all such part of the immersed solid as is in a horizontal plane, or can be reduced to one. The repellent force has also relations to the difference in temperature between the solid and the molten metal on which it floats. The author then extends his experiments to lead and solidified iron furnace slag, with analagous results.

WHY SOLID IRON FLOATS IN MOLTEN IRON.

Two explanations, says Dr. Vander Weyde, are given of the floating of solid iron in molten iron. The first is that the iron expands in solidifying, as water does, and that therefore solid iron when heated is specifically lighter than liquid iron, and floats upon it as ice floats upon water. This supposition, however, is incorrect, inasmuch as it is based upon an erroneous assumption. Iron does not expand in solidifying, a fact of which any one may convince himself by brief observation in a foundery. The fact is just the reverse; the metal shrinks during solidification, after having been cast in a mold. By casting, for instance, a long piece in a vertical mold, the solidified piece will not fill the mold to the top, as did the liquid iron. The explanation given by Dr. Van der Weyde himself is that the iron is surrounded by a film of air adhering to it, which repels the molten iron and prevents contact; on which account the solid piece displaces more liquid metal than its own weight amounts to, and consequently it floats.

PRACTICAL MECHANISM.

NUMBER VII.

BY JOSHUA ROSE.

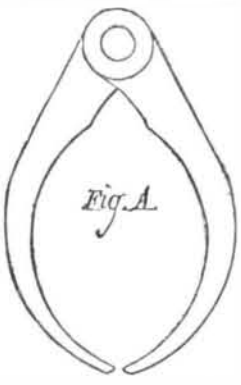
VISE WORK—TOOLS.

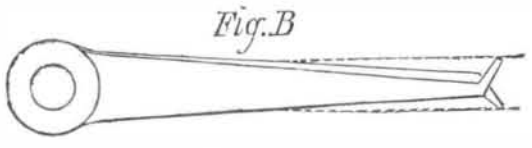
The tools used by the vise hand being nearly all supplied to him ready made, but few remarks need to be made to him upon the subject of their form.

CALLIPERS.

Outside callipers, that is, those used for measuring external diameters, should have larger rivets in them than they are generally given, a fair proportion being a rivet of one half inch diameter for a pair of callipers intended to measure up to diameters of seven inches. The points of such callipers should be tapered to a wedge shape, the tapering face being on the outside edge, so that the same part of the points of each leg will touch the work, whether the latter is of small or large diameter; the points where they meet together should be slightly rounding, so that they will touch the work at the middle of each point.

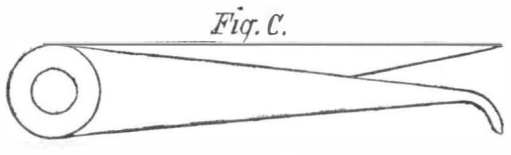
Fig. A represents an excellent proportion and shape for outside callipers. For use on threads, the points must either be made very broad, and come together level and even so as to gage the tops of the thread, or be made very thin, to gage the bottom of the thread. The proper shape for inside callipers is that given in Fig. B. The points and legs being made of the form here represented enables the callipers to have a large rivet and washer, and to enter a smaller hole, and clear a longer distance, than is possible where the points are bent round in the manner commonly employed. The dotted lines denote the distance the callipers would clear when in the position shown.





Another feature to the advantage of this form is that, when the legs are extended, the points are still at the extreme end of the callipers, so that the points will measure to the extreme end of the hole, even though the latter is closed by metal, that is, terminates in the metal. This is not the case when the calliper ends are bent round to the usual extent, for the curve of the bend will touch the end of the hole and prevent the calliper points from reaching it. In measuring with callipers, let the points be set to touch the work very lightly indeed, or they will spring from the pressure due to forcing them over the work.

Compass callipers, such as illustrated by Fig. C, are



valuable tools. When opened in the manner here shown, they may be employed to mark off the centers of holes or to try if a center already existing is in the exact center of the hole. Or they will mark off a face, so that it will fit another face, whether it be regular or irregular, the curved point being kept against the irregular face, and the point describing (by moving the compass along) a similar line on the face to be fitted. They will answer for many of the uses to which a scribing block is put; and being lighter and more easily handled, and, furthermore, capable of doing duty without the use of a surface or scribing plate, they are in such cases far preferable.

