controlled conditions. The timber is stacked in a kiln, of which there are several types, and air, heated to the desired temperature and containing a certain amount of moisture, is circulated through the piles. The air is heated by being passed over steam pipes. This hot air, which accelerates the evaporation of moisture from the timber, must contain a certain amount of moisture, otherwise splitting and case-hardening of the wood will result owing to the rapid drying or baking of the surface before the removal of the requisite amount of moisture from the interior. The necessary humidity of the air is obtained by the admission of steam in the form of a spray, and this must be regulated carefully. Adequate circulation of the air is essential, as stagnant air would take up moisture from the timber and gradually become incapable of reducing the m.c. sufficiently Hence the air should be of uniform and sufficient velocity ; fresh air must be admitted, and saturated or exhaust air must be removed as required.

Kilns are classified into (*a*) those in which the air is circulated by mechanical means, such as fans, and known as *Forced Draught Kilns*, and (*b*) *Natural Draught Kilns* in which the circulation of the air is due to differences of temperature which cause the warmer and lighter air to rise and colder and denser air to fall.

(a) *Forced Draught Kilns* include (i) External Fan Compartment Kilns, (ii) Overhead Internal Fan Compartment Kilns and (iii) Tunnel or Progressive Kilns.

(a) (i) *External Fan Compartment Kiln.*—This is illustrated and briefly described in Fig. 3. The timber is piled as shown, the layers being separated by piling sticks, which are from 1 to 1½-in. thick and spaced at from 1 to 3-ft. apart, according to the thickness of the timber ; these sticks must be in true vertical alignment, especially if the timber consists of thin boards, otherwise the latter may become distorted. The piles are shown built up on bearers placed on the floor. Alternatively, the timber may be piled on trucks ; this is economical, as the piling is done outside the kiln and therefore little time is wasted between the removal of the trucks of dried timber and the charging of the kiln with trucks of unseasoned stuff. It is desirable to leave a 2 to 3-in. space between adjacent pieces of timber if it is thick, otherwise the boards are placed with their edges close together. The face of a pile over the inlet duct is usually inclined as shown at A, as this assists in distributing the warm air throughout the pile. The width of the piles should not exceed 6-ft. ; wider stacks make uniform drying difficult. As shown, the air is heated by steam pipes, humidified by sprays and circulated in the direction of the arrows by a fan situated outside the kiln. One difficulty is that of securing uniform circulation along the length of the kiln ; short-circuiting at the end nearest the fan is prevented by the provision of baffles along the air-inlet duct and the adjustment of the dampers at the openings in the inlet and return ducts. This is a very good type of kiln for general work.

Careful adjustment of the temperature and humidity of the air in the kiln must be made and the moisture content of the stacked timber taken at intervals during the drying process. This m.c. is determined by testing one or two representative sample boards, which are about 6-ft. long. The procedure is as follows : A small test piece is cut from a sample board and its m.c. calculated by using either the formula (*a*) or (*b*) as explained on p. 7. The m.c. of the test piece is assumed to be that of the board. The wet weight of the sample board (less the test piece) is taken at the same time and its dry weight calculated. Thus, taking the example given on p. 7 (where the m.c. of the test piece is 40 per cent.), and assuming the wet weight of the sample board is 10·5-lb., then the dry weight of the board is found from the formula (*b*), *i.e.*,

$$\text{m.c.} = \left(\frac{\text{wet weight}}{\text{dry weight}} - 1\right)100.$$

Therefore,
$$\text{dry weight} = \frac{\text{wet weight}}{\frac{\text{m.c.}}{100} + 1} = \frac{10{\cdot}5}{1{\cdot}40} = 7{\cdot}5\text{-lb.}$$

This dry weight is, of course, constant. The m.c. of this sample can now be determined at any time during the drying operation. For example, if seasoning has been in operation some time and the sample board is removed from the pile and re-weighed,

$$\text{the current m.c.} = \left(\frac{\text{current weight}}{\text{dry weight}} - 1\right)100.$$

Thus, if the current weight is 9¾-lb., the

$$\text{m.c.} = \left(\frac{9{\cdot}75}{7{\cdot}5} - 1\right)100$$
$$= 0{\cdot}3 \times 100 = 30 \text{ per cent.}$$

The drying process has thus reduced the m.c. from 40 to 30 per cent. The sample board is re-weighed at intervals until the m.c. has been reduced to that required (see p. 7 for recommended moisture contents) to complete the process.

The sample boards should be conveniently placed in the pile, and in order that they can be withdrawn readily it is usual to notch the lower edges of the piling sticks above the boards for a width slightly in excess of that of a board.

The length of the drying period and the temperature and humidity of the air depend upon such factors as the species, quality, behaviour (such as a tendency to warp) and size of the timber, and the purpose for which it is to be used. Satisfactory manipulation of the kiln is dependent upon the operator who must take these factors into consideration when regulating the supply, temperature and humidity of the circulating air to suit the changing condition of the timber, as indicated by the periodical testing for m.c. described above.

The temperature and relative humidity of the air in a kiln are ascertained by the use of a dry-and-wet bulb thermometer. The dry bulb indicates the temperature of the air, and the relative humidity is ascertained by referring the readings of both bulbs to a humidity chart or table.

The man in charge of a kiln is guided by tables or *kiln-drying schedules*. Such schedules [1] are evolved by a qualified operator as the result of his experience of handling many kinds of timbers and after taking into account the factors of species, quality, etc., stated above. On page 11 is an example of a schedule, the figures being hypothetical only.

Such a schedule is applied in the following manner : It is assumed that the timber piled in the kiln can be appropriately seasoned by adherence to the schedule and that the sample board (or the wettest of four sample boards—one on the inlet side and one on the outlet side of each pile) has a m.c. of that referred to above, *i.e.*, 40 per cent. (or between 35 and 40 per cent.). The temperature and relative humidity of the circulating air at the beginning of the drying process must therefore be 120° F. and 75 per cent. respectively, the humidity being obtained by admitting steam through the jets to the kiln until the wet bulb registers the appropriate temperature, which in this case is 112° F. The kiln must be gradually warmed up to the dry bulb temperature of 120° F. whilst the humidity is kept constant at 75

[1] Eight schedules recommended for 178 timbers appear in " Kiln-drying Schedules," Forest Products Research Records, No. 26.