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

No. 12

Of a Series of Booklets
for Training Operators

Centering, Drilling, Counterboring,
Longitudinal Turning, Forming
and Cutting Off

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

1968

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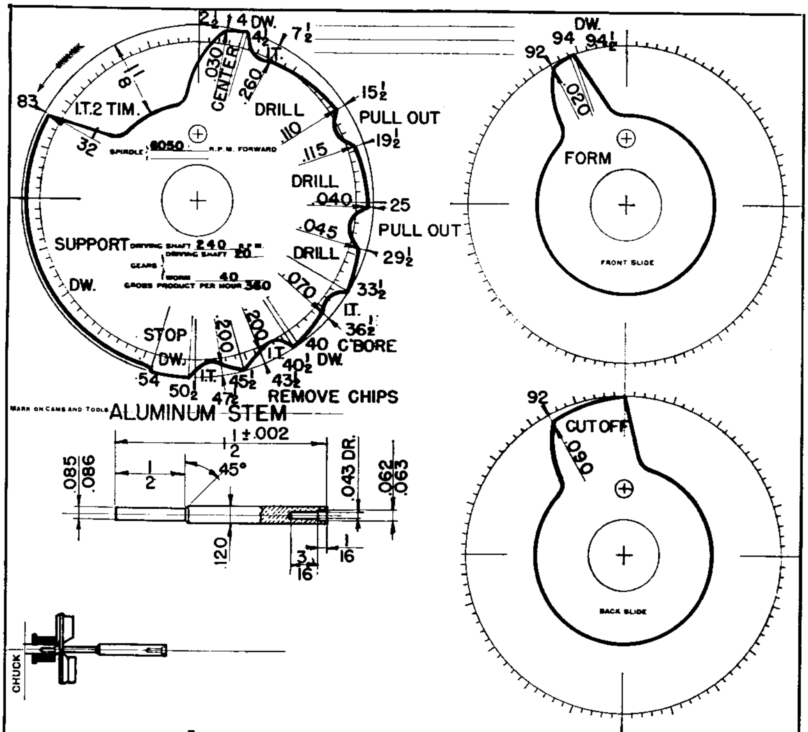

ADJUST TURRET ABOUT $1\frac{7}{8}$" FROM CHUCK WITH CAM ROLL ON TOP OF STOP LOBE

MATERIAL AND SIZE ALUMINUM .120 DIA.
SECONDS TO MAKE ONE PIECE 10 GROSS PRODUCT PER HOUR 360
____ SET OF CAMS AND TOOLS WITH ____ MACHINE.
____ SAMPLE RECEIVED. ____ DRAWING RECEIVED.

SPINDLE R.P.M. 6050 REV.	ORDER OF OPERATIONS AND TOOLS	FEED PER REV.	SUR. FT. PER MIN. OF STOCK
25	CLEAR		
20	CENTER *00AC FLOATING HOLDER	.002	
30	I.T.		
81	DRILL *00AC FLOATING HOLDER	.0025	
40	PULL OUT		
60	DRILL *00AC FLOATING HOLDER	.0015	
41	PULL OUT		
40	DRILL *00AC FLOATING HOLDER	.001	
30	I.T.		
40	COUNTER BORE *00AC FLOATING HOLDER	.002	
30	I.T.		
40	REMOVE CHIPS *00AC FLOATING HOLDER	.010	
30	I.T.		
35	FEED 2 TIMES TO STOP & SUPPORT		
40	BRING LONGITUDINAL TURN TOOL IN POS.		
40	FORM IN " " "	.0007	
212	TURN " " "	.002	
91	CLEAR		
	FORM FRONT SLIDE	.001	
81	CUT OFF BACK SLIDE I.T. 2 TIMES	.0012	
1008	TOTAL REVS. IF SPINDLE RUNS 6050 R.P.M. CONTINUALLY		

LIST OF TOOLS FURNISHED

- 4 *00AC FLOATING HOLDERS
- STOP & SUPPORT
- COLLET .120 DIAM.
- FEED FINGER .120 DIAM.
- BUSHING .121 DIA. FOR TURN. ATT.
- TURNING BLADE
- FORM TOOL
- CUT OFF TOOL
- CENTER DRILLS 1/8 DIAM.
- TWIST DRILLS *57 .043 DIAM.
- COUNTER BORES .0625 DIAM.
- CHIP REMOVER *57 DRILL
- DRILL BUSHINGS .126-.044 & .063 DIAM.
- SPEC. TRIP DOG FOR FEEDING 2 TIMES

TIME No. MACH. SERIAL No.

