

PLANING AND MOULDING MACHINES.—As implied, these are used for machining the exposed face or faces to the desired finish and for moulding blocks of stone. One of the simplest, known as the *canting arm* or *reversible planer*, is shown at J. For surfacing, the stone (of a maximum length of 9-ft.) is fixed upon the *rocking table* between the two vices, with the face to be dressed uppermost. Wide blocks of stone fixed on the rocking table (which may be only 6½-in. wide) are accommodated by supporting the overhanging portions by wood struts resting upon wedges on the main table. One or more tools are fixed by wedges in the *tool box* and the latter is moved along the *cross-head* to the required position by manipulating the handwheel shown; the cross-head is lowered by power or by the operator pulling down on the rope until the edge of the tool is just below the surface of the stone. As the main table which supports the loaded rocking table moves forward on inverted vee-slides, the surface of the stone is cut as indicated at H; the cross-head (or *canting arm* or *reversible head*) swings over on the return travel of the stone which automatically occurs when the *stop*, adjusted as required at the side of the main table, comes in contact with the *kicker* which moves the driving belt from one pulley to the other. It thus cuts in both directions, and for this reason is recognized to be the best machine for surfacing.

The cross-head is lowered as required after each cut. The rate of surfacing stone is dependent upon several conditions, but an approximate average speed is 10-sq. ft. per min.

Whilst essentially used for surfacing, this machine can also be used for moulded work. Thus, for cornices and similar members, a *plate box* into which is fitted a plate or tool having an edge smithed to the reverse of the required mould is fixed in the tool box. The rocking table is rotated and fixed at the desired angle so as to bring the surface of the stone to be moulded into a convenient position relative to the tool which cuts the stone during the forward movement of the table. Before a stone is placed on the machine for moulding, one end is "cut in" to the required section by hand by the mason.

The rocking table can be removed so that large blocks can be machined by fixing them directly on to the main table.

For circular work, such as column "turning," two metal brackets are fixed to the main table. The block of stone is supported by two horizontal metal "centres" which are attached to the brackets and are let into the ends of the stone. The cutting process is as described above, the main table moving forward towards the tool box fixed in the middle of the cross-head and the stone rotated after each cut by means of gearing fixed on one side of the brackets. Flutes are formed, after the turning has been completed, by specially shaped tools fixed in the tool box. A column shaft up to 8-ft. long and 4-ft. 6-in. diameter can be worked on this machine.

Circular column shafts, caps and bases, balusters, etc., are also turned in a *lathe*. Like the wood-working lathe described on p. 30, Vol. III, the stone is fixed to two centres, and as it rotates it is cut by a tool fitted in a holder which traverses the length of the stone. Flutes are formed by the planing machine or by hand.

Other machines cut the stone in the forward direction only, and are known as *rigid head planing machines*. They have a quick return. They are especially invaluable for forming intricate moulded work. No hand finishing is necessary, as the machined-cut surfaces are excellent.

One of these rigid head planing machines, called an *open-side planer*, has two tool boxes, one within the cross-head (or cross-arm) and the other at the side of the single pillar. The upper tool box traverses the cross-arm and the tools can be made to move vertically; the side tool box has a rise and fall motion and the horizontally fitted tools can be moved horizontally. The top tools cut the upper surface of the stone whilst the side tools mould the vertical surface at the same operation. A big saving of time thereby results. This machine is particularly effective for deep cornices. Unlike the canting-arm planer (see J), it has only one pillar and it can therefore deal with wide (up to 7-ft.) blocks; it is employed for forming return mouldings on stones such as quoin cornices and string courses, square pillar and pilaster bases and caps, etc.

Another rigid head planing machine is the *four-head planer*. As implied, this has four tool boxes, *i.e.*, two in the cross-head and one at the side of each of the two pillars. Like those in the open-side planer, these tool boxes are independently

operated, and the machine is therefore capable of moulding and surfacing the top and side faces of two blocks of stone at the same time.

