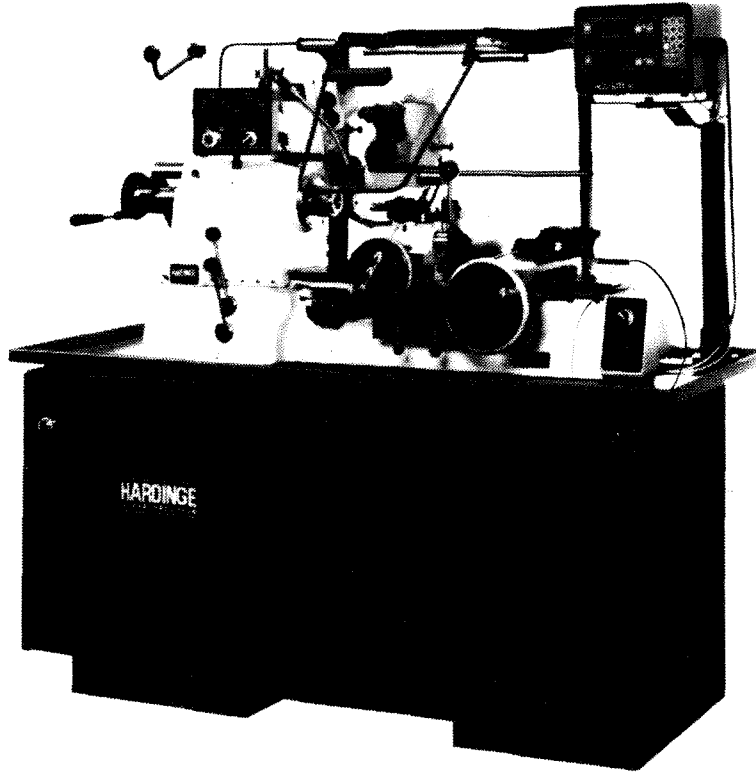


HARDINGE
SUPER-PRECISION

MAINTENANCE MANUAL



HC[®] Chucking Machine shown equipped with optional Threading Unit and Acu-Rite[®] III Digital Readout

HARDINGE HIGH SPEED SUPER-PRECISION[®] HC CHUCKING MACHINE

This maintenance manual applies to machines
with serial number HC-8495-T or higher.

HARDINGE BROTHERS, INC.
ELMIRA, NEW YORK 14902

Manual No. M-9C
Part No. M C-0009500-0009

Litho in U.S.A.
November, 1989

Information in this manual is subject to change without notice.

This manual covers the maintenance of the Hardinge Super-Precision® HC Chucking Machine.

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READ COMPLETE INSTRUCTIONS CAREFULLY BEFORE OPERATING MACHINE

When this instruction book was printed, the information given was current. However, since we are constantly improving the design of our machine tools, it is possible that the illustrations and descriptions may vary from the machine you received.

- WARNING -

Occupational Safety and Health Administration (OSHA) Hazard Communication Standard 1910.1200, effective May 25, 1986, and various state "employee right-to-know laws" require that information regarding chemicals used with this equipment be supplied to you. A complete list of the chemicals used with this machine, their reference data sheet numbers, and their suppliers appears as an insertion at the end of this manual. Refer to the applicable section of the Material Safety Data Sheets supplied with your machine when handling, storing, or disposing of chemicals.

HARDINGE SAFETY RECOMMENDATIONS

Your Hardinge machine is designed and built for maximum ease and safety of operation.

However, some previously accepted shop practices may not reflect current safety regulations and procedures, and should be reexamined to insure compliance with the current safety and health standards.

Hardinge Brothers recommends that all shop supervisors, maintenance personnel, and machine tool operators be advised of the importance of safe maintenance, setup, and operation of Hardinge-built equipment. Our recommendations are described below. **READ THESE SAFETY RECOMMENDATIONS BEFORE PROCEEDING ANY FURTHER.**

READ THE APPROPRIATE MANUAL OR INSTRUCTIONS before attempting operation or maintenance of the machine. Make sure you understand all instructions.

CONSULT YOUR SUPERVISOR when in doubt as to the correct way to do a job.

DON'T OPERATE EQUIPMENT unless proper maintenance has been regularly performed and the equipment is known to be in good working order.

DON'T REMOVE any warning or instruction tags from machine.

DON'T OPERATE EQUIPMENT if unusual or excessive heat, noise, smoke, or vibration occurs. Report any excessive or unusual vibration, sounds, smoke, or heat as well as any damaged parts.

MAKE SURE equipment is properly grounded. Consult National Electric Code and all local codes.

DISCONNECT MAIN ELECTRICAL POWER before attempting repair or maintenance.

DON'T REACH into any control or power case area unless electrical power is OFF.

DON'T TOUCH ELECTRICAL EQUIPMENT when hands are wet or when standing on a wet surface.

ALLOW ONLY AUTHORIZED PERSONNEL to have access to enclosures containing electrical equipment.

DON'T ALLOW the operation or repair of equipment by untrained personnel.

REPLACE BLOWN FUSES with fuses of the same size and type as originally furnished.

ASCERTAIN AND CORRECT cause of a shutdown caused by overload heaters before starting machine.

WEAR SAFETY GLASSES AND PROPER FOOT PROTECTION at all times. When necessary, wear respirator, helmet, gloves and ear muffs or plugs.

KEEP AREA THE AROUND THE MACHINE well lighted and dry.

KEEP CHEMICAL AND FLAMMABLE MATERIAL away from electrical or operating equipment.

HAVE THE CORRECT TYPE OF FIRE EXTINGUISHER handy when machining combustible material and keep chips clear of the work area.

DON'T USE a toxic or flammable substance as a solvent cleaner or coolant.

MAKE SURE PROPER GUARDING is in place and all doors are closed and secured.

TO REMOVE OR REPLACE the collet closer it is necessary to remove the guard door at left end of the machine. Make certain the guard door is replaced before starting the machine.

DON'T ALTER THE MACHINE to bypass any interlock, overload, disconnect or other safety device.

DON'T OPEN GUARD DOORS while any machine component is in motion.

MAKE SURE chucks, closers, fixture plates and all other spindle-mounted work-holding devices are properly mounted and secured before starting machine.

MAKE CERTAIN all tools are securely clamped in position before starting machine.

REMOVE ANY LOOSE PARTS OR TOOLS left on machine or in the work area before operating machine. Always check machine and work area for loose tools and parts especially after work has been done by maintenance personnel.

REMOVE CHUCK WRENCHES before starting the machine.

BEFORE PRESSING THE CYCLE START PUSHBUTTON, make certain that proper functions are programmed and that all controls are set in the desired modes.

KNOW WHERE ALL stop pushbuttons are located in case of an emergency.

CHECK THE LUBE LEVEL and the status of indicator lights before operating the machine.

MAKE CERTAIN that all guards are in good condition and are functioning properly before operating the machine.

INSPECT ALL SAFETY DEVICES AND GUARDS to make certain that they are in good condition and are functioning properly before the cycle is started.

CHECK THE TURRET POSITION before pressing the Cycle Start pushbutton.

CHECK SETUP, TOOLING AND SECURITY OF WORKPIECE if the machine has been OFF for any length of time.

DRY CYCLE a new setup to check for programming errors.

MAKE CERTAIN you are clear of any "pinch point" created by moving slides before starting the machine.

DON'T OPERATE any equipment while any part of the body is in the proximity of a potentially hazardous area.

DON'T REMOVE CHIPS with hands. Use a hook or similar device and make certain that all machine movements have ceased.

BE CAREFUL of sharp edges when handling newly machined workpieces.

DON'T REMOVE OR LOAD workpieces while any part of the machine is in motion.

DON'T OPERATE ANY MACHINE while wearing rings, watches, jewelry, loose clothing, neckties or long hair not contained by a net or shop cap.

DON'T ADJUST tooling or coolant hoses while the machine is running.

DON'T LEAVE tools, workpieces or other loose items where they can come in contact with a moving component of the machine.

DON'T CHECK finishes or dimensions of workpiece near running spindle or moving slides.

DON'T JOG SPINDLE in either direction when checking threads with a thread gage.

DON'T ATTEMPT to brake or slow the machine with hands or any makeshift device.

ANY ATTACHMENT, TOOL OR MACHINE MODIFICATION not obtained from Hardinge Brothers, Inc., must be reviewed by a qualified safety engineer before installation.

USE CAUTION around exposed mechanisms and tooling especially when setting up. Be careful of sharp edges on tools.

DON'T USE worn or defective hand tools. Use the proper size and type for job being performed.

USE ONLY a soft-faced hammer on turret tools and fixtures.

DON'T USE worn or broken tooling on machine.

MAKE CERTAIN that all tool mounting surfaces are clean before mounting tools.

INSPECT ALL CHUCKING DEVICES daily to make sure they are in good operating condition.

REPLACE DEFECTIVE CHUCK before starting machine.

USE MAXIMUM ALLOWABLE gripping pressure on the chuck. Consider weight, shape and balance of workpiece.

USE LIGHTER THAN NORMAL feedrates and depth of cut when machining a workpiece diameter that is larger than the gripping diameter.

DON'T EXCEED the rated capacity of machine.

DON'T LEAVE the machine unattended while it is operating.

DON'T CLEAN the machine with an air hose.

DON'T OVERFILL tote pans.

KEEP TOTE PANS a safe distance from machine.

DON'T LET STOCK project past the back end of the collet closer or machine spindle without being adequately covered and properly supported.

USE FEED TUBE BUSHINGS when using a bar feed.

MAKE CERTAIN that any bar feed mechanism is properly aligned with spindle. If floor-mounted type, it must be securely bolted to floor.

FOR YOUR PROTECTION - WORK SAFELY

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- NOTES -

CHAPTER 1 - CARRIAGE

CARRIAGE DISASSEMBLY

1. Place a drain pan capable of holding one pint of liquid under drain plug "A", Figure 1.1 .
2. Remove and clean magnetic drain plug "A".
3. Allow the reservoir to drain.
4. Remove the drain pan and properly dispose of the used oil.
5. Remove four screws "C", Figure 1.2, and remove handwheel assembly "H", Figure 1.3 .
6. Remove eight screws "D", Figure 1.2, and the two clutch housings.

- NOTE -

Do not misplace the seal under cover "J", Figure 1.4 .

7. Remove two screws "I" and cover "J", Figure 1.4 .
8. Remove nine screws "E" from apron cover "F", Figures 1.2 and 1.4 .

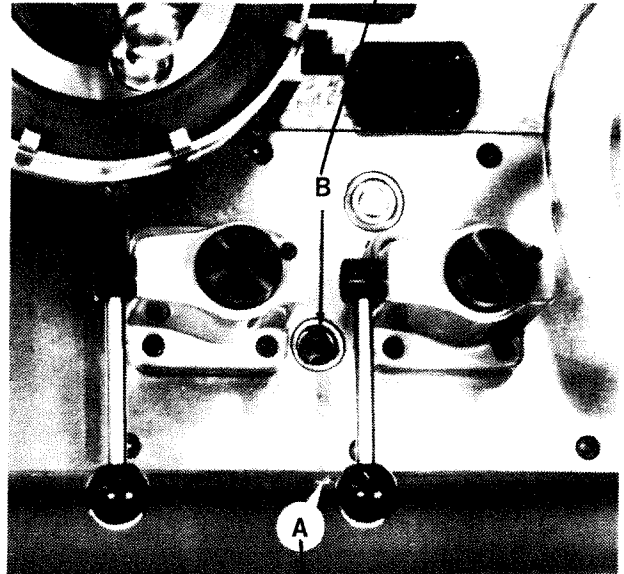


Figure 1.1 - Lubricant Sight Window and Drain Plug

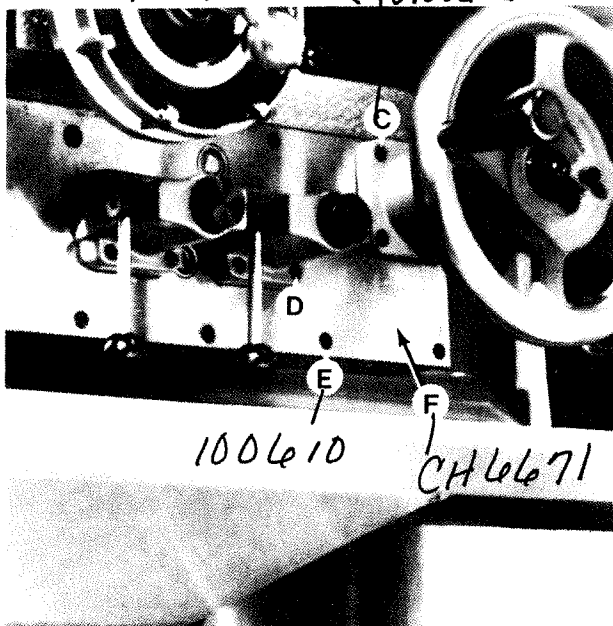


Figure 1.2 - Carriage Clutches and Handwheel

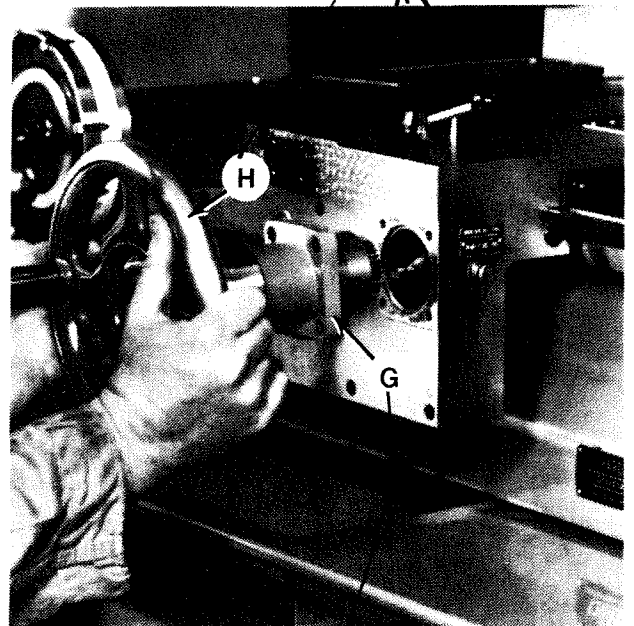


Figure 1.3 - Carriage Handwheel Removal

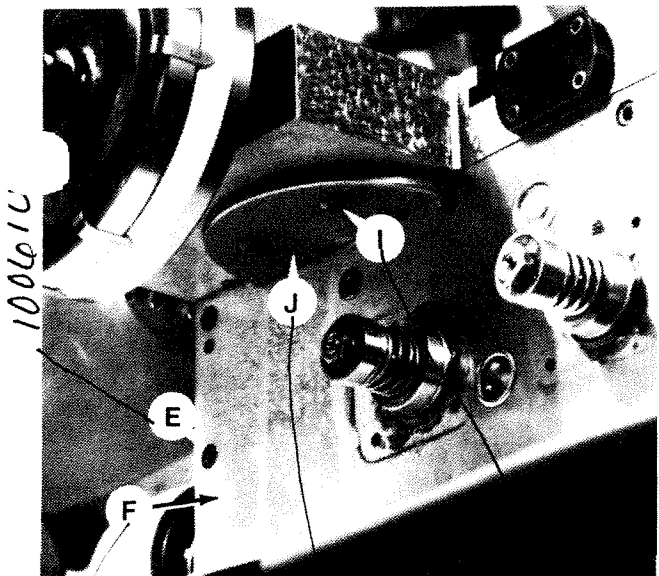


Figure 1.4 - Carriage Cover

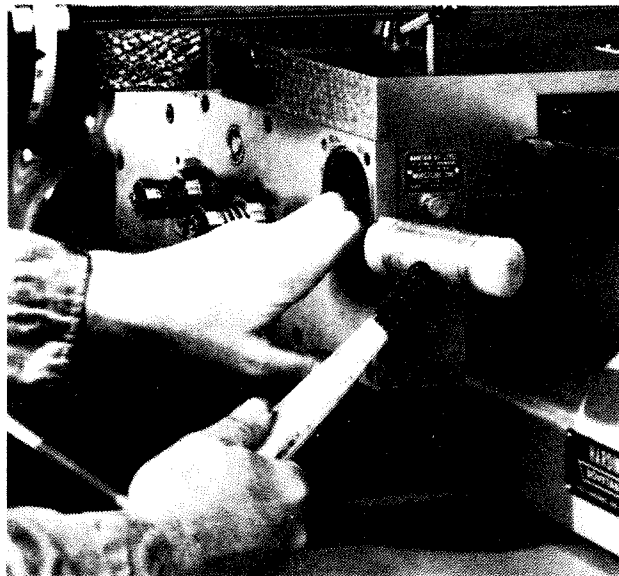


Figure 1.5 - Apron Cover Removal

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- NOTE -

The apron cover is sealed with Permatex sealant.

9. Remove apron cover "F" :

- a) Pull the cover outward with the left hand while striking the edge of the cover with a soft-faced hammer until a crack appears in the sealant. Refer to Figure 1.5 .
- b) Tap the cover back into place.
- c) Repeat steps "a" and "b" until the seal is completely broken and the apron cover can be removed.

- WARNING -

Spring "R", Figure 1.7, is under tension. Use caution when loosening and removing nuts "K" and "L", Figure 1.6 .

- NOTE -

Clutch components on the front side of the apron cover are identical, with the exception of the springs. DO NOT interchange the springs.

10. Carefully loosen and remove nuts "K" and "L", Figure 1.6 .
11. Remove bearing "P", washer "Q", spring "R", spring seat "S", and spacer "T", Figure 1.7 .
12. Remove two nuts "U", Figure 1.7, to remove carriage and cross feed clutch assemblies, Figure 1.8 .

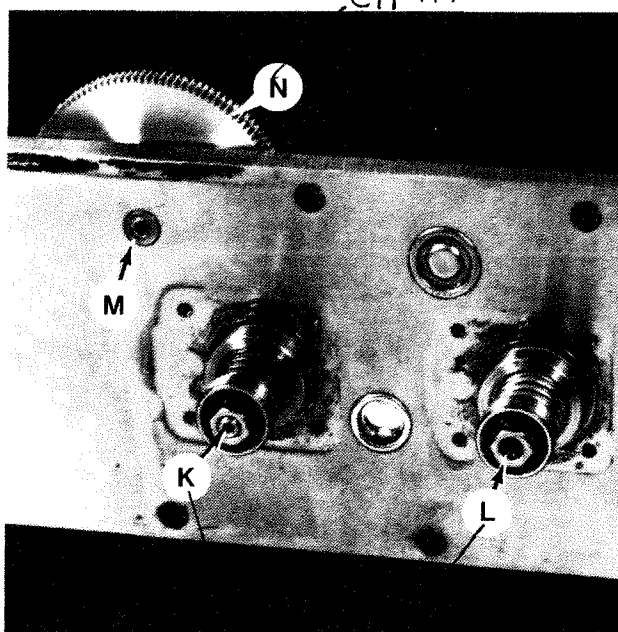


Figure 1.6 - Apron Cover and Clutches

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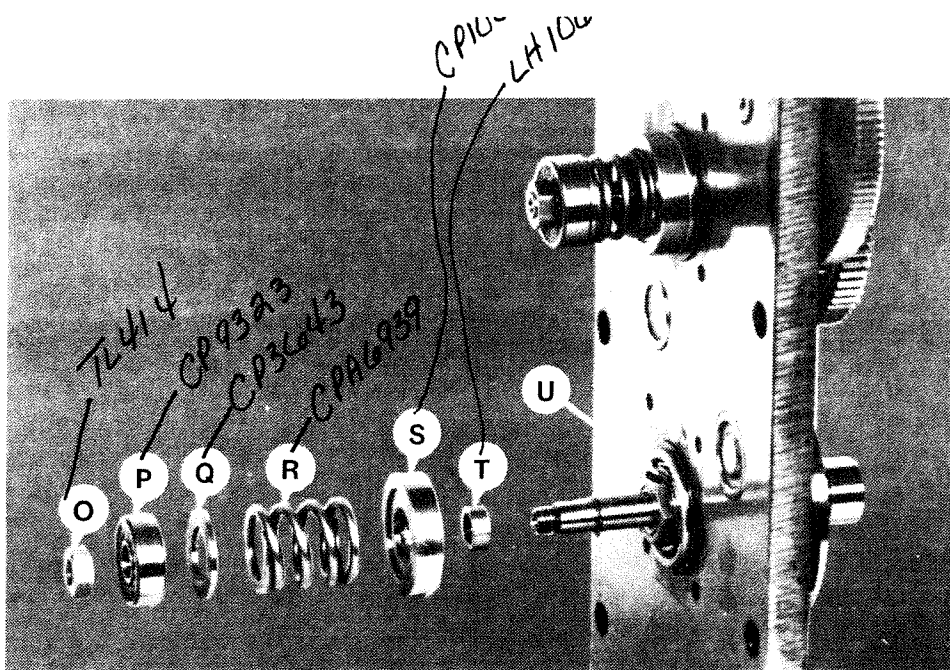


Figure 1.7 - Power Feed Clutch Components

- NOTE -

It is not necessary to remove snap ring "U" from bearing "V", Figure 1.17, to disassemble the clutch assemblies.

13. To disassemble the carriage clutch assembly:

- a) Remove snap ring "V", Figure 1.9 .
- b) Remove 70 tooth gear "X" and clutch plate "W", Figure 1.10 .
- c) Remove snap rings "D", clutch disc "C", clutch plate "B", and wave washer "A", Figure 1.11 .

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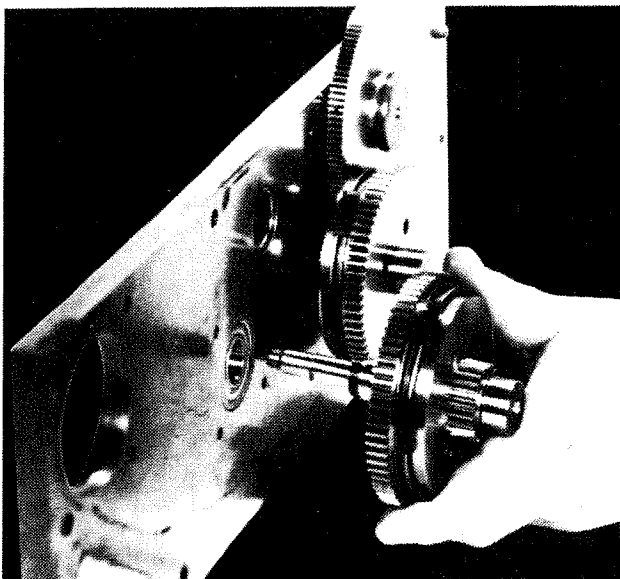


Figure 1.8 - Power Feed Clutch Removal

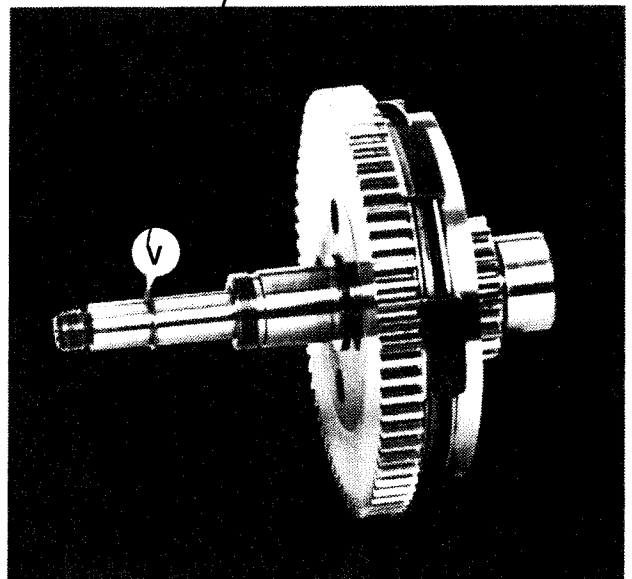


Figure 1.9 - Carriage Clutch

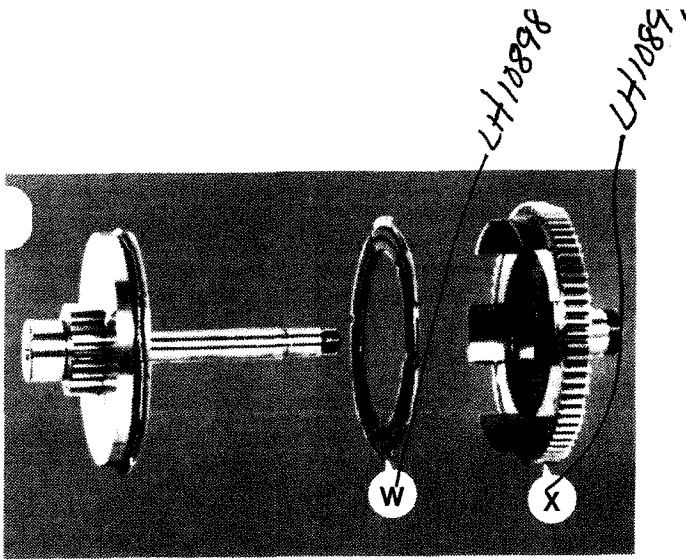


Figure 1.10 - Carriage Clutch Components

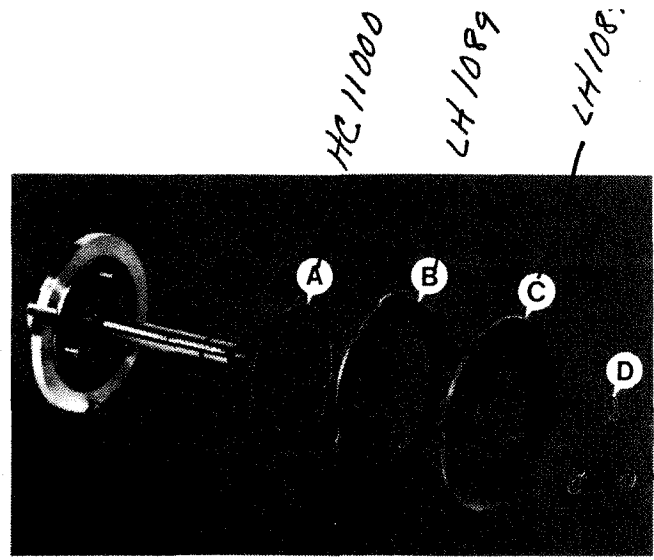


Figure 1.11 - Carriage Clutch Components

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14. To disassemble the cross feed clutch assembly:

- a) Remove snap ring "E", Figure 1.12 .
- b) Remove 70 tooth gear "G" and clutch plate "F", Figure 1.13 .
- c) Remove snap rings "K", clutch disc "J", clutch plate "I", and wave washer "H", Figure 1.14 .

15. To disassemble the clutch housings:

- a) Remove spring "L" and plunger "M" from clutch housing "N", Figure 1.15 .
- b) Remove cap "T" and nut "S", Figure 1.16 .
- c) Loosen screw "O" and remove camshaft "P".
- d) Remove sleeve "R" and bolt "Q".

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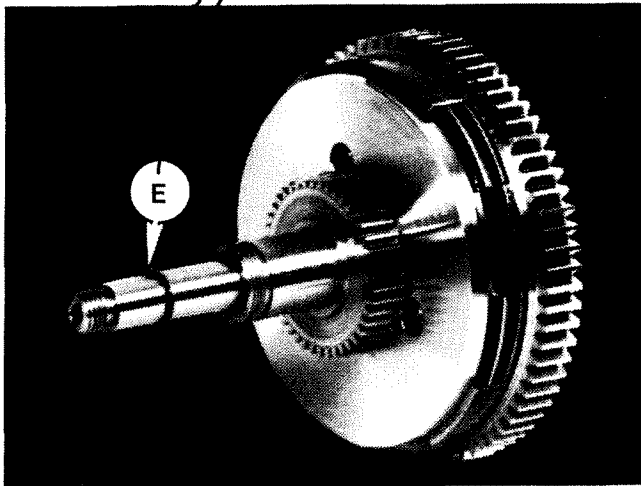


Figure 1.12 - Cross Feed Clutch

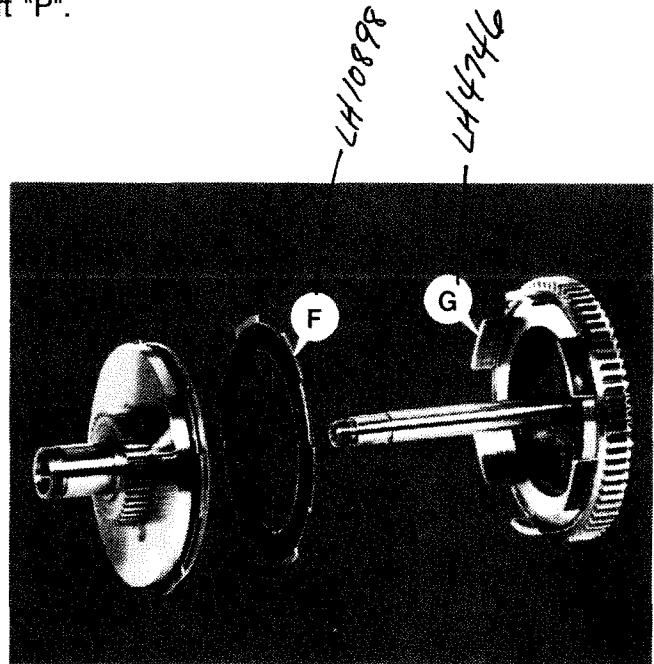


Figure 1.13 - Cross Feed Clutch Components

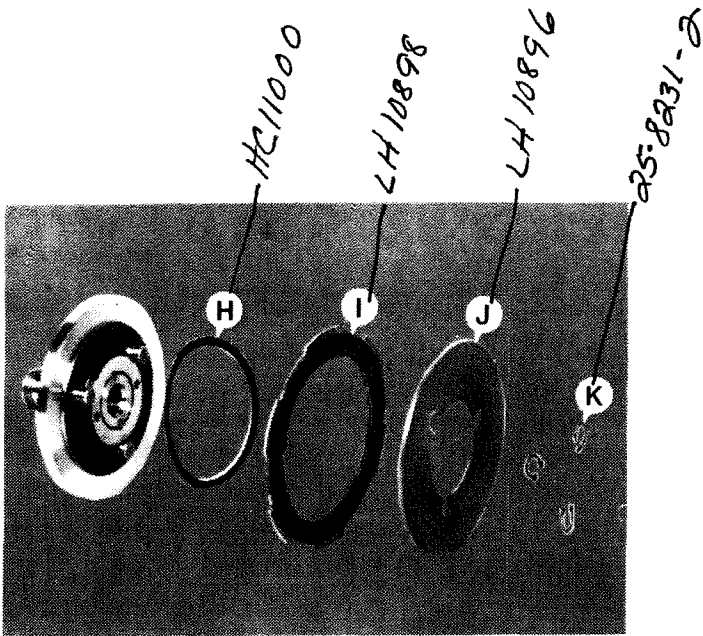


Figure 1.14 - Cross Feed Clutch Components

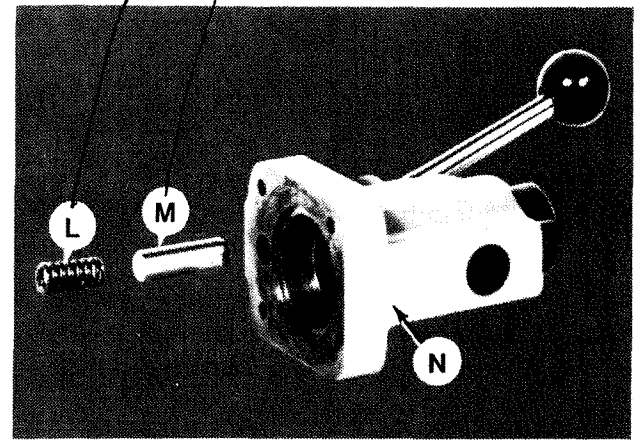


Figure 1.15 - Clutch Plunger and Spring Components

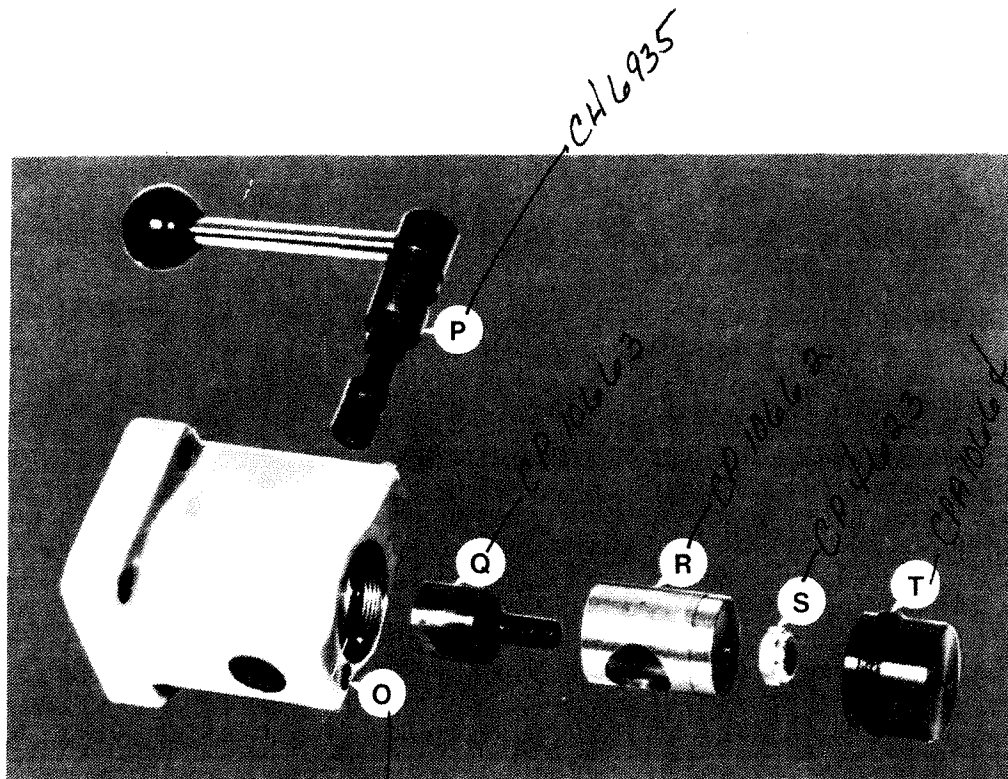


Figure 1.16 - Clutch Housing and Components

CP 10674

16. Remove clutch bearings "V", Figure 1.17, from the face of the apron cover.
17. Remove 120 tooth gear "N" by driving out stud "M", Figure 1.6, with a punch.
18. Remove intermediate gear "A", Figure 1.18.

