steel hinges are provided at the top and bottom of a sash (see A, E, G, H and K, Fig. 28), the fixed arm being riveted or welded to the frame and the moving arm (rotating on a hard-wearing pin of phosphor-bronze or stainless steel) is fixed to the sash. The sketch at M shows the position of the partially extended hinge relative to the frame and sash.

The sash is provided with a casement fastener, or *two-point handle*, and a casement stay. These are of bronze or gunmetal.

A two-point handle is shown in the two small-scale elevations at A and E and the plan at N. It is mounted on a pin attached to a back plate which is riveted or welded to the inner flange of the sash, and is so called because of the points formed at the nose by the notches (see N). As shown, a thin bronze *striking plate* (about 1-in. by $\frac{3}{8}$-in.) is secured to the inner flange of the frame. Its object is to prevent the nose of the handle contacting the flange and damaging the paint. When the position of the nose is as shown, a tight fit between the sash and frame should result; the clearance shown is exaggerated to make the details clear. As noted, ventilation can be afforded by engaging the flange of the frame (and striking plate) in either notch "1" or "2"; an opening up to 1-in. in width can thus be maintained.

Additional ventilation can, of course, be obtained by applying the casement stay. This may be a peg stay (see D, Fig. 59, Vol. I), when a pin plate or bracket is fixed to the inner flange of the horizontal member of the frame. The objection to this stay is the damage to glass which may be caused if the sash is blown violently against the wall in the event of the window being left open without the pin engaging in one of the holes in the bar. A better form is the *sliding stay* (consisting of a horizontal arm fixed to the sash which slides through a pivoted fitting at the free end of a rotating bracket fixed to the frame), as this, whilst permitting the sash to be maintained at any angle up to 90°, always keeps it under restraint.

FIXING.—The metal frame may be fixed direct to the wall, or it may be screwed to a wood frame or surround.

The window shown at A, B and C, and detailed at G, H, J and K, is fixed direct. Eight ($\frac{5}{16}$-in. diameter) countersunk holes are provided in the web of the frame to receive the fixing screws (see A). If it is to be fixed to masonry, terra-cotta or concrete, $\frac{1}{2}$ or $\frac{5}{8}$-in. diameter holes are cut in the jambs, head and sill opposite the holes in the frame. These are preferably plugged with lead, although hardwood plugs or rawlplugs are more often used. The window is then placed in correct position and the frame is screwed to the plugs. The frame is finally grouted in and pointed with cement mortar, or bedded and pointed with mastic. The details at G and H shows these fixings. As mentioned above, the jambs may be plugged and screwed in this manner. The details at J and K show an alternative method of fixing the frame by means of 4-in. by $\frac{5}{8}$-in. by $\frac{1}{4}$ or $\frac{1}{6}$-in. lugs (provided by the manufacturers) which are bent-up 1-in. Holes are cut in the jambs of the wall at the correct position, and the lugs are inserted and firmly cemented in. The frame is secured to the lugs by $\frac{1}{4}$-in. diameter fixing bolts.

The above method conforms to the best practice, as windows should never be fixed in position until the roughest work has been completed. Otherwise damage may be caused, not only superficially from daubs of set mortar, etc., but to distortion of sashes which can only be straightened with difficulty and often cause subsequent leakage between them and the frames.

It is, however, the usual practice in cheaper work to build-in the metal windows as the construction of the walls proceeds, especially if the walls are of brick. Typical fixing details of a built-in frame are shown at J and K, already referred to. The lugs are bolted to the frame and the window is placed in position. It is kept level and plumb as the building of the wall proceeds, and the lugs are securely built-in with mortar. The lugs are shown bedded in the horizontal joints (see A, J and K). Cutting of the bricks, stone, etc., must be resorted to when the joints do not coincide with the lugs. Lugs are also built-in at brick heads and sills.

A vulnerable part of a metal window which opens outwards is the outer flange of the top horizontal sash member where it contacts the frame. In an exposed position water may enter here even if the sash is tight fitting. It is advisable, therefore, to throat the underside of the head and adopt wide external jambs by fixing the windows well away from and not nearer than 2-in. to the face of the wall. The more elaborate type of window has a metal projecting strip, fixed to the top of the frame just above the sash, which serves as a protection.

Criticism is directed against metal windows fixed direct in certain types of buildings because of the mean appearance presented by the narrow frames. This is emphasized if the colour of the painted windows contrasts with that of the adjacent walling. Hence, as shown at D, E and F and detailed at L, N, O, P and Q, metal windows are often fixed in wood frames. The latter are rebated, or double rebated as shown, to receive the metal frames. *The steel frame is bedded in mastic, and this must be well done to prevent the entrance of water between the two frames.* The metal frame is then screwed to the surround, $\frac{5}{16}$-in. diameter holes being provided in the former for this purpose.

Putty is used for glazing standard metal windows. Ordinary putty (whiting ground in raw linseed oil) alone is useless for this purpose, as it will "run," and gold size is added to it to enable it to set. Small metal dowels or sprigs ($\frac{1}{8}$-in. diameter) are sometimes used to retain temporarily the panes of glass until the putty has set (see G, H and N). Holes ($\frac{1}{8}$-in. diameter) are provided to receive these. Alternatively, thin metal clips provided at each corner of a pane and fixed to the sash serve the same purpose. These are bent against the glass before the puttying is completed.

Metal windows quickly corrode unless suitably treated. Spraying them with zinc after the surface has been thoroughly cleaned and roughened by sand-blasting is one of several rust-proofing processes which has been adopted on a large scale.

Steel windows compare favourably with wood casements in excluding weather. Unlike those made of wood, metal windows are not, of course, affected by atmospheric changes and consequently they do not jam (see p. 78), a defect common to certain wood casements due to swelling. Steel windows are very durable, especially if rust-proofed. The standard types are economical in price.

Perhaps the chief demerit of the standard steel window is its poor appearance, due to the small size of the frame and sash members. If, in order to counteract