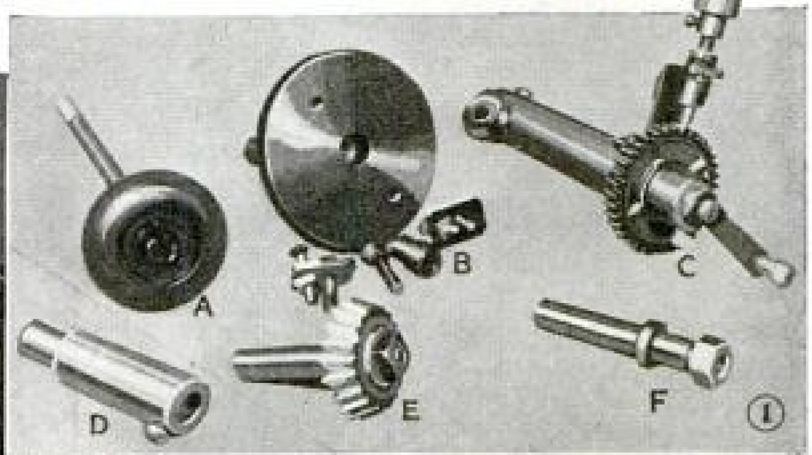
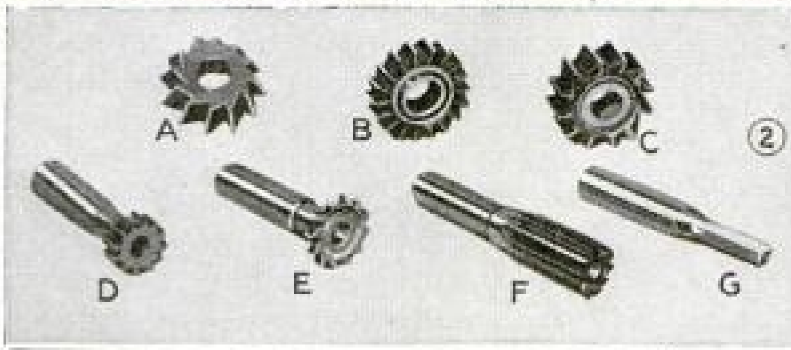
Make Your Own MILLING CUTTERS *and Accessories*



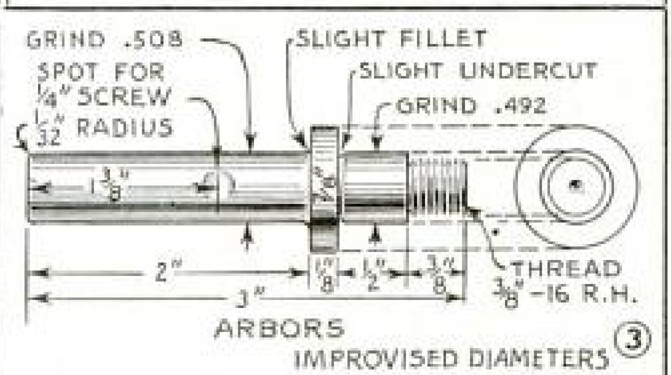
ACCESSORIES

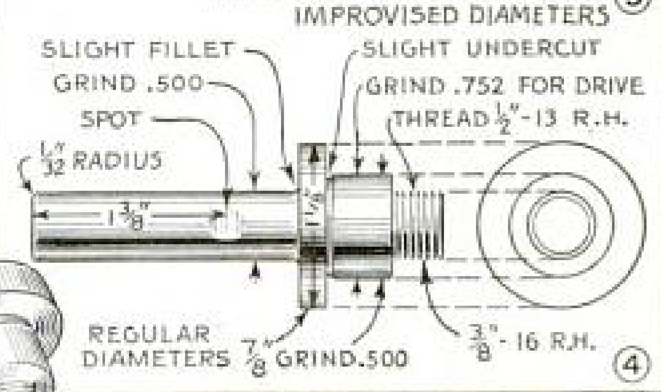
A—Draw-in rod	D—Collet
B—Faceplate	E—Cutter and arbor
C—Index fixture	F—Index arbor



