SET-UP and OPERATION
of
Brown & Sharpe
Automatic Screw Machines

No. 10

Of a Series of Booklets for Training Operators

Turning, Knurling, Centering, Forming, Drilling, Recessing and Cutting Off

Brown & Sharpe Mfg. Co.
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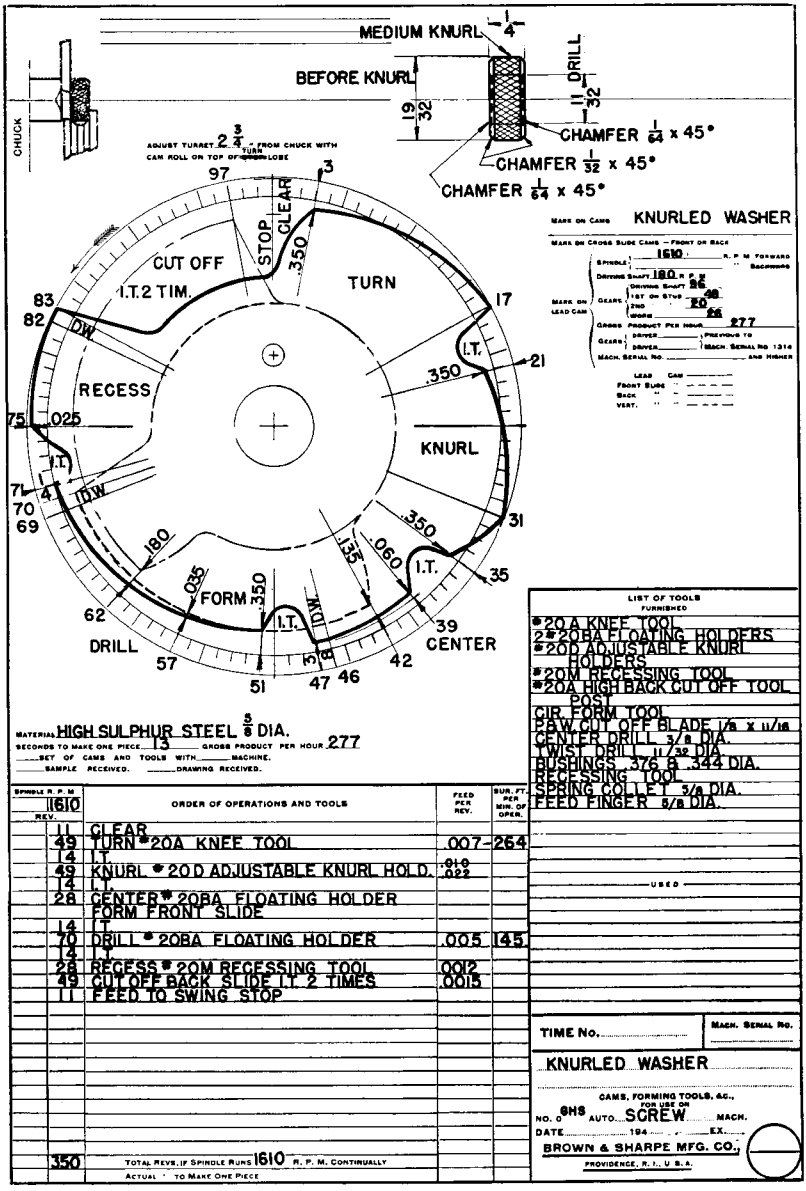

Fig. 1. Work Sheet for Job No. 9

NO. 10 OF A SERIES OF BOOKLETS FOR TRAINING OPERATORS

JOB NO. 9

Turning, Knurling, Centering, Forming, Drilling, Recessing and Cutting Off

Five of the six possible turret stations and both cross slides are required to support tools for the seven operations performed in machining the knurled part of Fig. 1. Of the seven operations, those of recessing, and turning with a knee tool are new to these booklets. The operation of knurling with two knurls to get a diamond pattern is only partially related to the straight knurling performed in Job No. 8 and cutting off with a straight blade is a variation from the use of a circular tool. Operations of centering, drilling and forming are essentially the same as described in the preceding jobs.

Strip the Machine.