ALUMINUM STEM

CAMS, FORMING TOOLS, &C., FOR USE ON NO. 00 GHS AUTO. SCREW MACH.
DATE 194 EX.
BROWN & SHARPE MFG. CO.,
PROVIDENCE, R. I., U. S. A.

Fig. 1. Work Sheet for Job No. 11

NO. 12 OF A SERIES OF BOOKLETS FOR TRAINING OPERATORS

JOB NO. 11

Centering, Drilling, Counterboring, Longitudinal Turning, Forming and Cutting Off

The long aluminum stem produced in Job No. 11 (Fig. 1) is an interesting piece. Having cut off the work piece, the stock is not immediately fed forward, but instead the centering, drilling, counterboring, and chip removing operations, are performed while the stock is close to the spindle and well supported. With this machining done, the stock is fed forward twice, and then the final operations of turning, forming, and cutting off are performed.

To get a reduced diameter on the spindle end of a long work piece, a longitudinal turning attachment is used. In preceding jobs we have used a swing tool or a form tool to turn a diameter to the left of a shoulder, but in this case, the work diameter is too small to stand the pressure of a wide form cut and a swing tool could not index by so long a work piece. Most of the other operations are familiar to us, although this is the first job which used a drill of so small diameter that it had to be advanced and withdrawn several times in being fed to depth.

Strip the Machine.

Back off cross slide stop screws.
Insert feed finger, collet and stock.
Adjust collet pressure.