For marble, granite and similar brittle stone, carborundum wheels of the required shape may be fitted into the tool boxes in lieu of steel tools. The abrasive action of these wheels, assisted by water delivered on the stone, forms the desired section as they rotate at a high speed.

POLISHING MACHINES.—These include the (a) Rubbing Bed, (b) Jenny Lind Polisher and (c) Disc Polisher.

(a) *Rubbing Bed*.—This consists of a circular metal table, 6 to 14-ft. diameter and 2 to 2½-in. thick, which revolves on a vertical spindle at a speed varying from 20 (the largest size) to 45 revs. per min. It has a circular trough round the rim to carry away the liquid slurry produced during the rubbing operation.

This machine is now used chiefly in marble and granite works, and whilst it was formerly employed for surfacing limestone and sandstone blocks, it is now rarely used for this purpose, as the circular saw—especially the carborundum saw—and planers give a surface which is satisfactory for most purposes at a cheaper cost.

The block or slab of marble, etc., is placed on the table, and sharp sand or steel shot, together with water, is applied as the table rotates. The friction created by the action of the abrasive between the table top and the stone produces a smooth surface. Large blocks are kept in position by a wood beam fixed across and slightly above the table. Small blocks are controlled by hand.

(b) *Jenny Lind Polisher*.—One of several types, known as the *rise and fall* model, is shown at G. It is used for smoothing and polishing flat surfaces of marble and granite blocks or slabs. The machine, which is fixed to a pillar or wall, consists of a metal frame carrying an arm and a vertical rotating *polishing spindle* to which is connected a *rubbing head* or a *polishing disc*; the diameter of the head is 10-in. and that of the disc is 12-in.; the discs of larger machines are up to 30-in. diameter. As shown, the frame with arm is in two sections and the swivel joints allow the head or disc to be easily guided in any direction; each section of the arm is 3-ft. long and a 9-ft. by 4-ft. slab can be covered by the head at one fixing. The frame has a 2-ft. vertical adjustment by means of the hand wheel and screw and, in addition, the polishing spindle can be vertically adjusted through 7 or 8-in. The rubbing head revolves at a speed of 250 revs. per min.; some machines have two speeds, one for smoothing and a quicker one for polishing.

A smooth surface is imparted to the marble or stone by carborundum blocks, which are of four grades, *i.e.*, coarse, medium, fine and finishing. These are fixed in turn in this order to the rubbing head; the abrasive action of these blocks as they rotate, together with the water which is delivered through the hollow polishing spindle, gives the smooth surface. This is followed by the final polishing process, the fine carborundum block being replaced by the *polishing disc*, which is a metal plate faced with felt; oxide of tin, known as *putty powder*, is applied, in addition to water; the rotary action gradually imparts a high polish to the stone.

A marble slab, after being sawn, is smoothed and polished (or "glossed") in the following manner: The slab is set on the stone bench, the coarse carborundum block is fitted to the rubbing head and the spindle is adjusted to the required height. The motor is started, the water is turned on and the operator, holding the guiding handle, gradually directs the rotating block over the whole surface. The pressure of the carborundum block is increased or diminished by the operator lowering or raising the handle. When the surface has been rubbed down to an even surface, the coarse carborundum block is replaced by the medium block and the process is repeated. After the fine and finishing blocks have been applied in a similar manner, the surface should be very smooth. Any grit on the marble must now be removed, the polishing disc is fixed, putty powder is sprinkled over the slab, and the surface is traversed as described until a high polish is obtained.

A splash-board, not shown in the sketch, is used to protect the operator from the slurry; it is fitted to the bench between the slab and the operator and with its upper edge about 6-in. above the top of the slab.

Slabs longer than 9-ft. must be re-set on the bench to allow the untreated surface to be dealt with. This is obviated if, instead of the fixed bench, a bogie—which runs on a track—is available.