CUTTERS

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

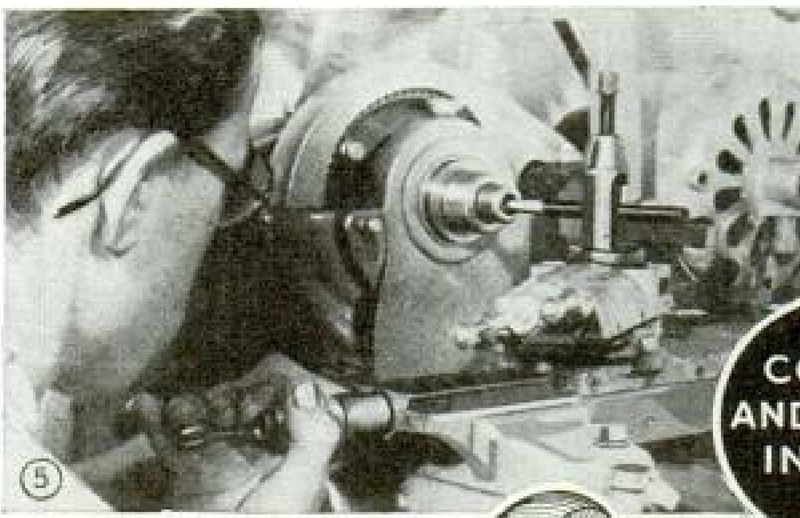


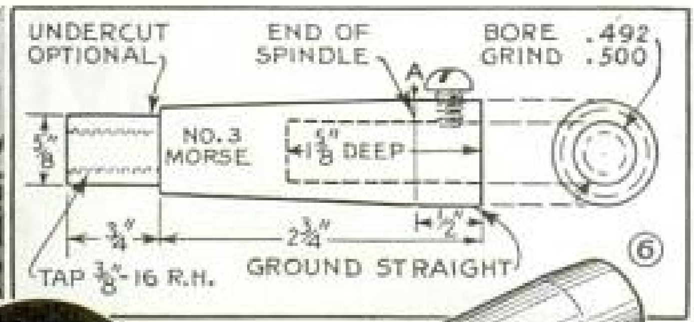


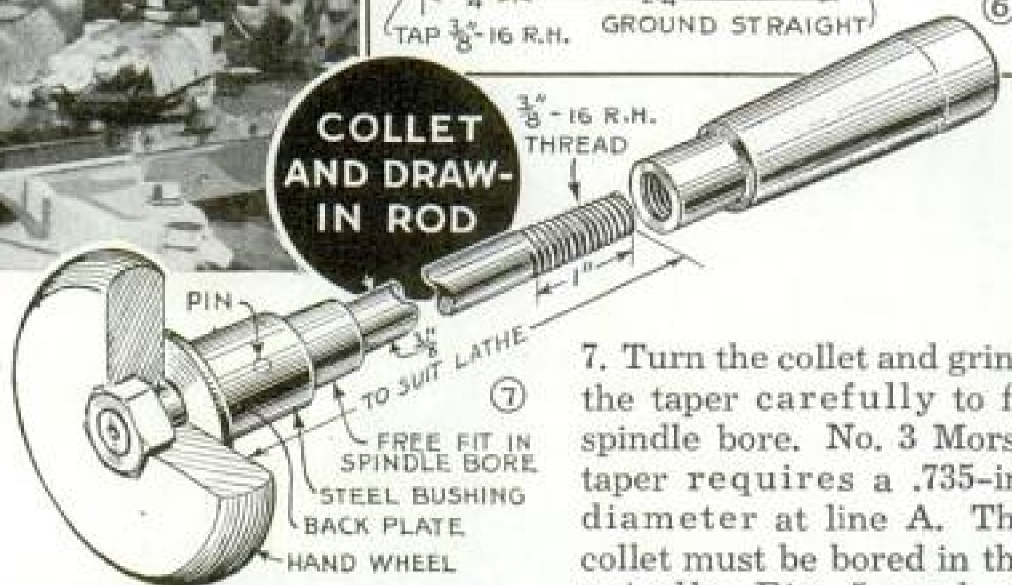
By H. J. CHAMBERLAND

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



