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

No. 4

Of a Series of Booklets
for Training Operators

Turning, Threading, Pointing
Forming and Cutting Off

Brown & Sharpe Mfg. Co.
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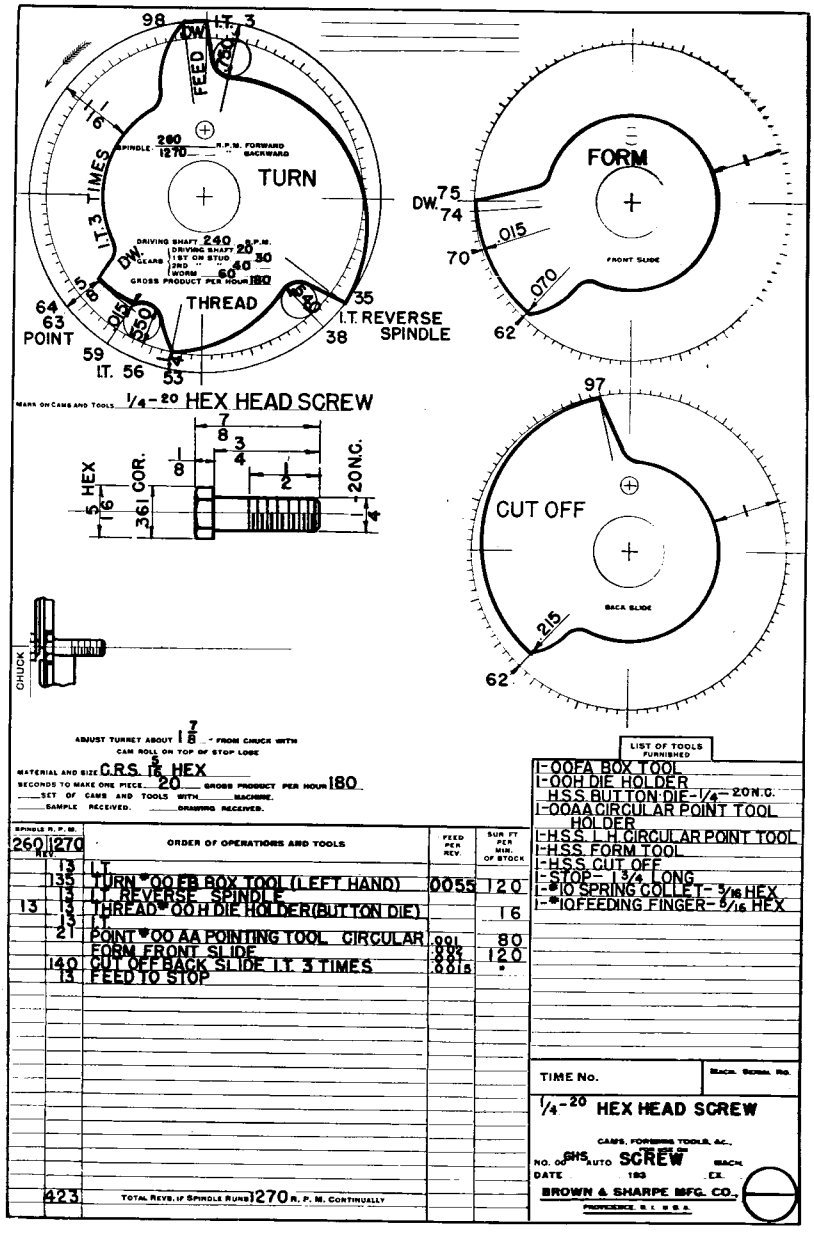

Fig. 1. Work Sheet for Job No. 3

NO. 4 OF A SERIES OF BOOKLETS FOR TRAINING OPERATORS

JOB NO. 3

Turning, Threading, Pointing, Forming and Cutting Off

On this third job we have the new operation of threading, an operation which is so common in screw machine work that it has given the machine its name. The work sheet, Fig. 1, shows a simple screw to be cut from a steel bar in 20 seconds. For the first time in these booklets it becomes necessary to index the turret, for there are four turret tools to be used. You will also note that we are for the first time using a forward and backward spindle speed, and that a turret stop is used in place of the swing stop.

Any step in the following not accompanied by detailed instructions, is a move which has been fully described in Jobs Nos. 1 or 2. Refer back to these jobs if you wish to reassure yourself on any point.

Strip the Machine.