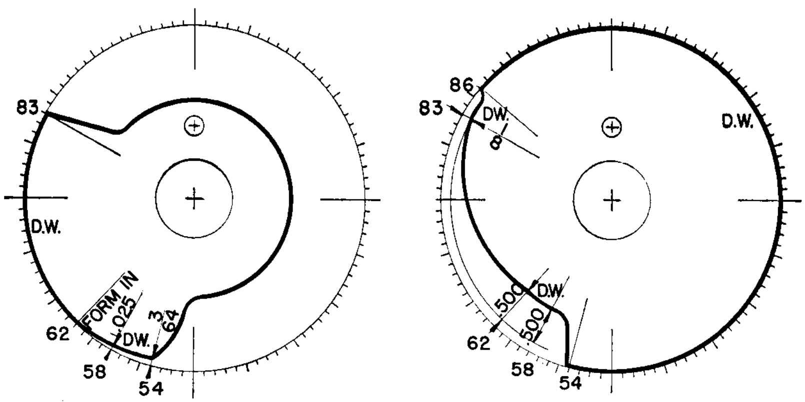

Fig. 2. Cams for Longitudinal Turning Attachment

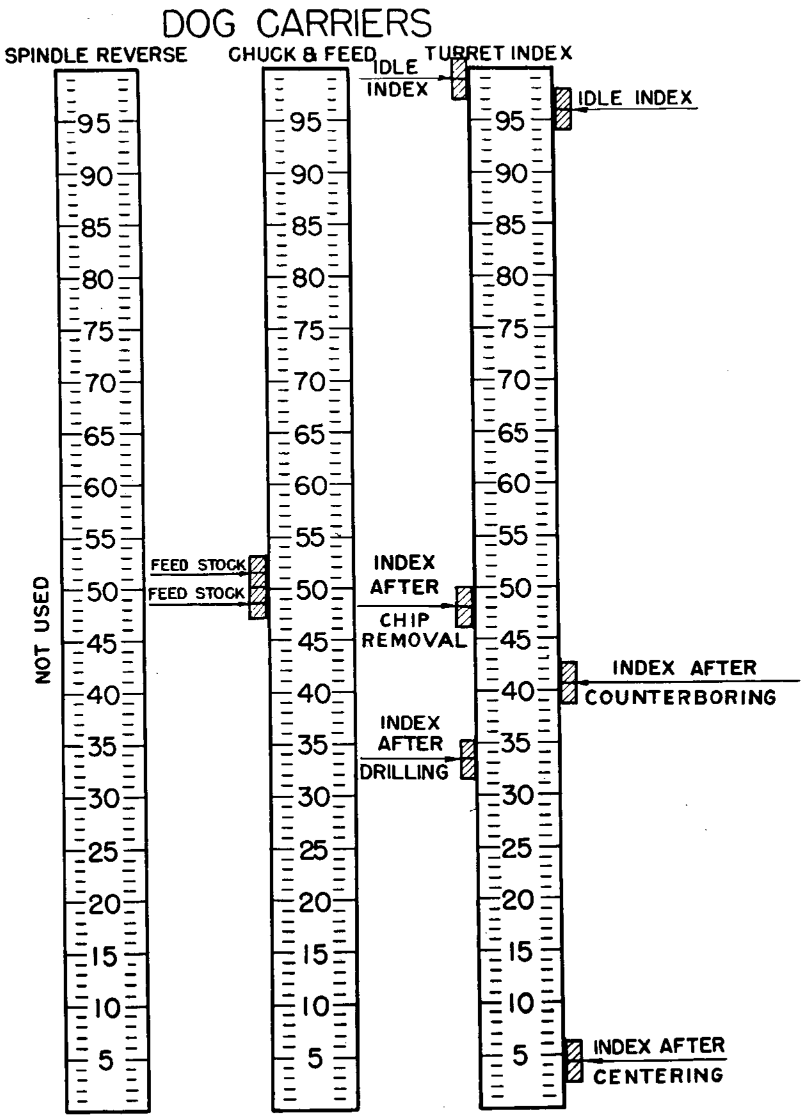

Fig. 3. Dog Settings for Job No. 11

Put on feed change gears.
Make changes to get spindle speed.
Put on cross slide and turret lead cams.

Adjust Length of Feed. Since the machine feeds twice in advancing the stock, set the length of feed at 7/8″, which will give about 1/4″ overtravel.

Set All Carrier Trip Dogs. Fig. 3 shows approximate dog settings. The 1/4 second required for indexing and for feeding stock represents 2.5 hundredths of cam surface on this 10 second job. Thus dogs cannot be set less than 2½ hundredths apart. To feed twice, two trip dogs should be set on the chuck carrier with this minimum separation of 2½ hundredths.