- NOTE -

Do not loose the brass plug located under set screw "B".

19. Loosen set screw "B" and remove nut "C" with a spanner wrench.
20. Remove washer "E" and 80 tooth gear "D".
21. Remove key "F", Figure 1.19 .
22. Loosen screw "G" to remove carriage stop "H", Figure 1.20 .
23. Remove three bolts "J", Figure 1.21, and set power feed control housing "K" toward the rear of the coolant pan.
24. Pull the carriage past the end of the bed so rack pinion "L", Figure 1.22, is accessible and remove the rack pinion from the carriage.
25. Slide the carriage off the bed.

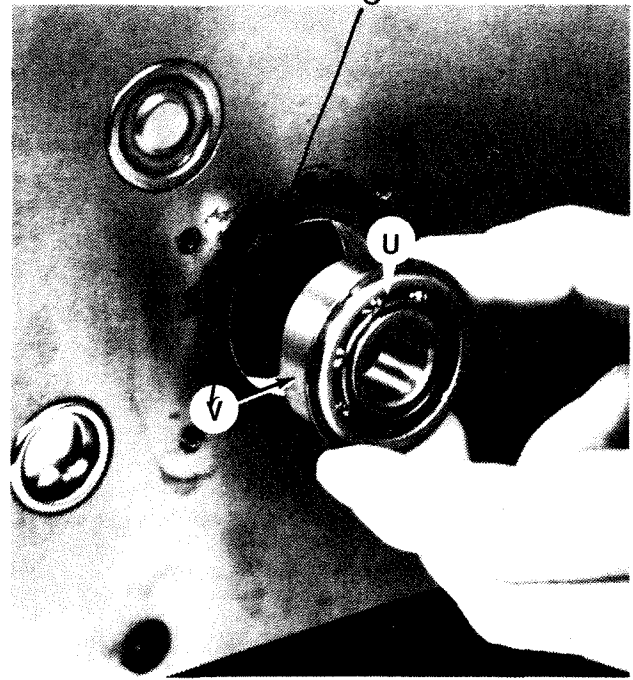


Figure 1.17 - Clutch Bearing Removal

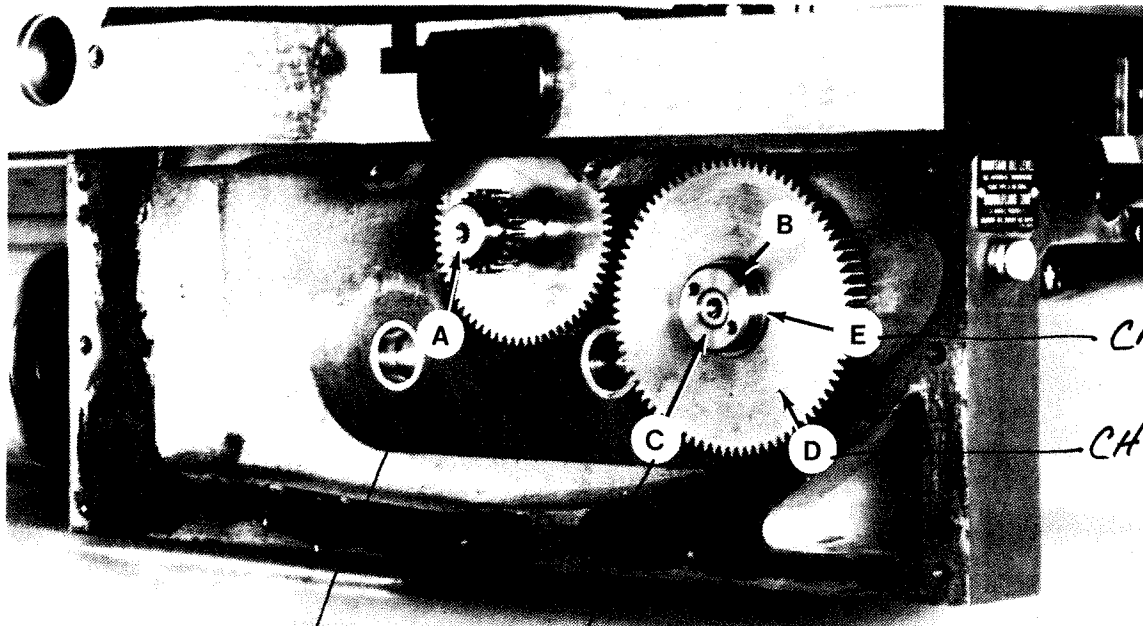


Figure 1.18 - Carriage Apron with Cover Removed

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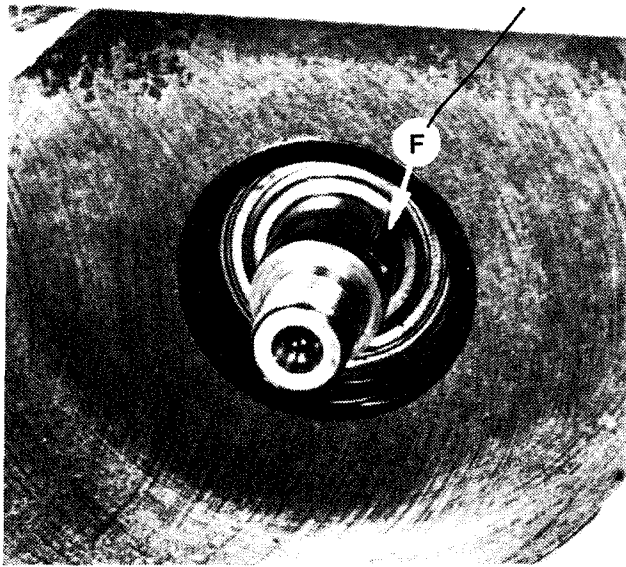


Figure 1.19 - Pinion Shaft and Key

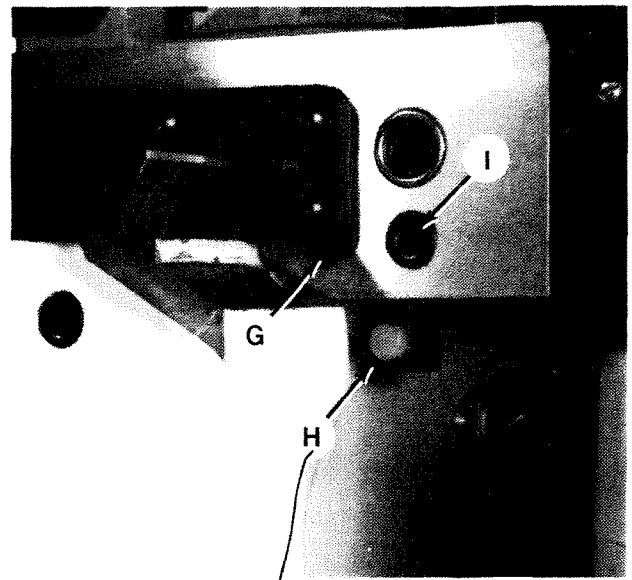


Figure 1.20 - Carriage Stop
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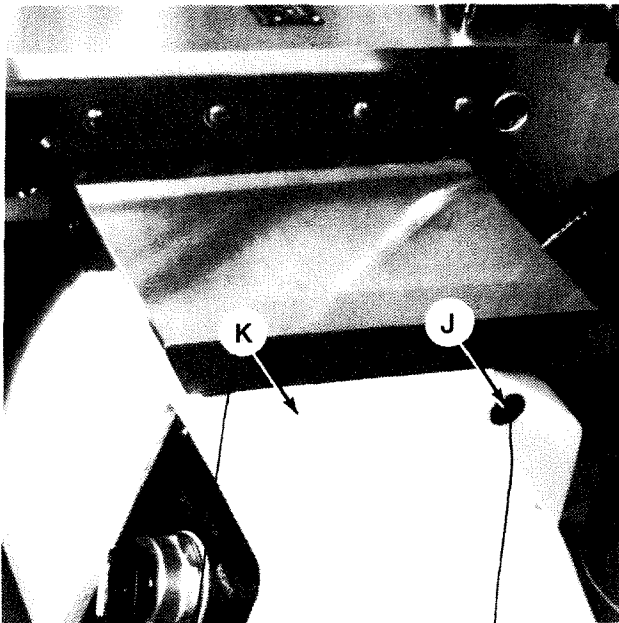


Figure 1.21 - Power Feed Control
Mounting Bolts

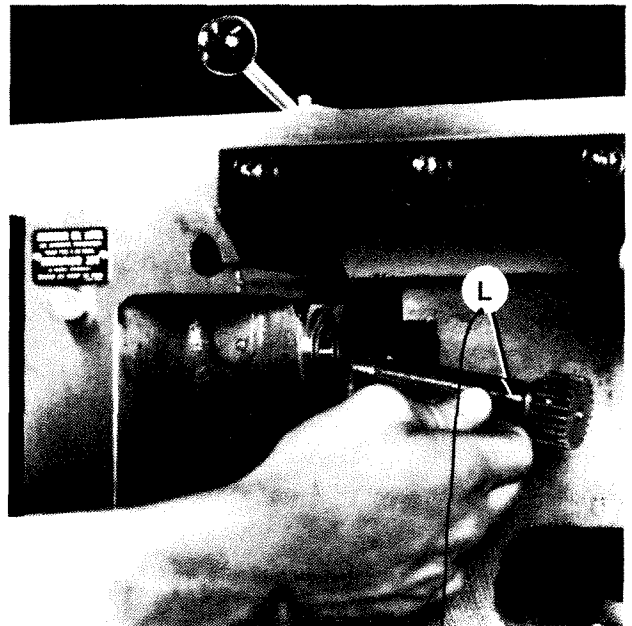


Figure 1.22 - Rack Pinion Removal

CARRIAGE REASSEMBLY

1. Position the carriage on the bed so the hole for rack pinion "L", Figure 1.22, is accessible and install the rack pinion on the carriage.
2. Slide the carriage back onto the bed.
3. Remount power feed control housing "K" to the end of the bed using three bolts "J", Figure 1.21 .
4. Replace carriage stop "H" and tighten screw "G", Figure 1.20 .
5. Install key "F", Figure 1.19 .
6. Mount washer "E" and 80 tooth gear "D", Figure 1.18 .
7. Install nut "C" and tighten set screw "B".
8. Install intermediate gear "A", Figure 1.18, and 120 tooth gear "N", Figure 1.6 .
9. Replace clutch bearings "V", Figure 1.17 .
10. Reassemble the carriage and cross feed clutch assemblies and the clutch housings. Reverse steps 13, 14, and 15 under "Carriage Disassembly".
11. Assemble nut "U", spacer "T", spring seat "S", spring "R", washer "Q", and bearing "P", Figure 1.7 .

- NOTE -

Some method of compressing spring "R", Figure 1.7, is necessary until nuts "K" and "L", Figure 1.6, can be threaded on flush with the top of the shaft. Notice the bracket used in Figure 1.23.

12. Install nuts "K" and "L", Figure 1.6 .
13. Apply Permatex sealant to apron cover "F" and remount the cover using nine screws "E", Figures 1.2 and 1.4 .
14. Apply Permatex sealant to cover "J"; then remount the cover and cover seal using two screws "I", Figure 1.4 .
15. In both clutch housings, pack spring "L", Figure 1.15, with Shell Alvania #3 grease.
16. Apply Permatex sealant to the surface of clutch housings "N" which will be against the carriage apron cover.
17. Remount the clutch housings to the apron cover with eight screws "D", Figure 1.2 .
18. Apply Permatex sealant to the surface of handwheel housing "G", Figure 1.3, which will be against the carriage.

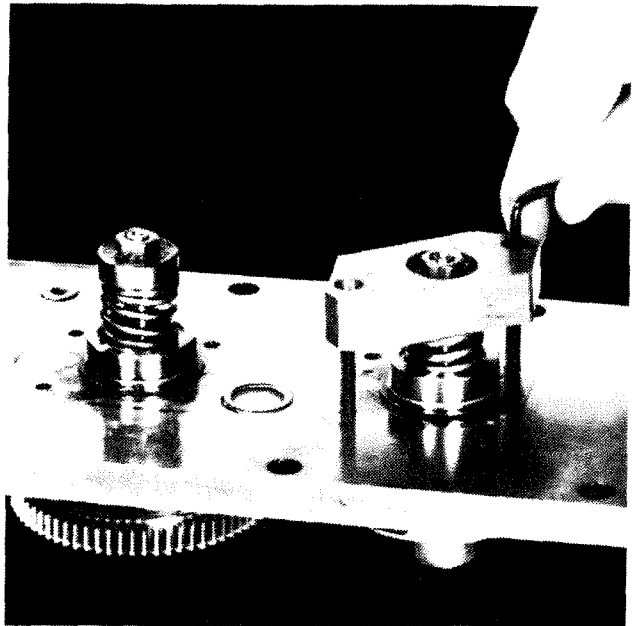


Figure 1.23 - Clutch Spring Replacement

19. Remount handwheel assembly "H", Figure 1.3, and install four screws "C", Figure 1.2 .
20. Install drain plug "A", Figure 1.1 .
21. Fill the apron oil reservoir:
 - a) Remove reservoir cap "U", Figure 1.25 .
 - b) Fill the apron reservoir with Mobilfluid® 350 or equivalent. The reservoir is full when sight gauge "B", Figure 1.1, is completely filled with oil.
 - c) Replace reservoir cap "U", Figure 1.25.

- NOTE -

When properly adjusted, each clutch will release when the ball lever is approximately 25° below horizontal.

The clutches are spring loaded and CANNOT be adjusted for more pulling power.

22. Check the clutches for proper adjustment.

If one or both clutch assemblies require adjustment, proceed to step 23.

If neither clutch assembly requires adjustment, proceed to step 25.

23. If necessary, adjust the carriage and/or cross feed clutch as shown in Figure 1.24 .

24. Repeat step 22.

25. Place the clutch handle in the notched position and tighten stop screw "O", Figure 1.16 .

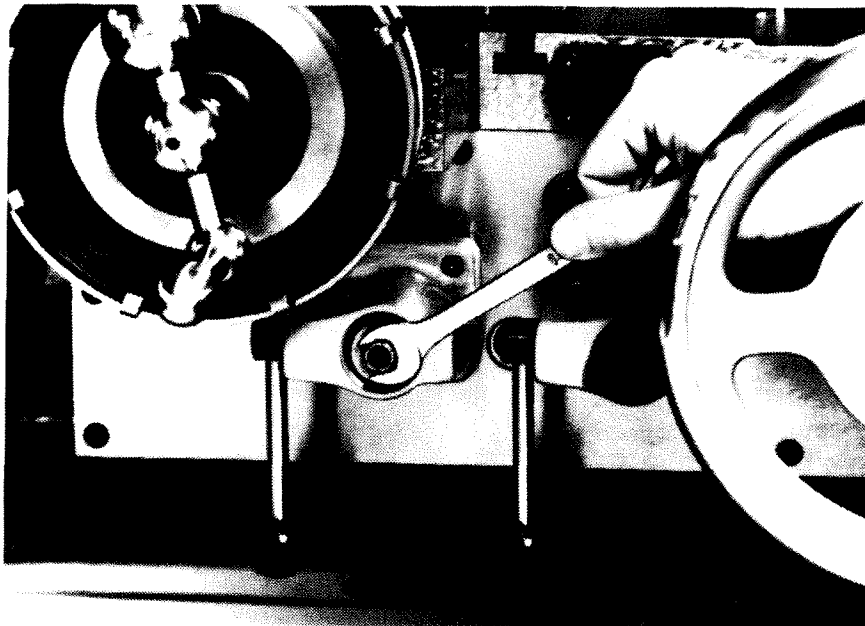


Figure 1.24 - Power Feed Clutch Adjustment

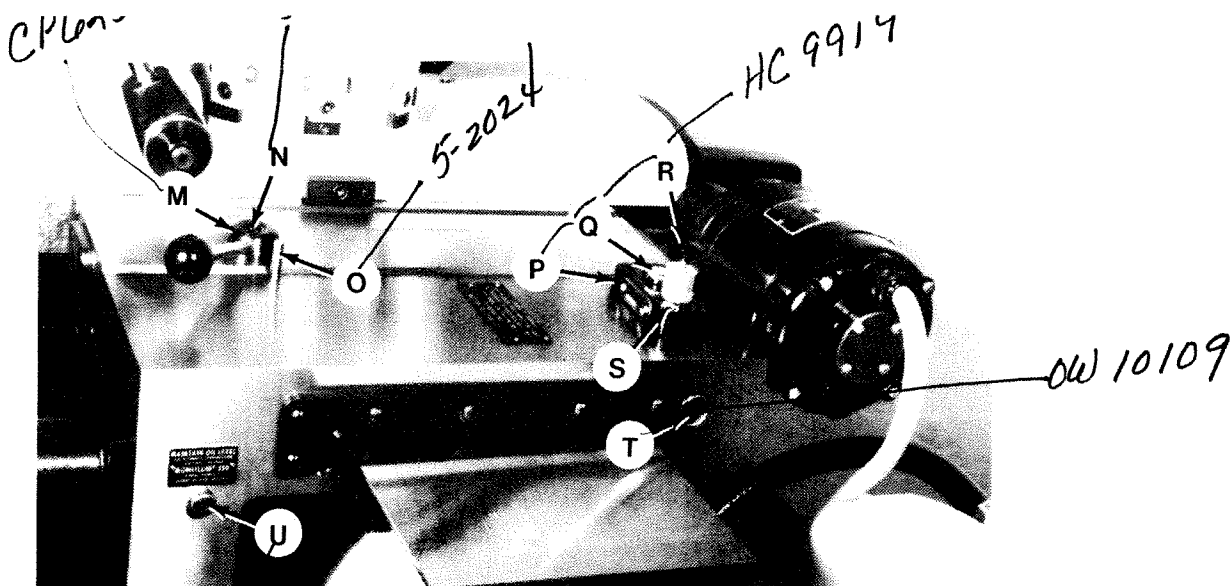


Figure 1.25 - Carriage Lubricator
 HL-10277

CARRIAGE LUBRICATION SYSTEM

Lubricator "P", Figure 1.25, is used to lubricate the carriage and bed ways.

Lubricating oil is channeled from lubricator "P" to a junction block at the rear of the carriage. The oil is fed from the junction block through four oil tube assemblies to channels in the top and bottom of the carriage. Three of these channels can be seen when the cross slide is removed. On the bottom of the carriage is an "X" shaped channel for lubricating the bed ways.

If an oil tube assembly becomes plugged, it should be replaced.

- CAUTION -

Oil tube assembly "D" feeds oil to the channel in the bottom of the carriage and is NOT interchangeable with oil tube assemblies "C", "E", and "F", Figure 1.30 .

REPLACING AN OIL TUBE ASSEMBLY

1. Remove the chip and coolant guard if the machine is so equipped.
2. Place a drain pan capable of holding one pint of liquid under pipe plug "I", Figure 1.20 .
3. Remove pipe plug "I" and allow the oil to drain completely.
4. Remove upper lock screw "V", Figure 1.26, to gain access to the lower lock screw.
5. Loosen lower lock screw "V" until the top of the lock screw is flush with the top of the cross slide.

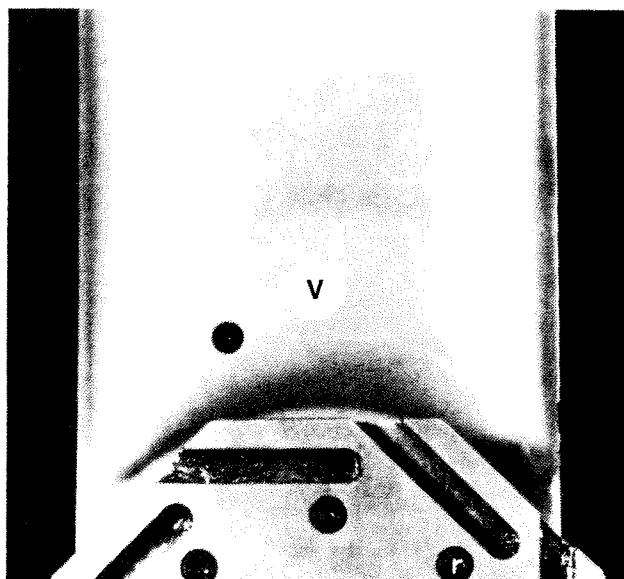


Figure 1.26 - Turret and Cross Slide

CHA 10651

6. Rotate the cross slide handwheel to move the cross slide to the back of the machine until the feed screw disengages from the cross slide feed screw nut.
7. Slide the cross slide toward the back of the machine approximately 1/2 inch more.

- NOTE -

Housing "X", Figure 1.27, is doweled in place. If necessary, tap the cover from behind with a soft-faced hammer to remove it.

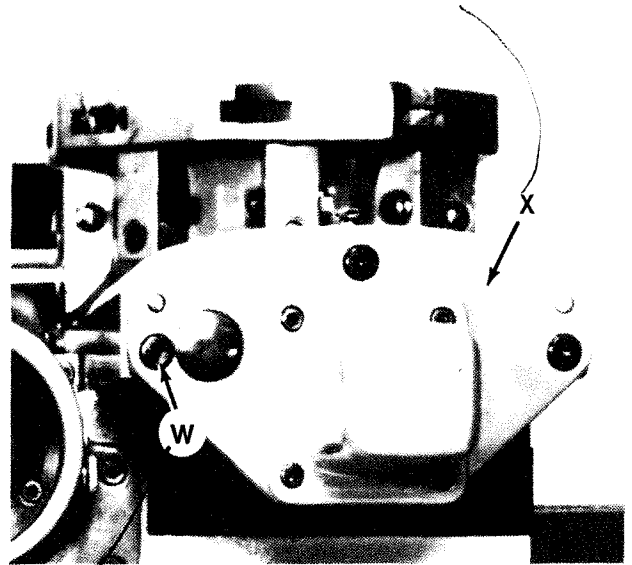


Figure 1.27 - Housing for Cross Slide Feed Screw Nut

8. Remove three screws "W" and housing "X", Figure 1.27 .
9. Remove four screws "Y" and cover "Z", Figure 1.28.
10. Remove four screws "A" and lubricator junction block "B", Figure 1.29, to gain access to the four oil tube assemblies.

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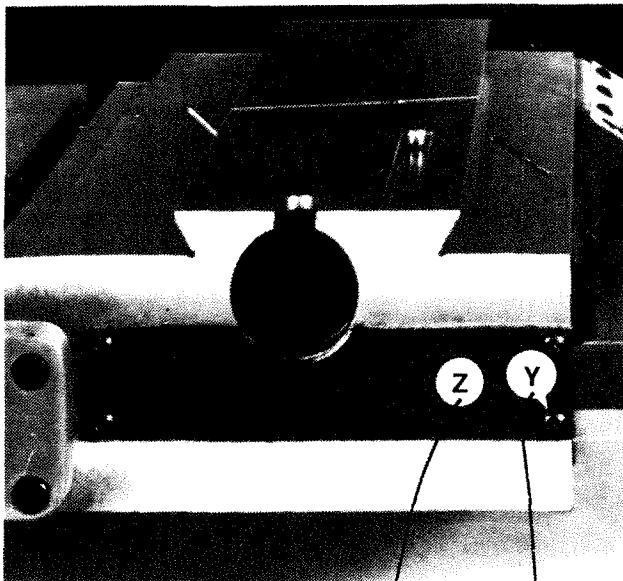


Figure 1.28 - Carriage Lubricator Junction Block Cover

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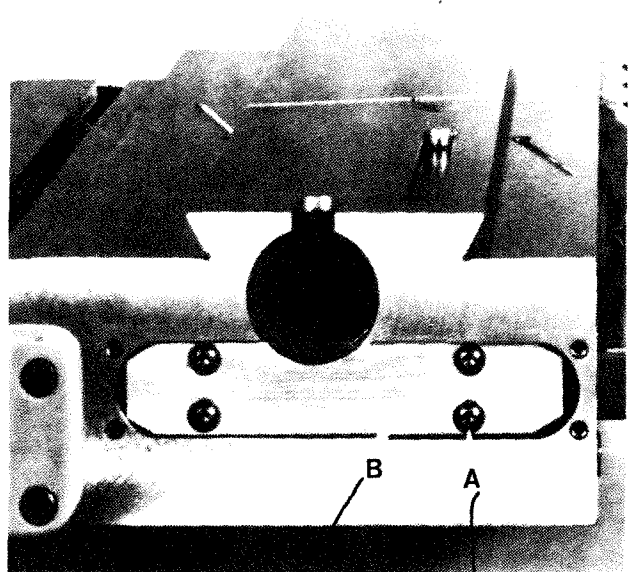


Figure 1.29 - Carriage Lubricator Junction Block

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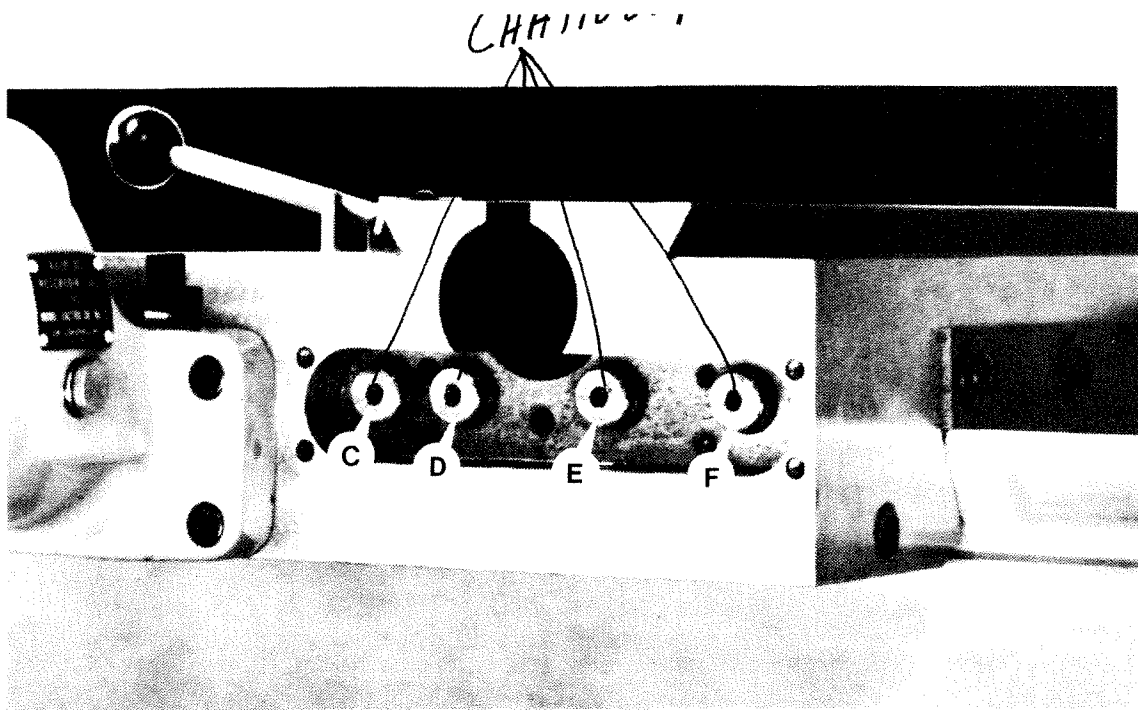


Figure 1.30 - Carriage Oil Feed Tube Assemblies

- NOTE -

Oil tube assembly "C", Figure 1.30, feeds oil to the channel in the top of the carriage to the left of the cross slide dovetail, as viewed from the front of the machine.

Oil tube assembly "D" feeds oil to the channel in the bottom of the carriage.

Oil tube assembly "E" feeds oil to the channel in the top of the cross slide dovetail.

Oil tube assembly "F" feeds oil to the channel in the top of the carriage to the right of the cross slide dovetail, as viewed from the front of the machine.

11. Replace the faulty oil tube assembly.
12. Remount lubricator junction block "B" using four screws "A", Figure 1.29 .
13. Install cover "Z" and four screws "Y", Figure 1.28 .
14. Install housing "X" and three screws "W", Figure 1.27 .

- CAUTION -

Move the cross slide slowly toward the front of the machine. Do not allow the feed screw to contact the feed screw nut in housing "X", Figure 1.27, forcefully. Damage to the feed screw nut may result.

15. Slide the cross slide CAREFULLY toward the front of the machine until the feed screw contacts the feed screw nut.
16. Apply light pressure to the back side of the turret and rotate the cross slide handwheel to engage the cross slide feed screw with the feed screw nut.
17. Rotate the handwheel to move the cross slide toward the front of the machine until the centerline of the turret is in front of the spindle centerline.

18. Tighten lower lock screw "V", Figure 1.26; then back off one turn.
19. Insert and tighten upper lock screw "V".
20. Clean and replace pipe plug "I", Figure 1.20 .
21. Fill lubricator reservoir "P", Figure 1.25, with Mobil[®] Vactra[®] Oil No. 2 or equivalent. The reservoir is full when sight gauge "T" is completely filled with oil.

OPERATING THE LUBRICATOR

To operate the lubricator, lift plunger "R", hold the plunger up briefly, and release. **DO NOT PUSH THE PLUNGER DOWN.** Allow the plunger to return to the down position on its own.

Operate the lubricator as often as required to keep the bed ways wet or a minimum of once a day.

CLEANING THE LUBRICATOR RESERVOIR

Remove four screws "S" and lift lubricator "P", Figure 1.25, from the carriage. Clean the lubricator and the oil reservoir with mineral spirits.

When the lubricator and the oil reservoir are clean; install the lubricator in the reservoir using four screws "S" and fill the lubricator reservoir.

FILLING THE LUBRICATOR RESERVOIR

To fill the oil reservoir, remove reservoir cap "Q", Figure 1.25, and fill with Mobil Vactra Oil No. 2 or equivalent. Maintain the oil level in sight gauge "T".

CLUTCH AND GEARBOX LUBRICATION

The carriage and cross feed clutches and gearbox are constantly lubricated by the oil contained in the apron reservoir. Periodically check sight gauge "B", Figure 1.1, to be sure that there is sufficient oil in the apron reservoir to properly lubricate the carriage and cross feed clutches and gearbox. Sight gauge "B" should be completely filled with oil.

- NOTE -

The apron oil reservoir should be drained and filled with fresh oil at least every 320 hours of machine operation.

DRAINING THE OIL RESERVOIR

To drain the apron oil reservoir:

1. Place a drain pan capable of holding one pint of liquid under drain plug "A".
2. Remove and clean magnetic drain plug "A", Figure 1.1 .
3. Allow the reservoir to drain.
4. Remove the drain pan and properly dispose of the used oil.
5. Replace drain plug "A".

FILLING THE OIL RESERVOIR

To fill the apron oil reservoir:

1. Remove reservoir cap "U", Figure 1.25 .
2. Fill the apron reservoir with Mobilfluid® 350 or equivalent. The reservoir is full when sight gauge "B", Figure 1.1, is completely filled with oil.
3. Replace reservoir cap "U", Figure 1.25 .

GIB ADJUSTMENT

After a period of continued use, it may become necessary to adjust the carriage gib. The gib is the tapered type and adjustment is made from the large end at "G", Figure 1.31 .

- NOTE -

Excessive gib pressure or drag does not improve machine performance.

To adjust the carriage gib:

1. Insert a $\frac{1}{4}$ " hexagon wrench into adjusting screw "G", Figures 1.31 and Figure 1.32 .
2. Loosen adjusting screw "G" by turning the wrench one full turn in the counterclockwise direction.
3. Push the wrench through adjusting screw "G" and into adjusting screw "H", Figure 1.32 .
4. Advance adjusting screw "H" by turning the wrench a fraction of a turn in the clockwise direction.
5. Pull the wrench out of adjusting screw "H" and tighten adjusting screw "G" by turning the wrench clockwise. Do not overtighten adjusting screw "G".
6. Test the carriage for "feel". The carriage should have a slight drag, but it should not bind.
7. Repeat this procedure if necessary.