Back off cross slide stop screws.
Insert feed finger, collet and stock.
Adjust length of feed and collet pressure.
Put on feed change gears.
Make changes to get spindle speed.
Disengage coupling driving spindle reverse dog carrier.
Put on cross slide and turret lead cams.

Set All Carrier Trip Dogs. Fig. 3 suggests the approximate settings. On a 13 second job, the ⅓ second required for turret indexing represents 2½ hundredths on the cam. Since we have ample time during cutting off, the fifth and sixth turret trip dogs have been set 7 hundredths apart, a liberal amount greater than the 2½ minimum required.

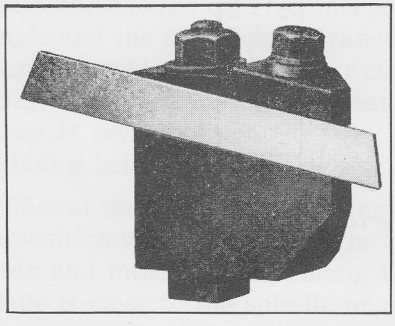

Fig. 2. Cutting-off Tool Post

Sharpen, Mount and Adjust the Cutting-Off Blade. Instead of the usual circular cutting-off tool, this job employs a straight cutting-off blade held in a high back cutting-off tool post. This tool post is shown in Fig. 2 and is mounted in position of the regular cross slide tool post in Fig. 4. The cutting-off blade has angular

