How to Sharpen

A CRAFTSMAN REG. TRADE MARK HANDBOOK

REVISED 1954

How to Sharpen

INDEX

Catalog No. 9-2924

An Illustrated Manual

for

MECHANICS CRAFTSMEN
FARMERS SHOP MEN
HOUSEWIVES

Easy-to-follow — Completely Illustrated Instructions for Everyone Who Uses Cutting Tools of Any Kind

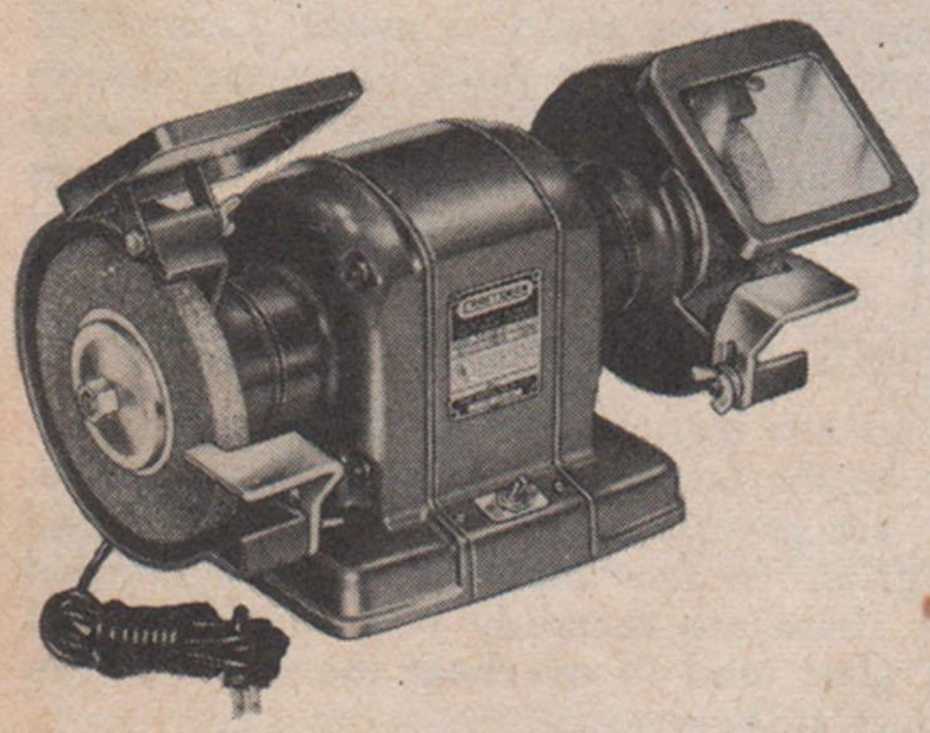
OVER 200 ILLUSTRATIONS

A CRAFTSMAN HANDBOOK FOR CRAFTSMEN

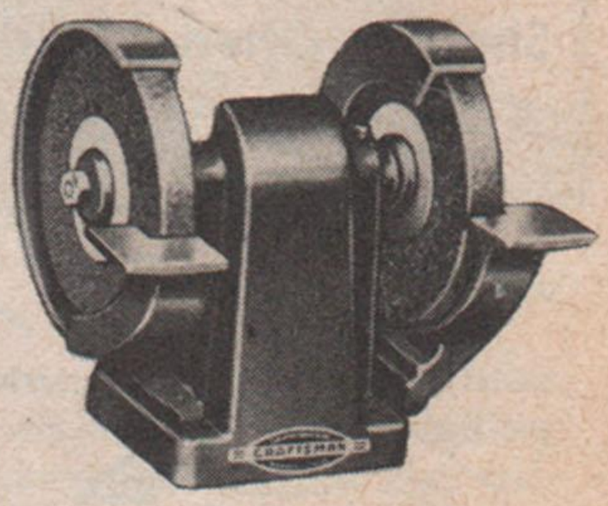
REG. TRADE MARK

SEARS, ROEBUCK and CO.

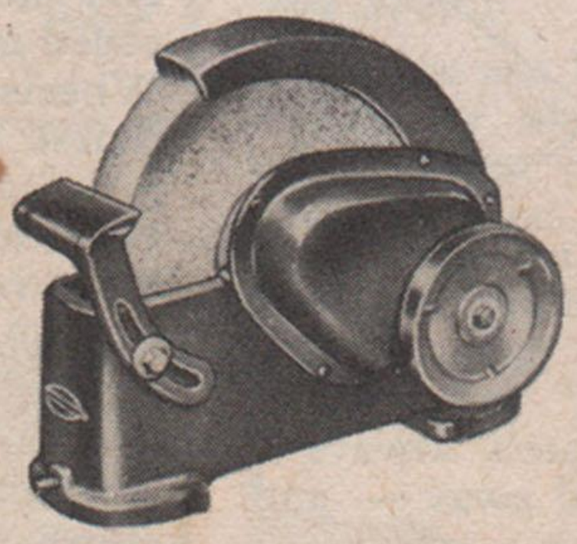
REVISED 1954



A typical power grinder with integral motor and two aluminum oxide (dry) grinding wheels: one medium grit and one fine grit. Note the handy, adjustable tool rests — the adjustable, shatter-proof eye shields — and the removable wheel guards.



Heavy-duty grinding head provides two aluminum oxide (dry) grinding wheels which can be driven by separate motor. Has adjustable guards and tool rests — fully shielded 2-step pulley.



Large (10-inch) natural grindstone of finest quality set in trough for wet grinding. Has hinged splash guard and adjustable tool rest. Motor extra.

An excellent electric cutlery conditioner for easy and positive sharpening and conditioning of all kinds of knives. Automatically positions blade to produce uniform bevels.

Double-purpose tool incorporates a vertical dry grinding wheel and a horizontal, reduced-speed honing wheel. Adjustable tool rests. Motor extra.

Printed in U. S. A.

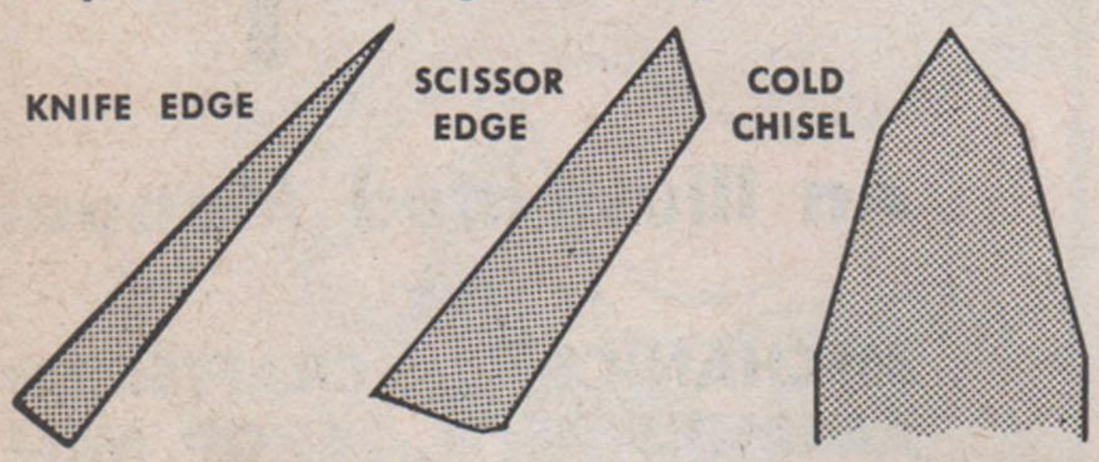
general data on sharpening

PRINCIPLES OF SHARPENING

Definitions

Grinding, as used here, means removing a visible amount of metal. The removal of practically invisible amounts — to give the final touch of fineness to an edge — is called honing. Both are necessary steps in sharpening.

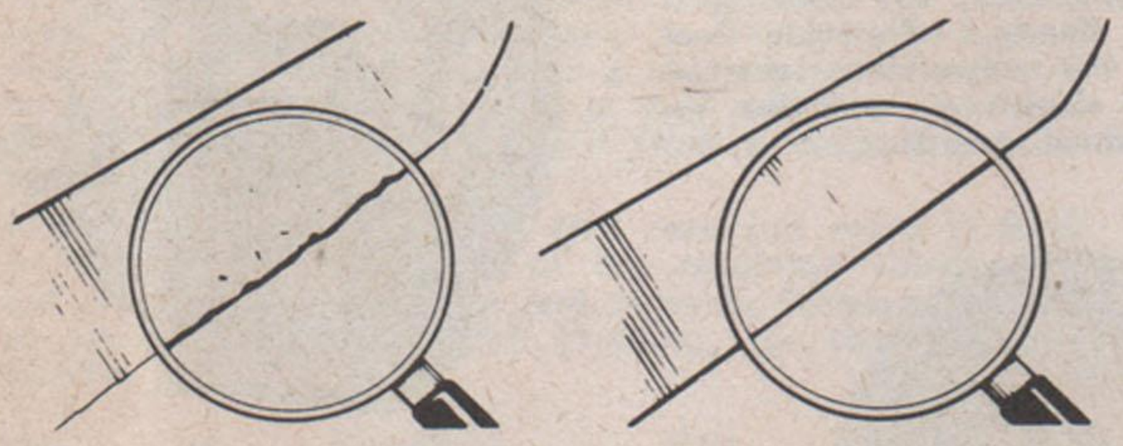
Duplicate the Original Shape



"Sharpness" varies with the tool. The three edges shown have different requirements calling for different angles between the two sides (Edge Bevels) that form each edge — yet in each case the usefulness of the tool depends upon the straightness and smoothness of the very edge, itself, and the smoothness and accuracy with which the Edge Bevels are formed. Sharpening, therefore, is creating Edge Bevels that meet at the correct angle and which are as true and smooth as possible.

Tools are generally made of metals best suited to the type edge required. Razors are made of hard brittle steel — to take and hold a microscopically fine, straight, slicing-type edge; while hatchets have tougher and less brittle edges better suited to chopping. The amount of cutting kneenness possible depends, then, on the kind and quality of the tool. It's more practical, therefore, to duplicate original shapes.

Sharpen Often — Grind Less



The worse an edge becomes the more grinding is needed to re-shape it. Some, "case hardened" tools have only a skin of hard metal — too much grinding exposes the "soft" interior and ruins the tool. In any case, there's always a limit to how much can be ground away — and proper care avoids much grinding.

Dulling starts when tiny, invisible particles of the edge break off to leave minute dents. Each dent causes a slight jolt as the edge is drawn or struck across the surface being cut — and the jolts hasten the widening of the dents. That's why a truly sharp (perfectly straight) edge lasts longer, and why frequent honing beats occasional grinding.

How to Sharpen

If grinding is necessary, support the tool as best you can to produce a flat straight bevel at the correct angle. Grind bevels carefully until you have a new correctly shaped, visibly straight edge. Don't let the tool overheat — the edge should never become too hot to touch — as this might draw the temper (soften it). Preferably, have the sharpening surface move outward, toward the tool edge, especially for the finishing grinds (as it's easier to control shaping the edge this way).

Grinding toward an edge will push some metal over the edge to form a Wire Edge at the top of the other side. The faster the metal is being removed, the thicker this Wire Edge will be. By grinding on one side then the other, the Wire Edge can be bent from side to side until it breaks off — but if it's thick the remaining tool edge will be thick. Therefore, to produce a fine edge it is necessary to alternate sides while removing less and less metal. Less metal is removed by using a finer abrasive, lighter pressure and slower speed. That's why razor sharp edges are finished by honing — with tools designed to remove only microscopic amounts of metal.

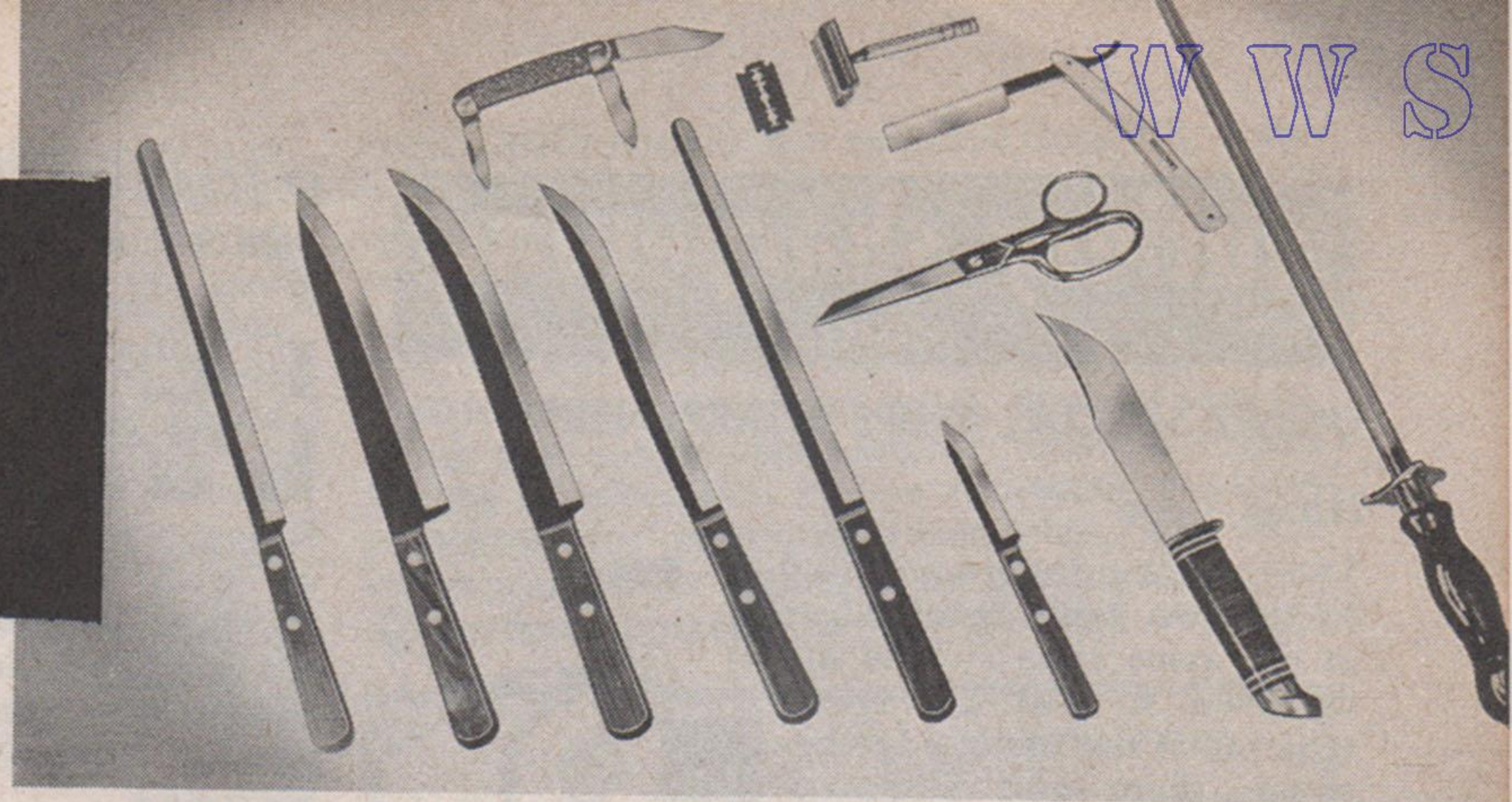
CHOOSING SHARPENING EQUIPMENT

Dry stones are man-made — are generally conceded to be the fastest cutting and most durable. Wheels are available in fine, medium and coarse grits. When mounted on high-speed grinders, these are certainly best for fast metal removal (but tend to overheat the work if you are not careful).

Wet stones are cut from natural stones — are "softer", run at slower speeds, and cut more slowly than dry stones do. They are always run moist, to prevent loading (clogging the stone with metal) — and are less likely to overheat the work. It is easier to hone on a wet stone than a dry one.

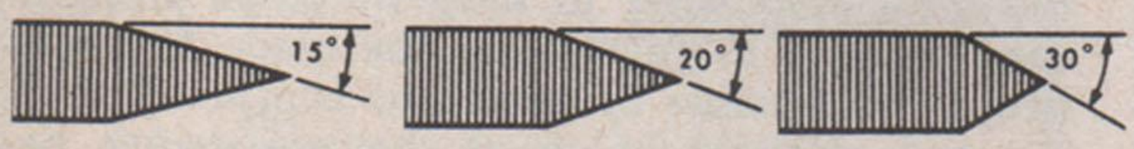
Oilstones are flat man-made stones in various medium to very fine grits. They are oiled or moistened for use, to prevent loading. Used, in the past, for hand honing, they are now available mounted on power tools (p. 1) for faster, easier work.

cutlery sharpening



HAND SHARPENING OF KNIVES

Grinding



Typical knife bevel angles are illustrated. These range from the sharp (15°) edge used on high quality, thin-blade flesh-cutting knives to the heavier duty (30°) edge used on thick-blade boning and scaling knives. Remember to hold the blade — at all times — at the correct angle to the sharpening surface.

If the blade is badly nicked, start by grinding new bevels to obtain a new, straight, true edge. Best use a wet grindstone, or a small hand-operated dry grinding wheel of the type shown. Power-driven dry grindstones heat a knife blade too quickly — are likely to draw the temper and ruin the blade. And the smaller the blade the more likelihood of overheating. Even with the small hand grinder, stop frequently to let the blade cool.

Use the edge of the wheel for grinding, not the side. Support the blade against the tool rest and hold it firmly in such a manner that you can draw it across the edge of the wheel without changing the angle between the blade and the wheel. Draw it across and back steadily until the first bevel looks finished — then grind the other bevel. Finish by drawing it across very lightly from butt to tip (one direction only) — first on one side, then the other — and repeating this three or four times.

Sharpening and Stropping

Knives with true edges need not be ground — and even those that are ground should be sharpened on a flat stone. Use a good medium-fine composition stone (such as a vitrified silicon carbide) or a natural oilstone. If very dull (or newly ground), start on the coarser side of stone; then finish on fine side. Putting a few drops of kerosene or light machine oil on the stone will help to produce a "scientific" edge.

Hold the blade steady at the proper bevel angle — and with the handle end slightly in advance of the point. Move the blade (in direction of arrow, as though peeling the stone) to make the sharpening stroke, using light pressure; use no pressure on return stroke.

Sharpening on the coarser side of the stone will produce a burr, or wire edge, which is removed by sharpening on the fine side. An even smoother edge can be produced by final stropping of the blade on an old razor strop or piece of leather belt, just as a razor is stropped.

Using Sharpening Steel

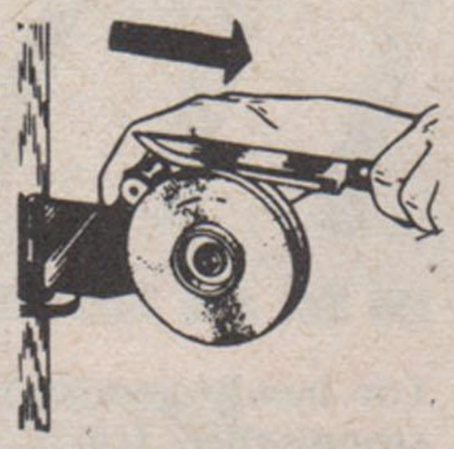
Another method of sharpening is to use a sharpening steel. Hold the steel in your left hand and the knife in your right hand. Tilt the knife slightly to obtain the desired bevel so that only the edge touches the steel — then draw the knife toward you, stroking the edge along the top edge of the steel. After the first stroke, turn the knife over and stroke it away from you to sharpen the other side of the blade.

An alternate method of making the return stroke is to again draw the knife toward you; but this time, with the edge touching the underside of the steel. When this method is used, care must be taken to twist the wrist a sufficient amount between strokes to obtain the proper bevel on each side of the blade. Sharpening on the usual type ribbed steel will produce a very fine wire edge on the blade. Unless knife is very dull, a few strokes on each side should suffice.

cutlery sharpening (cont.)

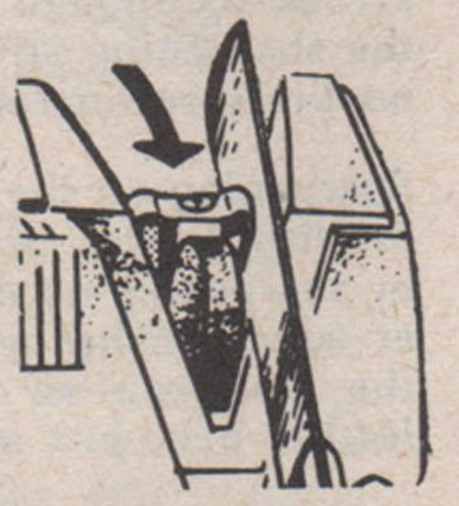
USING SPECIAL KNIFE SHARPENERS

Hand Type

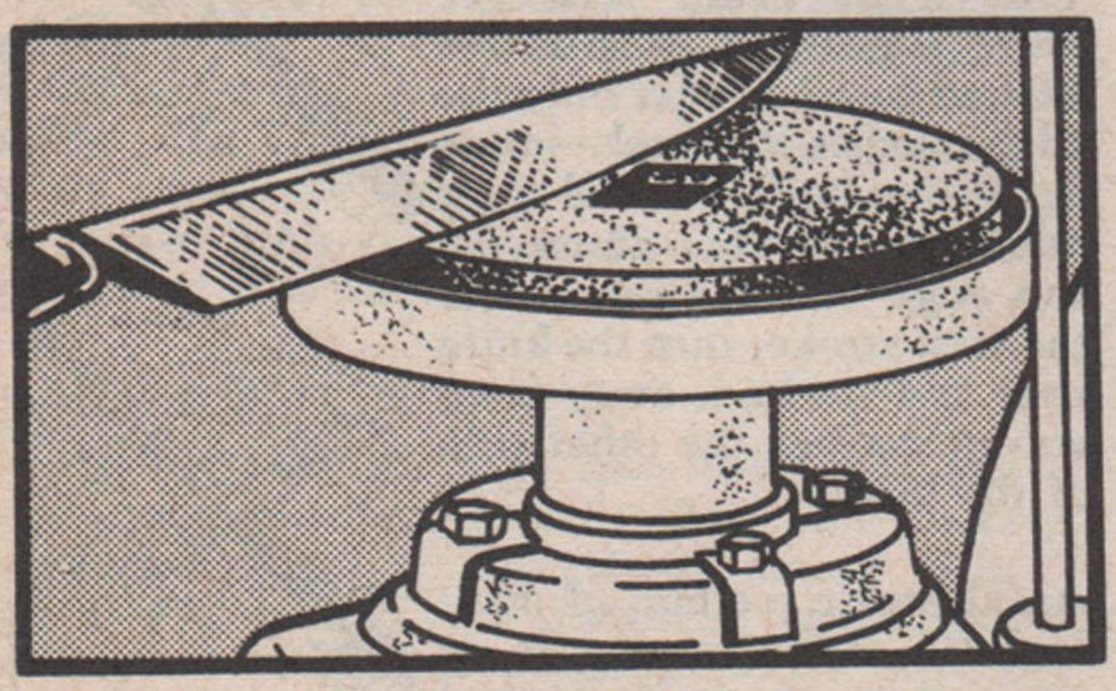


Dual stone grinders are used to sharpen both bevel edges at the same time — and are designed so that the stones will pinch the blade edge between them and automatically maintain a fixed bevel angle. Only the one bevel angle is possible. The "trick" to using such a sharpener is *not* to press the knife edge too far in between the stones. Instead, rest the butt lightly in the crevice and draw the blade quickly through to the tip (while turning wheel steadily). Repeat until edge is sharp.

Electric Type



Electrically operated knife sharpeners are similar in principle to the hand operated type above. The one illustrated has only one stone, but a spring clip holds the blade against the stone at a correct angle. Only one bevel is sharpened at a stroke — and the blade must be drawn through (from butt to tip), first on one side, then on the other. This tool can use a finer stone — power driven at a higher speed and steadier pace — and therefore does a much better job than a hand operated tool.



USING A HONE-SHARPENER

Any edged tool that can be sharpened on a flat stone can be sharpened to perfection on the stones of this tool. Two different grit stones furnished. The finer stone is used with a lubricant – preferably, a generous amount of vaseline. The exceedingly rapid motion imparted to the stone by operation of the tool leaves both your hands free to guide the work — and makes honing a very simple, speedy and pleasant job. You simply hold the work at a proper angle to the stone, and stroke across the stone using about the same downward force that you'd use in writing with a pencil.

SPECIAL KNIVES

CAUTION

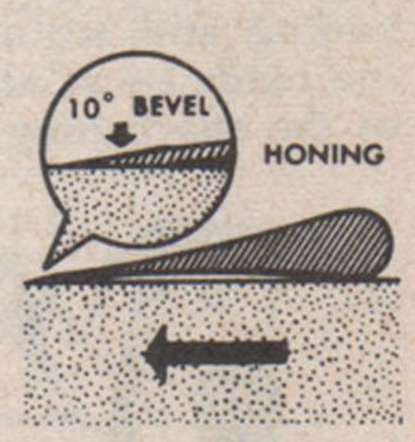
Serrated knives cannot be sharpened. Knives with small teeth can be sharpened with a file; but are hardly worth the effort.

Knives with rippled edges (such as bread knives) or with other special shaped blades can be successfully sharpened if care is used to follow the original bevels accurately. Whether the blades are thick or thin, one of the procedures already given will apply.

RAZORS

Shaving bends the keen edge of the razor to form tiny projections at each side so that the edge becomes rippled — and it is necessary to strop the razor frequently to keep the edge straightened out and useful. After the blade has been stropped a number of times, the continual forming and restraightening of the projections begins to break them off and leaves the edge jagged so that honing is then required to form a new cutting edge.

Straight Razors



Unless abused, the straight razor should never require regrinding; but can be reground successfully if the same rules which apply to straight edge knives are followed.

In honing, use a good quality fine-composition stone or fine natural oilstone. Lay the razor flat on the hone to obtain the proper bevel. (Top edge is just thick enough so that when razor is laid flat there will be approximately a 10° bevel at the edge.) Hold the blade diagonally across the hone with the handle end in advance of the outer end — then draw the blade straight across the hone as though peeling a slight sliver from the stone. Never move the blade in the opposite direction. At the end of the first stroke, turn the blade over, rolling it on the back, move the handle end slightly in front of the outer end, and push the blade back to the starting point on the hone. Use very light pressure. Heavy pressure will take off, instead of put on, a keen edge. Ordinarily, 6 or 10 strokes are sufficient. Great care must be taken not to over hone as this will produce a fine wire edge which will not give a good shave. Be sure to keep the hone in a dust-proof container when not in use — and clean the hone with soap and water after each dozen times of use. A dirty hone will do more damage than good.

When stropping, hold the strop tightly. If allowed to sag, the strop will round the razor edge and dull it. Also strop away from the cutting edge — not toward the cutting edge as in honing. First on one side, then on the other, draw the razor the length of the strop, diagonally

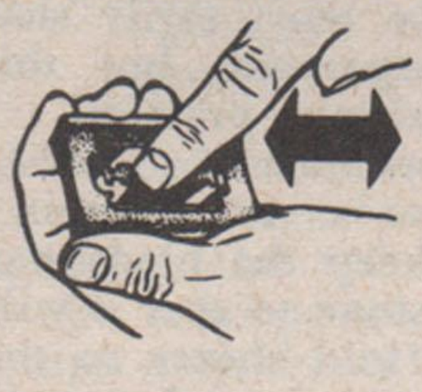
from heel to point. At the end of each stroke roll the razor on its back to start the return stroke. The last couple of strokes should be planned to turn the edge so that it will be away from the skin when the razor is put to use. Stropping provides the friction a razor blade needs to give a good clean shave. It is good practice to strop before each shave; then strop again after each shave to make sure that the blade is truly dry.

The strop should be kept clean by washing with soap and water, if necessary. Strops with cracks or ridges should not be used.

Safety Razor Blades

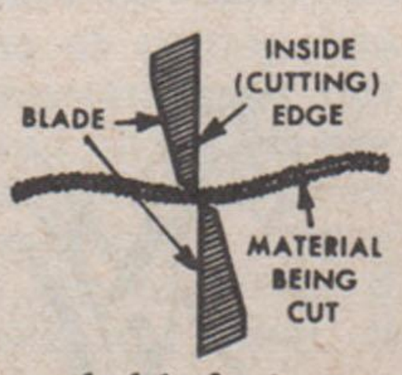
Double-edge safety razor blades can be sharpened by using a small convex hone of the type illustrated. Work the blade back and forth across the hone lengthwise a few times (as indicated by arrows) — then turn it over to hone the opposite side. The inside of a good-quality smooth-surface drinking glass can be used in the same manner to produce the effect of stropping.

Single-edge safety razor blades provided with fixed backs can be honed on a flat stone in the same manner as a straight razor. Stropping of such a blade is, however, quite difficult because of the small hand hold—and the drinking glass method as suggested above is recommended, instead.

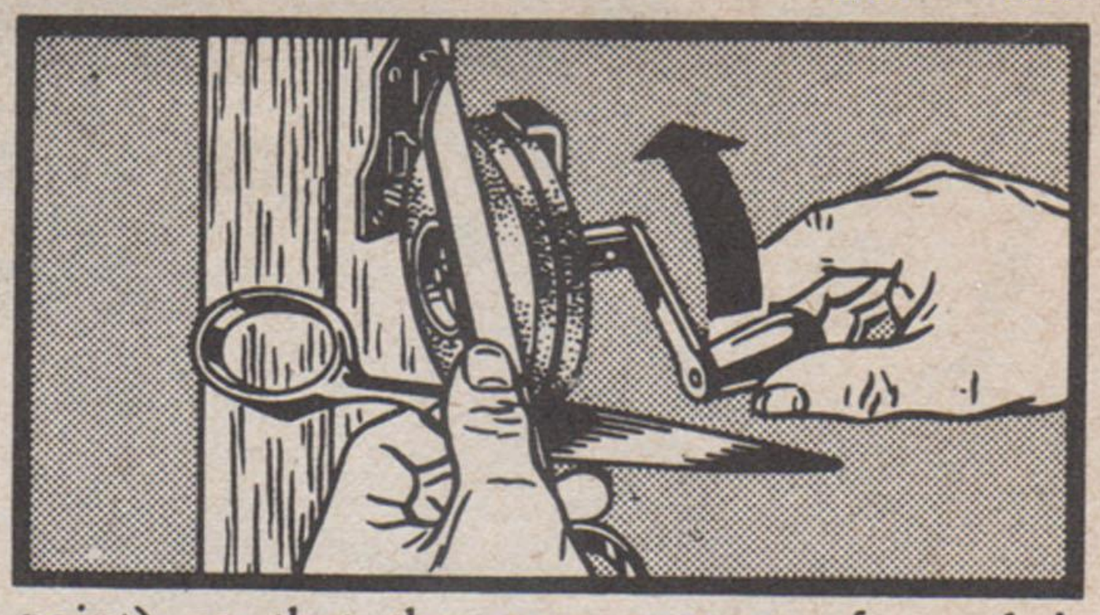


SCISSORS

Scissors cut by breaking the material along the line at the intersection of the two blades. Consequently, the edges are not sharpened for slicing, as the edge of a knife; but are ground almost flat so that the inside edge of each blade is true and free from burrs. The best method for sharpening is to use a low rpm power-driven wet grinder. This leaves both hands free to guide the blades against the stone so as to maintain the exacting straightness of the edge of each blade, as required.

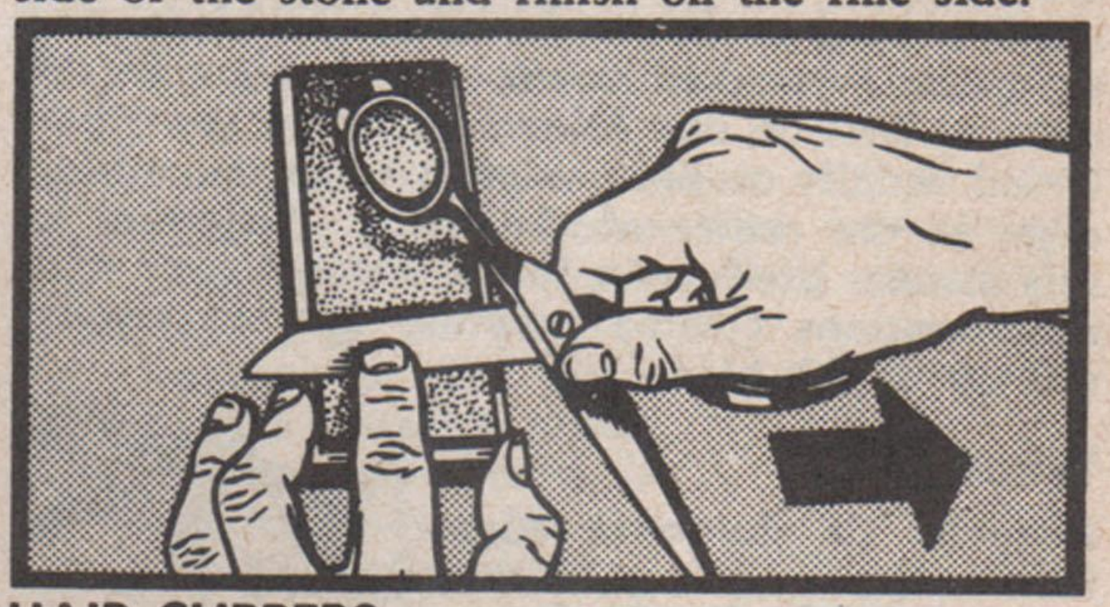


Hold the blade steady against edge of stone with the inner side of the blade on top and the back of the blade slightly higher than the edge being ground (to maintain proper bevel on ground edge). Use both hands to hold blade and move it, in a straight line, back and forth across the stone. Be sure to maintain the original bevel exactly. Use very light pressure, and keep moving the blade steadily (without stopping at any



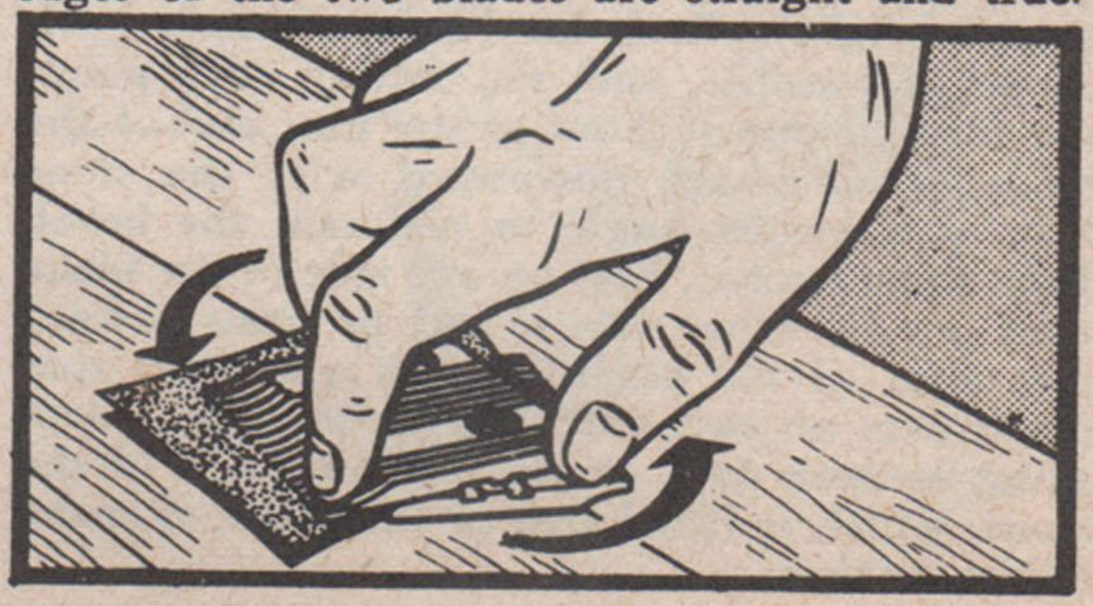
point) so that the same amount of metal is removed all along the edge. Remove as little metal as possible to produce a sharp, straight line along the inner edge of the blade. Afterwards, hold the blade lightly against side of stone to make certain that edge is straight from end to end.

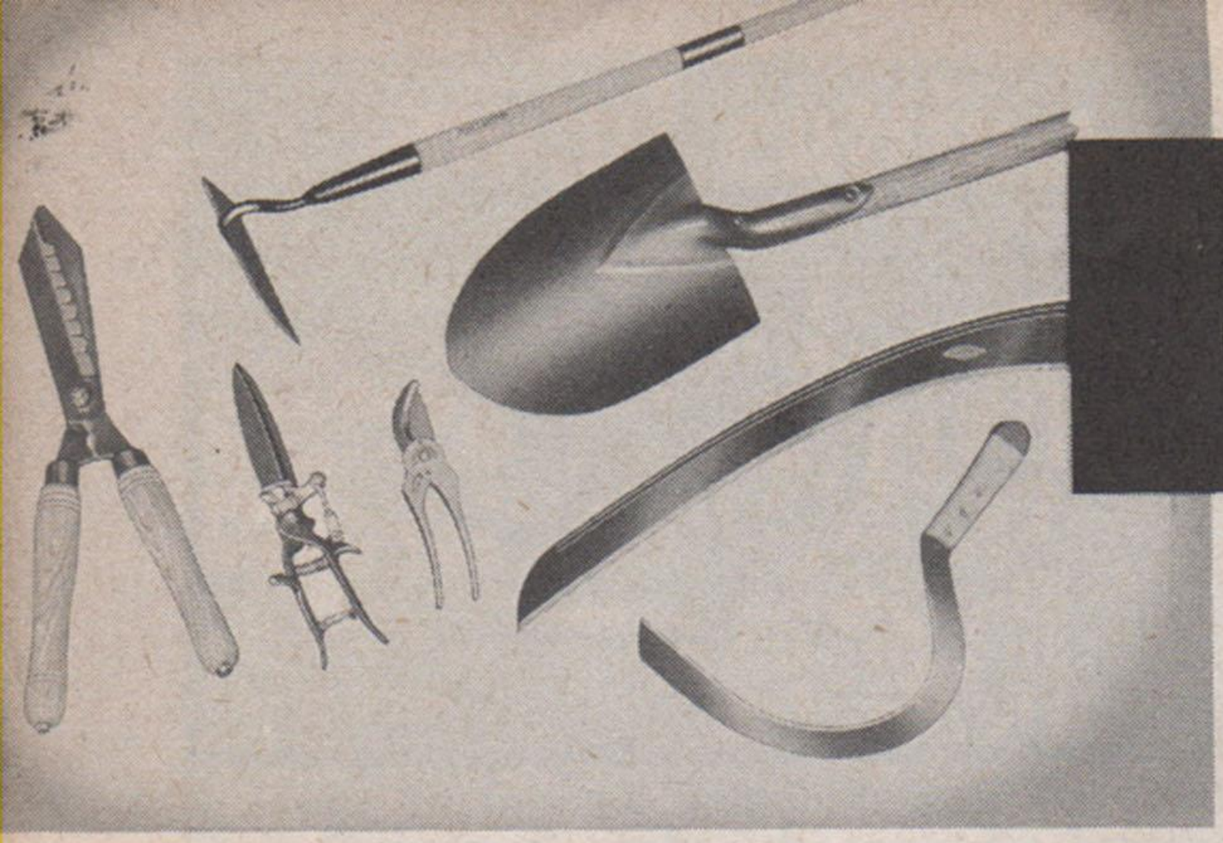
A household sharpener of the type illustrated can also be used. Such sharpeners generally have a metal disc at the side against which the scissor blade can be rested to maintain the proper bevel. Scissors can also be sharpened on a flat stone such as used for sharpening knives. Hold the blade down on the stone so that the bevel lies accurately across face of the stone. Use a finger of your free hand to steady the blade in this position. Then draw blade from heel to point across the stone, without moving it away from its position on the stone. At the end of each stroke, lift the blade and start over again at the heel. Do not allow the blade to rock. If blade is very dull, start on the coarse side of the stone and finish on the fine side.