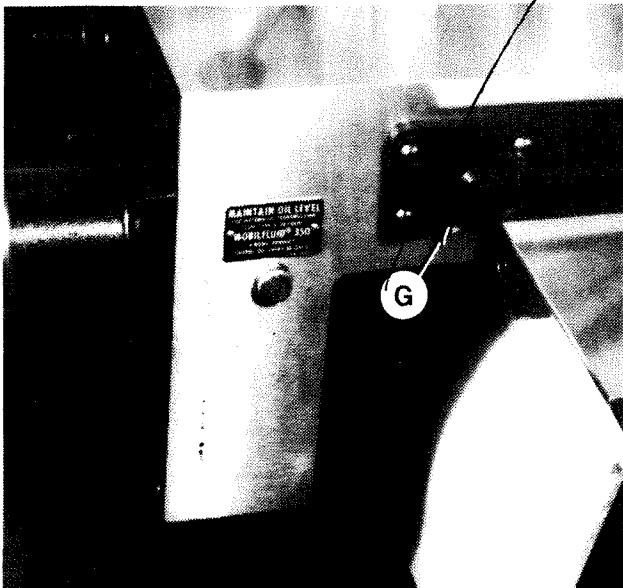


Figure 1.31 - Gib Adjustment Screw

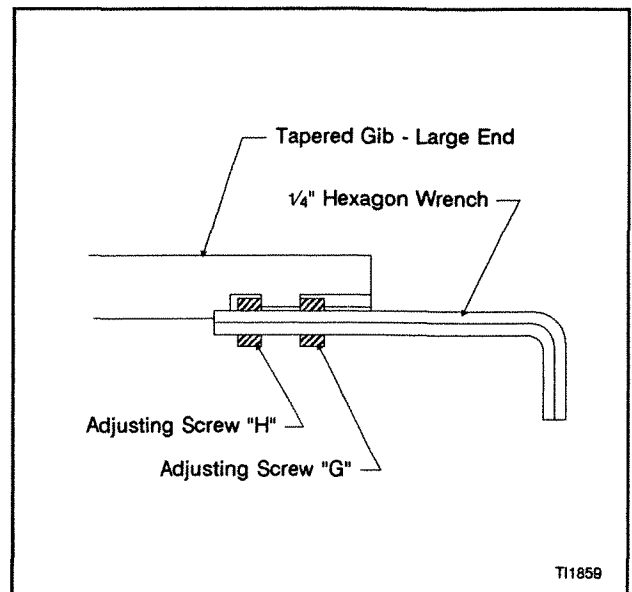


Figure 1.32 - Gib Adjustment Illustration

CARRIAGE HANDWHEEL

After a period of continued use, it may become necessary to remove handwheel assembly "H", Figure 1.3, to clean or replace internal components.

DISASSEMBLY

1. Remove four screws "C", Figure 1.2, and remove handwheel assembly "H", Figure 1.3.
2. Remove nut "I" and washer, Figure 1.33.
3. Remove handwheel "J".
4. Remove nut "L", Figures 1.34 and 1.35, with a spanner wrench.
5. Remove bearing "M", spacer "P", and shaft "Q" from housing "O", Figure 1.35. Bearing "R" is pressed onto shaft "Q".
6. Remove snap ring "S" to remove dial "T", Figure 1.36, from the handwheel.
7. Clean or replace handwheel components, as needed.

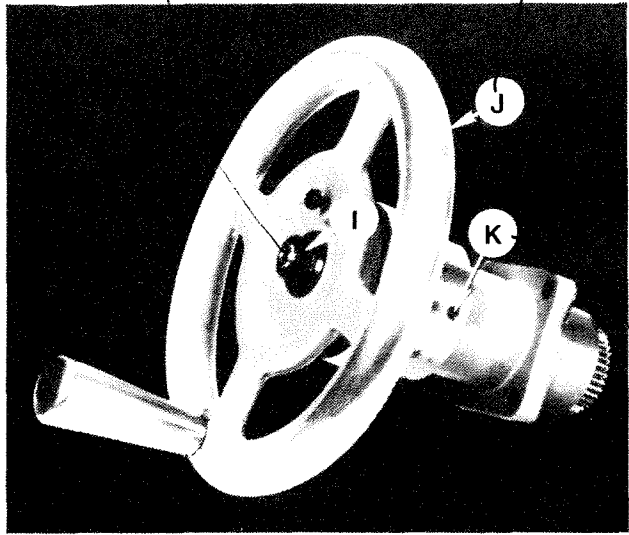


Figure 1.33 - Carriage Handwheel

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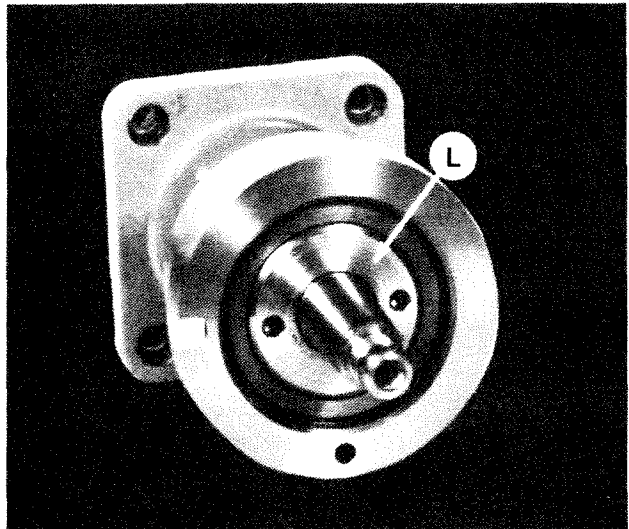


Figure 1.34 - Carriage Handwheel Housing

ASSEMBLY

1. Replace dial "T" on the handwheel; then replace snap ring "S", Figure 1.36.
2. Replace bearing "M", spacer "P", and shaft "Q" in housing "O", Figure 1.35.
3. Install nut "L", Figures 1.34 and 1.35, with a spanner wrench.
4. Remount handwheel "J", Figure 1.33.

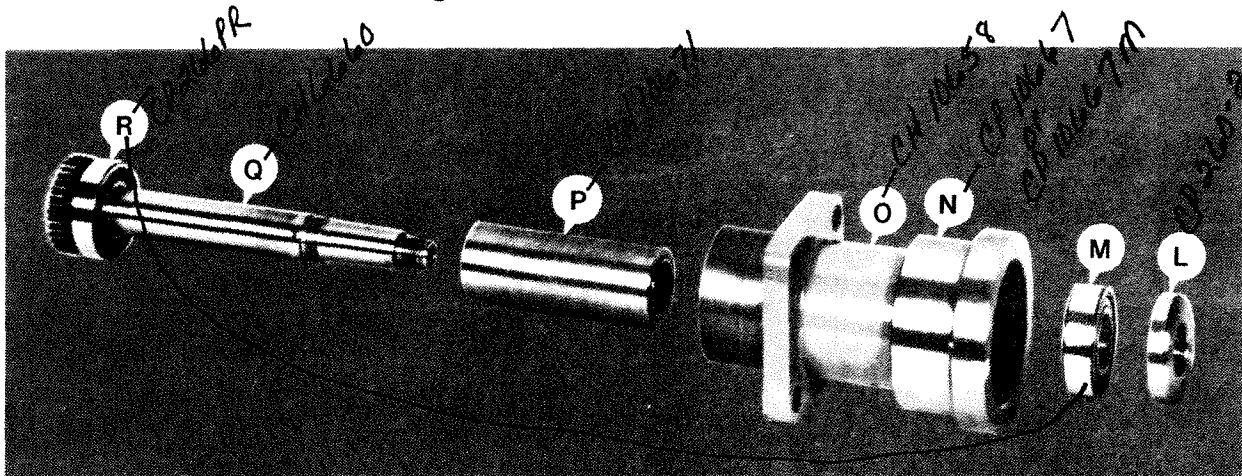


Figure 1.35 - Carriage Handwheel Components

5. Install washer and nut "I".
6. Apply Permatex sealant to the surface of handwheel housing "G", Figure 1.3, which will be against carriage apron cover "F", Figure 1.2 .
7. Remount handwheel assembly "H", Figure 1.3, and install four screws "C", Figure 1.2 .

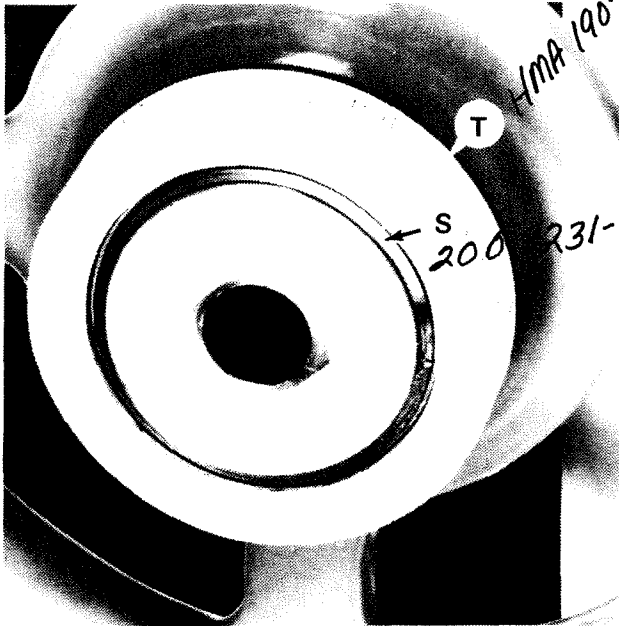


Figure 1.36 - Carriage Handwheel Dial

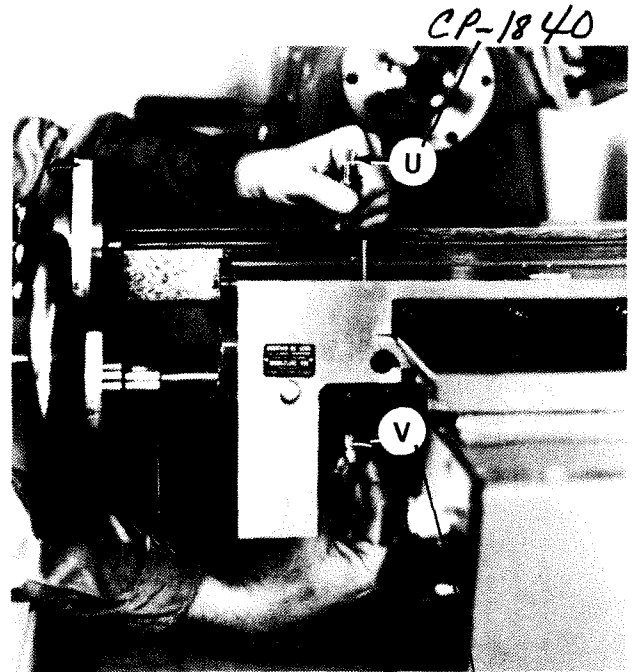


Figure 1.37 - Lock Bolt and Plug

CARRIAGE LOCK

REMOVAL

1. Rotate locking handle and hub "M", Figure 1.25, counterclockwise against pin "O" to release the carriage lock.
1. Remove screw "N" and washer.
2. Lift locking handle and hub "M" off the carriage.
3. Unscrew bolt "U", from lock plug "V", Figure 1.37 .

REPLACEMENT AND ADJUSTMENT

1. Locate plug "V", Figure 1.37, in the socket in the bottom of the carriage with the flat side of the plug facing toward the bed way (down).
2. Thread lock bolt "U" into plug "V".
3. Replace locking handle and hub "M", Figure 1.25, orientated as shown in Figure 1.38 .

- NOTE -

Figure 1.25 shows the carriage locking handle in the locked position. The carriage should be locked in position when the locking handle is orientated 60° to 90° in the clockwise direction from pin "O".

4. Rotate the locking handle in the clockwise direction and check the orientation of the handle to pin "O" when the carriage is firmly locked in position.

If the handle is not orientated properly when the carriage is locked, proceed to step 5.

If the handle is orientated properly when the carriage is locked, proceed to step 9.

5. Turn the locking handle counterclockwise to the release position.
6. Remove locking handle and hub "M".
7. Tighten or loosen lock bolt "U", Figure 1.37, to correct handle orientation.
8. Repeat steps 3 and 4.
9. Install washer and screw "N", Figure 1.25 .

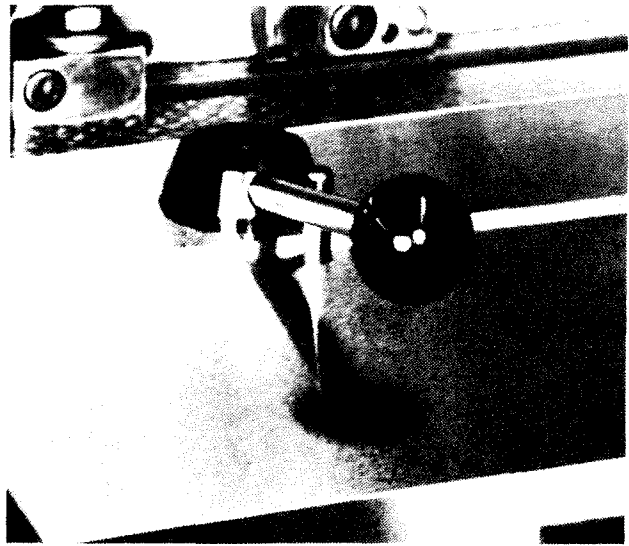


Figure 1.38 - Locking Lever in Released Position

CARRIAGE RACK

REMOVAL

1. Remove carriage drum stop "W", Figure 1.39 .
2. Move the carriage to both extremes of travel and remove five screws "X", Figure 1.40 .

- NOTE -

It may be necessary to tap the rack back into place to position dowels "Y" midway in the rack for removal.

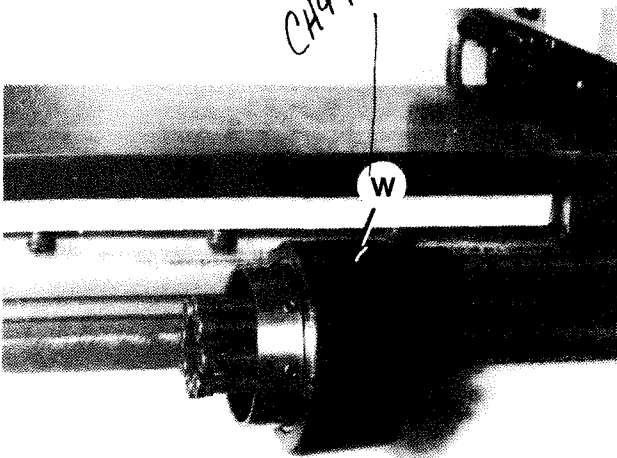


Figure 1.39 - Carriage Drum Stop

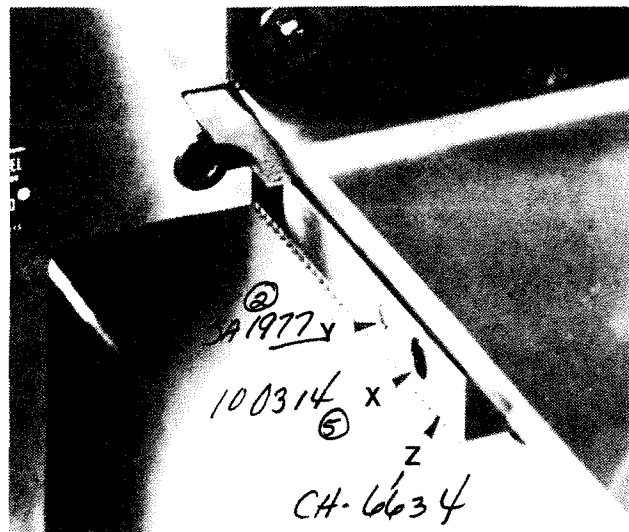


Figure 1.40 - Carriage Gear Rack

3. Remove rack "Z" by prying alternately and evenly at both ends of the rack with a small screwdriver.

REPLACEMENT

1. Line up the dowels in the rack with the dowel holes in the side of the carriage and gently tap the dowels slightly into the dowel holes.
2. Move the carriage to both extremes of travel and install five screws "X", Figure 1.40 .
3. Alternately and evenly tighten five screws "X".
4. Remount carriage drum stop "W", Figure 1.39 .

LUBRICATION

Use a pressure oil can to lubricate carriage gear rack "Z", Figure 1.40, weekly with Mobil® Velocite® No. 6 oil or equivalent.

- NOTES -

CHAPTER 2 - CROSS SLIDE AND TURRET

CROSS FEED SCREW AND DIAL

REMOVAL

1. Rotate cross slide handwheel "A", Figure 2.1, to move the cross slide to the back of the machine.
2. Place a drain pan capable of holding one pint of liquid under drain plug "B", Figure 2.2 .
3. Remove and clean magnetic drain plug "B".
4. Allow the reservoir to drain.
5. Remove the drain pan and properly dispose of the used oil.
6. Remove the set screw located at "E", Figure 2.3, to gain access to the stop screw.
7. Loosen the stop screw located at "E" until the top of the lock screw is flush with the top of the cross slide.

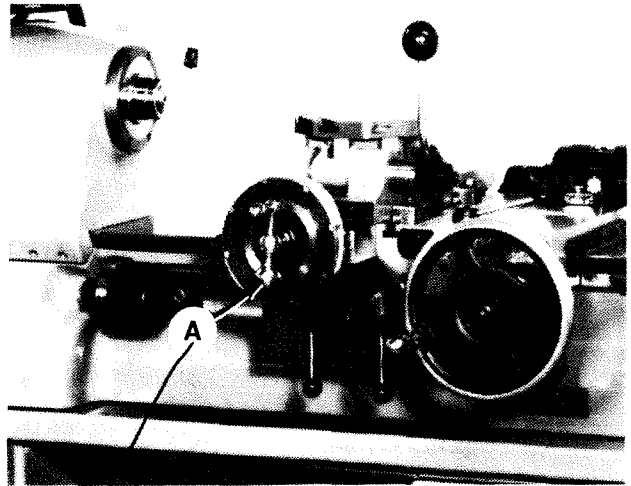


Figure 2.1 - Cross Slide Handwheel
CW-7670

- NOTE -

Do not misplace the seal under cover "I", Figure 2.4 .

8. Remove two screws "J" and carriage cover "I", Figure 2.4 .
9. Remove four screws "D", Figure 2.2, and remove handwheel assembly "K", Figure 2.5 .

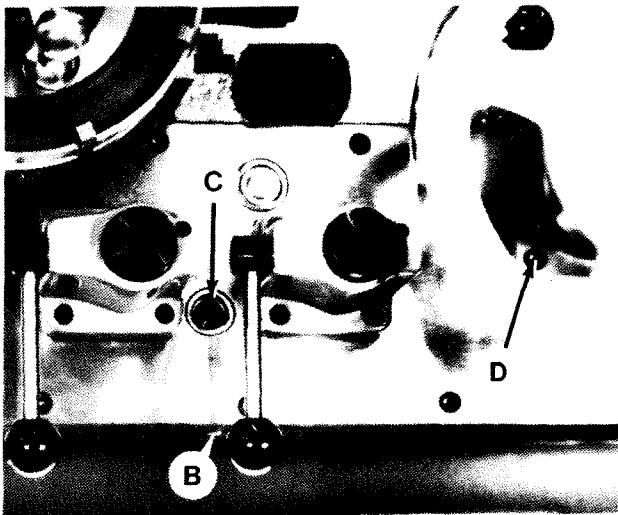


Figure 2.2 - Lubricant Sight Window and Drain Plug

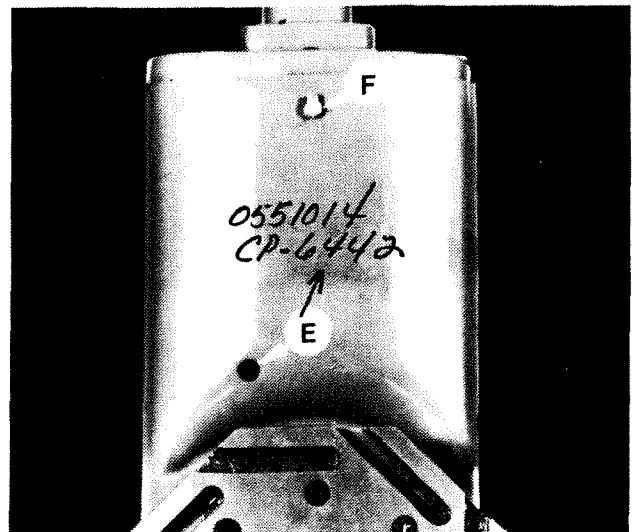


Figure 2.3 - Cross Slide Lock Screws

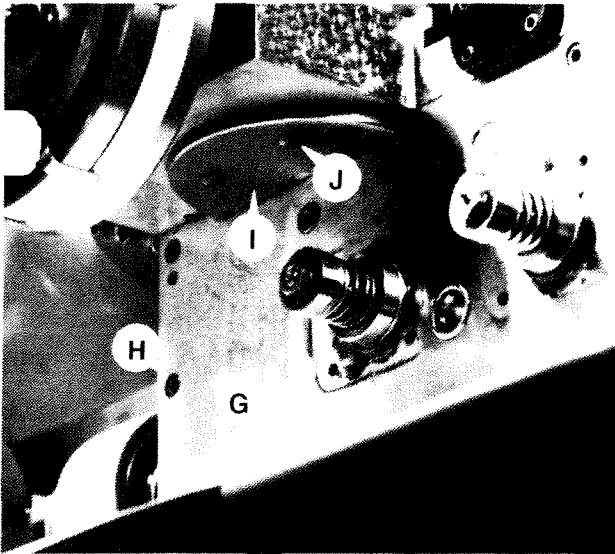


Figure 2.4 - Carriage Cover

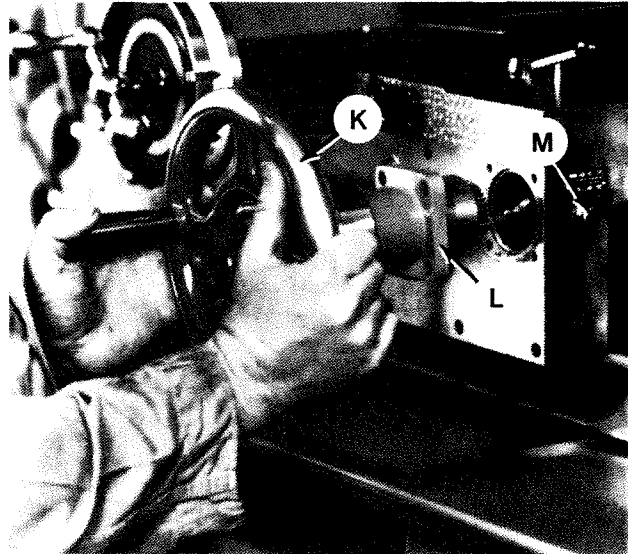


Figure 2.5 - Carriage Handwheel Removal

10. Remove nine screws "H" from apron cover "G", Figure 2.4 .

- NOTE -

The apron cover is sealed with Permatex sealant.

11. Remove apron cover "G":

- a) Pull the cover outward with the left hand while striking the edge of the cover with a soft-faced hammer until a crack appears in the sealant. Refer to Figure 2.6 .
- b) Tap the cover back into place.
- c) Repeat steps "a" and "b" until the seal is completely broken and the apron cover can be removed.

12. Remove lock screw "P", Figure 2.7, and the set screw and pin located under lock screw "P".

13. Remove handle "N".

14. Remove nut "O" and dial assembly "R".

15. Remove nut "S", Figure 2.8, and the bearing behind the nut.

- NOTE -

If the turret is on the machine, it may be necessary to mount handle "N", Figure 2.7, to remove the cross feed screw from the feed screw nut.

16. Remove cross feed screw "V", Figure 2.9 .

- NOTE -

Removing two screws "T" will allow bearing housing "U", and zero ring "Q", Figure 2.8, to be removed.

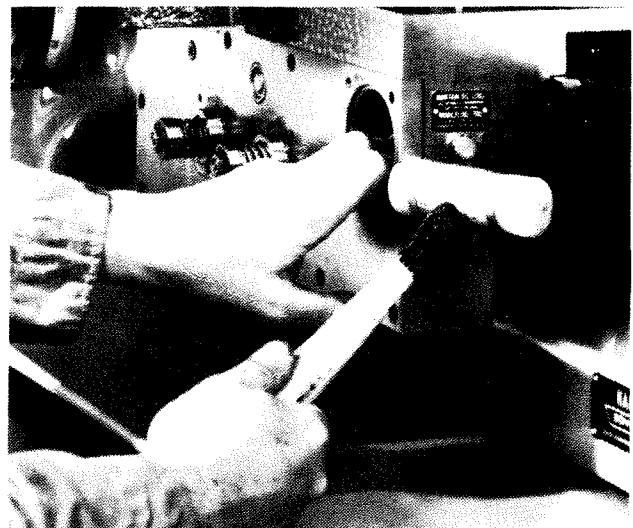


Figure 2.6 - Apron Cover Removal

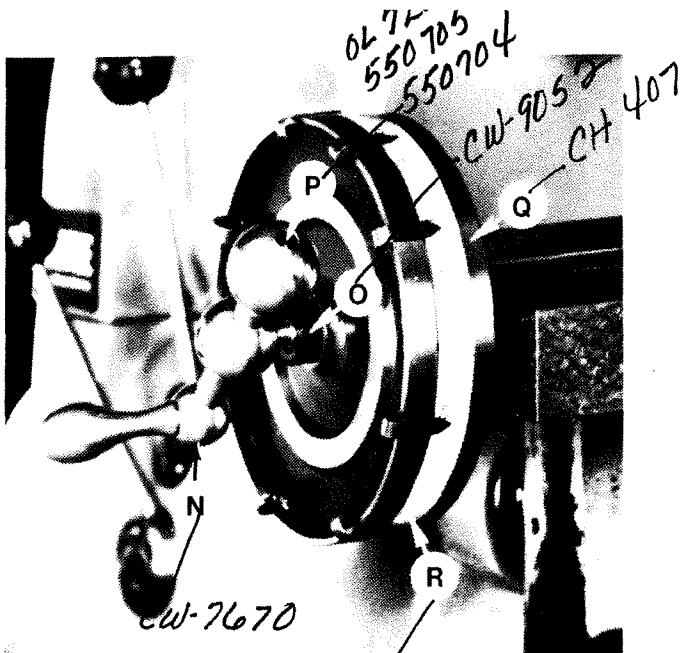


Figure 2.7 - Cross Feed Screw Dial

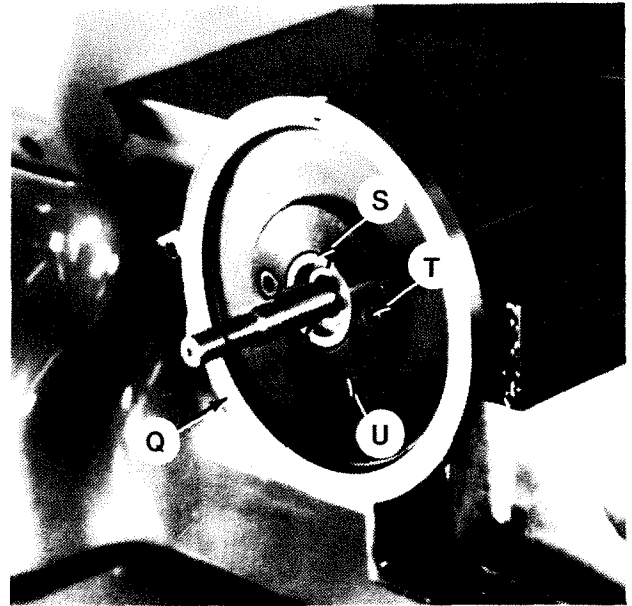


Figure 2.8 - Feed Screw Bearing Housing

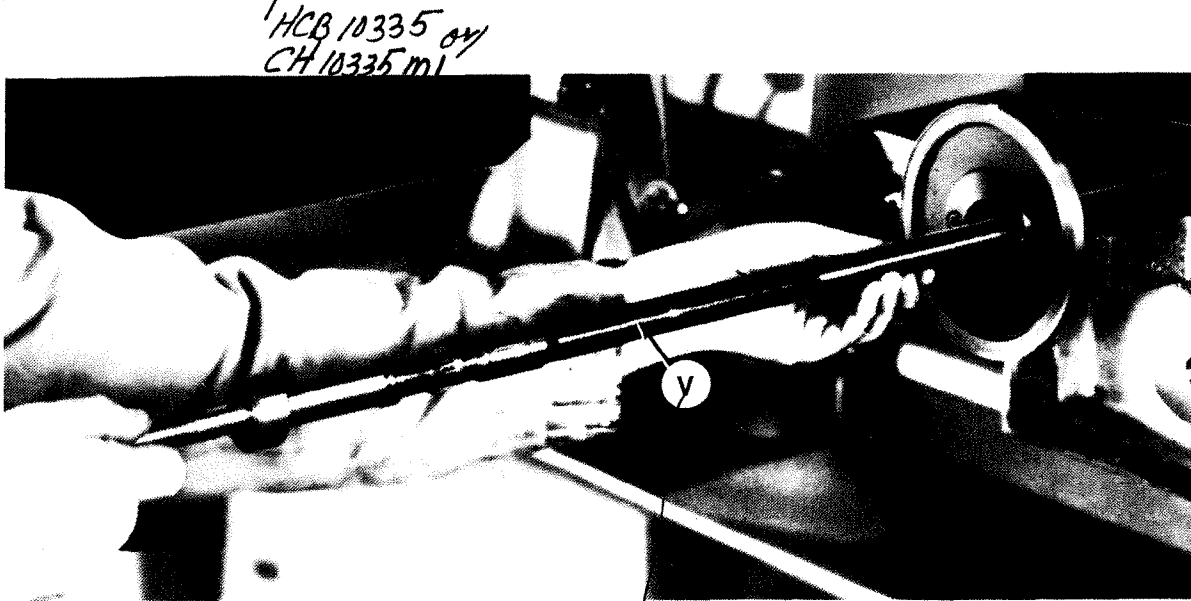


Figure 2.9 - Cross Feed Screw Removal

CH-325

REPLACEMENT

1. If removed, replace zero ring "Q", bearing housing "U", and two screws "T", Figure 2.8 .
2. Install cross feed screw "V", Figure 2.9 .
3. Replace the bearing and nut "S", Figure 2.8 .
4. Remount dial assembly "R" and nut "O", Figure 2.7 .
5. Remount handle "N".
6. Install pin, set screw and lock screw "P". Tighten the lock screw.
7. Apply Permatex sealant to apron cover "G" and remount the cover using nine screws "H", Figure 2.4 .

8. Apply Permatex sealant to cover "I"; then remount the cover and cover seal using two screws "J".
9. Apply Permatex sealant to the surface of handwheel housing "L", Figure 2.5, which will be against the carriage apron cover.
10. Remount handwheel assembly "K", Figure 2.5, and install four screws "D", Figure 2.2 .
11. Install the stop screw and set screw in hole "E", Figure 2.3:
 - a) Thread the stop screw IN until it bottoms; then turn it OUT one full turn.
 - b) Install and tighten the set screw.
12. Fill the apron oil reservoir:
 - a) Remove reservoir cap "M", Figure 2.5 .
 - b) Fill the apron reservoir with Mobilfluid[®] 350 or equivalent. The reservoir is full when sight gauge "C", Figure 2.2, is completely filled with oil.
13. Lubricate the cross slide feed screw nut at oil cup "F", Figure 2.3, with Mobil[®] Vactra[®] Oil No. 2 or equivalent.

- NOTE -

The gap between dial "R" and zero ring "Q", Figure 2.7, should be set at .002" [.05mm] to .004" [.1mm].

14. Check the gap between dial "R" and zero ring "Q", Figure 2.7 .
If the gap needs to be adjusted, proceed to step 15.

If the gap is correct, this procedure is complete.
15. Loosen the set screw located in the hub of zero ring "Q".
16. Adjust the gap between dial "R" and zero ring "Q".
17. Tighten the set screw.
18. Repeat step 14.

CROSS SLIDE

Remove the cross slide every three months, depending on the amount of use, and lubricate the cross slide ways with Mobil® Vactra® Oil No. 2 or equivalent.

REMOVAL

1. Remove the chip and coolant guard, if the machine is so equipped.
2. Remove the set screw located at "E", Figure 2.3, to gain access to the stop screw.
3. Loosen the stop screw located at "E" until the top of the lock screw is flush with the top of the cross slide.
4. Loosen the cross slide gib to allow the cross slide to move freely:
 - a) Remove dot plug "W", Figure 2.10 .
 - b) Insert $\frac{1}{4}$ " hex wrench in screw "A", Figure 2.11, and loosen one turn.
 - c) Insert $\frac{1}{4}$ " hex wrench on through into screw "B" and loosen one turn.
5. Remove the rear cross slide stop or any other stop in use.
6. Using cross slide handwheel "A", Figure 2.1, feed the cross slide toward the back of the machine until travel stops.

- NOTE -

While removing the cross slide, hold the cross slide gib in place to prevent it from dropping out.

7. Pull the cross slide off at the rear of the carriage.

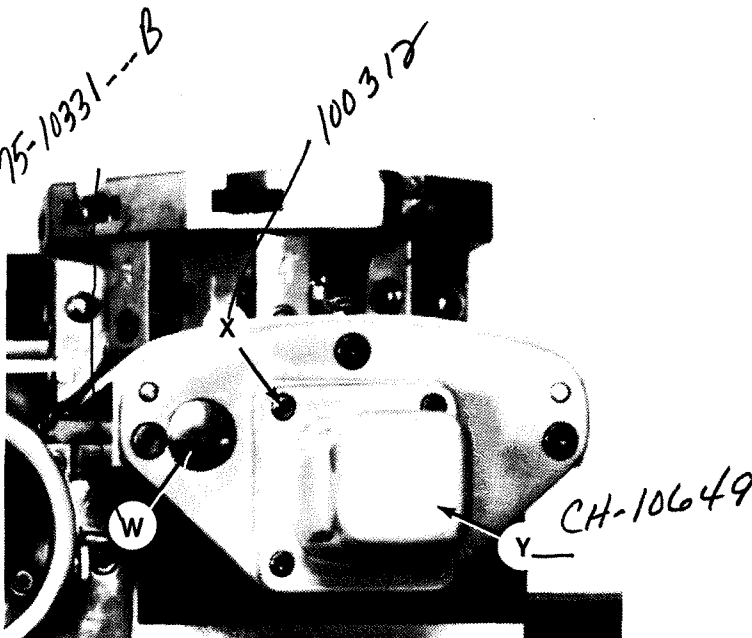


Figure 2.10 - Access to Cross Slide Gib Screws

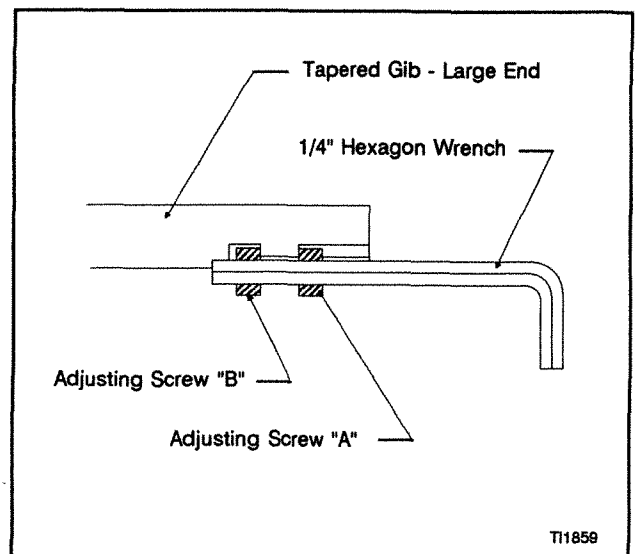


Figure 2.11 - Gib Adjustment Illustration

REPLACEMENT

- CAUTION -

During cross slide replacement do not force the cross slide into position. Damage to the feed screw or feed screw nut may result.

