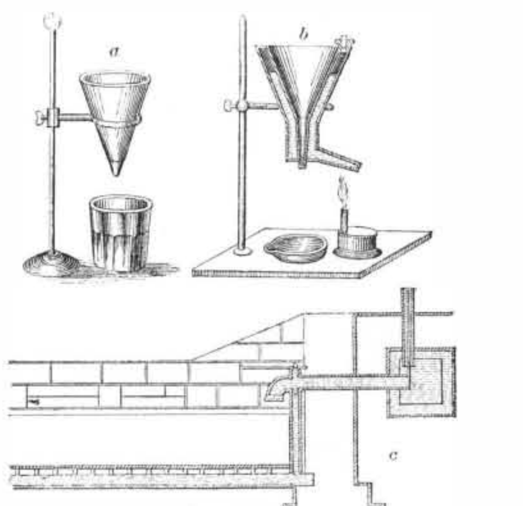
FILTERS AND LIQUID METERS.

In many localities, where the water supply is drawn from rivers adjacent to cities or from sources liable to be contaminated by decaying organic substances, filtration of the fluid, before using it for drinking or cooking, is an important sanitary precaution. To this end various devices have been invented, all so constructed that the water passes through certain substances which, while arresting the passage of matter mechanically suspended, are sometimes of such a nature as to absorb deleterious gases and effete substances. In the annexed engravings, from Knight's "Mechanical Dictionary"*, will be found representations of several different inventions in the filter line.

LABORATORY FILTERS,

used by chemists, are of the simplest construction, and are represented at *a* and *b*, in Fig. 1. The first is made of a circle of bibulous paper, folded and opened into a quadrant and inserted into a funnel of glass or paper. For filtering matters which becomeviscid on cooling, such as gelatin, tallow,

Fig. 1.



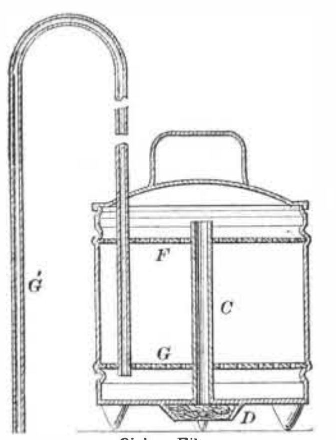
Filters.

wax, etc., the apparatus shown at *b* is used, in which the filter is placed within a water bath which has a leg heated by an alcohol lamp.

DOMESTIC FILTERS

are frequently made in the form of a submerged jar or box composed of porous stone, through which the water passes and is withdrawn by an exterior faucet, as represented at *c*, Fig. 1. In another form the filter is placed within a barrel, and the water passes through a coarse filter, D, Fig. 2, and up a central tube, C, to an upper chamber and thence through filtering material placed between two perforated diaphragms, F G. The water is drawn from the lower annular chamber by a siphon, G′, having a stop cock at its lower end. A good domestic filter is easily constructed of a deep wooden tub divided by a tight vertical partition through the middle, the partition being perforated near the bottom. The tub should be nearly filled on both sides of the partition with granulated charcoal, made from sugar maple and screened through a mesh of one sixteenth of an inch, the fine dust being separated by bolting. The foul water enters the tub on one side, passes down and through the holes in the partition, and rises up on the other side, leaving all its impurities in the charcoal. Fig. 3 is a

Fig. 2.

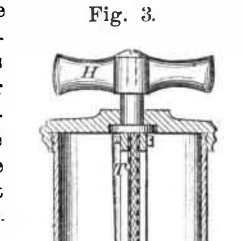


Siphon-Filter.

REVERSIBLE FILTER

interposed in a length of pipe. The water flowing from A to the filtering surface, T, has its impurities detained, while the strained water runs off at B. When the filter surface, T, has become foul, the handle, H, is turned, throwing the dirt to the delivery side, where it carried off by the current of passing water. A

Fig. 3.