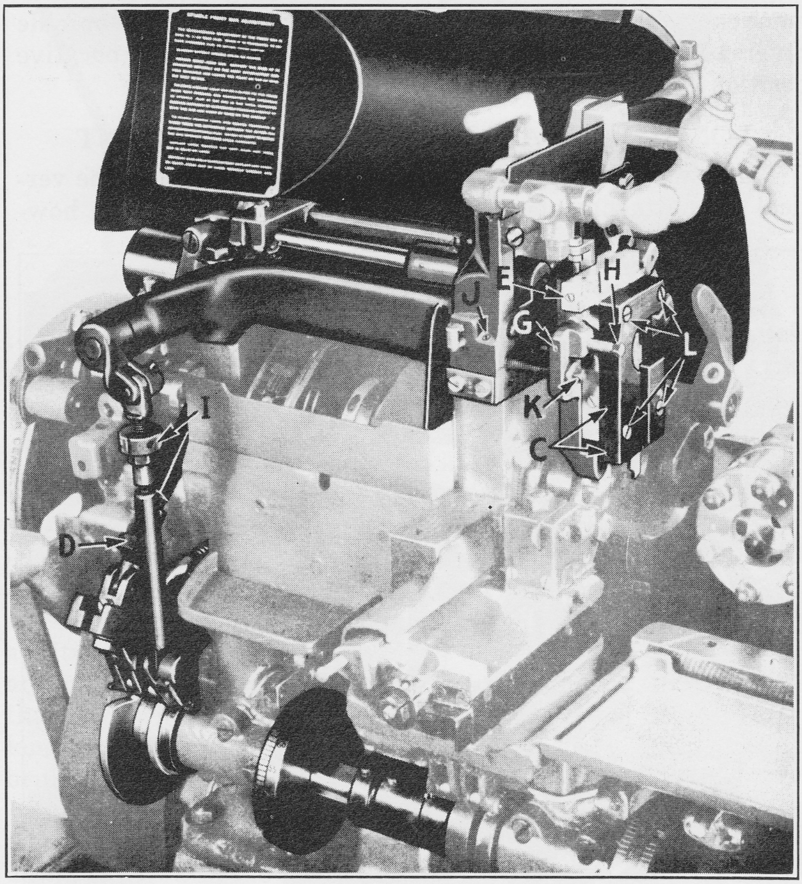

Fig. 4. Longitudinal Turning Attachment

Actually the regular trip dogs cannot be set closer together than 5 hundredths for they are butt to butt at this setting. Thus to get a double feed in 2.5 hundredths, a special trip dog (Fig. 5) is required. With its dwell this dog holds the trip lever up long enough to permit the feeding mechanism to operate twice.

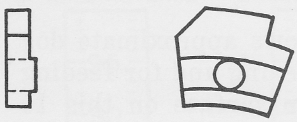

Fig. 5. Special trip dog

The last idle index is delayed until position 99 for if the work piece has not been cut off, the center drill would strike the piece as it swung down to working position.

The spindle reverse is not used, for a constant spindle speed is required on this job. However, the reverse carrier shaft coupling cannot be disengaged, for attachment cams on the end of the shaft must be driven. The spindle reverse trip lever dog should be turned up to the inoperative position to eliminate spindle reverse.

LONGITUDINAL TURNING ATTACHMENT

This attachment, Figs. 4 and 6, is closely related to the vertical slide attachment used in the last job, No. 10. Here, how-

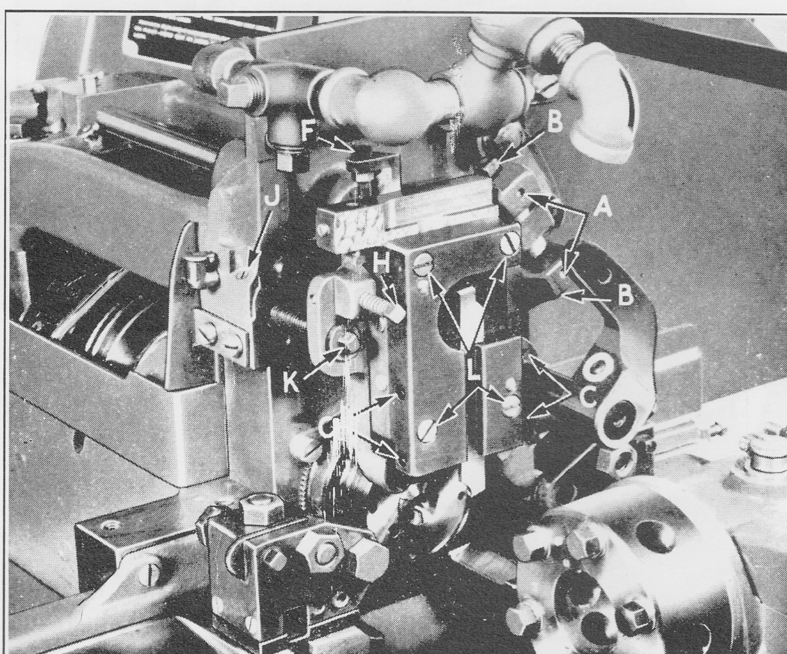

Fig. 6. Parts of Longitudinal Turning Attachment head

ever, the cutting blade not only moves toward the work axis but it can be moved parallel to the work axis while turning a work diameter. The attachment will be mounted in position on your machine. Insert a hand lever in each of the attachment cam levers and observe the movement of the head as you lift the levers.