- NOTE -

Be sure the cross slide gib is in place when replacing the cross slide

1. Start the cross slide onto the carriage dovetail and move it slowly into position while turning the cross slide handwheel counterclockwise until the feed screw engages the feed screw nut.
2. Using the cross slide handwheel, feed the cross slide toward the front of the machine until the turret centerline is in front of the spindle centerline.
3. Install the stop screw and set screw in hole "E", Figure 2.3:
 - a) Thread the stop screw IN until it bottoms; then turn it OUT one full turn.
 - b) Install and tighten the set screw.
4. Adjust the cross slide gib. Refer to "Cross Slide Gib Adjustment", Page 2-8.
5. Install dot plug "W", Figure 2.10 .

CROSS SLIDE FEED SCREW NUT

REMOVAL

1. Remove the chip and coolant guard, if the machine is so equipped.
2. Remove the set screw located at "E", Figure 2.3, to gain access to the stop screw.
3. Loosen the stop screw located at "E" until the top of the lock screw is flush with the top of the cross slide.
4. Loosen the cross slide gib to allow the cross slide to move freely:
 - a) Remove dot plug "W", Figure 2.10 .
 - b) Insert $\frac{1}{4}$ " hex wrench in screw "A", Figure 2.11 , and loosen one turn.
 - c) Insert $\frac{1}{4}$ " hex wrench on through into screw "B" and loosen one turn.
5. Remove the rear cross slide stop or any other stop in use.
6. Using cross slide handwheel "A", Figure 2.1, feed the cross slide toward the back of the machine until travel stops.

- NOTE -

While removing the cross slide. hold the cross slide gib in place to prevent it from dropping out.

7. Pull the cross slide off at the rear of the carriage.
8. Remove four screws "X" and cover "Y", Figure 2.10 .
9. Remove nut "C", Figures 2.12 and 2.13, with an adjustable spanner wrench.
10. Remove half nut "D", which is threaded into housing "E".

11. Remove screw "F", Figure 2.13 .
12. Remove half nut "G".

REPLACEMENT

1. Replace half nut "G", Figure 2.13 .
2. Replace screw "F".
3. Replace half nut "D".
4. Start the cross slide onto the carriage dovetail and move it slowly into position while turning the cross slide handwheel counterclockwise until the feed screw engages the feed screw nut.
5. Using the cross slide handwheel, feed the cross slide toward the front of the machine until the turret centerline is in front of the spindle centerline.
6. Install the stop screw and set screw in hole "E", Figure 2.3:
 - a) Thread the stop screw IN until it bottoms; then turn it OUT one full turn.
 - b) Install and tighten the set screw.
7. Adjust the cross slide gib. Refer to "Cross Slide Gib Adjustment", Page 2-8.

- NOTE -

Maximum backlash should not exceed two graduations on the cross slide handwheel dial.

8. Adjust half nut "D", Figure 2.12, for minimum backlash.

- NOTE -

When replacing nut "C", hold half nut "D" securely while tightening nut "C".

9. Replace and tighten nut "C" securely.
10. Replace cover "Y" using four screws "X", Figure 2.10 .

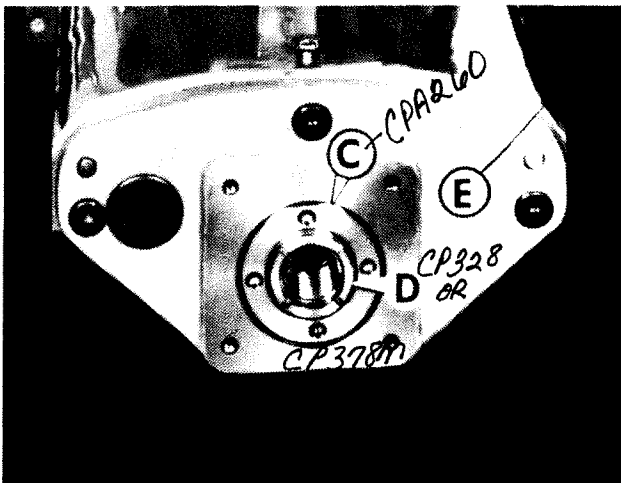


Figure 2.12 - Cross Feed Screw Nut

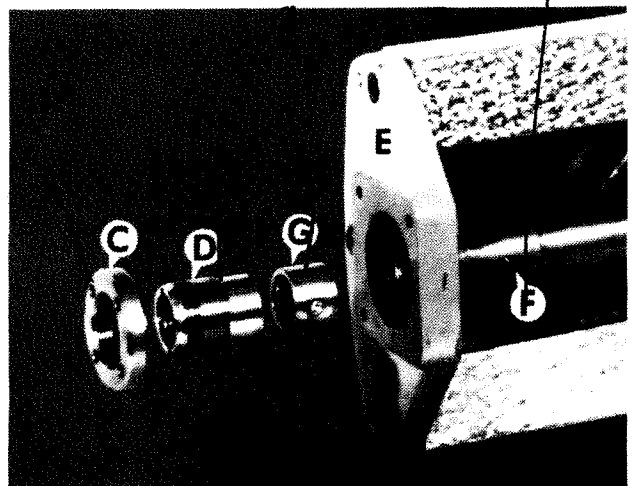


Figure 2.13 - Cross Feed Screw Nut Components

ADJUSTMENT

1. Remove four screws "X" and cover "Y", Figure 2.10 .
2. Loosen nut "C", Figure 2.12, with an adjustable spanner wrench.

- NOTE -

Maximum backlash should not exceed two graduations on the cross slide hand-wheel dial.

3. Adjust half nut "D" for minimum backlash.
4. Hold half nut "D" securely while tightening nut "C" securely.
5. Replace cover "Y" using four screws "X", Figure 2.10 .

CROSS SLIDE LUBRICATION

Lubricate the cross slide feed screw nut monthly at oil cup "F", Figure 2.3, with Mobil® Vactra® Oil No. 2 or equivalent.

CROSS SLIDE GIB ADJUSTMENT

1. Remove dot plug "W", Figure 2.10 .
2. Insert ¼" hex wrench in screw "A", Figure 2.11, and loosen one turn.

- NOTE -

Excessive gib pressure or drag does not improve machine performance.

3. Insert ¼" hex wrench on through into screw "B" and advance screw "B" a fraction of a turn to increase gib pressure or retract screw "B" a fraction of a turn to decrease gib pressure.

- CAUTION -

Do not overtighten screw "A".

4. Pull the hex wrench out of screw "B" and tighten screw "A" until snug.

- NOTE -

The cross slide should have a slight drag, but should not bind.

5. Move the cross slide to test for proper gib adjustment:
If the gib is properly adjusted, proceed to step 6.
If the gib is not properly adjusted, repeat steps 2 through 5.
6. Replace dot plug "W", Figure 2.10 .

TURRET

The eight station turret is mounted on preloaded ball bearings for accuracy and absolute rigidity. The turret bearings are grease packed and sealed and require no further lubrication.

DISASSEMBLY

1. Remove the chip and coolant guard, if the machine is so equipped.
2. Remove the set screw located at "E", Figure 2.3, to gain access to the stop screw.
3. Loosen the stop screw located at "E" until the top of the lock screw is flush with the top of the cross slide.
4. Loosen the cross slide gib to allow the cross slide to move freely:
 - a) Remove dot plug "W", Figure 2.10 .
 - b) Insert $\frac{1}{4}$ " hex wrench in screw "A", Figure 2.11, and loosen one turn.
 - c) Insert $\frac{1}{4}$ " hex wrench on through into screw "B" and loosen one turn.
5. Remove the rear cross slide stop or any other stop in use.
6. Using the cross slide handwheel, feed the cross slide toward the back of the machine until travel stops.

- NOTE -

While removing the cross slide, hold the cross slide gib in place to prevent it from dropping out.

7. Pull the cross slide off at the rear of the carriage.
8. Remove oil plug "H", Figure 2.14 .

- NOTE -

Lock screw "I", Figure 2.15, is located directly under oil plug "H", Figure 2.14 .

9. Remove lock screw "I", Figure 2.15, using a $\frac{1}{8}$ " hex wrench.
10. Remove lock plug "J" and the O-ring under the lock plug.

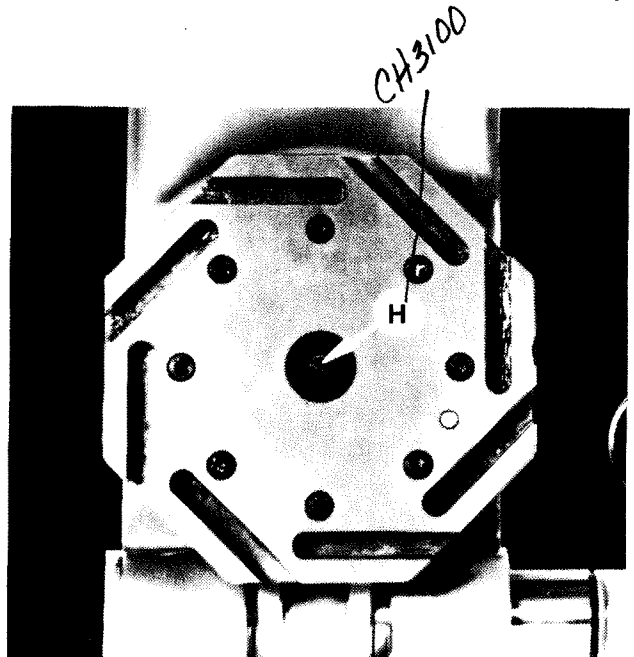


Figure 2.14 - Turret Top Plate Plug

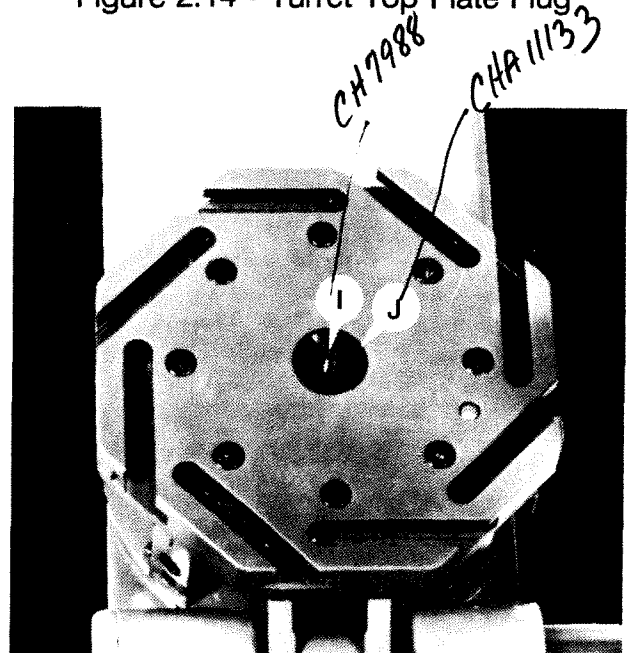


Figure 2.15 - Lock Screw and Lock Plug

11. Remove clutch assembly "K", Figure 2.16, from the bottom of the cross slide.

- NOTE -

When disassembling the clutch assembly, be careful not to lose pins "M" and spring "L", Figure 2.17 .

12. Remove gear "N", Figure 2.17, to disassemble the clutch assembly.

13. If necessary, remove stud "O" to remove gear "P", Figure 2.18 .

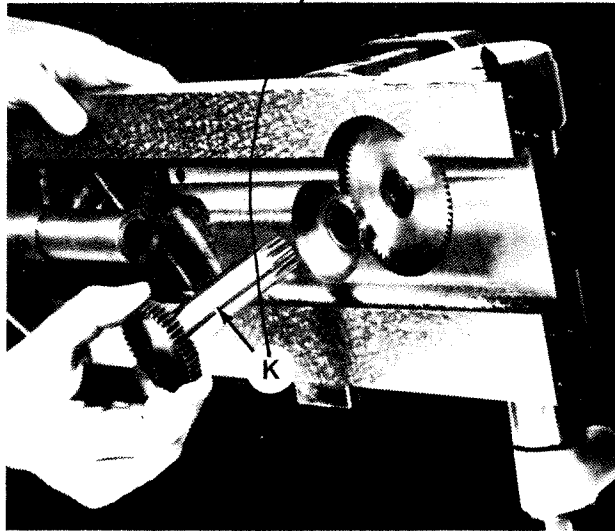


Figure 2.16 - Turret Clutch Removal

CHB1111
CH6708 Pins
CHA9859 Springs

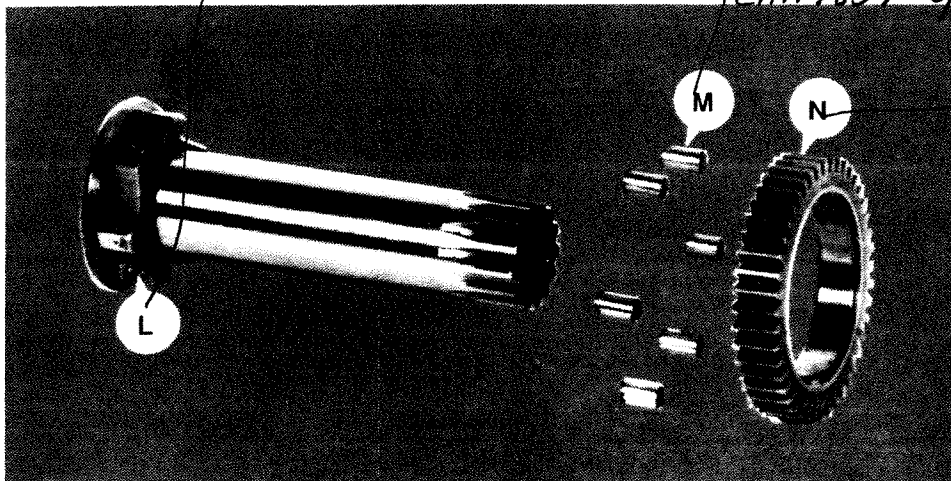


Figure 2.17 - Turret Clutch

- NOTE -

Before proceeding beyond this point, it must be noted that the original accuracy of the turret cannot be guaranteed after the removal of the preloaded ball bearings.

Should the original accuracy be required, the turret and cross slide should be returned to Hardinge Brothers, Inc. for the necessary repairs.

14. Remove eight screws "R" and top plate "S", Figure 2.19 .

15. Remove four screws "U" and retaining ring "T", Figure 2.20 .

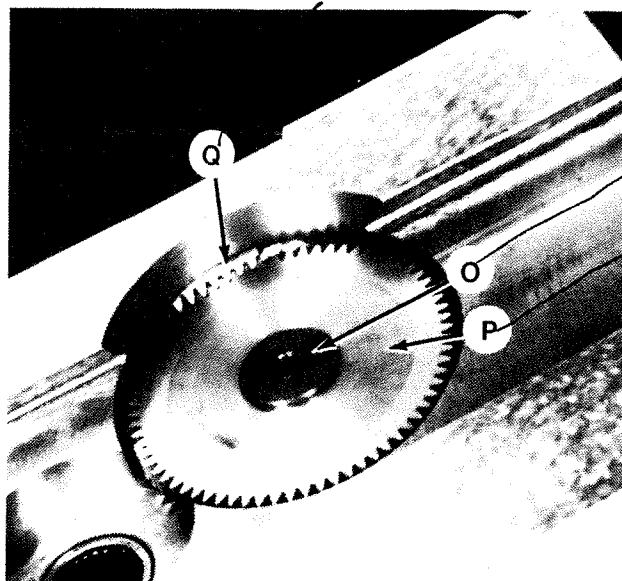


Figure 2.18 - Turret Rack and Gear

CH1113D

CH7370-1
CH6147-7

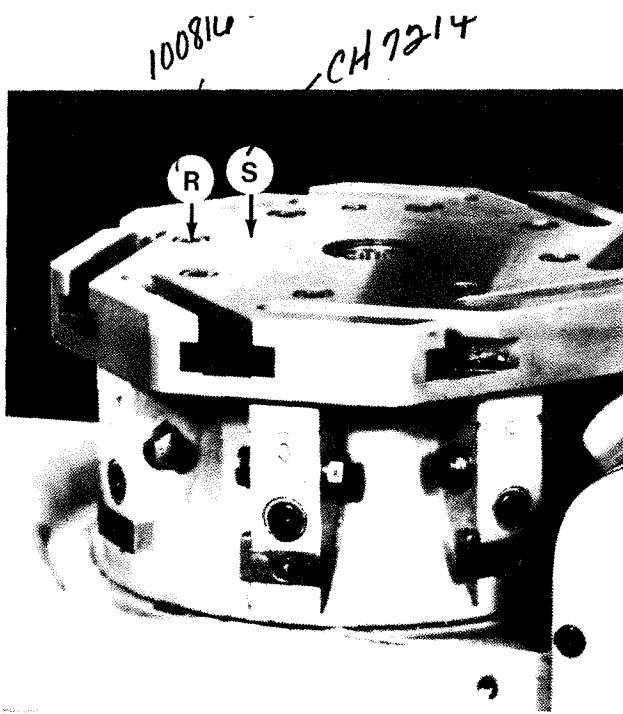


Figure 2.19 - Turret Top Plate

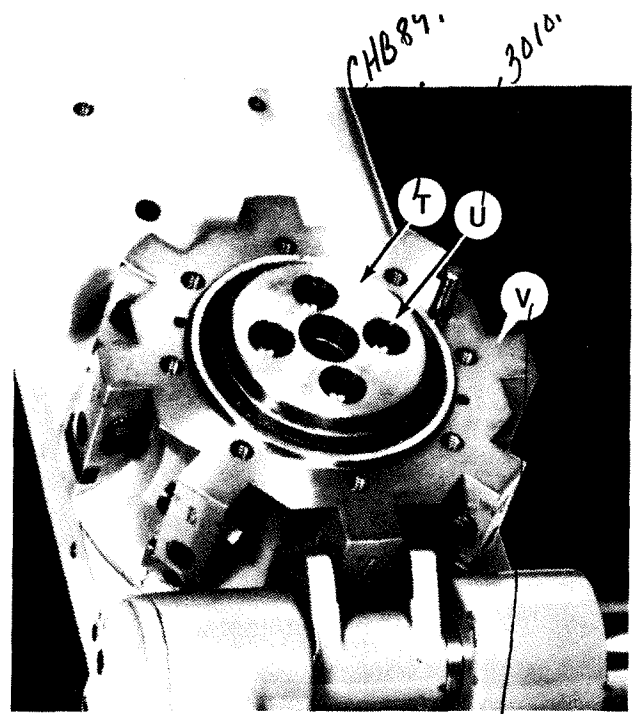


Figure 2.20 - Turret Retaining Plate

- NOTE -

CWD 7201

To remove the turret body, it will be necessary to fabricate a puller arrangement similar to that shown in Figures 2.21 and 2.22 .

16. Remove the turret body.
17. Remove ball "W", spring "X", and sealing ring "Y", Figure 2.23 .
18. Remove bearing shield "E", Figure 2.24 .

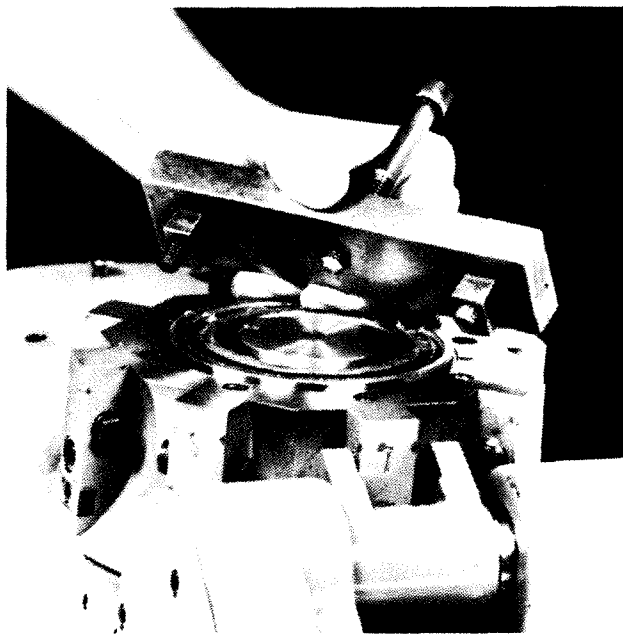


Figure 2.21 - Puller Arrangement for Turret Body

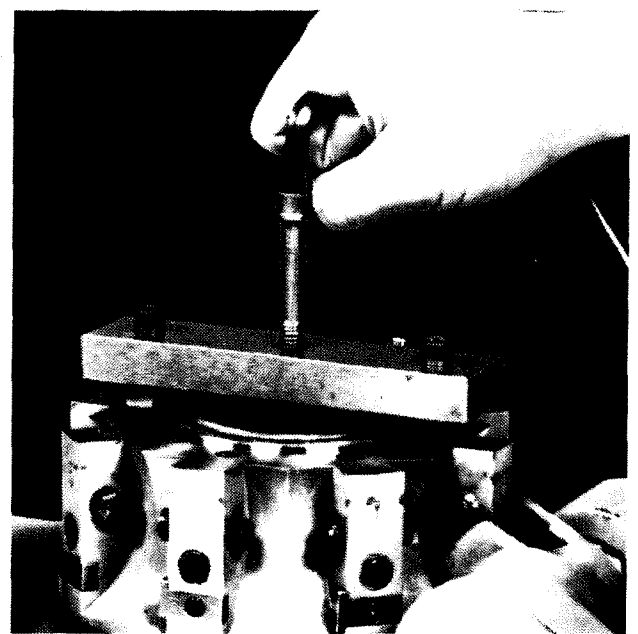


Figure 2.22 - Turret Body Removal

- NOTE -

Knockout holes have been provided in the turret body for bearing removal in the event that lower bearing "D", Figures 2.23 and 2.24, remains with the turret body.

Knockout holes have been provided in the cross slide base for bearing removal in the event that lower bearing "D" remains with the cross slide base.

19. Remove lower bearing "D":

If lower bearing remained with the turret body, remove the bearing by tapping pins, as shown in Figure 2.25 .

If lower bearing remained with the cross slide base, remove the bearing by tapping pins, as shown in Figure 2.26 .

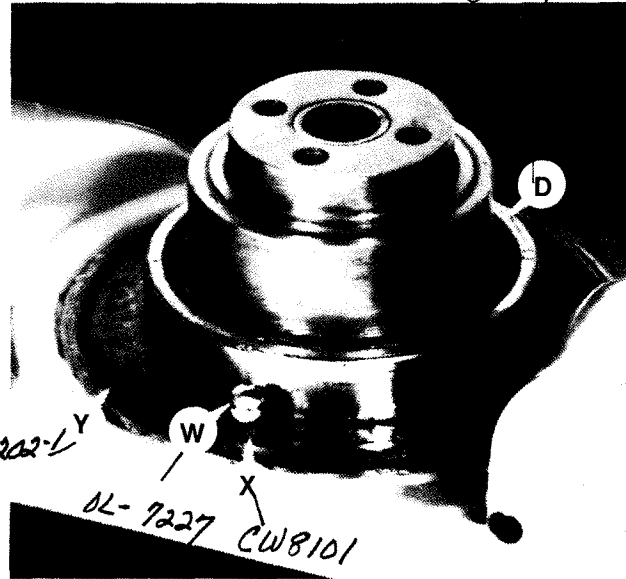


Figure 2.23 - Post for Turret Body and Components

20. Remove spacer "C", Figure 2.24 .

21. Remove upper bearing "A", Figure 2.24, by alternately tapping pins as shown in Figure 2.27 .

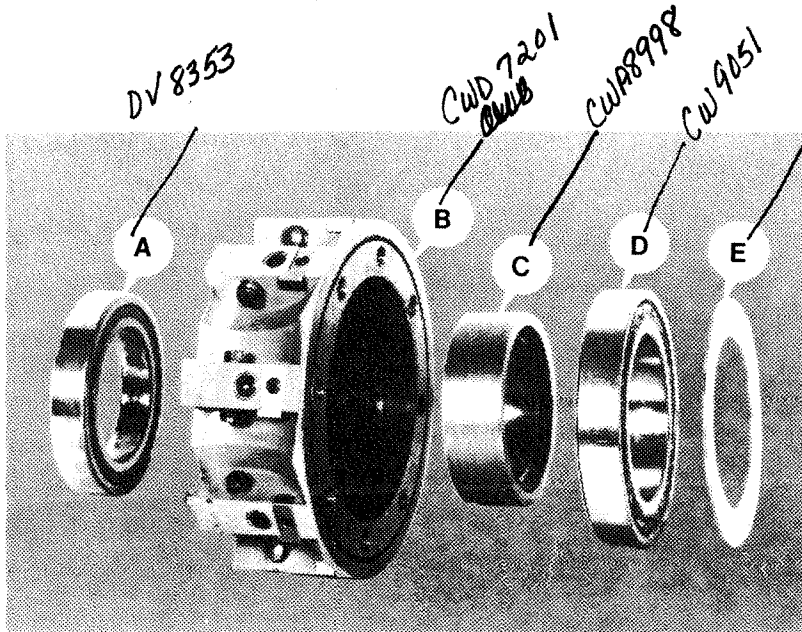


Figure 2.24 - Turret Body and Components

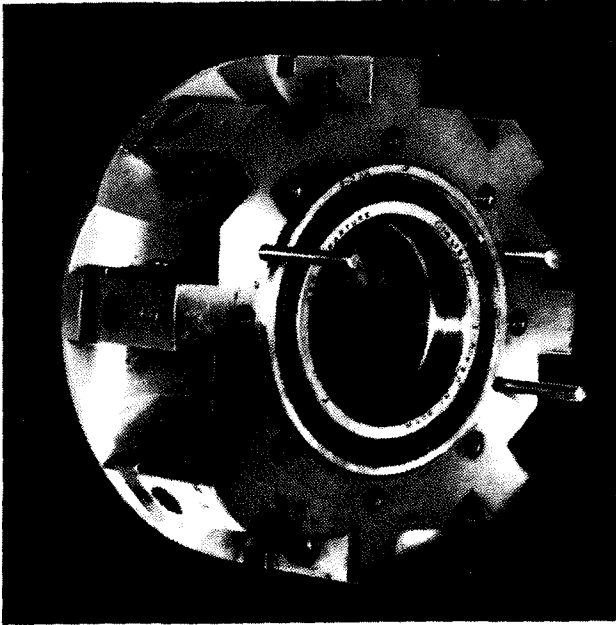


Figure 2.25 - Knockout Holes for Lower Bearing

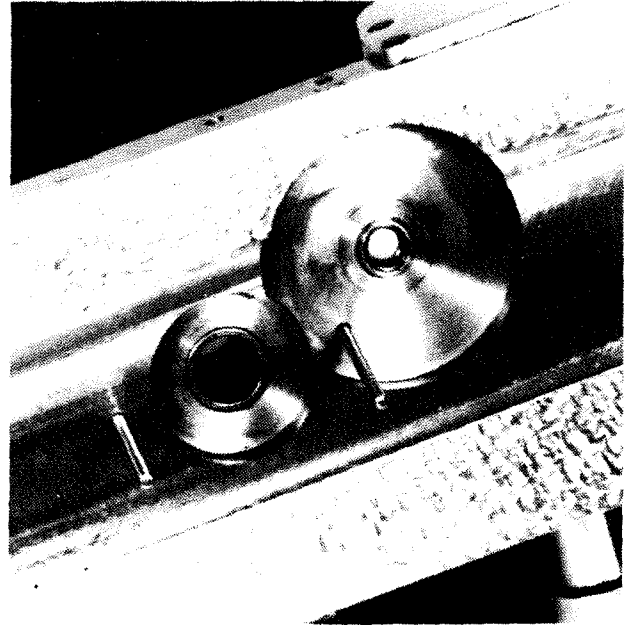


Figure 2.26 - Knockout Holes for Lower Bearing

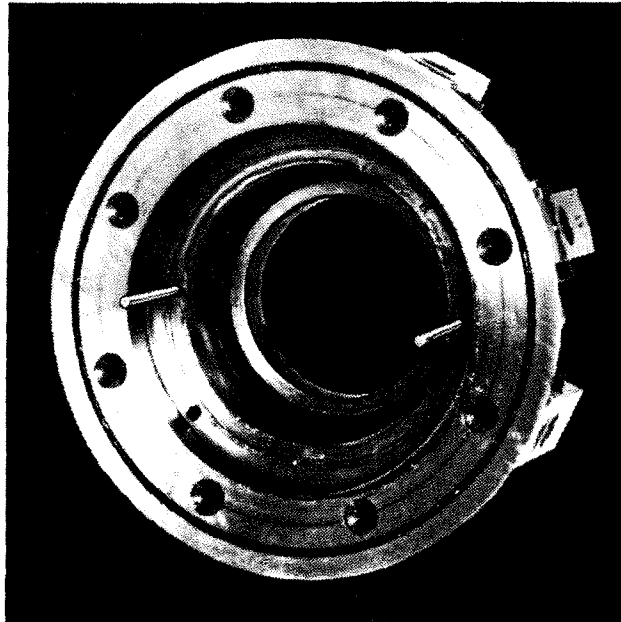


Figure 2.27 - Knockout Holes for Upper Bearing

REASSEMBLY

1. Replace ring "Y", spring "X", and ball "W", Figure 2.23 .
2. Grease the ball and pack the ring and spring with Shell Alvania #3 grease.

- NOTE -

Line up the marks on bearing "D", Figure 2.24, indicating the bearing high points on the inner and outer races with station number one on the turret body.

The open side of the bearing faces out.

3. Replace bearing "D" in turret body "B", Figure 2.24 .
4. Replace turret body "B" on the cross slide post.

- NOTE -

Line up the marks on bearing "A" indicating the bearing high points on the inner and outer races with station number one on the turret body.

The open side of the bearing faces out.

5. Replace spacer "C" and bearing "A".

- NOTE -

Screws "U", Figure 2.20, must be torqued to 200 lb-in (22.6 N•m).

6. Replace retaining plate "T" and four screws "U", Figure 2.20 .

- NOTE -

Apply Permatex sealant to screws "R", Figure 2.19, before they are installed.

7. Replace top plate "S" and eight screws "R", Figure 2.19 .
8. Replace gear "P" and stud "O", Figure 2.18 .

- NOTE -

Pins "M" can easily be replaced by compressing springs "L", Figure 2.17, with a small wire.

9. Replace pins "M" and gear "N", Figure 2.17, on the clutch shaft.
10. Replace clutch assembly "K", Figure 2.16, in the turret.
11. Assemble lock plug "J" and the O-ring, Figure 2.15 .
12. Tighten plug "J" until it is snug; then back it off ½ turn.
13. Tap the head of the plug down to seat in the counterbore of the top plate.
14. Replace set screw "I" and tighten securely.

- NOTE -

Hold the cross slide gib in place while the cross slide is being mounted on the carriage dovetail.

15. Start the cross slide onto the carriage dovetail and move it slowly toward the front of the machine while turning the cross slide handwheel counterclockwise until the feed screw engages the feed screw nut.
16. Using the cross slide handwheel, feed the cross slide toward the front of the machine until the turret centerline is in front of the spindle centerline.
17. Install the stop screw and set screw in hole "E", Figure 2.3:
 - a) Thread the stop screw IN until it bottoms; then turn it OUT one full turn.
 - b) Install and tighten the set screw.
18. Adjust the cross slide gib. Refer to "Cross Slide Gib Adjustment", Page 8.
19. Lubricate the turret indexing mechanism by applying several drops of Mobil® Vactra® Oil No. 2 or equivalent in the opening which will be sealed by oil plug "H", Figure 2.14 .
20. Replace O-ring and oil plug "H".

LUBRICATING THE TURRET INDEXING MECHANISM

Lubricate the turret indexing mechanism monthly with Mobil Vactra Oil No. 2 or equivalent.

1. Remove oil plug "H" and O-ring, Figure 2.14 .
2. Apply several drops of lubricating oil.
3. Replace oil plug "H" and O-ring.

INDEX LEVER AND LOCK ASSEMBLY

DISASSEMBLY

1. Remove the chip and coolant guard, if the machine is so equipped.
2. Remove the set screw located at "E", Figure 2.3, to gain access to the stop screw.
3. Loosen the stop screw located at "E" until the top of the lock screw is flush with the top of the cross slide.
4. Loosen the cross slide gib to allow the cross slide to move freely:
 - a) Remove dot plug "W", Figure 2.10 .
 - b) Insert ¼" hex wrench in screw "A", Figure 2.11, and loosen one turn.
 - c) Insert ¼" hex wrench on through into screw "B" and loosen one turn.
5. Remove the rear cross slide stop or any other stop in use.
6. Using the cross slide handwheel, feed the cross slide toward the back of the machine until travel stops.

