

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

No. 5

Of a Series of Booklets
for Training Operators

Turning, Threading, Forming
and Cutting Off

Brown & Sharpe Mfg. Co.

North Kingstown, R. I., U. S. A.

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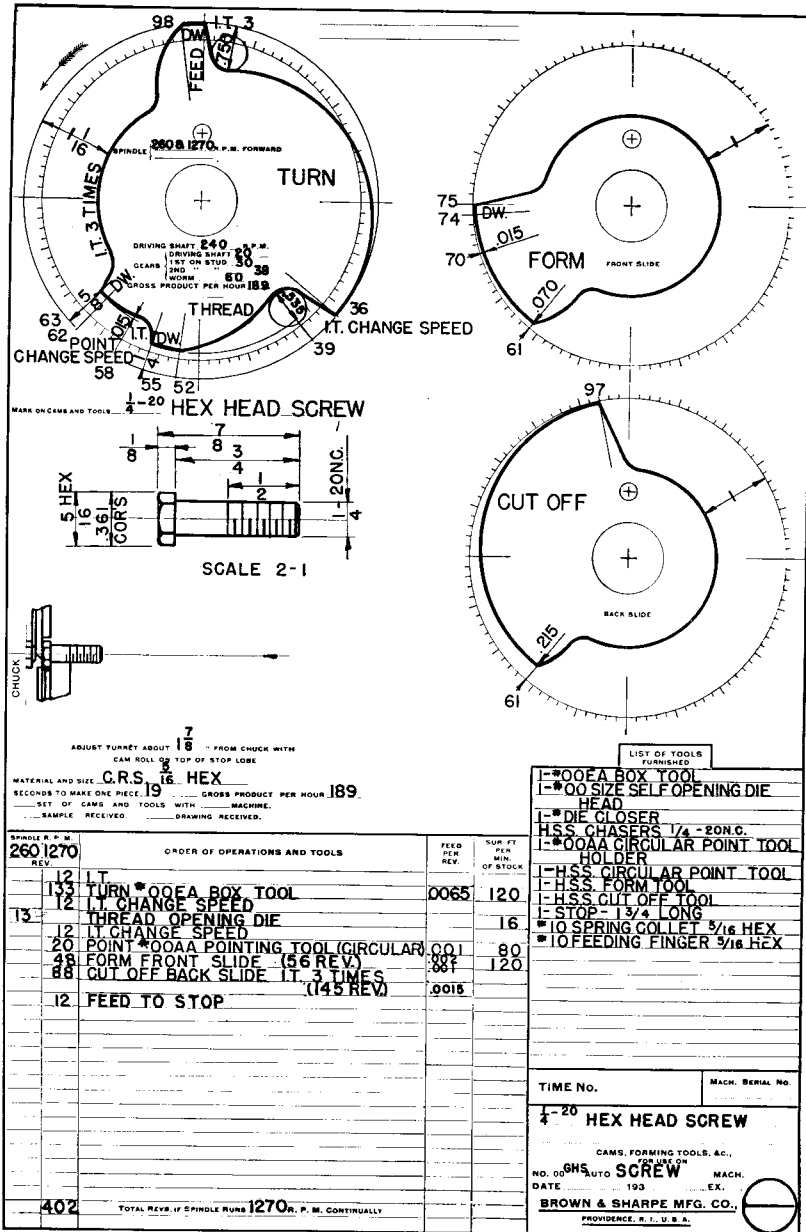


Fig. 1. Work Sheet for Job No. 4

NO. 5 OF A SERIES OF BOOKLETS FOR TRAINING OPERATORS

JOB NO. 4

Turning, Threading, Forming and Cutting Off

The work sheet, Fig. 1, shows a screw which is identical with that produced in Job No. 3. Although the piece is the same, there is a change in operations, for the thread is to be cut with an opening die instead of the button die just described.

