

common to both chambers 7 and 8; this is in order to simplify the kiln. The chamber flues are connected to two main flues which lead to a chimney (40-ft. high and 4-ft. internal diameter) conveniently near.

To fire this kiln for the first time, six or seven chambers are set with green bricks and each section is separated by being papered off. Thin brown paper, obtained in rolls, is usually used for this purpose, and this is pasted over (liquid clay, called *slip*, being used as an adhesive) the last completed end face of stacked bricks. The wickets in these chambers, 2 to 7 inclusive, are bricked up with temporary walls, and a small fireplace is prepared in each. A temporary brick wall, shown at H on plan C, is built, and this is prepared with four fireplaces. Fires are lit in these fireplaces and the heat is steadily applied to the bricks in chamber 2. The damper controlling this section is open to allow the steam and gases to escape. When the temporary wall at H gets too hot to the hand, the paper partition separating chambers 2 and 3 will have burnt away. No. 2 damper is then closed and No. 3 damper is opened, thus allowing the heat to pass through chamber 2 to chamber 3, and hence into the main flue to the chimney. This is repeated until three or four chambers are red hot. Coal is then passed through the feed-holes and down the 5-in. square fire columns (see p. 7). Meanwhile further chambers will have been set with green bricks until all of the chambers, excepting No. 1, are filled. The open fires in the temporary wall at H and those in the wickets are maintained until a sufficient body of heat has been built up to light and support combustion of coal fed from the top. The open fires are then stopped in rotation, chamber 1 is set and papered over as described above, and the bricks in chamber 2 are removed. The kiln is now prepared for normal working, when one chamber is emptied and another is filled daily.

After the whole of the chambers have been fired, the following is a normal daily schedule for this kiln, assuming that the direction of the fire is clockwise as shown by the arrow, and that chamber 3 is being unloaded:—

Chamber.	Bricks.		Chamber.	Bricks.	
1	Drying	Temperature. 25° C. (min.)	10	Heating	700° C. to 120° C.
2	Being set	Cool	11	Heating	
3	Being drawn	Cool or cold	12	Heating	
4	Cooling	50° C. to 1,000° C.	13	Heating	
5	Cooling		14	Drying	120° C. (max.)
6	Cooling	1,100° C. (max.)	Wickets 2 and 3 are open, remainder are built up.		
7	Cooling		Damper 1 is open, rest are closed.		
8	Firing		Paper partition pasted on bricks stacked in chamber 1 on face adjoining chamber 2.		
9	Firing	700° C. (min.)			

The cold air entering wickets 2 and 3, whilst cooling the bricks, gradually increases in temperature, especially when it traverses those in chamber 7 which had been subjected to the maximum temperature the previous day. This supplies the primary heat to burn the coal, which is fed in small quantities every fifteen minutes from the top of chambers 8 and 9. As the hot air proceeds on

its travel, it pre-heats the bricks in chambers 10, 11, 12 and 13, and dries and steams those in chambers 14 and 1 before escaping down the branch flue No. 1.

This being a continuous process the operations are maintained in this sequence, but are advanced by one chamber daily. Thus, on the following day chamber 3 is filled and chamber 4 is emptied.

As the whole of the waste heat is utilized to dry the bricks in this kiln, and as that from the firing chambers may cause discoloration (see p. 14), it follows that the kiln is best suited for the manufacture of common bricks, for which purpose it is most economical. The provision of hot air flues (see below) is necessary for the production of good-coloured bricks.

During slack periods, when the output from half the kiln would be sufficient to meet the demand, it may be used intermittently as follows: Four small fireplaces are constructed in the external end wall of chamber 1, the two openings between chambers 1 and 14 and 7 and 8 are built up temporarily, and the chambers 1 to 7 inclusive are filled with green bricks. Fires in the end fireplaces are maintained until there is sufficient heat to fire coal fed through the feed-holes. Top feeding of the chambers is continued until the bricks are thoroughly burnt, when the half kiln is emptied and re-set.

ZIGZAG KILN (see J, K, L and M, Fig. 3).—This is one type of Zigzag kiln<sup>1</sup> which is divided by permanent walls into fourteen chambers. The fire is drawn in a zigzag direction owing to the position of the openings in the division walls being staggered, causing it to traverse each chamber diagonally.

Each chamber has a transverse *downcast flue* under the floor which is connected to the *main or smoke flue* and controlled by a damper from the outside. There is, in addition, a *hot air flue* immediately over the main flue and extending the full length of the kiln. When required, each chamber is connected to this hot air flue by raising the damper controlled from the top of the kiln (see K and dampers 1, 14, 2, etc., at M). As mentioned on pp. 7 and 14, hot gases from the firing chambers must not be used to dry bricks if scumming is to be avoided, and only hot gases from the *cooling* chambers should be admitted for this purpose. Hence the necessity for the hot air flue. In addition to the downcast flue and hot air flue dampers, each chamber has a third or main flue damper immediately over the crown of the smoke flue and controlled from the top of the kiln (see K and dampers 10, 5, 9, etc., at M). These together with the downcast flue dampers, are opened wholly or partially as required in the drying chambers for the rapid removal of the steam.

The process is continuous, at least one chamber being loaded and one unloaded daily. The daily schedule of the operations varies according to the nature of the clay, quality of bricks, draught (velocity of the air created by the chimney or fan), length of fire circuit, etc.

The Zigzag is exceptionally efficient for the following reasons: (1) It can be effectively controlled; (2) it produces bricks of first quality, comparatively free from undesirable discoloration and other imperfections enumerated on pp. 13 and 14; and (3) the fuel consumption is relatively low.

HABLA KILN.—This has several features which resemble the Zigzag kiln. The plan is similar in that the *trace holes* (openings in the partitions) are staggered, causing the fire to take a zigzag course, but these partitions, instead of being permanent as in the Zigzag kiln, consist of dried bricks (without mortar) and are therefore temporary.

For the production of common bricks the kiln has not a permanent top, and is therefore classified as of the "archless" type. After the loading chamber has been set, it is covered with either two courses of bricks laid close together with a layer of sand or ashes on top, or concrete slabs with metal trays containing kieselguhr, a light porous earth which serves as a heat insulating material. The kiln is fired by pulverized

<sup>1</sup> From details supplied by Messrs John Jones & Sons, Buckley, Chester.