

The hack-ground is level and well drained. There is a space of about 9-in. between each *line* or *blade* of bricks forming a hack; the bricks are placed on edge at $\frac{1}{2}$ -in. intervals to a height of from five to eight courses, the bricks in one course bridging the spaces between those in the course below. One course, which may be 200-ft. or more in length, is completed first to allow the bricks to stiffen before the next course is laid. The hacks are spaced at about 3-yds. apart and should run in a north-south direction so that both sides will be exposed to the sun. The bottom course is placed on planks or hollow rectangular tiles or 2-in. thick layers of sand, breeze, etc. As a temporary protection the top of each hack is covered with a series of portable light wood "caps" which are about 6-ft. long with sloping sides in the form of a roof. The sides are also protected by hurdles or screens called *loo-boards*; these are about 6-ft. long and 3-ft. high. This temporary protection is removed during favourable weather, but the hacks should be covered immediately when necessary, otherwise much damage to the bricks may be caused. The bricks are *scintled* when half dry, *i.e.*, they are set diagonally with a 2-in. space between each and with alternate courses reversed.

As bricks containing moisture are readily damaged by frost, hack-drying can only be carried out during six months of the year, from April to September inclusive. The process is extremely slow, the bricks taking from three to six weeks to dry, depending upon the weather and the nature of the clay.

4. BURNING.—This is the final process in brick manufacture. Permanent kilns are chiefly used for burning bricks, although clamp-burning (see p. 11) is still adopted in certain parts of the country. Kilns may be classified into (a) intermittent, (b) continuous and (c) tunnel.

(a) *Intermittent, or Periodic or Single Kilns.*—These are permanent structures and may be divided into (i) down-draught, (ii) horizontal draught and (iii) up-draught kilns, according to the direction of the fire.

(i) *Down-draught Kiln.*—This is the most efficient form of intermittent kiln, and it is the only type adopted to any extent in this country. Even in works having large outputs, it is not unusual to find that the common bricks and certain facings are burnt in a continuous kiln (see next column), whilst best class sand facings and blue bricks are burnt in a down-draught kiln, as the heat which influences the colour can be better controlled in the latter.

The section of a down-draught kiln is shown at T, Fig. 3. That adopted for bricks is usually rectangular, although circular kilns for ware goods (see Chapter Two) are common. The capacity varies from 20,000 to 40,000 bricks. The rectangular chamber has four walls and an arched top which incorporates a heat-insulating ring composed of porous bricks (probably made of a fossil earth known as *kieselguhr*); this reduces the amount of heat transmitted through the structure and thus effects a saving in fuel. The kiln is lined with fire-bricks. Fireboxes are formed at intervals, and a special feature is the continuous screen wall, called a *flash-wall* or *bag-wall*, constructed parallel to and about 9-in. from the inside of each long wall. The heat from the fuel (which is usually small coal called *slack*) thus passes upwards to the arch, which deflects it down through the openly stacked green bricks (see p. 7), the gases escaping through perforations in the floor to a horizontal flue connected to a tall chimney. The screen walls are perforated at intervals near the bottom to allow sufficient heat to pass direct to the lower portion of the stack during the drying process. An opening or *wicket* is provided at one end through which the kiln is filled

and emptied. This is bricked up with a temporary wall after the green bricks have been set, and the outside of this wall is luted with clay.

Glazed bricks and certain red bricks (in addition to terra-cotta, etc.) must not be exposed to the direct flames from the fires, otherwise they would be damaged by the gases, dust, etc. Such bricks are heated in *muffle kilns*. This type of kiln consists of an outer rectangular chamber and an inner compartment. A simple form has a fireplace at one end of the chamber and a horizontal main flue, extending the full length, at the floor level. Cross walls at intervals are arched over this flue and these support the inner shell comprising firebrick bottom, sides, top and one end. There is a space between the inner shell and outer structure so that hot gases from the fire can completely traverse it before escaping through openings in the outer roof into an upper horizontal flue extending the full length. The bricks are stacked in the inner compartment and the open end is built-up and daubed with clay. Thus, these bricks are heated entirely by the heat transmitted through and radiated from the firebrick shell.

Sometimes six or more down-draught chambers are constructed to form what is known as a *semi-continuous kiln*. This type provides for the waste heat from one chamber being utilized to dry and heat the bricks in others. Thus, after chamber 1 and 2 have been loaded and the fire in No. 1 lighted, the heat not required passes through holes in the floor of No. 1 chamber, along a flue to an opening (controlled by a damper) in the division wall and over a flash wall into No. 2 chamber, where it circulates round the green bricks before entering the main flue to the chimney. The fire in chamber 2 is maintained, chamber 3 is loaded and the bricks in the latter are gradually heated by the waste gases from No. 2. Each chamber is progressively heated in this manner until the final one is reached. An economy in fuel thus results.

(ii) *Horizontal Draught or Newcastle Kiln.*—Comparatively few of these are now in operation, it having been gradually replaced by the continuous type of kiln. It is a rectangular building with an arched top, and is approximately 15-ft. wide and more than 30-ft. long. The fireplaces are arranged at one end, together with a perforated flash-wall, and a chimney is provided at the opposite end. The gases traverse horizontally and pass into the chimney at the floor level. A wicket in one or both long walls is formed to permit of loading and unloading.

(iii) *Up-draught or Scotch or Score Kiln.*—This is the most primitive form and is now almost obsolete. It is rectangular on plan, having three permanent brick walls and a temporary end wall; there is no roof, the top being open. The size is roughly 25-ft. by 16-ft. by 10-ft. high. Fire-openings are provided at intervals in the side walls at the ground level. Coal fires are gradually applied after the kiln has been loaded, and when the bricks are dry the top is closely covered with old bricks; the temporary end wall are daubed with clay paste. Hot fires are now maintained for two or three days, after which they are damped down and the bricks are allowed to cool. The heat is irregular and consequently there is a large proportion of over-burnt bricks at the bottom and under-fired bricks at the top.

Intermittent kilns are not economical, as the walls have to be heated up at each setting of the kiln, and this results in a heavy fuel consumption.

(b) *Continuous Kilns.*—This type, evolved from the intermittent and semi-continuous kilns, is most suitable for large and regular outputs. It is so called because the operations are uninterrupted, each chamber in turn being loaded, dried, burnt, cooled and emptied, and the waste heat is utilized to dry and pre-heat the green bricks. The kiln is thus economical in fuel consumption.

The structure consists of walls of ordinary brickwork, lined with firebricks jointed with refractory cement, the top is generally arched and lined with purpose-made firebricks, and the floor is usually constructed of hard bricks bedded on sand or concrete. The kiln is divided into compartments of