- NOTE -

While removing the cross slide, hold the cross slide gib in place to prevent it from dropping out.

7. Pull the cross slide off at the rear of the carriage.
8. Remove oil plug "H", Figure 2.14 .

- NOTE -

Lock screw "I", Figure 2.15, is located directly under plug "H", Figure 2.14 .

9. Remove lock screw "I", Figure 2.15, using a $\frac{1}{8}$ " hex wrench.
10. Remove lock plug "J" and the O-ring.
11. Remove clutch assembly "K", Figure 2.16, from the bottom of the cross slide.
12. Remove seven screws "F" and three wipers "G", "H", and "I", Figure 2.28 .
13. Remove plug "P", spring "Q", and plunger "R", Figure 2.29 .

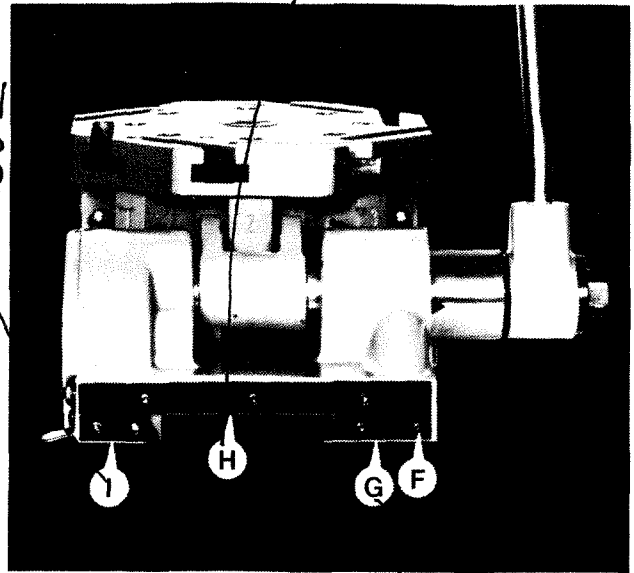


Figure 2.28 - Dovetail Wipers for Cross Slide

CH 8050 R

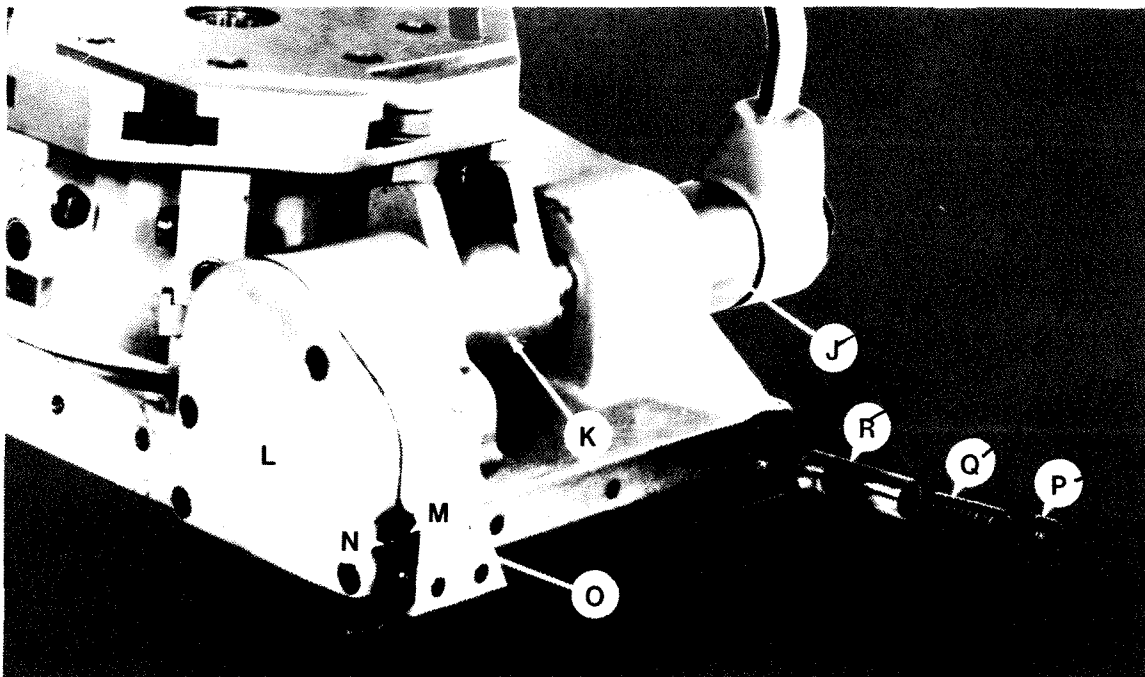


Figure 2.29 - Index Lever and Lock Assembly

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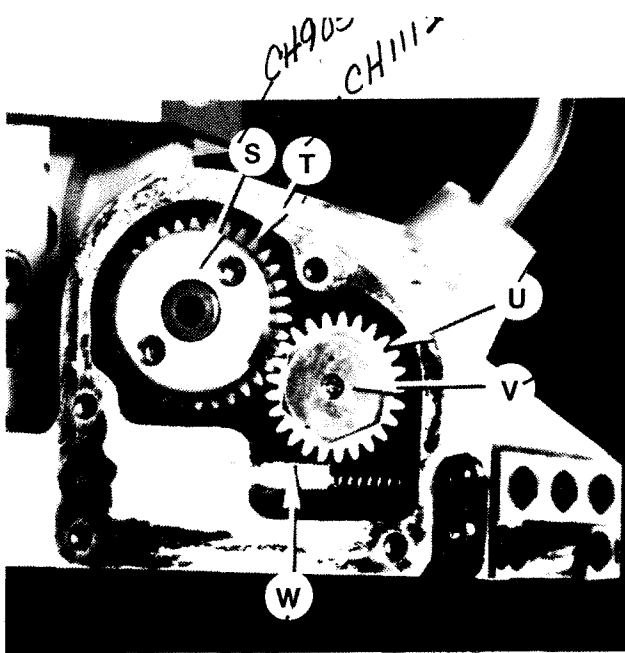


Figure 2.30 - Turret Indexing Gears and Rack

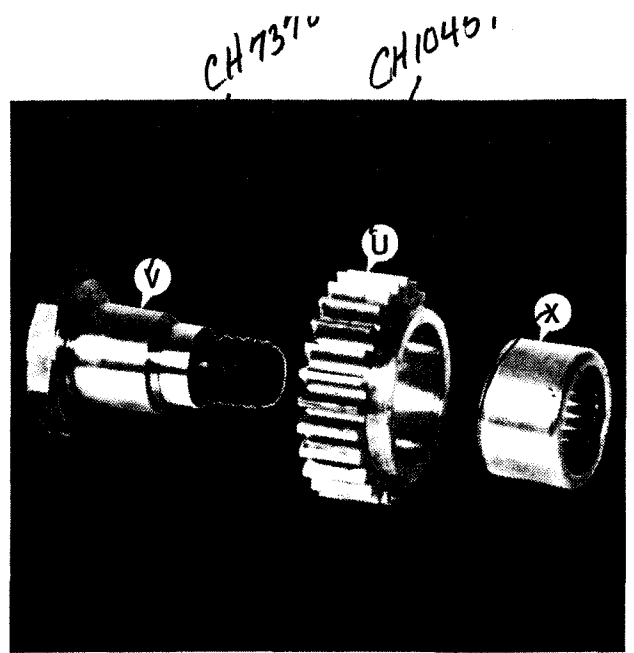


Figure 2.31 - Rack Gear, Stud, and Bearing

14. Remove cover "L".
CH 11130

- NOTE -

Bearing "X" is pressed into gear "U", Figures 2.30 and 2.31 .

15. Remove stud "V" and gear "U", Figures 2.30 and 2.31 .
 16. Loosen nut "M" and remove screw "N", Figure 2.29 .
 17. Remove plug "O", Figures 2.29 and 2.32 .

- NOTE -

Do not disturb adjusting screw "C", Figure 2.32, which determines rack travel.

18. Remove spring "A" and rack "W", Figure 2.32 .
 19. Remove nut "S" and gear "T", Figures 2.30 and 2.33 .
 20. Remove bushing "D", bearing "E", and spacer "F", Figure 2.33 .

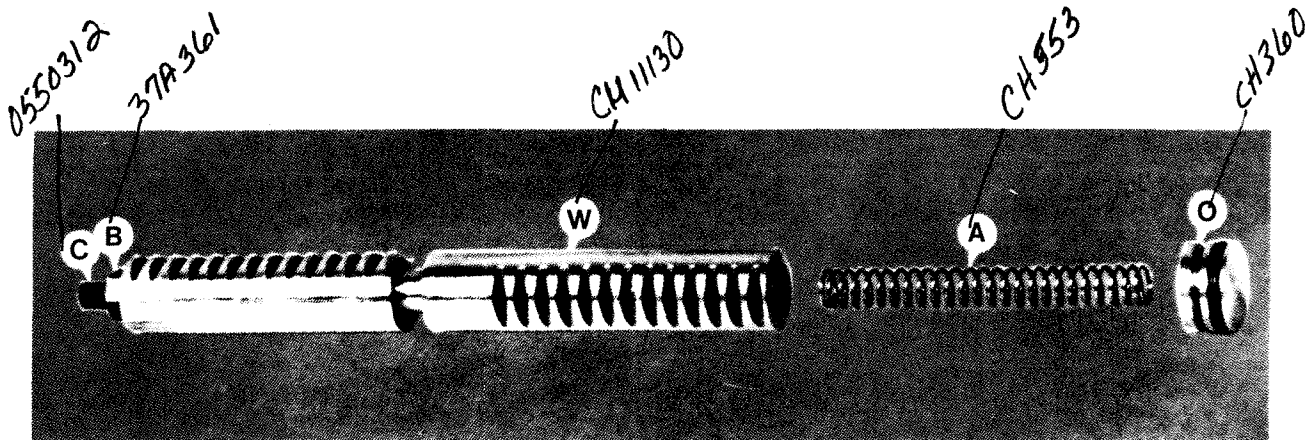


Figure 2.32 - Turret Rack and Components

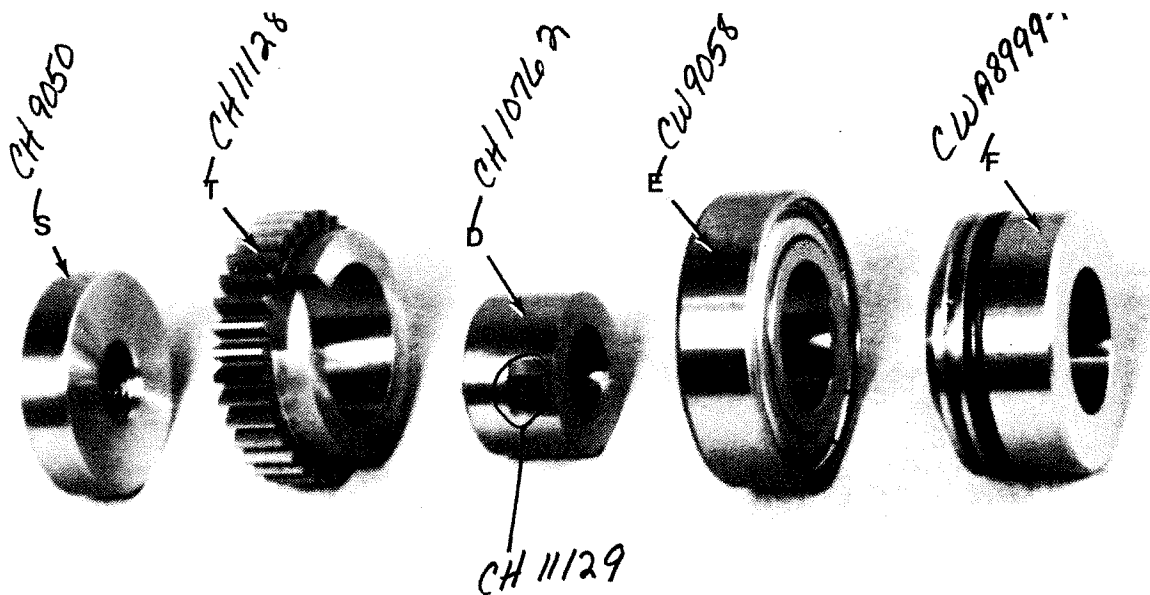


Figure 2.33 - Turret Indexing Shaft Components

- NOTE -

Use a pointed punch in the center drilled hole to remove shaft "J", Figure 2.29 and 2.34 .

21. Remove index shaft "J" and fork "K", Figure 2.29 .
22. Remove key "I" to remove bearing "H" and spacer "G", Figure 2.34 .

- NOTE -

After nut "M" and washer "L" are removed, it may be necessary to tap the handle at the casting with a soft-faced hammer to loosen the taper lock.

23. Remove nut "M" and washer "L" and remove handle "K".

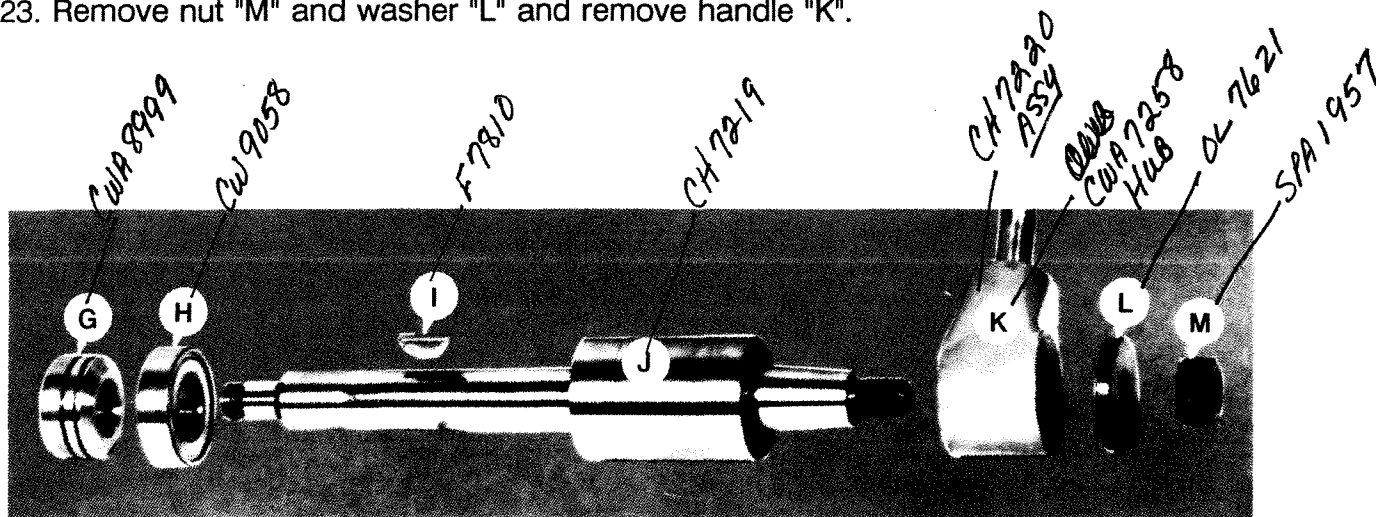


Figure 2.34 - Turret Indexing Shaft and Components

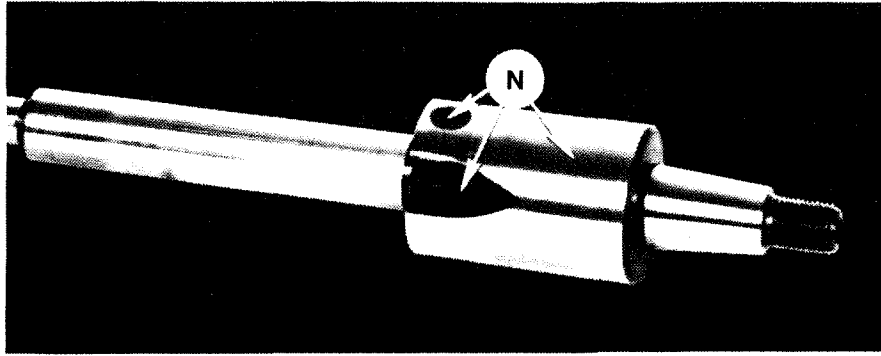


Figure 2.35 - Indexing Shaft Lubrication Points

REASSEMBLY

1. Replace bearing "H", spacer "G", and key "I" on shaft "J", Figure 2.34 .
2. Coat the O.D. and notches of the shaft at points "N", Figure 2.35, with Molyube[®] lubricant.
3. Coat the O.D. of spacer "G", Figure 2.34, with Molyube lubricant.
4. Position fork "K" and replace shaft "J", Figure 2.29 .
5. Assemble handle "K", washer "L", and nut "M" on shaft "J", Figure 2.34 .
6. Coat the O.D. of spacer "F" and bushing "D", Figure 2.33, with Molyube lubricant.
7. Replace spacer "F", bearing "E", bushing "D", and gear "T".

- NOTE -

Torque nut "S", Figures 2.30 and 2.33, to 250 lb-in (28.2 N•m).

8. Replace nut "S", Figures 2.30 and 2.33 .
9. Coat rack "W", Figure 2.32, with Mobil[®] Vactra[®] Oil No. 2 or equivalent.

- NOTE -

If adjusting screw "C", Figure 2.32, has been disturbed, it may be necessary to adjust screw "C" to limit rack travel to a point short of where the teeth on gear "P", Figure 2.18, would hit the non-toothed section of rack "W", Figure 2.32 .

10. Replace rack "W", spring "A", and plug "O", Figure 2.32 .
11. Replace screw "N" and lock nut "M", Figure 2.29 .
12. Coat plunger "R" with Mobil Vactra Oil No. 2 or equivalent.
13. Replace plunger "R", spring "Q", and plug "P".
14. Thread plug "P" in until the index lever will not operate.
15. Back plug "P" out until lock fork "K" clears for indexing; then back the plug out an additional $\frac{1}{3}$ of a turn.

- NOTE -

If gear "U" fails to mesh or the fork fails to lock securely at all stations, adjust screw "C", Figure 2.32 .

16. With rack "W", Figure 2.32, at full travel, the index lever in the locked position, and gear "U" turned to the right, assemble stud "V", bearing "X", and gear "U", Figure 2.31 .
17. Coat the gears with Mobil[®] Vactra[®] Oil No. 2 or equivalent.
18. Apply Permatex sealant to cover "L", Figure 2.29, and remount the cover.
19. Replace clutch assembly "K", Figure 2.16, in the turret.
20. Assemble lock plug "J" and the O-ring, Figure 2.15 .
21. Tighten plug "J" until it is snug; then back it off ½ turn.
22. Tap the head of the plug down to seat in the counterbore of the top plate.
23. Replace set screw "I" and tighten securely.
24. Start the cross slide onto the carriage dovetail and move it slowly into position while turning the cross slide handwheel counterclockwise until the feed screw engages the feed screw nut.
25. Using the cross slide handwheel, feed the cross slide toward the front of the machine until the turret centerline is in front of the spindle centerline.
26. Install the stop screw and set screw in hole "E", Figure 2.3:
 - a) Thread the stop screw IN until it bottoms; then turn it OUT one full turn.
 - b) Install and tighten the set screw.
27. Adjust the cross slide gib. Refer to "Cross Slide Gib Adjustment", Page 8.
28. Lubricate the turret indexing mechanism by applying several drops of Mobil Vactra Oil No. 2 or equivalent in the opening which will be sealed by plug "H", Figure 2.14 .
29. Replace plug "H" and O-ring.

- NOTE -

Set the wipers .0015" above the dovetail surfaces.

30. Use screws "F" to remount wipers "G", "H", and "I", Figure 2.28 .

- NOTES -

- NOTES -

CHAPTER 3 - SPINDLE AND POWER FEED DRIVES

SPINDLE DRIVE

CHECKING DRIVE BELT TENSION

- NOTE -

If the drive belts slip when they are properly adjusted, the machine is being overloaded.

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
3. Place lever "H", in range "3" and set speed selector "F" to 3000 rpm.
4. Turn brake switch "G" to the OFF position.
5. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 3000 rpm.

6. Place lever "I" in the "Brake" position and allow the spindle to coast to a stop.
7. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
8. Open door "J", Figure 3.2.

- NOTE -

The drive belts should not be loose or excessively tight. Proper belt tension will allow approximately 1½ inch [38.1 mm] of belt deflection by hand.

9. Check drive belts "K" and "L", Figure 3.3, for proper tension.

If the drive belts are not properly adjusted, refer to the next section, "Adjusting Belt Tension".

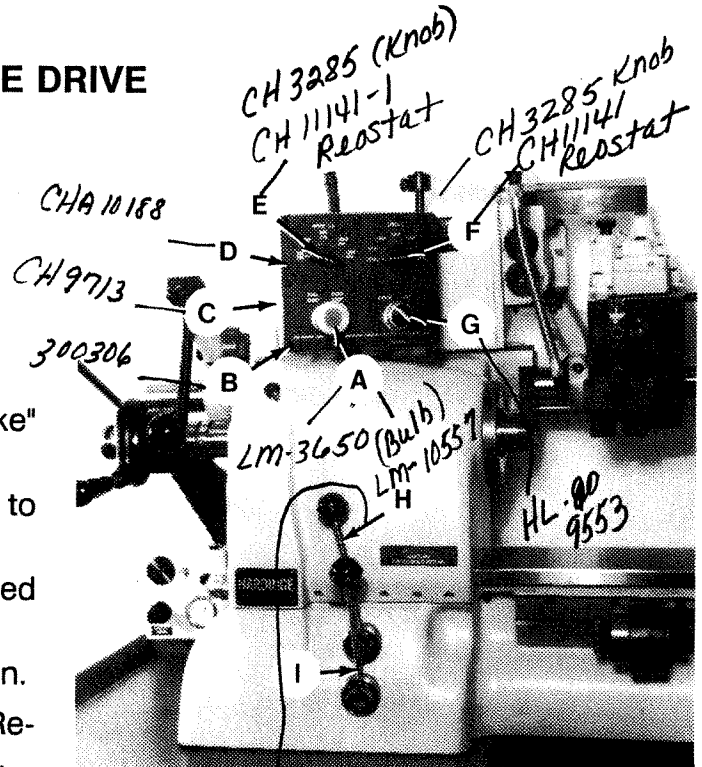


Figure 3.1 - Headstock and Variable Speed Control



Figure 3.2 - Pedestal Door

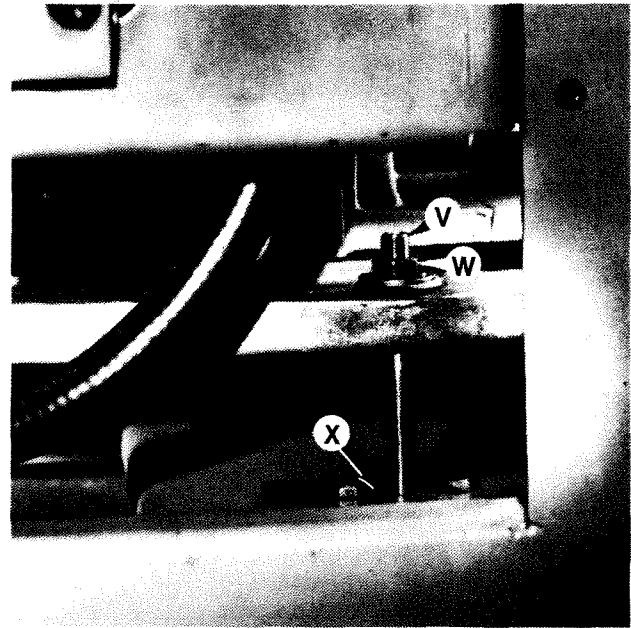
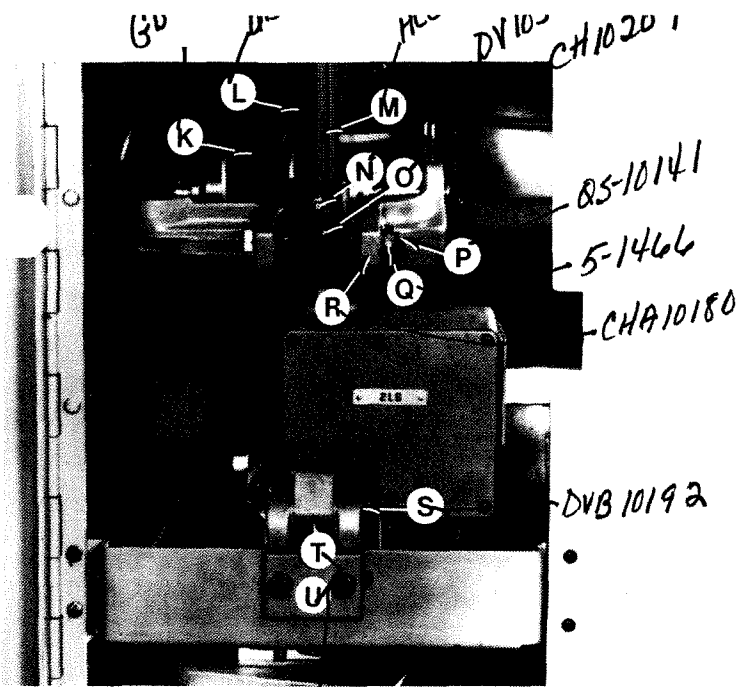


Figure 3.3 - Spindle Drive Compartment

Figure 3.4 - Drive Belt Adjusting Screw

DVA10561
DV 10540

ADJUSTING DRIVE BELT TENSION

1. Press "Start/Stop" pushbutton "A", Figure 3.1, IN to turn the machine OFF.
2. Open door "J", Figure 3.2 .
3. Determine whether the drive belts are too loose or too tight.
4. Loosen lock nut "W", Figure 3.4 .
5. Turn adjusting screw "V":
 Clockwise to lower the drive motor and tighten the drive belts.
 Counterclockwise to raise the drive motor and loosen the drive belts..
6. Tighten lock nut "W".
7. Recheck drive belt tension. Refer to the previous section, "Checking Drive Belt Tension".
8. Close door "J", Figure 3.2 .

MOTOR AND SPINDLE BELT REPLACEMENT

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
3. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
4. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

5. Place lever "I" in the "Brake" position to stop the spindle.
6. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.

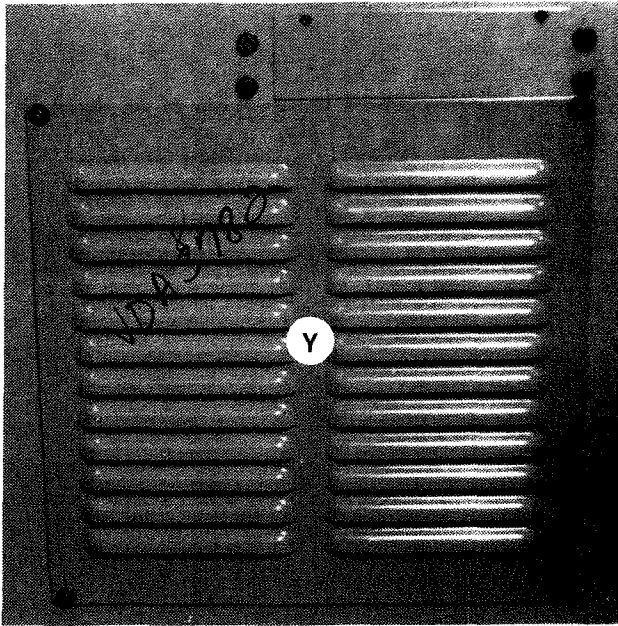


Figure 3.5 - Pedestal Rear Cover

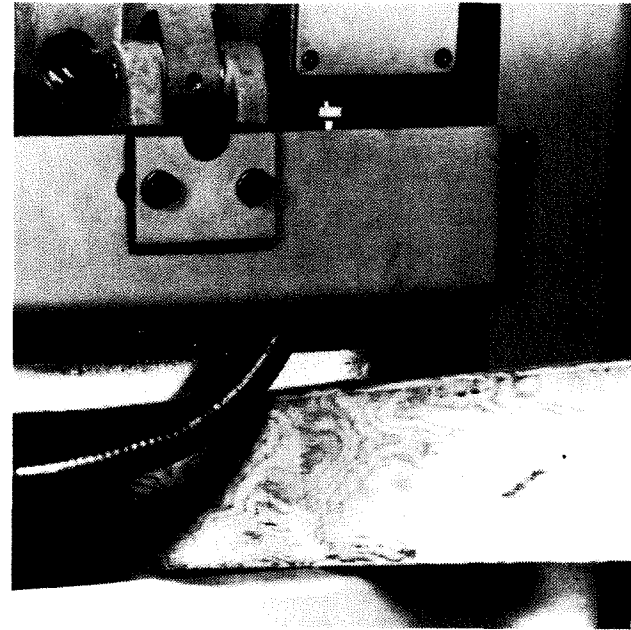


Figure 3.6 - Motor Plate Blocked in Position

7. Open door "J", Figure 3.2 .
8. Remove pedestal rear cover "Y", Figure 3.5, to prevent damage when the motor mounting plate is raised.
9. Remove lock nut "W", Figure 3.4 .
10. Raise the front of the motor mounting plate approximately two inches and block it in this position, as shown in Figure 3.6 .
11. Roll motor belt "B", Figure 3.7, to the right off the pulley and let it rest on the pulley hub, as shown.
12. Loosen mounting bolts "G" on brake assembly "F", Figure 3.8.
13. Pull the brake assembly away from motor pulley "C".

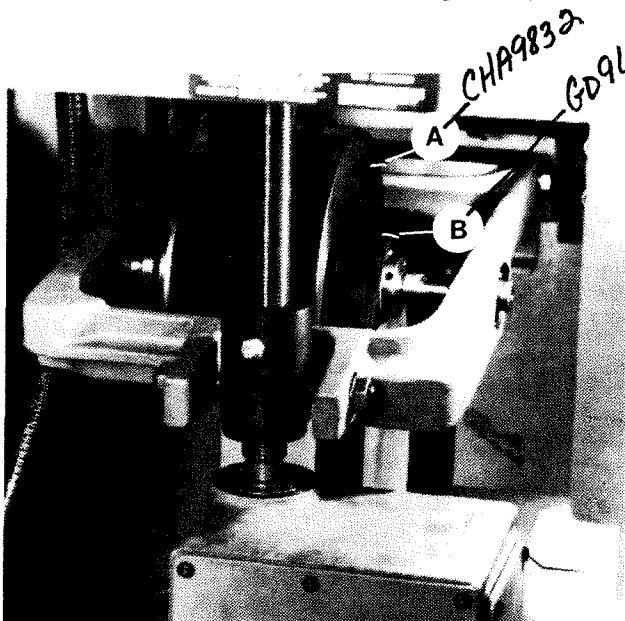


Figure 3.7 - Motor Belt on Pulley Hub

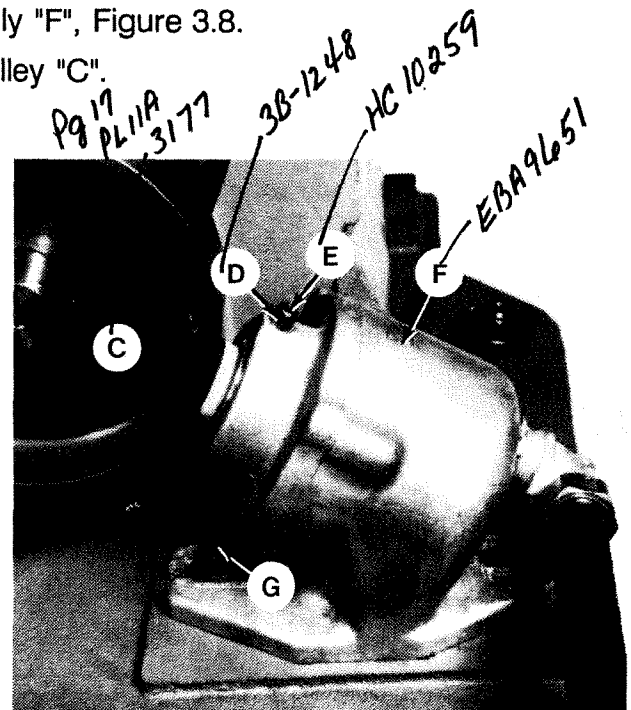


Figure 3.8 - Spindle Brake

14. Remove the motor belt from motor pulley "C".
15. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
16. Place lever "H", in range "3" and set speed selector "F" to 3000 rpm.
17. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 3000 rpm.

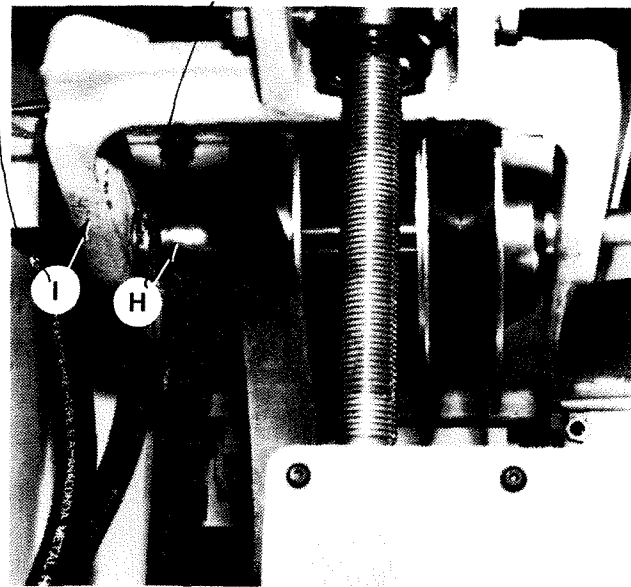


Figure 3.9 - Belt Removal from Countershaft

18. Place lever "I" in the "Brake" position to stop the spindle.
19. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
20. Slide countershaft assembly "H", Figure 3.9, to the extreme right and remove both belts over the left end of the countershaft.
21. Remove the collet closer according to the procedure outlined Chapter 4.
22. Remove the headstock cover by loosening two set screws, as shown in Figure 3.10 .
23. Remove the cotter pin from the speed change pull rod, which passes through the headstock belt in the motor compartment.
24. Move the headstock belt around the end of the pull rod.
25. Pull the headstock belt off the spindle pulley, over the end of the spindle pulley, and out of the headstock, Figure 3.11 .
26. Slide the new motor belt over the left end of countershaft assembly "H", Figure 3.9, and onto the right pulley on the countershaft assembly.

