sheet are turned over the standing edge of the second sheet (see second stage), and all three are bent over to form a double lock welt, as shown in the final stage. The height of the finished joint is approximately $\frac{3}{4}$-in.

The setting out of a copper covered roof, therefore, somewhat resembles that of the lead flat shown at A, Fig. 72, Vol. I, the *side joints* consisting of rolls or standing seams, and the *cross joints* being welts, staggered, instead of drips.

DRIPS.—As mentioned on p. 130, drips are only provided in parapet gutters in order to increase the flow of water towards the outlet. As shown at E, the timber construction is similar to that of a lead drip (see Fig. 72, Vol. I), except that an additional 45° angle fillet is fixed. The adjacent copper strips covering the gutter are jointed by a *single* lock cross welt at the centre of the fillet. Sometimes the welt is formed at the top of the fillet.

RIDGES.—A satisfactory treatment at a ridge is shown at F. Here the ridge roll or *king roll* is higher than the adjacent wood rolls. The copper covering the king roll is as described on p. 130 in connection with the rolls at C, a capping being provided and welted to the upturned sheets. The overcloaks of the conical rolls (or the cappings if the rolls are of type C) are widened and welted into the king roll capping.

If the side joints of the copper roof covering are of the standing seam type (D), it is usual for the sheets covering the two slopes to be welted at the ridge intersection and dressed down on one side over the felt covered boarding (butt jointed as shown at F and without the roll). The standing seams forming the side joints are gradually flattened for a distance of about 6 in. down from the apex and folded into the ridge welt.

HIPS are formed as described for ridges.

VALLEYS.—The woodwork is of the usual construction (see J, Fig. 45). Welted joints are formed between the copper strip covering the valley and the sheets covering the slopes. If wood rolls are adopted for the side joints the ends of the rolls are cut short of the intersection and bevelled back, the copper is dressed round the ends and the welted undercloaks and overcloaks are continued and tucked into the valley welt. If the standing seam method has been employed the seams are gradually flattened at the ends and linked into the valley welt.

STEPPED, ETC., FLASHINGS.—These are very similar to those executed in lead and described in Chapter Six, Vol. I.

Copper roof covering in the form of corrugated sheets, tiles, etc., is also obtainable, but there has been only a very limited demand for such in this country.

NOTE.—*In the details shown in Fig. 50 the space between the copper at the welts has been exaggerated.*

ZINC ROOFING

MANUFACTURE.—Zinc is extracted from certain ores, the chief of which are the dark coloured *blende* and the light coloured *calamine*, found in England (on a small scale in Cornwall, Cumberland, Derbyshire and Somerset), Wales, Canada, Poland, Spain, Sweden and the U.S.A. Several methods are adopted for extracting the metal. In one the powdered ore is roasted in a furnace and then heated in horizontal retorts. Here the zinc is volatilized and the vapour is condensed in receivers. The condensed zinc is removed and poured into metal moulds, when it is commercially known as *spelter*. The metal at this stage is brittle. The spelter is re-heated and made malleable, after which it is re-cast into rectangular cakes, allowed to partially cool and finally rolled. It is passed between two sets of rollers until the required thickness is obtained, the direction of rolling in the finishing mill being at right angles to that in the first or roughing mill. The sheets are finally trimmed (sheared) to size.

SIZES.—The standard size of sheets is 7 to 8 ft. long and 3 ft. wide, the latter length being usually adopted. Zinc is specified according to gauge. For best work, 16 Zinc Gauge [1] is used, and 14 Z.G. is the recommended minimum thickness.

CHARACTERISTICS.—Zinc is a white metal with a bluish-grey tint. When exposed to the atmosphere a carbonate is formed which forms a protective coating to the underlying metal. It is brittle at ordinary temperatures. Zinc is a very light roofing material, although the sheets are heavier than copper. It is fairly durable, provided it is used for roofing purposes in atmospheres free from smoke, but it has a relatively short life if subjected to acids. Its initial cost is low.

The coefficient of expansion of zinc is higher than that of copper and is 0·0000291 per ° C., or practically the same as that of lead. Therefore, when applied on flat roofs both rolls and drips must be used to permit of expansion. The minimum fall for flat roofs is 1 in 64 ($1\frac{1}{2}$-in. in 8-ft.). Zinc does not creep and it is therefore suitable for steeply pitched roofs.

JOINTS.—The setting out of a zinc covered flat roof is similar to that for lead flats (see A, Fig. 72, Vol. I), (*a*) rolls and (*b*) drips being formed as described below.

The boarding should not be less than $\frac{3}{4}$-in. thick and, like that for copper and lead covering, it should be laid diagonally or in the direction of the fall. It is generally butt jointed, but t. and g. boarding is occasionally employed. Building paper or felt is used to cover the boarding. This provides thermal and sound insulation, and acts as a cushion.

(a) *Wood Rolls.*—As shown at G, H, J, M and N, Fig. 50, the wood rolls are slightly tapered, and as the zinc sheets placed between them have each side turned up $1\frac{1}{2}$ in., it follows that the rolls are spaced at a distance of 2-ft. 9-in. apart (2-ft. $10\frac{1}{2}$-in. centres) or 3-in. shorter than the width of the sheets. Zinc clips, $1\frac{1}{2}$-in. wide, are spaced at about 3-ft. 6-in. centres under each roll and the latter is then nailed at 1-ft. 9-in. intervals, every alternate nail passing through a

[1] Zinc Gauge should not be confused with the Standard Wire Gauge (see footnote to p. 130.) The Zinc Gauge, unlike the S.W.G., increases in number with the thickness. Thus, the thickness of 14 Z.G. is 0·031-in. (approximately 21 S.W.G.) and the thickness of 16 Z.G. is 0·041-in. (approximately 19 S.W.G.). The weight per square foot of 14 Z.G. is 18·58-oz. and that of 16 Z.G. is 24·57-oz.