HAIR CLIPPERS

Valve grinding compound (as used by auto mechanics) can be used to good advantage in sharpening hair clippers. Take the clippers apart and remove the two blades. Spread compound lightly over ground inner surface at both edges of one blade, then place the second blade — with ground inner surface down — on top of the first blade. Rub the two blades together, using a circular motion. Sharpen until all four edges of the two blades are straight and true.

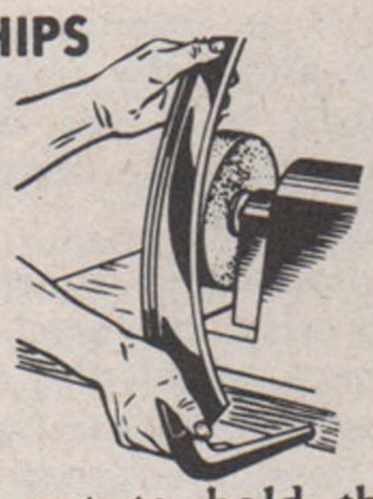




garden tools

SCYTHES AND GRASS WHIPS

Grinding



Scythes and grass whips (sometimes called hooks) are best sharpened on a medium grain grindstone. Either a dry stone of aluminum oxide or a natural wet stone can be used. If a dry stone is used, care must be taken not to hold the blade against the stone too long at any one spot, or the temper will be drawn from the blade. The grinder used should have the guard removed so that the large sized blade can be held properly in position against the stone. Remove the blade from the snath, then adjust the position of the blade against the stone — before starting the grinder — until you have found out how to hold it in order to maintain the original bevel. Blade should be held with the pointed end up. Grinding is started at the snath end of the blade, and the blade is worked down over the face of the stone — first on one side and then on the other. Grind equally on both sides to make the cutting edge at the center of the blade. Grinding in this manner produces a finely serrated edge with the serrations (teeth) pointing upward toward the tip of the blade.

Whetting

Removal of the wire edge formed by grinding is not necessary as this edge adds to the cutting efficiency of the blade. It is well, however, to have a scythe stone handy for maintaining the edge while on the job. A stone of this type can be used to remove small nicks, and to restore portions of the blade dulled by heavy chopping in brush.

For whetting, hold the scythe as shown in the accompanying sketch — with the snath on the ground (if it is long enough to hold blade at proper height). Keep the blade as nearly horizontal as possible, with the cutting edge pointing straight down. Start at the butt end of the blade — and stroke downward with the stone held at a proper angle to maintain the bevel. Take short strokes, first on one side of the blade then on the other side — and progress toward the point of the blade in such a manner that the strokes on each side overlap slightly. Sharpening is done only on the down strokes of the stone, which is lifted free of the blade to make return strokes.

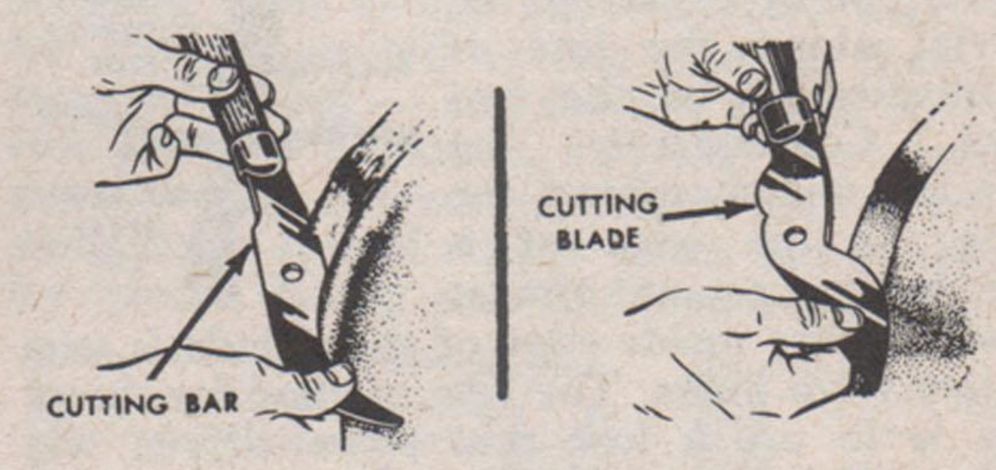
HEDGE AND PRUNING SHEARS

General Information

There are a variety of garden shears intended for this purpose. In general, those used to cut light twigs and grasses should have a comparatively long thin bevel (20° to 35°). On the other hand, those used for tree pruning and similar heavy operations should have short thick bevels (10° to 20°).

Grinding

Shears can be ground on a dry aluminum oxide stone; but for the lighter weight shears, especially, a wet stone is preferable because it is less apt to draw the temper from the small blades. Blades can be most easily sharpened if separated; but this is not always practical. The important thing to remember is to hold the shears (or single blade) so as to maintain the desired bevel — and to keep the blade moving across the face of the stone so that it will not be heated at one point. Hold shears so that the face of the stone rotates into the cutting edge.



The cutting bar of curved pruning shears must be ground on a round face wheel, as shown. When grinding the cutting blade of these shears, move it back and forth over the face of the wheel (using a square edge wheel) to produce the desired rounded surface.

Honing

After grinding, remove the wire edges produced on the cutting edges by light honing with a natural or composition medium oilstone. Pass the stone over the bevel edge — maintaining the bevel produced in grinding — and stroking from the edge toward the back of the blade. Then pass the stone over the opposite edge holding it flat against the blade. Alternate sides in this manner until desired degree of sharpness is obtained.

After sharpening, check to make certain that blades come together properly when closed. As blades are closed, they should continually rub together at point of contact. If they do not close properly, it may be necessary to slightly spring one blade.

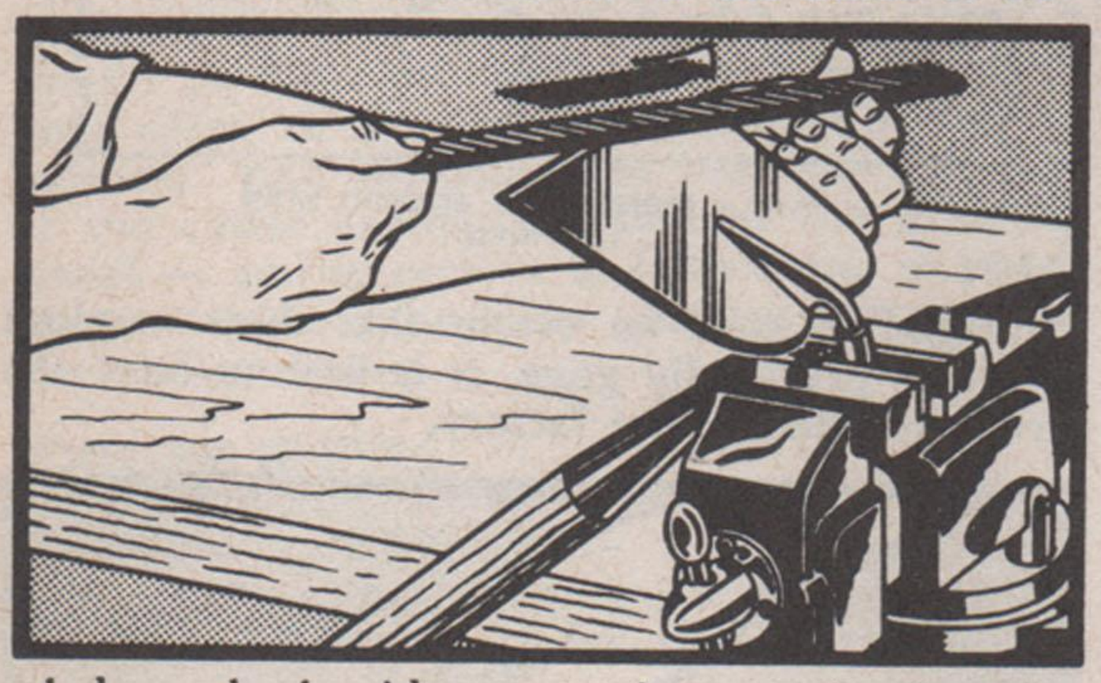
SNAP-TYPE PRUNING SHEARS AND FLOWER CUTTERS

There are many patented pruning shears with short lightweight blades. Leverage for cutting with these types is often obtained by snap-type mechanical boosting action. Often, the cutting bar is backed by a toothed rack intended for holding the flower or twig that is cut off. In some types, the actual cutting edge is a very lightweight piece of steel fused or bolted to the blade.

Discretion must be used in sharpening these types of cutting shears. In general, the same principles of sharpening apply as for sharpening scissors, page 4. As the blades are small, it is not advisable to sharpen them on a power grindstone, which will remove metal too quickly and also draw out the temper from the blades. A small hand operated (kitchen type) grind wheel, or flat oilstone, should be used. Sharpening is always done by drawing the stone across the bevel into the edge — and by then honing lightly on both sides to remove any wire edge produced.

HOES

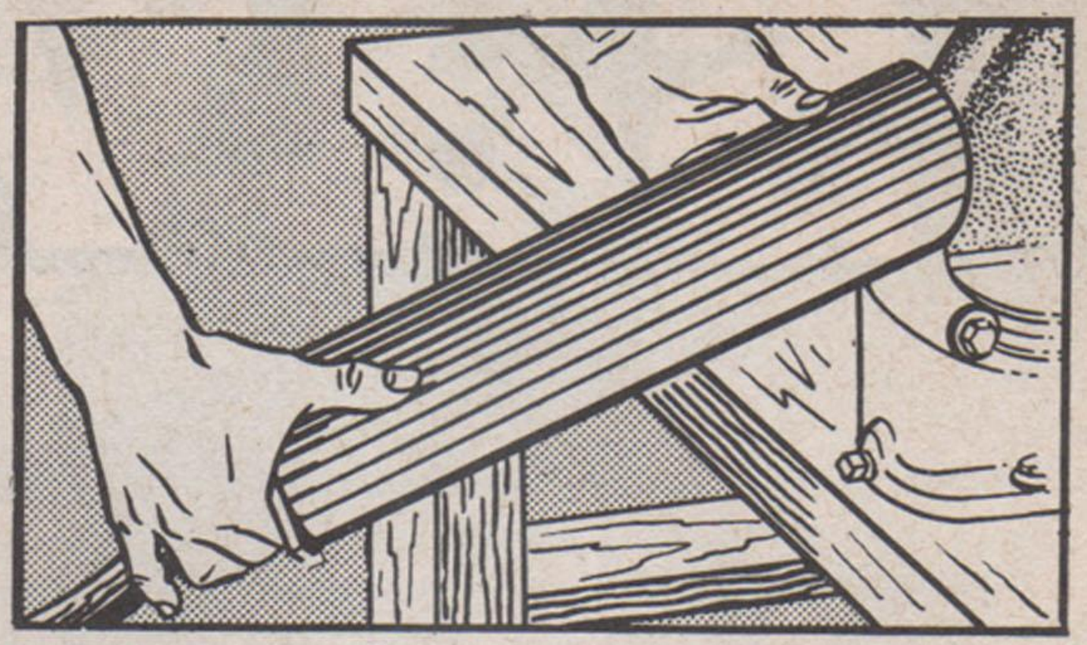
A good medium grained flat file is all that is needed to keep a keen edge on a garden hoe. Place the hoe in a vise, as shown, and file the top edge, maintaining the desired bevel. File only on the push strokes — and file into the edge. Hold the file at approximately a 45° angle to the sides, and take long steady strokes that move along the edge. Some hoes have the bevel all on the top side of the blade; others are beveled on both sides. If the blade is bev-



eled on both sides, turn it over in the vise after filing the top side, in order to file the under side. Short bevels (about 15°) are best for general work; but long bevels (up to 35°) are sometimes desirable if the hoe is to be used for chopping weeds, etc. After filing the bevel, work file very lightly over both sides of the edge alternately to remove any wire edge.

SPADES AND SHOVELS

Long, heavy-bladed spades are best sharpened on a power grinder, either on a dry aluminum oxide wheel or on a wet stone. If the spade has a curved blade, a round-faced wheel is preferable; but square edge wheels can be used if the spade is held at one edge of the wheel. Hold spade so as to grind into the cutting edge to form a bevel on the inside of the blade only.



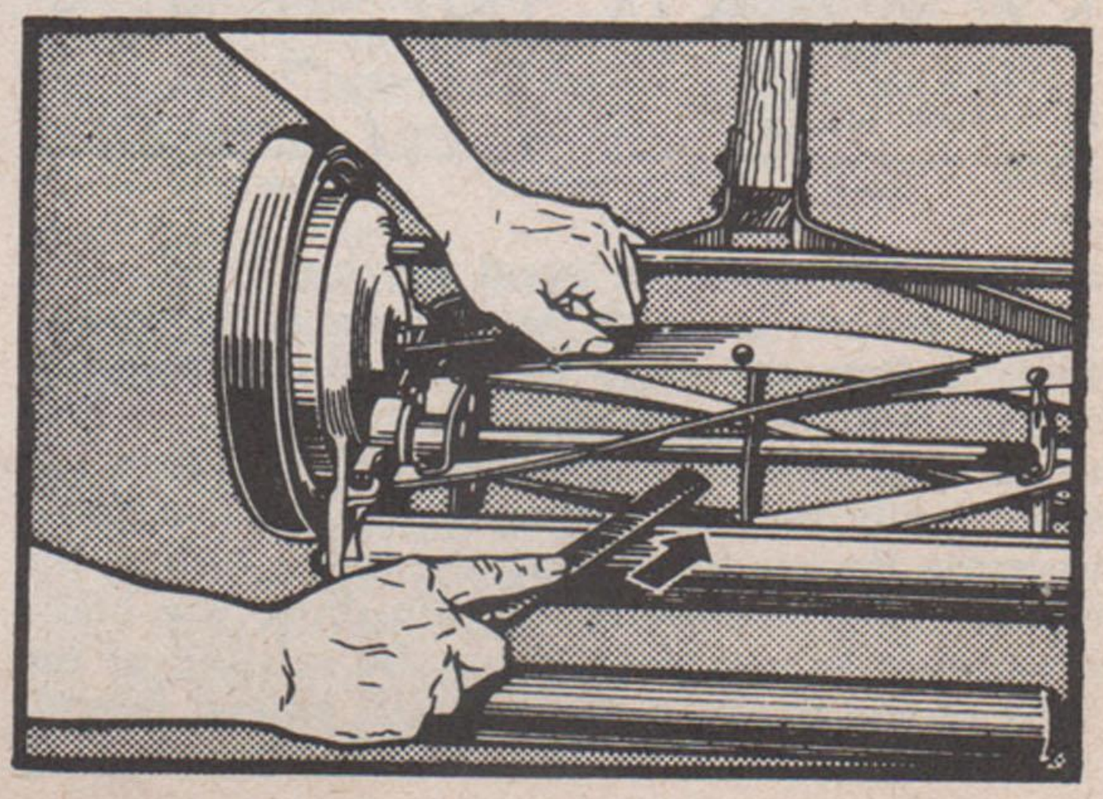
Keep the blade moving steadily back and forth across the wheel so as not to draw the temper by heating it in any one spot. Removal of the wire edge is not necessary, but can be done, if desired, with a medium file or oilstone.

Lightweight spades and shovels are best sharpened in the same manner as the hoe, using a flat medium-grained file.

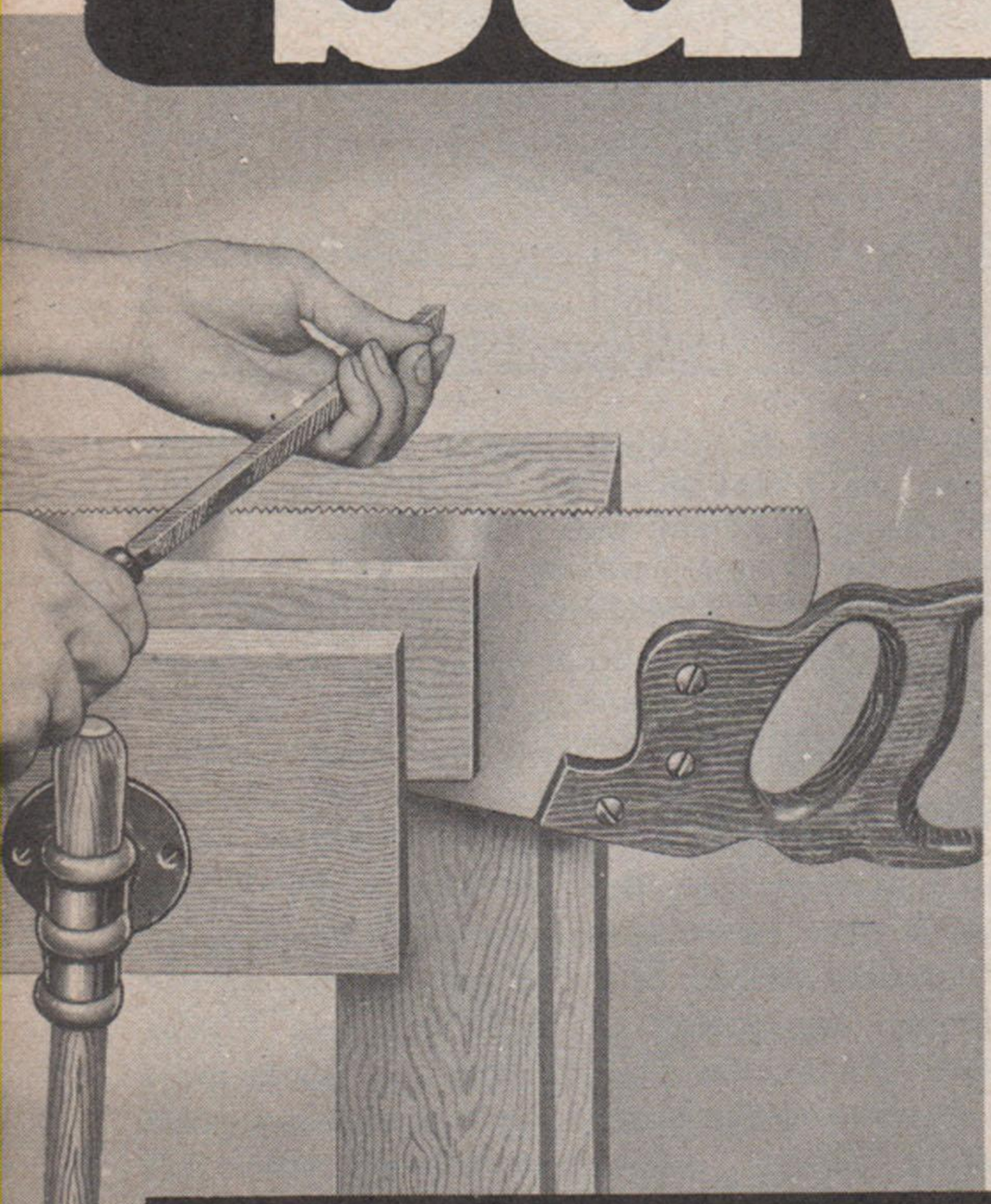
LAWN MOWERS

Lawn mowers that have become badly dulled and in need of sharpening should be restored by an experienced operator having the proper grinding equipment to grind all reel blades evenly. Also, the edge of each reel blade must be restored to the proper angle to produce good cutting action. On most mowers, the reel blades are very hard and the cutter bar is softer. This feature enables the cutter bar to be sharpened by filing when dulled, and in this way, the mower can be made to perform a good cutting job provided the cutter bar is adjusted to provide the right amount of clearance with the reel blades after each time the cutter bar is sharpened. Small niches caused by wire, stones, etc. can be safely removed from the reel blades with a carborundum stone if care is exercised.

To sharpen the cutter bar, turn the mower upside down and file the forward edge of the cutter bar until a sharp edge is produced. Be sure to maintain the same angle as the cutter bar had originally. Do not file the edge of the cutter bar where the reel blades pass over it, because this would destroy the self-sharpening feature of the mower.



saws



hand saws

General Information

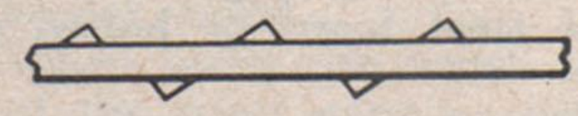
There are two general types of hand saws: the crosscut saw, for cutting across the grain of the wood; and the rip saw, for cutting with the grain of the wood. The difference between the two is in the shape of the teeth. The teeth of a crosscut saw are filed at an angle, and cut like knives; while the teeth of a rip saw are filed straight across the saw at right angles to the blade, and cut like chisels.

SIDE VIEWS—SHOWING PROPER TOOTH ANGLES

CROSSCUT RIP

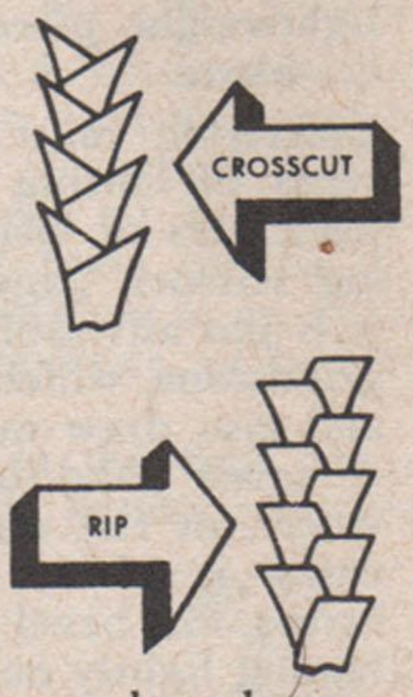
A saw will not give good service or cut correctly unless the teeth are of the same length, with gullets the same depth; and are properly shaped and properly set — and the saw is free from rust. In reconditioning a saw that has been badly damaged, five stages are necessary: jointing the teeth; shaping the teeth; setting the teeth; filing the teeth; and finishing the blade with an oilstone. Jointing is the refiling of the tops of the teeth so that all will extend exactly the same distance up from the blade. Shaping

VIEW FROM BACK OF SAW



CORRECTLY SET TEETH EXTEND BEYOND EDGE OF BLADE

VIEWS OF TEETH EDGES

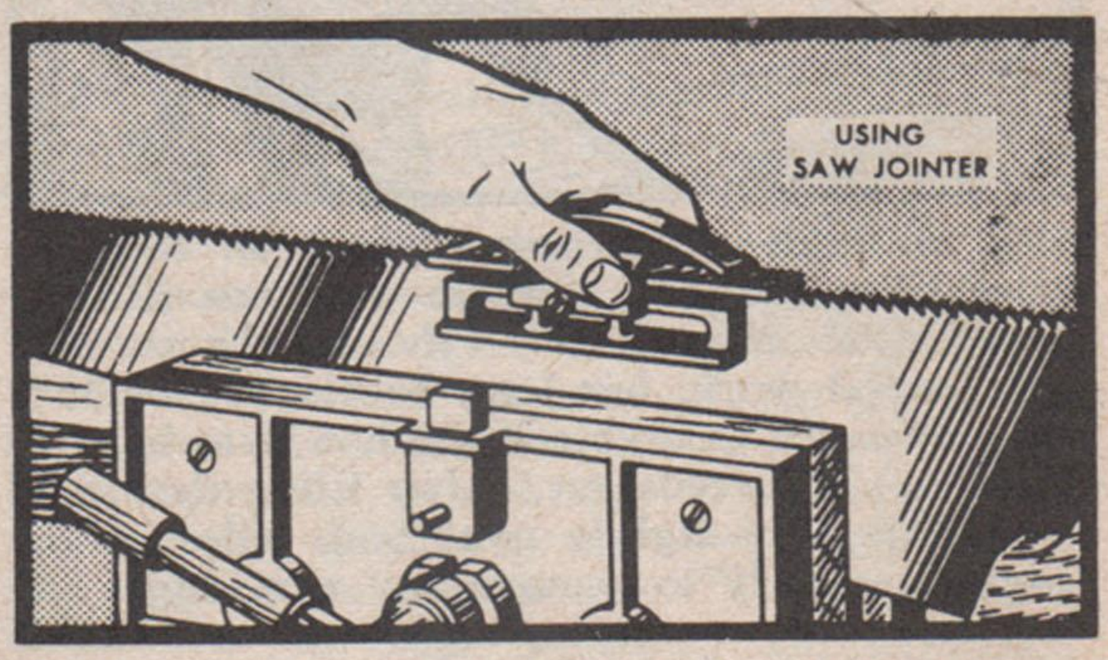


is done to reform the teeth so that the gullets between the teeth will be the proper depth and the teeth will have the proper contours. All saws have the teeth set; that is, the teeth are sprung over at the top, alternate ones being sprung in opposite directions, so that the saw will cut a kerf slightly wider than the blade to keep the blade from binding. Filing is done to put the cutting edges on the teeth. Finishing with an oilstone is necessary to correct small errors in filing and setting.

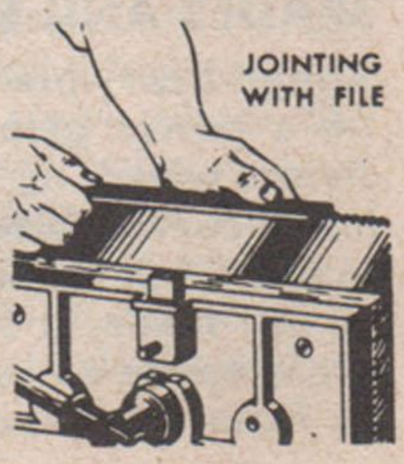
Generally speaking, it is unnecessary to reset the teeth of a saw every time it is sharpened. Teeth should only be reset when sharpening has altered the teeth sufficiently to eliminate the original set; or when individual teeth have been damaged. Whenever the saw teeth have been

HAVE A PROFESSIONAL RETOOTH SAWS LIKE THESE

damaged to such an extent that their original shape is practically gone, it is best to have the saw retoothed at the factory.



Jointing



If the teeth of a saw are uneven or incorrectly shaped, the top edges must be filed down to the same level before sharpening. Place the saw in a wood vise, using two boards with the saw fitted between them and the teeth extend-

ing above the boards as shown. Run a mill file lightly back and forth the length of the blade; or use a regular saw jointer, instead. The jointer is preferable because it holds the file squarely on the teeth edges and eliminates all chances of tipping and rounding the teeth.

Under ordinary circumstances, filing is continued until the file touches the top of every tooth. If the blade is worn down in the center, however, care must be taken to reform the teeth edges from end to end. The teeth edges can be perfectly straight from handle to end of saw — but many craftsmen prefer to have a rise at the center of approximately 1/8-inch (so that saw will track in the slight orbit that the arm describes when sawing). On an especially bad job in which the teeth are very uneven, it is best not to joint them all at once. Instead, joint only the highest teeth first — then shape these teeth, but do not sharpen them. Afterwards, joint all of the teeth together.

A bright light, arranged so that the light falls on the teeth, will enable you to determine the points which have been touched by the file.

Shaping

Shaping is necessary whenever the teeth have been worn crooked, or when a saw has been jointed down so that the gullets between the teeth are no longer deep enough to properly clear the chips. It is done with the saw still mounted in the wood vise, as for jointing. Arrange the boards at either side of the saw so that the bottoms of the gullets (as they will be when finished) are approximately 1/8-inch above the tops of the boards. Allowing more of the teeth to project will cause the file to chatter and screech, and quickly dull the file. Use a slim-tapered triangular-shaped file which is proper for the size teeth on the saw. The following table gives file sizes that are proper for various size teeth:

To determine the points of a saw (when this figure is not stamped on the blade), count the number of tooth points to the inch. In most rip saws of 6 points and coarser, the teeth at the unhandled end are finer than the teeth throughout the remainder of the blade; therefore, be sure to measure the regular teeth at the butt of the blade close to the handle.

Crosscut Saws

5 or 6 point saw.....Use 7-in. slim file

7 or 8 point saw....Use 8-in. extra slim file

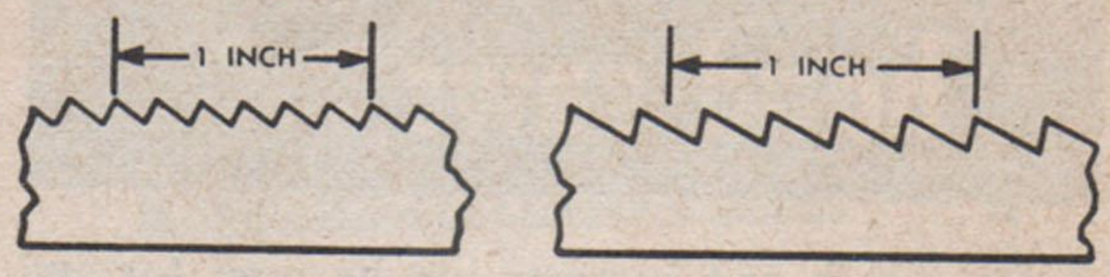
9 or 10 point saw—Use 8-in. double extra slim file

11 or 12 point saw—Use 7-or 8-in double extra slim file

Rip Saws

5, 5½ and 6 point saw—Use 7-in. slim file

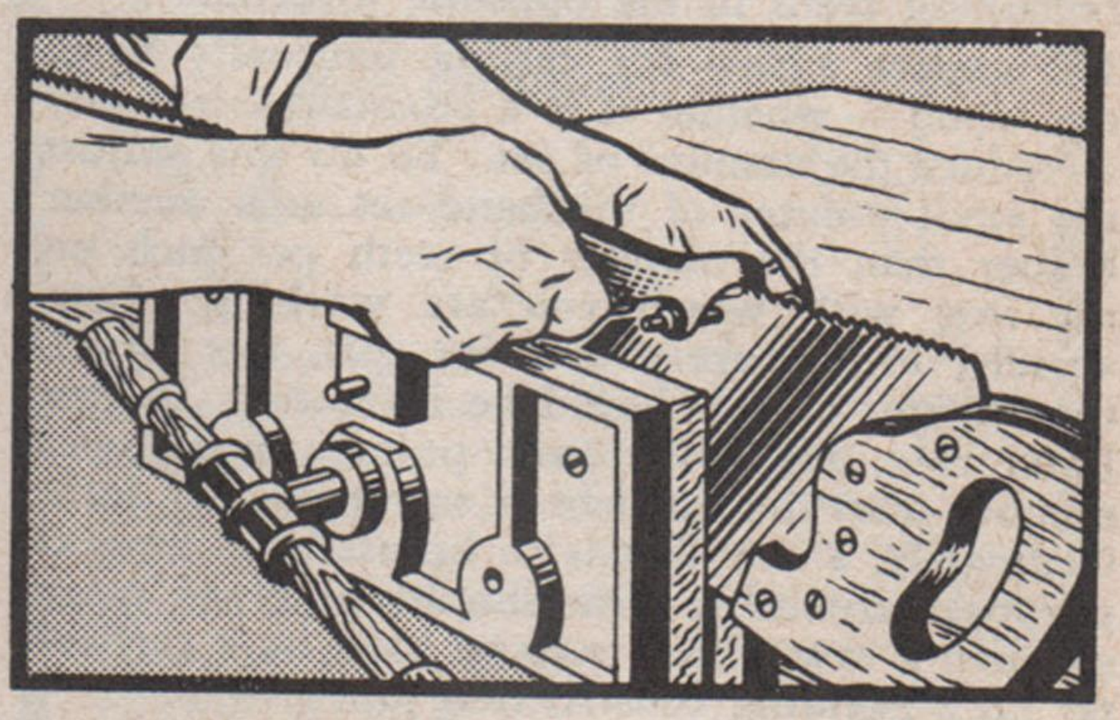
7 point saw—Use 7- or 8-in. extra slim file



7 POINT CROSSCUT SAW

5½ POINT RIP SAW

To shape the teeth, place the file all of the way down in the gullet between any two teeth, and file straight across the saw at a right angle to the blade. Take long even strokes, cutting only on the forward stroke. Raise the file each time for the return stroke. If the teeth are of unequal sizes, press the file against those teeth having the largest tops until you reach the center of the flat, top surface made by jointing. When filing on the opposite side of a tooth just filed, continue filing until the remainder of the flat top disappears and the tooth has been brought to an edge on top. Keep in mind that the teeth must be all alike in size and shape to cut an equal amount of wood and make the saw operate smoothly. File the gullets between the teeth as deep as the gullets originally were. In nearly all cases, a few of the teeth at the handle end will still be in the same condition as when the saw left the factory — and you can determine from them the proper gullet depth. A rubber cap on the end of the file will protect your fingers, while filing.



Setting

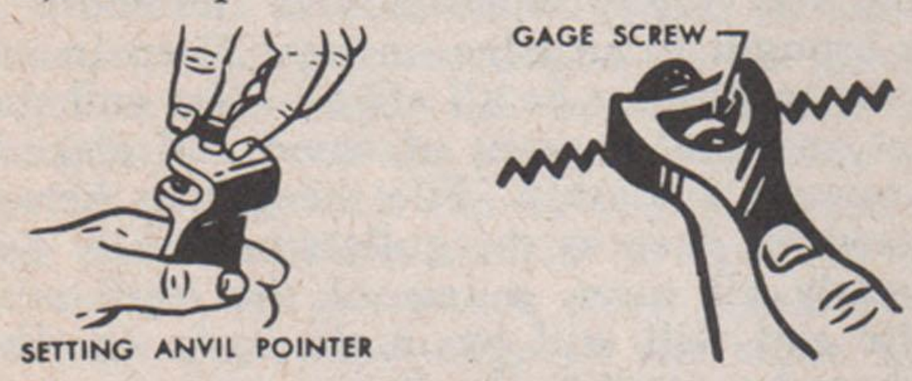
The teeth should be set prior to sharpening in order to avoid injury to the cutting edges with the set. It is important to remember that the depth of set given to the teeth must never go lower than half the length of each tooth. This rule applies, whether the saw has fine or coarse teeth. If the set runs deeper, it is almost certain to spring, crimp or crack the blade — or to break out the tooth entirely.

TWO TYPES OF SETS

A saw that is properly taper ground when manufactured, especially one with fine teeth, requires but little set. This is true because the blade tapers thinner from cutting edge to back, and also from butt to point, providing most of the clearance necessary for easy running.

hand saws (cont.)

A pin punch and hammer can be used for setting; but the usual practice is to use a regular saw set, as illustrated. A saw set is preferable because it can be adjusted to bend each tooth at the proper place, and just the right amount. When using a saw set, first determine the number of teeth per inch of your saw (as already explained), then set the anvil pointer of the set to the same number. Next, adjust the gage screw under the plunger of the set so that the saw blade will pass easily between the end of the screw and the anvil. Now, starting at one end, set each alternate tooth by completely closing the set upon it. The direction of the set



is correct when the thin cutting edges of the teeth are bent outward. Continue until you reach the end of the saw; then reverse the position of the saw in the vise and set all the remaining teeth in the opposite direction.

To prepare a saw for cutting unusually hard, dry wood — whether it is a crosscut or rip saw — reduce the amount of set. To do this, adjust the anvil pointer of the hand set to a number higher than the number of teeth per inch on the saw with which you are working. Conversely, to prepare a saw for soft, wet wood, the amount of set should be increased. In this latter case, adjust the anvil pointer to a lower number than the number of saw teeth per inch. Ordinarily, a saw that is to be used for general purposes around a farm should be given more set than a saw which is to be used by a carpenter on a building construction job.

In setting the teeth, particular care must be taken to see that the set is regular. That is, it must be the same width from end to end of the blade — otherwise the saw will not cut true, but will run out of line so that the cut will be "snaky." Sometimes, when it seems that a saw is soft and will not hold an edge, the principal trouble is the irregularity of the width of the set.