Opening dies (Fig. 2) have four cutting jaws called chasers which cut the screw thread. These chasers are held in radial slots in the die head and can be instantly withdrawn from the screw thread when the die is opened or released. With the chasers withdrawn from cutting position, the die can be moved off the work piece without having the spindle reverse. Notice that the work sheet calls for two speeds but that they both have a forward direction.

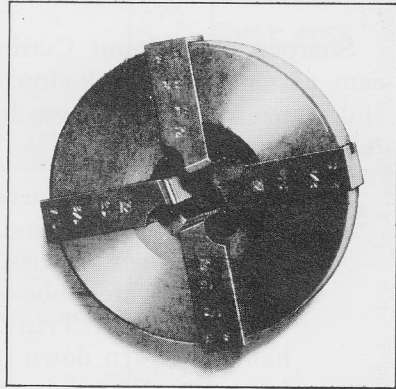


Fig. 2. Opening Die Holder

Because an opening die does not have to be threaded off the work and can be pulled back as fast as the turret slide can move, there is usually a small saving in production time when an opening die is used. Job No. 4 is completed in 19 seconds, where with a button die Job No. 3 required 20 secs. The saving made with an opening die is approximately equal to the time required to back-off a button die.

Many of the set-up directions for this fourth job are the same as those given for Job No. 3. Refer back to that job for details which are missing here.

Strip the Machine, insert proper feed finger and collet, insert bar of stock and adjust length of feed and chuck pressure. This duplicates the procedure in Job No. 3.

Set Spindle Speed. (Refer to Fig. 12, Booklet No. 1.)

- (a) Set motor reverse switch in proper position for forward speeds.
- (b) Mount spindle speed change gears (39-56).
- (c) Mount ratio change gears (53-42) with lower gear in rear position.
- (d) Use open belt for driving shaft drive.
- (e) Start the spindle and engage the driving shaft clutch. Trip the spindle reverse trip lever by hand once or twice to engage the friction clutch on the high speed side.

Mount the Feed Change Gears. The compound gears are 20/30-38/60.

Sharpen and Mount Cutting-Off Tool, mount turret lead cam, adjust turret stock stop, cut off a piece, put on both cross slide cams and adjust them for depth of cut. This procedure follows that for Job No. 3.

Set Six Trip Dogs for Turret Indexing.

- (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 work sheet. Trip the turret trip lever with your hand and turn down into working position the trip lever dog. Now slide a carrier dog around in its T-slot until it has lifted the trip lever to its peak position and is just about to slide by the tip of the trip lever dog. Clamp the carrier dog securely in this position.
- (b) Turn the handwheel further. When the follower roll is just over the peak of the turning lobe, about position 36-37 on the sheet, trip the turret trip lever and set a second carrier dog.
- (c) Continue turning the handwheel until the follower roll is at position 55 on the work sheet or until the turret slide has just started to return from its threading operation. Trip the turret trip lever and set the third carrier dog.
- (d) Set the fourth trip dog when the cam follower roll is at the end of the dwell on the pointing lobe (at position 63).
- (e) The fifth and sixth dogs can be set at positions 72 and 80 just as they were in Job No. 3.

