INSTALLATION OF SUBSTATION SERVICES.

FIXING METHODS.

1. GENERAL.

1.1 It is not possible to cover all the various methods of fixing which will be met in practice, but this Instruction describes generally the conditions applying and gives details of the types of anchors stocked.

Whenever it is necessary to fix equipment to floors, walls or ceilings, the method used will depend on -

(i) The composition of the structure to which the equipment is to be fixed, and
(ii) The strain which will be imposed on the fixing device.

Care must be taken in selecting the most suitable method for a particular application because inefficient methods could cause damage to the apparatus or structure or both.

2. SURFACES.

2.1 The more common types of surface used for building construction are discussed below and the preferred methods for fixing apparatus to each type are mentioned -

(i) Woodwork. Timber construction simplifies the fixing procedure. Providing that the surface is strong enough to carry the load to be imposed, the fixing is done by using screws of suitable gauge and length for the apparatus to be fitted. Plywood panelling, in general, is not a suitable surface to attach any equipment heavier than a terminal block or sub-station protector unless a support (either vertical or horizontal) can be located. In certain cases, apparatus may be attached by using some of the specialised anchors described in later Paragraphs. In other cases it may be possible to fix a backboard on the other side of the panel, the fixing screws for the apparatus passing through the panel into the back-board.

(ii) Lath and Plaster. This type of construction is often used for walls and ceilings in older buildings but is not common for new structures. By using a small pricker or bradawl, it is possible to locate the laths to which apparatus may be screwed directly. Care must be taken, however, as between the studs these walls are somewhat flexible and any force applied will crack the plaster. On no account shall heavy equipment be attached so that it relies on the laths alone for support; instead a stud should be located into which main holding screws are driven. Steadying screws may then be driven into the surrounding laths. For heavy equipment, battens screwed to studs which are usually spaced at 18 inch intervals are required. Apparatus or backboards should be placed so that the pricker holes are covered.

(iii) Fibrous Plaster, etc. These surfaces comprise a range of materials which are generally unsuited for any anchoring methods except some special fitments. The range of these surfaces includes fibrous plaster (that is, hemp filled gypsum sheets), asbestos cement sheets, masonite, hardboard, caneite, and cement rendered expanded metal. In general, the most satisfactory fixing method for apparatus to be secured to these materials is to locate a stud by means of a bradawl in fibrous plaster or inspection for nail holes in the other substances and to fit a backboard to this stud. However, on masonite, hardboard or asbestos cement sheets. light equipment may be attached by special anchors such as toggle bolts, but because these surface materials are usually very brittle, care must be taken not to overload them by attaching too heavy a load, unless the main weight is taken by screwing into studs, which are usually spaced at 18 inch intervals.

(iv) Hollow Masonry. These surfaces are usually of terra cotta or breeze blocks and normal expansion anchors including wood plugs are not suitable. The most satisfactory fixing is the toggle bolt.

(v) Solid Masonry. The usual types of solid masonry surfaces are concrete, single and double brick and in some of the older structures, inner walls are composed of a rubble substance which is very loose once disturbed. In the latter case, because of the damage which may be caused, such surfaces should be regarded as unsuitable for holding apparatus and an alternative should be sought. If the subscriber insists on having the equipment attached to such walls, the Technician should ask the subscriber to sign a Form S.E. 80, relieving the Department of all responsibility for damaging the surface unless caused by careless workmanship.

Single brick walls are undesirable surfaces for the attachment of equipment and before proceeding with the work, the Technician should explain the situation and endeavour to obtain an alternative. Failing this, no work shall be carried out unless the subscriber signs Form S.E. 80 indemnifying the Department against damage caused by other than careless workmanship. In fixing anchors to single brick walls, either one of two approved methods may be used -

(a) Where the seams can be located, the mortar can be raked out and a lead anchor used. If the seams are too wide, wood plugs may be used, but their use is not favoured.

