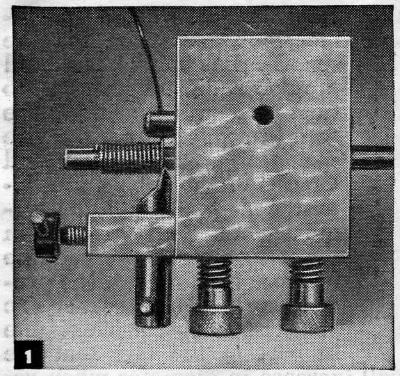

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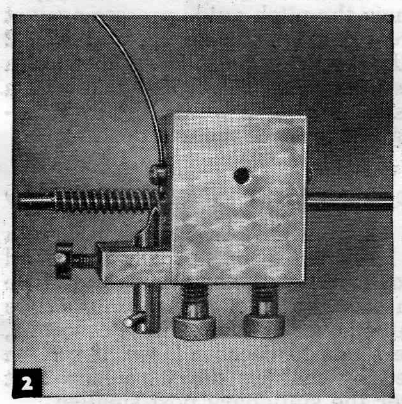
Above: Relative position of pitch guide and wire when winding a tension spring, and below, setup for compression spring



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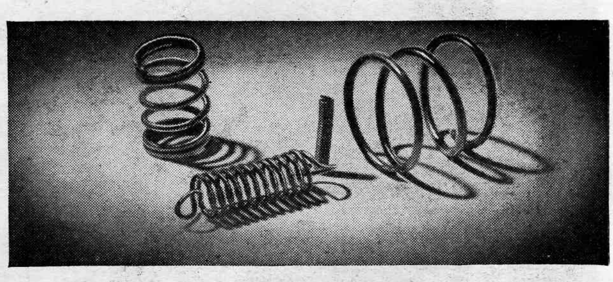
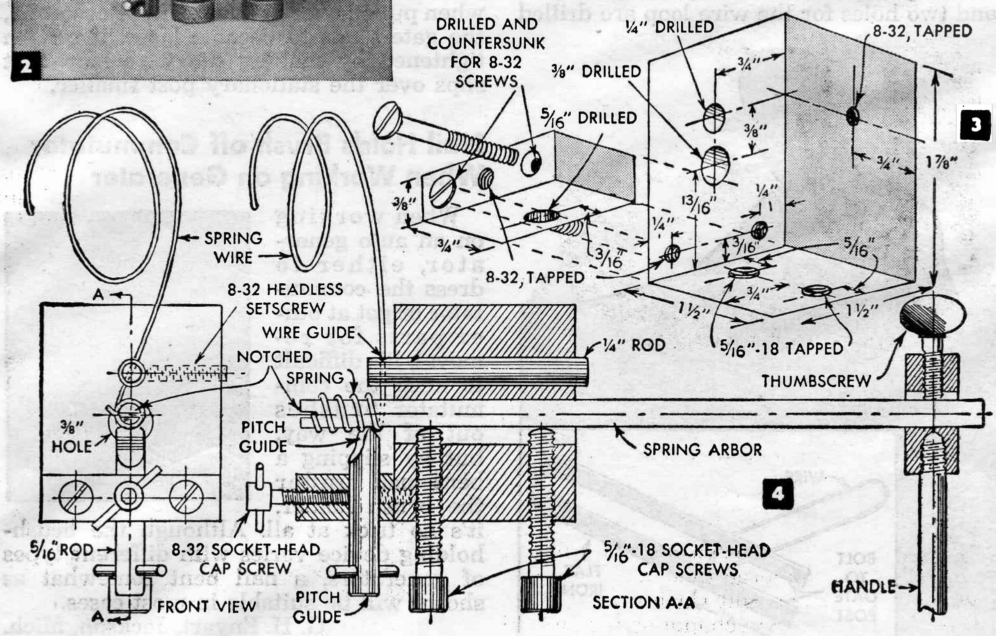


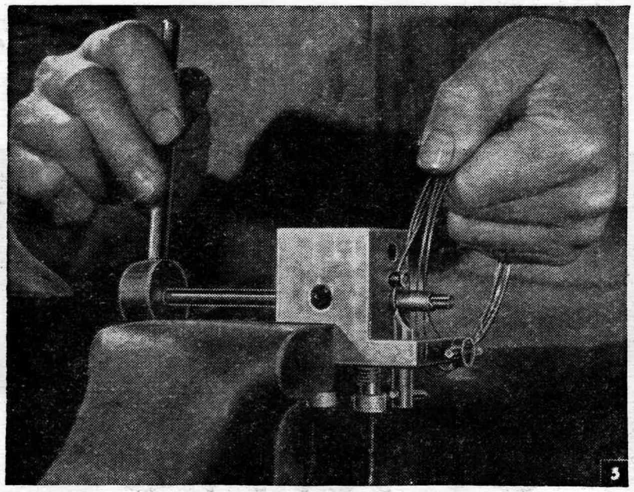
SPRINGS

Wind Them Yourself

By E. F. Bowley

Ranging in size from approximately 1/8 to 3/4-in. outside dia., tension or compression springs of almost any pitch can be made with this winder. Construction of the tool is simple and requires only two pieces of steel bar stock for the body, some rods and several cap screws. Fig. 3 gives the necessary dimensions for the body, which is composed of a main block and a smaller one for the pitch guide. When drilling and tapping the two pieces, note that the hole for the spring arbors is made large enough to accommodate rods up to about 3/8 in. in dia. Two



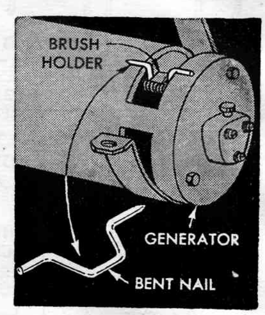


cap screws in the bottom of the body serve to position the arbors. Although the body of the tool is spot finished for appearance, this is not necessary. Lengths of the rods for the pitch guide and wire guide are made to suit. Both rods are locked in position by means of setscrews after being adjusted. The locking screw for the pitch guide is a cap screw fitted with a small pin that serves as a handle to permit easier adjustment. The end of the pitch guide is ground to the shape indicated in Fig. 4 and it, also, is provided with an adjusting handle. Complete assembly of the tool is indicated in Fig. 4. While no dimensions are given for the spring-arbor handle, it should provide sufficient leverage to turn the arbor against the tension produced by the spring, Fig. 5. Diameters and lengths of the arbors are determined by individual requirements. Some practice in the use of the winder will be necessary before you can produce springs of the exact size you wish to obtain. This is due in part to the fact that the spring will increase in diameter when removed from the arbor, the amount of expansion depending on the type and diameter of wire used to wind them. Fig. 1 shows how the pitch guide presses against the wire for a tension spring and Fig. 2 shows the way the guide is set to wind a compression spring. Pitch of the coils in a compression spring is controlled by twisting the guide to space them as desired.

Lever-Operated "Latch" Helps Keep Fence-Wire Gate Stretched Tautly

If you have a gate made of fencing wire, here's a locking device that will keep it stretched tightly. A U-shaped piece of flat iron is pivoted to the end post of the gate and two holes for the wire loop are drilled about 4 in. from the pivot holes. A length of wire is passed through these holes and looped over the stationary fence post. The flat iron acts as a lever to tighten the gate when pulled over as shown. If, after a time, the gate tends to become loose, it can be tightened by making the wire loop that slips over the stationary post smaller.

Nail Holds Brush off Commutator When Working on Generator

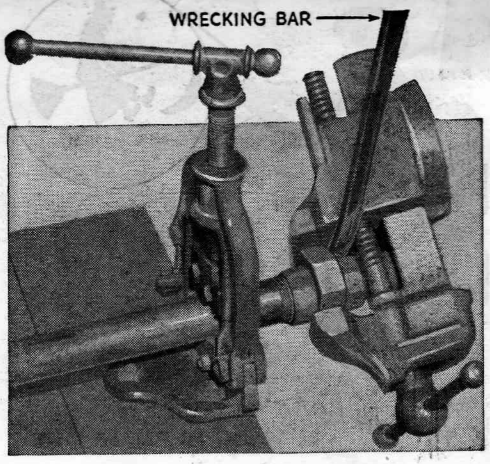


When working on an auto generator, either to dress the commutator or get at other parts for removal, it's difficult to keep the commutator brushes out of the way, but by slipping a bent nail under the brush holder, it's no trick at all. Although the brush-holding device varies with different types of generators, a nail bent somewhat as shown will be suitable in most cases.

G. H. Enyart, Jackson, Mich.

Bench Vise Is Used With Bar To Loosen Pipe Fitting

When a pipe fitting is tightly rusted and you haven't a wrench that's large enough to turn it, use a bench vise and a wrecking bar to do the job. Grip the work in a pipe vise and clamp the bench vise to the fitting. Then place the bar between the fitting and the back jaw of the vise. Use the bar as a lever to turn the vise and fitting.
Wayne A. Ward, Watertown, N. Y.

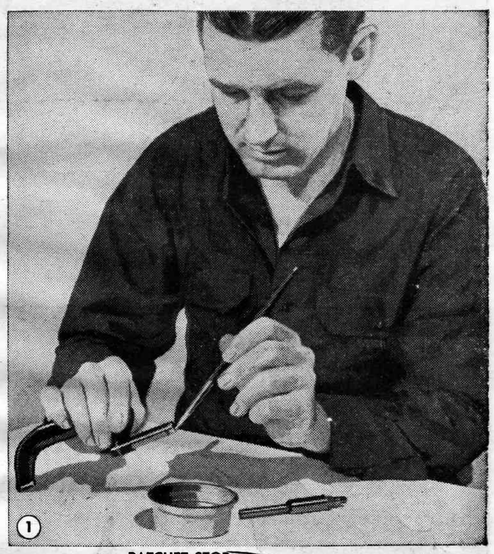


¶After cleaning out your stoker for the summer, internal parts can be kept from rusting by running oil-soaked sawdust or wood chips through the feed screw into the retort. The sawdust will be burned in the first fire made in the autumn.

Care and Use of THE MICROMETER

By Arthur Youngquist

ALTHOUGH micrometers are made in many shapes, types and sizes, the principles of operation are very much the same and should be understood thoroughly by anyone attempting to clean or adjust these delicate measuring instruments. If you're not familiar with the operation of a micrometer think of a C-clamp, Fig. 2, as a comparison. Most micrometers have 40 threads to the inch, therefore you can assume that the C-clamp has 40 threads to the inch. Now, if you can imagine the threaded spindle on the clamp as being a coil spring and assuming that you



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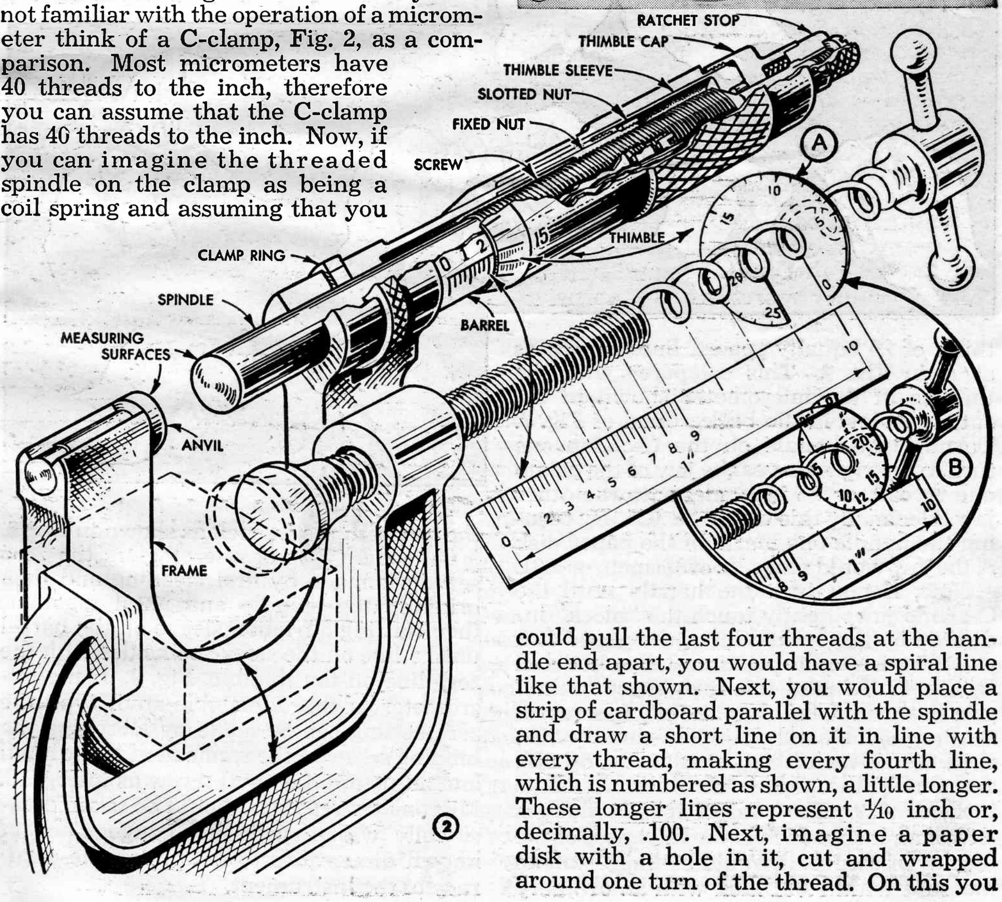
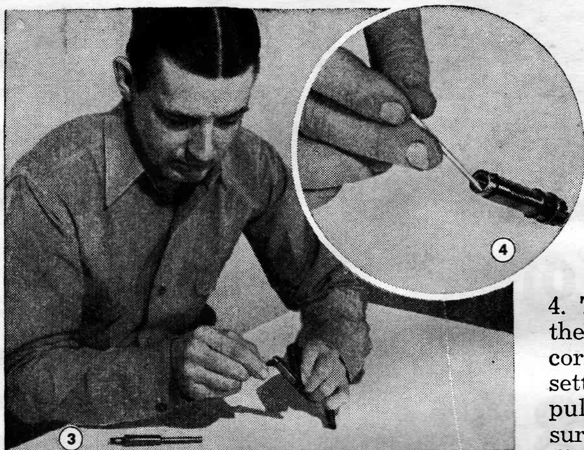
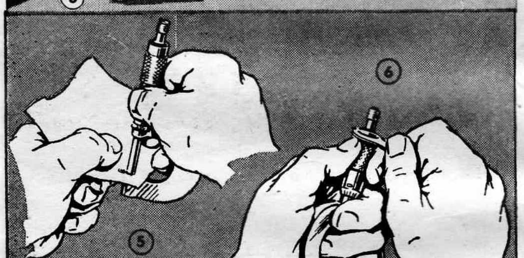
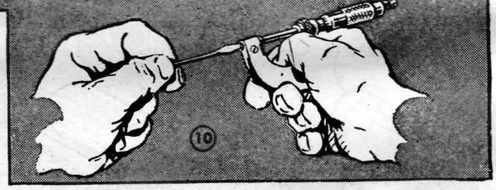


2

could pull the last four threads at the handle end apart, you would have a spiral line like that shown. Next, you would place a strip of cardboard parallel with the spindle and draw a short line on it in line with every thread, making every fourth line, which is numbered as shown, a little longer. These longer lines represent 1/10 inch or, decimally, .100. Next, imagine a paper disk with a hole in it, cut and wrapped around one turn of the thread. On this you







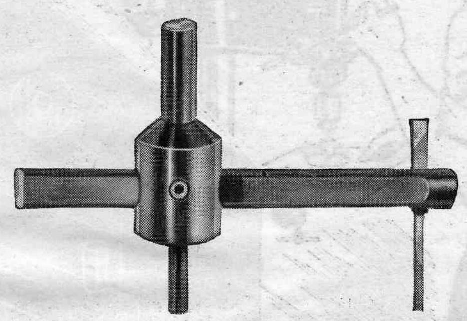
think of 25 equally spaced lines drawn as at A in Fig. 2. This compares with the thimble of the micrometer shown in the cutaway view in the background of Fig. 2. Turning the handle on the C-clamp one turn to the right moves the jaw of the clamp one thread, or $\frac{1}{40}$ inch, closer to the other jaw. Decimally this would be .025. By turning the handle one mark on the paper disk A the jaw would move $\frac{1}{25}$ of $\frac{1}{40}$ inch, or .001.

Now, if you turn the handle until the C-clamp jaws lightly touch the "block" indicated by the broken lines, the paper disk will advance to the position shown in detail B, Fig. 2. To read this imaginary "mike," you first count the number of lines representing $\frac{1}{10}$ inch and write it decimally .900; then the $\frac{1}{40}$-inch lines, which is $\frac{2}{40}$ or .050, and finally the paper-disk lines $\frac{12}{25}$ of $\frac{1}{40}$ inch, or .012. The sum of these values is .962 of an inch, which is the thickness of the block. Of course, it would be impossible to measure within .001 inch with an ordinary C-clamp, but by studying the comparisons you will have a better understanding of the micrometer mechanism.

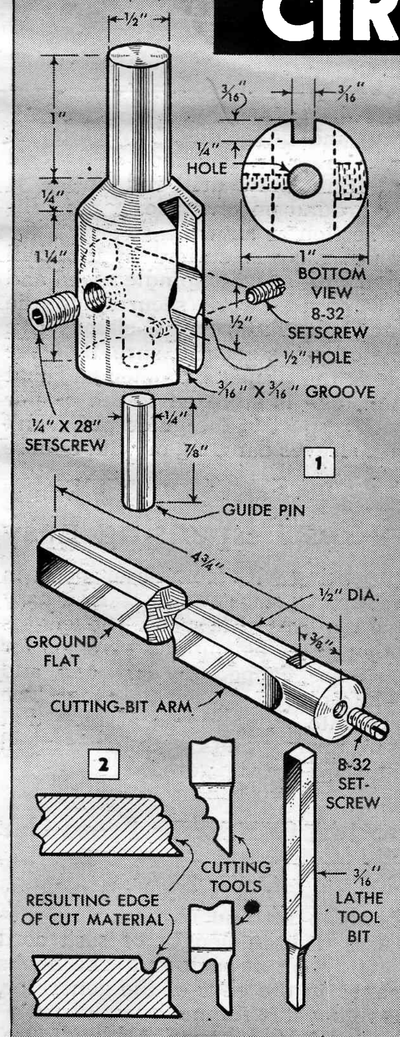
If the micrometer does not give a correct reading due to play in the threads, adjust it with the slotted nut, Fig. 2. Remove the screw spindle from the barrel and clean with pure naphtha, Fig. 1. Then place a few drops of light oil on the threads with a toothpick as in Fig. 4. Tighten the slotted nut on the end of the barrel, Fig. 3, by stages to secure the correct adjustment. To adjust for zero setting clean the anvil and spindle by pulling a piece of soft paper between the surfaces, Fig. 5. With the anvil and spindle apart, unlock the thimble cap with a spanner wrench, Fig. 6, then tighten the cap lightly. Bring the anvil and spindle together and set the zero line on the thimble to coincide with the line on the barrel, Fig. 7. Hold the micrometer by the frame and move the spindle away from the anvil by turning the spindle only. Then, grasping the thimble, tighten the cap with the wrench as shown in Fig. 8.

On some types of micrometers the zero setting is made by first cleaning and then bringing the spindle and anvil together, then turning a friction sleeve on the barrel until a line on the sleeve coincides with the zero line on the thimble, Fig. 9. If the micrometer is the adjustable-anvil type the zero setting can be made by loosening the binding screw in the frame next to the anvil and adjusting the anvil screw as in Fig. 10. Micrometer readings should be taken occasionally with a precision gauge block of known dimensions to determine the accuracy of the instrument.

DRILL-PRESS CIRCLE CUTTERS

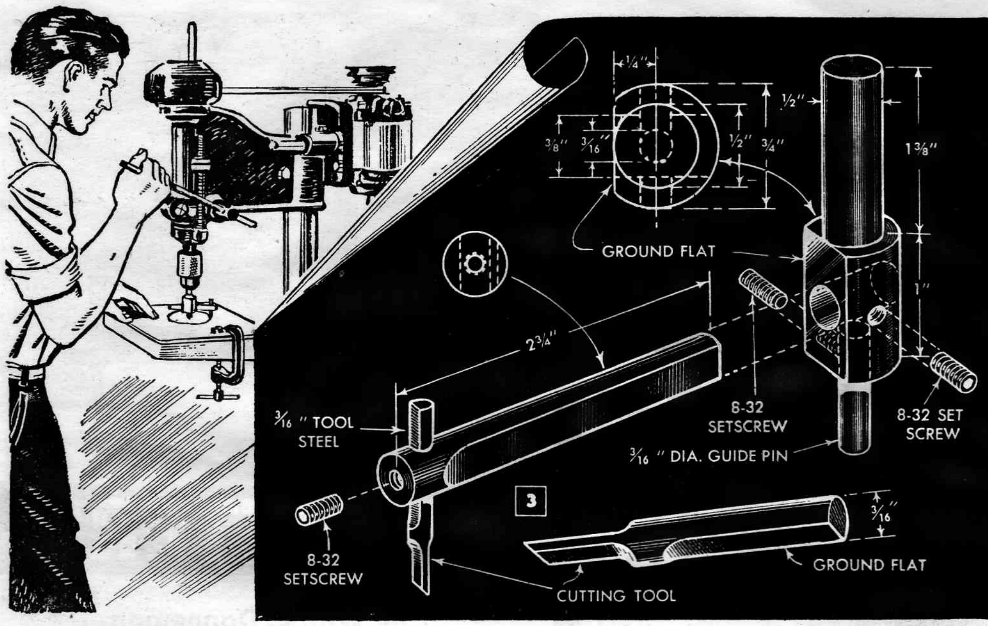


By Wm. E. Danneman



IN THE AVERAGE JOB SHOP there's only occasional need for a circle cutter, but when you do need one you generally need it badly. It does work which is impractical to do by any other means except in a lathe or perhaps with a hole saw, that is, if you happen to have one just the right size for the work at hand. Within its limits the circle cutter is adjusted quickly to cut different sizes of circular disks or holes in any ordinary material such as wood, fiber, plastic, aluminum, brass or mild steel. Not only that, but by grinding shapes on the cutters you can cut disks with molded edges as in Fig. 2. Or by grinding a shape on the outside edge of the cutter you can cut holes with molded edges. The swinging arm, made from drill rod, carries the cutting bit and must be hardened and drawn on both sizes of the circle cutters detailed. All turning, milling, tapping and broaching must be done first, of course. Broaching required is merely the squaring of the hole taking the larger cutter bit and this can be done with a small file if necessary. The flat on one side of the arm can be milled or ground to size according to the facilities available. Hardening procedure is quite simple. First you heat the part to a cherry red and quench in No. 20 lubricating oil. Clean with fine emery cloth to remove the scale completely. Again heat slowly and uniformly until the metal comes to a light straw color. This temperature is quite critical and the process must be closely watched. At the instant the metal turns uniformly straw color, and before it turns blue, quench in cold water. This process hardens the part sufficiently to prevent the locking setscrew from cutting into the milled surface.

The holder, Fig. 1, is a simple machining job

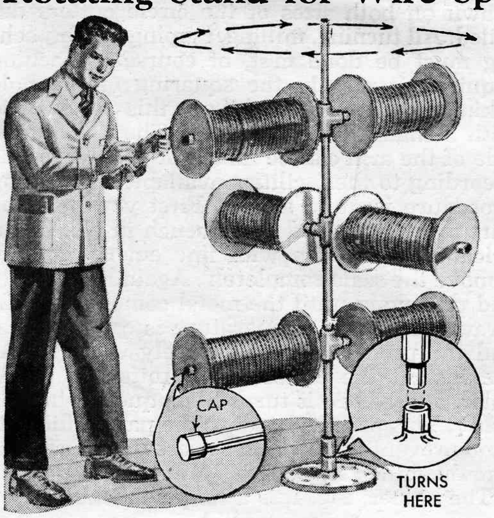


in mild steel. If desired, the guide pin can be hardened by the process already described. It will last much longer if hardened. Holes drilled in the holder for the guide pin and the arm carrying the cutting bit are reamed to final size. The groove milled in the body of the holder allows the cutting arm and the bit to slide to within 5/16 in. of the center of the pilot hole. This brings the minimum hole size that the tool will cut down to 5/8 in.

The small cutter detailed in Fig. 3 is made up in essentially the same way as the larger size already described. The cutting tool is made from 3/16-in. drill rod, hardened by heating and quenching. The cutter is not drawn, however. The body of the tool is turned from 3/4-in. drill rod. A flat is milled or ground on one side of the full-diameter section as shown.

When using circle cutters in the drill press drive with slowest spindle speed and always clamp the work securely to the table, using bolts, fixtures or C-clamps. Use a cutting oil on steel. Be sure that the pilot hole is the proper diameter and that the cutting tool is adjusted to the proper depth with respect to the guide pin. Don't work with sleeves dangling or with a loose necktie.

Rotating Stand for Wire Spools Makes Dispensing Easy



For dispensing wire from large spools in a hardware store, this rotating stand is easy to use and requires little space. The lengths of pipe that serve as spindles or arms for the spools are capped on one end and screwed into pipe crosses at the other. The crosses fit into other pieces of pipe that serve as an upright and rotate in a flanged base. The arms are staggered.

Sling to Lift Generator From Car

Generators in automobiles are not only heavy, but often are located where they are difficult to lift and remove. One mechanic uses a 36-in. length of sash cord with a wire hook at each end. The hooks are attached to the ends of the generator, which is removed with much less effort.

W. V. Athanas, Ashland, Ore.

FUNDAMENTALS of MILLING-

By H. J. Chamberland

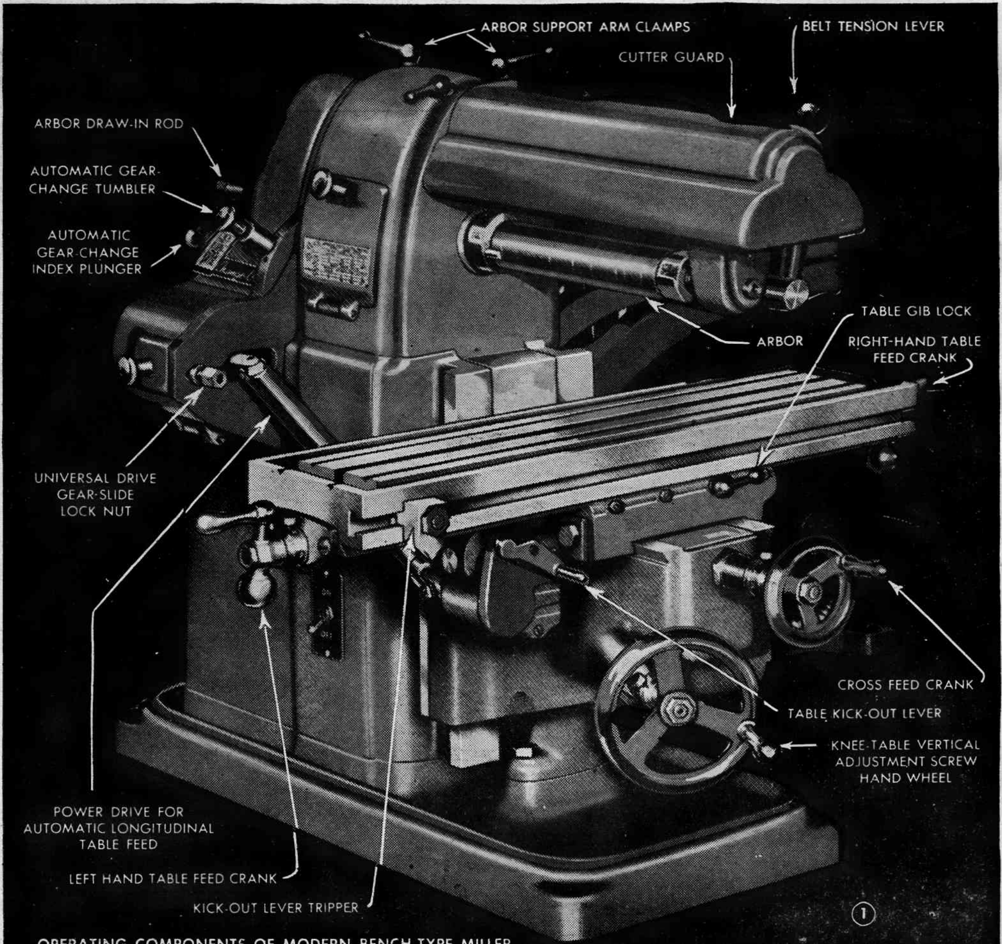
RANKING second only to the lathe in importance in many machine shops, the modern milling machine is so efficient from the standpoint of operation that it compensates for at least 85 percent of operator experience. Because of this and the fact that the small bench-type machines of today incorporate to the smallest detail all features found in modern floor-type tools, owners of small machine shops, garages and even home workshop enthusiasts are becoming interested in them. Although intended for the reader who has had very little of this phase of machining, this article also should prove of value to the lathe hand who has had some experience with a milling attachment.

Milling Machine Technique

The first step in mastering the miller is to study the various components of the machine, such as movements, and the levers, cranks and other means which control them, Fig. 1. Acquaint yourself thoroughly with the micrometer dial facilities which permit raising the table on its traverse and transverse advance in increments of .001 in. As with most machining operations, the essentials for milling accurately are based on the selection and care of the cutting tools and the speeds and feeds favoring their life, as well as the cutting rate and quality of work.

Know Your Cutters

Only milling operations on work held in a swivel vise or on an angle plate are covered here. Cutters described are therefore those commonly used on such work. High-speed stee cutters are preferred as they give long service when proper attention is given to preserving the cutting edges.



OPERATING COMPONENTS OF MODERN BENCH-TYPE MILLER

MACHINE OPERATION . . . .

The cutter being used in Fig. 2 is called a plain or slabbing mill and is intended to make a cut equal to, or less than, its own width. Since this cutter has peripheral teeth only, it is used for surfacing, or slabbing, as this operation often is termed. The cutter in Fig. 3 is a side mill, the teeth having cutting edges on both sides. It is used when milling a certain depth of cut the width of the mill, or any desired width through repeated cuts. Fig. 4 shows a slitting saw, its chief purpose in the small machine shop being to cut off bar stock.

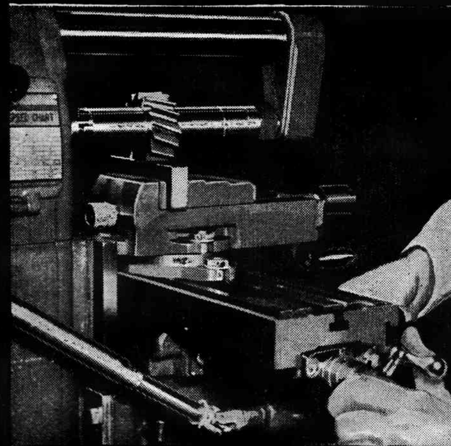
One of the most popular cutters is the shell end mill shown in Figs. 7 and 8. This is the most efficient tool to use when the nature of the cut permits because it is mounted on the end of the spindle nose and gives maximum cutting power. A similar but lighter cutter is the end mill shown in Fig. 9. With this tool, the end teeth and not the peripheral teeth do most of the cutting. A typical application of an end mill is shown in Fig. 10 where the tool is sinking a cut into a small steel plate bolted to an angle plate. Another very useful cutter is the angular or dovetail mill shown cutting a male dovetail in Fig. 11. It also has side teeth and requires careful use to preserve the delicate points resulting from angular peripheral teeth. Fig. 12 shows the same mill cutting the female or mating dovetail.

Right and Left-Hand Cutters

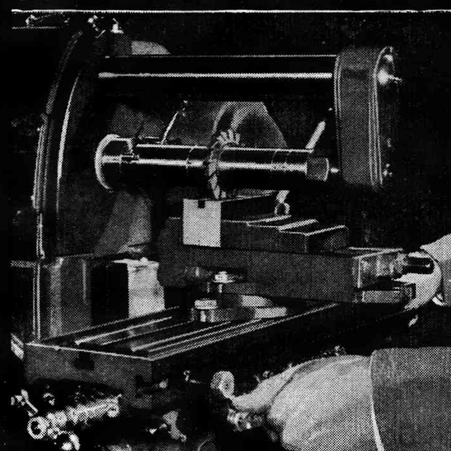
Milling can be done with the spindle rotating in either direction, but on most machines the cutting must be done with the work or table traveling in the direction opposite to cutter rotation. However, climb milling or feeding the work in the same direction as cutter rotation is now being done in machines designed for this method. To attempt this in a light milling machine not intended for this purpose will prove disastrous to both machine and cutting tool. The cutters shown in Figs. 2, 3, 4 and 5 are of the type that only have to be reversed on the arbor to operate right or left hand. Other cutters cannot be used in this way as the teeth are made to cut either left or right hand.

To determine the difference, hold a mill with the top of the teeth coming toward you as in Fig. 6-A. Note that the side teeth are cut on the left side of the mill which makes it a left-hand angular or dovetail cutter. Cutter 6-D is therefore the opposite, or right hand, and so are end mill B and shell end mill C.

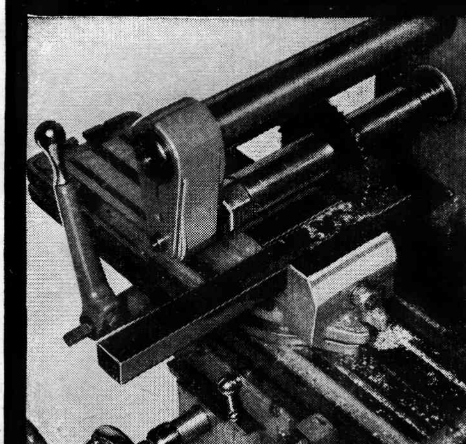
There is no need for having cutters of both hands, particularly for experimental



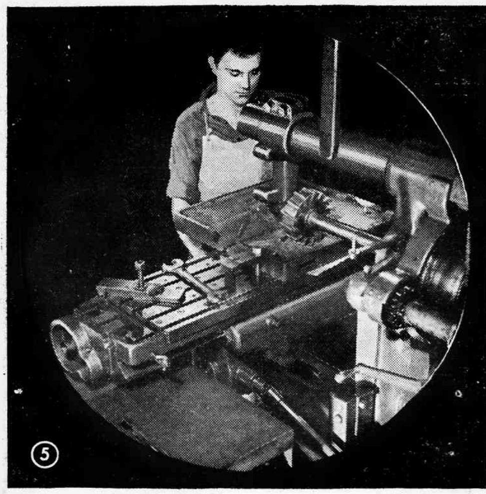
(2) SLAB MILLING STRAIGHT WORK HELD IN SWIVEL VISE

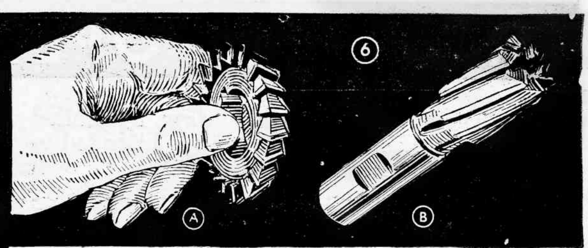


(3) SIDE MILL MAKES CUT THE FULL WIDTH OF TEETH



(4) SLITTING SAW CUTTING OFF STOCK IN SWIVEL VISE





or limited milling operations; instead, specialize in either right or left-hand cutting mills. All cutters used herewith are milling right-hand.

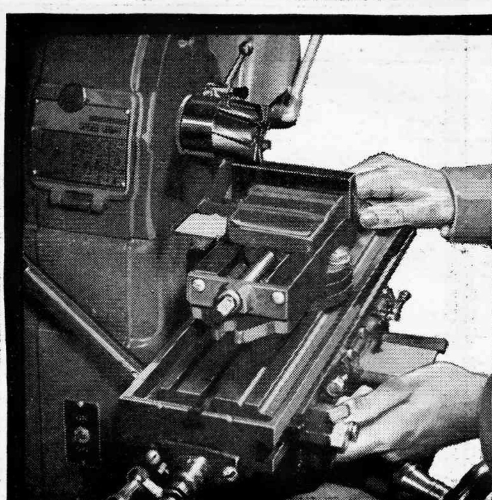
Keep Cutters Sharp

There's no secret about keeping cutters sharp. Simply go over them frequently with a medium-grade oilstone. If you viewed one of the cutting edges through a high-power microscope, it would appear rough; that is, full of peaks and valleys. The cavities thus formed pick up small particles of metal which cause the edge to roll over. On the other hand, oilstoned edges have a straight, uninterrupted line. The idea is to use the oilstone so that minute chips don't have a chance to become embedded in the cutting edges. The oftener the stone is used, the better.

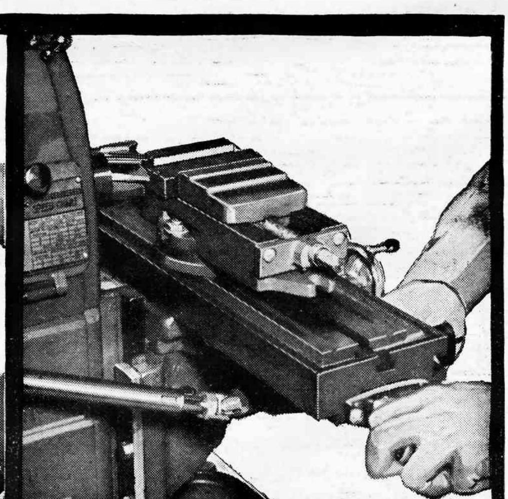
Peripheral teeth of all cutters should be oilstoned while mounted on the arbor, taking care to preserve the original clearance of the teeth; the stone should be held at the correct angle to avoid destroying the edges of adjacent teeth. The side teeth of shell end mills should be oilstoned by resting the cutter on a small surface plate or similar smooth surface as in detail A of Fig. 13. The side teeth of side mills always should be favored. It is advisable to oilstone them only every fourth time the peripheral teeth are conditioned. A good way to check the side teeth is shown in detail B. All that's needed is a pencil and a shaving action which shows whether or not the cutting edges are still in good shape.

The end mill gets its toughest treatment on the end teeth and it is imperative that all end teeth present a flat surface or be square in relation to the peripheral teeth. After oilstoning as shown in detail C, squareness is determined by holding the mill on any flat surface, detail D. Any rocking action indicates a variation in the height of the end teeth, which must be corrected by stoning until the mill will remain upright on the plate without holding it and with no light showing under the teeth.

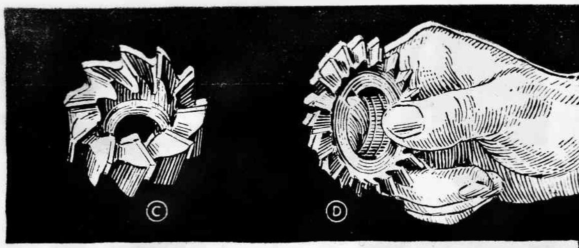
Although some cutters are still being made with teeth cut on center, as shown in



7 SHELL MILL HAS CUTTING EDGES ON SIDE AND END

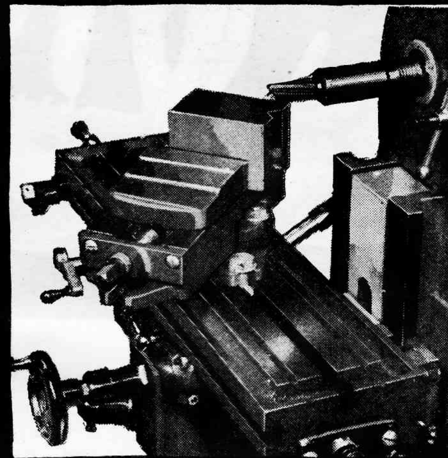


8 SHELL-END MILL FACING WORK HELD IN SWIVEL VISE

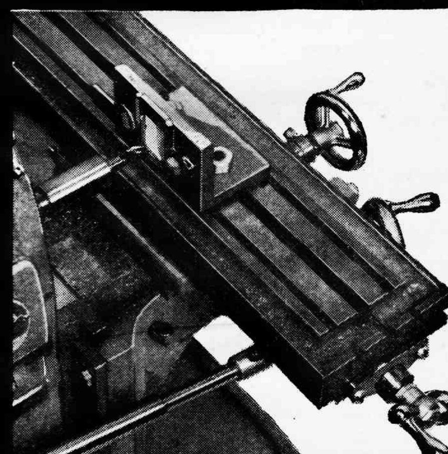


detail A of Fig. 14, most of them have undercut teeth as in detail B. In the process of manufacture, the cutter blank is located on center in relation to the tool doing the cutting, then the blank is relocated or thrown off the actual center at a predetermined margin, X, detail A, to provide a 10-degree undercut as shown when the cutting edge of the tooth coincides with the center or axis of the blank as in B. The usual tooth clearance is from 4 to 6 degrees with 5 degrees a standard, provided the face of the tooth is on center as in detail A. However, if the undercut cutter at B had only a 5-degree clearance, its cutting edges would actually be in reverse in relation to its axis by 5 degrees. To compensate for the 10-degree undercut, the clearance of cutter B must therefore be 15 degrees as the gauge indicates; in other words, this represents a compound angle of 5 plus 10 degrees, although the cutting edge actually has but a 5-degree clearance.

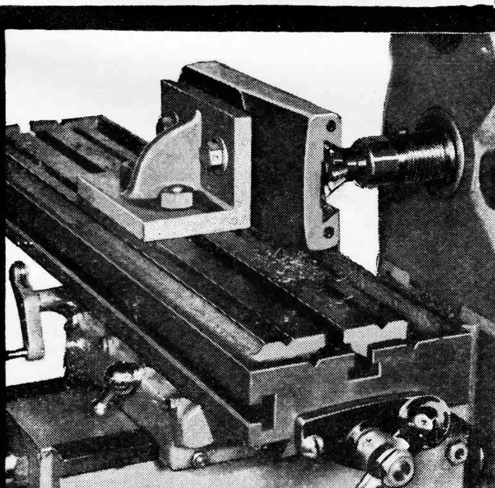
The clearance of side or end teeth on a cutter is approximately one half that of the peripheral, usually 2½ or 3 degrees. Care must be exercised when oilstoning side or end teeth to avoid reducing the original clearance. It's equally important not to alter the shape of the cutting edges.



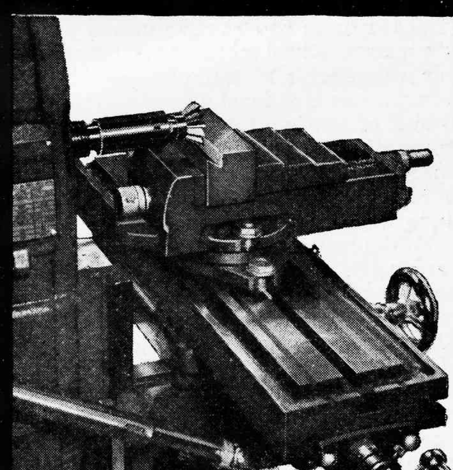
(9) END MILL CUTTING VEE IN WORK SET AT 45 DEGREES



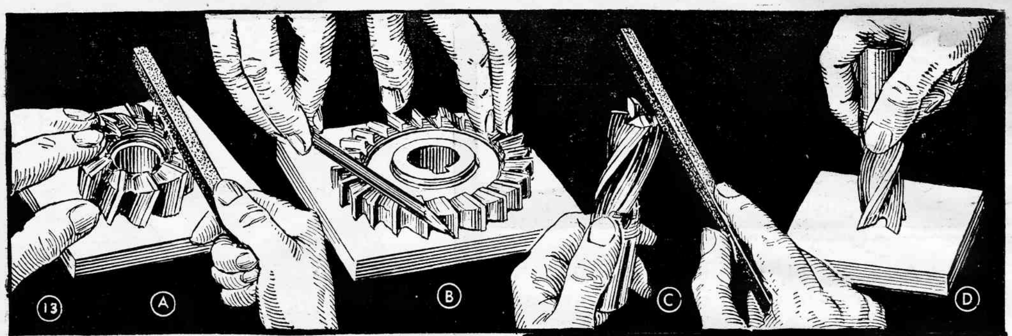
(10) END MILL CUTTING WORK MOUNTED ON ANGLE PLATE



(12) ANGULAR MILL CUTTING FEMALE HALF OF DOVETAIL



(11) ANGULAR MILL MAKING FIRST CUT IN MALE DOVETAIL

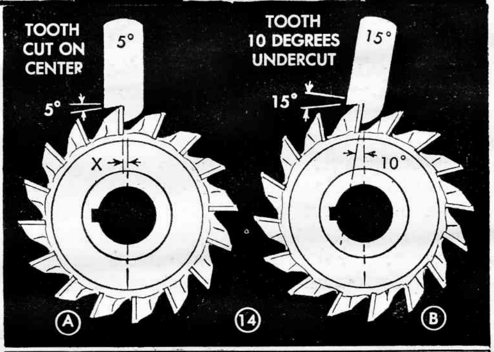


Spindle Speeds and Work Feeds

The term "speed" refers to the rotation of the spindle or cutter, and "feed" means the rate at which the work is moved into the cutter. The kind of material to be milled, the kind of material of which the cutter is made and the depth and width of cut all are factors affecting the selection of cutter speeds. These factors, as well as the rigidity and power of the machine, finish desired and accuracy of work, must be taken into consideration in determining rate of feed. General speed recommendations to aid the beginner are given in Fig. 15.

The rate of spindle speed is computed in surface feet per minute, or the distance the cutter would travel if it were rolling on the ground. Table or work feed is, of course, in linear inches. It is well to remember that the speed of a cutter in revolutions per minute does not by itself determine the rate at which the cutting edge is advancing through the work. The diameter of the cutter and its revolutions per minute really determine what is referred to as the surface feet per minute of the cutter. For example: If a cutter is 2 in. in diameter, its circumference is approximately 6 in. (2x3.1416), so at 500 revolutions per minute it covers 3000 inches or 250 surface feet per minute. The table of speed recommendations is at least a good starting point. Depth of cut is a problem you must solve yourself. The various cutter speeds given apply to a normal depth of cut, meaning the most efficient work the cutter can produce without being overloaded.

To determine the speed and feed for the respective machine dial or chart settings, knowing the diameter of and number of teeth in the cutter, let us again refer to Fig. 15. The rule to establish cutter speed is to divide cutter speed in feet, as given in the table for the kind of material being milled, by the circumference of the cutter expressed in feet. To establish the amount of table travel or work feed per minute, multiply feed per tooth per revolution by number of teeth in cutter and then by speed (number of revolutions per minute). The five rules given serve to make all computations easily. Figures obtained will not, of course, correspond exactly to those listed on machine charts or dials, but will come close enough to be dependable. On most work of a more precise nature it's always well to calculate the speed-feed ratios as a precaution against overloading.



15 GENERAL SPEED RECOMMENDATIONS

Kind of Material to Be Milled	Cutter Speed in Feet Per Minute Using High-Speed Steel Cutter	
	Min. F.P.M.	Max. F.P.M.
Steel—Soft	60	90
Steel—Medium	50	80
Steel—Hard	30	50
Cast Iron—Soft	50	80
Cast Iron—Hard	30	50
Cast Iron—Chilled	20	40
Malleable Iron	70	100
Brass—Soft	70	175
Bronze—Hard	65	130
Bronze—Very Hard	30	50
Aluminum	500	1000

Note — With cutters made of carbon steel, reduce speeds given from 40% to 50%.

Five Simple Rules in Speed-Feed Arithmetic

1—Diameter of cutter in inches multiplied by 3.1416 (circumference), multiplied by revolutions per minute, divided by 12 gives speed of cutter in feet per minute (F.P.M.).

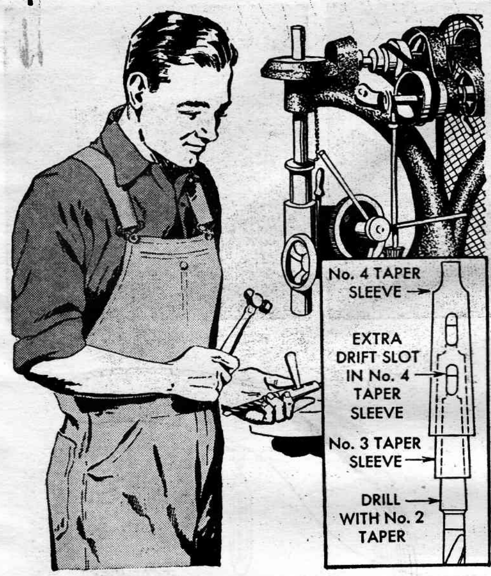
2—Feet per minute divided by circumference of cutter in feet (diameter multiplied by 3.1416, divided by 12) gives revolutions per minute (R.P.M.).

3—Feed per minute divided by revolutions per minute gives feed per revolution (F.R.).

4—Feet per minute in inches divided by number of teeth per minute (number of teeth in cutter multiplied by revolutions per minute) gives feed per minute.

5—Feed per tooth per revolution multiplied by number of teeth in cutter, multiplied by revolutions per minute, gives feed per minute. Also, feed per revolution multiplied by revolutions per minute gives feed per minute.

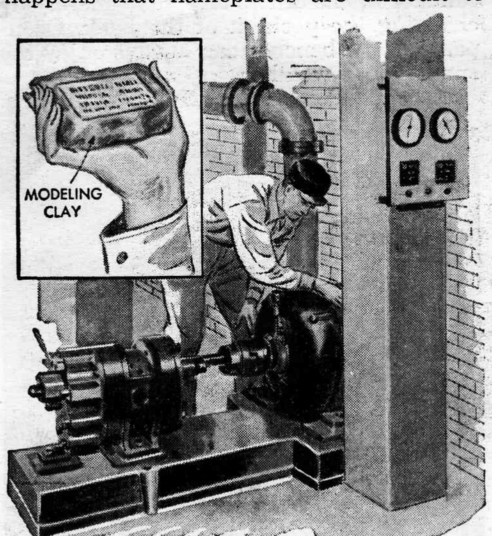
Extra Drift Slot for Taper Sleeve Speeds Removal of Drill



When using small taper drills and reamers in a large drill press, considerable time can be saved by cutting an extra drift hole in the large sleeve to match the one in the smaller sleeve. This permits removal of the drill without having to take the taper sleeve apart each time the drill is changed.
Alvin O. Nelson, Fargo, N. Dak.

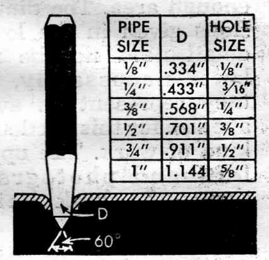
Taking Data From Nameplates By Using Modeling Clay

If electric motors or other machinery are located in close quarters, sometimes it happens that nameplates are difficult to read because they are against a wall or other obstruction. If necessary data, such as current characteristics, horsepower, etc., must be obtained, this can be done by pressing a piece of modeling clay against the nameplate. Although the impression shows the letters in reverse, it can be read by holding the clay up to a mirror.



Better Way to Tap Thin Metal

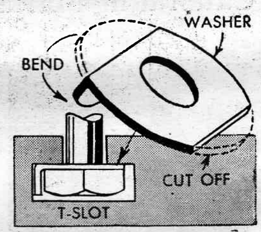
To obtain greater depth of thread when tapping thin sheet metal, drill an undersize hole and enlarge it to the proper diameter with a tapered punch. A small line scribed around the punch will serve as a guide in determining how far to drive the punch for any particular size of hole. For pipe threads, the taper on the punch should be the same as the taper on the thread. The table shows the size hole to drill, and the enlargement to make with the punch, D, for the pipe sizes indicated in the left-hand column.



PIPE SIZE	D	HOLE SIZE
1/8"	.334"	1/8"
1/4"	.433"	3/16"
3/8"	.568"	1/4"
1/2"	.701"	3/8"
3/4"	.911"	1/2"
1"	1.144	5/8"

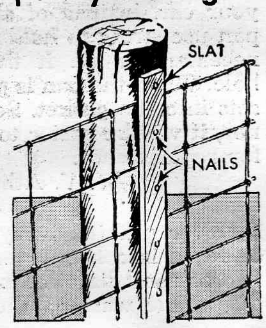
Bolt Head Can't Turn in T-Slot If Fitted With Special Washer

Should a T-slot in a machine table be too large for the bolts on hand, so that the heads turn in the slot when being tightened or loosened, a standard washer can be cut and bent to prevent this. The upper detail indicates the method of cutting and bending, and the lower one shows how the washer is placed on the bolt and set in the table.
Earl R. Goddard, Denver, Colo.

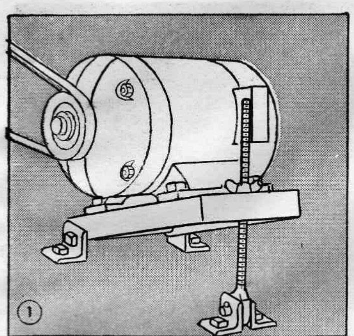


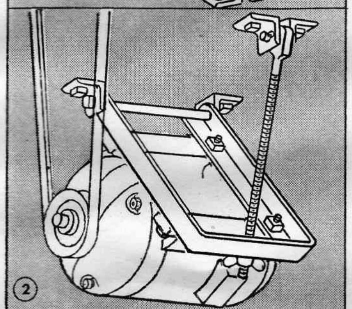
Slats Fasten Temporary Fencing

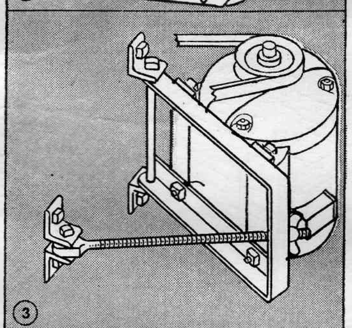
Putting up fencing for temporary use is easy when slats and nails are used instead of staples. The job is done quickly and, when the fence is to be taken down, all that you have to do is remove the slats by pulling out the nails.

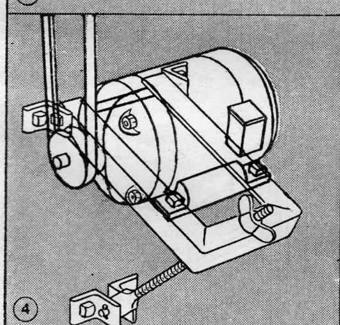


QUICK-CHANGE MOTOR MOUNT SERVES ALL MACHINES





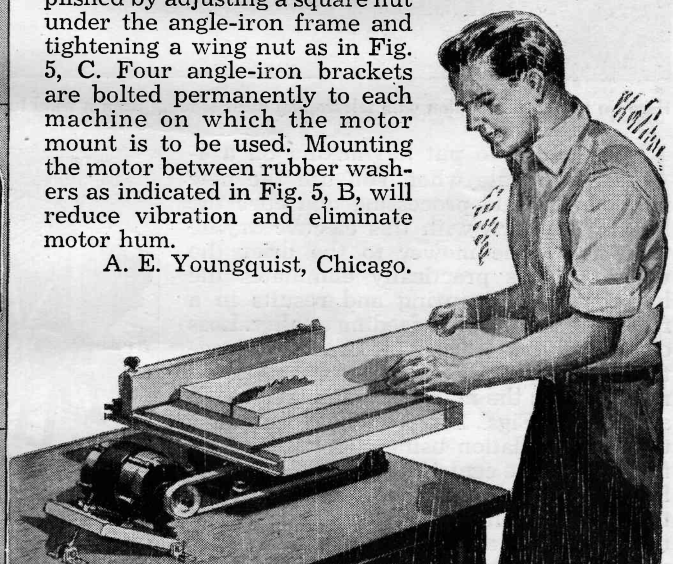


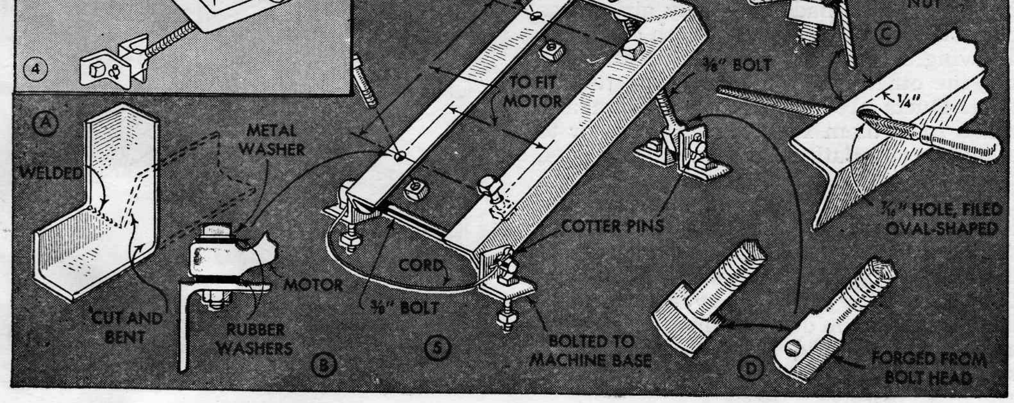


CHANGING a motor from one machine to another in the home can be done in less than a minute with this all-position motor mount. Some of the many different positions in which it can be used are shown in Figs. 1 to 4 inclusive. Only motors built for vertical as well as horizontal mounting should be used as illustrated in Fig. 3.

Dimensions for the angle-iron frame (Fig. 5) are not given as these will vary according to the type and size of motor used. The corners are cut, bent and welded as detailed in Fig. 5, A, and two holes are drilled to take a ⅜-in. bolt on which the frame hinges. A third hole is drilled and filed to an oval shape for an adjustment screw, which is a ⅜-in. square-head bolt forged and drilled as shown in Fig. 5, D. Belt tensioning is accomplished by adjusting a square nut under the angle-iron frame and tightening a wing nut as in Fig. 5, C. Four angle-iron brackets are bolted permanently to each machine on which the motor mount is to be used. Mounting the motor between rubber washers as indicated in Fig. 5, B, will reduce vibration and eliminate motor hum.

A. E. Youngquist, Chicago.



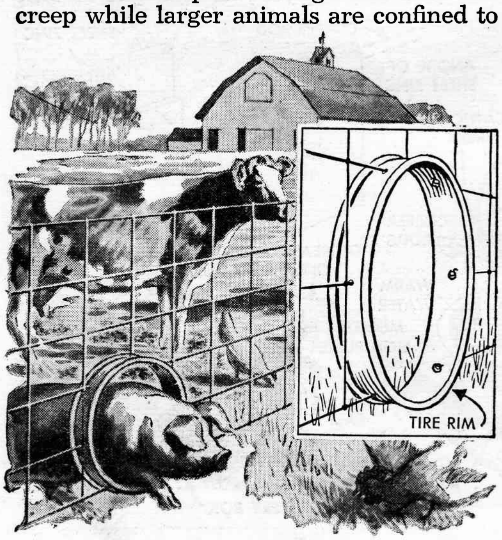


Mechanics' Cleaning Tank and Rack Made From Oil Drum

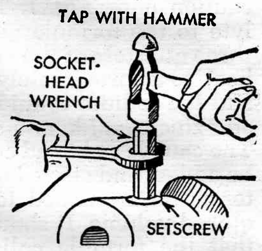
Inexpensive to make, this cleaning tank and racks require only an oil drum and a few odds and ends of lumber. The drum is cut lengthwise and then halfway around the ends so the sides can be bent back to form the racks. The ends are cut to be level. When cutting and forming, be sure to lay out the work so the drain plug will be at the bottom. A wooden cradle holds the tank at the proper working level.
Wilford Leach, Williamsburg, Va.

Auto-Wheel Rim Makes Creep For Farm Animals

Small animals, such as hogs and sheep will be able to pass through this auto-rim creep while larger animals are confined to one field. The rim is held in place by means of holes to which the wires of the fence are attached.—Wm. P. Houser, Organ, N. Mex.



Loosening "Frozen" Setscrews

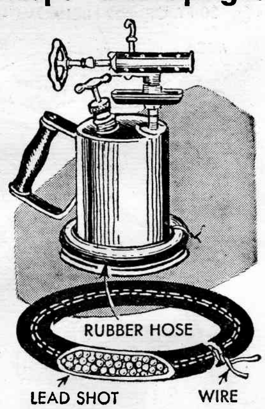


Socket-head setscrews, which are "frozen" or rusted in, can be loosened and removed by the following method: Grip the setscrew wrench with an end wrench as shown and tap the former lightly with a hammer as tension is applied. The hammering plus the tension of the end wrench helps break the threads loose. Square-head setscrews are loosened by a similar method.

Replacing Flywheel Ring Gears

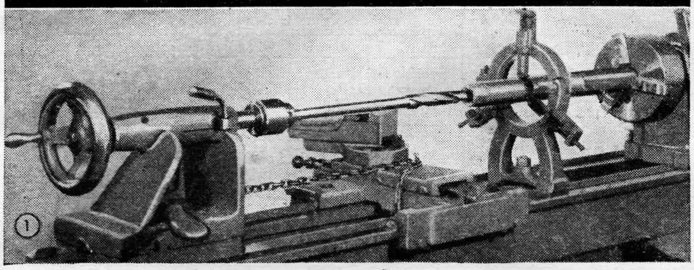
Since ring gears on flywheels are a shrink fit, it's necessary to heat them before they can be installed and this calls for the use of an acetylene torch or some similar source of heat. However, if such equipment is not at hand, the gear can be heated as follows: After removing the old ring, lay the new one on several bricks to support it 3 or 4 in. above the ground. Then place some old rags in a circle beneath it and saturate them with gasoline. Ignite the rags and allow them to burn down. Then lift the gear with two pairs of pliers and slip it in place. Adjust the gear by tapping it with a punch as the metal cools.
D. W. Brentlinger, Richmond, Calif.

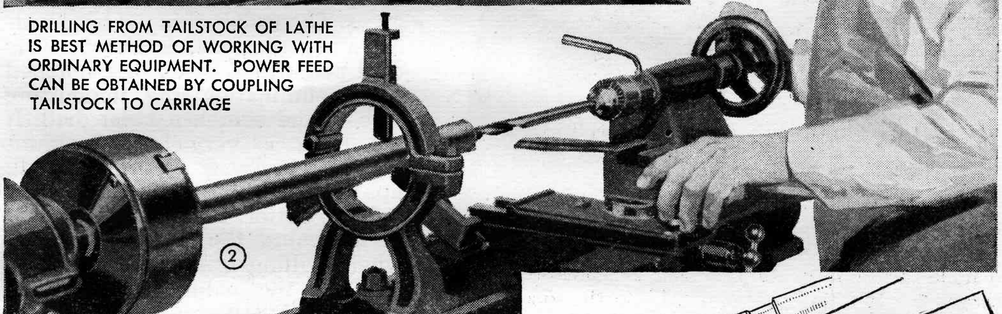
Weighted Hose Keeps Torch Upright



One plumber who had trouble keeping his blowtorch from tipping over fitted a piece of garden hose filled with lead shot around the base. This adds enough weight to the bottom of the torch to prevent it being top heavy. A piece of wire is inserted in the hose and the ends are twisted tightly to keep the shot from spilling out. As a further precaution, wrap tape around the hose where the ends join.
Edgar Barnhart, Whittier, Calif.

Drilling DEEP HOLES in Metal

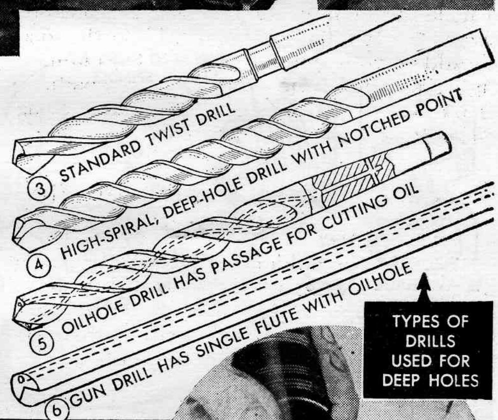




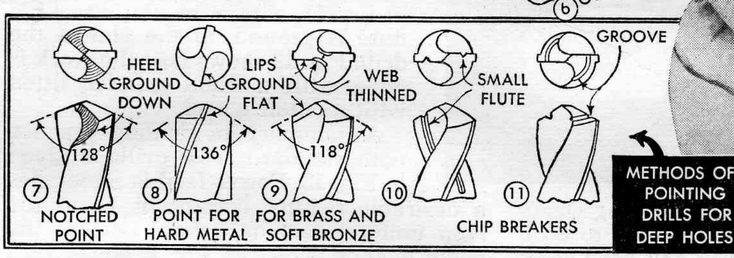
DRILLING FROM TAILSTOCK OF LATHE IS BEST METHOD OF WORKING WITH ORDINARY EQUIPMENT. POWER FEED CAN BE OBTAINED BY COUPLING TAILSTOCK TO CARRIAGE

DRILLING cylindrical work from the lathe tailstock, as shown in Fig. 2, is practical for either shallow or deep holes. This method is accurate, easy to set up, and will handle the average job nicely. A power feed, if desired, can be obtained by coupling the tailstock with the carriage by means of a chain, as shown in Fig. 1.

The occasional job of deep-hole drilling can be done with a standard twist drill. For regular work of this kind, the drills shown in Figs. 4, 5 and 6 are preferable. Fig. 4 shows a high-spiral type of twist drill made especially for deep-hole work (sometimes called a crankshaft drill). Other than the fast twist, which gives better chip elevation, this drill differs from a standard twist drill in that it has a notched point. Fig. 5 shows a standard twist drill with oilholes through the solid metal. It requires a special socket which permits coupling to a force-feed oil line. The cutting oil cools and lubricates the drill, and washes the chips out through the flutes. The gun drill, Fig. 6, also works on the force-feed system, chips being washed out through the single flute. Properly supported, it is the truest tracking of all deep-hole drills.



TYPES OF DRILLS USED FOR DEEP HOLES



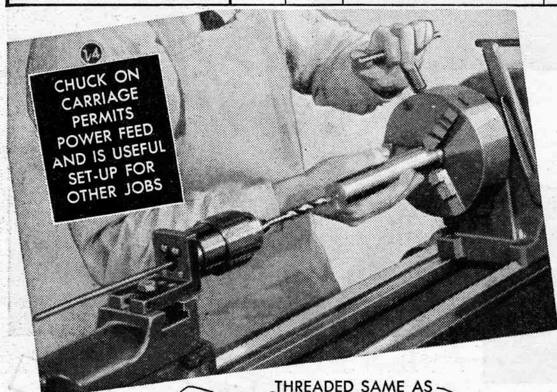
METHODS OF POINTING DRILLS FOR DEEP HOLES

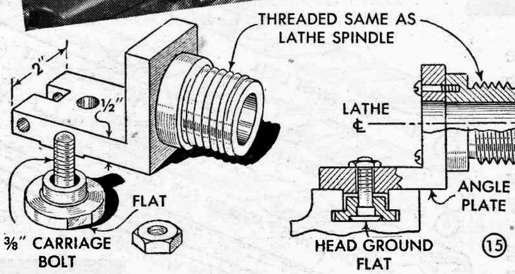
You can drill to almost any depth with a standard type of twist drill by simply backtracking the drill frequently. The hole should be drilled about one diameter or less, then the drill should be withdrawn

⑬ DEEP-HOLE DRILLING PRACTICE WITH STANDARD TWIST DRILLS

Material	F.P.M.*		Feed	Cutting Comp.	Style of Drill Point
Aluminum	250	Reduce speed 25% at depth of 8 diameters	Depends on drill size:	50-50 Kerosene and Lard Oil	Sharp point—90° to 110° included angle
Brass and Soft Bronze	200		Under ⅛"—.001 to .002 in. per revolution	Dry or Soluble Oil	Standard 118° point with cutting lips flattened
Soft Cast Iron	120		⅛" to ¼"—.002 to .004	Dry	90° to 118° included angle
Soft Steel	110		¼" to ½"—.004 to .008	Soluble Oil, Mineral Lard Oil or Sulphurized Oil	Notched point, 118°
Tool Steel	60		½" to 1"—.008 to .015		125° to 135° included angle—angle increases with hardness
Cast Plastic	250		Over 1"—.015 to .025	Dry (withdraw drill frequently)	118°—Relieve heel as shown in Fig. 7 but without notching web

* For high-speed steel drills


⑭ CHUCK ON CARRIAGE PERMITS POWER FEED AND IS USEFUL SET-UP FOR OTHER JOBS



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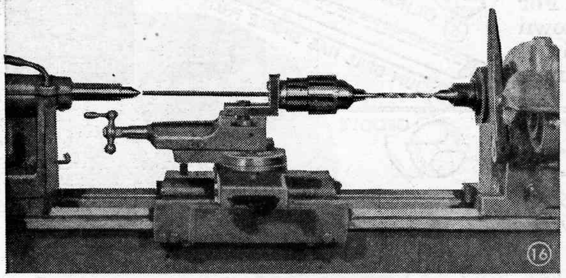

⑯

completely. This method of drilling clears the hole of chips, allows the drill to cool, and gradually wears away any hard spots on the walls of the hole. If the drill is not long enough, a shank of suitable length and diameter can be welded on. One important thing to check is the margins of the drill. A high, clean margin is absolutely necessary—don't try deep-hole drilling with a drill that has margins worn away, especially within 1 in. of the lips.

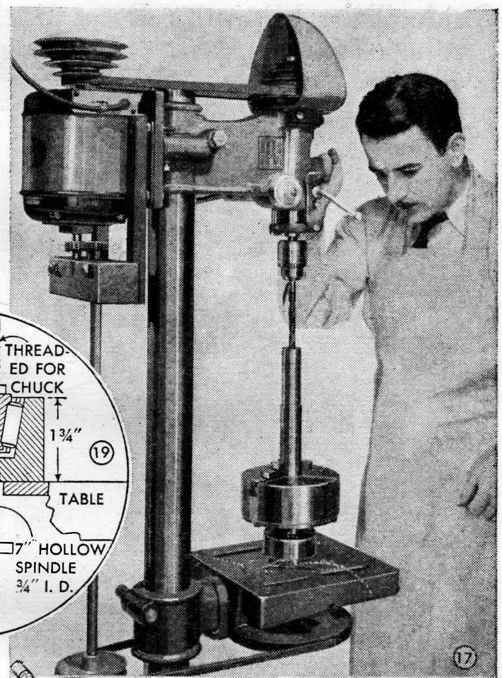
Special pointing of the drill is sometimes helpful. Fig. 7 shows the best all-around point for deep-hole drilling. The included angle is 128 degrees, which is a bit sharper than the normal 118 degrees. The web is thinned by grinding away the heel, as shown. This drill penetrates easily, the notched point eliminating the noncutting web of the standard twist drill. If the work is very hard, a blunt point, as in Fig. 8, with the cutting lips slightly flattened, will cut and hold up better. The same treatment of flattening the lips is required when drilling brass, Fig. 9, but in this case the included angle is the standard 118 degrees. Fig. 9 also shows web-thinning by grinding with a round edge wheel. A moderate amount of this is good practice, especially on larger drills.

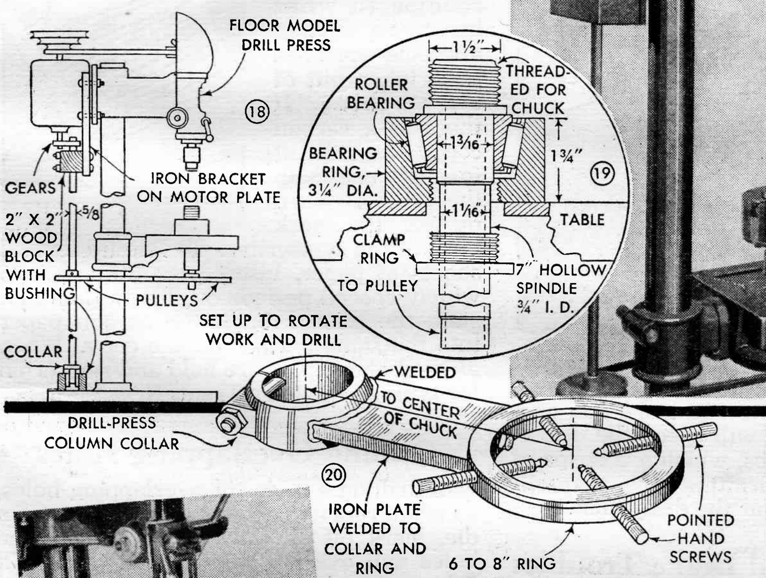
Figs. 10 and 11 show two styles of chip breakers. The purpose of a chip breaker is to divide and break up the chip so that it can be expelled readily through the flutes of the drill. In factory-made drills of this style, the chip breaker consists of one or more flutes within the main flute, as in Fig. 10. A simpler style for occasional work is shown in Fig. 11, where the chip-breaking flute is ground on the end of the drill. Fig. 12 shows how the work is done with a hand grinder fitted with a cutoff wheel.

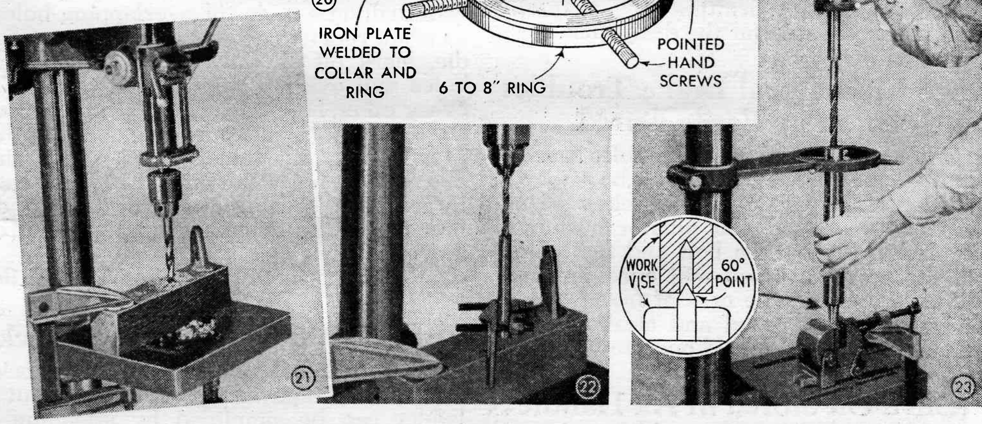
A summary of drilling practice with standard twist drills is given in Fig. 13. Power feed is sometimes a desirable feature because it keeps the chip uniform and unbroken. Besides the chain method shown in Fig. 1, power feed on the lathe can be obtained by drilling from the carriage, as shown in Figs. 14 and 15. This setup is easily aligned by using a straight rod or the drill itself, as in Fig. 16.

When the work is done on the drill press, various methods can be used to assure an accurate hole. Many machinists rotate both work and drill, as shown in Figs. 17, 18 and 19. The diagram, Fig. 18, shows a 1:1 ratio from motor to pulley spindle, but a reduction of 2:1 is better as it decreases vibration and gear noise. A further reduction is obtained by the pulleys, so that the final speed of about 200 r.p.m. is obtained.

Figs. 21 and 22 picture one of the best methods of drilling round work of small diameter. A wood block is clamped to the drill table and a drill of the same diameter as the work is used to run a hole into the block, as in Fig. 21. Then the work is mounted in the hole, with the actual work drill in the drill chuck as in Fig. 22. Note







that the drill table and the wooden block remain in a fixed position.