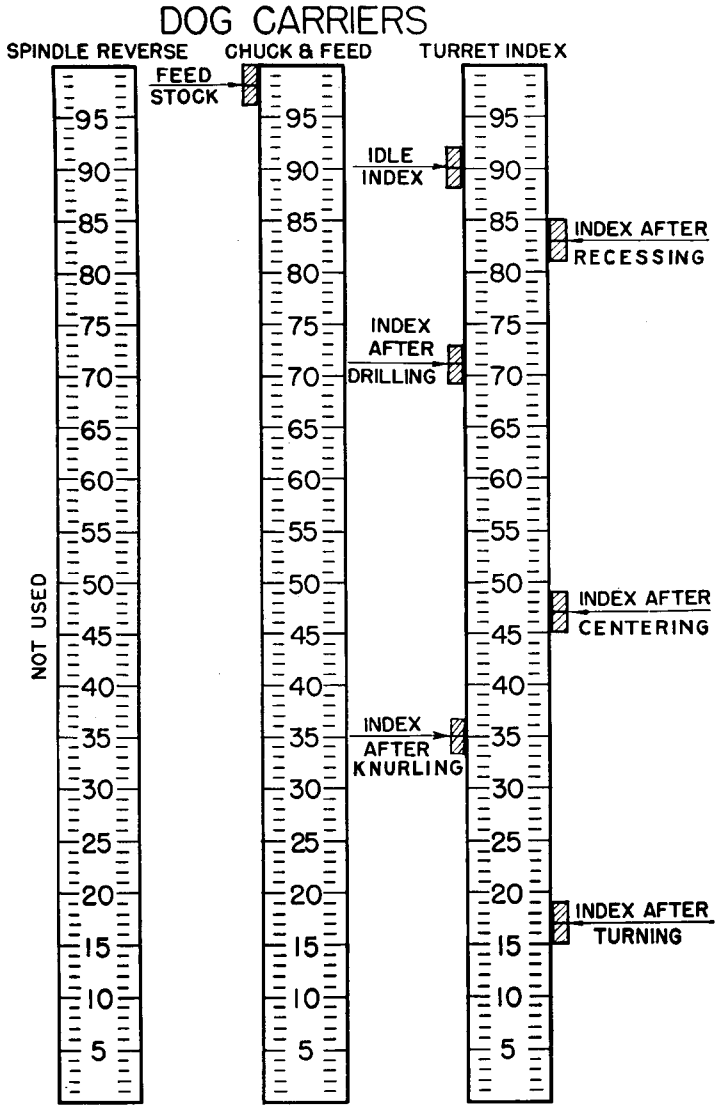

Fig. 3. Dog Settings for Job No. 9

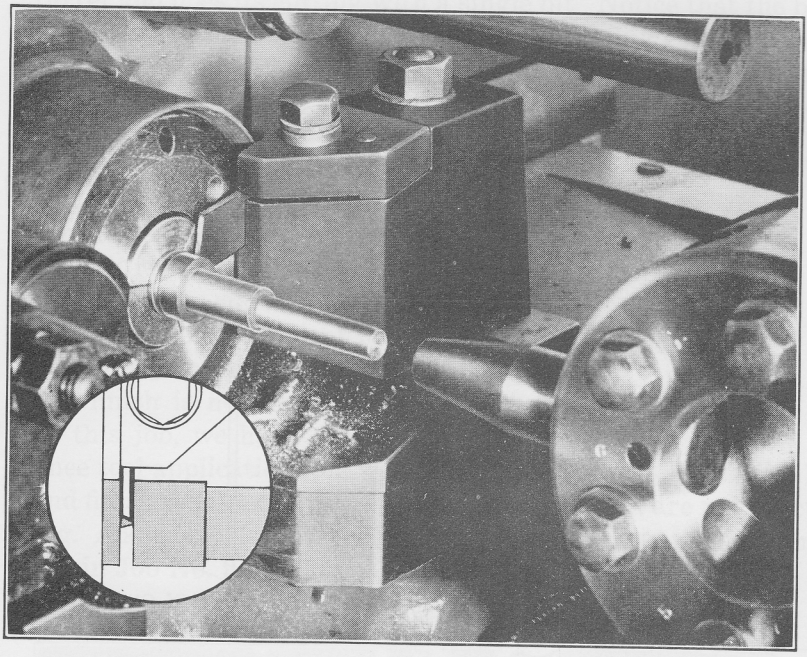

Fig. 4. Cutting-off Tool Post in use on back cross slide

or beveled edges and when clamped on these edges, is pressed securely against the flat side of the tool post.

In first sharpening the cutting-off blade, grind off the beveled edge for a distance of about 3/8" from the cutting point (see Fig. 5). This is necessary if no teat is to be left on either the work or stock after the cutting-off operation. Having removed this short section of bevel, grind the end of the blade by holding it against the flat side of a grinding wheel. Hold the blade enough off from perpendicular to give the 15° shear angle and the 20° back clearance angle. The shear angle is the same as employed on circular cutting-off tools and gives a tool point which cleans off the teat on the work just before the piece is severed from the bar. The clearance angle prevents rubbing between the work and the end of the tool.

Mount the blade in the cutting-off tool post and hold it lightly in position with the clamp. Place the tool post on the back cross slide and move the post along the cross slide T-slot until the blade is close to the spindle or so that it can cut off the stock just in front of the collet nose. Clamp the tool post tightly