Sharpen Turning Blade. The attachment slide moves the blade in a radial direction toward the work axis. In operation the blade is first fed to depth and is then advanced along the work to turn the ½″ length of small diameter. In feeding to depth the angular cutting edge of the blade turns the 45 degree shoulder which joins the two diameters.

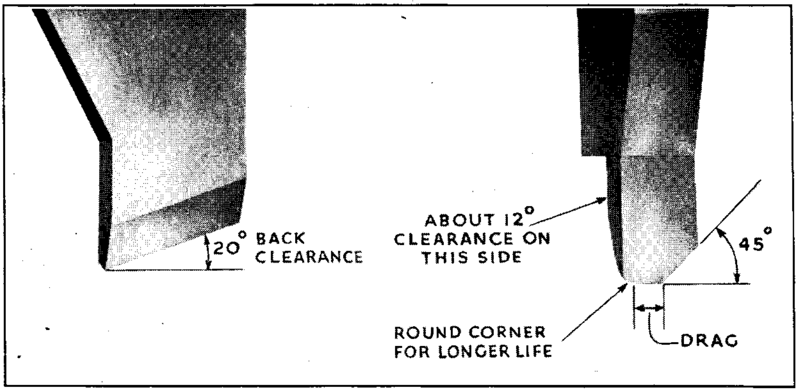

Fig. 7. Blade for longitudinal turning

Fig. 7 shows the blade used for longitudinal turning. There is a 45 degree cutting edge which produces the angular shoulder and there is a cutting edge parallel to the work axis which has enough drag to produce a smooth finish on the .085″ diameter surface. Clearance is ground in back of both these cutting edges to eliminate rubbing when feeding radially to depth and in addition is ground on the broad side of the blade to give a clearance as the tool is fed longitudinally into the stock. Notice also that the corner of the blade is rounded or stoned off to give a longer cutting life to this point on the blade which gets the brunt of the cutting.

Since the blade forms a shoulder, it cannot be hooked without changing the angle of the shoulder, thus there is no rake angle on the blade and the surface above the cutting edge lies in a radial plane. To resharpen the blade, grind the two flat end surfaces which run back from the cutting edges and round over or stone the corner or edge facing the spindle. The flat side of a grinding wheel can be used in grinding both surfaces.

Mount the Blade and Adjust the Attachment. On the work sheet, a bushing which supports the stock is shown just in front of the chuck and close to the turning blade. The bushing is mounted in the attachment head and moves axially along the stock in step with the longitudinal movement of the turning blade.

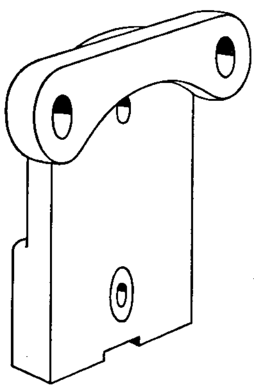

Fig. 8. Guide bushing in holder

Select or prepare a bushing with a .121″ hole and mount it in the small holder shown in Fig. 8.

Start the machine and feed stock forward. Stop the machine, slip the bushing over the stock and clamp the holder to the attachment. There are two screw holes in the head which will normally line up with the holes in the holder. If these do not line up swivel the head slightly by releasing the set screws A, Fig. 6, and adjusting the locating screws B. The final setting of the screws B should leave almost no clearance between the screw shoes and the guide and yet the shoes should not be pressing on the guide hard enough to oppose longitudinal movement of the head. The bushing should be free on the stock, or should not be binding at any point. At a speed of 6000 r.p.m., steady pressure would soon cause heating and would rough up the work.

