glazed bricks (see next column) are also used for internal walls of dairies, factories, lavatories, etc.

(b) *Bricks for Exterior Purposes.*—The essential requirements of facing bricks are durability, colour, texture and freedom from defects. Colour and texture are not important if the walls are to be rough-casted or plastered, good quality commons being sufficient for this purpose. They should have sufficient suction capacity to ensure the thorough adhesion of the mortar (see p. 14). The crushing strength is not material unless heavy loads have to be supported, as any durable brick will safely support the load which has to be normally resisted. Bricks to be used below the horizontal damp proof course should be carefully selected, as these are subjected to the greatest frost action (p. 15), and absorption of certain salts from the soil may cause deterioration if the bricks are not durable.

(c) *Bricks for Pressure-resisting Purposes.*—These are required for the construction of piers, large-spanned arches, etc., where large stresses have to be resisted. Strength is therefore the chief requirement, and engineering bricks (p. 17) which are very strong and hard burnt are most suited for this purpose.

(d) *Bricks for Fire-resisting Purposes.*—Those best suited to resist high temperatures, as for lining furnaces, chimney stacks, boilers, etc., are fireclay, silica, ganister, bauxite and magnesite bricks (see below).

The following is a summary of several types of bricks which have not been already described :—

Firebricks.—These are capable of resisting very high temperatures and are used for lining fireplaces, tall chimneys, furnaces, gas retorts, etc. They are made from (*a*) fireclay, (*b*) silica rocks and (*c*) silica rocks together with *ganister*.

(a) *Fireclay Bricks.*—Fireclays or refractory clays are associated with coalfields, and are usually obtained by mining as distinct from quarrying. They are found in many parts of this country. The clay contains from 55 to 75 per cent. silica and 22 to 35 per cent. alumina.

The fireclay is crushed and finely ground. Grog (finely ground burnt fireclay) is often mixed with the material to reduce shrinkage. The mixture is then soured to increase its workability (p. 4), moulded (pressed), dried and hard burnt for about seven days. The maximum temperature for firing first-class bricks should not be less than 1,500° C. The bricks are of a cream or buff colour.

(b) *Silica Bricks.*—These contain 95 to 97 per cent. of silica and 1 to 2 per cent. lime. The rock is crushed by heavy rollers, then ground in a pan mill in which the lime is added in correct proportion and in liquid form ; the lime acts as a binding material. Powerful presses are used to mould the bricks and the burning takes place in kilns of either the down-draught, chamber (similar to the zigzag) or tunnel type. Good silica bricks should resist a minimum temperature of 1,300° C. They are very brittle. Well-known silica bricks are produced in South Wales (from the Dinas rock, quarried near Swansea) and they are particularly suited for the lining of metallurgical furnaces and coke ovens.

(c) *Ganister Bricks.*—Ganister is a dark-coloured sandstone containing up to 10 per cent. of clay. It is quarried in this country (Sheffield being an important centre), Wales and Scotland. Their manufacture is similar to that of silica bricks. They are very refractory, as they are capable of withstanding a temperature of 1,800° C., and are therefore particularly suited for lining furnaces, etc.

Bauxite Bricks (made from an aluminous earth imported from France), Magnesite Bricks and Chromite Bricks (both also made from imported material) are other highly refractory products. They are used for lining special furnaces, such as steel and blast furnaces and cement kilns, and are generally gas-fired.

Rubbers or Cutters are soft red (chiefly), white or buff coloured bricks, consisting of washed loamy clay containing a large proportion of sand, and are usually hand-made in a box-mould (p. 4) and baked (not burnt) in a kiln. The colour is uniform throughout, and owing to their softness and fine-grained texture they are easily cut, rubbed and carved. They are used principally for gauged arches, decorated quoins and jambs.

Glazed Bricks.—Fireclays or shales are best for producing glazed bricks. As they are usually required to be built with joints not exceeding $\frac{1}{8}$-in. thick, they must be true to shape, with fine straight arrises. They are therefore carefully pressed and sometimes re-pressed, with the arrises hand-trimmed with a strike. Glazed bricks are impervious and are of two kinds, namely : (1) salt-glazed and (2) enamelled.

1. *Salt-glazed Bricks* are usually produced in a down-draught kiln.[1] Salt is thrown on to the fires of the kiln after the bricks have reached a temperature of about 1,200° C. The heat vaporizes the salt and causes it to combine with the clay to form a vitreous or glassy surface which cannot scale off. Usually two, and not more than three, charges of salt are applied at about twenty-minute intervals when the bricks have reached the required temperature, a shovelful of salt being thrown on to each fire. The colour of the glazed surfaces is a brown of various shades. Such bricks are used for internal dadoes, lavatories, basements, areas, large brick sewers, inspection chambers, etc.

2. *Enamelled Bricks.*—These are now obtainable in a large variety of colours. There are two methods of producing these, namely : (*a*) dry-dipped and (*b*) wet-dipped.

(a) *Dry-dipped Process.*—These enamelled bricks are called *biscuit-ware*. They are moulded, dried, burnt to a temperature of approximately 1,200° C. (this is called *biscuit-burning*), cooled, prepared for glazing, coloured, glazed and re-burnt. The colouring, glazing and preparation (called *bodying*) are done on a bench in a shed. At least three vessels containing liquid or *slurry* of varying consistency are placed on the bench. The first vessel contains the *slip* or *engobe* or *body*, and is a mixture of china clay (which is slightly plastic and found in Cornwall, Devon and Dorset), crushed burnt flint, ball clay (more plastic than china clay), etc., and water. The second tub contains a similar mixture with the addition of metallic oxides (such as those stated on p. 13) to give the required colour. The liquid in the third vessel is called the *glaze*, and this is a mixture of china clay, felspar (a silicate of alumina with varying proportions of sodium, potassium, etc.), whiting and water. The proportions of the ingredients vary considerably. More than one tub containing colouring bodies are sometimes required to give the desired colour, the ingredients and proportions being determined as a result of experience and exhaustive tests. The bricks are first washed, one stretcher or one header face (or both) being hand-brushed with water. Each brick is then separately treated, the washed face(s) being hand-dipped into the slip, then into the colouring solution and finally into the glaze. After the edges have been trimmed with a wire brush to remove the surplus glaze, the bricks are very carefully stacked in the kiln and burnt to fuse the glaze. Thus, these bricks are subjected to two separate burnings. Coal and gas are the fuels used, gas kilns being most successful for this class of bricks.

(b) *Wet-dipped Process.*—The slip, colouring solution and glaze are applied direct to the bricks immediately after they have been moulded and dried. They are afterwards very carefully burnt. Whilst this is a cheaper method than (*a*), only one burning being required, the results are not so good and there is a large proportion damaged during the handling operations. Such bricks are only suitable for inferior work.

Glazed bricks, especially biscuit-ware, are used for first-class faced work as required for factories, dairies, certain shops, abattoirs, corridors, dadoes of classrooms, lavatories, areas, wells of large buildings, external facings, etc. The surfaces can readily be washed down, and white glazed bricks are particularly effective in areas of buildings and in places where the maximum reflected light is required.

Perforated Bricks.—Perforated bricks, such as is shown at U, Fig. 5, are made by the wire-cut process (p. 3), the small holes of varying diameter ($\frac{3}{4}$ to $\frac{3}{8}$-in.) being formed as the clay column is extruded through the mouthpiece in which short horizontal bars are fixed. The advantages claimed for these bricks are : A saving

[1] Tunnel kilns are also used for this purpose.