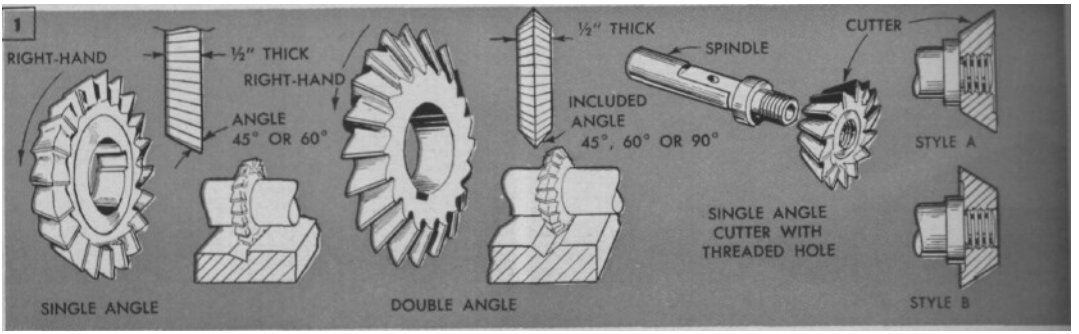
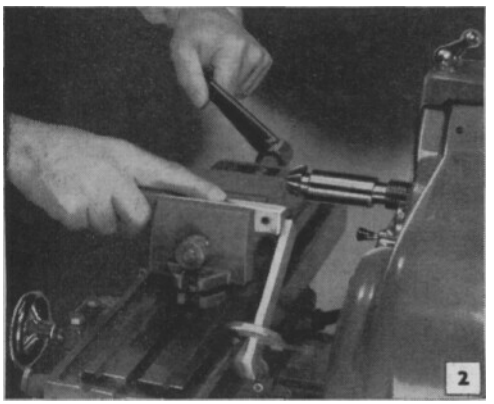
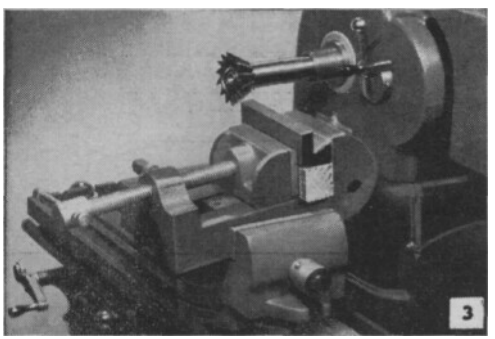


MILLING WITH ANGULAR CUTTERS



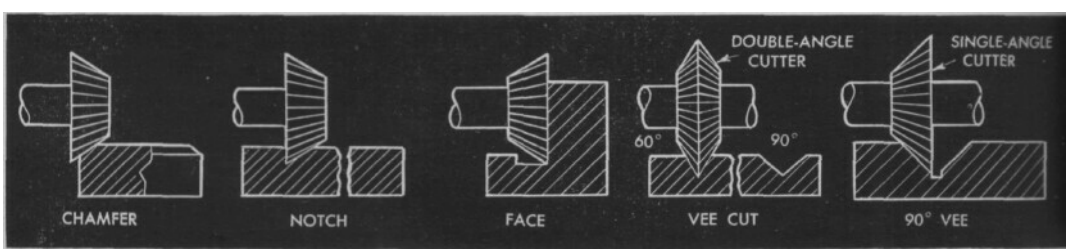
Chamfer is most common cut made with angular cutter. Stop clamped to machine table assures accuracy