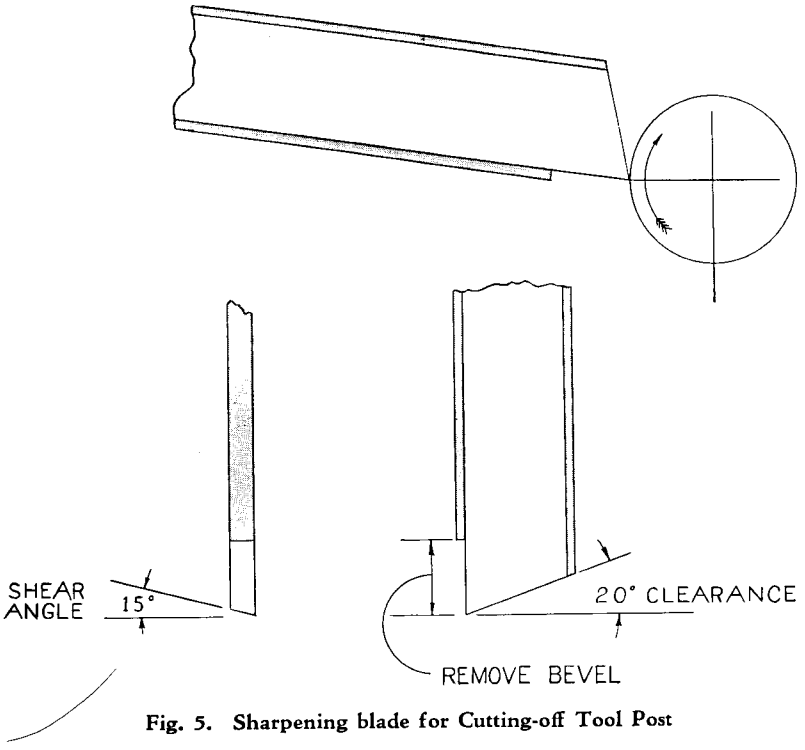

Fig. 5. Sharpening blade for Cutting-off Tool Post

in this position. Now tap the blade forward or back in the post until its cutting point is exactly on center with the work. Clamp the blade securely, start the spindle and bring the cross slide forward by hand to cut off the work piece. If a teat is left, the cutting edge is too high and if the blade tends to crush or push through a teat, the edge is too low. Make any readjustment which is indicated.

The cross slide will not be adjusted for depth of cut until later, for its inmost position must be judged in relation to the drilled hole.

Set the Swing Stop. The stop must be ¼" from the nearest edge of the cutting-off tool.

Adjust Turret Position. Turn the driving shaft handcrank until the turret lead cam lever is on top of the turning lobe or at position 17. Adjust the turret slide until the turret is 2¾" from the face of the chuck.

Select Knee Tool. A knee tool is shown alone in Fig. 6, and in cutting position in Fig. 7. It is a turning tool mounted in the

turret and does its cutting with a single bit. Notice that the bit is square with the work axis and that the cutting edge lies in a radial line from the work center. The tool does not provide any support for the work and cutting pressures are not balanced. For this reason knee tools are usually used on short work pieces where there is little overhang, and the work has enough rigidity to resist deflection under cutting forces. The knee tool is excellent for light roughing cuts where a fine finish is not demanded. In this job, we have a good knee tool application, the work is short, the cut is light ($\frac{1}{64}$"), and finish requirements preparatory to knurling, are not exacting. A knee tool is also well qualified in facing square shoulders but in Job No. 9, we do not make use of this ability.

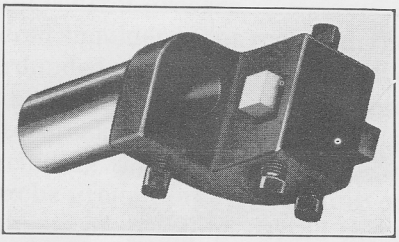

Fig. 6. Knee Tool

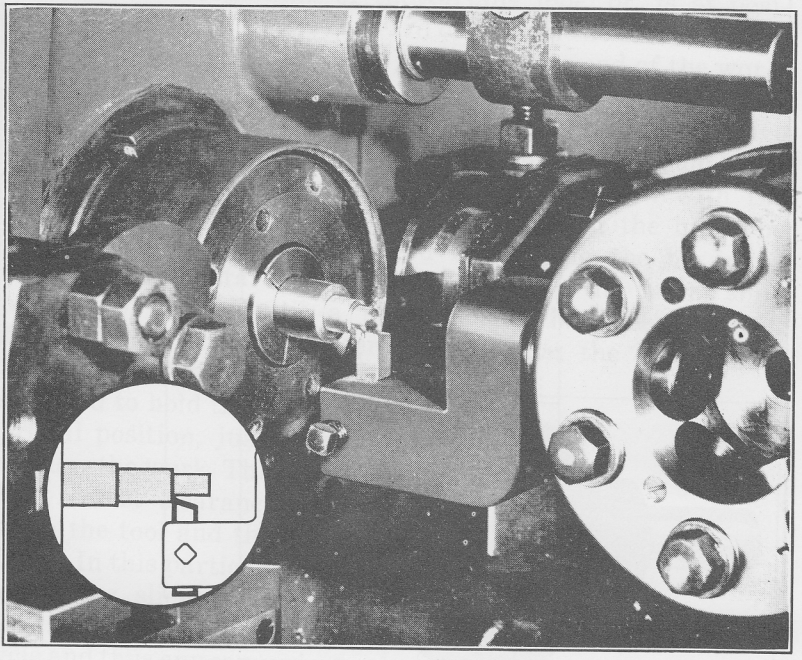

Fig. 7. Knee Tool turning work piece

Sharpen Bit of Knee Tool. The basic angles or surfaces required on a knee tool bit are shown in Fig. 8, which pictures a bit in cutting position against the work. Behind the radial cutting edge is the clearance surface ground at a 15° angle. Run-

