

(b) **THREE-LIGHT CASSED WINDOWS** (see Fig. 27).—Like casements (see B, Fig. 56, Vol. I), windows with vertical sliding sashes may each consist of two or more lights or pairs of sashes separated by vertical members, called mullions. A wide opening may be divided into three lights, and as shown at A, B and C, it is usual to make the central pair of sashes wider than the adjacent side lights. In some such windows all of the sashes are made to open, and others have fixed side lights with opening central sashes.

In the part elevation at A, the side lights are fixed, being screwed to the frame, and the central pair of sashes only are free to move. As the mullions are solid (see detail at G) the weights for the central sashes must be accommodated in the frame at the jambs. Four *pairs* of pulleys are therefore required, four pulleys for each of the top and bottom hung sashes. At A the weights for the bottom central sash are shown in full to make them conspicuous, and portions of the sash cords are indicated by broken lines. The cords from the sashes to the weights pass over the pulleys fixed at the top of the mullions and those secured to the head of the pulley stiles at the jambs. The pulleys must be fixed as high as possible, and to permit of this a portion is removed from the top of each pulley cover or face plate. The cords between the pulleys pass immediately under the head of the frame at the side lights, those fixed to the top sash being accommodated in grooves in the top rails of the two upper side sashes, and the other two cords are hidden from view when, as shown at D, grooved cover beads are screwed (in order that they may be removed readily when broken cords require attention) to the heads of the side lights.

The solid mullions, which vary from $1\frac{1}{2}$ to 2-in. in thickness, are double tongued or housed to the outer lining (see G), rebated to receive the inner beads and grooved for the parting beads. The side boxes are constructed in the usual manner, *i.e.*, the $1\frac{1}{4}$ -in. pulley stile is tongued (see p. 70) to the 1-in. inner and outer linings, a $\frac{1}{4}$ -in. back lining (often omitted) completes the box, and a $\frac{1}{4}$ -in. parting slip is provided to separate the weights (see F).

The head is usually solid (see D) with an outer lining (or it is the full width of the frame and an outer bead is planted on). The mullions (G) are tenoned and wedged to the head, and the pulley stiles (F) are housed into the latter.

An alternative arrangement for hanging the central sashes consists of the provision of cased or framed mullions in lieu of the solid mullions, and solid 3-in. thick jamb posts instead of the built-up side boxes. The mullions resemble that shown at J, except that the internal width need only be 2-in. and the thickness of the stiles next to the fixed side lights may be reduced to 1-in.

The whole of the sashes of the window at B are made to open. The boxes at the jambs are as shown at F. The mullions are double boxed or cased, *i.e.*, arranged to accommodate two sets of weights as shown at B and detailed at H. In each mullion the weights of the central sashes are separated from those of the side sashes by a $\frac{1}{2}$ -in. dividing strip, and the top and bottom weights of each sash are separated by the usual $\frac{1}{4}$ -in. parting slip. The finished width of the mullions is 8-in.

The part elevation of the window at C also shows each light to consist of sliding sashes. A detail of one of the cased mullions is given at J. It accommodates two large weights, one to balance the sum of half of the weights of the central and side bottom sashes and the other to counterbalance half of the adjacent top sashes.¹ A pulley is fixed at the top of each weight, and four pulleys are screwed to, and near the head of, the pulley stiles of each mullion—one for each of the adjacent top and bottom sashes. Each cord passes under the weight pulley, over the two mullion pulleys and fixed to both of the central and side top (or bottom) sashes (see broken lines at C). Cylindrical cast iron weights are preferred, but if heavy weights are unobtainable from stock, specially cast lead weights are employed. This is an alternative arrangement for hanging the sashes to that shown at B and H and results in a reduction of 2-in. in the width of the mullions. The construction of the side boxes is as shown at F.

If brick or stone mullions are employed, it is usual for each light to consist of a separate cased frame of normal construction (see Fig. 60, Vol. I), although types B and C are sometimes preferred.

(c) **METAL WINDOWS**.—These are included in this chapter, as many windows of this type are used in conjunction with wood frames and are fixed to the latter by the joiner.

The metals used in the manufacture of these windows are mild steel, bronze and other alloys. Undoubtedly bronze windows are the best, as they are rust-proof and are finished with a good surface of a pleasing colour which, if kept clean, improves with age. They are, however, relatively expensive, and for this reason their use is restricted. Since 1920 there has been a big demand for steel windows in lieu of wood casements. There are several forms, including fixed lights, casements opening outwards, inwards and pivoted, etc.

Most manufacturers produce what is known as the "standard metal window," made in several sizes from steel of the same thickness rolled to a common section. They have been used extensively for houses and small buildings, and it is this window, in its simplest form, which has been illustrated in Fig. 28. A fixed light consists of a frame only, and a casement has a sash which is attached to the frame by means of two hinges. The details show that the *frame and sash are of $\frac{1}{8}$ -in. thick metal and their sections are identical in size and shape*. They are of Z-section, 1-in. deep with $\frac{3}{4}$ -in. wide flanges, one of the latter having a slight projection beyond the web to allow the sash and frame to overlap $\frac{1}{4}$ -in. both internally and externally. The horizontal and vertical members of the frame and sash are solidly welded at the corners. Sashes are made with and without $\frac{3}{4}$ -in. by $\frac{3}{4}$ -in. by $\frac{1}{8}$ -in. glazing bars or astragals of T-section, the bars being threaded and locked at the intersections. That at A is of the horizontal bar type, for, unlike the sash at E, vertical bars are not provided.

The hinges usually preferred are of the extension type (see Fig. 59, Vol. I), as, when fully extended, the 4 to 5-in. clearance resulting between the sash and the frame enables the outside of the glass to be cleaned from the inside. These

¹ See note on p. 118, Vol. I, regarding the determination of weights for sashes.