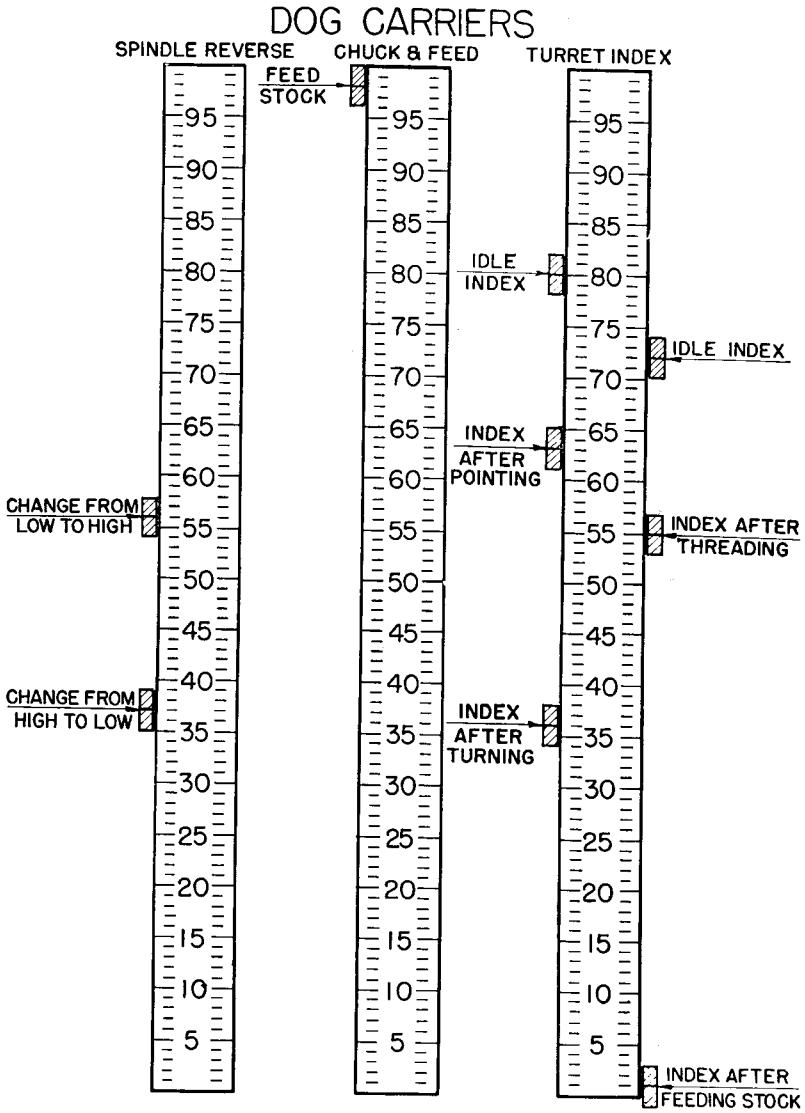


Fig. 3. Dog Settings for Job No. 4

Set Spindle Reverse Trip Dogs. (Fig. 3.) The spindle is not reversed but the dogs must be set to change the spindle speed from high to low.

- (a) Engage the camshaft coupling so that the reverse dog carrier will rotate with the camshaft.
- (b) Turn the driving shaft handwheel until the turret slide has been withdrawn from its turning position or the lead cam lever roll is close to position 37 on the work sheet. Trip the spindle reverse trip lever and turn the trip lever dog down to operating position. Set a carrier trip dog. The spindle will now be shifted from high to low speed at this point in the cycle.
- (c) Start the spindle and engage the driving shaft clutch. Disengage the clutch when the spindle speed has been changed and the cam follower is on the threading lobe.
- (d) Turn the driving shaft handwheel until the turret index has tripped and the turret slide is being withdrawn. This will be close to position 56 on the work sheet. Set a carrier dog to trip the reverse trip lever. The spindle will now be prepared to change from threading to turning speed at this position.
- (e) Start the machine. Disengage the driving shaft clutch after the stock feeding operation but before advancing for the turning operation.

Sharpen Box Tool Bit and Mount and Adjust Box Tool.
See Job No. 3.

Sharpen Opening Die Chasers. The two surfaces to be ground on a chaser are the same as those already considered in sharpening the cutting jaw of a button die. The chamfer must be ground to obtain new cutting edges on the first or starting threads and the hooked surface must be occasionally touched up to renew the edges of the following or full depth threads. See Fig. 4.

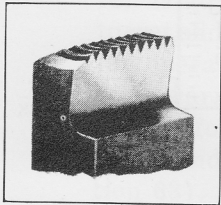


Fig. 4. Opening Die Chaser

In grinding the cutting jaws of a button die it was easier to grind the hooked surface than the chamfer, especially if the die was being held by hand. Thus it was that operators usually left the chamfered surfaces alone and did their sharpening by grinding the hooked surface. Since each opening die

chaser is a separate cutting tool and can be removed from the die head for grinding, it is recommended that the chaser be sharpened by grinding the chamfer and that the cutting face or hooked surface be ground lightly only after several chamfer sharpenings or when the shiny edges of the full depth threads indicate that they have become dull or have rounded over.