(b) Where the seams cannot be located, the face of the brick should be drilled by using a carbide tipped bit in an electric drill.

Because of the risk of damage, percussion type drills shall not be used for making holes for anchors in single brick walls. Double brick, concrete and other similar solid masonry structures are the usual types in large buildings and holes for anchors may be made by using the percussion or hammer-twist types of drill such as Rawl or Sebco, or rotary carbide tipped bits for use in electric hand drills. In depots where the volume of work warrants, it may be more economical to carry in a floating tool kit electrically driven hammers fitted with a chuck to take the hammer-twist drills.

3. TYPES OF ANCHOR.

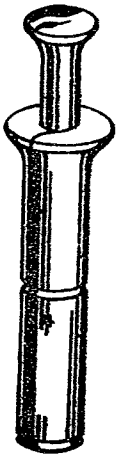
3.1 On wooden walls, etc., apparatus is fixed by wood screws directly into the surface. For other surfaces, a suitable anchor is necessary to provide a grip for the fixing screws. The following description covers the usual types of anchor available and lists their characteristics.

(i) Wood Plugs. This form of anchor is not desirable and shall only be used where the size or shape of the hole does not suit the more suitable forms of anchor available. The main objections are deterioration of efficiency in certain types of structure and unsightly appearance when the equipment is dismantled.

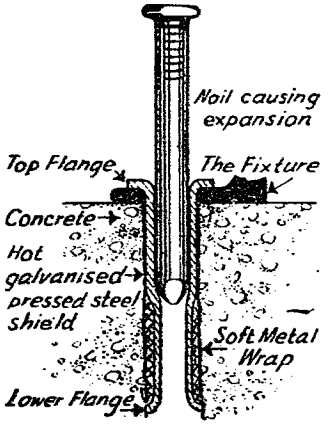
Wood plugs are prepared on the job from scraps of wood, preferably soft wood. They are shaped with a slight taper and made a little larger than the hole available so that they require firm blows to wedge them into the material. They should be somewhat longer than the depth of the hole and should be driven almost home, trimmed off with a hack-saw blade or pad saw about 3/16" from the wall surface and then carefully driven home flush. To provide a secure fixing, they must engage the solid brick or concrete for at least 1 inch irrespective of the thickness of any plaster coating. Care must be taken when sawing off the waste that the surface of the wall is not damaged by the teeth of the saw. To assist in starting the fixing screw, a hole should be made in the plug with a bradawl.

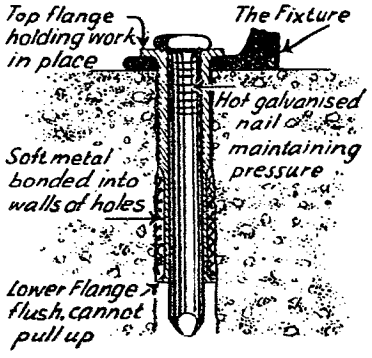
(ii) Metal Anchors. These are specially made anchors of varying types and sizes and they are most suitable for use in fixing telephone equipment. The following types are available -

(a) **DRYVIN.** This is a plated steel shield with a lead collar around the bottom which is reduced in diameter (see Fig. 1). It is hammered home through the hole in the article to be fixed and then the fixing is locked by driving in a special plated nail which expands the reduced portion into intimate contact with the wall material. The fixing, not the nail, holds the load. Dryvins are usually stocked in two sizes, 7/8" x 3/16" diameter and 1" x 1/4" diameter, respectively, and the safe working loads are 130 lb. and 200 lb. To be effective, the length chosen should be such that the outer end of the soft bonding metal will be located below the surface of the solid masonry (not the plaster coat), a distance equal to, or more than, the diameter of the shield. Dryvins are used for fixing conduit clips and saddles but they are not suitable for fitting equipment. Dryvins are usually supplied complete with fixing nails to suit the particular size and if other nails are used, care must be taken to select one of correct diameter and length. Nails which are too long for the depth of the drilled hole will force the fixing out.



