PRACTICAL MECHANISM.

NUMBER IV.

BY JOSHUA ROSE.

SCREW CUTTING TOOLS.

Lathe tools for cutting screws have necessarily, from the nature of their duty, a comparatively broad cutting surface, rendering them very subject to spring. Those used for V threads, being ground to fit the V of the thread, are, in consequence, weak and liable to break, to avoid which they should only be given enough bottom rake to well clear the thread, and top rake sufficient to make them cut clean. They are used at a slow rate of cutting speed, and may therefore be lowered to a straw-colored temper (as reducing the temper strengthens a tool). Firmness and strength are of great importance to this class of tool, so that it should be fastened with the cutting edge as near to the tool post as is convenient.

For use on wrought iron, it is sometimes given side rake; but this is not a necessity and is of doubtful utility, because the advantage gained by its tendency to assist in feeding itself is quite counterbalanced by its increased liability to break at the point. It should always be placed to cut at the center of the work. For use on brass, it must be ground on the top face to an inclined plane, of which the cutting point is the depressed end, that is to say, it must have negative top rake.

For cutting square threads, the tool shown in Fig. 14, with the sides ground away beneath sufficiently to well clear the sides of the thread, is used.

If the pitch of the screw to be cut is very coarse, a tool nearly one half of the width of the space between one thread and the next should be employed, so as to avoid the spring which a tool of the full width would undergo. After taking several cuts, the tool must be moved laterally to the amount of its width, and cuts taken off as before until the tool has cut somewhat deeper than it did before being moved, when it must be placed back again into its first position, and the process repeated until the required depth of thread is attained.

Fig. 24.

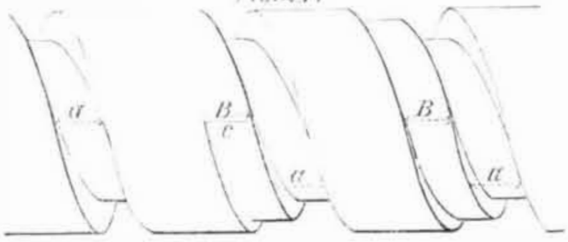


Fig. 24 represents a thread or screw during the above described process of cutting. *a a a* is the groove or space taken out by the cuts before the tool was moved; B B represents the first cut taken after it was moved; *c* is the point to which the cut, B, is supposed (for the purpose of this illustration) to have traveled.

The tool used having been a little less than one half the proper width of the space of the thread, it becomes evident that the thread will be left with rather more than its proper thickness, which is done to allow finishing cuts to be taken upon its sides, for which purpose the side tool (given in Fig. 22) is brought into requisition, care being taken that it is placed true, so as to cut both sides of the thread of an equal angle to the center line of the screw.

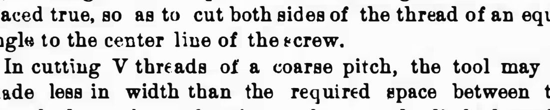
In cutting V threads of a coarse pitch, the tool may be made less in width than the required space between the threads demands, so that it may be moved a little laterally in order to take a cut off one side of the thread only at a time, by which means a heavier cut may be taken with less liability for the tool to spring in; but the finishing cut is better if taken by a tool of the full width or shape of the thread.

The most accurate method of cutting small V threads is to use a stout chaser fastened in the tool post, and then feed it with the screw-cutting gear of the lathe, the same as with a common screw cutting tool. Such a chaser should be made hollow in the length of the tooth, possess a minimum of top rake, and be placed to cut at the center of the work; and it should be so placed in the tool post that the teeth stand exactly parallel to the line of the cut.

CHASERS.

An outside chaser for cutting wrought iron by hand should be made hollow in the length of the tooth, and have top

Fig. 25.



rake, as shown in Fig. 25, to enable it to cut easily; for the strain required to bend the shaving out of the straight line will hold the teeth to their cut. Top rake may, in fact, be applied to such an extent that the chaser will cut well of it self without having any force applied to it except sufficient to keep it level, but if made so keen, it soon loses its edge and is very apt to break. The bottom edge of the teeth is rounded off so that the chaser will slide easily along the rest. It is an error to make this tool very thick. For cutting 14 threads to an inch, the chaser should be one quarter of an inch thick; and for cutting 8 to an inch, the thickness should be five sixteenths of an inch, so that the fulcrum off which the teeth take their cuts may be close to the cuts, in which case the chaser will be steadier and more under control. The leading tooth should always be a full one and come just level with the edge. When finishing the thread being cut, hold the chaser horizontally, or it will, in consequence of the top rake, cut a thread deeper than itself. For use in the tool post, with the rest fed by the proper gear for the pitch, less top rake is required, and the thickness must be much increased to gain strength and avoid spring; for the fulcrum off which the tool thus used takes its cut is at the point *a*, described in Fig. 11, instead of being directly beneath the cut, as in the case of a hand chaser.