In drilling long work on a drill press, the biggest difficulty is holding the work upright. For this purpose, the ring shown in Fig. 23 is excellent. The bottom end of the work is supported on a 60-degree point held in a drill vise, the point being aligned exactly below the drill point previous to the drilling operation.

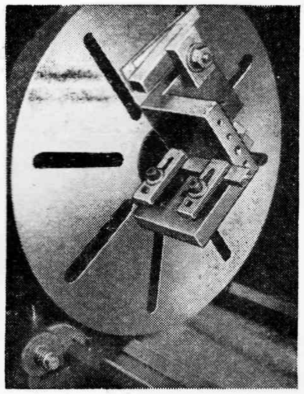
Keeping Circular Saw in Balance

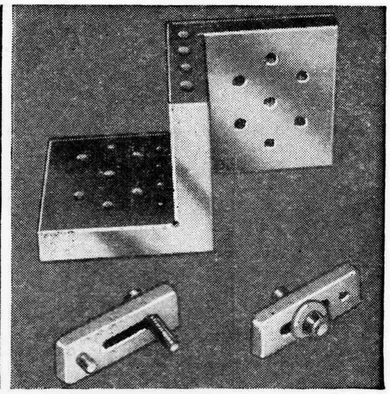
When a circular saw runs untrue and out of balance often the trouble is due to play between the mandrel and the hole in the saw blade. Jointing seldom improves this condition unless care is taken to place the saw on the mandrel in the same position each time it is removed. However, by putting an identifying mark on the blade and keeping it uppermost when placing the saw on the mandrel, the relation between the mandrel and saw is always the same and, after jointing a few times, the saw will run true and in balance. The same thing applies to dado heads, cutoff wheels and other attachments used on a saw.

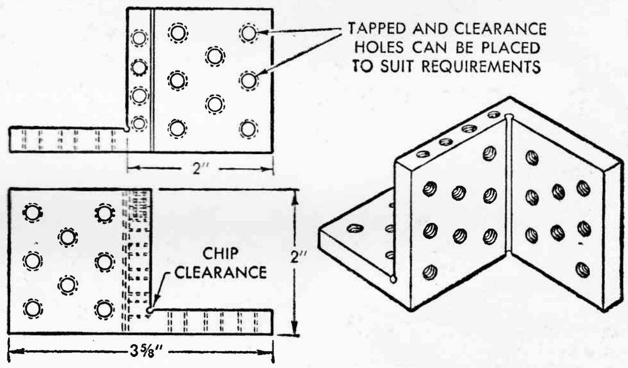
L.A.B. Hutton, Ottawa, Can.

Double Angle Plate For Tricky Setups

This angle plate has all the advantages of the regular plate plus an additional surface and precision angle, which is parallel with the axis of the lathe when mounted on the faceplate. It's small, as you will see from the dimensions, and can be cast in gray iron from a simple wood pattern, or milled from a block of steel. Any number of clamps for holding the work can be made, but those shown proved satisfactory for a wide range of small work. Pattern of the drilled and tapped holes on the flat surfaces may be made to suit your requirements. After machining, drilling and tapping, the plate is hardened and ground on all flat surfaces.—Edmund L. Johnson, Pittsburgh, Pa.



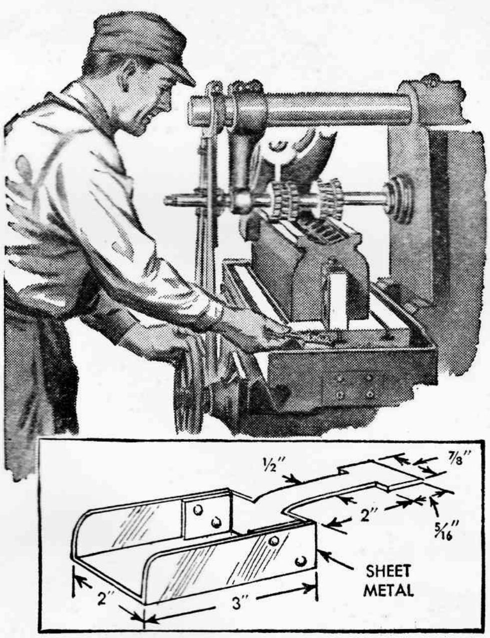




Scoop Made With T-Shaped Handle Cleans Slots In Machine Table

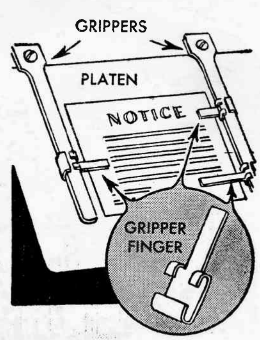
It's difficult to clean chips from T-slots on milling-machine tables and do a clean job, but with this special scoop, the work can be done in a short time. The detail gives dimensions for the scoop, but these may have to be altered to fit a specific machine; especially the handle, which must be a loose fit in the table slots. To use the device, clean the chips from the slots by using the handle and then pick them up with the scoop. This handy tool can be used on many types of machines.

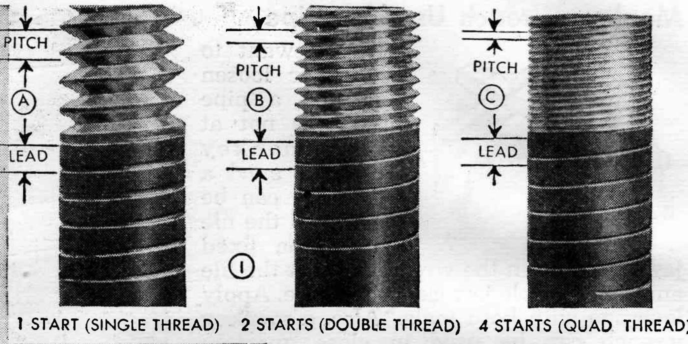
Harold B. Eastman, Cleveland, Ohio.



"Gripper Fingers" Hold Small Forms

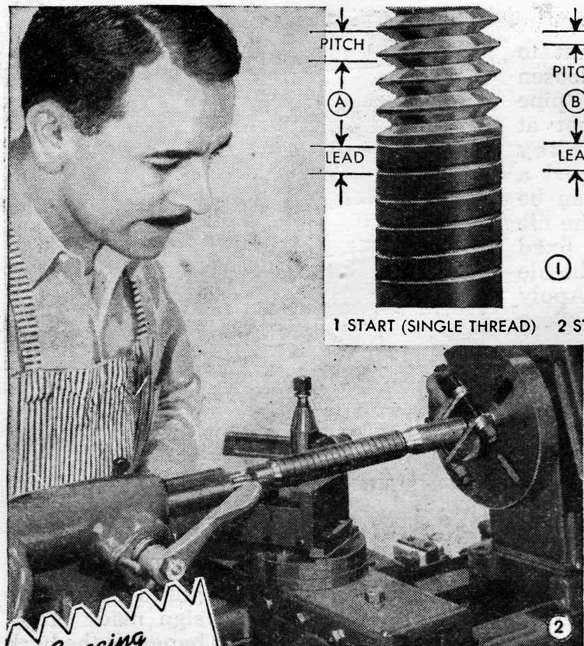
Printed forms that are too small to be held by the regular grippers on a job press will stay in position when these gripper fingers are used. They can be formed from light sheet metal cut and bent as shown in the circular detail. Dimensions are governed by the size of the grippers and the size of the forms. —George T. Clayton, Los Angeles, Calif.



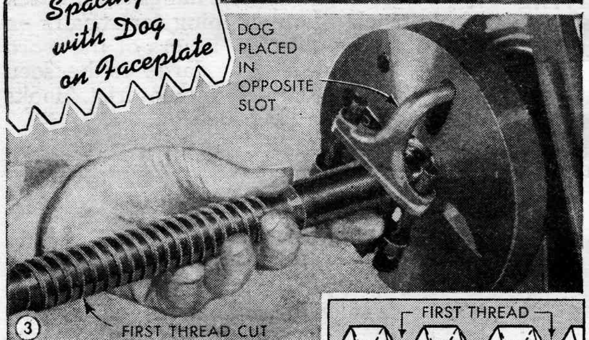


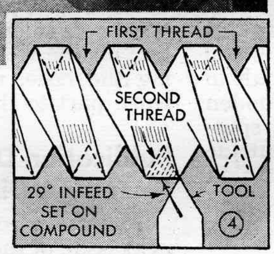
MULTIPLE

By Sam Brown



Spacing with Dog on Faceplate





SPACING MULTIPLE THREADS BY PLACING DOG IN VARIOUS SLOTS IS USEFUL METHOD OF WORKING. PHOTOS SHOW DOUBLE THREAD. THREE STOPS ARE USED FOR TRIPLE THREAD

WHEN you want fast travel with a fine thread, you use a multiple thread, breaking the original lead distance into two, three or more threads as desired. The cap of a fountain pen is a good example—you want the cap to screw on quickly and a coarse thread is not satisfactory. Focusing devices on cameras and binoculars offer another everyday example of the use of multiple threads.

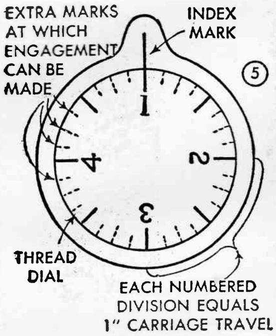
General terms: Fig. 1 illustrates the two terms used to describe any thread—lead and pitch. Lead is the distance the thread advances in one revolution; pitch is the distance between threads. In a single thread, detail A, Fig. 1, lead and pitch are the same. The second detail, B, shows the original lead broken into two threads so that the pitch is one half the lead. Detail C shows a quad or 4-start thread, where the pitch is one fourth of the lead. In all multiple

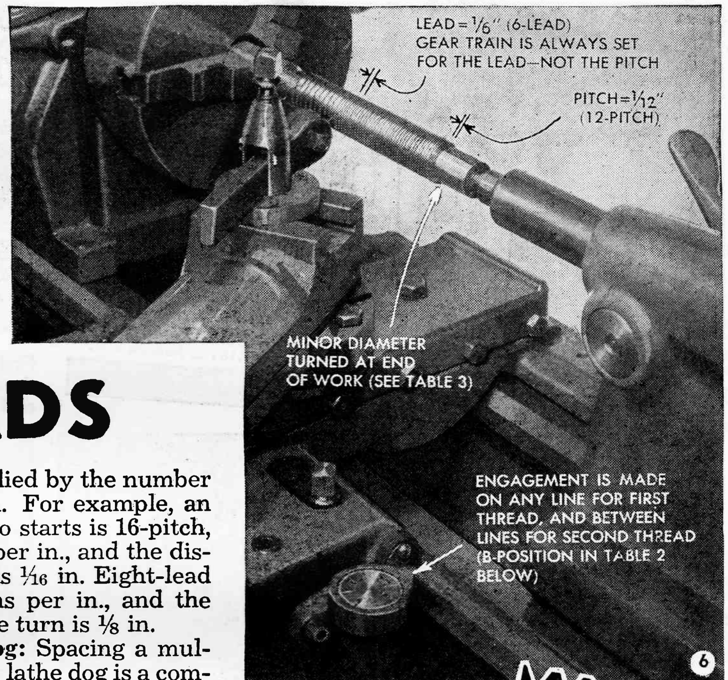
TABLE 1 USEFUL RANGE OF MULTIPLE THREADS

NUMBER OF STARTS	LEAD (NUMBER OF TURNS PER INCH OF SINGLE THREAD)																						
	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	8	9	10	11	11½	12	13	14	16	18	20
2 STARTS	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	22	23	24	26	28	32	36	40
3 STARTS	4½	6	7½	9	10½	12	13½	15	16½	18	19½	21	24	27	30	33	34½	36	39				
4 STARTS	6	8	10	12	14	16	18	20	22	24	26	28	32	36	40								
5 STARTS	7½	10	12½	15	17½	20	22½	25	27½	30	32½	35	40										
6 STARTS	9	12	15	18	21	24	27	30	33	36	39												
8 STARTS	12	16	20	24	28	32	36	40															
10 STARTS	15	20	25	30	35	40																	
12 STARTS	18	24	30	36																			

FIGURES IN BODY OF TABLE GIVE PITCH OF THREAD (NUMBER OF THREADS PER INCH)

NOTES
1. FIGURES IN SHADED BOXES CAN BE CUT WITH USE OF THREAD DIAL
2. FAST LEADS FROM 1½ TO 3½ ARE NOT USUALLY SHOWN ON GEAR CHARTS BUT CAN BE SET UP WITH REGULAR GEARS





THREADS

threads, the lead multiplied by the number of starts gives the pitch. For example, an 8-lead thread having two starts is 16-pitch, or there are 16 threads per in., and the distance between threads is 1/16 in. Eight-lead means there are 8 turns per in., and the distance advanced in one turn is 1/8 in.

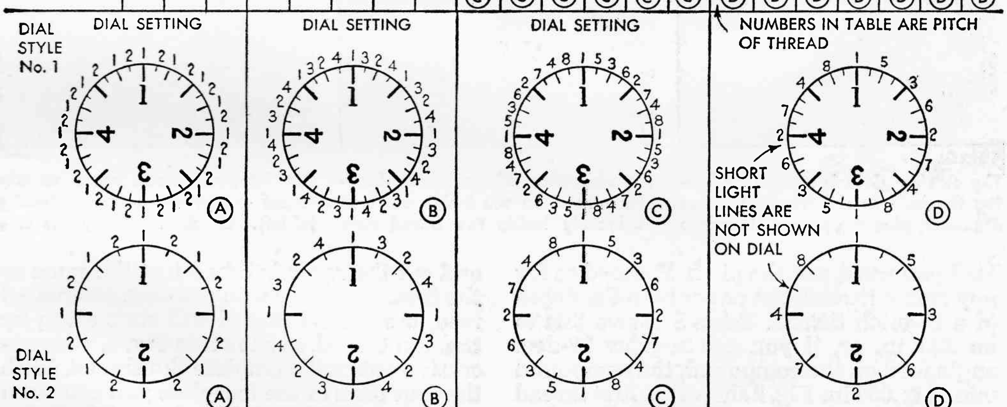
Spacing with lathe dog: Spacing a multiple thread by using the lathe dog is a common method of working. Suppose, for example, you want to cut a double thread of 8-lead and 16-pitch. Set up the gear box or gear train for the lead. Always gear for the

PHOTO SHOWS HOW THE THREAD DIAL IS USED TO CUT A DOUBLE THREAD OF 6-LEAD, 12-PITCH

Using the Thread Dial

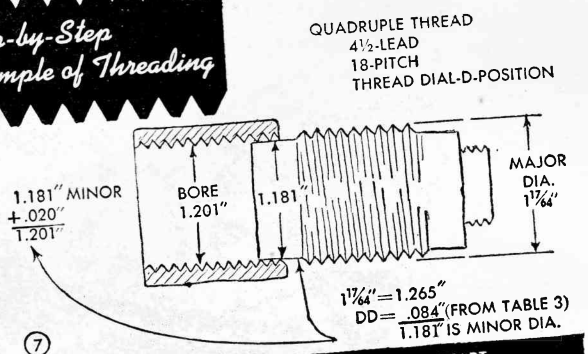
TABLE 2 THREAD DIAL SETTING FOR MULTIPLE THREADS

STARTS	LEAD																				
	4	12	20	2	6	10	14	18	3	5	7	9	11	13	1½	2½	3½	4½	5½	6½	11½
2 STARTS	8 (A)	24 (A)	40 (A)	4 (B)	12 (B)	20 (B)	28 (B)	36 (B)	6 (C)	10 (C)	14 (C)	18 (C)	22 (C)	26 (C)	3 (D)	5 (D)	7 (D)	9 (D)	11 (D)	13 (D)	23 (D)
4 STARTS	—	—	—	8 (B)	24 (B)	40 (B)	56 (B)	72 (B)	12 (C)	20 (C)	28 (C)	36 (C)	44 (C)	52 (C)	6 (D)	10 (D)	14 (D)	18 (D)	22 (D)	26 (D)	46 (D)
8 STARTS	—	—	—	—	—	—	—	—	24 (C)	40 (C)	56 (C)	72 (C)	88 (C)	104 (C)	12 (D)	20 (D)	28 (D)	36 (D)	44 (D)	52 (D)	92 (D)

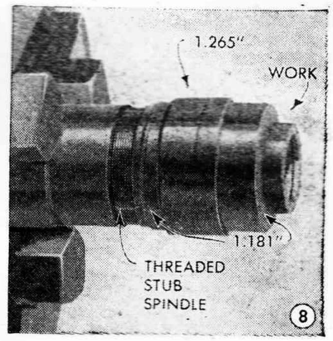


FOR DOUBLE THREAD, ENGAGE AT ANY POINT MARKED 1 (ON OUTSIDE RIM OF DRAWING) FOR FIRST THREAD AND AT ANY POINT MARKED 2 FOR SECOND THREAD. IF A QUAD THREAD IS DESIRED, ENGAGE AT 1-2-3-4 FOR THE RESPECTIVE THREADS. FOR 8 STARTS, ENGAGE AT 1-2-3-4-5-6-7-8 AS MARKED.

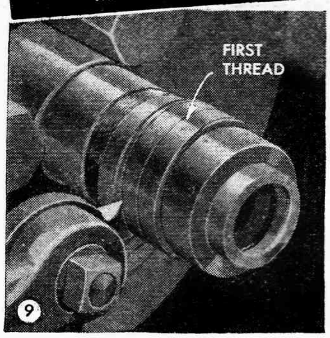
Step-by-Step Example of Threading



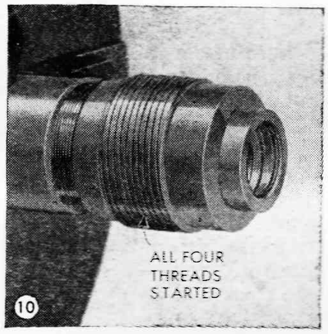
MAKE A ROUGH DRAWING LIKE THIS BEFORE YOU START



First the work is mounted on a threaded stub spindle. Then major and minor diameters are turned

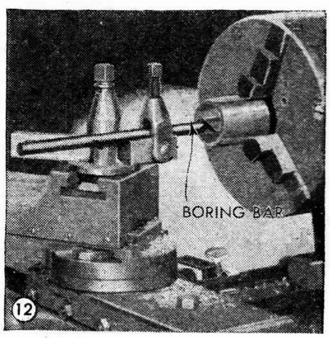


Set the gear train for 4½-lead and make the first cut using the thread dial, as is indicated by D in Table 2

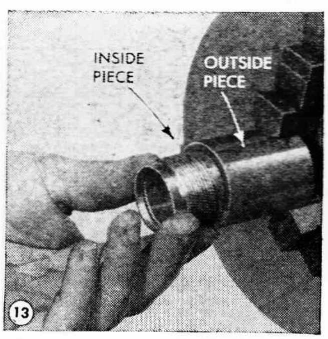


Engaging the dial as outlined produces four starts which are finally deepened to finish the threads

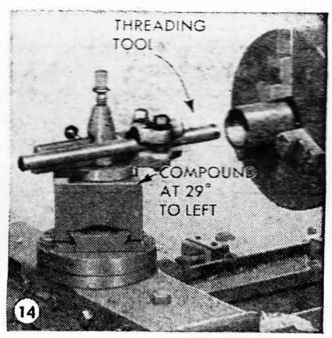
Note that the compound is in the 29-deg. position, swung to the right. Always use plenty of cutting oil



The outside piece is started by boring the hole to the required minor diameter, plus the proper clearance



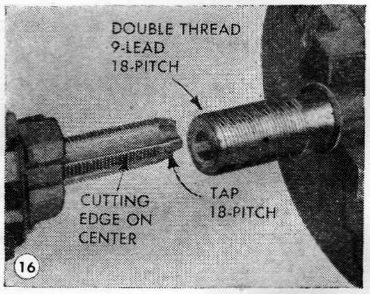
The clearance allows minor diameter turned on the inside piece to fit loosely inside the bored hole

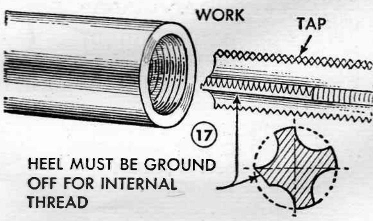


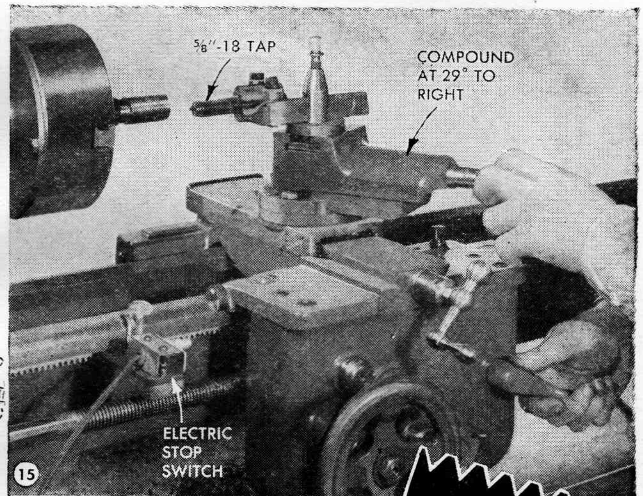
Cut internal thread same as external except compound is swung to left. Check frequently for size

lead you want, not the pitch. Proceed as for any single thread, but cut only to the depth of a 16-pitch thread. Table 3 shows this to be .047 in. or, if you use regular 29-deg. angle feed on the compound, the compound infeed is .054 in. Fig. 2 shows the first thread being cut. After cutting the first thread to full depth, back up the tailstock and fit the tail of the dog in a slot opposite to the one used for the first thread, Fig. 3. Back the compound to the original starting position and cut the second thread just the same as the first. If you are using 29-deg. compound feed, the second thread will start along by the first thread, as shown in Fig. 4, and successive cuts will complete the thread. With the four slots of the faceplate you can cut a quad thread. If a triple or 3-start thread is desired, tap three equally spaced holes in the faceplate for studs and use a straight-tail dog.

Using thread dial: Most small lathes are







IF LATHE IS GEARED FOR ½ THE PITCH OF A TAP THE TAP WILL CUT A DOUBLE THREAD

How to Use Taps

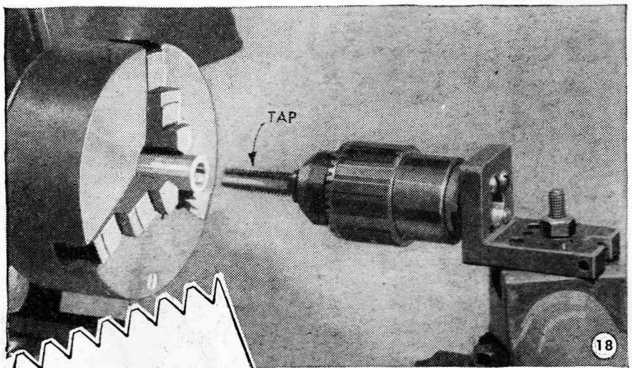
fitted with a thread dial, and this can be employed for a wide range of multiple threads. Table 1 shows the complete useful range of multiple threads, with pitches that can be cut using a thread dial indicated by shaded boxes. A typical dial is shown in Fig. 5. In addition to the engagement points marked, you can also engage at the points indicated by the dotted lines. Table 2 shows threads that can be cut and dial settings for cutting them. Two different standard types of dials are shown. The table is based on an 8-pitch lead screw, standard on most small lathes.

As an example of threading, consider Fig. 6. This shows a double thread of 6-lead, 12-pitch being cut. Refer to Table 2 and you will note this requires engagement similar to the B position. Gear for 6-lead and cut the first thread by engaging the dial at any point marked 1 on the outside rim of the drawing. Without changing the compound infeed, engage at any point marked 2. That's your double thread. Make successive cuts at each compound setting until the double thread is complete. With this method, no attention need be given the minor diameter since you simply go on turning until the crest of thread is sharp. However, as a matter of convenience, it is always good practice to turn the minor diameter. This can be determined by noting the double depth of thread in Table 3 and subtracting this figure from the full diameter of the work.

How thread dial works: It's a good idea to understand just why the thread dial splits the thread. On any such dial, numbered divisions indicate 1 in. of carriage travel. One half of a numbered division is ½ in. of carriage travel, etc. Fig. 5 shows that the dial can be subdivided to ⅛ in. of

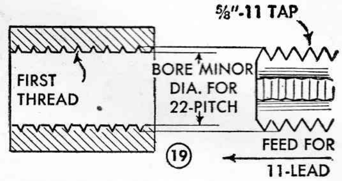
TABLE 3 DEPTH OF THREADS

Pitch	Pitch Inches	Single Depth of Thread	Double Depth of Thread	Infeed at 29 Degrees
3	.333	.253	.506	.292
4	.250	.190	.380	.216
4½	.222	.169	.338	192
5	.200	.152	.304	.174
6	.167	.127	.254	.146
7	.143	.108	.216	.124
7½	.133	.101	.202	.114
8	.125	.095	.190	.108
9	.111	.084	.168	.096
10	.100	.076	.152	.087
10½	.095	.072	.144	.082
11	.091	.069	.138	.079
12	.083	.063	.126	.072
13	.077	.059	.118	.068
13½	.074	.058	.116	.067
14	.071	.054	.108	.062
15	.067	.051	.102	.057
16	.063	.047	.094	.054
16½	.061	.046	.092	.053
18	.055	.042	.084	.047
19½	.051	.039	.078	.045
20	.050	.038	.076	.043
21	.048	.036	.072	.041
22	.045	.035	.070	.039
23	.043	.033	.066	.037
24	.042	.032	.064	.036
25	.040	.030	.060	.035
26	.038	.029	.058	.034
27	.037	.028	.056	.032
28	.036	.027	.054	.031
30	.033	.025	.050	.029
32	.031	.024	.048	.027

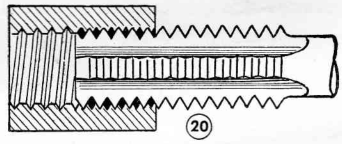


More on Use of Taps

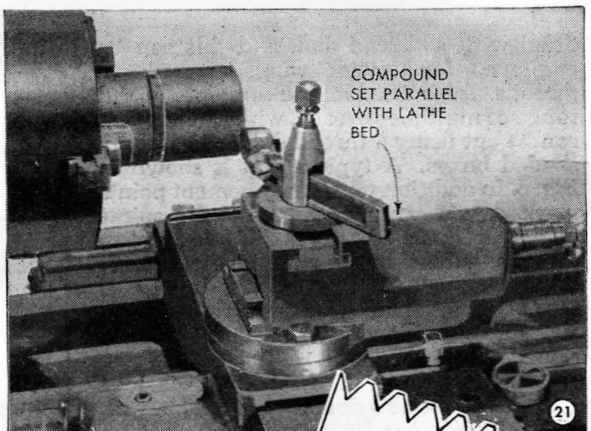
REGULAR TAPPING TECHNIQUE CAN BE USED FOR SMALL HOLES. USE A TAP OF THE LEAD YOU WANT. SPLIT THE THREAD BY USING THREAD DIAL



FIRST STAGE OF 11-LEAD 22-PITCH DOUBLE THREAD



SECOND STAGE—THREAD DIAL IS ENGAGED TO SPLIT AN 11-LEAD THREAD. RESULT IS DOUBLE THREAD OF 22-PITCH



Setting Threads with Compound

IN THIS SETUP, THREAD DIAL IS USED AS FOR SINGLE THREAD. THE THREAD IS SPLIT BY MOVING THE COMPOUND BACK ½ OR ⅓ OF THE LEAD DISTANCE FOR DOUBLE OR TRIPLE THREAD RESPECTIVELY

carriage travel. Now, consider the previous example of a 6-lead thread. In 1 in. of carriage travel, the tool will engage at the first and the sixth threads. At ½ in. of carriage travel, the tool will "hit" the third thread, but if you engage at ¼ in. of carriage travel, the tool will hit at 1½ threads and will split the thread. Engagement at ⅛ in. of carriage travel will again split it producing a quad thread. This is as far as this particular lead can be split, but other leads, C and D positions, Table 2, can be split into 8 starts. Triple threads cannot be cut because the number of striking points (32) cannot be divided by 3.

Example of threading: Figs. 8 through 14 show both external and internal thread cutting for the work detailed in Fig. 7. The external thread usually is cut first because this commonly carries the major diameter. In boring for the internal thread, use Table 3 to find minor diameter and then add to this about one fourth of the double depth of thread. Always allow this clearance as a full thread cannot be cut. In boring the hole oversize, you are not presetting a loose thread because the fit of any thread comes from the angular contact, not the crests.

How to use taps: The use of taps for cutting single threads is an old lathe trick, and it can be used just as well for multiple threads. What happens here is that you have a multiple-point threading tool which will cut two, three or more threads in one operation. The example, Fig. 15, shows an 18-pitch tap being used. If you want to cut a double thread, the gear box or train is set for 9 threads, not 18. Engagement of the thread dial is normal for a 9-thread and the tap catches both threads of the double thread in one operation. Successive infeeds are made at the compound until the thread is complete, Fig. 16. With the same tap, a triple thread would be cut with the gear train set for 6-lead; a quad thread would be cut with gear train set for 4½-lead. In all cases, the pitch is the same as the tap, which in this case is 18-pitch.

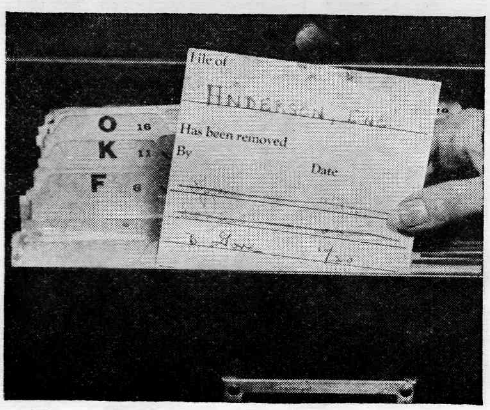
If a tap is used to cut an internal thread, it will be necessary to grind away the heel of the cutting teeth, as shown in Fig. 17, in order to get needed clearance. Taps are not good for heavy cutting—use a light feed and plenty of oil. In this setup, the tap is smaller than the hole in the work and only one set of teeth does the cutting.

Another method of using a tap is shown in Fig. 18. In this instance a tap having the desired lead is used and the thread dial is employed to split the thread. This method is handy for small holes where a single-point tool could not be used. The original tap thread can be split into double or quad thread, but not triple. The example shown in Figs. 19 and 20 uses an 11-thread, or lead, tap. Splitting the 11-lead gives a double thread of 22-pitch. The bore diameter should be for 22-pitch thread, with due allowance for clearance. In this setup, all teeth of the tap cut.

Setting threads with compound: This method is sometimes useful, especially for roughing the thread for 3, 5 and 6 starts which are cleaned up later by chasing with a tap of proper pitch. As shown in Fig. 21, the compound is set parallel. Assuming 6 starts and 4-lead, the thread will be 24-pitch. Gear for a 4-lead and cut a single thread to the depth of a 24-pitch thread, making successive plunge cuts by infeeding the cross slide. Then move the compound back a distance equal to the pitch, in inches, of a 24-pitch thread. Table 3 shows this to be .042 in. Make the second thread and proceed with remaining threads in the same manner. Threads cut by this method may show a slight variation in pitch, but this is equalized readily by running a few chasing cuts with a 24-pitch tap.

Card Indicates Location of File

In locating papers that have been removed from a file case, one firm uses cards that are slipped into the file when a folder is removed. Space is provided on the card for the name of the file, the person who removed it and the date it was taken. Any person seeking papers that are not in the file has only to look at the file card to see who has them.



Clay Used as Balancing Weight Permits Close Adjustment

To balance accurately the weight of an empty container, which is often difficult with the graduated weights on hand, one laboratory worker uses modeling clay. After the container is balanced, it is filled and the contents weighed in the regular manner.

Felt Pad Is Convenient Wiper For Gas Station Attendant

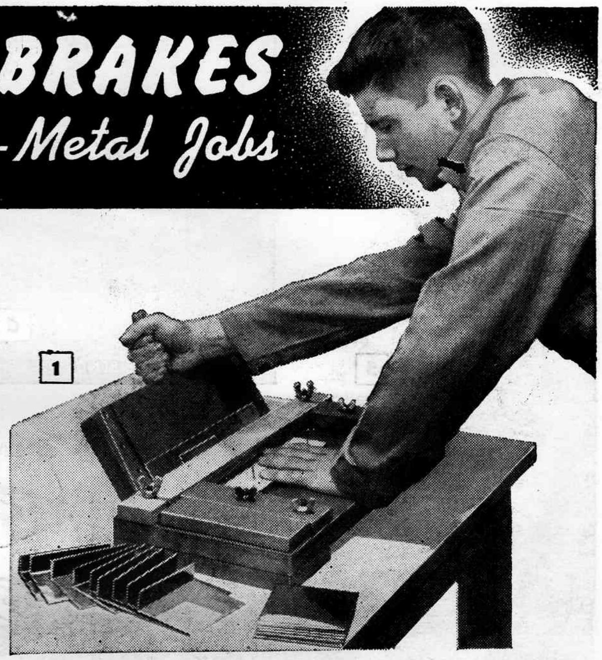
A pad made of several pieces cut from a felt hat is handy at filling stations for wiping the oil-gauge stick. The leaves are bolted in a clamp that has a hook to fasten to the attendant's belt.

BENDING BRAKES for Your Sheet-Metal Jobs

By Sam Brown

THESE bending brakes will simplify sheet-metal fabrication. Two designs are described, both capable of bending 24-ga. galvanized iron the width of the brake, or heavier metal when the bend is not at full 12-in. capacity. Design No. 2, Fig. 8, while more difficult to make, is somewhat superior in that it offers stronger construction and also permits partial (tab) and reverse bends which are not possible with No. 1 design.

Design No. 1: Both designs are of the folding-leaf variety, and the general features of construction are grasped easily from Fig. 3. The essential feature is that the center of hinge pin must line up exactly with the meeting edges of folding leaf and table. This is diagramed in Fig. 4. The working of the brake is shown in Fig. 1, the metal being clamped under the forming bar and then bent by pulling up on the folding leaf. The forming bar should be notched for easy removal. It is positioned exactly for duplicate work by means of two sliding



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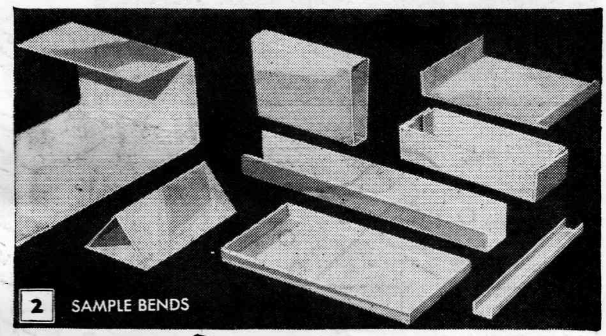
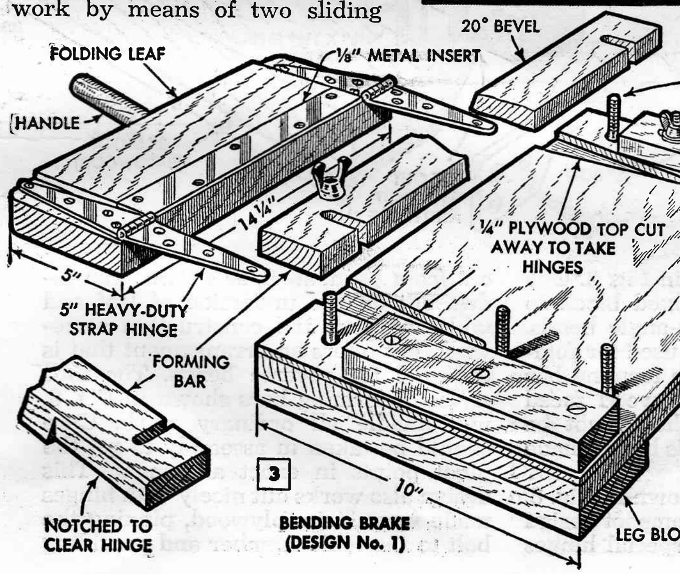
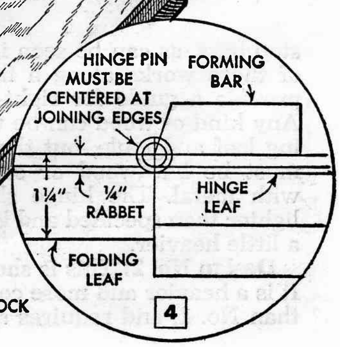
BENDING METAL TILE—ONE OF MANY JOBS POSSIBLE WITH BRAKE



2 SAMPLE BENDS



3 BENDING BRAKE (DESIGN No. 1)



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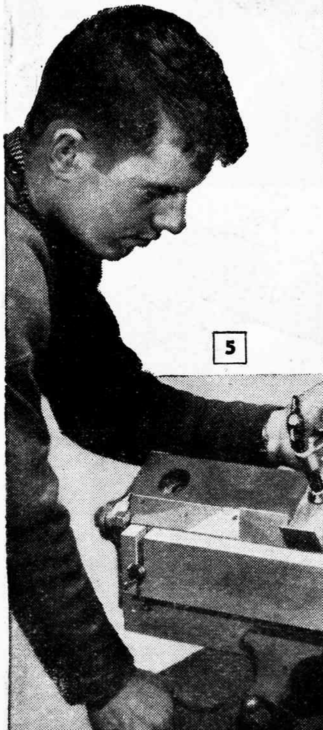
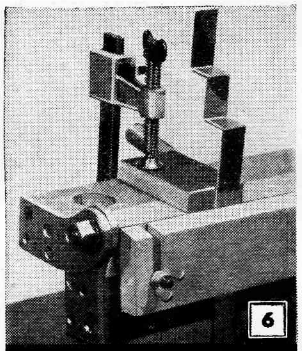
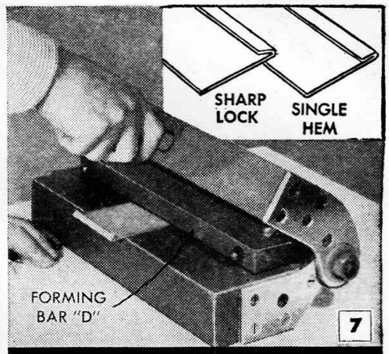


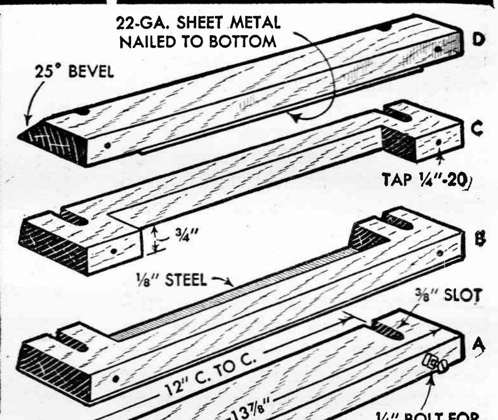
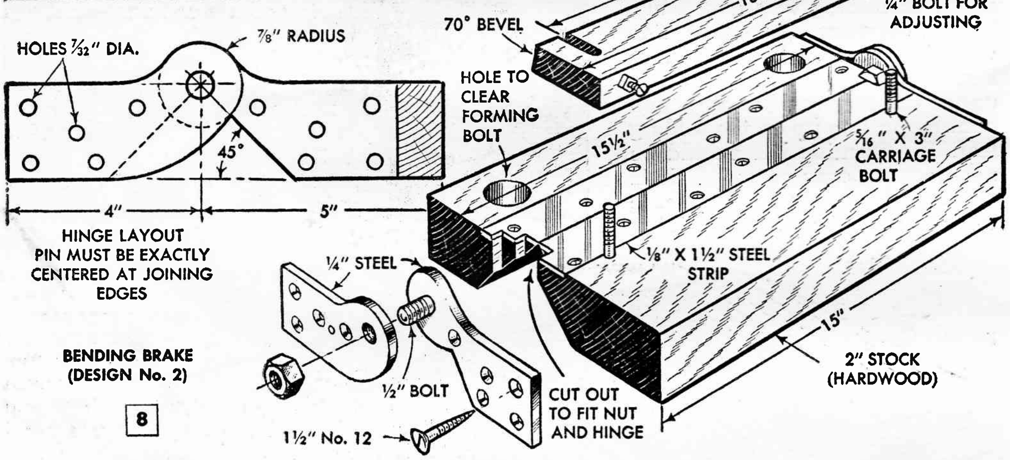
USING No. 2 BRAKE TO MAKE TAB BEND



REVERSE BENDS



SHARP LOCK OR SINGLE HEM

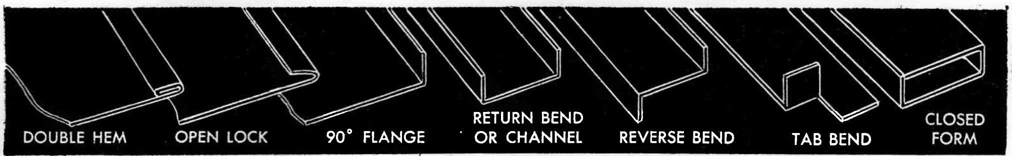



BENDING BRAKE (DESIGN No. 2)

8

stop bars, as can be seen in Fig. 3. One of these works along a fixed block to provide a guide for right-angle bends. Any kind of wood can be used for folding leaf and table, but the forming bar must be hardwood or softwood faced with metal. The hinge should not be lighter than specified and is better made a little heavier.

Design No. 2: This is shown in Fig. 8. It is a heavier and more compact design than No. 1, and requires special hinges cut from ¼-in. steel, as shown. The 45-deg. cut on the underside of leaf and table weakens the construction somewhat, but offers an arrangement that is essential for reverse bends. The four styles of forming bars shown in Fig. 8, will handle all ordinary work. Care should be taken in assembly to get the pivot points in exact alignment. This design also works out nicely with hinges made from ¾-in. plywood, pinning the bolt to the table member and providing



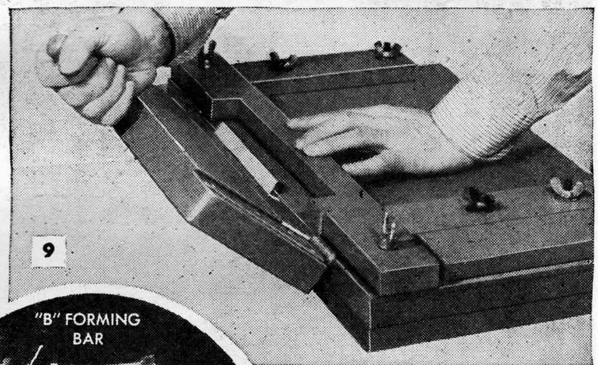
a brass bushing in the other to prevent wear.

Tab and reverse bends: Tab and reverse bends are worked on No. 2 brake by mounting the brake on edge in a vise and folding the leaf all the way back. A block of wood is clamped to the folding leaf and becomes the forming member. Fig. 5 shows the operation on a tab bend; Fig. 6 shows the same setup for reverse bends. Neither can be done on the No. 1 brake.

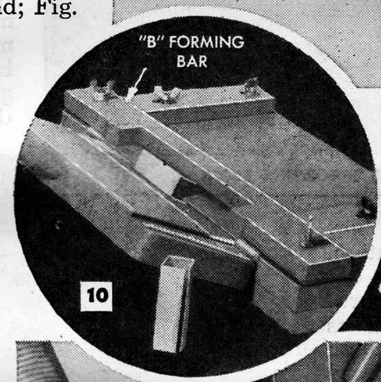
Standard operations: The sharp lock, Fig. 7, is made by using the brake in a normal position with a style D forming bar. This bend is used frequently for fastening two pieces of metal together. If the bend is at full capacity (12 in. long), it is best to form it to a flange with the stronger A or B bar and then complete the lock with the sharp-edge D bar. The single sharp lock when pressed tightly together in a vise or by hammering becomes the single hem or bend, as shown. If the single bend is hemmed again, it makes a double hem. At full capacity on a narrow hem less than ¼ in. wide, this bend offers the ultimate strength and accuracy test for your brake—a poorly made brake will fail in this double-hem operation.

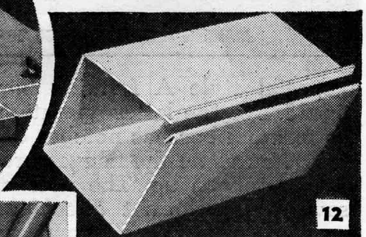
Large return bends or channels are made with the standard forming bar (style A), and offer no difficulties. Smaller channels are made with the B bar, which permits working as small as ⅛-in. cross section. This operation is shown in Fig. 9. The B bar is used also for bending small closed forms, as shown in Fig. 10. As can be seen, the brake does not fully close the form on the final bend, but it is close enough so that a little springing by hand will complete it. Style C bar offers another way of working small closed forms, as shown in Fig. 11. Complete closure is possible with this bar, but the work must be resprung to remove it from the bar. When the closed form has a seam joint, Fig. 12, the final bend, as in Fig. 11, is really a reverse bend and is best worked by the method shown in Fig. 5. However, the reverse caused by the narrow flange is slight and does not materially affect the bending operation. Fig. 13 shows how the seam joint is closed by hammering. This is not an easy joint to make and should be practiced before you attempt it on finished work.

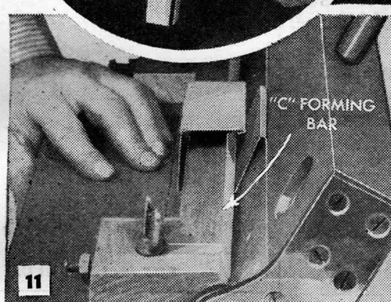
Box bends: One of the most used forms of sheet-metal work is the simple square box. Like its companion in wood, it can be made a dozen different ways. Simplest way is to cut out the corners and then bend the work over a forming block, Fig. 14, or over

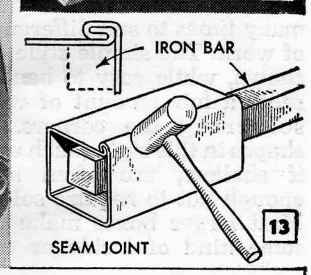


MAKING A CHANNEL WITH STYLE "B" FORMING BAR

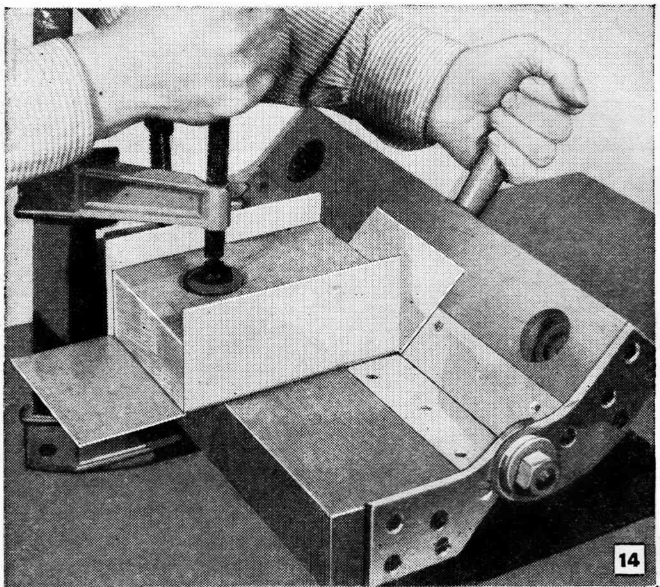








SEAM JOINTS ON SMALL CLOSED FORMS CAN BE MADE WITH "B" OR "C" BARS

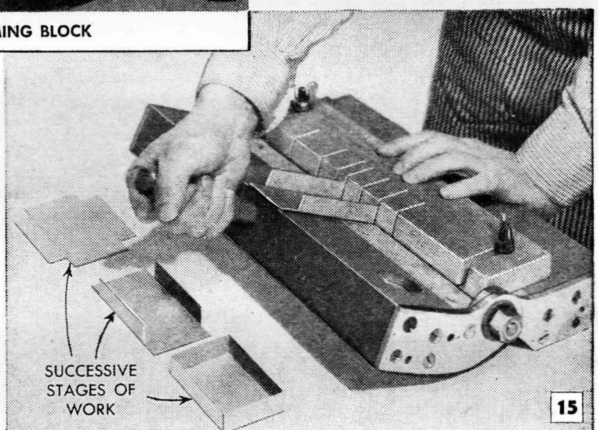


MAKING A BOX WITH USE OF FORMING BLOCK

flange which can be riveted or soldered to the sides (a sample is shown in Fig. 2), and this style is made easily by first forming the tabs, working as shown in Fig. 5, and then bending the sides over a forming block.

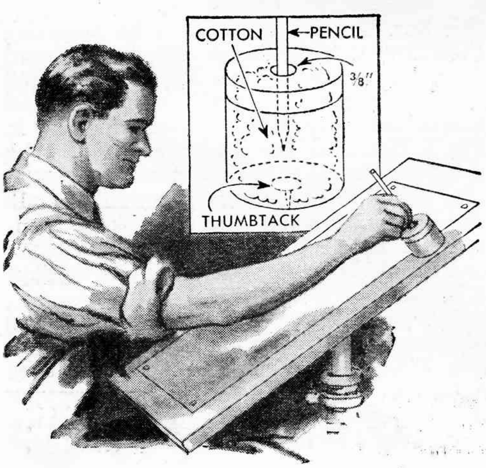
Work capacity: Work capacity of both brakes described is about 12 in. No. 2 design will work satisfactorily up to about 18-24 in. No. 1 brake will not handle metal thicker than 24 ga. (usual furnace-pipe weight as obtained at tin shops); No. 2 brake will work 22-ga. material. Both will handle much thicker metal if the bend is short. Dimensions given are working specifications and can be varied.

a special style A forming bar, Fig. 15. For the latter operation, the forming bar has notches cut to accommodate the flanges previously turned up. The notches (saw kerfs) do not affect the bend, and one bar can be notched many times to suit different sizes of work. The simple style of box shown, while easy to bend, presents a fair amount of work in soldering the corners. Some shapes in this style (such as lids), if shallow, are often strong enough not to require soldering. Most larger boxes make use of some kind of inside or outside



BOX MADE WITH USE OF NOTCHED "A" BAR

Absorbent Cotton Stuffed in Covered Box Cleans Drawing Pencil



Finding a way to clean the point of a pencil after sharpening it is always a problem for the draftsman. One solution is to fill a small, covered box with absorbent cotton. Cut a hole in the top large enough for the pencil. To clean the point, insert it in the hole and rotate in the cotton. This will remove powdered lead.

"Manicure" for Small Commutators

Emery boards, which are strips of fine sandpaper bonded together to form a resilient blade shaped like a nail file, are well suited to the job of cleaning, smoothing and polishing the commutators of small generators and motors. Because of the low cost, a new one can be used for each job.

Paul H. Woodruff, Chicago.

Checking √ √ √ for Refrigerator Ills

Much of the repair work done on domestic refrigerators requires special tools and equipment, but if you know how a refrigerator works—and why—there are simple maintenance routines that you can follow to keep the unit in condition and make frequent calls for a serviceman unnecessary

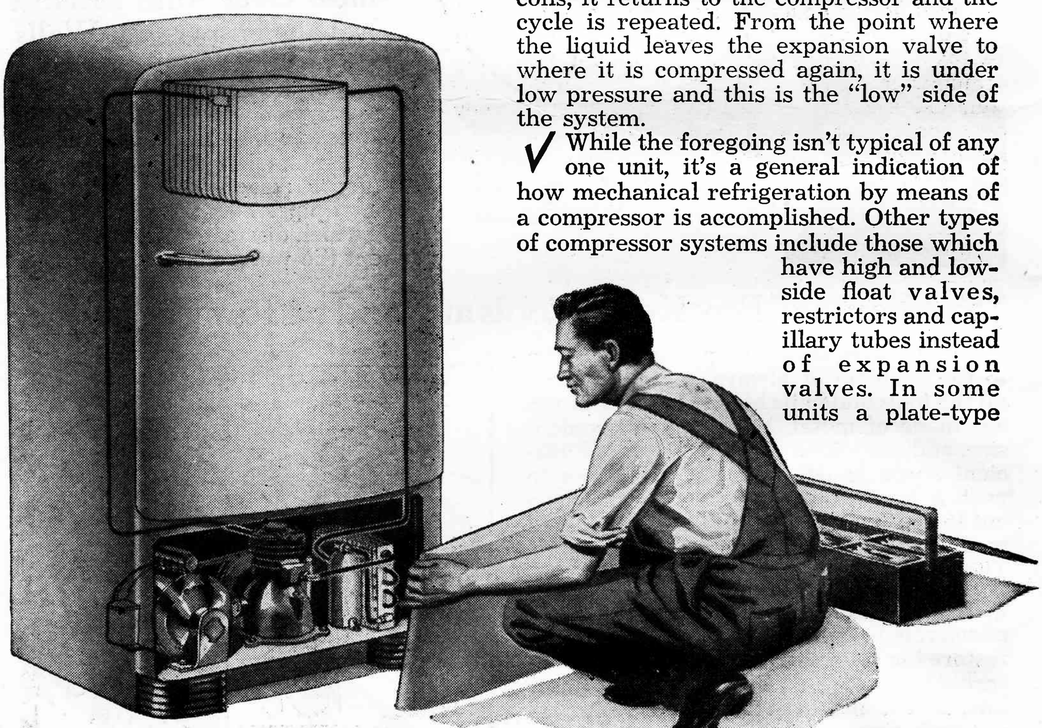
By John F. Shrock

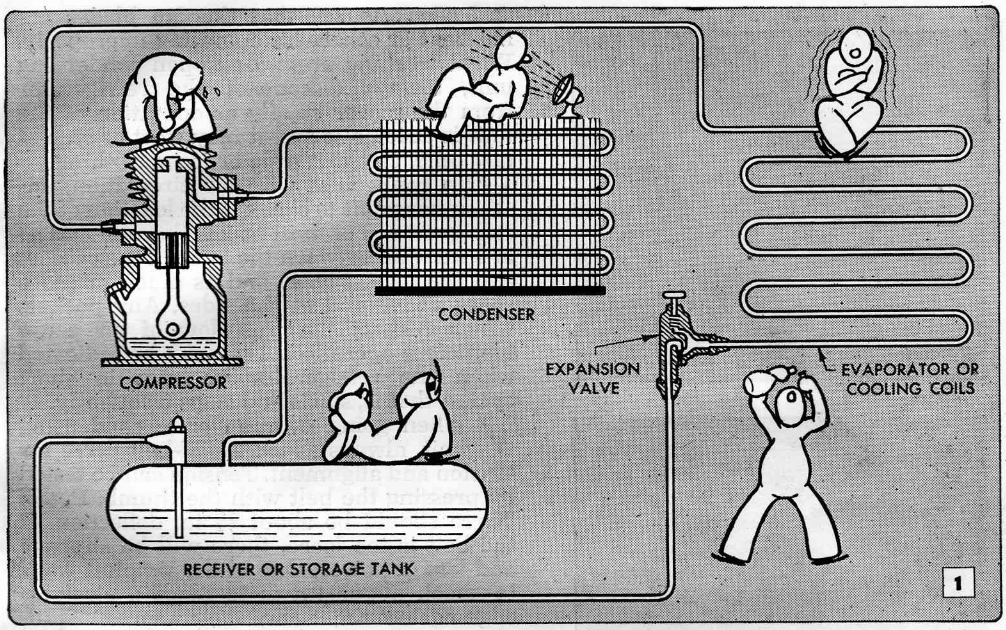
√ Like any fairly complex mechanism, a mechanical refrigerator must be serviced properly and maintained if it is to deliver the peak performance for which it was designed. Some repairs, which do not require "opening" or "pumping down" the system, are fairly easy to make and can be done with ordinary tools. (Opening or pumping down a system refers to the removal, or partial removal, of all refrigerant to get at some particular part. To do this, special equipment is needed and generally it is better to have a serviceman do the work. Also, when a system is opened, you may be handling gases that are toxic and, therefore, dangerous.) Only repair and maintenance that do not require opening the system are discussed here.

√ Fig. 1 shows schematically how a refrigeration system works. Warm, low-pressure refrigerant vapor is admitted to the compressor where its temperature and pressure are raised and then it passes to the condenser where the vapor is liquefied and partially cooled. From here the liquid goes to the receiver, which functions as a storage tank to supply refrigerant according to the fluctuating demands of the system. At the expansion valve the liquid is metered and admitted into the evaporator or cooling coils; these are the coils that generally encase the ice-cube trays and also refrigerate the interior of the cabinet.

√ From the point where the refrigerant is compressed to where it passes through the expansion valve or a similar metering device, it is under high pressure and this generally is referred to as the "high" side of the system. At the expansion valve the pressure and temperature are reduced so that the liquid will absorb heat and "boil," thereby evaporating and cooling the interior of the refrigerator. After the refrigerant passes through the cooling coils, it returns to the compressor and the cycle is repeated. From the point where the liquid leaves the expansion valve to where it is compressed again, it is under low pressure and this is the "low" side of the system.

√ While the foregoing isn't typical of any one unit, it's a general indication of how mechanical refrigeration by means of a compressor is accomplished. Other types of compressor systems include those which have high and low-side float valves, restrictors and capillary tubes instead of expansion valves. In some units a plate-type



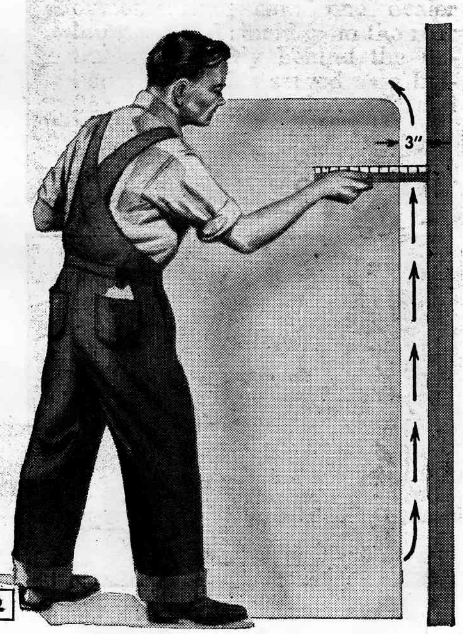


In brief, here's what happens during a compression refrigeration cycle: Refrigerant is raised to a high-pressure gas in the compressor, liquefied in the condenser, stored in the receiver, metered at the expansion valve, "boiled" in the evaporator to cool the interior of the cabinet, and returned to the compressor to complete the cycle

condenser is combined with the receiver and is air-cooled instead of being the fin-and-tube type, Fig. 4, that is cooled by a fan.

✓ To start and stop the unit when refrigeration is needed, there is a system of automatic controls. Usually these are switches or relays that are operated by temperature or pressure, and if they do not function properly, they should be adjusted or replaced by a serviceman. Sometimes adjustments can be made by referring to instruction sheets pasted inside the cover of the switch box. However, first check the electrical current to be sure that it is supplying power and test the motor for proper operation. When possible, also check the wiring for shorts, grounds and continuity. If the unit is of the "hermetic" type, the motor and compressor are sealed in a housing and require replacement as a unit if defective in operation. The "open" unit has the motor connected to the compressor by a V-belt drive. "Semihermetics" are a combination of the open and hermetic types, having a sealed compressor that is direct-connected to the motor. Any of these types can have either a reciprocating compressor, which has pistons that function like those in an automobile engine, or a rotary compressor that is like a positive-action pump.

✓ An efficient machine is one that's clean, and a condensing unit (compressor, condenser, receiver, metering device and evaporator) is no exception. Accumulations of dust, dirt and oil act as insulation and prevent proper air circulation and removal of heat from the unit. This is especially true of the condenser. Both the fin-and-tube type and the plate condenser should be cleaned with a brush to remove any accumulated dirt, Fig. 4. With the fin-type condenser, be sure that the passages between the fins are free of obstructions



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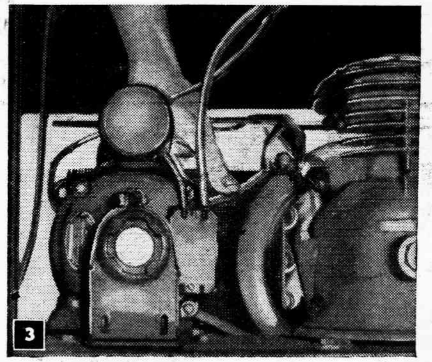
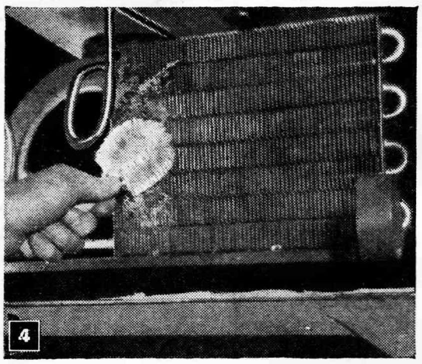
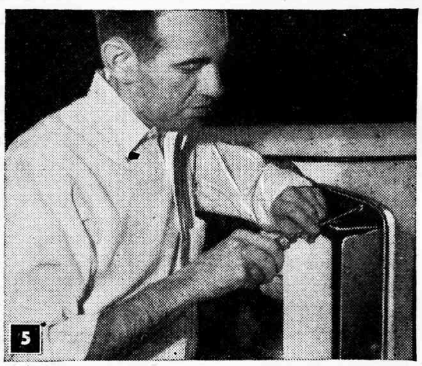
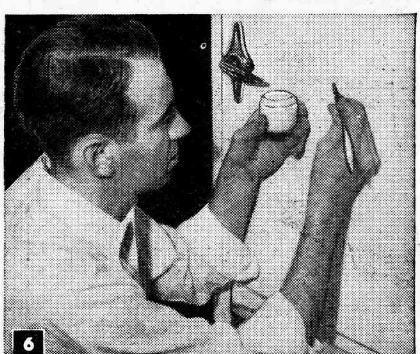








and check to see that the fan blades are not bent or otherwise operating improperly. When working around an open condensing unit, always disconnect the refrigerator from the power supply as operation of the unit is automatic and it may start or stop at any time, catching a tie or loose clothing.

✓ In connection with air circulation, another point to check is the location of the refrigerator. For most makes there should be at least 3 in. between the back of the cabinet and the wall, Fig. 2, and as much or more space above and at the sides. Any pockets which restrict the free flow of air cause inefficient operation. This may be indicated when the refrigerator operates in short cycles; that is, starts and stops frequently.

✓ When going over an open condensing unit, always check the V-belt drive for tension and alignment. Tension can be tested by pressing the belt with the thumb, Fig. 3. There should be about ½ in. deflection. If the belt is too loose, there will be slippage and loss of power. One of the simplest ways to check alignment is to place a straightedge against the face of the compressor pulley and see that it is parallel with the face of the motor pulley. When a belt becomes loose or frayed it should be replaced. This is done by loosening the motor-mounting bolts and sliding the motor toward the compressor. After the belt has been replaced, check the new one for tension and alignment, but remember that it will stretch somewhat.

✓ Although most motors do not require frequent oiling, if they run dry they will overheat and burn out bearings. Lubricate the motor according to instructions for the particular type that you have, but do not use too much oil or grease, as this, too, will cause overheating. Be careful not to drop oil on the V-belt as this causes deterioration of the rubber. When testing the drive, tighten all mounting bolts to eliminate a possible cause of excessive vibration.

✓ Sometimes a compressor runs continuously or too long. Some causes for this are an excessive refrigeration load, or food placed in such a way as to obstruct the circulation of air inside the cabinet so that only the space around the evaporator coils is cooled. When placing food in the refrigerator, do not have it above room temperature.

✓ It may be necessary to replace the gasket around the refrigerator door if it becomes loose and allows cold air from inside the cabinet to leak and cause frequent operation of the condensing unit. The gasket can be replaced by removing the screws or loosening the metal flanges that hold it in place, Fig. 5, and inserting new strips. To keep the unit neat appearing, repair chips or scratches with porcelain enamel or glaze, Fig. 6, or use a lacquer. Clean the damaged area before patching.

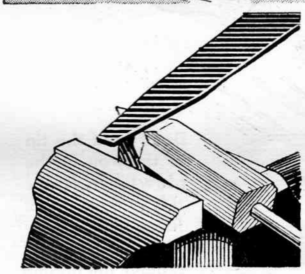
Solder it RIGHT

By Wm. Riederich

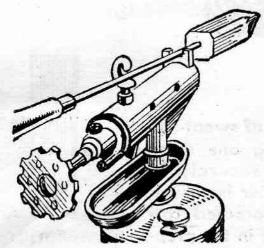
SOLDERING is something like painting—at some time or other nearly everyone finds it necessary or desirable to do the job himself and save both time and money. But in making the average soldered joint the procedure is so simple that there is a tendency to slight some of the details essential to good work. Correctly made, a soldered joint is durable. Take as an example gutter and downspouts, the parts of a building which are exposed to the most severe weathering. If you examine old gutters which have long since eroded to the point where they no longer serve their purpose you will see that in nearly every instance the soldered joints are still sound. The same will be found true of many other kinds of work, parts of which have been joined by soldering.

There are three general requirements for good soldering on average light work. They are, a correctly-tinned iron heated to the proper temperature, the right flux for the job, and a clean surface. Tools required for the ordinary job are a soldering iron or bit, as it is often called, a suitable means of heating the iron or the work quickly and efficiently, a coarse file, sandpaper and a wire brush, a damp cloth and clamps to hold the parts to be joined firmly in place. Of course, if the work is of such a nature that it can be dipped, you will need a ladle of sufficient size. If you use an electrically heated iron exclusively then that disposes of the heating problem.

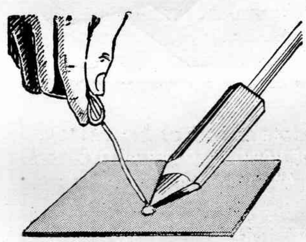
A new iron must be tinned and where the iron is in continuous use frequent retinning is necessary. The chief purpose of tinning is to prevent the formation of copper oxides on the bevels of the tip. Oxides act as an insulator, interfering with rapid heat transfer from the iron to the work. Also an untinned bit won't "take" the solder properly. To tin a new iron or retin one that has been in use, first heat it to a temperature of 500 to 700 deg. F., and clean with a wire brush.



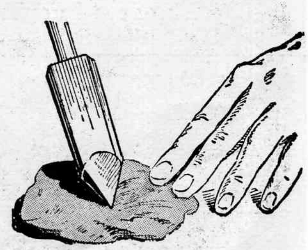
The soldering iron must be cleaned before tinning. Use a coarse file but be careful not to remove more copper than necessary



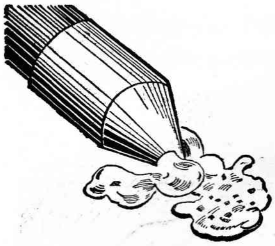
Heat the iron with a blowtorch and watch that it does not get too hot. Always place the iron in the special rack as indicated



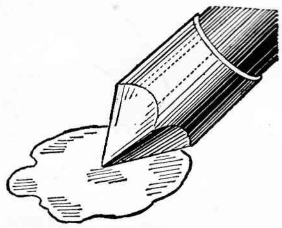
Apply flux to the tip, then coat the four bevels with solder. Build up sufficient solder so that it can be spread out evenly



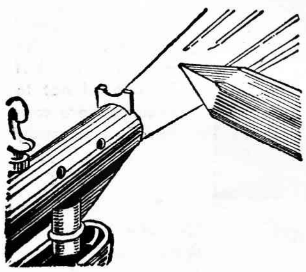
Finally, wipe and twist the tip on a damp cloth to spread patches that remain on the surface. Reheat if necessary



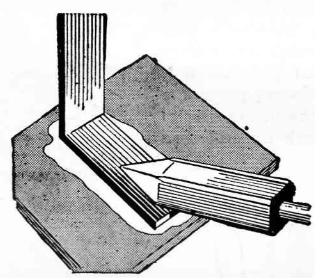
Here's what happens when the iron is too cold. The solder won't flow, but only softens to a waxlike consistency on the surface



But when the iron is heated to just the right temperature the solder flows or "draws" smoothly into joint without piling up



Don't hold the tip of the iron in the blowtorch flame this way. Direct flame will overheat the iron and remove the tinning



Trick of sweat-soldering one small part securely to another is easy if you proceed correctly in the preparation of the work

TABLE I
MELTING POINT OF VARIOUS SOLDER ALLOYS

Tin	Lead	Antimony	Melting Point °F.
0	100	0	618.8
10	90	0	577.4
20	80	0	532.8
30	70	0	491.0
31	67	2	370.4
38	60	2	370.4
40	60	0	446.0
49.25	50	.75	365.0
50	50	0	401.0
60	40	0	368.0
66	34	0	356.0
70	30	0	365.0
80	20	0	388.4
90	10	0	419.0
100	0	0	450.0
0	0	100	1166.

Sometimes it will help to rub the beveled tip on a block of sal ammoniac or ammonium chloride. Usually, however, it is only necessary to apply a rosin flux to the cleaned tip and flow on solder until the entire tip of the iron is covered. Finally, wipe and twist the tip on a damp cloth to spread the solder in a uniform coating.

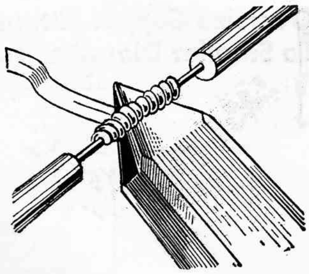
The purpose of a flux is in most cases twofold—to help clean the work and to prevent the formation of oxides which interfere with the flow of solder. There is no all-purpose flux. Different metals require different fluxes. See Table II. Two commonly used fluxes are those made from rosin and from muriatic acid (hydrochloric acid) which has been "cut" with zinc, forming zinc chloride. Most fluxes are available ready to use in both liquid and paste forms. For light work you use the handy wire solder with acid core. The acid flux is contained in the hollow wire so no separate flux is necessary. Solder is also supplied in solid-wire form without the flux and in convenient bars. It comes in varying proportions of lead and tin, and in lead-tin-antimony and lead-tin-bismuth alloys. These are all commonly known as "soft" solders. A 50-50 solder, 50 percent tin and 50 percent lead, is good for average light work, although these proportions do not give maximum strength. Where the greatest holding power and resistance to bending or flexing is called for, a 60-40 solder, 60 percent tin and 40 percent lead, is generally used. Some alloys contain 67 percent tin and 33 percent lead. On the other hand, for special jobs such as soldering pewter, a solder composed of 1 part lead, 1 part tin and 3 parts bismuth is quite commonly used. The melting point of this alloy is only 240 deg. F. See Table I.

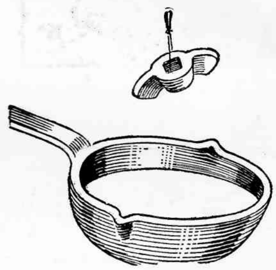
Cleaning of work to be soldered is done with sandpaper or emery cloth, steel wool, files or a wire brush. A power-driven wire wheel speeds up the job of cleaning where the size or shape of the work allows its use. Tinsmiths use reduced solutions of muriatic acid to clean galvanized sheet metal. Hydrochloric acid is an excellent cleaner on some metals, but it is necessary to give the work a thorough washing in a strong solution of soda water immediately after soldering to remove all traces of the acid and stop its corrosive action. Small, irregular-shaped parts, difficult to clean by brushing or by other means, can be dipped in hydrochloric acid. Suspend these on a wire and don't get the acid on your hands or clothing. Avoid breathing the acid fumes at any time. Some metals and certain types of work won't stand the acid bath. Don't use it to clean electrical work.

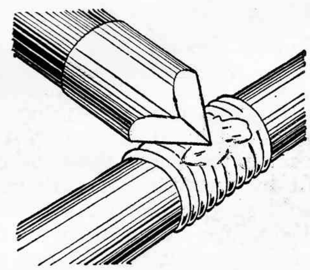
The requirements of the soldering operation are just as simple as actually doing the job. The first of these essentials is that the parts to be soldered shall be heated as nearly as possible to a temperature equal to the melting point of the solder. This assures the strongest bond. On large parts to be joined which contain considerable metal or where the cross sections of the parts are thicker than ordinary, preheating usually is necessary. This ordinarily is done with a blowtorch. Where work must be preheated it is necessary that it be held together with clamps during the heating period, also for a time after soldering until the work cools well below the melting point of the solder. Work soldered in this way should not be subjected to any strain during the cooling period. Where seams, butt joints, corner joints, and curved work are to be joined by soldering, parts must always be carefully fitted beforehand and provision made for holding the assembly in place while soldering. Galvanized sheet-metal parts should always be held together with clamps or by other means. Where you have an intricate assembly requiring soldering several joints in close proximity, use damp or wet cloths to protect the joints already soldered. When using a torch to heat large work preparatory to soldering, heat all the area about the joint but avoid playing the flame directly on the meeting surfaces or on the solder as it is applied. When doing such a job, flux the work first then heat until the flux boils. Apply the solder immediately. When it melts and flows into the joint, withdraw the heat and allow the work to cool to room temperature before removing the clamps or other fasteners that hold the parts together.

Soldering with an iron is much the same as with the torch except that the iron is used to heat the work and melt the solder in a more or less simultaneous operation. A suitable flux is applied to the work which is then heated by applying the iron to the surface. After a preliminary heating, solder is flowed into the joint. On some types of work such as a common butt joint, flowing the solder onto the iron as it moves slowly along the joint will often give the smoothest job. If the temperature is right the molten solder will flow off the iron onto the work in just the right amount.

Making a lap joint on two flat surfaces is done by a method known as "sweat-soldering." First the edges are fluxed and tinned. The tinned surfaces are then placed together and heat applied. Where an acid flux is used wash the work immediately with a solution made by dissolving ½ lb. baking soda in a gallon of water. This will remove all remaining traces of acid and stop any corrosive action on the metal.