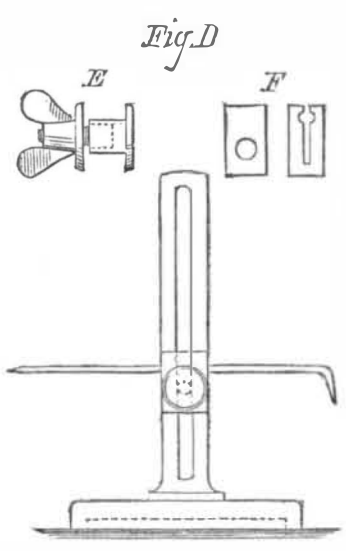
The legs may be crossed so that the curved point inclines to the straight point, in which position they will mark the centers of shafts or rods, either round, square, or any other shape, or try such centers, when they already exist, more accurately than can be done by any other tool. They will, in this case, mark off a line at the distance to which they are set, round any surface; they are employed to mark off keyways, or the taper of a gib when the key and one edge of the gib is placed, and for a variety of other uses too numerous to recapitulate, being among the most useful tools the fitter can possibly possess. The points of callipers should be tempered to a blue, and of compass callipers to a straw color.

THE SQUARE.

The square is too common a tool to require any description of its form. The best method to make one is to make the back of steel, and in two halves, one half being the thickness of the blade thicker than the other. The slot for the blade must then be filed in the thickest half, to the depth exactly equal to the thickness of the blade. The two halves composing the back must then be riveted together, and the edges surfaced each true of itself (using a surface plate to try them), and also true with each other. The blade, which should be made of saw blade, may then be put into its place, ready to have the holes for the rivets drilled. It should be placed so that the outer end is a little depressed (on the inside angle) from the right angle; this is done so that whatever there may be to take off the blade (after it is riveted to the back), to make its edges form right angles to the back, will require to be taken off the outer end of the inside angle and the end of the blade forming the corner of the outside angle, so that no work will require performing on the blade in the corner, formed by the blade entering the back on the inside angle, where it would be difficult to file or scrape without injuring the edge surface of the back. The best way to true a square is to turn up a piece of round iron equal in length to the square blade, being careful to make it quite parallel, and then true up the end of the iron, making it hollow towards the center, or cutting it away from the center to within an eighth of an inch of its diameter, so that it will stand steadily on its end. If the piece of iron be then stood on its end on a surface plate, its outline on each side, which represents its diameter, will form a true right angle to the surface of the plate, and hence a gage with which to true the square.

THE SCRIBING BLOCK.

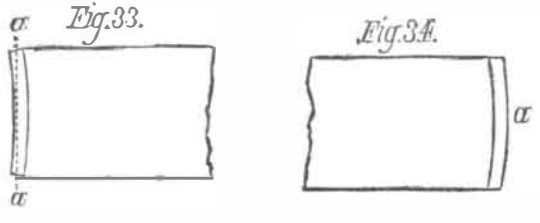
This tool is made in a variety of forms, but the simplest and best form is that shown in Figs. D, E, and F. Fig. D is the block complete, the scriber being a simple piece of round steel wire. The dotted line on the foot is the distance to which the foot is hollowed out to make it stand firm. Fig. E is the bolt and nut; the bolt has a flat side filed on each side of it to fit it to the slot in the scribing block stem, so that the bolt cannot turn when it is being tightened. Fig. F is a face and edge view of the piece or clamp for the scriber which passes through the hole in the slot.



The advantages possessed by this form over other forms of scribing block are that it is easy to make, and that the scriber, being a piece of wire, is easily renewed. It holds the scriber very firmly indeed, and the scriber may be moved back and forth without the nut becoming slack, an object of great importance not attainable in the common form of this tool.

CHIPPING.

The chisel requires special notice, since it is frequently made of the most ill-advised shape (for either cutting smoothly or standing the effects of the blow), that is, hollow, as in Fig. 33, in which case there are two sections of metal, represented by the dotted lines, *a a*, which are very liable to break, from their weakness and from the strain outwards placed upon



them by the cut, which, acting as a wedge, endeavors at each blow to drive them outwards instead of inwards, as would be the case in a properly shaped chisel, as shown in Fig. 34, *a* being the cutting edge.

When using, hold it firmly against the cut, and it will do its work smoother and quicker.

The cape, or, as it is sometimes called, cross-cut chisel, is employed to cut furrows across the work to be chipped, which furrows, being cut at a distance from each other less in width than the breadth of the flat chisel, relieve the flat chisel and prevent its corners from "digging in" and breaking. If a large body of metal requires to be chipped off cast iron or brass, the use of the cape chisel becomes especially advantageous, for the metal, being weakened by the furrows, will break away in pieces from the force of the blow, without requiring to be positively cut by the chisel; but care must be taken to leave sufficient metal to take a clean finishing cut, for when the metal is broken away, by the force of the blow, it is apt to break out below the level of the cut. It is also necessary to nick deeply with a chisel the outside edges of the work at the line representing the depth of the metal to be chipped off, so that the metal shall not break away at the edges deeper than the cut is intended to be.