(a) Dryvin.
(Nail and Shield.)



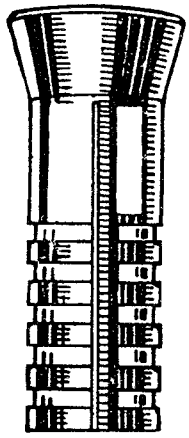


(b) The Shield Holds the Load.

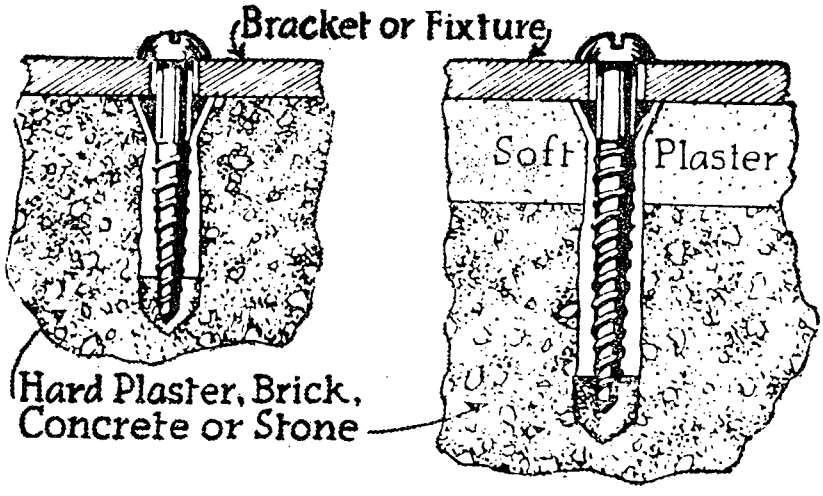
DRYVIN AND IT'S USE.

FIG. 1.

(b) **SCRUIN.** This is the most common of the metal anchors because it is suitable for fixing most of the equipment installed in substation work. It is made of a non-corrosive metal alloy shaped as shown in Fig. 2 and is expanded when the fixing screw is turned home. Scruins are placed in a hole deep enough to allow the bell shaped end to be flush with the surface and with a clearance at the bottom to allow the point of the screw to penetrate through (Fig. 2b). Scruins are usually stocked in two sizes 3/4" and 1-1/2". Both sizes are fitted in a hole 1/4" diameter and No. 8 wood screws long enough to completely open the full length of the anchor are used. The safe loading is 100 lb.



(a) Scruin.
(Lead Anchor.)



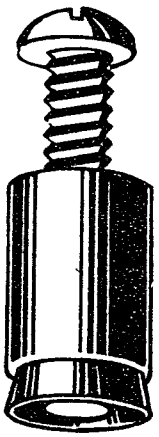
(b) Short Scruin for Direct Attachment.

(c) Long Scruin for Deep Anchorage.

SCRUIN AND IT'S USE.

FIG. 2.

(c) **TAMPIN.** This is a combination lead alloy sleeve and a threaded metal core, assembled in a compact unit and can be used in a shallow hole to obtain a fixing of great strength.



(a) Tampin.