When soldering small parts such as a wire splice, hold the iron under the work. The solder will "draw" into the joint neatly


Small parts can be rustproofed by tinning in a bath of molten solder. Attach a wire to work and hold in solder until heated


To repair a cracked tube, wrap it with wire, closely spaced, then heat and run solder until spaces between wires are filled

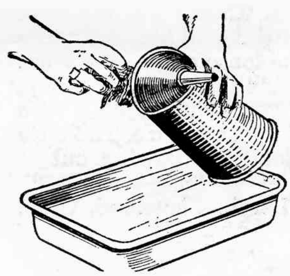

Wash parts to remove the flux. A shallow porcelain-enameled pan is generally the best. Always do a good job of washing

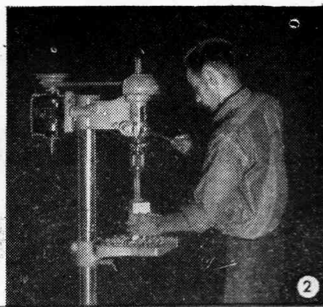
TABLE II
SOLDERING FLUXES USED FOR VARIOUS METALS

Metal	Flux
Iron - - - -	Ammonium chloride or zinc chloride
Steel - - -	Ammonium chloride or zinc chloride
Copper - - -	Ammonium chloride or zinc chloride
Brass - - -	Ammonium chloride or zinc chloride
Bronze - - -	Ammonium chloride or zinc chloride
Gun metal - -	Ammonium chloride or zinc chloride
Nickel - - -	Ammonium chloride or zinc chloride
Lead - - -	Rosin or tallow
Steel (Tinned) -	Zinc chloride or rosin
Galvanized steel	Hydrochloric acid
Zinc - - - -	Hydrochloric acid
Pewter - - -	Tallow
Silver - - -	Chloride of zinc
Gold - - -	Chloride of zinc
Cast iron - -	Chloride of zinc with tallow added
Stainless steel -	Muriatic acid

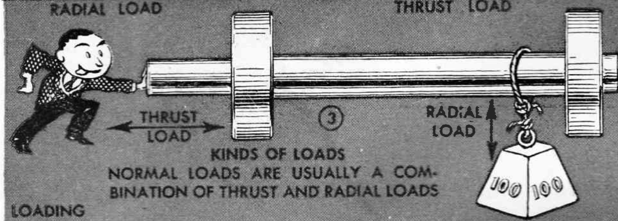
BALL

By Sam Brown

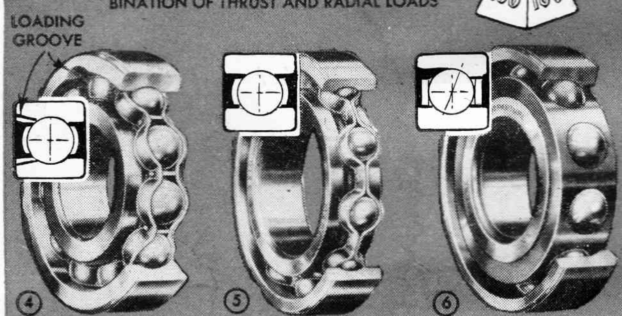
RADIAL LOAD



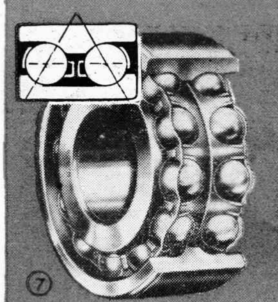
THRUST LOAD



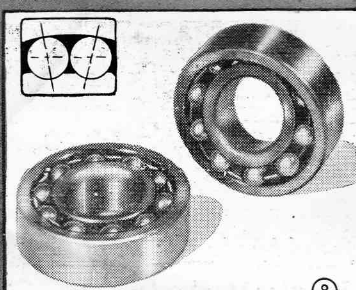
KINDS OF LOADS
NORMAL LOADS ARE USUALLY A COMBINATION OF THRUST AND RADIAL LOADS



SINGLE-ROW RADIAL WITH LOADING GROOVE — SINGLE-ROW RADIAL WITHOUT LOADING GROOVE — SINGLE-ROW ANGULAR CONTACT

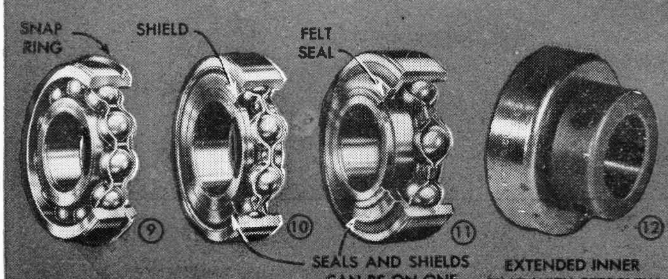


DOUBLE-ROW ANGULAR CONTACT



DOUBLE-ROW SELF-ALIGNING

BEARING TYPES
FIVE OF THE MOST POPULAR TYPES ARE SHOWN ABOVE

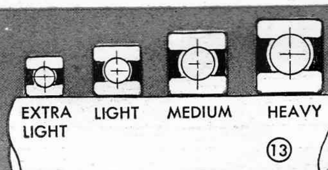


SPECIAL FEATURES

New Departure photos

BECAUSE of excellent manufacturing methods, servicing of ball bearings usually is negligible, but the time does come when a bearing may need replacement or, more often, adjustment. Also, if interested in building your own power tools, ball bearing "know how" is essential for best results.

Kinds of loads: Any bearing is subject to two kinds of loads: thrust and radial. The thrust load is a push or pull parallel with the spindle, Fig. 2; the radial load is across the spindle, Fig. 1; both types of loads are diagrammed in Fig. 3. In most power tools, the load is a combination of the two. The load in a wood lathe, for example, is primarily radial, but it can be seen that in certain operations such as boring and faceplate turning there is a thrust load as well. Some consideration must always be given the nature of the load when selecting bearings for any job.



BORE SIZES

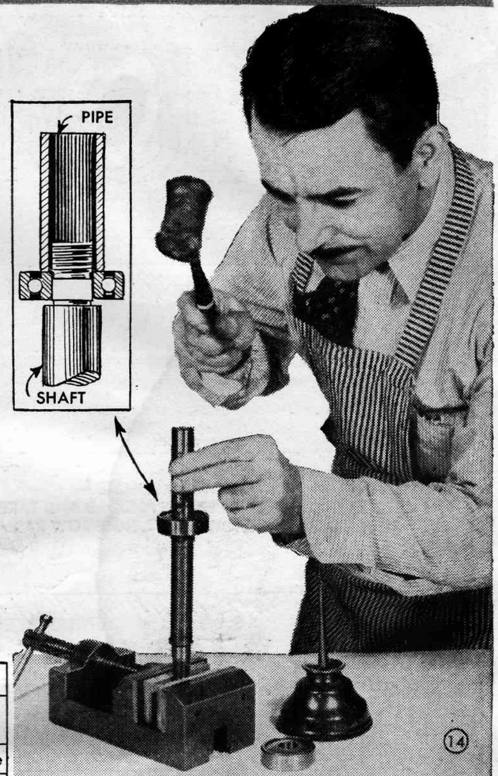
Bore No.	Bore Size in Inches	Average Load*
0	.3937	¼ HP.
1	.4724	¼ or ⅓ HP.
2	.5906	¼ or ⅓ HP.
3	.6693	⅓ or ½ HP.
4	.7874	½ or ¾ HP.
5	.9843	¾ or 1 HP.
6	1.1811	¾ or 1 HP.
7	1.3780	1 or 1½ HP.
8	1.5748	1 or 1½ HP.

*HP. rating is for light series.

BEARINGS

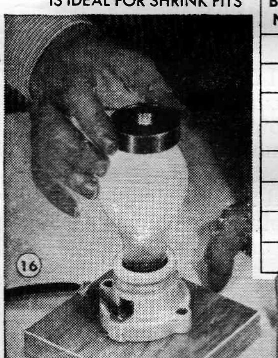
- SELECTING
- SERVICING
- INSTALLING

Bearing types: Although there are hundreds of bearing types, selection for typical power tools usually is confined to three or four popular styles, as shown in Figs. 4 to 8. The single-row radial with loading groove or a similar device, Fig. 4, contains the maximum number of balls which can be introduced into a bearing. It is the strongest type of bearing for a pure radial load, and will also stand up under all average thrust loads. It is never used for thrust alone. The single-row radial, Fig. 5, has fewer balls, but because the outer and inner rings are continuous this bearing has higher thrust capacity. The angular-contact type, Fig. 6, is preferred for jobs where end play must be restricted. This bearing will take a maximum thrust load, but from one direction only unless it is of the type manufactured to take thrust from either direction. The double-row angular contact, Fig. 7, is used where maximum rigidity is desired. The latter is seldom used in pairs because it has practically no "give," indicating that two in tandem would re-



(14) FITTING
BEARINGS SHOULD BE A PRESS FIT ON SHAFT, AND CAN BE FITTED BY DRIVING OR WITH USE OF ARBOR PRESS

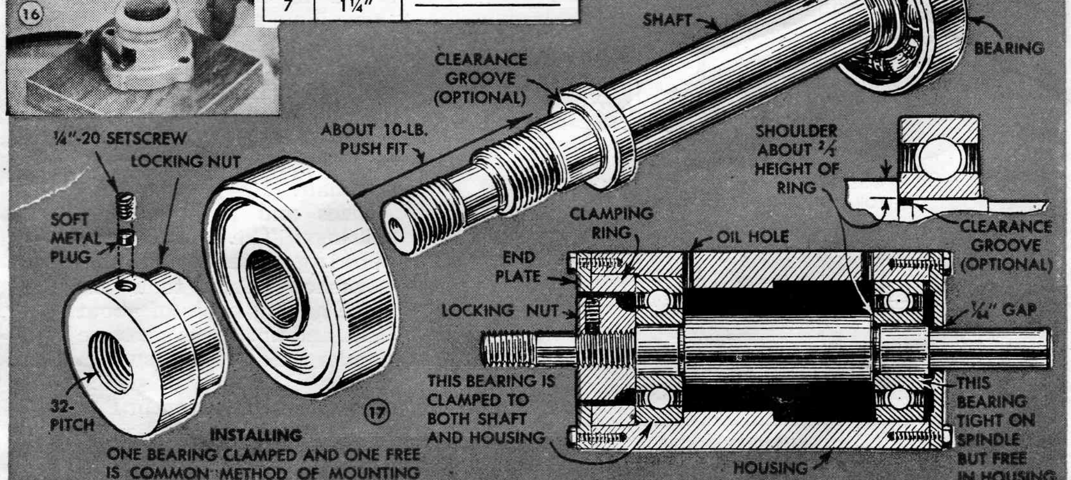
HEATING
HEAT FROM 60-W. LAMP IS IDEAL FOR SHRINK FITS



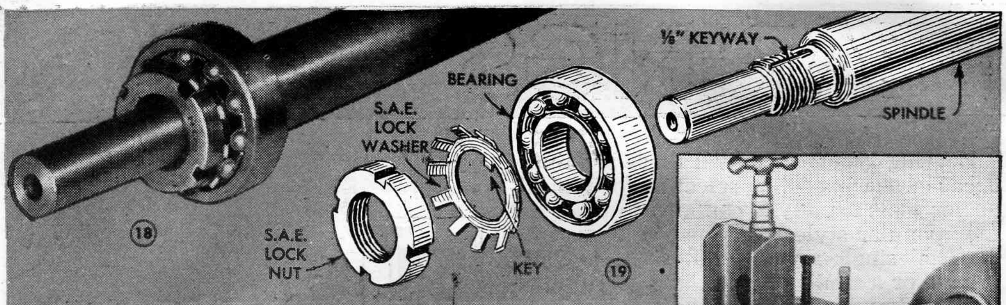
(16)

(15) DRIVING SLEEVES

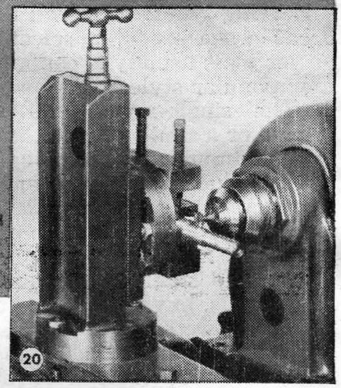
Bore No.	Standard Pipe	Tubing
0	———	½" O.D. - 18 Gauge
1	⅜"	⅝" O.D. - 1/16" Wall
2	½"	¾" O.D. - 1/16" Wall
3	———	⅞" O.D. - 3/32" Wall
4	¾"	1" O.D. - 3/32" Wall
5	1"	1¼" O.D. - ⅛" Wall
6	———	1½" O.D. - ⅛" Wall
7	1¼"	———

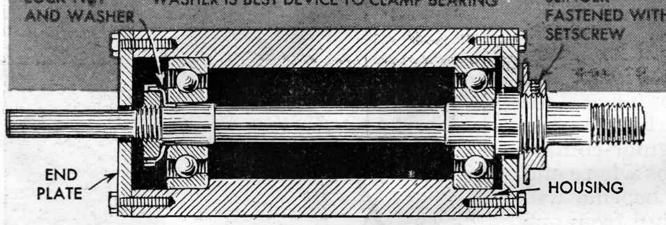


(17) INSTALLING
ONE BEARING CLAMPED AND ONE FREE IS COMMON METHOD OF MOUNTING

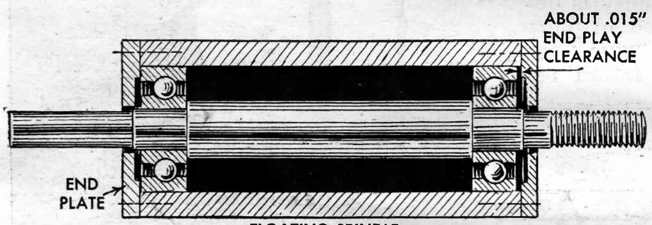


S.A.E. LOCK NUT
THIS APPROVED STYLE OF LOCK NUT AND WASHER IS BEST DEVICE TO CLAMP BEARING

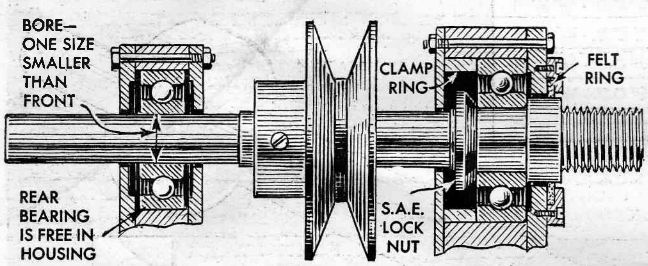




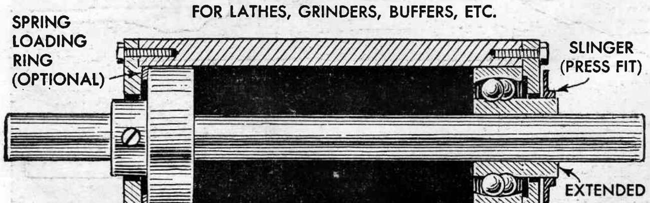
PRELOADED SPINDLE
SPINDLE MOUNTED LIKE THIS PERMITS PRELOAD AND TAKE-UP. ANGULAR CONTACT BEARINGS ARE SHOWN BUT SINGLE-ROW RADIAL CAN BE USED



FLOATING SPINDLE
BOTH BEARINGS ARE PRESS FIT ON SPINDLE AND PUSH FIT IN HOUSING



CENTER DRIVE
A STANDARD FORM OF INSTALLATION FOR LATHES, GRINDERS, BUFFERS, ETC.

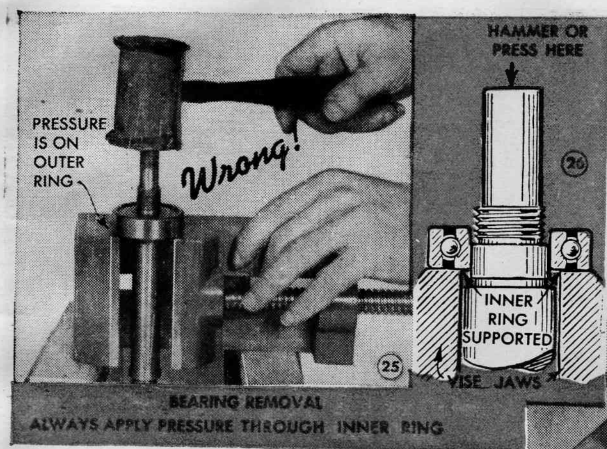


SELF-ALIGNING SPINDLE
USES SELF-ALIGNING BEARINGS WITH EXTENDED INNER RING

quire perfection in alignment when installed. However, when combined with a single-row bearing, this type makes an excellent installation for certain tools. Fig. 8 shows the double-row self-aligning type. Although rated somewhat lower than the single-row radial for any kind of load, the self-aligning feature makes it very popular with the home mechanic.

Special features: Most bearings can be obtained with a metal shield or felt seal on one or both sides, Figs. 10 and 11, the latter, the "sealed for life" type. A snap or retaining ring, Fig. 9, is sometimes useful when there is no shoulder against which the bearing can be located. An extended inner ring, Fig. 12, is a favorite with home workshoppers because it provides an easy way to clamp the bearing to the shaft.

Sizes and numbering of bearings: The most-used bearing sizes for home-workshop power tools are those having bores of about 3/8 in. and up. These sizes are standardized with a system of bore numbers, of which sizes 0 to 8 are given in Fig. 13. Each bore number is made in four outer ring sizes, Fig. 13, the light and me-



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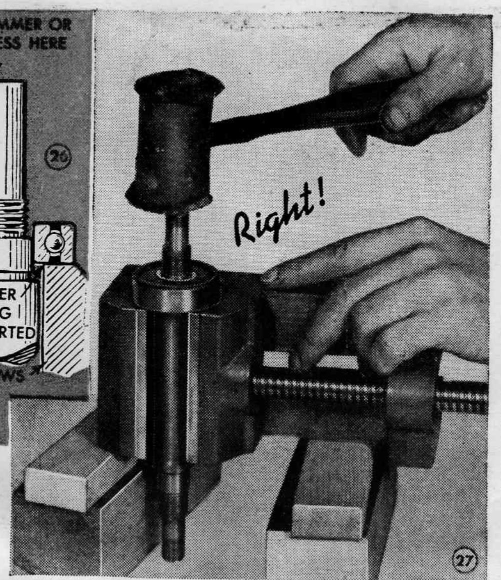
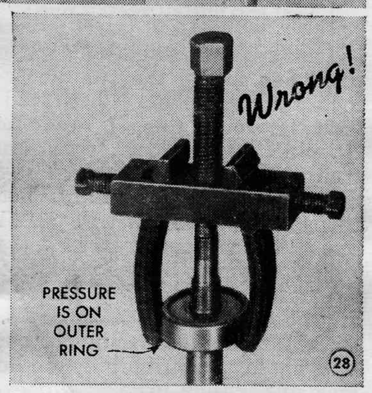


(27)

dium series being the most popular for all small power tools. Most manufacturers designate the light series as "200 series" and medium as "300 series." A No. 304 bearing is medium series, No. 4 bore. In practically all numbering codes, the two right-hand figures give the bore number or the bore size in millimeters. L or 1 in the third digit from the right indicates extra light series; 2 is light series; 3 is medium series; 4 is heavy series; 5 is nonloading groove light series, and 6 is nonloading groove medium series. Other numbers to the left indicate type or extra features. Small power-tool construction is mainly of the light series type. This is sturdy enough for all average loads and does not require a bulky housing. A fair guide to the selection of a suitable bore size for any power tool is the motor rating given in Fig. 13. For example, if you are making a lathe to be driven with a $\frac{1}{3}$-hp. motor, you would use No. 2 or 3 bore light series bearings. Of course, if you wanted a hollow spindle, you would have to take a bigger bore to accommodate the Morse taper.

Installation: In the basic installation, Fig. 17, both bearings are a press fit on the spindle and a push fit in the housing. The press fit should require about 50 lbs. pressure with an arbor press, or equivalent hammer taps, Fig. 14. The turning allowance for press fitting should be about .0002 or .0003 over the bore size, Fig. 13. If the bearing is held with a lock nut, as shown in Fig. 17, a press fit of about 10 lbs. is sufficient. Both bearings are a push fit in the housing, which means that they can be pushed in by hand but there should be no looseness. A study of Fig. 17 will show that one bearing is clamped to the spindle and in the housing. This bearing fixes the spindle and takes up the thrust load. The other bearing, as stated before, is a press fit on the spindle and is a push, floating fit in the housing, which allows for shaft expansion. Press-fit bearings are commonly driven on with a piece of pipe, Fig. 14. Fig. 15 suggests suitable pipe sizes for the bores of various bearings. Heat often is used to expand the bearing so that it can be pushed on by hand for a shrink fit. A 60-watt bulb, Fig. 16, gives off about 240 deg. F. heat and can be used in some cases. Immersion in an oil bath is sometimes used to heat bearings but care should be taken in either case not to use too high a heat.



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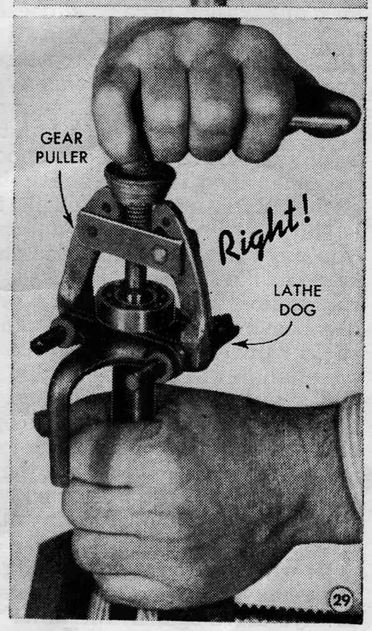

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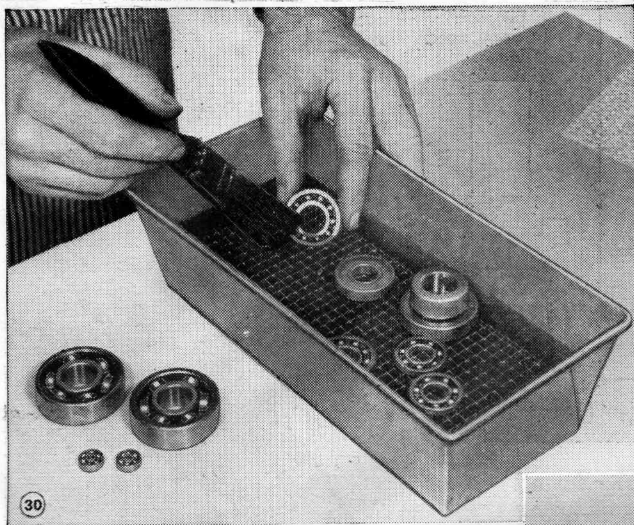
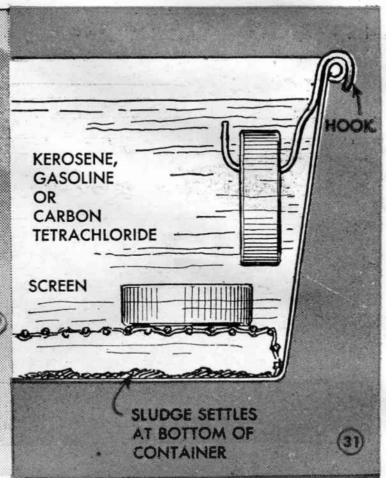
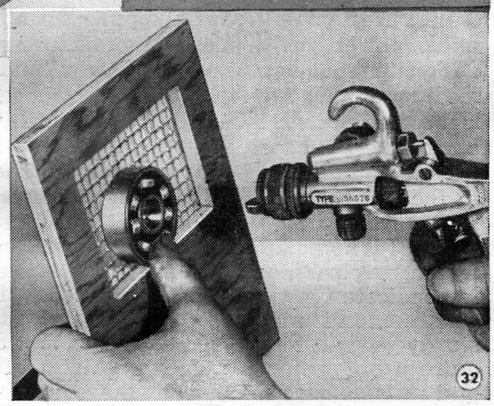


CLEANING
BEARINGS SHOULD BE WELL BRUSHED WITH SOLVENT AND THEN BLOWN OUT WITH COMPRESSED AIR





The approved method of locking the fixed bearing to the spindle is the S.A.E. lock nut and washer, illustrated in Figs. 18 to 20. However, this requires a keyway, Fig. 20, which makes more work than the plain lock nut shown in Fig. 17. The S.A.E. lock nut and washer are so arranged that a 1/24 turn of the lock nut will permit engaging one of the washer prongs.

Fig. 21 shows the S.A.E. lock nut used as the take-up nut on a preloaded spindle to align the inner and outer races. In this installation, the outer rings of both bearings butt against shoulders in the housing. The lock nut is then used to squeeze the inner rings into alignment, creating a preload on the bearings. This kind of installation is particularly recommended for lathes, grinders and other tools where end play must be restricted and a rigid spindle is essential. Fig. 22 is just the opposite. Here, both bearings float in the housing, with about .015 in. end play. This installation is suitable for buffers, countershafts, motors and other jobs where end play need not be controlled exactly. Fig. 23 is a standard installation for center drive and features one bearing locked and the other floating, as previously described. Fig. 24 is a typical installation of the self-aligning bearing. A stiff circular spring is indicated as a means of taking up end play. This is optional and can be eliminated, in which case the left end plate would butt against the bearing, as does the right end. Slingers and felt rings shown in some of the installations are used to keep out dirt.

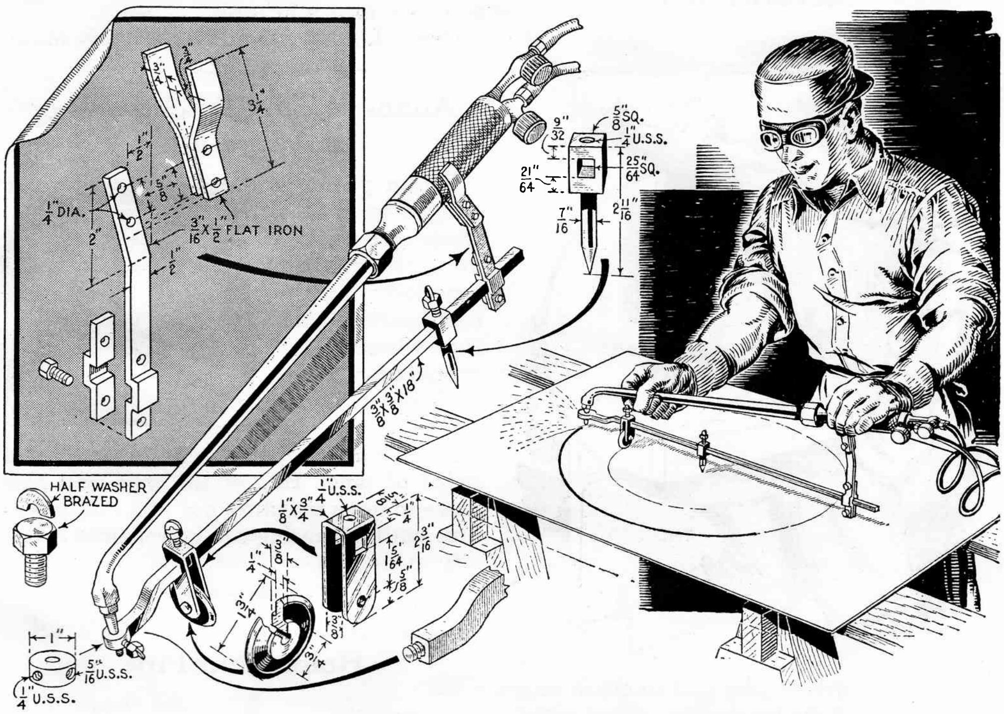
Bearing removal: Two rules govern bearing removal: keep the bearings clean, and always drive against the inner ring. It can be seen that pressure against the outer ring, Figs. 25 and 28, puts the load through the balls and may damage the bearing. Figs. 26, 27 and 29 show the right way—the inner ring is supported and takes the full force applied.

Cleaning: Surplus grease should be wiped from bearings, after which they are soaked and brushed with suitable solvent. The cleaning pan should have a wire rack, as shown in Figs. 30 and 31, to keep the bearing above the sludge. After cleaning, the bearing should be blown dry with compressed air, Fig. 32. Bearings should not be spun without lubricant since the dry condition makes them liable to scratching. Oil immediately after cleaning, especially if a drying solvent like carbon tetrachloride or alcohol is used.

Maintenance of Fence Reduced

After running a strand of barbed wire directly above the woven-wire portion of the fence, instead of 3 in. above as is the general practice, one farmer found that stock did not attempt to reach through the fence. This greatly reduced the maintenance work required.

Gas-Torch 'Compass' to Cut Out Metal Disks

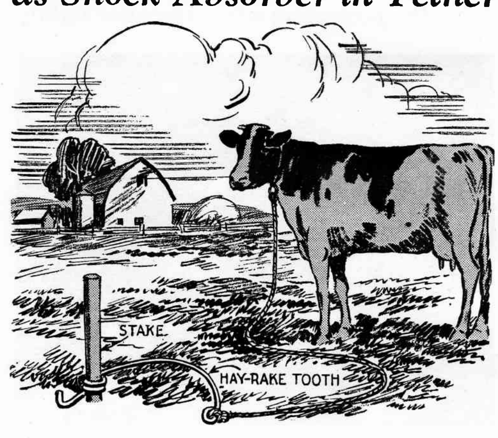


Owners of small shops who do not have equipment for cutting circles or disks in steel plates, will find this inexpensive attachment for a gas-cutting torch just the thing for the job. When the work is done free hand, it is almost impossible to avoid ragged edges that require considerable machining to finish them. With the attachment anyone can cut circles having smooth edges and ranging in size from a few inches to nearly 3 ft. in diameter. If the small wheel near the torch tip interferes with moving the adjustable pivot close enough toward the end of the torch for a very small radius, it is a simple matter to remove the wheel and put the pivot in its place. When a number of duplicate disks are to be cut from stock up to ½ in. in thickness, several pieces of the metal can be stacked and cut in one operation, and thus save considerable time.

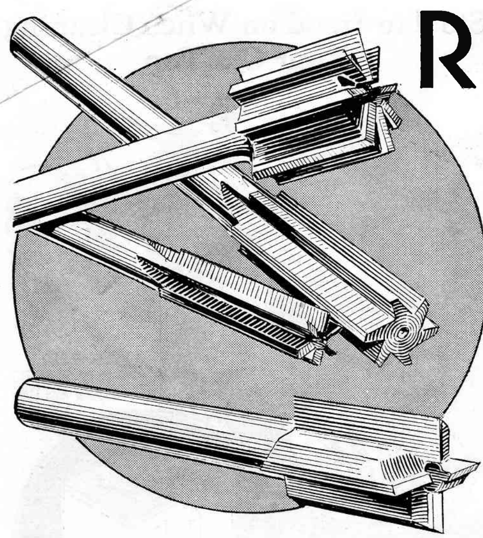
—A. L. Havens, Rutland, Vt.

Tooth from Hay Rake Serves as Shock Absorber in Tether

To provide a spring in a tether that would tend to absorb shock on an animal's neck when it stretched the tether suddenly, and at the same time allow it to rotate on the stake without winding up, a farmer used a hay-rake tooth. This was annealed at the pointed end and an eye was formed to attach the tether. The tether stake was driven into the ground through the coiled portion of the tooth near the other end.



¶A tool box is more efficient if the partitions are cut a few inches lower than the top of the box to leave room for carrying wide, flat tools on the trays.



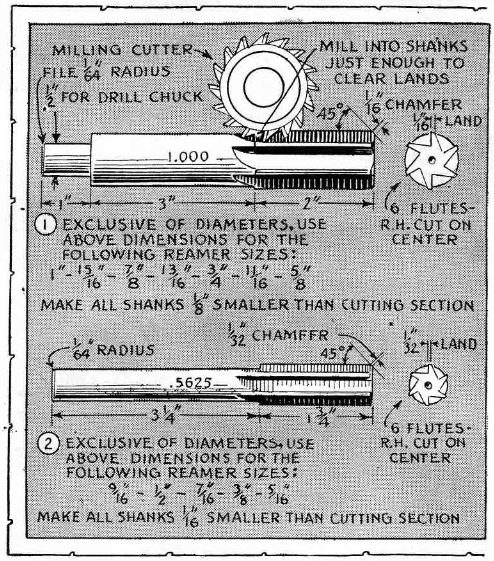
REAMERS *and* ... *made in your*

By H. J. CHAMBERLAND

BORING work to precisely a predetermined dimension is not difficult if you have an assortment of reamers and counterbores at hand. Reamers are strictly precision tools and perform best when they remove a minimum amount of stock, 1/64 in. being about the maximum. Of utmost importance is the fact that with reamers, there is no worry as to the outcome of a standard hole whether it is .004 or .015 in. undersize previous to reaming. Counterbores, while not classed as close precision tools, are very useful around the shop. They are equipped with various sizes of pilots, which serve as aligning members. Counterbores are intended mostly to bore openings for the heads of screws, bolts and similar parts for sinking under the work surface. Usually twelve straight-shank chucking reamers and three counterbores will fill the requirements of any one who has a small metal-working shop. As the process of making reamers and counterbores is somewhat similar to that used in making mandrels and nut arbors, which has been fully described in a previous article, data such as material required and method of hardening need not be repeated.

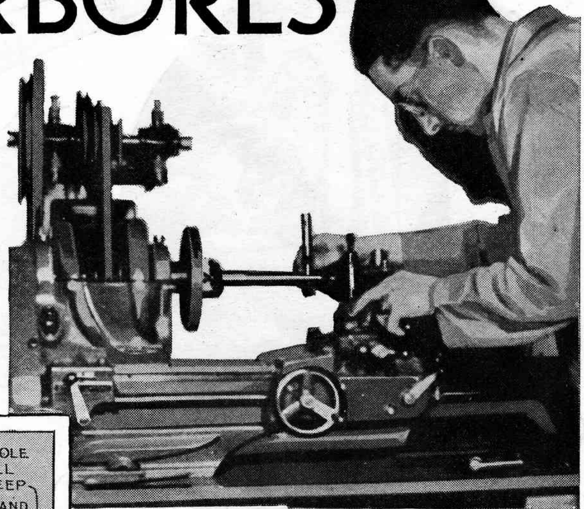
Figs. 1, 2 and 3 show how the recommendations for dimensions have been simplified so that anyone can make the tools. While it is necessary in a case of this kind to deviate from manufacturers' standards as to individual length, shape of flute, etc., practicability and quality of the tools have not been overlooked. You will notice that all sizes in each group are of identical length, which tends to keep turning and grinding cuts straight and thus eliminates frequent changes in tailstock adjustments.

You may center the stock your own way and according to available facilities but do not countersink it more than necessary. Also, allow for facing. A 1/16 by 3/16-in.

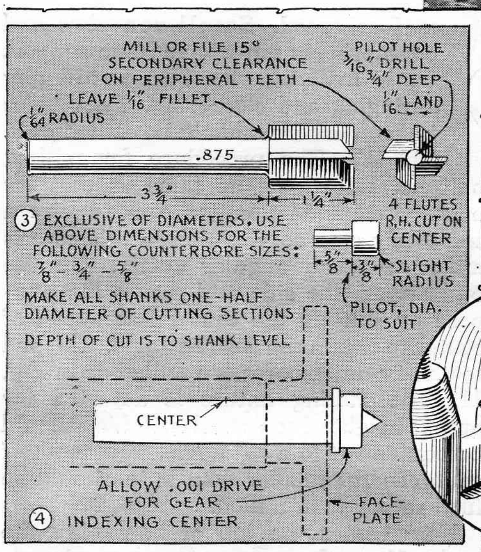


combination center drill is about the correct size to use. The turning operations are routine, .010 to .012 in. being allowed on all cutting dimensions for grinding purposes. Shank dimensions are not critical and a variation of 1/64 in. either way will do no harm, exclusive of the 1/2-in. undercut, Fig. 1, which should be to size or slightly undersize. Assuming that you have a milling attachment for your lathe, but have done little of this work, and want to do the work as economically as possible, get an assortment of worn milling cutters from a machine shop or metal-working plant. Usually these can be purchased at scrap-metal prices, and a good-natured boss may sharpen them for you at no extra cost. For the present, select a small double-side mill about 2 1/4 to 2 1/2 in. in diameter, with a

COUNTERBORES *own shop*

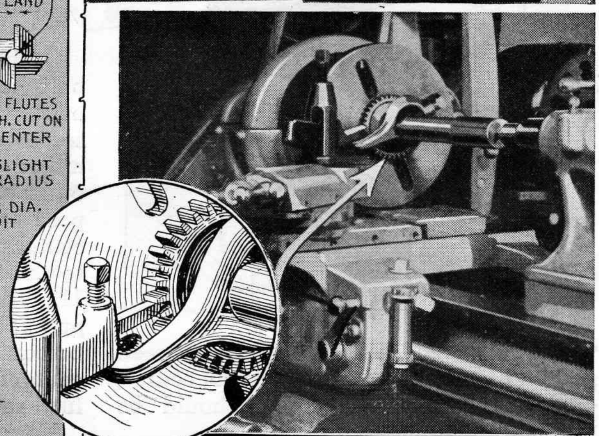


½-in. face. Your next move is to make a soft-steel arbor as shown in Fig. 8. Be sure that its shank fits perfectly into the lathe spindle. If the cutter is pressed on with a .002 drive, it will be rigid and will stand ten times the feed that you will give it. Such an im-



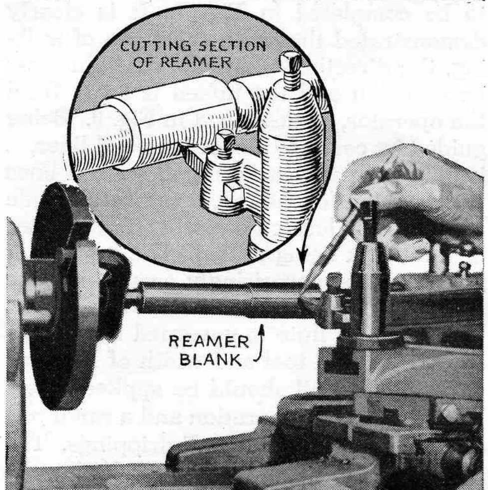
③ EXCLUSIVE OF DIAMETERS, USE ABOVE DIMENSIONS FOR THE FOLLOWING COUNTERBORE SIZES: 7/8" - 3/4" - 5/8"

④ INDEXING CENTER

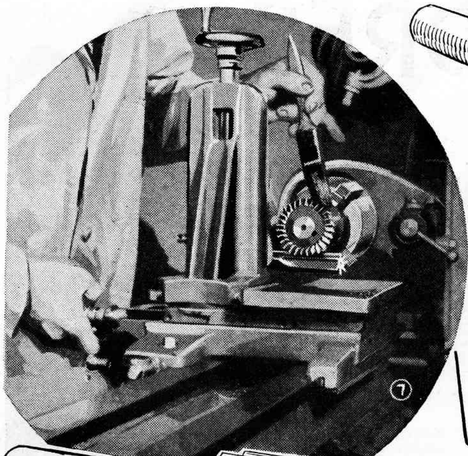

⑤ METHOD OF INDEXING FLUTES

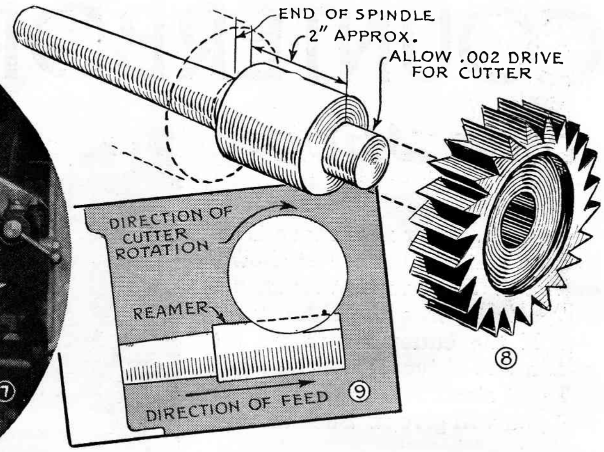
provised arbor serves the purpose well and the cutter may be sharpened easily without removing it.

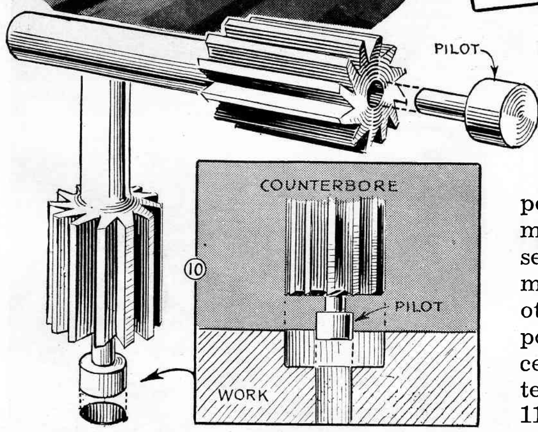
Now you are ready to do some milling but probably wonder how you are going to index the flutes evenly in the reamers or counterbores. If your lathe has indexing facilities in the headstock, you proceed as follows: Grind a tool bit to a V-shape and mount it in the tool holder exactly in the center of the work. All you have to do now is to scribe the required number of divisions on the cutting sections of the blanks, as shown in Fig. 6. If you have no indexing facilities on your lathe, you can get the same results by fitting a 36-tooth threading gear to a special center made and used as in Figs. 4 and 5. Note in this case that the bit serves as a plunger as well as a scriber.



⑥ SCRIBING THE GAUGE LINES



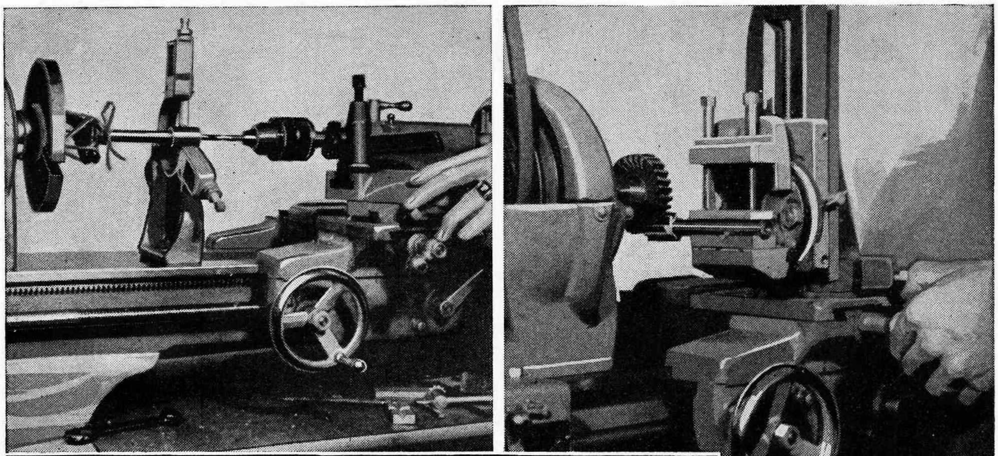




The work should be held tightly between centers before drawing the lines. Of course, with either set-up the dog should be locked into the faceplate slot.

The last flute of the 1-in. reamer is about to be completed in Fig. 7. It is clearly demonstrated that with this form of milling, the direction of spindle rotation must be reversed and the infeed is away from the operator, as described in Fig. 9. Being guided by correctly spaced scribed lines, it is only necessary to bring all scribed lines into position for milling, if the cutting side of the mill is located directly on the center of the blank being milled. The spacing of flutes will be surprisingly accurate if the above instructions are followed closely. The depth of flute is governed by the diameter of each tool and width of land required. Lard oil should be applied freely during a milling operation and a small pan should be used to catch all drippings. The depth of cut should not exceed 1/16 in., the feed should be slow and a 2½-in. cutter should rotate at 300 r.p.m. for a correct surface speed. Small reamers and counterbores must have some support while milling them to avoid any springing and chattering. Pilot holes in counterbores should be drilled as in Fig. 11. The procedure for milling peripheral teeth is the same as that for milling reamers. Counterbores require a secondary clearance, which in this case is milled with an angular cutter. On the other hand, the side mill serves the purpose by shifting the center line ahead of center to obtain the desired angle. The end teeth of counterbores are milled as in Fig. 11. The milling fixture is adjusted for proper height of concaved cut which should be equivalent to a 55° angle. End teeth of counterbores smaller than ½ in. should be filed rather than milled.

Next comes the job of hardening the tools. If you have a small gas or electric furnace follow instructions given for mandrels and arbors. However, the fact that you have no regular equipment should prove no handicap. Reamers and counterbores need not be hardened over their entire length, therefore the improvised set-up shown in Figs. 12 and 13 will serve the purpose. All you need are four 4 by 8-in. firebricks, an old cast-iron plate and a regular size blowtorch. Arrange the bricks as shown, after cutting an opening for the flame. After starting and locating the torch, place the piece to be hardened shank first into the chamber but without contacting the flame, then close the front. Enough heat will be generated in about 10 min. to relieve the tool of all strain. Now bring the cutting end to a bright red by rotating the work slowly but continuously, and quench quickly. Harden the end of the shank the



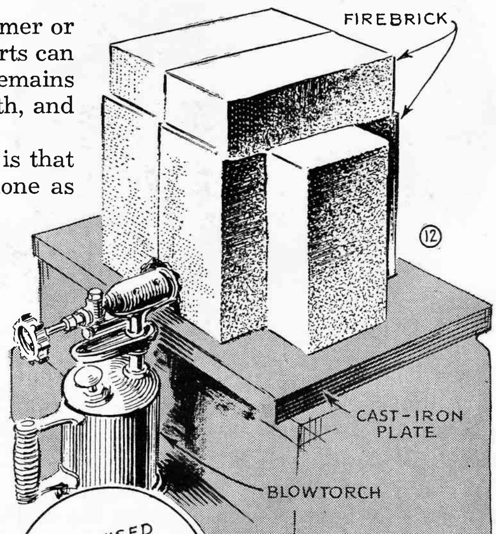
(11) DRILLING PILOT HOLES AND MILLING FLUTES IN SMALL COUNTERBORES

same way and repeat the cycle for every reamer or counterbore. If any distortion occurs, the parts can be straightened easily as the center portion remains soft. After hardening, clean with emery cloth, and your tools are ready to be ground.

The first grinding operation with reamers is that of surfacing the faces of the flutes and is done as shown in Fig. 14. The purpose is to produce fine edges in connection with the cylindrical grinding operation. It is best to index if possible. Good results can be had by holding the reamer with one hand and traversing the wheel with the other, removing only enough stock to brighten up the faces.

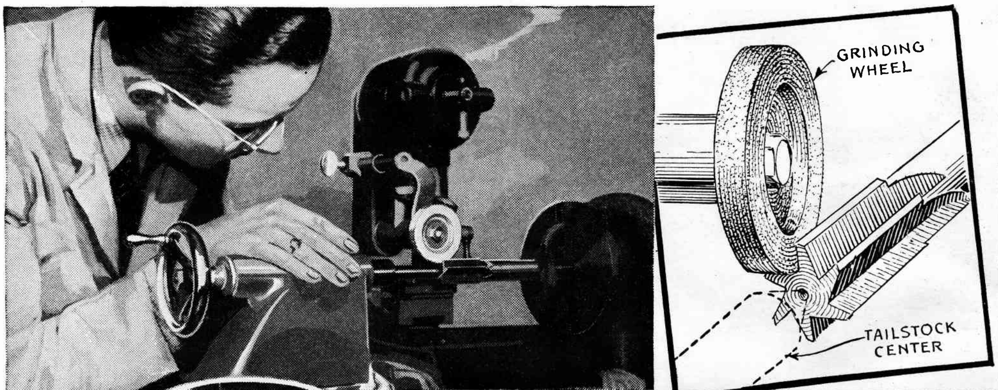
Next comes dressing of the wheel face previous to grinding cylindrically. A diamond dresser is necessary for precision work; small ones are available for a few dollars. The setting must be held rigidly in some kind of fixture bolted to the lathe bed. Regardless of your grinding facilities, the work must always rotate in the opposite direction to that of the wheel. It is advisable to grind the shanks first, Fig. 17. They need only be ground straight and concentric. The wheel traverse movement should be slow and about .0005 in. of stock should be removed per pass. The operator should not attempt to go nearer than .0005 in. from the required finish size.

The next operation with reamers is that of clearing the lands, Fig. 16. The clearance angle should be 4 to 6° to within .005 to .008 in. from the edges. Grinding the 45° chamfers completes the reamers. This operation is done by setting the compound rest accordingly. The clearance should be 5 to 7° and to sharp edges.

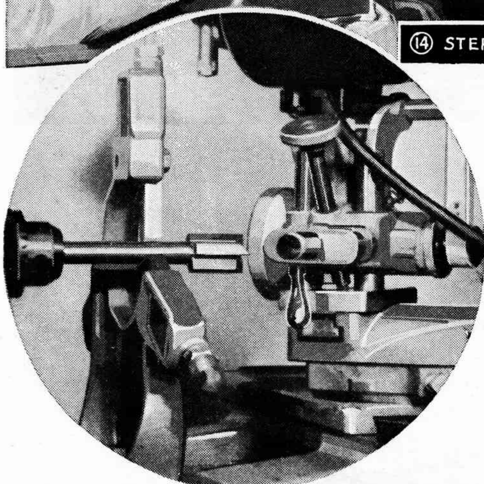


(12) IMPROVISED FURNACE FOR HEATING SMALL REAMERS AND COUNTERBORES

(13) WORK SHOULD BE TURNED WHILE HEATING

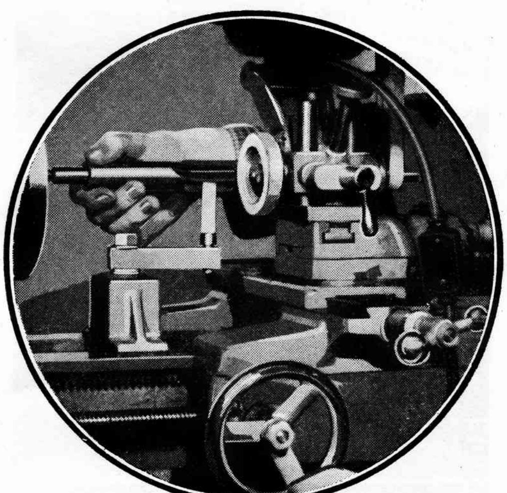


⑭ STEPS IN GRINDING COUNTERBORES AND REAMERS

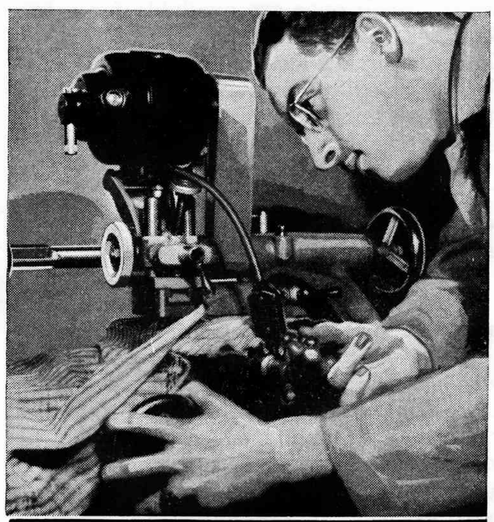


⑮ CLEARING END TEETH

Counterbores are cylindrically ground the same as reamers, but lands resulting from the secondary clearance are not relieved. These tools do their cutting from the ends and one way of clearing the end teeth is by indexing from the headstock if possible, and using the steadyrest for forward support, Fig. 15. Indexing the flutes with the finger rest will give the same results. End teeth of counterbores also require a 5 to 7° clearance angle to sharp edges. Pilots can be made from cold-rolled steel and casehardened, Fig. 10. It is best to make the pilot .001 in. undersize, the stem being a medium press fit in the pilot hole. The fitting is done after completing the tool. The size and date of making are stamped on the tool before hardening. Electric etching pencils can be obtained inexpensively and are economical for a final touch. Be sure to keep your reamers sharp by grinding them regularly. Reamers and counterbores will last almost indefinitely as they need only be chromium-plated to size when worn.

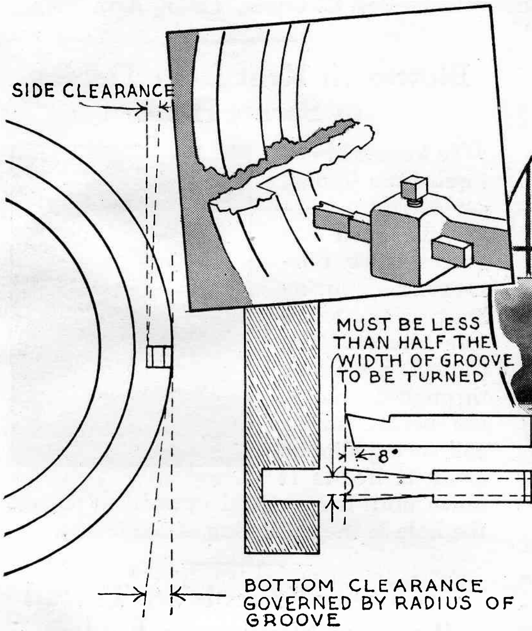


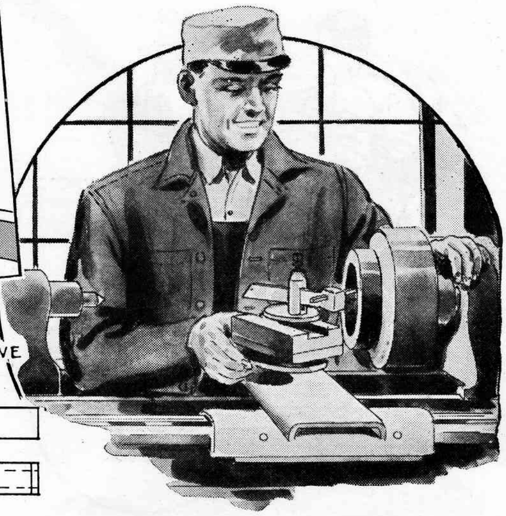
⑯ CLEARING THE LANDS



⑰ FINISH-GRINDING THE SHANK

Non-Chatter Tool for Grooving Metal Disks



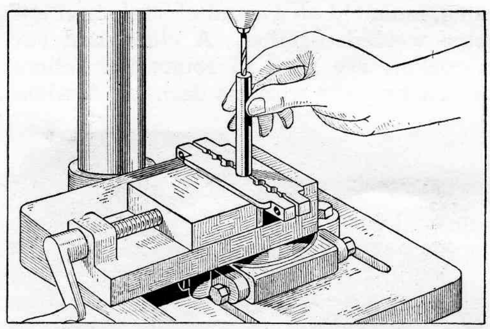


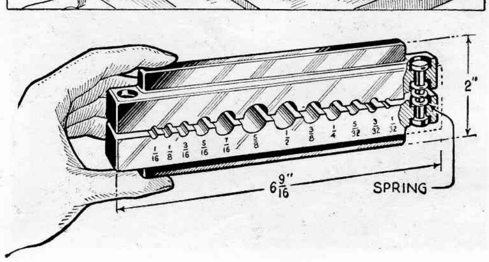
After experiencing difficulty in turning grooves in the faces of metal disks, due to the tendency of a square-nosed cutting tool to chatter or dig in, I ground this special tool, which has two cutting edges as shown. It must be adjusted in the tool post so that the edges are perfectly square with the surface in which the groove is to be cut. Then, by feeding the tool radially back and forth across the groove, with the crossfeed of the lathe set to suitable stops, a perfectly smooth groove results and there is no tendency to chatter. The distance between the two cutting edges of the tool should be less than half of the width of the groove to be turned. This permits the tool to be moved radially to avoid leaving a ridge in the bottom of the groove as it is cut.

—E. B. Davenport, Ross, Calif.

This Jig Supports Round Work Vertically to Drill the Ends

Capable of gripping round work varying in diameter from 1/32 in. to 1/2 in., this jig was made to support rods and pins in a bench vise or vertically in a drill press for drilling holes in the ends. Made of steel, the jig consists of two jaws bolted together at the ends, short coil springs being slipped over the bolts and held by collars to keep the jaws spread slightly for easy insertion of the work. In use, the jig is clamped in the drill-press vise, the jaws of the latter forcing the jaws of the jig to grip the work tightly. Notice that the outer edges of the jig are flanged to rest flatly on the upper surfaces of the vise jaws. The depressions ground in the facing edges of the jig to form holes when the jaws come together, must be slightly smaller than one-half the diameter of the work to be gripped so that the latter will be clamped tightly before the jaw edges touch.



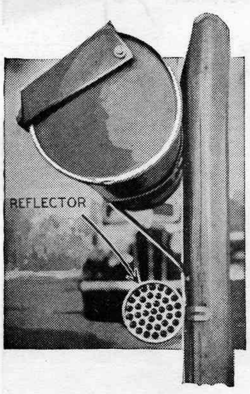


Removal of Fruit from Barrel Simplified with Tray

A merchant who dispenses apples, potatoes, etc., directly from barrels in his store improves the appearance of partly emptied barrels and simplifies removal of the contents in small quantities with this tray. It is made from heavy wire, the side stay wires being bent to a hook shape at the upper ends to fit over the side of the barrel. After the contents have been lowered sufficiently to make room for it, the tray is filled and placed in the barrel.

—Opie Read, Jr., Chicago.

Reflector Protects Mailbox



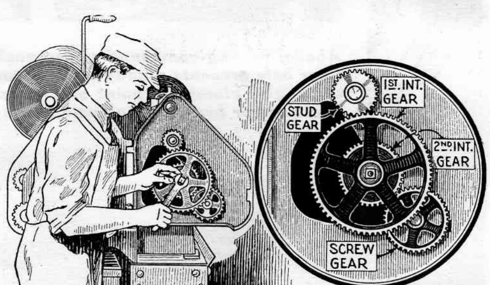
Rural mailboxes are often knocked over at night by motorists who in passing other cars on narrow roads, sometimes get off the pavement slightly and do not see the boxes in time to avoid them. To help prevent this, one farmer placed a red reflector on the standard of his box as indicated. The reflector should be fastened to the post about 30 in. above the ground. At this height, it will be sure to reflect the light of cars coming toward it.

—John M. Avery, Holley, N. Y.

Changing Lathe Gears in Pairs Saves Time

In small shops a general-purpose screw-cutting lathe is often used to handle a great variety of work for which desirable feeds cover a considerable range, and much time is required to change the gears. The time-consuming part of setting the yoke and intermediate gear pivot, getting the intermediate gear center in the right place, can be speeded up by changing the gears in pairs, with the pairs selected so that the sum of the teeth in each pair is the same. The application of this idea to my lathe is as follows: Gears available were 24, 32, 36, 40, 42, 44, 45, 46, 48, 52, 54, 56, 60, 80 and 96-tooth. By cut and try, the table for longitudinal feeds worked out as shown. It will be seen that the sum of the teeth for the stud gear and the first intermediate one is 92 in each case, and as the sum is constant, the proper center distance for each of these pairs is the same. Thus eight feeds from .005 to .017 in. per spindle revolution are available by selecting the proper pair for the first gears in the train without making any other changes.

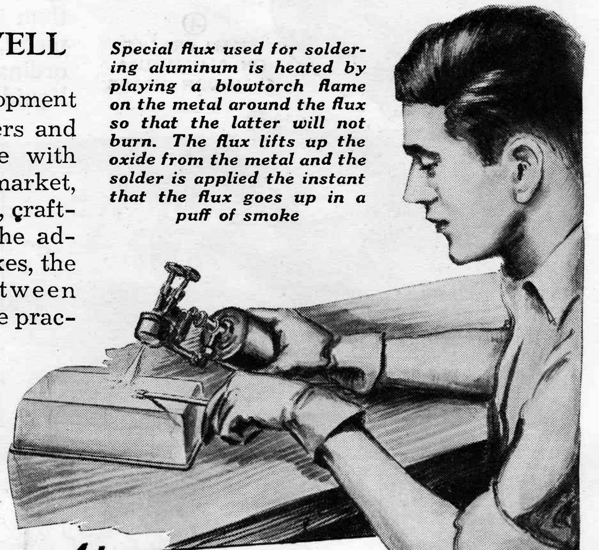
—Walter T. Gorton, Washington, D. C.



STUD GEAR	FIRST INT. GEAR	SECOND INT. GEAR	SCREW GEAR	FEED, IN. PER REV. OF SPINDLE
32	60	42	54	.005
36	56	42	54	.006
40	52	42	54	.007
44	48	42	54	.008
48	44	42	54	.010
52	40	42	54	.012
56	36	42	54	.014
60	32	42	54	.017
32	60	54	42	.008
36	56	54	42	.009
40	52	54	42	.011
44	48	54	42	.013
48	44	54	42	.016
52	40	54	42	.019
56	36	54	42	.023
60	32	54	42	.028

"Split-second" SOLDERING
new fluxes-new solders-new methods

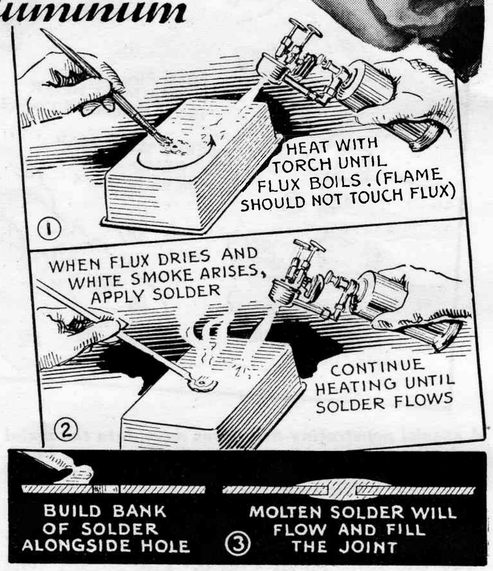
By ALEXANDER MAXWELL



Special flux used for soldering aluminum is heated by playing a blowtorch flame on the metal around the flux so that the latter will not burn. The flux lifts up the oxide from the metal and the solder is applied the instant that the flux goes up in a puff of smoke

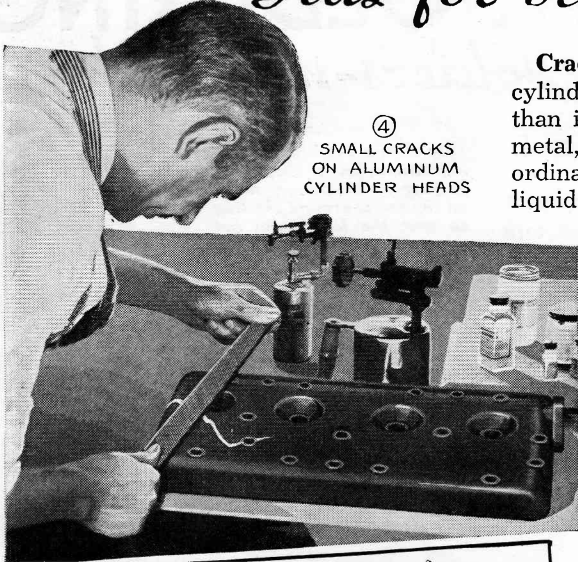
KEEPING abreast with the development of numerous new alloys, solders and fluxes especially prepared for use with these alloys have been put on the market, and are available to every shop man, craftworker and experimenter. Since the advent of these special solders and fluxes, the previous specific distinction between "hard" and "soft" solders has become practically obsolete and is now merely a general distinction between groups of solders, while the individual solders have highly specialized uses for certain definite purposes. Several of the new alloy solders have proved so phenomenal in application that they have opened fields which were until recently the exclusive "property" of riveting and welding. To avoid confusion, manufacturers are labeling the solders and fluxes according to their exact purpose and method of application. Those for the base metals and alloys are stocked by mill-supply houses; those for the precious metals by dealers in jewelers' supplies and equipment.

Aluminum

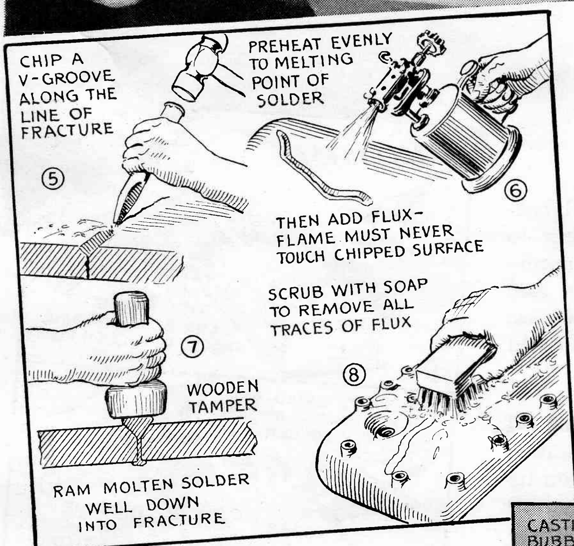


Aluminum Soldering: Aluminum has defied soldering most persistently of all popular metals. When aluminum is heated, an invisible layer of oxide is formed on its surface, which prevents ordinary solder from reaching the metal. A special oxide-cutting flux and a solder of zinc alloy have solved this problem if the proper method is applied carefully. Take for example a leaky aluminum pan: The surface to be soldered must be cleaned thoroughly with steel wool and then with emery cloth, after which the dust is brushed away and a generous drop of liquid flux is applied to the metal around the hole. With a torch, the metal is heated until the flux boils as indicated in Fig. 1, taking care that the flame does not touch the flux. As aluminum conducts heat very rapidly, a blowtorch, either of the alcohol or gasoline type, which provides intense heat, should be used. The flame is played on the surface in a circular path as indicated by the arrow, until the flux boils. The flux lifts the oxide, but a single breath of the flame will replace it, so be sure to keep the torch moving well back from the hole. When the flux has boiled dry, it will suddenly go up in a puff of white smoke. Have your solder stick ready and apply it the instant the smoke appears as in Fig. 2. Keep on heating the

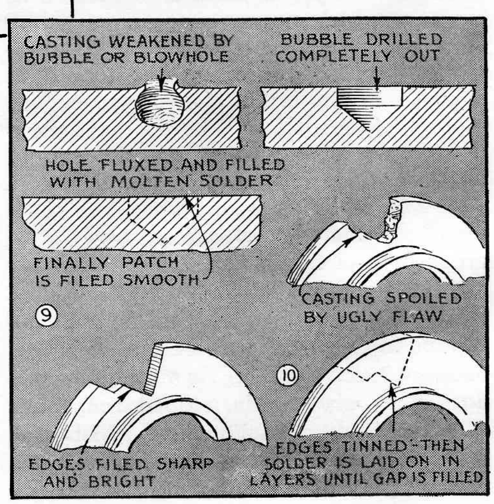
Fills for broken castings



Cracked Cylinder Heads: Many cracked cylinder heads can be repaired for less than it would cost to replace them. Cast metal, be it iron or aluminum alloy, resists ordinary flux, but yields to a penetrating liquid which "bores" down into the metal itself, allowing the solder to knit in a positive bond. First, you chip a V-groove along the edges of the fracture as in Fig. 5, then preheat the entire head slowly and evenly in an oven or with a heavy-duty torch as in Fig. 6, until the metal gets hot enough to melt solder when touched to it. When preheating, be sure to keep the flame away from the chipped portion. As soon as solder will melt on contact, the flux is applied. In the case of an iron cylinder head, the solder is applied as the flux boils away. In case of an aluminum cylinder head, solder is applied when the flux smokes. Then, by means of a wooden tamper, you ram the semi-liquid solder well down into the crack as shown in Fig. 7. Go over the crack repeatedly, building up and ramming the solder into it until it will take no more. Use extreme care not to warp the cylinder head by uneven heating or too rapid cooling. After it has cooled, the job is cleaned up by scrubbing thoroughly with a



A special penetrating flux bores down into the metal and allows the solder to knit in a positive bond. The casting is preheated and the solder is rammed down into the crack firmly



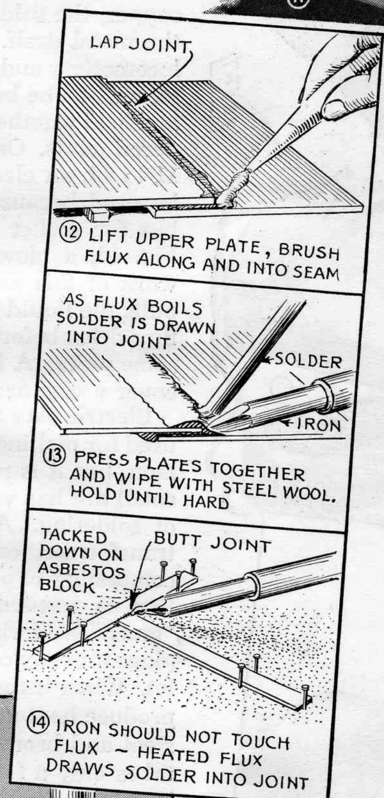
vessel and build up a bank of solder alongside the hole as in Fig. 3. The solder will presently melt, will slowly encircle the hole and at last fill it. Then you remove the heat gradually and allow the metal to cool. The plug, formed as shown in the right detail of Fig. 3, can be left as is, or it can be dressed down flush. The same solder and method also can be used on sheet copper, brass, iron or steel with equal success, but the white smoke is most noticeable when using the flux on aluminum.

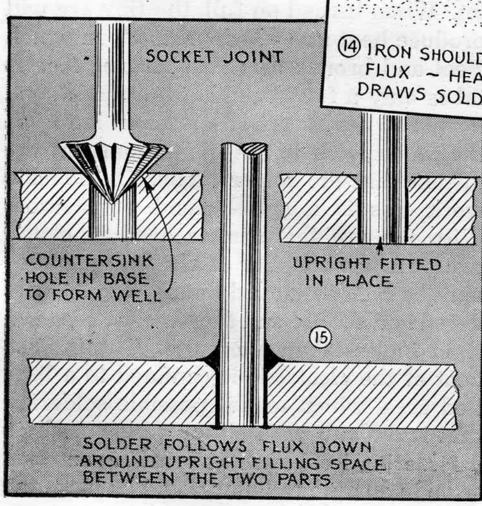
soap solution, Fig. 8, and the ridge of solder is filed down neatly as in Fig. 4.

Other Castings of Hard and Soft Metal: In general, castings run all the way from slush metal to steel and bronze, with a high percentage in the new aluminum-zinc alloy group. Pewter and Britannia metal, being softer than ordinary solder, are repaired with bismuth-alloy solder, which flows at only 518 degrees F., about a hundred degrees less than lead. Alloy metals containing magnesium will take a zinc solder without flux. The casting is tinned with dry solder brushed on with steel wool or a wire brush, then bonded in the usual manner. For the very hard metals and castings, which must withstand hard service, a copper-base solder and proper flux are used. Stainless steel is soldered best with a solder containing antimony applied at about 900 degrees F. This solder will bond with Iconol, Monel, hard steel, bronze, gold and platinum.

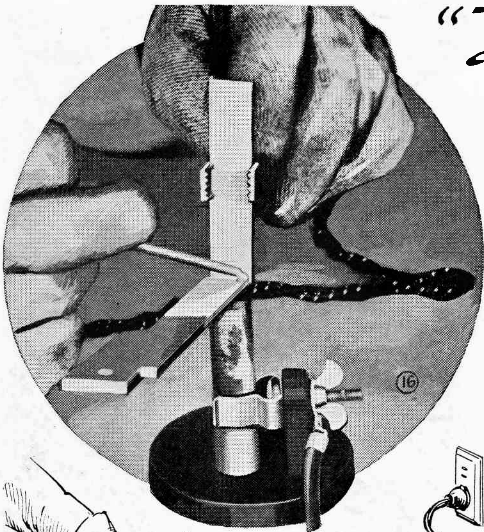
Repairing Blowholes in Castings: Frequently a casting is weakened or ruined by the presence of a tiny blowhole, although the casting may be perfect in all other respects. To repair a blowhole in any metal, select the proper solder and flux to use, then drill out the defect slightly larger than the hole as in Fig. 9. After heating the casting carefully, fill the hole with flux and apply solder in the manner already explained. When the casting has been allowed to cool, file the patch flush with the surrounding surface. Many of the solders that are in use will take plating, including chromium, and any defects that have been patched in this way will be concealed fully after plating.

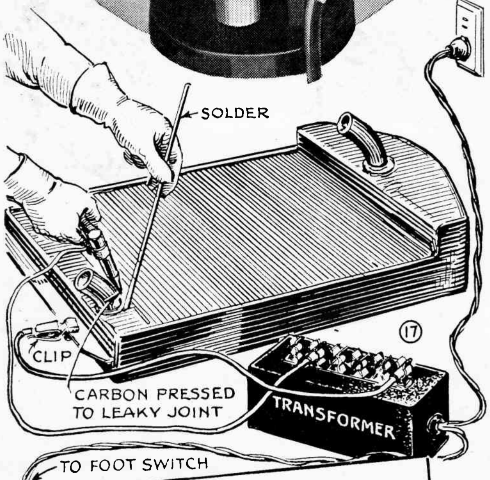
The flux used with zinc-alloy solder causes the solder to enter a seam by capillary attraction and the joint produced will often be as strong as one which is riveted





Missing Parts of Castings Filled: Zinc-alloy solder can be patted and molded into shape and can be used frequently to build up missing sections on castings as illustrated in Fig. 10. After the casting has been prepared by filing down the broken edges until they are bright and preheating the metal as already explained, the brightened edges are tinned at high temperature, and the heat is slowly lowered while layer after layer of solder is applied until the gap has





been filled. Zinc-alloy solder is very sluggish in flowing and must be encouraged with a metal or wooden paddle.

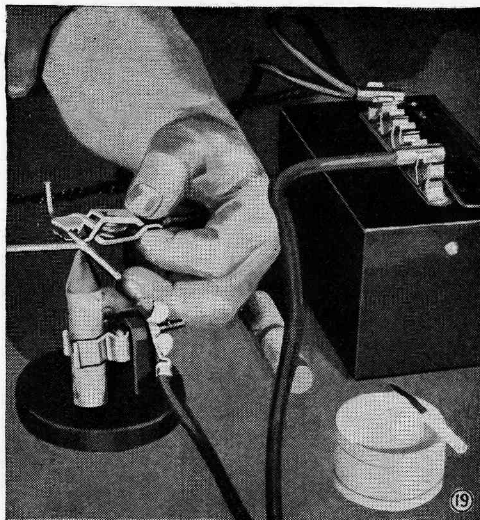
Help from Capillary Attraction: Zinc-alloy solder and its flux will also enter a seam by capillary attraction. Modelmakers and workers on delicate projects will find these of great value on many jobs. It is possible to solder joints which formerly had to be riveted or tapped and threaded. In the case of brass, bronze, aluminum and copper, the soldered joint is stronger than the metal itself. With this in view, model locomotives and engines, which run on live steam, can be built up from stock material and held together entirely by carefully soldered joints. On some delicate work, Figs. 11 to 14, an electric soldering iron should be used because it gives a uniform heat, but for socket joints in the larger sizes, Fig. 15, a blowtorch is desirable. In all work of this nature, the evaporating flux pulls the liquid solder along after it. If the flux dries before the joint is finished, add some more. A tiny quantity of solder will cover a vast area.

