A-414

OPERATORS' HANDBOOK

GREENLEE
Automatic
Bar Machines
4 and 6 Spindle

GREENLEE BROS & CO
A Unit of Ex-Cell-O Corporation XLO

For clarity, guarding required by the Occupational Safety and Health Act has been removed from some equipment depicted in this publication.

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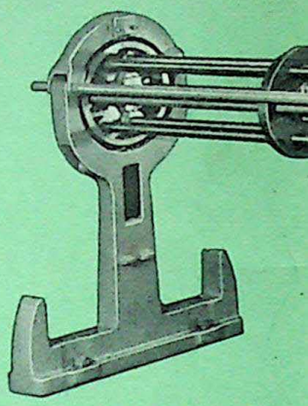
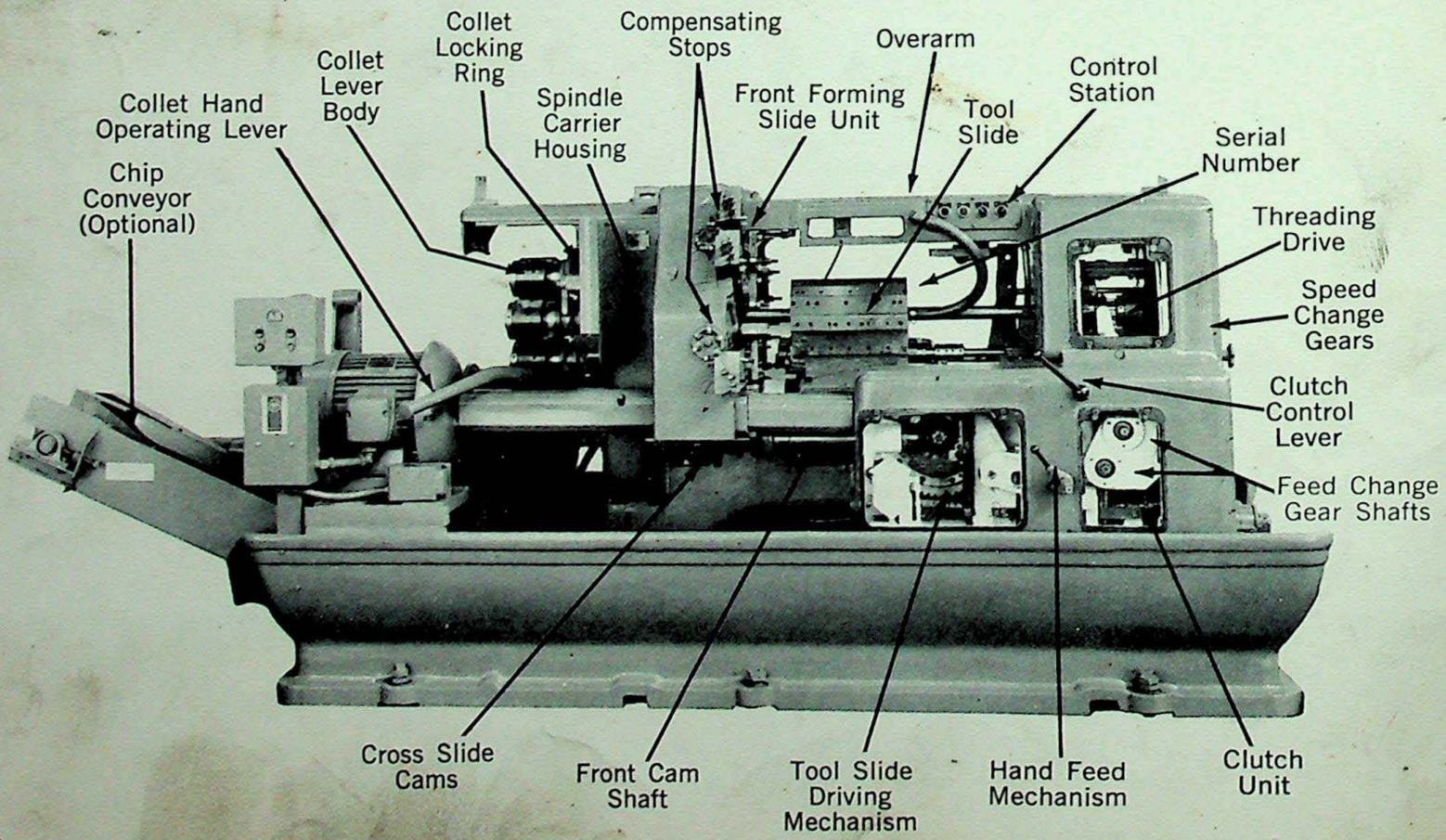
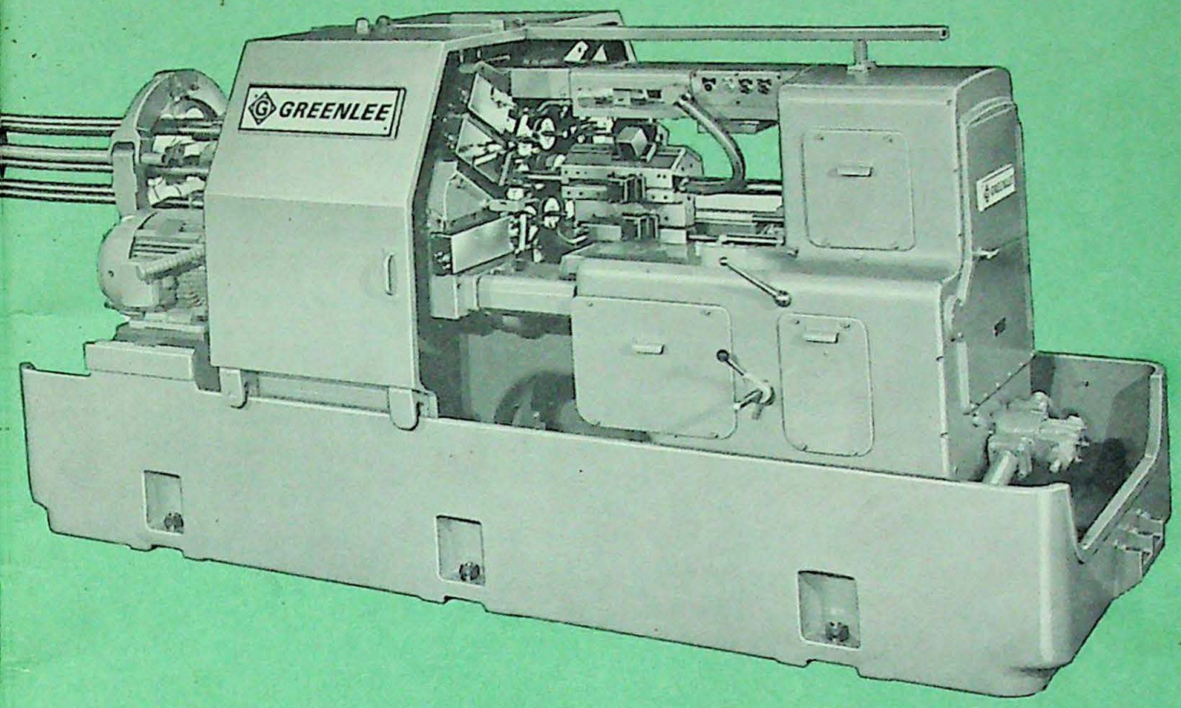
Greenlee Bar Automatics

1″ — 6 Spindle
1¼″ — 6 Spindle
1⅝″ — 6 Spindle
2″ — 6 Spindle
2¼″ — 6 Spindle
2⅝″ — 4 Spindle

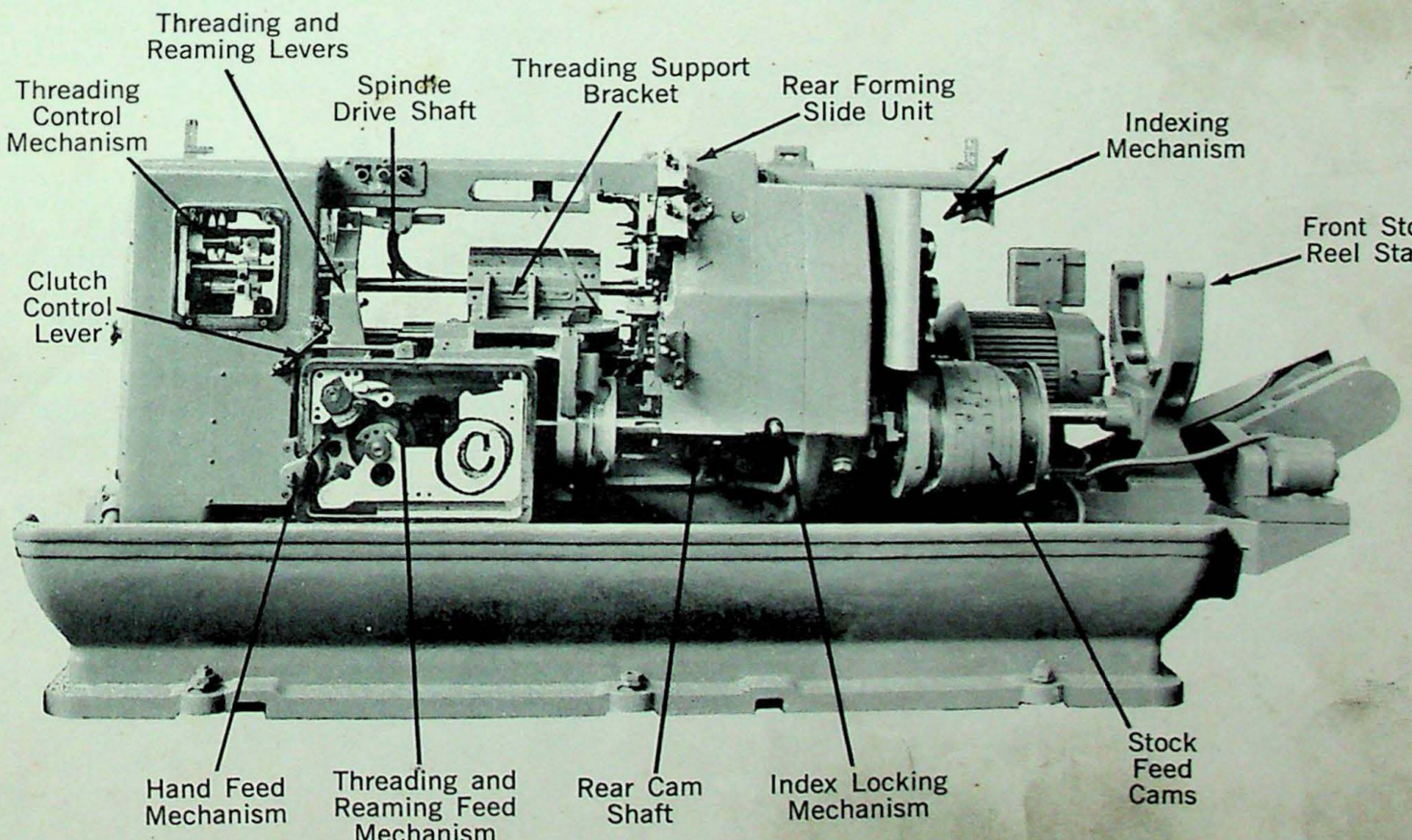


FRONT VIEW




GREENLEE

REAR VIEW


Threading and Reaming Levers
Threading Control Mechanism
Spindle Drive Shaft
Threading Support Bracket
Rear Forming Slide Unit
Indexing Mechanism
Front Stock Reel Stand
Clutch Control Lever
Hand Feed Mechanism
Threading and Reaming Feed Mechanism
Rear Cam Shaft
Index Locking Mechanism
Stock Feed Cams

SETTING UP AND OPERATING INSTRUCTIONS

PLANNING THE SET-UP

A well planned sequence of operations and several preliminary calculations are necessary before a job can be set up on the Automatic Bar Machine.

(1) Determine the correct feeds and speeds for the specified material and stock size shown on the part drawing.

(2) Select a sequence of operations which will give a workable and efficient arrangement of tooling.

(3) Calculate the proper stroke.

(4) Select the proper cams for cross slide.

(5) Calculate the total machining time and the estimated production.

The part drawing should give some of the information listed above and also give the following information:

(A) The material specifications, which will determine the machineability of the material and the speeds and feeds at which the job will be run.

(B) The stock diameter and its basic shape (round, hexagon, or square), which will determine the R.P.M. of the work spindle, size and shape of the collets and pushers, and the stock reel bushing size.

(C) The contour of the part, as well as tolerances and finish, which will determine the type of tooling to be used.

(D) The length of the part, plus the cut-off width and facing stock, which will determine the length of stock to be fed out.

Now proceed with the following steps:

1. Calculate the recommended R.P.M. for the work spindles, using the following formula:

O.D. = Outside Diameter of Stock

S.F.M. = Surface Feet Per Minute

R.P.M. = Revolutions Per Minute

$.262 = \frac{3.1416\ (\pi)}{12}$ (converts the circumference from inches to feet)

$$\frac{\text{S.F.M.}}{.262 \times \text{O.D.}} = \text{R.P.M.}$$

Refer to the speed gear charts for the R.P.M. that is nearest to the computed R.P.M. (See speed charts in tooling and attachments book.)

EXAMPLE: A part is made from ¾-inch round B1112 stock on a 1⅝-inch 6 Spindle Greenlee Automatic. Find the required R.P.M. for the work spindles.

SOLUTION: The machineability of B1112, according to the steel handbook, is rated at 165 surface feet per minute. Substitute the known factors in the above formula.

$$\frac{165\ (\text{S.F.M.})}{.262 \times .750\ (\text{O.D.})} = 845\ \text{R.P.M.}$$

2. Make a tentative list of the tool slide and cross slide operations needed to machine the part and divide this list among the cross slide and tool slide positions available. Use as many tooling positions as possible to achieve a well balanced tooling arrangement, so that no one tool is subjected to an extremely heavy cut which will necessitate frequent down-time for resharpening. This also keeps the tool slide stroke down to a minimum.

3. Determine a tool slide stroke that will satisfy the end-working tools and cross slide operations. Add ⅛ of an inch to the stroke, which is the amount of approach allocated to the machine for shifting from quick approach to the feed cycle before cutting begins.

4. With this stroke and the recommended feed for the specified material, select the desired feed gears from the feed gear charts. (See feed charts in tooling and attachments book.)

5. Select the cross slide cams by determining the amount of travel needed to complete the operation, and also the amount of feed desired for the operation. Cross slide cams are figured in direct ratios to the tool slide travel. EXAMPLE: A 2:1 cam designates a relationship of ½-inch travel on the cross slide for each inch of travel on the tool slide. This also applies to the feed. If the feed on the tool slide is .006-inch and a 2:1 cam is used, then the feed on the cross slide would be .003-inch. Add 1/16 of an inch to the amount of travel needed for approach, which is the allowance allocated to the machine for shifting from a quick approach to the feed cycle before cutting begins. Cross slide cams for Greenlee Automatics are in ratios from 1:1 to 8:1. Special cams can be furnished for knurling, stenciling, thread rolling, and other operations. The selection of cross slide feeds will depend upon the type of machining operations performed, the width and depth of cut, and the tolerance and type of finish required.

