from, the operator, the saw (if not a circular one) being turned end for end upon the strightening block when necessary.

The method of using the blocking hammer, shown in Fig. 3, is as follows: The shape of the face of the hammer, in conjunction with the line of motion in which it falls, determine the direction in which the effects of the blow shall extend. If, for example, the face, A, of the blocking hammer were flat, and the blow fell vertically true, the effect of the blow would radiate equally on all sides of the spot which received the blow. If, however, the face, A, of the blocking hammer, while falling, traveled also laterally, the effects of the blow will be greatest on the side towards which the lateral travel took place. Thus, in Fig. 7, if the hammer, in falling, traveled from B towards the hammer mark shown, the effect of the blow would be as denoted by the radical lines; while if the position of the hammer face were turned to a right angle, and blow were struck with the hammer traveling laterally from C towards the hammer mark shown, the effects upon the plate would be in the direction denoted by the radial lines, shown at C. The curve of the face of the blocking hammer, at A, also has an influence in extending the effects of the blow forward; and the result of these combined elements is that the blows lift the plate in front of them, so that, if blows were delivered as shown in Fig. 8, at A, the plate would bend upwards, assuming the shape denoted by the dotted lines at that end: while by blows delivered in the direction indicated by the marks at B, the plate or blade would curl up, as shown by the dotted lines at that corner of the plate.

A sawplate or blade may have a bend in it that is not discernible to the unpractised eye; and yet the expert workman will readily detect the defect as the saw lies upon the straightening block; and all the coarser defects can be attacked and remedied without sighting the plate at all. But when the finer part of the straightening is to be performed, and the tension of the blade, as well as its straightness, is to be perfected, the workman casts his eye along the blade nearly in a line with its length, when, the light coming in front of the operator, any unevenness upon the blade will be denoted by shadows, as shown in Fig. 9. which represents an ordinary handsaw being sighted, the shadows showing the want of straightness. Having detected the part of the blade which is out of true, the workman reverses the position of the blade, holding it in his hands as shown in Fig. 10, and he then bends the plate slightly backwards and forwards, the object of which is as follows: The defects in the plate exist by reason of some part being either unduly expanded or contracted, thus creating undue local tension in one place, and removing the natural tension in another. Tha workman, when bending the plate backward and forward, finds that the loose place (or, in other words, the expanded part) moves easily, while the contracted part offers a resistance to the bending movement; so that, by noticing the amount of the movement during the bending, the workman discovers where the contracted part is, and he proceeds to remove it by stretching the blade in that spot. Thus while straightening the blade its tension is also equalized, giving to the plate a uniform resistance to its becoming bent or sprung. During the hammering process, the straight edge is frequently applied to the blade as a guide to test the work by. If, while attacking the necessary places, the saw blade does not lie solid upon the straightening block, the hammer will drum, as it is called; and the effect of the blow will be to stretch the outside skin of the saw blade, causing it to rise up because of its being elongated. Thus, were the blade to be hammered all over one face without bedding solid on the block, it would become bow-shaped, the face struck being the convex side.

In Fig. 11 is shown a saw blade having a loose place in the middle, as denoted by the shade shown upon the face. The method of attack here would be to deliver the blows denoted by the marks shown at A and B, using the doghead hammer for the purpose. The parts so struck would be stretched, giving room for the loose place to flatten, and taking the undue tension from the outer surface and imparting it to the loose place, the saw becoming slightly elongated by the process. If, however, the bending process or test showed the contraction to be in the middle of the blade, the doghead would be used to deliver the blows shown in Fig. 12, at A, which would stretch the metal there, removing the contraction and equalizing the tension. Suppose, however, that the saw was atwist, as shown in Fig 13: the method of attack would be to take the blocking hammer, and deliver the blows denoted by the marks shown, using the hammer so that, while falling, it would travel laterally slightly from the workman. The blade would be placed upon the block with the drooping side downwards, because the effect of the blows of the blocking hammer is, as before noted, to lift the plate in front of them.

If one edge of the saw blade had a kink or wave in it, as shown in Fig. 14, the method of procedure would be as follows: The blade would be placed upon the block with the hollow side of the kink downwards, as shown in Fig. 14, and the blows shown at A would be delivered. The effect of these blows will be to stretch the metal of the plate, removing the tension behind the kink, and producing a tension tending to lift the part kinked. The plate is then turned upside down, and the blows denoted by the marks shown in Fig. 14, at B, are delivered, which will remove the kink.

In performing any one of these operations new contractions or expansions of parts may be induced; and it not unfrequently happens that a kink and a twist, or a twist and a loose place, may be attacked at the same time. Numerous combinations of contracted or expanded places may of course exist in a blade, and the process for removing one may be modified or carried on in conjunction with that necessary to remove another; the principles employed, however, are in all cases those explained above, the application being varied to suit the circumstances.

In the edge view of Fig. 15 is shown a circular saw dished; and here it may be noted, that in this case as well as when the saw is out of straight, the first thing to do is to get the dish out, and afterwards, proceed with the straightening. To remove the dish, the saw is placed upon the block with the concave side uppermost; and the blows are delivered with the doghead in the places denoted by the marks shown on the face view of the saw in Fig. 15. The testing of the saw is made by bending it, by sighting it, and by applying a straight edge to its surface. Some circular saws are too thick and strong to be easily bent, and in that case the bending test is omitted. If a circular saw is atwist or has a kink in it, the method of attack is the same as that already described for similar defects in hand or frame saws: except that, as before explained, a slight tension is left upon the outer diameter so as to allow for the expansion of the saw created by the centrifugal motion and force. J. R.

## WOOD-GROOVING MACHINE.

(See page 169.)

The above illustration shows two views of a machine designed by Mr. J. Richards, London, and constructed by Richards, London, and Kelley, Philadelphia, engineers. The machine is intended for cutting the grooves for steps and risers in stair strings, and for preparing casework of any kind requiring grooves to be cut either at a right angle to the pieces, or diagonally as shown in the details. The same machine is arranged so as to be used for mitre-cutting when not required for grooves. The details on the right shows the mitring table and the double-edged cutter employed for the last-named purpose.

The machine, as shown, is provided with spurs and grooving cutters to be operated by hand, the tools sliding on the pivoted bracket, which can be set to any angle across the lumber. The cutters are moved forward and back by means of the lever seen in the front view, and are fed down at each stroke by means of the crank on top. In mitring the grooving cutters are replaced by the double cutter before mentioned. The machines can be constructed to operate by power with rotary cutters, but this, considering the small amount of wood to be cut away, offers but few advantages over hand movement, and complicates the machines; besides in most cases machines of the kind are most conveniently used in joiner shops in connexion with the bench-work where power is not at hand.

TURKISH ARMAMENTS.—The British steamer J. B. Walker, Captain Duncombe, has arrived in the Bosphorus from New Haven, United States, with a large cargo of arms and munitions of war for the Turkish troops, which has since been landed at the Artillery Department at Tophaneh. This cargo forms part of an order given by the Turkish Government to the Providence Tool Company, Rhode Island. It is valued at 170,000*l.* sterling, and consists of 33,400 Martini-Henry rifles, 4,700,000 Martini-Henry metallic cartridges, with the same number of balls fitting them, and 10,000,000 Snider cartridges. The Seraskierate expects the speedy arrival from Liverpool of 7000 revolvers of the Smith and Warren partern. These weapons are provided with self-acting mechanism which instantly expels the discharged cartridge cases from the chamber, and they have the advantage of being usable with the same cartridges as the Winchester carbines with which the Turkish cavalry is at present armed.