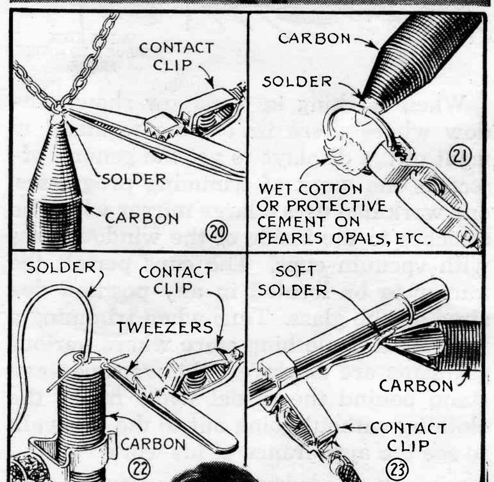
Electric-Arc Soldering: An electric arc, used for melting and welding is quite common, but it is not generally known that a small arc has vast possibilities in the field of soldering. A low-voltage, heavy-duty transformer, carbon electrode, circuit-completing clip and a foot switch, are all that is needed. Fig. 19 shows such a "touch"-soldering outfit, which the user plugs into any convenient 110-volt a.c. outlet. When turned on full, the tiny arc will produce heat at 4,000 degrees F., in which steel and bronze drip like melting ice. It takes only a few seconds to produce such heat, and the secret of operation is to use the foot switch to cut off the current the instant that the solder melts. On delicate work this is a split-second proposition. With the arc there is no need to clamp work in position, for fairly heavy pieces may be held in gloved hands, Fig. 16, soldered in a second and they will be cool and rigid in less than a minute. The intense heat of the electrode is confined to a limited area, which makes possible soldering that is difficult with either a blowtorch or a soldering iron, such as mending an open seam in an auto radiator, Fig. 17, where the

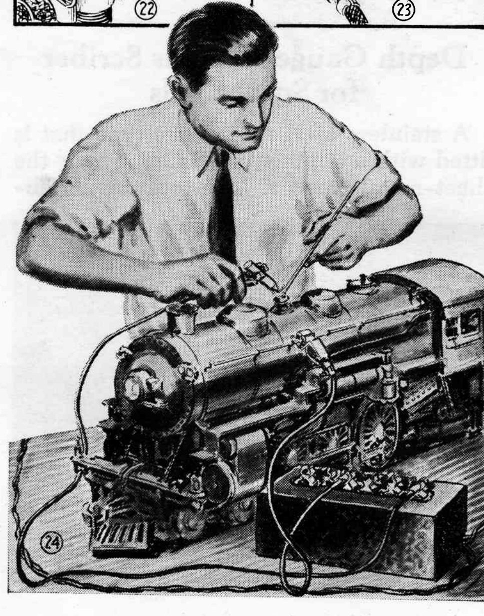
with a carbon arc

joint must be completed before near-by seams get hot enough to melt. Commutator leads and starting-coil connections that break usually mean taking down an electric motor to do a two-minute repair job. However, with this arc-soldering outfit, these leads can be reached and repaired in most motors by merely removing the end plate and reaching inside the motor as shown in Fig. 18. Oil and gas pipes on automobiles, refrigerating coils and other pipes also can be repaired easily. With ordinary soldering irons and torches these jobs are often very difficult because the copper conducts the heat away so rapidly from the area to be soldered that sometimes the solder applied will not even melt. But with the arc, the intense heat suddenly applied over a relatively small area, is so great that the job is quickly accomplished in spite of the conductivity. An arc-soldering torch, which consists of a 10-tap reactance coil in series with a carbon holder, was described in the May, 1937, issue of Popular Mechanics, and a plan showing its construction is also available for those who wish to make one. In this arc torch, the two carbons are held in a V position so their ends can be touched together to start the arc and then allowed to separate slightly to keep it.

Tiny Joints: When used in conjunction with capillary solders, the electric arc is capable of producing positive joints which are almost invisible. Figs. 20 to 24 inclusive show work such as done by jewelers. As you see, there are several methods of using the arc soldering outfit shown in Fig. 19. In these cases the solder is cut in tiny pieces and is laid in place against the joint, being held there by flux. On certain jobs it is advisable to pulverize the solder, mix it with lard and stick the paste in place. The lard goes up in smoke, and the flux handles the solder. For jewelry and model work, the quantity of solder needed is unbelievably small. Gold solder, silver solder and steel solder are obtainable in sheet form for all hard-soldering operations. Borax flux does not work in electric-arc soldering because it insulates the carbon and breaks the contact. There is a prepared solution available which will handle most hard-soldering jobs.





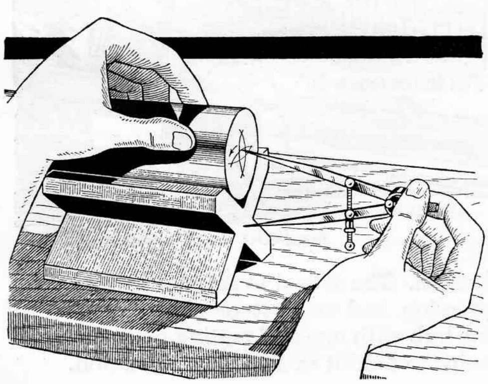


Portable Mailbox Is Supported by Concrete Base

Cast in an old washtub with the bottom removed, the base of this mailbox has plenty of weight to withstand winds, yet the handles permit easy shifting when the road maintainer comes along. An L-shaped angle iron with the lower end embedded in the concrete supports the box. The handles are iron rods bent to wide U-shapes and set in the concrete.

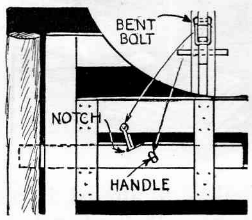
Using V-Block to Center Work

A quick method of locating the center of round work is to use a small V-block and a pair of dividers. A tiny hole in the end of the block takes one leg of the dividers, which are set a trifle larger than one half the diameter of the stock. In use, an arc is struck on the end of the work, which is then given a quarter turn and another arc struck, continuing this operation until you have the pattern shown on the end of the work.—E. E. Stanton, Huntington, Mass.



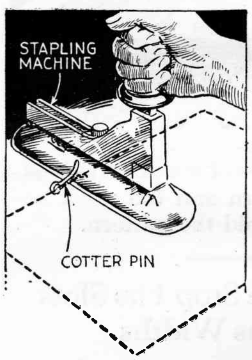
Lock for Sliding-Bolt Gate Latch Prevents Cattle Opening It

Gate latches of the type shown are often opened by cattle that slide back the latches by pressing against the handles with their noses. To avoid this, a farmer provided his latches with locks like the one shown. It is simply a short length of ¼-in. iron rod bent to a U-shape and pivoted to one of the gate boards so that it will drop into a notch cut in the latch.



—Norman Wyatt, Lexington, Mo.

Office Stapler Has Depth Stop as Aid in Inserting Paper



Inexpensive office staplers that are not provided with stops to gauge the depth to which papers may be inserted, can be provided with them by using small cotter pins. These are bent as indicated and are slipped over the bases.

Oil-Coated Lids on Ink Cans Are Not Likely to Stick

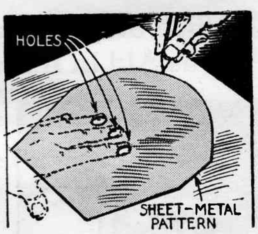
To prevent ink collecting on the can lids and causing them to stick, one printer coats the lids with oil or glycerin. This is applied with a felt pad kept on the ink shelf.

it is necessary to pound on the end. If such a support is not provided, the work must be gripped tighter than necessary, and the pounding throws excessive strain on the vise jaws, especially the front one.

Spindle Paper Holder Bent at End Will Not Injure Hands

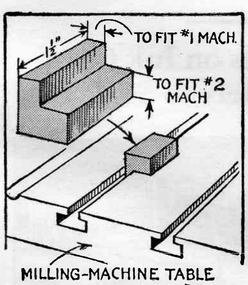
Spindle-type paper holders, often used in stores, shops and sometimes in homes, can be rendered much safer to have sitting around if the pointed end of the spindle is bent as indicated. This makes it almost impossible to strike the point with the hands accidentally, and also provides a handle for lifting the holder.

Finger Holes in Small Patterns Prevent Slipping on Work



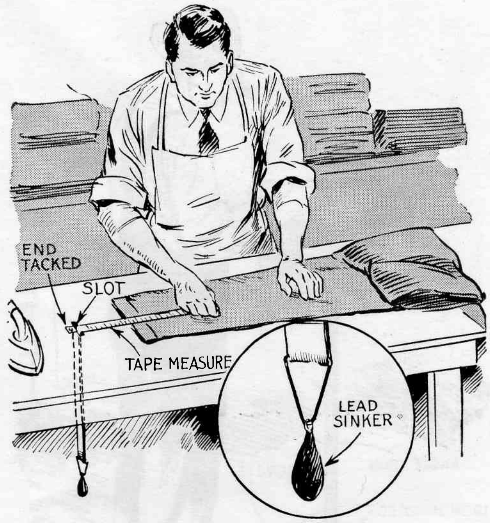
Annoyed by frequent slipping of small sheet-metal patterns when marking duplicate cutouts, one tinsmith overcame the trouble by punching finger holes in them. The tips of the fingers pressing against the pattern and the work beneath it, served to hold the pattern.

Machine-Table Stop Fits Slots of Various Widths



As most machine shops are equipped with planers and milling machines that have table slots of various widths, this stop will make it unnecessary to have a number of them. Machined from cold-rolled steel, it has two sides of different widths, thus making it usable on more than one machine.

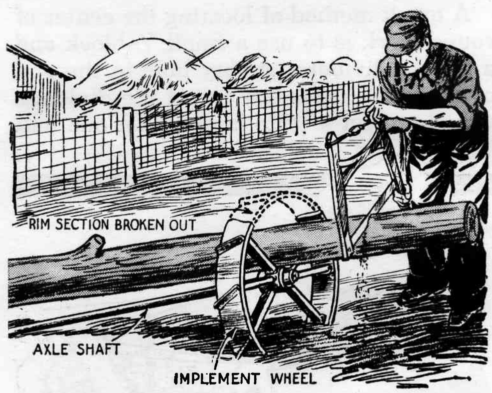
Tailor's Tape Measure Disappears Through the Worktable



To keep his tape measure out of the way, yet have it always at hand when needed, a tailor attached it to his worktable so that it would automatically disappear when not in use. To do this, a small slot was cut in the table top and one end of the tape was tacked to the side of the slot. Then the tape was folded and a small counterweight fastened to it as indicated.

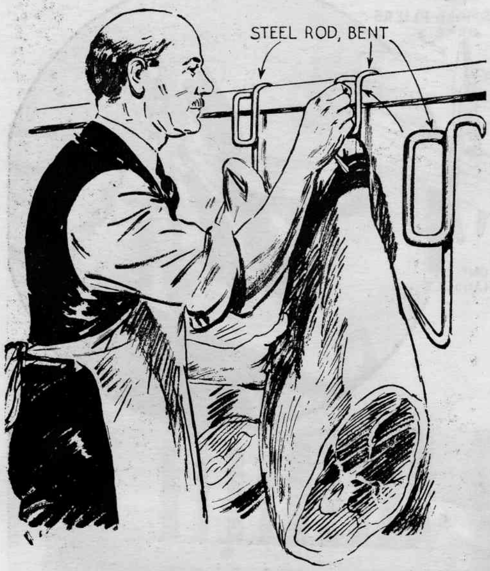
Sawbuck Made from Wheel Supports Light Logs

A sturdy sawbuck may be made from an old farm implement wheel from which two spokes and a section of the rim have been



broken. The wheel is set in a shallow depression and an axle or shaft inserted in the hub with one end resting on the ground helps to hold it in an upright position.

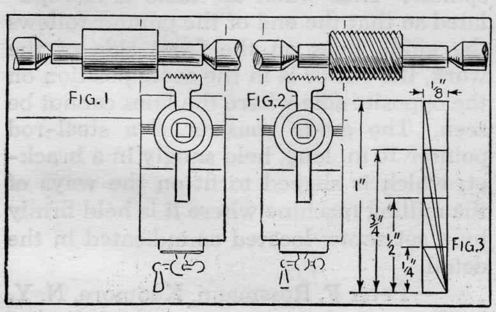
Meat Hook Has Loop for Hand to Avoid Pinching Fingers



Often pinching his fingers when hanging up heavy pieces of meat on his refrigerator racks, a butcher made a number of hooks like the one shown. It is bent from a length of steel rod and has a loop for the hand so that there is no possibility of the fingers coming in contact with the rack.

Multiple Threads Cut Accurately without Indexing Equipment

Anyone can cut multiple threads without special equipment at a considerable saving in time. Assuming that a multiple thread of 32 pitch having a 4-lead is desired, set the lathe to cut a 4-thread and use a 32-pitch thread-chasing tool set at the proper helical angle, Fig. 1. Start the tool clear of the work, taking the first cut as though you were cutting a 4-thread. Let the tool complete its cut, clearing the work as in Fig. 2. If the lead screw is 8 or

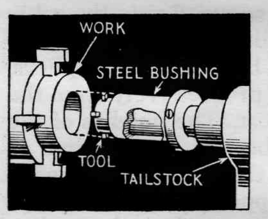


a multiple of the thread being cut, the half nut can be disengaged and the carriage run back for each succeeding cut. It is important that the tool be set at the proper angle otherwise the heel will drag and ruin the job. The tool angle must be set according to the diameter of the work. It is a simple matter to compute this as shown in Fig. 3. Draw two vertical lines a distance equal to one half the lead. In this case your lead is 1/4 in., therefore the vertical lines would be 1/8 in. apart. A diagonal line intersecting each line 1/2 in. apart will give the proper angle for cutting a 32-pitch 4-lead thread on 1/2-in. stock.

—C. A. Mowrey, Elmira, N. Y.

Heavy-Duty Boring Tool Held in Tailstock of Drill Press

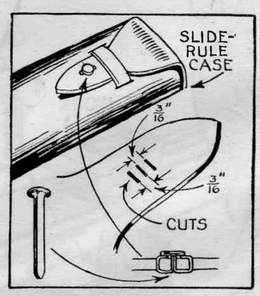
When I have a boring job to do where a pilot or guide on the end of the boring tool cannot be used, I use the tool shown, which can be held in the tailstock of a lathe or in the spindle of a drill press. The tool-bite holder is turned to fit the lathe or drill-press spindle, and a steel bushing is turned to fit snugly over the holder as indicated. The shoulder at the end of the bushing is just slightly smaller than the hole to be bored so that the bushing follows the tool into the work to act as a guide.



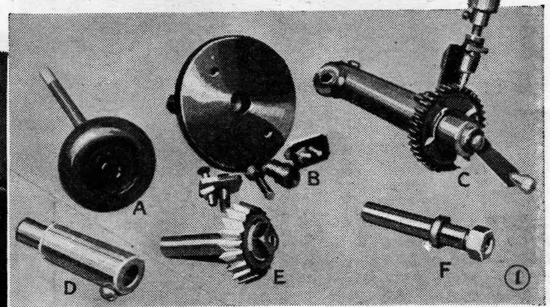
—W. P. Davies, Topeka, Kan.

Keeping Flap of Slide-Rule Case Closed with Staple

Men who carry slide rules in their pockets, and are bothered by the flaps of the cases opening, will find that staple paper clips of the type shown will keep them closed. To use one of the clips, make three slits in the flap as indicated and insert the clip as shown. The clip head prevents the flap from slipping out of the guide strip when closed.

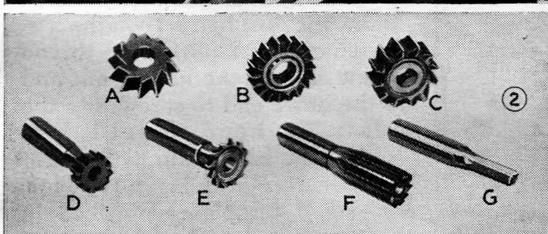


Make Your Own MILLING CUTTERS and Accessories



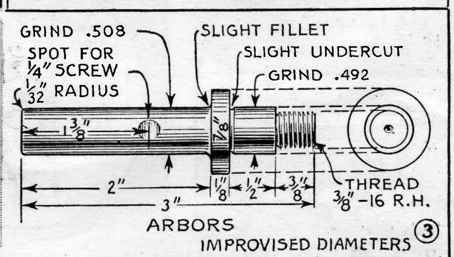
ACCESSORIES

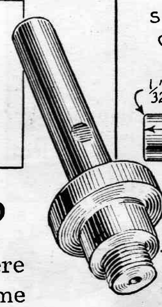
A—Draw-in rod
B—Faceplate
C—Index fixture
D—Collet
E—Cutter and arbor
F—Index arbor

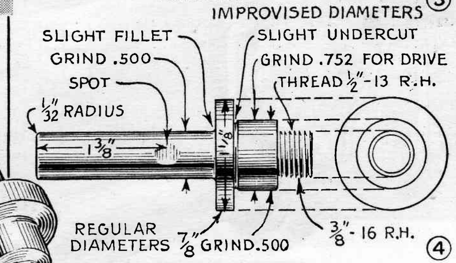


CUTTERS

A—Angular cutter
B—3/8-in. Side mill
C—3/4-in. Side mill
D—T-slot cutter
E—Keyway cutter
F—3/4-in. End mill
G—3/8-in. End mill



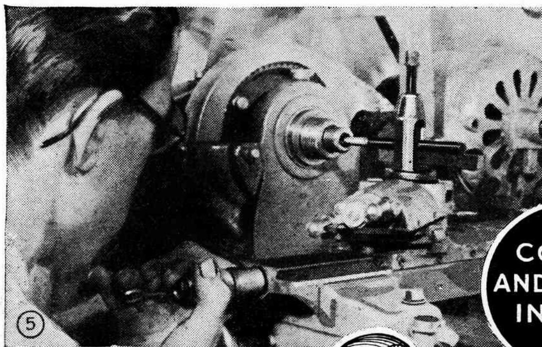




By H. J. CHAMBERLAND

MECHANICS in small shops where machines are limited, and home craftsmen who have metal-turning lathes can equip them to do milling jobs by making their own milling cutters and accessories, Figs. 1 and 2. To make cutters, you should have at least one that is ready-made before you can proceed. In this case, you require a right-hand angular cutter with a 45° included angle. This will cut a single angle of 22½° with measurements taken horizontally. However, the angle of the cutter itself will be 67½°, measured from its side. New cutters of this type are too large in diameter for bench-lathe milling, but this is to your advantage as you can easily obtain a used one, inexpensively, from a local machine shop. One worn to 1¾ or 1⅝ in. from successive grinds is just right.

Making the accessories: Your improvised cutter is likely to have no less than a ¾-in. bore, so you will require the arbor described in Fig. 4. As designated, it is first turned to suitable diameters for immediate use and refinished to suit cutters to be made. The arbor in Fig. 3 is to hold the side mills and angular cutter to mill the teeth. Note that the shank diameter is finished .508 in. As a milling cutter and its arbor must be held rigidly in the spindle, your next requisite is the collet and draw-in rod combination described in Figs. 6 and



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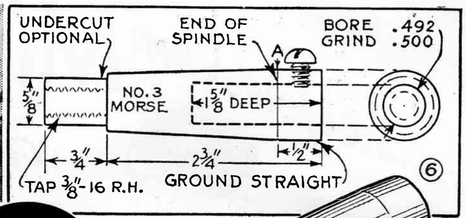

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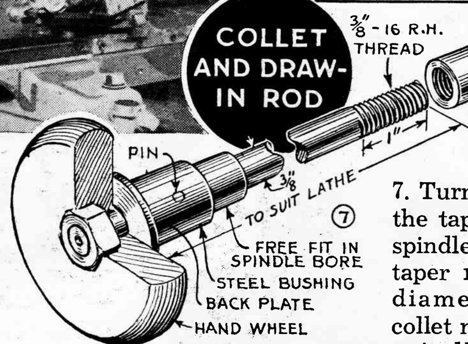
COLLET AND DRAW-IN ROD

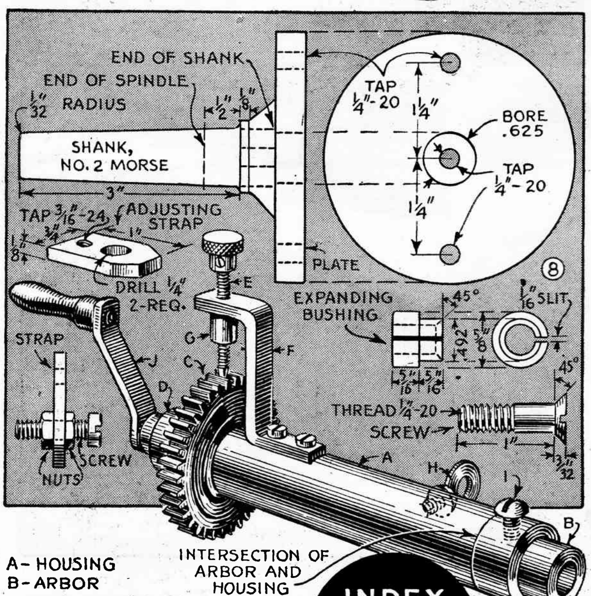


(7)

After turning the collet, grind it carefully to fit the taper of the lathe spindle. It must be held in the spindle while boring it out, after which it is ground to .500 in.

7. Turn the collet and grind the taper carefully to fit spindle bore. No. 3 Morse taper requires a .735-in. diameter at line A. The collet must be bored in the spindle, Fig. 5, and, of course, ground to .500 in. The draw-in rod is simplicity itself. Make the bushing to lathe requirements and pin to the thread at one end for the handle nut and at the other end to screw into the collet. The hand wheel is held against the back plate with nut.

For cutter-grinding purposes, the small faceplate described in Fig. 8 will be found convenient for numerous occasions besides this particular time. It is made in two parts. The shank is made first and then driven into the bore of the plate blank. Then, the assembly is held in the spindle for facing, counterboring and tapping. The expanding bushing is for holding cutters while grinding the sides



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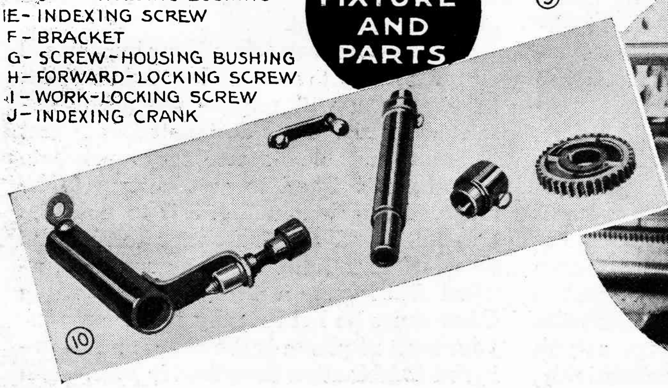
(9)

INDEX FIXTURE AND PARTS

A- HOUSING
B- ARBOR
C- LATHE GEAR
D- GEAR-HOLDING BUSHING
E- INDEXING SCREW
F- BRACKET
G- SCREW-HOUSING BUSHING
H- FORWARD-LOCKING SCREW
I- WORK-LOCKING SCREW
J- INDEXING CRANK



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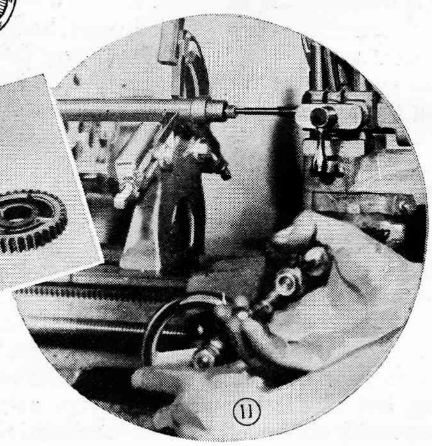
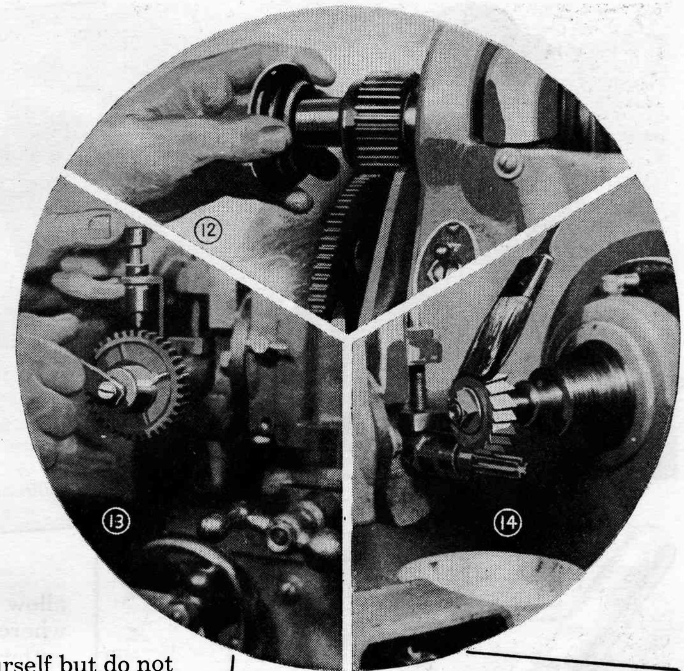


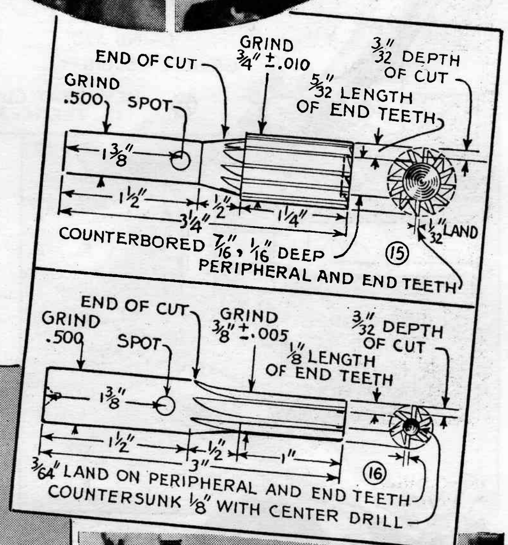
(11)

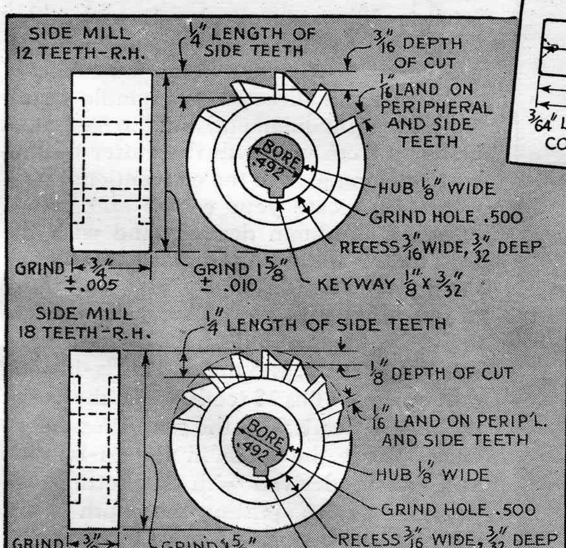
parallel, and the adjustable straps for holding them to grind the bores.

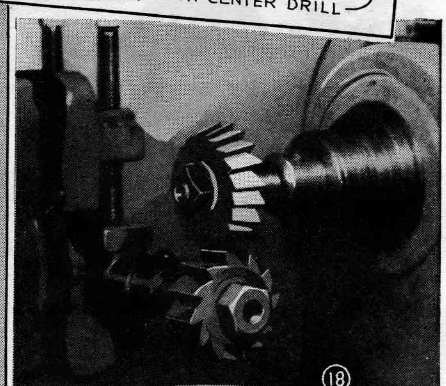
Of utmost importance is the indexing fixture. You will need it to divide the teeth accurately in all mills. Made entirely of scrap, except for one of the lathe's threading gears, it has done a surprisingly fine job as you note in Fig. 2. Clearly detailed in Fig. 9 with the parts illustrated in Fig. 10, you can duplicate this tool easily. Use steel tubing for the housing if possible, but brass piping will do in a pinch. Spline the lathe gear to the bushing. This assembly bolted to the arbor takes care of end-play adjustment. Make the fixture to suit yourself but do not omit the thumbscrew as it is your positive rigidity for milling. Fig. 11 shows grinding the bore of the arbor to .508 in. Fig. 13 is the end view of the fixture.

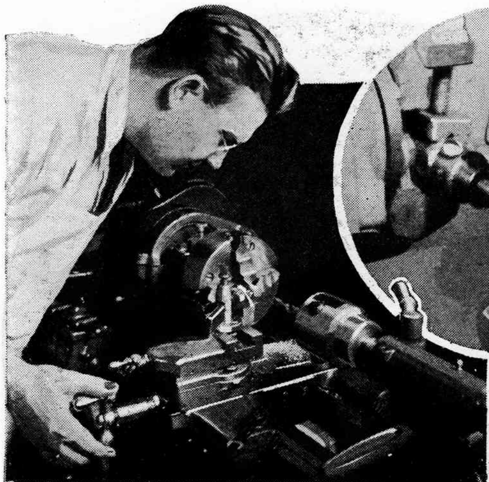


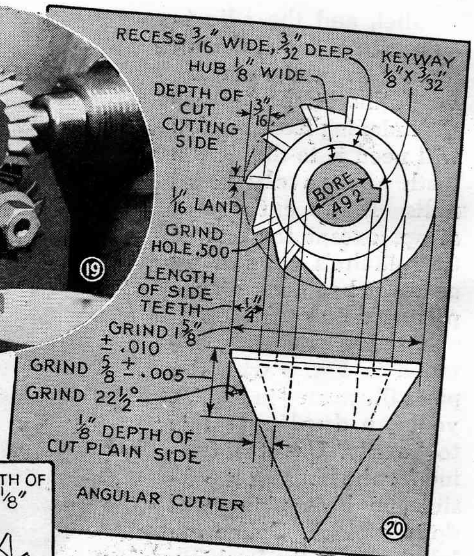
Making the cutters: You are now well equipped to mill teeth. To simplify and economize, you must standardize. In this instance we have ½-in. shanks and ½-in. bores. Use practical diameters for all tools and give the preference to 12 teeth, exclusive of two items. Machine the blanks and

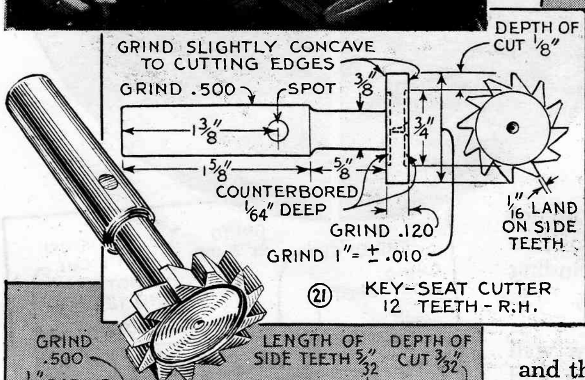


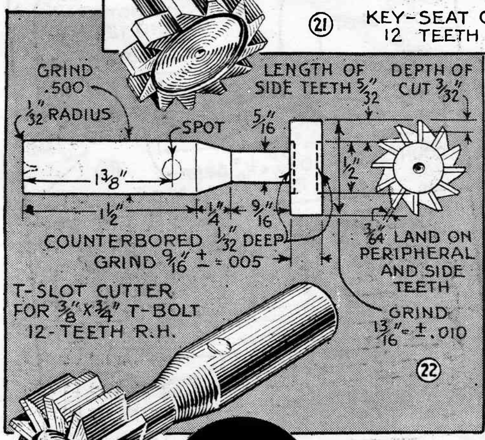




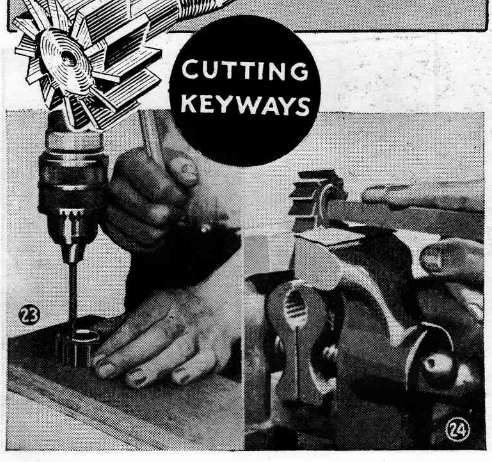






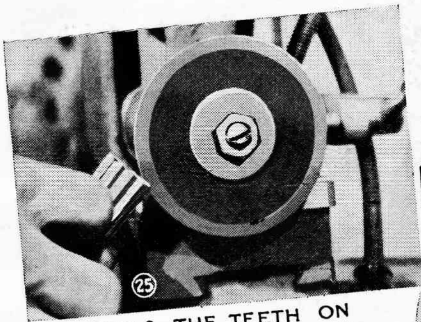


CUTTING KEYWAYS

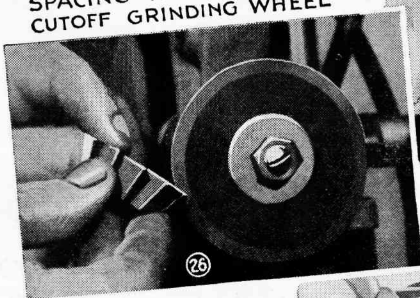


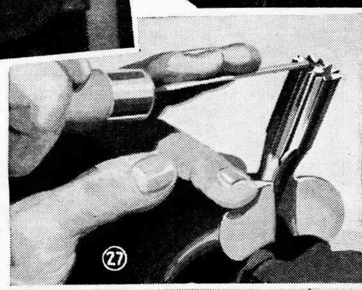
allow .007 to .008 in. for grinding, where so specified. If you use a cutter similar to the one mentioned, use the same number of teeth and depth of cut recommended in the individual sketches. See that the cutter is sharp, has a 1/32-in. flat or radius at the point, and the arbor tightly drawn in, Fig. 12.

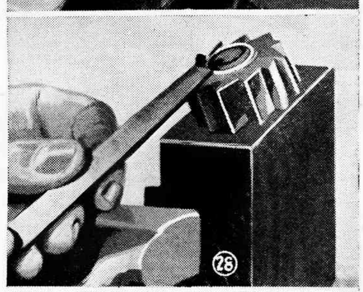
Milling peripheral teeth: For milling all peripheral teeth, the 36-tooth gear is used because 6, 12 and 18 divisions go into that number of teeth. You must, of course, make the bracket of the indexing fixture to suit a few other gears with different pitches. Eliminate all play in both index fixture and milling attachment and lock the carriage securely. You must necessarily reverse direction of spindle as all teeth are right-hand cut, and the feed must be away from you with the cutter milling bottom coming. Use the conventional procedure to locate your center and take a light cut to obtain desired land with the next index. Fig. 14 shows this operation on the 3/8-in. end mill. These teeth and those of the 3/4-in. mill are milled with a single cut. Figs. 15 and 16 describe, respectively, the 3/4 and 3/8-in. end mills. The 3/4-in. side mill in Fig. 17 has 12 teeth, while the 3/8-in. mill has 18 teeth with the same circumference. While the teeth in the 3/8-in. side mill can be derived with one setting, although I advise splitting the depth of cut with two indexings, you must follow a different course to cut the teeth in the 3/4-in.

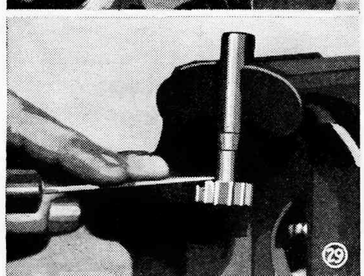


SPACING THE TEETH ON CUTOFF GRINDING WHEEL







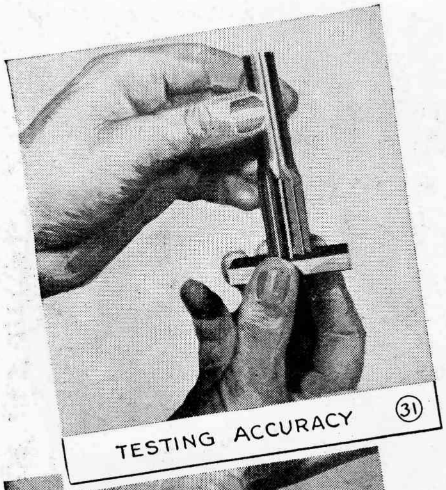


FILING TEETH

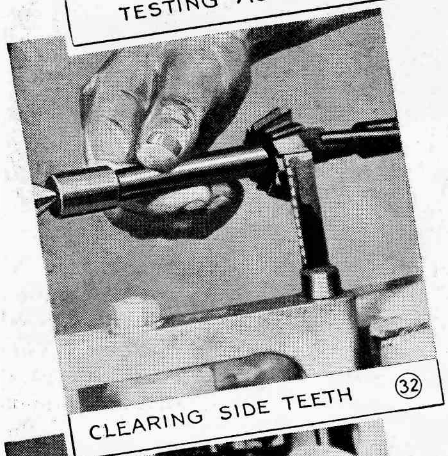
side mill, the reason being that if you milled deep enough to get a practical land for the teeth, the depth of cut would be abnormal and quite out of proportion. The procedure here is to mill to required depth first, preferably taking a double cut. Now instead of skipping three teeth on the indexing gear, you only go two for adjusting to a third cut. With this change in angle, you can obtain your land without milling any deeper. Obviously, this means changing the radial line, and, of course, the two-teeth change is for the initial indexing only. Fig. 18 shows taking this final cut on the ¾-in. side mill. Note that the line resulting from a change in angle is quite visible.

The problem of milling the peripheral teeth of the angular cutter in Fig. 20 is more complicated but not hard to solve. The fact is that you are faced with two diameters and must still obtain a uniform width of land. After setting the vise component of the milling attachment to a related angle so the cutter to be milled represents a straight surface, you get the desired depth on the cutting side with a double cut. The depth on the opposite side, of course, varies with the amount of angle. The rest is up to you to figure out. Besides duplicating the secondary setup of the ¾-in. side mill, you will have to readjust the graduation slightly to mill heavier at the front of the tooth. By proceeding carefully, you will succeed in obtaining good-looking teeth and uniformly straight lands. You can judge by Fig. 19 how the radial position has been altered to obtain a worthwhile shape of tooth for this mill. Milling the teeth in a key-seat cutter, Fig. 21, and the T-slot cutter, Fig. 22, should cause you little inconvenience.

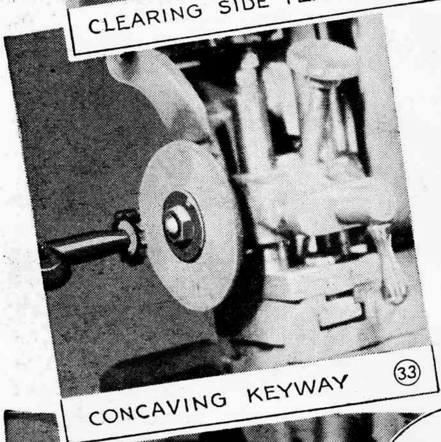
Making keyways: Here is an improvised method that makes keyway cutting easy. First, drive soft steel plugs into the under-



TESTING ACCURACY (31)



CLEARING SIDE TEETH (32)



CONCAVING KEYWAY (33)

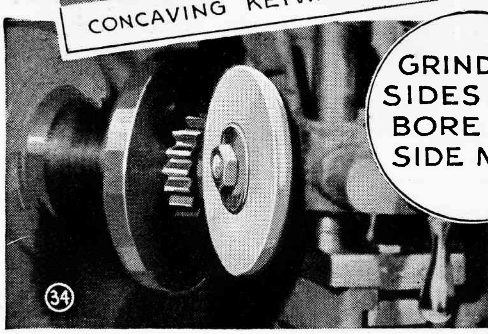
size cutter bores and drill a $\frac{5}{32}$-in. hole anywhere on the intersecting line, Fig. 23. The results are a $\frac{5}{64}$-in. radius, which is a guiding line to file keyways $\frac{1}{8}$ to $\frac{3}{32}$ in., Fig. 24.

Cutting end and side teeth: The next step is to divide accurately the end and side teeth so that they can be filed to shape. The easiest and quickest way is to mount a 3 or 4 by $\frac{1}{16}$-in. cutoff wheel in the lathe grinder. Then line up the face of peripheral teeth against the side of the wheel and cut across to recess or counterbore and equal depth. The end of $\frac{3}{4}$-in. end mill is shown being cut in this manner in Fig. 25. A similar operation is shown being performed on the side teeth of the angular cutter, in Fig. 26.

Filing: The end and side teeth are produced by filing at an angle that corresponds to the required lands and depths of the previous dividing grinds. Fig. 27 shows the correct hand position for filing end teeth on end mills. In this particular case, it is advisable to file the 3° clearance angle to within $\frac{1}{64}$ in. of the cutting edges. For filing side teeth on side mills and angular cutters, they are held to a wood block sawed as per Fig. 28. The inner side teeth of the T-slot cutter are filed as in Fig. 29. Also, it is best to file the clearance angle on the side teeth of this mill.

Hardening the tools: To harden the tools, the instructions given in articles of this type, published previously in Popular Mechanics, fit this case perfectly. Don't forget to file all burrs, and stamp to suit, unless you intend etching them. If you burn coke in your home heating plant, a good hardening job can be done by placing one or two of the tools on a $\frac{1}{4}$-in. steel plate previously heated to a red color. However, nothing can replace an electric or gas furnace, Fig. 30.

Grinding the tools: Cylindrically grind the shanks to size and give the peripheral teeth a 5° clearance angle, stoning the end teeth of the end mills to a sharp cutting edge. Fig. 31 illustrates a reliable method to test the end teeth on a small plate. If the mill rocks it



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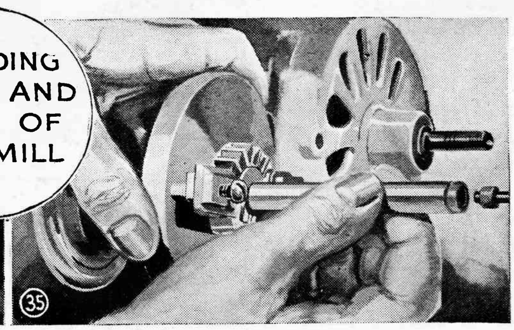


(35)

GRINDING SIDES AND BORE OF SIDE MILL

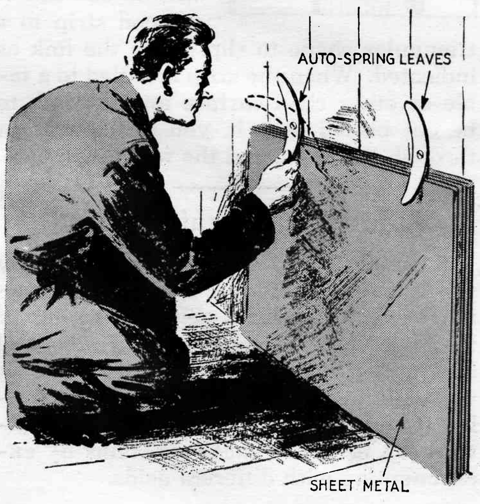
won't cut good. An internal-grinding wheel is safest to clear side teeth of angular cutters and side mills, Fig. 32. The key-seat cutter has no side teeth but is ground concaved on both sides, Fig. 33. Both sides of side mills and angular cutters are ground parallel with their respective bores as in Fig. 34. The expansion bushing holds the cutters securely to the small faceplate. The bores of these mills are then ground to .500 in. after centralizing with the tailstock and strapping to the faceplate, Fig. 35. A plug gauge is most convenient for testing bore size.

Toothpicks Serve as Wedges When Rewinding Motors

When I replaced the starting winding of an electric motor, using cotton-covered enamel wire, there was not much room to drive wedges to hold windings in place, as the original winding was plain enamel wire. To overcome this, I used round toothpicks which did not damage the insulation on the wire, as might have been the case if a straight wedge had been used.
—C. J. Umphenour, Beatrice, Nebr.

Sheet Metal Kept Against Wall With Large Turnbuttons

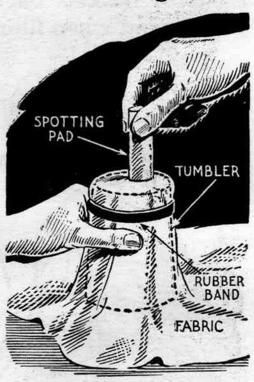
In order to hold sheet metal against a wall, where it can be removed conveniently as needed, attach a couple of short leaves from a discarded auto spring to the wall above the stock to serve as turnbuttons. These hold the metal securely in place but are easily swung to one side.



Rake Teeth Make Dump Manger That Is Cleaned Easily

Two hay-rake teeth and some narrow boards were used to make this round-bottom manger for calves. It may be tipped over to empty out all chaff and residue. Each of the bottom boards was fastened to the teeth with large staples, and the ends nailed to them. The coiled ends of the teeth fit in holes in the supporting posts.

Tumbler Used as 'Spotting Table' for Garment Cleaning



To hold thin fabrics for treatment of spots and stains with chemicals, one dry cleaner employs a glass tumbler. This is inverted under the garment and the fabric spread over it to bring the spot in working position. A rubber band may be snapped around the cloth to keep it from slipping while the work is in progress.

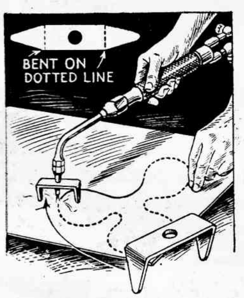
Rub the reflector and lens of a flashlight with carbon paper that has been heated and it will give a blue, white light.

Two consecutive sheets of veneer will give a perfect match at one joint, while the other joint will be an approximate match depending on the continuity of the grain. In this respect, mahogany gives almost perfect results even when all four pieces are cut from the same sheet. After each joint has been taped, the edges can be folded back and glue applied to the veneer edges with a small roller, Fig. 37. Fig. 38 shows the completed diamond pattern, all ready for the press. The familiar herring-bone pattern, Fig. 39, is made much the same as the diamond except every other piece is turned over.

Treatment of edges: The edges of a lumber-core panel require no treatment and can be molded and finished the same as a solid piece of wood. Edges of veneer cores are frequently finished dark with burnt umber to conceal the layers of veneer. A better method is to use an edging of the same wood as the face veneer, as shown in Figs. 40, 41, and 42. The edging can be applied either before or after the veneer is laid, the neatest method being to veneer over the edging. The strips should be mitered neatly at the corners, as can be seen in Fig. 44. Where the edges of the core are veneered, Fig. 43, the end grain of the core must be well sized with glue in order to secure good adhesion.

(To be continued)

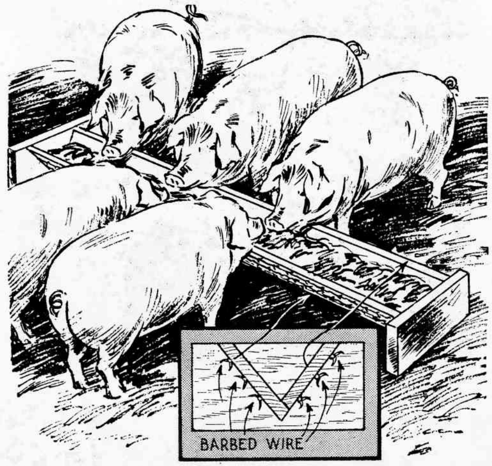
Simple Cutting-Torch Guide for Flat Work



This little clip will be found an aid in cutting designs from flat work with a torch. It is made from thin steel and the ends that slide on the work are ground smooth so that they move easily over the work. In use, the torch tip is simply rested in the hole of the guide, which helps to support it as it is moved.

¶All painted surfaces should be washed before repainting them, to remove film of oil, grease, dirt and stains. Also less paint is required if this is done and often a coat of paint is saved.

Barbed Wire under Trough Edge Prevents Hogs Tipping It

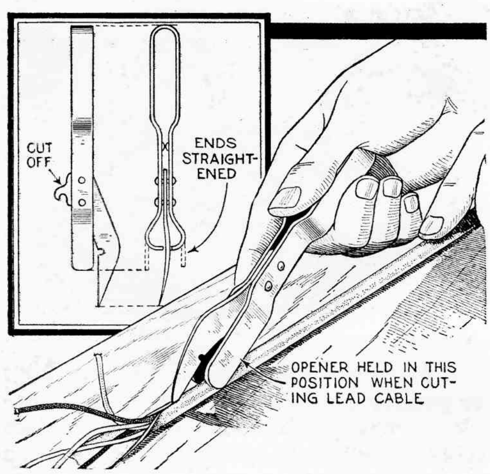


To keep his hogs from rooting and overturning the feed troughs, or from spilling the contents at feeding time, one farmer fastened lengths of barbed wire under the edges of each side. Regular staples were used to attach the wire, which was stapled at 1-ft. intervals.

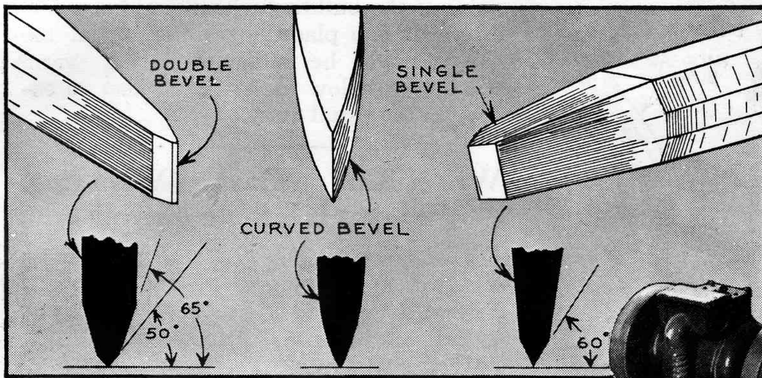
Covering of Armored Cable Removed with Can Opener

Electricians and others who have to open the ends of lead cables will find that the job can be done quickly with a can opener of the type shown. Slit the rounded end with a hack saw and straighten the severed ends to act as a guide on the cable. Then sharpen the cutting edge of the blade and use it as shown.

—Herman R. Wallin, New York, N. Y.



Grinding Your Cold Chisel to Suit the Work

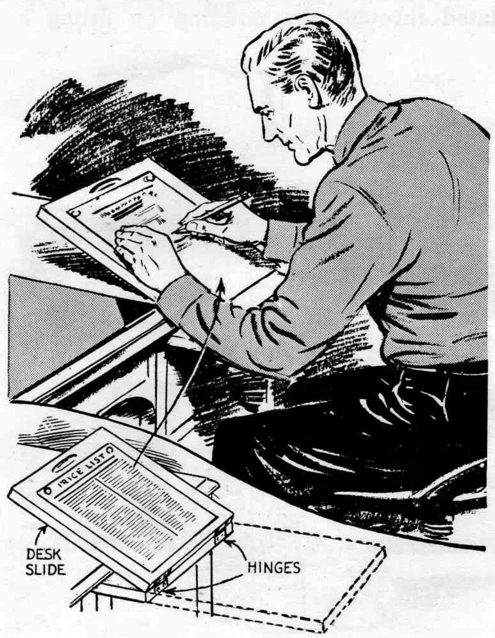


While the general-purpose cold chisel is ground with a single-beveled edge to best suit all kinds of work, specialized jobs require that the chisel be ground for the particular work at hand. The man who has occasional jobs of the latter type can grind his chisel to suit. To do clean work on thin sheet metal or to make a deep cut in soft metals, the bevel on each side should be ground to a long curve. This type of bevel is also used in cutting off the peened ends of rivets. It will help still more if you flatten one bevel slightly for this work. For heavy work, a double bevel gives best results. The wider angle across the bevels gives sufficient metal just above the cutting edge to prevent turning or chipping the edge. In the details above, the angles are only close approximations. The exact degree at which the bevels are cut is not so important as it is to have the bevels on both sides cut at the same angle.

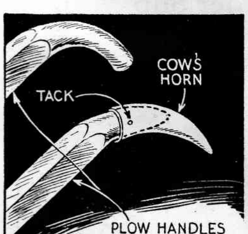
—W. C. Lammey, Naperville, Ill.

Desk Slide Used for Sketching When Hinged in Center

By hinging one of the wooden slides in his office desk as indicated, one executive converted it into a handy and convenient sketching board. Also, he found that the underside surface of the hinged end provided a suitable place to conceal confidential price lists.



Cow's Horn Repairs Handle of Walking Plow



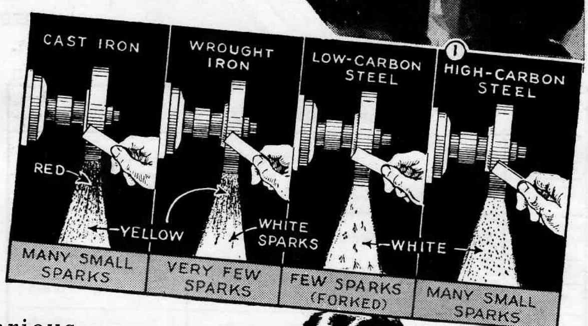
When the curved end of one handle of his walking plow was accidentally broken off, one farmer repaired it for temporary use by slipping a cow's horn over the end. Thus urgent work was done in the field while a new part was being ordered.

Simple Methods Identify
METAL *of* BROKEN CASTINGS

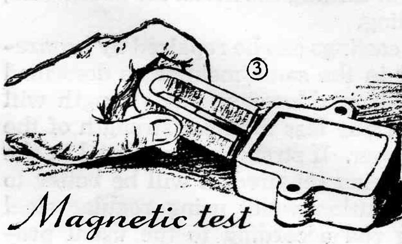
STAINLESS Alloys: Stainless steel and Monel metal usually present no identification problem as the maker will generally call attention to the fact that these metals were used. In addition, their bright stainless surface distinguishes them from other metals although it is important not to confuse these metals with chromium plate. Monel metal can be distinguished from stainless steel by the difference between their specific gravities. See Figs. 4 and 5.

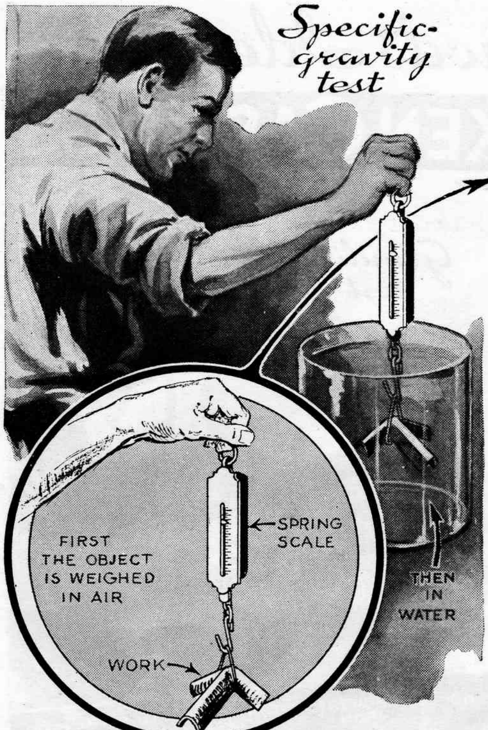
Copper Alloys: Bronze, brass and aluminum bronze are reddish or yellow in color, and can be distinguished from other metals if surface coatings of paint, dirt and corrosion, and plating are filed or ground off to expose the base metal. The other commonly used metals are white or gray in color. Bronze is definitely reddish in color and most brasses are yellow. Red brass is difficult to distinguish from bronze, but both are repaired by the same methods. Aluminum bronze is a yellow-gold color but can be distinguished from brass by the specific-gravity test.

Identifying Iron and Steel: Various grades of iron and steel can be distinguished most easily by the kind of sparks given off in grinding, as shown in Fig. 1. The chip test, Fig. 2, is another means of identification. Malleable iron differs from cast iron in its extreme hardness, as a file will hardly touch malleable iron. The fractured surface often gives a clue as to the kind of iron or steel; cast iron shows a very dark gray fracture while the fractures in wrought-iron and low-carbon steel castings are bright gray and those of high-



CAST IRON	WROUGHT IRON	LOW-CARBON STEEL CASTINGS	HIGH-CARBON STEEL
Chips break into small pieces, leaving fairly smooth surface	Soft and easy to chip; chips usually break in large pieces. Chipped surface quite smooth	Easily cut, leaving smooth surface. Chips are long, and have little tendency to break under chisel	Difficult to chip due to hardness. Chips are large. Chipped surface very light gray





EXAMPLE

WEIGHT IN AIR = 6.50 LBS.
WEIGHT IN WATER = 5.75 LBS.
LOSS OF WEIGHT = 0.75 LB.

④ SPECIFIC GRAVITY $\frac{\text{WEIGHT IN AIR}}{\text{LOSS OF WEIGHT}} = \frac{6.50}{.75} = 8.7$

If metal is white and non-magnetic, it is nickel silver (see table)
If metal is yellow or reddish and non-magnetic, it is brass (see table)

⑤ PROPERTIES OF ALLOYS

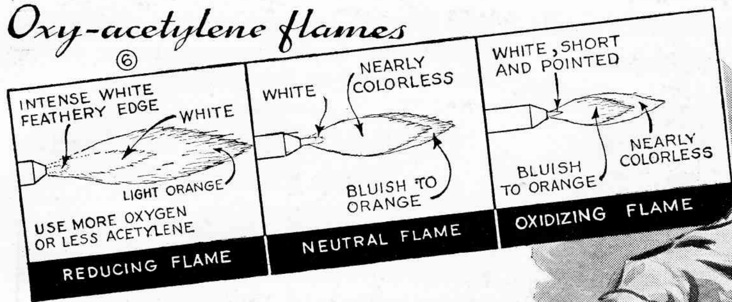
Specific Gravity	Color	Magnetic Properties	Name of Alloy	Repair Methods
8.9	White (stainless)	Non-mag.	Monel metal	Gas-weld; braze or silver-solder
8.8 to 9.0	Reddish-yellow	Non-mag.	Bronze	Bronze-weld (fusion); silver-solder or soft solder
8.7 to 8.8	White	Non-mag.	Nickel-silver	Silver-solder or soft solder
8.4 to 8.8	Yellow or reddish	Non-mag.	Brass	Braze; silver-solder or soft solder
7.5 to 8.2	Yellow-gold	Non-mag.	Aluminum-Bronze	Braze; silver-solder or soft solder
7.6 to 7.8	White (stainless)	Non-mag.	Stainless steel	Gas-weld; arc-weld; silver solder or soft solder
7.6 to 7.8	White	Magnetic	Steel	Bronze-weld; gas or arc-fusion weld
Ab. 7.6	White	Magnetic	Malleable iron	Bronze-weld
7.0 to 7.6	White	Magnetic	Cast iron	Bronze-weld
7.0 to 7.6	White	Non-mag.	Pewter	Soft solder
6.7 to 6.8	White	Non-mag.	Zinc alloys	No satisfactory methods
2.7 to 3.0	White	Non-mag.	Aluminum alloys	Gas-weld or soft solder with special flux
2.0 to 2.5	White	Non-mag.	Aluminum-magnesium alloys	Solder with aluminum solder and flux
1.7 to 1.8	White	Non-mag.	Dowmetal	Gas-weld with special rod and flux

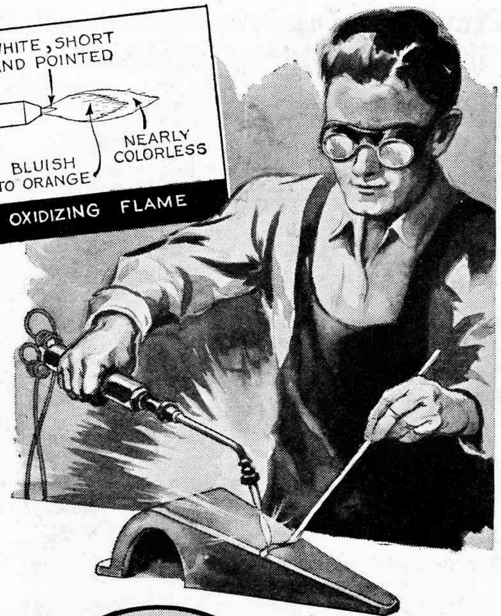
carbon steel are light gray. Iron and steel are the only metals appreciably affected by an ordinary magnet and can be identified readily in this way, as shown in Fig. 3.

Other White Metals: To distinguish other white or gray alloys commonly met with, it is only necessary to determine their specific gravity (specific gravity is the weight of an object divided by the weight of an equal volume of water). Measuring specific gravity is shown in Fig. 4. First suspend the article from an ordinary spring scale by a light wire or string to get the weight in air. Then suspend the article in water, using the same scale, and subtract this weight from the weight of the article in air to find the loss of weight. Then the specific gravity is found by dividing the weight in air by the loss of weight. White non-magnetic alloys vary in specific gravity from about 1.7 to 8.8.

Repair Methods for Iron and Steel: The best repair methods depend primarily on the alloy, but in some cases there is a choice of methods, depending on whether the casting is or is not subject to severe strain. Cast iron is best repaired by bronze-welding, using the oxyacetylene torch. Bronze-welding also should be used on malleable iron. The crack should be "veed" out as shown in Fig. 7, and the surfaces should be freed thoroughly from rust and scale by grinding, and then cleaned. The same procedure is necessary before any brazing or welding operation. Heat is applied with the torch, using a neutral or slightly oxidizing flame as shown in Fig. 6, heating the metal to a dull red heat, which will just permit the bronze welding rod to flow. The metal must not be overheated, and an excess-acetylene flame must not be used. The rod is dipped in flux and applied to the hot surfaces to tin them, and then more welding rod is applied to fill the gap, using flux as needed to remove oxide. The weld should be made a couple of inches at a time, first tinning the metal for about 2 in., then filling.

Steel castings can be repaired by bronze-welding in the same manner as described for cast iron. However, the strength will be materially less than the strength of the steel proper. If strength is essential in the casting being repaired, it will be better to make a fusion weld, using regular steel welding rod according to the usual pro-



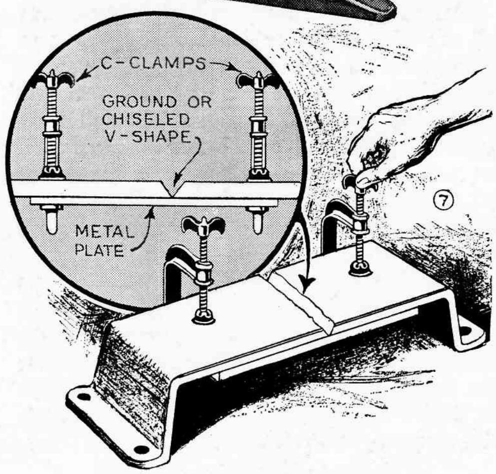


cedure. If preferred, arc-welding equipment can be used for this purpose.

Stainless steel can be welded with a flame either neutral or slightly excess in acetylene, as shown in Fig. 6. If arc welding is done, shielded-arc electrodes must be used, and the electrode is made positive, the work negative. Stainless-steel welding electrodes having approximately the same composition as the stainless steel itself should be used. Stainless steel also can be brazed or silver-soldered, and if strength is not needed, it can be soldered with ordinary solder, using hydrochloric acid as a flux. Monel metal should be welded using Monel welding rod, or silver-soldering may be applied.

Aluminum Alloys: Aluminum alloys and magnesium-aluminum alloys can be soldered by using commercial aluminum solders and flux, and a blowtorch or similar heat source to heat the metal. However, the work is somewhat exacting and frequently gas welding is a better solution. The flame used should be neutral or slightly reducing (excess acetylene). An active flux designed for use on aluminum also should be used liberally. Aluminum is very weak at its melting point and so the work must be well supported. The welding rod used preferably should be of about the same composition as the alloy used in the casting; and the work should be preheated to save on gas in welding. Dowmetal should be welded with a special welding rod and flux made for acetylene-welding Dowmetal, which are available from the manufacturer of the metal. The flux should be removed from the metal after welding to prevent corrosion.

Copper Alloys: Brass castings can be bronze-welded by a technique very similar to that used in bronze-welding cast iron. However, the melting point of brass is only slightly higher than that of the bronze welding rod, and care is needed to prevent overheating and melting the base metal. Brass also can be soldered very readily, using zinc-chloride flux, if great strength is not required. Brazing or silver-soldering will give considerably greater strength, and in many cases these are the most satisfactory methods to use on brass castings. Bronze also can be welded with bronze welding rod, but the technique is different. The melting point of bronze is about the same as that of the bronze welding rod, and so the base metal is melted and fused with the welding rod to make the joint. Welding flux is used as usual to remove oxide. Silver solder or ordinary soft solder also can be used on bronze. Aluminum bronze and nickel silver can be brazed, silver-soldered, or soldered.



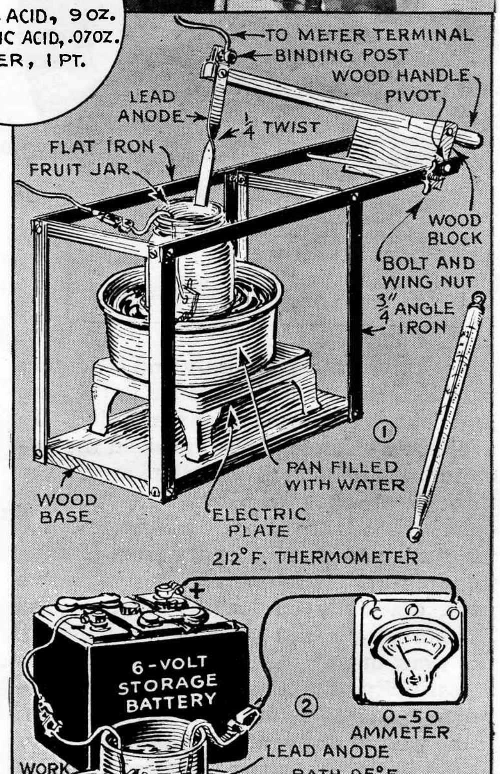
CHROMIUM PLATING *Simplified*

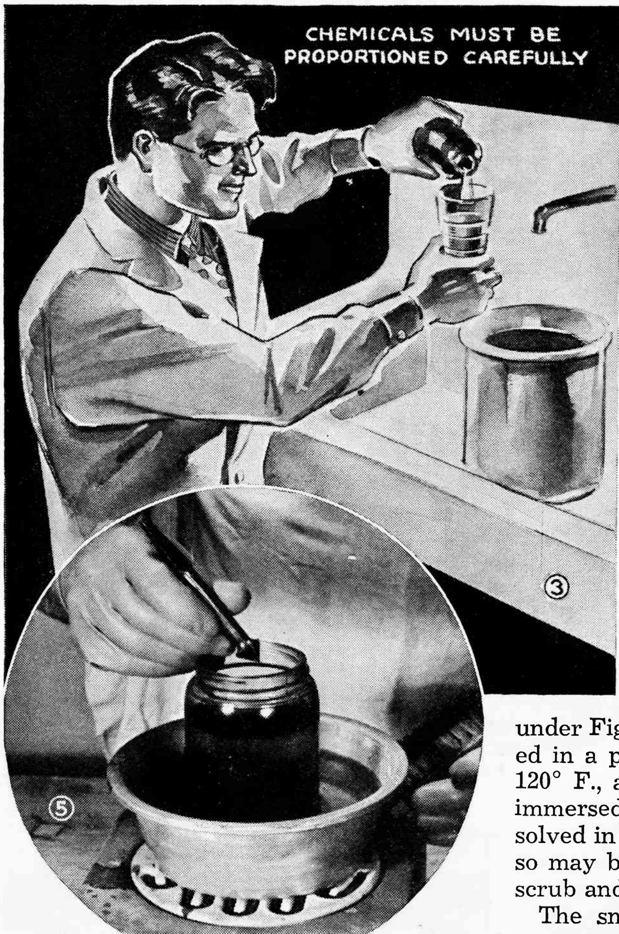
Lever to immerse anode in the plating solution gives accurate current control

***By* Alexander Maxwell**

WHERE an exceptionally hard surface is needed for wear-resisting quality, such as cutting edges of tools, chromium plating with subsequent honing has been found highly successful. Compared to a diamond, which for the sake of comparison we will rate at a hardness of ten, and tool steel, which ranges from four to seven, chromium is about nine. Applied directly to steel, it enables a tool to be used about four times as long as normally possible before sharpening.

A convenient chromium-plating arrangement for small work is shown in Figs. 1 and 2. A wood or metal framework on a wood base holds a gas or electric plate for heating a pan or pail of water in which a glass or stone container is set. The latter contains the plating solution, which is kept at uniform temperature by the hot water. Spacing blocks are provided under the jar to avoid direct contact with the pan. The framework also supports an anode holder, which is pivoted so that the anode can be immersed slowly into the plating solution until the correct current flow is registered on a 0-50 ammeter. When the anode, which is lead, has been immersed as far as required, the anode handle is locked in position by turning a wing nut on the frame until plating has been completed. Where considerable plating is done, a switch controlled by a thermostat in the water bath has been found helpful in turning the electric plate on and off to maintain uniform temperature automatically. While plating,





RUST-REMOVING FORMULA
HYDROCHLORIC ACID, 1 OZ.
WATER, 10 OZ. (HEAT TO 120°)

CURRENT REQUIREMENTS FOR SURFACE AREA
(at 75 amps. per sq. ft.)

1 sq. in.	requires	0.52 amp.
2 "	"	1.04 "
3 "	"	1.56 "
4 "	"	2.08 "
5 "	"	2.6 "
6 "	"	3.12 "
7 "	"	3.64 "
8 "	"	4.16 "
9 "	"	4.68 "
10 "	"	5.2 "
20 "	"	10.4 "
30 "	"	15.6 "
40 "	"	20.8 "
50 "	"	26.0 "
60 "	"	31.2 "
70 "	"	36.4 "
80 "	"	41.6 "
90 "	"	46.8 "
100 "	"	50.2 "

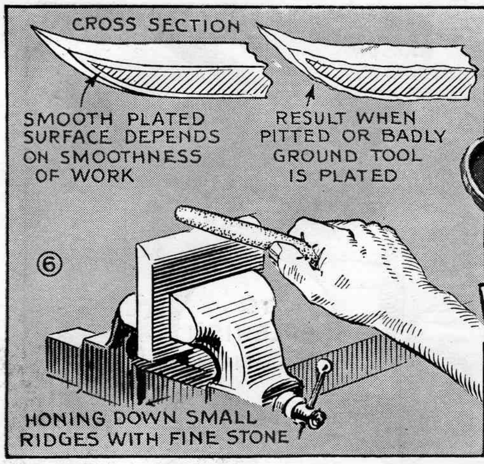
④

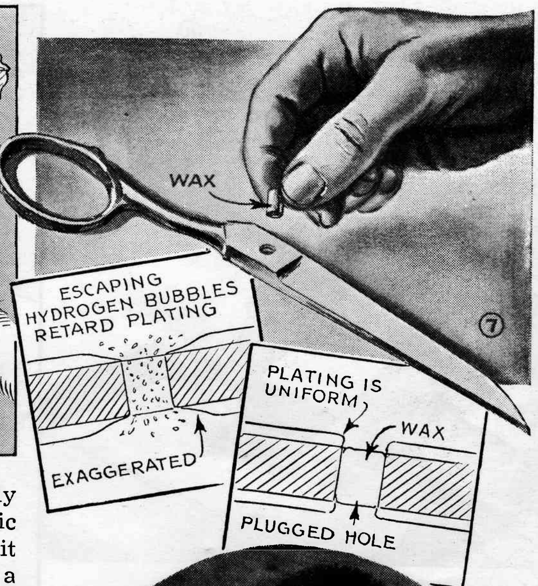
the solution gasses violently and the fumes produced should not be inhaled as they are injurious to the nose and throat lining. To avoid this, a fan is placed between the operator and the tank to blow the fumes away through an open window. Fan-equipped exhaust hoods are also used. An additional precaution to prevent injury from breathing the fumes is to rub vaseline inside the nose, especially on lengthy plating jobs. Rubber gloves are worn when handling the work or any other time when there is a possibility of getting the plating or rust-removing solution on the hands. However, if the worker accidentally gets some on his hands, immediate rinsing in running water will prevent any harm.

Rust on the work to be plated should be removed, although scrupulous cleaning procedure necessary with most plating baths is not essential with chromium, as the acid itself is better than any soap or solvent available. For rust removal a bath of hydrochloric acid and water (see formula under Fig. 5) is prepared, and this is heated in a pan of water to a temperature of 120° F., after which the rusty objects are immersed. Light coatings of rust are dissolved in about 10 minutes, but an hour or so may be necessary for bad cases. Then scrub and rinse well with water.

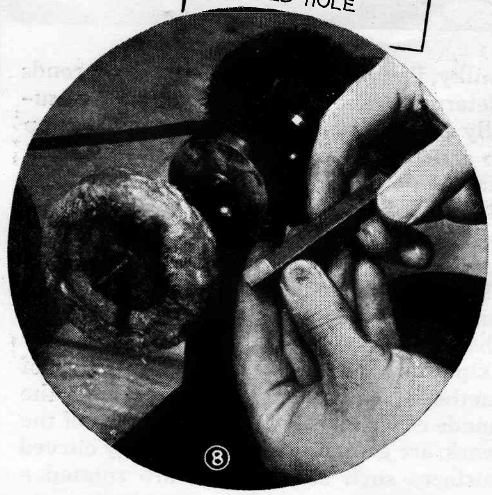
The smoothness of the plated surface varies with that of the surface underneath as shown in Fig. 6. Therefore surface irregularities of the work are removed before plating it. Preliminary smoothing of a rough surface is accomplished by grinding with suitable stones. This is followed by a thorough buffing, Fig. 8, using a cotton buff charged with fine silicon carbide in lard, then tripoli. For final polish a high-speed flannel buff charged with rottenstone is used. Holes, such as those in a pair of pliers or scissors, resist plating because the hydrogen generated is sufficient to drive chromium away from surrounding surfaces. These holes are plugged with wax, plastic clay or cork as in Fig. 7.

Successful chromium plating depends on keeping the sulphate percentage of the solution within bonds, keeping the temperature of the solution constant at 95° F., and applying the proper amount of current, which is 75 amps. per square foot of surface being plated. An effective plating solution is given at the left of Fig. 1. The

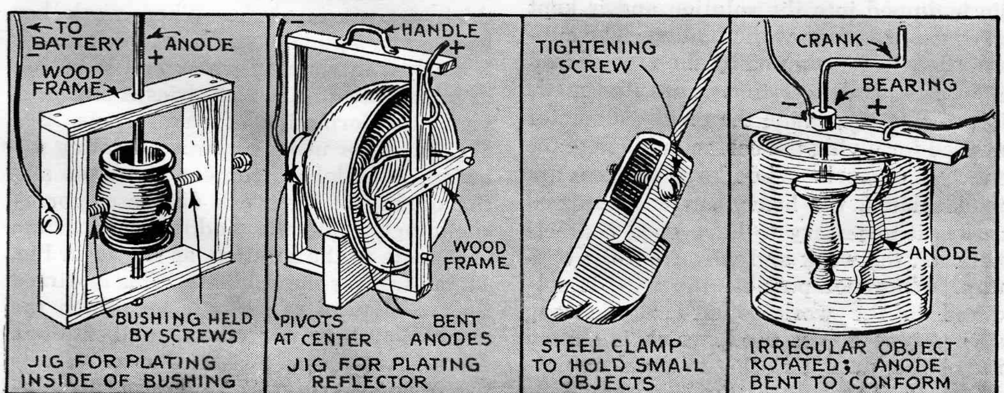




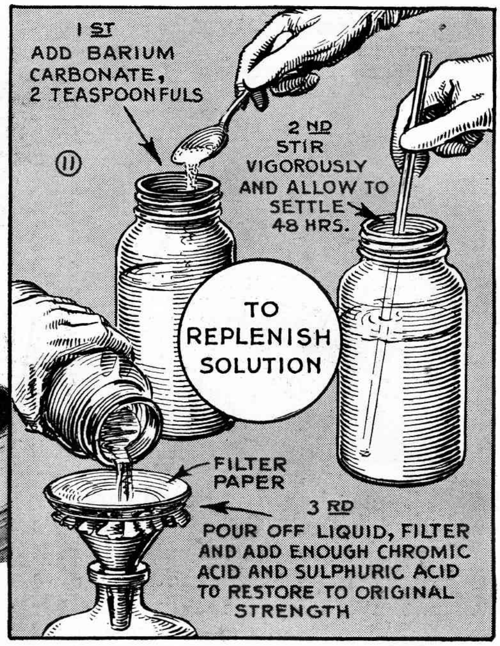
chemicals must be proportioned carefully as indicated in Fig. 3. Commercial chromic acid has a light amount of sulphate in it and usually requires the addition of a small amount of sulphuric acid with a medicine dropper. When the correct amount of sulphate is present, a bright deposit of chromium will be produced at a temperature of 95°, provided the correct amperage is applied. To test, add sulphuric acid drop by drop while plating a sample piece. The table given in Fig. 4 shows exact current requirements for various areas from 1 to 100 sq. in. Current is supplied by a 6-volt, heavy-duty storage battery. The negative side is connected to the work and the positive side runs through the ammeter to the anode, as shown in Figs. 1 and 2. Use heavy rubber-covered wire or flexible cable of large enough size so that it will not heat excessively when a large current is passed. If any one or more of the three factors controlling the success of the work are at fault, the plate deposited will be



Tools to be plated must be free from rust, pits and scratches if a smooth coating of chromium is expected. If necessary, grind down the tool and polish to a mirror-like surface



⑨ IRREGULAR WORK REQUIRES SPECIALLY SHAPED ANODES

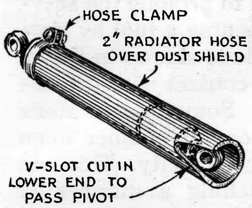


milky, flaky or muddy. The first 5 seconds determines the type of deposit, but it usually takes about 20 minutes to build it up to satisfactory thickness. If the deposit at first is not right, it can be removed from the work by immersing in the warm rust-removing solution.