Remove Tools
Remove Cross Slide Cams
Remove Turret Slide Cam
Set Chuck Trip Lever Dog on its side
Set Turret Trip Lever Dog on its side
Set Spindle Reverse Trip Lever Dog on its side
Back Off Cross Slide Stop Screws

Insert Proper Feed Finger. ($\frac{5}{16}$" hexagonal.) As you put the feed tube in the spindle, observe the position of the flat sides of the feed finger, which will bear against the flats on the hex stock.

Insert Bar of Stock. ($\frac{5}{16}$" hexagonal cold rolled steel.) Turn the bar until its flats are in approximately the same position as those on the feed finger, then hurl the tube and bar forward and insert the bar just as described for round stock. The stock should be left protruding about $\frac{1}{4}$" beyond the spindle nose.

Insert Proper Collet. ($\frac{5}{16}$" hexagonal.) The stock is already in position. Slip the collet over the stock and there will be no chance of having the collet and stock flats out of line. All other assembly and adjustment moves are the same as described in Job No. 1. When restocking a machine, glance at the collet to

determine the position of the flats and then hold the stock in a similar position as you force it into the feed finger and through the collet.

Adjust the Length of Feed. Setting is 1⅛" for a ⅞" screw.

Adjust Chuck Pressure.

Set Spindle Speed.

(a) Set motor reverse switch in to run high speed sprocket backwards.

(b) The ratio of speeds is 5 to 1 (1270 to 260 R.P.M.) which requires 53-42 change gears.

(c) Place lower (42) change gear on forward center.

(d) Mount speed change gears (39-56).

(e) Use crossed belt for driving shaft drive.

(f) Start spindle and engage driving shaft clutch. Trip the spindle reverse trip lever by hand once or twice until friction clutch is engaged on the high speed side.

Mount Feed Change Gears. (20/30-40/60) These are compound gears. The 30 and 40 tooth gears are mounted side by side on the adjustable stud. Get the 30 tooth gear in proper mesh with the 20 tooth driving shaft gear and clamp the stud. Then rotate the arm until the 40 tooth gear is in mesh with the 60 tooth worm gear and clamp the arm.

Sharpen Circular Cutting-Off Tool.

Mount Cutting-Off Tool. Use raising block. Get tool close to chuck, on center and square with the work.

Mount Turret Lead Cam. Check to be sure the cam is not put on backwards and that the driving pin is seated in the hole in the cam. Clamp collars and cam tightly with the shaft nut.

Adjust Turret Stock Stop. For this job the swing stop is left idle and a stop in the turret is provided. See Fig. 2.

(a) Loosen clamp and remove swing stop from its shaft.

(b) Turn driving shaft handwheel until turret cam lever roll is on top of stop lobe of lead cam (about position 98 on work sheet).

(c) Clamp (lightly) a stock stop in the turret station directly in front of the stock. Tap the stop forward until its working face is ⅞" from the nearest cutting edge of the cutting-off tool. Clamp tightly.

Cut Off Piece.

(a) Start the spindle. The driving shaft clutch is disengaged and the cam lever roll should still be at the peak of the stop lobe (position 98).

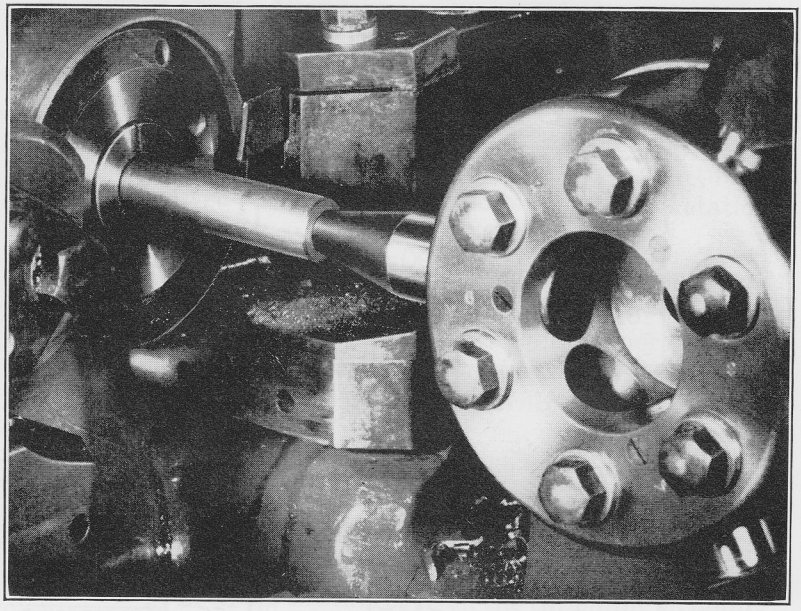

Fig. 2. Turret Stock Stop

(b) Bring the cutting-off tool forward by hand and cut off the work piece or clean off the end of the bar.

