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

# No. 9

Of a Series of Booklets
for Training Operators

Rough and Finish Turning,
Pointing, Forming, Knurling
and Cutting Off

**Brown & Sharpe Mfg. Co.**
North Kingstown, R. I., U. S. A.

1968

PRINTED IN U.S.A. 1M-12-68

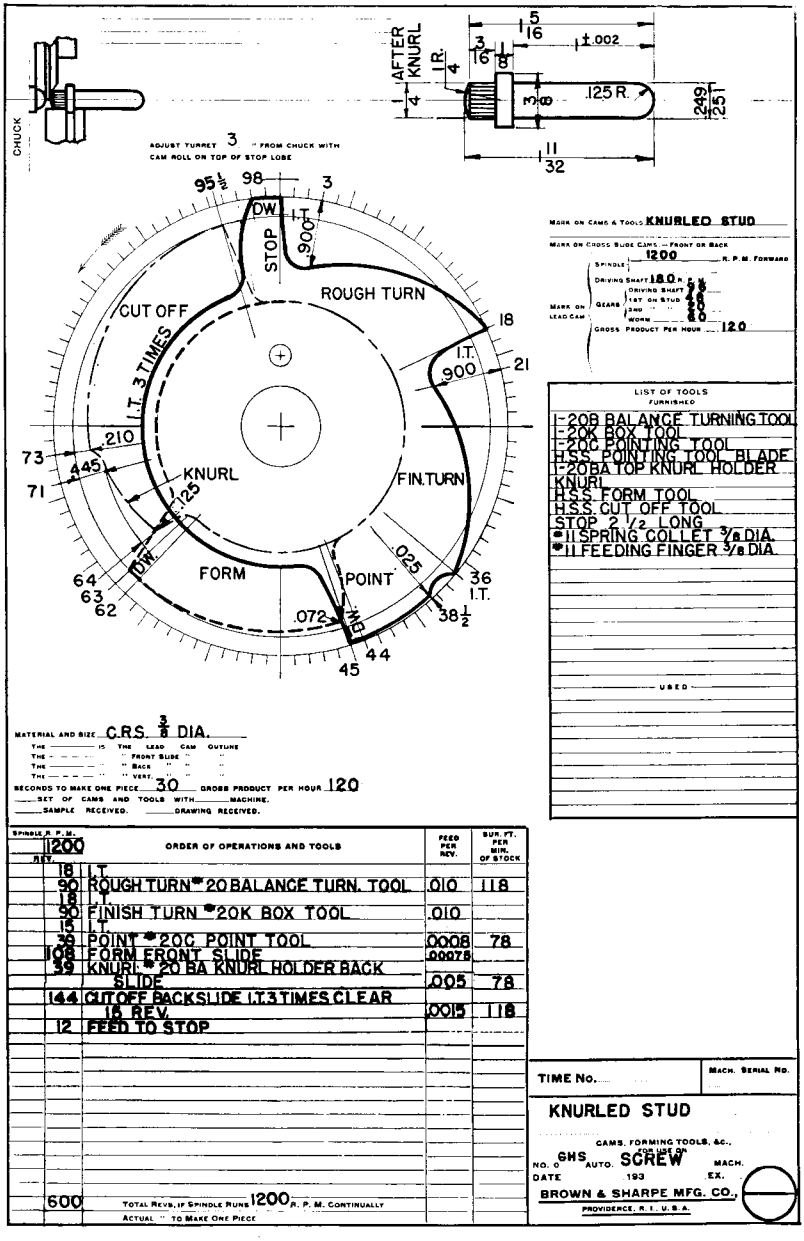


Fig. 1. Work Sheet for Job No. 8

# NO. 9 OF A SERIES OF BOOKLETS FOR TRAINING OPERATORS

## JOB NO. 8

### Rough and Finish Turning, Pointing, Forming, Knurling and Cutting Off

All of the jobs studied thus far have been on the small No. 00 Size Machine. We are now going to produce some pieces on the larger machines. Job No. 8 described on the work sheet of Fig. 1 is done on a No. 0 Machine.

