The vertical tie, called a *king tie* and connected at the apex and to the main tie, is required as an intermediate support, if, as shown at F, a plastered ceiling is to be provided. Otherwise it can be dispensed with. It is shown to be a flat bar. As explained on p. 121, flats are likely to become damaged in the course of transport and erection of the truss, and a small angle is often preferred for this reason. There is very little stress in this member (0·5-tons only) and only one bolt is shown at each connection. If two-bolted or riveted connections are insisted upon (see p. 121) the details would be modified to those shown at V and Y, Fig. 50.

A common method of fixing the wood ceiling joists is shown at F. The joists are fitted tightly between the vertical legs of the angles of the main ties, the ends being notched over the horizontal legs as shown. These are nailed to runners provided near each truss and at mid-centres, and the runners are spiked to hangers, the heads of which are nailed to purlins (if of wood) or fillers and to the ridge. Runners and hangers are detailed in Fig. 38, Vol. I.

The remaining details will be understood from the description of the previous trusses. The rivets are $\frac{3}{4}$-in. diameter for the rafter angles and $\frac{5}{8}$-in. diameter for the remaining members. All the gussets are $\frac{5}{16}$-in. thick. The external walls are of cavity construction with 14-in. by $4\frac{1}{2}$-in. piers at truss intervals.

TRUSS SUITABLE FOR A 40-FT SPAN (see Fig. 50).—The outline elevation at A shows the setting out. Each rafter is divided into four equal parts. The struts are normal to the rafters and the foot of each main diagonal tie scratter line meets the intersection between those of the 3-in. by 3-in. by $\frac{5}{16}$-in. main strut and main tie. When arriving at the sizes of the members it was assumed that the roof covering was slates, that a plastered ceiling had to be supported, and that the distance between trusses was 12-ft.

This is known as a *Fink*, *French* or *Belgium* truss and is of good design, each half consisting of a symmetrical triangulated frame. The king tie is only necessary if a ceiling is required and serves as an additional support for the main tie.

As stated on p. 122, the gauge or scratter lines and not the centre lines have been drawn when setting out these details. This is in conformity with the usual practice adopted by structural engineers when preparing working details showing the position of the rivets, etc. The spacing of the rivets is fully dimensioned.

The rafters, main tie and diagonal ties, consist of double angles placed back to back and between which the $\frac{3}{8}$-in. gussets are fixed.

The shoe is detailed at N, O and P. The padstone is 9-in. thick (or equal to three courses of brickwork), as it has to accommodate two $\frac{3}{4}$-in. lewis bolts which are 6-in. long (see B, Fig. 47). Two cleats are riveted to the gusset and these are countersunk riveted to the bearing plate in which slotted holes for the fixing bolts are provided. The section at P shows the double rafter and main tie riveted to the gusset.

Trusses of this size cannot be conveniently transported as complete structures from the works to the building site. Each truss is therefore fabricated in two halves at the works and conveyed in parts to the building. Thus the left half detailed in Fig. 50 would be riveted together with the gusset plate at the apex connected as shown and holed in order that the right half may be readily bolted or riveted to it subsequently. The gusset at the bottom of the diagonal tie will be fixed and holed similarly, and the detached *middle* main tie will have a holed gusset plate riveted at its centre to receive the lower end of the king tie. On arrival on the site each truss is quickly assembled by (*a*) connecting the upper ends of the rafter and diagonal tie of the right half to the apex gusset, (*b*) bolting or riveting (according to the type of fixing designed for) the middle main tie to the gusset at X and to the corresponding plate on the right half truss, and (*c*) connecting the king rod to the apex and middle main tie gussets. If site riveting is resorted to, all of these members are fixed together by means of temporary service bolts before the final operation is carried out; if they are to be bolted connections, which are common, the nuts are not finally spannered until all the bolts have been inserted. It will be observed that the diameter of the holes is $\frac{1}{16}$-in. larger than that of the bolt or rivet shanks.

As the stress in the main tie decreases towards the centre, the middle portion consists of smaller angles, as shown at X.

The king tie is sometimes omitted if the roof is to be open, *i.e.*, no ceiling is required.

The detail at Z is somewhat similar to that at W, and, with exception of those of the purlins, a description of it and the remaining details is unnecessary.

Four different types of purlins are shown at N, S, T and U. That connecting the feet of the trusses (N) is similar to that detailed at F and G, Fig. 48, described on p. 124. Members such as this may be provided at the shoes of each of the trusses shown in Figs. 47, 48 and 49 if preferred to fixing the feet of the spars to wall plates.

An alternative to the above is shown at U. Here the purlin is reversed and the short plates are bolted at the back. For the reason stated on p. 124, this is not so convenient for fixing the fillers.

The large wood purlin shown at S is fixed in a similar manner to that illustrated at K, Fig. 47, but the cleat leg fixed to the rafter is shorter, as the required two bolts or rivets are provided when one is fixed to each of the angles of the rafter. The purlins should be sufficiently long to span across two bays (24-ft.) to allow their ends to come over alternate trusses. The cleats will be 12-in. long at the purlin ends (see Q) and 6-in. long at the intermediate trusses. These purlin joints should be staggered to ensure that all the joints do not come over the same pairs of trusses. The type of end joint used for steel purlins, like those in Figs. 48 and 49, and N and U, Fig. 50, usually consists of a 3-in. by 3-in. by $\frac{3}{8}$-in. angle cleat, twice bolted to the back of the rafter, to which each purlin end is twice bolted.

The steel purlin at T is bolted to an angle cleat bolted or riveted to the two angles of the rafter. A 3-in. by 2-in. wood plate is carriage-bolted or coach-screwed (see p. 126, Vol. I) to it at 3-ft. intervals to provide a fixing for the spars. This type of purlin, without the wood plate, is commonly employed for fixing asbestos-cement or corrugated iron sheets (see K, M and N, Fig. 47, Vol. III).