(c) Trip by hand the chuck trip lever. Turn down to working position the trip lever dog and slide the carrier trip dog around in its groove until it lifts the chuck trip lever and is on the verge of sliding by the tip of the trip lever dog. Clamp it in this position. Remove or make inactive all other chuck carrier trip dogs.

(d) Engage the driving shaft clutch. When the stock has been fed forward and the turret stock stop withdrawn, disengage the clutch, cut off the piece and measure it for length.

(e) Make readjustments if necessary.

Put on Both Cross Slide Cams.

Adjust Cross Slide for Depth of Cut. The stop screw may be left in its backed off position, for no diameter controlled by the cutting-off tool is held to close limits.

Set Six Trip Dogs for Turret Indexing. (Fig. 3).

(a) Turn the driving shaft handwheel until the turret lead cam lever roll has just started to move down the drop on the stop lobe of the cam, about position 1 on the

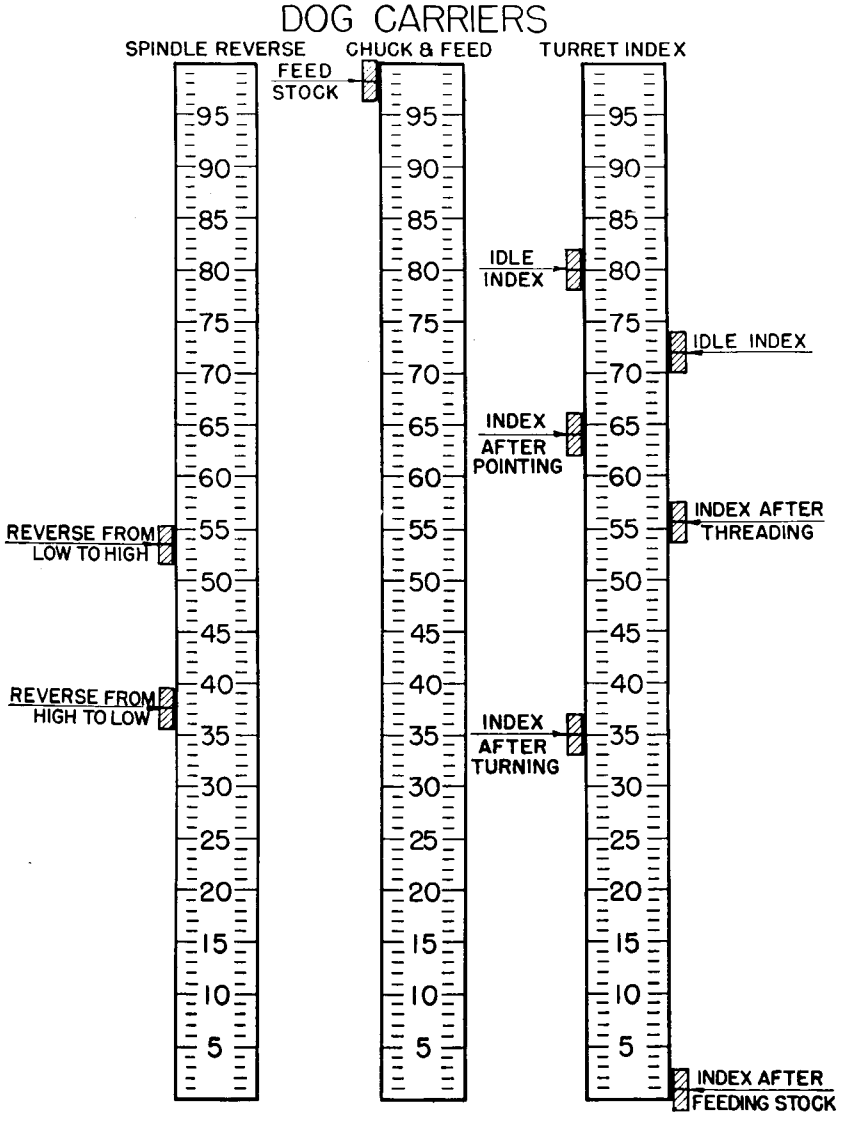

Fig. 3. Dog Settings for Job No. 3

work sheet. Now trip the turret trip lever by hand and snap the lever trip dog down into working position. Slide a carrier trip dog around in the T-slot until it has lifted the trip lever to its top position and is just about to slide by the tip of the lever trip dog. Clamp the carrier dog securely. This index moves the turret stop out of position and brings the turning tool station into position.

