in clay results, the drying and burning processes are facilitated, resulting in a reduction of fuel, they are light to handle (the perforations reducing the weight by about one-fifth) and because of this comparative lightness the cost of carriage is reduced. Several forms of perforated bricks are used in *reinforced brickwork* (see p. 45). Additional mortar may be required for the bed joints, especially if the holes are large.

AIR BRICKS.—If of standard size, the green bricks are machine-made in the usual manner (pressed or wire-cut), otherwise they are hand-made in a box-mould (p. 4). Each slab is then perforated thus: A templet of thin zinc, the size and shape of the bed and perforated as required, is placed on top of the slab (which usually has an oiled surface) laid on bed, fine sand is dusted over it, the templet is removed, leaving a light-coloured pattern of sandy squares on the surface. These serve as a guide for the moulder who takes a hollow steel tool, square in section and having sharp cutting edges, and presses it through the slab at each square of the pattern. The tool is withdrawn, and the clay within is removed by passing a solid metal rod down it. The section is similar to U, Fig. 32, Vol. I. Cheaper air bricks, having thin perforated panels, are stamped by a press.

HOLLOW, CELLULAR OR CAVITY BRICKS (see V and W, Fig. 5).—The cellular type has ¾ to 1-in. thick "walls" or "skins" with two or more "webs" or "diaphragms." They are light and are therefore suitable for partitions; their cavities also reduce the transmission of sound and heat. They are machine pressed, the plunger, having solid metal cores, forming the cavities as they descend. These bricks are sometimes glazed and are often made of fireclay.

HOLLOW BLOCKS (see Y, Fig. 5).—These are used in the construction of partitions. Somewhat similar blocks are employed in the construction of fire-resisting floors.[1]

They are usually made of fireclays or shales by the wire-cut process (p. 3). The shape of the blocks depends upon the special provision made in the mouthpiece of the auger, and there are several patent devices for forming the hollows. One of the simplest consists of a strong thin metal frame which projects into the die from the front and two solid horizontal metal cores or bars which are secured to it. As the clay is pushed through the die, the cores produce two voids in the extruded column. At the same time any grooves in the sides are formed by projecting ribs on the sides of the die. The extruded column is passed to the cutting table, the frame being pivoted to cause the wires to cut it into the required lengths by a downward movement.

Some hollow blocks are solid-ended. One device fixed in the die to produce such blocks consists of a square shutter (the size of the cross-section of the void) which is fitted to the top and caused to descend and rise automatically at required intervals. When the shutter is down it occupies a central position in the die, and this produces the hollow portion of the column as it proceeds. When the shutter rises clear of the die, the section of the moving clay band is solid. Thus a column is produced which is hollow, having solid partitions at intervals, the thickness of the latter being equal to twice the finished thickness of an end. The column is then cut at the table, the wires being drawn centrally down through these solid portions. Drying and burning complete the process.

PAVINGS are very hard-wearing bricks used, as implied, for paving roads and paths. They are sometimes salt-glazed, each with one face roughened or chequered to increase the foothold. They are laid on edge on a concrete bed with a ½-in. bed joint of cement and sand (1 : 2) and the vertical joints, $\frac{1}{2}$-in. thick, are grouted with cement and sand (1 : 1½). These bricks are now very rarely used.

ENGINEERING BRICKS.—These are exceptionally strong and durable, and are used for piers, bridges, sewers and similar engineering purposes. Those most noteworthy are Accringtons (pressed), Southwaters (pressed and wire-cuts), blue Staffordshires (wire-cuts and hand-made) and Hunzikers (made of crushed flint and lime).

SAND-LIME BRICKS.—These are of the same size as ordinary clay bricks and are made of a mixture of sand, lime and water which is pressed into moulds and hardened. Their colour is grey or a dull white, although oxide pigments may be added to give other colours. The sand should be clean and well graded, and the normal proportion used varies from 92 to 95 per cent. of the dry mix. The 5 to 8 per cent. of lime which is mixed with the sand may be of any class, provided it can be thoroughly well slaked. It must be properly burnt (see p. 19) as overburnt lime does not readily slake and underburnt lime has a high calcium carbonate content which is valueless. The slaking or hydration must be complete before the mixture is pressed.