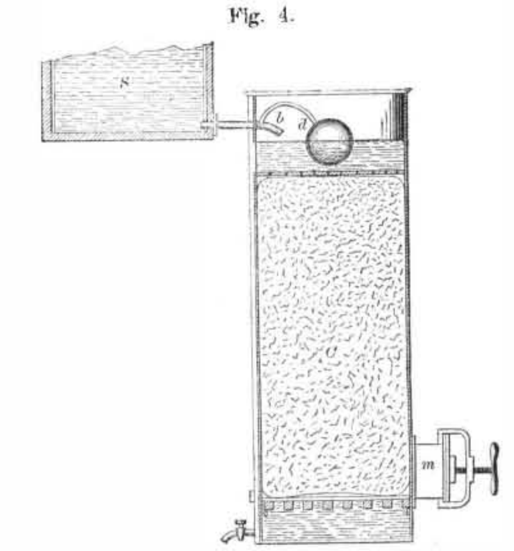
Reversible Filter.

CHARCOAL FILTER

in shown in Fig. 4, which is used for sugar refining. Upon the bottom of a high cylindrical vessel, which is charged with animal charcoal, C, a filter cloth is spread, and upon this the lower charcoal layer is tightly packed, while the remainder of the filling is left loose. Another cloth and a perforated plate complete the column. The sirup to be filtered is let in from the cistern, S, the supply being regulated by the ball cock, *b d*. *t* is a tube by which air is allowed to escape, and *m* a manhole for giving access to the interior for cleansing, etc. An arrangement of a filter in connection with a cistern is represented in Fig. 5. The water passes down through the

*Published in numbers by Messrs. Hurd & Houghton, New York city.

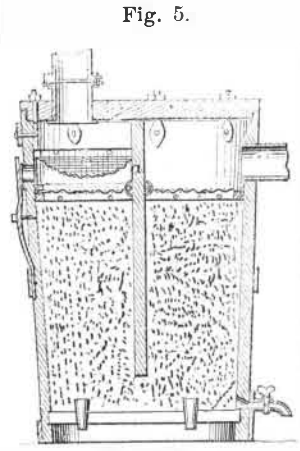
Fig. 4.



Charcoal-Filter.

charcoal or other filtering material in a permanent chamber, on one side of an axial division, and, after passing beneath the latter, rises up and is drawn off from the other side.

Fig. 5.



Filtering-Cistern.

In order to ascertain the quantity of a liquid discharged or received through an orifice.

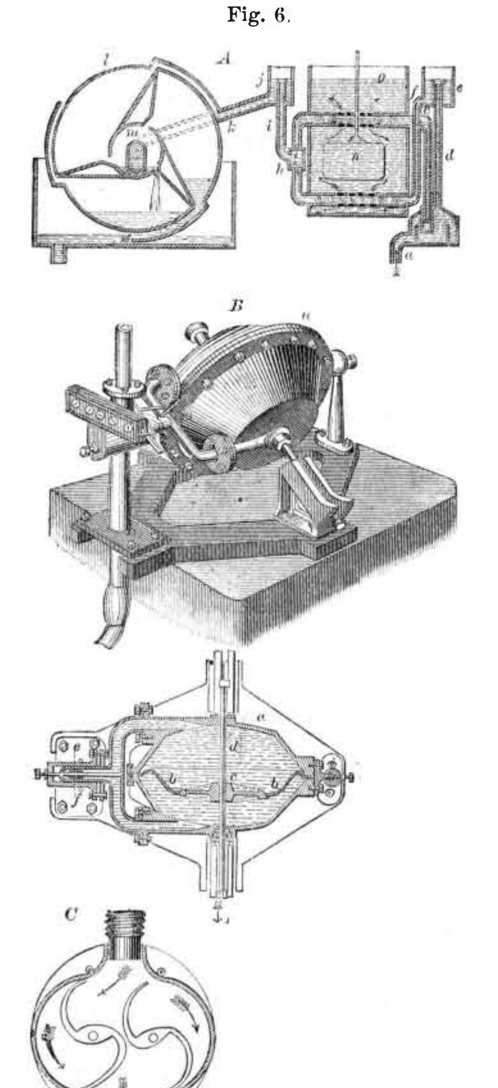
MECHANICAL LIQUID METERS of various forms are employed, the principal being known as the diaphragm, the balanced(in which compressed air is used), the piston, the propeller, and the flexible tube and roller.