Filing

CAUTION

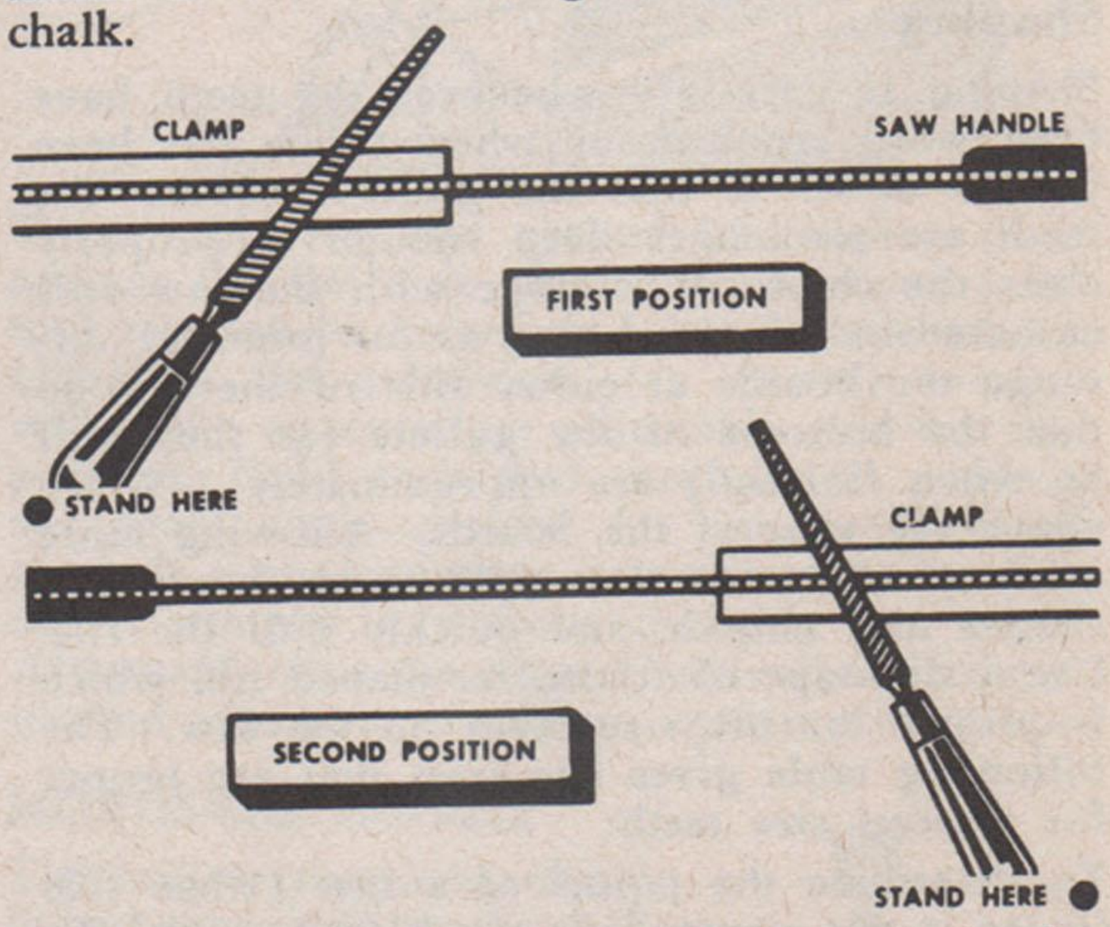
These instructions state that a saw should be turned around to file teeth on the opposite side of the blade. Inexperienced filers may be tempted to try to file all the teeth on the same side of the blade to save time. Don't do it! Such a practice is one of the things that make saws run to one side.

Crosscut Saws

Crosscut saws adapted for different special types of work are given a variety of teeth shapes (variations of angles, bevels, etc.); but average users, those who do not know from experience exactly the type of teeth desired, will do well to keep the original tooth shape when refiling saw teeth. The original shape can generally be observed by noting the teeth close to the handle — which will ordinarily not be worn out of their original shapes.

It is important to use the proper file — as already explained under "shaping" — and to fasten the saw in the vise so that the gullets are exposed approximately 1/8-inch.

Place the saw in the vise with the handle at the right. Now, before filing, pass your file lightly over the tops of the teeth — just as instructed under "jointing." This will form a small flat top on each tooth and provide a guide for filing. Be careful to take just barely enough off the tops of the teeth to accomplish this purpose. An alternate method is to smoke the teeth lightly with a lighted candle to provide smudge marks on the teeth for guides; or to use blue chalk.



At the start, stand in the position shown in the accompanying illustration. Start at the unhandled end of the saw. Pick out the first tooth that is set toward you. Now, place the file in the gullet on the left side of this tooth, holding the file directly across the blade. Next, swing the file handle toward the left until the file finds its own bearing against the adjoining teeth which it will cut. Maintain the angle at which the file comes to rest — hold the file level — be sure that it sets well down into the gullet between the teeth — and start to file. The file should cut only on the push stroke; should be pulled back without exerting any pressure against the teeth at either side of it. It is important that you do not allow the handle end of the file to drop down — the file must either be kept level, or with the handle end slightly elevated. Some craftsmen prefer to keep the handle elevated so that the bottom of each gullet will have a slight slope outward and rearward (toward handle of saw) — the purpose being to permit faster clearing of chips. When filing, the file will cut into the teeth at both its left and its right, simultaneously, mak-

ing alternate edges on these two adjoining teeth. Continue filing at the starting position until you have cut away one-half of the flat tops of the two teeth being filed (or one-half of the marked portion at the tops, if a candle or chalk was used).

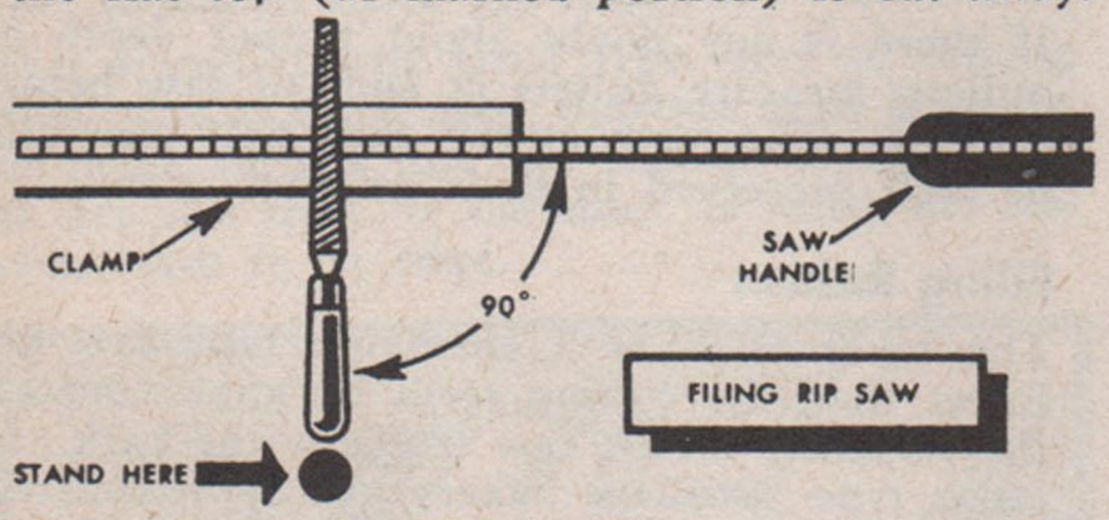
Now, skip the next gullet to the right, and place the file in the second gullet toward the handle. Repeat the operation of letting the file find its own bearing against the two teeth on either side; then proceed with filing these two teeth in the same manner. Continue toward the handle, skipping every other gullet and filing in every second gullet — until you reach the handle end of the saw. Now, turn the saw completely around in the vise so that the handle is at the left. Take the position shown in the accompanying illustration. Place the file in the gullet to the right of the first tooth set toward you (this will be the first of the gullets that you skipped when filing on the opposite side of the saw). Swing the file hand to the right (instead of the left) to let it find its own angle against the adjoining teeth. Now file until you have cut away the remaining top halves of the two teeth being filed. At this stage, these teeth should have needle sharp points. Continue filing in every other gullet until you have again reached the handle end and all of the teeth are sharpened with points at the top.

It may take a little practice to master the skill of filing saw teeth properly. Proceed slowly. Better still, practice first on an old saw, if you have one available.

Rip Saws

The principal difference between filing rip saws and crosscut saws is that rip saws are filed with the file held straight across the saw, at a right angle to the blade.

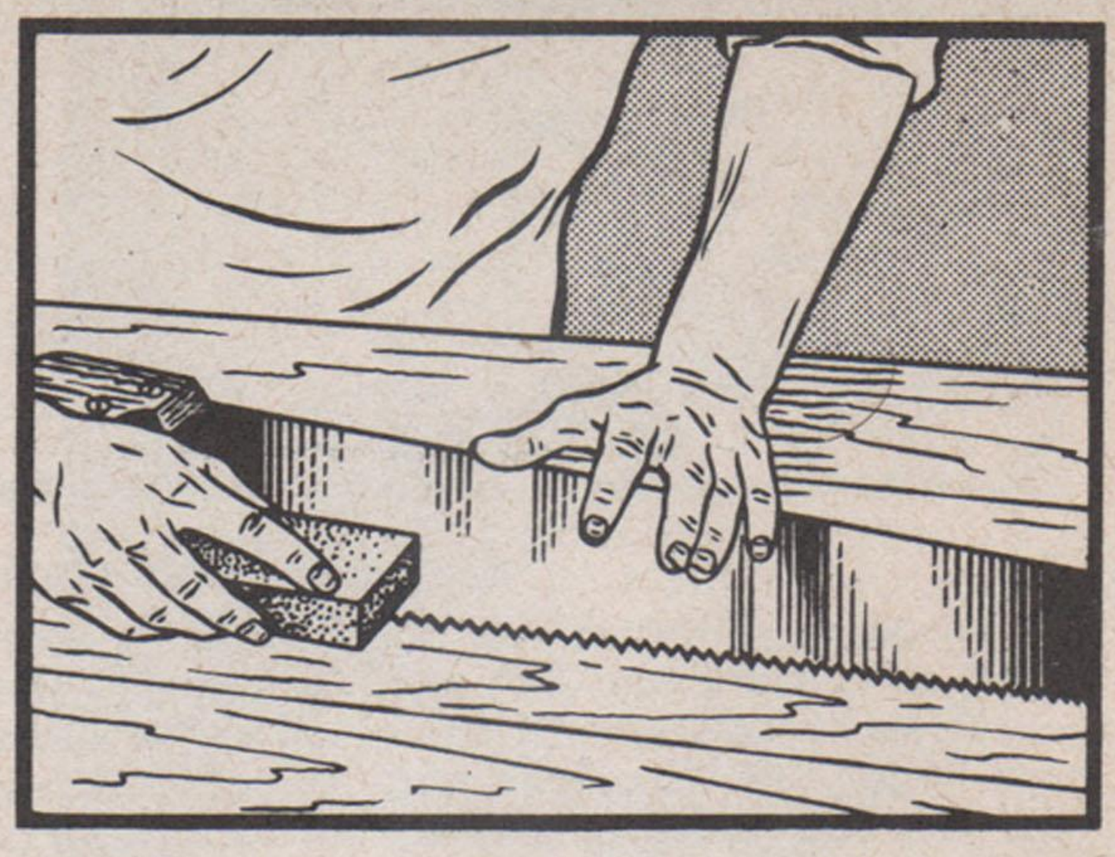
Place the saw, as before, in the vise with the handle to the right. Start at the unhandled end of the saw. Place the file in the gullet to the left of the first tooth. that is set toward you. Pressing against the tooth at the right, and filing only on the push strokes, file until one-half of the flat top (or marked portion) is cut away.



FILING RIP SAW

Now, rotate the file handle to press the file against the tooth at the left, and file this, in the same manner, until one-half of the flat top is cut away. Be careful to file straight across the blade — not to tip the file (but to hold it absolutely level) — and not to press downward so as to deepen the gullet. Remember that the teeth should have chisel edges, not points.

Continue placing the file in every second gullet until the handle end is reached; then turn the saw end-for-end and file the opposite side in the same manner.



Finishing

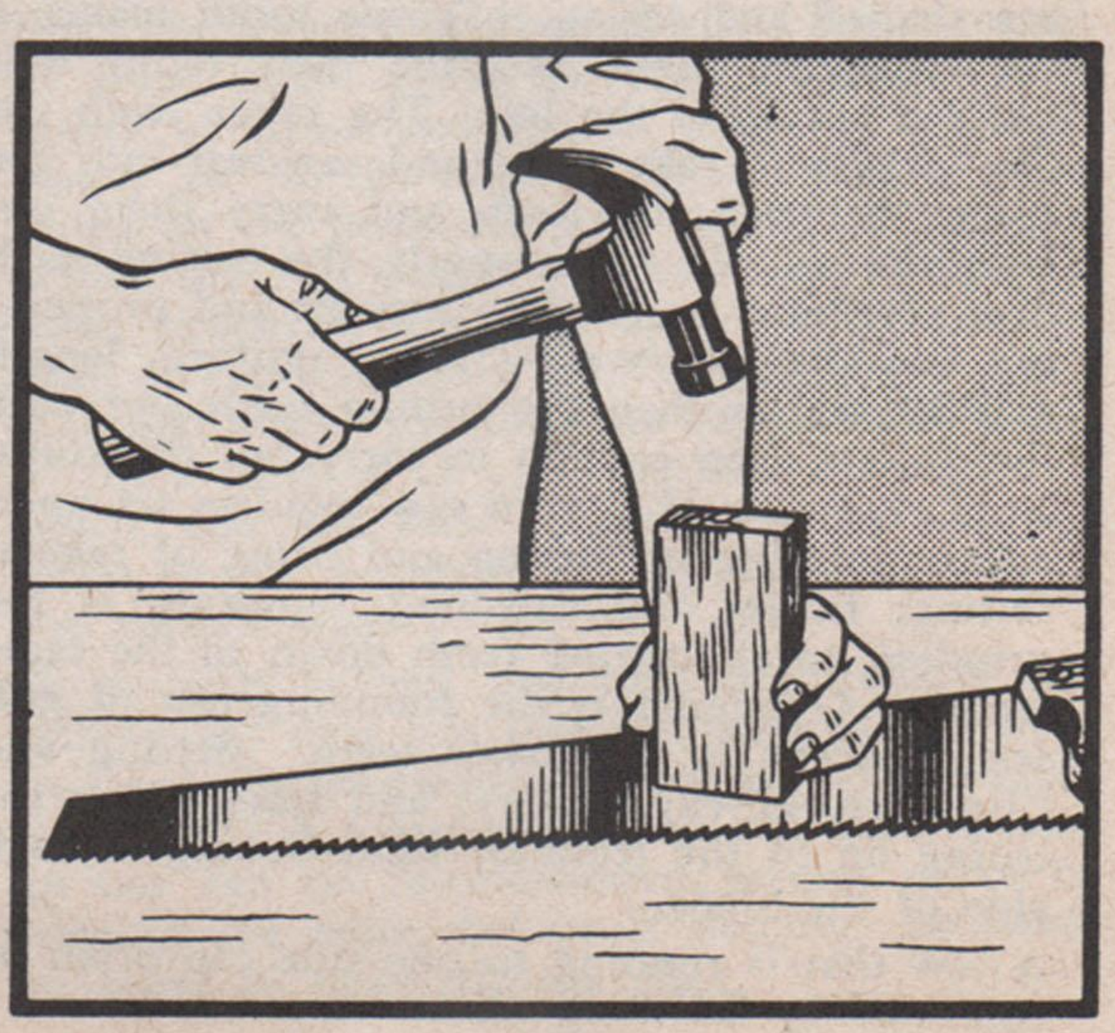
For finishing, use a good quality fine combination oilstone, either of aluminum oxide or silicon carbide — or a natural oilstone. Lay the saw flat on the bench. Run the oilstone very gently from end to end over the sides of the teeth. Turn the saw, and do the same on the other side.

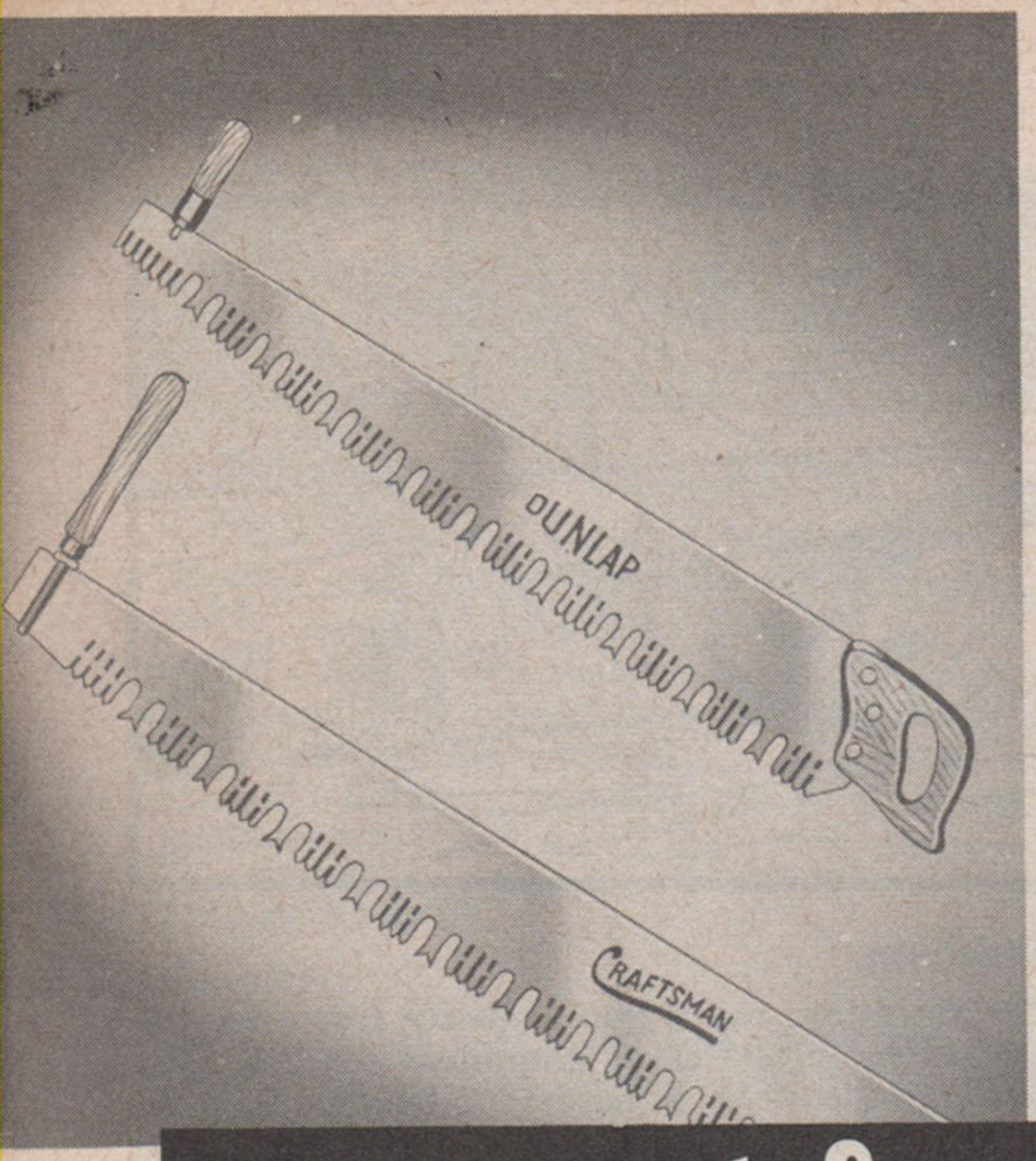
This will correct small inaccuracies in setting, remove any burrs or wire edges that may be present on the teeth — and make the saw cut more smoothly. This same treatment will usually correct a saw that "runs."

CARE OF SAWS

A saw having minor kinks in the saw blade can be straightened by use of a wood block and hammer, as illustrated.

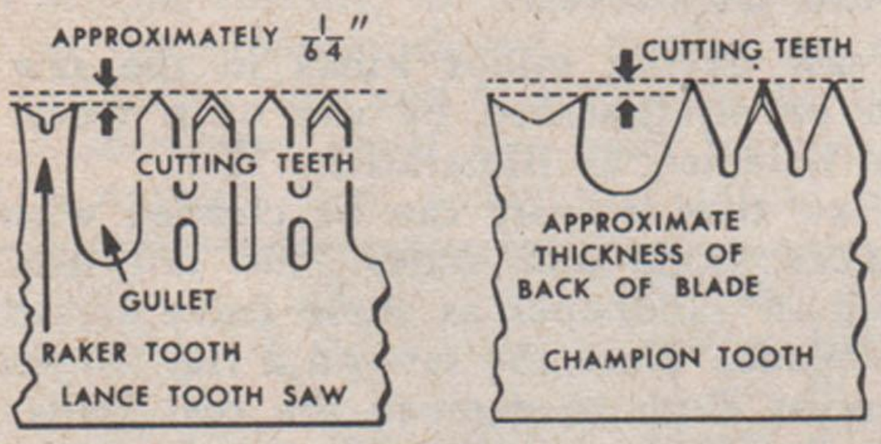
A saw that is rusty can be cleaned with lump pumice stone and water. Do not use emery cloth or sandpaper as these leave scratches on the blade. Place the saw on a flat surface. Use a moist cloth to dampen the rust spots. Then rub the blade with the lump of pumice until the rust is loosened. Rinse off the pumice and wipe the blade dry with a clean cloth. Apply a thin coat of light machine oil to keep the blade from rusting before it is needed again. Always protect saws by racking them in a manner in which the teeth will not be struck by other tools.





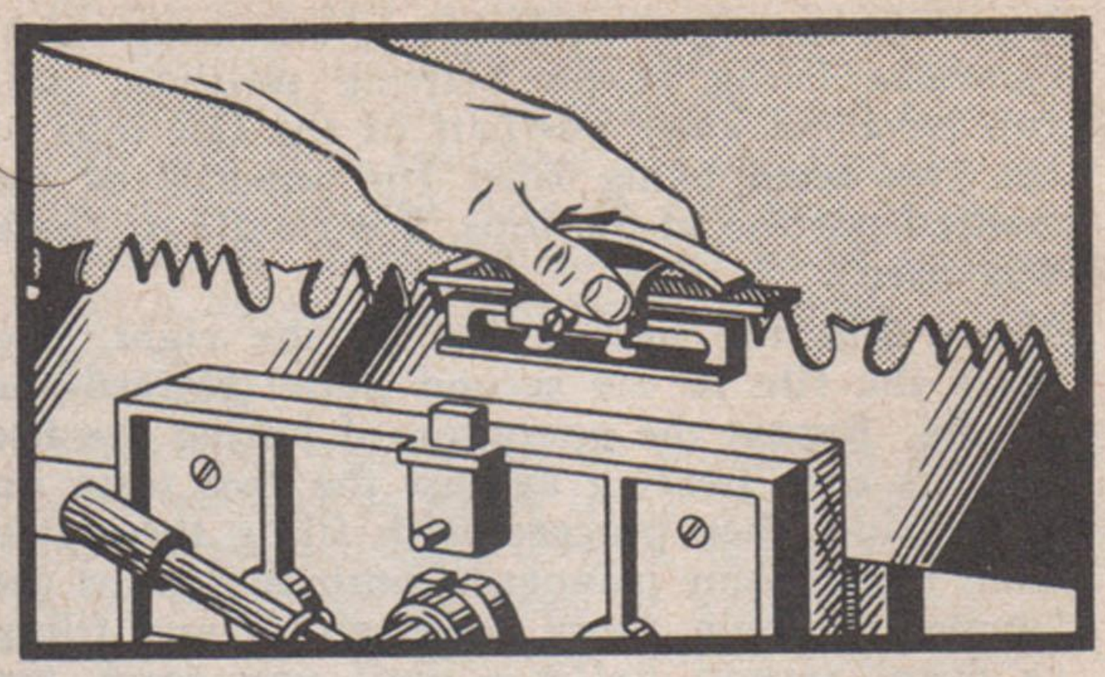
crosscut & timber saws

Two General Types



Crosscut timber saws are generally of two types: those having "champion" type teeth; and those having "lance" type teeth. Both types are illustrated. Each type of saw has two kinds of teeth: cutting teeth; and raker teeth, the latter being used to clean out the cut of the saw. The cutting teeth are like small knives. They are shaped and set so that one tooth makes a cut from the right and the next tooth will make a cut from the left. The raker teeth cut like chisels to rake chips and sawdust into the spaces between the teeth and carry them out from the cut. To cut properly, the cutting teeth of a saw must be filed to a point and properly set, and the rakers must be of uniform length a little shorter than the cutting teeth and with the gullets deep enough to carry out the chips. Reconditioning of a worn saw requires six operations: jointing; gumming and filing of rakers; setting; filing; and finishing. Jointing is the grinding of all cutting teeth down to the same length. Gumming is the rounding out of gullets adjacent to the raker teeth. Setting and filing are self-explanatory; and finishing is the truing up of the teeth by light honing at each side of the blade.

A saw that is running to one side can often be corrected by finishing alone.



Jointing

Place the saw in a suitable vise with the teeth projecting upwards and the bottoms of the gullets approximately 1 inch above the vise jaws. Now file the tops off of all the cutting teeth until all are exactly the same height. A regular saw jointer is the best to use, as this will hold the file steady and in an accurate horizontal position. A regular 8-inch mill file held in the hands can be used, but care must be taken not to tip the file to either side, or toward front or back. Do not take any more metal off of the teeth than is absolutely necessary.

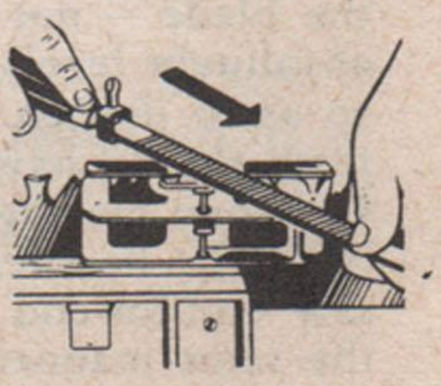
Gumming

When cutting teeth have been cut down somewhat in length by jointing, this will leave the gullets too shallow or too small — and the rakers will not function properly. The gullets must be shaped to their original depths and contours by filing. Use a 10-inch or 12-inch rat-tail file, and file straight across the blade, holding the file so that it is perpendicular to the blade both vertically and horizontally. Cut only on the push strokes and lift the file to make the return strokes. Keep moving the file from side to side to obtain rounded bottoms of gullets, as desired. There must be no angular portions or indentions in the gullets as a crack in the blade can start from any irregularity of the rounded contours.

If there is any doubt about proper depth of gullets, measure gullets at ends of saw before jointing. The teeth at the ends will generally be well preserved in their original state.

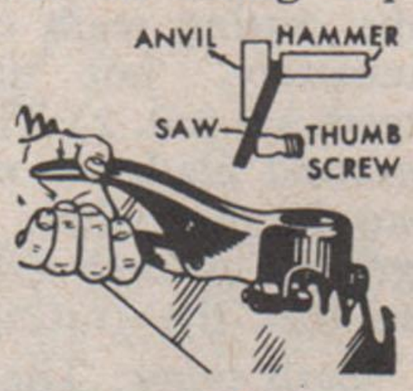
Filing Rakers

The raker teeth of a champion type saw are lower than the cutting teeth by approximately the thickness of the saw blade at the back. In lance type saws the rakers are approximately 1/64-inch lower than the points of the cutting teeth. The top edges and sides of the raker teeth are filed straight across the saw — are not beveled nor sloped in either direction. Use an 8-inch mill file to joint each raker tooth down to give it the proper clearance below the cutting teeth — and to then reshape it and sharpen it according to its original pattern. A saw tool, as illustrated, can be used to fit

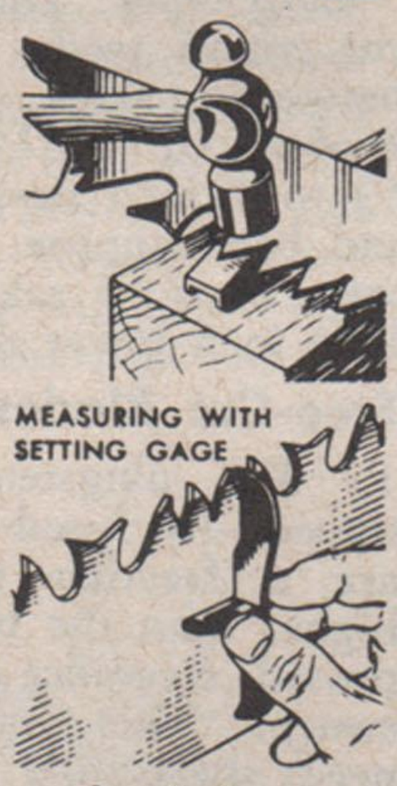


down over the raker tooth and support it for filing. This tool also provides means for measuring clearance below cutting teeth — and serves to hold file for jointing and finishing. Hold file perfectly horizontal and file straight across blade cutting on the push strokes only. In shaping the rakers, file on the top edges only until teeth are perfectly shaped and a chisel like edge is produced at the corners formed where the top edges meet the sides. Afterwards, touch the sides of the raker teeth very lightly with file to remove any burrs turned over in filing top edges.

Setting



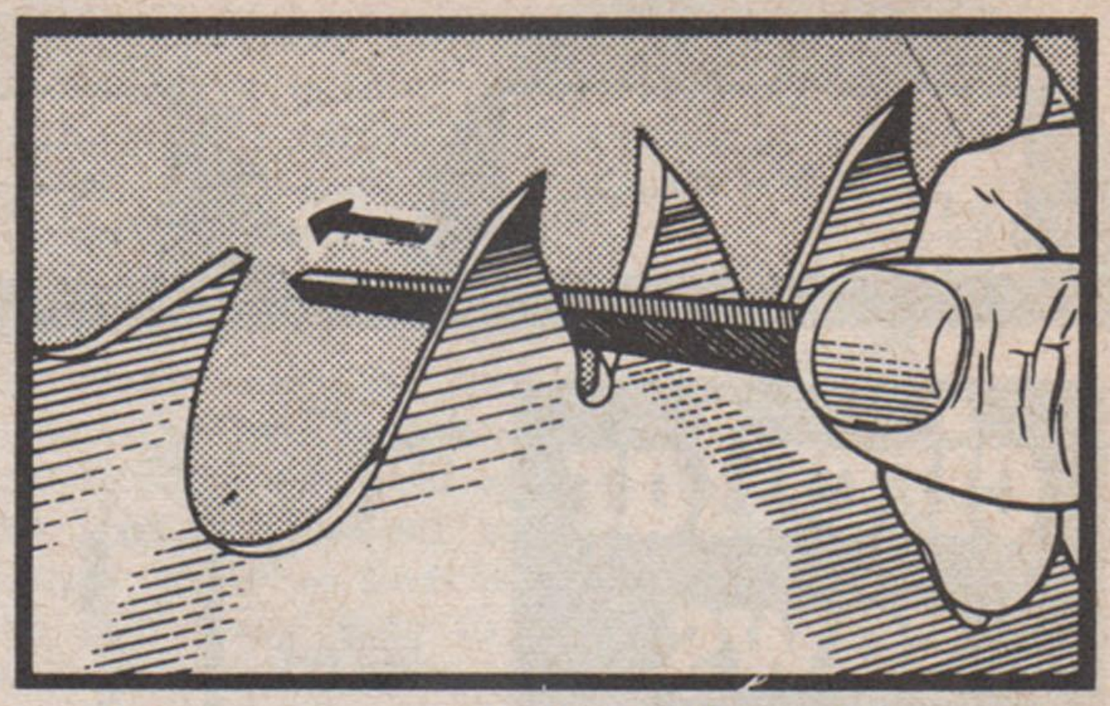
Only the cutting teeth are set; and these are set in alternate directions. Not more than one-third of the length of each tooth should be bent to form a set. Do not set teeth any more than necessary to insure the cut being slightly wider than the thickness of the blade, so that saw will not bind in the work. If saw is to be used for softwoods, the set should be a trifle more than if saw is to be used for hardwoods. Setting can be either with a hand set, or with a setting block and hammer. If a hand set is used, adjust it for the proper set by presetting it to one of the teeth at either end of the saw. Chances are that one of these teeth will have maintained the original set. If a setting block is used, place the saw on the block as shown in accompanying illustration; then strike the tooth that is in place on the block two or three light blows with a light hammer. Strike the tooth close to the point and note that it takes the shape of the setting block. Set alternate cutting teeth with one side of the blade turned upward; then turn the blade over and set all of the remaining teeth in the opposite direction.


MEASURING WITH SETTING GAGE

A regular setting gage can be used for measuring the amount of set. For cutting hardwoods, gage by the point at the short end of the gage. For cutting softwoods, use point at long end.

Filing Cutting Teeth

Before filing cutting teeth, color the flat tops left by jointing with candle smoke or blue chalk so that these can easily be seen. File one tooth at a time, completely shaping it before moving on to the next tooth. File alternate teeth while working from one side of saw; then turn saw around to file all the remaining teeth. For filing, place saw in the vise; but lower it

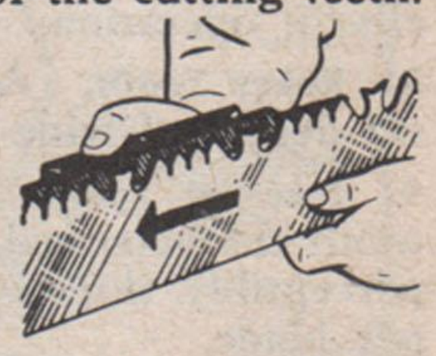


so that only about 1-inch portions of the cutting teeth are exposed. This will keep teeth from vibrating. Use a 6-inch fine, smooth-cutting mill file or a slim tapered file. Hold file so as to obtain original bevel. This is usually from 45° to 60°. File on one side of the tooth first until half the flat top left by jointing is cut away; then file on the other side until tooth is brought to a perfect joint. File only on the push strokes, and do not allow file to wobble while cutting. Points of teeth must be at exact centers. If the shape of the cutting teeth changes the radii between the teeth so that these become angular instead of curved, these radii must be reshaped to make them rounded. Use a 6-inch fine, rat-tail file. File straight across the blade — on push strokes only — until radius between each of cutting teeth is given a properly rounded contour.


ROUND RADII

Finishing

After filing the cutting teeth, fit a fine, smooth-cutting file flat into the saw tool and pass it very lightly from end to end over the teeth at each side of the blade. A smooth honing stone can be used in place of a file. This will remove any burrs or rough edges on the sides resulting from the filing and shaping of the cutting teeth. If, in use, the saw runs to one side, restroke the blade in the same manner on the side to which the blade tends to run.



CARE OF SAW BLADES

Saw blades can be straightened, cleaned of rust, and should be cared for in the same manner as hand saws. Refer to page 11.

BUTCHER SAW BLADES

Butcher saw blades are similar to rip hand saws. The teeth are set alternately right and left to clear the side of the blade by about .005 to .007-inch on each side. The teeth are not beveled. They are filed straight across and have chisel-type cutting edges. Use a fine smooth-cutting triangular file, and file only on the push strokes taking care to reshape the teeth in accordance with their original angles.

circular saws

TEETH CHARACTERISTICS

Standard blade patterns are illustrated above. In reconditioning saws, teeth should be re-shaped as nearly as possible to the original patterns. For this reason, it is good practice to make a paper reference pattern of each blade you own. Note on each the degree of tooth set, bevel angles, and other useful information.

Types of Teeth

There are four general classifications of circular saw teeth:

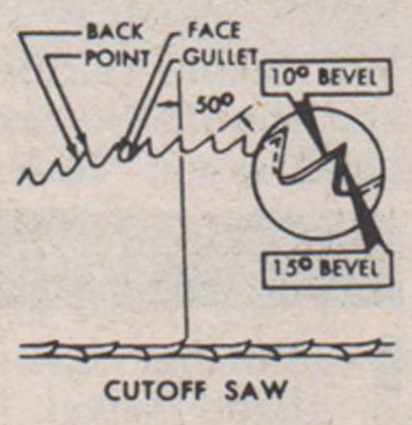
1) Cut-Off Tooth. This is a knife-edge, needle-point tooth designed to sever the wood fiber and cut across the grain.

2) Chisel Tooth. Shaped like a chisel end (flat in front, with a sharp, horizontal top edge), this tooth is designed to clean out fibers in a rip-cut operation.

3) Raker Tooth. A chisel tooth having an extra deep and wide gullet in front of it.

4) Free-Cut Tooth. A new design chisel-type tooth characterized by its very long, almost imperceptibly sloped back. There are fewer teeth per blade.

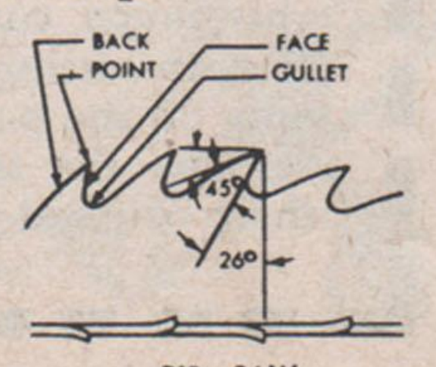
A Cross-Cut Blade



CUTOFF SAW

Shallow, evenly spaced cut-off teeth — set alternately. Front edges hooked-to-center (if extended down, would pass through blade center) — and beveled on outside at 15° to 20°. Back edge beveled on outside at 10°. Both edges straight. Angle of back edge approx. 50°. Gullets usually 5/32 inch deep. Tooth set 1/3, approx. 1/8 inch deep.

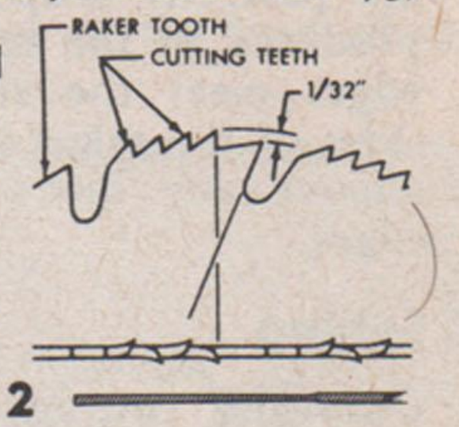
A Rip-Cut Blade



RIP SAW

Larger, evenly spaced chisel teeth — set alternately. Front edge hooked 1/4 (if extended down, would touch circumference of a concentric circle 1/4 the diameter of the blade) — and no bevel. Back edge beveled approx. 5° on outside (to compensate for set and keep backs of teeth level) — and straight bevel portion is angled in direction of tip of seventh tooth back. Gullets 5/16 inch deep, rounded at bottom — shape and depth critical to clear out chips (blade may crack if gullet is too shallow or not rounded). Tooth set 1/3, approx. 1/8 inch deep.