(b) Turn the handwheel further. When the cam lever roll is at the peak of the turning lobe or a fraction beyond it, trip the trip lever and set a second carrier trip dog (approximately position 35 on the work sheet). This indexes the turret from the turning station to the threading station.

(c) Continue turning the handwheel and bring the cam lever roll to the bottom of the threading lobe drop (between positions 55 and 56 on the work sheet). Trip the trip lever and set the third carrier trip dog. This dog shifts the turret from the threading to pointing station.

(d) Bring the cam lever to the peak of the pointing lobe, position 64. Set the fourth trip dog to act in this position.

(e) We have now taken care of four turret indexings. There are two more to be made before the turret gets back to its original position. Thus between positions 64 and 90 we must set two carrier trip dogs so that the turret stock stop will be directly in front of the stock when the turret slide is advanced by the stop lobe of the lead cam. On this machine a complete index of the turret requires ¼ second. Since the turret lead cam makes one turn in 20 seconds, ¼ second would represent $\frac{1}{80}$ of a cam turn or less than two hundredths of cam surface. The dogs may thus be set as close together as desired so long as they are two divisions apart. Since we have ample time we might set the fifth carrier dog at position 72 and the sixth at position 80. Start the machine and engage the driving shaft clutch. Disengage the clutch just after feeding stock but before the turret slide reaches its forward position on the peak of the turning lobe.

Set Spindle Reverse Trip Dogs.

(a) Engage the camshaft coupling so that the reverse dog carrier will rotate with the camshaft. The jaw teeth on the coupling or clutch are marked and the zeros on the driving and driven clutch members should be placed together for proper engagement or correct timing.

(b) Turn the driving shaft handwheel until the turret slide has been withdrawn from its turning position or the lead cam lever has reached work sheet position 37-38. The box tool must have left the work before the spindle changes speed. Otherwise the tool marks on the work may show the effect of the change in speed.

(c) Trip the reverse trip lever, turn down to operating position the trip lever dog and slide a carrier trip dog around until it has lifted the trip lever to its top position. Clamp the dog. The spindle will now reverse from high to low speed at this point in the cycle.

(d) Start the spindle and engage the driving shaft clutch. Disengage the clutch when the spindle has been reversed and the cam lever is on the threading lobe.

(e) Turn the driving shaft handwheel until the turret slide has started to withdraw from the threading operation. (Position 53-54 on work sheet.) By placing a finger at a point to touch the slide and bed at the same time, you can tell when the slide has moved a few thousandths. Trip the reverse trip lever, move a carrier trip dog into working position and clamp it. The spindle is now prepared to reverse from low to high speed at the completion of the threading operation.

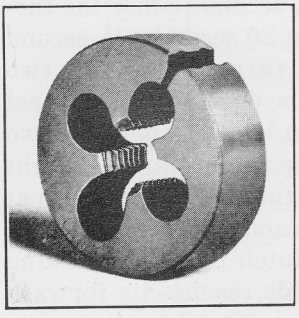

Fig. 4. Button Die

(f) Start the spindle and engage the driving shaft clutch. Disengage the clutch after the stock feeding operation but before advancing for the turning operation.

Sharpen Bit of Box Tool. This roller box tool must be a left-hand tool, for the high speed spindle rotation is backwards. Hold the bit in

the position where it is expected to cut and you can readily identify the cutting edge and the surfaces which are ground for side and back rake.

Mount and Adjust Box Tool.

(a) Set the rolls against a diameter which has been turned .003" to .004" smaller than standard.

(b) Set the tool in such a position in the turret that when the cam lever roll is on the top of the lead cam turning lobe, position 35 on the work sheet, a length .005" to .010" less than ¾" will have been turned. The .005" to .010" of stock is left on the shoulder to allow a finishing cut with the form tool.