6. After establishing the correct speed, feed, and tool slide stroke, calculate the machining time by using the following formula:

$$\frac{\text{Stroke}}{\text{Feed}} \times 60 \div \text{R.P.M.} = \text{Machine Time in Seconds.}$$

Add the index time, which includes stock feedout, to the machine time to arrive at the total time required to machine the part.

MACHINE SIZE	STANDARD INDEX TIME
1" - 6	2.00 Seconds
1⅝" - 6 2" - 6	2.25 Seconds
2⅝" - 4	2.50 Seconds

EXAMPLE: The tool slide stroke is ¾", 845 R.P.M., .0063" feed. *FIND:* Total machine time.

Substituting known factors in the above formula:

$\frac{3/4"}{.0063"} \times 60 \div 845 = 8\frac{1}{2}$ Seconds (Machining Time)

8½ Sec. + 2.25 Sec. (Index Time) = 10.75 Seconds. This is the total machine time.

7. Calculate threading and tapping time, making sure that there is enough time to do the operation.

Formula for figuring threading and tapping time:

$$\frac{\text{No. of threads to be cut} \times 60 \div \text{R.P.M.}}{\text{Threading Ratio}} = \text{Threading Time}$$

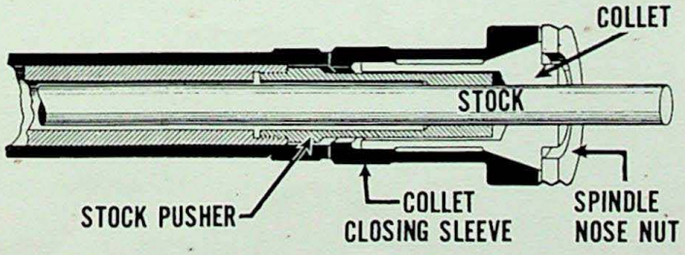
Tapping time formula:

$$\frac{\text{No. of threads to be cut} \times 60 \div \text{R.P.M.}}{\text{Right-Hand Threading Ratio}} = \text{Time For Tap Going In}$$

$$\frac{\text{No. of threads to be cut} \times 60 \div \text{R.P.M.}}{\text{Left-Hand Threading Ratio}} = \text{Time For Tap Coming Out}$$

NOTE: Include diehead approach when calculating number of threads to be cut.

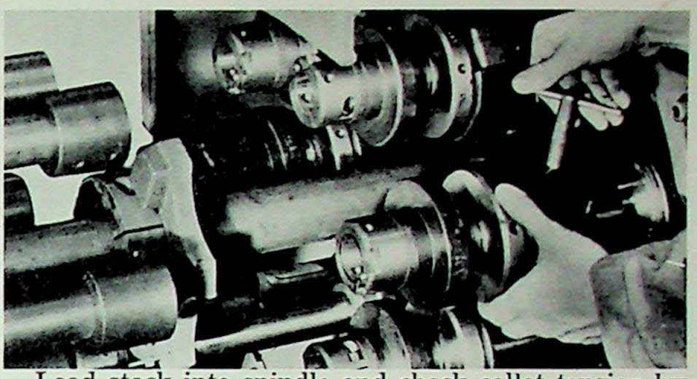
CHANGING COLLETS



1. Open the first position collet by using the collet hand operating lever.
2. Remove the spindle nose nut by turning it counter-clockwise.
3. Remove the collet and collet closing sleeve.
4. Clean collet, collet closing sleeve and the inside of the spindle nose.
5. Replace the collet closing sleeve, collet, and spindle nose nut. Apply a few drops of oil to the threaded portion of the spindle nose before replacing the spindle nose nut.

ADJUSTING COLLET TENSION

For machines with serial numbers through A-1521. See page 22 for instructions.

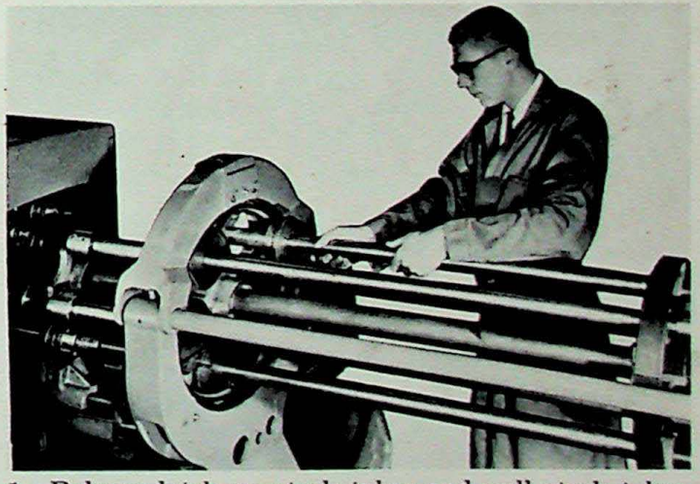


Load stock into spindle and check collet tension by opening and closing the collet with the collet hand lever. If the tension has to be adjusted, then proceed with the following steps:

1. Insert collet body wrench in hole on the side of the collet lever body and turn clockwise 180 degrees to disengage plunger.
2. Turn the collet lever body nut clockwise to loosen or counterclockwise to tighten the tension on the collet. Turn nut far enough either way so plunger will drop into the next hole.
3. Re-engage plunger. *Caution:* Remove wrench from collet lever body.
4. Open and close the collet by using hand operating lever, checking to see if there is enough tension on the collets.

CHANGING PUSHERS

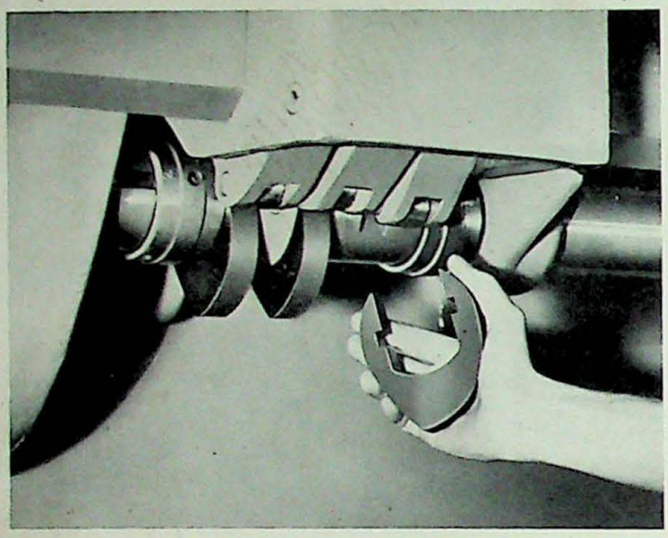
For machines with serial numbers through A-1521. See page 22 for instructions.



1. Release latch on stock tubes and pull stock tubes back far enough to allow removal of feeder tubes.
2. Pull out the plunger on the safety plate and turn the plate until the feed tube is free to move to the rear. Remove the feed tube.
3. Return stock tubes and safety plate to original position.

CHANGING CROSS-SLIDE CAMS

Applies to machines with serial numbers A-1815 and greater. See page 22 for machines with serial numbers through A-1521.



1. Jog the spindle carrier just enough to complete index, stopping machine before the cross-slide starts its forward stroke.
2. Depress spring plunger in cam carrier and slide back to remove cams.
3. Change cams and slide cam carrier back against cam to lock-up.

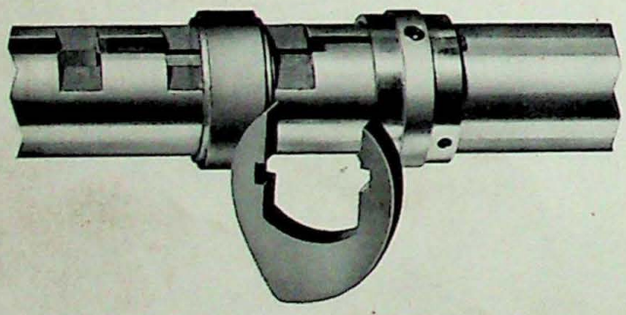


Fig. 1 Sectional view shows the sliding cam-carrier on shaft with cam removed.

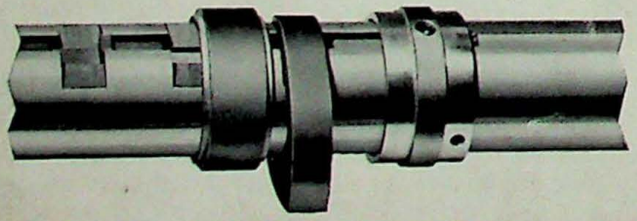


Fig. 2 Cam slips easily into place on shaft with slots in alignment with offset key ways.

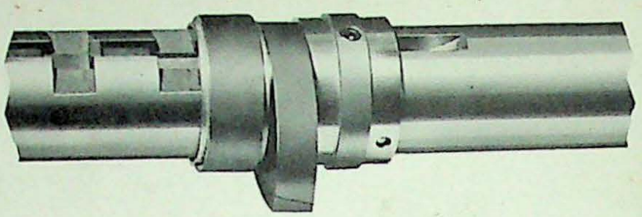
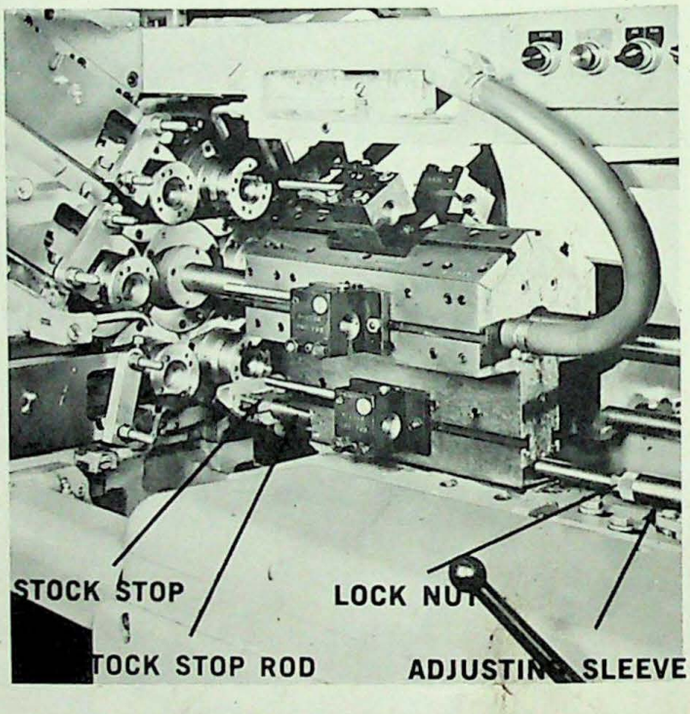


Fig. 3 The sliding carrier quickly locks cam in proper position on shaft.

Jogging the machine as outlined in step 1 rotates the cams to a position of maximum accessibility. NOTE: Cams fit only one way on camshaft. There is no danger of improper installation. All are designed with a uniform high point, so you can change them without having to re-adjust tools or holders.

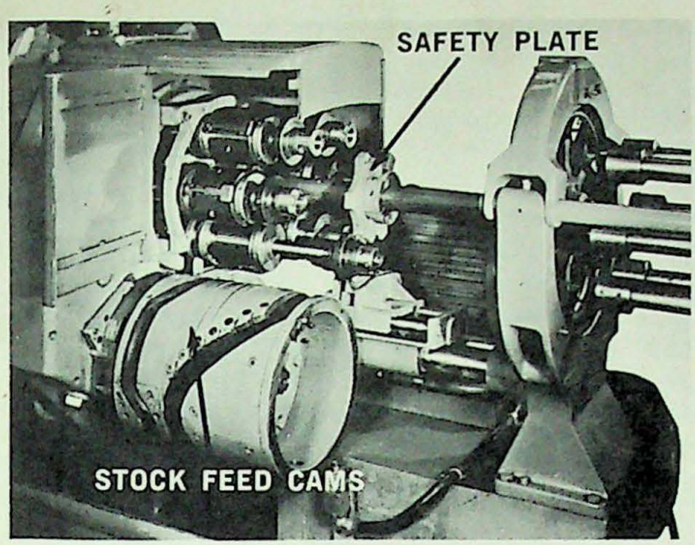
SETTING STOCK STOP



1. Determine the total length to be fed out, by adding length of part, cut-off blade width, and amount of facing stock.
2. Loosen stock stop lock nut, turn stock rod adjusting sleeve until face of stock stop is at the desired distance from the cut-off blade.
3. Tighten stock stop lock nut.

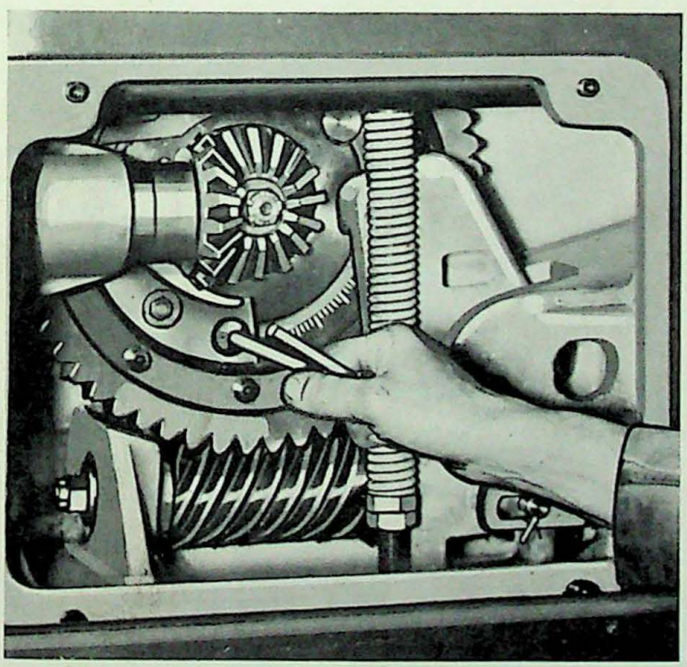
INSTALLING STOCK FEED CAMS AND SETTING SAFETY PLATE

1. Determine length of stock to be fed out.
2. Install a sufficient number of stock feed cams on cam drum to obtain the desired amount of feed out, allowing extra travel to compensate for any slippage that may be caused by the stock pusher. Each cam strip is equal to one inch of feed out.



3. Jog machine or use hand crank until roller on the stock feed shoe is against the last stock feed cam. The roller on feed shoe is against the last stock feed cam when the machine has started to index.
4. Move safety plate up to stock feed spools until the set screw on safety plate hub is in line with the hole on the stock reel center shaft. The safety plate should be at least one-eighth of an inch away from the stock feed spools.