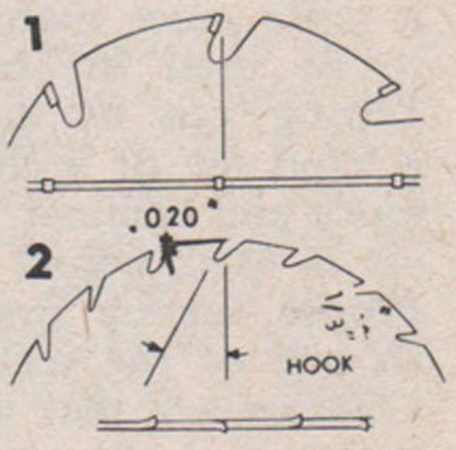
Combination Blades



1) The flat-ground blade — the cutting teeth are set alternately, but the raker teeth are not. 2) The hollow-ground blade — no set. Instead, the whole blade is ground on each side to taper in at the center — so that the cutting edge is the thickest part.

Both types: The cutting teeth are like cross-cut cut-off teeth. Raker teeth spaced regularly between groups of cutting teeth. Each raker hooked 1/4 to 1/2 (patterns differ). Gullets 1/2 to 1 inch deep, 1/4 to 1/2 inch wide, front and back approx. parallel — rounded at bottom. Tops of raker teeth — jointed 1/64 to 1/32 inch lower than the cutting teeth.

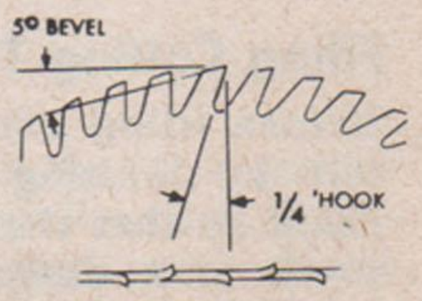
Free-Cut Blades



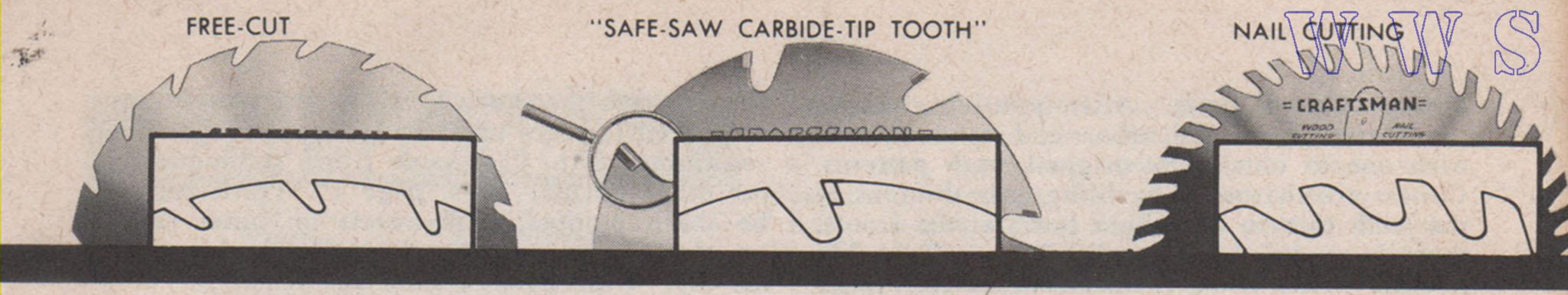
1) The tungsten - carbide tipped—has fused-on tips that are a fraction wider and higher than the blade — to provide clearance and cutting sweep. This type rarely needs sharpening — and can only be sharpened on a diamond wheel. It has 8 teeth. 2) the flat ground 8- or 20-toothed blade on which the teeth are set alternately.

A template is required (and a special jig is highly recommended) for sharpening the set-tooth types. The cut of the blade depends entirely upon maintaining accurately the .020 inch rise of the back of each tooth. This rise is a gentle curve, up to the cutting edge. No bevels. Front edges hooked from 1/3 to 1/2 (on different blades). Gullets are similar to those of raker teeth, 1/2 to 3/4 inch deep and 1/4 to 1/2 inch wide. Tooth set is 1/3, approx. 1/8 inch deep.

Nail-Cutting Blade

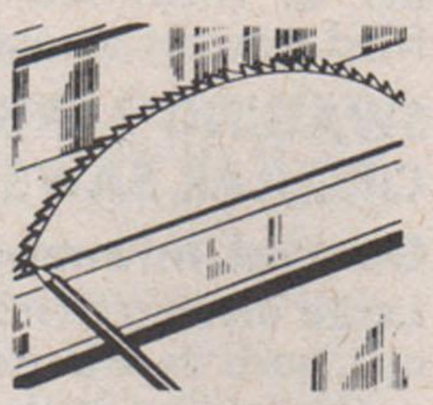


Large, evenly spaced chisel teeth — specially hardened steel. Front edge hooked 1/4 — no bevel — slightly curved at bottom. Back edge straight, beveled 5° on outside, angled to approx. the 5th tooth back. Gullets 1/2 to 3/4 inch deep, 1/4 to 1/2 inch wide, rounded at bottom. Tooth set 1/3, approx. 1/8 inch deep.



Marking Gullets

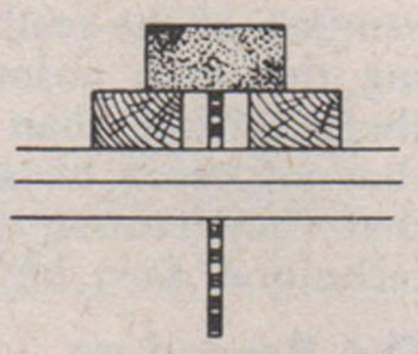
Before removing blade from arbor, mark new depth of gullets with a pencil held to the spinning blade, as illustrated. Position of pencil point can be measured before starting the saw. Refer to the plan (page 14) made of the original saw blade to determine the depth.



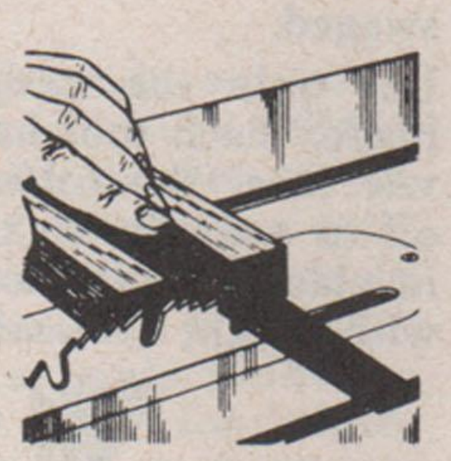
SHARPENING OPERATIONS

Sequence

Usually, three separate steps are required: 1) Jointing, 2) Setting, 3) Filing. Jointing is re-grinding of the blade to a perfect circle. Setting is bending the tips (only) of the teeth alternately right and left — so the teeth will cut a kerf slightly wider than the blade thickness, and allow the blade to run freely. Filing restores the proper edges, bevels and gullets.



Jointing (Not for Free-Cut Blades)

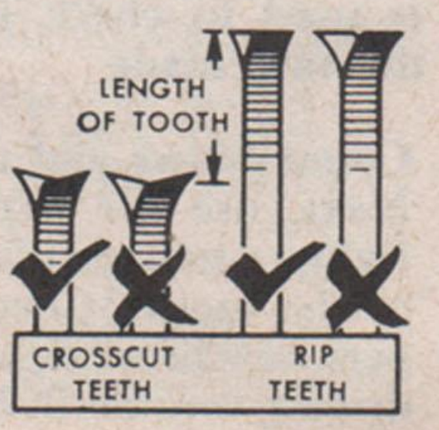


Run the blade (under power) backwards on the saw arbor. (This will probably require reversing the blade on the arbor.) Lower the blade and position an oilstone, resting on two wood blocks, above it. Blade should not touch stone. Start the saw. Raise blade a fraction of an inch at a time, until every tooth (excepting raker teeth) has touched the stone. Remove as little metal as possible.

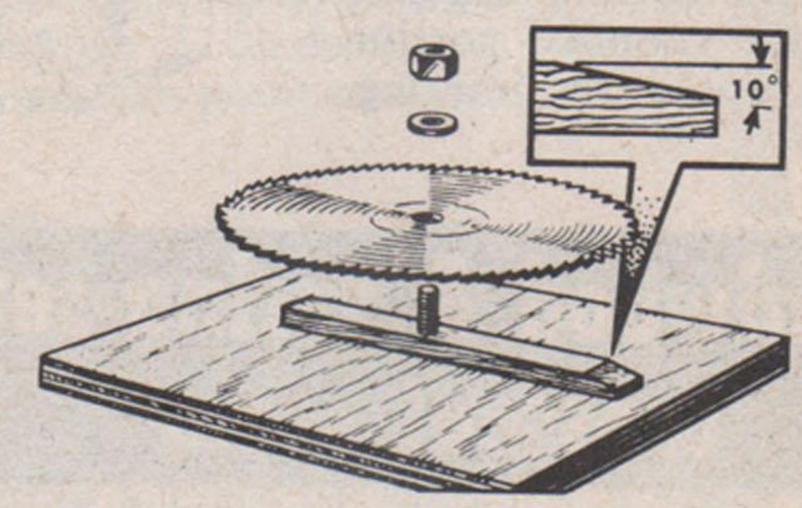
Joint rakers by blocking the blade stationary and filing straight across the top of each. Use a wood block to help keep file (or stone) level at proper height.

Setting

Setting, as a rule, is required only about every third or fourth time a blade is sharpened. Check carefully. Set should not exceed the stipulated amount ("1/3" means that tip is moved 1/3 its thickness to one side — and "1/8 inch" down from the tip).

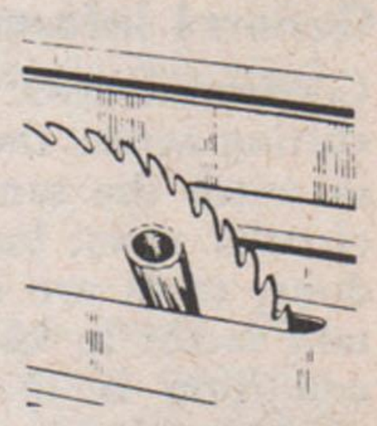


You may use a punch and anvil — or, better, a hand set (tool made for the purpose). An anvil set-up is illustrated. If a hand set is used, hold the blade in a vise. Work first on one side of blade, setting every other tooth; then turn blade over and set the remaining teeth. All must be set exactly alike.

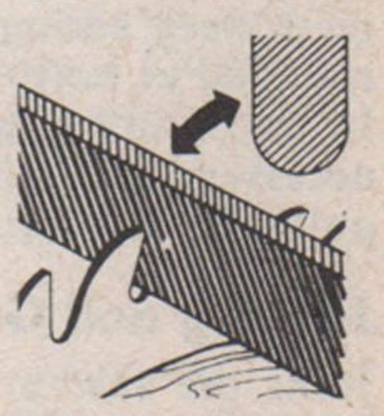


Filing

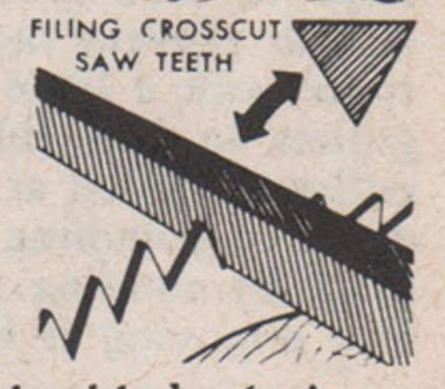
Either keep the blade on the saw arbor and wedge it stationary with a piece of rubber hose, as illustrated — or use a saw filing vise (illustrated on page 8). Always file every other tooth around the blade (working from one side), then file the remaining teeth from the other side, also working around the blade in regular sequence. This equalizes the stresses caused by filing.



Use a 7- or 8-inch mill file for chisel teeth, filing the front edges with the round side and the back edges with the flat side. File each tooth to shape, then make the back bevel. Clean out the gullets with a rat-tail file, using a rotary motion.



Use a 6- or 7-inch slim taper file on cut-off teeth. Shape the teeth while filing the bevels at front and back.

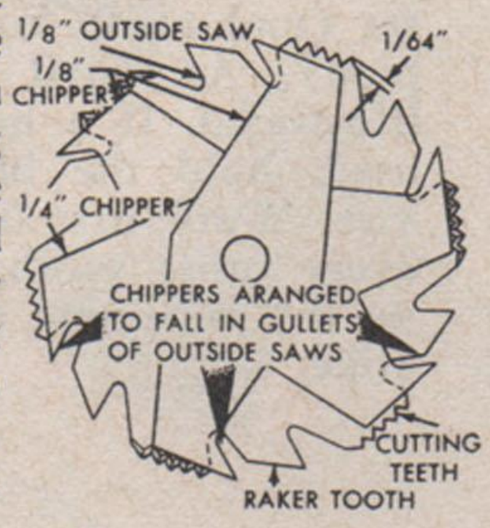


Use the same procedure for free-cut teeth as for chisel teeth — but mark the rise of each tooth back on the blade (using a template and sharp scribing instrument) before you start. File carefully to the line with long, forward-moving strokes.

DADO HEAD BLADES

Dado head blades can be reconditioned in much the same manner as circular saw blades. For jointing, assemble all the cutters together on saw arbor so that they run backwards. Use the

coarse side of stone. After jointing, remove the cutters from the arbor and carefully file each one to obtain the original teeth patterns. Cutters are sharpened by filing only the tops of the teeth to turn over light burrs at the fronts, these burrs being removed wih very light file strokes. When filing is finished, give each raker tooth an additional stroke with a flat file to make it a trifle shorter than the cutting teeth. Now reassemble all of the inside chippers (only) on the arbor and joint them again very lightly, while running them backward. Remove the chippers from the arbor and file the top of each chipper tooth straight across, just back of the cutting edge, to remove the rounded portion on top caused by jointing.



cordwood & spring-set crosscut saws

General Information

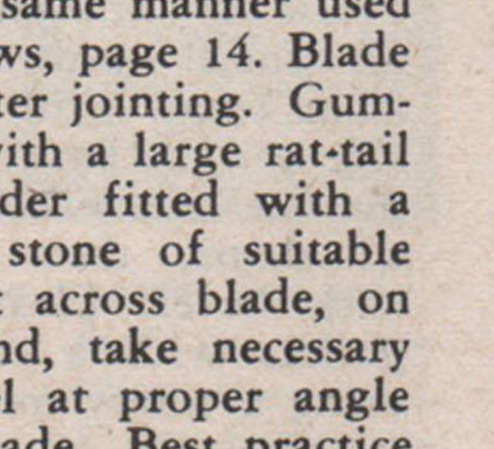
Cordwood saws are circular saws used only for cutting across the grain. They are reconditioned in much the same manner as ordinary crosscut circular saws; but, because of heavy work to be done, teeth are differently shaped. The important factor in keeping a cordwood saw in good condition is to keep the gullets between the teeth deep enough to clear the chips — and well rounded at bottoms to prevent cracking of blade. In reconditioning these blades, four steps are necessary: jointing; gumming (regrinding of gullets); setting; and filing.

Jointing and Gumming

Joint the saw in exactly the same manner used for jointing other circular saws, page 14. Blade should always be gummed after jointing. Gumming can be done by hand with a large rat-tail file; or with a power grinder fitted with a round-face 6-inch diameter stone of suitable width. If filed, file straight across blade, on push strokes only. If ground, take necessary steps to feed blade to wheel at proper angle and to prevent heating of blade. Best practice is to work a little at a time on each of several gullets to keep blade cool. Be sure to make gullets rounded at bottom. A circle to indicate depth of gumming can be drawn on blade with chalk by rotating it on saw arbor by hand, before removing it for reconditioning.

Setting and Filing

Teeth are set like those of other circular saws, page 15. Never more than one-third of a tooth is set. After setting reshape teeth to original pattern, as nearly as possible. A flat mill file, about 10- to 12-inch size, is best. First, file all teeth that have bevels facing you (alternate teeth), then turn blade around and file remaining teeth. Use same filing technique as for other circular saws, page 15. Teeth are to be sharp pointed, with bevels on outer sides on the cutting edges and on the backs, near the top. Bevels range from 20° to 35°.



SPRING-SET CIRCULAR RIP SAWS

These saws are reconditioned in the same manner as cordwood saws, except that teeth are filed straight across to have chisel edges at tops.

SWAGING LARGE DIAMETER CIRCULAR SAWS

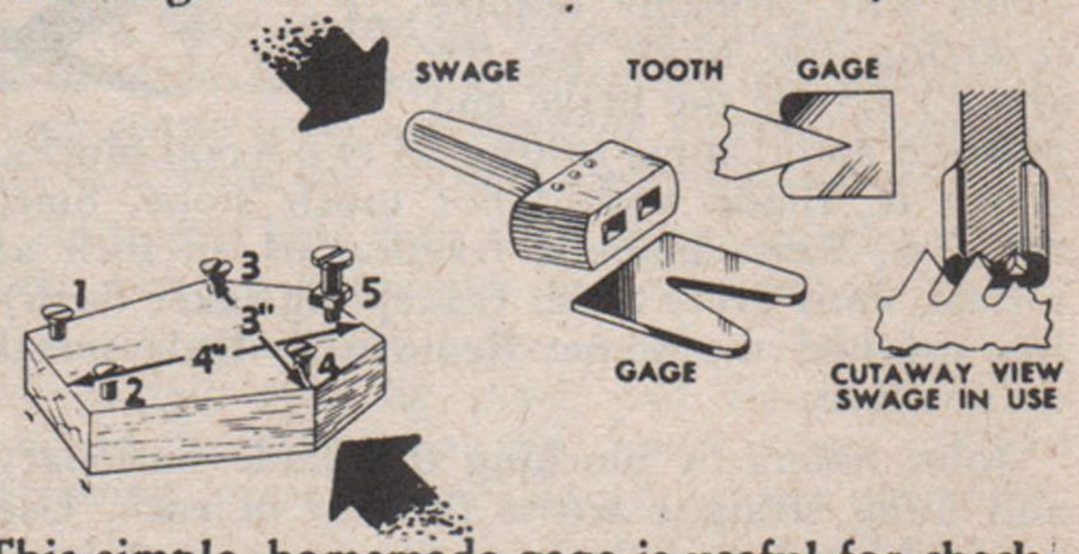
General Information

Large diameter circular rip saws (18 inches and up), such as are used in saw mills, are generally made to cut their own clearance by swaging the teeth, instead of setting them. Saws of such size are usually too thick to permit of easy bending of the teeth. Swaging consists of pounding the teeth points to spread them and make them thicker than the blade. It is important that all teeth be spread the same amount and that they remain the same height. A definite technique must be followed.

The Procedure

Joint, gum and file the teeth in the manner describe for circular rip saw blades, page 14. In filing, however, teeth must be shaped to fit the tooth gage furnished with every saw blade of this type. This is important as the amount of metal at tip of tooth will determine the result of swaging. Teeth are always filed straight across, as only chisel point rip teeth can be swaged.

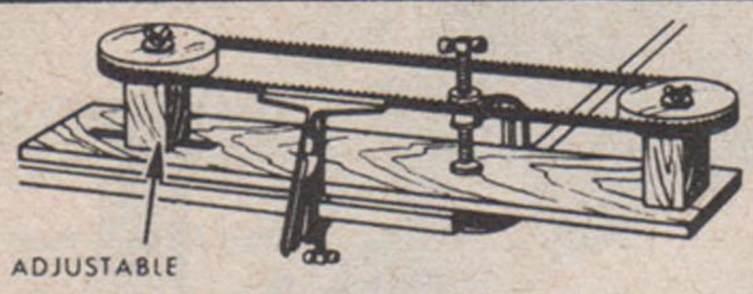
Use only the swaging tool designed for the blade. Each tool has two dies, one with a convex face, the other with a flat face. Apply oil to a tooth, set the tool with the convex die in place over the tooth, and tap the tool lightly with a light hammer. Do not strike heavy blows.



This simple, homemade gage is useful for checking the degree of set in saw teeth. Screw heads 1, 2, 3 and 4 are placed flat against blade and screw 5 is turned until the head touches tip of tooth that is properly set. This screw is then locked by tightening the locknut; and the gage is used to check setting of all other teeth on the saw blade.

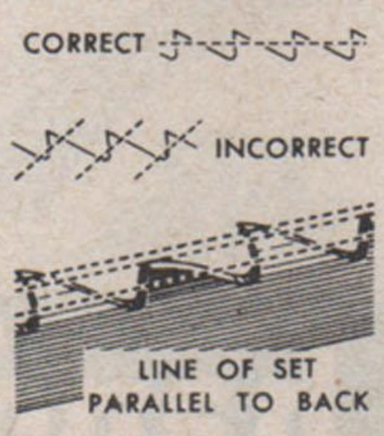
Count blows and use same number on all teeth. Next, use die with flat face, and again strike light, counted blows to square up the point of the tooth. Check constantly with preset calipers as you work around the blade to keep from driving any tooth below the height of the others.

band saw blades



General Information

Nothing will break a narrow bandsaw blade as quickly as forcing it to work when dull. Touching up the blade to keep it sharp is not difficult. There are three steps: setting; filing and honing. The teeth are set much like those of other saws and are filed to proper shapes and sharpness. Honing knocks the burrs left by filing from the teeth, and helps the blade to run true in the work.



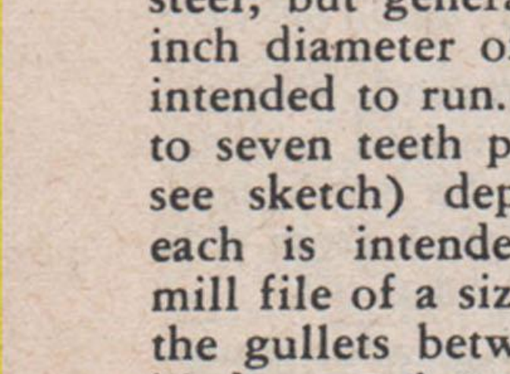
Setting

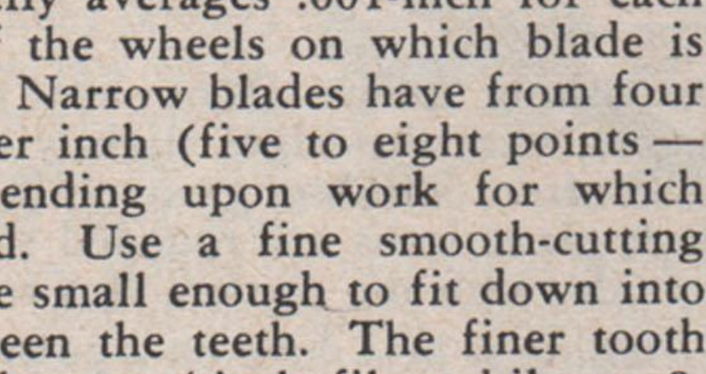
Setting is the bending of teeth outward, alternately in opposite directions so that blade cuts its own clearance. Only the tooth points are bent — never bend teeth more than half-way down. All teeth should be bent on the same line — a line parallel to back edge of blade. A number of special tools are made for setting bandsaw blades; but the occasional worker can use an ordinary hand set. Teeth should be set so that from one-third to one-half the cutting edge of each tooth extends outward from the side of the blade.

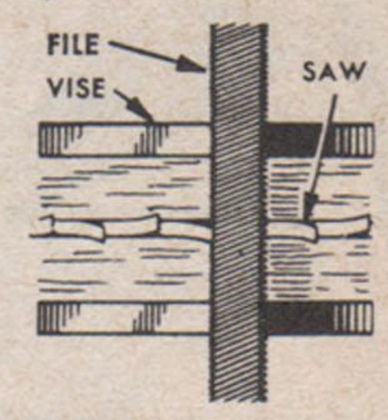
Filing

Blades from 1/8- to 3/4-inch wide are commonly considered to be narrow blades. Blade thickness varies according to the quality of the steel; but generally averages .001-inch for each inch diameter of the wheels on which blade is intended to run. Narrow blades have from four to seven teeth per inch (five to eight points — see sketch) depending upon work for which each is intended. Use a fine smooth-cutting mill file of a size small enough to fit down into the gullets between the teeth. The finer tooth blades require about a 4-inch file, while an 8-inch file can be used on coarser toothed blades. Filing can be done in an ordinary bench vise holding two boards, about 10-inches wide, between which the blade is held. A better arrangement, however, is shown at top of page. The wheels which hold the blade are adjustable on the supporting board so that the blade can be stretched taut.

Clamp a section of blade into the vise with about one-half the blade projecting up. File one tooth at a time. File straight across the blade, without allowing the file to dip or turn to either side. Maintain original tooth patterns as nearly as possible. Teeth are hooked from 8° to 15°, depending upon style of blade and number of teeth per inch. Gullets must be carefully rounded — any angles or corners in the gullets will cause blade to crack in use. (On coarser teeth it may be necessary to use a rat-tail file in gullets.) File only on the push strokes, lifting file for return strokes, and try to give same number of strokes to each tooth. Work around blade, resetting it in vise, until finished If teeth were badly worn, set a pair of outside calipers to check heights of teeth points above back of blade, check all teeth, and refile any which are too high. Occasional touch-up filing can be done with blade mounted in bandsaw. This method works even better if blade is reversed so teeth point upward.





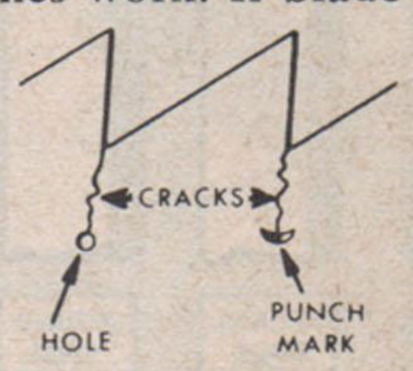


Honing

Mount the blade and operate the bandsaw. Touch each side of blade very, very lightly with a fine oilstone — just enough so that all teeth will have been touched on each side. Test blade by cutting a piece of wood. If it tends to run to one side, again touch stone to it — on side to which it tends to run — to correct this tendency.

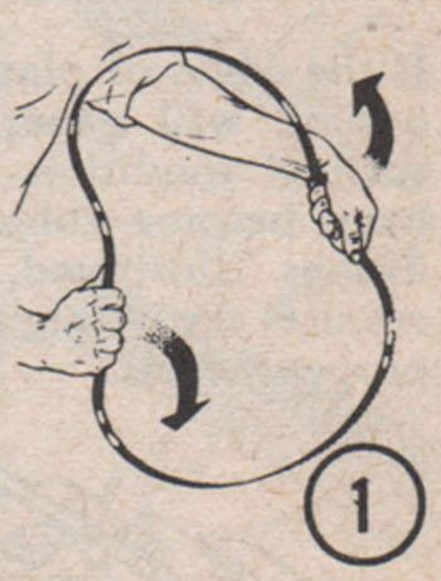
Stopping Cracks

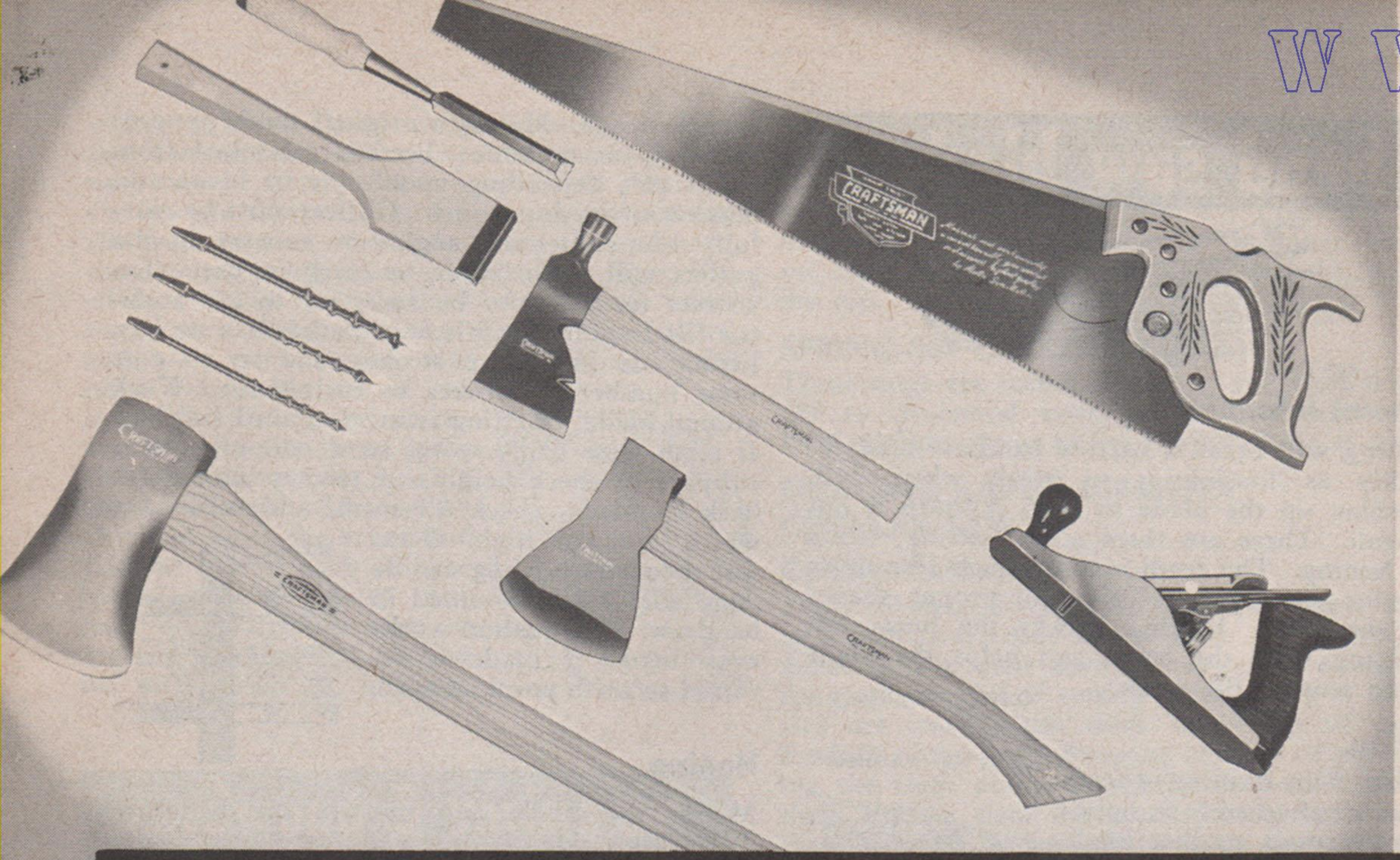
If a crack does not extend across more than one-sixth the width of the blade, it can be stopped by drilling a small (about No. 60 drill) hole at bottom of crack, as shown. Crescent-shaped punch marks on each side of blade—instead of a hole—will sometimes work. If blade is less than 1/4-inch wide, it should be broken and re-brazed. Broken blades can be mended either by brazing or silver-soldering; but this is generally a job for the expert workman.



Storage

When not in use, wipe blades with an oily rag and fold them for storage. To fold: grasp blade with back toward you — left hand with thumb up and right hand with thumb down. Hold firmly. Now simultaneously rotate left wrist to move thumb down and right wrist to move thumb up — at same time allowing hands to move toward each other as pulled by the blade. Keep twisting wrists and blade will coil up into a triple loop. Tie loops with string or tape and hang blade on peg. Before using, wipe off oil.

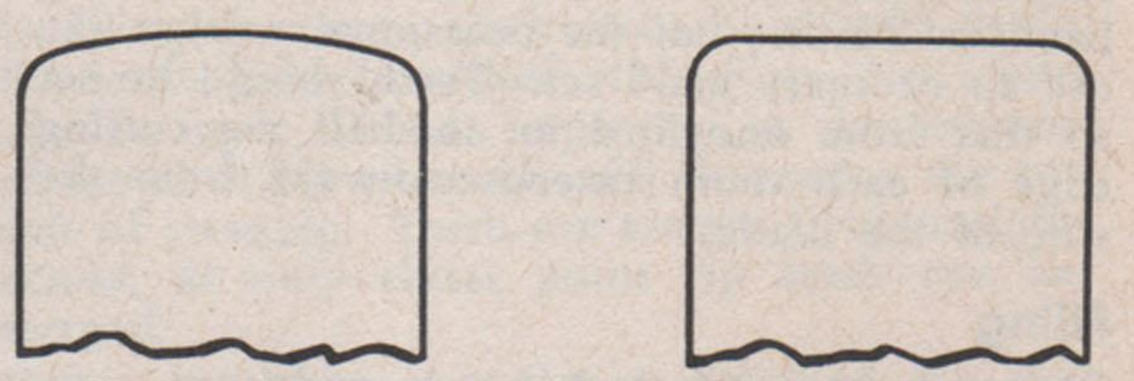




woodworking hand tools

PLANE IRONS
Grinding

If the edges of plane irons are straight and true, honing will generally restore them to proper cutting condition. However, when the irons have become subject to any of the five conditions illustrated, they must be reground to restore the straightness of the edges and the proper bevels.

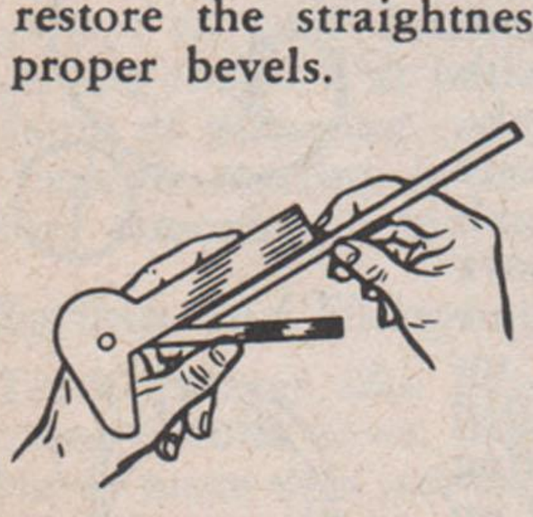


properly, or use a protractor. Use an accurate square to check the squareness of the plane iron edge.

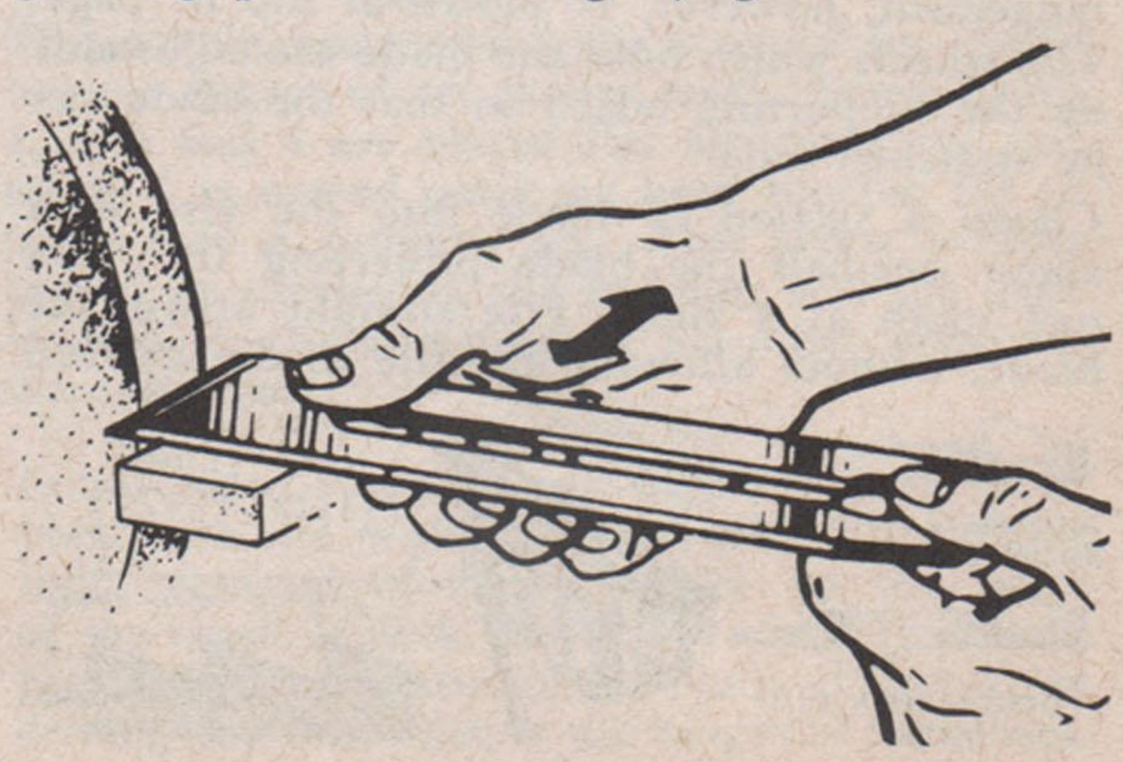
Smoothing plane irons are ground straight across, with the edges slightly rounded to keep them from making grooves in the workpiece. Jack plane irons are rounded slightly from side to side, with the corners also rounded off.

Grinding is best done on a power grinder equipped with an aluminum oxide wheel of 70-grit.