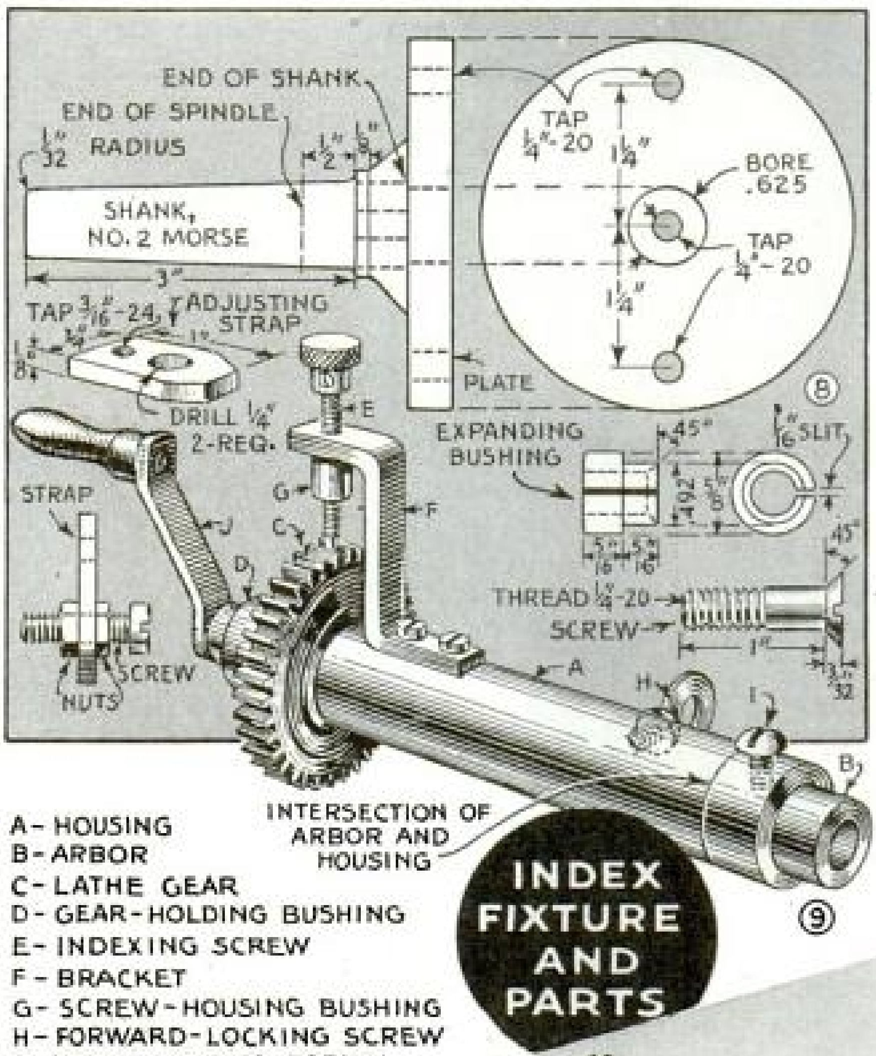


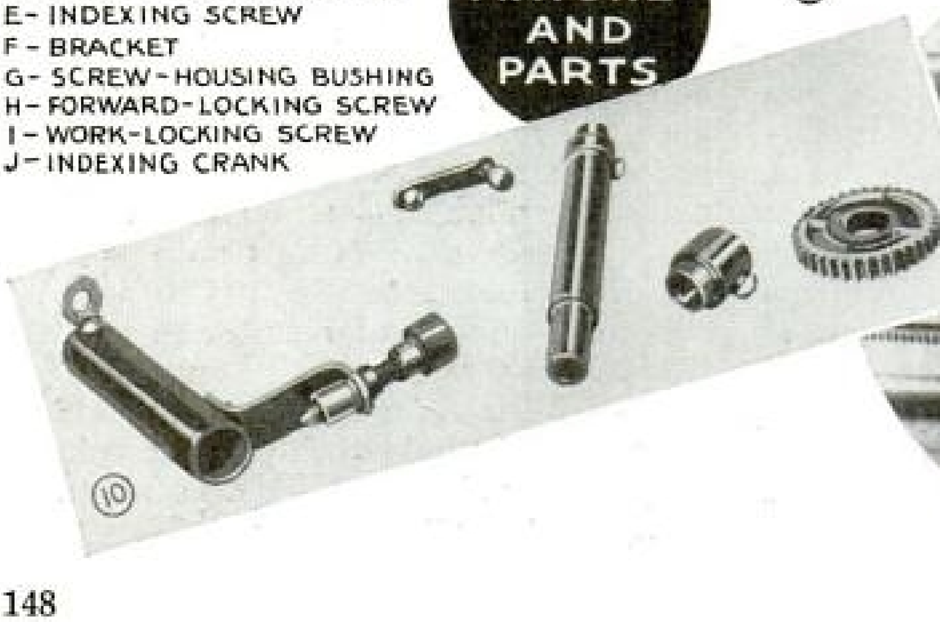


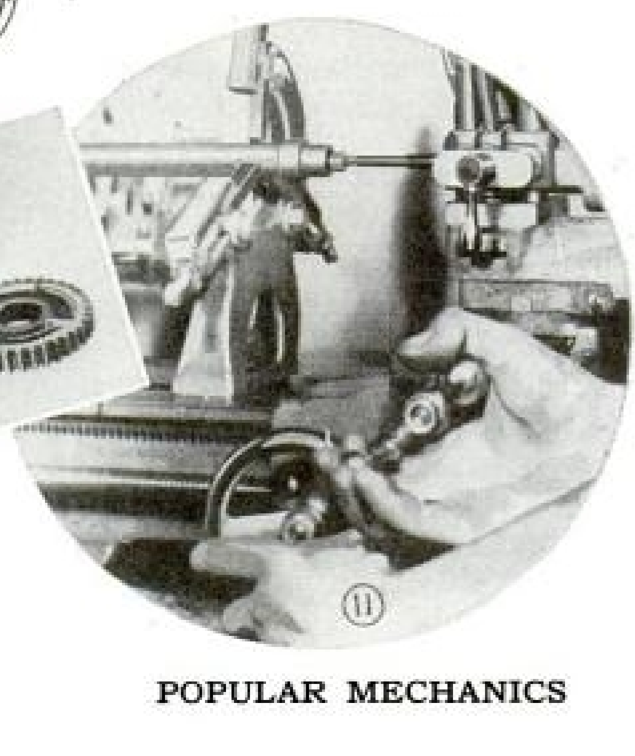
After turning the collet, grind it carefully to fit the taper of the lathe spindle. It must be held in the spindle while boring it out, after which it is ground to .500 in.