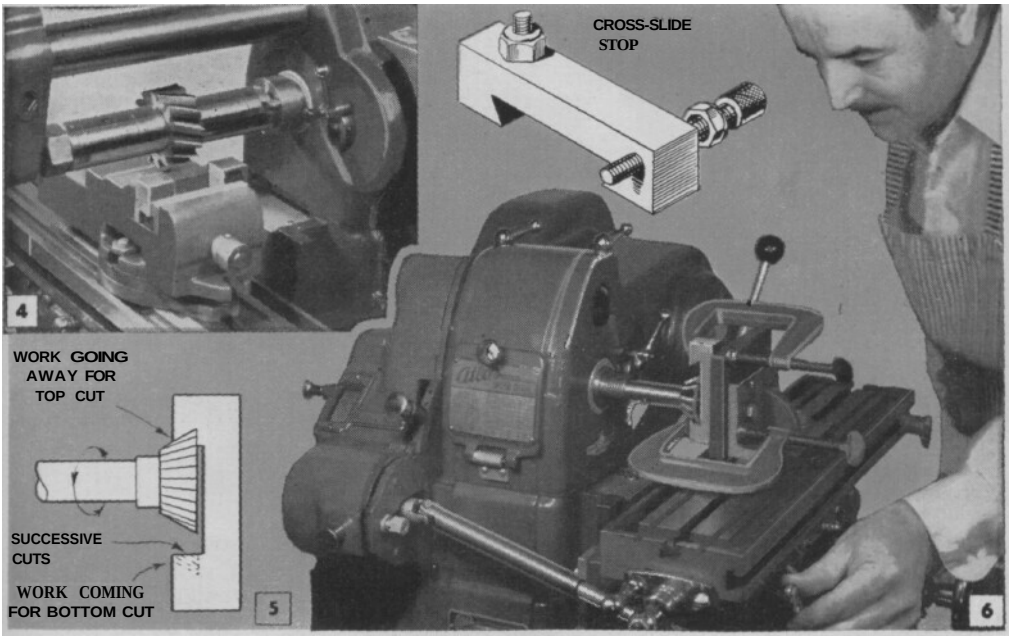


Vises used in combination permit work to be tilted to desired angle. Note stub spindle carrying cutter

BEVEL, VEE AND DOVETAIL cuts necessary when making ratchet wheels, racks, dovetail slides and similar work in metal are made with angular cutters. These include both the single and double-angle cutters, Fig. 1, and are intended for use on the overarm spindle of a milling machine, Fig. 7. Angular cutters of smaller diameter have threaded holes and fit a threaded stub spindle as in Fig. 3. These cutters are available in two common styles, A and B in Fig. 1, and come in two stock sizes, 1¼ and 1 5/8in. in diameter. Although both styles are useful, the style designed to be run with the larger diameter to the outside has the greater number of applications. As a rule right-hand cutters are used on a lathe (with milling attachment), small milling machines and drill presses. A right-hand cutter is one which rotates clockwise when viewed from the driven end of the spindle.

The simplest angular cut is the plain chamfer, an example of which is shown in Fig. 2 and also in the details at the bottom of the page. Note in Fig. 2 that a stop clamped to the machine table locates each edge so that the depth of cut on the four edges is precisely the same dimension. The cut is made in one pass at a cutter speed of 450 r.p.m. and a work feed of .012 per revolution. Using a 12-tooth cutter this feed rate will give a chip thickness of about .001 per tooth, a good standard value.