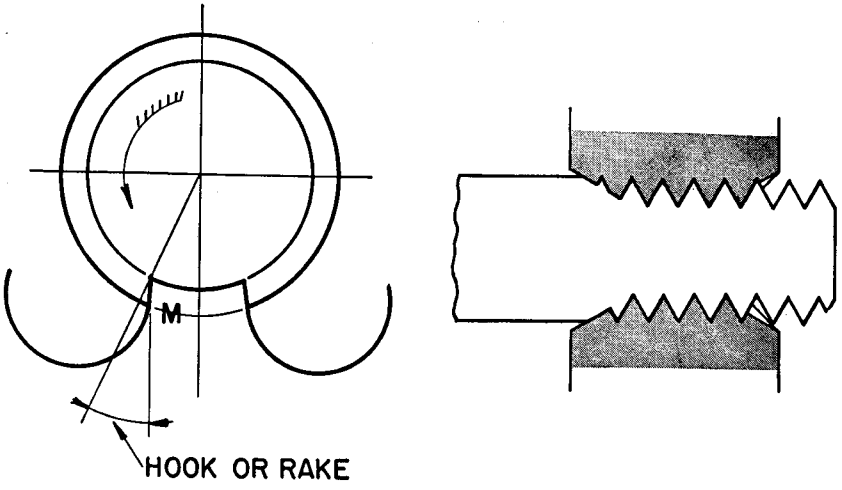

Fig. 5. Cutting jaw of die in contact with work

(c) When a job requires turret indexing, the clearance between the tools and the bed must be checked. Having clamped a tool in the turret, release the turret locking pin and spin the turret through one complete turn. If there is rubbing or interference, shift the position of the tool or turn it about its long axis. Each time the tool is shifted or adjusted forward, this one turn check should be made. Having rotated the turret be certain it is returned to its original station.

Select a Button Die. The thread on the screw is to be cut with a button die which is supported in a non-releasing (non-

rotating) die holder. The screw has a right-hand thread and will require a right-hand die. On both screws and dies the thread is understood to be right-hand unless left-hand is specifically marked on the drawing or die. Fig. 4 shows a typical

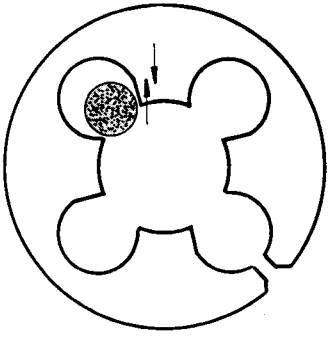

Fig. 6.

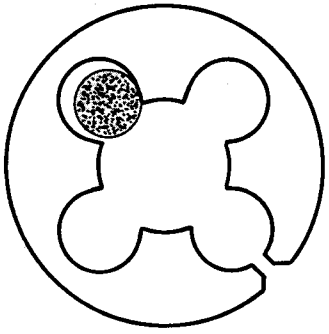

Fig. 7.

button die. The outer rim of the die has a slot and a taper screw or wedge in this slot permits a slight adjustment of the pitch diameter of the die.

Sharpening a Button Die. In the left-hand sketch of Fig. 5, the end view of a single jaw or cutting arm of a die is shown in contact with the work.

The cutting edges of the die threads lie in the side surface M and can be sharpened by grinding this surface. Notice that the ground surface is not radial with the work but makes a hook or rake angle with the radial line. Just as in our other tools this rake angle gives freer cutting and pulls the chips away from the work. The cutting surface M is ground with a small pencil wheel mounted in a high speed grinding attachment. The button die is held by hand and moved axially back and forth along the pencil. It can be moved toward and away from the wheel axis to give an approximately flat surface, Fig. 6, or it can be held in one position and ground to the radius of the pencil wheel, Fig. 7. Rake angles from 10 to 25 degrees are employed, the larger values being used on steel while the smaller values serve for brass.

The general statements may be made that—

(a) There is probably too little hook if the die drags and tears the thread or tends to load with chips.

(b) There is too much hook if the tips of the cutting threads break off or round over quickly.

In grinding the four cutting surfaces, grind off approximately the same amount on each surface. If the arms are ground unequally, one arm will do more cutting than another.

The right sketch in Fig. 5 shows a longitudinal cross section of two cutting jaws in position on the screw. You will notice that the first two threads on the jaws have been partially cut away or chamferred. This is done to spread the cutting burden over several teeth rather than to have a single tooth in one jaw remove all the metal which is to be cut away when machining the screw thread.