In Fig. 6, at A, is shown

THE SIEMENS AND HALSKE SPIRIT METER,

which registers the quantity of spirit discharged and also the amount of absolute alcohol contained therein. The liquid entering at *a* passes through the pipes, *c d*, one of which terminates in a chamber, *e*, whence it is carried by the pipe, *f*, through the vessel, *g*. The other conducts it directly to the upper part of *g*. The parts of the pipes passing through *g* are perforated so as to make currents in the vessel in order thoroughly to mingle the spirit, and the two pipes meet at *h*, whence the liquid is led by *i* into a chamber, *j*, and thence to the volumeter,

Fig. 6.



Liquid-Meters.

which is a hollow drum. *l*, having a concentric cylinder, *m*, the space between the two being divided into three compartments. Three slits in the central cylinder permit the liquid to flow successively into each compartment, as it in turn occupies the lowest position, and the apparatus remains stationary until the lower chamber is full. The discharge of this then begins, while the aperture through which it received its supply is carried, by the rotation, above the liquid in the central chamber. The registering dials are actuated in the usual manner. The amount of pure spirit is determined by a hydrometer, *n*, in the tank, *q*, the instrument being filled with alcohol, and rising and falling according to the density of the spirit. Its motions actuate suitable registering devices which give an indication each time the volumeter is emptied, and to an extent showing the quantity of pure spirit contained therein.

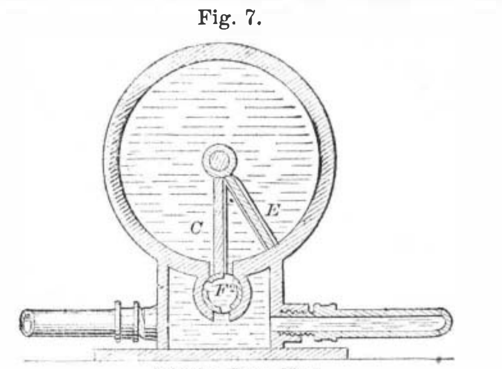
DUBOY'S WATER METER

is represented at B. A diaphragm, *b*, in a casing, *a*, carries a closely fitting metallic disk, *c*, held in position by the rod, *d*. Water enters through either duct, *e* or *f*, raises the diaphragm, and forces out the water on the opposite side until the vessel is full, when the diaphragm fits against that side. When the weight rises to the top, that side is given a preponderance, causing the vessel to turn on its pivots until the relative places of the sides are changed. At the same time, the supply opening is closed and that for discharge opened. Payton's meter, C, same figure, contains two S-shaped arms, whose extremities are during rotation in close contact with each other and with the sides of the box. The arrows indicate the direction of the current.

ATWILL'S PULSATING PISTON METER,

Fig. 7, has a piston, E, which turns on an axle shaft com

Fig. 7.



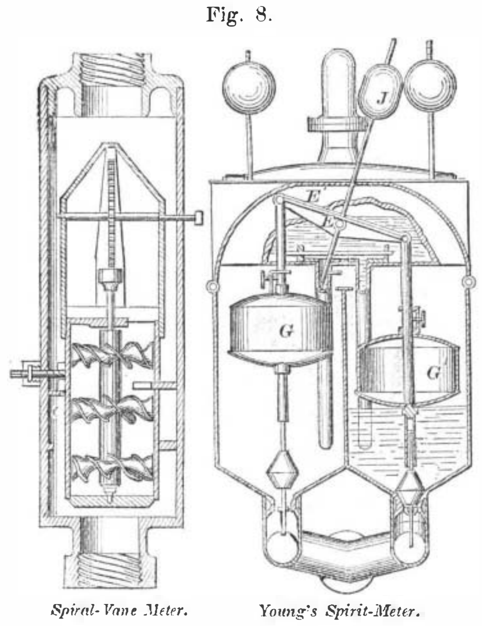
Pulsating-Piston Meter.