Odd-shaped pieces of work require specially shaped anodes because the chromium is deposited first and most on parts of the work closest to the anode, and may skip those farthest away. A number of methods for spacing the surface of the anode equidistantly from the surface of the work, are given in Fig. 9. Uniformly curved surfaces such as reflectors are rotated a few degrees every minute to obtain uniform plating. In lining a bronze or steel bearing, the anode is a lead rod located in the exact center of the bearing. The entire jig is dipped into the solution and is kept in constant motion while plating. The current flow is determined by the area of lead immersed, and experiments are first made in order to determine the proper diameter needed for giving the correct amperage for the area of work. When large surfaces are to be plated, the heavy current required makes it necessary to have good contacts between the work and wire from the battery. Wherever possible the wire is soldered to the work; otherwise a strong spring-type clip is used, which is shifted in position during plating to avoid unplated spots. The area of the clip should be added to that of the work to get correct figure for current. Statuettes and ornaments are best plated in a dilute plating solution. Start them at lower current than the maximum given in the table and increase the current gradually to maximum as the plating progresses. Objects having irregular surfaces not sufficiently pronounced to require specially shaped anodes should be kept moving constantly in the plating bath to assure an even coating of chromium all around. In order to plate metals other than steel, copper or nickel, they must be copper or nickel plated before applying chromium. For cutting and abrasion resistance on tools, a .005-in. plate is sufficient. When plating tools, allowance is made for grinding down the surface to a keen edge, and for this reason an extra thick deposit is made. When work has been given a plate of sufficient thickness, it is washed in running water and is buried in maple sawdust, which dries it and prevents the formation of water spots. See Fig. 10. After using chromium-plating solution, its sulphate content increases and the quality of the work decreases correspondingly, but the addition of barium carbonate to the solution, as shown in Fig. 11, neutralizes the sulphate. This is stirred in and allowed to settle, after which the clear liquid is poured off and filtered. More chromic and a slight amount of sulphuric acid are added to restore the solution to original strength.

batteries that are to be recharged. The lid of the pot was removed entirely and the perforations between the body and the spout were punched out to make pouring easier. The shape of the spout makes it an easy matter to apply any amount of compound exactly where it is required.

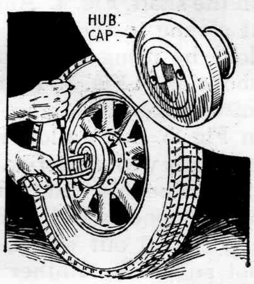
Protecting Shock Absorbers Against Gravel and Rocks



Instead of purchasing expensive shields to protect the direct-acting shock absorbers on my car, I made some from radiator hose. This was cut in sections long enough to cover each shock absorber completely and held in place with regular radiator hose clamps.

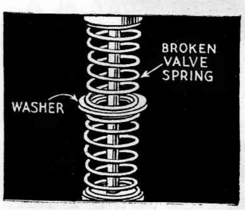
—Emil J. Novak, Omaha, Nebr.

Unscrewing Slotted Hub Caps



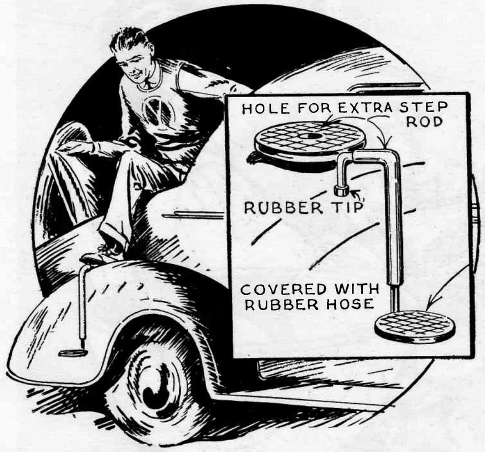
If an old car of the type having wooden wheels, which have slots in the hub caps to take a tool for removing them, comes into your shop and the caps have to be removed and there is no tool at hand, try a pair of pliers. Just insert the ends of the plier handles into the slots and use a screwdriver as shown to unscrew the cap.

Emergency Valve-Spring Repair



When a valve spring breaks and a new one is not at hand, an emergency repair can be made by placing a large washer between the broken ends. This prevents the ends from telescoping or twisting to one side, so that the valve will continue to function until a new one can be obtained.

Removable Step on Car Fender to Enter Rumble Seat

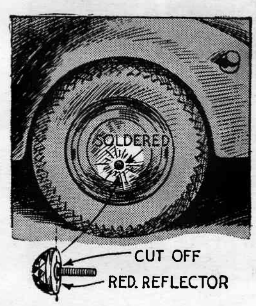


To facilitate entering the rumble seat of his car, especially for the lady members of his family, one motorist provided the extra step shown. It fits into a hole drilled in the regular fender step and is stored in the rumble-seat compartment when not in use.

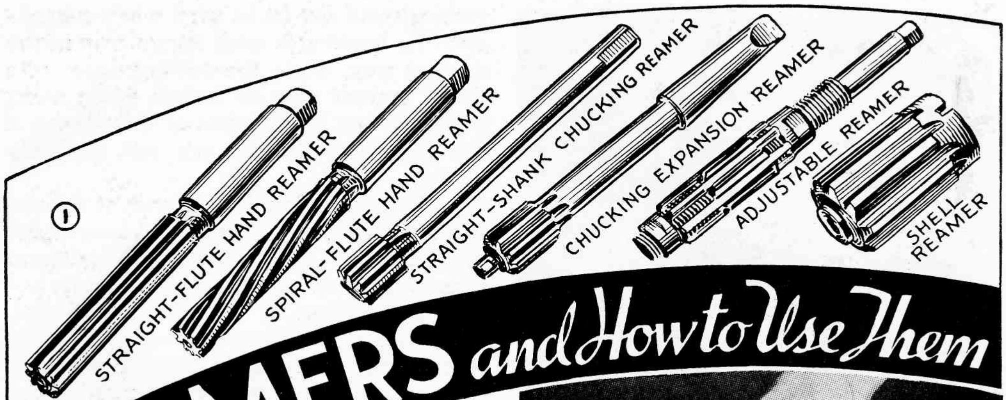
Lock on Car Door Changed Over to Steering-Wheel Side

Tired of sliding across the front seat of his car many times during the day with a sample case, one salesman changed the lock on his car door over to the steering-wheel side for convenience. The lock, being of the type that operated in the door handle, was easily changed in a few minutes by merely switching the handles.

Hub Reflectors Safety Precaution When Crossing Highway

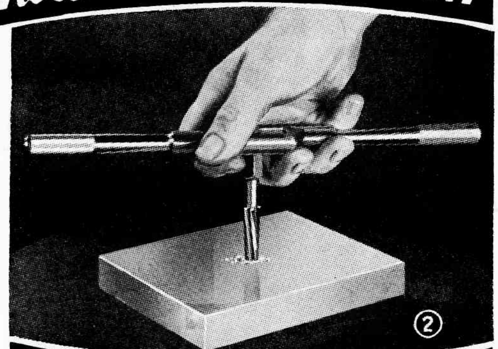


Have you ever had a bad scare when crossing a dark highway or street because an oncoming motorist did not see your car? If so, reflectors attached to the hub caps will help avoid this in the future. The reflectors should be attached near the edge of the cap so they will form a ring of light when the lights from an oncoming car strike them.



REAMERS and How to Use Them

By C. A. Crowley



REAMER CHUCKED IN A TAP WRENCH

WITH the use of a reamer you can enlarge slightly the size of a hole in metal to within .001 in. of the desired finish size, or even closer. There are various kinds of reamers available, which differ in their own particular purpose and advantage. Some of these are shown in Fig. 1.

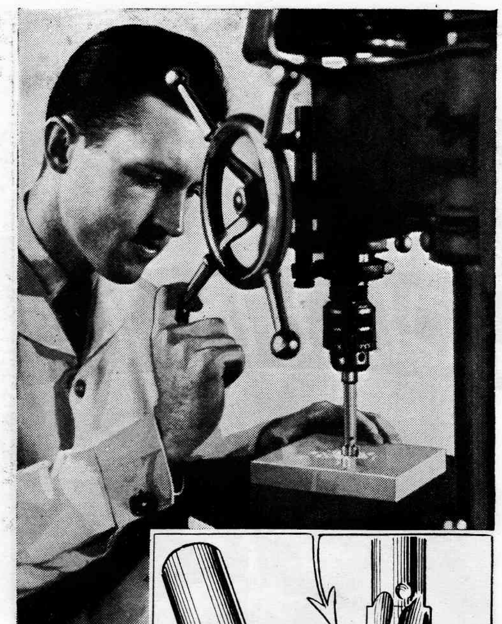
A hand reamer of either the straight or spiral fluted type, as in the two left-hand details of Fig. 1, is used for finishing to size where a very accurate hole is required, after the hole has already been rough-reamed to within a few thousandths of an inch undersize. These reamers are ground straight except for a short distance at the end where they are slightly tapered to enable them to enter the drilled hole. A hand reamer never should be used to remove more than .005 in. of metal.

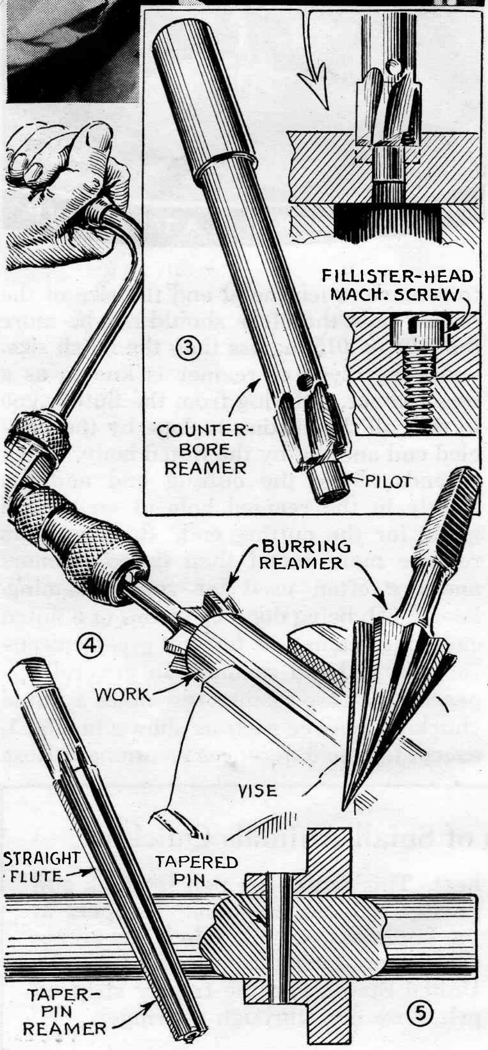
Fluted machine reamers may be of the straight or tapered-shank variety. The cutting edges extend the entire length of the flutes and the teeth are beveled slightly at the end so that the tool will enter the hole. While such a reamer produces a smooth and accurate hole, it cannot be used to remove much metal and the size of the drilled hole therefore should not be more than .01 to .015 in. less than the finish size.

Another type of reamer is known as a rose reamer, differing from the fluted type in that all the cutting is done by the beveled end and not by the fluted body, which extends above the cutting end and fits closely in the reamed hole to serve as a guide for the cutting end. Rose reamers remove more metal than fluted reamers and are often used for rough-reaming, later finish being done by means of a fluted chucking reamer, or for still greater accuracy, by a hand reamer. In general appearance a rose reamer resembles a fluted chucking reamer such as shown in Fig. 1, except for the differences mentioned. Rose

Clothes Wringer Dries Pelts of Small Animals Quickly

Fur pelts ordinarily take a long time to dry, even when carefully cleaned by an experienced hand of all excess fat and moisture. Amateur trappers on farms and in small towns are prone to rush the drying process with artificial heat. This causes the pelt to crack and greatly reduces its value. Trappers in the Louisiana swamps, one of the greatest fur-producing territories in the United States, run the freshly stripped pelt, nose first, through a wringer.





reamers will not be injured when a hardened jig bushing is used for guiding in the normal way, while the cutting edges of a fluted reamer may be dulled, when using a jig bushing, on account of side thrust if the hole and the jig are not perfectly aligned.

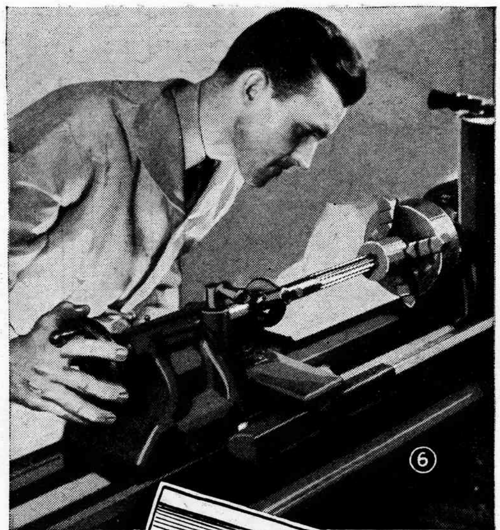
A shell type of reamer, shown at the extreme right in Fig. 1, is drilled lengthwise concentrically so that several different sizes can be interchanged on the same arbor. In addition to the types mentioned, there are also adjustable and expansion reamers as shown in Fig. 1; adjustable and expansion shell reamers; repairman's taper reamers, Fig. 2; counterbores, Fig. 3; pipe-burring reamers, Fig. 4; taper-pin reamers, Fig. 5; countersinks, Fig. 7, and also combination drills and countersinks, Fig. 8.

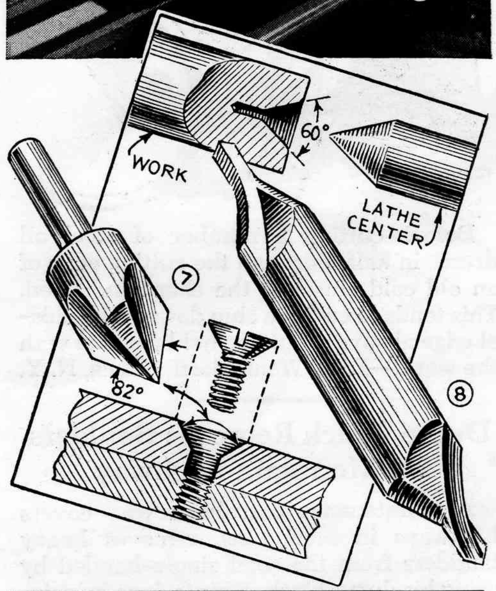
Whether or not a hole is to be reamed, and how carefully it should be reamed, depends on its purpose. Holes for bolts and screws, whether body size or tap size, are not generally reamed. Where an accurate, close fit is necessary, a hole is invariably reamed, as for instance, a hole for a mandrel on which work is to be placed for further machining, as in the case of a pulley. In some cases, sufficient accuracy can be obtained by machine-reaming only; in other cases the required accuracy can only be obtained by hand reaming. Holes that are to be reamed should be drilled 1/64 to 1/32 in. less than the finished size. After drilling, it is best to follow immediately with the machine reamer, without disturbing the setup or unclamping the work, so that the reamer will follow the drilled hole. Speed for reaming should be somewhat less than the speed for drilling. The feed should not be too rapid or the reamer may tear. It is always best to err on the side of feeding too slowly rather than too fast. Cutting lubricants should be used as in drilling most metals; lard oil or other suitable cutting oil being used on steel. No lubricant is used in the case of cast iron. A reamer should be started into the work with great care; otherwise, it may chatter and spoil the mouth of the hole. It is frequently better to start the reamer by hand, pulling the belt if necessary, in order to start it true.

Work may be reamed in a lathe, as shown in Fig. 6. The work can be left on the faceplate or in the chuck after drilling, and the drill in the tailstock is replaced with a reamer. The reamer can then be fed in while the work is turned. The speed should be somewhat less than that used in drilling.

If the hole is to be hand-reamed, it first should be machine-reamed to within .005 in. of finished size. The hand reamer never should be used except with a tap wrench, and great care is needed to start the hand reamer straight. The reamer should not be forced into the hole, but should be advanced carefully and evenly. A burr on a reamer may spoil a hole. Consequently, before using a reamer, it is best to feel the cutting edges, and if there is a burr, remove it with an oilstone. Reamers should never be turned backward under any circumstances.

The counterbore, shown in Fig. 3, is used for making the recess for a fillister head screw. The guide or pilot is the size of the drilled hole, so that it fits snugly yet without binding. The pilots are generally interchangeable so that the same size cutter can be used for a number of screw sizes. The cutter head is the size of the desired hole. The countersink shown in Fig. 7 is used for enlarging the mouth of a hole to cone shape for a flat-head screw. This type of countersink, ground at an angle of 82°, should be distinguished carefully from the 60° countersink used to ream out the centers on lathework. A combination drill and countersink is also available for making lathe centers, as shown in Fig. 8.

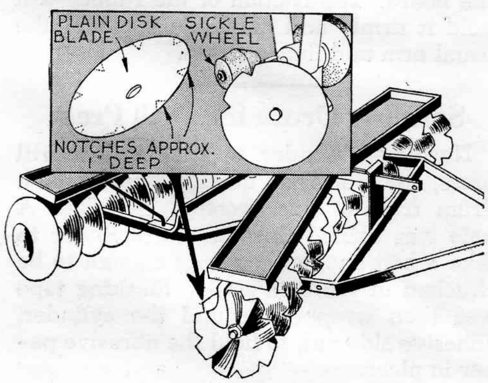




Disk Harrow Blades Notched to Cut Cornstalks

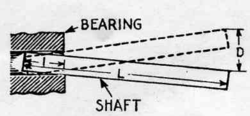
When disking cornstalks trouble often experienced with clogging of the disk harrow can be avoided by grinding equally spaced notches in each blade of the front gangs of a tandem disk. The notches catch loose stalks and pull them under the gangs where they are cut into short pieces.

—W. C. Lammey, Naperville, Ill.



Shaft Clearance Measured Easily Without a Micrometer

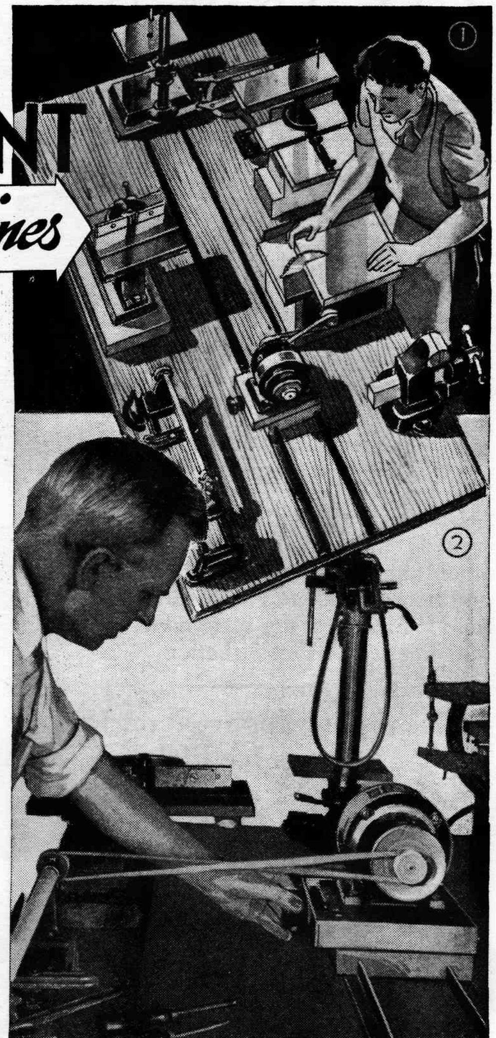
Shaft clearance in a worn bearing can be measured without a micrometer in a few minutes. First measure the length of the shaft L, push it part way back into the bearing and measure distance I. Now move the end of the shaft from one extreme to the other and get distance D. After marking down these dimensions in inches, multiply the movement D by distance I and divide by twice the length of shaft L. The result will be the clearance in inches.



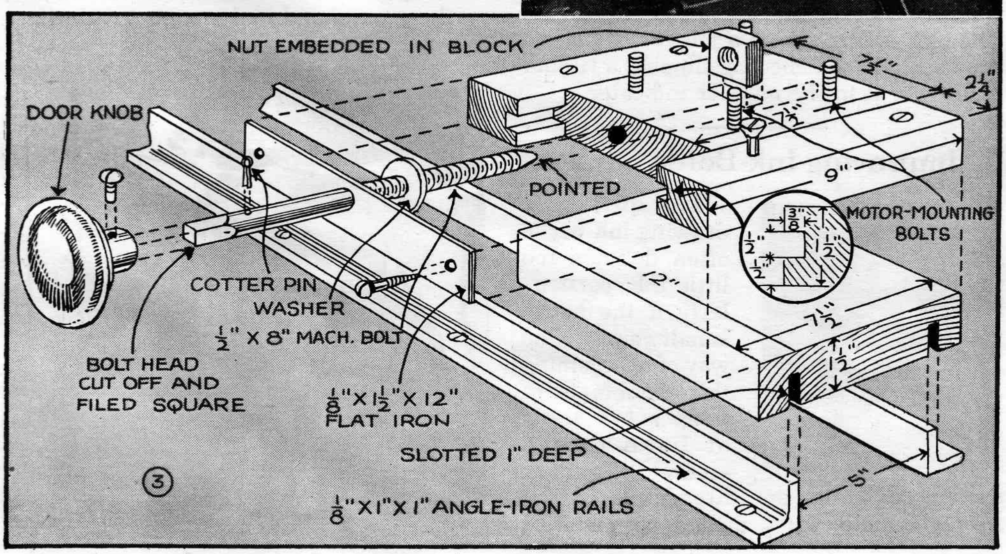
Sliding MOTOR MOUNT

Serves bench-top machines

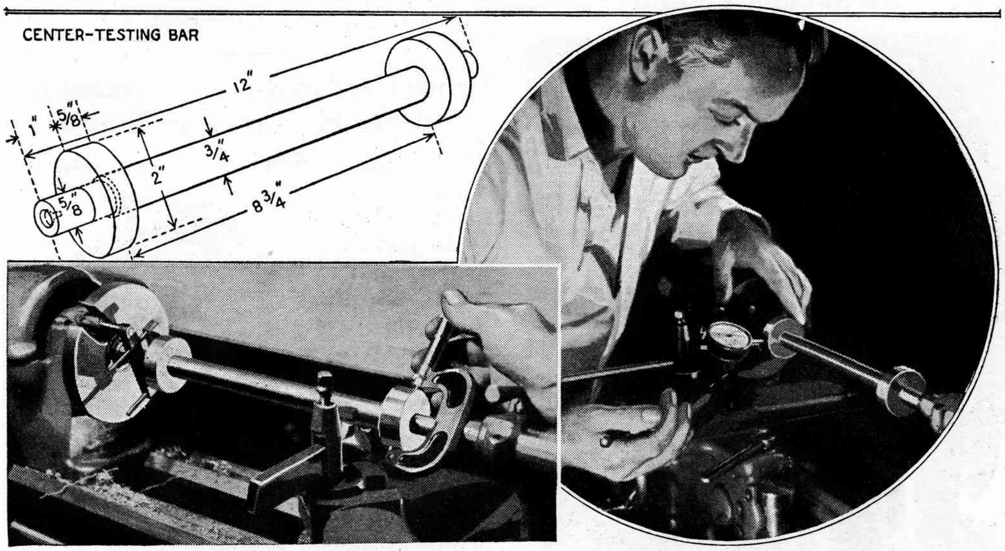
By H. O. BUMANN



MOVABLE longitudinally on two angle-iron rails running down the center of your bench top so that it can be slid into position quickly, to operate any one of several small power machines mounted on each side as in Fig. 1, this quick-change motor "carriage" is adjustable laterally as well, for tensioning the belt of each machine as shown in Fig. 2. The lower block of the "carriage" is slotted to slide freely on 1 by 1-in. rails spaced about 5 in. apart. The center piece of the upper assembly to which the motor is bolted, slides on two grooved members screwed to the lower block, and is made adjustable crosswise by means of a bolt passing through a flat-iron brace and into a nut embedded into the wood as shown in Fig. 3. Machines which may be operated either clockwise or counterclockwise, such as a jigsaw, disk sander, etc., should be mounted along the rear side of the bench so that other machines, which must run clockwise, can be driven without twisting the belt.



Aligning Bar Checks Lathe Centers Accurately

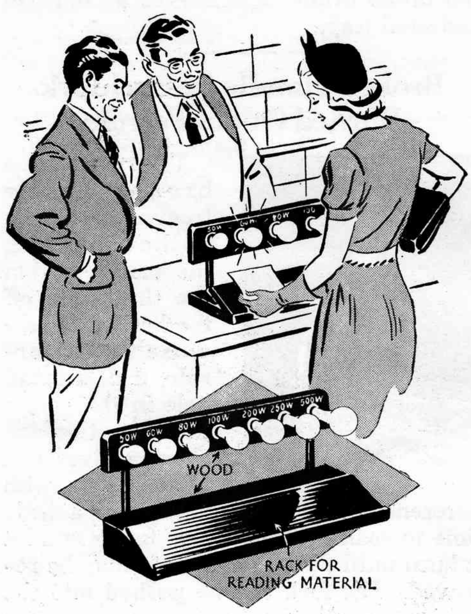


Checking lathe centers for perfect alignment, which is necessary in precision work, is a simple matter when this testing bar is used. It consists of a steel shaft turned accurately to size with shoulders formed on the ends to take steel disks with a light, drive fit. In use, the bar is mounted between the centers to be checked. Then a dial indicator is placed in the tool post, and moved up against the disk at the headstock end, after which the indicator is adjusted by means of the cross slide so that the dial reads zero. Now, without changing the adjustment, the carriage is moved to bring the indicator against the disk at the tailstock end of the bar. By adjusting the setover screw on the tailstock base until the needle on the dial again points to zero, the centers are aligned accurately.

—C. W. Woodson, East Aurora, N. Y.

Display Rack of Lamps Aids in Selecting the Correct Size

Customers who have difficulty in selecting an electric lamp of a size to provide the illumination desired, will appreciate a display rack of the type shown in your store. One each of all sizes of lamps carried in stock is screwed into a socket on the rack, which is wired so that the lamps can be turned on individually. With this arrangement, a customer can check the illumination produced by each lamp by reading printed material held directly under it.

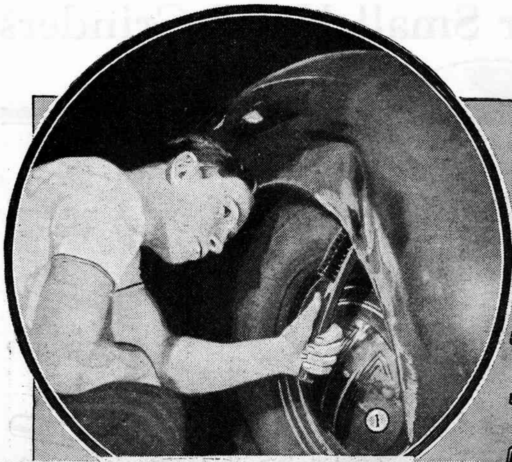


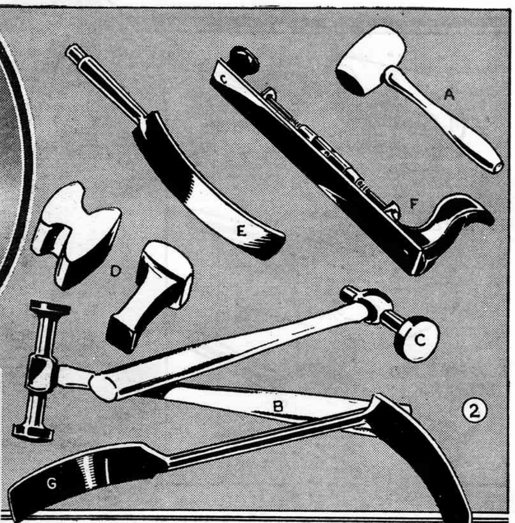
Triangle Useful for Pressmen

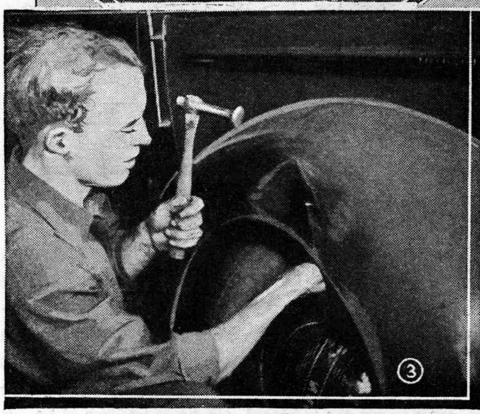
One of the handiest tools to have around a platen press is a transparent celluloid triangle. Nonpareils and picas can be scored on the two edges for ascertaining the margins when drawing lines before setting the gauge pins, thus assuring a straight margin on the printed sheet.

—W. F. Hagerman, Quincy, Ill.

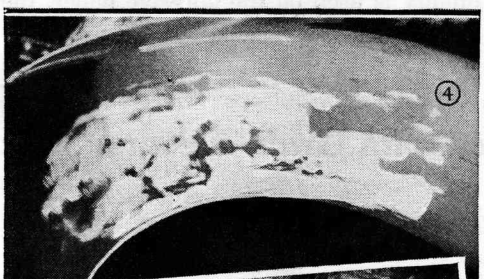
OUT WITH

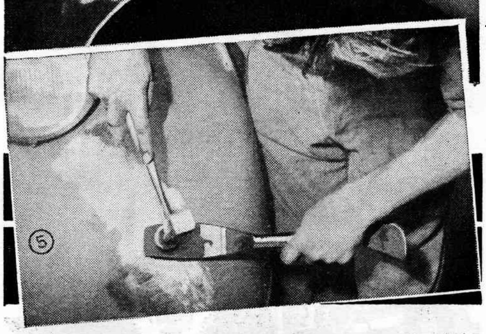






It is a simple job to remove small dents quickly with a dinging hammer and a dolly





Dinging will smooth up the job after all large dents have been removed

By RORY O'SHANE

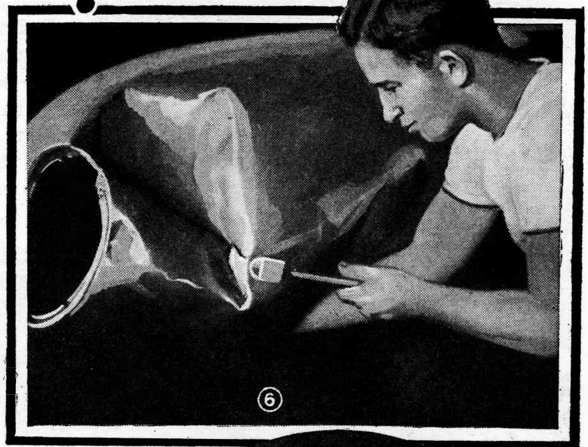
FEW motorists think of repairing a damaged fender, yet it's not so difficult if you have some spare time and exercise a little patience. Your tools, Fig. 2, should include a bumping hammer, A, for heavy work, a dinging hammer, B, for light work, and a half-hammer, C, for use where space is limited. Be sure to get several dolly blocks, D, and an assortment of dinging spoons, G and E. The former are used primarily in raising low metal during the dinging process, while the latter act as pads between hammer and metal in transferring the force of the blow to the fender without marring its surface. An adjustable file, F, completes the list.

The first step is to remove all dirt from the top side of the fender, and then scrape the underside free of tar and clinging particles with a wire brush, Fig. 1. Next, spread a thin film of oil over both sides of the fender. It will reflect light into hidden indentations, and also protect the paint while the fender is being repaired. A basic rule of fender repair is that the dent must come out the way it went in. Though no two damaged fenders look alike, they are nothing more than a differently patterned series of ridges and valleys. Therefore, determine the path of the force that caused the pattern. In repairing, work from the last buckled ridge back to the point of first

the DENTS!

contact. The larger dents are removed first, Fig. 6. This process is called bumping. Never try to bump out small dents. If the fender is folded into tight "accordion" layers, bring these out by pulling on the fender or by prying the folds open with a dinging spoon.

Place a dinging spoon on the first ridge and strike the spoon a sharp blow with the bumping hammer. Never hammer at an angle; bring the hammer squarely down on the ridge. This starts the high metal down. Then start on the next high ridge and go through the same process until all the high metal has been beaten to the contour of the fender. The general rule for using a dolly is to hold it against the low spot while you hammer at the high spot. Figs. 3 and 8. Hammer off the dolly rather than squarely on it to prevent the metal from stretching. In the case of a deep, narrow dent, remember to place the dolly directly underneath, exerting a vertical pressure while you hammer at the rim of the dent. When the dent is broad and shallow, place a dolly block opposite the side on which the dent was made and bump at the outer edges, working in toward the center. Al-



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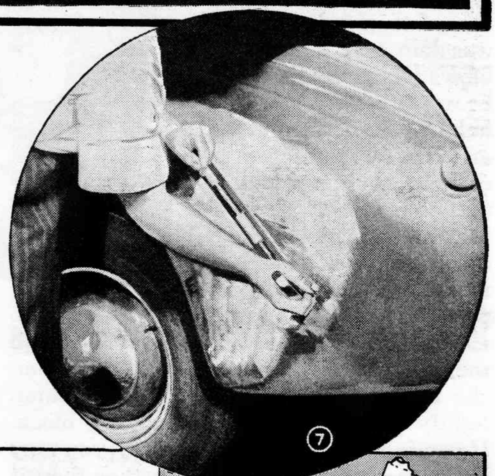

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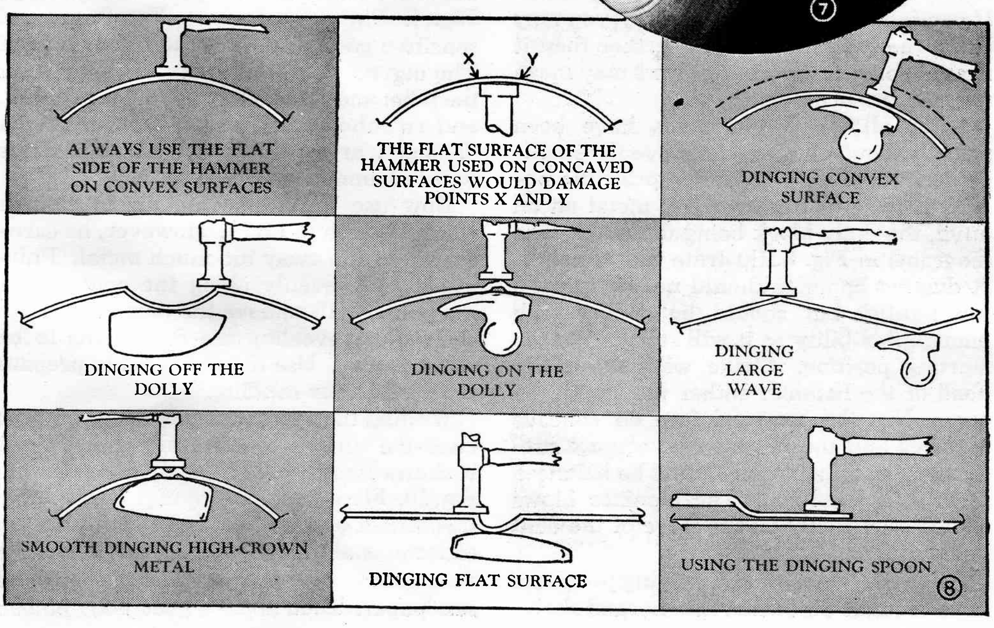

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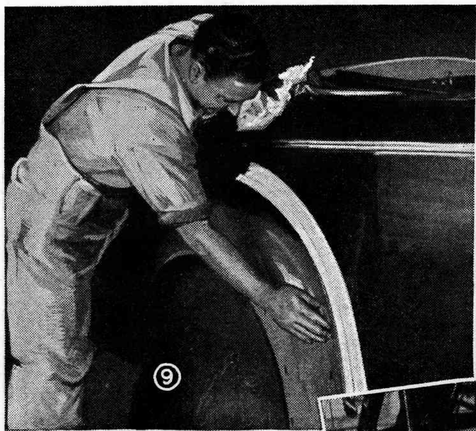
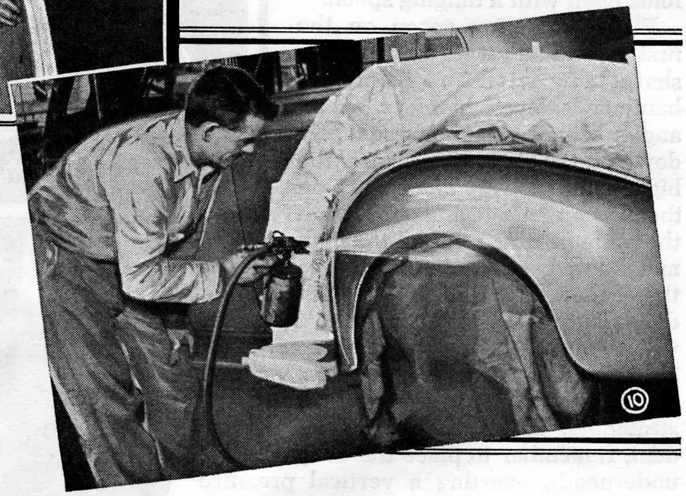




ways use a dolly block having the same contour as that of the fender before it was damaged. Several light blows are better than a few heavy ones. Be sure your hammer and dolly surfaces are free of scratches and nicks to avoid scarring the fender surface. When the high metal has been backed down to normal, the low metal can be sprung into position. It will go quite easily because the removal of the high metal has eliminated most of the strains on the fender. All you have to do is bump lightly from underneath with a dolly block. If you fail to bump systematically, you may bring the high metal down farther than it should go. A few careless blows may mean extra hours of work.

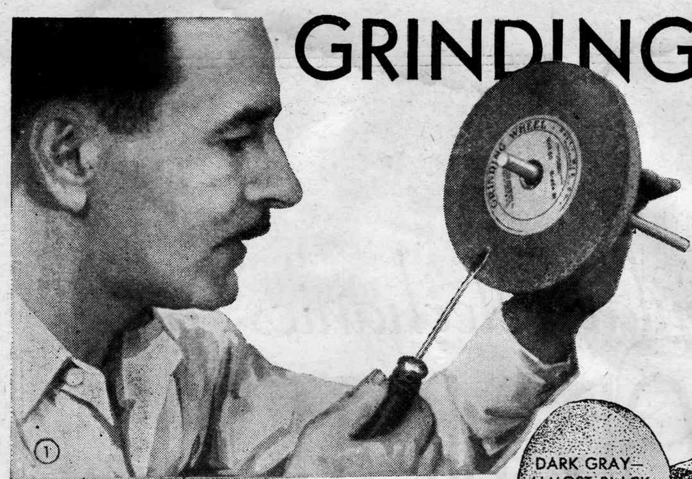
After all the larger dents have been smoothed out, dinging to remove the smaller dents is next, Fig. 5. The principle behind it is similar to working metal on an anvil, the dolly block being the anvil. The diagrams in Fig. 8 illustrate the principle. A dinging hammer should not be gripped too tightly, but should be swung with enough flexibility so it will rebound to the starting position. Strike with the entire head of the hammer rather than with the edge. Use the crowned face on concave surfaces and the flat face on convex surfaces. A dinging spoon should be balanced loosely in the hand. The hammer blows should be directly on the ridge of the dent being dinged.

After the bumping and dinging processes have brought the fender into normal shape, it is ready for finishing and painting. Sight across the back or front of the car to see if the fenders line up evenly. If both have been damaged, compare fenders with a car of similar make and age. You can bring a fender that is out of line back to its original position with a fender jack or by heating the brace. Though the fender may now seem perfectly smooth, slight irregularities still exist. The metal finishing operation will take care of this. The defects may be detected by holding a long piece of chalk flat against the damaged portion and rubbing up and down. The high spots will be white and the low spots will be dark, Fig. 4. The fingers alone, Fig. 9, are not sensitive enough to find the irregularities. The correct way is to lower the elbow, lay the palm and fingers flat against the fender, and rub the hand up and down over the damaged area. Remove the small dents with a hammer and dolly.

Now use the adjustable file to smooth the surface as in Fig. 7. However, be careful not to file away too much metal. Pulling the file evenly along the contours of the fender will remove the tops of the high spots thus revealing the final dents to be dinged away. Use the file again to prepare the surface for sanding.

Wetting the sandpaper with gasoline will clear the surface of dirt and polish. When it shines like new, it is ready for painting, Fig. 10. First comes a coat of primer. After this, brush or spray on three or four coats of lacquer about 20 min. apart. When the final coat is dry, sand it with fine-grained sandpaper. Then apply a good body polish.

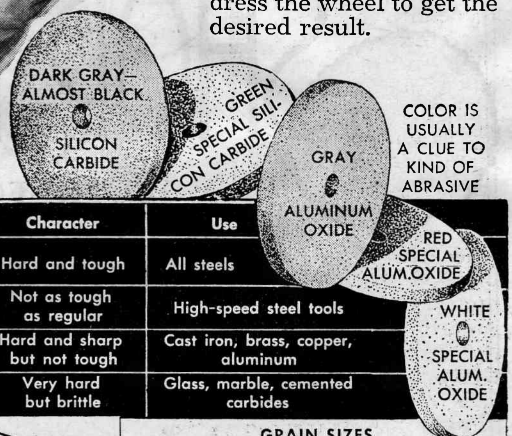
GRINDING WHEEL



Above, checking wheel for hidden cracks by tapping it lightly with a screwdriver. A good wheel will produce a metallic ring; a cracked wheel, a dull thud

By Sam Brown

A KNOWLEDGE of grinding wheels pays out in better grinding. This is true even in home shops with limited selection, since the "know how" enables the workman to manipulate or dress the wheel to get the desired result.



FIVE CHARACTERISTICS OF GRINDING WHEELS

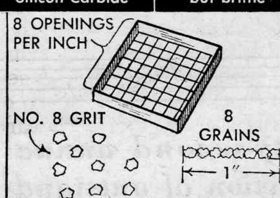
KIND OF ABRASIVE

There are two artificial abrasives used in making grinding wheels — (1) Aluminum Oxide, (2) Silicon Carbide. Each is made in a regular and special type

Abrasive	Character	Use
Regular Aluminum Oxide	Hard and tough	All steels
Special Aluminum Oxide	Not as tough as regular	High-speed steel tools
Regular Silicon Carbide	Hard and sharp but not tough	Cast iron, brass, copper, aluminum
Special Silicon Carbide	Very hard but brittle	Glass, marble, cemented carbides

GRAIN SIZE

Indicates number of abrasive grains per inch. There are 25 common grain sizes or "grits'



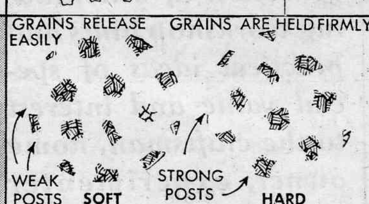
GRAIN SIZES

Very Coarse	Coarse	Medium	Fine	Very Fine	Flour Sizes*
8	12	30	70	150	280
10	14	36	80	180	320
	16	46	90	220	400
	20	60	100	240	500
	24		120		600

* Water floated for classification

GRADE (Hard or Soft)

Grade indicates strength of bond. It has nothing to do with the hardness of the abrasive grain



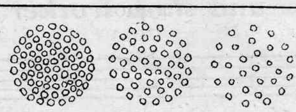
WHEEL GRADING

Grade	Norton System	Carborundum System
Very soft	E F G	Very soft U T
Soft	H I J K	Soft R P O N
Medium	L M N O	Medium L K J I
Hard	P Q R S	Hard G F
Very hard	T U W Z	Extra hard D

Norton system runs alphabetically from soft to hard. Carborundum system is alphabet in reverse

STRUCTURE

Structure indicates spacing of grains. This is a special feature. Most wheels are not made to structure



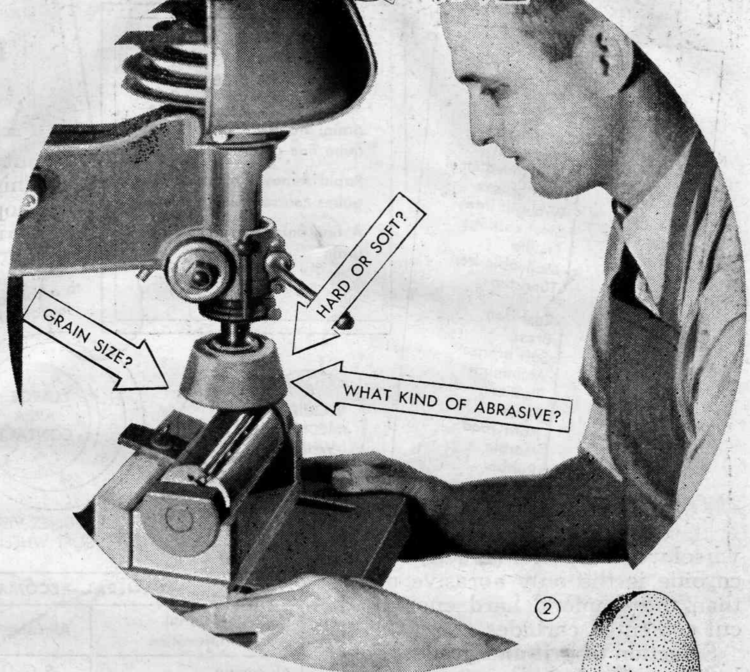
	CLOSE	MEDIUM	WIDE
Norton	0-1-2-3	4-5-6	7-8-9-10
Carborundum	D3-D2-D1	FA-F1	F2-F3

KIND OF BOND

Bond is material used to hold grains together. There are five main kinds of bonds

VITRIFIED—Used for 75% of all wheels
SILICATE—Generates less heat
RESINOID—For high speed
RUBBER—For high speed, especially cut-off wheels
SHELLAC—For high finish

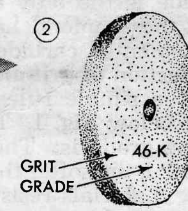
SELECTION and CARE



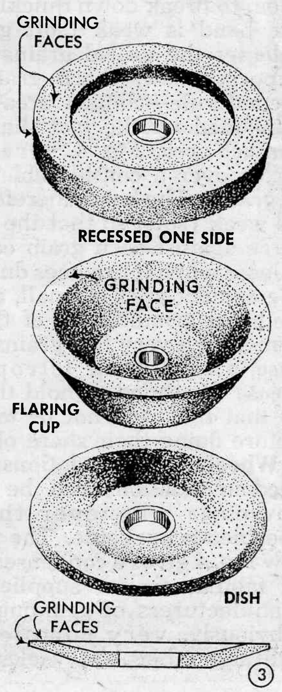
Anatomy: What you might call the "bare bones" of grinding wheels is pictured in the tabular diagram shown below Fig. 1. The two types of abrasive grains—aluminum oxide and silicon carbide—are sold under various trade names, such as Aloxite, Alundum and Borolon for aluminum oxide, and Carborundum, Crystolon and Carsilon for silicon carbide. Color is a good means of identification, silicon carbide wheels being almost black, while aluminum oxide wheels run from light to medium gray. A white wheel indicates aluminum oxide with a special porous bond and with the grain itself treated so that it is not as tough as regular. Red wheels are aluminum oxide with regular vitrified bond and the same treated grain used in the white wheel. A green wheel is a very hard type of silicon carbide. The nature of other physical characteristics—grain size, grade, structure and bond—should be plain enough from the diagram. Fig. 3 shows a few shapes in which wheels are made.

Selecting the abrasive: When the material to be ground is hard and tough, the right abrasive to use, Fig. 2, is hard, tough aluminum oxide. If the work is extremely hard, such as glass or cemented carbides, it must be ground with silicon carbide. In addition to being very hard, silicon carbide grains have sharp corners, which make the wheel ideal for grinding soft metals and nonmetallic materials. As long as the material being ground is not tough, silicon carbide does excellent work. When you get up to metals with a tensile strength of 50,000 lbs. per square inch or more, the silicon carbide wheel begins to wear away fast without doing much cutting because the brittle grains break down against the tougher material. Hence, the general rule that all high tensile strength materials (this includes all of the steels) can be ground best with aluminum oxide. On the other hand, aluminum oxide is not so good for low tensile strength materials such as brass, plastic, wood, etc. These materials are not tough enough to fracture the tough grain and each grain simply wears to a dull, noncutting edge with resultant loading, glazing and burning.

The special types of aluminum oxide feature a grain somewhat less tough than regular. These wheels are excellent for grinding carbon and high-speed steel tools because the ready fracturing of the grain keeps the wheel continually sharp, fast-cutting and cool. The obvious drawback is rapid



STRAIGHT WHEEL



Learn These Simple Rules ...

The Selection of ABRASIVE depends on the material to be ground

Use aluminum oxide for all hard, tough materials of high tensile strength: Carbon steel, Alloy steel, High-speed steel, Hard bronze, Wrought iron, Steel castings, Stellite, Malleable iron, Tungsten

Use silicon carbide for low tensile strength materials and most non-metallics: Cast iron, Brass, Soft bronze, Aluminum, Plastics, Glass, Hardwood, Marble, Rubber

The Selection of GRAIN SIZE*

Soft materials require coarse grain; hard materials require fine grain

Rapid removal of stock requires coarse grain

A fine finish requires fine grain

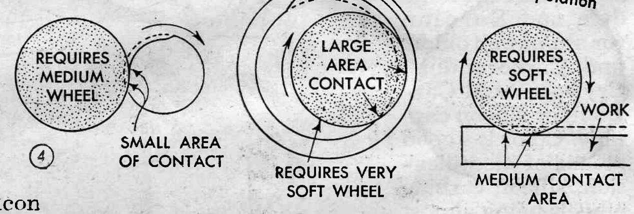
The Selection of GRADE*

The harder the material being ground, the softer the grade

Large area of contact requires a soft wheel. (See drawing)

High wheel speed and low work speed require a soft wheel

* Both grit and grade can be controlled to a considerable extent by proper dressing of wheel and work manipulation



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wheel wear. Special (green) silicon carbide is the only abrasive other than the diamond hard enough to cut cemented carbides.

Selection of grit and grade: Follow the simple rules given in the table below Fig. 1. The key to selecting grade is: The harder the material, the softer the grade. Hard, dense materials resist the penetration of the abrasive grains and cause them to break down quickly. When the bond is weak (soft grade), it releases the dulled grains quickly, exposing new, sharp grains. The second rule—contact area—can be explained by the fact that a wide contact area, Fig. 4, spreads the stress over a considerable number of grains. The bond, therefore, must be weak (soft) so that the lessened force against each grain can break it loose when it becomes dull. When the contact area is small, as in cylindrical grinding, all of the stress comes on a very few grains. In this case, a hard grade (strong bond posts) is needed to hold the grains so that they will not be torn away before doing their share of cutting.

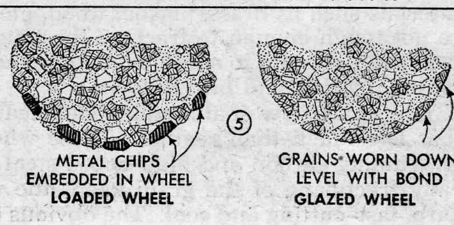
Wheel recommendations: Specific recommendations can be used to advantage whenever the wheel specified is available. The table below Fig. 4 gives a condensed version of tabular matter supplied by all manufacturers of grinding wheels. Obviously, very complete hair-splitting tables are useless to the

GENERAL RECOMMENDATIONS*

Material or Operation	Abrasive	Grit Rough	Grit Finish	Grade
Aluminum	S. C. (1)	30 (2)	40	Soft
Brass	S. C.	36	60	Soft to Med.
Cast Iron	S. C.	30	46	Soft to Med.
Chisels (wood)	A. O.	—	60	Medium
Copper	S. C.	36	60	Soft to Med.
Cork	S. C. (1)	36	46	Soft
Duralumin	A. O. (1)	30	46	Soft
Drills (H.S.S.)	A. O. (wht.)	—	60	Medium
Glass	S. C. (green)	80	220	Medium
Grinding (general)	A. O.	46	60	Medium
Mal Iron (annealed)	A. O.	30	46	Hard
Mal Iron (not annealed)	S. C.	30	46	Hard
Plastic	S. C.	46	120	Medium
Rubber (soft)	S. C.	24	46	Soft
(3) Rubber (hard)	S. C.	36	46	Soft
Saws (gumming)	A. O.	—	60	Medium
Steel (soft)	A. O.	46	60	Medium
Steel (carbon)	A. O. (1)	46	60	Medium
Steel (hi-speed)	A. O. (1)	46	60	Soft
Welds (smoothing)	A. O.	24	46	Med. to Hard
Wood (hard)	S. C.	24 (2)	30	Soft
Wrought Iron	A. O.	30	46	Med. to Hard

1 White or red aluminum oxide also used
2 Tends to load if fine grit is used
3 Resinoid bond preferable

* All wheels vitrified bond. Structure is not considered



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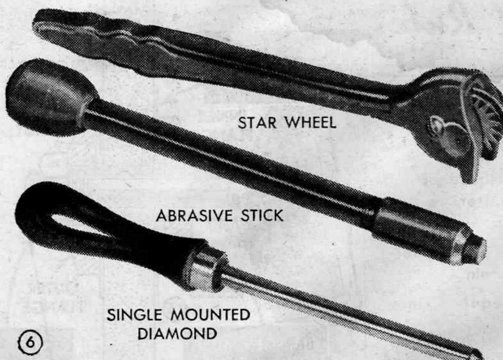
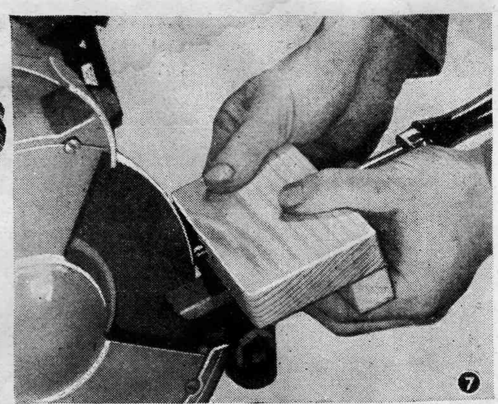
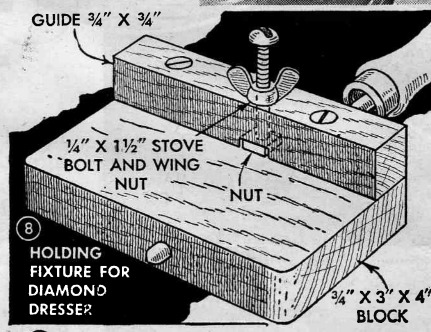


GRINDING-WHEEL DRESSERS



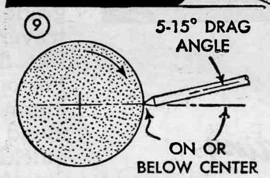
Dressing removes the outer dulled layer of abrasive grains and exposes new sharp grains. Truing is precision dressing so that the wheel runs perfectly true. Proper manipulation of the dressing tool can alter the wheel's cutting action within reasonable limits



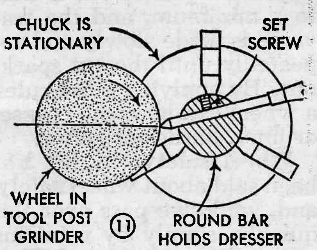
average worker because he does not have the wheels. The best system of selection is to know why a certain wheel should be used, and then manipulate such wheels as are available to get the desired result.

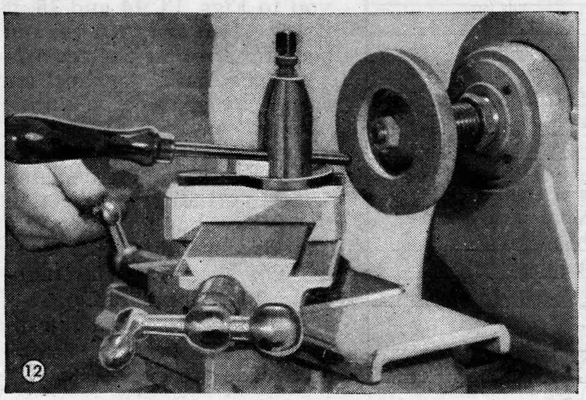
Dressing and truing: When a wheel becomes loaded or glazed, Fig. 5, it is necessary to press some hard object against it while rotating to restore the cutting edges. Simplest device for this is the star-wheel dresser, Fig. 6. The metal disks and wheels are actually much softer than the grinding wheel, but by using firm pressure the faulty abrasive grains can be torn loose. This dresser is worked freehand, but always supported on the tool rest. It should not spark. Sparking is an indication that the grinding wheel is cutting the dresser and therefore, the dressing tool should be pressed harder against the wheel. The stick-type dresser is inexpensive and efficient. It is a very coarse, silicon carbide abrasive, which readily cuts the finer grain of the grinding wheel. Best of all is the diamond, especially for precision dressing (truing). It should be used only for precision work. If dressing requires removal of embedded metal chips or heavy shaping, the star-wheel or stick dresser should be used first, and can then be followed by the diamond. Use a simple jig like the one shown in Fig. 8 to hold the diamond dresser. Always contact the wheel on or below center and always at a drag angle, as in Figs. 7 and 9. Fig. 11 indicates how the dresser can be held when dressing the wheel of a tool-post grinder. Fig. 12 pictures the dressing of a recessed wheel mounted and used on the lathe.

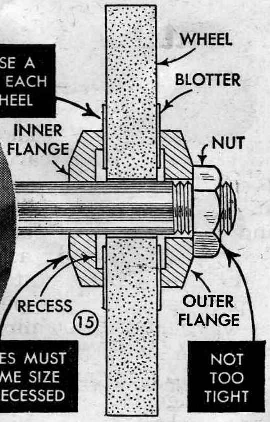
An important feature of dia-



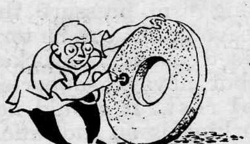
CORRECT POSITION OF DIAMOND TOOL







Safety First!



Trouble Shooting

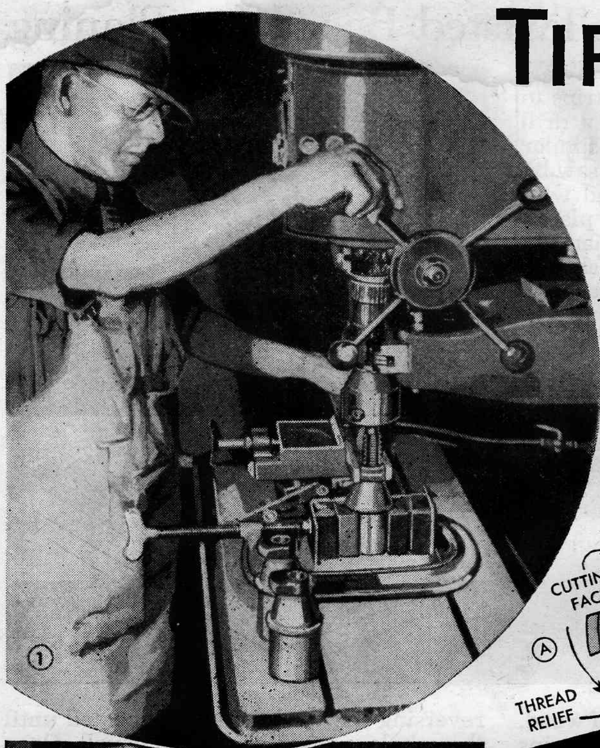
FAULT	CAUSE	CORRECTION
WHEEL LOADING (Metal chips embedded in wheel)	Wrong wheel	Use coarser grain or open structure wheel
	Faulty dressing	Dress with rapid traverse
	Faulty operation	Use slower wheel speed and faster work speed or traverse
WHEEL GLAZING (Slick, shiny appearance —does not cut)	Wrong wheel	Use coarser grit, softer grade
	Faulty dressing	Use faster traverse with deeper penetration
	Faulty operation	Use more pressure. Increase work speed
WHEEL DOES NOT CUT (Glazes and burns)	Wheel is too hard	Use coarser grit and softer grade
		Open up wheel by fast dressing
		Decrease wheel speed, wheel diameter and width
		Increase work speed and pressure
RAPID WHEEL WEAR	Wheel is too soft	Use harder wheel
		Dress with slow traverse and very little penetration
		Increase wheel speed, wheel diameter and width
		Decrease work speed and pressure
ROUGH WORK	Wrong wheel	Check abrasive, grit and grade
	Wheel out of round	Dress wheel
	Machine fault	Check bearings and wheel mounting

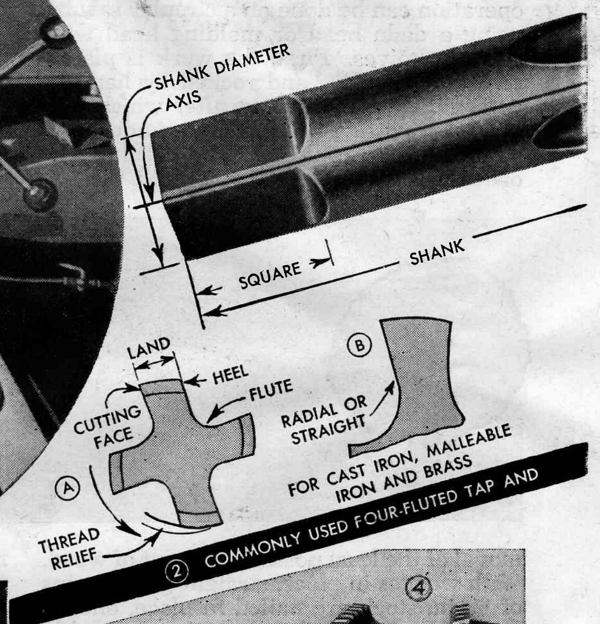
mond dressing is the depth of cut and the speed rate at which the diamond is moved across the wheel. In all cases the cut must be very light, not over .001 in., as shown in Fig. 10. A fast traverse opens up the wheel, making it, in effect, a coarser grain and a softer grade than it actually is. A slow traverse makes the wheel, in effect, finer grain and harder grade. For open dressing you use a maximum depth of cut, and the diamond is pushed just once, and quickly, across the wheel. When dressing the wheel for fine finishing, the depth of cut is held to a minimum, and the traverse is made slowly and repeatedly until the cut sparks out. By applying these rules, a wheel can be made coarser or finer, harder or softer.

Wheel safety: A lot has been said about wheel safety, and, while we pass over this quickly, simply by referring you to Figs. 13, 14 and 15, it is of prime importance and should not be neglected. Always check a new wheel for cracks by striking it with a screwdriver as in Fig. 1.

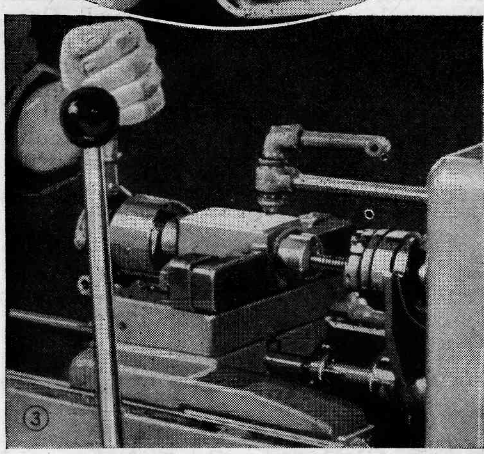
Trouble-shooting: Some of the common faults encountered in grinding are listed in the table shown below Fig. 13. Observe how the work and wheel can be manipulated for hard or soft effect. This can be used to advantage in making one or two wheels do a wide variety of work.

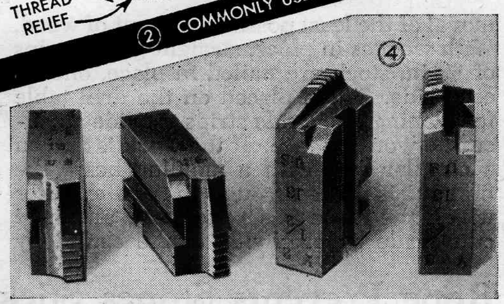
TIPS on TAPS





(2) COMMONLY USED FOUR-FLUTED TAP AND

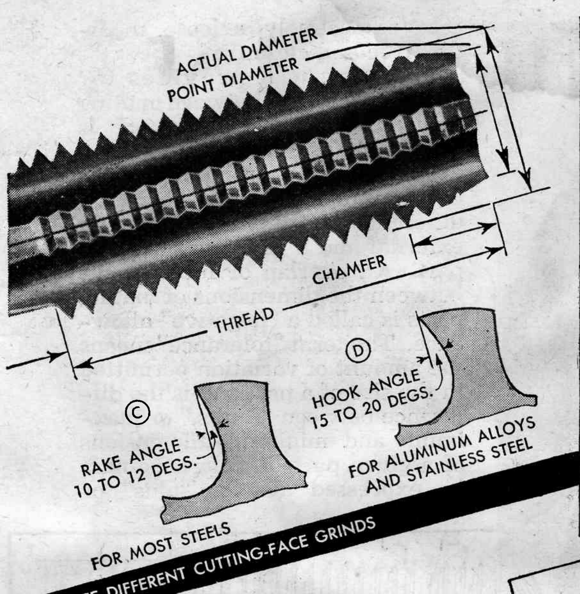




A TAP cuts a screw thread internally, in a hole, and differs from a threading die, which cuts a thread externally, as on a shaft. Taps are used more extensively than threading dies for quantity production because most external threads are produced either with automatic die heads or thread-milling machines. As shown in Fig. 2, a tap consists of a shank squared at one end and a threaded section into which flutes are milled to provide the necessary cutting action and chip passage. The shape of a flute and its relation to the cutting face varies with the material to be cut. Three standard face grinds are shown in details B, C and D of Fig. 2.

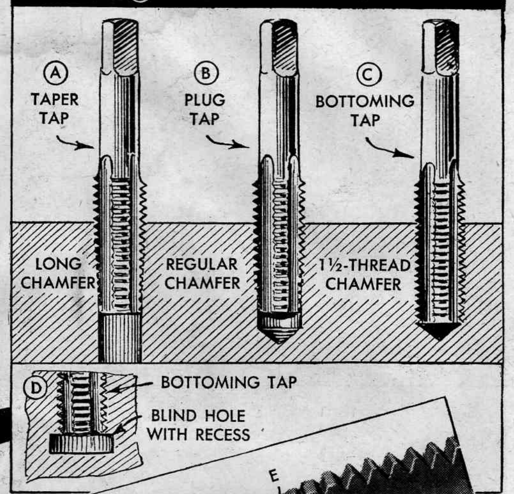
Most important are the chamfers at the entering end of a tap. These do most of the work by removing metal progressively. Very few taps have a thread relief as shown in detail A of Fig. 2 because they must be sharpened on the face and this gradually reduces the diameter of those having thread relief. Shops making their own taps in small quantities thread them in a lathe, mill the flutes and occasionally relieve the threads. However, this is too slow for production work so threading machines as shown in Figs. 1 and 3 are used. The machine in Fig. 3 has an automatic die head fitted with chasers illustrated in Fig. 4.

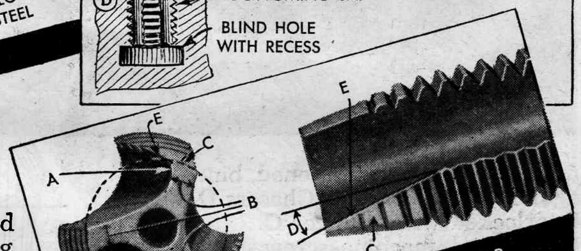
Taps commonly used: Types of taps used most frequently in shop practice are standard hand taps, serial hand taps, "gun" taps, adjustable chaser taps, collapsing taps, standard and stub machine-screw taps and nut taps. Standard hand taps are available in sets of three as shown in Fig. 5. The one in detail A has a long chamfer angle com-



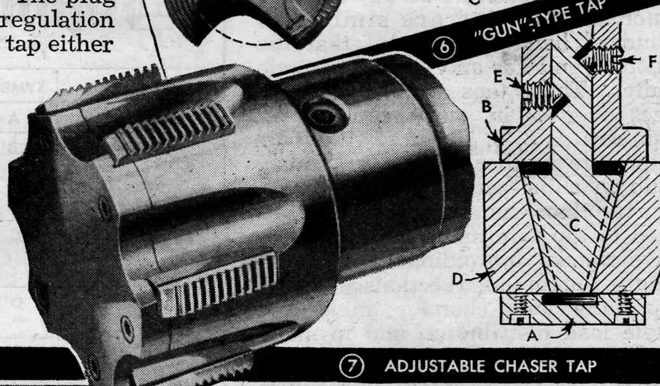
THREE DIFFERENT CUTTING-FACE GRINDS

⑤ STANDARD HAND TAPS





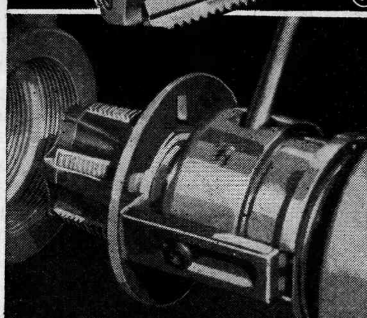
⑥ "GUN"-TYPE TAP



⑦ ADJUSTABLE CHASER TAP

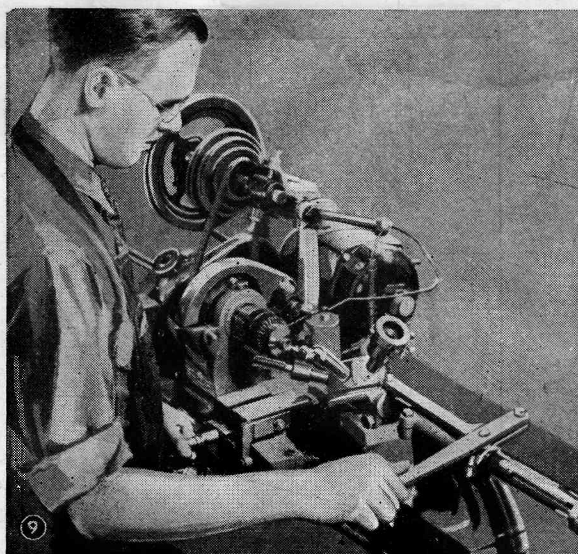
prising some seven or eight threads and is used to tap an open hole. The plug type in detail B has the regulation chamfer angle and is used to tap either an open or a blind hole. Detail C shows a tap that has only a 1½ thread chamfer and is used for a blind hole with a flat bottom or a blind hole with a recess as shown in detail D. This type is marked in fractional sizes from ¼ to 2 in. in diameter.

Serial hand taps, which come in fractional sizes up to 1 in. in diameter, are similar to the standard type but all three are necessary to obtain full thread diameter. No. 1 is undersize and is used to rough in the thread. No. 2 is a little larger and cuts a fuller thread and No. 3 finishes the thread to size. Chamfers of serial taps are shorter than those on standard hand taps.


⑧ COLLAPSING TAP

The "gun" tap shown in Fig. 6 is a three-flute, plug type for threading open holes only. It is the strongest and most productive tap to select when it can be used. The angular cutting edge produces a long curling chip similar to that from a lathe tool. The flutes are not as deep as those of other taps, which results in greater strength. The flutes should never have to be ground if due attention is given the point.

Solid taps are seldom over 2¼ in. in diameter. Therefore, adjustable chaser taps such as shown in Fig. 7, or collapsing taps as the one in Fig. 8, are used for larger dimensions. Adjusting chaser taps is very simple. Screws holding cap A are loosened and the body B, which is bored for steep taper plunger C, expands to contact chasers D by means of adjusting screws E and F. These screws provide ample adjustment due to vees in C and also act as a locking

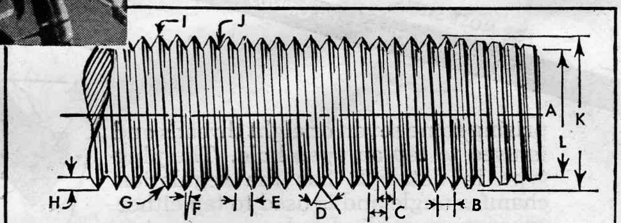


medium. A, when tightened, binds D against shoulder of B. Chasers D are interlocked with plunger C.

Standard machine-screw taps for automatic tapping are similar to standard hand taps except that the chamfer end has an external or male center. These taps are not made in sizes over ¼ in. and are listed by numbers as 3, 6, 10, etc., with their respective number of threads per inch. Stub machine-screw taps are much shorter than the standard and are used to tap thin materials. Nut taps have shanks approximately twice as long as the threaded sections and have especially long chamfer angles for angle load distribution and to make them free-cutting.

Screw-thread terms and forms: Although all terms defined in Fig. 10 are important, there are several more worth recognition. There are three classes of taps designated as follows: The "cut" tap is an ordinary one for average work and has threads polished only before hardening. Any distortion in pitch or lead due to defective heat treatment is transferred to threads produced therewith. The "commercial-ground" tap is one with threads ground to make allowance for heat-treating distortion, yet is not guaranteed to produce threads for certain classes of fit requirements. "Precision-ground" taps are finished to three varying degrees of precision to meet all demands of limits and tolerances. There are four classes of fits in connection with screw-thread assembly, Nos. 1, 2, 3 and 4, which indicate, respectively, a loose, medium, free and close fit.