An inside chaser, that is, one for cutting threads in a hole or bore, should be, if to be used for cutting a right handed thread, cut off a left-handed hub, otherwise the chaser will have its thread sloping in the opposite direction to the thread to be cut, as may be demonstrated by placing an inside and outside chaser (both having been cut off the same hub) together, when it will be seen that the teeth of one will not fit in the teeth of the other, as they should do; the cause being that, after an inside chaser is cut by the hub, it has to be turned around to be placed in a position to cut, which turning reverses the direction in which its teeth slant.

All chasers should be tempered to a brown color and be used at a slow rate of cutting speed.

TOOL STEEL.

The cutting tools for all machines should be made of hammered (which is tougher and of finer grain then rolled) steel. Even in a bar of hammered steel, the corners, from receiving the most effect from the action of the hammer, are of better quality (that is, more refined) than the rest of the bar. This fact is clearly demonstrated in the manufacture of the celebrated Damascus swords and gun barrels, in which the square bars of metal are, after being hammered, twisted and then hammered square again; the twisting process is then repeated, and the bar again forged square, the whole operation being repeated until the body of the entire bar is completely intersected with metal which has, at some time during the forging process, formed the corners of a square. The effect of this treatment becomes apparent upon immersing the metal in acid, which will eat away those parts which have not formed a corner at some stage of the process of manufacture, more rapidly than the rest of the metal, and that to such a degree as to give to the whole the appearance of having been engraved, thus evidencing that the parts that have received the most hammering are of finer quality than the rest of the bar.

For cutting tools, it is highly necessary to gain every attainable superiority in the steel; and if we cannot take three months of time to prepare bars for this special purpose (as they do in the above process), we can at least employ well hammered steel, and thus secure the best known practicable results.

The test of tool steel is the speed at which it will cut and the length of time it will last without being ground, concerning which it is difficult to get data, unless by actual experiment with different kinds of steel upon work of the same diameter and texture of metal, because the cutting speed employed by workmen varies as much as 8 feet per minute upon the same diameter of work. The proper cutting speed for work is, however, to be hereafter treated upon, hence nothing further upon the subject need be now said. The use of more than one kind of tool steel in a workshop should always be avoided, because different kinds of steel require different treatment, both in forging and hardening; and when more than one kind is in use in the shop, the whole of them are liable (from not noticing the particular brand) to wrong treatment.

Mushet's "special tool steel" makes an excellent tool for roughing work out on the lathe or planer, and will undoubtedly stand a higher rate of cutting speed than other steel. Its peculiarity is that it is hard of itself, and therefore requires no hardening. Immersing it in water when it is heated causes it to crack. The advantages claimed for it are its high rate of cutting speed, and that it is easily ground, since it will not soften by heating during the operation. It is, on the other hand, difficult to forge in consequence of its excessive hardening even when heated; it must not be forged at so great or so low a temperature as other steel, or it will crack; and as it is not adapted for general tool purposes, its disadvantages, independent of its increased cost, render its introduction into the general machine shop unadvisable.

FORGING TOOLS.

In forging a tool, it should be formed in as few heats as possible, for steel deteriorates by repeated heating, unless it is well hammered at each heat; and if the tool has a narrow edge, care should also be taken to hammer it on that edge before the metal has lost much of its heat, and to strike it more lightly as it gets cooler, for striking a narrow surface of steel when it is somewhat cool has the same injurious effect upon it as striking it endwise of the grain (which is termed upsetting it), destroying its cutting value and strength.

In using American chrome steel, be careful to forge it according to the directions supplied by its manufacturers, its treatment being almost the opposite for that applicable to English tool steel, the former requiring to be heated to a much higher temperature for forging, and to a less temperature for hardening, than the latter.

TOOL HARDENING.

The degree to which a tool may be hardened is dependent in a great measure upon its shape. Stout tools, such as are shown in Fig. 6, may be made as hard as fire and water will make them; so also may the tools presented in Figs. 8, 9, 18, 19, 20, and 23; while slight tools, such as are given in Figs 14 and 22, should be lowered in temper to a light straw color, which leaves them stronger than they would be if hardened right out, that is, made to a moderate red heat and quenched in the water, without being taken out until quite cold.

The practice of lowering stout tools to a straw color is sometimes resorted to, but it is certainly an error, for it is undoubtedly advantageous to make the tool as hard as it can be made, so long as it will bear the strain of the cut, which is possible and easy of accomplishment with Jessop's, Moss', Sanderson's, or other similar grades of tool steel.

