having a 3 to 5-in. point, which slide along a hardwood stick which may be 1¼-in. by ½-in.; the points can be fixed as desired to the stick and one of them may be replaced by a pencil socket.

Callipers are used for measuring diameters of curved surfaces; *outside* callipers, used for external dimensions, consist of a pair of hinged steel curved legs which are shaped to a fine point; *inside* callipers, for inside measurements, have two hinged and tapered legs which finish with points which turn outwards.

GAUGES are tools used to mark one or more lines on the wood which are parallel to the edge; the varieties include the marking gauge, cutting gauge, mortise gauge and panel gauge.

Marking Gauge (see 4).—The holed beech head receives the boxwood stem, near one end of which is a sharp steel marking point (pin, spur or tooth) which projects $\frac{3}{16}$-in. below the lower surface; the stem can be fixed to any desired position by means of the thumbscrew; after the stem has been set as required and the screw tightened, the face of the head (that nearest the point) is placed against the edge of the timber, the point is pressed down firmly and this scores a line on the surface as the head traverses the edge.

Cutting Gauge.—This is similar to the marking gauge except that it has a steel cutter in place of the spur; the cutter is about 1⅜-in. long, $1\frac{3}{16}$-in. wide and $\frac{1}{16}$-in. thick, sharpened to a point; it is used for cutting parallel strips from thin stuff such as veneers and for marking across the grain.

Mortise Gauge (see 9).—This has two marking points, that nearest the end of the stem being fixed and the other being movable; the movable pin is attached to one end of a brass slide which is dovetailed into the stem and extends from the fixed pin to a collar which is fitted over the brass screw at the opposite end; this screw penetrates the stem, and as it rotates it withdraws the slide (and the movable pin) to increase the distance between the two pins; this distance may be adjusted from ¼ to 2-in.; the head or stock is fixed in the desired position to the stem by means of the brass thumbscrew shown at the top of the head. The gauge thus enables two parallel lines to be marked and is employed for setting out mortises and tenons; as mentioned on p. 106, the points of the gauge are set to the width of the mortise and the head is then adjusted to the required distance from the movable pin.

Panel Gauge.—This is larger than but resembles the marking gauge; it is usually made by the joiner, the stem being ¾-in. by ¾-in. by about 28-in. long, and the head being about 2¼-in. wide, 1-in. thick and about 8-in. long. The pin is fixed, and the head is adjusted and fixed as described for the marking gauge; it is used (as stated on p. 106) in the construction of door panels.

(2) CUTTING AND PLANING TOOLS.—These comprise saws, chisels, gouges, planes and spokeshaves.

SAWS.—The many varieties include the cross-cut saw, rip saw, tenon saw, dovetail saw, compass saw, pad saw and bow saw. A saw has a spring steel blade with a wood (usually beech or apple wood) handle securely riveted to it; the lower edge or front of the blade is divided into serrations or fine teeth; this cutting edge is usually specified according to the number of *points* (not teeth) to the inch; thus at A, C and D, Fig. 67, the number of points per inch is six, four and ten respectively. The teeth are bent alternately to the right and left of the blade to enable the blade to pass through the cut being formed in the timber with the minimum of friction as the sawing proceeds; this bending of the teeth is called *setting* (see B) and causes the teeth to form a slightly wider cut in the timber than the thickness of the blade; in addition, the blades of the larger saws are ground thinner at the back (opposite edge to the teeth) than at the cutting edge. A saw should be as thin as possible, otherwise waste of material would result because of the wider cut which would be formed by the thicker blade.

Cross-cut Saw (see 12).—This is essentially used for cutting across the fibres of the wood, but it is also used with the grain, and in carpentry for general sawing; it is made in sizes of 20 to 28-in. (length of blade), advancing by 2-in., a 26-in. blade being standard; the number of points is 5, 5½, 6, 7 and 8 per inch; the eight-point saw is considered best for hardwoods, a seven-point saw for both hardwood and softwood, and a five-point saw for rough carpentry; the teeth are shaped as shown in the enlarged sketch at A; the hollow back improves the appearance.

Rip Saw.—This is rarely used, unless machinery is not available, when it is used for cutting timber along the grain; it resembles the cross-cut saw, is 28-in. long, and has teeth shaped as shown at C with four points to the inch.