An "allowance" provides for variations in fits between mating threads. Maximum allowance is the difference between a minimum external and a maximum internal part; minimum allowance is the difference between a maximum external and a minimum internal part. An overlap or interference between the dimensions of mating parts is called a "negative" allowance. The term "tolerance" means the amount of variation permitted in the size of a part and is the difference between "limits," or maximum and minimum dimensions of a given part. A tolerance may be expressed also as "plus" or

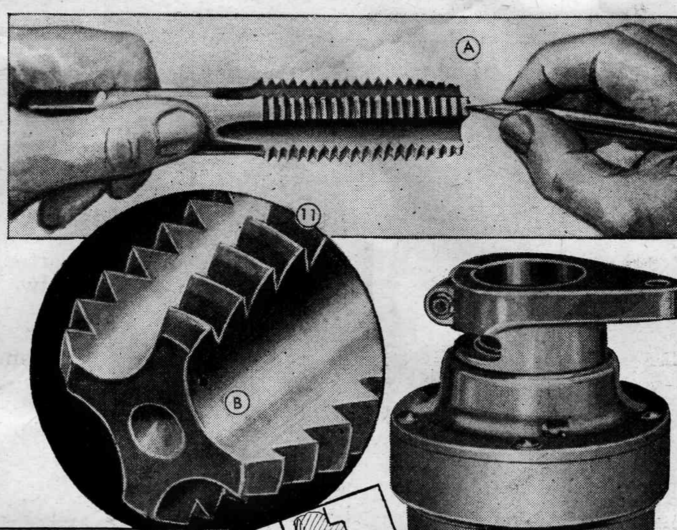


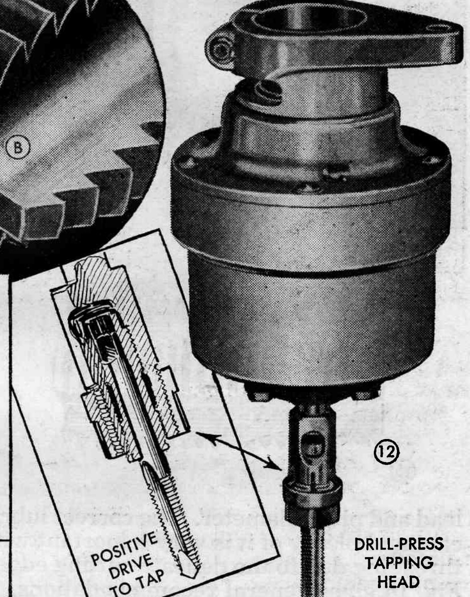
TERM	SYMBOL	DEFINITION
Axis of screw	A	Longitudinal center line.
Pitch	B	Distance from one point on thread to corresponding point on next thread. Pitch equals 1 divided by number of threads per inch.
Pitch diameter	C	Equal distance between width of thread and width of space between thread.
Angle of thread	D	Included angle between sides of thread, measured in an axial plane.
Lead	E	Distance a screw thread advances axially in one turn. Lead E and pitch B are identical with single thread. (See note.)
Helix angle	F	Angle made by helix of thread at pitch diameter with a plane perpendicular to axis.
Side of thread	G	Surface of thread which connects crest with root.
Depth of thread	H	Distance between top and base of thread, measured normal to the axis.
Crest	I	Top surface joining the two sides of a thread.
Root	J	Bottom surface joining sides of two adjacent threads.
Major diameter	K	Commonly known as outside diameter, largest diameter on screw or nut.
Minor diameter	L	Commonly known as core or root diameter, smallest diameter of screw or nut.

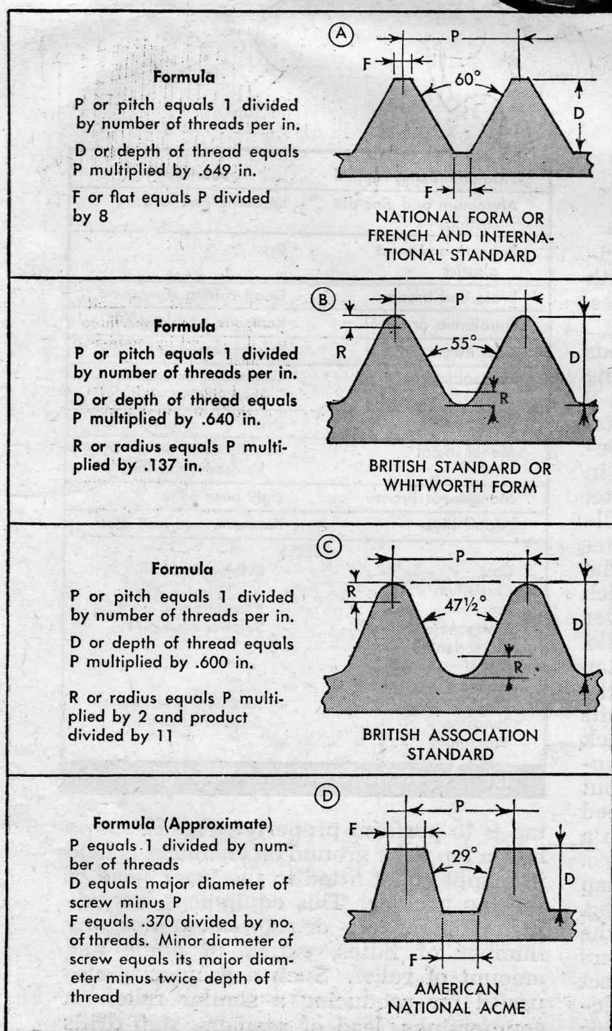
Note: Single thread means a thread in which lead is equal to pitch. In a double thread the lead is equal to twice the pitch, in a triple thread the lead is equal to three times the pitch.

(10) SCREW-THREAD TERMS AND THEIR DEFINITIONS

"minus." Fig. 13 shows the four thread forms covering American and European screw thread requirements. Forms A and B are widely used and form D is best where an exceptionally strong thread is required to carry substantial loads such as is the case with screw jacks. The included angle varies with all four forms. Respective formulas make it easy to compute any desired depth of thread and also the flat or radius if the pitch (1.000 in. divided by the number of teeth per inch) is known.



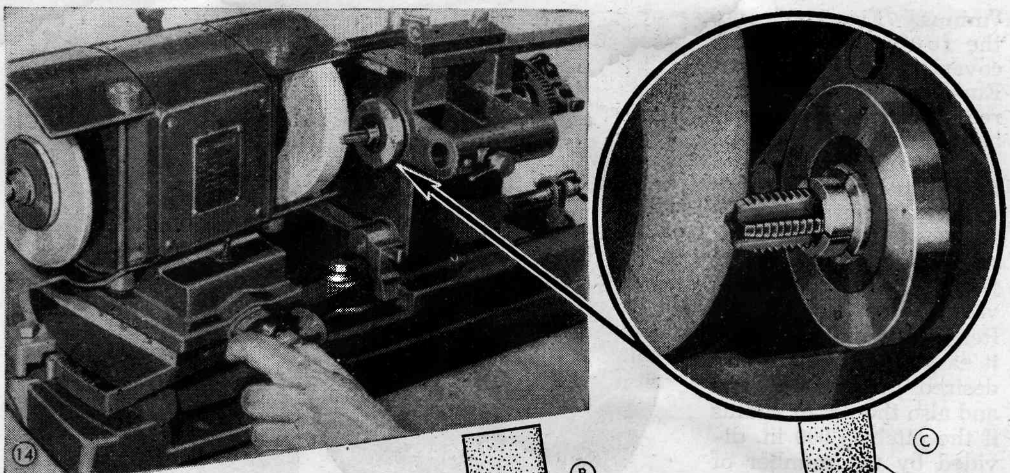




13 SCREW-THREAD FORMS AND THEIR FORMULAS

Drill-hole and tap sizes, lubrication, etc.: A hole to be tapped must be of correct size, clean and concentric. If the hole is undersize, the tap will break or the first full threads will be stripped when it enters the hole. If the hole is substantially oversize, rough or out of round, the thread cut will be of little value. The National thread form has a 75 percent depth of thread, meaning that the drill hole is 25 percent larger than the minor or root diameter of the tap to be used. It is well to bear in mind that a 75 percent depth of thread requires only one third the tapping power of a 100 percent depth, but has 5 percent less strength.

For maximum economy in tool cost, power and production speed, the depth of thread should be not less than 62 percent or more than 83 percent. The tougher the material and the deeper the hole, the more you must favor the diameter of the hole. Misalignment between the tap and the work results in a poor thread; the thread will be oversize and off as to



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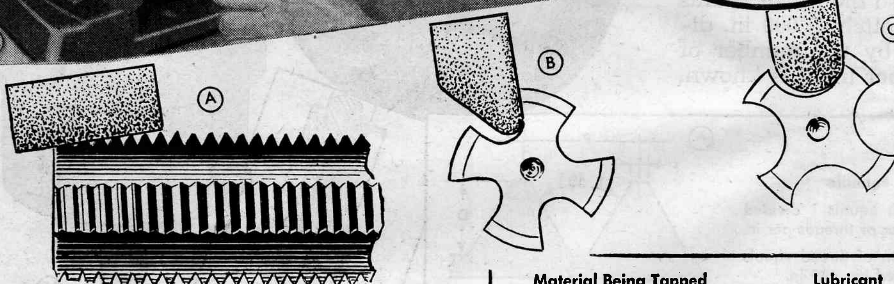


15

lead and pitch diameter. The correct lubricant and plenty of it is very important with threading due to the delicate cutting edges. Fig. 16 gives general recommendations.

As a tap has a positive lead and feeds itself, the operator cannot control feeding pressure. If a turret is used as in Fig. 9 it must be capable also of free horizontal movement. Tapping in a drill press requires an attachment such as shown in Fig. 12. This attachment does not rotate; the housing or shell is clamped to the drill-press quill so that the spindle itself operates the mechanism of the tapping head. The tap is driven by a friction clutch which automatically regulates tap driving power by pressure applied through the spindle. The clutch slips instantly when the tap strikes the bottom of a blind hole or sticks from loading of chips. This device permits reversing the tap at a higher speed to back it out of a threaded hole. Most manufacturers recommend a safe cutting speed but the safest method is to select a slow speed and increase it, rather than to cut down a high speed after the damage has been done.

Grinding taps: If the chamfers of a tap are kept properly ground (detail A of Fig. 11) it is seldom necessary to grind the flutes as in detail B. Special tap grinders make it possible to keep taps in perfect condition. All taps originally have an eccentric relief on the chamfers and this should be reproduced with each grind if a tap is to perform properly. Fig. 14 shows how a tap to be ground on chamfers is held in a split collet fitted to the work head of the tap grinder. This equipment has adjustments for left- or right-hand taps, any number of flutes, extent of angle and amount of relief. Such a grinder is also useful for producing a similar relief on countersinks, lead of reamers, step drills and three or four-fluted drills, etc.

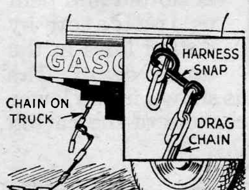
Material Being Tapped	Lubricant
Aluminum and zinc die castings	Kerosene and lard oil
Bakelite and most plastics	Dry
Brass and bronze	Good cutting compound
Duralumin or dural	Kerosene and lard oil
Cast iron	Dry or compound
Malleable iron	Compound or sulphur-base oil
Fiber	Dry
Monel metal	Sulphur-base oil or kerosene and lard oil
Manganese bronze	Light-base oil
Nickel silver	Kerosene and lard oil
STEELS	
Cast	Sulphur-base oil
Chromium	" " "
Machinery	Kerosene and paraffin
Manganese	Sulphur-base oil
Molybdenum	" " "
Nickel	" " "
Stainless	" " "
Tool	Kerosene and lard oil
Tungsten	Sulphur-base oil
Vanadium	" " "

16 RECOMMENDED TAP LUBRICANTS

When a dull tap needs regrinding, start at the chamfered end as in detail A of Fig. 15, using an aluminum vitrified wheel, 80-J. Grind it exactly the same angle, covering the same number of threads as is the case with an identical new tap. Grind just enough to remove the dulled edges of the threads, being sure that the point diameter is the same as the root diameter of the thread. All cutting lands must be the same height and must be equidistant. The flutes are ground only if the edges of the unchamfered teeth are dulled and nicked. A saucer-shaped grinding wheel is used if the cutting face of the flute is straight as in detail B of Fig. 15, but a formed wheel is needed if the cutting face is hooked as in detail C. An aluminum vitrified wheel, 60-R, is recommended for grinding flutes of small taps while a 46-L wheel of the same kind is best for large taps. Broken teeth of a tap should be removed by grinding as they cause damaged threads when tapping.

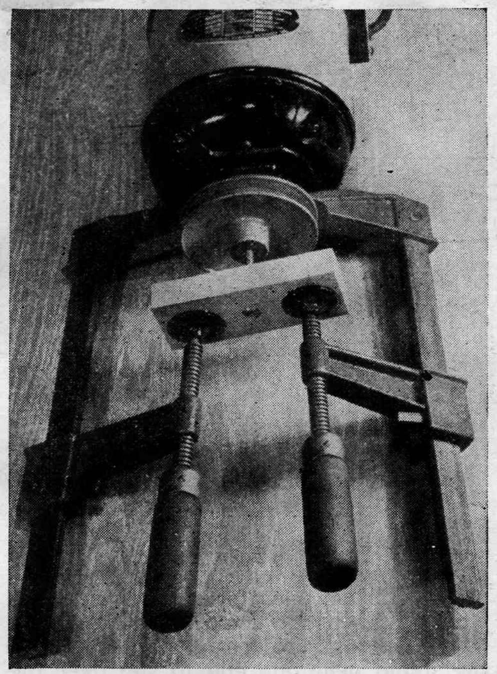
In grinding gun-type taps, first have a new tap of the same size at hand to help in keeping the ground tap to the same form in regard to the angle of flutes and the cutting edges. The grinding wheel is formed to exact fit for flute to keep the identical hook shape—detail E of Fig. 6. After the ends of the lands B have become thin from repeated regrinding, grind the end of the tap straight back until the lands again are of normal thickness, after which the cutting edges and flutes are ground, and the hook is reformed, keeping a straight cutting edge. When chamfer C is reground, the relief is ground carefully, leaving cutting edge A gradually receding toward the heel. See the end view of the tap in Fig. 6. Also keep the angle D for shearing.

Adjustable Safety Ground Chain For Use on Tank Trucks



Because of the frequency with which drag chains on gasoline tank trucks have to be changed due to rapid wear, they sometimes are neglected and wear so short that they do not make good contact with the ground. To make changing the chain an easy job, one truck driver uses two lengths of chain, one being fastened to the truck to reach almost to the ground and the other being fitted with a harness snap at one end. With this arrangement, the chain is lengthened merely by dropping the snap one link on the chain.
—James H. Gosch, Scotia, N. Y.

Bar Clamps Used to Force Pulley Jammed on Shaft

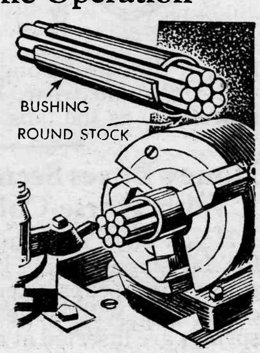


Pulleys can be removed easily, when jammed on a motor shaft, by using a pair of bar clamps as shown. With the stationary jaws placed behind the pulley, a bolt driven through a block of wood and secured with a lock nut is set against the shaft and the screws turned with equal pressure.

Water Expands Shrunken Gasket

When installing a new cork gasket on a valve cover or oil pan and the gasket has shrunk, making an oil leak likely, first place it in warm water for a few minutes. This will expand it to about normal size and assure a good fit.—C. Swope, Danville, Pa.

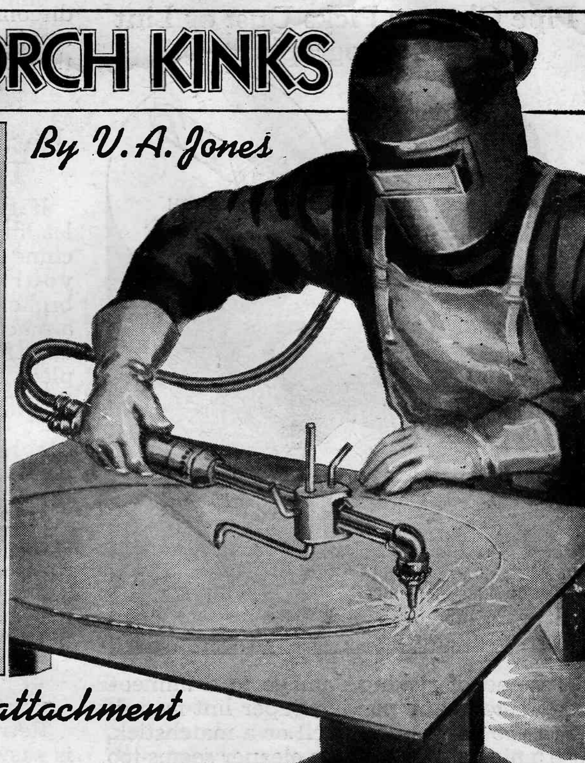
Several Pieces of Round Stock Faced in One Operation



Next time you want to face several short pieces of round stock, use a split bushing as shown and you can do it in one operation. When clamped in a universal chuck on a lathe, the bushing will grip the pieces firmly, even if the lengths vary.

CUTTING-TORCH KINKS

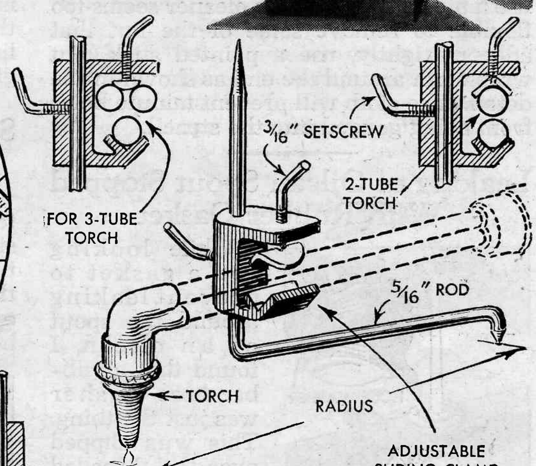
By V. A. Jones

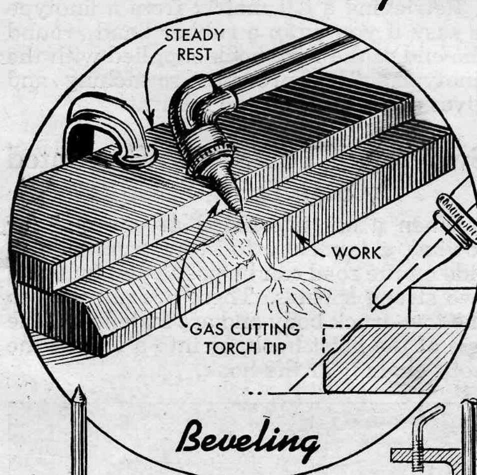


CIRCLE-CUTTING ATTACHMENT—Clamped to an oxy-acetylene cutting torch as shown, this attachment, which can be adapted to fit two or three-tube torches, provides an adjustable center point that makes accurate circle cutting a matter of moving the torch around like a compass. As the welder does not have to watch the burning-line as closely as when cutting freehand, he is less likely to inhale the fumes from the torch flame. The pointed rod is held in a punch mark made in the work, and the size of circles possible is limited only by the length of the torch tubes

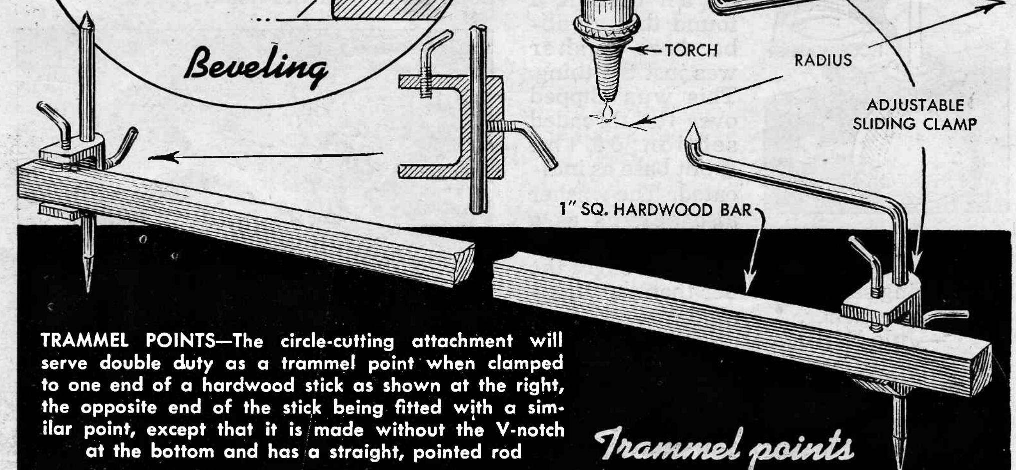
BEVELING—Ragged bevels that result from inability to hold the torch steady freehand are overcome by clamping a straightedge parallel to the edge of the work as shown below, against which the torch tip can be guided at the proper angle as it is drawn along

Circle-cutting attachment





Beveling

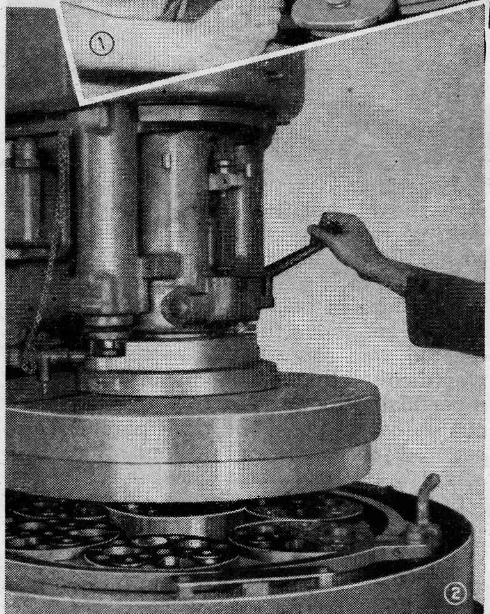


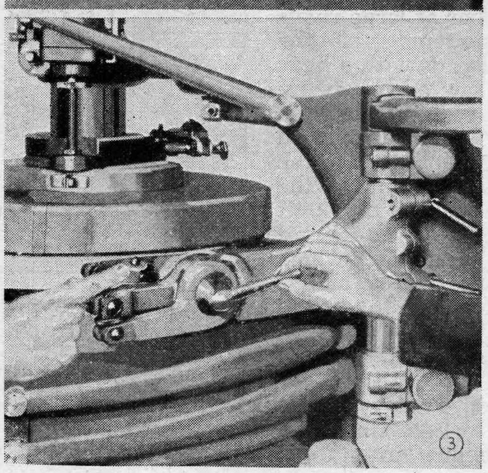
TRAMMEL POINTS—The circle-cutting attachment will serve double duty as a trammel point when clamped to one end of a hardwood stick as shown at the right, the opposite end of the stick being fitted with a similar point, except that it is made without the V-notch at the bottom and has a straight, pointed rod

Trammel points

LAPPING *Gives Metal*

By H. J. CHAMBERLAND





TREMENDOUS airplane speeds of today would be impossible if the motor parts were finished only with metal-cutting tools. Where accurate fit and surface-to-surface contact of moving parts are involved, as in airplane or automobile motors, the initial wear must be removed by lapping the parts to "micro-precision" dimensions before assembling them. Dimensional accuracy is impossible without surface accuracy. This article includes methods of mechanically lapping a number of similar parts for fine external finish, either cylindrical or flat.

Types of lapping machines: There are two distinct types of external lapping machines. The one shown in Figs. 1 and 5 is the original design, having two metal disks or laps the diameter of which varies to suit individual requirements. Only the bottom lap revolves and on it the parts to be finished are supported by means of retainers, spiders and other work-holding devices. The top lap, which does not rotate, does an equal share of the work and provides the necessary light pressure. This lap is made to "float" because it must be dismounted often for reconditioning. Without this floating action of the upper lap, the parts would not be finished parallel nor straight. Fig. 1 shows the lapping of gauge blocks while Fig. 5 shows the lapping of six plug gauges mounted on a retainer which allows them to rotate on their centers.

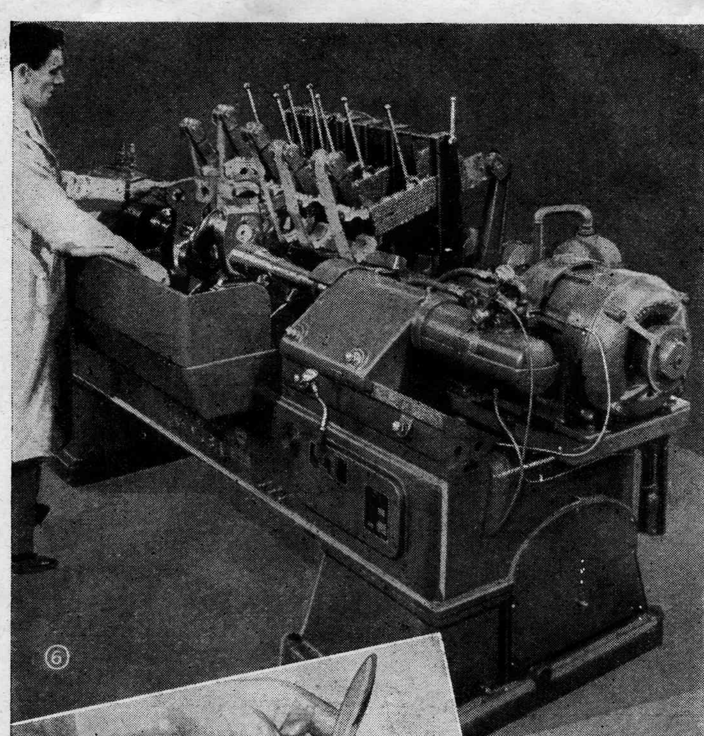
The machine shown in Fig. 2 is more modern. In this case both laps consist of fine-grit grinding wheels that rotate horizontally in opposite directions, the upper one clockwise and the lower one counterclockwise. The upper one is lowered to contact the work, and the feed is hydraulically operated. To keep the surfaces of the wheels in perfect parallelism, a twin

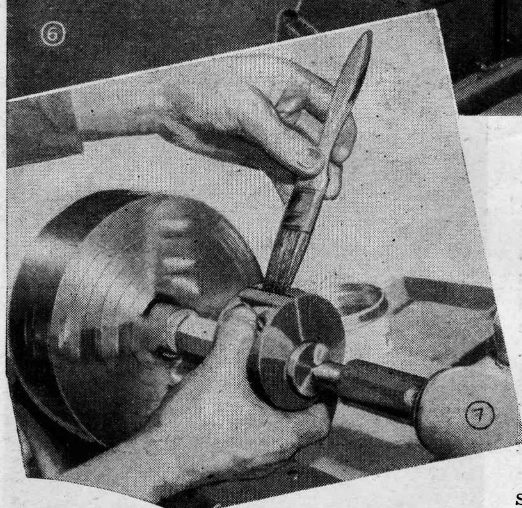
"Micro-Precision" Finish

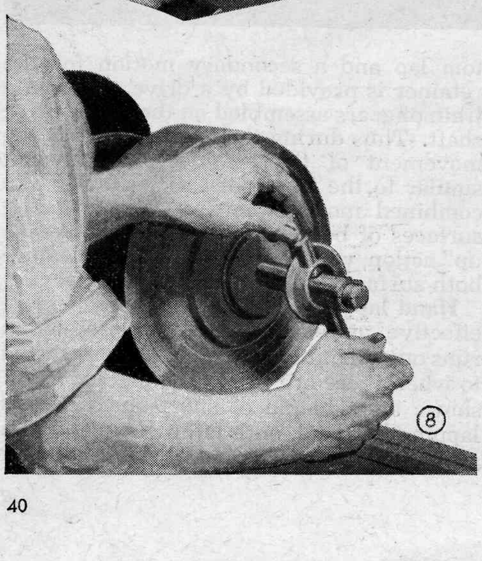
diamond dressing arm, shown in Fig. 3 is provided. This also is hydraulically controlled. With these facilities and an electrical gauge showing how the lapping operation is progressing, very little training is required to operate this machine. Besides the common types of lapping machines already described, there are some that have been specially designed for certain jobs. Fig. 6 shows such a machine which laps all bearings on a crankshaft simultaneously.

"Break-up" motion: On lapping machines a variety of work-holding devices forms the basis of the equipment. The machine itself is of relatively simple construction. The metal or grinding-wheel laps rotate at less than one-tenth of the peripheral speed of regular grinding wheels. The retainer, spider or work holder, which serves as a chuck, provides the proper travel for the work during the cycle for each piece to cover the entire abrading surface of the lapping members. The primary motion given to the work is a rolling one produced by movement of one lap with regard to the other with the work in frictional contact between them. The secondary motion is produced by the eccentric drive pin driven by a train of gears from the lower lap spindle. This single motion however, is not sufficient for a perfectly flat, parallel or straight finish. The retainer or spider is not concentric with the bottom lap but it is fixed to the spindle of the bottom lap and a secondary motion for the retainer is provided by a drive pin from a train of gears assembled on the lower drive shaft. Thus during the operating cycle the movement of the retainer is somewhat similar to the throw of a crankshaft. The combined motions between the abrading surfaces of both laps provide the "break-up" action, which corrects defects to assure both surface and dimensional accuracy.

Hand lapping: As lapping machines are effective and economical for production runs only, manual lapping must be resorted to when there are just a few pieces. Fig. 7 shows an example of short-run external lapping by hand, on a lathe. One end of a go-and-no-go plug gauge, which is being



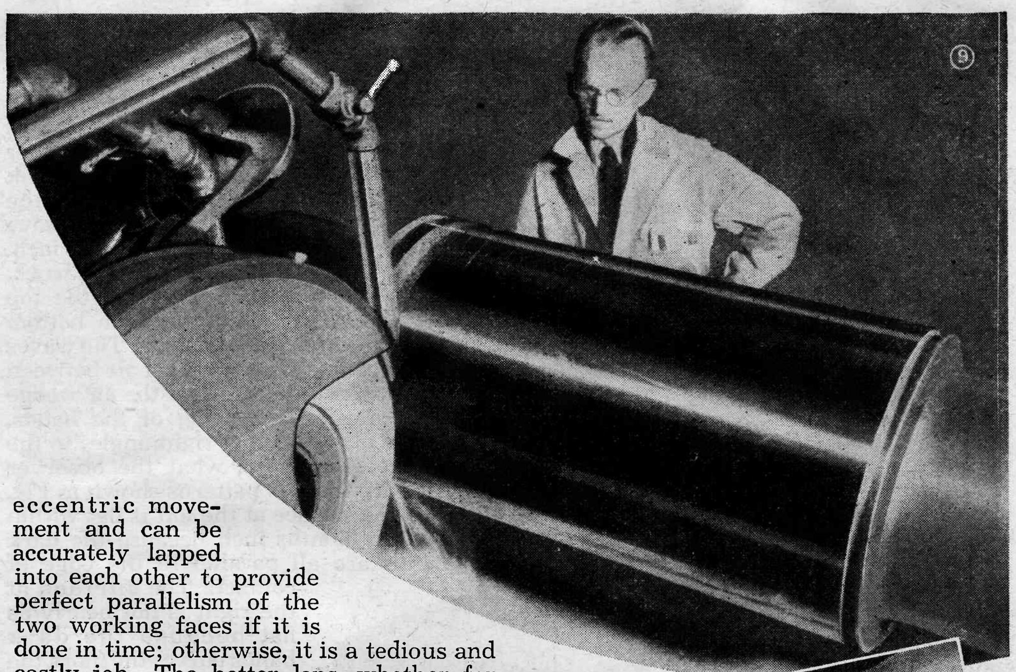


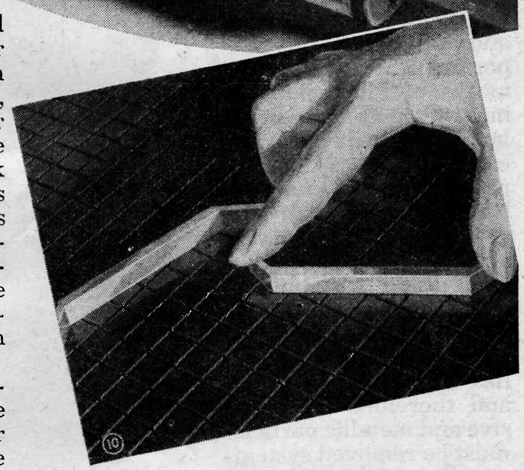


lapped in this case, is held in a three-jaw chuck and the other end is centered on the tailstock. The working surface of the lap is bored eccentric to provide space for two socket-type screws which are used for adjustment. The lap is slit after the holes have been tapped. The lap shown in Fig. 8 consists of a piece of slit tubing and lapping pressure is provided by a lathe dog. For flat lapping manually, one must still resort to a lapping plate as shown in Fig. 10.

Rolling axis and transposition: Cylindrical lapping is done on wrist pins, valve stems, tappet rollers, roller bearings and other similar parts. In the construction of retainers for cylindrical parts, the rolling axis of the work is not in line or radial with that of the laps. For free rolling action, the work must be positioned at the greatest angle possible, which varies from 10 to 22 degrees, depending on the nature of the work. This angular position of the work is necessary to introduce a slippage as the work is rolled on the face of the laps. Mechanical flat lapping requires a particular technique, called transposition, to assure precision of parallelism. After some lapping has been done, the machine is stopped and the parts are exchanged with the corresponding parts diametrically opposite them for the next lapping cycle.

Metal laps and lapping compounds: Fine-grit lapping wheels introduce no maintenance problems as they remain permanently located and automatically wear themselves down uniformly, from repeated dressings and surface-to-surface contact. However, the face of metal laps must be reconditioned regularly. Preparation of the surface to be flat-lapped is highly important; it must be machined accurately, the part must be stabilized by heating and freezing alternately several times to eliminate internal strains, and the surface to be lapped is finally hand-scraped. Two surfaces of square or rectangular shape are made precisely flat by lapping them into each other with reciprocal movement. Disk laps are finished similarly by circular or



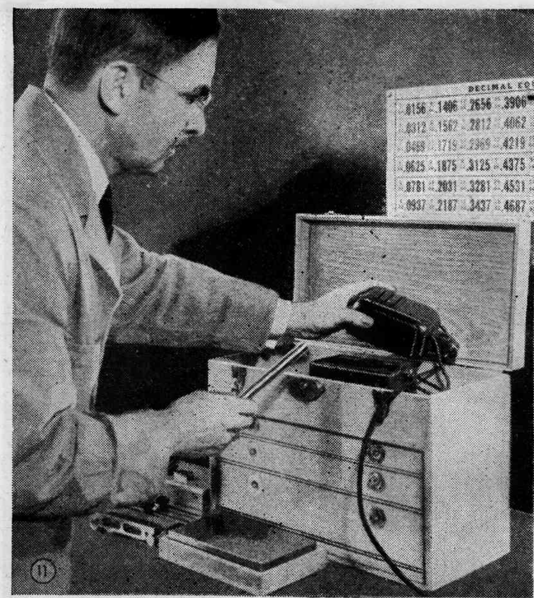


eccentric movement and can be accurately lapped into each other to provide perfect parallelism of the two working faces if it is done in time; otherwise, it is a tedious and costly job. The better laps, whether for machine or bench work, are made from castings of soft and close-grain gray iron, which must be free from alloy. The softer and finer the grain, the better will be the surface of the laps and the quality of work they will do. On lapping machines, it has been found economical to make the laps interchangeable so that they can be transposed each time they are removed for resurfacing. This practice is said to help the surfaces wear more evenly and thus prevent a concave-convex condition, which cannot by remedied simply by lapping.

Proper selection and use of lapping compound is highly important. The abrasive grain should mix well with the vehicle or lubricant so that the mixture will adhere readily to the surface of the laps. Fine silicon carbide of 400 or 500-grain size is excellent for general lapping requirements. Rouge and lavigated alumina are particularly recommended for extra fine finishes. Kerosene, with a little machine oil added, makes a fine vehicle for the grain, but sperm oil has no equal and olive oil is a close second. The excessive use of the compound is worse than using too little. The compound should be spread uniformly but sparingly on the entire surface of the still member and then lapping should be carried on for 2 min., after which both surfaces should be cleaned with naphtha and wiped dry.

Mirror-like finishes: External lapping includes finishes produced by fine grinding. What correct grinding technique can do is shown in Figs. 4 and 9, which show lapped finishes on rolls such as used in sheet-metal rolling mills and also in textile and paper mills. This kind of work requires the use of several wheels varying in grit size. As the diameter of the roll increases, the diameter of the wheel should decrease in order to obtain a small arc of contact between the wheel and the work. To obtain mirror-like finishes, four different wheels are used generally on hardened steel rolls. A 46-L5B is used first for roughing off the greatest amount of stock. It is followed with a 150-J5B for a second roughing cut. Both wheels are vitrified aluminum oxide. Then the rolls are finish-ground with a silicon-carbide shellac-bonded wheel, 320-I8L. The fourth wheel, also of silicon carbide, 500L9L, removes no stock but imparts the mirror-like finish.

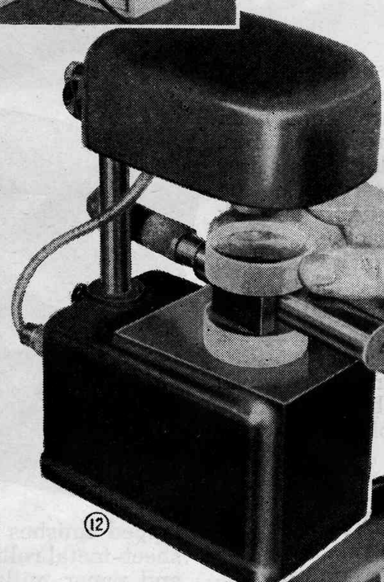
The choice of coolant in connection with



(11)

the bonded abrasive laps and roll grinding is important and so are the means of filtration. The most efficient solution for lapping consists of just enough soap in water to produce a light but not a heavy suds. For the ground reflective finish, a solution consisting of a good grade of soluble oil gives good results and even sal soda can be used. The use of a dirty coolant has most serious effects and therefore the abrasive and metallic particles must be removed systematically. Many filtering devices have been tried but the most effective is centrifugal clarification. In large plants all lapping operations are performed in air-conditioned rooms.

Measuring surface finish with light waves: The apparatus shown in Figs. 11 and 12, consisting of a monochromatic (one-color) light and two optical flats, is a natural micrometer to measure accuracy of flatness by means of light waves. The surface to be inspected should have an accuracy of at least fifty-millionths inch. Fig. 12 shows the finish of a plug gauge being checked against that of a precision gauge block. Light waves have crests and troughs which usually equal each other and a wave length is measured from where it begins to where it begins to repeat itself. The length of the wave remains constant but its width varies with the intensity of the light. With incandescent helium, used in this case, the light wave has a length of 23.2 millionths inch. When the waves cross each other they blank each other out at the point of crossing. The blank spots are called black interference bands and they occur at every wave length or every 11.6 millionths inch. When the light is turned on the work, the waves are reflected from the top surfaces of the parts and the bottom surface of the top optical flat. The waves are produced by a wedge of air between the two, and the width of the air wedge determines the spacing of the bands. These always run at right angles to the wedge of air. So, what the observer sees are the two patterns shown in Fig. 13. The surface at the left is flat within four-millionths inch because the dark bands are all parallel to the edge of contact. The surface at the right is not nearly as flat because the dark bands curve; the more the curvature the greater is the inaccuracy of the surface finish.



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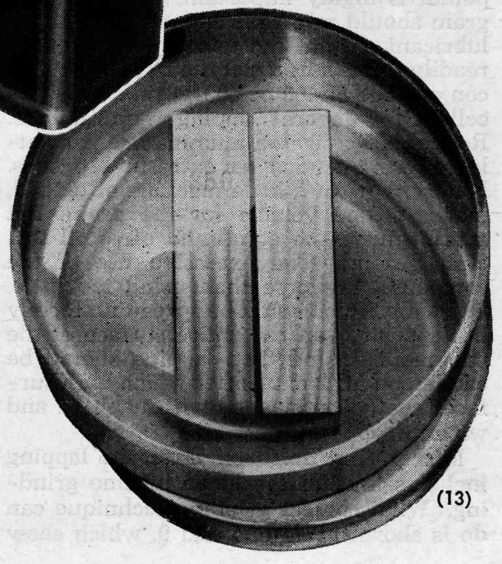


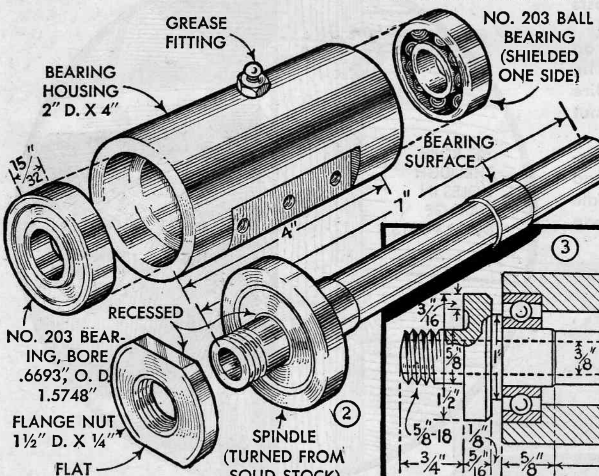
(13)

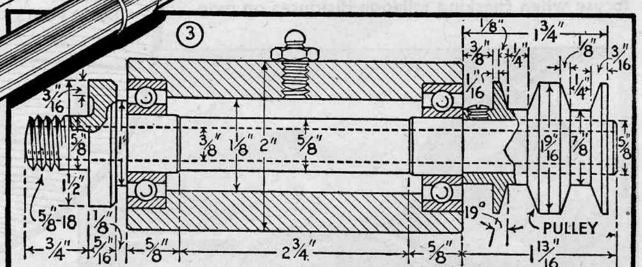
DUAL TOOL-POST GRINDER

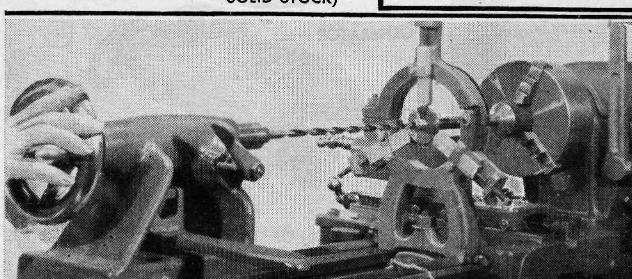
By James Brown

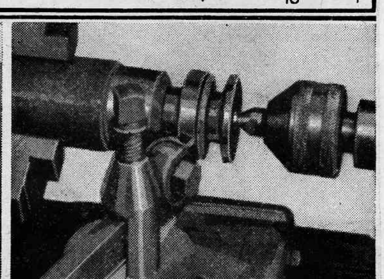
THE tool post grinder is necessary in lathe work whenever a superfine, accurate finish is required, especially if the work is too hard to be turned. The unit described here carries a 4-in. diameter wheel for cylindrical grinding, Fig. 6, and can be fitted with an insert spindle for internal work, Fig. 1. Speeds of approximately 4600 and 7000 r.p.m. are provided, the higher speed being used only for internal work.

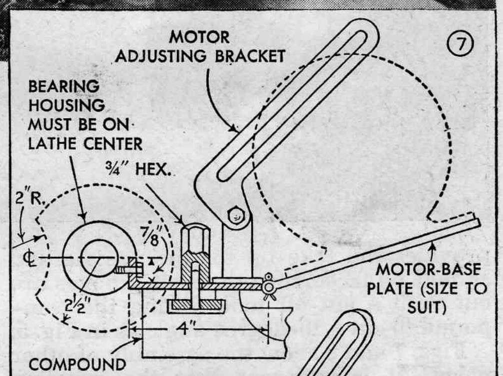
Construction is started by turning the bearing housing and spindle as in Figs. 2 and 3. The spindle



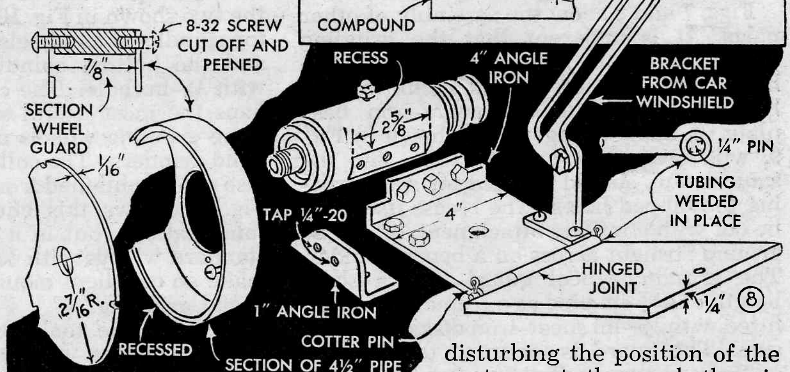


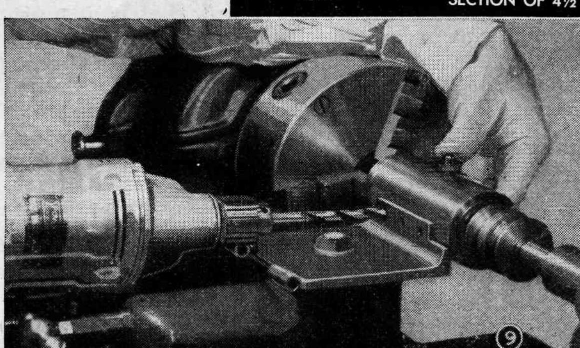


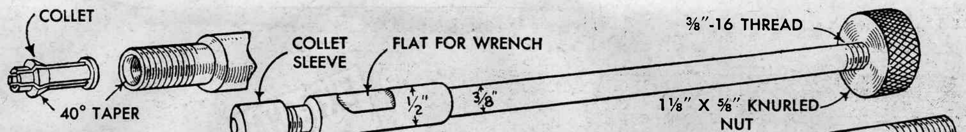
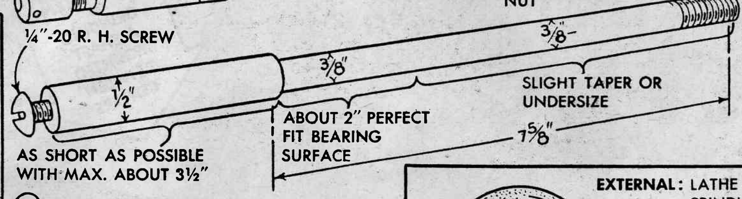




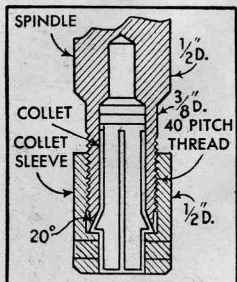
has a 3/8-in. hole from end to end, which should be reamed for a distance of about 2 in. from the flanged end in order to provide an accurate seat for the insert spindle. The hole should be drilled almost through from the flanged end as shown in photo Fig. 4, after which the work is reversed and drilled from the opposite end. A slight misfit is permissible since the insert spindle can be turned to fit. The important point is to have both ends accurately centered. For external turning, the bearing housing is mounted in a three-jaw chuck, after which a center rest is used and the center hole and outer bearing seat is turned to size. Without disturbing the position of the center rest, the work then is reversed for turning the bearing seat at the opposite end. Great care should be exercised in turning all bearing surfaces as the bearings must be a snug, press fit both inside the housing and around the spindle. Ball bearings recommended are No. 203 light duty, with shields on one side. These are standard size in any make and usually can be obtained at automotive supply houses. Bronze bearings may be substituted if desired. The drive pulley



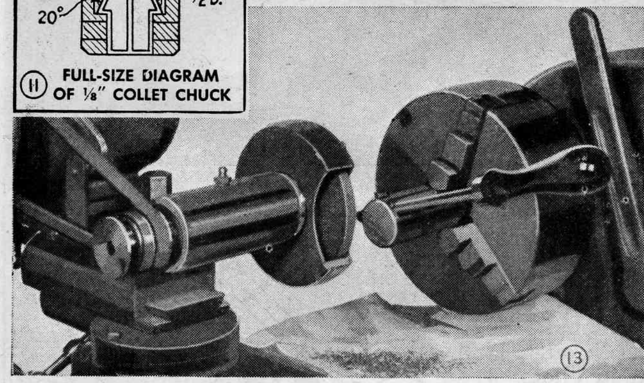


(10) INTERNAL SPINDLES



(11) FULL-SIZE DIAGRAM OF ⅛" COLLET CHUCK



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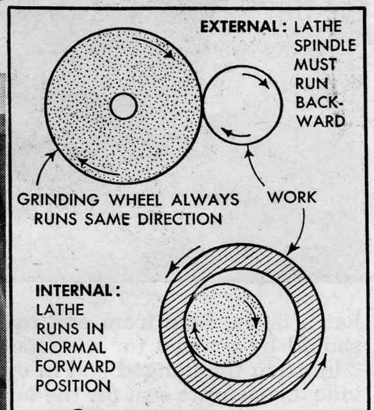


(12) LATHE ROTATION

provides the take-up for the spindle and should be faced smooth. Belt grooves are cut with a cut-off tool, setting the compound to cut a 19-degree angle as in Fig. 5.

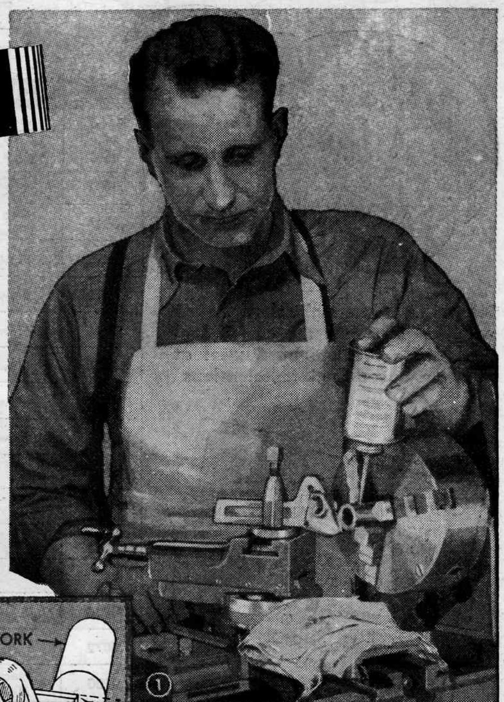
Figs. 7 and 8 show the assembly of other parts. It is apparent that the grinding wheel must come on the lathe centerline, hence care is necessary in mounting the bearing housing to the angle-iron base plate. Actual setting-up, as shown in Fig. 9, will locate the recess exactly, and the same set-up should be used for spot-drilling the tapped holes. The recess itself can be cut with a milling attachment, or can be ground straight across on a bench grinder. The grinding-wheel guard uses a short length of 4½-in. pipe as a frame, this being fitted with 1/16-in. sheet-iron disks on either side. The guard is mounted to the 1-in. angle as shown in Fig. 8, using two, ¼-20 round-head machine screws, the heads of which are ground down to about 3/32 in. thick.

The motor should be no less than ⅙ hp. Naturally, you will want the motor as small and compact as possible, but at the same time you need power. A standard ¼-hp. motor, while a bit on the bulky side, is perhaps the best from a performance viewpoint. Drive pulleys should be 4 and 6 in. The belt has a ⅜-in. face, 38-degree vee, with a circumference of about 25 in. The motor-adjusting bracket shown was obtained from an old model car; it works on a machine screw threaded into the top motor end bell hole.

Insert spindles for internal grinding can be made up in any of a number of styles, the two shown in Fig. 10 being typical. The top spindle takes wheels with ⅛-in. shanks, and the bottom spindle requires wheels with ¼-in. hole. The collet chuck is perhaps the most useful since it utilizes the same grinding wheels used in the popular hand grinders. The collet and collet sleeve also can be obtained from the hand grinder. Fig. 11 shows this chuck full size. The same pattern, but in a larger size to take standard wheels with ¼-in. shanks, would make an excellent mounting for heavy internal grinding.

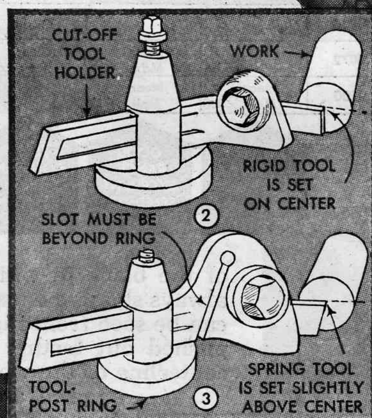
In using the tool-post grinder for external grinding on cylinders, the lathe spindle must be reversed, that is, it must run backward. This is accomplished with a standard reversing switch, which should be standard equipment on every lathe. When the job is internal grinding, the lathe runs in normal forward position, Fig. 12. Proper dressing of the wheel, preferably with a diamond dresser, is essential for clean smooth work. Dressing should be done mechanically, not freehand. A simple mounting for a diamond dresser is shown in Fig. 13. A somewhat similar mounting can be made for a square or round stick dresser, which can be used satisfactorily if a diamond is not available.

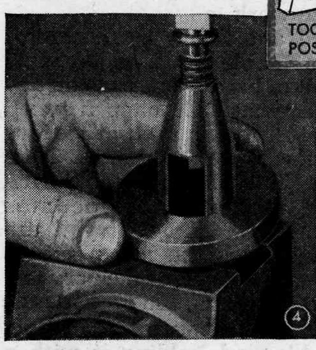
Tricks of CUTTING-OFF *in the lathe*

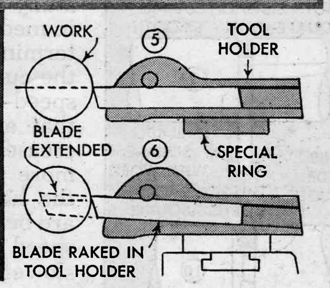


OIL IS NEEDED ONLY WHEN CUTTING TOUGH, HARD STEEL. MILD STEEL AND ALL OTHER MATERIALS CAN BE CUT DRY

THE cut-off tool is a narrow, ready-shaped blade which requires only grinding of end clearance to keep it sharp and ready for work. It is held in a cut-off tool holder. There are two common types of tool holders—rigid and spring. The rigid type is always used with the blade set on the centerline of the work as shown in Fig. 2. With the spring type the blade is set slightly above the center of the work as in Fig. 3. Of the two, the spring type is slightly more expensive, but it is far superior for all general cutting and it is the only type that works well with a power feed. Both rigid and spring types of tool holders can be obtained in straight, right offset and left offset patterns. The right offset pattern is most generally used as it can work closer to the chuck than either of the others. Since the tool is always used in a fixed relation to the centerline of the work it is a good idea to use a special toolpost ring as shown in Fig. 4, to automatically support the blade at the right height. This arrangement works with the blade at any extension if the blade is parallel with the tool holder, as shown in Fig. 5. If the blade is set at an angle or "raked" in the tool holder as in Fig. 6, the ring should be made up for a 1-in. extension







Correct Installation of Belts

There are a few things to remember when installing new belts. Be sure that the shafts are parallel and that the pulleys are in correct alinement; also that the belt is of the proper length and that the ends are cut square across where the splice is to be made. Splicing should be given considerable attention, whether the ends are laced or glued. It is not a good idea to cut the belt too short and then stretch it to make it fit, as this will weaken the material so that it will wear out faster and will also cause undue wear on the shaft bearings.

What speeds and feeds are best?

The table at the right shows what will happen when the cut-off tool is used on medium hard steel at various speed-feed combinations

CUTTING IS POSSIBLE IN THIS RANGE

BEST FEEDS AND SPEEDS FOR GENERAL WORK

NOT SATISFACTORY CUT CANNOT BE MADE

TIME IN MINUTES TO CUT 1-IN. DIAMETER BAR

TEST CUTS IN MEDIUM HARD STEEL — Table No. 1

Feed Per Rev.	SPINDLE SPEED				
	50 R.P.M. 13 S.F.M.	100 R.P.M. 13 S.F.M.	150 R.P.M. 40 S.F.M.	300 R.P.M. 80 S.F.M.	500 R.P.M. 130 S.F.M.
.0002	Rub / 50	Rub / 25	Squeal / —	Squeal / —	Squeal / —
.0004	Too Slow / 25	Slow / 12.5	Slow / 8.3	Squeal / —	Squeal / —
.0005	Slow / 20	Slow / 10	Slow / 6.6	Squeal / —	Squeal / —
.0010	Slow / 10	Slow / 5	/ 3.3	Chatter / —	Squeal / —
.0014	Slow / 7.1	/ 3.5	Good / 2.4	Light Chatter / 1.2	Squeal and Chatter / —
.0018	Slow / 5.5	/ 2.7	Good / 1.8	Light Chatter / .9	Squeal and Chatter / —
.0021	Slow / 4.7	Good / 2.4	Good / 1.6	/ .8	Chatter / —
.0024	Slow / 4.2	Good / 2.1	Good / 1.4	Good / .7	Chatter / —
.0027	/ 3.7	Good / 1.8	Good / 1.2	Good / .6	Near Max. / .3
.0031	/ 3.2	Good / 1.6	Good / 1.1	/ .5	Stall / —
.0036	/ 2.8	Good / 1.4	/ .9	Near Max. / .5	Stall / —
.0043	/ 2.3	Good / 1.2	/ .8	Near Max. / .4	Stall / —
.0050	/ 2.0	/ 1.0	Grunt / .7	Stall / —	Stall / —
.0072	/ 1.4	Near Max. / .7	Near Max. / .5	Stall / —	Stall / —
.0100	Near Max. / 1.0	Near Stall / .5	Stall / —	Stall / —	Stall / —

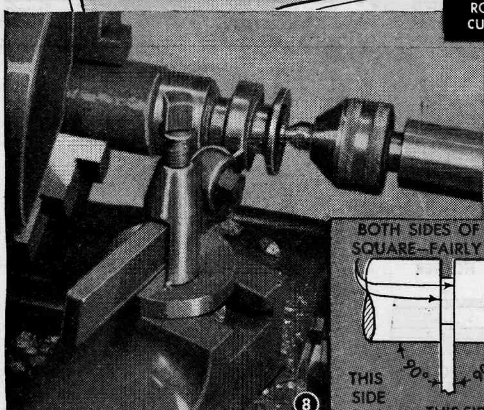
50 R.P.M.	100 R.P.M.	150 R.P.M.	300 R.P.M.	500 R.P.M.
O.K. BUT SLOW AND ROUGH CUTTING	GOOD RANGE. EXCELLENT SPEED FOR HARD STEEL	BEST CONSTANT SPEED FOR GENERAL WORK	FASTEST. BLADE CUTS BEST WITH BACK RAKE	VERY CRITICAL AS TO FEED AT THIS SPEED

(7) IF YOUR LATHE DOES NOT HAVE POWER FEED, APPLY THIS FORMULA:

6 ÷ (WORK SPEED IN R.P.M. TIMES FEED)

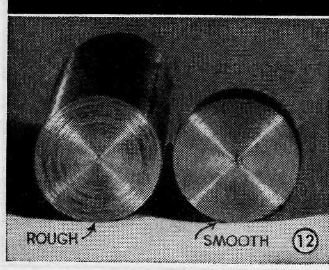
THE RESULT IS TIME IN SECONDS FOR ONE COMPLETE REVOLUTION OF FEED HANDLE

EXAMPLE:
WORK SPEED = 150 R.P.M.
FEED PER REV. = .002 IN.
150 X .002 = .3
6 ÷ .3 = 20 SECONDS



(8)

The blade will cut rough or smooth, depending on angle it is fed to work



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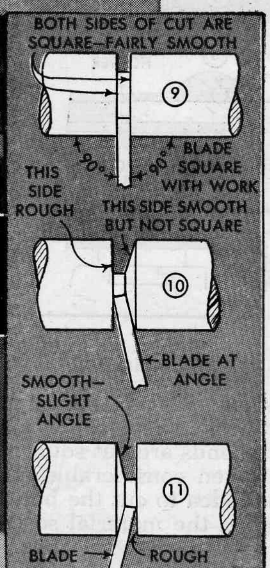
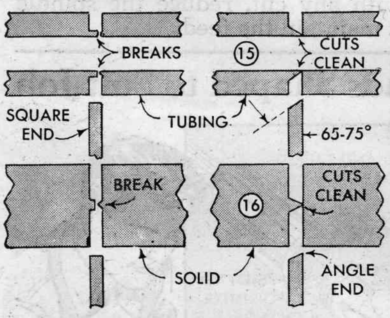


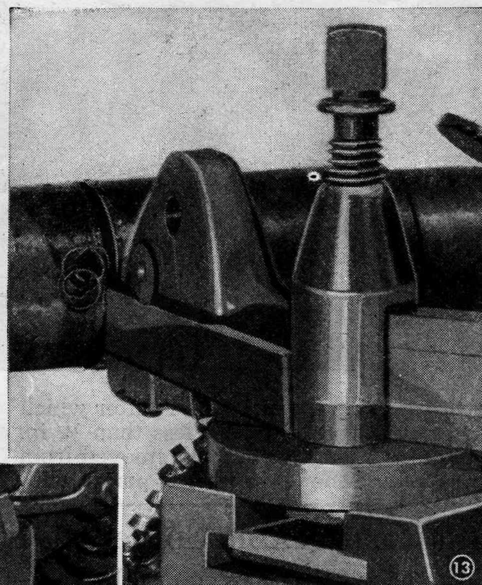
of the blade in which case the the blade always should be used at this extension. It can be seen from Fig. 6 that if the blade is pushed out farther it will be above the centerline of the work.

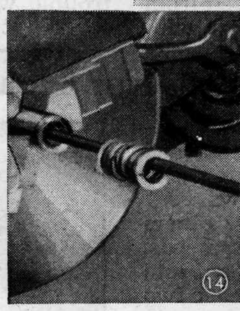
Speed and feed: By a careful study of Table No. 1 on test cuts in medium hard steel, you can determine what will happen when the cut-off tool is used at various speed-feed combinations. Note that as the spindle speed is increased, the feed rate becomes more critical. Hence, if you use the hand feed, the lower speeds are best. However, at the very low speed of 50 r.p.m., the operation is slower than hack-sawing. Picking up a chip and holding it with a steady feed is the secret of cutting-off. General fault is too slow a feed, which should be at least .0015 in. per rev. in order to hold a chip in steel with a straight blade as shown in Fig. 13. If your lathe does not have a power crossfeed, use the formula given in Fig. 7 to determine time required. This will tell you how fast to turn the cross-slide handle to get a specific feed per rev. A little practice with a watch in view will enable you to approximate any given feed.

Feed angle of blade: This should be straight in as shown in Fig. 9. If you are making a cut at an angle, as for example in making a pulley, the tool holder must be mounted perfectly square with the compound and fed with the compound handle as in Fig. 8. If the blade is not square with the work, it will cut one side rough and the other side smooth, as shown in Figs. 10, 11 and 12. In cases where a slight angle does not matter, this kind of cut can be used to advantage occasionally in order to produce a smooth surface.

Chatter and "hogging"; Chatter is caused by the inability of the cutter to penetrate the work and hold the chip. A fine feed will cause chatter because the blade does not penetrate. If the blade does not have back rake, it takes a minimum of about .015 in. to pick up and hold a chip. On hard steel and hard brass, chatter is present at all feeds if a straight blade is used. Therefore the remedy here is to use a blade with back rake. This permits easier penetration and holds a chip at a slower feed rate than is the case with a straight blade. "Hogging" occurs when the feed is too heavy—when you try to take a chip that is too much for the lathe or the tool—with the result that the lathe stalls, the work twists out of the chuck, or the tool breaks.







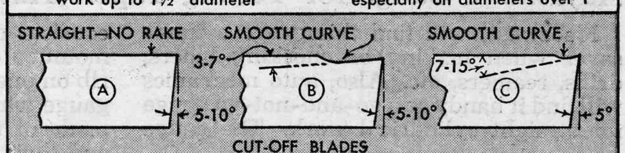
Picking up a chip and holding it with steady feed is secret of cutting-off. Most turners feed too slow—it takes at least .0015 in.-per-rev. feed to hold a chip in steel with straight blade

RECOMMENDATIONS FOR CUT-OFF WORK — Table No. 2

Material	Nature of Chip	Work Speed in R.P.M.*	Tool Feed Per Rev.	Blade
Mild Steel	Short Curl	250	.0025	A or B
Medium Steel	Medium Curl	150	.0025	A or B
Hard Steel	Stringy	100**	.002	B or C
Yellow Brass	Short-Brittle	500	.0015	A
Hard Brass	Stringy	300	.002	B or C
Bronze (Phosphor)	Stringy	300	.002	C
Cast Iron	Short Chips	150	.002	A or B
Cast Plastics	Long Ribbon	500	.002	A or B
Copper	Stringy	300	.0015	B or C
Aluminum	Medium Curl	500	.0015	C

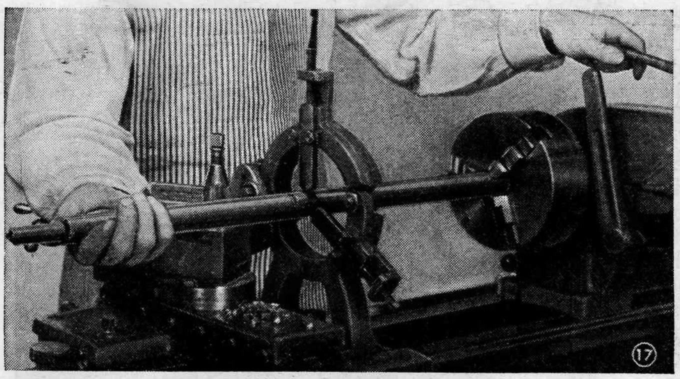
* Constant speed—Use for all work up to 1½" diameter

** Use cutting oil (lard oil) especially on diameters over 1"



Large work: Maximum diameter for cut-off work on a small lathe is about 3 in. Do not project the blade the full distance at the start, but work it out gradually, a quarter of an inch at a time. Cutting a double groove in order to obtain more clearance is good practice generally followed in making deep cuts. All cuts made in hard and also in mild steel that has a diameter greater than 1 in. should be given a liberal application of cutting oil as in Fig. 1.

Special setups: When you are cutting washers it is a good idea to fit a small rod inside the hole to catch the finished work as it is cut free, as shown in Fig. 14. When cutting-off in the center of a bar, always support the work at the point of cutting with a steady rest as in Fig. 17, and cradle the free end in your hand. All cuts over 3 in. from the chuck should be supported



a hacksaw. If you want to eliminate the small nib, which forms when work is cut off with a standard straight-end blade, use a blade ground at 65 to 75° angle as shown in Figs. 15 and 16.

Various metals: Recommendations for cutting off various metals are given in Table No. 2. Use the constant speed system specified and you will quickly get the feel of the work. You should have

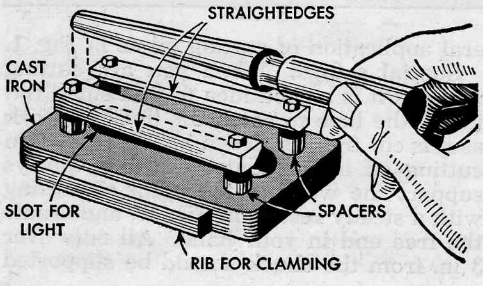
by bringing up the tail center; after which the stock is turned to not less than 1/4 in. diameter. Then the work is removed from the lathe and the 1/4-in. neck is parted with three cut-off blades, as shown in details A, B and C below Table 2. When you have trouble with any cut, reduce the spindle speed but maintain the feed.

Interchangeable Soldering-Iron Heads Shaped to Suit Job

Anyone who has considerable light soldering work to do, such as radio repairing, will find interchangeable soldering-iron heads of copper like the ones shown very convenient. Besides these heads, others can be made to suit your particular needs. They can be of irregular shape to get into hard-to-reach places, or they can have two soldering points for soldering in two positions at the same time. However, the heads should not be too long or too slender if a soldering temperature is to be maintained at the ends. In preparing a soldering iron for the interchangeable heads, unscrew the original head and slot it as indicated. Then drill and tap a hole through the head from opposite sides of the slot for a retaining screw to hold the interchangeable heads in place. If possible, it is a good idea to obtain another head like the original one for the iron so that it can be used for heavy work whenever necessary.

Adjustable Gauge for Testing Tapers Has Many Uses in the Shop

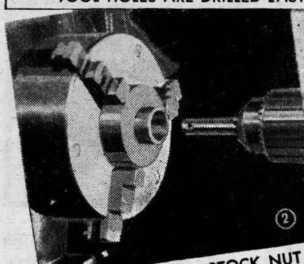
Machinists will find this gauge a time-saver when making or checking tapers, drills, reamers, etc. Also, auto mechanics will find it handy as a go-and-not-go gauge for straight cylindrical work. The gauge consists of two adjustable straightedges mounted on a cast-iron base, which has a rib on one side for holding or clamping the gauge when in use. The straightedges are made of tool steel hardened and ground, and their testing faces are lapped flat and straight to very close limits. They can be adjusted to any standard taper. An opening milled in the base admits light.



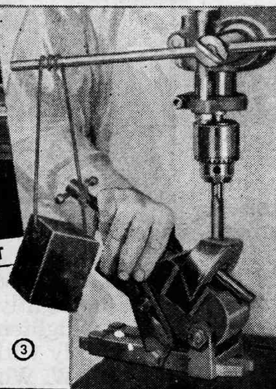
Often slight perspiration on the hands will cause rusting of polished steel. If you experience this trouble, rub your fingers lightly on the back of your head before handling precision steel tools. Natural oils transferred to the fingers in this manner will prevent the trouble.

Construction and Use of TAILSTOCK TURRETS

TOOL HOLES ARE DRILLED LAST TO ASSURE ACCURACY



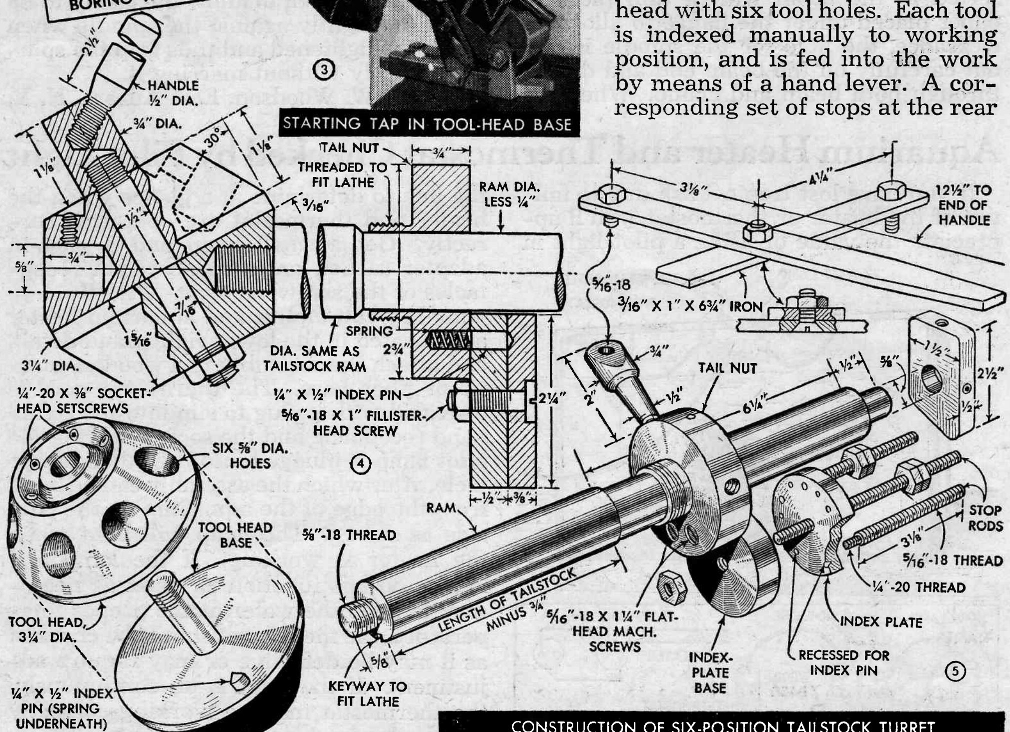
BORING THE TAILSTOCK NUT



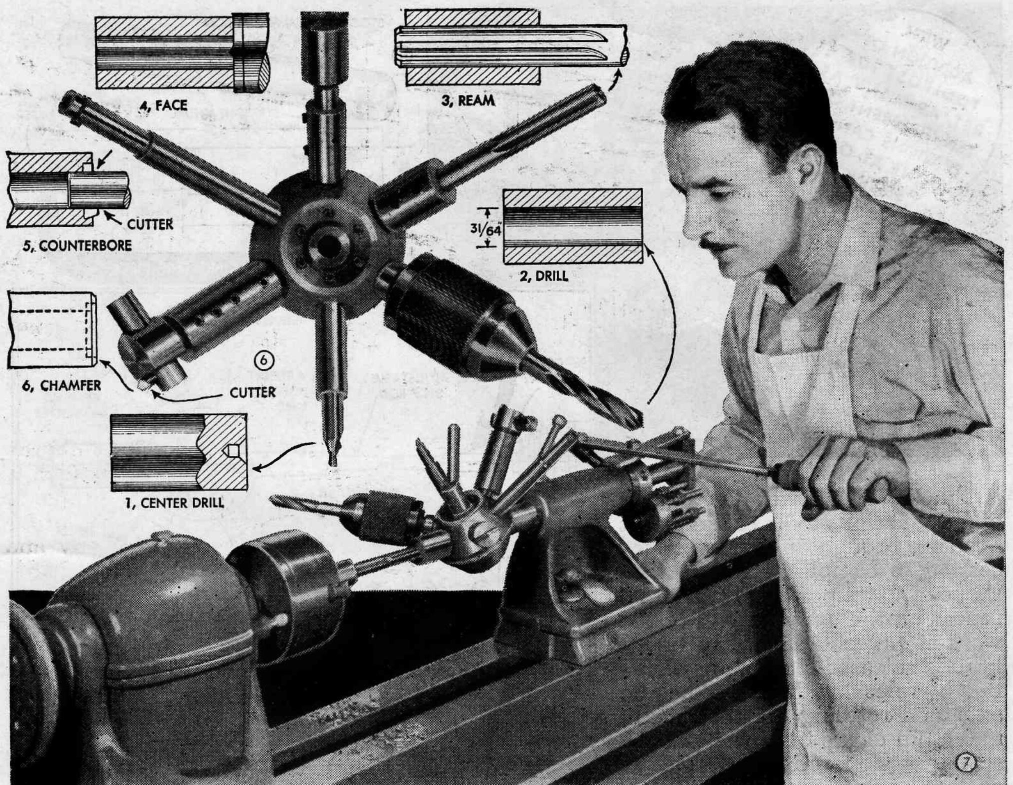
STARTING TAP IN TOOL-HEAD BASE

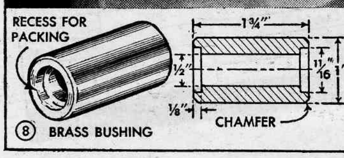
ARE YOU looking for a bottle-neck smasher for lathe production? You may find the answer in tailstock turrets. The tailstock turret is not new, but it took a war, with consequent shortage of standard turret lathes, to prove that this device was speedy and practical on hundreds of light-duty jobs. The simplicity of setting up this type of turret makes it ideal for short-run work; in fact, it can be used to advantage as a standard accessory in ordinary lathe work.