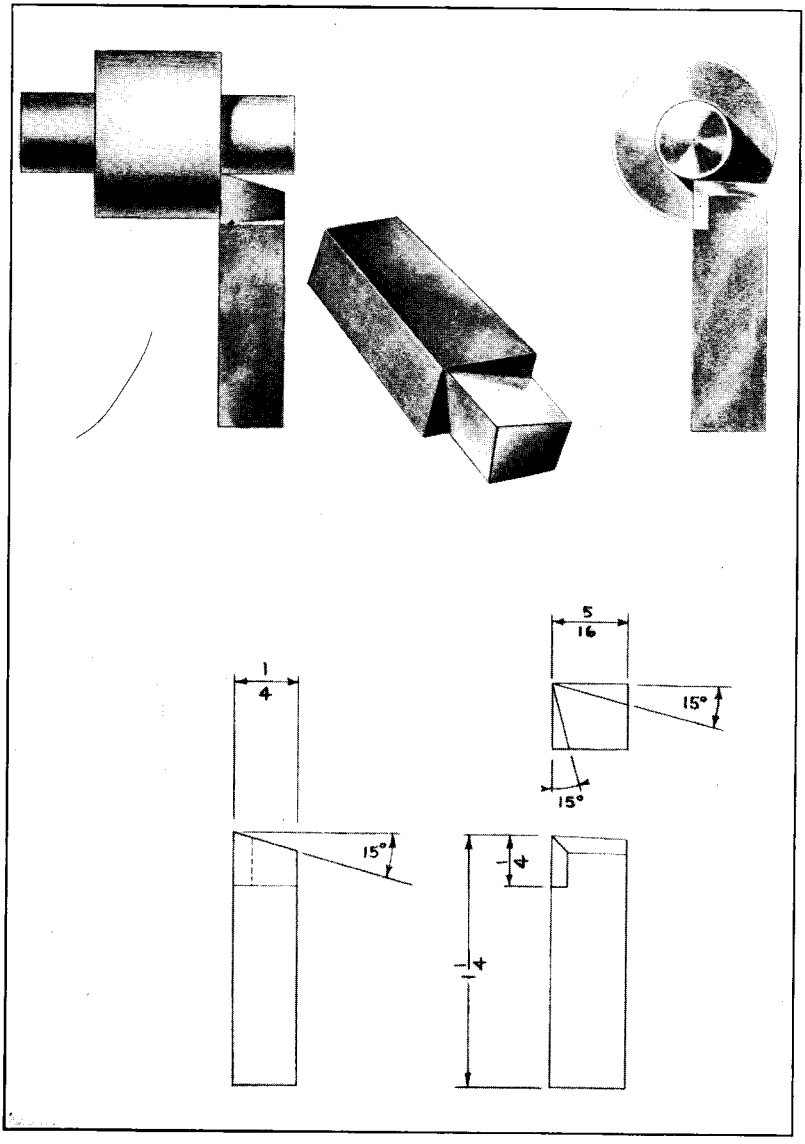

Fig. 8. Knee Tool Bit showing angular surfaces

ning away from the cutting edge is the 15° rake surface against which the chips press as they are turned off the stock. On the end of the bit is the 15° surface ground to give clearance between the tool and the turned body of the work. Knee tools taking light cuts do not use chip control grooves.

On work where a sharp-cornered shoulder is not required, the pointed tip of the tool may be rounded slightly. This will give the bit a longer life between grinds and will eliminate the acute point which is often the first to break down as the bit dulls.

The bit is resharpened by grinding the three 15° surfaces. All the surfaces may not have to be ground in resharpening or they may not require equal amounts of grinding. Grind those surfaces which will most readily restore a keen cutting edge. Use the flat side of a cylindrical wheel for grinding and get the clearance and rake angles by supporting the bit on an angle block when grinding its faces.