The work sheet is the same as those already used except that the three cam drawings instead of being separate sketches are superimposed on each other. The full line drawing is the turret cam with lobes for a turret stock stop, rough turning, finish turning and pointing. The drawing made with short dashes is the front cross slide cam and has a single lobe for forming. The cam outlined by the alternate short and long dashes is the back cross slide cam and has a long lobe with one lead for knurling and another for cutting off.

One new operation, that of knurling, is required on this work piece. All other operations are the same or similar to those described in 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 speeds.
Disengage coupling driving spindle reverse trip dog carrier.
Put on cross slide and turret lead cams.

**Set All Trip Dogs.** Fig. 2 shows the approximate trip dog settings. You have had enough experience by now so that by studying the work sheet you can see why each dog has been set in the position shown. Time required for turret index is ⅓ second on a No. 0 Machine. On a 30 second job, ⅓ second represents a little more than one hundredth of cam surface. As long as the idle index dogs are two hundredths apart, indexing will be satisfactory. Actually, there is ample time during knurling and cutting off, so the idle index dogs have been set ten hundredths apart.

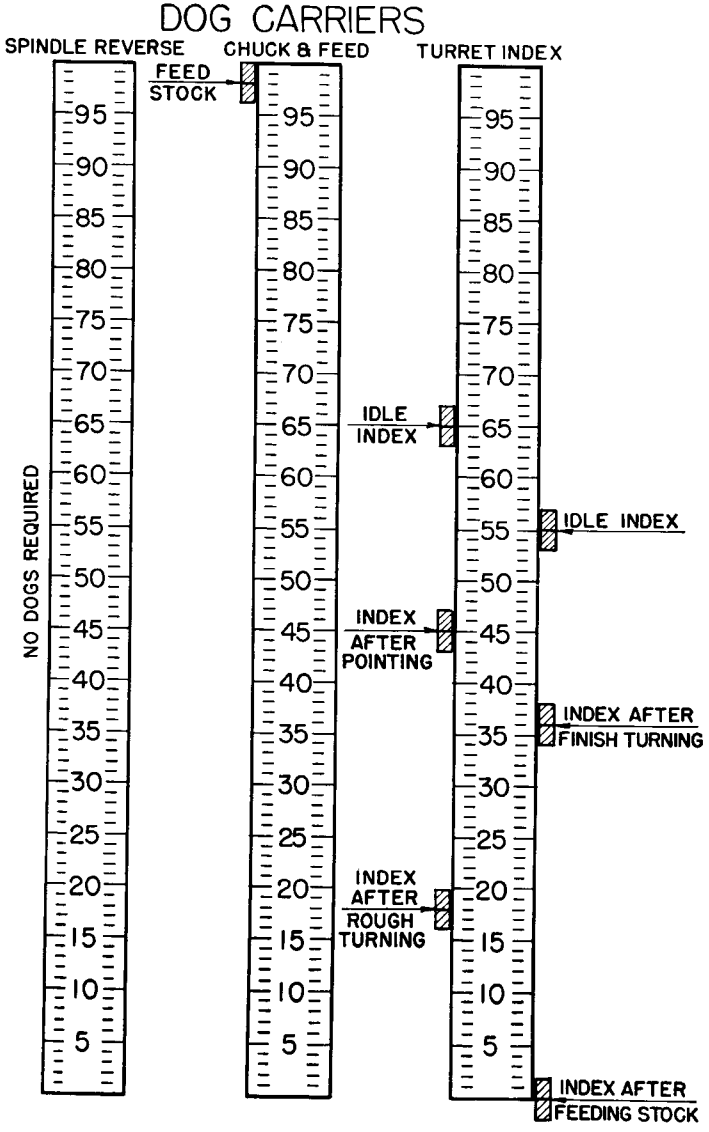


Fig. 2. Dog Settings for Job No. 8

**Sharpen, Mount and Adjust the Cutting-Off Tool.** Again, the circular cutting-off tool has a forming function, and thus will be ground without rake or hook. Maintain closely the $\frac{5}{32}$" drop figure which has been established for No. 0 form tools.