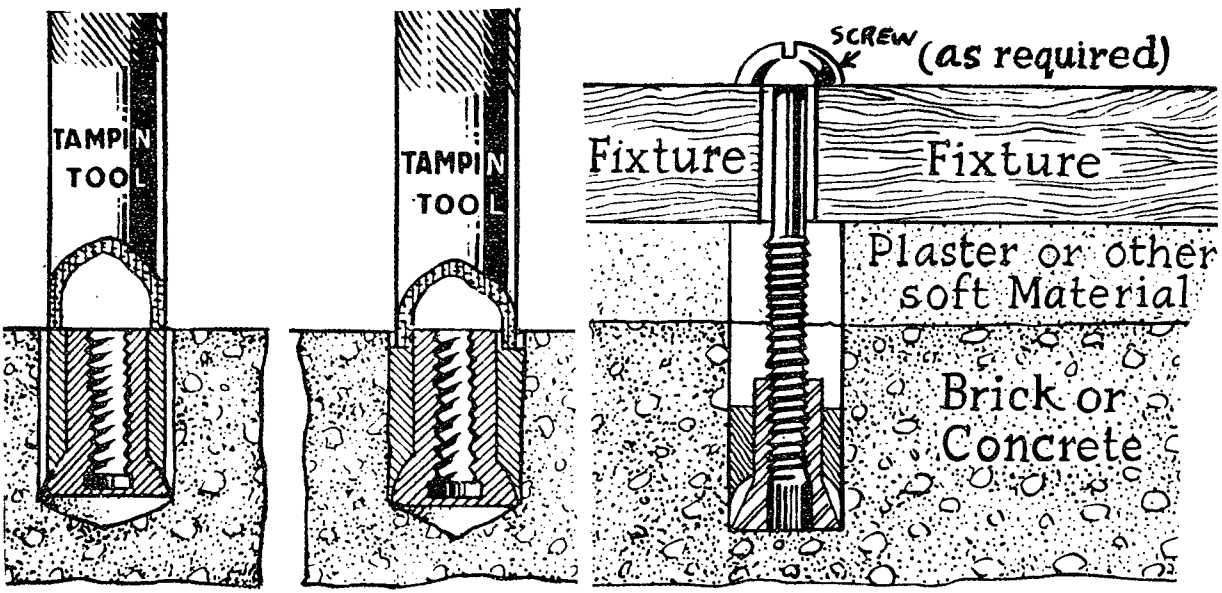
The treated core which takes a machine screw or bolt has two projecting fins which prevent it turning in the lead sleeve after the tampin has been tamped into position and the screw is being turned home.

The 1/4" size is stocked and the characteristics are as follows -

Hole required (hard masonry)	3/8" diameter x minimum of 5/8" deep exclusive of plaster.
Size of screw	1/4" diameter of suitable length.
Safe loading	400 lb.

They are installed by drilling the hole and inserting the tampin with the insert at the bottom of the hole. The anchor is then tamped (see Fig. 3b) with a special tool (supplied in each box) to swell the lead towards the base of the cone and into intimate contact with the masonry. The equipment to be fixed is then placed over the tampin and the machine screw inserted and tightened.

A deeper hole is required if the masonry is soft, otherwise the fitting may pull out a large section of the wall or ceiling, etc.



Before Expansion. After Expansion.

(b) Driving in Tampin.

(c) Using a Tampin Below Soft Surface.

TAMPIN AND IT'S USE.

FIG. 3.

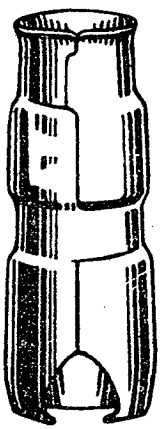
(d) **LOXIN.** This is an anchor for exceptionally heavy working loads. Fig. 4 shows the construction which consists of two steel halves with a tapered shaped nut at the base. Like the tampin, a metal thread screw or bolt is used which draws up the wedge shaped nuts forcing the sides of the loxin outwards.

They are usually stocked in two sizes which take 1/4" or 5/16" bolts, respectively, and Table 1 shows the characteristics -

