HOW TO USE A FILE.

BY JOSHUA ROSE, M.E.

The excellence of a piece of work operated upon by a file is only limited by the skillfulness of the operator, because a file can be made of any required form and size, and the quantity of metal it will cut away and the location of the same may be varied at will, hence it is evident that it is possible to perform with the file every cutting operation assignable to steel tools.

The legitimate use of the file may be classed under four headings: 1. The removal of surplus metal. 2. To correct errors in the truth of work that has been operated upon by such machine tools as the planer and shaper. 3. The production of small intricate or irregular forms. 4. To fit work together more accurately than can be done by the use of other tools. With reference to the first, the domain of the file has of late years been greatly circumscribed by the introduction of special machines which will finish small work sufficiently accurate to render subsequent filing unnecessary. As a correcting process, however, filing still maintains a pre-eminent position from the fact that no other tool can be so delicately or minutely applied, and it is found that work produced by special or other machine tools, though sufficiently true for ordinary purposes, yet require correction in all cases where the utmost attainable exactitude and smoothness are required. One of the main reasons for this is to be found in that work to be operated upon in special machines requires to be held or clamped firmly, and as a result is almost inevitably sprung. Another reason is that in filing, the work unclamped and therefore unsprung may be tried to its place or to gauge, etc., and any detectable error remedied.

On large work this is especially the case, and for this reason the file is almost the only finishing tool.

In the production of small intricate or irregular forms the file is either used to originate a cutter or tool to be used in a machine tool, or if but few of the pieces are required it is applied direct to get out the work, machine tools being employed to rough the work out somewhat near to the required shape.

It is always desirable that the surface to be filed should lie horizontally level, and for ordinary work the face to be filed should be about the same height as the operator's elbow. If the work is large and requires a long reach, it is better to be lower, while if it is very small, so that but little pressure is required upon the file, it may be placed higher, so as to render less stooping necessary, and the eye may be able to add its scrutiny to the sense of feeling of the hand, upon which principally successful practice depends. When the work is level with the elbow the first joint of the arm is in a line with the force required to push the file, which places less strain upon the arm. This is of great consequence in filing chipped surfaces or removing a quantity of metal.

The teeth of a file are unequal in height, and as the file warps in hardening it is evident that, even supposing the operator to move the file in a straight line, the surface filed would not be straight, hence files to be used upon flat surfaces should be thickest in the middle and thinner at each end of their lengths. This gives to the surface of the teeth tops a curve or sweep in the length of the file, so that if it should warp slightly in the hardening process the effect is to merely lessen the sweep on one side and increase it on the other. This is of but little consequence, because by altering the height of the respective ends of the file to the work any part of the file may be brought into contact with the work and its action located to any required part of the work. If the file is moved in a straight line it will file flat so long as the surface is curved, but if the file is hollow in its length it cannot under any circumstances file a flat surface, and one of the greatest objections to recut files is that the original curve is not maintained. The most expert mechanic, however, cannot move a file in a straight line, and the curve of the file is usually about sufficient to compensate for the variation of the stroke from a horizontal plane.

The level of the teeth across the file may either be flat or slightly rounding, but in no case should it be hollow, for in that case the two file edges would cut two grooves.

For convex surfaces a flat file is usually employed, but for concave surfaces the file must be given a convexity greater than the concavity of the work, so that any desired part of the file may be brought into contact with the work, notwithstanding a slight irregularity in the curve of the file. A round file should always be a trifle smaller in diameter than the hole it is to be used upon, and before inserting it in the hole the eye should be cast along the length of the file while the latter is revolved slowly in the fingers. By this means we may select the curve in the length of the file, and bring it to bear upon the work so as to avoid filing the edges away.

If we closely examine a flat, square, or half round file we shall find that the cutting edge of the teeth does not come fully up at the corner, hence neither of them will file a clean corner, but leave it slightly round; to remedy this defect the only plan is to grind away the edge of the flat or one side of the square file, making it smooth, or at least so that the teeth points will meet the corner. Care should be taken to select the worst side of the file to grind away, and this will be the side hollowest in its length. Sometimes a smooth half round file is used to square out a corner, in which case the smoother the file the better.