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



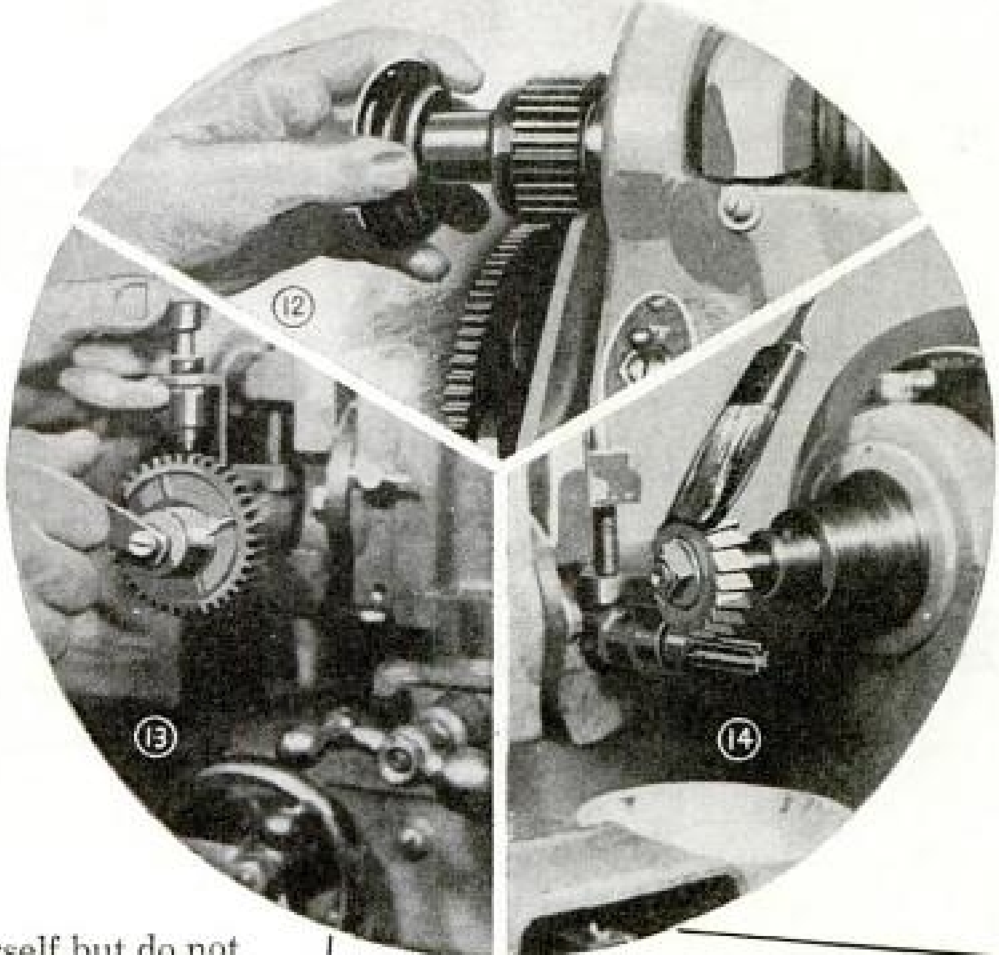


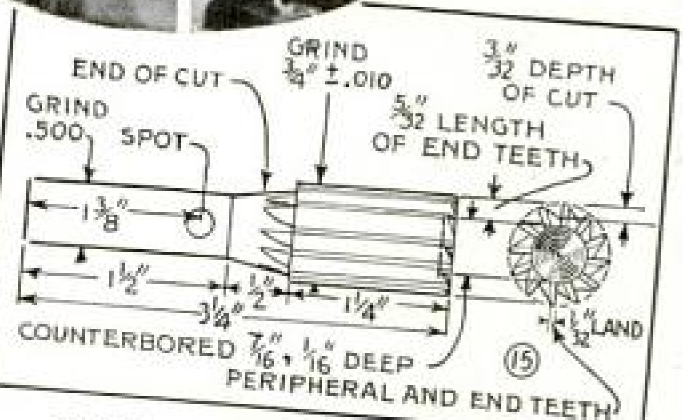


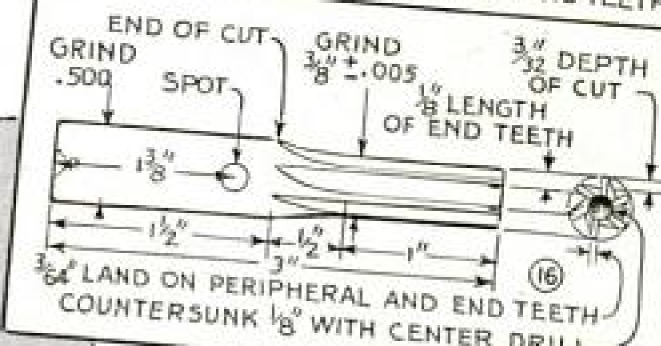
parallel, and the adjustable straps for holding them to grind the bores.