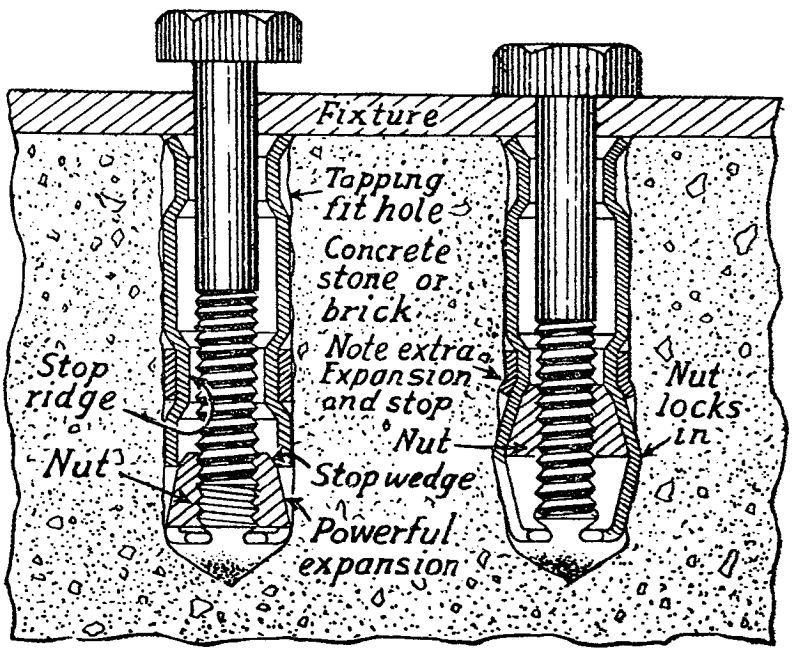
	1/4" Size	5/16" Size
Length of shield	1-1/4"	2"
Diameter of drill for hole	1/2"	5/8"
Safe working load	500 lb.	800 lb.

TABLE 1.

The hole should be slightly deeper than the length of the loxin and the length of the bolt required is the length of the loxin plus the thickness of the fixture. A long thread is necessary on the screw or bolt to ensure that the nut may be drawn up freely.



(a) Loxin.

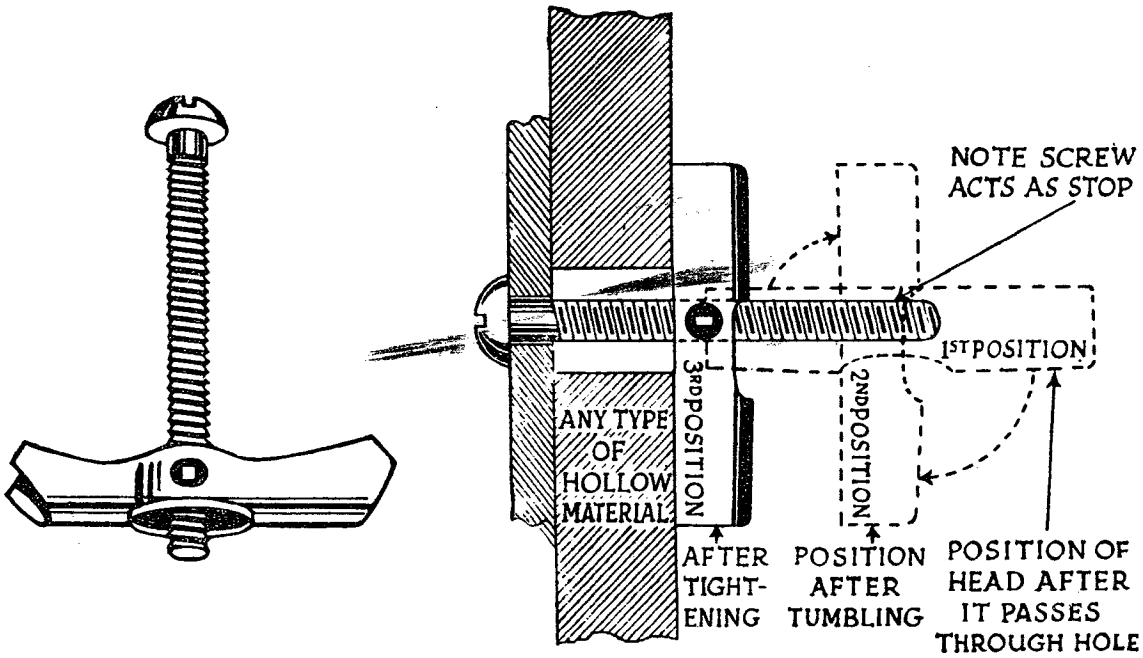


(b) How Loxin Works.