There are three stages in their production, namely: (*a*) mixing, (*b*) pressing and (*c*) hardening.

(a) *Mixing*.—The burnt lime (quicklime) is finely ground in a ball mill (p. 22) and passed through a sieve to eliminate coarse-grained particles. This is mixed with sand in the correct proportion in an edge-runner (p. 2) and slightly more than the required amount of water added to slake the lime. The mixture is passed to a hopper or silo and left for a variable period (generally twenty-four hours) to ensure thorough hydration.

(b) *Pressing*.—The rotary table type of press (p. 3) is generally used, a measured quantity of the material being fed, pressed into a slab and removed. The pressure varies with the water content and must be sufficient to enable the bricks to be handled without damage.

(c) *Hardening or Autoclaving*.—A "kiln" in which the bricks are hardened is a 5½ to 7-ft. diameter steel cylinder, varying from 30 to 70-ft. long, and is called an *autoclave*. The pressed bricks are stacked on cars (similar to those used in tunnel kilns, see p. 10), each truck taking up to 1,500 bricks. The loaded cars are run into the autoclave, the tight-fitting doors are closed, steam is admitted and the pressure gradually increased. The maximum steam pressure varies with the length of time at which it is steadily maintained, the greater the pressure the shorter the time of autoclaving; thus, if a steady pressure of 120-lb. per sq. in. is applied, the period varies from eight to twelve hours, whilst this time may be halved if the pressure is increased to 200-lb. per sq. in. After steaming for the required period the supply of steam is shut off and the bricks allowed to cool by opening a valve. The loaded cars are then removed.

Sand-lime bricks are of uniform colour, texture, size and shape, with sharp square arrises. Their fine texture renders them suitable for carving, and figures carved *in situ* on the brickwork have successfully relieved the somewhat monotonous appearance of large uniformly coloured surfaces.

Although these bricks have not been subjected to prolonged tests, it is considered that those of best quality compare favourably with good quality common bricks as regards compression strength and durability. They are only moderately resistant to frost action and are therefore not suitable for brickwork below ground in water-logged sites. They have been used successfully as a cheap substitute for white glazed bricks in wells of buildings and similar positions where maximum light is required.

CEMENT AND CONCRETE BRICKS.—Portland cement is used to a relatively small extent in the making of bricks. Sand as a fine aggregate is added to the cement in varying proportions, suitable mixes being 1 part cement to 6 or 8 parts graded sand. The materials are well mixed in a machine, just sufficient water being added to ensure adhesion. The mixture is then pressed in moulds or in a rotary table machine, removed and dried slowly for at least a fortnight (preferably a month) before being used. The bricks are covered with damp cloths during the maturing period. Rapid-hardening cement (p. 24) in lieu of ordinary Portland cement expedites the setting period.

CONCRETE BLOCKS of various sizes and mixes are also made, the aggregates being sand, broken brick, broken stone, gravel, coke breeze, etc. (see p. 28).

Cement and concrete bricks or blocks have not become popular in this country, chiefly on account of their dull, uninteresting appearance, although concrete slabs are often employed in the construction of internal partitions, (p. 45, Vol. III).

BREEZE SLABS of various sizes (usually 2 to 2½-in. thick) and consisting of 1 part cement to 6 or 8 parts powdered breeze have been extensively used for partitions in positions where loads have not to be supported (p. 15). These are cast in wood moulds. Cavity walls (p. 40) are sometimes constructed of breeze slabs which are approximately 3-ft. by 1-ft. by 2½-in. thick, placed on edge between reinforced concrete pillars.

SPECIAL SHAPED BRICKS.—A selection of special shaped bricks, most of which are standard, is shown in Fig. 5. They are kept in stock by the larger brick

[1] Detailed in Vol. IV.