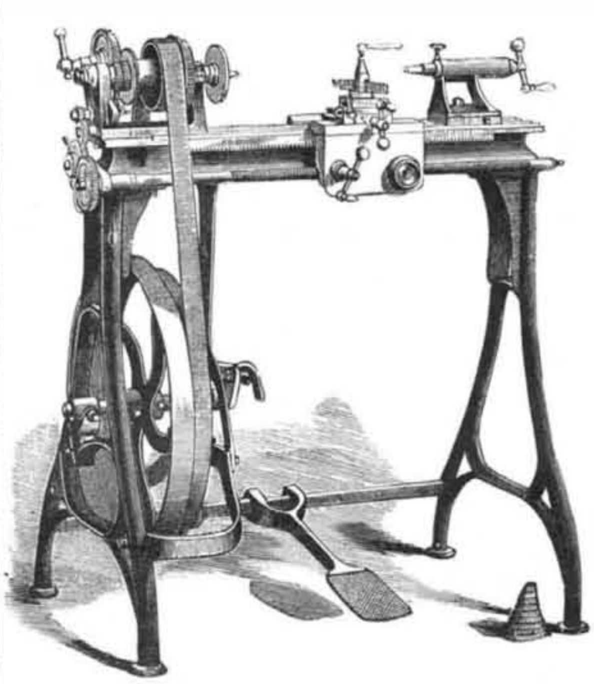
Safe edge files are those which have one edge left without teeth, so that it will not cut, the object being to enable that edge to be moved against a flange or projection of the work without cutting it. As a rule, however, it will be found that cutting the teeth on one side throws a burr over the edge, and it is necessary, unless in very fine files, to pass the safe edge over the grindstone to make it absolutely safe.

In using parallel files for keyways it is often necessary to finish with the end of the file only, so as to take any roundness in the keyway surface. It is to be especially noted that by giving the file a slight lateral motion at each forward stroke and reversing the direction of that motion, so that the file marks cross, there will be less liability for the file to pin and the file will cut more freely, but with a lateral motion from right to left the file cuts cleanest. This is because the deepest serrations forming the file teeth are diagonal and nearest to the end of the file on the lefthand side, hence with a motion from right to left there is a partial draw filing action.

For finishing, very light strokes should be taken, the cross filing being done with smooth files before the draw filing is begun, and to prevent pinning a frequent application of chalk should be given to the file teeth.

NEW SCREW CUTTING LATHE.

To meet the demand for a first class and yet low priced screw cutting foot lathe, Messrs. Goodnow & Wightman, of 128 Washington street, Boston, Mass., have perfected the lathe shown in the accompanying engraving.



NEW SCREW CUTTING LATHE.

This lathe occupies a floor space of 25x36 inches, and the centers are 44 inches from the floor. The whole weight is 266 pounds. The bed is 35 inches long, 5 inches deep, and has double Vs for the carriage and tail stock. It swings 8 inches over the bed and $5\frac{3}{4}$ inches over the carriage, and is 18 inches between centers.

The head stock is back geared, and the cone has two speeds for $1\frac{1}{2}$ inch belt, the smaller being $2\frac{1}{2}$ inches diameter, the larger 5 inches diameter. This with the back gears gives four speeds, the fastest being 1,100 revolutions of the arbor to 100 of the balance wheel, and the slowest 75 revolutions of the arbor to 100 of the balance wheel. This gives sufficient range for all kinds of work.

The arbor in the head stock is 9 inches long, $1\frac{1}{4}$ inch diameter in the largest part, and has a $\frac{3}{8}$ inch hole through it, making it very convenient for turning the ends of long rods, making small screws, studs, etc. There is an attachment in the head stock for reversing the motion of the carriage.

The carriage has a rack and pinion for moving it by hand, and a split nut moved by a cam on the face of the carriage to throw it into engagement with the feed screw. The tool post has a slot for tools $\frac{3}{8}$x$1\frac{1}{8}$ inch. The tools are adjusted by a wedge made on the arc of a circle and fitted to a convex washer. Gears for cutting threads from 8 to 48 accompany the lathe. By compounding the gears other threads may be cut.

The tail stock can be set over for turning tapers. The spindle of the tail stock is $\frac{5}{16}$ inch diameter, and has a motion of 3 inches.

The crank of the foot motion is adjustable, and the shaft has swivel bearings. The balance wheel weighs about 60 pounds, is $21\frac{1}{2}$ inches diameter, and has two speeds to match the cone on the head stock.

For further particulars address Messrs. Goodnow & Wightman as above.

Our Iron Industry.

As supplemental to our article under the above heading, in our issue of June 29, we mention Mr. C. M. Du Puy's direct process of making iron. This process has been indorsed by Messrs. Miller, Metcalf & Parkin, of Pittsburg, Pa. Rich hematites or magnetites are crushed and pulverized, together with carbon and fluxes in the proper proportions, in an ordinary Chilian mill, such as is generally used for grinding the fix. This mixture is then filled into annular cylindrical sheet iron canisters, of No. 26 iron, which are about 16 inches diameter and from 16 to 36 inches high, holding each enough ore to make a cake of metal that will shingle from 100 to 250 lbs. of iron. The carbon used for deoxidation may be either charcoal, coke, or anthracite.