This cutting-off tool is different from those already discussed in that it has a cylindrical band or shoulder on its outer side on which the top knurl holder is mounted. This shoulder serves as a pivot stud or locating shaft for the holder. Fig. 3 shows a top knurl holder by itself, and Fig. 4 when mounted in working position. Notice that there is an adjusting screw in the knurl holder which presses against the top surface of the cross slide tool post. As this adjusting screw is tightened, the knurl is forced down toward the work.

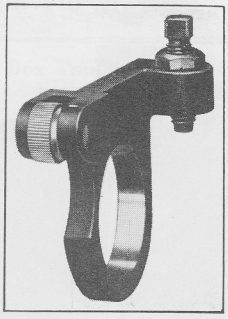

Fig. 3.
Top Knurl Holder

Place the knurl holder on the cutting-off tool and mount the tool in the back cross slide tool post. Now back off the knurl holder adjusting screw and swing the holder

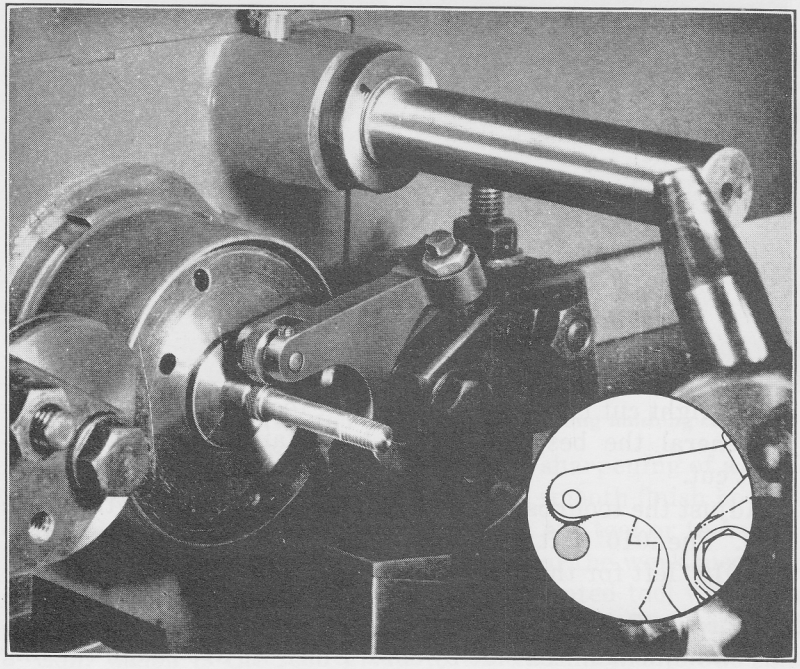

Fig. 4. Top Knurl Holder in place on cutting-off tool

up so that the knurl will not touch the work. Proceed to adjust the circular cutting-off tool just as you have in preceding jobs.

**Set Turret Stock Stop.** At the top of the work sheet you will see the direction to "adjust the turret 3″ from the chuck when the cam roll is on top of the stop lobe". On these larger machines, this figure is given to help the operator in obtaining a setting which will permit all tools to clear the bed walls as they are indexed through the six positions.

Turn the driving shaft handcrank until the turret lead cam lever roll is on top of the stop lobe, position 99. Loosen the check nut shown in Fig. 5 and turn the adjusting screw in or out until the distance from the face of the chuck to the nearest point on the cylindrical surface of the turret is 3 inches. Lock the screw with the check nut.