The attachment slide has been designed to hold the turning blade close to the spindle chuck. In a set-up which uses a work supporting bushing, the turning blade must be moved out toward the turret enough to provide room in front of the chuck for the supporting bushing. To move the block which holds the turning blade, unscrew the four slotted screws L, Figs. 4 and 6, in the face of the slide and pull the block off. Two dowel pins in the block will be withdrawn from holes in the slide. Now mount the spacing block, Fig. 9, on the slide, engaging the dowel pins with the slide holes and mount

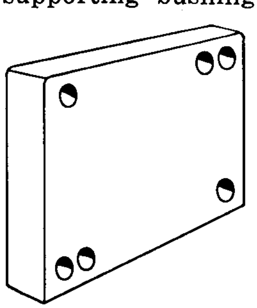

Fig. 9. Spacing block

the turning blade block on the spacing block. Clamp the members securely to the slide with screws (four longer screws than the ones you removed).

Mount the attachment cams, Fig. 2, on the end of the reverse or cam shaft. The longitudinal feed cam goes on the inside and the radial feed cam on the outside. Toothed or serrated cam holders are provided. There are, however, zero lines marked on the mating members and if these are lined up and the cams are mounted on the holder driving pins, the timing of movements will be correct without further adjustment. Clamp the members up tight with the shaft nut.

Mount the turning blade in position in the head slide block. There are two screws C on either side of the slide to adjust and clamp the blade. First get the blade on center so that its cutting edge will move radially toward the work axis. Then tap the blade forward or back until it protrudes about 3/8″ beyond the last point of support on the slide. Clamp it securely in this position. Now start the spindle and turn the driving shaft handwheel until the radial feed cam lever is on the cam dwell between positions 62 and 83. Loosen the clamp screw in the knurled adjusting nut D on the operating rack and turn the nut until the turning blade has fed to depth and has turned a diameter .002″ to .003″ smaller than .085″. Lift the longitudinal feed cam lever by hand and turn a work length long enough to permit checking the diameter with your micrometer. Clamp the nut in position.

Since the limit on diameter is .085″-.086″, we want a positive stop to control size. Back off the set screw E and turn out the stop screw F so that it will stop the slide at the point where the turning blade will turn a mean diameter of .0855″. Tighten the set screw E. The thousandth or so more which the slide would have moved without the stop, will be taken up in spring or give in the mechanism and will serve to maintain a steady pressure between the slide and the stop.

In its final position, the attachment bushing should be as close to the nose of the chuck as possible. Loosen the set screw G and back off the longitudinal stop screw H. This stop screw is used to give an exact "in" position for longitudinal movement, but since the turning blade is no longer in contact with the work when the cams reach position 86, it is unnecessary to use the stop for this job. Turn the driving shaft handwheel until the longitudinal feed cam lever is at position 86. Now loosen the clamp screw in the knurled adjusting nut I and turn the nut until the attachment work supporting bushing moves close to ($\frac{1}{32}$" to $\frac{1}{16}$") the chuck. Clamp the nut in this position.

Start the machine and let it run until the cams reach position 60 or the longitudinal feed cam lever is on the dwell between positions 58 and 62. The turning blade will be in its outermost position. Loosen the set screw J and turn in the stop screw K until its head strikes the face of the attachment and lifts the cam lever roll a few thousandths off the cam. Lock the stop screw in this position. This setting will insure a positive or steady position for the head while the slide and blade are feeding radially to depth.

Sharpen, Mount, and Adjust the Circular Cutting-Off Tool. Set the tool in such a position on the slide that the nearest edge of the cutting-off blade will be ½" from the 45 degree work shoulder. Notice that the cutting-off tool also trims off any burr or chamfers slightly the end of the bar of stock. A back cross slide stop screw, to control the end position of the tool, will not be necessary.

Adjust Turret Stock Stop. The stop used in this job has two functions. It serves as a supporting bushing on the end of the work piece and it acts as a stop when feeding stock. Notice that although stock is fed at position 49, the stop is not indexed out of the way until position 96. The stop is shown in Fig. 10.