SETTING THE TOOL SLIDE STROKE

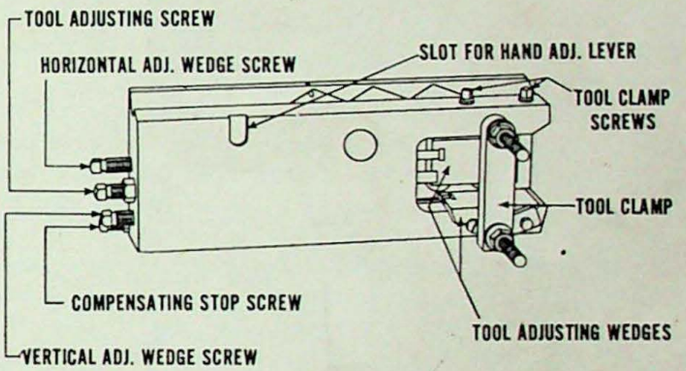


1. Check the pointer setting in relation to the graduated scale on the tool slide. The pointer should indicate zero on the scale when the tool slide is all the way forward.
2. Jog the machine to half index, loosen the screws on the low-speed dog, and move the dog until index mark is at required setting on worm gear graduated scale.
3. Run machine through a complete machining cycle and stop the tool slide at the point where it starts into feed. Check stroke on tool slide graduated scale and make final adjustments on low-speed dog if necessary. Set the brake operating cam so that the brake lever roller is on the high point of cam.

INSTALLING STOCK REEL BUSHING

The internal diameter of the stock reel bushing should be at least 1/16 of an inch larger than the outside diameter of the stock. Insert the stock reel bushing into the stock reel bushing sleeves and tighten set screws.

SETTING FORMING SLIDE TOOLS

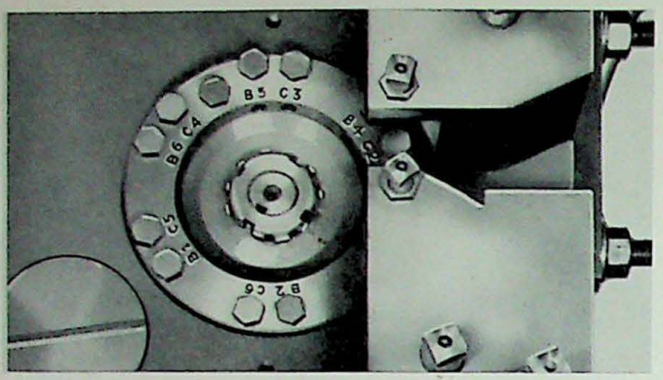


1. Place tool holder in forming slide cavity and hold it in place with tool clamps, screws, and wedges.
2. Position tool in correct location and on center of work.
3. Hand crank tool slide to its extreme forward position.
4. Start spindles rotating and adjust tools to their proper depth by turning the tool adjusting screw. Release tool clamp, screws, and wedges so the tool holder is free to move. Use coolant while adjusting tools to depth.
5. Tighten tool clamps, screws, wedges and tool adjusting lock nut.

Forming slide wedges provide ⅛-inch adjustment vertically and horizontally. Position wedges so the tool holder can be adjusted 1/16 of an inch in either direction. Fillers are available for any additional adjustment.

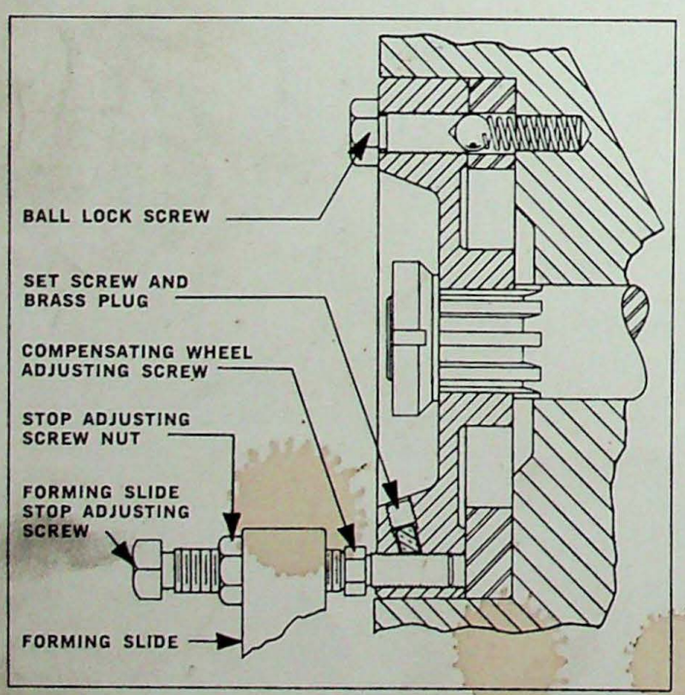
COMPENSATING STOP ADJUSTMENTS

Compensating stop adjustments are necessary to maintain machine accuracy. The stops are designed to compensate each cross slide for any difference in its maximum forward stroke in each spindle position. It is almost impossible to make a spindle carrier that will not show some slight deviation in the distance between spindle locations or in the distance from the axis of the carrier to the axis of the spindles.



Each slide, therefore, except the sixth (cut-off) position slide, is controlled by a series of six stop screws, located on the compensating wheels, which regulate the end of the forward stroke of the slides. (An auxiliary stop is available for the 6th position slide when it is expedient to use this slide for forming operations.)

There are three compensating wheels on each 6-Spindle Automatic. One controlling the first position slide, one controlling the second and third position slides, and one controlling the slides in the fourth and fifth positions. Each adjusting screw is keyed with a letter and a number. The letter indicates the slide controlled by the screws, for example: A — 1st position slide; B — 2nd position slide, etc. The number indicates the spindle controlled. For instance, the screw marked A-1 indicates it controls the depth of the first position cross slide in relation to spindle No. 1; screw A-6 the first position slide in relation to spindle No. 6; screw E-4 the fifth position slide in relation to spindle No. 4, etc.



Compensating stops are adjusted when the machine leaves the factory and ordinarily do not need readjusting except, after a long period of use, to compensate for wear on the stop screws. Some operators use these stops for making slight adjustments in tooling. While this is not in itself injurious to the machine, it does defeat the purpose of the stops and may, in some cases, result in failure of the machine to hold sizes where close tolerances are required.

In rare instances where trouble is experienced in holding sizes on a job, the following procedure can be used to reset the compensating stops to their proper height. Remove completed pieces from each of the spindles as they are cut off in the sixth position and note the spindles in which they were machined. Measure the formed diameters with a micrometer and prepare a chart as follows:

EXAMPLE:

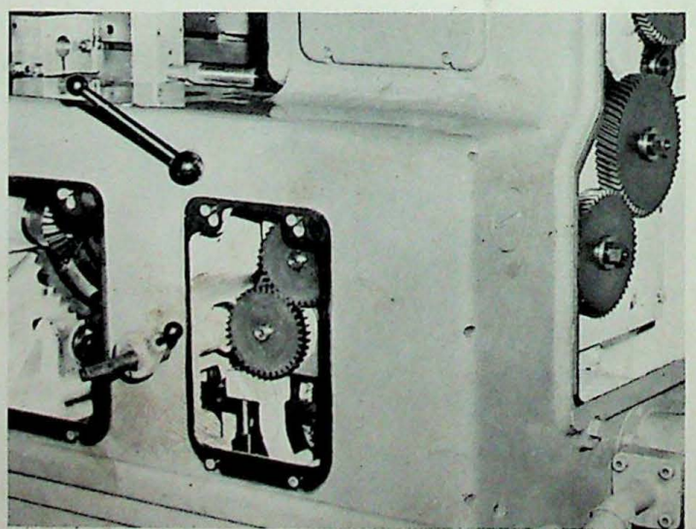
Spindle No. 1	.750
Spindle No. 2	.750
Spindle No. 3	.750
Spindle No. 4	.753
Spindle No. 5	.750
Spindle No. 6	.746

If the form tool is in the third position cross slide, for instance, remove compensating wheel cover on the stop controlling this slide and adjust the compensating stop screw for those positions where the diameters are not right: As an example, in the chart above the diameter of the work from spindle No. 4 is oversize, so stop screw C-4 must be lowered slightly. The work in spindle No. 6 is undersize, so raise stop screw C-6 slightly. Check another piece from each spindle and make additional adjustments if necessary.

CHANGING FEED AND SPEED GEARS

Speed gears are located in the end section of gear box, and are easily changed by removing the gear box cover and mounting helical gears on the splined shafts.

Feed gears are located in the lower right-hand section of the gear box. They are easily changed by removing the front cover plate and mounting pick-off gears on the splined shafts.



MACHINE CONTROLS

Operating levers are conveniently located on both sides of the machine for complete control at all times. Moving operating lever towards the work spindles disengages tool slide feed. Moving it towards the gear box engages tool slide feed.

To hand crank the tool slide, move operating lever forward, place crank on hand feed worm shaft, and rotate hand feed lever clockwise.

Duplicate *electrical controls* are conveniently located on each side of the overarm.

The flow of coolant is controlled by control levers located on both sides of the gear box below the hand feed worm shaft. Move levers counterclockwise to start the flow of coolant and clockwise to stop the flow.

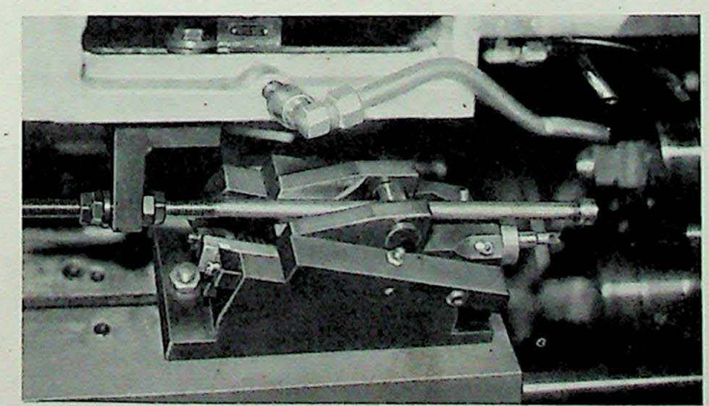
Coolant pressures can be controlled by turning the adjusting stem in or out, the stem is located in the coolant valve bracket. A minimum pressure of 8 lbs. p.s.i. is realized by turning the stem all the way out and a maximum pressure of 24 lbs. p.s.i. by turning the stem all the way in.

SETTING END-WORKING TOOLS

The following is a basic procedure for setting up most end-working tools and attachments, such as; drilling, turning, facing, trepanning, etc.

1. Place tool or attachment in an approximate position on the tool slide.
2. Hand crank the tool slide until the tool slide scale pointer indicates the amount of travel required for the tool.
3. Remove nearest coolant outlet plug and position tool or attachment base over the opening. Adjust tool to proper cutting location and tighten securely.
4. Start the machine with feed lever disengaged and crank the tool slide to its extreme forward position. Coolant should be applied while preliminary cuts are being made to avoid damaging cutting tool.
5. Check length of cut and make any final adjustments that may be necessary.

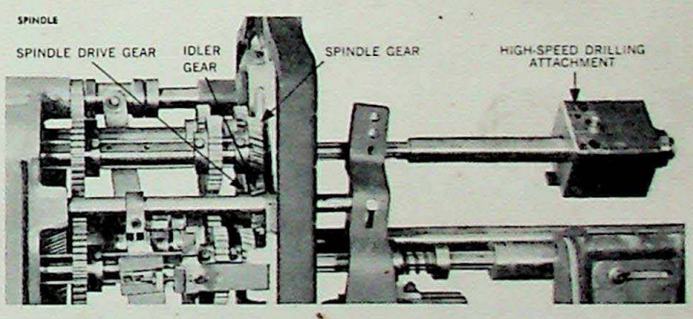
SETTING UP A STANDARD RECESSING ATTACHMENT



After the basic sequence of operations, speeds, feeds, and strokes have been determined and set up, the following steps outline a procedure for setting up and adjusting the draw-back type recessing attachment:

1. With the recess tool in the attachment, place the attachment and the stop-rod assembly in the required position on the toolslide. Check to see if the tool will clear the hole in the work piece. If the tool does not clear the hole, then adjust the stop screw at the base of the dovetail until there is about .010 clearance. Set the cutting edge of the tool on the center line of the work. The distance from the toolslide surface to the center line of the work is 1.594 inches on the 1"-6-spindle automatic and 2.047 inches on the 1-5/8" and 2"-6 spindle automatics.
2. Run the toolslide to its maximum forward position.
3. Move attachment and tool into the drill hole and tighten the attachment down when the cutting edge of the tool is at the required distance from the end of the part.
4. Set stop collar against the stop bracket.
5. Retract toolslide until recess tool clears work piece, and then move attachment forward a distance equal to four times the required depth of the recess. The attachment is designed to provide a lateral movement of ¼ of an inch for every one inch of forward travel on the main tool slide, or at a ratio of four to one.
6. Run the machine through the machining cycle and check part for correct location and depth of the recess. If further adjustment is necessary, move the adjusting screw on the stop bracket or move the stop collar.

INSTALLING HIGH-SPEED DRIVE



All Greenlee Automatics are equipped with a self-contained drive for operating high-speed drilling attachments. The splined shafts of these attachments engage drive sleeves in the gear box which are driven through a gear train from the spindle drive shaft.

The proper idler gear is provided with the attachment to produce the drive ratio required. The attachment is installed as follows:

1. Disengage the threading spindle gear by moving it out of contact with the threading drive gear.

2. Mount the idler gear assembly on the front cover of the gear box.
3. Mesh the idler gear with the spindle drive and high-speed drive gears.
4. Mount the high-speed drilling attachment on the tool slide and adjust in a manner similar to the other end-working tools.

THREADING & TAPPING DRIVE

The drive consists of four ball-bearing splined sleeves which provide facilities for operating threading or tapping attachments in the 3rd, 4th, 5th, or 6th positions. A duplex clutch with two drive gears is mounted on the main spindle drive shaft, which alternates the speed of the threading spindle for threading-in and threading-out or the speed of the tapping spindle for tapping-in and tapping-out. The clutch is actuated by an adjustable shifting mechanism.

In operation, the threading or tapping spindle is driven at alternate speeds by the high and low-speed drive gears on the main spindle drive shaft. These gears mesh with gears mounted on the splined sleeve and rotate the threading or tapping spindle at the required speed. As the threading or tapping spindle advances into the work, it is rotating in the same direction as the work spindle, but at a slower speed, (R.H. thread) thereby allowing the tap or die to feed itself on the work. When the depth of the thread is reached, the clutch is shifted to the high-speed side by a tripping mechanism. This rotates the spindle faster, in the same direction, than the workpiece, allowing the tap or die to back off the work by its own thread. Return movement of the tool slide resets the clutch to the threading speed for the next workpiece.