LOXIN AND IT'S USE.

FIG. 4.

(e) **TOGGLE BOLTS.** These anchors consist of a toggle head on a round head machine screw (see Fig. 5). The toggle head is off centre to enable it to fall into place quickly after passing into the hollow wall.



(a) Toggle Bolt. (b) Toggle Bolt in Use.

TOGGLE BOLT AND IT'S USE.

FIG. 5.

They are used to secure apparatus to surfaces composed of hollow bricks, lath and plaster, wall boards and plywood, asbestos cement and sheet metal, etc., that is, any comparatively thin material which will not hold the normal lead or wood anchor and which has a cavity which allows the toggle to function.

To fit apparatus by means of toggle bolts, a hole of suitable diameter is made in the particular surface. The toggle head is removed from the screw which is then passed through the fixing hole in the apparatus. The toggle head is then replaced on the screw for a short distance then folded back along the screw, as shown in Fig. 5b, and then inserted in the hole in the wall and the head allowed to drop into place by giving the bolt a slight jar. The screw is then tightened and if the toggle head is found to be turning, it may be held firm against the inside surface of the wall by tending to withdraw the screw as it is being tightened.

4. TYPES OF MASONRY DRILL.

4.1 Holes may be made in masonry by using one of the following types of drill –

Star Drill or Cold Chisel Hammer twist drills	} (Percussion Types)
Tungsten-Carbide tipped drills	(Rotary Type).

Star drills and cold chisels are mostly used for making large holes for cable runs or for drilling through very thick walls or floors. The hammer-twist and tungsten-carbide tipped drills are the usual types used for fixing equipment.

(i) Star Drills. These are usually made from hexagon tool steel with the cutting end dumped to increase the diameter and then fluted to permit the extraction of the particles of masonry ground off.

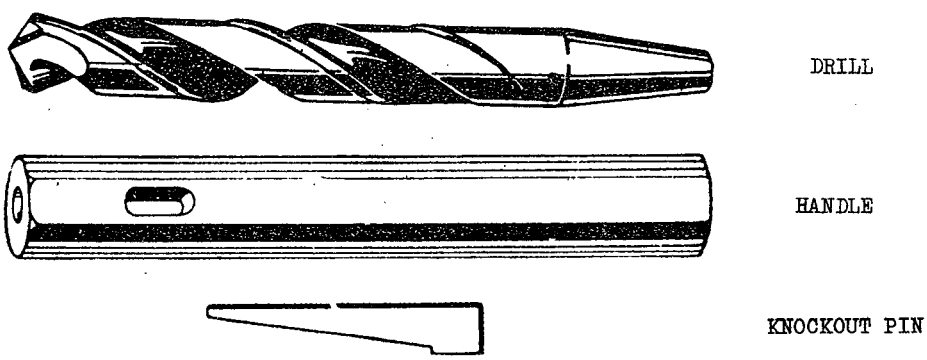
The cutting end is cross-shaped and edges are ground on the arms of the cross, as shown in Fig. 6.

STAR DRILL.

FIG. 6.

Star drills are made in various diameters and lengths.

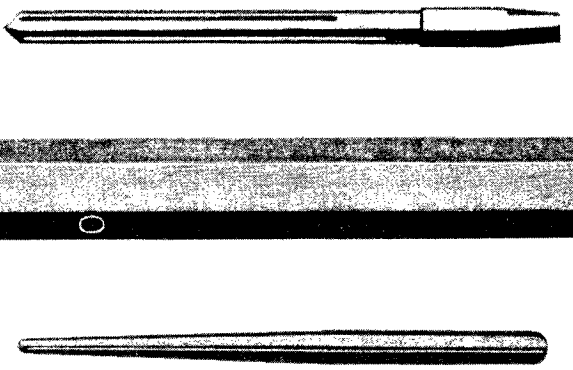
(ii) Hammer-Twist Drills. These consist of kits containing several sizes of drill, a holder which takes the hammer blows and an extraction pin to remove the drills from the handle after use. The bits are fluted to allow the waste to be extracted from the hole being drilled and the flutes may be either straight or twisted. (See Fig. 7.)