The six-position turret: Best of the three turrets described in this article, the six-position turret, as its name implies, is a revolving head with six tool holes. Each tool is indexed manually to working position, and is fed into the work by means of a hand lever. A corresponding set of stops at the rear



CONSTRUCTION OF SIX-POSITION TAILSTOCK TURRET

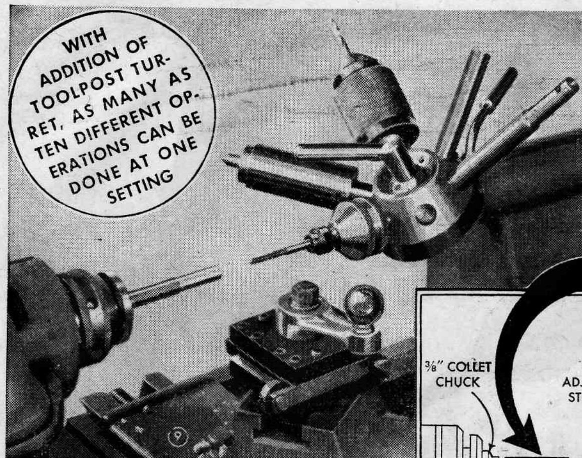


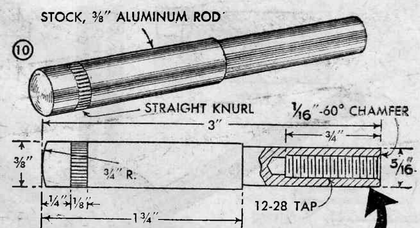


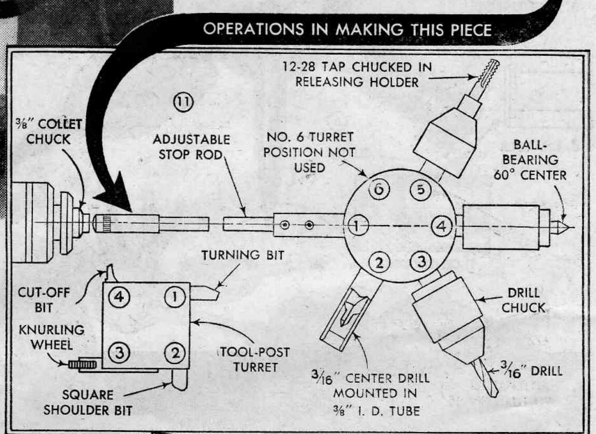
This Typical Set-up Shows how Turret Speeds Production

of the turret controls the depth of feed for each tool. Construction of the turret is shown in Figs. 4 and 5. Starting out, you make the ram or tailstock spindle first, making the larger diameter of this the same as the regular tailstock ram on your lathe. A new tail nut, threaded to fit the lathe and bored ¼ in. less than the full diameter of the ram, Fig. 2, is next, followed by the tool-head and stop-rod index plates. The rear of the lower portion of the tool head is flattened to furnish a neater and more substantial joint with the ram spindle. The flattening job can be done by routing and grinding on a drill press with the work held at the required angle in a vise (or the drill table is tilted). In the same working position, the hole for the ram thread is drilled and the tap started, as shown in Fig. 3. The tool head is finished complete except for the tool holes; the drilling of these should be the last operation and is done by a reversal of the process which the turret will later do on actual work. Fig. 1 shows the operation. It can be seen that absolute accuracy is assured. The stop-rod device consists of two plates. One of these carries the six stop rods, and the other is fastened to the rear face of the tail nut, as can be seen in Fig. 5. The position of the two flat-head machine screws used for mounting should be figured closely, as the hole for the index pin will be drilled between them later. Actual indexing of both stop rods and the tool head is controlled by a hardened steel pin under spring pressure, which engages in conical recesses in the tool-head top and index plate. The feed mechanism is a simple arrangement of levers, permitting a feed of about 3½ in. The short lever should be positioned to ride on the tail nut, which supplies a support. The endpiece of the ram is held in place by a setscrew, and is drilled to slide over the uppermost stop rod.

Typical setups: A typical setup using the six-position turret is shown in Figs. 6 and 7. Fig. 8 shows the job—a plain brass bushing with recessed ends to take packing rings. Preparatory to turning, the 1-in. bar stock used is sawed to length, allowing about 1/16 in. for trimming. Then the work







Turret Position	Job	Feed Needed	Max. Feed Less Feed Needed	Tool Length
1	Stop Rod	0"	3½"	2½" to 6"
2	Center Drill	¾"	2¾"	3¼" to 6"
3	Tap Drill	⅞"	2⅝"	6"
4	Tail Center	⅛"	3⅜"	2⅝" to 6"
5	Tap	¾"	2¾"	3¼" to 6"
6	Open	—	—	—

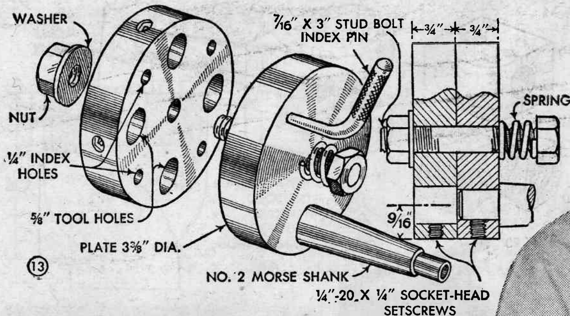
(12) CHECK CHART TO DETERMINE TOOL LENGTHS

is chucked in a three-jaw chuck, and the various tools in the turret head are brought into play in succession to complete the required shape. Turret positions 4, 5 and 6 repeat on the opposite end of the work after rechucking. The turret head is released for each new station by releasing the clamp handle and then rotating the tool head until the index pin clicks into position. The corresponding stop rod is indexed with a flip of the fingers.

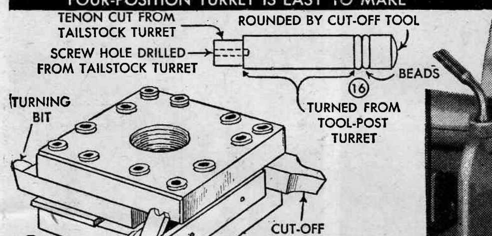
Figs. 9, 10 and 11 picture another simple setup. In this case, the job is an aluminum guide post as shown in Fig. 10. Bar stock is used and is fed in suitable long lengths through a collet chuck, turret position A, controlling the advance of each new piece. Other operations follow in rotation, as can be seen in Fig. 11. It will be noted that four of the operations in this setup are worked from a four-position tool post turret. Placement of this device for the various cuts should be controlled by swinging stop links clamped to the lathe bed and cross slide.

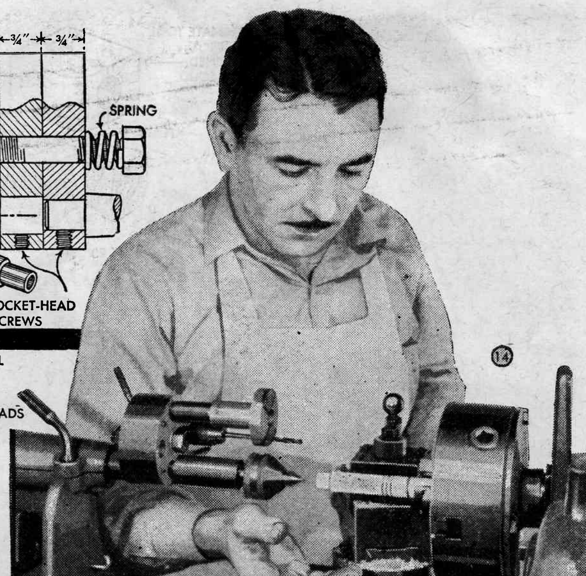
Determining tool lengths: An important part of any turret setup is the determination of suitable working tool lengths. If the setup is made by fit-and-try methods, one or more tools may be found to be too long or too short to permit working. A chart similar to the one shown in Fig. 12 should be made up for each new job. This sample applies to the job shown in Fig. 11. Columns 1, 2 and 3 of this are self explanatory. Column 4 is obtained by subtracting the feed needed by each tool from the maximum feed. Thus, if the maximum feed is 3½ in. and the feed required for turret position No. 2 is ¾ in., the figure opposite No. 2 station on the chart will be 2¾ in. Column 5 shows a heavy box in which is marked the length of the longest tool used in the setup, as measured from the face of the turret to the end of the tool. From this figure (6 in. in this case) are subtracted the figures in column 4. The result in each instance is the shortest possible length of each tool, and the bushing or other holding device used for the tool, should be made or arranged so that the total length of the tool comes between the minimum and maximum length. Altogether, this sounds a bit complicated, but you will find it quite simple and a real timesaver in making setups. Obviously, if fittings already available show short on two or more turret positions, it is advantageous to reduce the length of the longest tool. In actual work, this usually will be a drill or reamer held in a chuck, and shortening can be done by rechucking the drill or reamer in a solid bushing.

Four-position turret: The four-position turret is a simple device with less scope than the six-position turret, but nevertheless a good accessory. As shown in Figs. 13 and 14, it is fitted with a Morse taper shank and is mounted and worked in the

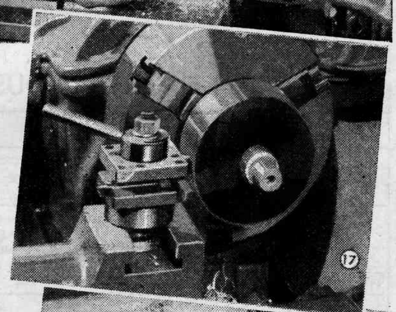


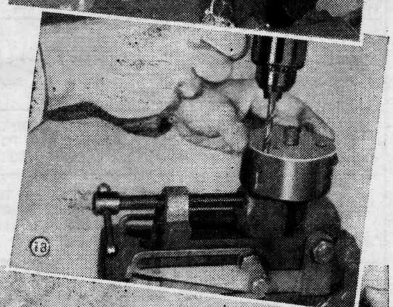
FOUR-POSITION TURRET IS EASY TO MAKE

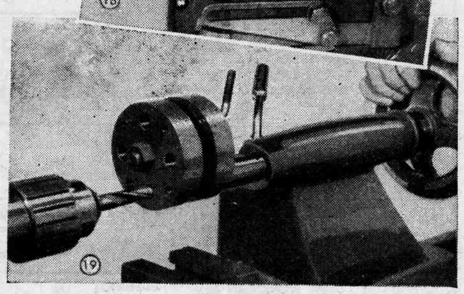




TOOLPOST TURRET HAS IMPORTANT PART IN MAKING THIS WOODEN HANDLE



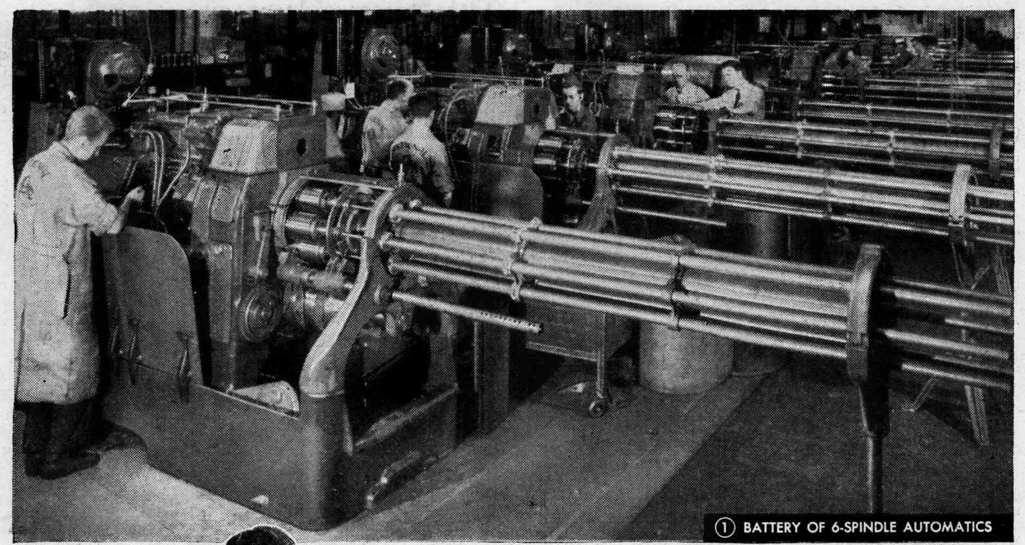




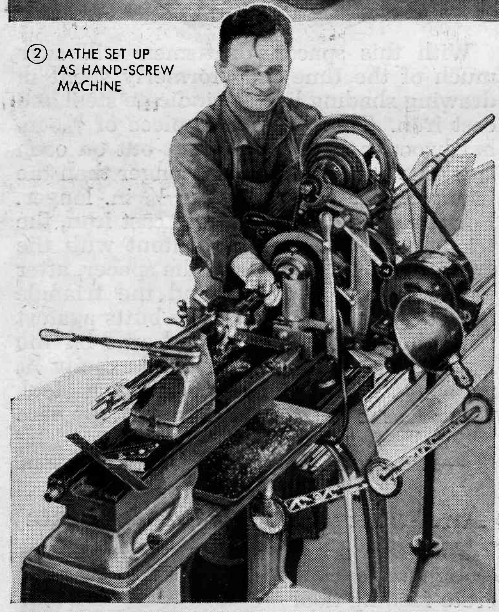
regular lathe tailstock. However, it is apparent that the same turret could be used with the same feed mechanism previously described for the six-position turret. In making this turret, the center hole for the stud is drilled first, after which the two plates can be mounted on the stud and turned, Fig. 17. The index holes are made by first drilling a hole at any point in the back plate and then moving it a quarter turn to drill each of the four holes in the front plate, Fig. 18. As in the six-position turret, drilling of tool holes comes last, with the head setup and indexed in the same position as it will take in actual work, Fig. 19.

A sample job with this turret is shown in Figs. 13, 15 and 16. The ¾-in. dowel stock used is fed through the lathe headstock spindle. After drilling and tenoning the work from the tailstock turret, the toolpost turret is brought into action, the work meanwhile being supported by a spinning center mounted in the turret.

Duplex semi-turret: The duplex semi-turret is a two-position tool holder, simple and practical for such jobs as drill-and-ream, drill-and-counterbore, drill-and-tap, etc. The one shown in Fig. 21, is made from a ½-in. 90-degree pipe elbow, which is machined flat in the lathe, as shown in Fig. 22. The sample operation with this turret, as pictured in Fig. 20, is a simple drill-tap and cut-off job on a brass rod. The method of tapping is worth noting. The tap is held in a bushing made to fit an inexpensive type of ball-bearing spinning center. By holding the spinning center stationary by hand, the tap can be fed into the work by pushing the tailstock. After cutting to depth, the spinning center is released, allowing the tap to spin with the work. Then the spindle is reversed to back the tap out of the hole. This method is practical on brass and aluminum; steel, too, when the tap is not over ¼ in. diameter. With a suitable bushing holder, the same setup can be used for small dies.



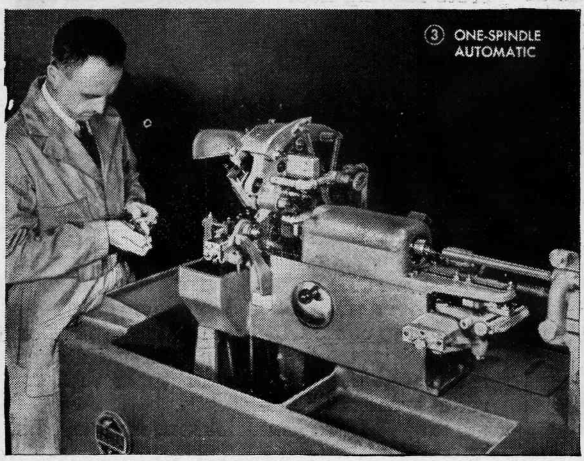
① BATTERY OF 6-SPINDLE AUTOMATICS



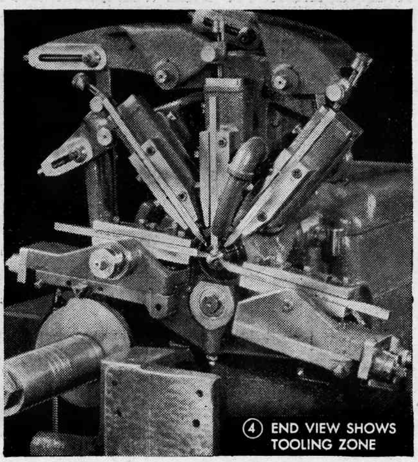
② LATHE SET UP AS HAND-SCREW MACHINE

THE automatic screw machine, originally nothing more than an automatic turret lathe, was first used, as its name implies, for making screws. However, after numerous improvements, this machine has become a complex multiple-spindle lathe used for producing amazing quantities of small turned parts of various sizes and shapes with a high degree of uniform accuracy and at a minimum cost. While some simple parts shown in Fig. 6, which require only a few operations, can be produced at the rate of 6,000 an hour, other parts requiring more operations may take 3 or 4 minutes to produce each.

Material from which the parts are made may be standard round, square or hexagon bar stock. The blank stock is automatically fed to the cutting tools which perform various operations on each piece in sequence. Speeds and feeds of the cutting tools to obtain economical operation

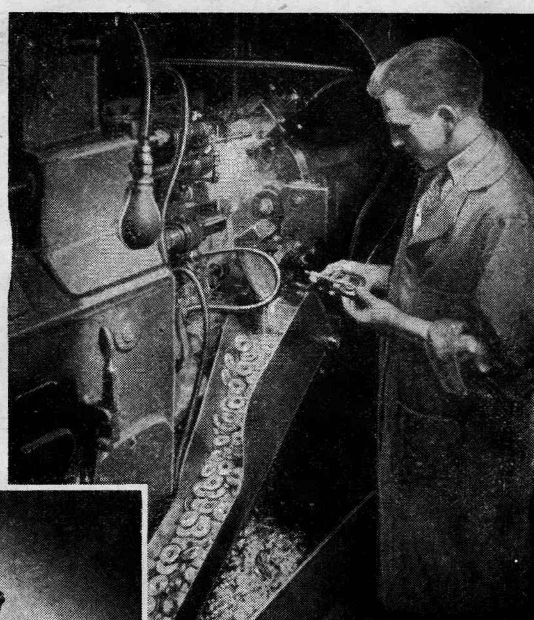


③ ONE-SPINDLE AUTOMATIC

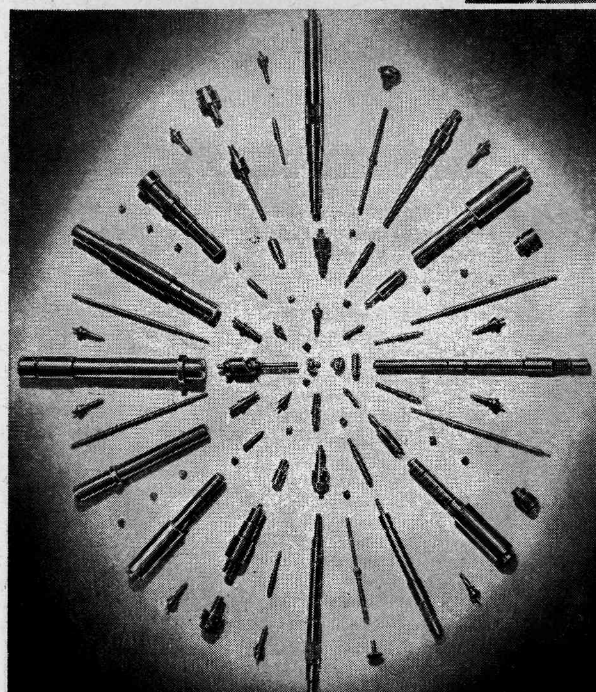


④ END VIEW SHOWS TOOLING ZONE

"Briefing" the AUTOMATIC SCREW MACHINE



⑤ FINISHED WORK "ROLLING OFF" 6-SPINDLE AUTOMATIC

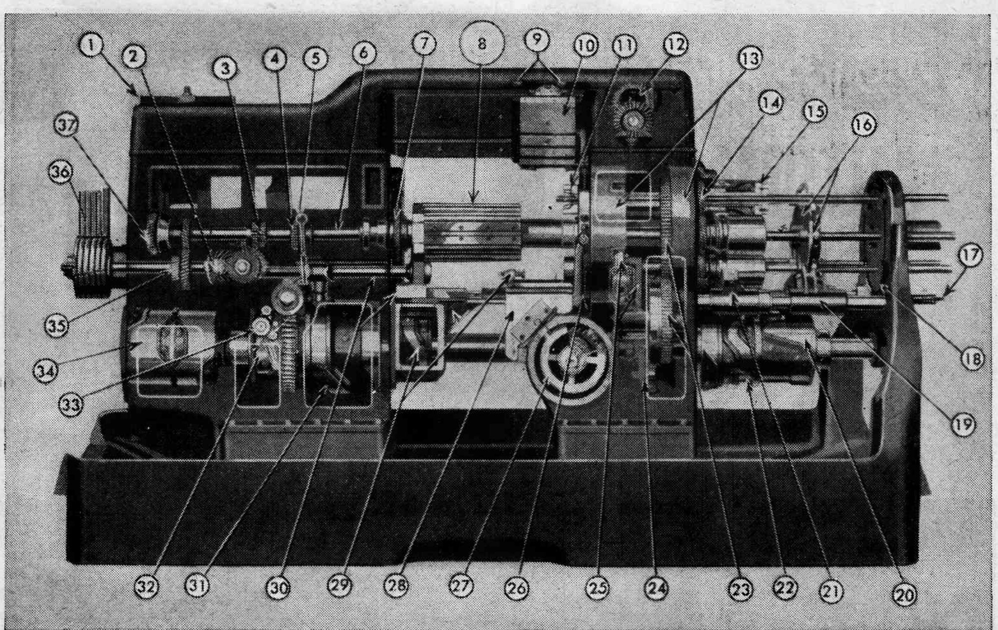


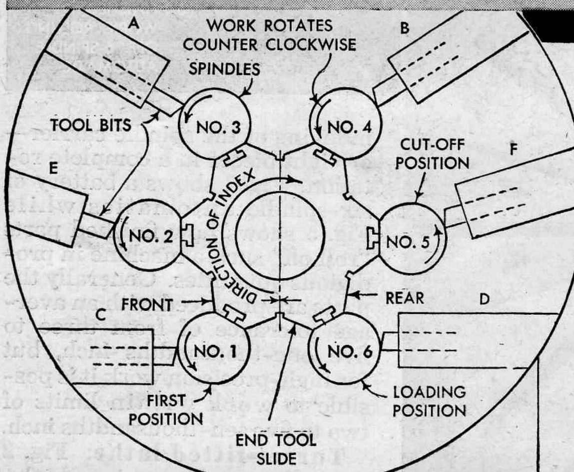
⑥ KIND OF WORK PRODUCED

also are varied automatically. Each spindle of a multiple-spindle screw machine holds a bar of stock and the cutting tools are fed forward against stock held in opposing spindles. After finishing its cut, each tool returns to its starting position and the work-spindle carrier or head rotates so that each bar of stock is brought to the next cutting position. After turning, drilling, reaming, counterboring, threading and other operations are performed, the finished piece is cut off. So, on an eight-spindle screw machine a piece of finished work is dropped off with each change of indexing of the spindle carrier—or eight pieces in a complete rotation. Fig. 1 shows a battery of six-spindle automatics while Fig. 5 shows how finished parts "roll off" such a machine in prodigious quantities. Generally the parts are produced with an average tolerance of from three to five one-thousandths inch, but for high-precision work it is possible to work within limits of two to five ten-thousandths inch.

Turret-fitted lathe: Fig. 2 shows a small engine lathe equipped with a turret, which is the forerunner of the present screw machine. This setup differs from a regular turret lathe in that bar stock for the former is inserted through the headstock and is gripped securely by means of a spring collet. Regular turret-lathe work applies to the machining of blanks already cut off from large-diameter stock, or else forgings or castings, which are held in jaw chucks, chucking devices and on faceplates.

Single-spindle automatic: This machine, Fig. 3, is the stepping stone between the original turret-fitted lathe and the multiple-spindle automatic. The end view, Fig. 4, shows five positions for tools to machine externally. When drilling, reaming, screw-cutting and tapping attachments are re-





(8) END VIEW OF SPINDLE-CARRIER ASSEMBLY

(7) DETAILS OF 6-SPINDLE AUTOMATIC

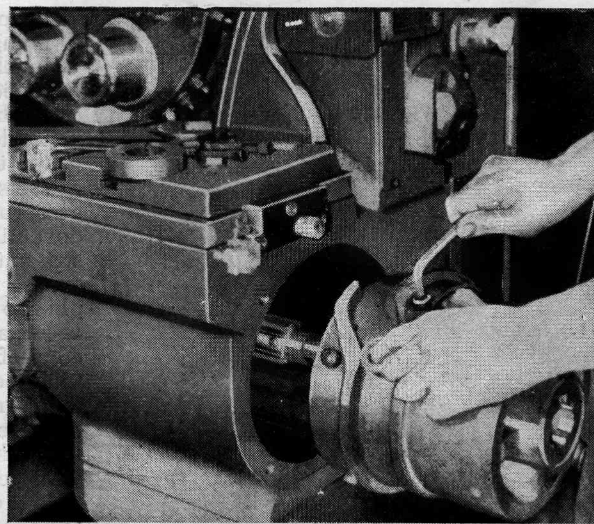
1—Motor plate
2—Oil pump drive
3—Threading sprockets (or gears)
4—High speed drilling drive
5—Feed clutch lever
6—Spindle drive shaft
7—Idler gear for high speed drilling attachment
8—End tool slide
9—Upper side slide drums
10—Upper side slides
11—Spindle collet and pusher
12—Intermediate side slide drum drive gears
13—Spindle carrier
14—Spindle gears
15—Finger holder mechanism
16—Stock feeding ring and aligning disc
17—Stock feeding spring
18—Stock reel index
19—Stock feeding slide
20—Stock feeding drum
21—Chucking slide
22—Chucking drum
23—Indexing gears for spindle carrier
24—Indexing arm for spindle carrier
25—Locking pin and lever for spindle carrier
26—Side slide stop bracket and stop screws
27—Lower side slide drums
28—Lower side slides
29—Drum operated sliding stock feed/stop
30—End tool slide pusher and guide
31—End tool slide drum
32—Drum for high speed clutch, threading clutch and brake
33—Worm wheel drive shaft brake
34—Threading slide drums
35—Range gears
36—Main drive
37—Spindle speed and feed change gears

quired they are bolted to the vertical section of the bed. While this type of machine is limited to small-diameter bars, the machining and stock-feeding cycle is fully automatic, each individual tool being timed to take a particular cut. Once the machine has been set up to requirements, all the operator has to do is to insert the stock.

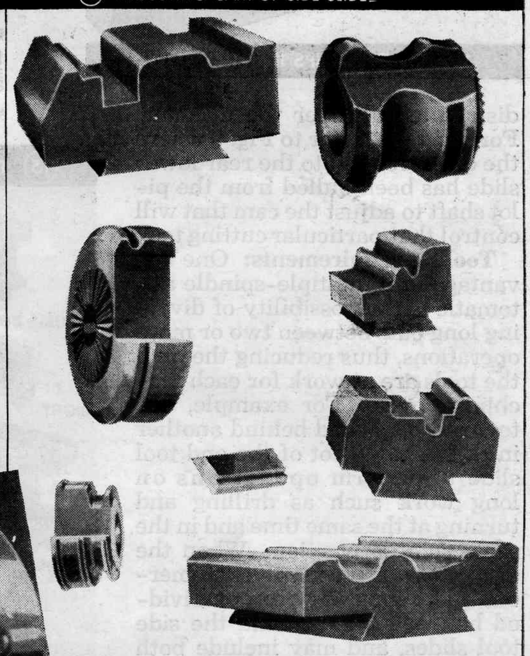
Arrangement and operation of multiple-spindle automatics: The number of spindles (4, 6 or 8) on an automatic screw machine limits the diameter of bars that the machine will accommodate. A 4-spindle machine takes bar stock 7/8 to 4¾ in. in diameter, a 6-spindle takes 9/16 to 3½ in., and an 8-spindle 1⅝ to 2⅝ in. The machines shown in Fig. 1 are 6-spindle units which are most generally used. In studying Fig. 7, which shows the rear view of a six-spindle screw machine, note particularly the location of the end-tool slide, 8. Its relation to the side tooling zone is shown in Fig. 8. A and B are upper side tool slides, C and D are lowers and E and F are intermediates. Tool slides A, E and C function from the front side of the machine while B, F and D function from the rear. The spindle locations are referred to as working positions and are indicated numerically from 1 to 6 in Fig. 8. Spindles revolve to the left or counterclockwise as viewed from the rear end of the machine. They are driven by gears on each spindle from a central gear on the drive shaft which runs the entire length of the machine, passing through the spindle carrier and its stem.

Bars are loaded into each spindle after indexing the above assembly to No. 1 position. Automatic feeding takes place at the No. 6 position. Then the spindle carrier indexes by steps to bring the bar of stock in each spindle successively into line with the various tools held on the end and side toolslides. The indexing occurs when all cutting tools have been withdrawn from the work.

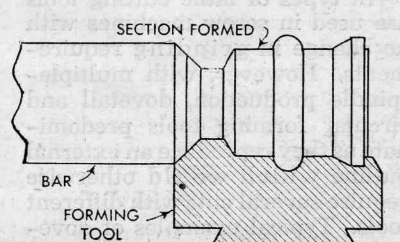
Drilling, reaming, counterboring, screw-cutting and tapping operations, including all customary turning operations, are done from the end tool slide. Provisions are made for the use of die heads and collapsing taps. High-speed drilling attachments also are used regularly and in this case some of the spindles are idled by means of a stopping mechanism. Slotting and cross-milling are operations frequently executed in these machines. All peripheral speeds, timing, depth of cut and amount of feed for each cutting tool are dependent on a network of gear combinations and cams



(9) ADJUSTING CAM OF SIDE SLIDE



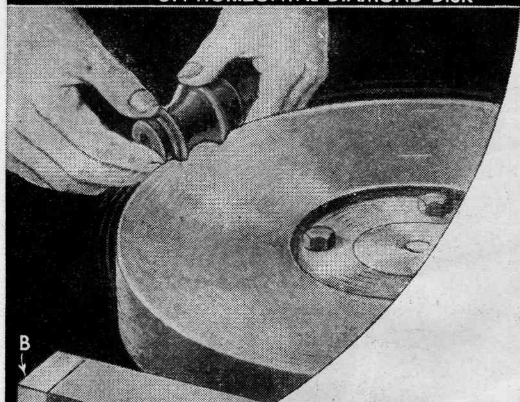
(10) DOVETAIL AND CIRCULAR FORMING TOOLS

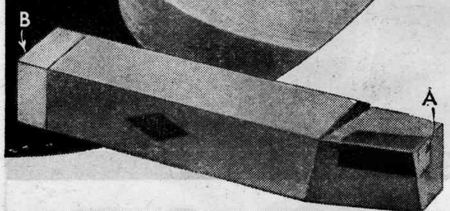


(11) HOW FORMING TOOL FUNCTIONS

(12) TOOL OUTLINE GROUND IN PLAIN SURFACE

(13) SHARPENING CIRCULAR TOOL ON HORIZONTAL DIAMOND DISK





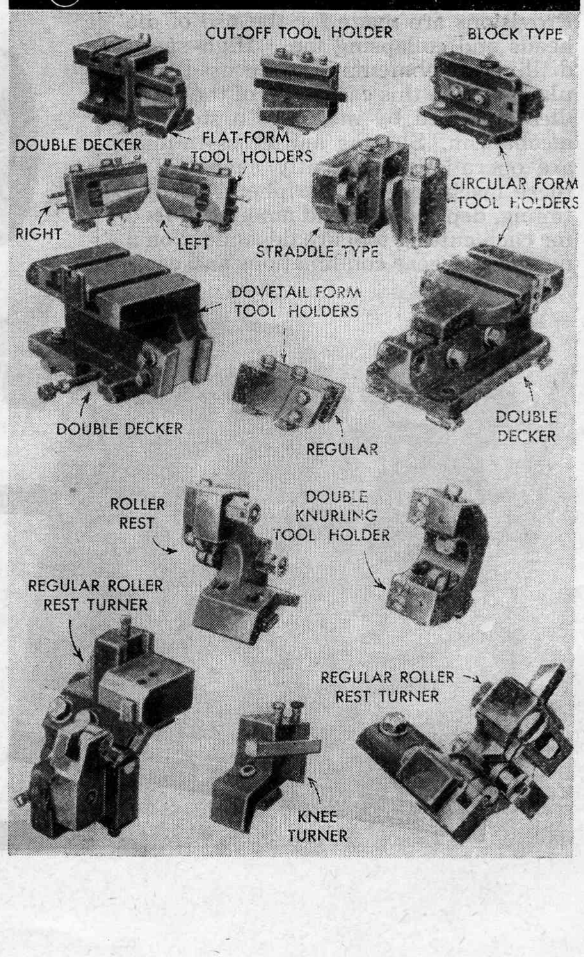
(14) COLORED TIPS IDENTIFY TOOLS

distributed all over the machine. For example, refer to Fig. 9 where the drum related to the rear lower slide has been pulled from the pilot shaft to adjust the cam that will control that particular cutting tool.

Tooling requirements: One advantage of a multiple-spindle automatic is the possibility of dividing long cuts between two or more operations, thus reducing the time the tools are at work for each machining cycle. For example, one tool can be placed behind another in the same T-slot of the end tool slide to perform operations on long work such as drilling and turning at the same time and in the same spindle position. When the design of a piece involves numerous operations, they can be divided between the end and the side tool slides, and may include both roughing and finishing tools in successive positions so they work on different bars simultaneously.

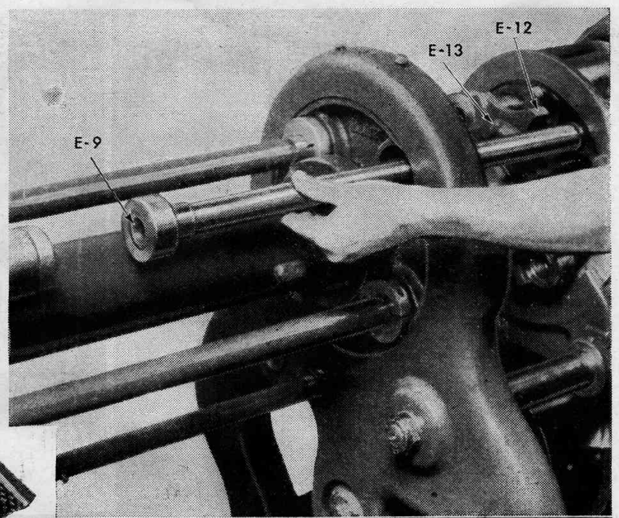
All types of lathe cutting tools are used in screw machines with no change in grinding requirements. However, with multiple-spindle production, dovetail and circular forming tools predominate as they reproduce an external outline which would otherwise require several cuts with different tools. Typical examples of dovetail and circular tools are shown in Fig. 10. Fig. 11 shows how these forming tools function, the one shown being a dovetail tool. A roughing and a finishing tool are used frequently simultaneously to avoid retarding other cuts of the cycle. As forming tools are intended for quantity production, a master tool is made first and the working tools are duplicated as needed. In some cases, as shown in Fig. 12, the outline of a dovetail tool is produced by grinding on a straight surface after the tool has been otherwise machined and hardened. This applies to a form where the deepest section is less than 3/16 in. Fig. 13 shows the cutting edge of a carbide-tipped circular forming tool being sharpened on a diamond-impregnated, horizontally-operated disk. A large number of carbide-tipped cutting tools like the one shown in Fig. 14 are used with screw machines. There are various grades of tips to suit different cuts and materials, and as a safeguard against using the wrong tool, tips are available in different colors. After brazing the tip to the body, the color shown in A is painted on the body at B to assure selecting the proper tool once the color on the tip is ground off.

(15) TYPES OF TOOL HOLDERS AND ACCESSORIES



Forming tools require an assortment of tool holders such as shown in Fig. 15.

Setting up a six-spindle automatic: Where batteries of these machines are operated, a number of units are assigned to a set-up man especially trained for this work only after years of operating experience. A good set-up man is a combination toolmaker and machinist who is versatile in tool and machine construction. In most screw-machine shops it is customary for the engineering department to



(16) REMOVING PUSHER TUBE

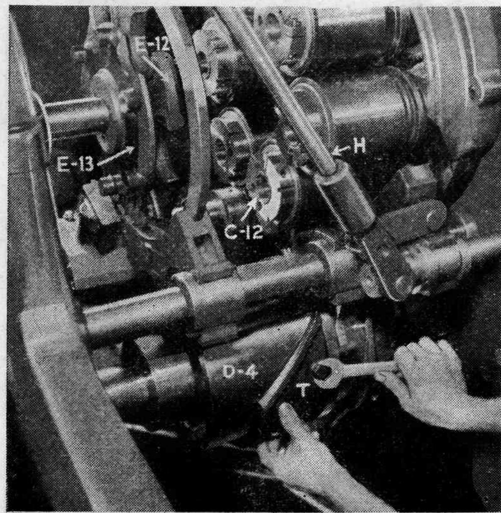
(17)

provide a drawing of each part to be machined and its dimensions. Also specified are the spindle speed for the job in revolutions and surface feet per minute, the related gearing, feed change gears, cam adjustments besides all tool holders, cutting tools and other requisites with their respective position in the tooling zone. This information is of great assistance not only to the set-up man, but also to the operator.

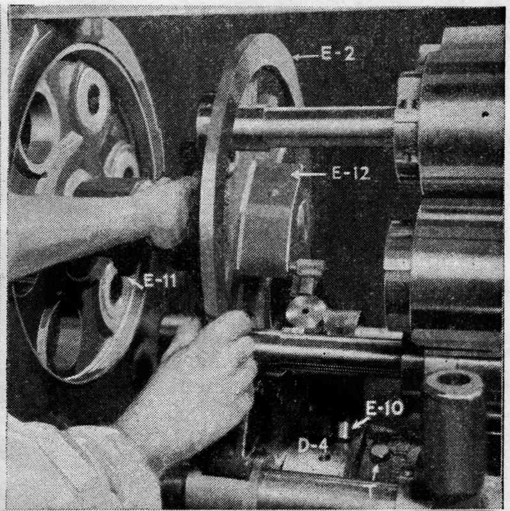
The primary step is to fit and adjust the six collets and pushers that automatically grip and feed the bars. Rather than use plain collets it is most economical to select a master type collet as shown in detail A of Fig. 17, in which case it is only necessary to change pads and the same collet can serve for various sizes of bar stock. As collets only chuck the work, master pushers shown in detail B advance the bar after each index and at the 6th or "loading" position. Pushers, often called feeding fingers, grip the bar just enough to carry it the required distance. To fit pushers or the pusher pads only, pusher tubes are removed one at a time by rotating guard disk E-13 of Fig. 16. E-12 is an aligning disk and E-9 is a spool bushing which is used on the end of all pusher tubes.

To change collets, each spindle must be indexed to the 1st position. The finger holder is released with the hand chucking lever H in Fig. 18, and the nut collar C-12 is screwed off to pull the tube through the spindle nose far enough to remove the collet thereon and substitute one of required size. The next step consists of installing all spindle-speed and feed-change gears as specified in the instruction sheet. The cam T on the stock-feeding drum D-4 is set to regulate the advance of each bar at the 6th position. E-12 is the aligning disk and E-13 the guard disk also shown in Fig. 16. Fig. 19 shows how the stock-feeding slide is located on the high point of the cam T of Fig. 18. The high point of the cam is put in line with roller E-10 of Fig. 19. This is accomplished by loosening screw E-11 and pushing the aligning disk E-12 and the stock-feeding ring E-2 forward. Then the various side-slide and end-slide cams are adjusted according to instructions. The speed at which the cams revolve and their contour govern the timing and depth of cut for each position. Fig. 20 shows setting the cam on the end tool slide drum.

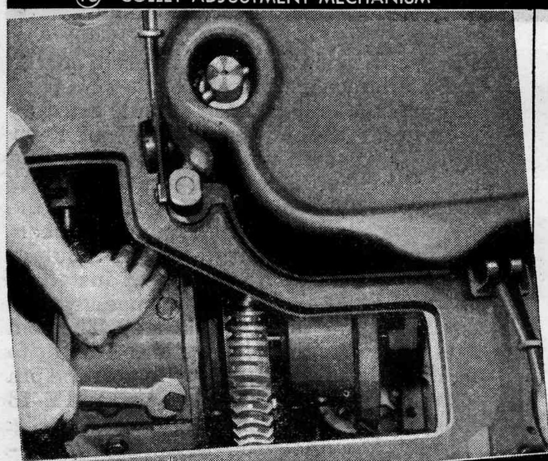
As previously stated and shown in Fig. 8, loading is done at the 6th position. This is where each bar is advanced by a pusher. The first side and end cuts therefore take place at this position and the second cuts are made at the 1st position, and so on. Once the cycle is in order and the machining is being started at the 6th position, a completed piece is cut off the bar at the 5th position although it was actually completed at the 4th position. Fifteen or twenty simultaneous operations often occur



(18) COLLET ADJUSTMENT MECHANISM

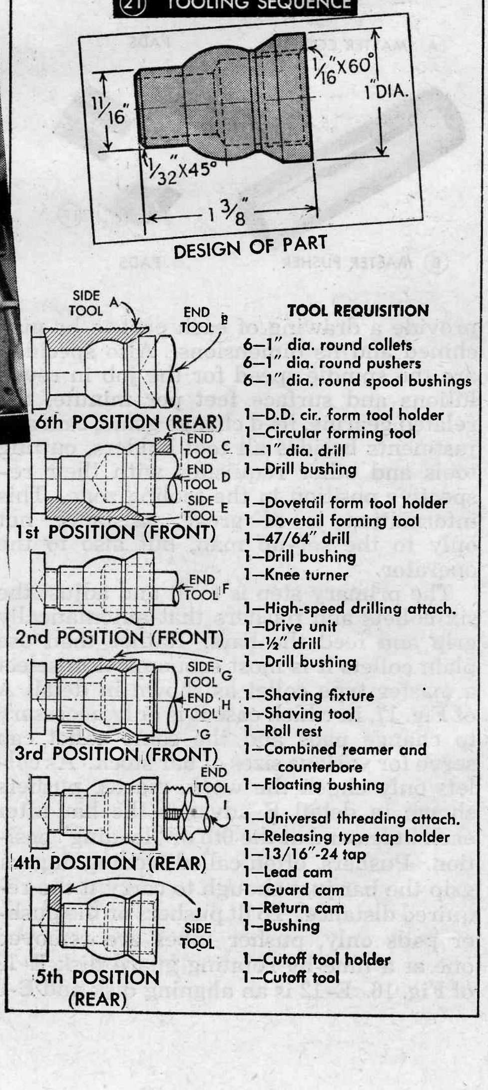


(19) LOCATING STOCK-FEEDING SLIDE



(20) ADJUSTING CAM ON END TOOL SLIDE

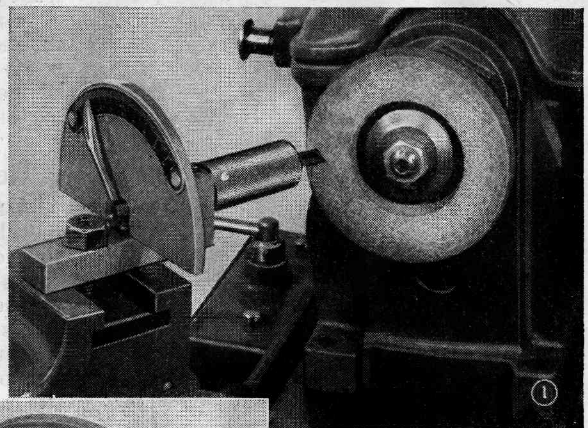
(21) TOOLING SEQUENCE



during the cycle which might consume bu' a few seconds. As a typical example, tak(the part shown in Fig. 21. This item required 45 pieces of tooling such as collets, pushers, spool bushings, cutting tools, rests and tool holders. It was produced at the rate of 336 pieces an hour. At the 6th position, the part is rough-formed at A and spot-drilled at B. At the 1st position it is finish-formed at E, faced at C and partly drilled at D; at the 2nd position it is drilled through at F. At the 3rd position, shaving tool G smooths the cuts A and E while a combination counterbore-reamer H goes to work. In the 4th position the part is being tapped (I) about ¼ in. deep and in the 5th position it is cut off (J). With screw-machine production, it is important that both the work and cutting tools be kept flooded with high quality coolants.

Grinding Angles of Tool Bits Set by Lathe Jig

Mounted on the compound rest of a lathe, this attachment or jig provides a means of setting a tool bit at an accurate angle for grinding. Construction is shown in Fig. 3. The rotating spindle is small enough so that it can be chucked directly in the tool post for cutting the tool-bit slot, Fig. 4. Clamping of the rotating spindle is done by a split bushing to prevent marring from direct contact of the setscrew. The scale, Fig. 2, can be a ten-cent protractor mounted on a plate, which is held in place by a tight fit against the base block. In use, the bit is clamped in the holder and then it is set by means of the protractor scale and the compound scale so that the edge to be ground will be in proper contact with the grinding wheel as in Fig. 1. The preferable grinding wheel is the recessed type, but a plain wheel will do. Wheel speed need not be over 1000 r.p.m. with a 4-in. wheel. Fast cutting is obtained by feeding the bit in with the lathe cross slide, taking off a small bite at a time until the full shape is obtained. Do this carefully so that you do not remove too much metal before you realize it. Angle settings can be obtained from any lathe-bit chart, four of the more common bit shapes being shown in Fig. 5.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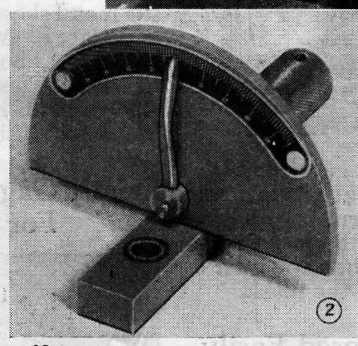
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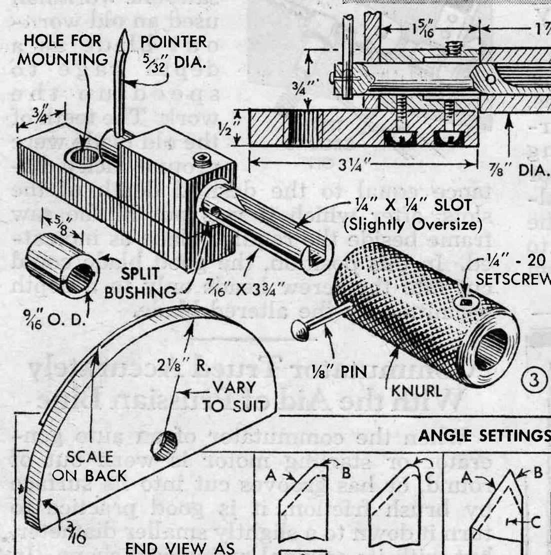

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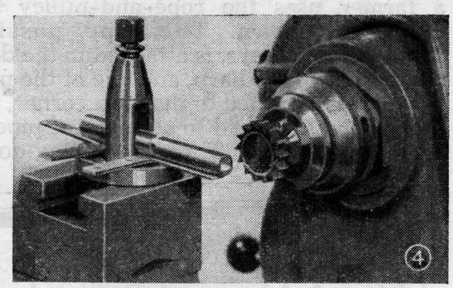
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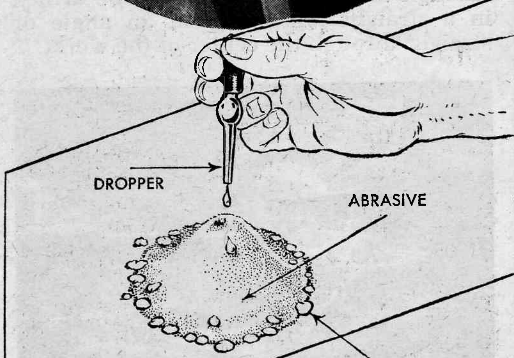
ANGLE SETTINGS FOR TOOL BITS

END VIEW AS SEEN BY OPERATOR (5)

	RIGHT HAND TURNING			RIGHT HAND SIDE			RIGHT HAND CORNER		BRASS TURNING			
	A	B	C	A	B	C	A	B	A	B	C	D
SIDE OF BIT DOWN	1	4	Grind Freehand	1	3	2	1	3	1	3	2	Grind Freehand
COMPOUND SETTING	45° R	62° R		28° R	26° R	0°	26° R	53° R	14° R	14 °R	15° R	
SCALE SETTING	22° R	0°		13° R	10° L	12° L	17° R	30° L	13° R	13° L	0°	

BOTH SCALE SETTINGS ARE DIRECT READING, STARTING AT ZERO. COMPOUND SWING IS SWING OF HANDLE

Metal POLISHING



METAL polishing is an abrasive operation which imparts a predetermined grade of surface finish for appearance rather than size tolerance. The purpose may be a complete operation to obtain a final finish or it may be a preparatory step for nickel or chromium plating. Metal polishing is closely related to grinding in that both operations require manufactured abrasives as a cutting agent.

Polishing wheels, such as the one in Fig. 5 where an airplane connecting rod is being finished, consist of wheels built up from layers of felt, canvas, sheepskin, walrus or other kind of leather either glued or sewed together. Unlike grinding wheels, polishing wheels are flexible and are classified as hard, medium and soft, depending on the degree of flexibility which is determined by the material of which they consist and the method used in binding the layers together. Polishing wheels are available in a semi-finished stage only and must be given their abrasive properties in the shop where used. The application of the abrasive to the periphery of the wheel is

④ POLISHING OPERATIONS

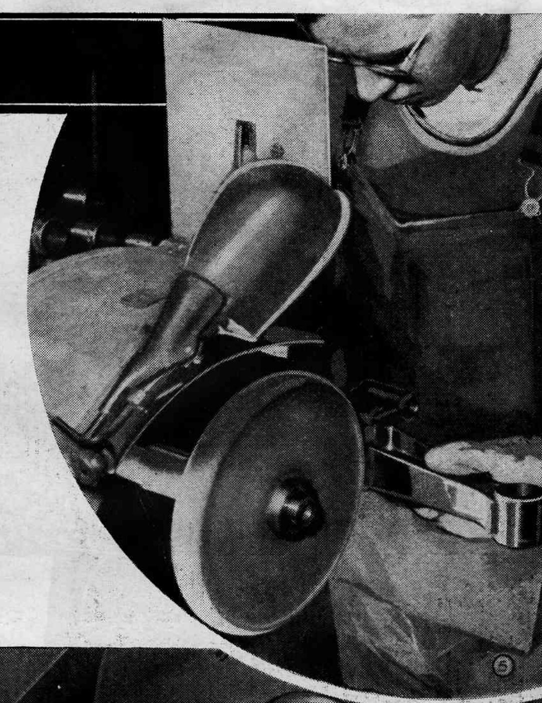
Part or Material	First	Second	Third	Fourth
Aluminum Castings	60-80	120-180	Buff	
Aluminum Sheets	120	180	Buff	
Band-Saw Steel and Similar Stock	60-80	120-150		
Brass Castings	60-80 With Oil	150-180 With Oil		
Brass Sheets	180-220	Buff		
Hammer Heads	46-60	100-120		
Knives—Table and Steel Blades	80-90	120-150		
Monel-Metal Castings	80	120	150	
Monel-Metal Sheets	180	180 With Oil	220 With Oil	Buff
Plow Discs	30-46	70-90		
Shovels	36-46	120		
Shears Tinsmith	46	60	120-150	180
Stainless Steel Mirror Finish	60-80	100-120	150 With Oil	220 With Oil
Stainless Steel Commercial Finish	80	100	120 With Oil	150
Wrenches	30-46	80	120 With Oil	
Lenses—Eye Glass and Telescopic	60-80	180-220	Optical Flour	Rouge

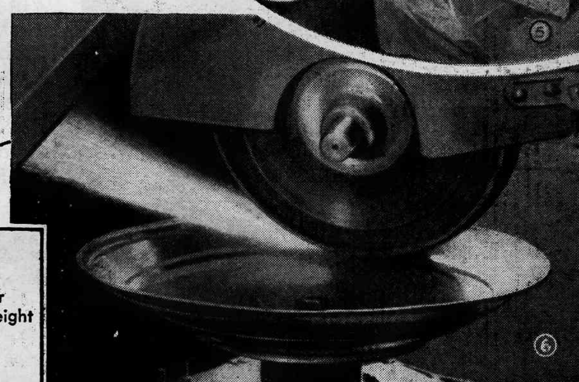
WHEELS . . .

called "setting-up" and the thickness of this application is referred to as "wheel head." The abrasive grain generally is aluminum oxide and varies in size to meet finish requirements. A specially selected and prepared glue is used to hold the grain in the wheels.

Most polishing wheels are mounted on pedestals, but there are portable ones also which are carried to the job as shown in Fig. 1. Small, irregularly shaped parts are polished most conveniently on an endless leather or canvas belt as in Fig. 2, which is coated with abrasive grains in the same manner as polishing wheels.

Selection of abrasive grain: The aluminum-oxide grain must be of the highest quality, must be extremely hard, tough and uniform in structure, size and shape. All these properties are important because there are various grades of finishes, obtained by as many as five consecutive operations. Often a different shape of grain, exclusive of size, is required for each polishing stage from rough to final finish. When selecting the type of grain, its rate of capillarity or how fast it will absorb water is an important consideration. In making the capillarity test, water is applied drop by drop to a pile of abrasive grains as shown in Fig. 3. If it rolls off, the grains are low in capillarity and a wheel set up with such grains will wear down quickly due to uneven spread of the glue. If the grain absorbs water readily, it will permit the glue to spread uniformly, resulting in durable fast-cutting wheels. Standard sizes of grain vary from coarse to fine and are known by numbers such as 24, 46, 70, 100 and up to 240. From 240 to 600 the grain is fine, extra-fine and super-fine flour. Fig. 4 gives a table of general recommendations regarding grain size for polishing operations on various materials and jobs.



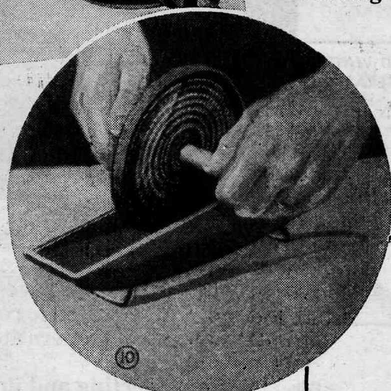


Photos by courtesy of Norton Co.

⑦ PROPORTIONS OF GLUE AND WATER FOR VARIOUS GRADES OF ABRASIVES

Size of grain Aluminum oxide	Glue % by weight	Water % by weight
24—— 36	50	50
46—— 54	45	55
60—— 70	40	60
80—— 90	35	65
100——120	33	67
150——180	30	70
220——240	25	75

Selecting and preparing glue: For maximum results it is advisable to use a good grade of animal hide glue as an adhesive. Bone, fish or cold glues are not suitable for this purpose. The glue and water should be mixed by weight accurately to eliminate any guesswork. It should be freshly made and used within 3 hrs. Fig. 7 gives size of grain and corresponding percentage of glue and water to use. The glue is soaked in cold water for some time to make it dissolve more readily when heated. Ground glue should soak from 1 to 2 hrs., flake glue from 6 to 8 hrs. and cake glue from 12 to 14 hrs. To melt the glue, a water-jacketed glue pot is recommended. The correct tem-



perature of the mixture, abrasive and room, as will be explained later, is highly important. Therefore, be sure to use a thermometer in the glue pot whether or not the heater has a thermostatic control.

Using correct type of wheel: For best results, the use of the correct type of wheel is just as important as the proper abrasive grain. The sewed canvas wheel is used generally for severe and not too important polishing operations when the grain size ranges from 24 to 46.

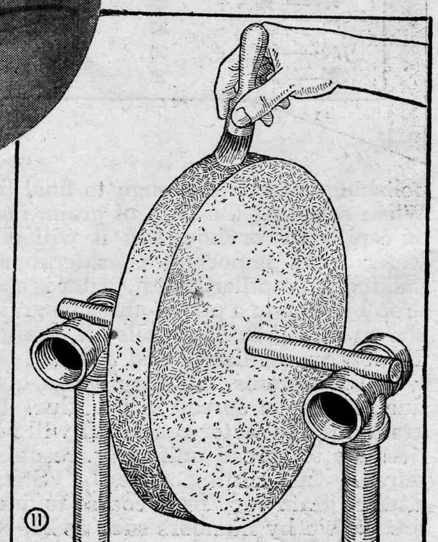
The disk canvas wheel is also a heavy-duty type. Each disk comprising the wheel is glued on both sides to stiffen the canvas, the glue extending close to the edge of the wheel when a hard face or head is desired. Such a wheel can be used to polish plow disks as in Fig. 6.

The compressed wheel is made of canvas or leather similarly glued on the sides. There are three grades known as hard, medium and soft, depending on how close to the edge of the wheel the layers are glued together. This wheel is used extensively to polish cutlery, and small tools such as auger bits, Fig. 8, button dies or similar parts with parallel sides. The advantage of this type wheel is that its periphery can be shaped to that of the surface to be polished. Any size grain can be used with the compressed wheel.

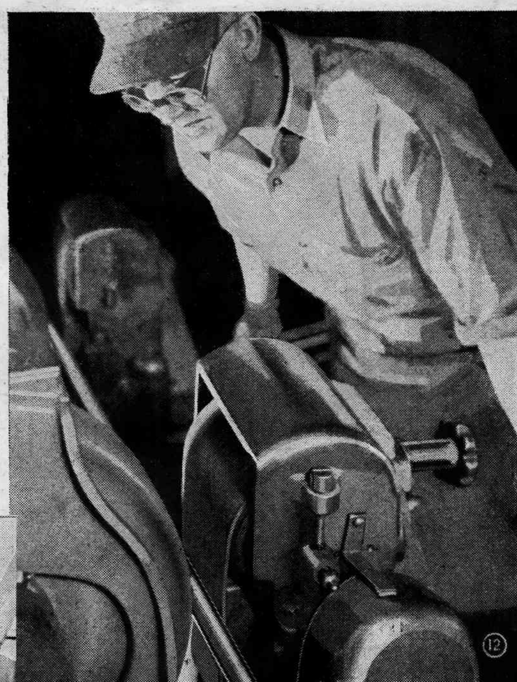
The felt wheel usually is set up with grain size 150 and finer. It is extensively used for producing a high finish on steel and iron or a somewhat medium finish on brass and aluminum castings. The sewed buff wheel is an all-purpose type and, as it is soft and flexible, it gives an excellent finish on brass, aluminum and sheet steel.

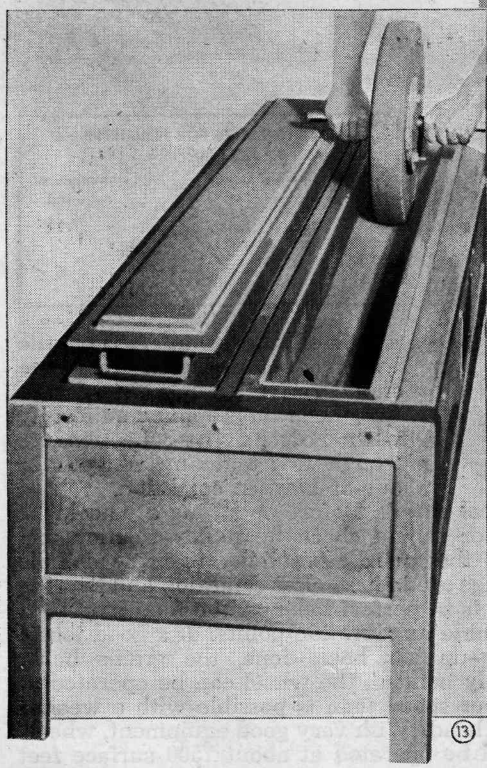
The sheepskin leather wheel is very flexible on brass and aluminum alloys and small stainless steel parts made of sheet stock. The walrus leather wheel is for finishing and is used to polish jewelry, instruments and small gun parts. Wooden polishing wheels are still used in many small plants and are most economical for experimental and home-workshop use.

Setting-up polishing wheels: Before attempting to set up a polishing wheel, make sure that the room is free from drafts and that the temperature is between 70 and 80 degrees F. to prevent jelling of the glue. If the abrasive and wheel are of



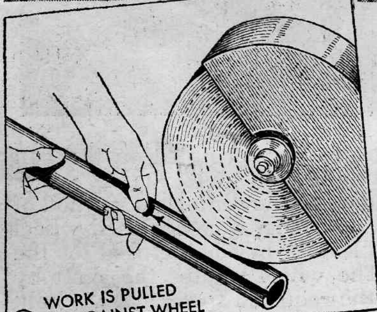
the same temperature, the glue should be heated to 160 degrees F. While small wheels may be held by hand while applying the glue as in Fig. 9, larger wheels should be mounted as shown in Fig. 11. After applying the glue, the wheel is rolled in a trough containing a sufficient quantity of abrasive grain as in Figs. 10 and 13, which illustrate troughs for small and large wheels respectively. Rolling should proceed evenly so the wheel will pick up all grains it can hold, and as quickly as possible for maximum adhesive results. In setting up wheels, some experts prefer preheating the grain and the cloth wheels to 100 or 120 degrees F., and then applying the glue at 140 degrees, the idea being that the grain will penetrate the glue more readily, and as a result produce a superior polishing wheel.

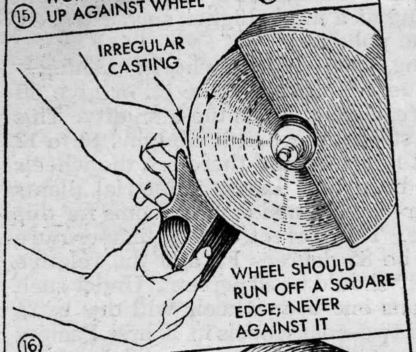


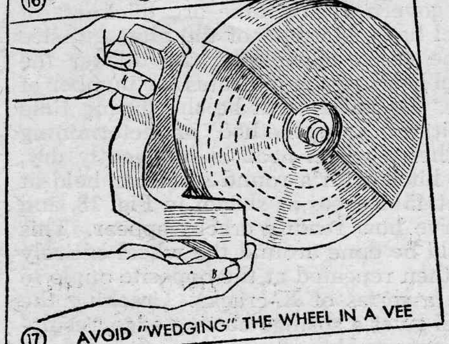


Polishing belts are set up by spreading, with a trowel, knife or brush, a suitable paste made by adding preheated abrasive grains to a heated glue solution. The mixture should contain the maximum amount of grains for a workable consistency. When coarse grains are used for severe polishing jobs, they should be pressed in with a roller. In this case it is advisable to give the belt a sizing coat consisting of water, 8 parts and glue, 1 part. Frequently, finer abrasive grains are sprinkled on the belt after painting it with glue. Fig. 12 shows what is known as the centerless method of cylindrical polishing, a compressed wheel and a wide leather belt being used for the purpose. The wheel rotates the shaft by friction at the required speed and the belt, operating at a much higher surface speed, does the polishing.

Drying glue-coated wheels: Animal-hide glue is known to take on or give off moisture, depending on the humidity. This glue is strongest when it contains 10 to 12 percent moisture and therefore the wheels should be dried. Large industrial plants have air-conditioned drying rooms for this purpose. The correct drying temperature should be 85 degrees F., and the relative humidity should be 50 percent. Under such conditions one-coat wheels will dry in 24 hrs. and two-coat wheels in 48 hrs. Factors that govern drying time are thickness of wheel head, strength of the glue and size of the grain. Generally, the thicker the wheel head, which indicates the number of coats, the longer will be the drying time required. One method of determining whether a wheel head is sufficiently dry, is to hit it with a round steel bar held at about 45 degrees as shown in Fig. 18, and observe how readily cracks appear. This should be done around the wheel entirely and then repeated at the opposite angle to form a series of X-cracks. Cracking the wheel gives a springy cutting edge, resulting in a combined wiping and polishing



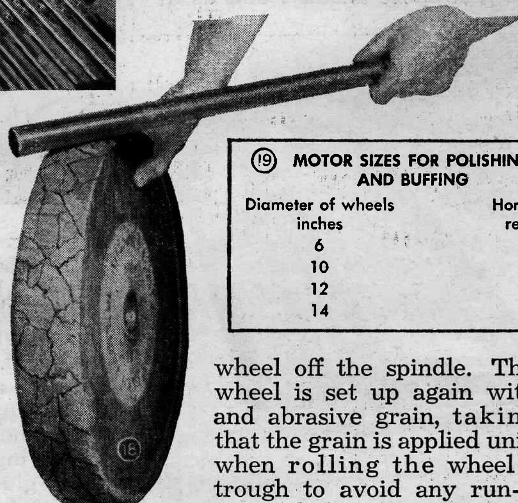




action. Final step is to dress the edge with a piece of broken grinding wheel.

Balanced wheels important: Material for polishing wheels is machine-cut and the hole is made sufficiently large for the use of a bushing, otherwise the wheels would lack the necessary support when placed on a spindle. The hole in the bushing should provide for a good fit on the spindle to keep the wheel in proper balance. Polishing wheels, like grinding wheels, require a collar on each side, the diameter of the collar depending on the diameter and type of wheel.

Once a polishing wheel is worn, the old grain and glue must be removed with an abrasive stick and the wheel should be trued, which can be done with the end of an old file, before taking the wheel off the spindle. Then the wheel is set up again with glue and abrasive grain, taking care that the grain is applied uniformly when rolling the wheel in the trough to avoid any run-out or out-of-balance condition.

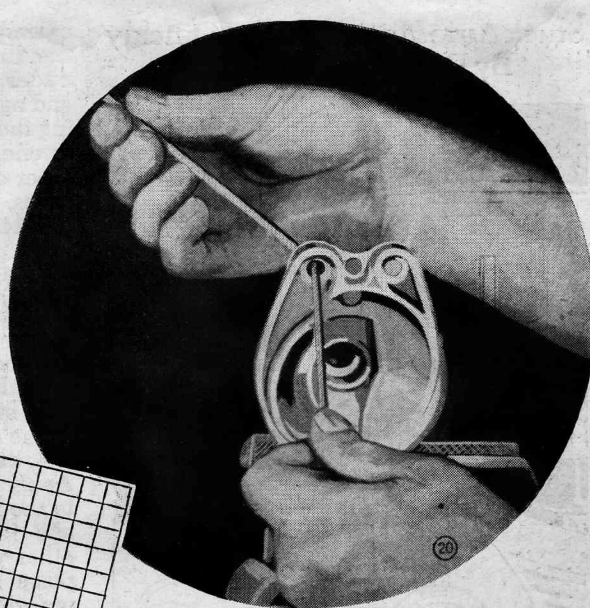


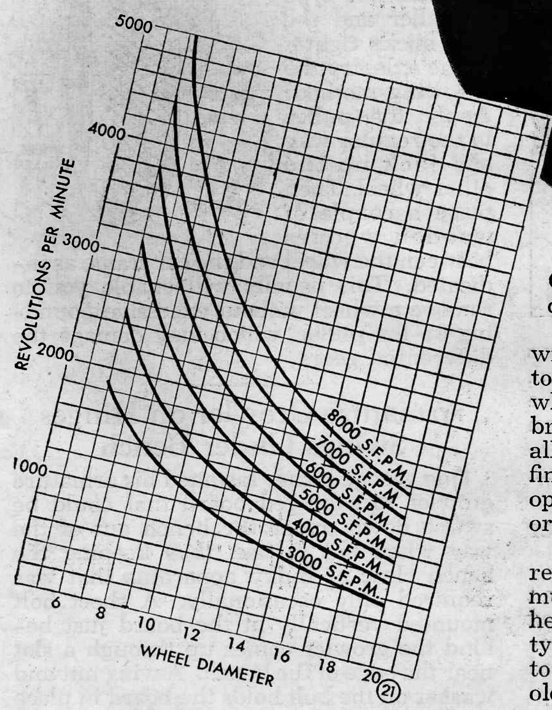
(19) MOTOR SIZES FOR POLISHING AND BUFFING

Diameter of wheels inches	Horsepower required
6	¼
10	1
12	2
14	3

Wheel speed: Before operating a wheel, the operator should check up pulley relation and adjust the guard. Assuming that the spindle bearings are in first-class condition and that the wheel is in perfect balance, the next step is to determine its vibration points. If a good job of setting-up has been done, the grains being strongly bonded, the wheel can be operated at a higher speed than is possible with a weaker wheel head. With very good equipment, wheels should be operated at about 7500 surface feet per minute (s.f.p.m.) for best polishing results. However, for general economy, some polishers claim that best all-around polishing speed is around 5000 s.f.p.m. as the wheels wear more rapidly as the speed increases, necessitating more frequent resetting, and the increase in cutting action at higher speeds does not seem to compensate for excessive wheel wear. Fig. 21 shows a graph giving s.f.p.m. of various size wheels at different speeds, while Fig. 19 gives horsepower requirements to operate wheels of various sizes satisfactorily.

Safety precautions and helpful hints: When polishing is done with a small bench type of grinder, certain safety precautions should be observed. After checking to see that the guard is set to clear the work, make sure that the wheel is tight on the shaft and runs true. A polishing wheel should always rotate in the same direction. An arrow painted on one side will serve as a reminder when the wheel is put on a spindle. Work is pulled upward against a wheel as





shown in Fig. 15. With irregular castings, the wheel should run off a square edge as in Fig. 16, but never against a square edge or the work may be pulled from the hands and thrown with dangerous force. The same risk is incurred when the wheel is "wedged" in a narrow portion of the work as shown in Fig. 17.

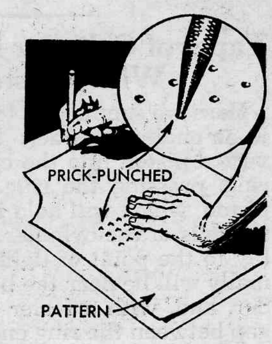
Where several polishing operations are to be done in sequence, wheels of the same diameter but having different abrasive coatings may be ganged on a single spindle as shown in Fig. 14. This arrangement is followed in large shops where convenience and the saving of time help to speed up production. When hard-to-get-in places have to be polished, narrow strips of twisted, tube-like abrasive cloth can be used by hand as in Fig. 20, or on a small mandrel chucked in an electric drill or grinder. Conelike polishing points of similar spiral design also are available.

Greasing the wheels with oil or tallow will prevent loading. This is recommended to buff or finish aluminum sheets and all wheels required to polish aluminum and brass castings. Buffing operations are usually performed by skilled operators. Satin finishes are obtained on brass by a first operation called "cutting down" and a coloring agent is used for second buffing.

When a large quantity of identical irregularly shaped parts require polishing, much time is saved by forming the wheel head or face accordingly. The compressed type of wheel may be shaped quite readily to the required outline with the end of an old file ground with a clearance and corners slightly rounded. The wheel will require a certain amount of dressing after setting up to fit the surface to be polished.

Metal Pattern Is Prick-Punched To Hold It Easily in Place

To facilitate holding a small metal pattern on work to be marked, one worker indents a section of the pattern with a prick-punch to make several slight, sharp elevations. The pattern may thus be held with the fingertips.



If you can see traces of a white line on the tool edge when held up to a light, the tool is dull and requires sharpening

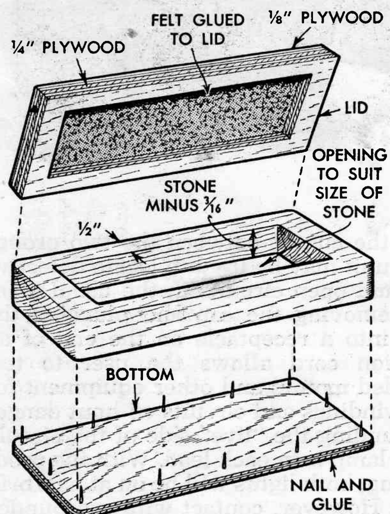
1

HONE TOOLS

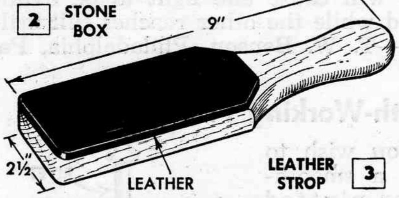
By Sam Brown

UNLESS there are nicks in the cutting edge, it's not necessary to grind a tool each time to sharpen it. Once ground, any tool can be kept razor sharp for many hours of use by frequent, light honing. The right stone to use in honing depends upon the type of tool and its purpose. Grass and bread knives cut best if honed on a coarse stone, while most other tools require honing on a medium or fine stone to prevent the edge from tearing the work and to hold up under cutting pressure.

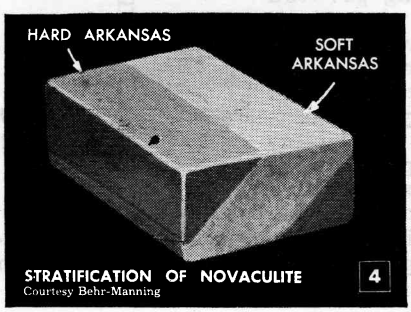
Artificial abrasives, aluminum oxide and silicon carbide, are gradually replacing natural or mined stones for honing tools. Aluminum oxide is of the same physical structure as natural corundum and is often called "India." In this country, Arkansas is about the only natural oilstone



2 STONE BOX

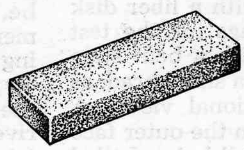


LEATHER STROP 3



STRATIFICATION OF NOVACULITE 4
Courtesy Behr-Manning

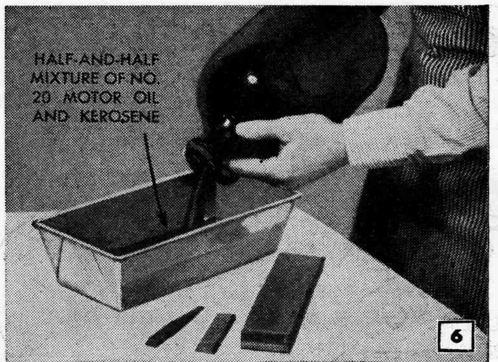
5 NATURAL STONES



HARD ARKANSAS — finest grit of all natural stones. Excellent for all delicate cutting edges

SOFT ARKANSAS — softer and more porous than hard Arkansas but cuts considerably faster

LILY-WHITE WASHITA—a soft but fast-cutting stone with good bite. Best for carpenters



Above, new stone should be soaked in oil before using and then always used with oil to prevent wearing unevenly

Right, if continued use produces hollow in the stone, rub the stone on smooth glass, using silicon carbide and water

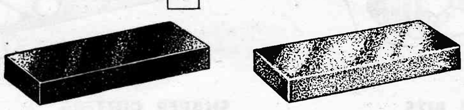
WITH THE RIGHT STONE

of commercial importance. This stone is mineral novaculite, and is largely composed of silica. The stratification of novaculite, Fig. 4, runs from hard Arkansas to soft and then grades off to the still softer and more porous lily-white Washita, Fig. 5. First-grade Washita is the same as lily-white, but is not graded for color.

The bench oilstone: The conventional combination coarse-fine oilstone is widely used in sharpening most straightedge tools in the home shop, although Fig. 1 shows several other shapes which are recommended for honing special tools. The combination oilstone usually consists of either aluminum oxide or silicon carbide. Artificial stones are graded coarse, medium and fine—150, 240 or 320 abrasive grains per inch. Natural stones are not graded by grit size, but by the variety of stone itself. Hard Arkansas, for example, is of both hard and fine texture, whereas soft Arkansas is soft and coarse. The soft stones cut faster but produce a coarse edge. Certain species of fine sandstone, such as Queer Creek and Hindustan, possess this feature to a marked degree and are used extensively for sharpening scythes and other tools requiring a coarse edge.