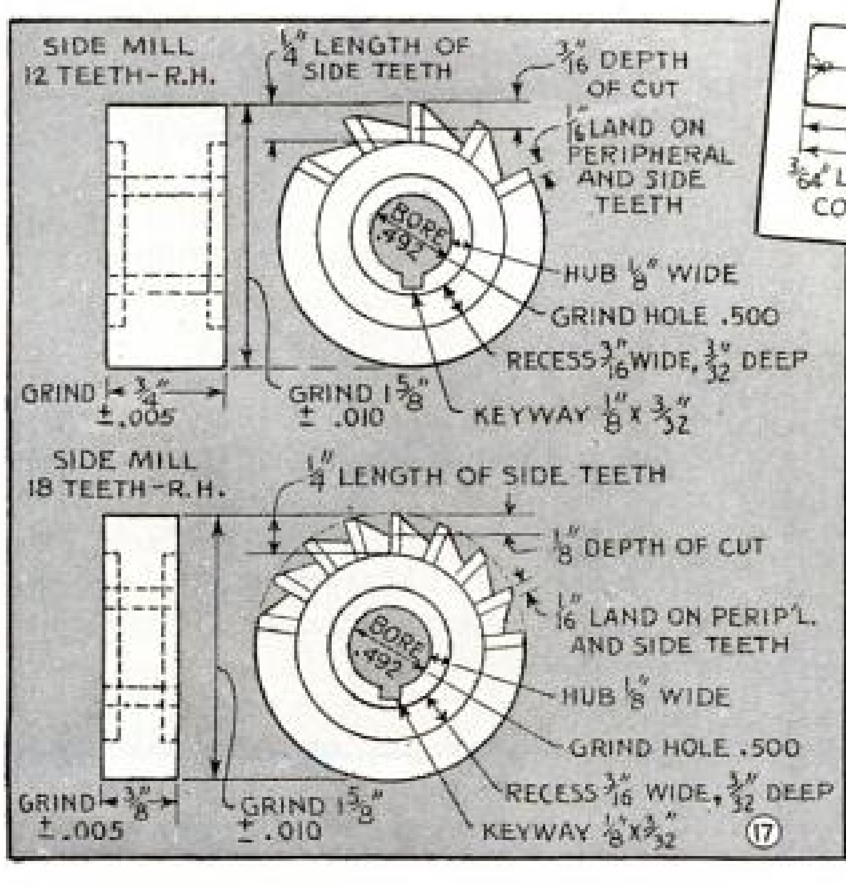
Of utmost importance is the indexing fixture. You will need it to divide the teeth accurately in all mills. Made entirely of scrap, except for one of the lathe's threading gears, it has done a surprisingly fine job as you note in Fig. 2. Clearly detailed in Fig. 9 with the parts illustrated in Fig. 10, 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.

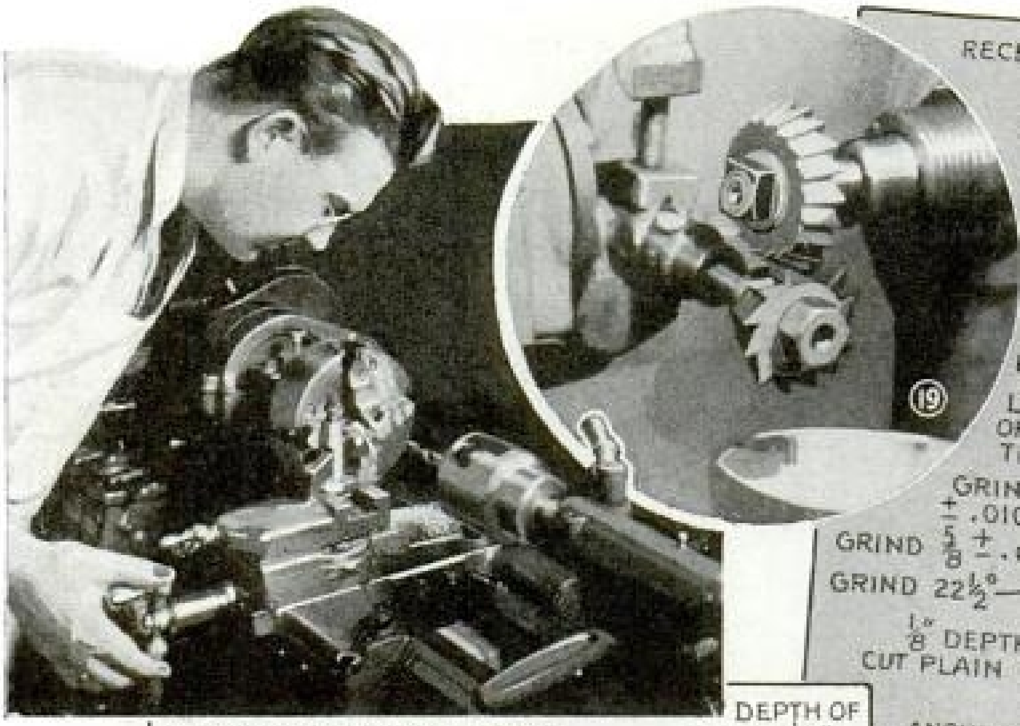
Making the cutters: You are now well equipped to mill teeth. To simplify and economize, you must standardize. In this instance we have ½-in. shanks and ½-in. bores. Use practical diameters for all tools and give the preference to 12 teeth, exclusive of two items. Machine the blanks and