(a) Twisted Flutes.

HAMMER-TWIST DRILLS.

FIG. 7A.



(b) Straight Flutes.

HAMMER-TWIST DRILLS.

FIG. 7B.

The drill points are made in various sizes up to 5/8" diameter and are usually contained in a canvas roll. They are fast in action because of the shape of the points, but require care in use especially in the small sizes because the metal used is hard and the bits will break if the hammer blows are not made squarely on the end of the handle.

(iii) Tungsten-Carbide Tipped Drills. These bits consist of a shaft of tough metal which may be straight or fluted into which are brazed two cutting edges made of tungsten-carbide steel. They are rotary drills fitted into an electric drill in a similar manner to an ordinary metal drill and they are not designed to be used with a hammer. Because of the difficulty in fixing the cutting edges to the shaft of the drill, care must be taken in selecting a durable type to use. Fig. 8 shows a drill of this type.

TYPICAL TUNGSTEN-CARBIDE TIPPED DRILL.

FIG. 8.

(iv) Instructions will be issued detailing the procedure for sharpening drill points.

5. METHODS OF DRILLING.

(i) Percussion Type Drills. These drills are struck with a hammer and the blows cause the cutting edge to break away small fragments of the substance being drilled. This breaking of the material can be achieved with a reasonably light blow whereas a heavy blow will tend to force the cutting edge into cavities in the material and cause it to jam. Consequently, the correct method is to strike many light blows instead of fewer heavy ones. The use of a heavy hammer does not increase the drilling speed but tends to make the user tired by placing too much strain on the wrist and forearm. The handle of the drill should be lightly held, the blows light and fast and the drill rotated slightly between each blow to present a new face to the cutting edge. When drilling deep holes in floors, a small amount of water helps to keep the cutting edge cool and it makes the powdery dust adhere to the drill shank thus assisting in clearing the hole. Too much water will only splash the user as it is forced out at each hammer blow.

(ii) Tungsten-Carbide Tipped Drills. These drills are fitted into the chuck of an electric drill. The best results are obtained at the relatively slow speed of about 800 to 1,000 r.p.m. Care must be taken to avoid trying to feed the drill too fast, particularly for the smaller diameters, because rough handling will cause the tips to be torn away from the shank. The drill must not be allowed to get too hot during prolonged drilling and frequent dipping in cooling water may be necessary.

6. DRILLING IN SPECIAL MATERIALS.

(i) Tiles and Glazed Bricks. Before holes can be drilled in tiled or glazed brick surfaces, the glazed surface must be removed. This can be done with an old screwdriver, a broken three-cornered file or by very careful tapping of the drill. When drilling holes in tiles, very light blows should be used until the glazed surface of the tile is pierced because there are often hollow gaps in the mortar behind tiles and any heavy blows will shatter the tile. Where tiles are fixed to expanded metal, percussion type drills are not suitable and a rotary type must be used. Toggle bolts are used as the anchor in these cases.

(ii) Marble Slats, etc. These are most successfully drilled with rotary drills rather than the percussion type.

(iii) Glass. It is not expected that it will be necessary for Technicians to be called on to drill glass, but where this has to be done, the best tool to use is a twist drill rotated very slowly and lubricated with turpentine and paraffin. As considerable pressure is needed to keep the drill in the cut, it is essential to see that the glass is properly supported.

It is essential that, if Technicians are called on to drill the substances mentioned in this Paragraph, they advise the subscriber of the risks involved and complete a Form S.E. 80 to be signed by the subscriber.

END.