NOTE: This shifting to the high-speed side of the clutch is not necessary when using a self-opening die head. The die head is opened by a yoke, permitting the chasers to clear the thread on the return stroke.

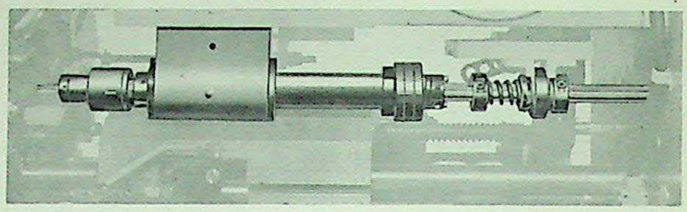
THREADING & TAPPING FEED

Forward and return movements of the spindle are controlled by cams mounted on a spider in the feed box. This cam spider rotates in relation to the movement of the tool slide. Cams are placed on the spider and contact the roller on the operating lever. These levers are connected to the threading spindle and control the forward and return movements.

The cams for loading, returning, and quick-approach of the die or tap are shown in the drawings.

The purpose of the feed cam is to provide the proper starting tension for the die head or tap, while the return cam controls the return of the spindle. The quick-approach is used to advance the die or tap to the work where the feed cam takes over.

SETTING UP FOR THREADING OR TAPPING



Before setting up the threading or tapping attachment the tool slide stroke, spindle rpm, cutting feeds and sequence of operation have to be determined. A general procedure for setting up a threading or tapping operation is outlined below. In this particular case the operation is in the fourth position.

1. Place attachment on the machine in the required position (in this case 4th).
2. Crank the tool slide to the required tool slide feed stroke.
3. Place the threading feed cam on the cam plate in line with the outer edge of the cam plate.
4. Position the cam plate on the spider so that the operating lever roller is on the high point of the feed cam. (Fig. 1).

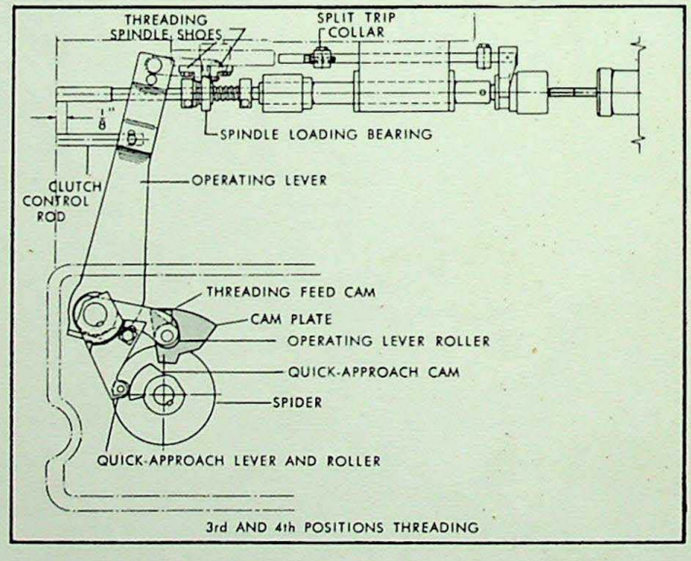


FIGURE 1

5. Make a pencil mark on the clutch control rod 1/8" from the gear box cover. (Fig. 1).
6. Crank back until the pencil mark is even with the face of the gear box cover. This will provide the proper starting tension for the die head or tap.
7. Push the threading spindle forward by hand until the tap or die head touches the area to be threaded (Fig. 1).
8. Set front and rear threading spindle shoes against the spindle loading bearing and tighten in place. (Fig. 1).

9. Crank back until operating lever roller is away from the threading feed cam.

10. Push operating lever forward until the die head or tap is 1/8" from the area to be threaded. With the spindle in this position, set quick approach lever roller against the quick approach cam.

11. Crank forward until the die head or tap touches the area to be threaded. If you are threading with a die head, set the split-trip collar away from the threading spindle bracket a distance equal to the length of threads desired. (The split-trip collar determines the point at which the die head opens). (Fig. 1).

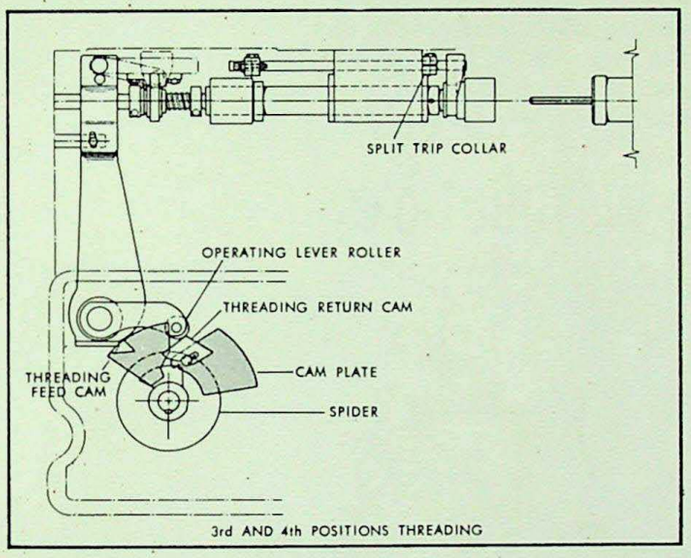


FIGURE 2

12. Run the machine until the toolslide is at its extreme forward position. Place the threading return cam on the cam plate and position the cam plate on spider so the operating lever roller is on the high point of the cam.

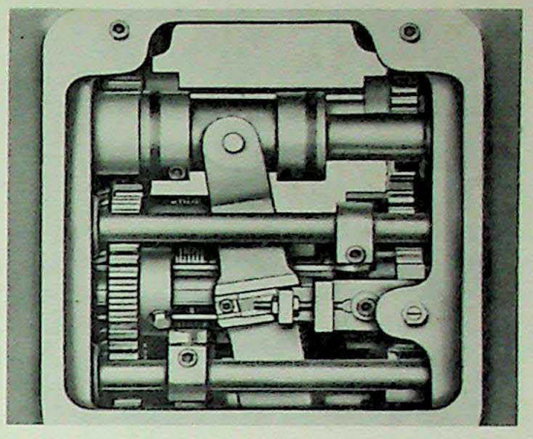
    If you are threading with a die head, close the die head manually and lock the front split-trip collar against the threading bracket. (Fig. 2).

13. Run the machine through the machining cycle and check all settings.

ADJUSTING FOR LEFT-HAND TAPPING OR THREADING

If the machine is set for right-hand threading or tapping, the following changes must be made to set the machine for cutting left-hand threads. First remove the plugs at each end of the control spring sleeve (1) and take out the spring. Remove the inner plug, insert it into the opposite end of the sleeve, and lock it into position. Insert the spring from the opposite end of the sleeve and replace both outer plugs.

Remove the reset cam (located on the rear of the main tool slide), turn it over, and tighten it in place again. Now crank the machine until the tool slide is



as far back as it will go. At this point the cam should have moved the clutch shifting spool over to the high side of the clutch. (Remove the back cover of the main gear box and check to be sure the spool is fully engaged in the clutch.)

Adjustments can be made by shifting the reset cam forward or back, if necessary to assure proper positioning of the clutch spool.

Adjust the trip lever insert (2) to lock against the trip lever block insert (3), holding the clutch in full engagement.

SETTING UP FOR REAMING

All Greenlee Automatics are equipped with a standard cam feed mechanism for accelerated reaming operations. This mechanism controls the accelerated approach, feed stroke, and rapid return movement of the reaming spindle. As in the threading operation, the operating levers which extend upward from the threading feed gear box control the movement of the reaming spindle. The long lever operates attachments for third and fourth position work, and the short lever for fifth and sixth position work.

The reaming attachment consists of a reaming spindle, spindle mounting bracket, operating shoe, collar with stop screw, and the required reaming cam for the operation.

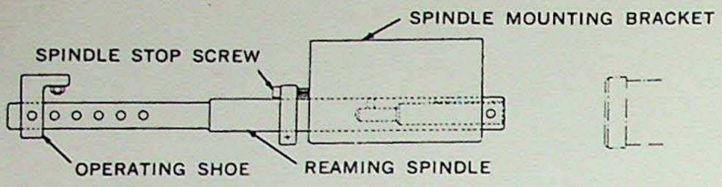
Assuming that the basic sequence of operations, speeds, feeds, and stroke have been determined, and the machine adjusted accordingly, proceed with the following steps:

1. With the spindle carrier at half index position, place attachment, reamer, and floating holder in the required position. Check to see if the reamer clears the workpiece. The spindle mounting bracket should be placed as far forward on the reaming spindle as possible, thus providing adequate support for the reamer. Securely tighten the spindle mounting bracket.

2. Run the machine until the tool slide starts into the feed cycle and stop the machine at this point.

3. Set the forward feed cam approximately 1/16 of an inch in front of the operating lever roller.

4. Crank the machine until the operating lever roller



is on the high point of the feed cam. Move the reamer spindle forward until the cutting edge of the reamer is approximately 1/16 of an inch from the workpiece. Mount the operating shoe on the feed shoe bracket and lock the reaming spindle to the bracket by inserting head pin in hole. Mark location of reaming spindle on back side of spindle mounting bracket.

5. Crank the machine backwards until the reaming spindle retracts a distance equal to the required distance for reaming the part. At this point loosen the operating shoe on the feed shoe bracket and move the spindle forward an equal distance. Tighten the operating shoe. Also set spindle stop screw against spindle mounting bracket.

6. With work spindles rotating, crank the machine until the operating lever roller is past the high point and is clear of the feed cam. At this point set the return cam in front of the roller. Crank the machine to the high point of the return cam. Adjust the return cam until the reamer clears the workpiece about ¼ of an inch. Set lever stop screws at this point.

If the reaming operation is being started beyond the end of the workpiece, as in reaming a counterbored hole, the quick-approach should be used. To set the quick-approach, stop the tool slide when it starts into its feed stroke and advance the reamer until its cutting edge is approximately 1/16 of an inch from the hole to be reamed. With the reamer is this position, lock the quick-approach lever against the quick-approach cam.

MACHINE ADJUSTING INSTRUCTIONS

RAPID-TRAVERSE SIDE OF THE MAIN CLUTCH

The main drive clutches control the slow feed cycle and the rapid approach, or idle cycle, of the Greenlee Automatic. Efficient operations are, therefore, dependent upon proper clutch adjustments.

For maximum efficiency, the clutches should engage positively. When disengaged, the clutches should operate with a minimum of friction. Too loose an adjustment results in slippage; too tight an adjustment prevents full engagement. Either or both conditions cause rapid clutch deterioration.

Because there are numerous locking seats in the adjusting nuts, fine adjustments of the main drive and threading clutches are possible.

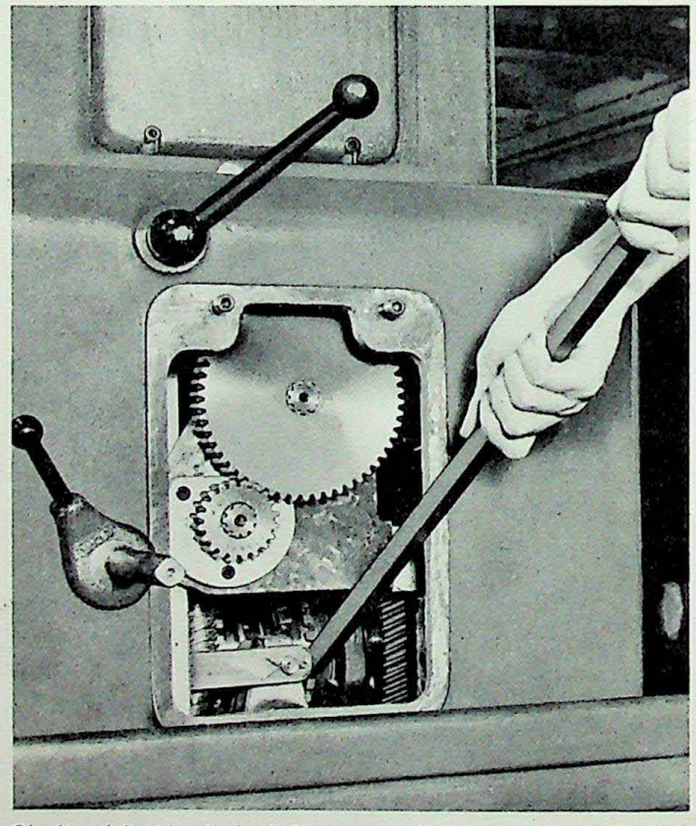
1. Disengage the main drive clutch with control lever while the machine is in rapid-traverse. Then stop the machine and remove the small cover from the lower right side of machine.

2. Check the position of the adjusting nut locking key "M." If necessary, crank the machine until key is rotated to a forward, accessible position.

3. Shift control lever slowly to the right. Now check the position of spool "S." If the clutch is too loose, rollers on the clutch fingers "C" will be found fully engaged on the spool "S."

4. To tighten clutch, shift control lever back to the left, or neutral position. With a screw driver of proper width, pry the locking key "M" from its seat and turn adjusting nut "F" up one notch. The adjusting nut has a lefthand thread.

5. Shift control lever slowly back to the right allowing spool to engage clutch fingers. If the operating spool "S" engages fully, shift the control lever to neutral and move adjusting nut "F" up another notch. Continue this process until the spool does not fully engage.

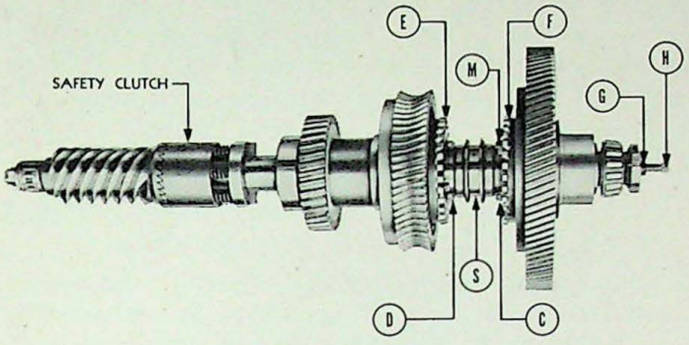


Checking left side of clutch for tension. Bar is placed against clutch shifting lever with the edge of gear box serving as the fulcrum point.

6. Check tension on clutch disc, using a ⅝" bar about 20" long. Move spool "S" to full engagement. When a slight effort is required to fully engage the spool with the bar, the clutch will be in proper adjustment.