When the die is backed off the screw there are left two incomplete or shallow depth threads which represent the farthest advance of the chamferred end of the die. For our screw with its ¼" length body, two partially formed threads are not objectionable. For parts which must be threaded close to a shoulder, a two-thread chamfer is too great and but one thread or a part of a thread is cut away or tapered. Most dies are chamferred at both ends. On one end the chamfer is short or abrupt. Have this end facing the stock when threading to a shoulder. The

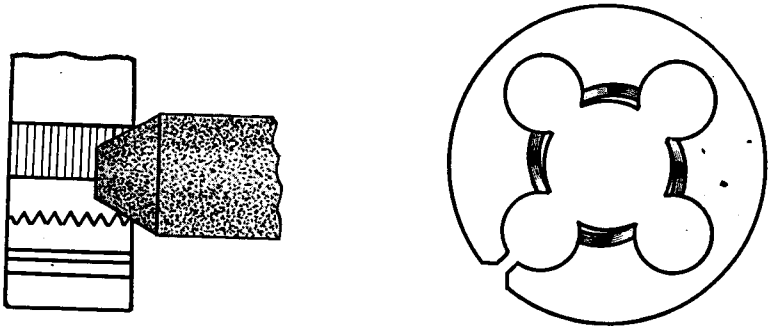

Fig. 8. Regrinding chamferred surface of die

other end has a long chamfer and should be used on all jobs where two incomplete threads can be tolerated. In general, manufacturers promise better cutting and longer life when long chamfer dies are used.

Operators in sharpening button dies usually leave the chamferred surfaces alone and grind only the cutting faces M of Fig. 5. However, the die can be sharpened by grinding the chamferred surface. In some cases an excessively dull or chipped die must be reground on the chamfer and of course if

the amount of chamfer is to be changed this surface must be reground.

To regrind the chamferred surface, a pencil wheel is used of a diameter approximately equal to the thread diameter. The die may be held in the hand and pressed against the wheel. To get clearance for the cutting edges the chamfer is ground deeper on the heel end of the jaw thread than it is on the front or cutting end. The shaded area of Fig. 8 exaggerates the clearance drop of the beveled or chamferred surface. To get balanced cutting from a die, it is imperative to remove the same amount of metal from each jaw when grinding the chamfer. With unequal grinding one jaw may do all the cutting which will be a severe strain on the die and will produce a poor or

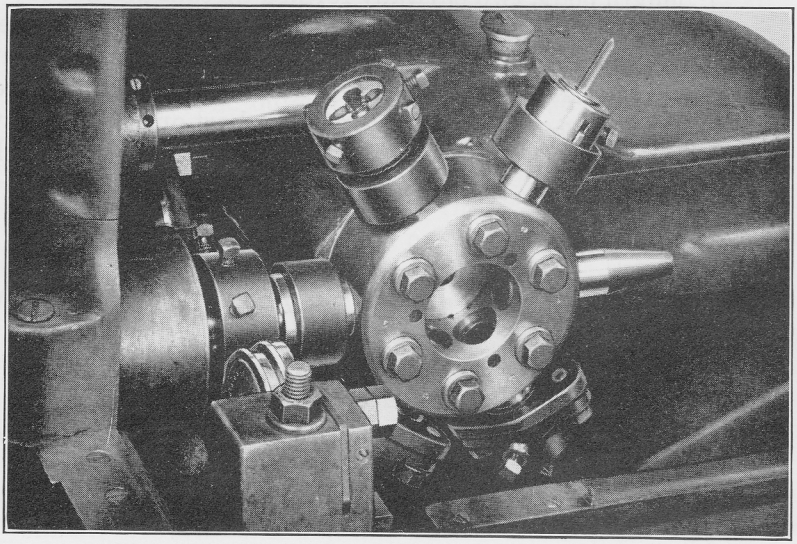

Fig. 9. Die Holder in use

rough thread. When the die is first threaded on to the work, observe the chips as they coil away from the cutting jaws. If a heavy chip is being cut by one jaw and only light or no chips are being turned off by the other jaws, then the chamfer grinding is poor and the die should be re-sharpened.

To avoid inequalities which may be obtained in hand grinding, some shops have indexing grinding fixtures which hold the die in a fixed angular position so that the chamfers on all jaws will be the same. These fixtures also hold the die so that the

jaw being chamferred will be a given distance ahead of wheel center. This permits the proper clearance to be obtained on all jaws. Since there are many different grinding fixtures for dies, these paragraphs have tried to suggest what is desired in a carefully sharpened die rather than to describe exactly how a given fixture is used. Get an experienced operator to explain and demonstrate the particular grinding fixture in your department.

Sharpen the Button Die.

Mount the Die in a Holder. Fig. 9.

(a) Clean the holder so that the die can seat squarely on the thrust surfaces.

(b) Insert the die in the holder screw cap. Turn in the pointed set screw and let it enter the slot in the die.

(c) Screw the cap containing the die on to the holder body. Turn the cap up until the die is clamped lightly against the thrust surfaces.

(d) Back off the clamp screws with your fingers. When the die is first threaded on the work it should be free to center itself. The clamp screws and cap should not be tightened until after the die is centered on the work.

