it enters the kiln and the larger particles continue to burn as they pass down the spaces between the stacks to the base. The air for combustion, drawn in through the exit by means of a fan, is pre-heated as it passes through the cooling zone, and the temperature, which increases as the draught of air proceeds through the firing zone, is gradually reduced as it traverses over the bricks in the pre-heating zone. The combustion is so complete that little smoke escapes at the fan outlet, and a chimney stack is therefore not required. At the exit end of the cooling zone a vertical air flue is provided which is connected to a horizontal flue that is continued over the arch of the cooling zone, along each side of the firing zone (see B) and over the pre-heating zone arch to a fan which delivers the hot air to the brick drier. Scumming of the bricks is avoided by the provision of a number of waste gas flues at the front end of the pre-heating zone which are connected to a common flue controlled by an extraction fan to withdraw the gases. A sand seal is provided at each side of the kiln throughout its length; these consist of metal channels containing sand through which pass the lower edges of the metal plates fixed at the sides of the cars. The seals prevent loss of draught and protect the wheels and axles of the cars.

The cars are caused to travel on a track for the full length of the kiln by means of a powerful hydraulic ram. The movement is intermittent, the cars being pushed forward at regular intervals to the extent of one-third the length of the car or the equivalent of a stack and one space. This distance is maintained uniformly so as to ensure that the spaces (called *combustion chambers*) between the brick stacks are immediately under the feed-holes. As these spaces extend the full width and height of the stacks, a uniform temperature throughout is ensured and this results in the bricks being uniformly burnt. It takes from two to three minutes to move the load, and the interval between each movement varies from thirty to fifty minutes according to the output required. The rate of travel varies, but for a 300-ft. kiln, the time taken between a car entering and leaving the kiln is approximately three days and the weekly output is about 160,000 bricks. The working of the kiln is very flexible as it can be readily speeded up or slowed down as occasion demands by regulating the rate of travel and the amount of coal supplied by the mechanical feeders. As each car of finished bricks emerges from the kiln, another car of green bricks enters the charging end.

The advantages claimed for the tunnel kiln are: (1) The bricks are evenly burnt, and it is therefore particularly suited for the production of first-class facings; (2) the output is regular and only a small percentage of bricks are damaged in the process; (3) low maintenance costs; (4) flexibility of working; and (5) on account of the complete combustion which results, there is no smoke nuisance and the conditions of employment are improved, as the kiln is not entered to load and unload the bricks.

The disadvantages of this type of kiln are: (1) The relatively high initial cost, and (2) the additional cost of providing power for the ram, fans, etc.

Temperature Control in Kilns.—The temperature in kilns in which first-class facings are produced is sometimes controlled by the use of either *Segar cones* or a *pyrometer*.

Segar cones are small L-shaped pieces made from special clays, having a flat base with a vertical leg, and are tested to bend at certain temperatures. Thus, a "No. 022 cone" will bend (*i.e.*, the leg will gradually collapse until the top touches the base) when subjected to a temperature of 600° C., whilst a "No. 10 cone" will do likewise at 1,300° C. Generally three cones of the desired "temperature resistance" are placed in different parts of the kiln, and in positions in which they will be seen through spy-holes in the walls. Firing ceases when the required temperature in the kiln has been reached, indicated by the bending of the cones.

Electric pyrometers are usually used in gas-fired kilns. Such consists of an electrical conductor (containing a coil of platinum wound round a strip of mica) which is exposed to the heat. This is connected by leads to an electrical system which automatically records temperature movement on a chart, and the rate of firing in the kiln is regulated according to the readings.

Clamps.—A clamp simply consists of a large mass of green bricks stacked, with several intermediate layers of breeze (cinders) as described below, upon a foundation of old bricks. It has neither walls nor roof. Clamp-burning preceded kiln-burning, and it is still adopted in certain parts of the country, particularly in Kent and Essex, where *London stocks* are made. Clamps are also occasionally used at works to provide temporary additional means of burning when the output of the permanent kilns is insufficient to meet heavy demands. The bricks are not uniformly burnt, and whilst a large proportion is satisfactory, those on the outside are underburnt, and those near the *live holes* (see below) and in the heart of the kiln are mis-shapen and cracked owing to the excessive heat.

A clamp is constructed in the following manner: The ground, which should be well drained, is paved with a layer of old bricks, placed on edge. The size of this paving is from 40 to 50-ft. square, although this varies. This paving is slightly dished, rising slightly from the centre to the edges, to prevent the stacked bricks when being burnt from falling outwards. The clamp is built with a series of 3-brick thick walls (called *necks*), and the construction may be commenced either (*a*) at one end or (*b*) down the middle.

(a) *End Clamping*.—The end wall, known as the *upright*, extends the full width of the clamp. It is about 4-ft. 6-in. thick at the base, and is formed with a vertical face internally and a battered face externally. The bottom course consists of old burnt bricks laid scintled (diagonally) on edge with 2-in. spaces between. The second course is also formed of burnt bricks laid on edge, but these are spaced as stretchers. Breeze and coal slack is placed in the spaces between the bricks, and the top is covered with a 6 or 7-in. layer of breeze. The first course of green bricks is laid as headers on top of this layer, the bricks being placed on edge and closely spaced. This is covered with a 4-in. layer of breeze, followed by the second course of raw bricks (stretchers) placed on edge, with a slight space between each. This course is given a 2-in. covering of breeze. The remainder of the wall is formed of alternate courses of headers and stretchers of raw bricks, placed on edge, slightly spaced and with a thin sprinkling of breeze between each course. The number of courses of green bricks is approximately thirty. A 3 to 6-in. layer of breeze is spread over the top course of raw bricks, and this is covered by a course of old bricks, closely set on edge, with the joints luted with clay.

The rest of the clamp is constructed with a series of parallel 3-brick thick walls or "necks," extending its full width, until the opposite end is reached, when an "upright" is built similar to the first with an external batter. These necks are formed exactly like the uprights, having alternate header and stretcher courses of green bricks on a double course of old bricks at the base, layers of breeze and a daubed hard brick finish. The breeze layers are continuous, and the bricks are so arranged that a stretcher course in one neck is opposite header courses in adjacent necks.

In the middle of each end neck a continuous horizontal flue (called a *live hole*) is formed between the double course of burnt bricks forming the base. It is formed by leaving a 9-in. wide space whilst constructing the base. Similar flues (which are 9-in. high) are constructed along the centre of every seventh or eighth neck. Dry brushwood is placed in these flues and this is covered by the 6-in. layer of breeze.

(b) *Middle Clamping*.—In this system the upright is constructed down the centre to the full extent of the clamp. It is built in a similar manner to the end uprights described above, except that it has a batter on each face, and a 9-in. by 9-in. horizontal flue is formed in the middle of the base for its entire length. The necks are formed on either side of the upright and with the faces parallel to the batter. Three transverse horizontal flues (one in the centre and one at about 7-ft. from each end) are formed in the base whilst the necks are being built, and these are connected to the central live hole. These cross flues are filled with brushwood.

It is usual to construct a wall of old bricks on each face of the clamp and extending the full height. This is 9-in. thick at the base and 3-in. at the top. These walls are daubed over with clay, except where holes have been left for the admission of air.

The clamp is fired by lighting the brushwood in the flues. Gradually the breeze