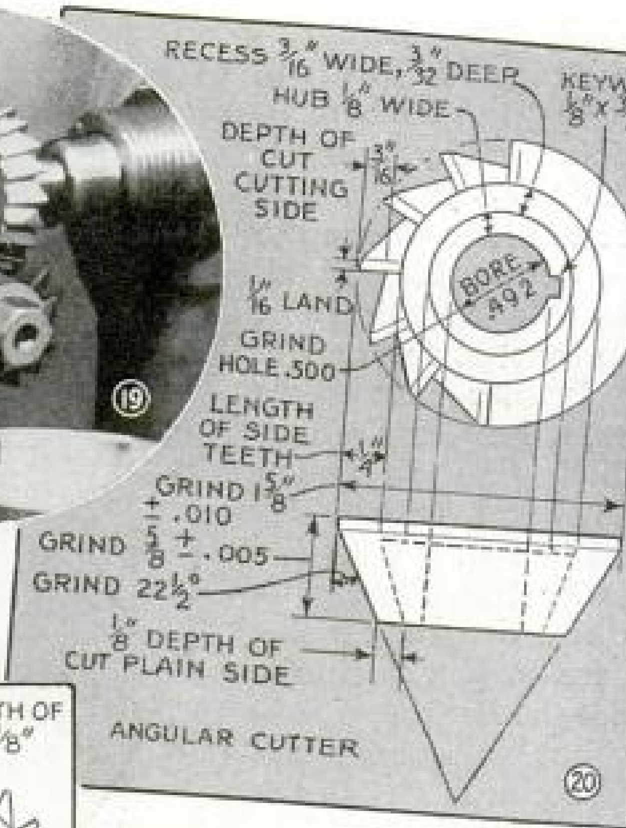


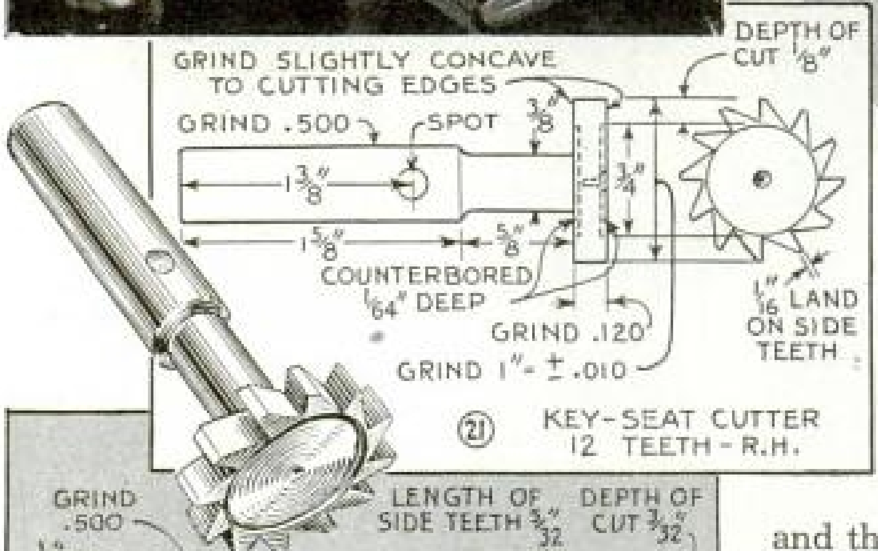


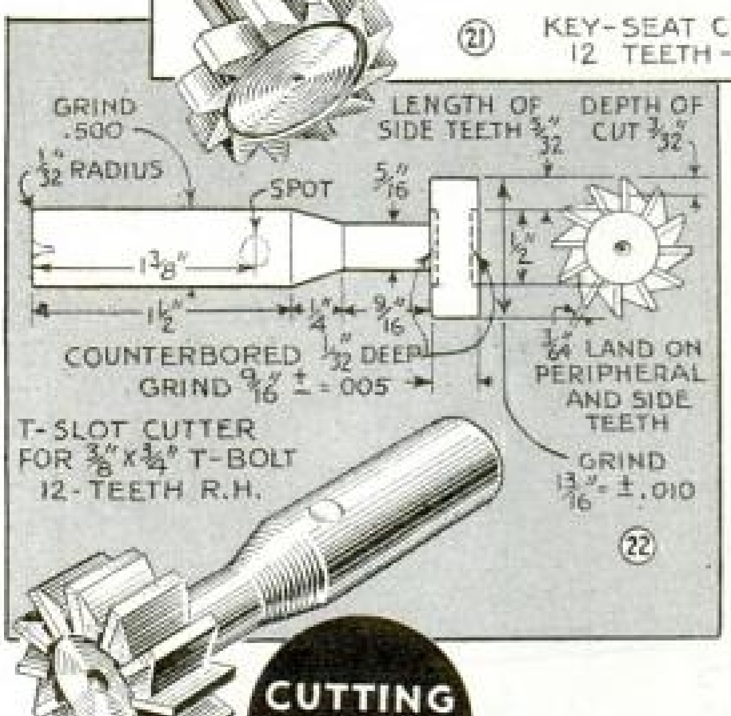


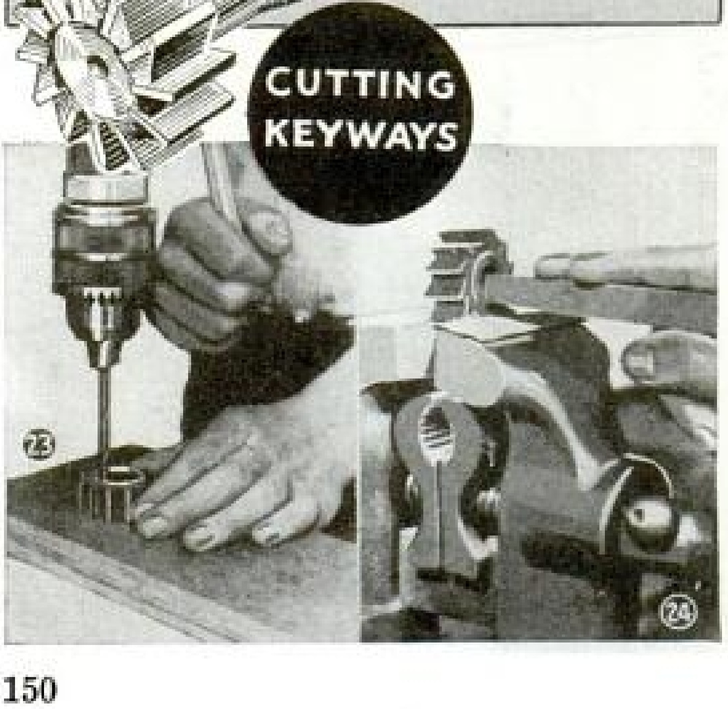






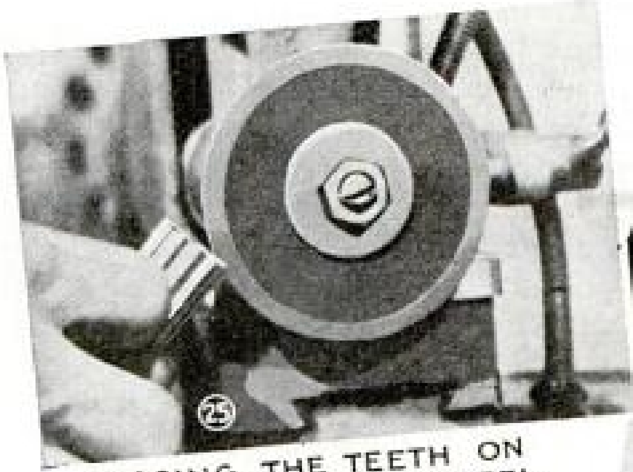




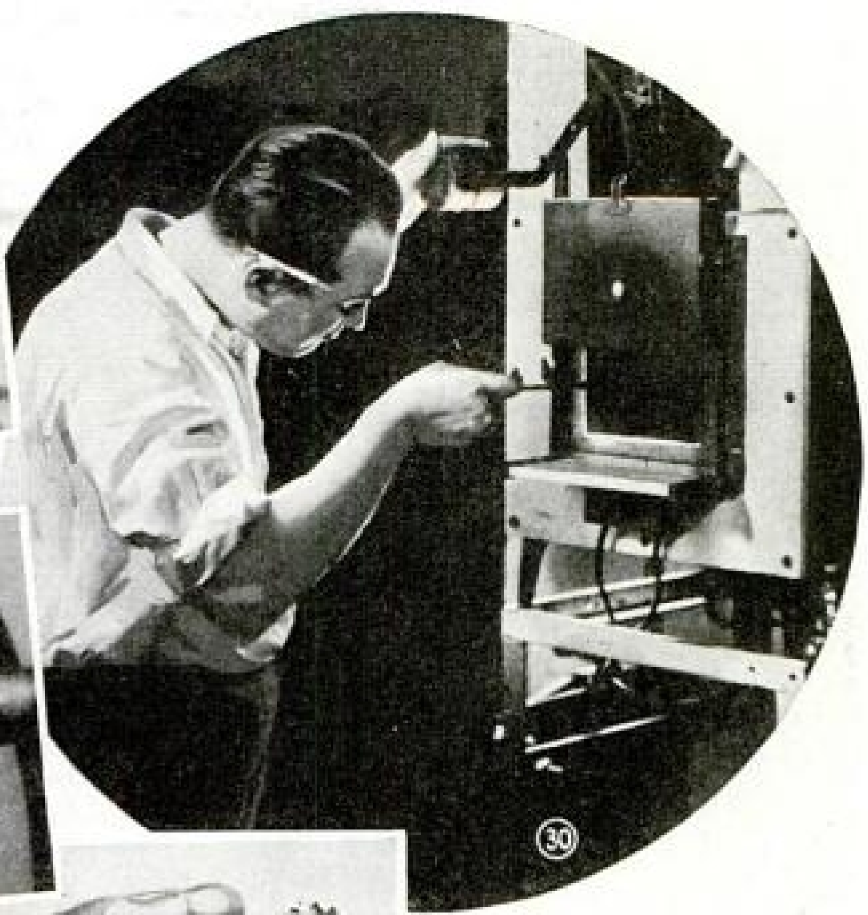


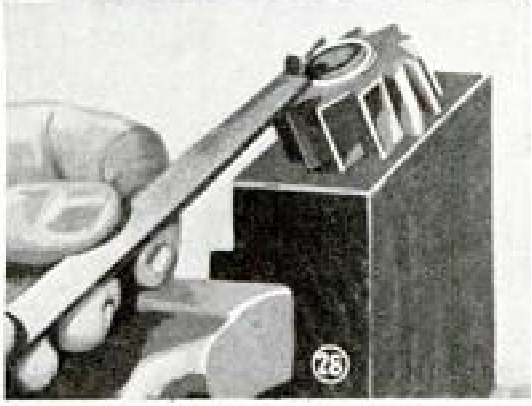
allow .007 to .008 in. for grinding, where so specified. If you use a cutter similar to the one mentioned, use the same number of teeth and depth of cut recommended in the individual sketches. See that the cutter is sharp, has a 1/32-in. flat or radius at the point, and the arbor tightly drawn in, Fig.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

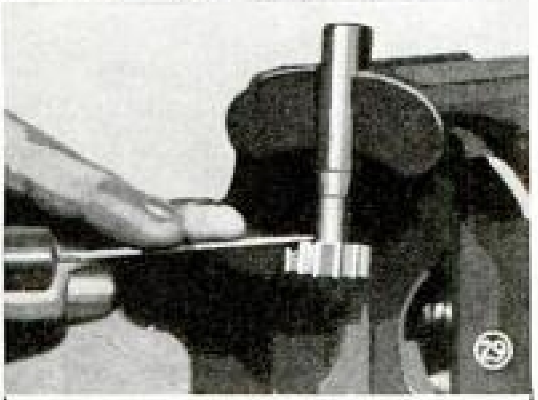
Milling peripheral teeth: For milling all peripheral teeth, the 36-tooth gear is used because 6, 12 and 18 divisions go into that number of teeth. You must, of course, make the bracket of the indexing fixture to suit a few other gears with different pitches. Eliminate all play in both index fixture and 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-size cutter bores and drill a 5/32-in. hole anywhere on the intersecting line, Fig. 23. The results are a 5/64-in. radius, which is a guiding line to file keyways 1/8 to 5/32 in., Fig. 24.