The canisters are placed on end in an ordinary heated reverberatory furnace, on a bed of coke, and placed seven or eight inches apart so as to allow a free circulation of heat. The door is then shut, and without manipulation the work is done. In five or six hours the canisters with their contents have consolidated into masses of metal, saturated with liquid slag, and after being transferred to the squeezer are made into blooms and rolled to muck bar without reheating.

The idea of enveloping ore, with carbon and fluxes properly proportioned, in sheet iron incasements or canisters, originated with Mr. Du Puy, and although partially successful many years ago, it has only been within the past year that quality and yield have been fully satisfactory. As with many other inventions apparently simple, much labor and thought have been required to make it commercially a practical success. We learn that now nearly all the metal can be extracted by it that originally exists in the ore.

Much of the difficulty at first met in perfecting the process was caused by the non-conducting nature of the mixture. Heat penetrates very well through about two and a half or three inches of ore and carbon in about five or six hours; but to penetrate further than this such a high heat and such a protracted time are required as to waste the exterior surface of the metal, lessen the yield, and add largely to the cost of fuel. It was this difficulty that suggested annular canisters, with an opening from top to bottom, through which the heat passes, so that it can penetrate from the inside of the ring of ore and carbon as well as from the outside. This inside space is about six inches in diameter, leaving in canisters of 16 inches outside diameter a ring of mixture five inches in thickness.

With a thorough penetration of the heat, however, success was not yet obtained. It is well known that ordinarily, in direct processes, every pound of silica carries off about three pounds of iron in the slag, since there is no other substance present in sufficient quantity with which to combine. Besides, to reduce iron ore to the metallic state in five or six hours requires a high heat, and this tends to partially reoxidize the iron as soon as it is reduced.

It occurred to the inventor that to dissolve the silica, which is an acid, by the means of alkalies, would serve a double purpose. The silica having a stronger affinity for the alkalies than for the iron, the iron would be saved, and there would also be formed a glazing material, or varnish, to cover and protect the metal from reoxidation. The use of alkalies proved successful, and secured a yield of almost the entire amount of metal contained in the ore.

The chemistry of the process is simple: the oxygen of the ore unites with the carbon and passes off as carbonic oxide, while the alkali combines with the silica and other impurities of the ore to form a glass, which is finally expelled by the pressure of the hammer or squeezer.

It is estimated that a reverberatory furnace, 8 by 14 feet inside dimensions, costing, say, $2,000, will produce over a ton of iron every six hours, or three and a half tons in 24 hours.

The metal has been proved by the analysis of Dr. Otto Wuth, of Pittsburg, to be of great purity, three fourths of the phosphorus existing in the ore being eliminated. The iron, without mixture with any other stock, has also been proved to make the finest steel, and it may be used for all grades of crucible steel, the grade being regulated by varying the carbon in the crucible.

Coming finally to the cost, which is the crucial test of commercial success, it is estimated that the crushing and mixing of the material, together with the cost of the canisters, will be from $6 to $7 to the ton of iron, and that at a like cost of material blooms may be produced at a cost of only $8 to $10 per ton above the cost of pig iron, while the quality will be equal to that of the highest grades of steel stock.

Two Ways of Looking at the Same Facts.

An English scientific paper remarks as a curious physiological fact that although open air life is so favorable to health, yet it has the apparent effect of stunting growth in early youth. While the children of well-to-do parents, carefully housed and tended, are taller for their age than the children of the poor, they are not so strong in after years. "The laborers' children, for instance, who play in the lonely country roads and fields all day, whose parents lock their cottage doors when leaving for work in the morning, so that their offspring shall not gain entrance and do mischief, are almost invariably short for their age. The children of working farmers exhibit the same peculiarity. After sixteen or eighteen, after years of hesitation as it were, the lads shoot up, and become great hulking broad fellows, possessed of immense strength. Hence it would seem that indoor life forces growth at the wrong period, and so injures." The inference is plausible, but is wide of the mark. The children of the well to do are tall not because they are kept indoors, but because they are well fed and saved from severe exposure. The children of the poor are stunted not by too much sun and air, but because they are ill fed. Give the first class plenty of outdoor play, with their proper diet, and they will be strong as well as tall; give to the laborers' children the food suitable to their years, and no amount of sun and wind will stunt them. On the contrary they will not have to wait till age brings capacity to turn strong food to bone and muscle, and time to overcome the evil effects of hard times in early life; but will grow from the first steadily and sturdily.