Mount Holder in Turret. Set the holder shank in the turret station just after that occupied by the box tool. Turn the driving shaft handwheel until the turret lead cam lever is about 1/8" from the top of the threading lobe of the cam, about position 49 on the work sheet. Now tap the holder shank forward until the die just clears the end of the work. Clamp shank tightly in turret. Release the turret locking pin and spin the turret to be certain the die holder clears the bed of the machine. Repeat this check each time the die holder is moved forward in the turret. Return the turret to its original station and see that the locking pin is seated.

Start the spindle and engage the driving shaft clutch. The die will move forward with the turret slide and will thread on to the work. The spindle will reverse and the die will be withdrawn.

Let the machine run until this piece has been cut off and a new blank turned to size. Stop the machine just after the turning operation but before the slide starts forward for threading. Now measure the threaded length of the piece cut off and figure how much the die holder must be moved forward to thread the desired length of 1/2". Loosen the turret clamp on the die holder

shank and tap the die forward the necessary amount. Make your measurements with a scale from the end of the work bar or the nose of the spindle. Reclamp the die holder.

Engage the driving shaft clutch. Jog the spindle (press the motor start button and then almost immediately press the stop button). Do this once or twice until the die has threaded on to the work for a distance equal to the width of the die. Now while the die is on the work, turn in the taper or spreading screw until it presses against the sides of the die slot. In threading on to the screw the die has probably sprung open making this take-up necessary. With a pin lever, screw the holder cap up tight. Tighten the four cap screws or bolts. Start the machine, and let it run until the turret has indexed around, threaded a new piece and cut it off. Catch this last piece for gage tests.

Fig. 10. Go-not go thread gage

Adjust Die for Size. To test the thread, a "go-not go" gage can be obtained from the tool crib. A popular gage is the Johnson type gage of Fig. 10. The screw must pass between the top set of threaded rolls but must not be so small that it can get by the bottom set.

If the screw thread has been cut large and will not enter the gage, the button die must be closed in. Loosen the die holder cap and back off the taper or spreading screw a small amount. For a small adjustment tighten the two clamp screws nearest the spreading screw. For greater adjustments tighten all four clamp screws so that the die may be kept central as well as closed in to size. Having closed in the die turn in the spreading screw (it may already be tight if you made a good guess on the amount to back it off) and screw tight the die holder cap. If the screw thread is too small and passes by the "not-go" rolls, the die must be opened. For small adjustments, back off the holder cap and the two clamp screws nearest the spreading screw and turn in the spreading screw. For larger adjust-

ments, release all four clamp screws before turning in the spreading screw. Screw tight the holder cap and tighten all clamp bolts.

Start the machine and engage the driving shaft clutch until the piece is threaded and cut off. Check this new thread with the gage. You will be lucky if it is right after your first adjustment. If it is not right, at least you will be prepared to make a better guess for the second adjustment.

Using Pick-Up Cams. With the set of cams designed for this job the setting of the spindle reverse dog (position 53-54) will be satisfactory. However, if a pick-up set of cams not specifically designed for this job is used, it may be necessary to vary the position of the spindle reverse dog. The lead given to the turret slide by the threading lobe of turret lead cam is about 10% less than the lead of the thread to be cut. Thus once a thread is started the die pulls itself on to the work and moves ahead of the turret slide. This advance, or gain in position of the die, is called "pull-out" and may be close to $\frac{1}{16}$" for a half inch threaded length of screw. The pull-out is possible because of the axial freedom provided in the die holder.

If the spindle is not reversed when the turret slide reaches its limiting forward threading position, the die will continue to thread itself forward even though the turret slide has started to withdraw. The pull-out will quickly become excessive (about $\frac{3}{8}$") and there will be a blow as the die, still threading forward, tries to pull the turret slide ahead with it. If there is too much pull-out and resulting shock, set the spindle reverse carrier dog ahead a little so that the spindle may be reversed sooner and less pull-out will occur.

If the spindle is reversed too soon or before the turret slide reaches its maximum forward position, then the die will be threading off the work piece or moving back while the turret slide is being advanced. The die will quickly move back through the pull-out clearance, will crowd on the thread, and with a blow will try to push the turret slide back. To correct such action the spindle reversal should be delayed or the carrier trip dog moved back a small amount.

Probabilities are that the carrier dog setting (53-54) first described will be correct, but if any bumping occurs the clues just given will immediately tell what dog adjustments to make.