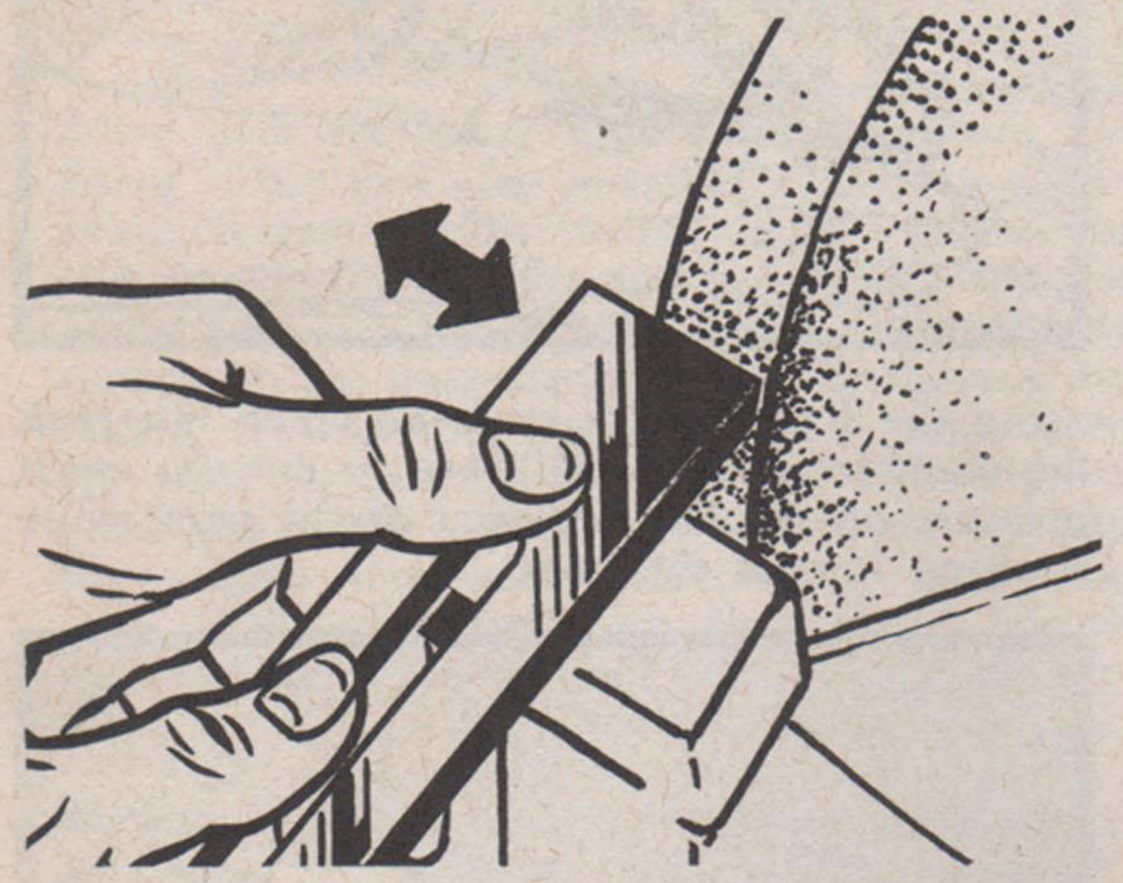
If much metal is to be removed, a coarser wheel of 36-grit may be used; but final grinding should be done on the finer wheel. When grinding, press the tool lightly against the wheel.



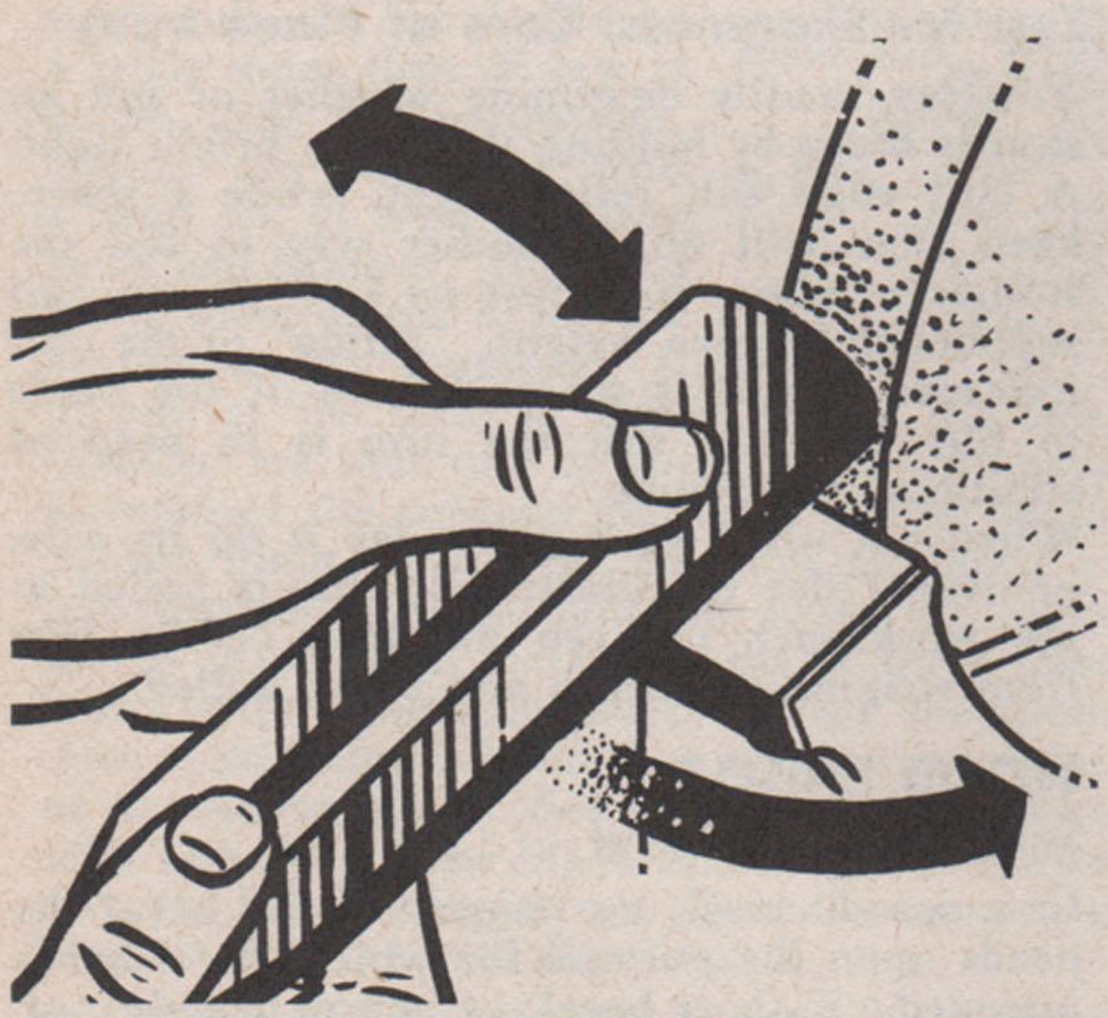
In general, proper bevels are 30° for both smoothing and jack planes. Bevels can be checked by using a "T" bevel; either place it over a plane iron you know is sharpened



Do not remove too much metal at one time; instead, dip the tool in water often to prevent all chances of drawing the temper. To straighten imperfect bevels or nicked edges, first hold the tool with bevel side up and press it straight

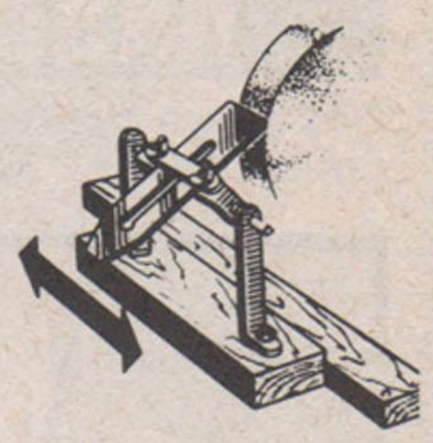


into the wheel, below the center of the wheel. Move the tool in a straight horizontal line back and forth across the edge of the wheel until the extreme edge is straight across and square at the sides. Check edge with accurate square. After straightening the edge, turn the tool over so that the bevel side is down — hold it against the wheel at the bevel angle desired — and again work it back and forth straight across the wheel, until the full bevel is established and a slight burr is turned over at the edge of the



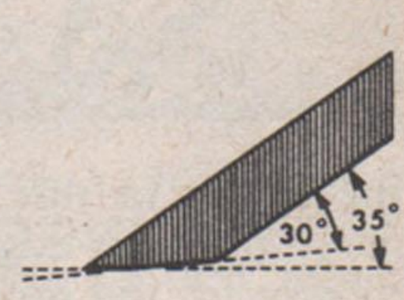
tool. Check your progress often while sharpening to be sure that a proper bevel is being obtained and the edge is straight and square at the corners. After a straight true edge and proper bevel have been obtained, round off the edge equally in both directions from center (if the iron is for a jack plane), or simply round off the corners (if the iron is for a smoothing plane). In forming a rounded jack plane edge, be careful not to start the curves exactly at the center (rather, a little to each side of center), and not to leave a break where each curve starts. A very slight curve is desirable.

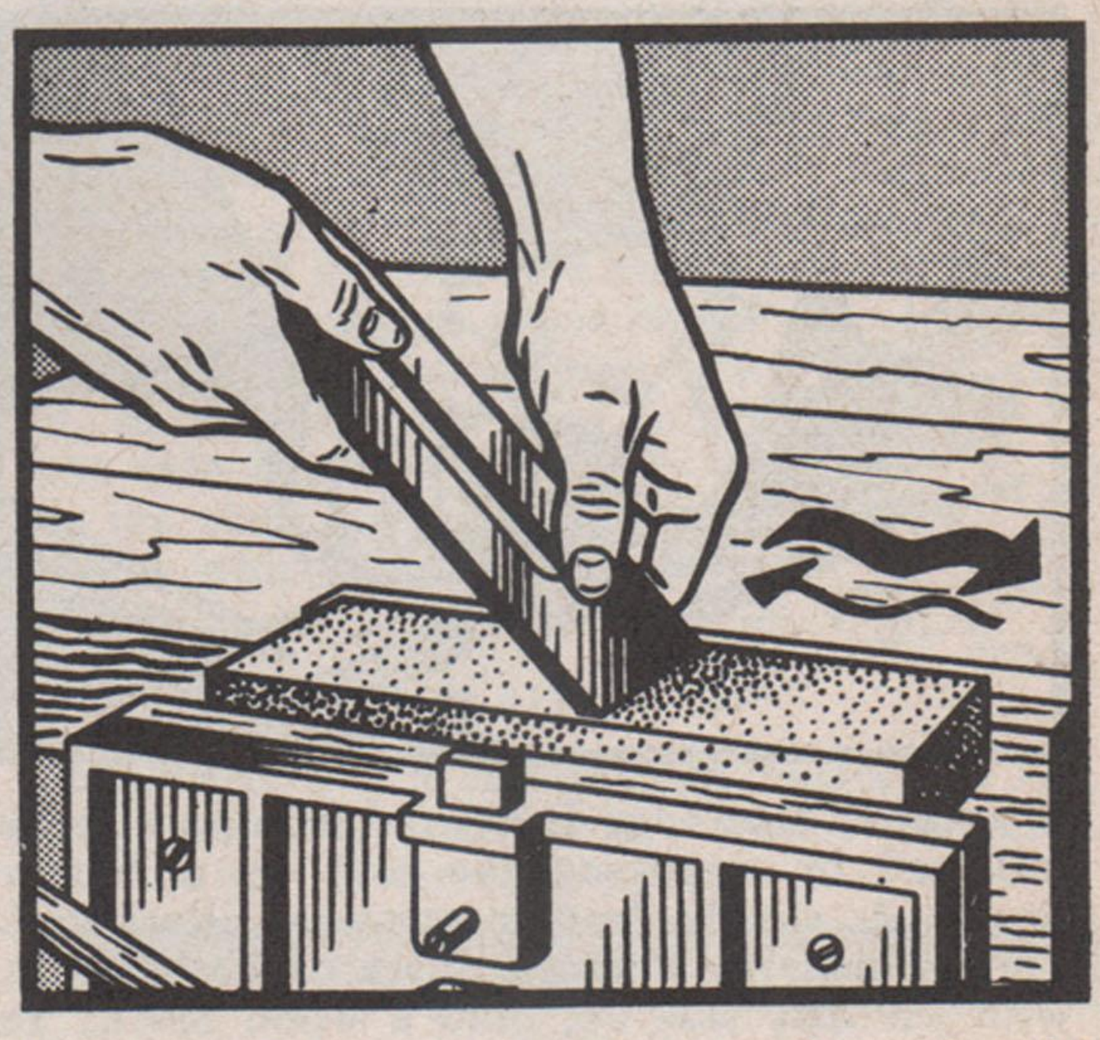
The illustration shows a tool-grinding clamp that is very helpful in maintaining the bevel at the proper angle. This is made by assembling pieces of 1/8-inch by 1-inch flat iron and a length of 1/4-inch rod upon a wooden block, as shown. To operate the clamp, slip the tool between the two bars and adjust it until it is held against the grinding wheel at the proper angle — then tighten the two wing nuts to hold it in this position.



Honing

After grinding, the plane iron must be honed to bring it to a fine cutting edge. Use a combination stone, either of silicon carbide or of aluminum oxide, with medium grit on one side and fine grit on the other. A natural oilstone can also be used. In honing a plane iron, you do not hone the entire bevel; instead, you start a new short bevel at a slightly greater angle than the ground bevel. The angle at which the plane iron is held for honing should be approximately 35°, if the ground bevel is at an angle of 30°. A few drops of kerosene or fine machine oil on the stone will give a better edge. The stone must be held securely — preferably in a vise — during the operation.

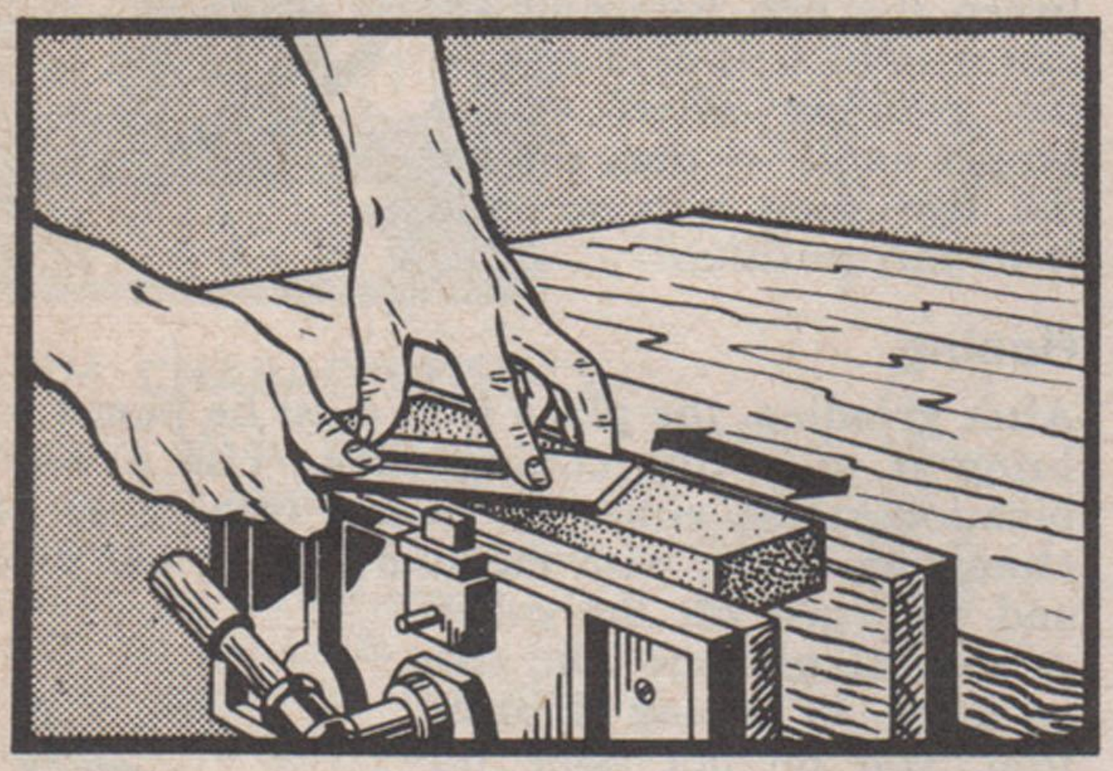




In freehand honing there is a tendency for the tool to rock. To avoid this, keep your wrist rigid so that all movement is at the elbows. Move the tool slightly from side to side while advancing it from end to end of the stone as though using it to peel a small sliver from the stone. At the end of this first stroke, reverse the motion to return it to the starting end of the stone — but use very little pressure on the return stroke. Occasionally turn the stone end to end. Repeat these strokes until a fine wire edge has been formed uniformly from side to side of the tool.

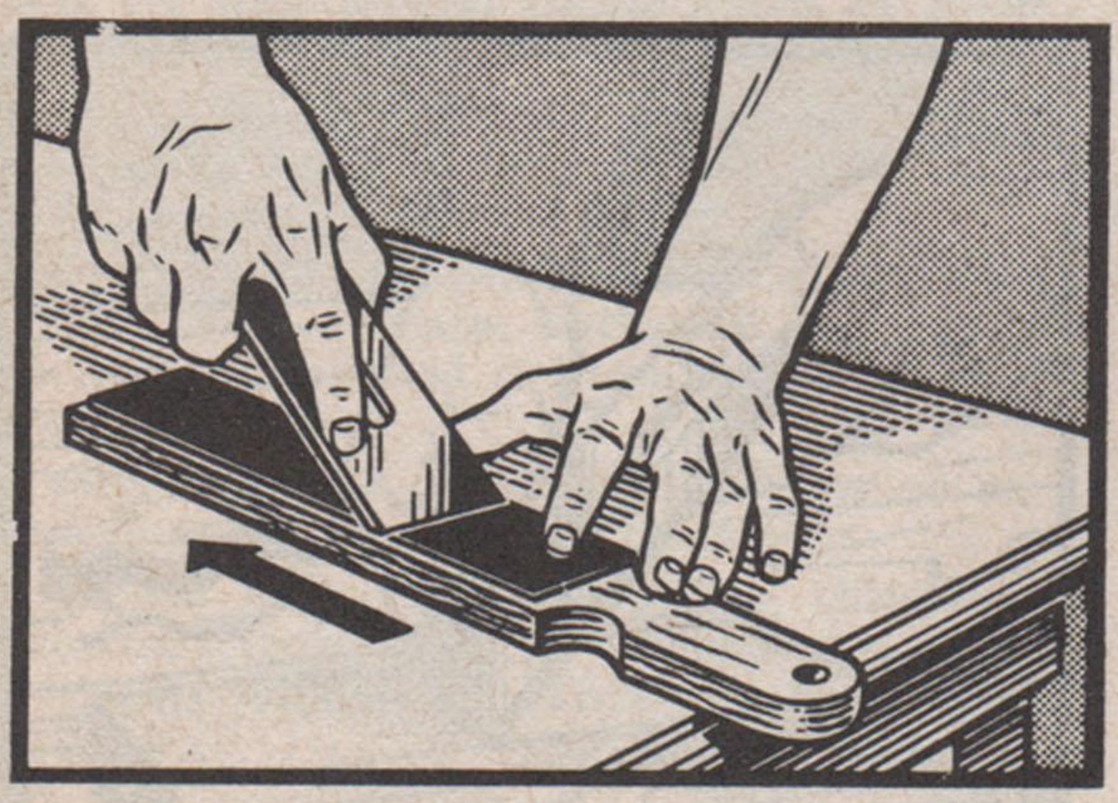
woodworking hand tools (cont.)

Next, turn the tool bevel side up and lay it flat on the stone. Move it back and forth across



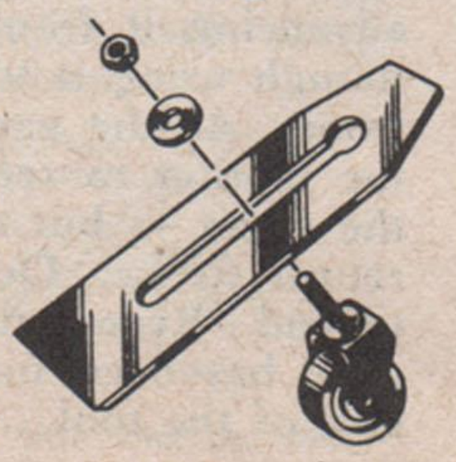
the stone, in this position, a few times, to remove the wire edge. During this step, take care to prevent the tool from being lifted away from the stone — or the edge will be destroyed by the formation of a slight bevel on the wrong side.

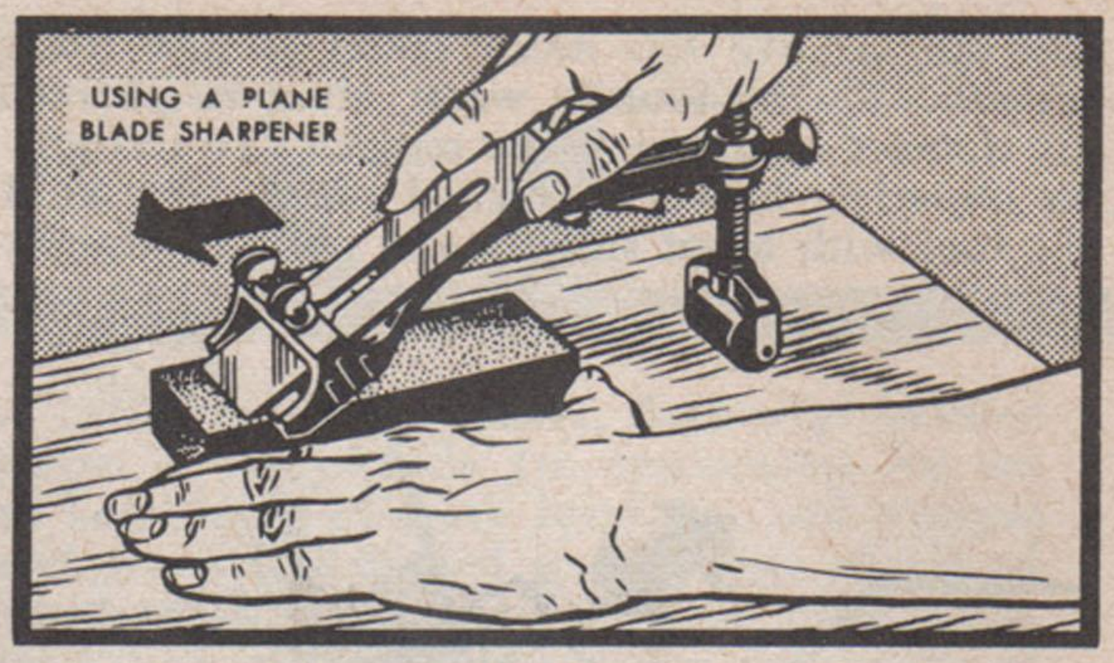
A neat way to remove the wire edge is to draw the tool edge through a piece of soft wood. This is not, however, as satisfactory as honing on the reverse side.



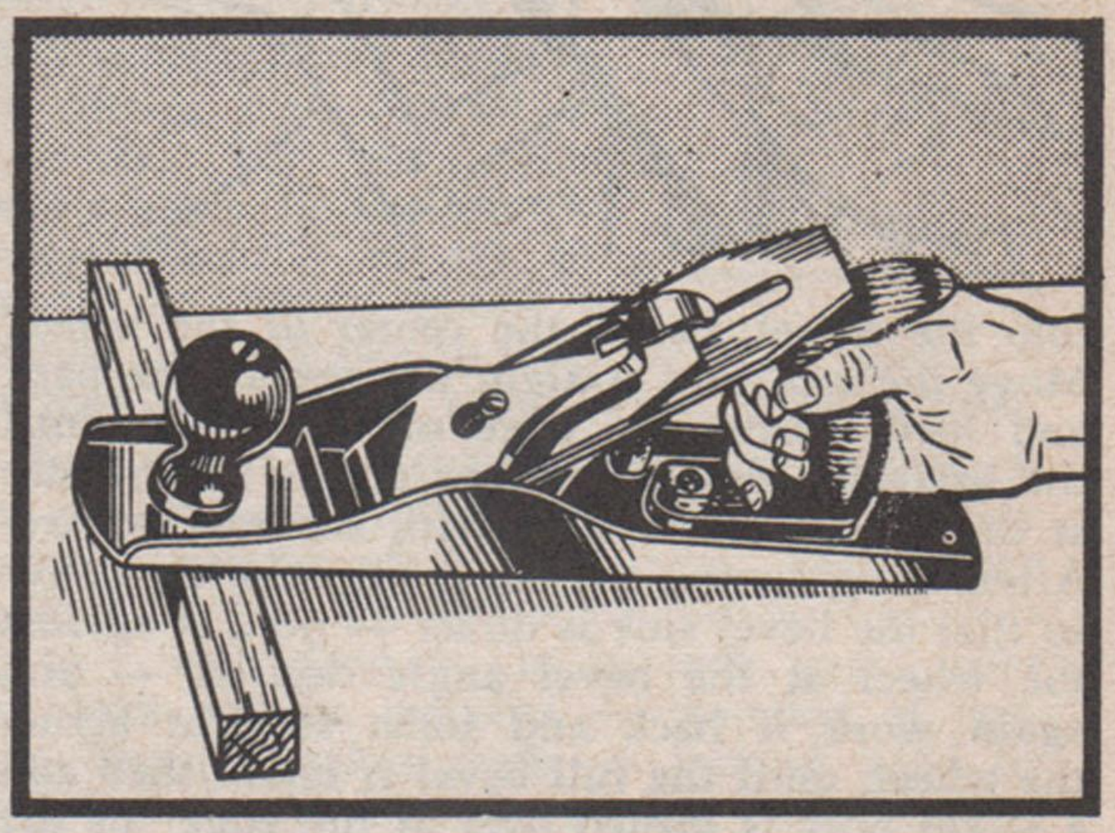
If an extra fine edge is desired, honing may be followed by stropping the tool on a leather strop. A simple leather strop is illustrated. This is made by gluing a piece of leather belt, with the hair side up, onto a wood block. In stropping, the action is opposite that of honing — you work away from the cutting edge, not against it. Always lift the tool, instead of making a return stroke, to prevent the edge from digging into the leather.

A simple honing fixture can be made by using an ordinary caster, a stove bolt, washer and nut. This fixture is assembled into the plane iron as illustrated, and its position is adjusted until the proper bevel angle is obtained. In





using the fixture, care must be taken not rock the plane iron on the roller or to put too much pressure on the forward part of the iron while stroking it over the hone.



Test for Sharpness; Care of Plane Irons

You can readily determine whether or not an iron is sharp by holding it up to a bright light. A dull edge will reflect light, while a sharp, keen edge will not. Another way to test the iron is to allow it to rest on your thumb nail supporting its own weight. "Biting" of the tool indicates that it is sharp; failure of the blade to bite indicates that the iron is in need of additional sharpening.

When not using your plane, lay it on its side, or over a slat (as illustrated) that is nailed to the workbench to keep the edge of the iron from striking the bench and being dulled.

WOOD CHISELS

Selecting the Bevel

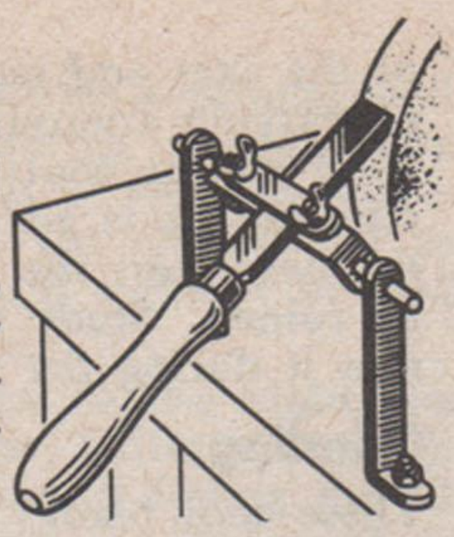
In a wood chisel, the length of the bevel depends upon the purpose for which the chisel is intended. A short bevel, of approximately 1/4-inch length, makes a tool suitable for heavy cutting of hardwood. If the tool is to be used for paring softwood, the bevel should be 3/8-inch long or longer.

Grinding

Wood chisels can be ground in the same manner as plane irons. This is especially true of low carbon steel chisels. High carbon steel chisels, of the type suitable for wood turning, should be ground as described on page 24.

A handy jig for holding wood chisels, when an adjustable rest is not available, is illustrated.

This is the same jig already described for use with plane irons; but it can be mounted directly onto the bench (instead of a sliding block) as the wood chisels are narrow enough not to require sidewise movement for the grinding process.



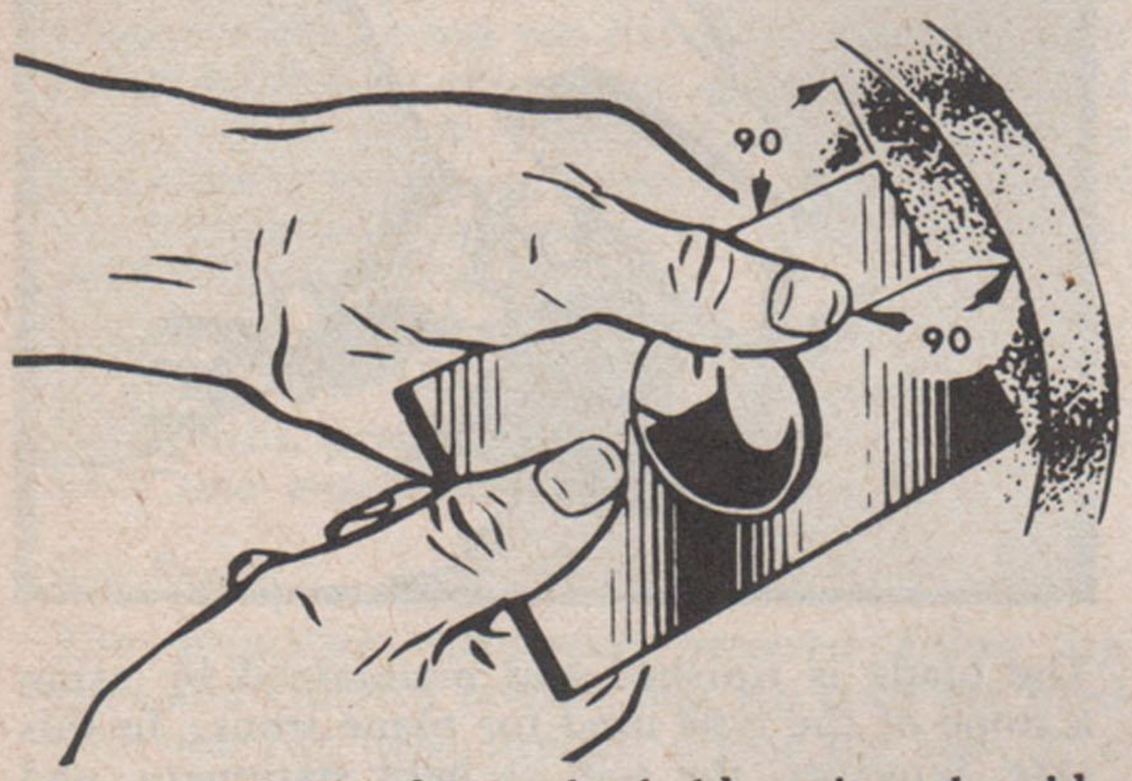
Honing

Wood chisels are honed in exactly the same manner as plane irons.

STRAIGHT EDGE CABINET SCRAPERS

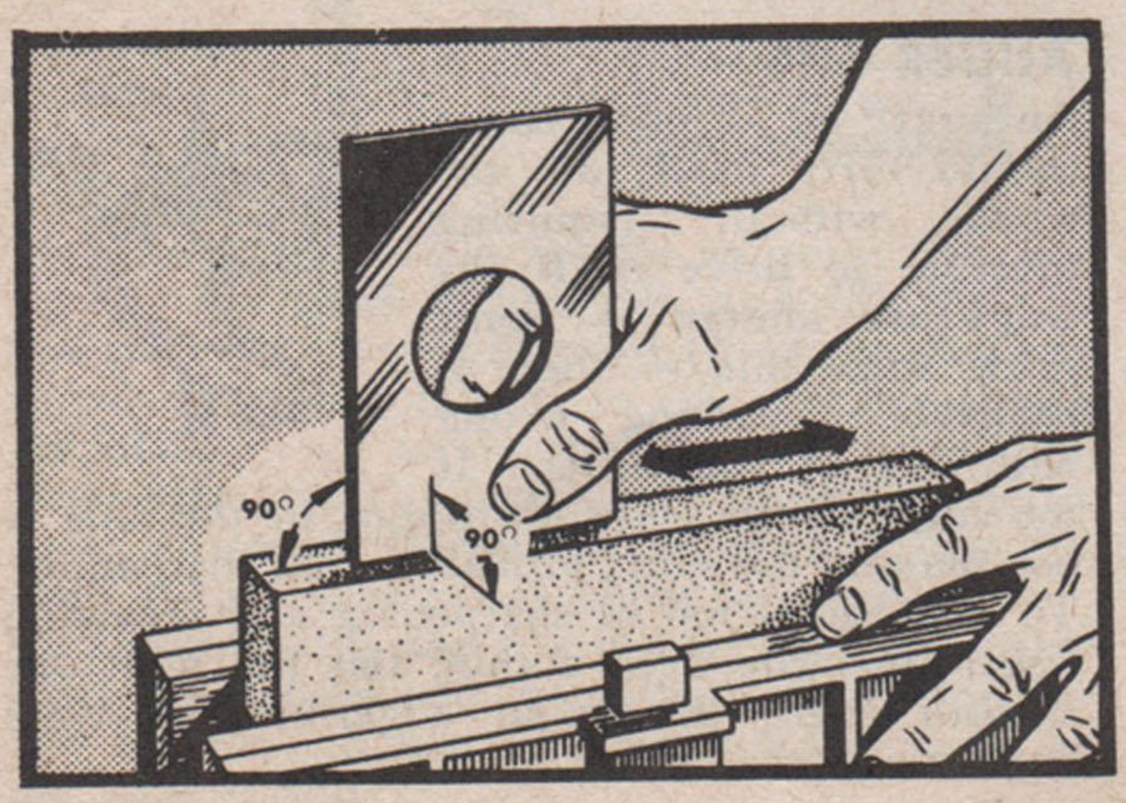
Removing Nicks

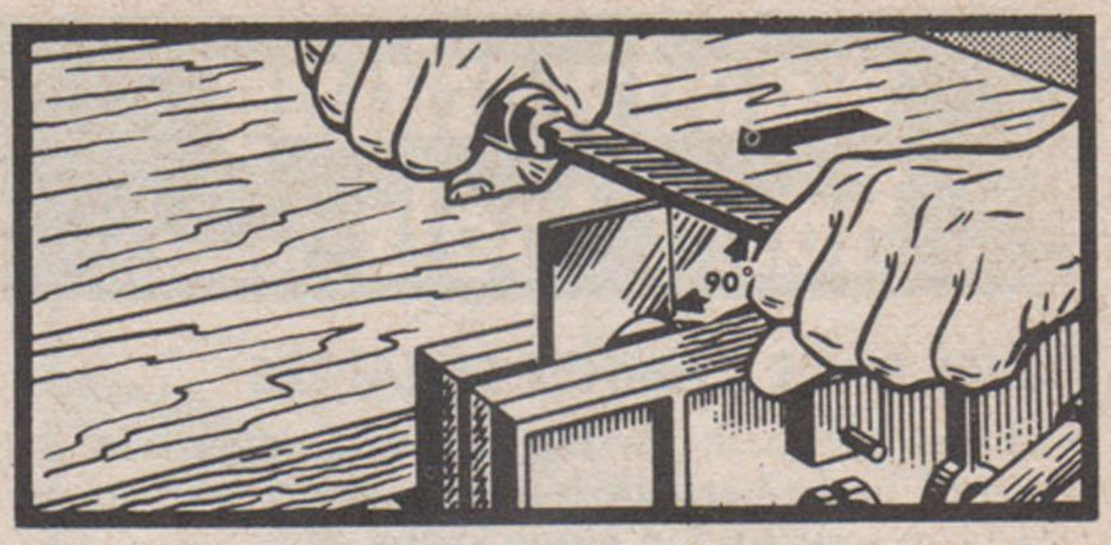
Cabinet scrapers are generally low carbon-steel tools which can be used for everything from scraping paint to smoothing of the finest cabinet work. Small nicks in the blade can be removed by use of a flat stone, or by use of a dry grinder. If a grinder is used, it should preferably have an aluminum oxide wheel of approximately



70-grit. The blade can be held against the side of the stone, or can be fed directly into the edge of the stone in the manner used to straighten the edge of a plane iron. In either case, the object is to produce a straight, true edge, square at the corners. Dip the tool in water often during the grinding operation, and use an accurate square to check the edge.

Flat stones of the same type used in honing plane irons can be used, but care must be taken to make certain that the surface of the stone is flat and true. If the stone is worn and uneven, turn it on edge.

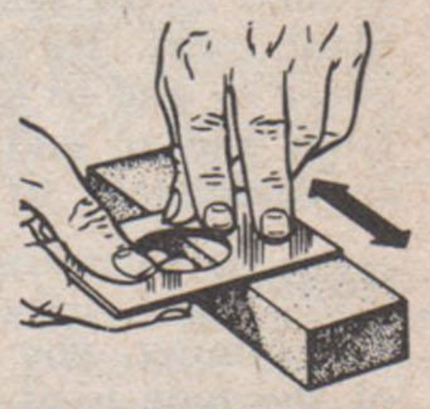


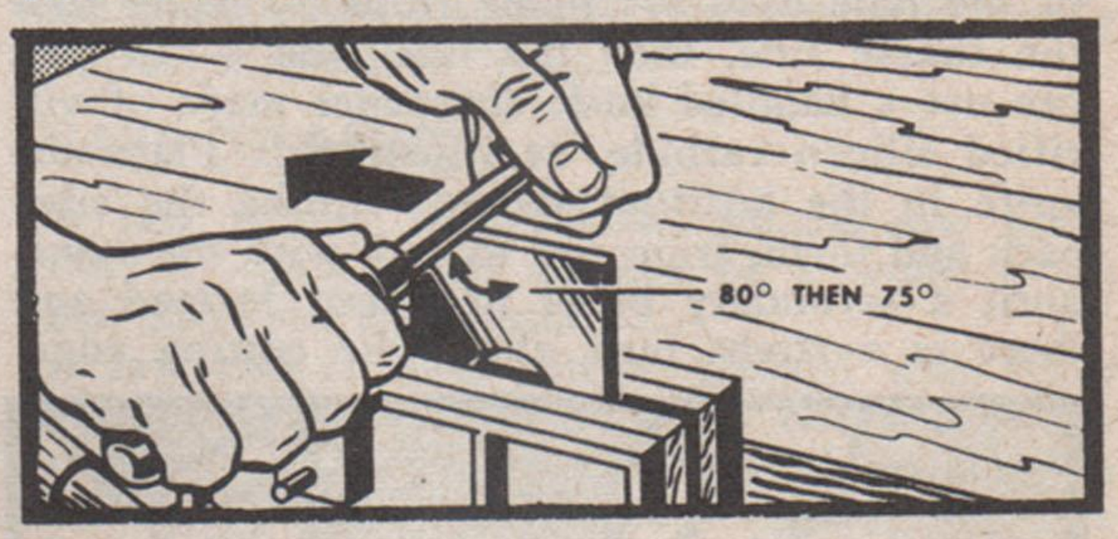


Draw-Filing the Edge

After grinding, place the scraper in a wood vise. Select a medium, flat file, and grasp it in both hands as shown in the illustration. Now draw-file the edge at right angles to the face of the scraper. File on the push strokes, and lift the file on the return strokes. Great care must be taken to keep the file squarely on the surface of the scraper. Continue with the filing until a burr or wire edge is formed along the cutting edge.

