; the lower end forms the oversheet of the drip and the upper end is dressed over the roll to provide the undercloak (see P).

The cover flashing is fixed, commencing at the cesspool end, after the opposite half of the gutter has been lined in a similar manner and finished with the upper end of the top section forming the overcloak of the roll. Enlarged details showing the laps, tacks and wedges are given at O, P and Q ; the detail at A shows the relative heights of the roll, drip, etc.

It will be seen that each piece of lead forming a gutter (and cesspool) is fixed along two adjacent edges only, the other two edges being free to allow the lead to expand and contract.

> *Snow Boards* should be provided to gutters in order that melted snow may have a free passage to the outlets and to protect the lead against damage by traffic ; without such boards, the snow on the gutter impedes the flow of water as the snow thaws on the underside, and this may cause the water to rise above the lead covering and penetrate the roof. A snow board may consist of two 4-in. by 2-in. longitudinal bearers, extending the full length of the section, to the top of which are nailed 2-in. by ¾-in. transverse laths at about ½-in. apart.

[1] The size of the pipe may be determined by allowing 1-sq. in. of pipe area to 75-sq. ft. of roof surface.