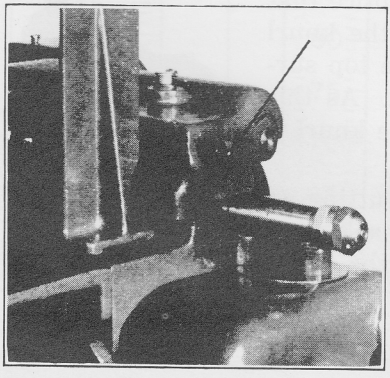

Fig. 5. Turret adjusting screw

Set the turret stock stop $1\frac{11}{32}$″ from the blade of the cutting-off tool.

**Sharpen, Mount and Adjust the Balance Turning Tool.** The bits for this tool will be sharpened with the same angles and style of chip control groove as were the bits used in the balance turning tool of Job No. 5. The diameter produced by the tool should be .255″ to .260″, or just large enough so that the box tool will have stock to clean out when finishing.

Although the balance tool is making a roughing cut, it should be remembered that the better the finish produced by the roughing tool the finer the finish which can be obtained with the finishing tool. If the roughing tool leaves a good finish, then only a very light cut is required of the box tool when finishing, and in general the best finish can be obtained when taking a light cut.

Adjust the tool position in the turret to turn a length of one inch. The .010″ left for finishing the shoulder is balanced by the .010″ left for the knee tool, thus the even 1″ turning figure.

**Sharpen Box Tool Bit.** This box tool, shown in Fig. 6, has two bits mounted side by side. Since we are rough turning

but one diameter, we will use only the outer bit and the inner one will be withdrawn enough to clear the stock. In place of the two roller rests which supported the stock in the box tool of Job No. 2, this box tool has a V-block back rest.

When taking a light cut, a chip control groove is not necessary. A chip .003″ thick and .010″ wide is too fine to require

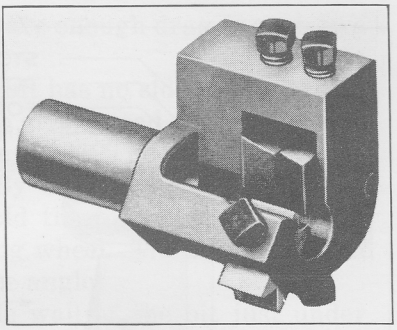

Fig. 6. Box Tool with V-block back rest

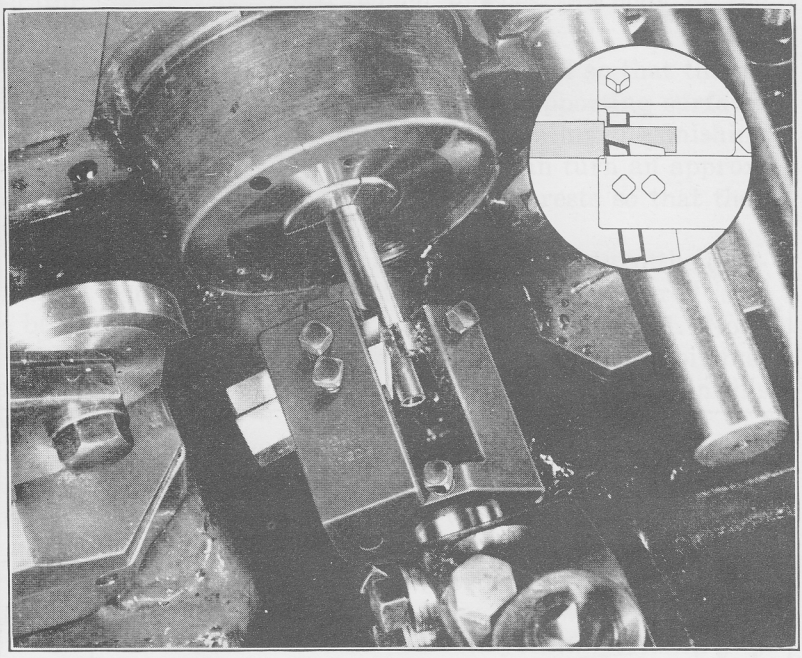

Fig. 7. Box Tool with V-Block back rest taking finishing cut

special coiling or breaking, and thus the sharpening of a bit for finish turning is simplified. To obtain a smooth finish however, it is desirable to have a little "drag" on the tool or to have following edge of the bit touch the body of the work piece for a distance of about 1/16″. See Fig. 8. A pointed tool will always leave a spiral on the work, showing the lead of .010″ per revolution, which is the feed given to the tool. To eliminate these