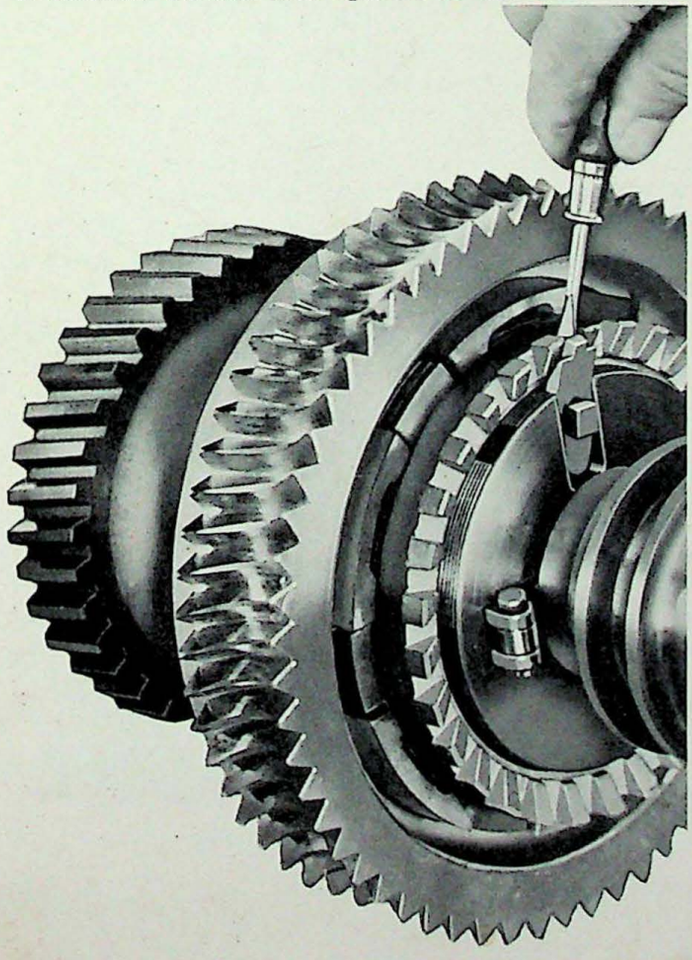
7. When the clutch is too tight, it will take considerable effort to engage the spool with the bar. To loosen the clutch, follow instructions under 4, 5, and 6, except move adjusting nut "F" down one notch at a time until proper tension is obtained.

MAIN DRIVE CLUTCH ASSEMBLY



FEED SIDE OF THE MAIN CLUTCH

Similar steps outlined in instructions 1 through 7 are followed in adjusting the left, or low-speed, side of the clutch. The only difference is that machine is stopped as it shifts into feed stroke with the clutch operating spool "S" engaging on the left-side of the clutch. Adjusting nut "E," with a left-hand thread, provides the means of adjustment; move downward to increase tension and upward to decrease tension.



Sectional view of left or feed side of main drive clutch illustrating how locking key is pried from seat in making tension adjustments.

SAFETY CLUTCH

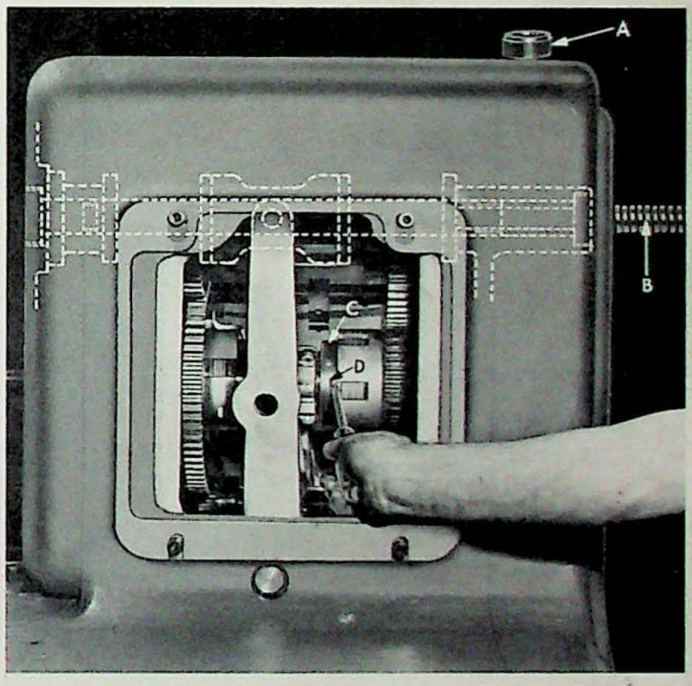
The safety clutch, or rattle clutch as it is sometimes called, is set at the factory to carry peak loads. During normal operation the drive is positive. If extreme torque develops, the safety clutch will slip, and the sharp noises that result warn the operator.

If it is necessary to adjust the safety clutch, remove the cover from the front end of the machine. Loosen the lock nut "G" and reset the clutch adjusting screw "H." Retighten the lock nut "G." WARNING: A high tension adjustment will reduce or eliminate entirely the protective feature of the safety clutch.

THREADING CLUTCH

The threading clutch provides the necessary means for changing the threading spindle speed for cutting right-hand or left-hand threads. Similar to the main drive clutch, its performance is dependent on proper adjustments.

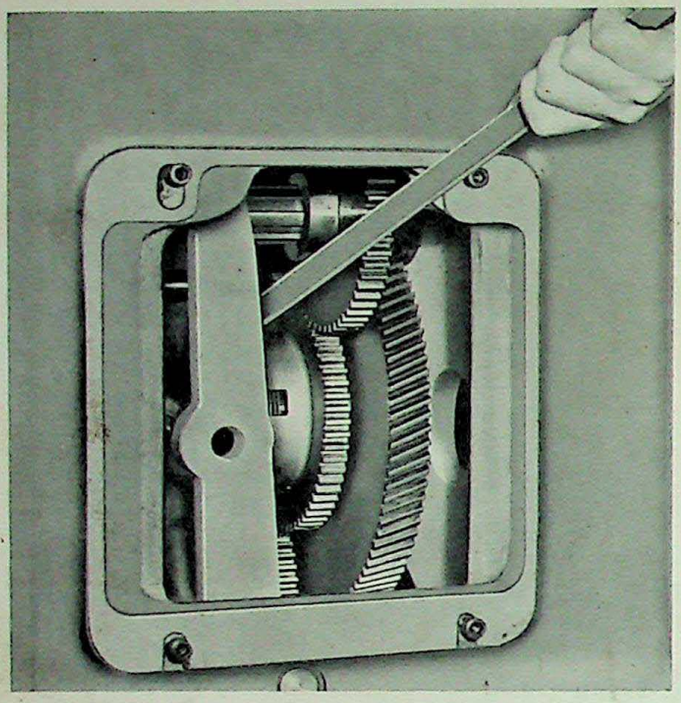
Each side of the threading clutch is adjusted by releasing a spring-loaded locking pin "D" and turning an adjusting ring "C." The adjusting rings have a right-hand thread.



When making adjustments, first release the tension on the spring-loaded, clutch shifting sleeve by removing plug "A" from the front end of the gear box. (If the machine is set up for left-hand threading, also remove the threaded plug from the end of the clutch shifting sleeve.) This will release spring "B" allowing it to protrude through the tapped hole in the front casting of the gear box.

Adjust the clutch, as outlined in paragraph 2, one notch at a time, checking tension with a 5/8" bar about 20" long. Continue to adjust until a slight effort is required to fully engage the clutch spool on each side. If considerable effort is required, the setting is too tight. Make sure the locking pin has been released and is seated before checking tension.

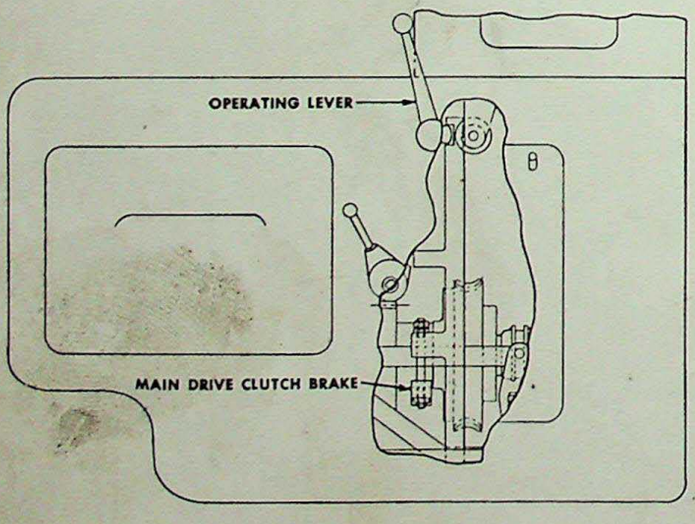
NOTE: On 1" Six-Spindle Machines, adjustments are made from the opposite side of the gear box.



View showing how the threading clutch is checked for tension. Bar is placed against clutch shifting fork. Edge of gear box serves as fulcrum point. Opposite side of clutch is checked in same manner.

MAIN DRIVE CLUTCH BRAKE

The function of the main drive clutch brake is to stop the rotation of the clutch shaft when the operating lever is moved forward. The brake is adjusted by tightening or loosening the adjusting stud nuts. When properly adjusted, the brake will produce a slight resistance on the operating lever as it is moved to its extreme forward position.

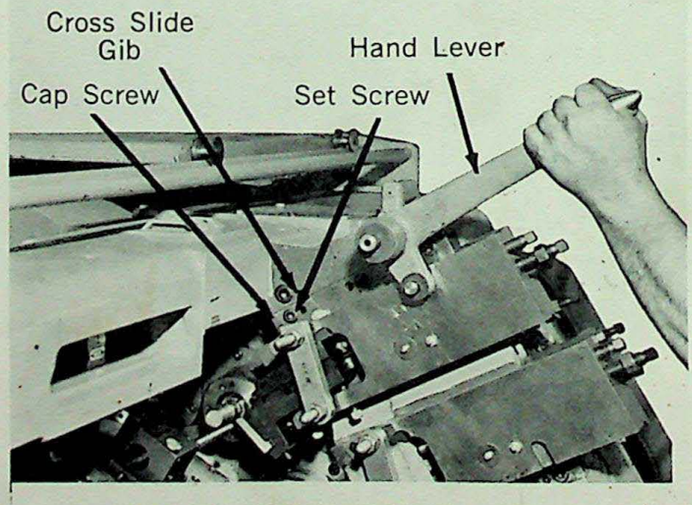


ADJUSTING CROSS SLIDE GIBS

The cross slide gibs on Greenlee Automatics should be adjusted periodically to prevent uneven wear and to insure maximum accuracy for precision work. By following the steps outlined below, the gibs can be set by the operator in a relatively short time. However, before the gibs can be tightened evenly, it is necessary to understand the action of the gib itself as the screws are turned. The cap screw (the one with the largest head) pulls the gibs against the slide when it is turned to the right. The set screw (the smaller of the two) serves as a stop to hold the gib in adjustment. Once properly adjusted, these two screws work together to hold the gib against the slide with just the right amount of pressure. Now proceed as follows:

1. Loosen all cap screws and set screws on the cross slide gib until the cross slide moves freely without any drag.
2. Starting with the center cap screws and set screws, tighten the cap screws until there is a slight drag on the cross slide when moved with the hand operating lever. Tighten set screws until a slight resistance is felt. Back off the cap screw to release the tension, thus allowing the next set of cap screws and set screws to be properly adjusted for tension.
3. Repeat the procedure above for the cap screws and set screws on each end of the gib.
4. Tighten all the cap screws on the gib and check the total amount of drag on the cross slide by using the hand operating lever. The amount of drag should not be greater than the tension of the forming slide spring. The forming slide spring should be able to return the slide.
5. Repeat the process until the required amount of drag on the cross slide is obtained.

Be sure to test each slide with the hand operating lever to see that it does not bind before putting the machine into operation.

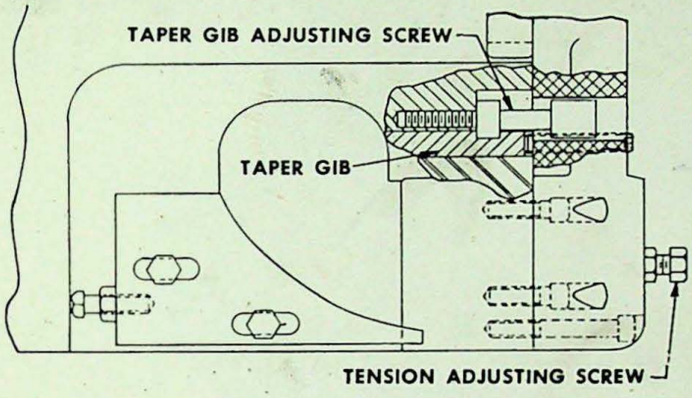


TOOL SLIDE TAPER GIB

A taper gib is located between the tool slide and the left-hand steel way to provide for take up in case of wear. It should be adjusted periodically to prevent uneven wear and to insure maximum accuracy of the main tool slide.

The following steps should be used for adjusting the taper gib:

1. Release the set screw on the left-hand side of the gib adjusting screw.
2. Turn gib adjusting screw clockwise until a slight resistance is encountered when moving the tool slide forward with the hand crank.
3. Tighten the set screw.
4. Back off adjusting screw until it becomes tight, locking taper gib against set screw.