FILING.

Large files should be fitted to their handles by making the tine of the file a low red heat and forcing it into the handle, so that it will burn its way into the handle, and thus prevent the handle from splitting, as it would do if the file tine were driven in; the file and handle should be turned in the hands occasionally to guide the eye in detecting whether the file is entering in a line with the length of the handle. Care should be taken to wrap a piece of waste around the end of the file, and to keep it wetted with water so as to avoid softening the teeth of the file while heating the tine. For small files, it is sufficient to bore a small hole in the handle and force the tine in by hand. A file should be held so that the butt end of the file handle presses against the center of the palm of the hand, the forefinger being beneath the body of the file handle.

In selecting a file, choose one that is thickest in the center of its length, and of an evenly curved sweep from end to end, so as not to make the surface of the work round by filing away the edges. Files that have warped in the hardening may be used on very narrow surfaces, or on round or oval work; or, if they are smooth files, they may be used on lathe work. Keyways or slots, especially, require an evenly rounded file; and if the keyway is long and the file parallel or uneven upon its surface, the end of the file only should be used to ease away the center of the keyway or the high spots. It is also highly advantageous to rub chalk on the teeth of the file, so that, after a little using, the eye can detect the part of the file which is highest, and govern its use accordingly.

Half round files should be rounded lengthwise of the half round side of the file, because it is difficult to file out a sweep evenly, even with a well shaped file, and it is impossible to do so with a file whose half round surface is hollow in the direction of its length.

These files must be used with a side sweep, caused by gradually bending the wrist at every stroke of the file, so that the file marks are not at a right angle to the curve, the sweep of the file being varied occasionally from right to left or from left to right, so that the file marks cross one another, otherwise there will be high ridges or waves in the curve.

In draw filing, be careful to note the higher parts of the file and use them only for flat surfaces, also to clean the filings out occasionally to prevent scratches in the work, and to rub chalk upon the file, which will prevent the filings from getting locked in the teeth; then, after every few strokes of the file, brush the hand over it to loosen the chalk and filings, and strike it lightly against the screw box or other soft part of the vise, which is more expeditious than, and equally as effective as, using the file card every time; when, however, the file requires chalking again, which will easily become apparent, the file card may be advantageously applied before applying the chalk.

Rough or bastard files are used to take off metal in quantity; but if the surface of the work is unusually hard, a second cut file will better answer the purpose. For finishing work very finely, cross file it with a smooth file and then draw file it with the same; then cross file it with a dead smooth file, and draw file it with the same, using very short strokes of the file and applying chalk to it.

A worn dead smooth will finish finer than a new one, and better results will be obtained by finishing the work crosswise of the grain than in a line with it, because any inequality in the texture of the metal will usually run with the grain, and the file teeth will cut the softer parts more readily when following in their length than when merely crossing them.

EMERY PAPER.

In applying the emery paper, use at first No. 1 paper both along and across the work, and repeat the process with No. 0, No. 00, No. 000, or No. 0000, according to the fineness of the polish required, bearing in mind that, the more the emery cloth or paper has been used, the finer is the polish it will give, the reason being that it becomes coated with a glazed surface, composed of particles of the metal it has been rubbing; and all metals polish finer and brighter with such a surface than with any other. If the finer grades of emery cloth or paper cannot be readily obtained, take the finest grade at hand, and wear it down by using it on a rod or piece of metal in a lathe at a high speed, wiping the rod once during the latter part of the operation with a piece of rag or waste slightly oiled, which will cause the oil to pass to the emery paper, and the latter to retain the particles of metal upon its surface. If this method of polishing be carefully executed, the work may be kept very true and even, and possess a finer finish and polish than by applying oil stone or by any other known method.

Before commencing any piece of work, measure it all over; and if it has a rectangular part, apply the square to it so as to be assured, before any work has been done to it, that it will clean up to the required dimensions.

MANUFACTURE OF LAMP BLACK.—J. H. Bottenberg, Ravenna, O., provides a revolving cylinder, which is kept cool. Within is a series of gas jets, which deposit carbon on the interior of the cylinder, which carbon is removed by scrapers by the turning of the cylinder.