

sandstone, Portland stone and Bath stone respectively; a similar machine, with four blades, will saw granite at the rate of from 1 to 1½-in. per hour; for cutting thin slabs of marble, the speed is reduced to about 1½-in. per hour in order to secure the desired accuracy.

An abrasive material, such as chilled shot (steel pellets), sharp sand or carborundum, in addition to water, must be used to facilitate the sawing operation. The water is supplied from a tank situated above the machine and is automatically distributed over the stone through small taps fixed in two transverse pipes which either swing backwards and forwards with the frame or are kept stationary. The abrasive, placed as required over the cuts or kerfs in the stone by the sawyer (man in charge of the machine), is carried by the water down the cuts to the lower edges of the blades, and thus deepens the cuts during the reciprocating action of the blades; in addition, the water cools the blades and thus prevents undue wear of the steel. Steel shot is generally used for corrugated blades, except for limestone, when sand should be used, as shot rusts and would cause discoloration.

The cross-section at A shows a block of stone partially sawn into seven slabs.

On completion of the "slabbing," the frame is stopped and raised, the bogie is run clear of the frame and the stone is removed.

The frame saw is the most useful machine for cutting hard stone.

Another machine, known as the *rip saw*, is somewhat similar to the above with the exception that its width is greater than its length and the wide bogie runs on a track at right angles to that shown at B; the swing frame has thus a transverse reciprocating motion. The rip saw is usefully employed for cross-cutting blocks and especially those which are too wide for the ordinary frame saw.

**DIAMOND SAW (see D).**—This machine is used for rapidly and accurately cutting relatively small blocks of stone, such as slabs from the frame saw. It has a circular steel saw blade which is caused to rotate by an electric motor at a high speed to cut the stone which travels towards it on a moving table. The size of saw blade varies from 24 to 84-in. Saw blades must be carefully tensioned (see p. 27, Vol. III). Welded to the rim of the blade are U-shaped steel sockets or clips into each of which a half carat diamond is securely fixed; an enlargement of a portion of a blade is shown at E; the diamonds are staggered, as indicated, in order that the width of the cut is fully covered; four sockets per inch diameter of blade are provided, thus a 60-in. blade is fitted with 240 sockets provided with the same number of diamonds. The maximum speed of the blade varies with its diameter; that of a 60-in. diameter blade is 575 revs. per min. whilst a 72-in. diameter blade has a maximum velocity of 480 revs. per min. This speed is regulated according to the character of the stone, it being much less for a hard sandstone than for a soft limestone; in order to avoid damage to the arrises of the stone, the speed of the blade is lowest when the blade is just entering and leaving the block. The deepest cut that a saw blade will make is less than half the diameter of the blade, thus, for example, the maximum depth of cut of an 84-in. blade is approximately 3-ft. and the thickness of stone would be restricted to this.

A water feed, necessary to cool the blade, is provided as shown at D. The pipe can be raised or lowered as required to deliver water on top of the stone. A guard is fixed to the upper half to prevent splashing.

The stone is placed upon, but not necessarily fixed to, a cast iron table which moves on rollers. After the blade has been brought to the required position by traversing the frame, the table is advanced quickly to bring the stone up to the blade and proceeds at the desired speed until the cut has been formed, after which the table is quickly returned. The machine has four changes of feed for cutting, in addition to the quick advance and return, and these changes are readily effected by the sawyer operating a lever.

The cutting speed depends upon the horse-power, hardness of the stone and depth of cut. A 30 h.p. machine will saw a 3-ft. thick block of Portland stone at the rate of 216 sq. in. per min. of sawn area. This rate is much higher than that of the frame saw, but whilst the latter can deal with all types of stone, including granite, a diamond saw is only suitable for relatively soft stones, such as limestones, as hard stones would quickly damage the blade and wear out the sockets.

The machine can also be provided with two tables which can be either used together or one can be loaded whilst the stone on the other is being cut.