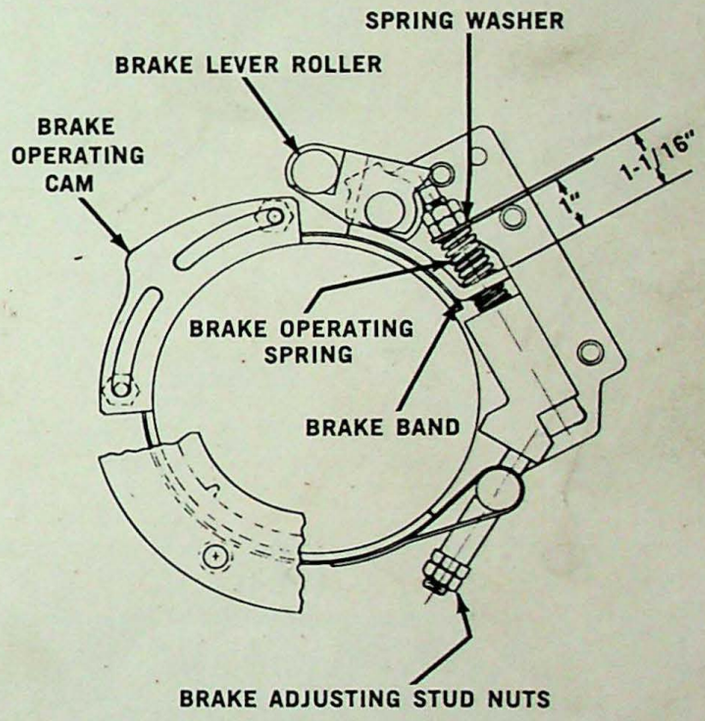
TOOL SLIDE TENSION

The tension of the adjustable stop screw against the hardened steel way should be checked periodically to insure maximum accuracy in the length of end-working operations. Proceed as follows:

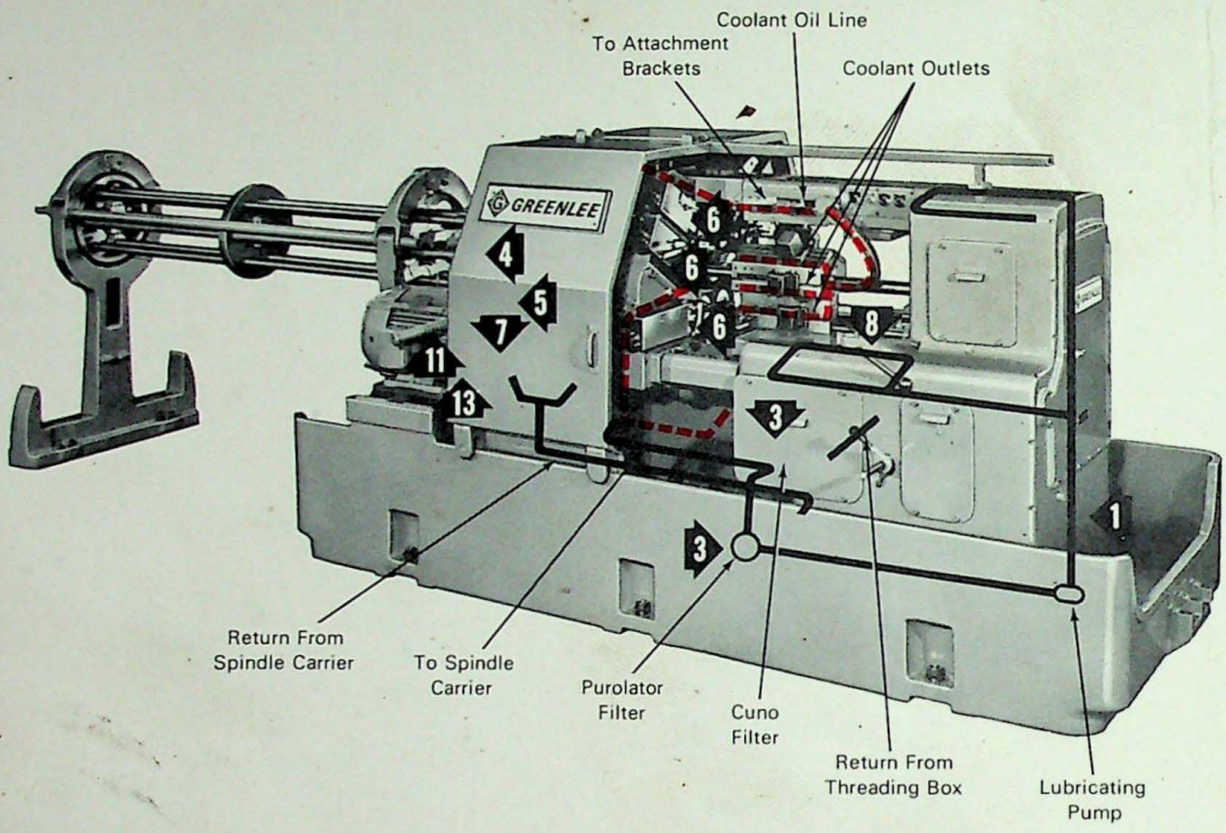
1. Relase locknut and back-off the tension adjusting screw.
2. Place a dial indicator on the tool slide so that it will record the forward movement of the slide.
3. Crank the tool slide to its extreme forward position. Refer to the indicator to determine the maximum forward position.
4. Turn tension adjusting screw until indicator reads between five and seven thousands of an inch tension.
5. Tighten the locknut.

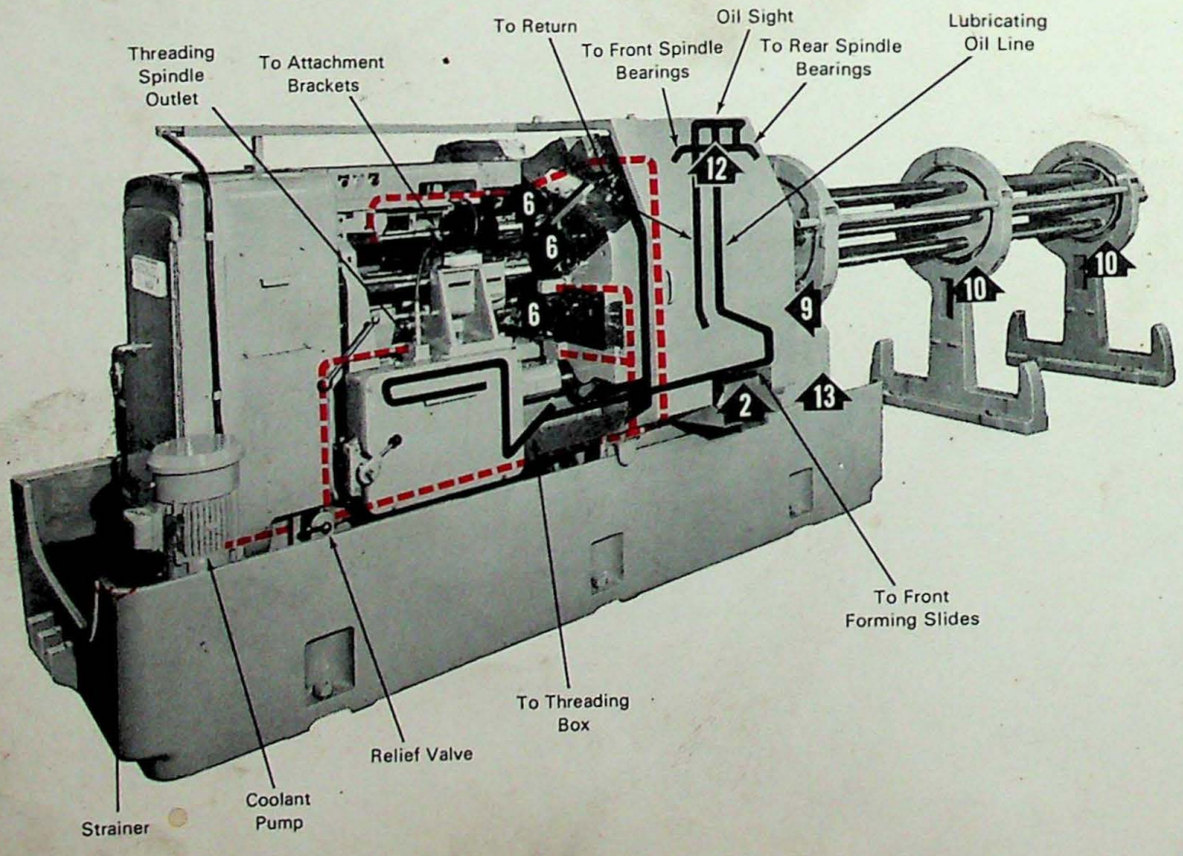
CAM DRUM BRAKE

1. With the brake free of tension, adjust the operating spring until there is 1-1/16 of an inch distance between the spring washer and the brake band anchor bracket.
2. Crank machine until the roller is on the high point of the operating cam and adjust brake adjusting stud nuts until there is one inch distance between the spring and the brake band anchor bracket.



LUBRICATING AND COOLANT SYSTEMS





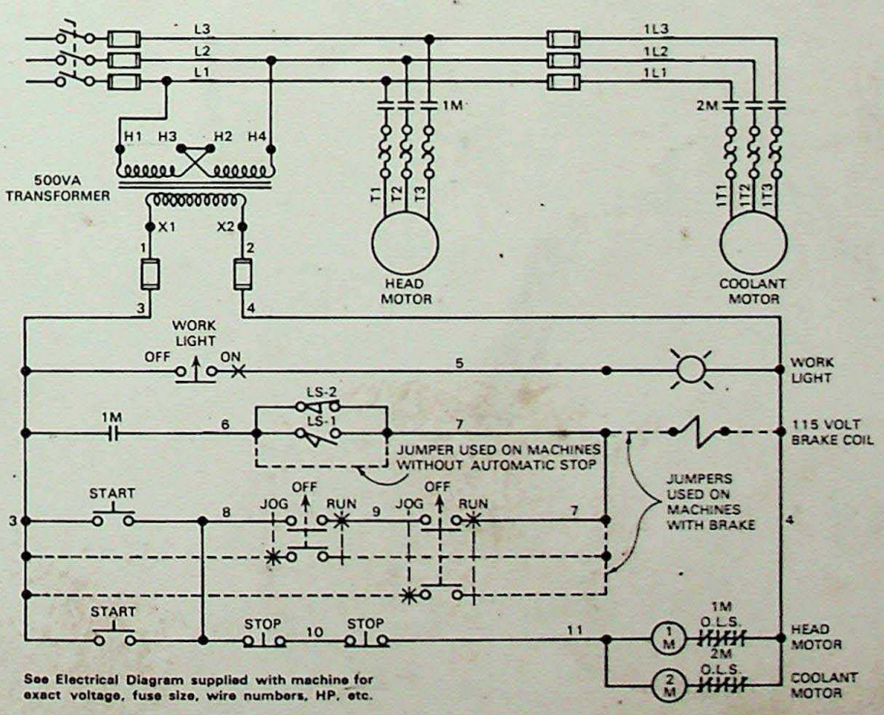
LUBRICATING INSTRUCTIONS FOR GREENLEE AUTOMATICS

A simplified lubricating procedure is illustrated in the chart below. The keyed arrows point to the main area of lubrication while the chart below specifies the type of lubricant, frequency, and method of lubrication. With this chart as a guide the machine operator or lubrication maintenance man can inspect and service the machine in a matter of minutes.

KEY	APPLICATION	METHOD	FREQUENCY	LUBRICANT
1	Gear box reservoir capacity: 1" - 6 — 32 qt. 1⅝" - 6 — 36 qt. 2" - 6 — 36 qt. 2⅝" - 4 — 36 qt.	Keep oil level to center of sight glass Drain and refill	Check daily Twice yearly	SAE-20 — E.P. oil Viscosity 300 at 100° F.
2	Index gear case reservoir capacity: 1" - 6 — 1½ qt. 1⅝" - 6 — 2½ qt. 2" - 6 — 2½ qt.	Keep oil level to center of sight glass Drain and refill	Check daily Twice yearly	SAE-20 — E.P. oil Viscosity 300 at 100° F.
3	Oil filters (Cuno) Remove plug at bottom to clean) (Purolator) Replace cartridge	Turn handle Drain and clean	Weekly Twice yearly	
4	Feed tube spool lubricators (6)	Grease gun	Daily	Grease
5	Collet spool lubricators	Grease gun	Daily	Grease
6	Forming slide lubricators (All positions)	Grease gun	Daily	Grease
7	Front cam shaft bearing lubricators	Grease gun	Daily	Grease
8	End working tool slide lubricator	Grease gun	Daily	Grease
9	Index gear shaft lubricator	Grease gun	Daily	Grease
10	Stock reel support wheel lubricators	Grease gun	Daily	Grease
11	Electric motors	Oil can Grease gun	Follow manufacturer's instructions	Oil Grease
12	Spindle oil sight glass		Check daily	
13	Collet and feed shoe lubricators	Grease gun	Daily	Grease

STANDARD ELECTRICAL WIRING DIAGRAM FOR GREENLEE AUTOMATICS

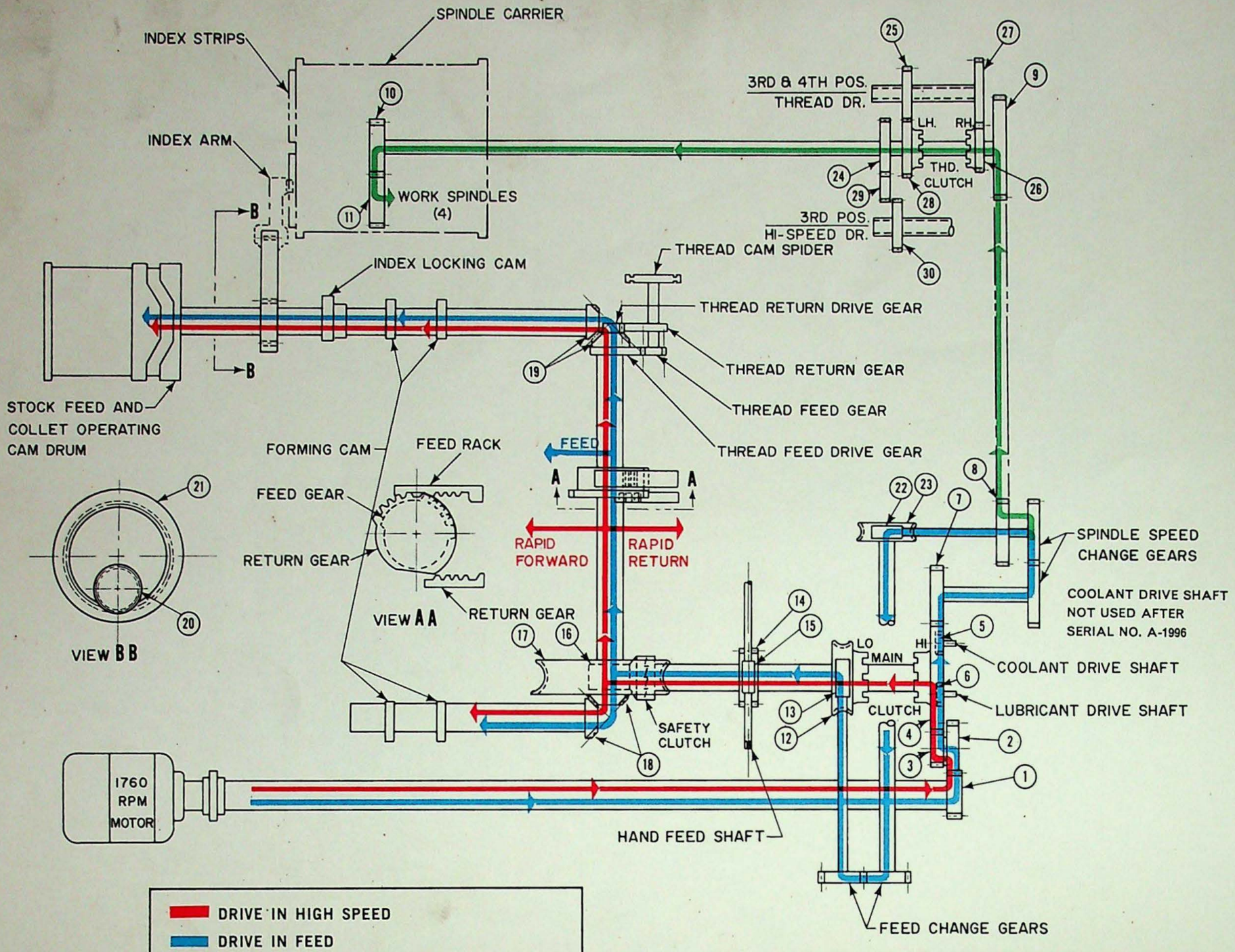
BASIC ELECTRICAL WIRING DIAGRAM FOR GREENLEE AUTOMATICS



See Electrical Diagram supplied with machine for exact voltage, fuse size, wire numbers, HP, etc.