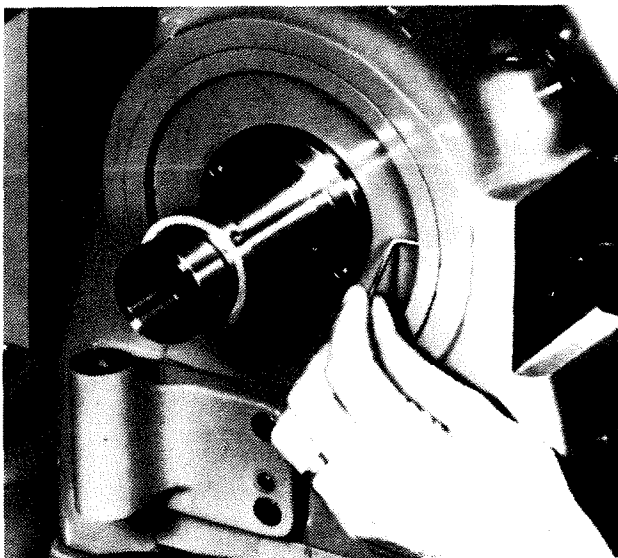


Figure 3.10 - Headstock Cover Removal

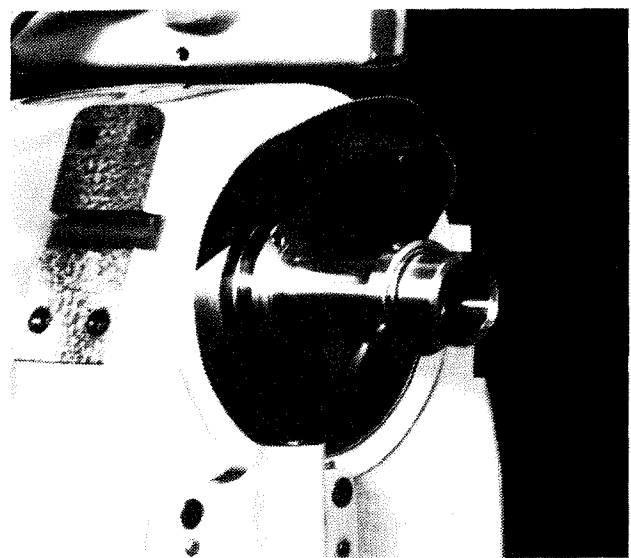


Figure 3.11 - Headstock Belt Removal

27. Slide the new headstock belt over the end of the spindle, into the headstock, and onto the spindle pulley.
28. Move the headstock belt over the end of the pull rod.
29. Slide the new headstock belt over the left end of countershaft assembly "H" and onto the left pulley of the countershaft assembly.
30. Remount the countershaft assembly by sliding the left end of the countershaft assembly back into countershaft support bracket "I".
31. Reconnect the pull rod and insert the cotter pin removed in step 24.
32. Install the headstock cover and tighten two set screws, as shown in Figure 3.10 .
33. Remount the collet closer according to the procedure outlined in Chapter 4.
34. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
35. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
36. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

37. Place lever "I" in the "Brake" position to stop the spindle.

- WARNING -

The spindle brake is not in position to stop the spindle. Allow the spindle to come to a complete stop.

Be sure the machine is turned OFF before attempting to work in the motor compartment.

38. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
39. Install the motor belt on motor pulley "C", Figure 3.8 .
40. Realign spindle brake "F" with the braking surface on the motor pulley and tighten the two brake mounting bolts.
41. Check and adjust the gap between the cork insert in the brake and the braking surface on the spindle motor pulley. Refer to "Spindle Brake Gap Adjustment", Page 3-6.

- NOTE -

Use care when lowering the motor mounting plate. Do not damage the threads on height adjusting screw "V", Figure 3.4, or the threads in the threaded hole in adjusting plate "X".

42. Remove the block and carefully lower the front of the motor mounting plate.
43. Install lock nut "W", Figure 3.4, but do not tighten.
44. Adjust belt tension according to the procedure outlined in "Adjusting Drive Belt Tension", Page 3-2.
45. Install pedestal rear cover "Y", Figure 3.5 .
46. Close door "J", Figure 3.2 .

SPINDLE BRAKE GAP ADJUSTMENT

- NOTE -

There should be a .010 to .013 inch [.25 to .33 mm] clearance between the cork insert and the brake drum.

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
3. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
4. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.
5. Set brake switch "G", Figure 3.1, to the "OFF" position.
6. Place lever "I" in the "Brake" position.

- WARNING -

Be sure the spindle motor has come to a complete stop before attempting to work in the motor compartment.

7. Open door "J", Figure 3.2 .
8. Turn adjusting screw "J", Figure 3.12, clockwise or counterclockwise until there is a .010 to .013 inch [.25 to .33 mm] clearance between the cork insert and the brake drum.

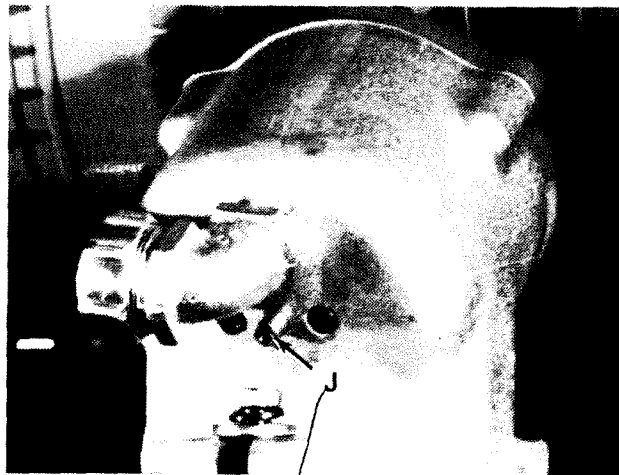


Figure 3.12 - Spindle Brake Adjusting Screw

EO-11167

SPINDLE BRAKE INSERT REPLACEMENT

- WARNING -

Be sure the machine is turned OFF before attempting to work in the motor compartment.

1. Push "Start/Stop" pushbutton "A", Figure 3.1, IN to turn the machine OFF.
2. Open door "J", Figure 3.2 .
3. Loosen two bolts "G", Figure 3.8, and remove the brake assembly for easy access to the cork insert.
4. Loosen locknut "D".
5. Loosen keyway guide screw "E".
6. Turn adjusting screw "J", Figure 3.12, counterclockwise until the cork housing is free from the brake.
7. Push the cork insert out of the housing by means of the threaded hole in the bottom of the housing.

- NOTE -

Be sure that the new cork insert bottoms out in the cork housing.

8. Install the new cork insert.
9. Replace the cork housing in the brake, orienting the keyway toward keyway guide screw "E", Figure 3.8 .
10. Turn keyway guide screw "E" clockwise until it bottoms out in the cork housing.
11. Back keyway guide screw "E" out ¼ turn and tighten locknut "D".
12. Reposition the brake assembly and tighten two bolts "G".
13. Adjust the gap between the cork insert and the brake drum according to the steps outlined under "Spindle Brake Gap Adjustment", Page 3-6.

SPINDLE BRAKE INSERT LUBRICATION

- NOTE -

Do not over-oil the cork insert.

Oil the cork insert in the spindle brake with two drops of spindle oil (Mobil® Velocite® No. 6 or equivalent) as needed. When it is dry, the cork insert will squeak when applied against the spindle motor pulley.

Allowing the cork insert to dry out will greatly reduce the life of the drive belts and cork insert.

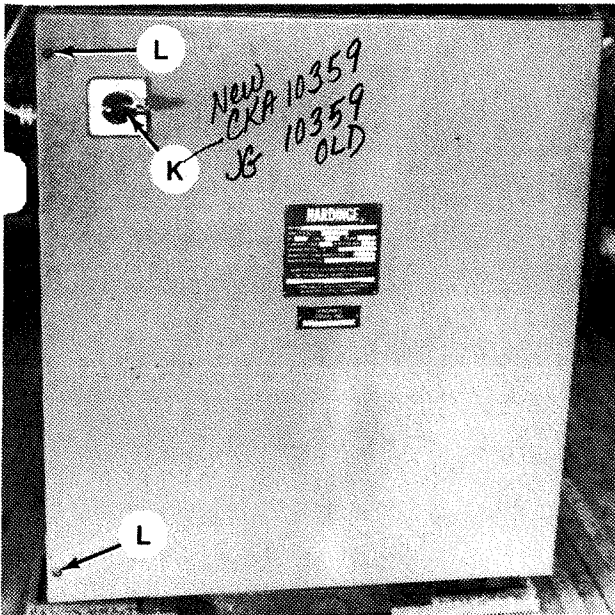


Figure 3.13 - Main Disconnect Switch

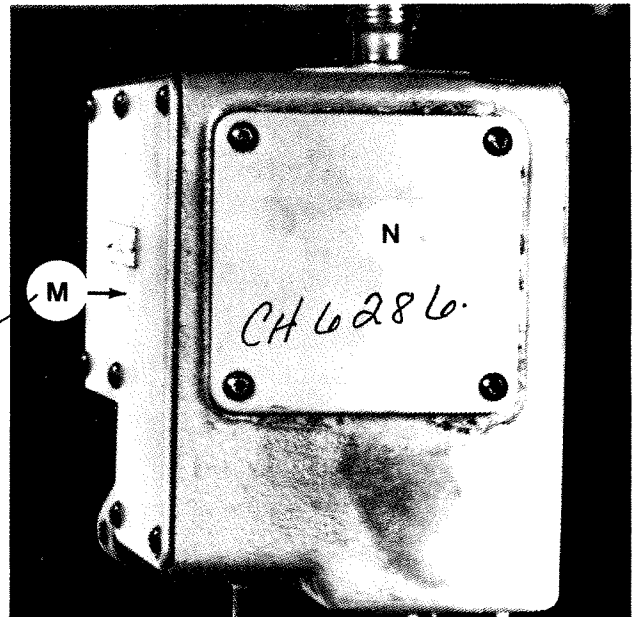


Figure 3.14 - Drive Housing Covers

DRIVE CARTRIDGE

REMOVAL

1. Press "Start/Stop" pushbutton "A", Figure 3.1, IN to turn the machine OFF.
2. Turn main disconnect switch "K", Figure 3.13, OFF.
3. Open door "J", Figure 3.2 .
4. Remove covers "M" and "N", Figure 3.14 .
5. Tag for reconnection; then disconnect the two red wires from limit switch "P", Figure 3.15 .
6. Tag for reconnection; then unsolder wires 26, 27, and 33 from the terminals on rheostat "R".
7. Remove screw "S" to remove the wire clamp and the ground wire.
8. Remove the lock screw at "O" and loosen the set screw under the lock screw.
9. Remove the drive cartridge, Figure 3.16, from housing "Q", Figure 3.15, by pulling it out of the housing to the right, as viewed from the front of the machine.

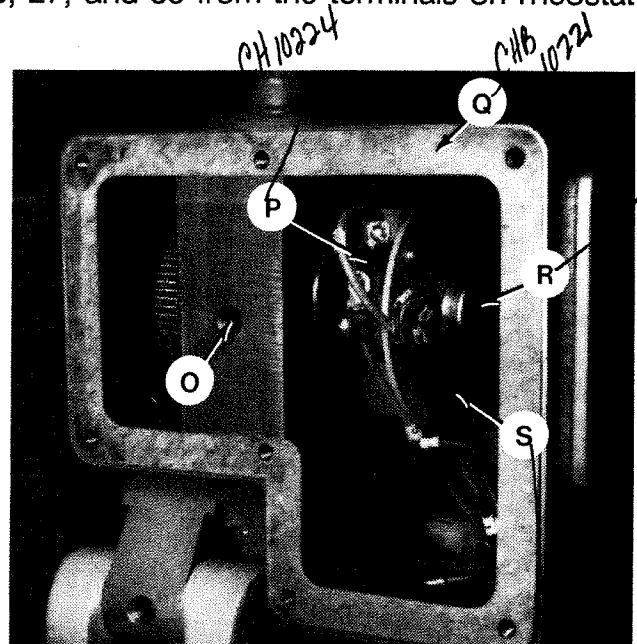
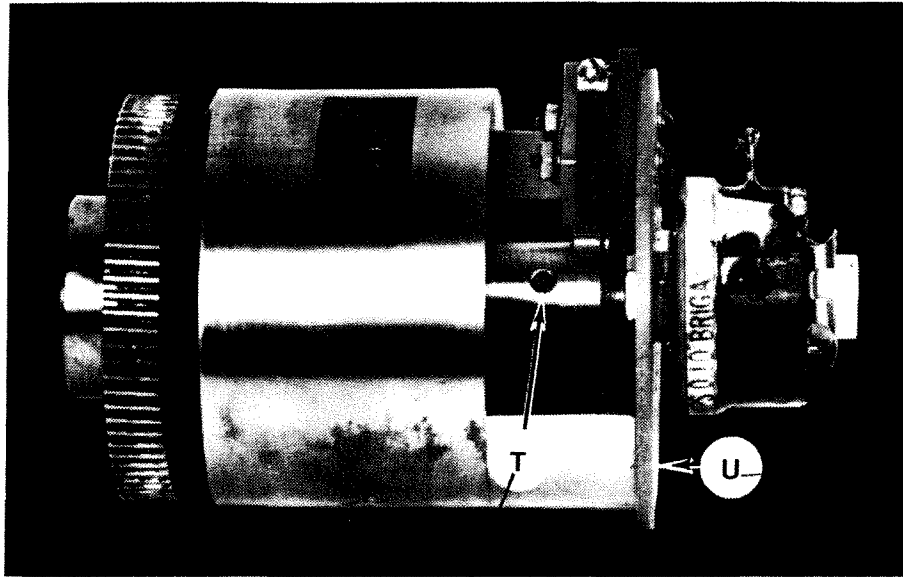


Figure 3.15 - Drive Housing



CHB-11169

Figure 3.16 - Drive Cartridge

CH 9841

DISASSEMBLY

1. Remove lock screw "T", Figure 3.16, and loosen the set screw under lock screw "T".
2. Remove the remaining screw and rheostat mounting plate "U".
3. Remove nut "V", Figure 3.17, to remove rheostat "W".

- NOTE -

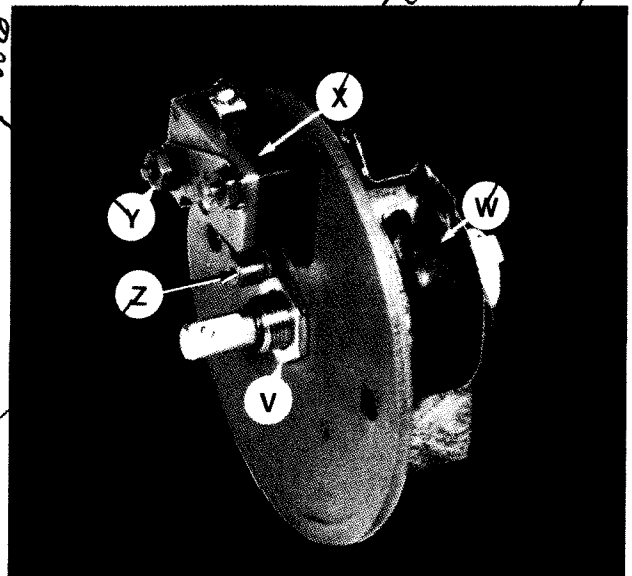
Do not misplace single roller actuator "Z" when removing limit switch "X", Figure 3.17 .

4. If necessary, remove two nuts "Y" to remove limit switch "X" and actuator "Z"
5. Hold shaft "A", Figure 3.18, with a hex wrench and remove nut "B" with an adjustable spanner wrench.
6. Remove worm wheel "C".
7. Remove woodruff key "H", Figure 3.19 .
8. Tap the shaft at the keyway end to remove shaft "I", bearing "G", and spacer "F".
9. Remove bearing "D" from housing "E".
10. If necessary, remove screw "K" and cam "J".

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CH-11136

Figure 3.17 - Limit Switch and Rheostat

REASSEMBLY AND REPLACEMENT

1. If they were removed, remount cam "J" and screw "K", Figure 3.19 .
2. Install bearing "D" in housing "E".
3. Install spacer "F", bearing "G", and shaft "I" in housing "E".
4. Install woodruff key "H".
5. Mount worm wheel "C", Figure 3.18 .
6. Hold shaft "A" with a hex wrench and install nut "B" with an adjustable spanner wrench.
7. If removed, mount limit switch "X" and actuator "Z", Figure 3.17, using two nuts "Y".
8. Mount rheostat "W" using nut "V".
9. Install rheostat mounting plate "U", Figure 3.16 .
10. Tighten set screw and install lock screw "T".
11. Fill the teeth of the worm and worm wheel with Andok® "B" grease or equivalent.

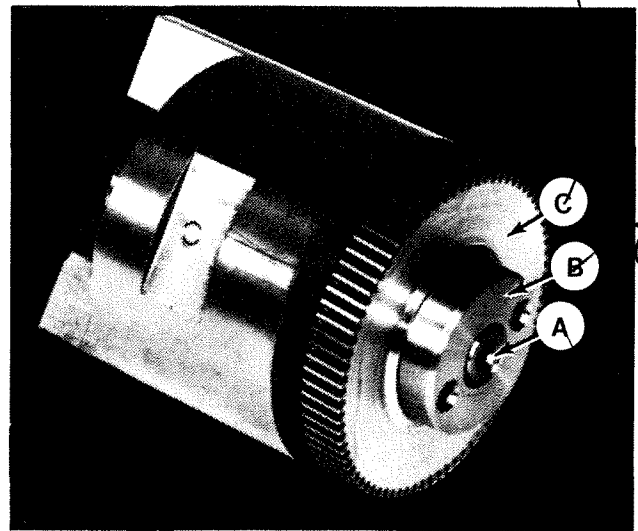


Figure 3.18 - Worm Wheel and Drive Cartridge

- NOTE -

When the wheel on the drive cartridge is engaged with the worm, the wheel should be aligned with the centerline of the vertical feed screw.

12. Install the drive cartridge, Figure 3.16, into housing "Q", Figure 3.15 .
13. Tighten the set screw and install the lock screw at "O".
14. Replace the two red wires on limit switch "P", Figure 3.15 .
15. Solder wires 26, 27, and 33 to the terminals on rheostat "R".

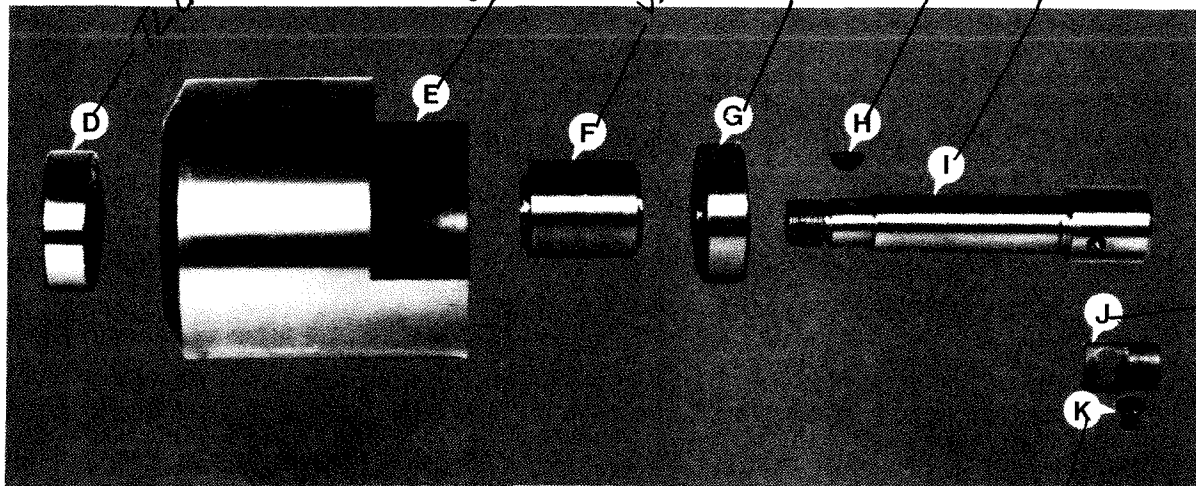


Figure 3.19 - Drive Cartridge Housing and Components

16. Replace clamp "S" and ground screw.
17. Replace covers "M" and "N", Figure 3.14 .
18. Loosen two lock nuts "Q", Figure 3.3 .
19. Thread pivot screws "P" away from feed screw nut "O" until the tips of the pivot screws are inside support bracket "R".
20. Place lever "I", Figure 3.1, in the "Brake" position.
21. Turn main disconnect switch "K" ON.
22. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
23. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
24. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle motor running until feed screw "M", Figure 3.3, stops rotating.

25. Place lever "I" in the "Brake" position to stop the spindle.

- NOTE -

To facilitate proper adjustment, feed screw nut "O", Figure 3.3, can be rotated 180° by interchanging grease fitting "M" and pipe plug "R", Figure 3.20 .

26. Hand feed nut "O" to within three to five threads from the bottom of the vertical screw, with the grease fitting toward the front.

- WARNING -

Do not activate the spindle motor while working in the motor compartment.

27. Set brake switch "G", Figure 3.1, to the "OFF" position.
28. Pull down on support bracket "R" while manually turning spindle belt "K", Figure 3.3 .
29. Line up pivot screws "P" in the pulley carrier with the pivot holes in feed screw nut "O".
30. Turn pivot screws "P" into the pivot holes in feed screw nut "O".
31. Tighten lock nuts "Q".
32. Run the drive through the entire speed range to check alignment.
33. Perform the procedure outlined in "Checking Limit Switch Adjustment", Page 3-14.

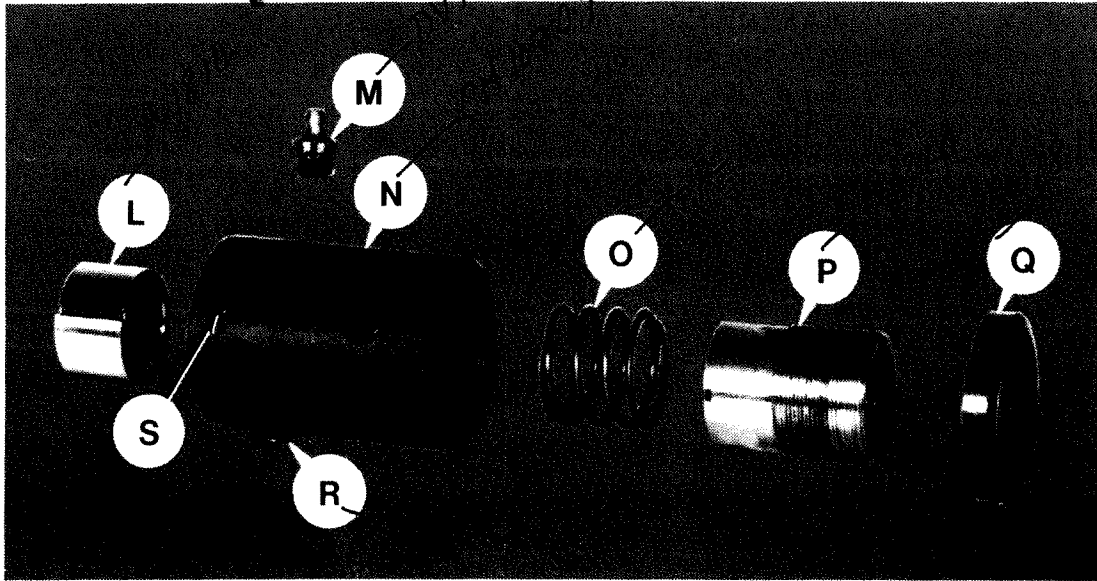


Figure 3.20 - Speed Change Feed Screw Nut

SPEED CHANGE FEED SCREW NUT

REMOVAL

1. Press "Start/Stop" pushbutton "A", Figure 3.1, IN to turn the machine OFF.
2. Open door "J", Figure 3.2.
3. Loosen two lock nuts "Q" and pivot screws "P" to clear feed screw nut "O", Figure 3.3 .

- NOTE -

Half nut "L", Figure 3.20, is spring loaded. Hold half nut "L" in place within nut body "N" while the feed screw nut is removed.

4. Thread feed screw nut "O", Figure 3.3, manually up and off the vertical feed screw.
5. Remove half nut "L", Figure 3.20 .
6. Remove nut "Q".
7. Remove half nut "P" and spring "O" from nut body "N".

REPLACEMENT

- NOTE -

Grease fitting "M" can be interchanged with plug "R", Figure 3.20, for adjustment purposes during reassembly.

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
3. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
4. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until feed screw "M", Figure 3.3, stops rotating.

5. Place lever "I" in the "Brake" position to stop the spindle.
6. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
7. Install spring "O" and half nut "P" in nut body "N", Figure 3.20 .
8. Install nut "Q".

- NOTE -

The slot in half nut "L" must be aligned with set screw "S". Set screw "S" is for alignment ONLY. Do not tighten set screw "S" against half nut "L".

9. Insert half nut "L" into nut body "N".

- NOTE -

Hold loose half nut "L" flush with the top of nut body "N" while threading feed screw nut "O", Figure 3.3, onto the vertical feed screw. When the threads inside half nut "L", Figure 3.20, engage the feed screw, half nut "L" may be released.

10. Thread feed screw nut "O", Figure 3.3, manually onto the vertical feed screw.
11. Hand thread feed screw nut "O" down to within three to five threads from the bottom of the vertical screw, with grease fitting "N" toward the front.
12. Line up pivot screws "P" in the pulley carrier with the pivot holes in feed screw nut "O".
13. Turn pivot screws into the pivot holes in feed screw nut "O".
14. Tighten lock nuts "Q".
15. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
16. Run the drive through the entire speed range to check alignment.
17. Stop the spindle at the low speed setting (125 rpm).
18. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.

- NOTE -

The motor belt should be flush to $\frac{1}{16}$ " out of the pulley.

19. Check the position of the O.D. of the motor belt.
If the position of the motor belt is not correct, proceed to step 20.
If the position of the motor belt is correct, this procedure is complete.
20. Loosen lock nuts "Q" and pivot screws "P", Figure 3.3 .

- NOTE -

The feed screw nut can be turned 180° by interchanging the grease fitting and the pipe plug.

21. Rotate the feed screw nut as needed to adjust pulley position.
22. Tighten pivot screws "P" and lock nuts "Q".
23. Repeat steps 15 through 19.

LUBRICATION

Grease at fitting "N", Figure 3.3, with Andok® "B" grease. Grease is sufficient when grease is forced out of the slot at fitting "N". Lubricate at least once a month or more often if necessary.

For proper lubrication of the speed change drive mechanism, run the machine through the entire speed range at least once a day.

The main drive motor and the speed change motor bearings are grease packed for life and require no further lubrication.

VARIABLE SPEED DRIVE LIMIT SWITCH

Drive limit switch "T", Figure 3.21, is a safety feature to prevent the drive from over-running at the top or bottom of travel. When properly adjusted, the limit switch will permit a total of 1-½ to 3 turns beyond the minimum and maximum speed settings before the limit switch is engaged, cutting the power to the variable speed motor.

CHECKING LIMIT SWITCH ADJUSTMENT

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
3. Place lever "H", in range "3" and set speed selector "F" to 3000 rpm.
4. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 3000 rpm.

5. Place lever "I" in the "Brake" position to stop the spindle.
6. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
7. Open door "J", Figure 3.2 .
8. Mark vertical feed screw "M" and nut "O", Figure 3.3, with a grease pencil.
9. Remove cover "M", Figure 3.14 .

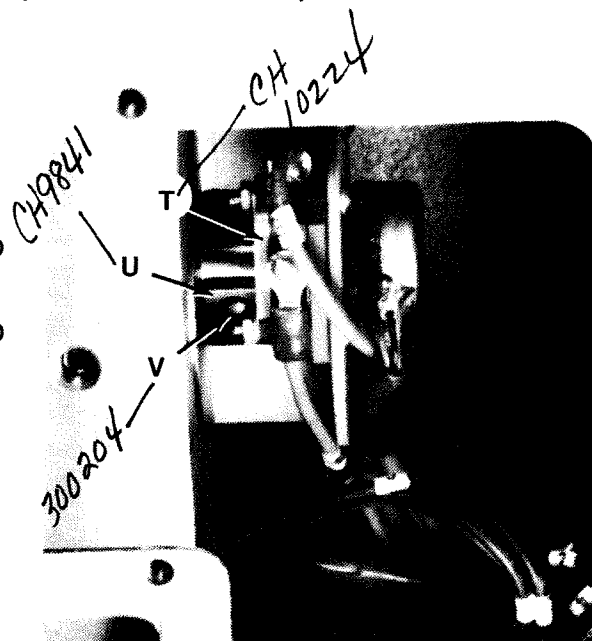


Figure 3.21 - Limit Switch Adjustment

10. Turn the vertical feed screw by hand clockwise (as viewed from the top) and count the revolutions of the feed screw before the click of the limit switch is heard.
11. Turn the vertical feed screw by hand counterclockwise (as viewed from the top) to back the drive off the limit switch.
12. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
13. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
14. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

15. Place lever "I" in the "Brake" position to stop the spindle.
16. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
17. Mark vertical feed screw "M" and nut "O", Figure 3.3, with a grease pencil.
18. Turn the vertical feed screw by hand counterclockwise (as viewed from the top) and count the revolutions of the feed screw before the click of the limit switch is heard.
19. Turn the vertical feed screw by hand clockwise (as viewed from the top) to back the drive off the limit switch.
20. Add the number of turns counted at the top and bottom together.

If the vertical feed screw has a total of 6 turns or less beyond the minimum and maximum speed settings, with an equal number of turns top and bottom, the limit switch is properly adjusted. Proceed to step 29 .

If the vertical feed screw has a total of more than six turns beyond the minimum and maximum speed settings, proceed to step 21.

If the vertical feed screw has a total of six turns or less beyond the minimum and maximum speed settings, but more turns top or bottom, proceed to step 25.

21. Loosen screw "V", Figure 3.21 .
22. Pivot cam "U" toward limit switch "T".
23. Tighten screw "V".
24. Repeat steps 1 through 20.
25. Loosen screw "V", Figure 3.21 .
26. Adjust cam "U" to equally divide the turns for 1-½ to 3 turns top and bottom.
27. Tighten screw "V".
28. Repeat steps 1 through 20.
29. Replace cover "M", Figure 3.14 .
30. Close door "J", Figure 3.2 .

PULLEYS AND SHAFT ASSEMBLY

REMOVAL

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
3. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
4. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

5. Place lever "I" in the "Brake" position to stop the spindle.
6. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
7. Open door "J", Figure 3.2 .
8. Remove pedestal rear cover "Y", Figure 3.5, to prevent damage when the motor mounting plate is raised.
9. Remove lock nut "W", Figure 3.4 .
10. Turn adjusting screw "V" counterclockwise until the adjusting screw disengages from adjusting plate "X".
11. Raise the front of the motor mounting plate approximately two inches and block it in this position, as shown in Figure 3.6 .
12. Loosen two bolts "G", Figure 3.8, and slide brake assembly "F" away from motor pulley "C".
13. Remove motor belt "L", Figure 3.3, from spindle drive motor pulley "C", Figure 3.8 .
14. Roll motor belt "B" to the right off pulley "A", Figure 3.7, and let it rest on the hub.

- WARNING -

Stay clear of the spindle drive motor compartment while setting the machine to 3000 rpm.

15. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
16. Place lever "H", in range "3" and set speed selector "F" to 3000 rpm.
17. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 3000 rpm.

18. Place lever "I" in the "Brake" position to stop the spindle drive motor.
19. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
20. Slide countershaft assembly "H", Figure 3.9, to the extreme right and remove both belts over the left end of the countershaft assembly.
21. Slide the left end of the countershaft assembly back into the left side of pulley hanger "I".
22. Remove the snap ring from the right side of the pulley hanger, as shown in Figure 3.22 .