Mount and Adjust the Knee Tool. Place the bit in position in the tool and clamp it lightly. Then mount the tool in the turret and turn the driving shaft handcrank until the turret lead cam lever is at the beginning of the turning lobe, or, is at position 3. Now move the tool forward or back in the turret station until the cutting edge of the bit just clears the end of the work. Clamp the tool in the turret.

Adjust the bit in the knee tool. It should have its cutting edge in a radial line from the work, or, its cutting point should be on center. The "on center" position can be adjusted with the three clamp or set screws which press against the bit. The turned diameter may be changed by tapping the bit in or out in the tool. Start the spindle and bring the turret slide forward by hand until a short length has been turned. Measure the turned diameter and readjust the bit.

In most jobs the knee tool is located to hold the bit in a vertical position, just above or below the work. This gives the greatest clearances between the tool and the cross slides. In this particular job, both cross slides are withdrawn during this part of the cycle and thus any convenient position may be selected.

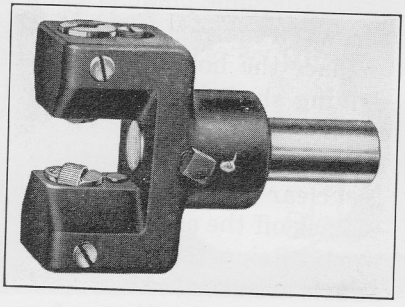

Fig. 9. Adjustable Knurl Holder

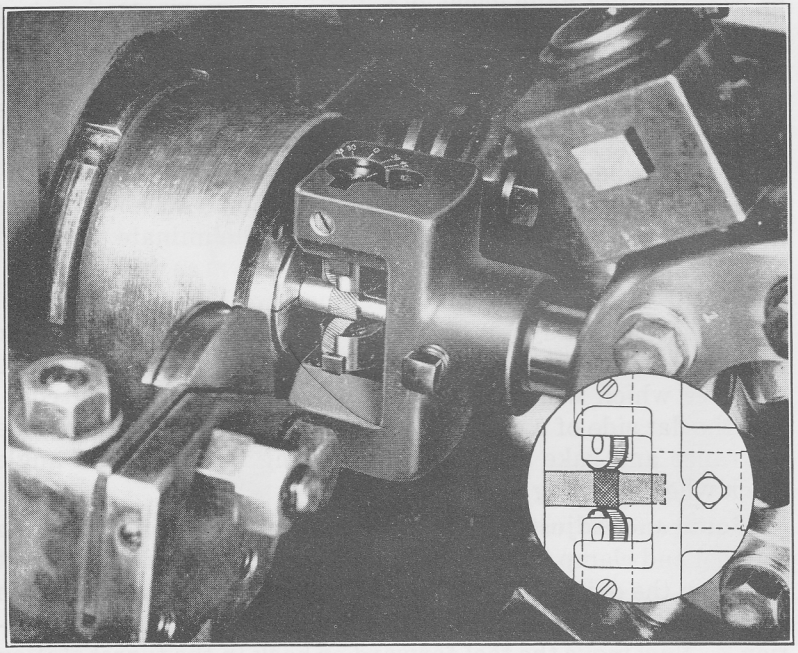

Fig. 10. Knurl Holder is adjustable to produce different types of knurling

Mount and Adjust Knurl Holder. The Adjustable Knurl Holder of Fig. 9 has two knurls, and is supported in a turret station as shown in Fig. 10. Select two knurls in good condition and check them to be sure they are the same diameter. Mount the knurls on pins in the swivels and assemble the swivels in the holder. The lines of the diamond knurl must make a 37½° angle with the axis of the work piece. Adjust the swivels to this angle using the graduation marks on the holder as a guide. Turn the knurls so that one is directly above the other or so that their axes are in the same plane. Clamp the swivels lightly with the clamp screws in the arms of the holder.

Place the holder in the second turret station and turn the driving shaft handcrank until the turret lead cam lever is at the beginning of the knurling lobe, or, is at position 21. Bring the knurl holder forward in its turret station until the knurls just clear the edge of the work; clamp the holder in this positon.