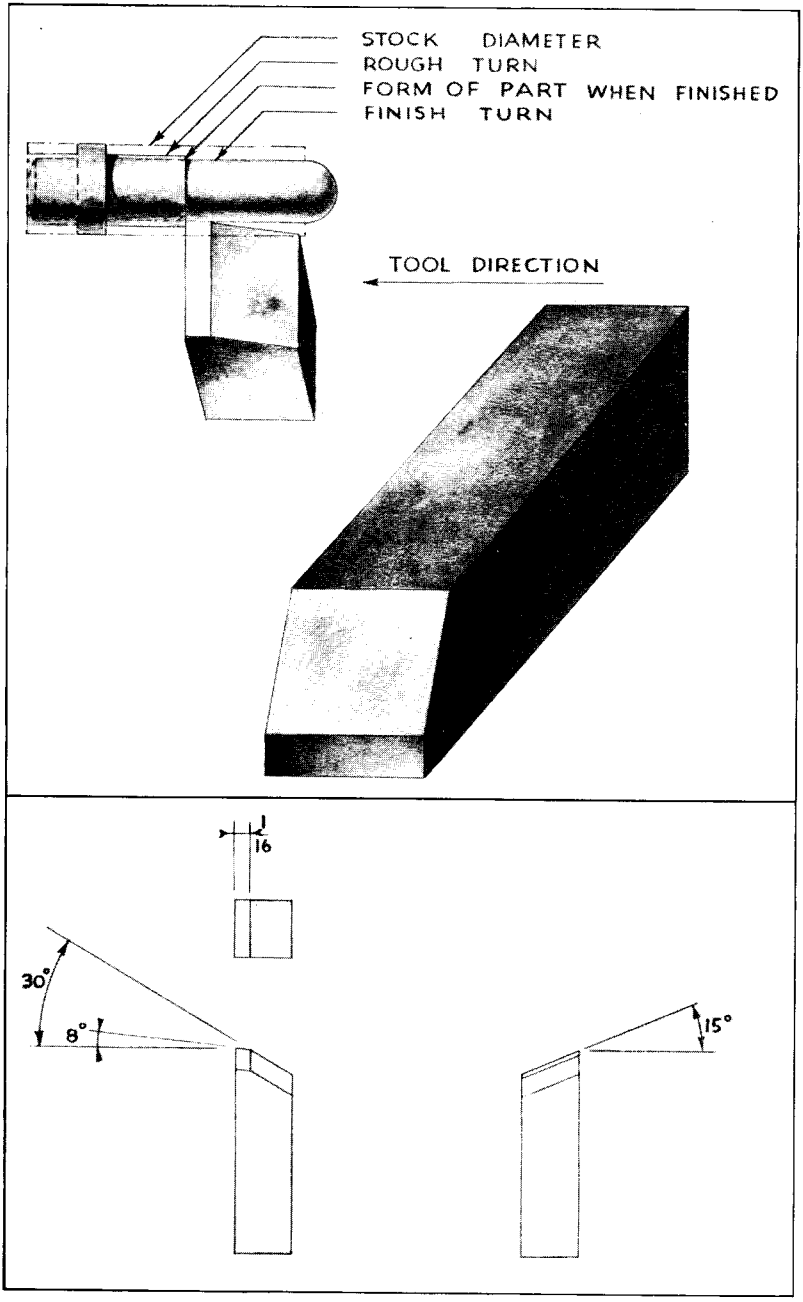


Fig. 8. Box Tool Bit showing back rake

ridges and hollows, the tool must have enough drag to span two or more ridges.