THIS DIAGRAM CONFORMS TO "OSHA," "JIC," AND "GM" SPECIFICATION.

GEAR TRAIN FOR 6 SPINDLE AUTOMATIC



KEY	NAME OF GEAR	NUMBER OF TEETH ON GEAR		
		1" - 6	1⅝" - 6	2" - 6
		Standard Speed	Standard Speed	Standard Speed
1	Motor Pinion Gear	26	28	28
2	Front Gear	50	59	59
3	Back Gear	30	29	29
4	Hi-Speed Clutch Gear	99	99	99
5	Lubricant Drive Gear	26	26	26
* 6	Coolant Drive Gear	23	20	20
7	Bottom Intermediate Gear	55	51	51
8	Top Intermediate Gear	60	61	61
9	Front Spindle Drive Gear	66	92	92
10	Rear Spindle Drive Gear	59	67	67
11	Spindle Gears (6)	30	42	42
12	Feed Worm Gear	60	60	60
13	Lower Feed Worm	4 Threads	4 Threads	4 Threads
14	Hand Feed Gear	38	38	38
15	Hand Feed Worm	2 Threads	2 Threads	2 Threads
16	Drive Worm	6 Threads	6 Threads	6 Threads
17	Tool Slide Worm Gear	55	55	55
18	Front Bevel Gears (2)	17	17	17
19	Rear Bevel Gears (2)	22	22	22
20	Index Drive Gear	23	28	28
21	Geneva Crank Gear	46	56	56
22	Geneva Plate Gear	46	56	56
23	Index Gear	69	84	84
24	Upper Feed Worm	2 Threads	2 Threads	2 Threads
25	Speed Worm Gear	30	30	30
26	Threading Drive Gear (L.H. Thds.)	70	79	79
27	Threading Spindle Gear (L.H. Thds.)	26	37	37
28	Threading Drive Gear (R.H. Thds.)	54	61	61
29	Threading Spindle Gear (R.H. Thds.)	42	55	55
30	Hi-Speed Drive Gear	59	67	67
31	Idler Gear (Std. Ratio)	19	23	23
32	Hi-Speed Spindle Gear (Std. Ratio)	26	32	32

* Not used after serial No. A-1996

THREADING RATIOS

The threading spindle rotates in the same direction as the work spindle but at a different speed. For right-hand threading, the threading spindle runs slower than the work spindle and for left-hand threading, the threading spindle runs faster than the work spindle. The difference in speed between the work spindle and the threading spindle determines the threading ratio.

Example:

When cutting with a right-hand tap or die, or returning a left-hand tap or die, the operating speed of the threading spindle is determined by the following formula:

Work Spindle Speed x R.H. Threading Ratio =
Threading Spindle Cutting Speed in R.P.M.

When cutting with a left-hand tap or die, or returning a right-hand tap or die, the formula is as follows:

Work Spindle Speed x L.H. Threading Ratio =
Threading Spindle Cutting Speed in R.P.M.

The chart below lists the standard threading ratios for the 1" - 6, 1⅝" - 6, and 2" - 6 spindle Automatics.

MACHINE SIZE	THREADING RATIO	
	RIGHT HAND	LEFT HAND
1" - 6	35%	37%
1⅝" - 6 2" - 6	30%	34%

HIGH SPEED DRILLING RATIOS

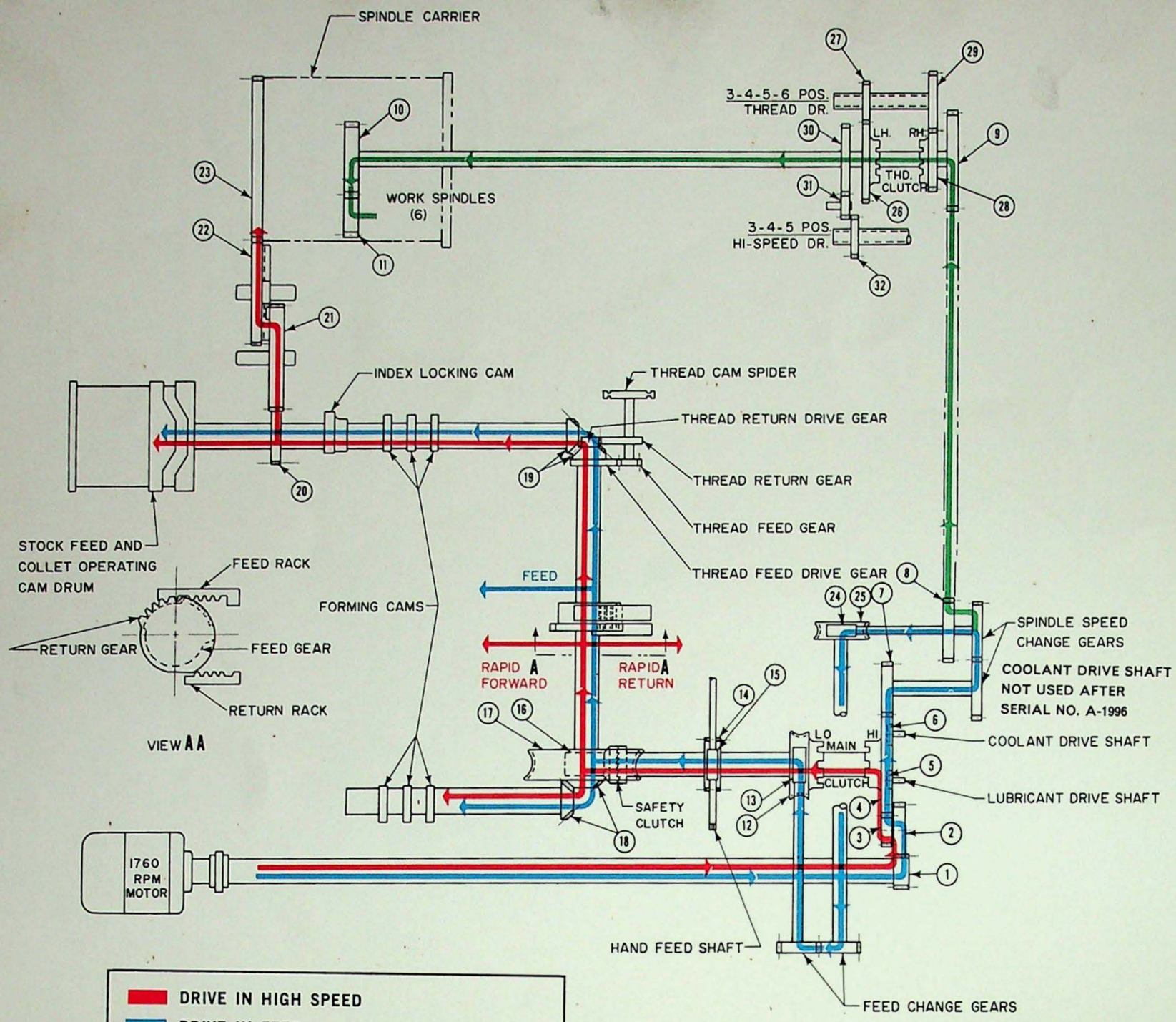
The high speed drilling spindle rotates in the opposite direction to that of the work spindle and at a speed proportionally faster than the work spindle. When calculating the drilling spindle cutting speed in R.P.M., use the following formula:

Work Spindle Speed x High Speed Ratio =
Drilling Spindle Cutting Speed in R.P.M.

The chart below lists the standard high speed drilling ratios for the 1" - 6, 1⅝" - 6, and 2" - 6 spindle Automatics.

MACHINE SIZE	STANDARD RATIO
1" - 6	2.15:1
1⅝" - 6 2" - 6	2.3:1

GEAR TRAIN FOR 4 SPINDLE AUTOMATIC



KEY	NAME OF GEAR	NUMBER OF TEETH ON GEAR
		2⅝" - 4
1	Motor Pinion Gear	26
2	Front Gear	61
3	Back Gear	29
4	Hi-Speed Clutch Gear	99
5	Lubricant Drive Gear	26
*6	Coolant Drive Gear	20
7	Bottom Intermediate Gear	51
8	Top Intermediate Gear	66
9	Front Spindle Drive Gear	74
10	Rear Spindle Drive Gear	51
11	Spindle Gears (6)	51
12	Feed Worm Gear	60
13	Lower Feed Worm	4 Threads
14	Hand Feed Gear	38
15	Hand Feed Worm	2 Threads
16	Drive Worm	6 Threads
17	Tool Slide Worm Gear	55
18	Front Bevel Gears (2)	17
19	Rear Bevel Gears (2)	22
20	Index Drive Gear	20
21	Index Gear	40
22	Upper Feed Worm	2 Threads
23	Speed Worm Gear	30
24	Threading Drive Gear (L.H. Thds)	61
25	Threading Spindle Gear (L.H. Thds.)	45
26	Threading Drive Gear (R.H. Thds.)	43
27	Threading Spindle Gear (R.H. Thds.)	63
28	Hi-Speed Drive Gear	51
29	Idler Gear (Std. Ratio)	26
30	Hi-Speed Spindle Gear (Std. Ratio)	46

*Not used after serial No. A-1996

THREADING RATIOS

The threading spindle rotates in the same direction as the work spindle but at a different speed. For right-hand threading, the threading spindle runs slower than the work spindle and for left-hand threading, the threading spindle runs faster than the work spindle. The difference in speed between the work spindle and the threading spindle determines the threading ratio.

EXAMPLE: When cutting with a right-hand tap or die, or returning a left-hand tap or die, the operating speed of the threading spindle is determined by the following formula:

Work Spindle Speed x R.H. Threading Ratio =
Threading Spindle Cutting Speed in R.P.M.

When cutting with a left-hand tap or die, or returning a right-hand tap or die, the formula is as follows:

Work Spindle Speed x L.H. Threading Ratio =
Threading Spindle Cutting Speed in R.P.M.

The chart below lists the standard threading ratios for the 2⅝" - 4 spindle Automatics.

MACHINE SIZE	THREADING RATIO	
	RIGHT HAND	LEFT HAND
2⅝" - 4	32%	35%

HIGH SPEED DRILLING RATIOS

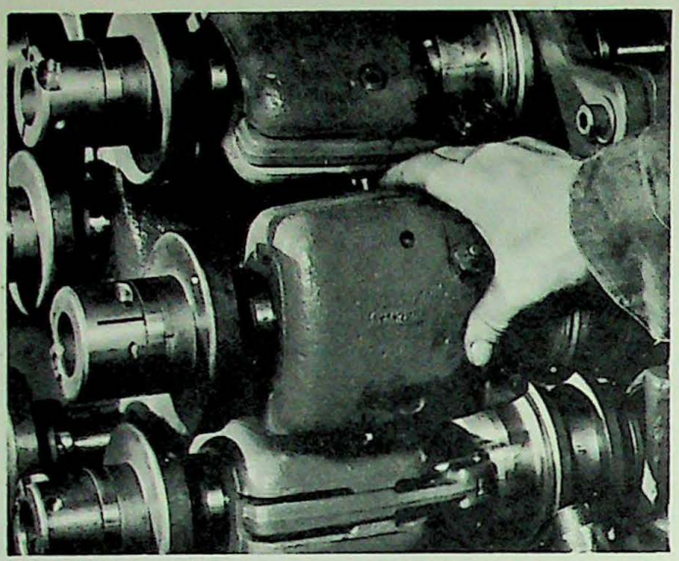
The high speed drilling spindle rotates in the opsite direction to that of the work spindle and at a speed proportionately faster than the work spindle. When calculating the drilling spindle cutting speed in R.P.M., use the following formula:

Work Spindle Speed x High Speed Ratio =
Drilling Spindle Cutting Speed in R.P.M.

The chart below lists the standard high speed drilling ratios for the 2⅝" - 4 spindle Automatics.

MACHINE SIZE	STANDARD RATIO
2⅝" - 4	2.1:1

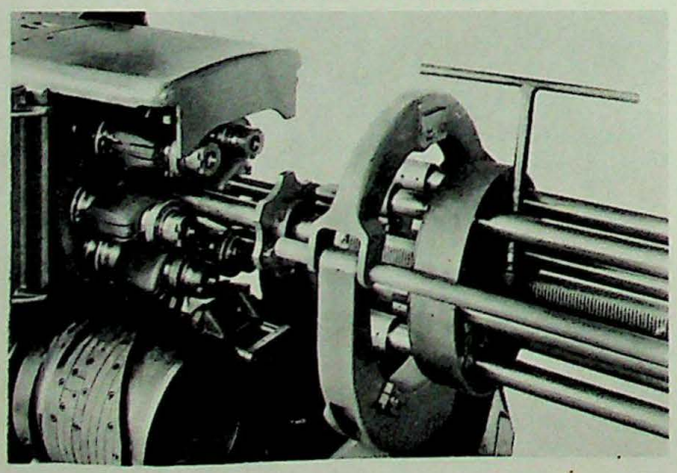
ADJUSTING COLLET TENSION



Load stock into spindle and check collet tension by opening and closing the collet with the collet hand lever. If the tension has to be adjusted, then proceed with the following steps:

1. Loosen the chuck body plunger nut until the chuck body plunger can be disengaged from the slot in the spindle.
2. Turn the collet lever body clockwise to loosen or counterclockwise to tighten the tension on the collet.
3. Open and close the collet by using the collet hand operating lever, checking to see if there is enough tension on the collets. Greater tension will be required when larger endworking tools are being used.
4. Re-engage the chuck body plunger with the slot in the spindle and tighten the chuck body plunger nut.

CHANGING PUSHERS



1. Loosen locking screw on stock reel and move the stock reel to the rear on the center shaft with the T-wrench until there is sufficient clearance for changing pusher tubes.
2. Pull out plunger on safety plate and turn plate until feed tube is free to move to the rear. Remove feed tube.
3. Screw stock pusher (left-hand thread) on pusher tube and replace in spindle.
4. Return the stock reel and safety plate to their original position.

CHANGING CROSS-SLIDE CAMS

1. Stop machine at the ½ index point of the spindle carrier.
2. Remove cam collar locking pins. Remove all four pins from the two camshafts if all cams require changing.
3. Jog the spindle carrier just enough to complete the index, stopping the machine before the end-working tool-slide starts its forward stroke.
4. Slide the cam locking collars away. Change cams. Return the locking collars to position.
5. Jog the machine again until the end-working tool-slide starts into the feed stroke.
6. Replace cam collar locking keys. Tap with hammer to make sure they fit tightly.