To remove the wire edge produced in draw-filing, lay the scraper flat on a flat stone of the type used for removing nicks, and give it a few strokes, first on one side then on the other.





Turning the Edge

The actual cutting edge of the scraper is formed by turning the edge to an angle of about 15°. This is preferably done with a burnisher — a tempered steel rod with a blunt point at one end and a handle at the other. If you do not have a burnisher, you can do a fair job with a nail set.

Place the scraper in a wood vise. Put a couple of drops of oil along the edge. Hold the burnisher as illustrated (at an angle of approximately 10° to the edge of the scraper) — bear down on the burnisher and pull it toward you across the full length of the scraper edge. If done properly, this first stroke will turn the edge at approximately a 10° angle. Now make a second stroke and turn the edge an additional 5° for a total of 15°. If you turn the edge too much, you can raise it again by drawing the point of the burnisher along the underside of the turned edge.

If properly turned, the edge will remove not only wood dust but fine shavings; it can even be used on hardwood veneers without tearing the wood. A scraper that has not been abused in use can be reconditioned several times by turning the edge, before it becomes necessary to grind or draw-file the edge.

woodworking hand tools. (cont.)

BEVEL EDGE CABINET SCRAPERS

Cabinet scrapers having a bevel edge can be ground and sharpened in the same manner already described for plane irons.

After grinding and sharpening, the edge should be turned with a burnisher, in the same manner used for turning the edge of a square edge scraper. In this case also, the turn should be approximately 15°.

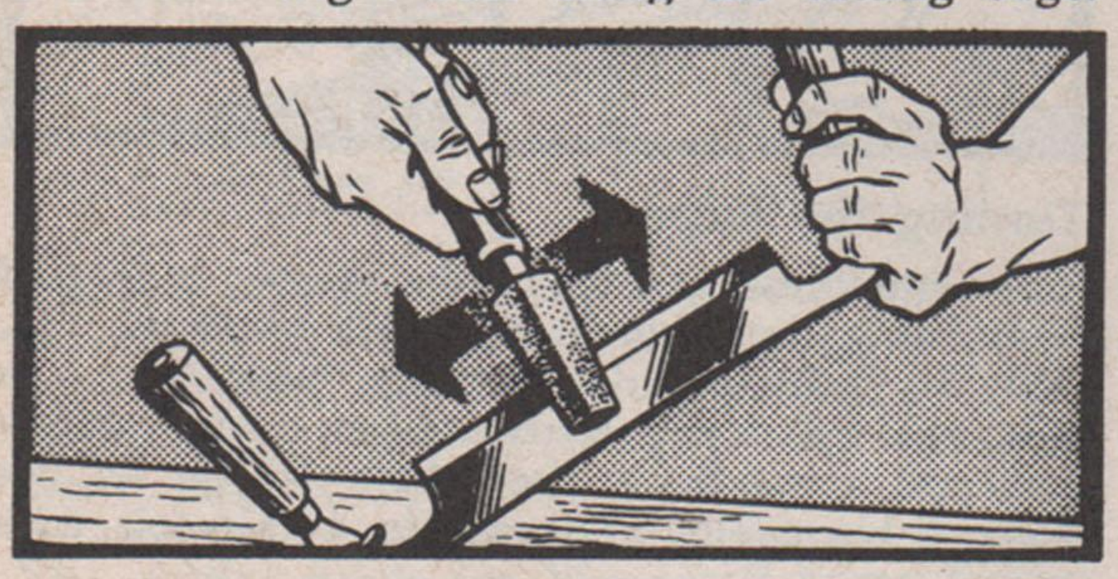
DRAW KNIVES

Grinding

A draw knife that is in bad shape can be reground in the same manner used for regrinding plane irons. Be careful to maintain the original bevel — and to keep the edge straight and true from end to end. Most knives are beveled at approximately 30°.

Honing

For honing, you can use a combination stone of the type used for plane irons — using first the coarse side, then the fine side — or you can use a handled knife sharpener made of vitrified silicon carbide, as illustrated. Place the knife in the position shown. Stroke the edge back and forth, from end to end, with the stone, until a secondary bevel has been formed and there is a slight burr along the cutting edge.



This secondary bevel should be at an angle of approximately 45°. When the bevel is true from end to end, turn the knife around and lay the stone flat against the back side. Draw the stone past the edge a couple of times to remove the burr formed in the previous process. Be careful not to lift the stone away from flat contact with the back of the knife, or a reverse bevel will be formed and ruin the cutting edge.

AXES, ADZES AND HATCHETS

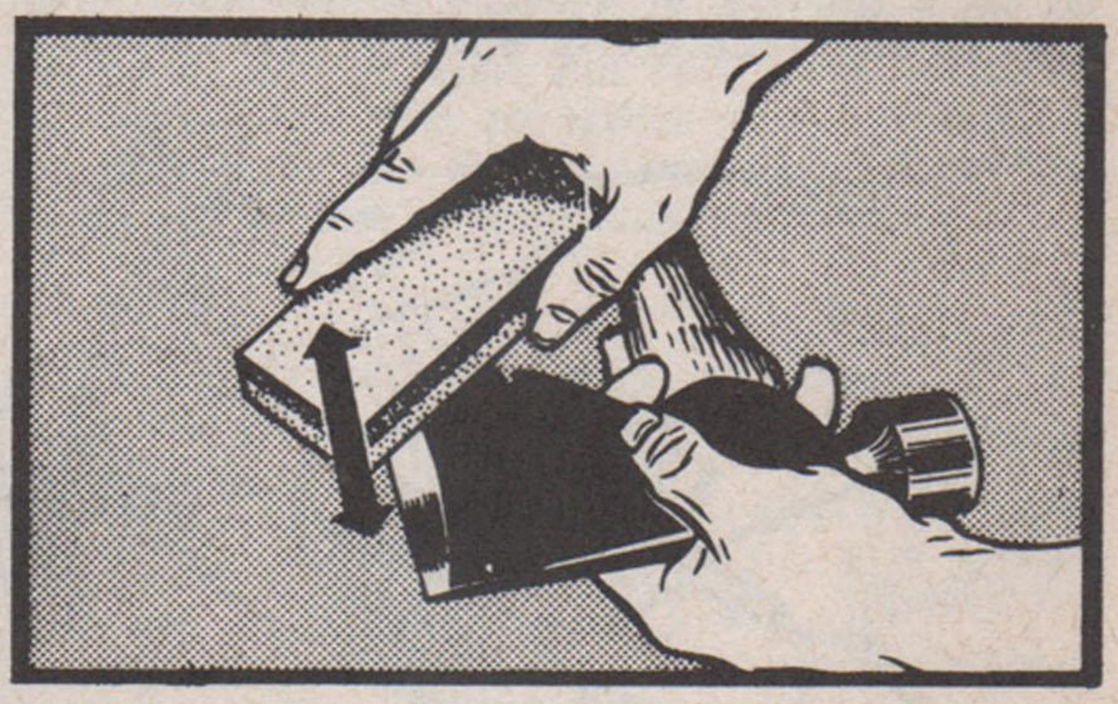
Selecting the Bevel

There are many different specialized types of axes, adzes and hatchets. In general, those used for splitting wood have a short bevel, and the axe blade is thick just back of the cutting edge; while those used for cutting, hewing, peeling, etc., have long bevels and thin, tapered blades. Most hatchets and many axes have straight edges with square corners; but many of the axes and most adzes have rounded edges of varying contours. As the entire head of a good quality tool has been designed for a specific job, it is advisable not to alter the original bevel lest the balance and bite of the tool be ruined. Study the original bevel and maintain it during the sharpening process.

Grinding

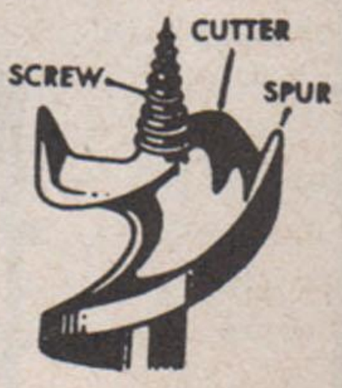
These tool blades can be ground in much the same manner as plane irons; or can be ground on a wet grindstone, instead. When a dry grinder is used, dip the head in water often during the process. If the tool has an edge made of especially high carbon steel, it is best to use a wet grindstone. Do not grind away more metal than is absolutely necessary, as many blades have specially tempered edges set into malleable metal heads — and grinding away of the entire edge would ruin the tool. Always grind toward the cutting edge.

Honing



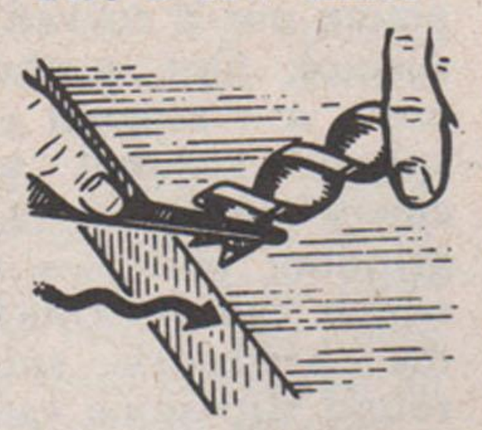
The blade is finished and maintained by using a stone of the type used for plane irons. In this case, however, the tool is held stationary, and the stone is moved across the edge. Also, it is best not to form a secondary bevel in the honing process; but to adhere to the same bevel formed by grinding. (On some types of axes a secondary bevel is formed; and on still other types the bevel is slightly rounded in a concave shape.) Using the coarse side of the stone first, and the fine side afterwards; slide the stone back and forth along the edge from end to end. Work first on one side then on the other. Continue to do this until the desired degree of sharpness is obtained and there are no burrs. Use progressively lighter strokes toward the finish.

AUGER BITS

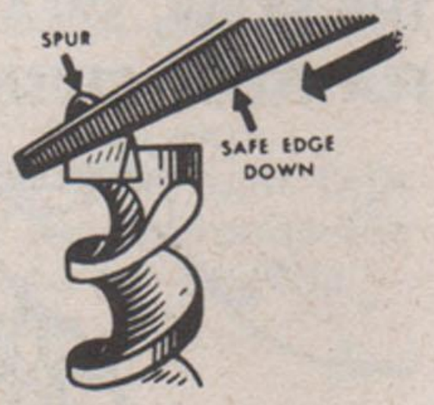


An auger bit in good shape should carry itself into the wood without requiring pressure to drive it. If the chips are uneven — some thick, some thin — there is probably something wrong with one of the cutters. If the edges of the chips are rough, or the hole is not smooth, the spurs probably need sharpening. To do a good job of sharpening and renewing auger bits, you need a thin, flat file with one smooth edge. A special auger-bit file costs but little.

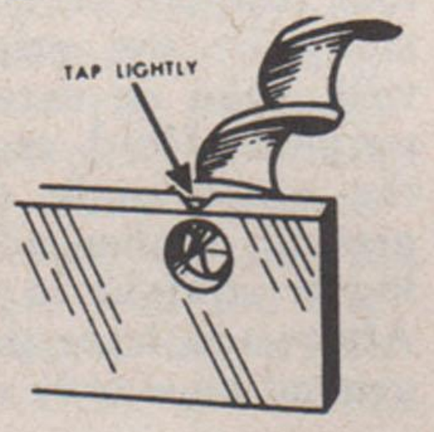
To sharpen the cutters, file through the throat as illustrated. Take a few strokes at a time, being very careful to maintain the original bevels as nearly as possible. File a few times first on one cutter then on the other. The trick is to file off the same amount from each cutter. Filing should be stopped when a fine wire edge appears. This edge can be removed by touching the file very lightly to the bottom side of each cutter; but do not remove any metal from the bottoms of the cutters, themselves. Unless the bottom sides are absolutely flat, the cutters will not feed properly into the wood.

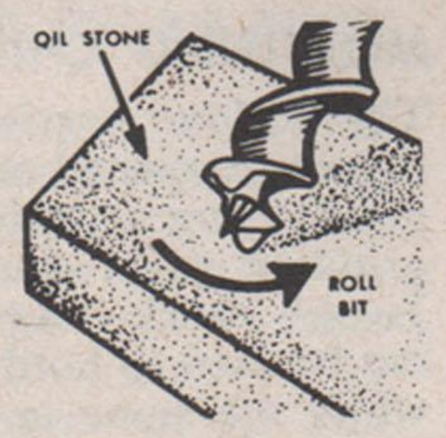


To sharpen the spurs, file each on the inside, using the same technique used on the cutters. Again remove the wire edge by touching the outer sides of the spurs very lightly with the file. The original contours of the spurs on the outer sides must not be altered, or the bit will feed improperly into the wood. If much sharpening has made the spurs short and thick, thin them by holding the file, when sharpening, to make a long bevel on each.



If the spurs are bent they can be straightened by using a metal block having a hole drilled, as illustrated, to receive the screw point. Tap the top of the spur lightly, after placing it over the block. After straightening, the spur must be honed to make certain that the outer contour is properly restored. Use a combination stone like that used for plane irons and hold the bit so that it is parallel to the surface of the stone. Rub it lightly on the stone, rolling it as you rub in order to form the rounded contour of the spur. Finish on the fine side of the stone. Bent bits may be straightened by the use of a wood block and hammer, as illustrated. Rust may be removed from the twist, and a clean shiny surface can be restored by the use of a piece of rope, as illustrated. A small fine stone can be used instead of a file for sharpening, if desired.



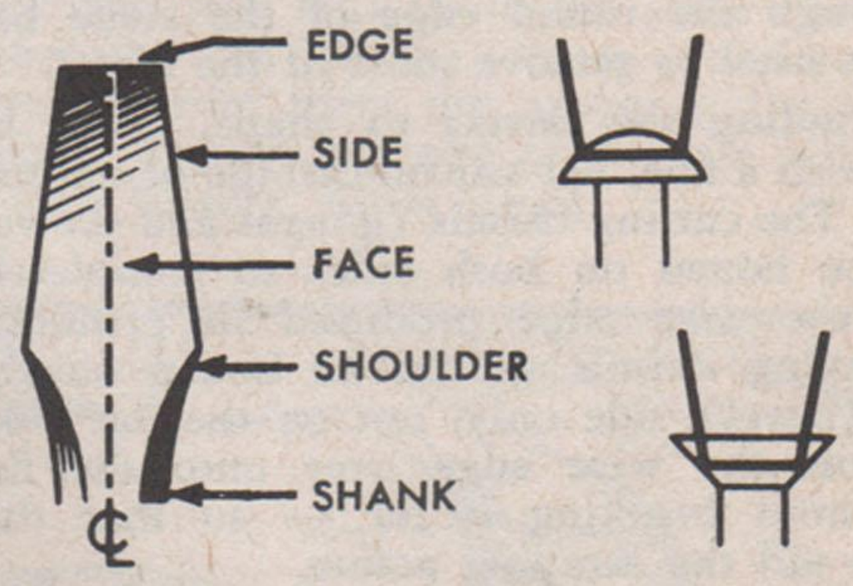


It is good practice to keep your bits in a rack that will store each one separately, tc protect the cutting ends by placing corks over the screw points, and to coat each one with a film of light oil. Separate muslin bags, soaked in oil then wrung dry, make excellent holders — especially if workroom is damp.

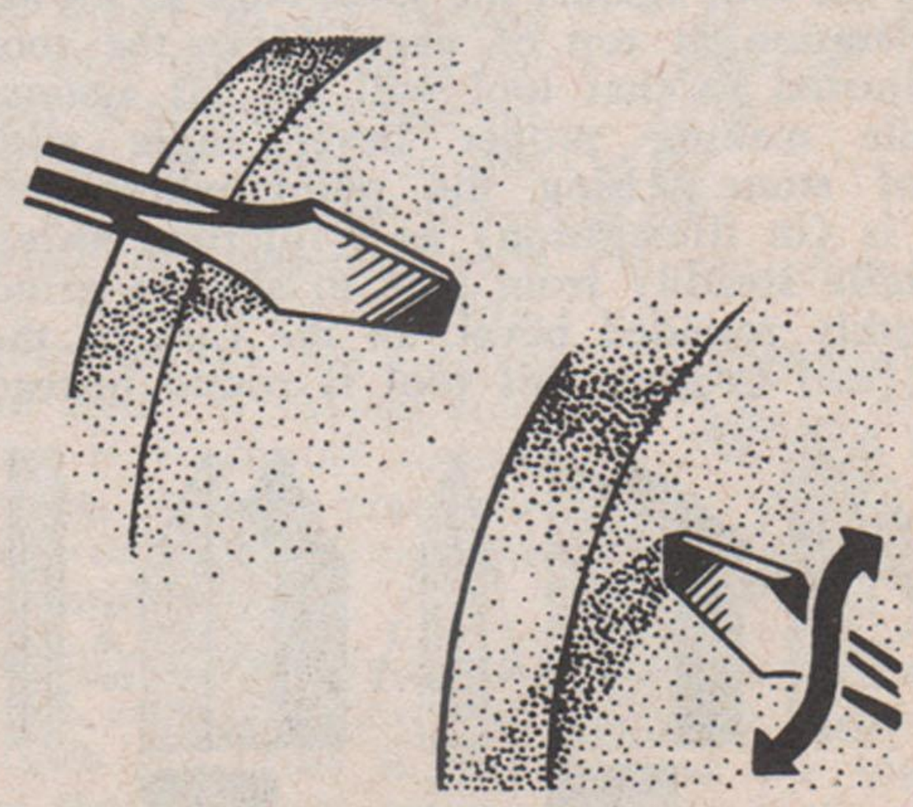
HOW TO SHARPEN A SCREWDRIVER

Few things are more bothersome than a dull or broken-edge screwdriver — or more ruinous of screws! When properly sharpened, the edge of a screwdriver should be a perfect rectangle with straight (not beveled) sides . . . should be absolutely flat and at right angles to the centerline of the shank. The two sides and two faces should taper outward slightly from edge to shoulder . . . should be perfectly flat (not beveled) and squared with each other. The sides and corners of the edge should be sharp. And, of course, the shank should be straight.

In use, the screwdriver should bottom in the screw slot and should fill the slot. Using an undersized screwdriver in too large a slot or failure to seat the screwdriver properly (because of paint or dirt) will damage both.



First, true up the sides and faces. If a dry grinder is used, dip blade in water frequently to prevent overheating. Hold blade against side of stone (never the edge) with edge of blade pointing approximately toward axis of stone. The resulting grind marks will increase the screwdriver's "grip." After truing faces, push edge squarely into side of stone to grind it flat and true. Edge should be moved about on stone to keep from "grooving" the stone.



woodworking power tools

WOOD TURNING CHISELS

Turning chisels are usually made of a select grade of steel with vanadium added for toughness. They should be ground on a wet grindstone. The bevels of each chisel should be maintained at the approximate angles given in the drawings on this page. All bevels should be straight (flat) — with the exception of those on the parting tool, which can be slightly convex. For this reason, bevels should be finished on the flat side of the grindstone when possible — even though the round edge of the stone has first been used to remove most of the metal.

After grinding the bevels to shape, finish by honing with a fine, flat silicon-carbide or natural oilstone. The cutting chisels (gouges and skews) should be honed on both sides to completely remove the wire edge produced in grinding. The scraping chisels should be honed on the ground (bevel) side only, not on the flat side. This turns the wire edge over onto the flat side without breaking it off — so that this edge can aid the scraping action.

THE PARTING TOOL

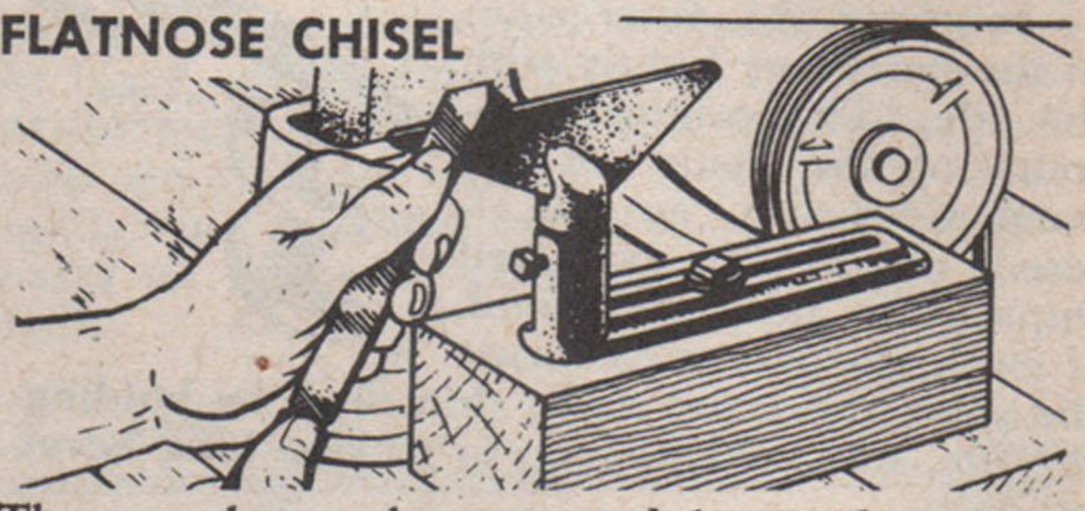
This can be sharpened against the stone edge by using the tool rest as shown for the gouge. Mark the center (where point is to be), and be careful to grind just up to this line from each side.

THE GOUGE AND ROUND NOSE CHISEL

Both of these tools have a rounded edge, and the curvature of this edge must be regular and symmetrical, without "flats" or angles. Start by holding the tool against the stone edge as shown in illustration at top of page. Have the tool rest adjusted so that tool will lie flat against it while making proper bevel angle with edge of stone. Using the point where left thumb is (in illustration) as a fulcrum, swing the handle steadily from side to side to grind a smoothly rounded bevel. In the case of the gouge (and because this tool is round instead of flat) it is necessary to simultaneously roll the tool while swinging the handle.

To hone the curved inside (unground) edge of the gouge use a curved abrasive surface. One method is to use a tapered wooden spindle covered with 3/0 emery cloth, or a tapered grinding point — either of which can be chucked into the headstock spindle. A round slip stone can also be used, as shown. The ground edge of either the gouge or round nose chisel is honed against a flat stone by steadying the tool with the left hand and using the same motions as for grinding.

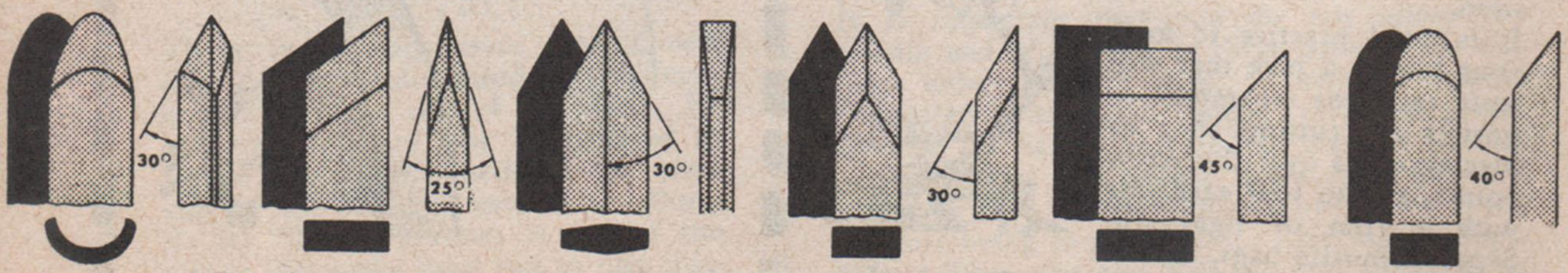
THE SKEW, SPEAR POINT AND FLATNOSE CHISEL



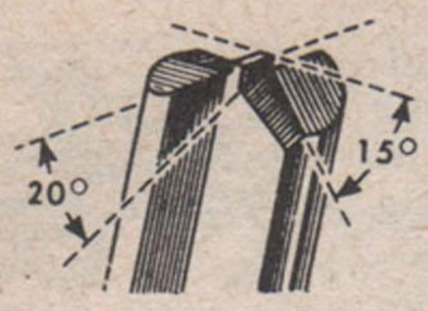
These tools are best ground by holding them against the flat side of the stone. Your lathe tool rest can be bolted to a wood block placed alongside the grindstone (as shown) — and will make an excellent adjustable rest for this purpose. Hold each tool carefully to produce the exact angle desired for the bevel being ground — then advance it to the stone by sliding it straight in without changing this angle. Afterward, hone the edges (both edges of skew; ground edge only of others) against a flat stone.

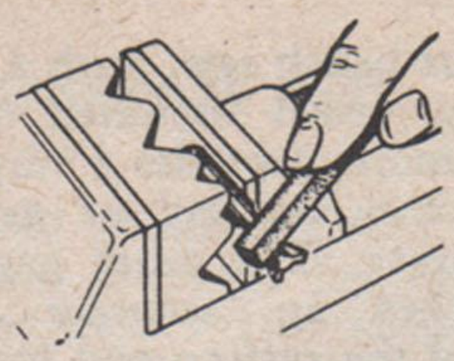
MORTISING CHISELS

The hollow mortising chisel is best sharpened on the drill press, using a conical-shaped grinding point chucked in a Jacobs chuck. A drill vise can be used to hold the chisel while the stone is fed down into it; or the chisel can be fed upward by hand. The inside corners are sharpened, afterwards, with a triangle file. A file is also used to remove any wire edges formed in grinding, but must be held flat against the outer sides during this operation.



GOUGE SKEW PARTING TOOL SPEAR POINT FLATNOSE ROUND NOSE





ROUTER BITS

If the bits are of carbon steel, they can be sharpened with a file; but high-speed steel bits must be touched up with an abrasive stick. Since metal removed from the outside of a bit changes its size, avoid sharpening on the outer surface more than absolutely necessary. Sharpen on the top, maintaining the bevels as illustrated. Touch the edges around the outer surfaces lightly to remove burrs. In cases like those of the dovetail cutter, which must be sharpened on the outer surface, remove as small an amount of metal as possible.

SHAPER AND MOULDING HEAD CUTTERS

Made of high-speed steel, these cutters do not often require sharpening. Prior to sharpening, always wash them in benzine or gasoline to remove any accumulation of pitch.

Sharpening is accomplished by whetting the flat side of each cutter on a composition stone or natural oilstone. Always stroke the cutters as if peeling a small slice from the stone. Never work on the bevel edge as this will destroy the original contour of the cutter. Remove burrs formed on the bevel edge during sharpening by taking very light file strokes along each edge.

If grinding is necessary to remove nicks, it should be done dry on a fine-grit wheel, stopping often to air-cool the cutter and prevent burning. Best method is to hold the flat side of the cutter against the side of the grinding wheel — and to remove as little metal as possible to eliminate the nicks. Always sharpen cutters after grinding.

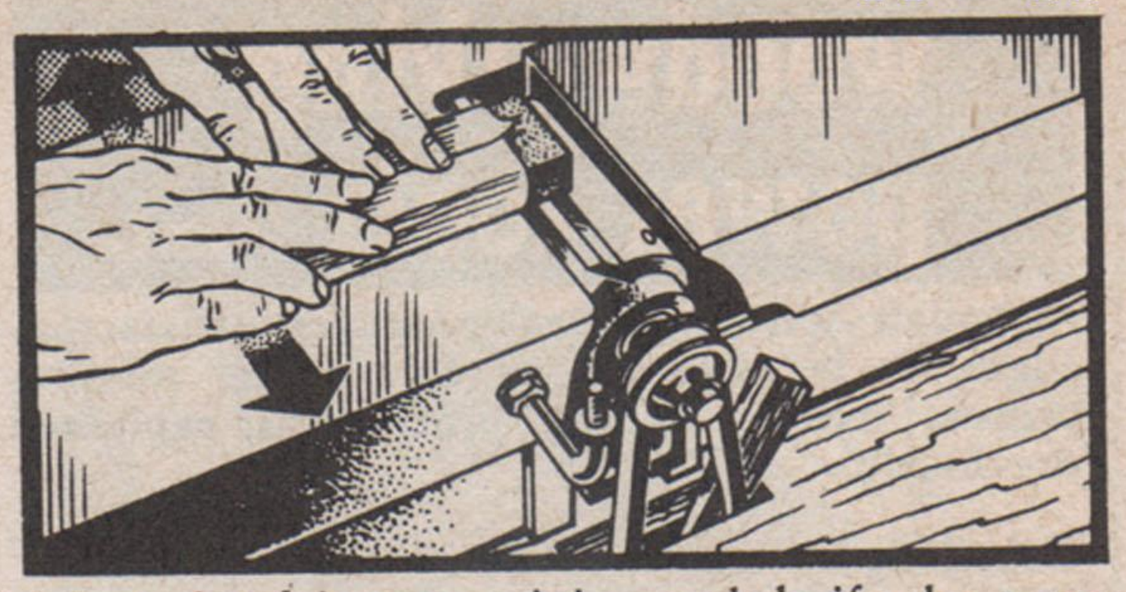
JOINTER KNIVES

Honing

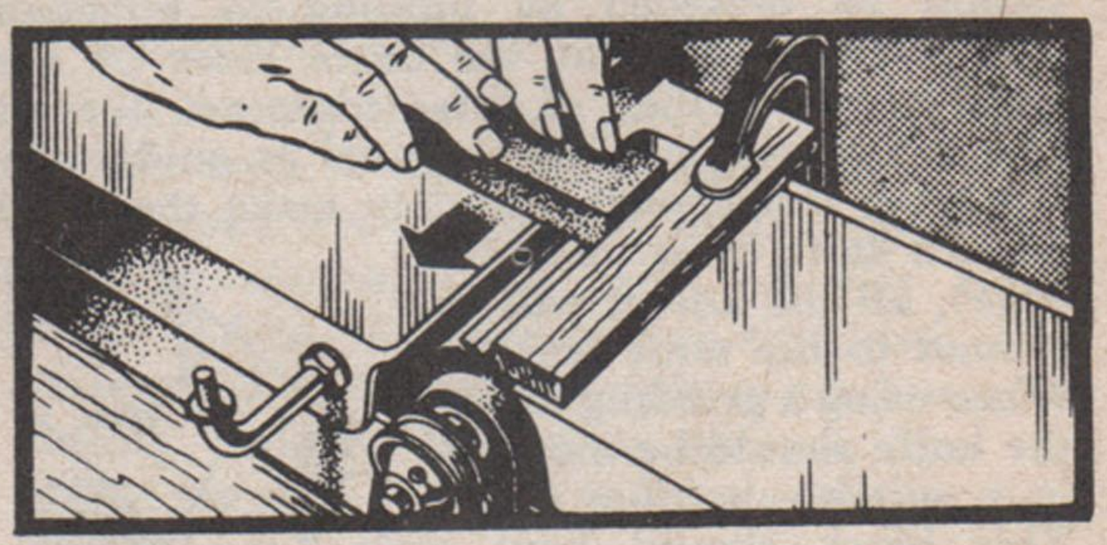
Jointer knives can be kept in satisfactory cutting condition by honing alone, provided the knives have not been abused.

Cover a fine abrasive stone with paper so that it will not damage the surface of the jointer table, leaving the end of the stone exposed. Rotate the spindle to place one knife in the table throat, with the bevel edge of the knife exactly parallel to the front table of the jointer — and hold the spindle so that the knife will remain in this position. To hold the spindle securely, you can wedge the belt with a block of wood, as shown in the accompanying illustration; or you can use a C-clamp to fasten the belt to the machine frame.

Now stroke the knife from end to end with the exposed portion of the stone, keeping the stone flat on top of the front jointer table. Hold the stone so that it does not twist as you move it back and forth. Stroke each knife of the jointer head in turn, giving each knife the same number of strokes so that the same amount of metal will be removed from each. Sharpen just enough to obtain true straight edges along the high sides of the knife bevels. The front table should be carefully adjusted so that the stone will press lightly against the full surface of the bevel of each knife.



A small abrasive stick or piece of abrasive paper wrapped around a steel rule can now be used in the same manner as the stone to remove any slight burr turned over by the honing action.



Jointing

Jointing is done with the machine under power. It is a necessary preliminary step to grinding — and will often condition the blades for honing without the necessity of grinding. Jointing, however, produces a secondary bevel on each knife, because the revolving knives will not strike the stone at the exact angles of their original bevels. Because of this, knives can only be jointed a limited number of times —then must be removed for complete regrinding to re-establish the original bevels and maintain a proper back clearance.

In jointing, the abrasive stone is placed on the front table, as in honing. Because the revolving knives will have a tendency to kick the stone backward, a stop block should be mounted on the table to hold the stone.

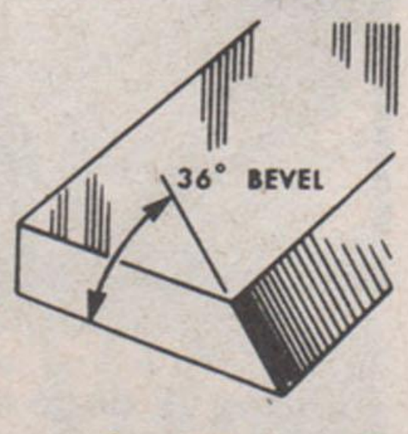
Raise the front table until the stone is entirely clear of knives. Start the jointer. Now gradually lower the table until the stone takes a slight bite on the revolving jointer head. Move the stone across the table to joint the full lengths of the knives. Do not make more than one stroke from end to end. Stop the machine and inspect each knife carefully. No more metal than is absolutely required to put a uniform bevel on each of the knives should be removed. One or two light strokes made in this manner should be all that are required to obtain straight, true bevel edges on all of the knives.

woodworking power tools (cont.)

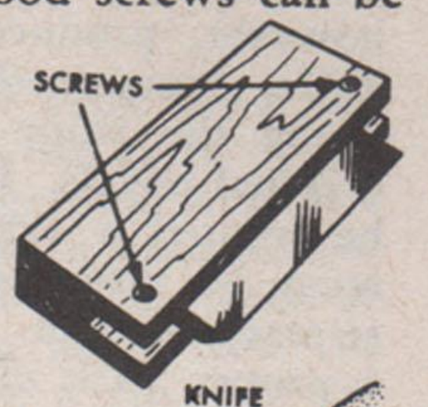
Although jointing often produces satisfactory edges, it is advisable to follow the jointing process with a honing process, as explained previously.

Grinding

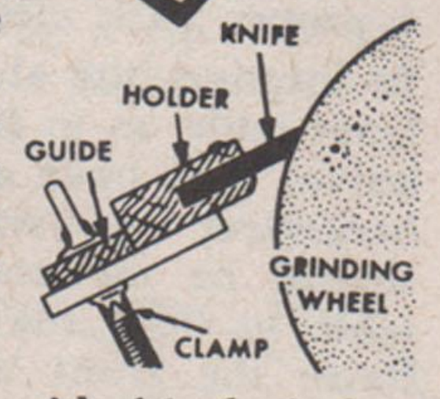
Jointer knives are usually made of high-speed steel. They should be ground dry and air-cooled at frequent intervals to prevent burning. The abrasive wheel should be of aluminum oxide, medium-soft and about 60-grit. A sanding plate holding an abrasive disc of about 80-grit aluminum oxide can be used, instead. Most jointer knives are ground to a 36° bevel — and this bevel should be maintained in the grinding operation. Great care must be used in any setup in order to make the removal of actual metal as little as possible. Grinding should be preceded by jointing to establish true straight edges at the outer sides of the knife bevels — then, if these edges are not cut into when grinding, but are used as guides (by removing just enough metal to make the bevel of each knife come up to the edge), all the knives will be ground to the same length.



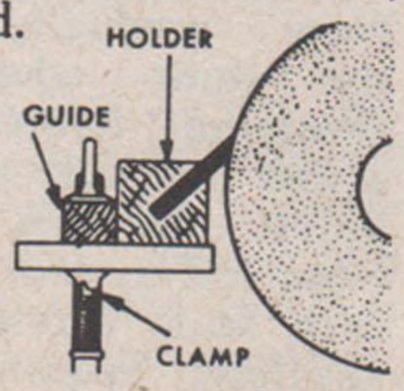
When using a grinding wheel, the knife should be mounted in a suitable holding block. This block should have a slot cut into one edge at a right angle to the bottom of the block. The groove thus formed will usually serve to hold a knife securely for the grinding operation — if it does not, wood screws can be used to clamp knife in place.



The tool rest of the grinder must be tilted to give the required bevel to the knife. A guide block can be clamped to the tool rest to insure grinding to a straight line. Set the guide block while the grindstone is stationary, and so that the knife edge is pressed lightly against the stone. Then operate the grinder and slide the holder back and forth across the guide several times. Stop the grinder, and again reset the guide block, before proceeding. Continue thus until a full bevel, as required, has been obtained.