Since with a dragging edge the bit has no side rake or hook, a liberal (15°) back rake is used to give a good shearing action and to pull the chip away from the work. The bit is sharpened by grinding two flat surfaces. By studying Fig. 8 you can obtain the angles at which to hold the bit when pressing it against the flat side of the grinding wheel. The tool itself will hold the bit at the proper clearance angle.

To get the finest finish, the side wall of the bit just under the dragging edge should be smooth. If the natural finish of the bit is rough, then grind this side. Often you will see a good operator stone this surface, which touches the body of the work piece.

**Mount and Adjust Box Tool.** Clean the tool so that the bit and V-back rests can seat squarely on the supporting surfaces of the tool. Assemble the bit in position, locating the finishing lip about 1/8" from the tool axis, where it can turn an approximate 1/4" diameter. Withdraw the V-back rests so that they will clear the stock.

Mount the tool in the third turret station and turn the driving shaft handcrank until the turret lead cam lever roll is at the beginning of the finish turning lobe, at position 21. Now, bring the tool forward in its station until the cutting bit just clears the end of the work piece. Clamp the tool shank in this position.

Adjust the bit to be "on center" by loosening one clamp screw and tapping the bit in or out. Start the spindle and bring the turret slide forward with the hand lever. Stop the spindle and measure the diameter which has been turned. Readjust the bit by loosening one clamp screw and tightening the other until the exact .249"-.251" limit on diameter is met. Now, press the supporting blocks or back rests forward with your finger until they touch the turned surface of the work. Press lightly, for the work must not be deflected, and we do not want a large rubbing friction between the work and support. Clamp the V-blocks firmly.

You will remember that with the roller box tool, the rolls were set to an undersize work diameter so that they would press hard on a standard diameter and thus cold work or burnish the finished surface of the work. This cannot be done with a V-block back rest for the pressures would soon cause the rub-

bing metals to seize and the work would be scored. V-blocks must be adjusted or set on standard diameters and must rub very lightly on the stock. In general, box tools with V-supports are used for light finishing cuts and roller rest tools are specified where heavy cuts are taken.

Start the spindle and turn the driving shaft handcrank until the cam lever is at the top of the finishing lobe, position 36. In this position, the box tool bit should clear the shoulder left by the balance turning tool by about $\frac{1}{64}$" to $\frac{1}{32}$". If the box tool bit reaches this position before you get to point 36 on the cam, stop the machine, loosen the turret clamp bolt and move the tool back a small amount.

