

and from which they slide on to the rollers to be delivered to the moulding machine. The feed table is connected to the feed mechanism of the moulding machine and its speed is in excess of that of the machine.

7. SPINDLE MOULDER OR VERTICAL SPINDLE MOULDING MACHINE (see B, Fig. 5).—This is a useful machine for forming mouldings on straight, curved or irregularly shaped lengths of timber; it is also used for planing, edging, recessing, tonguing, grooving, tenoning, dovetailing and jointing. The cutterblock may be circular, as shown at C, or square, as shown at B. It is provided with a pair of straight fences and a pair of ring or circular fences, all of which can be moved and fixed in position on the table to suit the timber. Two adjustable spring pressures are fixed to the straight fences for holding the timber to the table and against the fences. The spindle speeds are usually 3,000, 4,500 and 6,000 revs. per min. It can rotate in either direction to suit the grain of the wood. A guard, not shown, is fitted over the cutter spindle to protect the operator. This machine is hand-fed and is known as a *single-spindle moulder*. Another type has two cutter-spindles and is hence called a *double-spindle moulder*. Both types can be mechanically fed when large outputs are required, the maximum speed-rate being 45-lin. ft. per min.

8. PLANING AND MATCHING MACHINE.—This very powerful machine, which is at least 20-ft. long and 4½-ft. wide, is designed to produce large and speedy outputs of accurately machined floor boarding, match-boarding, skirtings, etc. The maximum output from the latest type can exceed 350-lin. ft. of tongued and grooved floor boarding per minute, and the maximum size of timber which the largest can deal with is 15-in. by 6-in. It is provided with either four, five or six rotary cutterblocks. It has, in addition, either two, three or four horizontal fixed knives in a box immediately after the first bottom cutterblock for producing a first-class finish to the face; side fixed knives may also be fixed next to the side cutterheads. They are positioned as described for moulding machines (p. 28).

The cutterblocks fixed on the side vertical spindles which form the tongue and groove on the edges of floor and match-boarding are called the *tonguing head* and *grooving head* respectively. The tonguing head has either six or eight cutters; each alternate cutter forms the edge and upper portion of the tongue during rotation, and the remaining cutters form its lower portion. The grooving head has either eight (four for edging and four for grooving) or twelve (six edging and six grooving) cutters; the straight edging cutters plane the edge of the boarding and alternate with the projecting grooving cutters or *bits*.

For tongued and grooved and single or double vee-jointed match-boarding (see L and M, Fig. 44, Vol. I) the cutters of both the tonguing and grooving heads are shaped to form the necessary chamfers. The bead at the tongued edge of the tongued and grooved and single beaded matching (see N, Fig. 44, Vol. I) is formed by the second horizontal bottom cutterblock or beading head of the six-cutter machine; if the matching is double beaded (see O) the second bead is shaped by the second top cutterblock. Other labours on the edges, such as are required for the boards shown at Q, V and W, Fig. 34, Vol. I, are formed by suitably shaped cutters in the side cutterblocks.

One type of machine is fitted with eight feed rolls (18-in. in diameter), two pairs immediately before the first cutterblock and two pairs before the side cutterblocks. It is provided with suitable pressures. A shaving breaker is mounted below the fixed knives to reduce the long shaving to small particles. An automatic feeding table, described on p. 28, must be provided.

The rates of feed vary. Thus, one machine has twelve distinct rates of feed varying from 22 to 350-lin. ft. per min. Another has nine rates varying from 68 to 450-lin. ft. per min. Those used for production work only have minimum and maximum speeds of 200 and 520-lin. ft. per min.

A four-cutter planing and matching machine will be suitable for flooring, plain matching and simple moulded skirtings. Thus, for tongued and grooved boarding, the sawn boards are successively (1) planed on the lower face by the bottom cutterblock, (2) given a high finish by the fixed blades (although these are not always provided), (3) planed and grooved on one edge by the grooving head, and tongued and reduced to the correct width by the tonguing head, and (4) finally reduced to the required thickness by the top cutterblock. Five and six cutter machines are necessary for beaded matching, more elaborate moulded skirtings, etc.