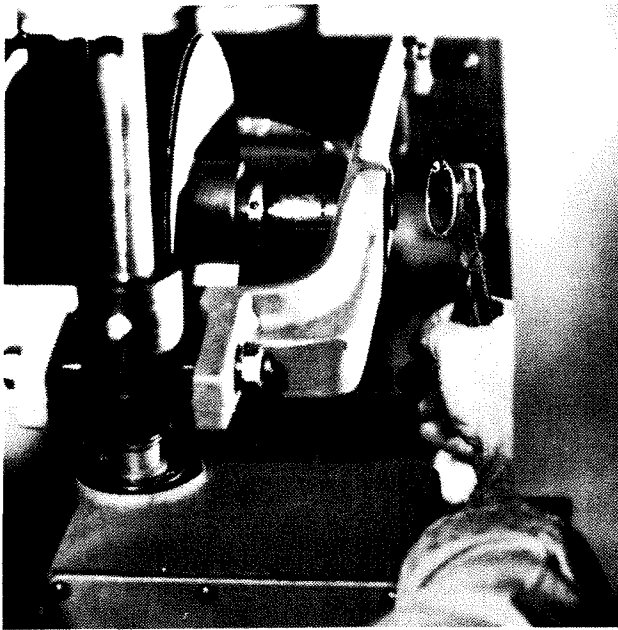


Figure 3.22 - Countershaft Snap Ring Removal

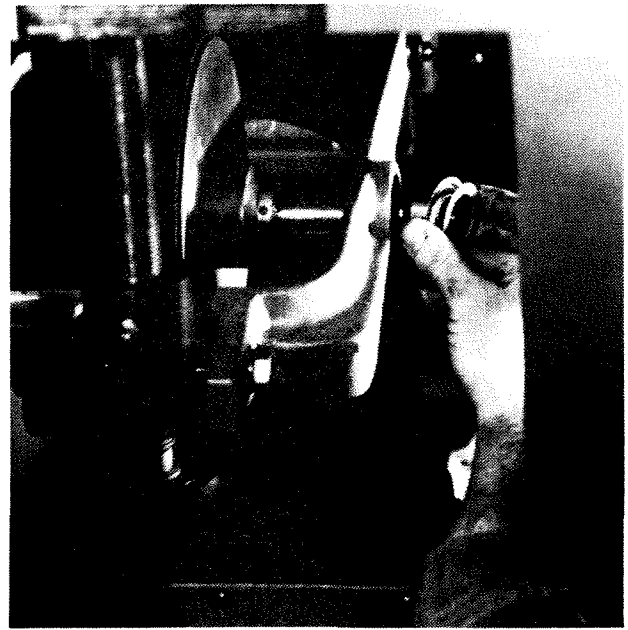


Figure 3.23 - Countershaft Bearing and Spacer Removal

23. Remove the bearing and spacer, as shown in Figure 3.23 .
24. Move the pulley shaft to the right, out of the bearing on the left side, and remove the countershaft assembly, as shown in Figure 3.24 .
25. If necessary, remove the snap ring from the left side of the pulley hanger to remove the remaining bearing and spacer.

REPLACEMENT

1. If removed, install the spacer, bearing, and snap ring in the left side of the pulley hanger.

- NOTE -

The shaft on the pulley assembly is longer on the right side, as viewed from the front of the machine.

2. Coat the bearing surfaces of the pulley shaft with Molykote[®] Anti-Seize grease and install the pulley assembly in the bearing in the left side of the pulley hanger.
3. Install the spacer, bearing, and snap ring in the right side of the pulley hanger.
4. Slide countershaft assembly "H", Figure 3.9, to the extreme right and slide the motor belt over the left end of the countershaft.
5. Position the motor belt at the right end of the pulley, resting on the pulley hub. Refer to Figure 3.7 .

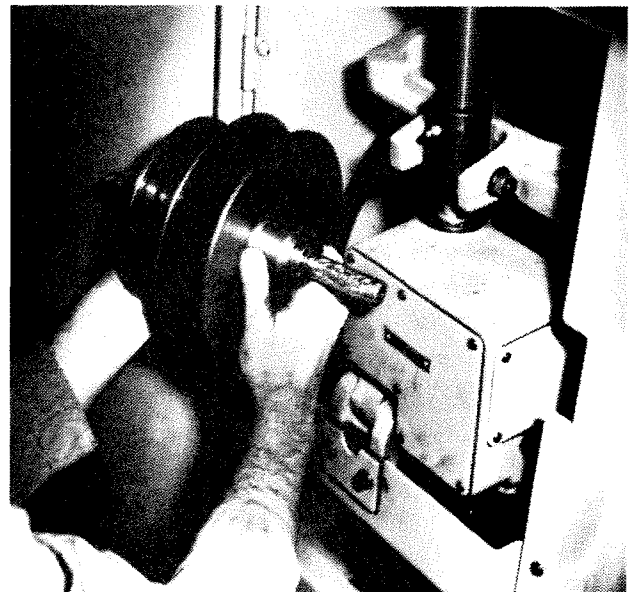


Figure 3.24 - Countershaft Removal

6. Slide the spindle drive belt over the left end of the countershaft and position it on the left pulley, as viewed from the front of the machine.
7. Slide countershaft assembly "H", Figure 3.9, to the left until the left end of the pulley shaft is positioned inside the bearing in the left side of the pulley hanger.

- WARNING -

Stay clear of the spindle drive motor compartment while the spindle motor is running.

8. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
9. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
10. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

11. Place lever "I" in the "Brake" position to stop the spindle.
12. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
13. Position the motor belt on the right pulley, as viewed from the front of the machine.
14. Replace motor belt "L", Figure 3.3, on spindle drive motor pulley "C", Figure 3.8 .

- NOTE -

Use care when lowering the motor mounting plate. Do not damage the threads on height adjusting screw "V", Figure 3.4, or the threads in adjusting plate "X".

15. Remove the block and carefully lower the front of the motor mounting plate.
16. Install lock nut "W", Figure 3.4, but do not tighten.
17. Adjust drive belt tension by turning adjusting screw "V":
 - Clockwise to lower the drive motor and tighten the drive belts.
 - Counterclockwise to raise the drive motor and loosen the drive belts.
18. Tighten lock nut "W".

19. Balance the tension on the motor and spindle belts:
 - a) Close door "J", Figure 3.2 .
 - b) Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
 - c) Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.
 - d) Place lever "H", in range "3" and set speed selector "F" to 3000 rpm.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 3000 rpm.

- e) Place lever "I" in the "Brake" position to stop the spindle.
 - f) Push "Start/Stop" pushbutton "A", Figure 3.1, IN to turn the machine OFF.
 - g) Open door "J", Figure 3.2 .
20. Recheck motor and spindle belt tension.

If belt tension needs to be adjusted, proceed to step 21.

If belt tension does not need to be adjusted, proceed to step 24.

21. Loosen lock nut "W", Figure 3.4 .
22. Adjust drive belt tension by turning adjusting screw "V":

Clockwise to lower the drive motor and tighten the drive belts.

Counterclockwise to raise the drive motor and loosen the drive belts.
23. Tighten lock nut "W".
24. Close door "J", Figure 3.2 .
25. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.
26. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
27. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

28. Place lever "I" in the "Brake" position to stop the spindle.
29. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
30. Open door "J", Figure 3.2 .

- NOTE -

The motor belt should be flush to $\frac{1}{16}$ " out of the pulley.

31. Check the position of the O.D. of the motor belt.

If the position of the motor belt is not correct, proceed to step 32.

If the position of the motor belt is correct, proceed to step 36.

32. Loosen lock nuts "Q" and pivot screws "P", Figure 3.3 .

- NOTE -

The feed screw nut can be turned 180° by interchanging the grease fitting and the pipe plug.

33. Rotate the feed screw nut as needed to adjust pulley position.

34. Tighten pivot screws "P" and lock nuts "Q".

35. Repeat step 31.

36. Close door "J", Figure 3.2 .

37. Pull "Start/Stop" pushbutton "A", Figure 3.1, OUT to turn the machine ON.

38. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

39. Place lever "H", in range "3" and set speed selector "F" to 3000 rpm.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 3000 rpm.

40. Place lever "I" in the "Brake" position to stop the spindle..

41. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.

42. Open door "J", Figure 3.2 .

- NOTE -

The spindle belt should be flush to $\frac{1}{16}$ " out of the pulley.

43. Check the position of the O.D. of the spindle belt.

If the position of the spindle belt is not correct, proceed to step 44.

If the position of the spindle belt is correct, proceed to step 52.

44. Remove eight screws "B", Figure 3.1 .

45. Remove variable speed control panel "D" from control housing "C".

46. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.

- WARNING -

Stay clear of the spindle drive motor compartment while the spindle motor is running.

47. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation at 3000 rpm.

- WARNING -

Voltage is present on the leads to the rheostats and switches. Use caution when adjusting rheostat "W", Figure 3.25 .

48. Adjust rheostat "W", Figure 3.25, as needed to adjust pulley position:

Turn the knob on the rheostat clockwise gradually to bring the spindle belt out of the pulley.

Turn the knob on the rheostat counter-clockwise gradually to bring the spindle belt into the pulley.

49. Place lever "I", Figure 3.1, in the "Brake" position to stop the spindle.
50. Push "Start/Stop" pushbutton "A" IN to turn the machine OFF.
51. Replace variable speed control panel "D" in control housing "C".
52. Close door "J", Figure 3.2 .

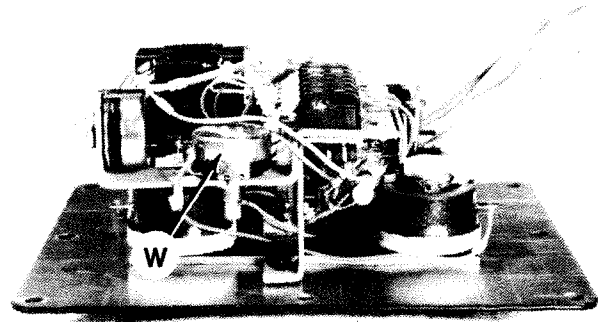


Figure 3.25 - Rheostat Adjustment

SPEED CHANGE MECHANISM

REMOVAL

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Pull "Start/Stop" pushbutton "A" OUT to turn the machine ON.
3. Place lever "H", in range "1" and set speed selector "E" to 125 rpm.
4. Place lever "I" in the "Forward" or "Reverse" position to initiate spindle rotation.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

5. Place lever "I" in the "Brake" position to stop the spindle.
6. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.

- WARNING -

Be sure main disconnect switch "K", Figure 3.13, is turned OFF while working in the power case.

7. Turn main disconnect switch "K", Figure 3.13, OFF.
8. Loosen two screws "L" and open the power case door.
9. Disconnect wires 5, 15, 16, 20, 26, 27, and 33 from the left side of terminal block "X", Figure 3.26 .
10. Disconnect wires T1R, T2R, and T3R from the lower side of terminal block "Y", Figure 3.27 .

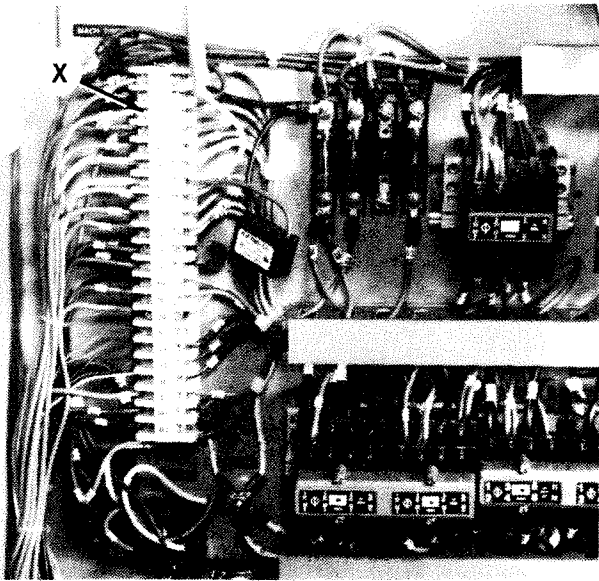


Figure 3.26 - Terminal Block 1TB

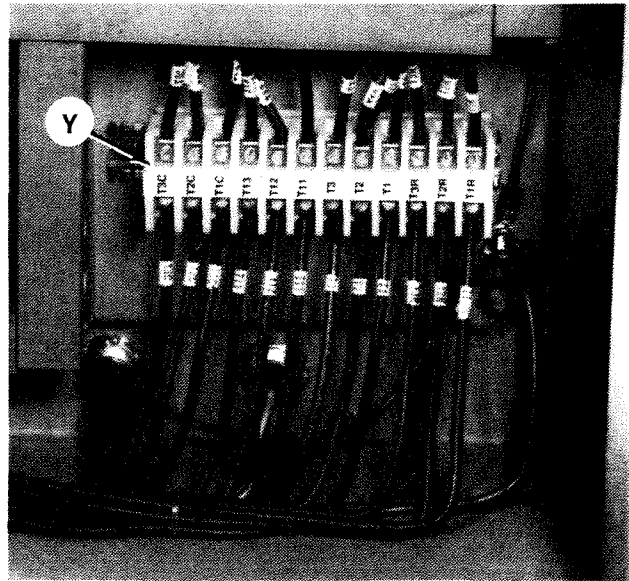


Figure 3.27 - Terminal Block 2TB

11. Remove nut "Z", Figure 3.28, from the conduit connector and pull the speed change mechanism wires into the pedestal.
12. Loosen two lock nuts "Q", Figure 3.3 .
13. Loosen two pivot screws "P" enough to clear feed screw nut "O".
14. Loosen set screw "T".
15. Support the control housing and remove pin "S" to the left with a brass punch.
16. Angle the control housing so that the vertical feed screw leans to the left and remove the control housing from the pedestal.

- NOTE -

Do not disturb mounting bracket "U", which is factory adjusted for alignment.

DISASSEMBLY

1. Remove the speed change mechanism from the machine according to the procedure outlined on Page 3-21.
2. Turn feed screw nut "O" off vertical feed screw "M", Figure 3.3 .
3. Remove covers "M" and "N", Figure 3.14 .
4. Tag for reconnection; then disconnect the three black wires (motor leads) and two blue wires (brake leads).
5. Remove the lock screw at "A", Figure 3.29, and loosen the set screw under the lock screw.

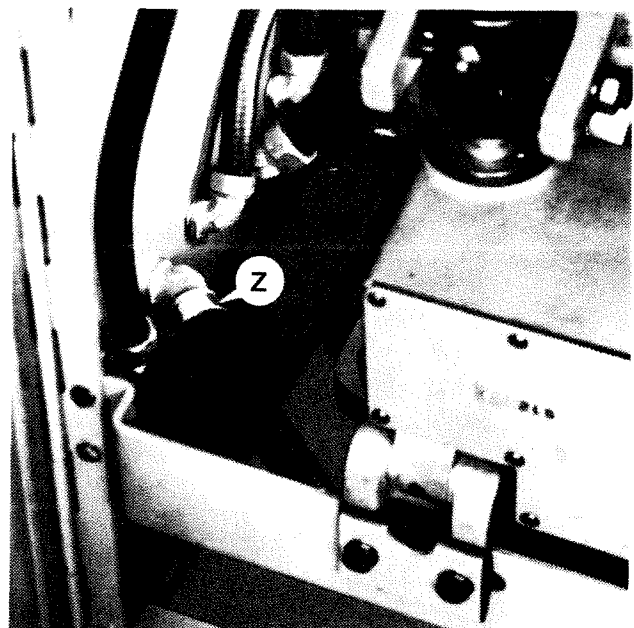


Figure 3.28 - Speed Change Conduit Connector

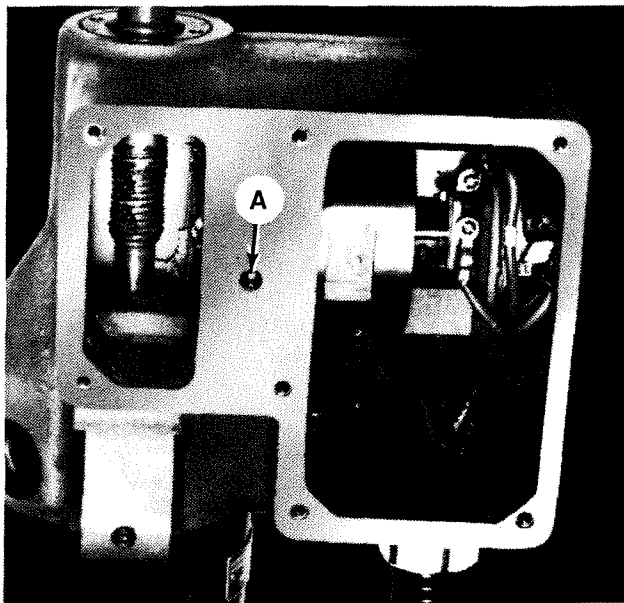


Figure 3.29 - Drive Worm and Worm Wheel Disengaged

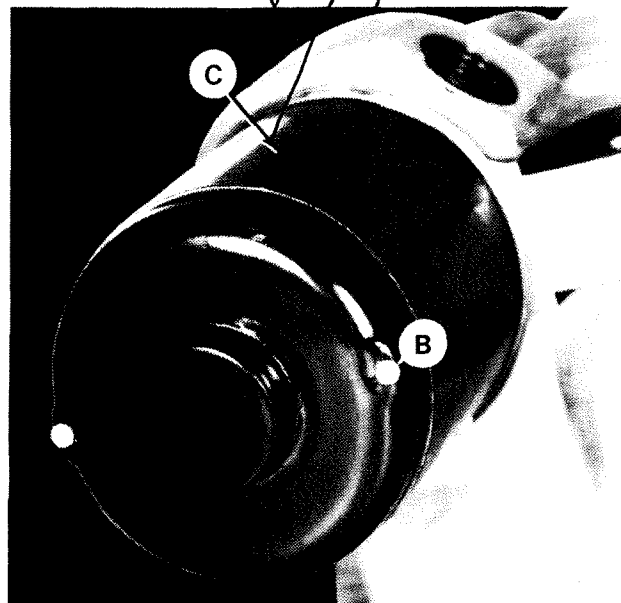


Figure 3.30 - Speed Change Motor

6. Slide the cartridge assembly out of engagement with the vertical feed screw, as shown in Figure 3.29 .
7. Remove two screws "B" and motor "C", Figure 3.30 .
8. Remove four screws "D" and brake "E", Figure 3.31 .
9. Remove spring "F", Figure 3.32 .
10. Remove nut "G", Figure 3.33, with an adjustable spanner wrench.
11. Remove the vertical screw assembly, Figure 3.34 .
12. Remove snap ring "H", bearing "I", nut "J", and bearing "K" from vertical screw "L", Figure 3.35 .

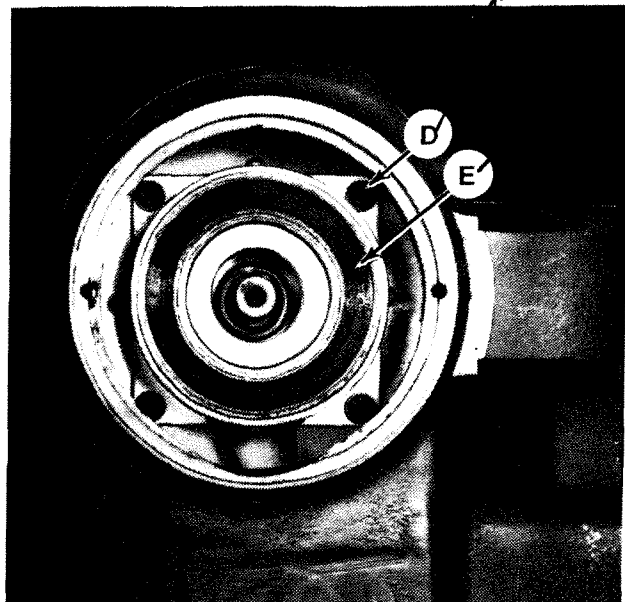


Figure 3.31 - Motor Brake

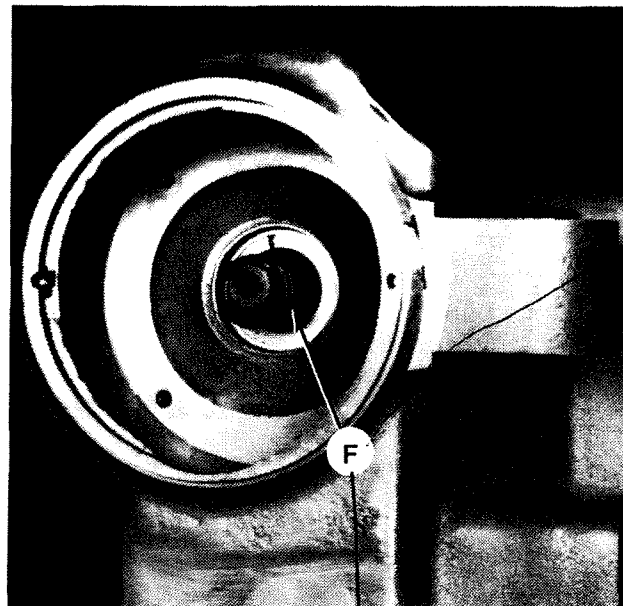


Figure 3.32 - Spring for Motor Brake

- NOTE -

When removing motor cap "P", Figure 3.36, do not misplace two bearing spacers "O".

13. Remove motor cap "P", Figure 3.36 .
14. Remove brake disc "M" and armature "N".
15. Press armature hub "Q" and bearing "T" from armature shaft "S", Figure 3.37 .

- NOTE -

Do not misplace the nylon plug located under the set screw.

16. Loosen the set screw and turn brake adjusting collar "R" OFF the armature hub.

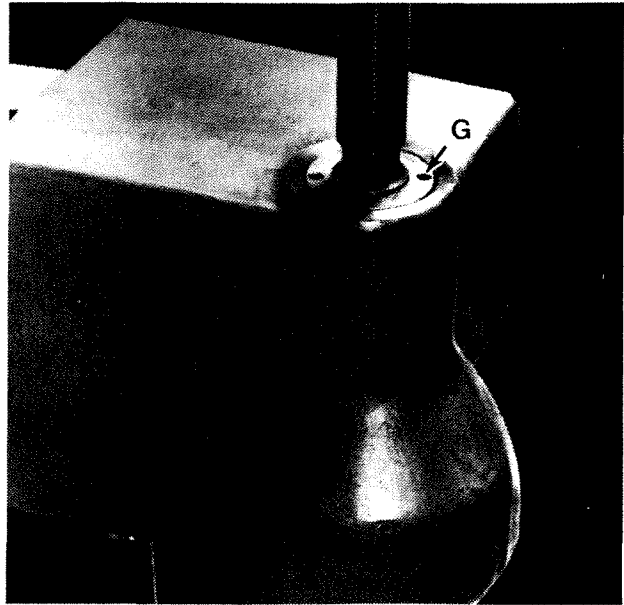


Figure 3.33 - Vertical Screw Retaining Nut

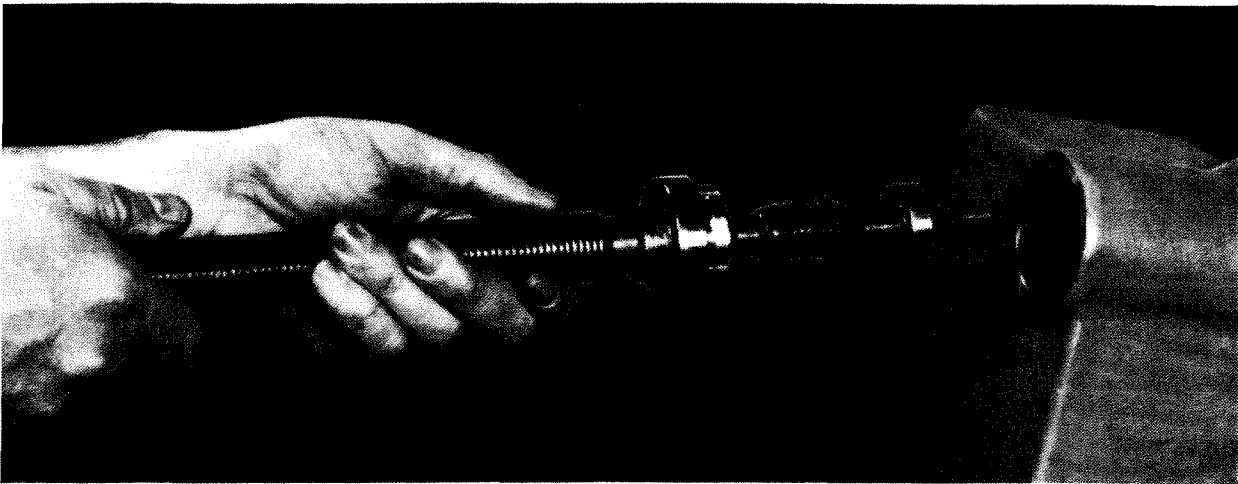


Figure 3.34 - Vertical Screw Removal

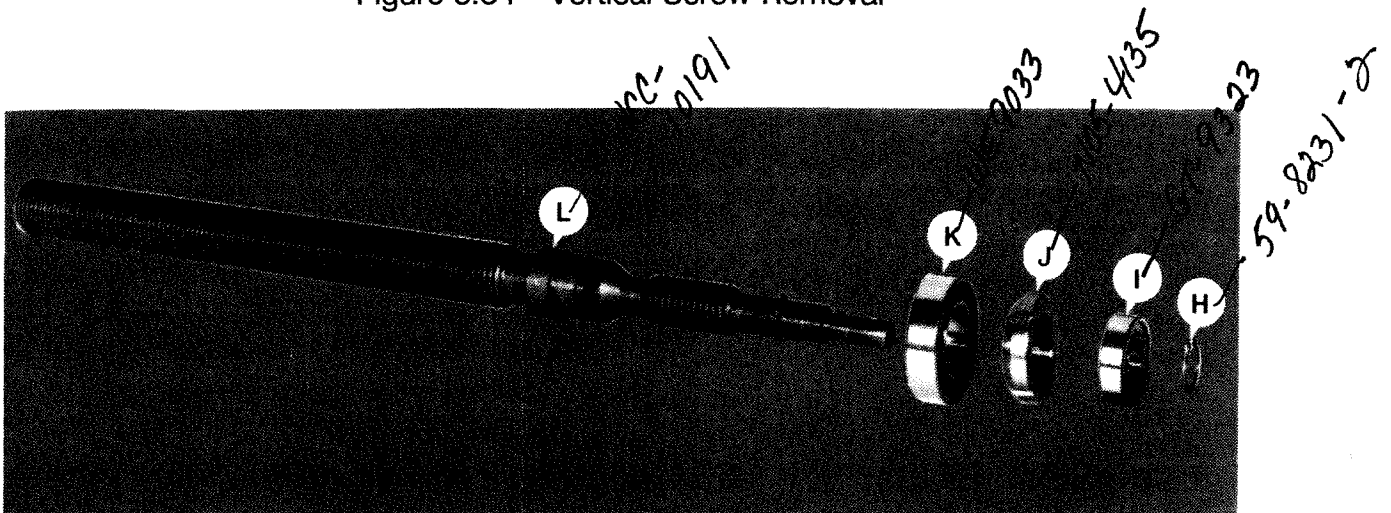


Figure 3.35 - Vertical Screw Components

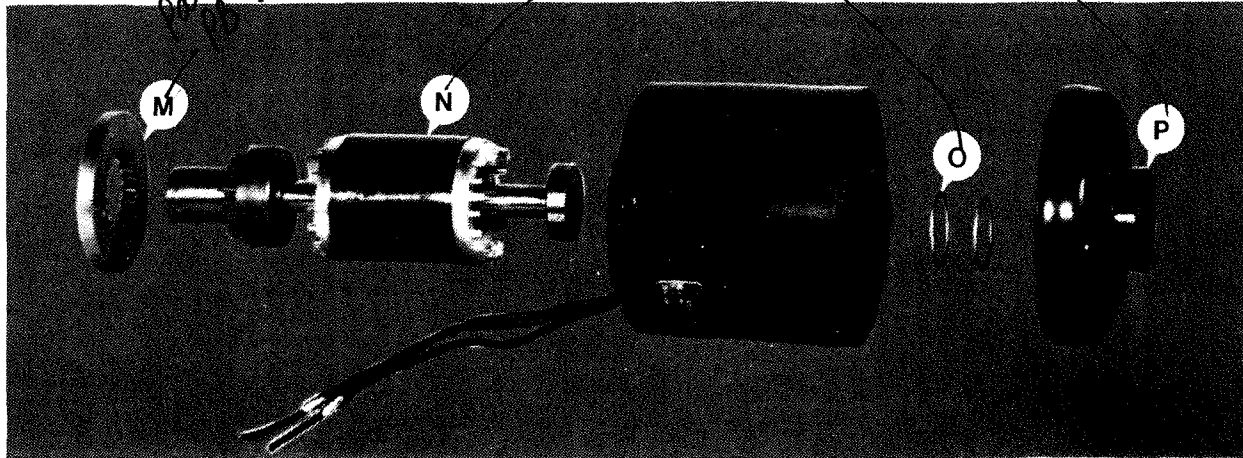


Figure 3.36 - Speed Change Motor Components

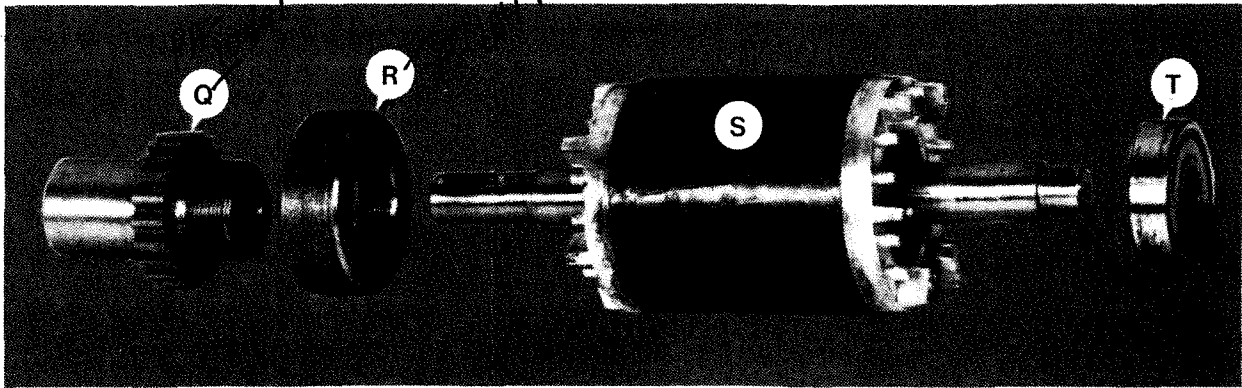


Figure 3.37 - Armature for Speed Change Motor

REASSEMBLY

1. Turn brake adjusting collar "R", Figure 3.37, onto the armature hub and tighten the set screw.
2. Mount armature hub "Q" and bearing "T" on armature shaft "S".
3. Install armature "N" and brake disc "M", Figure 3.36 .

- NOTE -

Be sure two bearing spacers "O" are in position before mounting motor cap "P".

4. Install motor cap "P".
5. Replace bearing "K", nut "J", bearing "I", and snap ring "H" on vertical screw "L", Figure 3.35 .
6. Install the vertical screw assembly, Figure 3.34 .
7. Install nut "G", Figure 3.33, using an adjustable spanner wrench.
8. Install spring "F", Figure 3.32 .
9. Mount brake "E" using four screws "D", Figure 3.31 .

10. Mount motor "C" using two screws "B", Figure 3.30 .
11. Fill the threads on the worm and the wheel on the drive cartridge with Andok[®] "B" grease or equivalent.

- NOTE -

When the wheel on the drive cartridge is engaged with the worm, the wheel should be aligned with the centerline of the vertical feed screw.

12. Slide the drive cartridge back into engagement with the vertical feed screw.
13. Tighten the set screw at "A", Figure 3.29 .
14. Install and tighten the lock screw at "A".
15. Connect the three black wires (motor leads) and two blue wires (brake leads).
16. Replace covers "M" and "N", Figure 3.14 .
17. Turn the feed screw nut onto the vertical feed screw.
18. Install the speed change mechanism in the machine according to the procedure outlined under "Replacement", below.

REPLACEMENT

- WARNING -

Be sure main disconnect switch "K", Figure 3.13, is turned OFF while working in the power case.

1. Place the drive in the pedestal and install pin "S", Figure 3.3 .
2. Tighten set screw "T".
3. Align the pivot holes in feed screw nut "O" with pivot screws "P".
4. Tighten two pivot screws "P"; then back off approximately 1/8 turn.
5. Tighten two lock nuts "Q".
6. Feed the wires from the speed change mechanism into the power case.
7. Install and secure the conduit connector with nut "Z", Figure 3.28 .
8. Connect wires 5, 15, 16, 20, 26, 27, and 33 to the left side of terminal block "X", Figure 3.26 .
9. Connect wires T1R, T2R, and T3R to the lower side of terminal block "Y", Figure 3.27 .
10. Close the power case door and tighten two screws "L", Figure 3.13 .

SPEED CHANGE MOTOR

DISASSEMBLY

1. Remove cover "M", Figure 3.14 .
2. Tag for reconnection; then disconnect the three black wires (motor leads).
3. Remove two screws "B" and motor "C", Figure 3.30 .

- NOTE -

When removing motor cap "P", Figure 3.36, do not misplace two bearing spacers "O".

4. Remove motor cap "P", Figure 3.36 .
5. Remove brake disc "M" and armature "N".
6. Press armature hub "Q" and bearing "T" from armature shaft "S", Figure 3.37 .

- NOTE -

Do not misplace the nylon plug located under the set screw.

7. Loosen the set screw and turn brake adjusting collar "R" OFF the armature hub.

REASSEMBLY

- NOTE -

Be sure the nylon plug is located under the set screw.

1. Turn brake adjusting collar "R", Figure 3.37, onto the armature hub and tighten the set screw.
2. Mount armature hub "Q" and bearing "T" on armature shaft "S".
3. Install armature "N" and brake disc "M", Figure 3.36 .

- NOTE -

Be sure two bearing spacers "O" are in position before mounting motor cap "P".

4. Install motor cap "P".
5. Mount motor "C" using two screws "B", Figure 3.30 .
6. Reconnect the three black wires (motor leads).
7. Replace cover "M", Figure 3.14 .
8. Adjust the speed change drive motor brake according to the procedure outlined under "Brake Adjustment", on Page 3-28.

BRAKE ADJUSTMENT

- NOTE -

The speed change motor brake will release when the machine is turned OFF.

1. Press "Start/Stop" pushbutton "A", Figure 3.1, IN to turn the machine OFF.
2. Turn main disconnect switch "K", Figure 3.13, OFF.
3. Open door "J", Figure 3.2 .
4. Remove plug "U", Figure 3.38 .
5. Loosen set screw "W", Figure 3.39 .
6. Hold the adjusting collar by inserting a hex wrench in set screw "W".
7. Turn vertical screw "V", Figure 3.38, by hand until a .010 to .015 inch [.25 to .38 mm] clearance is achieved between the brake and brake disc at point "X", Figure 3.39 .
8. Tighten set screw "W".
9. Replace plug "U", Figure 3.38 .
10. Close door "J", Figure 3.2 .