Back off the adjusting screws so that the knurls will clear the work. Bring the turret slide forward by hand and while the knurls are over the work, turn the adjusting screws in until the knurls just touch the surface of the work. Let the turret slide

go back and then give each adjusting screw an additional 1/10 turn (approximate) and clamp the swivels with the clamp screws.

Start the machine and cut off the work piece after it has been knurled. Examine the knurled surface and make the adjustments necessary to get proper depth of cut and equal action by the two knurls.

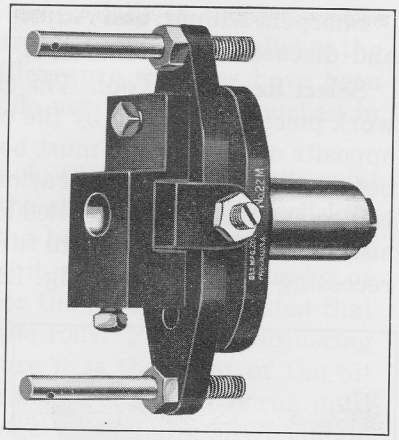

Fig. 11. Recessing Tool

Sharpen, Mount, and Adjust Center Drill. The directions given in Job No. 6, apply equally well here.

The center drill will be adjusted to feed in enough to leave the 1/64" chamfer.

Sharpen, Mount, and Adjust Circular Form Tool.

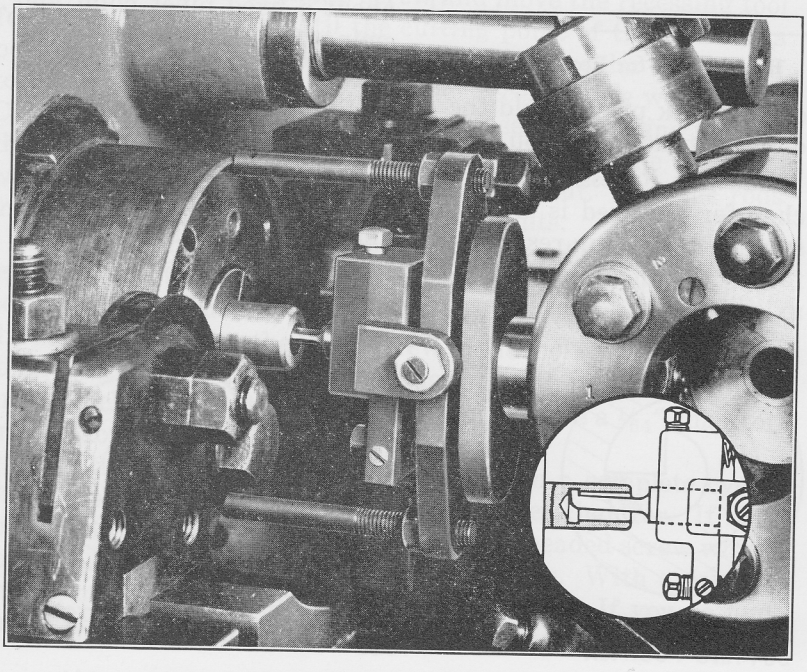

Fig. 12. Recessing Tool cutting internal chamfer

Sharpen, Mount, and Adjust the Drill. Review the directions and discussion of Job No. 6.

Select Recessing Tool. The chamfer on the turret end of the work piece is produced by the center drill. The chamfer on the opposite or spindle end must be machined with a recessing tool before the cutting-off operation. The bit of the recessing tool is inserted through the drilled hole and at the desired position is advanced to the hole wall to turn the groove. Fig. 11 shows the recessing tool alone and Fig. 12 shows it mounted in the turret.

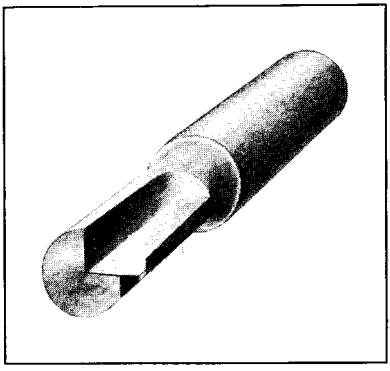

Fig. 13. Bit for Recessing Tool

The bit mounted axially in the tool enters the hole in the work piece without touching any part of the work. When the cutting point reaches the desired location in the hole, the projecting arms or adjusting rods of the tool press against the spindle front box. Any further turret slide movement rotates the bit and clamp block about a fixed pivot point and swings the bit into cutting contact with the internal surface of the work piece. Hold the Recessing Tool in your hand and observe its action as you press on and release the adjusting rods.