The bench oilstone should be kept in a box such as shown in Fig. 2. If the stone has not been preoiled, it should be soaked overnight in a mixture of oil, 1 part, and kerosene, 1 part, Fig. 6. In use, the stone should be worn down uniformly to prevent the formation of a hollow. However, should the stone become hollowed, it should be rubbed flat on a piece of glass, Fig. 7, using

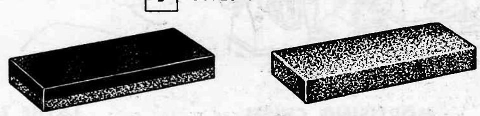
8 ARTIFICIAL STONES



SILICON CARBIDE
Hardest abrasive made. Cuts fast with light pressure, but breaks down under a heavy pressure

ALUMINUM OXIDE
Physically the same as natural corundum, hence often called "India." It is fast-cutting oilstone

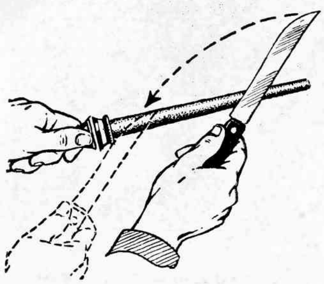
9 TYPES OF GRITS

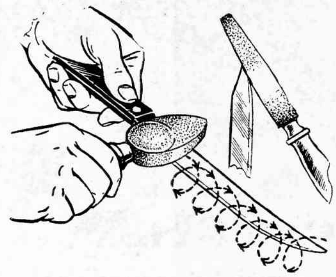


COARSE-FINE
All oilstones can be obtained in a combination of two stones. Coarse-fine is most widely used

MEDIUM
The standard grits in artificial oilstones are: coarse, medium and fine. Combination type is best

Tips on Sharpening a Variety of Tools





KNIFE (first method)

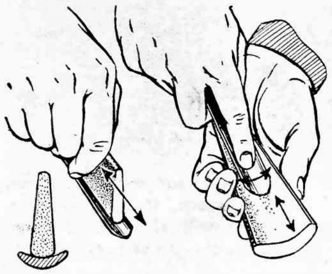
This type of sharpener is coarse-fine, cuts fast with little pressure and requires no oil. Start the initial stroke as shown, pulling the knife down smartly from heel to tip. Repeat on other side

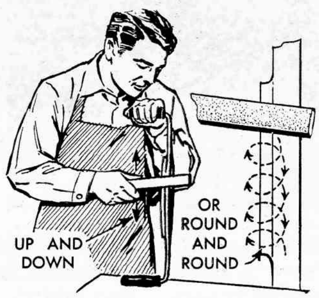
KNIFE (second method)

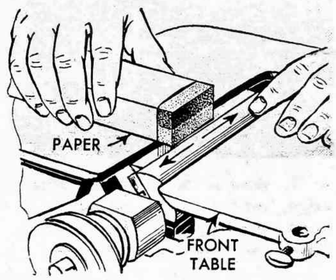
Stone is fine-grit silicon carbide, excellent for sharpening stainless steel. Honing is done dry or with water lubricant. Use little circular strokes, as indicated, working stone on one side, then on other

GOUGE

Use flat side of round-edge slip or surface of bench stone. Apply oil, then hold gouge steady and move stone up and down, at same time slowly rotating gouge. Clear view of bevel is had at all times







GOUGE (continued)

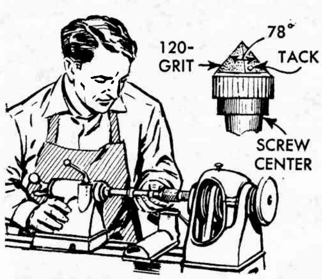
Wire edge from previous operation is removed by honing with round-edge. Use oil, hold stone flat on tool. Hollow stone is used to hone gouge having outside bevel to help keep proper bevel

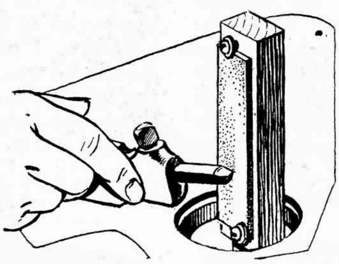
DRAWKNIFE

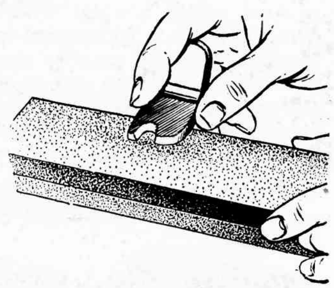
Use a scythestone or a flat stone of coarse grit. Stroke up or down or round and round. Watch bevel by sighting and use stone dry or wet. Same technique is used to sharpen blade of scythe or sickle

JOINTER

Hone jointer knives by wrapping bench stone in paper to prevent marking table. Wedge pulley to hold cutterhead steady. Use oil and hone lightly. Use coarse side of stone first if blades are dull







MORTISING CHISEL

If you are unable to obtain a stone of the correct cone shape for sharpening a mortising chisel, turn a wooden cone and cover it with silicon-carbide paper. Apply oil and run lathe at slow speed

LATHE TOOL BITS

Although having blunt edges, lathe bits will stand up much longer if honed to a medium or fine edge. If tool is carbide tipped, use silicon-carbide stone. Mount stone in chuck of jigsaw

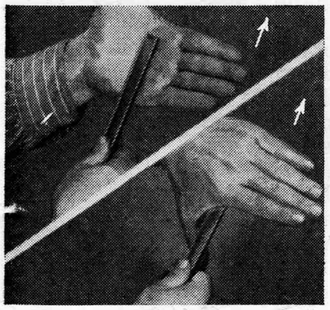
SHAPER CUTTERS

Use coarse, then fine side of bench stone. Hone only on flat side of cutter. Give bevel a light paring stroke with sharpening stick to remove wire edge. Molding cutters are honed the same

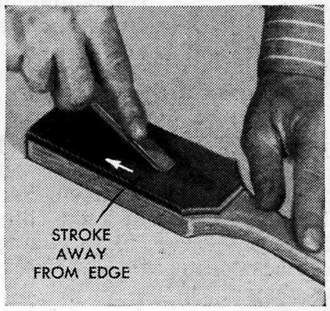
1. Chisel has been newly ground on 60-grit wheel, so honing starts on coarse side of stone. Apply a few drops of light oil beforehand

2. Hold chisel with heel slightly above stone, as shown in the side view. Stroke chisel back and forth using medium pressure

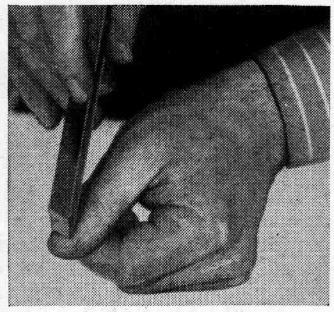
3. Alternate operations 2 and 3 until edge shows sharp with minimum of burr or wire edge. Repeat same steps on fine side of stone



4. To remove final burr or wire edge, hone the chisel on palm of hand, stroking away from edge. This bends and breaks wire edge



5. Velvety smoothness, provided previous steps have been done properly, is obtained by stropping chisel on smooth piece of leather



6. Test on your thumbnail — if chisel is sharp, it will bite in; if not, it will slide off. Make this test also at end of step 3

80-grit silicon-carbide grains and water as a lubricant. Silica sand also can be used to dress a hollowed stone.

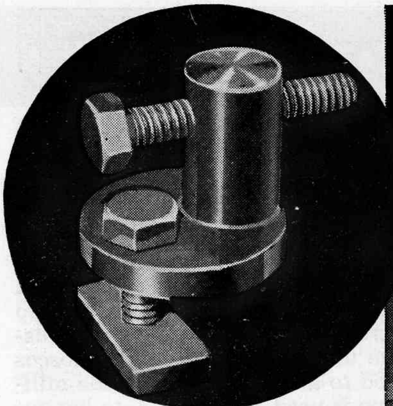
Using the oilstone: There are no stroking rules in honing other than the obvious one of having the tool in contact with the stone at the proper angle. It is advisable, however, to hone against the edge of the tool whenever possible to hold burring to a minimum. Always use oil but avoid charging the stone with anything heavy or gummy. A kerosene-and-oil mixture is excellent. Being fairly thin, the mixture floats away any metal particles and prevents them from becoming embedded in the stone. It also permits smooth stroking and reduces friction. After a stone has been used, it should be wiped dry with a clean cloth. Never let oil containing metal particles dry on it, as this will form a glaze.

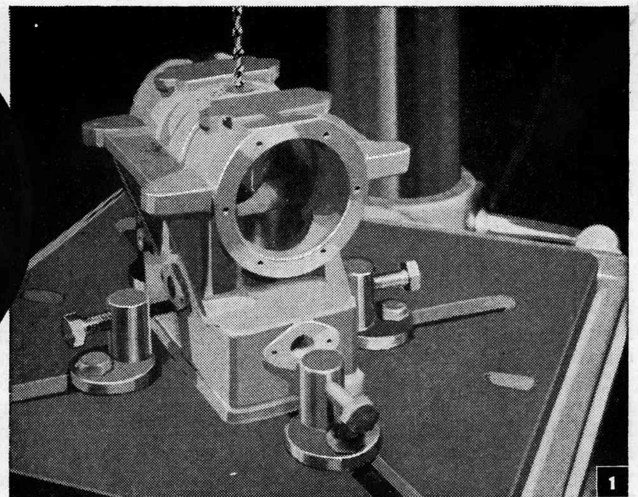
Kinds of edges: When magnified, any edge will show as a series of sharp "mountain peaks," and the relative size of the peaks classes the edge as coarse, medium or fine. When a chisel is ground on a 60-grit wheel, the edge may be sharp but it is very coarse. Honing on the coarse side of an oilstone gives an ordinary coarse edge, which then can be brought to any degree of fineness by honing on the fine side.

Honing suggestions: The photos in Fig. 10 show the general procedure in honing a chisel and the steps also apply equally as well to plane irons and similar tools. To construct a strop, Fig. 3, glue the leather to a wooden block with the hair side up. Hints on the opposite page cover honing operations for a variety of tools.

Household Lye Distinguishes Aluminum Stock From Similar Metals

When you wish to determine if a piece of metal actually is aluminum or another type of metal with a similar appearance, try this easy test. First make a 40-percent solution of household lye in water, being sure to use a glass container. Then, file or cut a few chips from the stock in question and drop them into the solution. If the chips produce a vigorous reaction and disappear in a few seconds, the metal is aluminum. When using this solution, be careful not to get it on your hands or clothing. Also, flush the drain thoroughly after disposing of the solution.

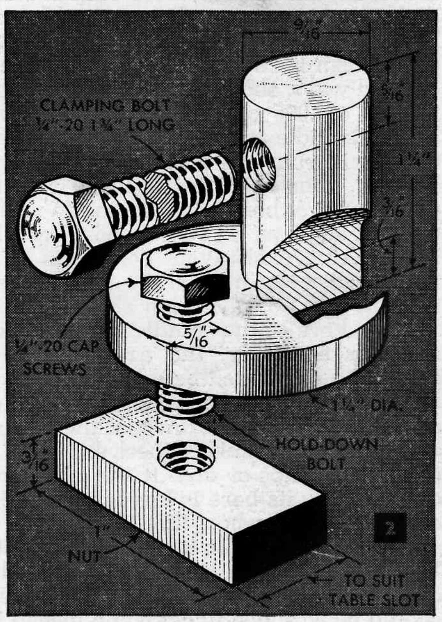




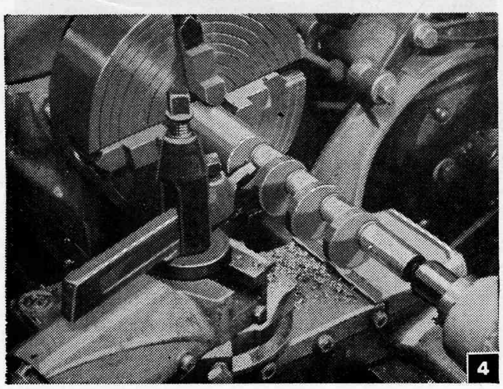
Quick-on DRILL-PRESS CLAMPS

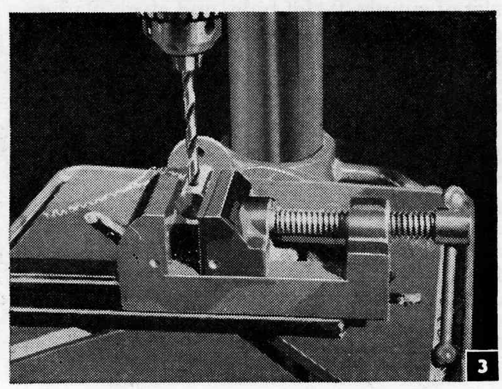
By Will Thomas

These clamps are so designed that they drop into the slots in the drill-press table and can be tightened in a jiffy. They are especially handy when doing close work because it's never necessary to remove nuts and washers from bolts that project under the table. As you see in Fig. 1, the individual clamps can be set in various positions to hold work which is irregular in shape. Fig. 2 details one unit, and you can make as many as you need by simply duplicating parts and operations. To make duplicate clamps, chuck 1½-in. round cold-rolled stock off-center as in Fig. 4, carrying the outer end of the piece on the tail center. Turn to the dimensions given in Fig. 2 and you have four cam shapes as in Fig. 4. Saw these apart, then drill and tap for the clamping bolts, Fig. 3. The rectangular-shaped nuts, Fig. 2, are cut from 3/16-in. flat steel and finished by filing. Be sure that the nuts slip through the table slots. Drill and tap nuts exactly in the center so that strain is equalized when the bolts are tightened.



Clamps also can be used on a milling machine or lathe faceplate to hold irregular-shaped work





MILLING PRACTICE

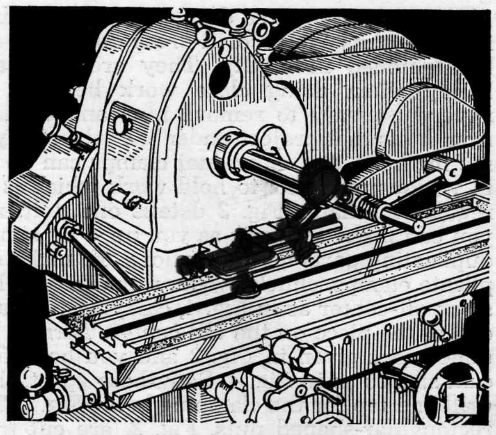
By H. J. Chamberland

PRODUCING accurate work efficiently with a horizontal-spindle milling machine requires accessories that clamp and support the work rigidly on the machine table. These are necessary to resist the machining forces caused by the milling cutter removing material from the work, as these forces create vibration which results in chatter, the worst enemy of machining.

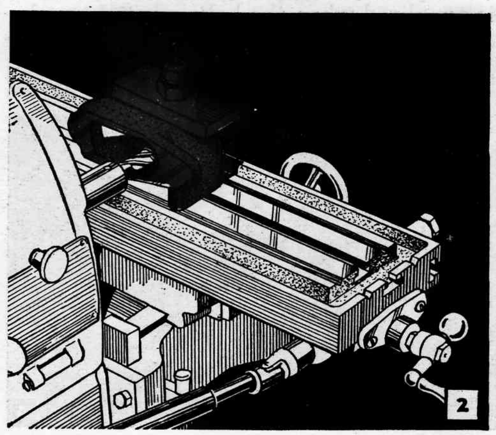
Maximum rigidity is attained when the table and the cutter are as close to the frame of the machine as possible. Before clamping the work to the table, the arbor, which is the "heart" of the milling machine, should be tested for runout with a dial indicator fastened to the table as in Fig. 1. Runout, which is the difference in parallelism between the arbor and the table and ways, should not exceed .002 in. A runout of .005 or .006 in. increases with higher spindle speed and, if permitted to exist, will ruin the arbor and its support bearing, shorten cutter life and result in poor work. Arbor runout is due to various causes, such as a bent arbor, resulting from taking excessively deep cuts or too fast a feed, wear in the arbor-support bearing and burrs on the arbor shank or in the tapered bore of the spindle. When making a cutter assembly, the arbor support should be positioned before tightening the arbor nut. If the arbor was true when tested with the dial indicator and the cutter is untrue after assembly, check between the collars for chips or dirt. If the cutter runs out radially, its bore is larger than the diameter of the arbor. The bearing in the arm support must be kept well-lubricated. When the arbor is removed, it should be cleaned thoroughly and when not in use it should be wrapped in cloth and placed in a drawer or cabinet.

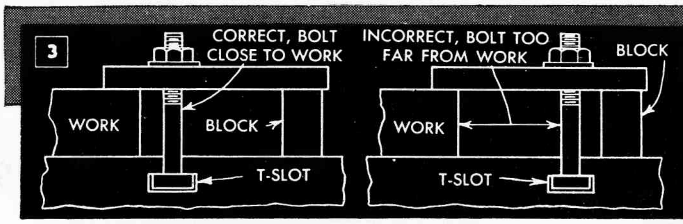
Accessories for clamping the work consist of simple T-slot bolts and strap clamps, as in Figs. 5 and 6; a milling-machine vise, Fig. 8, or the more complicated indexing equipment shown in Figs. 11 and 12. The correct and incorrect locations of the T-slot bolt in relation to the work are shown in Fig. 3. The casting being machined internally with an end mill in Fig. 2 presents no clamping problem, as the flat surfaces of the casting rest on the table and the T-slot bolt projects through a hole in the work. The comparatively larger casting in Fig. 5, also being machined internally, is clamped at each end with a T-slot bolt and blocks. Milling forces in this case are much less than in Fig. 6 where they are increased by the wider cut being taken with a shell end mill. Where a number of different machining operations are to be done, the clamping naturally should be sufficient to take care of the heaviest load. An irregularly shaped casting, such as the one shown in Fig. 7, must be blocked at the bottom to align the work accurately and prevent distortion due to clamping. Machining forces are reduced to a minimum when the milling machine is used, as in Fig. 4, to lay out and center-drill holes that are to be drilled and bored later. Nevertheless, the high degree of accuracy involved still makes clamping a major factor.

The milling vise, shown in use for contour milling, Fig. 8, offers an efficient method of holding some types of work. The base of the vise is bolted to the milling-ma-



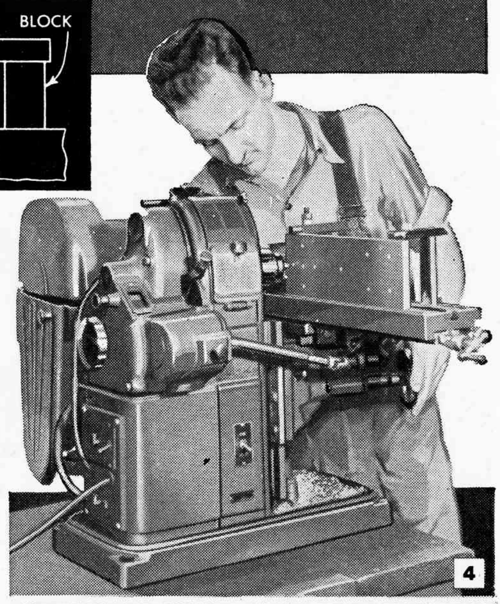
Above, a dial indicator is used to test accuracy of milling-machine arbor. Below, only one T-slot bolt is needed to hold small casting in place on table

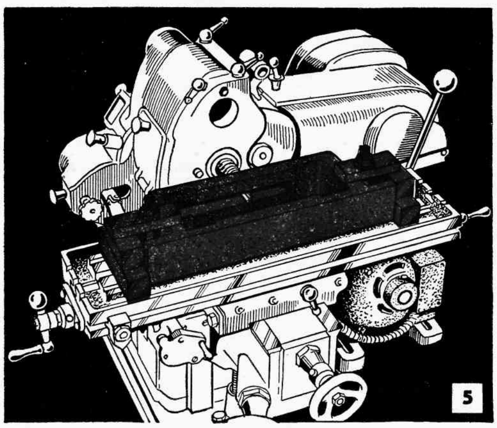


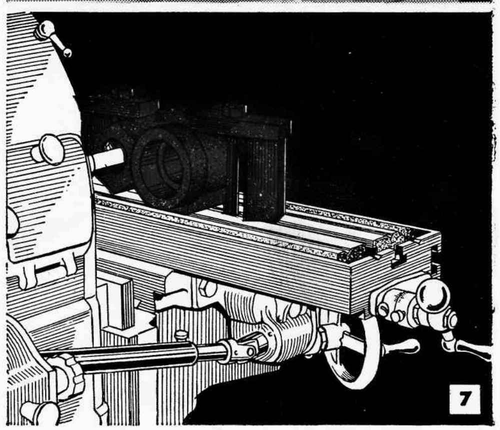


chine table and the work is held between the vise jaws. Many such vises are equipped with a graduated swivel base which permits the work to be set at any angle to the table ways.

Two types of indexing equipment are in general use. These are the rotary indexing table, Fig. 11, and indexing heads, or centers, Figs. 9 and 13. The rotary indexing table is used for cutting straight or circular slots and grooves in flat work, usually circular in shape. The base of the indexing table is bolted to the milling-machine table and the work is clamped to the indexing table, which can be rotated and locked

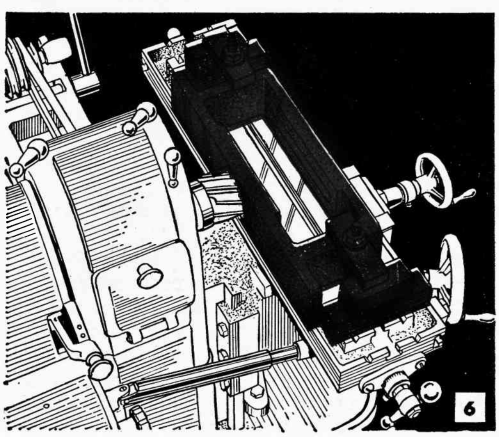


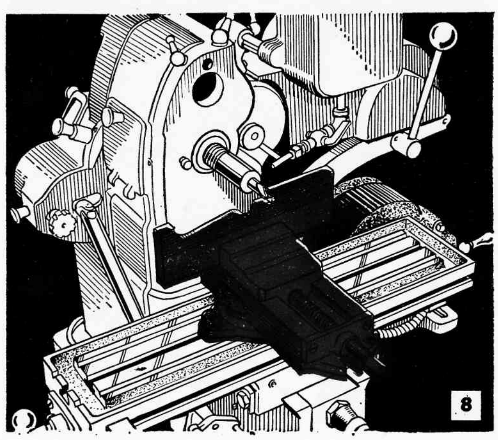


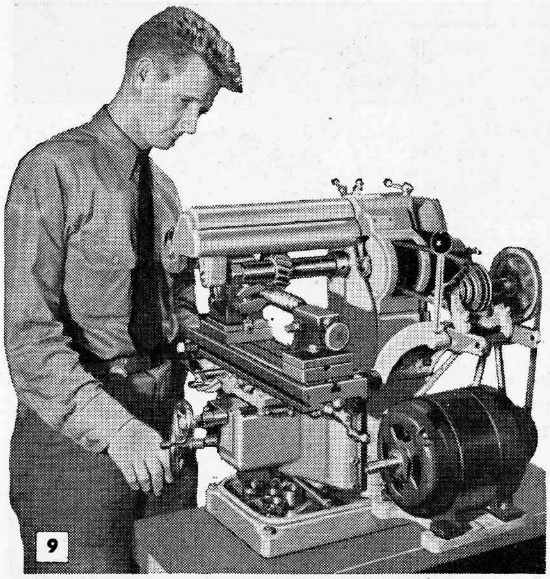


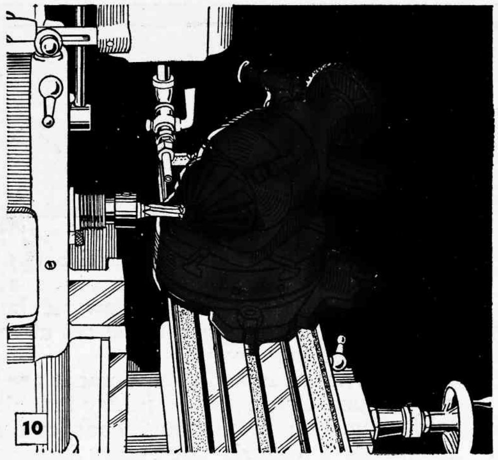
Large castings, as shown above and below, must be clamped down at each end. See Fig. 3 for the correct position of T-slot bolt in relation to the workpiece

Above, irregularly shaped work is blocked at bottom. Below, milling-machine vise, which is bolted to top of table, is used to hold work for contour milling

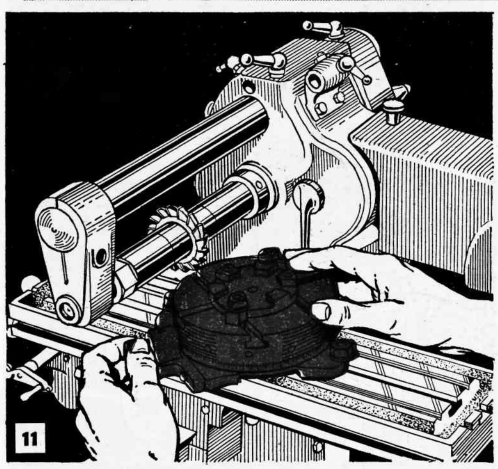




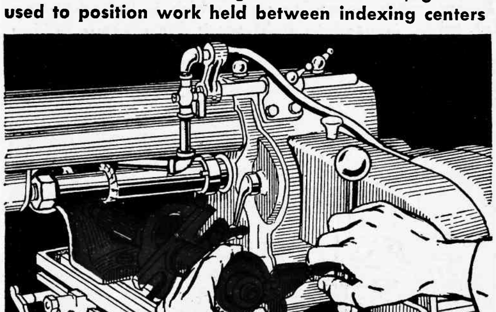




Accurate spacing for milling the teeth of an angular cutter is accomplished by mounting the work in a chuck fastened to an indexing center which, in turn, is bolted to an indexing table. Angular cutter is then heat-treated and ground



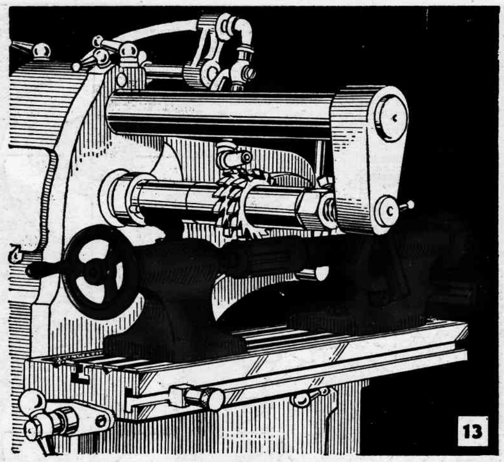
Above, work is clamped to a rotary indexing table which is bolted to milling machine. Below, gear is used to position work held between indexing centers



in place at the desired position. Indexing centers, which resemble the head and tailstock assemblies of a lathe, are used to position work, ordinarily cylindrical in form, for machining equally spaced grooves or surfaces across the periphery of the work. Milling splines on a shaft, as in Fig. 13, and making a gear, as in Fig. 18, are good examples. The method of indexing or positioning the work varies with the type of centers used. With the centers shown in Fig. 12, this is accomplished by rotating a gear fastened to the spindle of the headstock indexing center. A sliding pin, which engages the teeth of the gear, locks it in position. The lockpin support bracket is adjustable for various gear diameters, thus making accurate indexing merely a matter of selecting a gear on which the number of teeth is divisible by the number of spacings required on the work. The tailstock indexing center has a handwheel for adjusting its center longitudinally.

Angular indexing is accomplished by mounting a headstock indexing center, equipped with a chuck to hold the work, on a rotary indexing table. Fig. 10 shows this type of setup being used. Here the rotary table provides the angular adjustment and the indexing center permits accurate spacing to produce the teeth of an angular cutter.

On a production basis, teeth or flutes are milled with special-formed cutters. However, as an ample supply of these cuttters would be expensive, an assortment of standard cutters is, in most cases, sufficient for small shops. Gear cutting requires a formed milling cutter. Fig. 14 shows what is known as an involute spur-gear cutter.

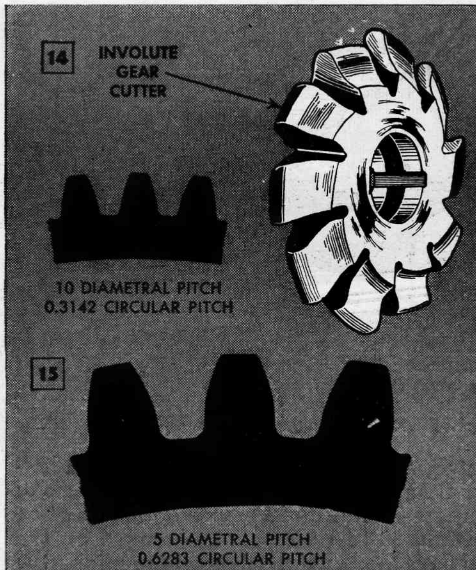


Milling spline on shaft with side milling cutters. Shaft held between indexing centers is rotated the required amount and locked in position for each cut

Eight different forms of these cutters comprise a set that will handle gear-cutting jobs within the ranges indicated in Fig. 16. These cutters are designed so their forms are correct for the lower numbers of teeth in each range, but if extreme accuracy is desired in the higher range, intermediate-numbered cuttters, such as 1½, 2½, 3½, etc., should be used.

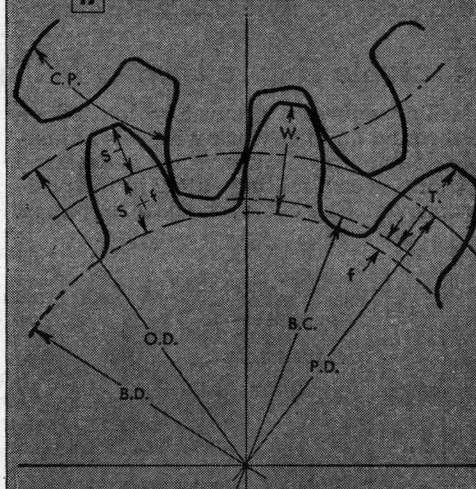
Therefore, knowing the exact diameter and number of teeth required for a gear, the mill operator can readily select a cutter of the correct diametral pitch for the job. The exact diameter of a gear is neither the outside diameter of the gear blank nor the diameter at the bottom of the teeth. Instead, it is the pitch diameter, indicated in Fig. 17 as P.D. Circumference of this diameter is an imaginary line known as the pitch circle. To find the diametral pitch of a given gear, simply divide the number of teeth by the pitch diameter. The diametral pitch is not an actual dimension but the ratio between the number of teeth in a gear and its pitch diameter. For example, a four-diametral-pitch gear has four times as many teeth as it has inches of pitch diameter. The two details of Fig. 15 show the actual sizes of gear teeth of five and ten diametral pitch.

For accurate work, gear cutters must be sharp. Frequent sharpening by removing only a slight amount of metal is better than allowing the cutter to become so dulled that a single sharpening will depreciate it from 10 to 15 percent. In sharpening, only the faces of the cutter teeth are ground. This must be done on a machine equipped with a dish-type grinding wheel and a sliding toolholder that will permit cutter movement as indicated in Fig. 19. Gear cutters having radial faces, Fig. 20, upper

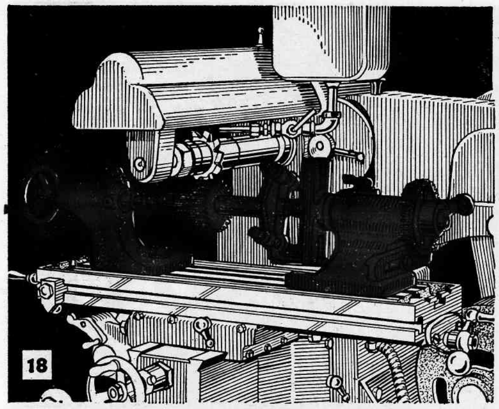


16 SIZE OF CUTTER	GEAR-CUTTING RANGE
No. 1 will cut gears from	135 teeth to a rack
No. 2 will cut gears from	55 teeth to 134 teeth
No. 3 will cut gears from	35 teeth to 54 teeth
No. 4 will cut gears from	26 teeth to 34 teeth
No. 5 will cut gears from	21 teeth to 25 teeth
No. 6 will cut gears from	17 teeth to 20 teeth
No. 7 will cut gears from	14 teeth to 16 teeth
No. 8 will cut gears from	12 teeth to 13 teeth

17 GEAR-TOOTH NOMENCLATURE



O.D. — OUTSIDE DIAMETER
P.D. — PITCH DIAMETER
B.C. — BASE CIRCLE
B.D. — BOTTOM DIAMETER
C.P. — CIRCULAR PITCH
W — WHOLE DEPTH OF TOOTH
T — WORKING DEPTH OF TOOTH
f — CLEARANCE
S — ADDENDUM
S+f — DEDENDUM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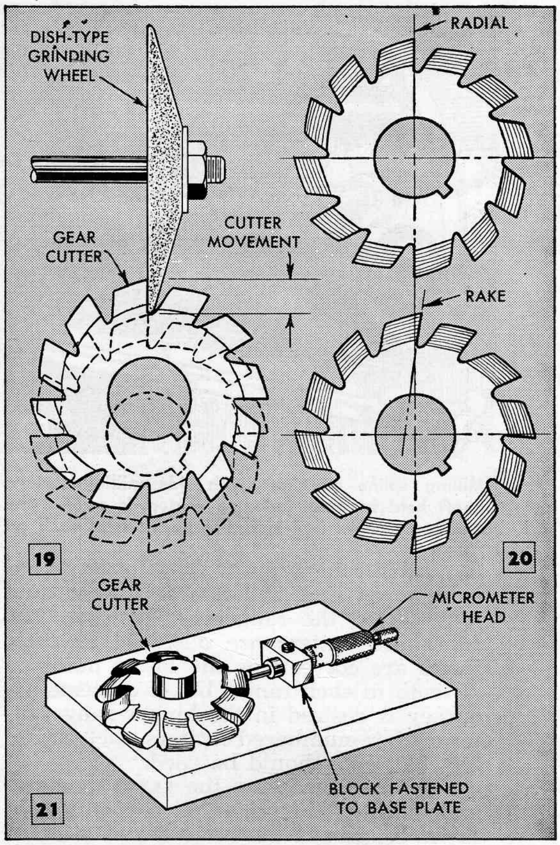
Typical setup for making gears with milling machine

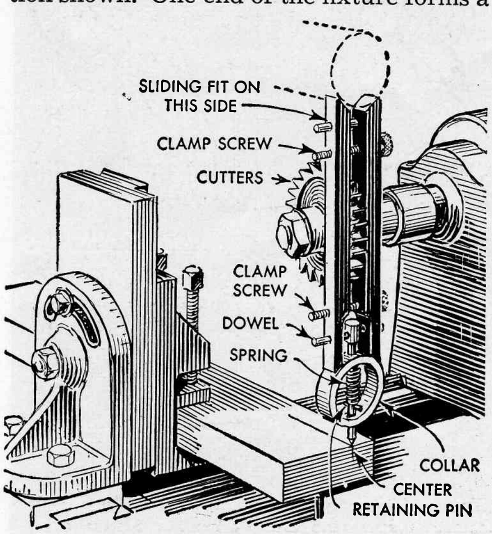
detail, must always be sharpened radially. Gear cutters with rake—faces back of center—as in Fig. 20, lower detail, must be ground to the rake angle stamped on the side of the cutter. After sharpening, the cutter should be checked for uniform depth of cut. A suitable fixture for checking this can be made as shown in Fig. 21. In use, the cutter is rotated and each tooth checked with the micrometer head. A variation of .001 in. is permissible between the extreme high and low teeth. Gear cutters, when properly sharpened, will produce duplicate work throughout their entire lives. Place gear cutters on individual racks when not in use. Never store loosely in a drawer.



Adjustable Fixture Locates Milling Cuts on Round and Flat Work

Milling cuts are accurately located on both round and flat work with this adjustable double-end fixture which is designed to clamp over a milling cutter in the position shown. One end of the fixture forms a vee to take round work while the other end contains a spring-loaded pointer for locating the cut on flat surfaces. Using the fixture for centering the cutter over a line scribed on the work, is merely a case of advancing the work until the line and the pointer coincide. This automatically centers the cutter over the line. When a keyway is to be cut in round work, the fixture is turned end-for-end and the work is positioned to cradle in the vee formed by the ends of the fixture. Construction is apparent from the drawing. Dowel guide pins and clamping screws are fitted in each end of the fixture which is made from two pieces of square bar stock beveled at the ends. The pointer, crosspinned by the dowel, passes through the exact center of a collar which is held by spring tension against the end of the fixture.

H. Moore, Leeds, England.



¶To detach a badly corroded car-battery terminal from the battery post, drench with boiling-hot water to remove the corrosion. Then, loosen the nut, spread the terminal with a screwdriver and lift off.

CONTOUR

By H. J. Chamberland

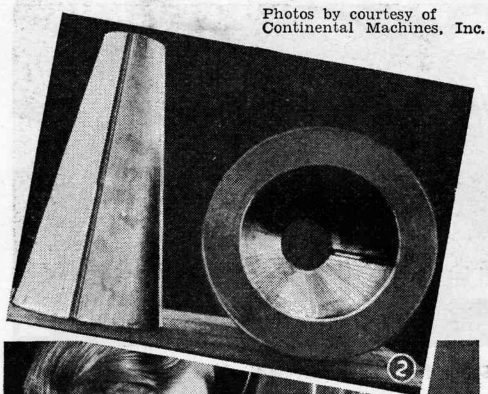
ALTHOUGH basically a band saw, a contour-sawing machine is especially designed to cut over seventy-five materials varying in hardness, including metals, plastics and wood.

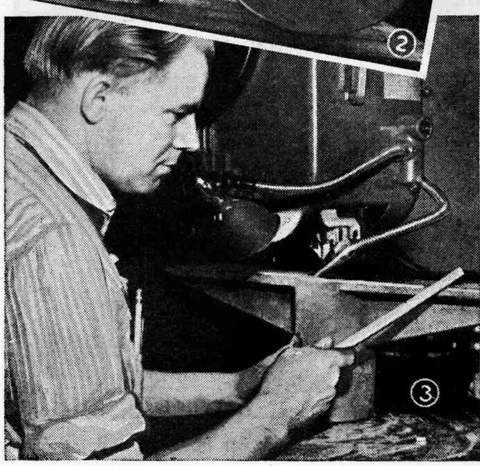
Saves time and material: Many improvements made in contour machines, plus a variety of saw bands for various specific purposes, have made possible an almost incredible saving of time and material when the contour machine is compared in performance to that of other basic machines such as lathes, millers, shapers, planers, slotters, etc. As much of the work done by these other machines can be performed better and faster on a contour machine, they are relieved from unnecessary jobs and can be employed solely for work that cannot be done otherwise.

Figs. 1 to 5 inclusive show operations in which a great saving of time and material is possible. Outstanding among these examples is the material-saving operation shown in Fig. 2. Here a tapered hole, 5 in. in diameter at one end, 2 in. at the other, and 9½ in. in length, was cut with a contour machine without any appreciable waste of metal as a single cone-shaped piece was removed, which would have been reduced to chips if the hole had been bored on a lathe. Cutting a keyway 10 in. long in a shaper is a 4-hr. job, owing to the light

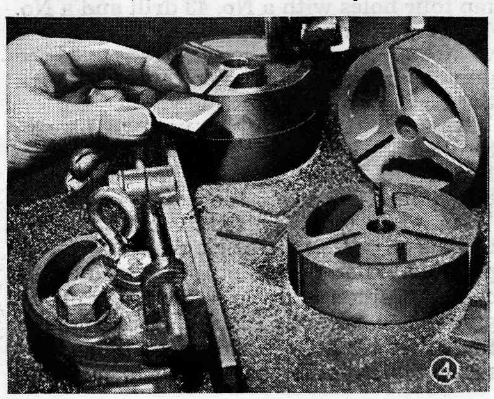
1—Contour-machining sector gears instead of milling made a 50 percent saving in costs. 2—Cone-shaped hole sawed in a large cylindrical piece without waste of material. Boring in a lathe would have resulted in chips. 3—The 10-in. keyway was sawed out in 20 min., which would take 4 hrs. on a shaper

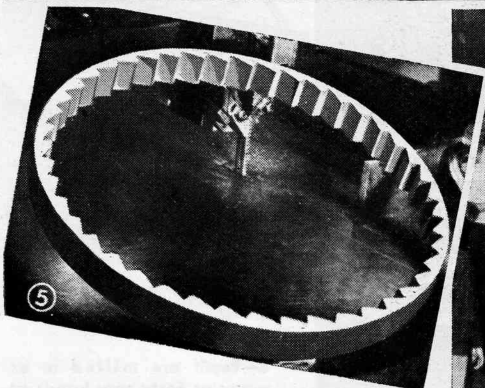
Photos by courtesy of Continental Machines, Inc.





4—Cutting three slots in each of these disks required only 30 min. on a contour saw but would have taken 1½ hrs. on a milling machine

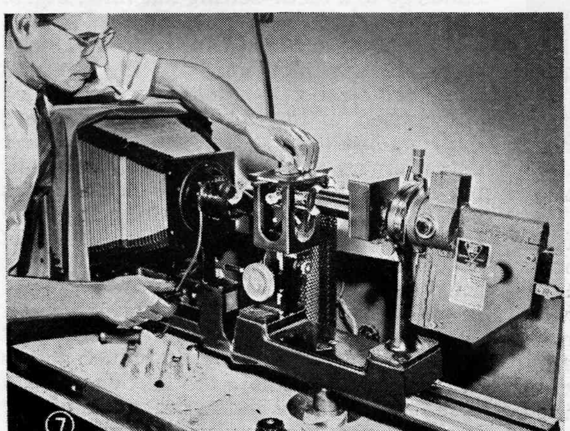




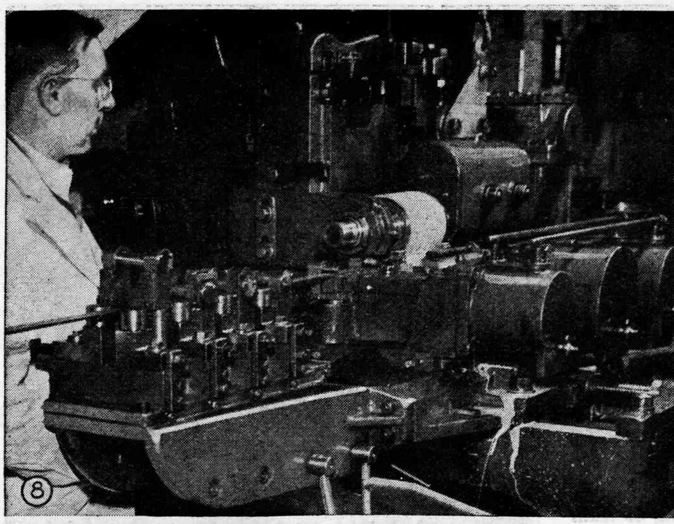
5—Another 4-hr. shaper job of cutting 45 teeth in a 20-in. internal ratchet was accomplished on a contour machine in one hour

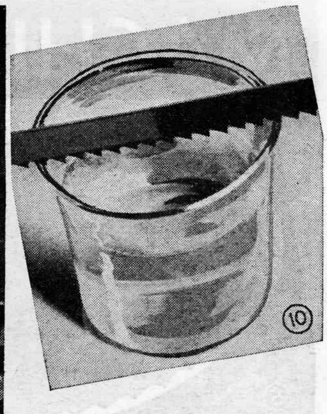
feeds required, but on a contour machine such an operation, shown in Fig. 3, was accomplished in 20 min. To cut three slots in each of the disks shown in Fig. 4 was only a 30-min. job by contour-sawing, whereas it would have taken 1½ hrs. on a milling machine; also, the small pieces cut out were found useful for other purposes. Fig. 1 shows another operation usually done on a milling machine—cutting off part of the tooth sections of gears. By means of a simple fixture to hold and guide the pieces on a contour machine, the work was done at a saving of 50 percent in production costs. The 20-in. internal ratchet shown in Fig. 5, which has 45 teeth, was formed in 1 hr. by sawing. This work required 4 hrs. in a shaper.

Easily and quickly mastered: As shown in Fig. 6, batteries of contour machines are found in many large plants, forty or fifty of them in one place not being unusual. Following a brief period of free instruction provided to industry by a large manufacturer of contour machines, the average apprentice can start to produce acceptable work. A contour-machining school turns out craftsmen in this work in a practical training period of 200 hrs. After the first day of instruction, trainees already are capable of turning out



6—Batteries of contour machines are found in many large production plants, forty or fifty units not being unusual. 7—Metal for saw bands being tested for grain structure with a metalscope, which shows enlarged views and makes photomicrographs

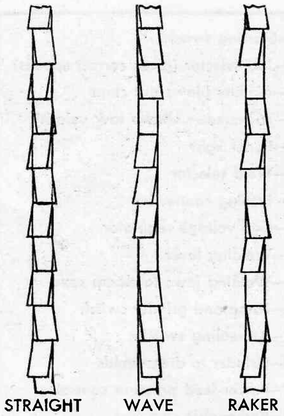




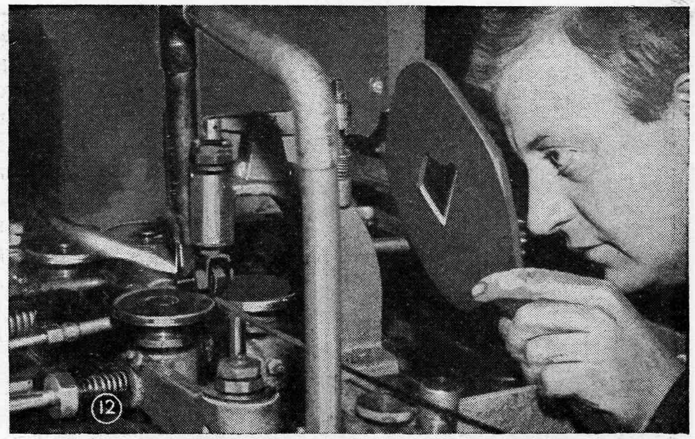
8—Teeth are milled in as many as forty saw bands at once, the bands being clamped side by side in an air-operated vise. 10—Acid test shows exact depth of flame-hardening on saw bands by discoloring hardened portions. 9—Tooth-setting machine that shows a magnified image of the teeth between limit lines so that operator can detect errors of set at a glance. The circular insert shows image as seen

lathe faceplate straps, wrenches and other useful items.

Precision in making the saws: Of the whole machine, the saw band itself, being the part that actually does the cutting, is of greatest importance. As a 1/16-in.-wide band must perform as efficiently in its range as a 1/2-in. band, the material from which saws are made must meet exacting requirements, and the teeth must be milled, set and hardened uniformly with extreme accuracy. To assure that no inferior steel is used in making the saw bands, the raw material is first tested for grain structure with an instrument known as a metaloscope, Fig. 7, which provides highly magnified views of the metal under observation, and enables the operator to make photomicrographs. In milling the teeth, Fig. 8, as many as forty similar bands are clamped together rigidly in an air-operated vise. After the teeth have been cut, the bands go to a teeth-setting machine, Fig. 9. Here the set of the teeth is checked so that it does not exceed .001 in. from specifications. A magnified image of the teeth as projected on a screen is shown in the circular insert of Fig. 9. The image appears between fine lines so that the operator can detect errors at a glance. Next, the tooth portion of the bands is flame-hardened as shown in Fig. 12, so that the back of the band will remain flexible. Hardness must reach the bottom of the tooth gullets but must not exceed this. Depth of hardening is so important that all bands are given an acid test to show just how far hardening has taken place. See Fig. 10, which shows how the acid discolors the hardened teeth to a dark shade, while the back of the band, if untouched by heat, remains light.

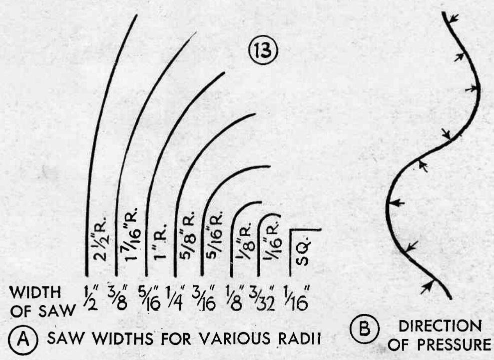


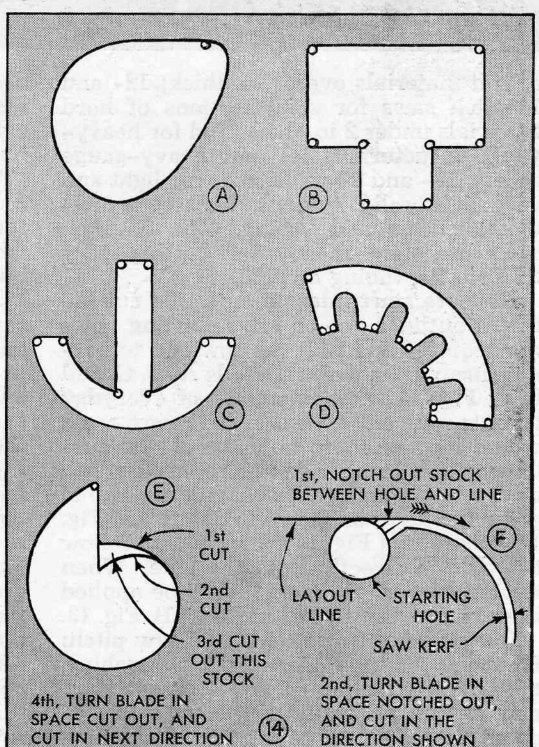
(11) TYPES OF SAWS

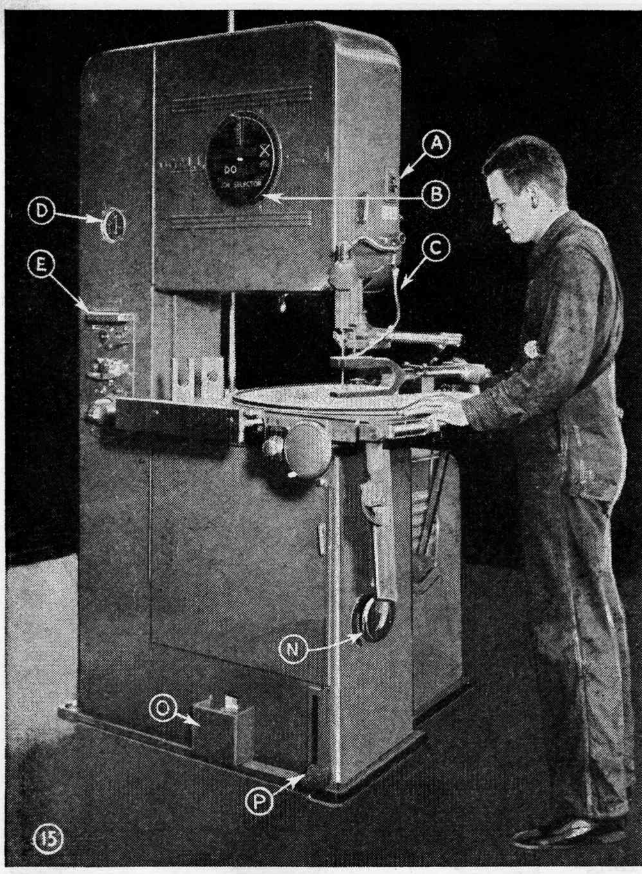


Types of teeth: There are three types of contour-saw teeth as shown in Fig. 11, the raker tooth predominating because it will cut all solid iron and steel. The wave tooth has the smallest possible tooth spacing and is used to cut sheet and tubular stock as well as stainless steel and ductile materials. The straight tooth clears the cut or kerf of chips, and is used for cutting brass, copper bronze, plastics and nonferrous materials.

Saw pitch: Contour saws are made in eight pitches (number of teeth per inch), varying from 6 to 32 teeth. The saws are made to cut curves and, although there are eleven widths ranging from 1/16 to 1 in., the maximum width used is usually 1/2 in. The widest band possible should be used always, and this depends on the radius of the curvature that must be cut. Detail A of Fig. 13 gives the approximate radius that each width of saw will cut. The widest saw possible permits more feed and decreases chattering. Using the widest set of saws is also advisable; this has .007-in. clearance on each side, giving considerable freedom to the back of the saw. As the width of a contour saw decreases, the pitch must necessarily get finer, although wide saws can have any number of teeth per inch. A standard saw for general work is a raker-type saw with a pitch of 14 heavy-set teeth per inch. Although these saws are made in three varying degrees of temper, known as A, B and C, the A-temper is given preference at present. Generally, the coarser pitches are used on soft or thick materials and operate at slow speeds. The finer pitches are used on hard or thin materials, the saws being run at higher speeds. Accordingly, 6-, 8- and 10-pitch saws are used for solid sections







A—Starting switch
B—Job selector (gives correct speeds)
C—Air line blows out chips
D—Tachometer shows saw velocity
E—Panel light
F—Weld selector
G—Etching connection
H—Line voltage regulator
I—Welding lever
J—Welding jaws to clamp saws
K—Lamp and grinder switch
L—Annealing switch
M—Grinder to dress welds
N—Power-feed pressure control
O—Removable chip box
P—Power feed release pedal

Many built-in units and controls on modern contour machines enable operators to do fast and accurate work. References above apply to Figs. 15 and 16

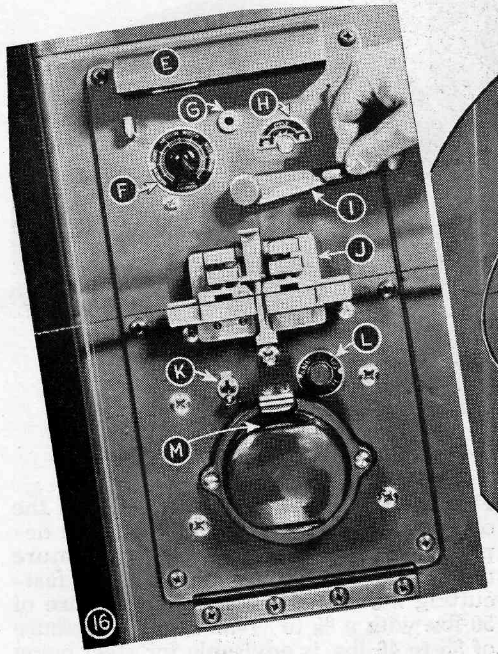
of soft materials over 2 in. thick; 12- and 14-pitch saws for solid sections of hard materials under 2 in. thick, and for heavy-gauge structural steel and heavy-gauge sheets; 18- and 24-pitch saws for light and very light solid sections, light structural metal, sheets and tubing. The 32-pitch saws are used mostly for cutting very thin sheets, tubing or pipe.

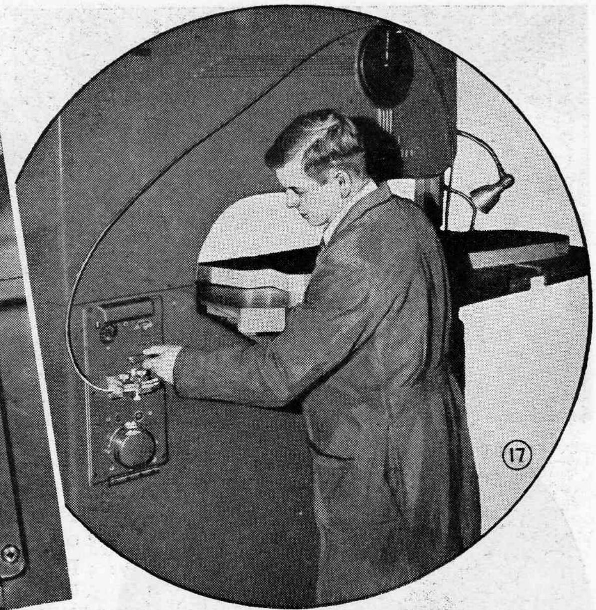
Holes to start internal cuts: To cut internal outlines one or more starting holes are required to insert the saw and to permit turning the work. Details A, B, C, and D of Fig. 14 show examples of everyday layouts for contour work. In many cases where four or more holes would be customary, the number can be reduced to one or two by notching a space with the saw to make the turns as shown in detail E of Fig. 14. Detail F of Fig. 14 shows how to follow the outline directly from the hole. When sawing curves, pressure should be applied as shown by the arrows in detail B, Fig. 13.

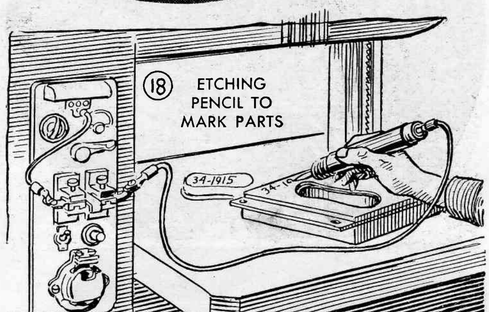
Determining speed, feed and saw pitch: Knowing the kind of material to machine, the operator simply turns a "job selector" dial, on the top cover of the contour machine (See Fig. 15) to a point designating the material. The selector gives the correct pitch of the saw to use, the speed and also the feed for the thickness to be cut. Having mounted the required saw band, the correct speed (50 to 2,000 feet per minute) is obtained by turning a hand wheel until a speed-indicator dial positioned at the left of the job selector, shows the speed desired. The wide range of speeds, very essential in cutting many kinds of materials of varying thickness, is provided by a built-in variable speed unit.

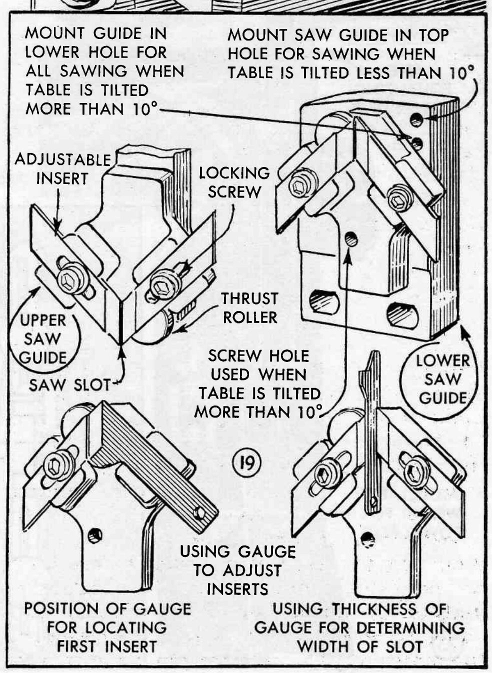
Welding saws: After a saw has been cut for internal machining, the severed ends are joined together again by welding, which can be done in a few moments on a built-in butt welder shown in Figs. 16 and 17. The severed ends of the saw must be squared on a small grinding wheel provided on the machine, before being aligned in the jaws of the welder, both of these operations being done after the saw has been passed through the starting hole in the work. The welding heat required for a particular width of saw is regulated by means of a "weld selector." After the saw has been allowed to cool slowly, the joint is annealed by operating a switch for this purpose. Then the welded joint is surface-ground on both sides until it passes through the weld-thickness gauge. The welding unit also provides a convenient means of connecting an etching pencil for the purpose of marking parts as shown in Fig. 18.

Adjusting the saw guides: Contour-sawing machines are equipped with specially designed saw guides and inserts as





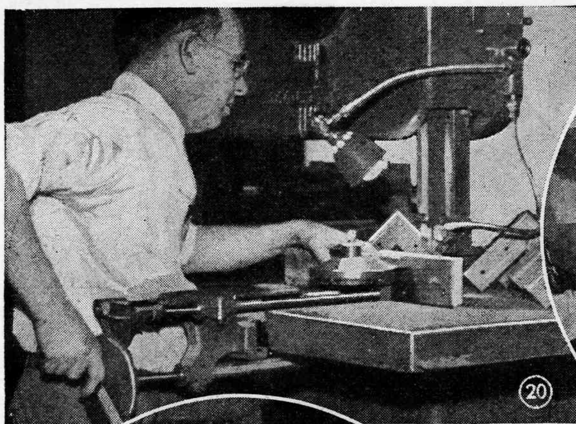


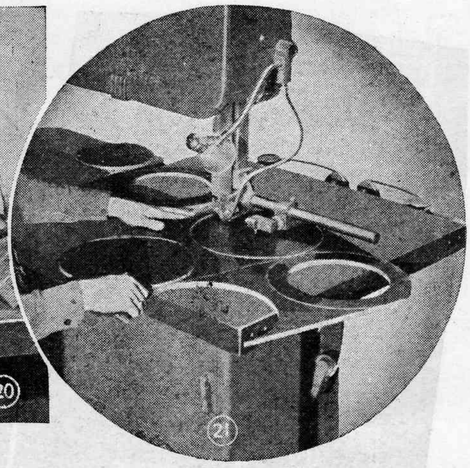


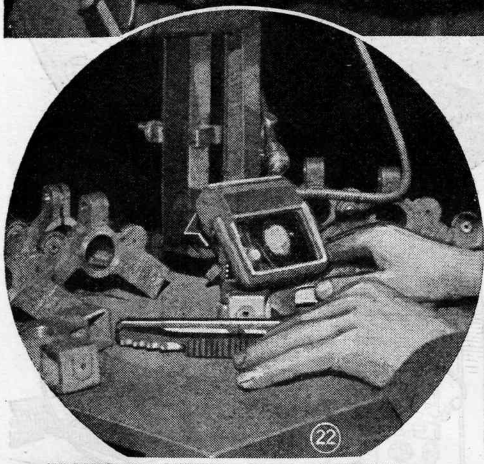
shown in the upper details of Fig. 19. There are several sets of inserts to suit all widths of bands. A gauge is provided to locate the left-hand insert and to determine the correct width of the slot, which is done before adjusting the right-hand insert. See the two lower details of Fig. 19. The saw must track perfectly before the inserts are adjusted. Proper coordination of precise tracking and adjustment of the inserts should cause the back edge of the band to contact the thrust roller lightly when the saw is not cutting.

Contour-machine accessories: There are a number of accessories used to protect the operator against errors and help him to do better work. For example, the air jet as seen in Fig. 15, blows chips out of the saw kerf continually. This prevents generating heat, which would tend to weld chips to the saw teeth and eventually damage the saw. Fig. 22 shows a magnifying unit that enlarges the cutting location three times, enabling the operator to follow the layout line on the stock closely. Fig. 21 shows an attachment used to cut large circular holes up to 30 in. in diameter in stock up to 12 in. in thickness. Fig. 20 shows a cut-off and mitering attachment for making straight cuts at various angles, resulting in accuracy difficult to obtain if this were done freehand.

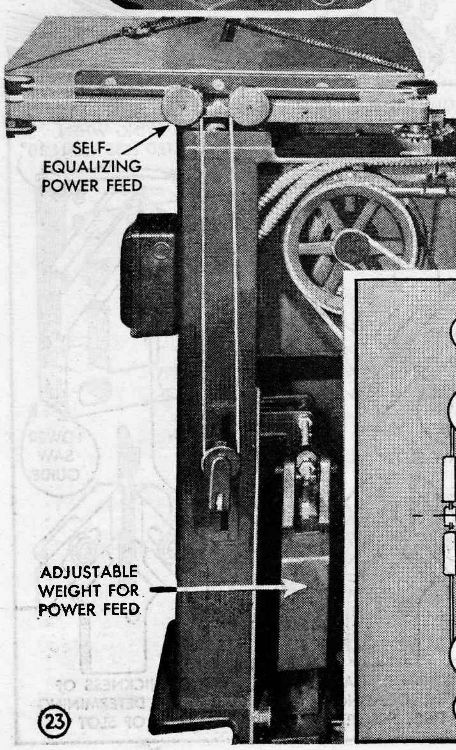
Importance of correct feed: Excessive feed will dull the saw teeth and produce bellied surfaces. Customarily, hand feed is used when making light cuts, but for heavy cuts the power feed, illustrated in

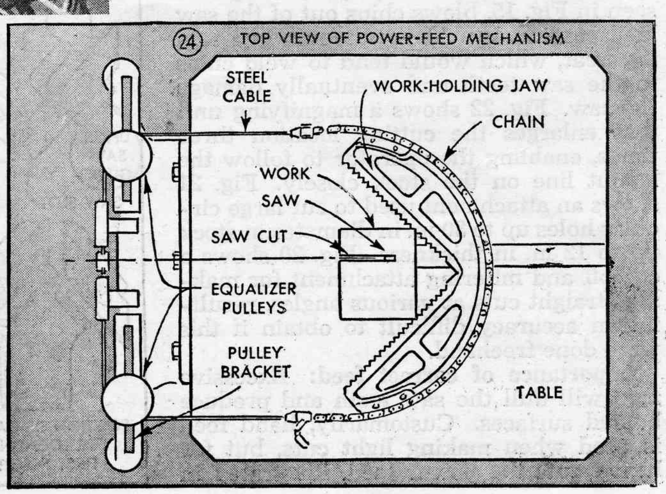




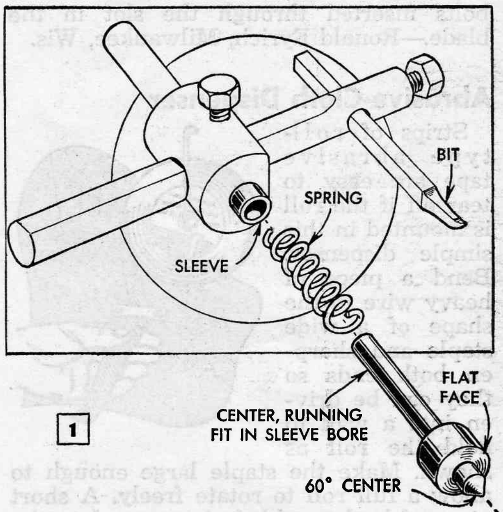


Figs. 23 and 24, releases both hands of the operator to guide the work. The feed depends on the width of a saw, the nature and thickness of the material. Soft or fast-cutting materials will stand a pressure of 50 lbs. with a 3/8 to 1/2-in. saw. A pressure of 35 to 40 lbs. is advisable for steel being cut with a 1/4 to 3/8-in. saw, but not more than 25 lbs. should be used on a 1/8 to 3/16-in. saw. When sawing parts having a variable thickness, the saw part of the time is cutting a thickness that is greater than that of the material itself as is the case when the saw enters the wall of a pipe. In such cases the saw velocity for the minimum thickness of the work is too great for that of its maximum thickness. Then the saw pitch should be based on the thickness of the material but the saw velocity should be based on double the thickness. The operator can determine easily what adjustment should be made in such cases by simply referring to the job selector incorporated in the machine, as shown in Fig. 15.





TRUE HOLES in LIGHT METAL



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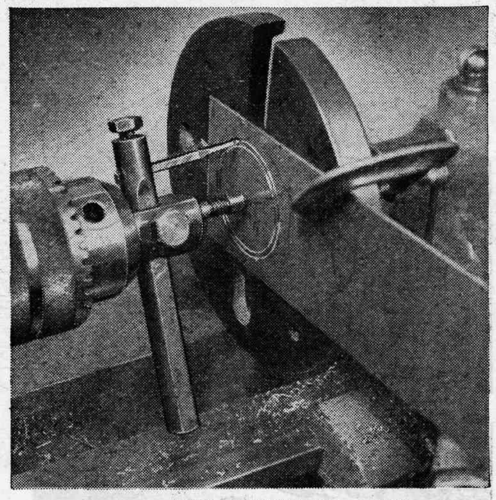
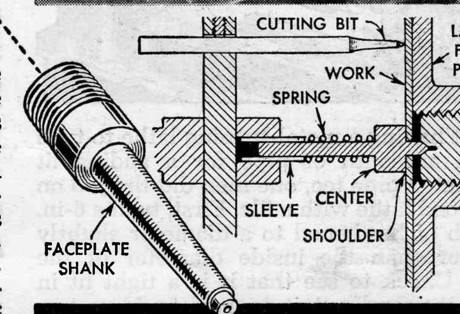


USING this exceptional tool, it's possible to cut a true hole every time without the usual distortion or elongation. The tool is attached to the headstock of a lathe and the work is backed by a faceplate screwed on the end of a specially turned shank inserted in the tailstock spindle. The tool is made from a standard adjustable hole cutter by removing the center drill and installing a steel sleeve, spring and center fixture, as in Figs. 1 and 2. The shank of the center should be a running fit in the sleeve bore and the bearing surface should be kept well oiled. A 15-lb. diemaker's spring is required to produce the desired thrust. Faceplate shank is threaded to fit the faceplate and the shank is turned to a Morse No. 1 or 2 taper, depending on the tailstock spindle. Dimensions for both tapers are given in Fig. 3. The threaded end of the shank is center-drilled to take pointed tip of the center fixture. In operation, the pilot hole in the work fits over the 60-deg. center which is engaged by the faceplate shank. The faceplate is advanced to allow the flat face of the center fixture to grip the work. When once adjusted, the feeding is done with the tailstock ram. Should a disk be desired without the pilot hole, it can be cut by clamping the work to the faceplate.

Various cutter bits and their uses are indicated in Fig. 4. These bits are made only from the hardest alloy steel honed to a razor edge. When a bit is used on a hole of smaller diameter than that for which it was designed, it may rub. In this case, part of the heel must be ground away to give the desired clearance. When using the tool, remember to keep the feed pressure light, as heavy feed will cause the bit to dig in.



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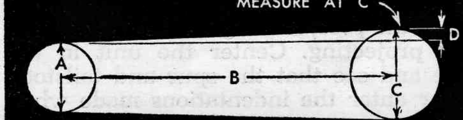
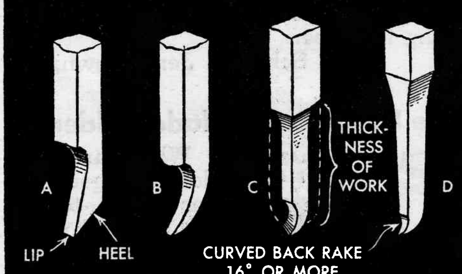


SPECIFICATIONS FOR MORSE TAPERS

MORSE #1	MORSE #2
A—0.369"	A—0.572"
B—2 7/16"	B—2 15/16"
C—0.475"	C—0.700"
D—0.0498 PER IN.	D—0.0499 PER IN.

3

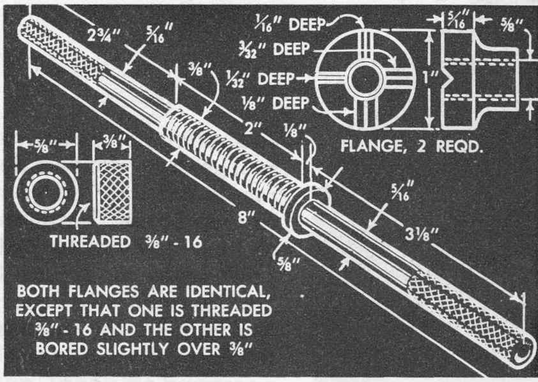


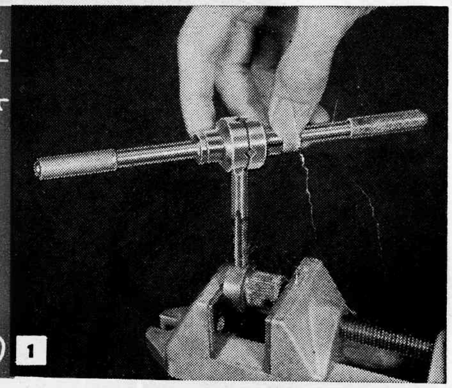
BIT SHAPES FOR VARIOUS TYPES OF WORK

A—LARGE HOLES IN SOFT METAL
B—HOLES IN BRONZE OR STEEL
C—SMALL HOLES IN SOFT METAL
D—HOLES IN THIN METAL, 1/64" TO 1/32" THICK

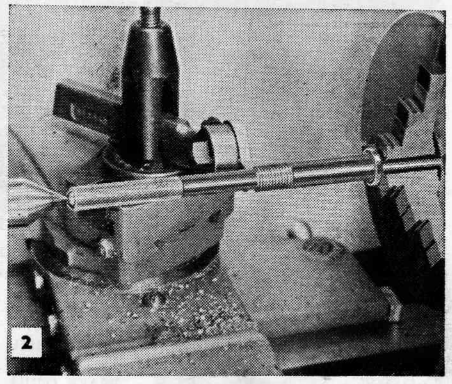
4

Flanged Tap Wrench Takes Four Shank Sizes





1

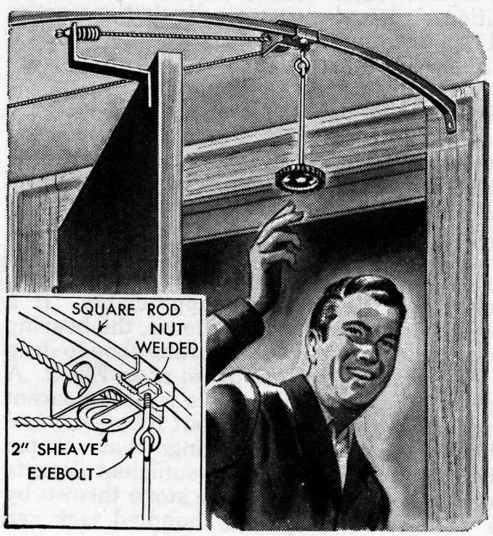


2

This versatile tap wrench, Fig. 1, makes an interesting and instructive project for either the home craftsman or the school shop. The handle unit is turned from 5/8-in. cold-rolled steel to the dimensions given in the detail. After knurling the ends, the center section is threaded in the lathe, as in Fig. 2, or with a 3/8-16 die. The flanges are turned from cold-rolled steel and then notched to take four sizes of tap shanks. The notches can be milled in each flange or they can be filed in the flanges by hand. If the notches are hand-filed, care must be taken to space them equidistantly. File the notches to exactly the same depth in both flanges so taps are gripped securely.

Counterweight on Door Automatically Returns It to Preset Stop

Because it was necessary to keep an entrance door partially open for proper ventilation, the workers in one powerhouse made an adjustable doorstop that runs on a circular overhead track. A counterweight brings the door back against the stop after someone passes through. The track is a length of square rod bent to a radius about 1 in. greater than the width of the door. The stop itself is made by bending a piece of flat iron to fit loosely around the track. A hole is drilled in the underside of this flat-iron sleeve and a nut is centered over the hole and welded in place. Then one side of the sleeve is welded to a piece of angle iron fitted with a 2-in. sheave as shown. An eyebolt, which serves as a setscrew to lock the stop in place, is turned in the nut by means of a steel-rod extension to which a valve handwheel is attached. A bracket bent from flat iron is fastened to the upper part of the door to take one end of the counterweight rope. This bracket may have to be offset slightly so the rope aligns with the doorstop sheave. Note that a short coil spring is brazed over the rope hole in the bracket to provide a shock absorber. Another sheave is attached to the wall at the same height as the stop and pivoted so it is always in line with the stop. A sash balance serves as a counterweight. This should slide in a wooden channel to protect the wall.



J. C. Montgomery, Bowness, Alta., Can.