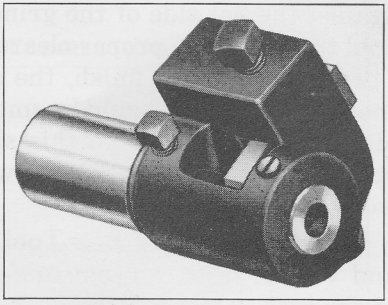

Fig. 9. Pointing Tool

**Sharpen, Mount and Adjust the Form Tool.** The tool post

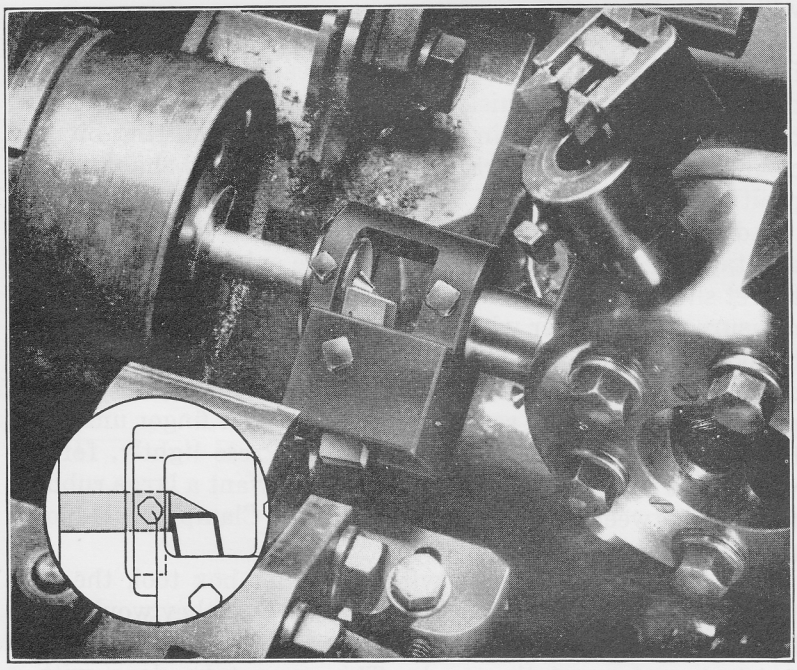

Fig. 10. Pointing Tool forming end of work piece

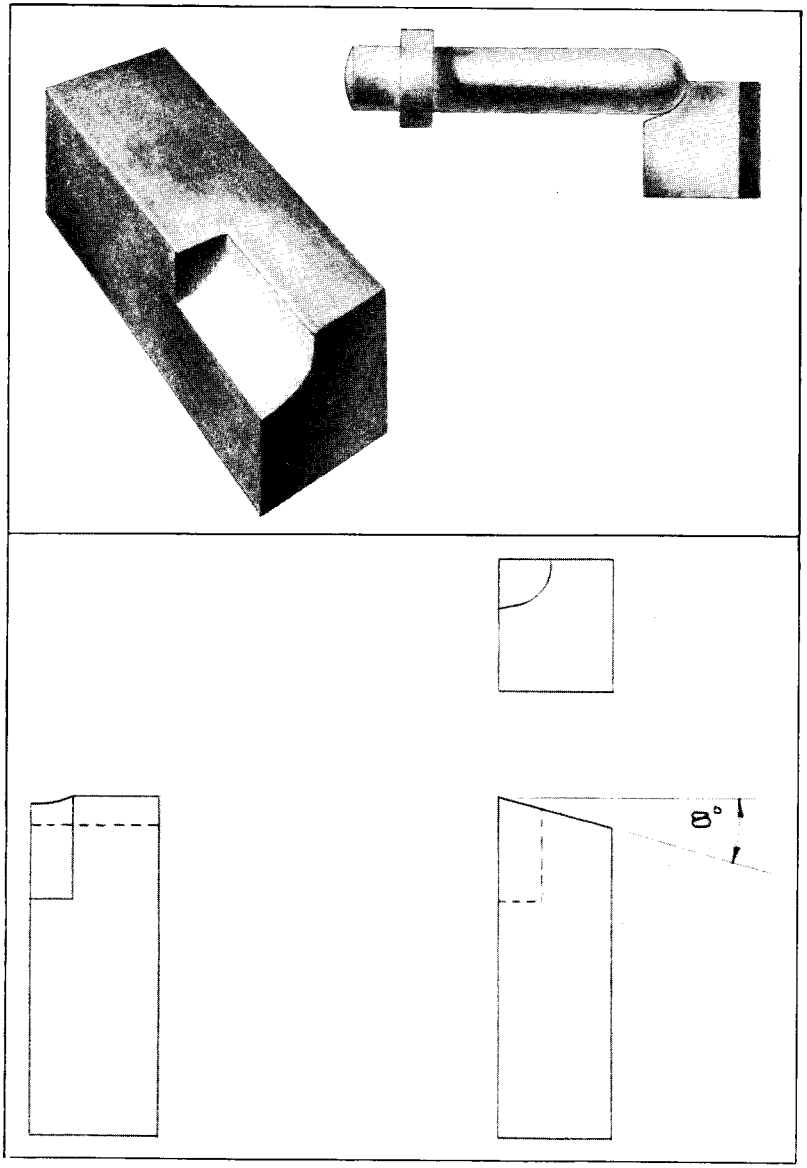


Fig. 11. Pointing Tool Bit formed on its cutting end

mounted on a raising block must be so located in the front cross slide T-slot that it will face off the shoulder left by the balance turning tool, removing the .005″ to .010″ of stock left for this purpose. The cross slide should be adjusted to a depth which will permit the .250″ diameter produced by the form tool to blend in with the diameter already finished with the box tool. Use the cross slide stop screw to give accurate control of this ¼″ diameter.