Sharpen Recessing Tool Bit. The recessing bit for the 45° chamfer required is shown in Fig. 13. There is a single flat surface to grind in resharpening the bit. This is the radial surface which includes the 45° cutting edge and runs back to the axis of the bit. The surface can be ground against the flat side

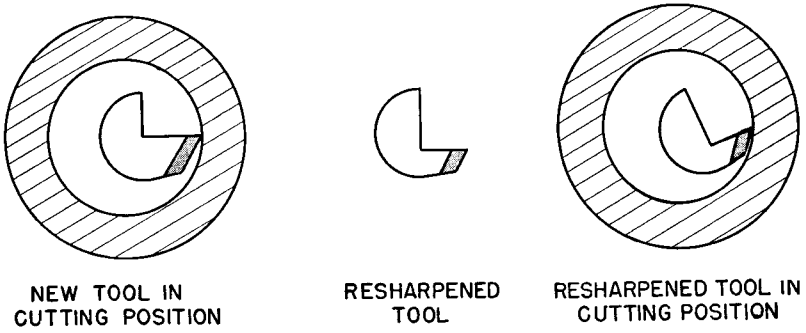

Fig. 14. Method of sharpening and mounting recessing tool bit

of a grinding wheel. Although the surface to be ground is radial in a new tool, it is not ground radially in succeeding resharpenings for each reground surface should be parallel to the original surface. See Fig. 14. Clearance surfaces have been machined in the original bit and do not have to be touched in resharpening.

Mount and Adjust Recessing Tool. Clamp the bit in the axial hole provided in the tool. Push the shank of the bit well into the hole, for the less overhang the better will be the cutting rigidity. The cutting point of the bit must be directly under or above one of the adjusting rods for the pivot is so located that the bit will swing toward one of the rods. Press the adjusting rods with your hands to make sure it is the point of the bit which swings outward. Start the machine and let it run until a piece has been drilled. Disengage the driving shaft clutch, bring the cutting-off tool forward by hand, and cut off the partly completed piece. Stop the spindle. Now mount the Recessing Tool in the fifth turret station, locating the arms at the top and bottom positions to clear the cross slides. See Fig. 12. Turn the driving shaft handcrank until the turret lead cam lever is at the beginning of the recessing lobe or is at position 75. Now loosen the turret clamp screw and move the recessing tool forward in its station until the cutting point of the bit is in a position about in line with the blade of the circular cutting-off tool and where it could turn the inner recess in the work piece. Clamp the tool tightly in the turret. Loosen the locking nuts on the adjusting rods and with a pin, turn or screw the rods forward until they touch the spindle front box nut. Lock the rods in this position by turning up the check nuts.

Turn the driving shaft handcrank further, bringing the cam lever to the top of the rise, or, to position 83. The bit will have been rotated to cutting position by this movement. To adjust the depth of cut, turn the small screw in the tool which is parallel to and just above the tool bit. Judging by the center hole left in the stock, try to get the bit in position to leave a $\frac{1}{64}$" chamfer on the work.

Start the machine and let it run through a complete cycle. Cut off the work piece and examine the inner chamfer. If it is too shallow or too deep, readjust the square headed screw which controls the position to which the bit swings. With a careful set-up, no other adjustments will be necessary. If you do find the point of the bit entering too far into the hole or falling short

of its proper position, repeat the initial adjustments of the tool in the turret station and of the rods in the tool.

Adjust Cutting-Off Tool for Depth. The blade does not have to come in to center, but only enough to pass the edge of the drilled hole. A cross slide stop screw will not be necessary for exact depth is unimportant.

Complete and Test the Set-up. Make the final adjustments of work deflector, etc., and have the first sample piece carefully checked.