municating motion to the register and carrying an arm which, at the end of each stroke, changes a cylindrical valve. F², so as to cause the water alternately to enter and discharge from the measuring chamber at opposite sides of the internal partition, C. The spiral vane meter, shown in Fig. 8, is simply a water wheel within a pipe connected to a register to indicate the flow of water. The flow is regulated by a sliding valve. In

YOUNG'S SPIRIT METER,

same figure, a float, G, in the measuring chamber, is at-

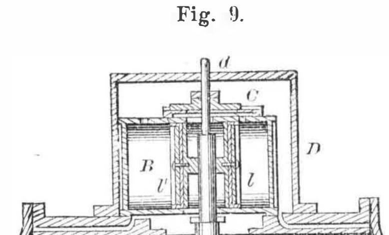
Fig. 8.



Spiral-Vane Meter. *Young's Spirit-Meter.*

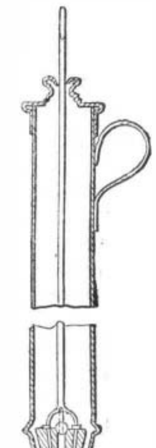
tached to each end of a pivoted beam. The alternate downward motion of the floats, as the chambers are discharged,

Fig. 9.



Sickles's Liquid-Meter.

Fig. 10.



Liquor-Thief.

directs the induction flow from one to the other. The valve stems have a limited sliding motion in the floats, so that each of the latter will rise to a sufficient hight without raising the valve to permit of emptying the chamber. At the point of discharge, the weighted rod, J, is thrown past the vertical and, closing the valve to one chamber, opens the induction pipe to the other, depressing that float sufficiently to close the escape valve. In

SICKLES' METER,

Fig. 9, the liquid flowing into the chamber, D, is, by means of the valve, C, admitted alternately to each end of the hollow valve, B, which is divided into compartments by the partitions, *l l'*. From these the fluid flows alternately through appropriate ports behind the pistons, *a a'*, on the rod, *b*, which has tappets that strike the pins, *e e'*, on the upright shaft, *d*, causing its partial rotation and operating the slide valve, C, which admits the fluid into the compartments of the valve, B.

We add, in Fig. 10, one more device used in connection with liquids, to which the name of

LIQUOR THIEF

has been applied. It is simply a tube which is let down through the bung hole of a cask and then closed, so as to withdraw liquid therefrom. It is closed at the bottom by a plug, actuated by a rod passing through the top, as shown.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

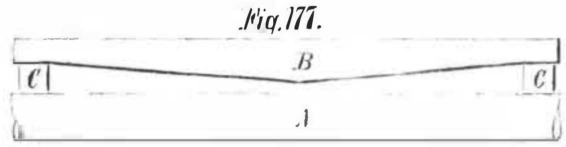
NUMBER XXXVIII.

MARKING OUT ENGINE GUIDE OR MOTION BARS.

If an engine guide bar is to be made parallel in its breadth and thickness, it may be marked off from the directions already given for marking a scale. Such bars, however, should always be made thicker in the middle than at the ends (as they are always made in English locomotives) for the following reasons: If the strain upon the bars is equal at all parts of the stroke, the middle of the bar will be subject to deflection because of its distance from the blocks or supports at the ends. Again, towards and at the end of the stroke, the connecting rod stands nearly parallel with the center line of the bore of the cylinder, and then the strain upon the guide bars is very slight; but as the stroke proceeds, the angle of the connecting rod increases until (near the center of the stroke) it becomes the greatest, and therefore places the most pressure upon the guide bars. If, then, the latter deflect in consequence of this pressure, the gland and packing ring in the cylinder cover act as a fulcrum, and the piston rod as a lever, forcing the piston against the top and bottom of the bore of the cylinder, tending to wear it oval and also to wear it to a larger bore in the middle than at the ends, because the deflection of the bar is inappreciable at the ends, whatever it may be in the middle. That the deflection of such bars is sufficient to be of practical importance will be perceived from the following:

During the years 1864, 1865, and 1866, I fitted up under contract nearly one thousand guide bars (for locomotives) their average size being about 30 inches long, 3½ inches broad, and 1⅝ inches thick or deep at the ends, and 3 inches thick in the middle of their length. They were filed up in the vise, and made practically true to a surface plate. When the first few sets were delivered to an inspector for examination, they were rejected on the ground of being hollow in their length, to a degree plainly perceptible in the surface plate marks, which showed very plainly at the ends of the bar, and graduated away until, in the middle of each bar, they were barely perceptible. This difference was obviously in the wrong direction, since the middle of the bar should, if there be any difference, mark the plainest, because it sustains the most abrasion. I was sent for by the inspector, who had a bar placed upon the bench, supported by a block of wood under each end; and by request, I applied the surface plate, and found, to my astonishment, the marks to be as above stated. As a consequence, the whole of the set of eight bars were returned to me to be refitted. Upon replacing them in the vise and applying the surface plate, I found each bar to mark as true and even as could be desired, and hence returned them untouched, perceiving that the bars, stout as they were, deflected from their own weight, the amount of the deflection being doubled by supporting them, in the one case in the middle and in the other by the ends. The inspector claimed that, by testing the bars while supported at their ends, he had tested them in the position in which, and supported them as they would be, when in their working places: but since no provision had been made for holding them (while being filed up) in that position, and since the top bars stand upside down when upon the engine, it was plainly impracticable to file them up in such a position. The bars were passed, the controversy having served to demonstrate their appreciable deflection, and also that the bottom bars should be filed up a little rounding and the top ones level in their respective lengths. To mark off such a bar as is here described, one face must either be first trued up, or the marking-off must be performed at two separate operations. The better plan is for the marker-off to examine the bar as to size, and have one face planed off. If either face appears defective, it should be the first planed. If the bar appears sound all over, the outside edge face of the bar should be the one to be planed off preparatory to marking off; and in setting it to surface it, care should be taken to set it true with the top and bottom faces, if they are parallel to each other; and if not, to divide whatever difference there may be between them. The bar may then be placed upon the marking-off table in the position shown in Fig. 177, A being the marking-off plate, B the guide bar, C C pieces of wood to lift the bar off the plate. By means of small thin wedges, the planed face, B, of the bar is set at a true right angle to the surface of the plate, and tested by a square. The next operation is to mark off the top or uppermost face, and the question here arises: Shall it be so marked that there will be an equal amount of metal taken off the top and bottom faces, or otherwise? First, then, since the quality

Fig. 177.

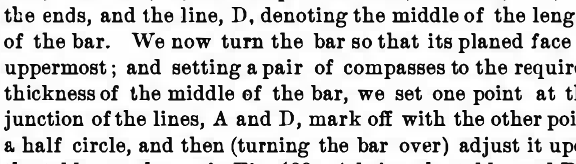


of the metal is the best towards the surface, it is a consideration to take off as little as possible, so as to leave a hard wearing surface; this may appear a small matter, but it is always right to gain every superiority attainable without cost. Therefore, all other things being equal, we should prefer to take as little metal off the top face as would be sufficient to make it true, and should therefore mark it out with that view. Here, however, another consideration arises, which is that the outline of the bottom face is not straight, and cannot therefore be planed lengthways from the center of the bar to the ends; and if such bottom face is to be shaped across its breadth, instead of lengthways, it is a comparatively slow operation, and much time will be saved by so marking off the bar that the bottom will only just true up, so that all the surplus metal will be cut off the top face, which, being done in a larger machine, and lengthways, is a much more rapid operation. There is, however, a method of obtaining both the advantage of taking as little as possible off the top face, and planing the bottom face for the most part lengthways. It is shown in Fig. 178, A being the bar;

Fig. 178.