**Sharpen the Pointing Tool Bit.** Except for its function, the pointing tool of Fig. 9 is entirely different from the circular pointing tool described in Job No. 3. This new tool has a square blade or bit formed on its cutting end to give the desired shape to the work piece. Fig. 11 shows the bit which will produce the spherical end required on this knurled stud.

Sharpening the tool bit is comparatively simple, for but a single flat surface must be ground. The end of the bit can be held against the flat side of a grinding wheel in such a position that one side rests on the horizontal supporting plate, and the adjacent side is 8° from being perpendicular to the wheel. In position in the tool, the bit will be held at an 8° angle, thus bringing this ground surface in line with the work axis and giving an 8° clearance under the cutting edge.

**Mount and Adjust the Pointing Tool.** In the nose of the pointing tool is a bushing which slips over the finished surface of the stock and supports the work while the pointing tool is cutting. Select or make a bushing having a .252″ hole, or a hole .001″ larger than the maximum finished diameter of the work. Be sure the hole is concentric and parallel with the outside surface of the bushing. Insert the bushing in the tool, lining up the flat with the set screw and clamp it in position by tightening the set screw.

Mount the bit in position and set it approximately by eye or by judging its position relative to one of the trial work pieces, which can be inserted in the bushing. The bit adjustments are the same as those provided on a box tool. The bit is tapped in or out for "on center" position and is adjusted for depth of cut by the opposed clamp screws.

Place the tool in the fourth turret station. Turn the driving shaft handcrank until the turret lead cam lever roll is at position 38. Now, bring the tool forward in its station until the bushing is on the work piece and the bit is just clearing the end

of the work. Clamp the tool shank and then bring the turret slide forward by hand. Having formed the end of the stud, examine it and then make the necessary bit adjustments to get the proper depth setting or to have the rounded end blend in with the body of the stud. If the bit is not cutting to proper depth, a small circular teat will be left on the tip of the stud.

Having secured the desired form on the spherical end, start the machine and let it run until the work piece is cut off and a new piece is ready for pointing. Measure the shoulder to tip length. You will notice that we are held to a close limit for this 1″ dimension. Loosen the turret clamp slightly to tap the pointing tool forward or back until you are able to produce a length within the limit.

**Adjust the Knurl.** Put a knurl in the holder. Use a new knurl or carefully inspect the knurls available from the tool crib and select one which has sharp teeth or serrations. If the top edges of the teeth are crushed, rounded over, or worn blunt, it will be difficult to obtain acceptable work. Place the knurl in position, insert the supporting pin and lock the pin in place with the set screw in the holder.

A correct form tool when adjusted to proper depth for the .249″-.251″ diameter will leave the diameter for knurling .008″ to .010″ small. The knurl will roll the metal, causing it to flow and to increase the diameter to the ¼″ desired.

Bring the back slide forward by hand until the knurl is directly over the work. Turn the adjusting screw, swinging the holder down until the knurl just touches the work. Let the slide go back and then turn the adjusting screw an additional $\frac{1}{10}$ turn and lock the screw with the check nut. Start the machine and let a piece be completed. Examine the knurl produced and make final adjustments of the knurl holder position to increase or decrease the depth of knurl and the final knurled diameter.

**Complete the Set-Up.** Make the routine adjustments for work deflector coolant, etc., and check clearances. Produce a few trial pieces and have them inspected.