All four chasers in a die must have the same amount of metal removed in sharpening and must be ground with the same chamfer angles if they are to cut evenly or to develop balanced threading forces. It is almost impossible to grind chasers right the first time when supporting them by hand and thus it is suggested that you use a grinding fixture for sharpening them.

Grinding Chamfer. Chamfer makes it easier for a die to start a thread on the work piece. It distributes the cutting load over several threads, making the chip per chaser thread smaller and the cutting life between sharpenings greater. Fig. 5 shows the approximate number of threads affected by various angles of chamfer.

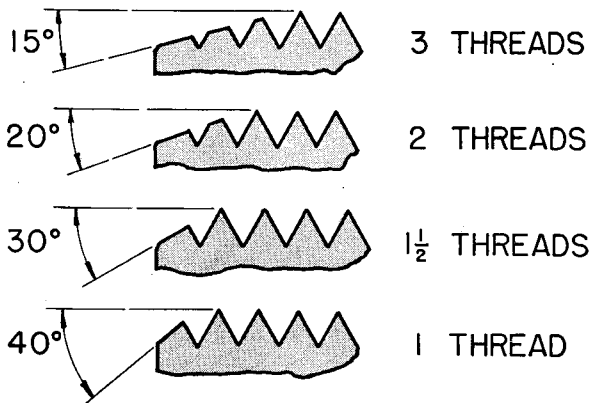


Fig. 5. Relation between chamfer angle and number of threads cut away

For free cutting steel and brass, a 1½ thread 30° chamfer is recommended.

For machinery steel and alloy steels, a 2 thread 20° chamfer is preferred.

For tool steel or tough steels, a 3 thread 15° chamfer may be necessary.

A 1 thread 40° chamfer is used only when a full depth thread must be cut as close to a shoulder as possible.

The chamfered surface must not only be ground to the proper angle, it must be ground with the proper concavity to give cutting clearance. A full sized wheel (about 7" diameter) with its grinding surface trued to a radius can be used to grind

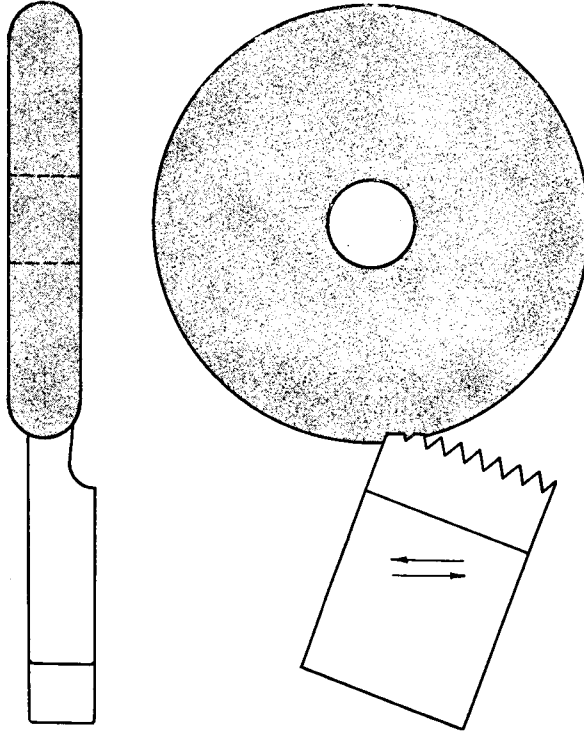


Fig. 6. Grinding chamfer, using full size wheel

the chamfer (Fig. 6) or a pencil wheel with a diameter approximately equal to the thread diameter can generate the surface (Fig. 7). The chasers are all located positively in the fixture using the cam grooves and sides of the chasers as locating surfaces. Exact details of the fixture available in your shop should be explained by the foreman or some experienced operator. The vital requirement for grinding chasers in any fixture, however, is that all four chasers must be ground with the same fixture setting and the same wheel truing. Otherwise, they will not cut equally.