TESTING ACCURACY (31)

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 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 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.

CLEARING SIDE TEETH (32)

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 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.

CONCAVING KEYWAY (33)

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 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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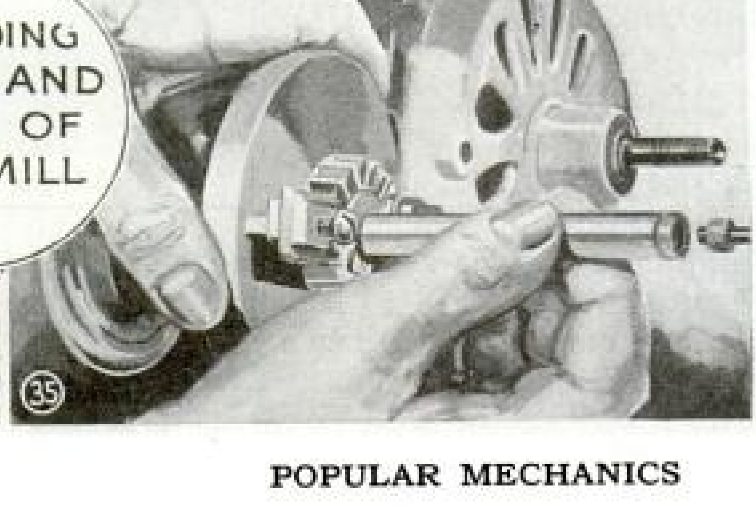


(35)

GRINDING SIDES AND BORE OF SIDE MILL

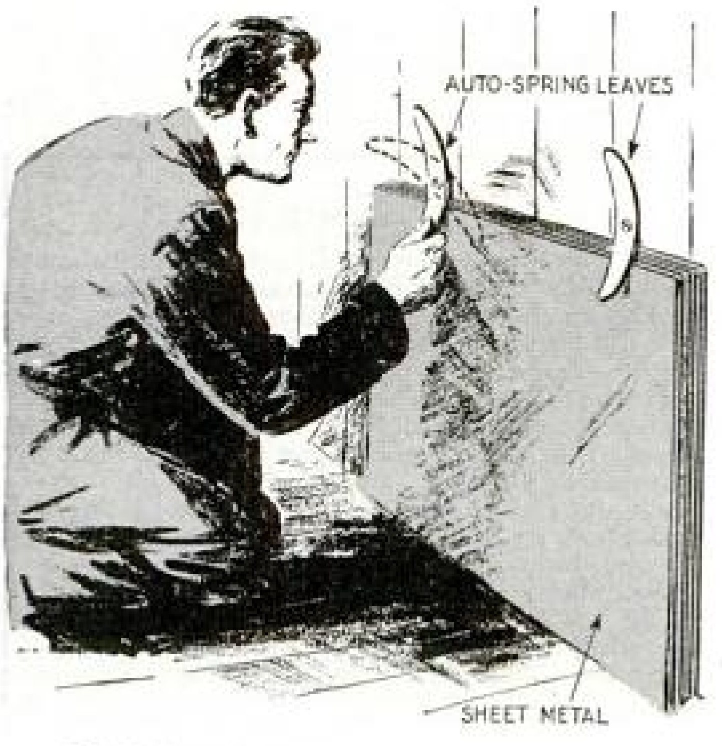
won't cut good. An internal-grinding wheel is safest to clear side teeth of angular cutters and side mills, Fig. 32. The key-seat cutter has no side teeth but is ground concaved on both sides, Fig. 33. Both sides of side mills and angular cutters are ground parallel with their respective bores as in 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

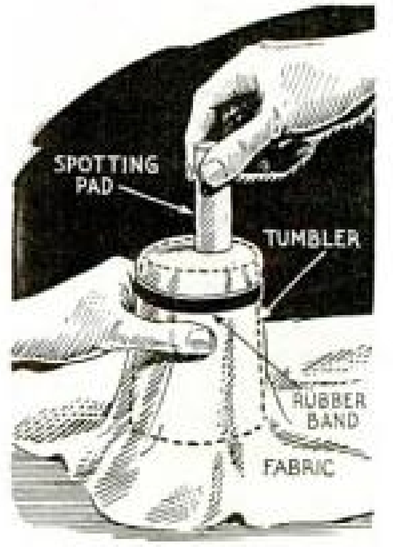
In order to hold sheet metal against a wall, where it can be removed conveniently as needed, attach a couple of short leaves from a discarded auto spring to the wall above the stock to serve as turnbuttons. These hold the metal securely in place but are easily swung to one side.



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.