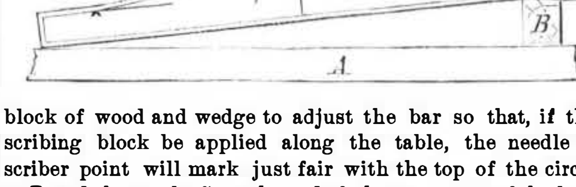
the two faces, B B, may be first planed parallel (as required) with the face, C; the back of the bar may then be planed in two operations from the point, D, to the junction with B at each end. Were the method of procedure employed, it would pay to leave the most metal to come off the back of the bar; but there are yet other considerations, which are the facilities in the shop. If the shaping machines are not kept fully occupied, while the planing machines are always in demand, it will pay (if there are not many bars to be planed) to leave as little as needs be to be taken off the bottom of the bar and the remainder off the top. If, however, many bars are to be planed, the most economical of all methods will be to plane the backs by placing, say, 8 of them at a time across the table of the planer, cutting off the ends at the same chucking. Supposing this plan to be adopted, we set the scriber of the marking block just below the lowest part of the surface of the bar, and draw a line along its planed surface, and then another line along each end, to denote the thickness of the parallel parts at each end, making this line longer than is necessary, as a guide in setting the bar in the shaper (in case the ends are shaped and not planed). We next mark off the length of the bar at the ends, using a square and allowing about an equal amount to be taken off each end; and then, still using the square, we mark a line equidistant between the end lines, to denote the center of the length of the bar, which will then present the appearance shown in Fig. 179, the inside line, A A, being for the top

Fig. 179.



face, the lines, E, for the parallel ends, the lines, B B, for the ends, and the line, D, denoting the middle of the length of the bar. We now turn the bar so that its planed face is uppermost; and setting a pair of compasses to the required thickness of the middle of the bar, we set one point at the junction of the lines, A and D, mark off with the other point a half circle, and then (turning the bar over) adjust it upon the table, as shown in Fig. 180, A being the table, and B a

Fig. 180.



block of wood and wedge to adjust the bar so that, if the scribing block be applied along the table, the needle or scriber point will mark just fair with the top of the circle at D and the mark, C, at the end of the taper part of the bar, A (the mark, C, showing the required distance from the end of the bar). Having made the adjustment, we draw the line, E, thus completing the marking of that half of the bar. We next remove the block of wood and wedge to the other end of the bar, and repeat the last operation, when the marking of the bar will be, so far as its outline is concerned, complete. It will be observed that we have drawn the lines in each case on the one planed surface of the bar only, and not all around the work. The reason for this is that the planed face is a guide, whereby to chuck the work and ensure its being set true. In the absence of one true face, it would be necessary, in marking off the first face, to mark the lines all around the work, which, when planed up, would serve as a guide whereby to set the work during the successive chuckings.

After the faces and ends are planed up, the holes in the ends may be marked by the compass calipers and compasses, as shown in Fig. 181, A being the bar, and B B the compass

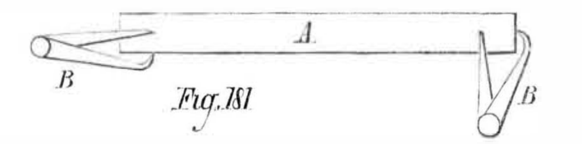
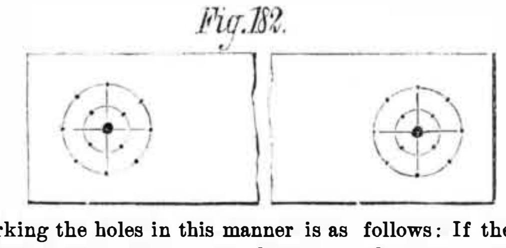


Fig. 181

calipers set to the required distance. At the junction of the marks thus made, we make a light centerpunch mark, and mark off the circles for the holes, first marking a circle of the requisite size and defining its outline by other light centerpunch marks. We next draw from the same center a circle smaller in diameter, and define its outline also by small centerpunch marks; after which we take a large centerpunch, and make a deep indentation in the center of the circle, which will appear as shown in Fig. 182. The philosophy of