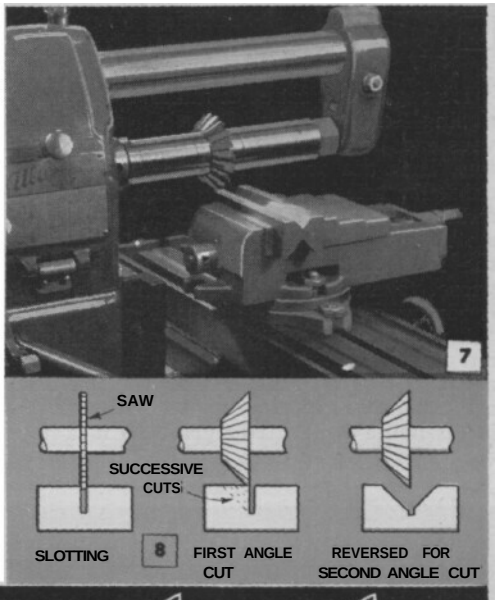


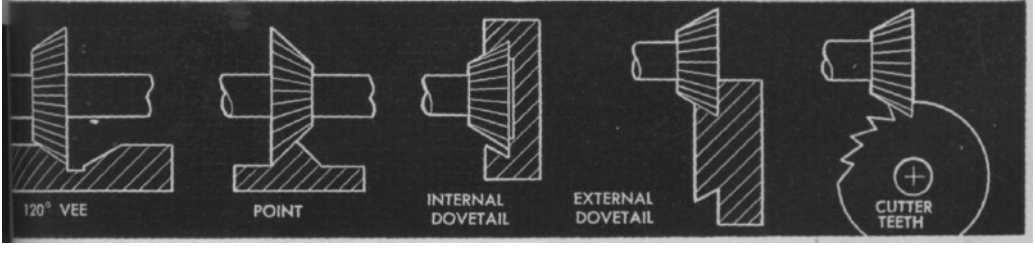


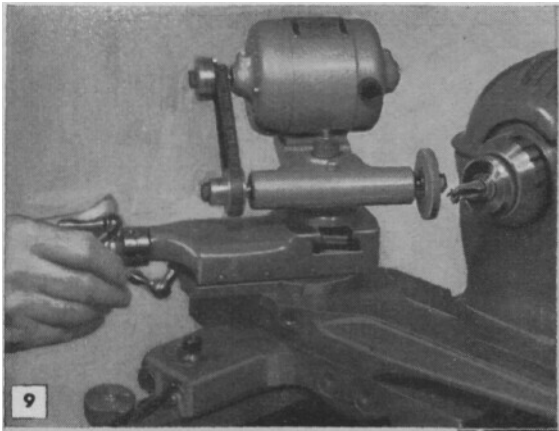
Although the principal use of the 60-deg. angular cutter is to make angle cuts of exactly 60 deg., it also can be used for angles of more than 60 deg. but less than 90 deg. This is done by making the 60-deg. cut first, then tilting the work and running a second cut to finish the work face to the desired angle with the surface. Fig. 3 pictures a convenient way of setting up for this operation, using a drill-press vise clamped in a regular milling-machine vise.

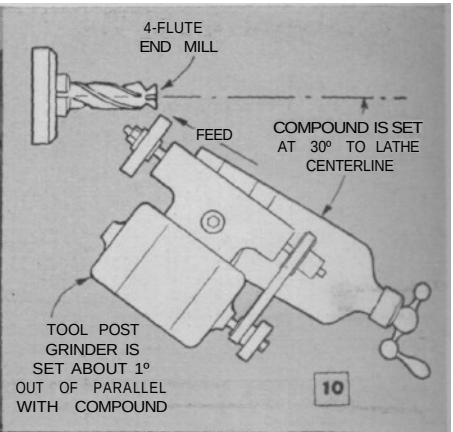
Figs. 5 and 6 show how a 60-deg. dovetail cut is made, a typical example of the internal dovetail being the cross-slide stop in Fig. 6. The same cutter is used for both internal and external cuts. When making the internal cut, the waste stock is first removed with a straight cutter as in Fig. 4. Then the angular cutter is used to run both sides of the dovetail as in Fig. 5, the work being clamped in position as in Fig. 6. The external cut is made in much the same manner, using the same cutter and the same direction of rotation but feeding from opposite directions for the top and bottom faces of the work.

Above, when milling wide dovetail, Fig. 6, first step is to rough out waste, Fig. 4. Below, vees usually are milled in three operations as in Figs. 7 and 8

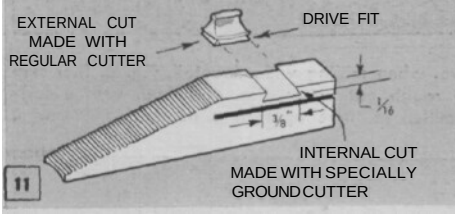


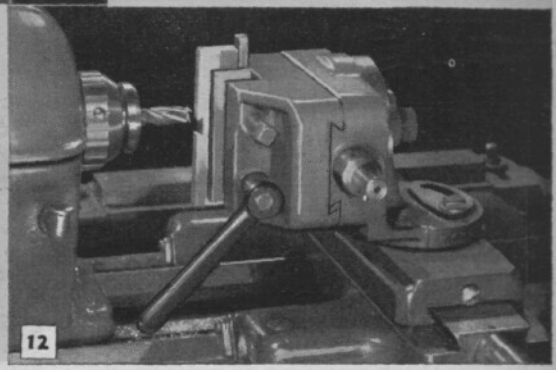






Dovetail cutters smaller than 1¼ in. in dia. usually are made by grinding 4-flute end mills to required angle, Figs. 9 and 10. Work is rotated while grinding. Shallow dovetail cuts 1/16 in. or less in depth, can be run in one pass *as* shown in Fig. 12





It's regular practice to make V-cuts with a single-angle cutter, Fig. 7, but small vees can be run with a double-angle cutter. When the bottom of the vee requires a chip-clearance groove, as required when making a V-block, this is first run with a slotting, or slitting, saw as in Fig. 8. Then the first angle cut is run in successive passes to the required depth and the work is reversed for the final cut, Fig. 8.

Dovetails smaller than 1¼ in. are usually cut with 4-flute end mills ground to the angle required, Figs. 9 and 10. The end mill is rotated at slow speed while grinding is being done. After grinding it is necessary to back off each tooth for clearance. This can be done on a bench grinder. When properly made these small cutters work very well on one-pass cuts up to 1/16 in. in depth. If the required depth is greater it is best to rough out the waste by straight milling. Figs. 11 and 12 show typical operations with a small, specially made milling cutter.

Angular cutters generally are operated at slower feeds than are normally used for straight cutters. Cutters 2½ in. or larger should be operated at about 60 r.p.m. with a feed ranging from .012 to .025 per revolution. The cutting depth per pass should not exceed 1/16 in. for best results on small machines.

* * *