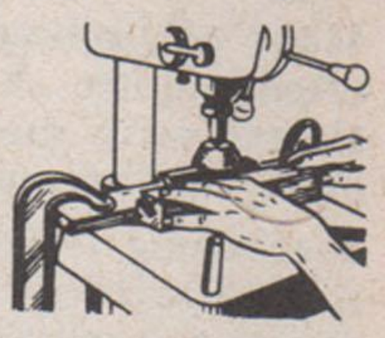
If the tool rest of the grinder does not tilt, the work can be done by mounting the knife at the required angle in the holder. In this case, the exact angle of the cut must be determined by making a full-size layout prior to slotting the block. Make your layout on paper, using a protractor to establish the correct angle — then slot the block carefully at this established angle.



The bench saw, with a grinding wheel mounted on the spindle, provides a very satisfactory method of grinding knives. The miter gage furnishes an accurate guide; and the raising and lowering mechanism of the saw provides for slight adjustments of the feed to obtain the proper bevel.

When using the bench saw, a fence — instead of the miter gage — can be used as a guide. In this case, the flat side of the wheel (which may be a sanding disc instead of a grinding wheel) is used. The correct bevel can be obtained, either by mounting the knife at an angle in the holder (as already suggested), or by tilting the saw table 36°.

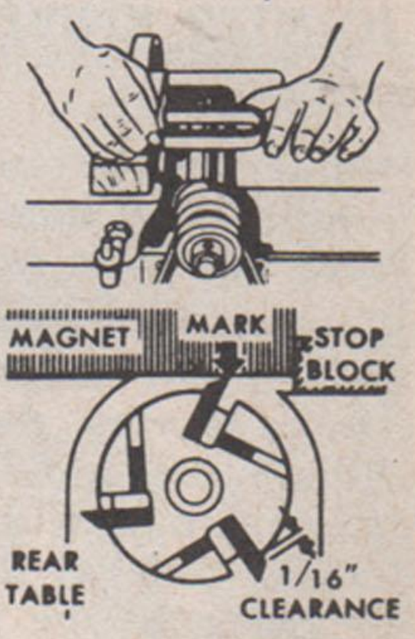
Grinding can also be done in the drill press, using a cup or recessed wheel. In this case, the grinding surface is horizontal—and the holder slot must be calculated accordingly. A drill press gives the advantage of perfect control over the feed. To properly set the wheel for each cut, bring the wheel down into light contact with the knife edge before starting the operation. Then, apply power to the wheel and make the cut by passing the knife under it along a guide clamped to the drill press table. Reset the wheel for additional cuts in the same manner. Be sure to carefully check the levelness of the wheel in relation to the knife by sighting at several positions along the knife edge before starting first cut.



Resetting Knives

After grinding, it is necessary to reset the knives in the cutter head. This is an important operation and must be done carefully, else an excellent job of sharpening will be wasted effort.

One of the best methods makes use of a magnet. To make the setup, clamp a block of wood across the front table of the jointer to act as a stop for the ends of the magnet. This block must be exactly parallel with the slots in the jointer head. Next, place the magnet on the rear table with the ends butting against the stop block. Now, insert one knife into the head — rotate the head to place this knife at its highest position — and raise or lower the spindle so that the magnet will hold the knife with its edge projected approximately 1/16-inch from the head. Tighten all of the setscrews which hold this knife. Mark on the sides of the magnet the exact spots where the knife touches it. Set each of the other knives to this same mark. When setting the knives, tighten the two end screws first, and then recheck your setting before tightening the remaining screws. Equal projection of all knives is essential for good work.



metal cutting tools

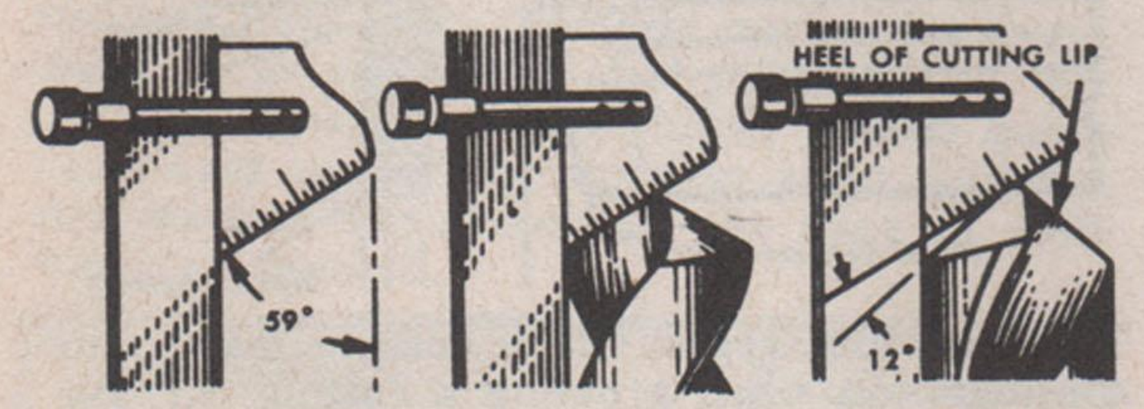
TWIST DRILLS

Grinding the Lips

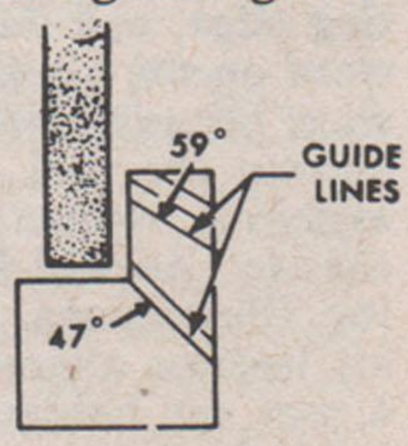
The importance of properly sharpening a metal twist drill cannot be overemphasized since a drill which is incorrectly ground will break, burn, or will drill off-center or over-size. Experienced mechanics can resharpen a drill accurately by eye; but the home craftsman will save money by purchasing a moderately-priced, drill grinding atachment, such as illustrated above.

LIPS and ANGLES UNEQUAL | LIPS UNEQUAL | ANGLES UNEQUAL

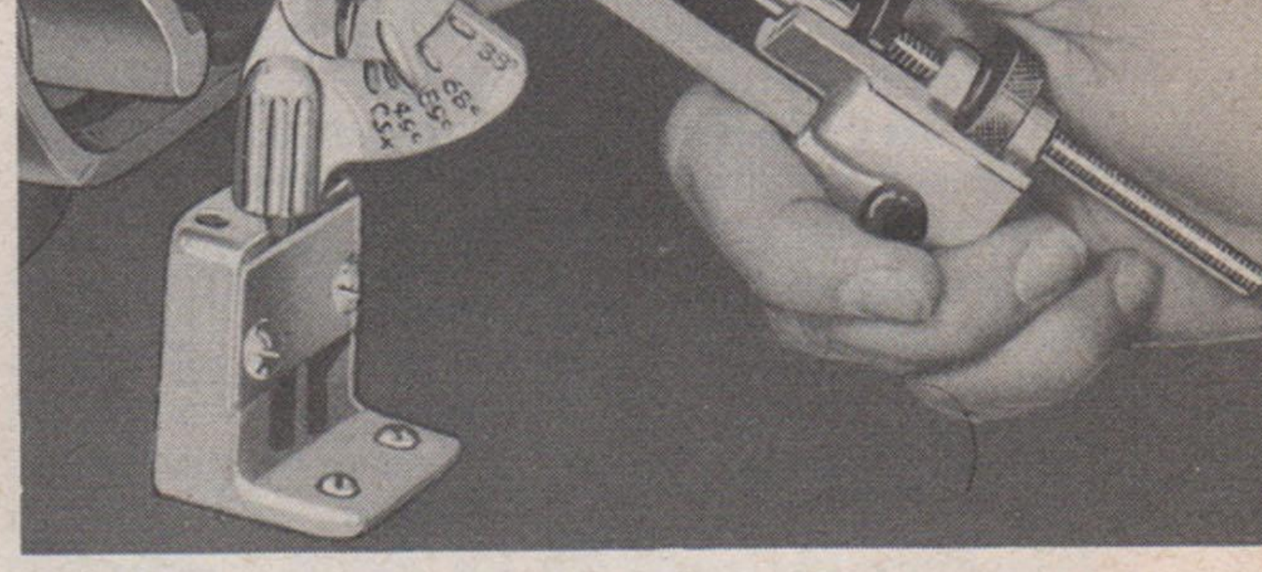
Experience has shown that the best all-around results are obtained from twist drills that are pointed with the cutting lips at an angle of 59° from the vertical, as shown in the accompanying illustration. Both cutting lips must be at the same angle, and both must be the same length. Results of unequalness of cutting lips are shown in accompanying illustration. If lips are unequal both in length and in angle, the drill point will revolve in the work and oversized holes will result. If one lip is longer than the other, the drill will not run true; if one lip has a greater angle than the other, it will do all of the work.

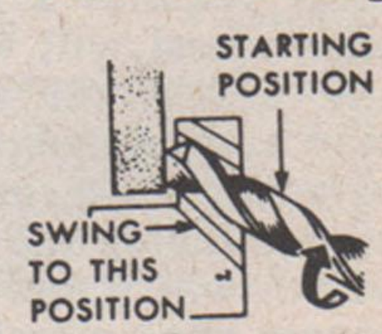


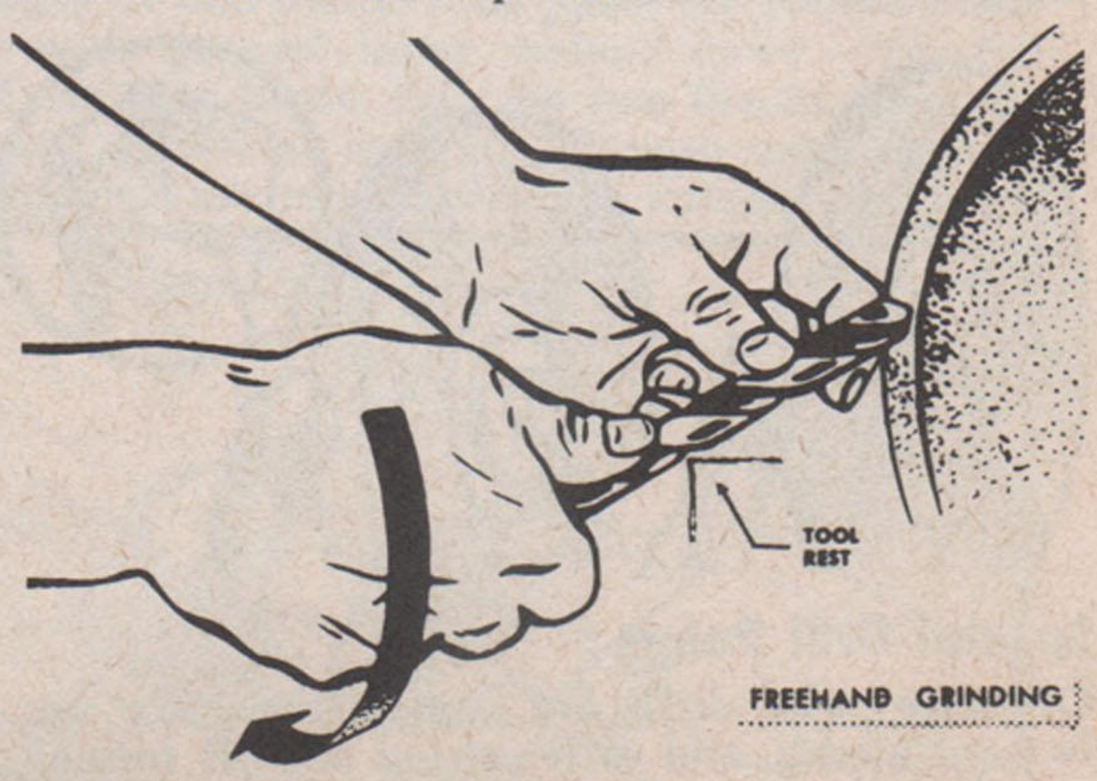
Each lip (the end of each of the two spiral twists is called a lip) tapers off from the cutting edge at the front of the lip so that there is a clearance at the heel (or back edge) of each lip of about 12°. This clearance is obtained by changing the angle of the drill against grindstone, while rotating it to grind the lip. Drills should be ground, preferably, on a power grinder having an aluminum oxide wheel. Grinding is done dry; but the drill must be removed frequently from contact with the stone so it will not become heated.



If a drill grinding attachment is used, the calibrations on the attachment will indicate the proper starting position and amount of swing to make while grinding each lip, in order to provide the desired heel clearance. If a grinding attachment is not available, a guide board — as shown in the illustration — can be made to fit on the tool rest of the grinder. This board should be laid out with scribed lines at 59° and at 47°, the latter line representing the position to which the drill is swung while grinding to provide lip clearance at the heel. Whether the grinding attachment or a guide board is used, start grinding at the cutting edge holding the drill at the desired 59° angle to the face of the stone — then swing it to the 47° position while rotating it approximately 1/6 turn. One or two light cuts taken in this manner on each lip will

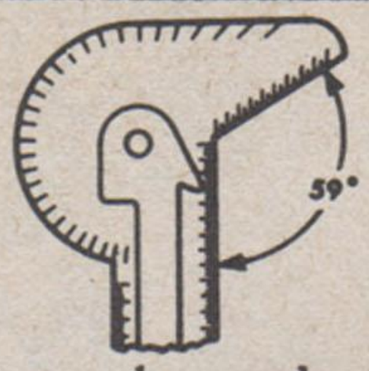






FREEHAND GRINDING

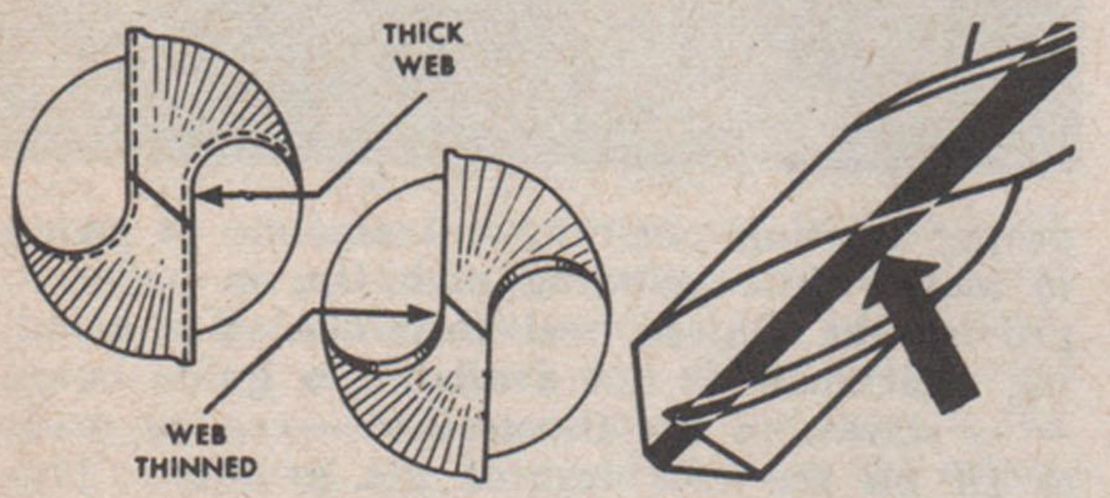
metal cutting tools (cont.)



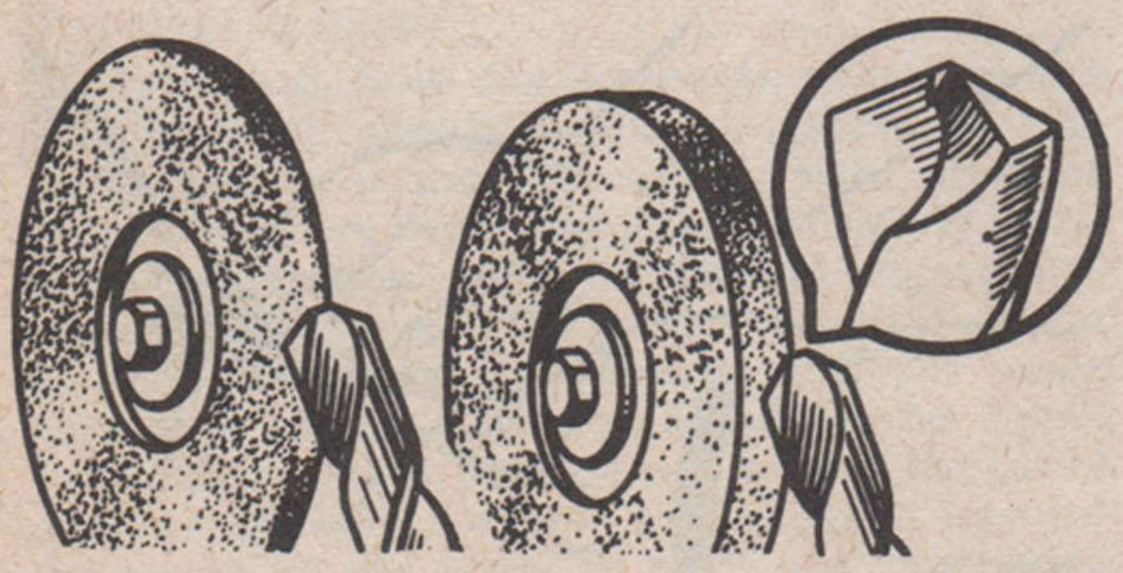
usually bring up sharp cutting edges. Use a drill gage to check grinding results and touch up either lip as required to maintain exact equality of angles and lengths. Two types of gages are illustrated, both of which can be used to simultaneously measure angles and lip lengths.

Web Thinning

In order that a drill will have strength and stiffness, the web (or core) of the body is increased in thickness toward the shank. The body is that portion of the drill containing the spiral twists. As a drill is shortened due to wear and successive sharpenings, the thickness of the web at the point is therefore increased. This is particularly true of the larger drills and, in some cases, the web thickness increase enlarges the chisel edge of the drill to an extent that makes excessive feed pressure necessary. Under these conditions, it is advisable to thin the web at the end of the drill.



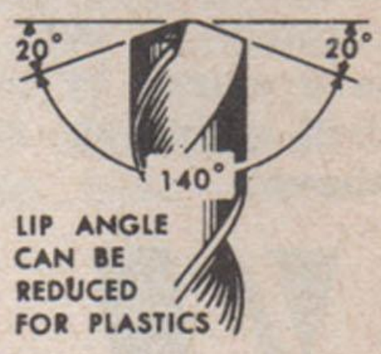
There are two methods used for web thinning. One method requires a round edge wheel; the other requires a square edge wheel. A round edge wheel will work in the flutes of the drill and follow the natural contour more readily than a square edge wheel. However, it is always necessary to grind the cutting edges straight after thinning the web on a round wheel, as the wheel will grind into the cutting edge. If a square edge wheel is used, thinning of the web is accomplished by grinding away the back portion, or heel, of each cutting lip — as illustrated. This will result in removal of a portion of the twist near the end of the drill; but will accomplish the purpose of reducing the web thickness satisfactorily.



Special Drill Points

Ordinary twist drills are manufactured for use in hard metals, and each cutting edge is formed along the line of intersection between the lip (at the end of the drill) and the face of the twist on which the lip is situated. Because the face of each twist spirals upward and approaches the lip at an angle, the cutting edge, in effect, is somewhat like a chisel edge. The slight backward sweep under the cutting edge is called its rake.

When an ordinary drill is used in soft metals or plastics, this rake gives the drill a tendency to hog-in to the material and take excessive bites. For drilling in such materials it is advisable to reduce the rake of the cutting edges by grinding a slight flat into the face of each flute where it meets the lip. This flat need not be more than 1/32-inch in width as measured at the outside of the drill.



For drilling very tough metals, such as certain tool steels, molybdenum, monel, and stainless steel, the same type of tip grinding can be employed with good results.

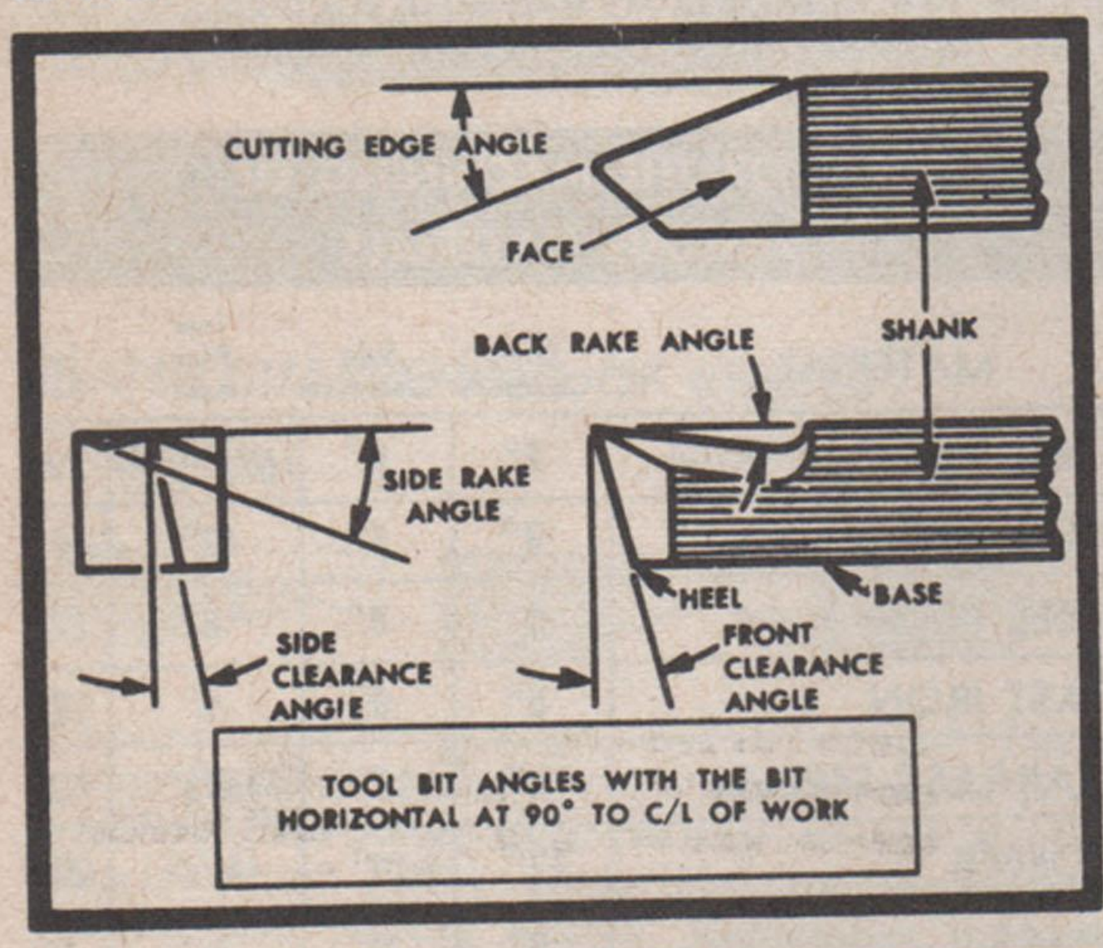
METAL LATHE BITS

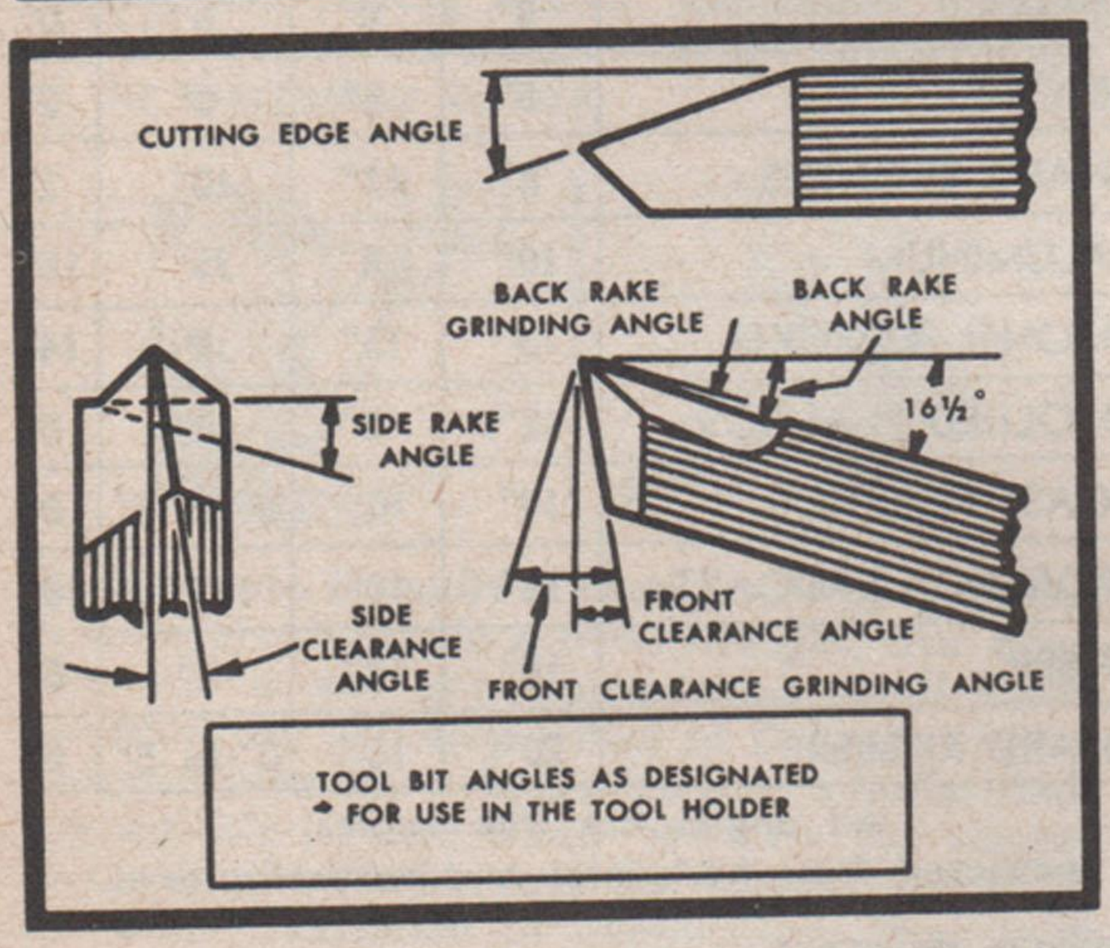
General Information

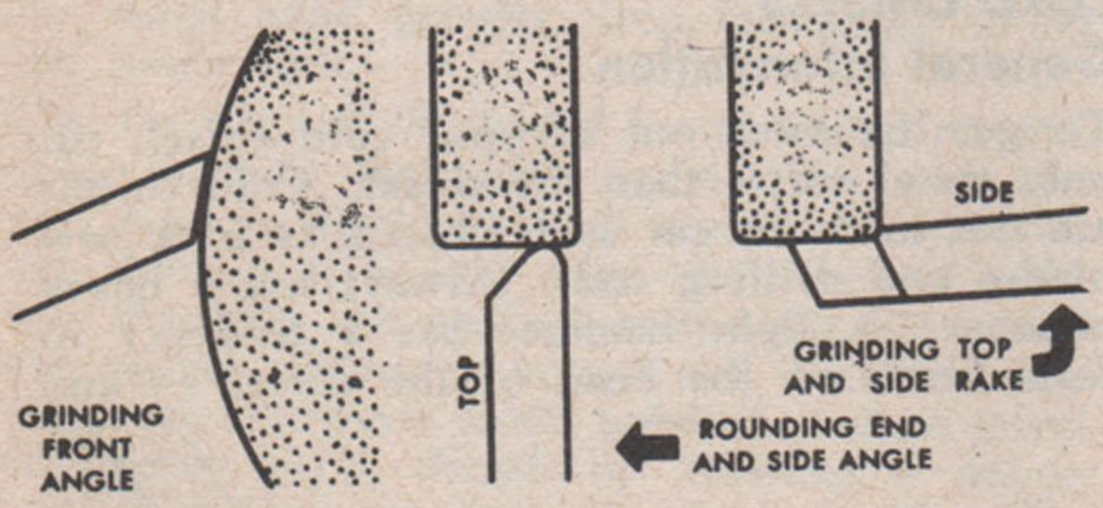
To get the best results from a metal lathe, the tool bit must have a keen, properly shaped cutting edge. This shape of the bit will depend upon the class of work (roughing or finishing) and upon the type of metal being cut. Five standard types of bits are illustrated here. Any bit can be ground to any one of these five standard shapes — and the five shapes will provide all the variations required for standard metal-cutting operations. There are, of course, many other special shapes which can be devised for special facing and finishing operations.

There are four angles which must be taken into consideration when grinding a cutting bit; the back rake angle; side rake angle; front clearance angle; and side clearance angle. Most important of these is the front clearance angle, which allows the part of the tool directly under the cutting edge to clear the work while taking a chip. Too much clearance weakens the cutting edge, and the great pressure exerted downward on the bit in operation demands that clearance be as small as possible while still permitting the tool to cut properly. A tool with excessive clearance always has a tendency to chatter. As will be noted from the accompanying illustrations, the various rake angles of a bit become altered when the bit is mounted in a tool bit holder. In grinding, angles are expressed as "true" angles — that is in relation to the horizontal center line of the bit. To determine the actual rake angles of the bit

in operation, it is necessary to alter each one of the true bit angles by the angularity of the tool bit holder with respect to the horizontal center line of the lathe. The angles of the tool bit in actual relation to the work are, of course, the angles which must be considered when grinding the tool bit — as these are the angles which will determine the operation of the bit in use.

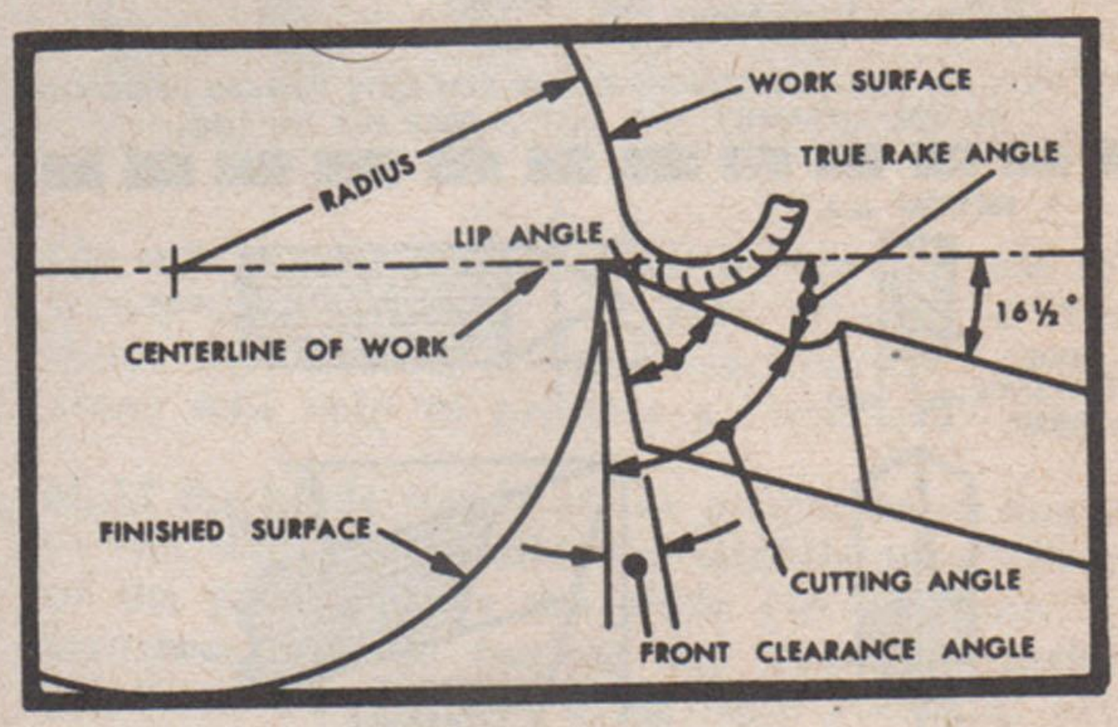


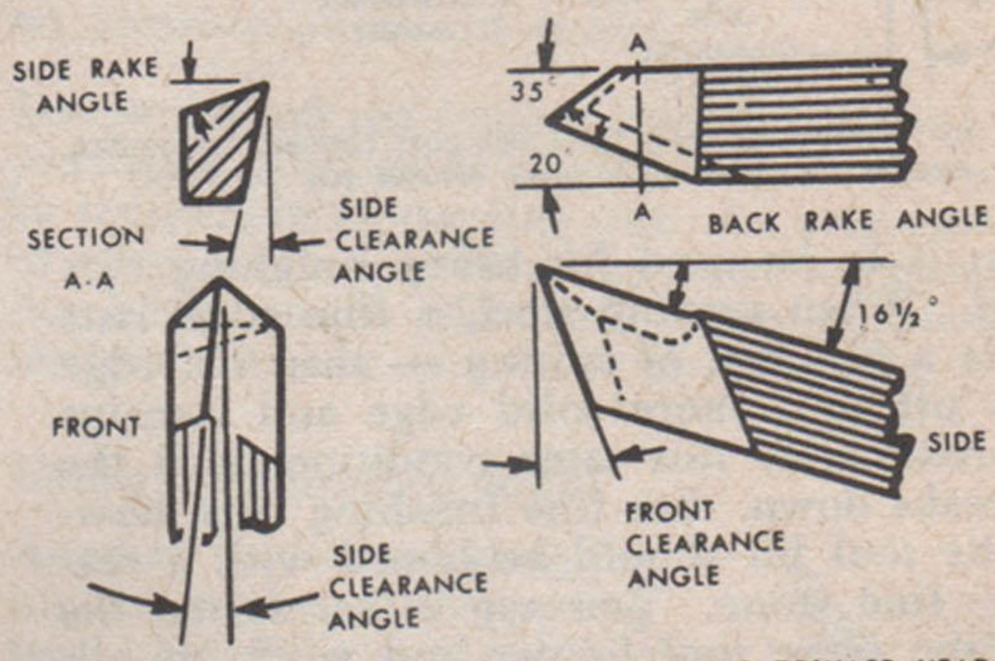




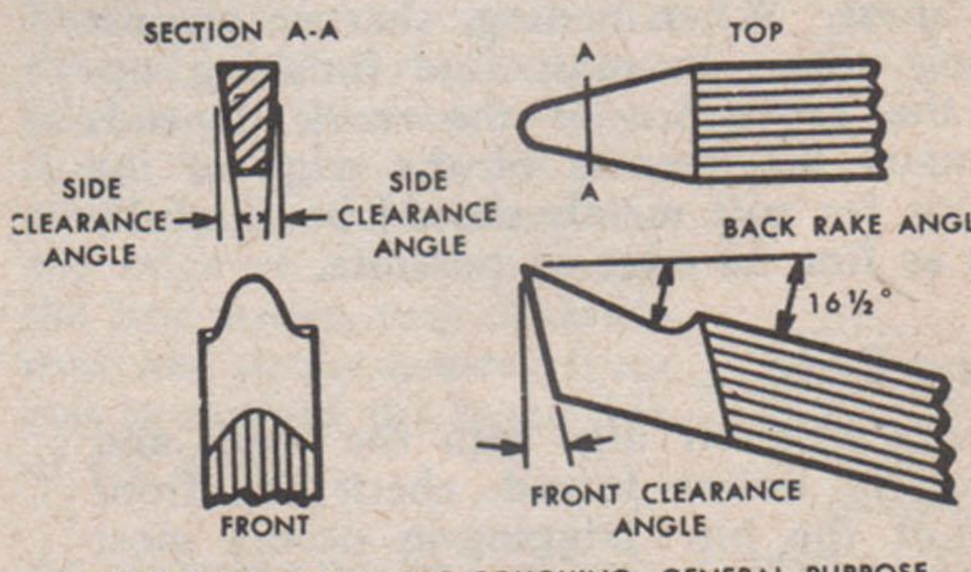
Grinding Operations

A power tool grinder is essential, preferably one fitted with a medium or medium-coarse grit wheel of aluminum oxide. Bits can be sharpened on either the side or the face of the wheel; but most machinists prefer to use the face. The most important factor in grinding is to keep from burning the bit. A cup full of water must be kept handy — and the bit must be dipped into the water frequently to keep it cool. Some experience is required to get the knack of tool bit sharpening. By carefully studying the angles indicated in the standard tool bit drawings, however, the average home craftsman can quickly learn the proper procedures for sharpening. All that is necessary is to grind the bit to one of the patterns illustrated, and to do this without burning the bit. When grinding special tools for special work, simply keep in mind the shapes and angles illustrated here for the standard tool bits — and apply the same principles for obtaining front, side, and back clearances in the special tools being ground. There is no point in honing the edge of a tool

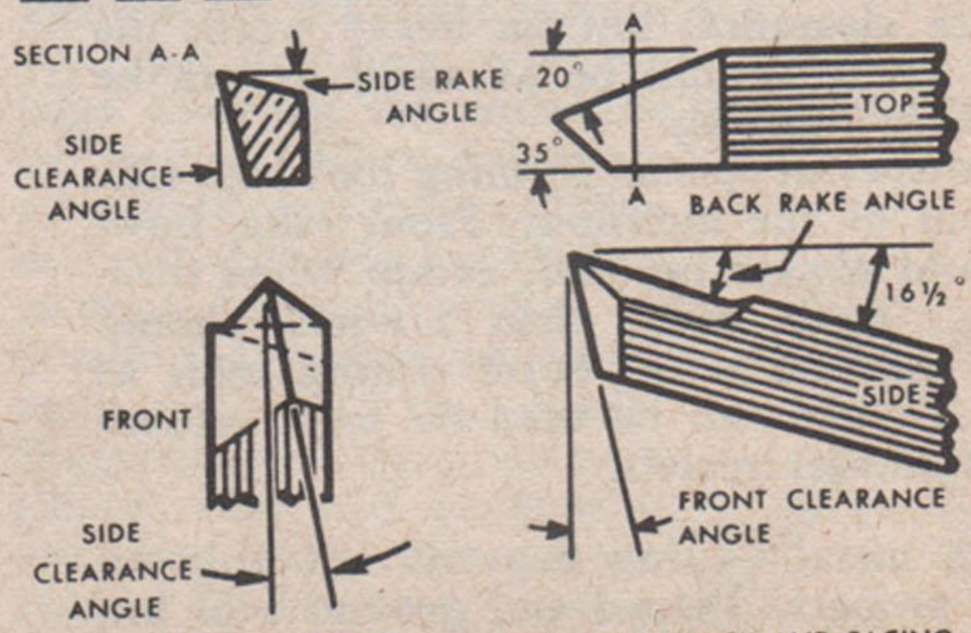




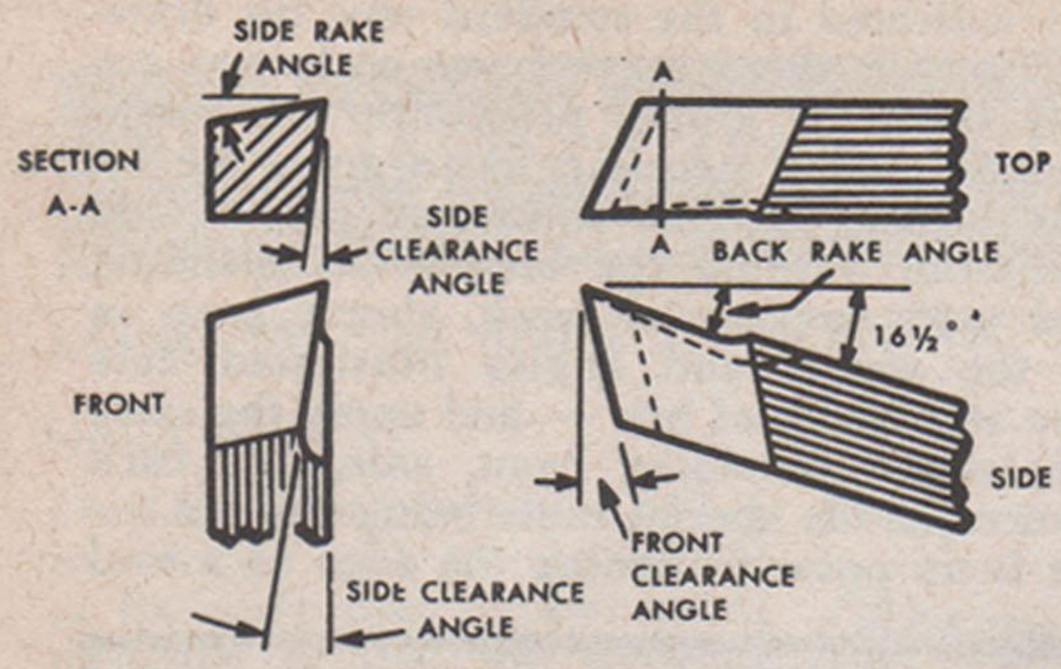
R-H TOOL FOR GENERAL TURNING AND SHOULDERING TOWARD HEAD STOCK; ALSO FACING. POINT SHOULD BE ROUNDED FOR FINISHING WORK.