Sharpen Circular Pointing Tool. A circular pointing tool is shown in Fig. 12. It is in principle exactly the same as the circular form tools already described in Jobs Nos. 1 and 2, the only difference being that this tool is supported in the turret instead of the cross slides.

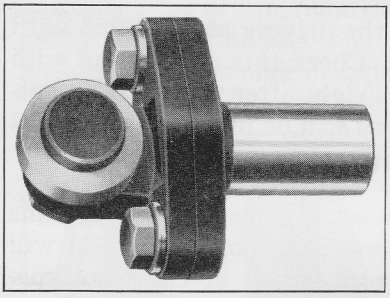

Fig. 11. Circular Pointing Tool Holder

The form on the tool is in this case simple, being an angular cutting edge to point or chamfer the end of the screw. To maintain the exact form for which the tool was designed, the drop below tool center must be maintained when sharpening the tool. For this No. 00AA tool the drop is $\frac{3}{32}$". Grind to this figure and do not put hook or rake on the tool.

Mount Pointing Tool in Turret. The Circular Tool should be clamped in position in a Floating Pointing Tool Holder and the unit placed in the fourth turret station. Rotate the circular tool on its stud until the ground surface or cutting edge is horizontal or parallel with the axis of the work. See Fig. 12. Clamp it in this position. Now loosen the float controlling screws, and move the tool and holder up or down until the cutting edge of the tool is on center with the work. Tighten the clamp screws.

Turn the driving shaft handwheel until the turret lead cam lever roll is at the beginning of the feeding portion on the pointing lobe, position 59. Now move the tool holder forward in its turret station until the tool cutting edge just clears the end of the work piece. Clamp the holder shank in the turret.

Start the machine and engage the driving shaft clutch. Disengage the clutch when the piece has been pointed and the tool withdrawn. Examine the pointed screw. If the length of chamfer is not correct adjust the position of the tool holder in the turret station.

Sharpen Circular Form Tool.

Mount Form Tool on Front Cross Slide. Set the tool on center. Carefully adjust the tool to be square with the work axis, for this wide $\frac{1}{2}$" cutting edge will turn a noticeable taper on the work if the tool is not square. Adjust the tool post along

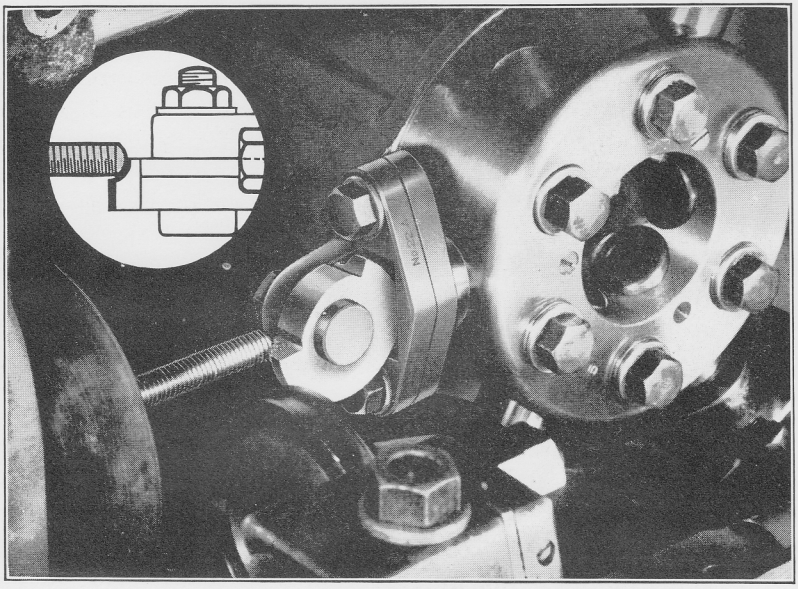

Fig. 12. Circular Pointing Tool in use

the cross slide T-slot until it is finishing from .005″ to .010″ from the screw shoulder.

Adjust Front Cross Slide for Cutting Depth. The tool should be fed in just enough to touch the body of the screw, or possibly only enough to clear the body by a crack of light. It is the purpose of the form tool to give a square finished shoulder and to remove any burr left at the end of the thread by the die. It is not intended to have the form tool finish the ¼″ body diameter above the screw threads. Set the stop screw on the cross slide.

Set Work Deflector.

Adjust Coolant Flow.

Make a Few Pieces. Start the machine and engage the driving shaft clutch. Let the automatic cycle be repeated a few times while you make a final check of one of the pieces. Have your foreman examine one of these first screws.