If a tool so hardened is found to break, it is in consequence either of its being bad steel or else it has been heated to too great a temperature in the process of forging or hardening, unless it has been given too much rake for the duty to which it has been allotted. Toolsteel may be forged at such a temperature that it is not positively burned, and yet has lost part of its virtue; and while under such circumstances it would break if hardened right out, it will cut and stand moderately well if the temper be lowered to a straw color.

This is simply sacrificing the degree of hardness to cover the blunder committed by overheating, and it is from such causes that the variation of cutting speed employed by mechanics arises; for a youth who has learned his trade in a shop where the tools were overheated, and consequently underhardened, settles down to the rate of cutting speed attainable under those circumstances and adheres to it; while he who has been accustomed to the use of tools properly forged and hardened right out, upon entering another shop where the tools are overheated in forging and underhardened to compensate for it, finding he cannot get the cutting speed up to his customary rate, breaks off the tool point to see if it has been burned, and, finding that the grain of the metal does not appear granulated, sparkling, and coarse, as it would do if positively burned, condemns the quality of the steel.

The grain of properly forged and hardened tool steel appears, when fractured, close and fine, and of a dull, whitish tint, the fracture being even on its surface.

American chrome tool steel may be made unusually hard by using very clean water and adding a piece of fuller's earth and a piece of common soda, each of the size of a hazel nut, to a pailful of water.

In all cases where a tool can be ground to sharpen it, it should be hardened before grinding, for steel hardened with the forged skin on is stronger and better than that in which the skin is removed before hardening. Heat the tool the distance that it is necessary to harden it, and plunge it into the water suddenly to the distance it requires hardening; and if it is intended to harden it right out, hold it still a moment, then dip it a little deeper, and withdraw it again to the amount of the last dipping, repeating this latter operation until the tool is cold; for by this means the junction of the hard and soft steel in the tool is graduated and not sharply defined, the result being that the tool is less liable to fracture either in hardening or in using. If the tool to be hardened has a thick part to it, let that part enter the water first and immerse the tool slowly, so that it will be cooled as nearly equally as possible and thus be prevented from cracking in hardening.

Tools heated by charcoal are much superior to those heated by common coal, and need not be made quite so hot to harden. To harden steel, never get it hot enough to cause it to scale. Thin pieces of steel, and taps, dies, reamers, drifts, and similarly shaped tools, should be dipped endways; for if dipped otherwise, they are sure to warp in hardening. Very slight tools may be prevented from cracking by making the water quite warm before immersing them, and then holding them still in the water; in fact, all water for hardening purposes should have the chill off it by heating, before being used, or the articles hardened in it are very liable to crack. If the article requires to be hardened all over, immerse it (suspended on a wire hook) so that the water may have free and equal access to the whole surface of the steel, which is not possible with tongs in consequence of their jaws covering part of the steel.

The best method of lowering the temper of taps, reamers, or other round steel is to heat a tube in the fire and hold the article in the center of the tube; and it is well to let the tube be rather shorter than the tap or reamer, so that the end, which is made square for the wrench to fit, may be kept longer in the tube than the rest of the tool so as to make it rather softer. The tool should be revolved slowly in the tube to make the temper even. Care should be taken not to make the tube too hot; for the more slowly a tool is lowered, the more even the temper will be.

Flat pieces of steel, as dies, etc., should be lowered (that is tempered) by placing them on a piece of heated iron and turning them over and over to temper them evenly.

The colors produced upon the surface of a piece of hardened steel by lowering it are from very light straw, deepening successively as it lowers, to yellow, bright brown, purple, and blue. As a general rule, tools which are stout and easy to make and to grind should be hardened right out. Those slight in proportion to the strain placed upon them should be tempered to a brown. All screw-cutting tools, such as taps, dies, etc., also reamers, flat cutters, revolving cutters, and spring tools, should be tempered to a brown color; drills should be tempered to a bright purple, and chipping chisels to a blue.

RAILWAY OR SEA ALARM.—Air is compressed in a cylindrical reservoir from which a tube conveys it to three organ pipes (giving *do, mi, sol*), which can be sounded separately or together. In fog the *do* is sounded; and whenever an engine driver hears it in an advancing train, he sounds his *mi*, then the other driver sounds his *mi* if he is on the right line, then both sound *sol*.

COMPOSITION FOR THE DESTRUCTION OF BUGS AND THEIR EGGS, FLEAS, ETC.—This mixture, which has been patented in France, consists of 80 parts of bisulphide of carbon and 20 parts of essence of petroleum.—*M. Doré*.