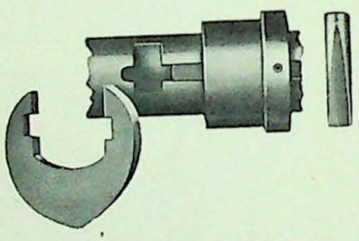


Fig. 1 *Sectional view shows the sliding cam-carrier on shaft with cam and lock-pin removed.*

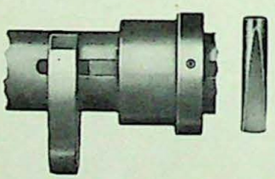


Fig. 2 *Cam slips easily into place on shaft with slots in alignment with offset key ways.*

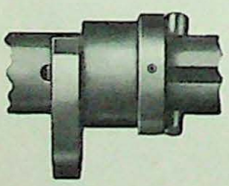
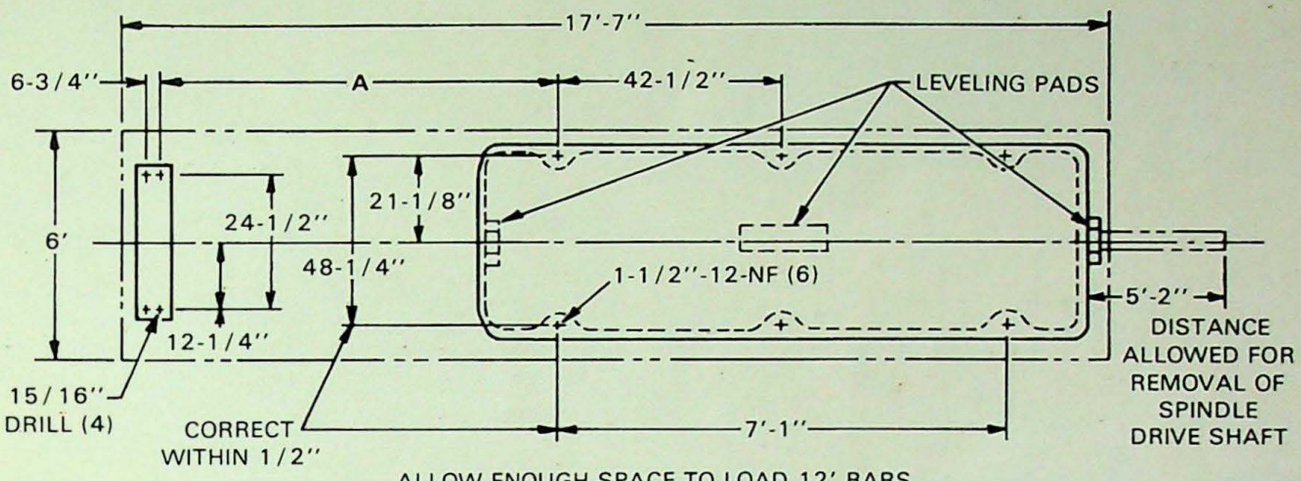
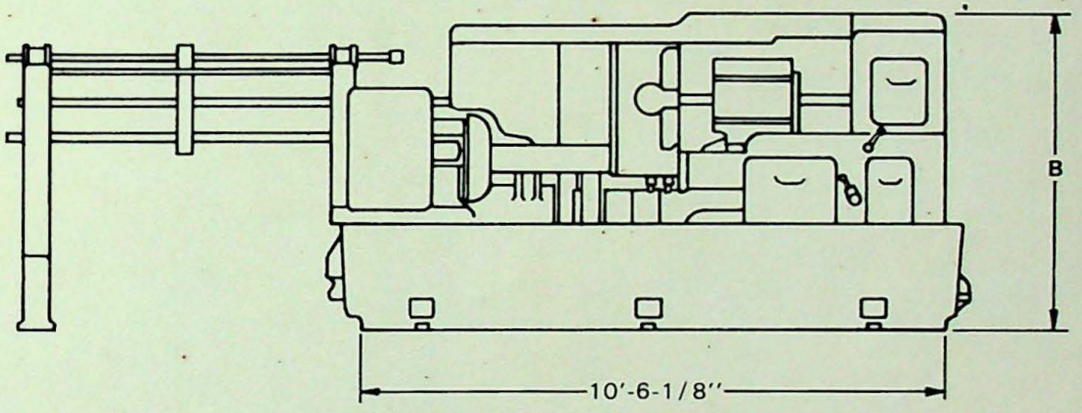


Fig. 3 *The sliding carrier with keys attached quickly locks cam in proper position on shaft.*

Jogging the machine as outlined in steps 3 and 5 rotates the cams and locking keys to a position of maximum accessibility. NOTE: Cams fit only one way on camshaft. There is no danger of improper installation. Furthermore, all are designed with a uniform high point. You can, therefore, change them without having to re-adjust tools or holders.

FLOOR PLAN FOR 2-5/8"-4 SPINDLE AUTOMATICS





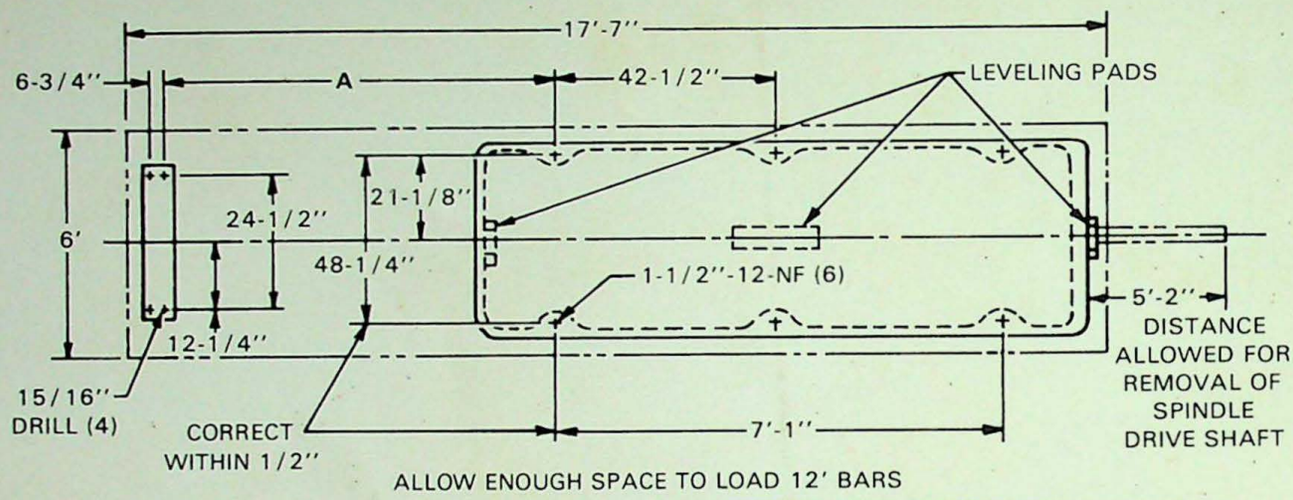
MACHINE SIZE	DIMENSIONS	
	A	B
2-5/8"-4	7'-3-1/16"	5'-2-5/8"

NOTE: Level stock reel by placing level on stock reel center shaft.
Level machine by placing level on the leveling pads.

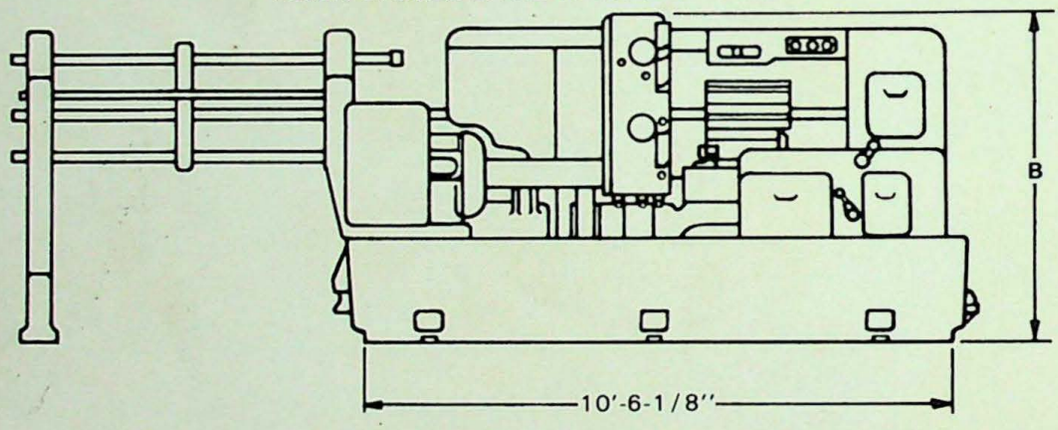
Machine serial number stamped on the top front side of the tool slide.

SPECIFICATIONS	MACHINE SIZE
	2-5/8"-4
Motor Horsepower	20
Motor R.P.M.	1800
Net Weight in Pounds	16510
Domestic Shipping Weight in Pounds	16960
Boxed for Export — Approximate Weight in Pounds	19500
Boxed for Export — Cubic Feet	580

FLOOR PLAN FOR 1"-6, 1-1/4"-6, 1-5/8"-6, 2"-6 & 2-1/4"-6 SPINDLE AUTOMATICS



ALLOW ENOUGH SPACE TO LOAD 12' BARS



MACHINE SIZE	DIMENSIONS	
	A	B
1"-6 & 1-1/4"-6	8'-1/8"	5'-2"
1-5/8"-6, 2"-6 & 2-1/4"-6	7'-3-11/16"	5'-6"

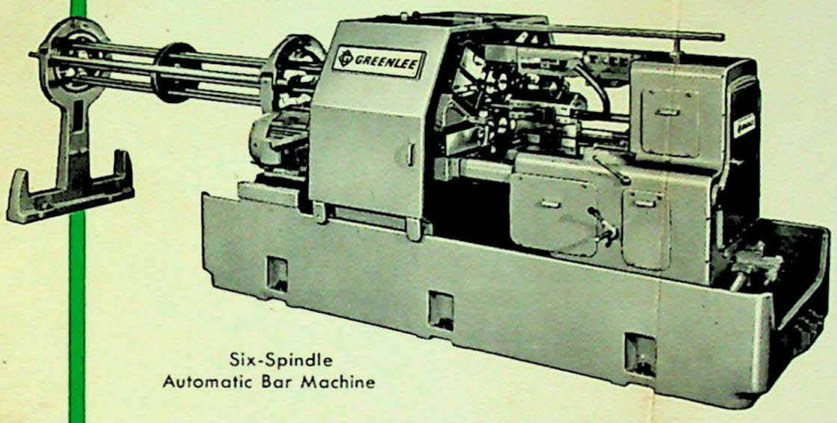
NOTE: Level stock reel by placing level on stock reel center shaft.
Level machine by placing level on the leveling pads.

Machine serial number stamped on the top front side of the tool slide.

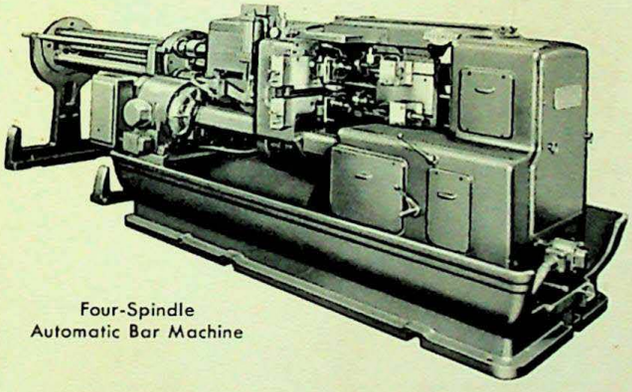
SPECIFICATIONS	MACHINE SIZE		
	1"-6	1-5/8"-6	2"-6
Motor Horsepower	15	20	25
Motor R.P.M.	1800	1800	1800
Net Weight in Pounds	14400	17940	18150
Domestic Shipping Weight in Pounds	14850	18390	18500
Boxed for Export — Approximate Weight in Pounds	17000	22000	22000
Boxed for Export — Cubic Feet	530	580	580

GREENLEE

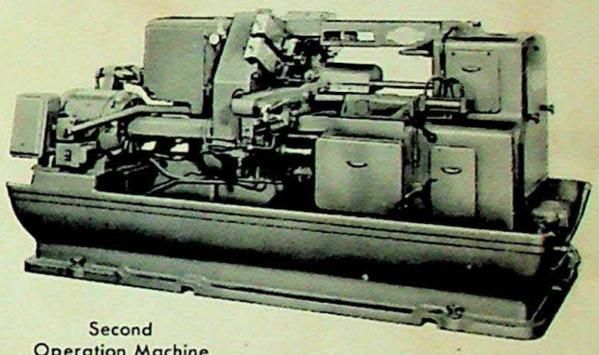
AUTOMATIC BAR MACHINES



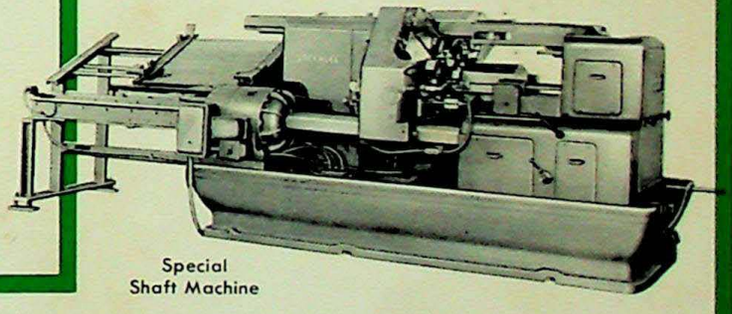
Six-Spindle
Automatic Bar Machine



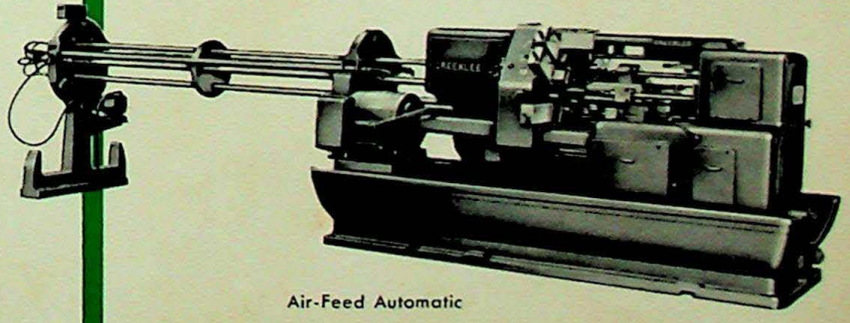
Four-Spindle
Automatic Bar Machine



Second
Operation Machine



Special
Shaft Machine



Air-Feed Automatic

GREENLEE BROS & CO
2136 12th St., Rockford, Ill. 61101 U.S.A.
A Unit of Ex-Cell-O Corporation XLO

Printed in U.S.A.

6-73-1MWH

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