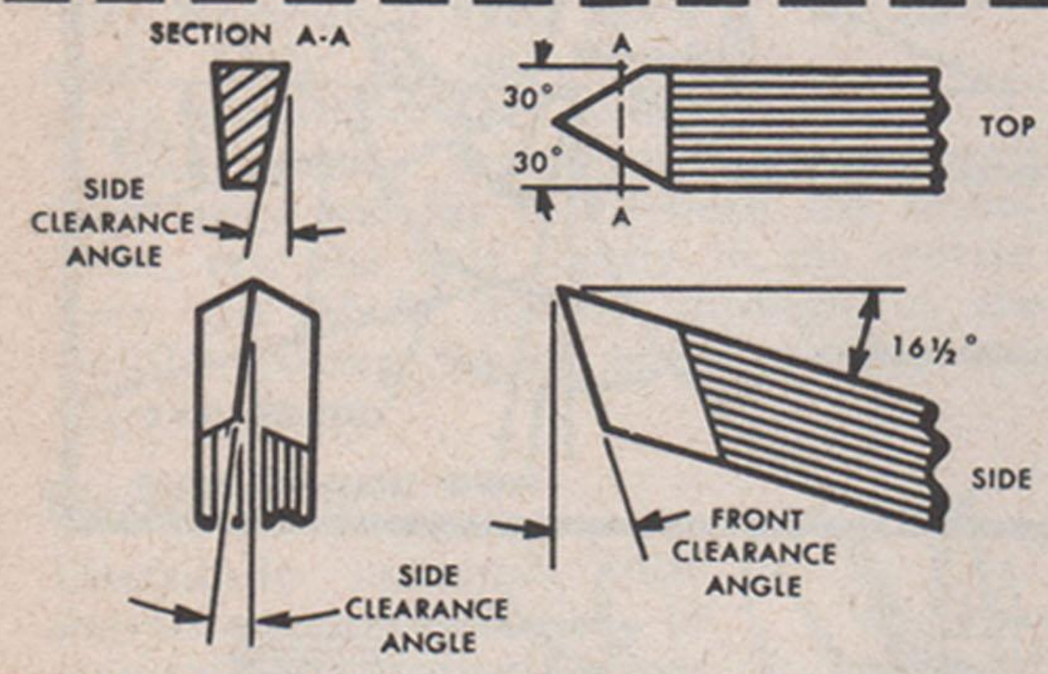
ROUND NOSE TOOL FOR ROUGHING, GENERAL PURPOSE



L-H TOOL FOR SHOULDERING TOWARD TAILSTOCK AND FACING. ROUND POINT TO DO FINISHING WORK.



HEAVY-DUTY R-H TOOL FOR ROUGHING AND DEEP CUTS TOWARD HEADSTOCK. REVERSE CLEARANCE AND RAKE ANGLES FOR L-H TOOL.



R-H 60° V-TYPE THREADING TOOL FOR CUTS TOWARD HEADSTOCK. REVERSE CLEARANCE AND RAKE ANGLES FOR L-H TOOL.

bit that is to be used for heavy roughing cuts in steel. When turning steel, a fine edge lasts for only a few feet of cutting — then the edge rounds off to a more solid edge and remains in approximately this same condition until the tool breaks down. For fine finishing cuts, however, the tool bit should be honed with a reasonably fine stone. You can either fasten the bit in the lathe tool holder and work an oilstone against the cutting edge; or can hold the bit in one hand and work it back and forth over the stone. When honing, sharpen against the cutting edge. In most fine finishing operations the excellence of the work depends directly upon the keeness of the edge of the tool. Tools for soft metals should be carefully honed to as fine an edge as possible.

Machining Data

Whenever a tool bit digs into the work and refuses to cut unless forced, check the front clearance of the bit. Digging-in occurs most often during facing and threading operations. For light turning it is better to allow just a little extra clearance; but on heavy work, the clearance angle should be as small as can be used without hogging.

In some shapes of special forming tool bits, side rake is out of the question. Front rake, however, should always be used, except when turning brass. Tools wider than 1/8-inch should never be used on steel. Form cutting tools as wide as 1/2-inch can be used on brass, aluminum, and similar metals.

Success in metal cutting depends not only on having a properly shaped and ground tool bit, but upon the bit being set at the right angle to the center line of the work and upon the correct choice of cutting speed. Too slow a speed not only wastes time, but leaves a rough finish on the surface of the metal. Too high a speed burns the tool. The following table gives angles as recommended by competent authorities. All angles are true angles, measured from horizontal and vertical planes. The speeds given are correct for standard high-speed tool bits. Special alloy bits permit somewhat high cutting speeds.

DATA FOR THE MACHINING OF VARIOUS MATERIALS

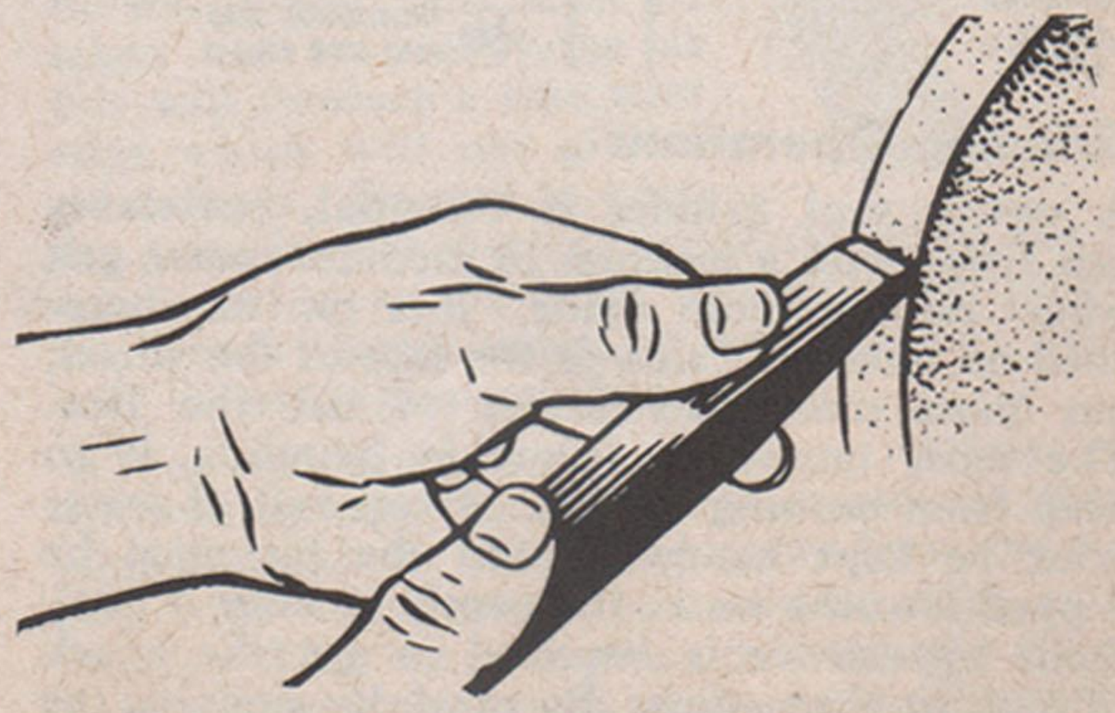
MATERIAL	Front Clearance	Side Clearance	Back Rake	True Side Rake
STEEL (MILD COLD ROLLED)	8°	8°	16½° TOOL HOLDER ANGLE	22°
STEEL (MEDIUM HARD)	8°	8°	12°	14°
STEEL (TOUGH ALLOY)	8°	8°	8°	12°
CAST IRON	8°	8°	5°	12°
STAINLESS STEEL	8°	10°	16½°	10°
COPPER	12°	14°	16½°	20°
BRASS	8°	8°	0°	0°
BRONZE	8°	8°	0°	2°
HARD BRONZES	8°	12°	10°	2°
ALUMINUM	10°	8°	35°	15°
MONEL & NICKEL	10°	13°	8°	14°
MOLDED PLASTICS	12°	8°	0°	0°
CAST PLASTICS	14°	10°	0° to -5°	0°
FORMICA & MICARTA	15°	10°	16½°	10°
FIBER	15°	12°	0°	0°
HARD RUBBER	20°	15°	0° to -5°	0°

All angles are true angles, measured from horizontal and vertical planes.

COLD CHISELS

General Information

To get the most out of your cold chisel, cut only metal softer than the chisel. Cold chisels are not made to cut such objects as hack saw blades and drilling rods. Always use a heavy hammer. A light hammer has a tendency to form burrs on the head of the chisel — and

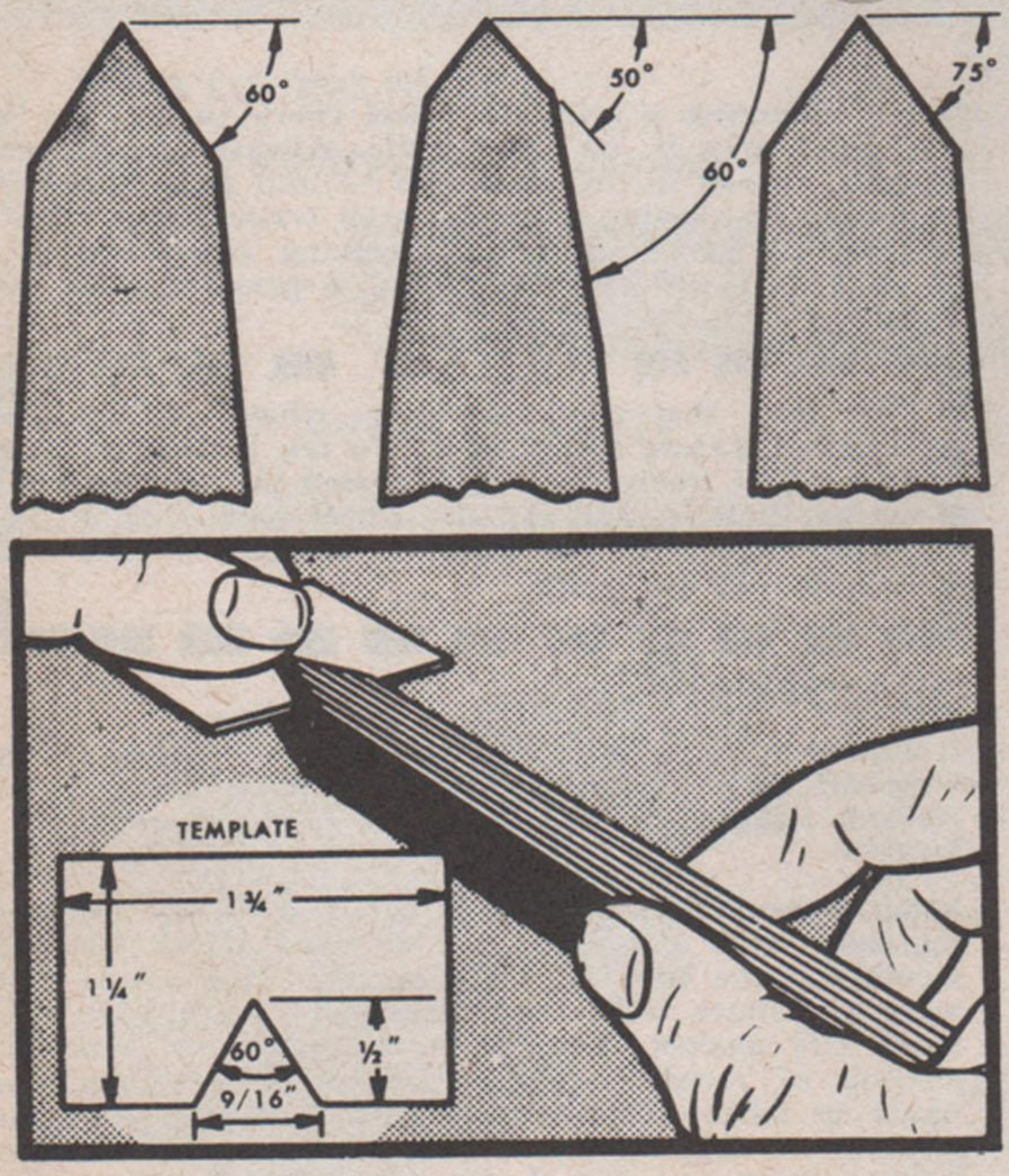


does not transfer the force of a blow to the cutting edge of the chisel as well as a heavy hammer will transfer it.

Grinding

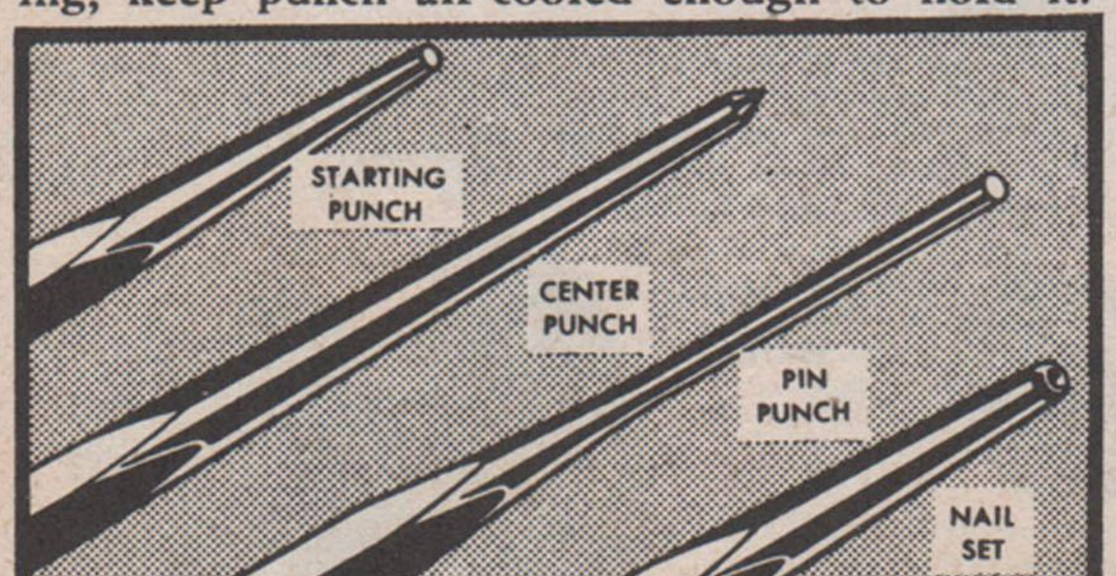
Chisels can be ground on a power grinder equipped either with an aluminum oxide or a wet grindstone. One important factor to remember is that the chisel must not be heated during grinding. Keep a cup of water handy and quench the chisel frequently. Another important factor to remember is that the bevels on opposite sides of a chisel should be alike. The angle of the bevels depends upon the use intended for the chisel. For average use, a 60° bevel is best; but many chisels have both lesser and greater bevels. Grind against the cutting edge and hold the chisel so as to maintain the desired bevel. Use the face of the wheel for best work. After grinding, remove any wire edge that may be present by honing with a medium oilstone. At the same time, round off the corners slightly and rub off any burrs along the sides of the chisel.

For extra heavy work, a chisel ground with a double bevel will give best results.



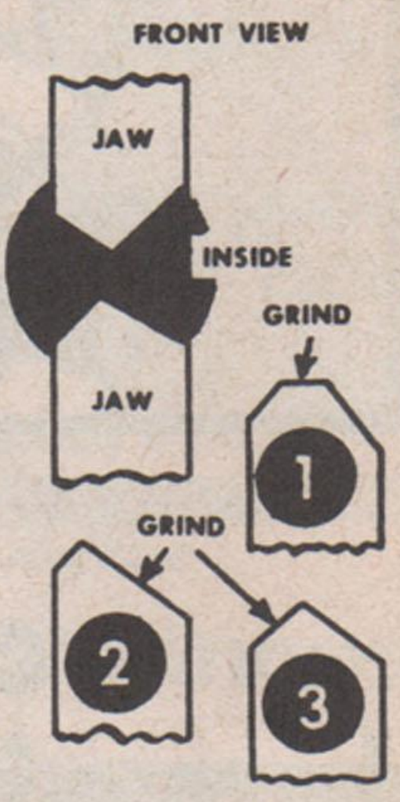
PUNCHES

Four basic types are illustrated. When grinding, keep punch air-cooled enough to hold it. Starting and pin punch heads are flat. The long straight neck of a pin punch should be polished after grinding with fine emery cloth (preferably on a lathe). Center punch heads are beveled from 15° (for steel) to 60° (for very soft metals and wood). The cup of the nail set can be reformed by drilling (preferably on a lathe).

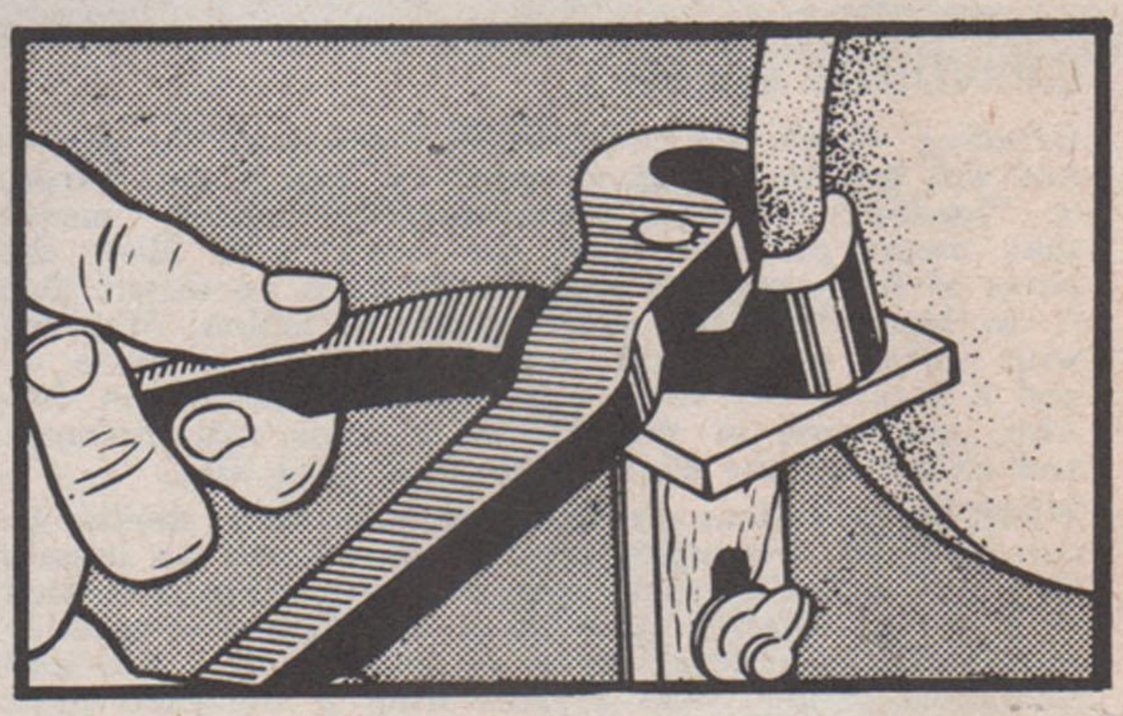


CARPENTERS NIPPERS

The correct bevel angles of nipper jaws are shown in the accompanying sketch. To obtain these angles, three successive grinds are required. These three grinds are also illustrated. The first grind is intended to remove nicks and should go deep enough to obliterate any inequalities along the edges. This grind is obtained by holding the face of each jaw against the sides of the grinding wheel. After removing the nicks, make the second and third grinds by holding each jaw against the side of the wheel at the proper angle for the grind.

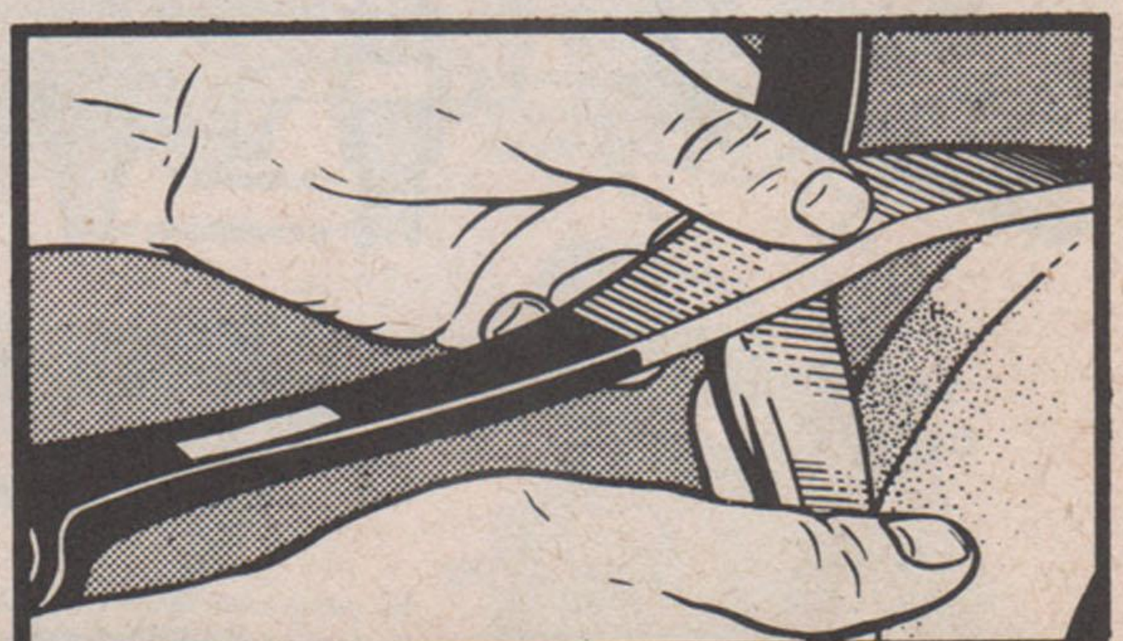


Grinding can be done on an aluminum oxide wheel or a wet grindstone. Care must be taken not to heat the nippers; and they should be quenched frequently in water during the grinding process.



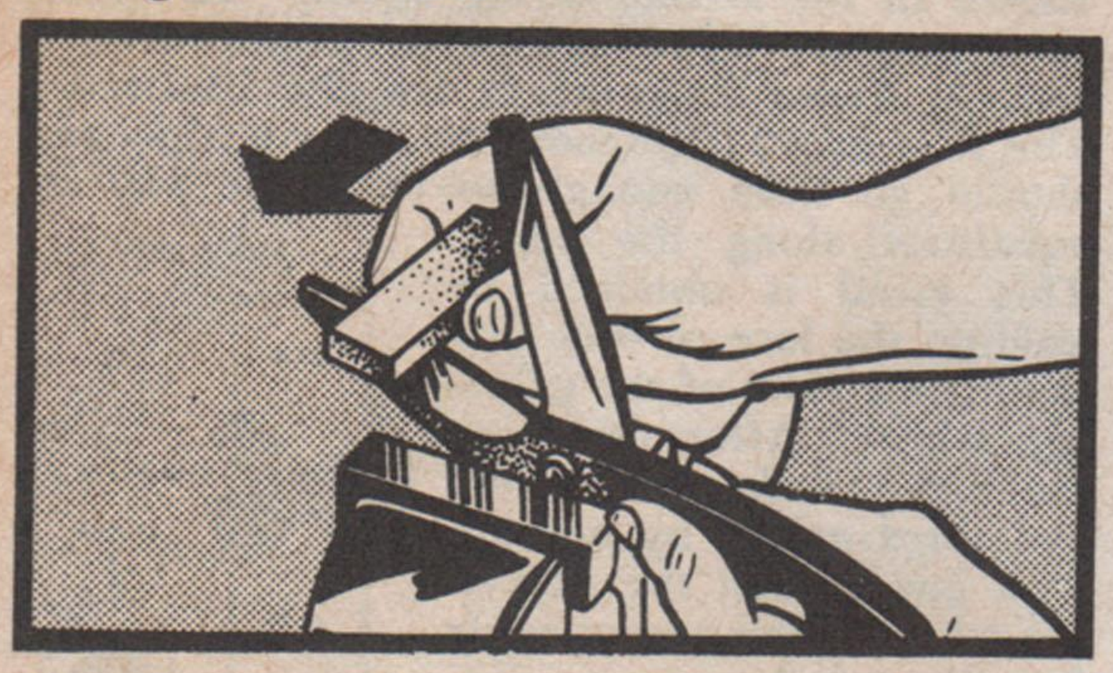
TIN SNIPS

Tin snips can be sharpened on a power grinder having an aluminum oxide or wet grinding wheel — or can be sharpened with a flat oilstone by hand. If a power grinder is used, care



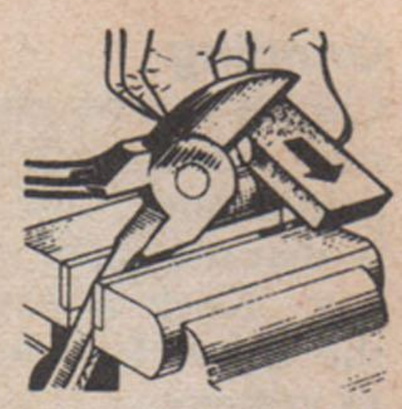
metal cutting tools (cont.)

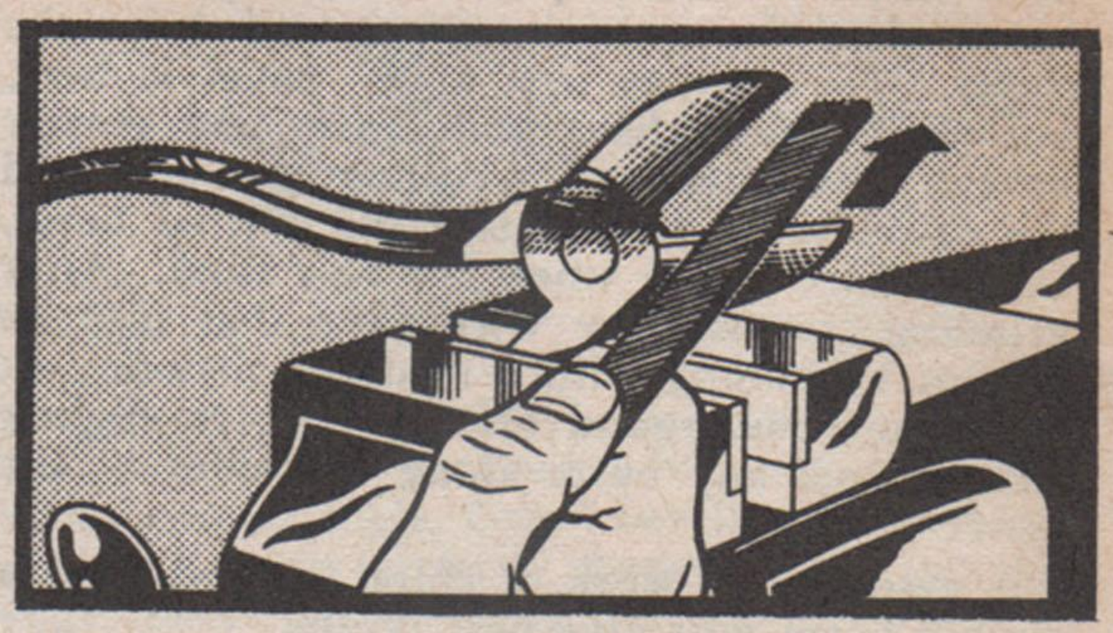
must be taken to air-cool the blades frequently during the process. Grind to the original bevel on each blade by drawing the blade across the face of the stone at the proper angle. After grinding, remove any burrs by touching up the inside face of each blade with an oilstone held flat against the face.



WIRE-CUTTING PLIERS

Pliers which are not too highly tempered can be sharpened with a small file. Those which are highly tempered must be sharpened with a thin abrasive stone; either a composition or natural oilstone is satisfactory. Sharpen to the original bevel by stroking lightly, then remove any wire edge produced by honing from the opposite side of the blade.





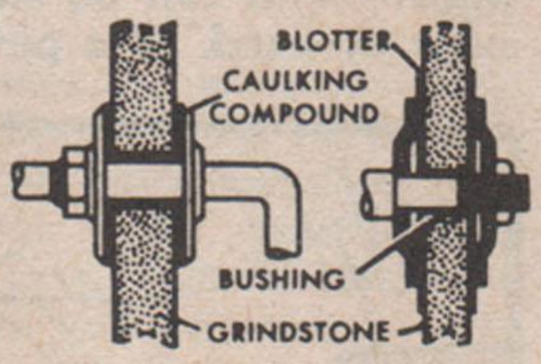
care of sharpening equipment

GRINDING WHEELS

Grinding wheels are continuously worn away by use — and will become ridged, rounded (at edges) out-of-true, or "loaded" depending upon usage. "Loaded" means that metal particles from the work have filled the pores of the stone and glazed it to such an extent that it no longer has the proper abrasive action. Working with softer metals will particularly load a stone — and a natural wet stone will become loaded if run dry. Also, much use of the side of a stone will undercut and chip away the edge, to shorten stone life.

When imperfections become apparent they should be corrected by dressing the stone. If allowed to remain they will hasten further damage. A dry stone is dressed with a steel wheel dresser (or a sharp piece of suitable steel); but a natural stone is too soft for this and should be dressed with a piece from a discarded stone or chunk of cement.

Rest the "dresser" on the tool rest and work it back and forth across the face of the revolving wheel until the edge is clean, straight and smooth. Remove as little as possible. If sides need dressing, do them in like manner.



When mounting a grinding wheel check to see that it is a good snug fit on the spindle. Always use cupped washers, turned in, as illustrated — and place discs of cardboard or blotting paper between washers and wheel to serve as shock absorbers. Caulking compound can be used as illustrated to cushion a grindstone on its shaft.

CAUTION

Be sure that your grinding wheel is not cracked, before mounting it. To test it, support the wheel freely on a stick passed through the center hole — and tap the wheel with a light metal object. If the wheel is cracked, a dull sound will be heard.

OILSTONES

It is important — for protection of an oilstone — to wipe off dirty oil each time the stone is used. Dried oil and light glaze can usually be removed with gasoline.

Small irregularities can often be removed by working the stone back and forth over an emery cloth fastened securely at the edges to a flat surface. One of the best ways to remove large irregularities is to grind the oilstone flat against the side of a grindstone. Another method of reconditioning is to use some aluminum oxide or silicon carbide grit a little coarser than the stone, in a lapping operation. Mix grit and water to form a paste and spread this on a flat metal surface, preferably cast iron. Work stone in a circular motion. Wash off loose grit and let the stone dry thoroughly before using it.

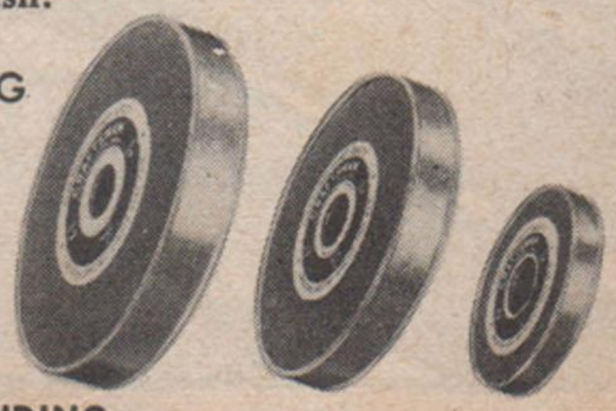
FILES

The greatest hazzard to a file is rust — and the second greatest is tossing it carelessly in with other tools (to batter the fine teeth points). Keep your files oiled, clean and protected. They can be cleaned with a wire hand brush.

WHEEL DRESSER

SAFETY GOGGLES

GRINDING WHEELS



ALWAYS WEAR GOGGLES OR A FACE SHIELD WHEN GRINDING

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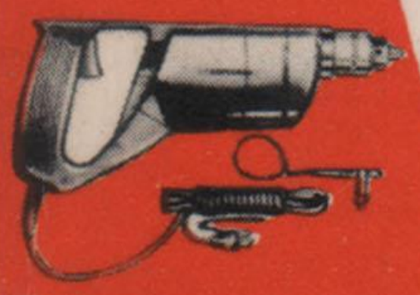

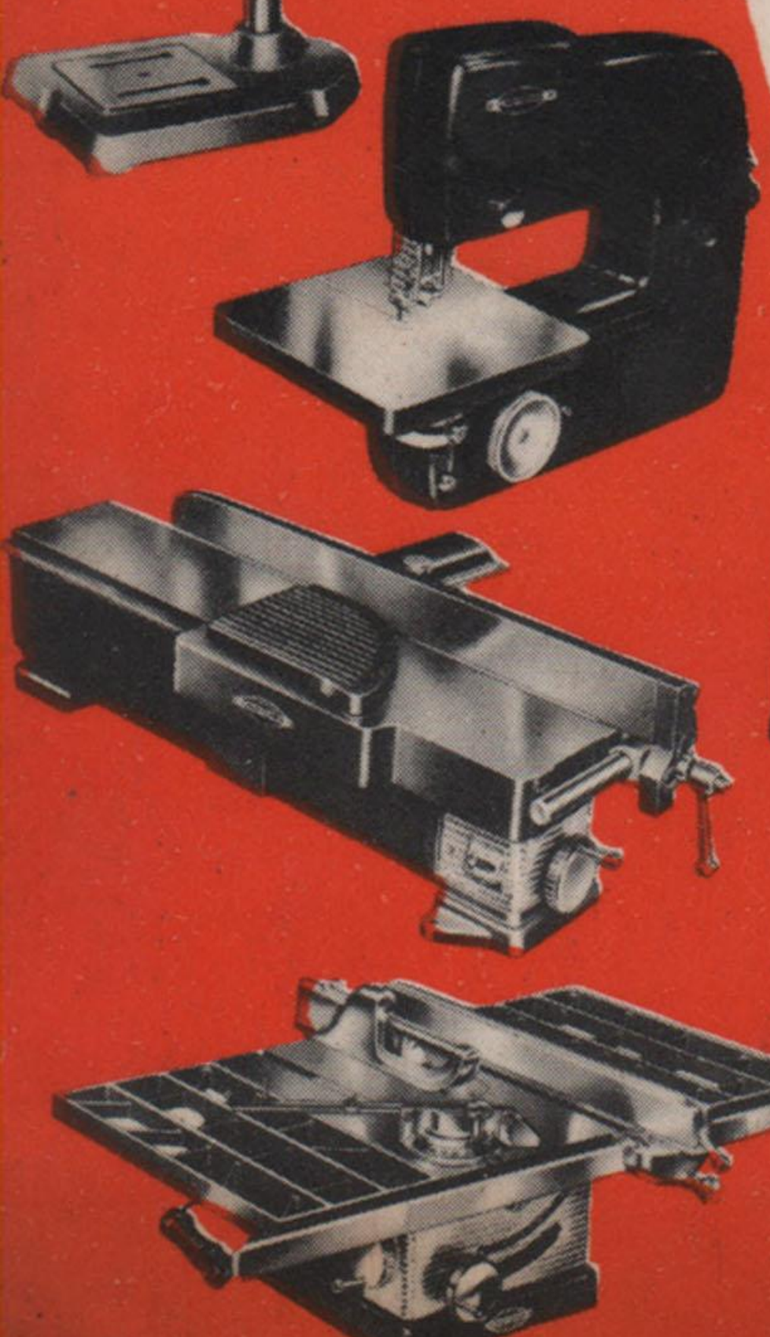

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