This machine may also be provided with two circular saw blades, when it is called a *twin blade* or *duplex machine*. It has either one or two tables, the latter moving on separate tracks parallel to each other. The blades, with a lateral movement, are independent and may be traversed in the same or opposite direction as required. These blades can be raised or lowered (known as a *rising and falling motion*) and are thus invaluable for forming cuts less than the thickness of the stone (an operation called *checking*) as required for grooves in window sills, etc., for *channelling* (removal of portions of the backs of stones such as are required to be fixed to steel beams and pillars of steel-framed buildings, etc.), *recessing* (e.g., jamb stones) and for sinking mouldings of cornices, etc. The maximum vertical movement is 3-ft. The area of sawn surface of Portland stone when the cut is 3-ft. deep and both blades are operating is approximately 800-sq. in. per min. This machine has largely replaced the single blade type.

**CROSS-CUT OR BEAM SAW.**—This consists of a long *transverse* cast iron beam, supported by a pillar at each end, along which a circular saw blade is caused to travel; it is obtainable in two sizes, allowing a maximum traverse of blade of 8 and 12-ft. The largest size of blade is 5-ft. and this gives a maximum depth of cut of approximately 25-in. A wide table, mounted on wheels or moving on inverted vee-slides (as shown at J), is usually provided, although side-by-side twin tables are also available.

The table, with the stone in position, is brought under the blade, adjusted and locked; the blade is then made to traverse and cut the stone. Both *fixed height* and *rise and fall movement* types are available, the former being useful for plain sawing and jointing (such as squaring ends of blocks of stone, edges of marble slabs, etc.) and the latter, which permits of a maximum vertical movement of the blade of 15-in., is invaluable for checking, channelling and recessing.

The blade may be of either the diamond or carborundum (see below) type. A typical cutting speed by a diamond saw is 220-sq. in. per min. for Portland stone; this speed is reduced to from one-third to one-half if the blade is of the carborundum type.

**GRAVITY SAW (see F).**—This type is so called as the table supporting the stone is pulled forward partly by the force of gravity. A counter-weight, adjusted according to the weight of the stone, is suspended by a wire rope which passes over pulley "1" (the block of which is secured to a roof, etc., beam), under the lower pulley "2," and is attached to the forward end of the moving table. Thus, a smooth pull, with a distinct economy in power, is obtained throughout the cut. The backward movement of the table is accomplished by operating the handwheel "1."

The cast iron table has transverse and longitudinal slots to receive clamps for the accurate setting and expeditious fastening down of the stone; it has a deep longitudinal slot to allow the blade to pass below the under surface of the stone. One type, of maximum size 120-in. by 39-in., is known as a *cross traverse table*, as it can be given a transverse movement by operating the handle of screw "2." The maximum cross movement is 30-in. A number of parallel cuts can thus be formed with one placing of the stone. The other type, called a *plain table*, cannot be moved transversely.

This machine may be provided with either a diamond blade or a *carborundum blade*. The latter is a steel blade with a 2 to 3-in. wide rim of carborundum (an abrasive material, being a crystalline compound of carbon and silicon); the carborundum, mixed with shellac, is heated and pressed round the periphery of the steel blade, which is dovetailed to provide a key. Carborundum blades give better finished surfaces and finer cuts than those formed by diamond blades, and they can be used for both hard and soft stones. Their cutting speeds are, however, not more than half those of diamond blades; thus, typical speeds are 8-in. per min. for 6-in. slabs of Portland stone and 4-in. per min. for 12-in. slabs, and these rates are approximately doubled if diamond blades are used.

Gravity saws are made of three types, namely, (1) *fixed height*, suitable for plain sawing and jointing, (2) *rise and fall* for checking, channelling and sinking, and (3) *universal*, which cuts the stone at any angle from vertical to horizontal, as it has a swivelling head which can be adjusted to a vertical or inclined plane as required. The latter can be provided with a carborundum wheel (16-in. diameter and from 1 to 2-in. thick) in lieu of the circular blade, which rotates in a vertical spindle and grinds and moulds the edges of the stone or marble.