Fig. 182.



marking the holes in this manner is as follows: If the outside circle alone is marked, there is nothing to guide the eye during the operation of drilling the holes (in determining whether the drill is cutting the holes true to the marks or not) until the drill has cut a recess nearly approaching the size of the circle marked; if the drill is not cutting true to the marks, and the drawing chisel is employed, it will often happen that, after the first operation of drawing, the drill may not yet cut quite true to the marks; and it having entered the metal to its full diameter, there is no longer any guide to determine if the hole is being made true to the circle or not. By introducing the inside circle, however, we are enabled to use the drawing chisel, and therefore to adjust the position of the hole during the earlier part of the operation; so that the hole being cut is made nearly if not quite true before the cutting approaches the outer circle, which shows the full size of the hole. If, on nearly attaining its full diameter, the outer circle shows it to be a little out of truth, the correction is easily made. It is furthermore much more easy to draw the drill when it has only entered the metal to, say, half its diameter than when it has entered to nearly its full diameter.

The object of making a large centerpunch mark in the center is to guide the center of the drill, and to enable the operator to readily perceive if the work is so set that the point of the drill stands directly over the centerpunch mark. This is of great importance in holes of any size whatever, but more especially in those of small diameter, say, for instance, ¼ inch, because it is impracticable to describe circles of so small a diameter whereby to adjust the drilling; and in these cases, if the drill runs out at all, there is but little practical remedy. The centerpunch marks for such holes should therefore be made quite deep, so that the point of the drill will be well guided and steadied from the moment it comes into contact with the metal, in which case it is not likely to run to one side at all. If a motion or guide bar requires to have one corner rounded off, as it should have to prevent its leaving a square corner on the guide block, which would weaken the flange of the latter, the corner cannot be marked off, but a gage should be made as shown in Fig. 183, A in the left hand

Fig. 183.

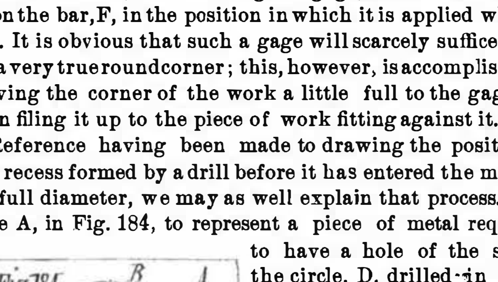
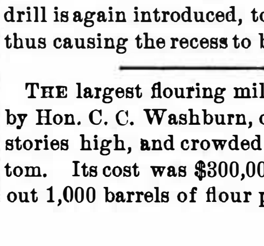


figure being a piece of sheet iron, say $\frac{1}{32}$ inch thick, with the lines, B and C, and the quarter circle, D, marked upon its surface. The metal, G, is then cut away, and the edges carefully filed to the lines, thus forming the gage, A, which is shown upon the bar, F, in the position in which it is applied when in use. It is obvious that such a gage will scarcely suffice to get up a very true round corner; this, however, is accomplished by leaving the corner of the work a little full to the gage and then filing it up to the piece of work fitting against it.

Reference having been made to drawing the position of the recess formed by a drill before it has entered the metal to its full diameter, we may as well explain that process. Suppose A, in Fig. 184, to represent a piece of metal requiring to have a hole of the size of the circle, D, drilled in it, and that the recess cut by the drill is out of true, as shown by the circle, C. A round-nosed chisel is then employed to cut, at D, the groove there shown, running from the outside to the center of the recess, and which will have the effect, when the drill is again introduced, to draw the recess toward that side, thus causing the recess to be true with the marks.

Fig. 184.



THE largest flouring mill in America, it is said, is owned by Hon. C. C. Washburn, of Minneapolis, Minn. It is seven stories high, and crowded with machinery from top to bottom. Its cost was $300,000, has 40 run of burrs, and turns out 1,000 barrels of flour per day.