Panel Saw.—Is similar to the cross-cut saw, but the blade is finer and the teeth are usually shaped as shown at A; a 26-in. blade with ten or twelve points to the inch is considered best; is used in preference to the cross-cut saw for accurate work and instead of the tenon saw (see below) for cutting panels and similar wide work.

Tenon Saw (see 13).—Used for finer work than both the cross-cut and panel saws; as implied, is used for the cutting of shoulders to tenons and where a clean cut is necessary; made in 12, 14 and 16-in. sizes, the 14-in. blade being generally preferred; its very fine blade is stiffened and increased in weight by the brass or iron back or bar which is tightly pinched on the upper edge. It has ten or twelve points to the inch and the teeth (called *peg* teeth) are of equilateral triangular shape as shown at D; is sometimes called a *back saw*.

Dovetail Saw (see 15).—This has an 8, 10 or 12-in. blade and an open handle; used for very fine work, as for forming dovetail joints in drawers and for cutting shoulders on narrow rails; this fine blade has fourteen points to the inch.

Compass or Turning Saw (see 16 and 17).—Is used for cutting curves; one type has the blade riveted to the handle and another has one or more slotted blades (as shown) which are fitted and screwed to the handle; the latter is usually provided with three blades of different sizes which are interchangeable; the teeth are shaped as shown at C.

Pad or Keyhole Saw (see 18).—Is useful for forming keyholes and similar curved work; it is the smallest saw, the blade tapering in width from ⅜ to a bare ¼-in.; the pad or handle is slotted so that the blade can be passed right through when not in use; when required, the blade is drawn out to the desired amount (see the broken lines) and tightened by two screws; the teeth are similar to those of the compass saw.

Bow Saw (see 19).—Used for cutting curved work with sweeps which are too quick to be negotiated by the compass saw; the frame is made by the joiner and the blade (⅛ to ½-in. wide) is fitted into the shafts of two boxwood handles; about 10-ft. of strong string is wound round the upper ends of the sides (of ash, beech, birch or mahogany) and a short wood lever is passed between it; the blade is tightened to the required tension by twisting the string by means of the lever; this shortens the string and the blade is stretched as the upper ends of the sides are brought together; the bar acts as a fulcrum and restrains the lever to prevent the unwinding of the string.

Frame Saw.—Is similar but longer and stronger than the bow saw.

SETTING AND SHARPENING SAWS.—The setting or bending back of the teeth has been already referred to. The points become worn as the saw is used and the amount of set is reduced; this decreases the width of the saw-cuts and freedom of the blade is restricted as the clearance becomes less; the teeth have then to be re-set and re-sharpened; the former operation is carried out before the teeth are sharpened, although it is usually only necessary to set once to every third or fourth sharpening process.

The teeth should be of regular length; if they are not, any correction is made before the setting is commenced; any irregularity can be seen by looking down the teeth from the heel (see 12) and removed by drawing a flat file two or three times along them; this is known as *breasting*.

The teeth are then set. The expert does this by holding the blade on a steel block or *set* (which has a bevelled edge) and uniformly tapping alternate teeth in turn with a special thin-edged hammer. Alternatively, a patent *saw set* (see 20) may be used; the saw is gripped between the pad and set-screw, both of which are regulated to produce the required set; the handles are squeezed together and this causes the plunger to press forward to bend each alternate tooth in turn; the saw is reversed and the teeth on the opposite side are set in a similar manner.

The saw is now ready for sharpening. It is fixed between the jaws of a *saw vice* (or sharpening block or saw chops) with the edge of the saw horizontal and about 1-in. above the jaws. A file (triangular in cross-section and of a size depending upon that of the teeth) is used; starting at one end, alternate teeth (those pointing away from the filer) are filed with the same number of strokes of equal pressure and in a manner which varies with the type of saw; the saw is reversed in the vice and the remaining teeth are filed similarly to bring them to a fine point. Bright points indicate blunt points, and sharp points are dull and difficult to see; if therefore the teeth have been breasted, each point will be bright owing to its blunt condition and the filing should be continued until this brightness disappears.