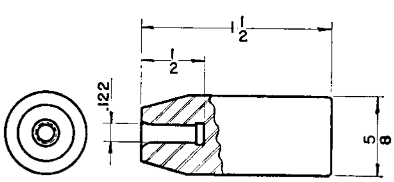

Fig. 10. Stop and support

Place the stop in the first turret station and turn the driving shaft handwheel until the turret lead cam lever is on the stop dwell between positions 50 and 54. Now set the stop so that the bottom of the hole will be 1½" from the nearest edge of the cutting-off blade. Since the length must be held to a close limit of ± .002", you may have to make several tries to get the exact length. Having clamped the stop in its station, check to see that the stock enters the supporting hole without interference or without being deflected off-center.

Sharpen, Mount and Adjust the Circular Form Tool. This tool removes any burrs on the end of the work piece which may have been thrown up by the cutting-off tool. A cross slide stop will probably be unnecessary.

Sharpen, Mount, and Adjust the Center Drill. Use a 1/8″ drill for this operation. There is nothing new or unusual in its sharpening or operation, and you can proceed directly to mounting it in the third turret station.

Sharpen, Mount and Adjust the Drill. A small drill cannot drill a deep hole in a single plunge but must feed in and withdraw a few times to remove chips and to give the coolant a chance to enter the hole and wash the drill. The three drilling lobes on the turret lead cam take care of the withdrawals. Notice that each successive lobe has a slower lead than the preceding lobe. The drill starts with a feed of .0025″ per revolution and finishes at a rate of .001″ per revolution.

Moves for sharpening and adjusting the drill are the same as have been discussed in earlier jobs and should be familiar to you. The sharpening of small drills is however, a delicate job and, like threading a needle, requires close scrutiny and a steady hand. Get the point central and have cutting lips of equal angle and length. Grind clearance behind the cutting edges and thin the web. The drill is mounted in a floating holder which is held in the fourth turret station.

Sharpen, Mount and Adjust the Counterbore. For a counterbore, select a 1/16″ drill and grind the end flat just as we did the bottoming drill in Job No. 10. Grind the clearance surfaces behind the cutting edges but do not bother to thin the web of the drill. A .043″ hole is already in the work and thus the center, or web section of the drill, will do no cutting.

Set the counterbore in a floating holder and mount it in the fifth turret station. Turn the driving shaft handwheel until the turret lead cam lever is at the beginning of the feed rise on the counterbore lobe, position 36½. Move the floating holder forward until the counterbore just clears the work. Clamp it in this position.

Since the counterbore does not have a 120° point and is not entering a hole already drilled to 1/16″ size, it has no tendency to center itself. You remember that drills, center drills, and reamers, were permitted to find their own center positions. A counterbore cannot be trusted to do this. Proceed then to float the counterbore to as near central a position as you can judge by eye and clamp it there. Start the spindle and bring the turret forward by hand until a short depth of 1/16″ diameter hole has been machined. Feed stock forward, cut off the work piece and examine the hole. You can judge by eye if the hole is very much off-center. You can also tell by testing the hole for size. When a counterbore is off-center, it produces an oversize hole. Before cutting off the work piece, bring the turret forward and notice where the counterbore is closest to the hole wall and where it has its greatest clearance. Move the counterbore or float it to have equal clearance on either side.

Produce another piece and if the $1/16''$ hole is good, make a final check for concentricity by inserting a $1/16''$ plug in the hole and rotating the work piece on the plug while the plug is held in a vise. An indicator held against the outside surface of the work will show the runout or the eccentricity which exists.

Adjust Drill for Removing Chips. The operation of counterboring has pushed quite a few chips into the .043″ hole. To remove these, use a .043″ drill, sharpened in the same manner as the one already prepared for the fourth station in the turret. This drill in its slow advance and withdrawal will collect in its flutes and remove most of the chips which are crowded into the hole. In adjusting the drill, float it to a central position and set it so that it will clear the end of the hole by .010″ or so. The feeding rate is .010″ per drill revolution and if you actually strike solid metal at this feed rate the drill will probably break.

On the diagram of trip dog settings, Fig. 3, the index after chip removal is set at position 48 and not at the peak of the lobe as is done on regular drilling. The speedy drill withdrawal obtained in indexing would not remove chips as effectively as the slow withdrawal of the cam drop.

Carefully Check Your Job and make the routine final adjustments.