bolted or riveted to the rafters, the former being preferred. A detail of one of these plates before bending is shown at H. *Care must be taken in setting out that the bolts or rivets connecting these plates to the rafters do not foul the rivets fixing the latter to the gusset.*

The purlins are of wood, and each is bolted to a cleat riveted or bolted to the rafter (see K). If riveted, the cleats are fixed at the works (or on the site *before* the truss is erected). A detail of the cleat is shown at J. Joints between purlins must occur at the trusses, and for such connections the cleats are 12-in. long to enable two bolts being fixed at the end of each purlin (see Q, Fig. 50). The bolts now commonly used for fixing these wood members are called *carriage bolts*, *coach bolts* or *timber bolts*. As shown at K, a carriage bolt has a flat cup head and a square *neck* (portion of the shank next to the head). Washers are not required.[1] Square nuts are used. Alternative purlins are shown at N, S, T and U, Fig. 50.

The detail at L shows the connection between the main and diagonal ties and the strut.

All the rivets are $\frac{5}{8}$-in. diameter. The pitch of the rivets is figured on the drawings. The "$1\frac{1}{4}$-$2\frac{1}{4}$-in." pitch shown is common for this size of rivet. It will also be noted that the sizes of the gussets are figured. A structural engineer's working drawing shows all of these dimensions. Many of them have been omitted in the following drawings in order to prevent a mass of figures from obscuring the details.

TRUSS SUITABLE FOR A 30-FT. SPAN (see Fig. 48).—An outline of the truss is shown at A, the rafters being equally divided by two purlins on each side, and the main tie is also equally divided.

Like the previous example, each member is a single angle, and to obtain a suitable balance some members are fixed at the near side of the gussets and others at the far side.

Details of the shoe are given at C, D and E. The main tie extends for the full width of the base plate and secured to it by a countersunk rivet (see M, Fig. 77, Vol. I) in order to give a level bearing. A short cleat is provided at the opposite side of the gusset and countersunk riveted to the base plate. As shown at D, two $\frac{13}{16}$-in. diameter holes are formed in the plate to receive the lewis bolts. Unlike that shown at C, Fig. 47, the gusset does not project below the main tie, and this arrangement is therefore more suitable if a plastered ceiling without cornices is to be provided.

The details at F and G are those at the heads of the struts. The method adopted of ensuring that the rivets are at least the minimum distance from the edges of the gussets, referred to on p. 121, is indicated (see also B).

The connections at the apex are shown at H, and those between the gusset, main tie, struts and diagonal tie are shown at K. The section at J shows a strut on each side of the gusset. The size of these struts and the diagonal tie is that of the smallest angles used in roof construction, *i.e.*, 2-in. by 2-in. by $\frac{1}{4}$-in.

The purlins in this example are of steel (see F and G). These are sometimes preferred to the timber purlins shown in Fig. 47. It will be noted that the purlins are fixed to the rafters by means of bolts. Rivets are never used for fixing these continuous members, as riveting is not practicable after the trusses have been fixed in position. It should also be observed that the centre line principle has been complied with and that the nut comes centrally between the pair of rivets below. Wood plates, called *fillers*, must be bolted at 2-ft. 6-in. to 3-ft. intervals to the purlins as shown to provide fixings for the spars. They are in short lengths. An alternative arrangement is shown at B, where the purlins are reversed and the fillers are placed against their backs. Whilst this is as sound as the type shown at F and G, the fillers are not so readily fixed. The wood plates, not being in continuous lengths, can be laid on the purlins if fixed as shown at F until required to be bolted, but such a temporary support is not available if the purlins are arranged as shown at B. The latter detail is adopted if soffit boarding is required and which is nailed direct to the fillers. The form of end joint between steel purlins is described on p. 128.

The detail at the ridge shows an alternative but more costly arrangement to that detailed at G, Fig. 47; this is usually adopted for the direct fixing of asbestos-cement sheets (see Fig. 47, Vol. III). The steel members are continuous and the spars are nailed to the fillers.

The usual type of tapered gutter is detailed at C and the external walls are $13\frac{1}{2}$-in. thick.

TRUSS SUITABLE FOR 30 TO 40-FT. SPANS (see Fig. 49).—The setting out of the truss is shown in the outline elevation at G. All the members, with exception of the rafters, are of 2-in. by 2-in. by $\frac{1}{4}$-in. angles. The rafters, main tie and main struts, consist of double angles with the gussets in between (see B).

The shoe is detailed at C, D and E. Both angles of the main tie are countersunk riveted to the base plate. Two slotted holes are formed in the base plate for the lewis bolts. These enlarged holes, as previously explained, are to facilitate fixing and not, as sometimes imagined, to allow for expansion and contraction due to temperature changes which, in such a small roof, are negligible. A sketch of the shoe is given at B.

The wood ridge connection is similar to that shown at G, Fig. 47.

The double members (rafters, main tie and main struts) are stiffened and held at the correct distance apart by the provision at intermediate points of *washer packings* placed between them and connected by bolts or *tacking rivets* (see A and H). The thickness of the washers equals that of the gussets, *i.e.*, $\frac{5}{16}$-in. According to the B.S.S. No. 449, the pitch of these tacking rivets should not exceed 3-ft. 6-in. when the members are in tension and 2-ft. 6-in. for compression members. In very large roofs the thickness of these washers may be as much as 2-in. to provide adequate space between the backs of the members for painting.

[1] A hole, of diameter equal to that of the bolt, is bored in the wood purlin. The bolt is inserted and the square-necked portion driven home. The latter prevents rotation of the bolt when the nut is being tightened.