Fig. 8 suggests the appearance of a chaser after repeated sharpenings. The solid metal which was below the thread root

diameter can be cut away on a surface grinder or by holding the chaser by hand against a bench grinder wheel.

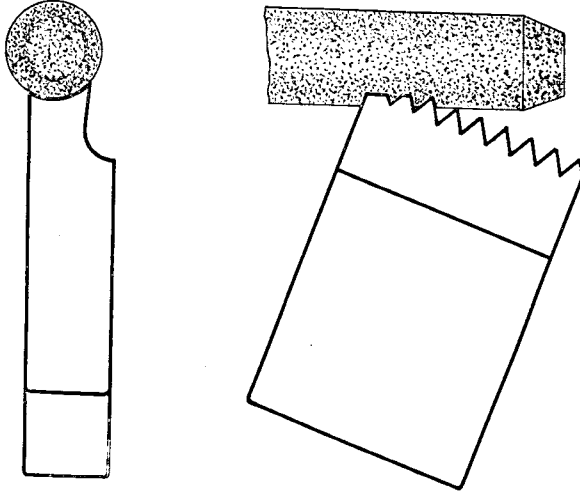


Fig. 7. Using pencil wheel to grind chamfer

Grinding Chaser Face. This flat surface which controls the hook or rake angle can be ground on a surface grinding machine or in the special chaser grinding machines. The angle of hook recommended for chasers is the angle A shown in Fig. 9. The actual or effective cutting rake angle B is greater than this; the amount being dependent on the distance ahead of center of the

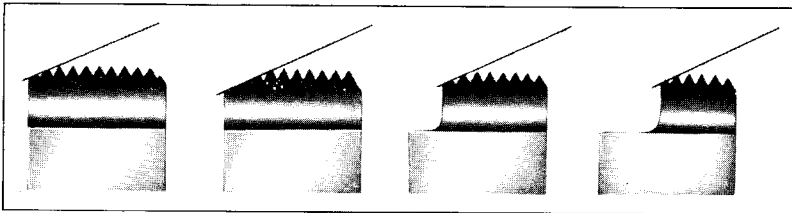


Fig. 8. Maintaining chamfer angle as chaser is resharpened

chaser cutting edges. Thus as a chaser is resharpened the ground hook angle should be increased to compensate for the loss in angle which occurs as the face is ground back. When the cutting face has been ground enough to bring the cutting edges on center, the ground value of the hook angle should be increased about 10° . A few recommended values for ground hook angles are:

Brass	5°
Machinery steel and screw stock	10°
Tool steel, alloy steel, aluminum, and copper	15°

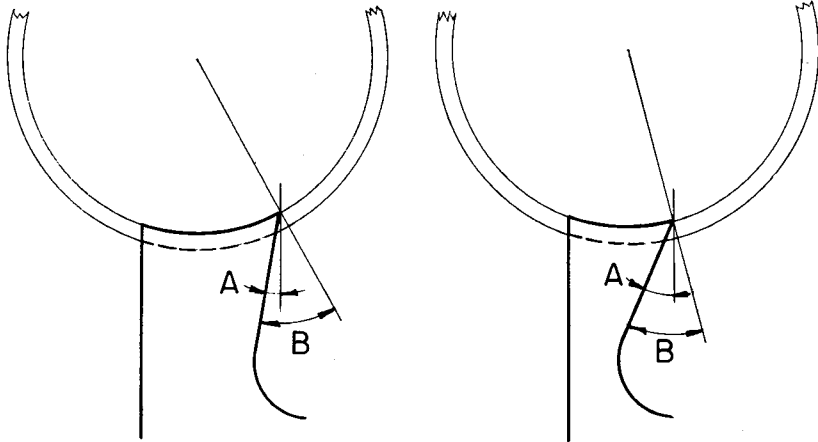


Fig. 9. Rake angles on new and resharpened chasers

The general standard given for rake on button dies may be repeated for chasers.