9. MORTISING MACHINE (see K, Fig. 5).—This is used for mortising framing of doors,

windows, etc. The two cutting tools chiefly used are the *hollow chisel* and the *chain cutter*.

The hollow chisel mortiser, as shown at F, Fig. 5, consists of a chisel in the form of a tube, square in section, and an auger bit which revolves within the chisel. The normal size of the chisel is up to 1-in. square (1½ and 2-in. square chisels are used in the heavier machines), and its lower end has a fine cutting edge. The chisel is attached to a spindle and works with an up-and-down movement, and the stroke can be varied to give any depth of mortise down to 8-in.

A chain cutter is an endless chain with links having cutting teeth on the outside. The chain travels vertically at a high speed over a top sprocket (cogged) wheel fixed to the spindle and a bottom guide wheel forming the lower end of a tension bar. The width of the chain varies from ¼ to 1½-in. and is capable of forming a mortise of 6-in. maximum depth.

The movement of the chisel is controlled by the hand lever. The timber is fixed to the table by one or two adjustable cramps. The table can be raised and lowered by a central screw when operated by handwheel "3"; it can be moved either backwards or forwards by a screw operated by handwheel "2," and longitudinally over the slide by operating handwheel "1."

Handwheels "2" and "3" are manipulated until the table is correctly positioned, i.e., the position of the mortise marked on the cramped timber is brought immediately under the chisel, which has been lowered until it almost touches the wood. Once the table has been set it is not necessary to alter its transverse position and height, provided all the timber is of the same scantling and the size and relative position of the mortises are common.

Mortising is performed by the simplest type of hand-lever machines by lowering the lever; this drives the chisel through the wood. The lever is raised; handwheel "1" is manipulated by the free hand to give the necessary short lateral movement of timber and the lever is again lowered. This is repeated until the mortise has been completed. If the machine is of the automatic type, the reciprocal feed motion of the chisel is controlled by the hand lever having automatic knocking-off and adjustable stops; mortises of uniform length are thus formed rapidly. In one type of automatic machine the feed of the chisel is operated by a foot lever, and the movement of the chisel continues automatically until the foot is released from the pedal of the lever.

In some machines the head carrying the hollow chisel can be quickly substituted for the chain cutter head. The mortising machine shown at K may be fitted with a chain cutter attachment in addition to the hollow chisel. Alternatively, a *boring* attachment, consisting of a spindle carrying a rotating auger, can be fitted. A boring machine is a form of mortiser, it being used to form circular holes for dowelling, etc. The auger, like the hollow chisel, has a vertical movement and is controlled by a hand lever. Some multiple-boring machines carry four or more spindles which operate simultaneously by a hand lever or foot treadle. A boring machine may also be of the horizontal type, the auger spindle being placed at the side of the table; this is a useful machine for recessing and slot mortising, for which purpose the rise and fall tables, fitted with a fence, can be moved horizontally.

Another form of vertical boring machine is known as a *router* or *recessing machine* or *overhead spindle moulder*. This consists of a bench, a vertical cutter spindle similar to that shown at B (see preceding column) and another cutter spindle or boring tool mounted on an adjustable horizontal arm overhanging the table. The overhead cutter spindle is used for housing, recessing and trenching, as required for stair strings (to accommodate the ends of treads and risers, see pp. 84 and 87), shelving, recessed panels, etc.

10. TENONING MACHINE.—The single and double tenoning of members of framing is performed by a machine which has two horizontal rotary cutterblocks, two vertical rotary scribing cutterblocks, a cross-cut saw and a table which travels on rollers. The two tenoning cutterblocks, one below the other, are at right angles to the travel of the table and carry two or four knives each; they can be adjusted both vertically and horizontally to suit the required thickness and length of the tenons. A cutter is fitted to the end of each cutterblock to sever the fibres across the grain and form clean cuts at the shoulders. The two vertical cutterblocks are adjustable for both top and bottom scribing. The cross-cut saw is adjustable and cuts the end of the timber prior to or after being tenoned and scribed. The sawing, tenoning and scribing are done in sequence at each