- There is probably too little hook if the chasers drag and tear the thread or tend to load with chips.
- There is too much hook if the tips of the cutting threads break off or round over quickly.

Assemble and Adjust Chasers.

- Clean the die and oil the chaser cams.
- Mount the chasers in the die head, making certain the chaser and slot numbers agree.
- Set the chasers for depth. If there is a master or sample screw available adjust the head (there is one adjustment which moves all the chasers together) until the screw can just be threaded into the die.
- If there is no sample screw, set the chasers for a shallow thread, or back off the adjustment until the graduation line on the die is on the L (large) side of zero. This is simply a precaution against cutting too deep, for when chasers are unexpectedly overloaded there is danger that the die springs will not be powerful enough to open the die. For a first cut it is safest to cut a thread which you know is shallow rather than take a chance on one which might be too deep.

Adjust Pull-Out Movement. Hold the shank of the die in one hand and pull the die head holding the chasers with your other hand. Notice that there is a free axial movement of about $\frac{1}{16}$ " and then, further movement pulls the releasing mechanism. When the die head has moved about $\frac{3}{16}$ " the release mechanism fires and opens the die. Turn up the pull-out adjusting nuts until they just touch the releasing member, then back them off about one turn and lock them.

It is the pull-out movement of the die head, while the turret slide cam lever is on the dwell of the threading lobe, which releases the die. Small adjustments of the threaded length of the work can be made by changing the amount of pull-out or altering the position of the pull-out adjusting nuts. Most length adjustments are, however, made by tapping the die forward or back in its turret station.

Mount the Die in the Turret. Set the die in the turret station just after the box tool. Turn the driving shaft handwheel until the turret lead cam lever roll is about $\frac{1}{8}$ " from the top of the threading lobe of the cam, about position 49 on the work sheet. Now tap the die forward until it just clears the end of the work piece and clamp it securely.

Start the machine and engage the driving shaft clutch. The piece will be threaded and the die withdrawn.

Disengage the driving shaft clutch just after the turret has indexed. Now release the turret locking pin and spin the turret to make certain the die has a clear path.

Re-engage the driving shaft clutch and let the machine run until the screw has been cut off and a new blank turned to size. Stop the machine and measure the threaded length of the piece which was cut off. From this length calculate the amount the die should be moved in to thread the desired length of $\frac{1}{2}$ ". Loosen the turret clamp and tap the die forward this amount. Reclamp.

Close the Die. A die closer must be mounted on the bed wall opposite the turret (See Fig. 10) to close the die as the turret is indexed around. If there is not a closer in position on your machine get one from the tool crib and clamp it to the wall.

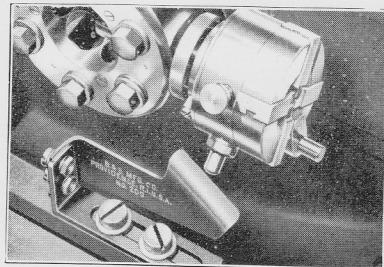


Fig. 10. Closer for closing die

Cut-off the work piece by bringing forward, by hand, the cutting-off tool.

Now loosen the turret clamp and turn the die about its long axis until the closing lever is in such a position that it will be actuated by the dog as the turret is indexed. Make a trial by releasing the turret locking pin and turning the turret until the die has passed by the dog.

Having adjusted the die position and having closed the die by the above test, release the die and make a final test by turning the driving shaft handwheel until the die has been indexed past the closing dog. Make any die or dog adjustments that are necessary to get proper closing.

Now start the machine and engage the driving shaft clutch. Let the machine run until a piece has been completed and a new blank turned to size. Stop just before the die is advanced for threading.

Adjust Chasers for Thread Size. Test the last screw which was cut off. If, according to the gage it is large or small, change the die head adjustment in the direction indicated by the graduations.

Cut and thread another screw and test it to check the adjustment. Continue readjusting until an acceptable size is obtained.

Duplicate the final steps beginning with "Sharpen Circular Pointing Tool" described in Job No. 3.