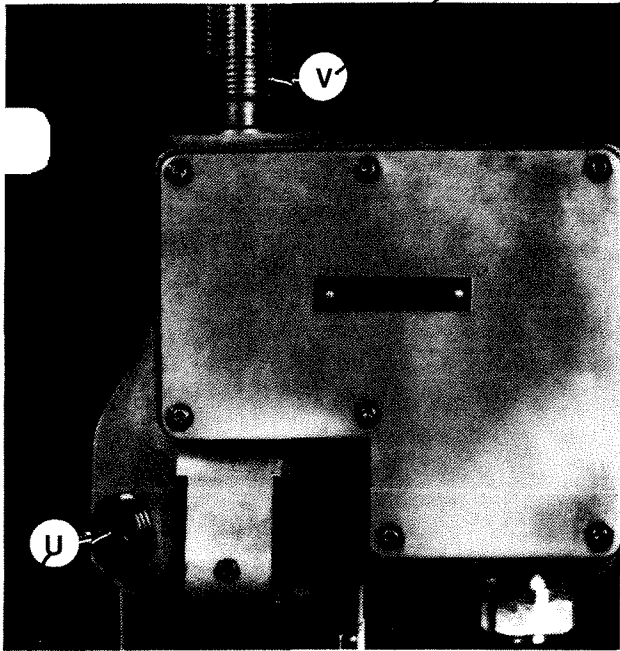


Figure 3.38 - Motor Brake Plug and Vertical Screw

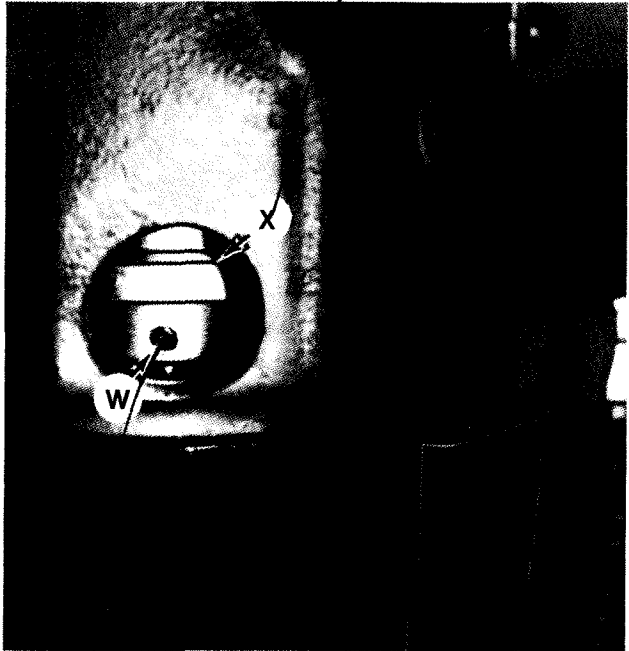


Figure 3.39 - Motor Brake Adjustment

POWER FEED DRIVE

POWER FEED CONTROL PANEL

Refer to Chapter 5 for information on the Power Feed control panel.

POWER FEED LUBRICATION

Lubricate the power feed drive at filler cap "Y", Figure 3.40, with Mobil® Vactra® Oil No 2 or equivalent. Be sure to keep the oil reservoir full. The power feed motor bearings are grease-packed for life and require no further lubrication.

DRIVE DISASSEMBLY

1. Place lever "I", Figure 3.1, in the "Brake" position.
2. Press "Start/Stop" pushbutton "A" IN to turn the machine OFF.
3. Turn main disconnect switch "K", Figure 3.13, OFF.
4. Remove six screws "A" and set power feed panel "B" out of control box "C", Figure 3.41 .
5. Record the connections; then disconnect the wires from connections 6, 7, and 8 on terminal block "D", Figure 3.42 .

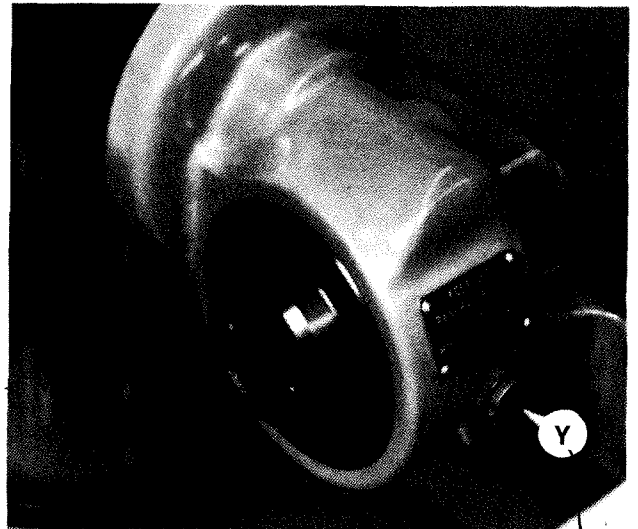


Figure 3.40 - Power Feed Drive Lubrication

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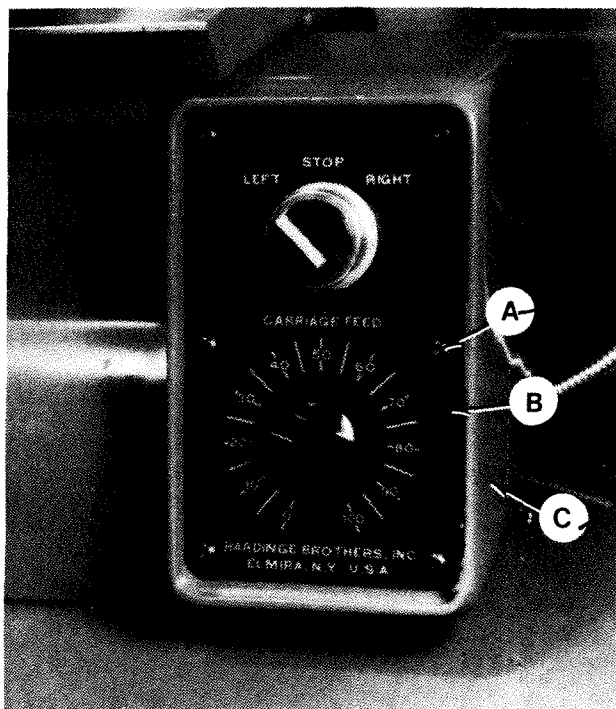


Figure 3.41 - Power Feed Control Box

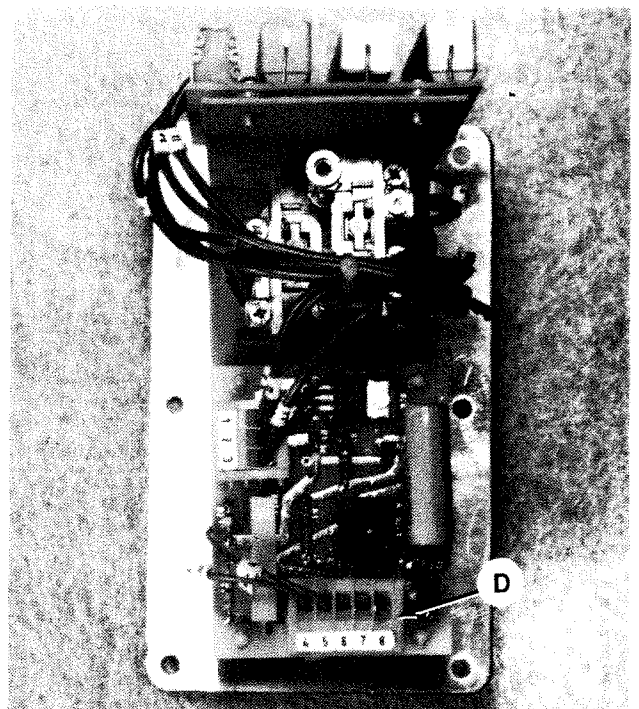


Figure 3.42 - Power Feed Module

6. Remove three bolts "E", Figure 3.43, and pull power feed control box "F" away from the end of the bed.

- NOTE -

Two cord grips are installed in the left side of power feed control box "F", as viewed from the front of the machine.

7. Remove the nut from the cord grip that secures the cable disconnected from the power feed module in step 5.

8. Remove cord grip "G", Figure 3.44, and pull the cable out through the bed.

9. Remove pipe plug "H" to drain the oil from the power feed drive assembly.

10. Remove three bolts "I", Figure 3.44, and pull the power feed drive assembly straight off drive shaft "J", Figure 3.45 .

11. To remove drive shaft "J", Figure 3.45:

a) Remove four screws "K" and bearing "L", Figure 3.46 .

b) Remove drive shaft "J", Figure 3.47, from the front of the machine.

13. Remove the motor brushes located under caps "M", Figure 3.48 .

14. Remove two screws "N" and motor "O".

15. Remove screw "P", Figure 3.49, to remove the motor cap.

16. Pull the rotor shaft assembly straight out, as shown in Figure 3.50 .

17. Remove spring pin "Q" and worm "R", Figure 3.51, from the rotor shaft assembly.

18. Remove adjusting bushing "S", Figure 3.52, with an adjustable spanner wrench.

19. Remove three screws "T" and bearing support "U".

20. Remove worm wheel "W" and bearings "V".

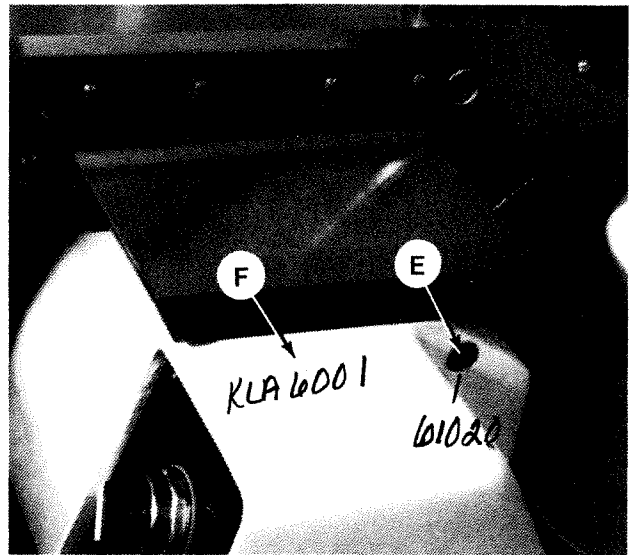


Figure 3.43 - Control Box Removal

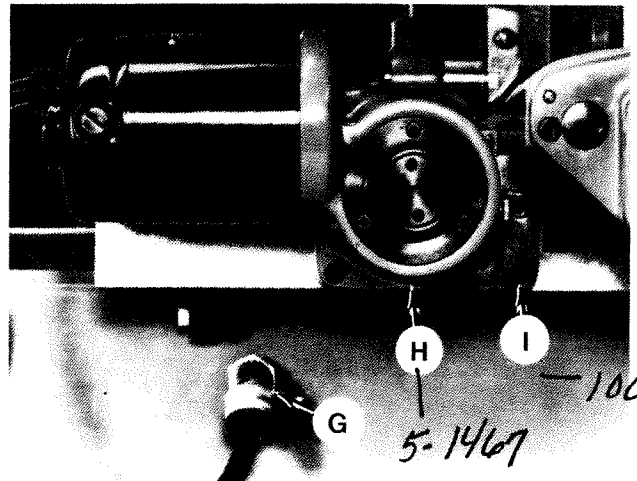


Figure 3.44 - Power Feed Drive

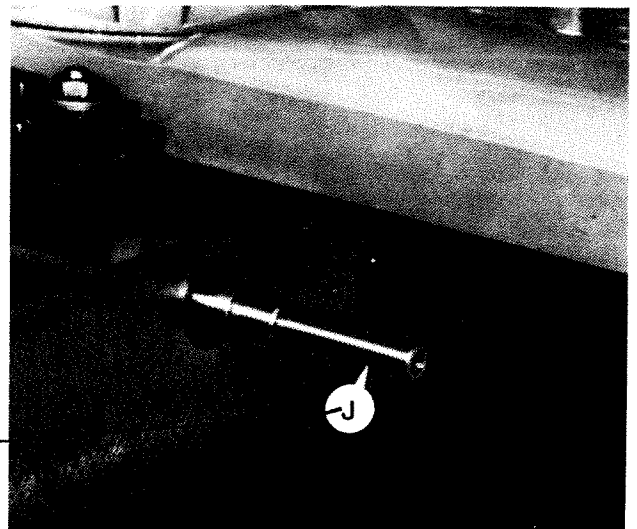


Figure 3.45 - Power Feed Drive Shaft

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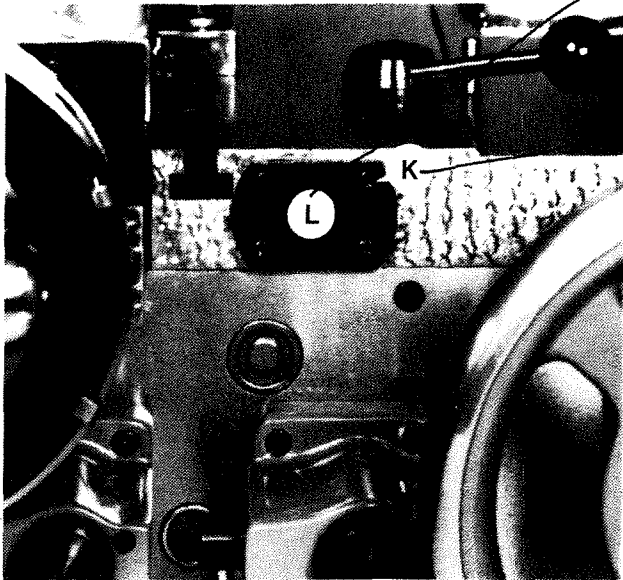


Figure 3.46 - Power Feed Drive Shaft Bearing

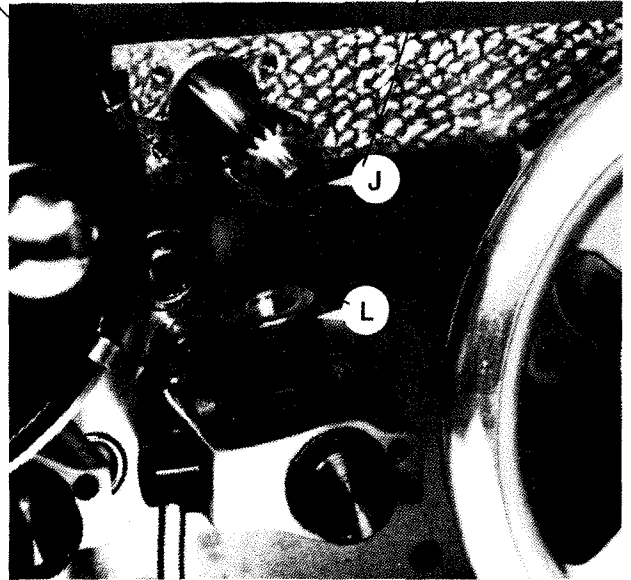


Figure 3.47 - Power Feed Drive Shaft Bearing

- NOTE -

Seal "Y" is pressed into bushing "X", Figure 3.53 .

21. Remove adjusting bushing "X", Figure 3.53 .

DRIVE REASSEMBLY

1. Install adjusting bushing "X", Figure 3.53 .
2. Install bearings "V" and worm wheel "W", Figure 3.52 .
3. Mount bearing support "U" using three screws "T".
4. Install adjusting bushing "S" with an adjustable spanner wrench.

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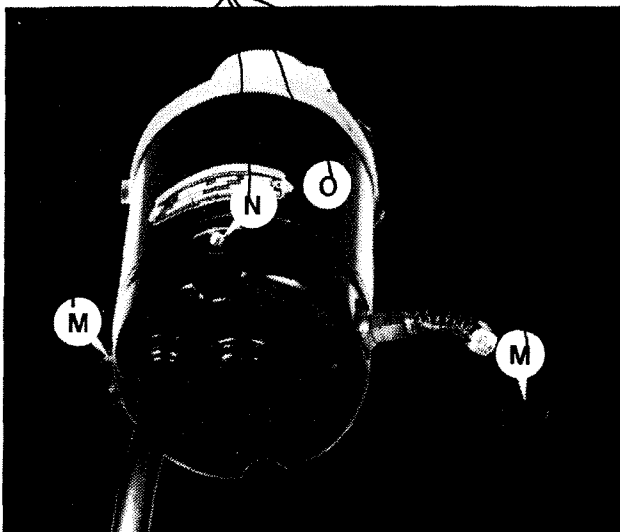


Figure 3.48 - Power Feed Motor and Brushes

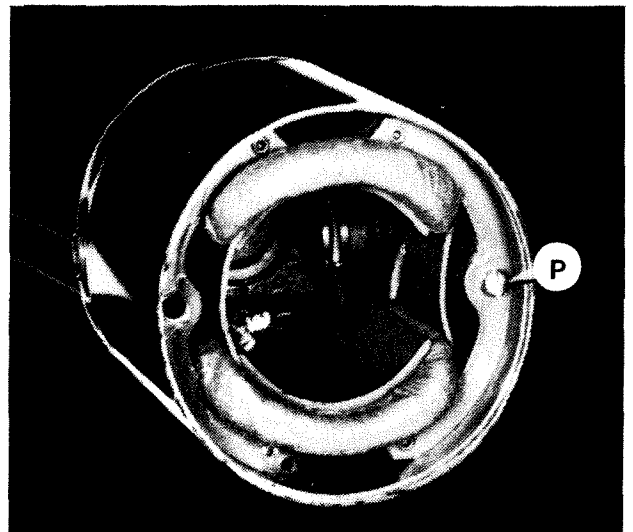


Figure 3.49 - Power Feed Motor (Internal View)



Figure 3.50 - Rotor for Power Feed Motor

- NOTE -

Worm wheel alignment is accomplished with adjusting bushings "S", Figure 3.52, and "X", Figure 3.53 .

5. Line up the centerline of worm wheel "W", Figure 3.52, with the centerline of the hole from which pipe plug "H", Figure 3.44, was removed.
6. Mount worm "R" and spring pin "Q", Figure 3.51, on the rotor shaft assembly.
7. Slide the rotor shaft assembly straight into the power feed housing, as shown in Figure 3.50 .
8. Install the motor cap and screw "P", Figure 3.49 .
9. Remount motor "O" to the power feed housing using two screws "N", Figure 3.48 .
10. Install the motor brushes under caps "M".
11. To install drive shaft "J", Figure 3.47:
 - a) Install the drive shaft at the front of the machine, as shown in Figure 3.47 .
 - a) Mount bearing "L" using four screws "K", Figure 3.46 .

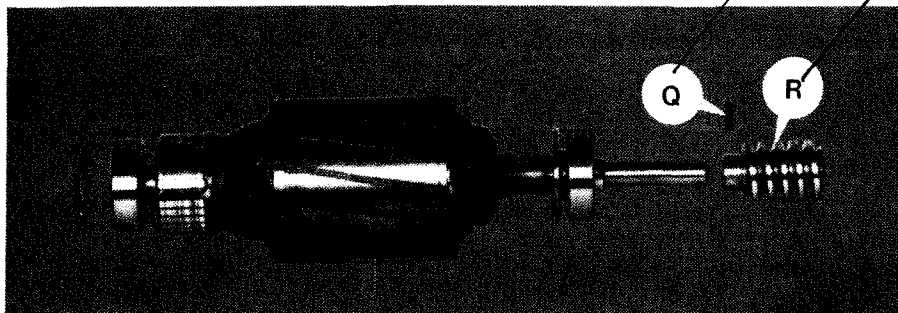


Figure 3.51 - Rotor Shaft and Components

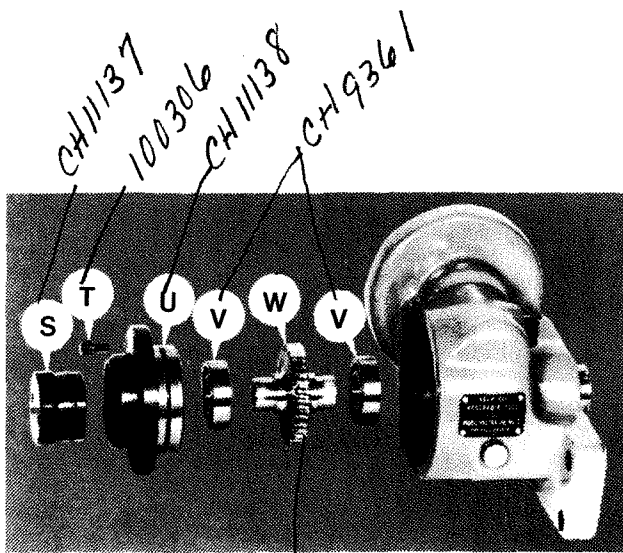


Figure 3.52 - Power Feed Housing and Components



Figure 3.53 - Power Feed Housing and Components

12. Slide the power feed drive assembly straight onto drive shaft "J", Figure 3.45, and install three bolts "I", Figure 3.44 .
13. Install pipe plug "H".
14. Fill the power feed drive at filler cap "Y", Figure 3.40, with Mobil® Vactra® Oil No 2 or equivalent.
15. Slide the nut for cord grip "G", Figure 3.44, over the power feed motor cable.
16. Insert the power feed motor cable through cord grip "G" and into the bed.
17. Using needle-nose pliers, reach into the end of the bed and pull the end of the power feed motor cable out of the end of the bed.
18. Slide the nut for the cord grip in the power feed control box over the power feed motor cable.
19. Insert the power feed motor cable through the cord grip and into the power feed control box.
20. Hand tighten the cord grip nut to secure the power feed motor cable to power feed control box "F", Figure 3.43 ..
21. Mount power feed control box "F" to the bed using three bolts "E".
22. Reconnect the wires to terminal block "D", Figure 3.42 .
23. Mount power feed panel "B" in control box "C" using six screws "A", Figure 3.41 .

- NOTE -

Leave enough slack in the power feed motor cable to allow the full range of carriage movement without putting excessive strain on the cable.

24. Hand tighten the nut for cord grip "G", Figure 3.44, to secure the power feed motor cable.

- NOTES -

CHAPTER 4 - HEADSTOCK

COLLET CLOSER

REMOVAL AND CLEANING

The collet closer should be removed from the machine weekly and between setups for cleaning. This will prevent chip buildup between the collet closer tube and the inside of the spindle, both at the rear of the spindle and at the collet threads.

1. Press "Start/Stop" pushbutton "A", Figure 4.1, IN to turn the machine OFF.
2. Remove link pin "G", Figure 4.2.
3. Remove the collet closer as shown in Figure 4.3.

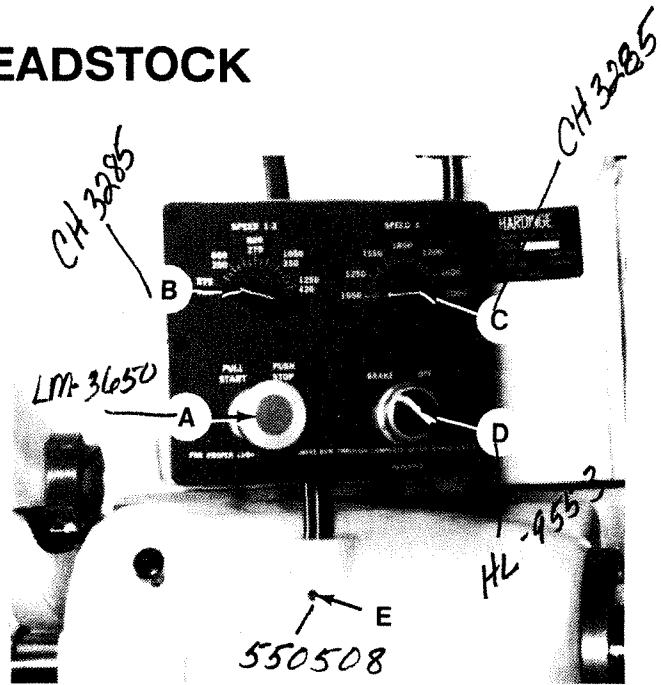


Figure 4.1 - Control Head

- NOTE -

Do not turn adjusting nut "N", Figure 4.3 . It is not threaded to the spindle.

4. Remove adjusting nut "N", Figure 4.3, by pulling it straight off the end of the spindle.
5. Use mineral spirits to clean the collet closer, adjusting nut, the inside of the headstock spindle, and the outer diameter at the rear of the spindle where the adjusting nut locates.

REPLACEMENT

- NOTE -

DO NOT force adjusting nut "N", Figure 4.3, onto the spindle. If the adjusting nut goes on tightly, remove the adjusting nut and examine for burrs or scratches.

1. Apply a film of light oil on the rear of the headstock spindle and replace adjusting nut "N", Figure 4.3.
2. Apply a film of light oil on bearing section "O" of the collet closer and install the collet closer onto the headstock spindle.
3. Install link pin "G", Figure 4.2.

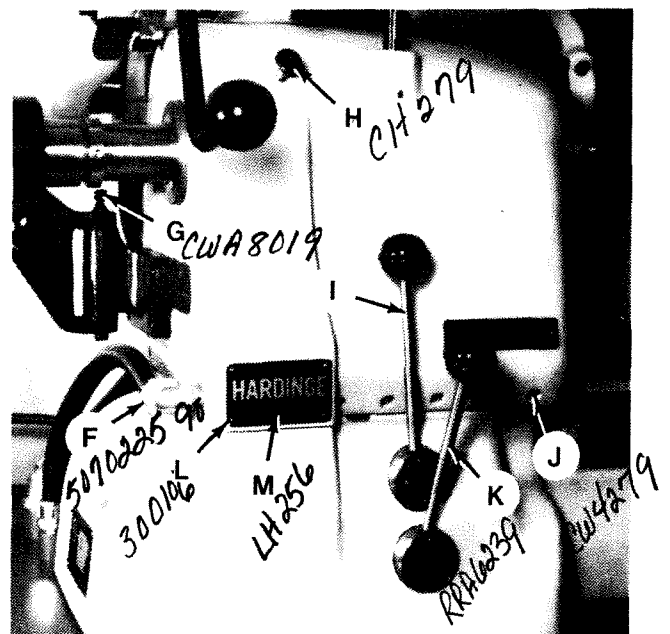


Figure 4.2 - Headstock and Collet Closer

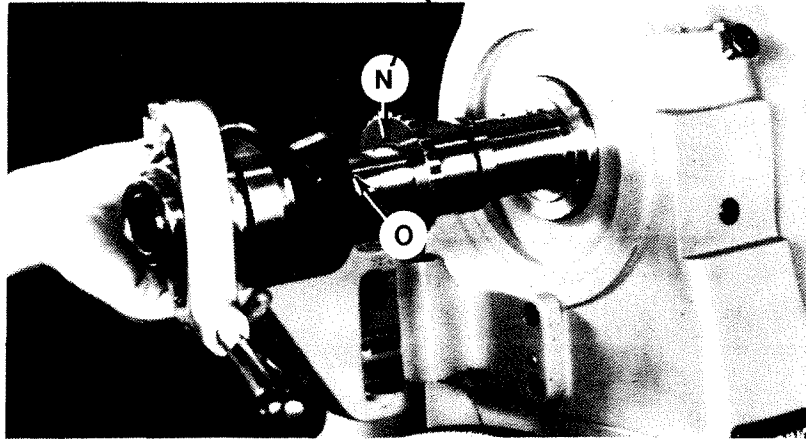


Figure 4.3 - Collet Closer Removal

COOLANT FACILITIES

Clean the coolant sump regularly, depending on the type of material being machined.

- NOTE -

Oil base coolants are recommended for maximum machine life.

TO CLEAN THE SUMP:

1. Press "Start/Stop" pushbutton "A", Figure 4.1, IN to turn the machine OFF.
2. Remove four screws "P", washers, and sump cover "Q", Figure 4.4.
3. Place a drain pan capable of holding at least 3 gallons of liquid under pipe plug "R", Figure 4.5.
4. Remove pipe plug "R" to allow the coolant in the sump to drain into the drain pan.
5. Remove any chips present in the coolant sump.
6. Clean the coolant sump and sump cover with mineral spirits.
7. Replace sump cover "Q", Figure 4.4, and pipe plug "R", Figure 4.5.
8. Remove the drain pan and properly dispose of the used coolant.
9. Refill the coolant sump with three gallons of fresh coolant.

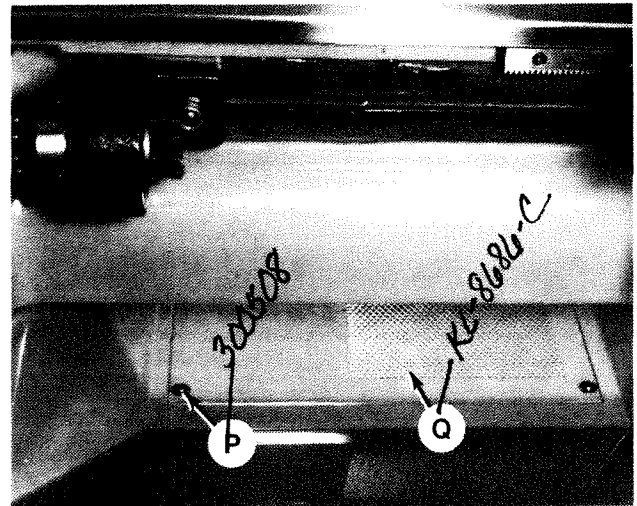


Figure 4.4 - Coolant Sump Cover

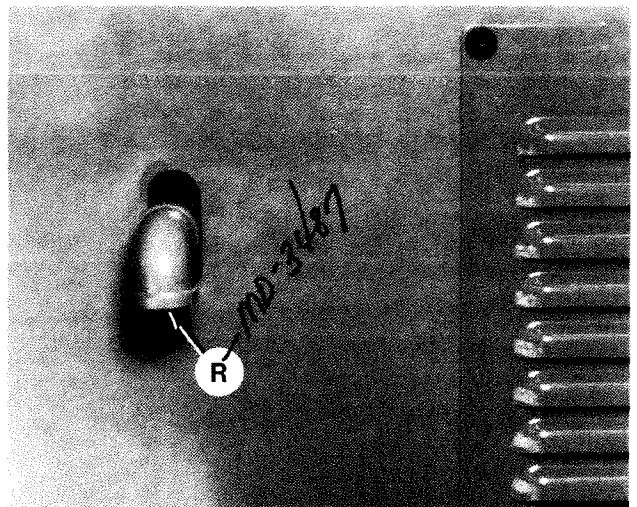


Figure 4.5 - Coolant Drain Plug

COOLANT PUMP MOTOR

The coolant pump motor bearings are grease packed for life and require no further attention.

HEADSTOCK

REMOVAL

For repairs to the headstock spindle or bearings, return the headstock to Hardinge Brothers, Inc. The headstock should be greased to prevent rust.

1. Place lever "K", Figure 4.2, in the "Brake" position.
2. Turn switch "D", Figure 4.1, to the "Brake" position.
3. Pull "Start/Stop" pushbutton "A", OUT to turn the machine ON.
4. Place lever "I", Figure 4.2, in range "1" and set speed selector "B", Figure 4.1, to 125 rpm.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

5. Place lever "K", Figure 4.2, in the "Forward" or "Reverse" position to initiate spindle rotation.
6. Place lever "K" in the "Brake" position to stop the spindle.
7. Press "Start/Stop" pushbutton "A", Figure 4.1, IN to turn the machine OFF.
8. Open door "S", Figure 4.6 .
9. Remove pedestal rear cover "T", Figure 4.7, to prevent damage when the motor mounting plate is raised.
10. Remove lock nut "U", Figure 4.8 .
11. Raise the front of the motor mounting plate approximately two inches by rotating adjusting screw "V".
12. Block the motor mounting plate in this position, as shown in Figure 4.9 .
13. Roll motor belt "W" to the right off pulley assembly "Z" and let it rest on pulley hub "Y", Figure 4.10 .
14. Pull "Start/Stop" pushbutton "A", Figure 4.1, OUT to turn the machine ON.

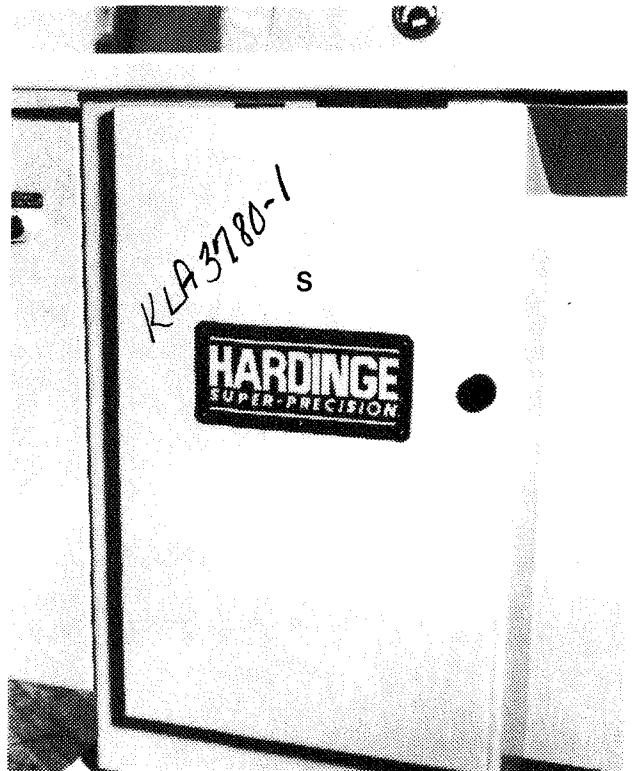


Figure 4.6 - Pedestal Door

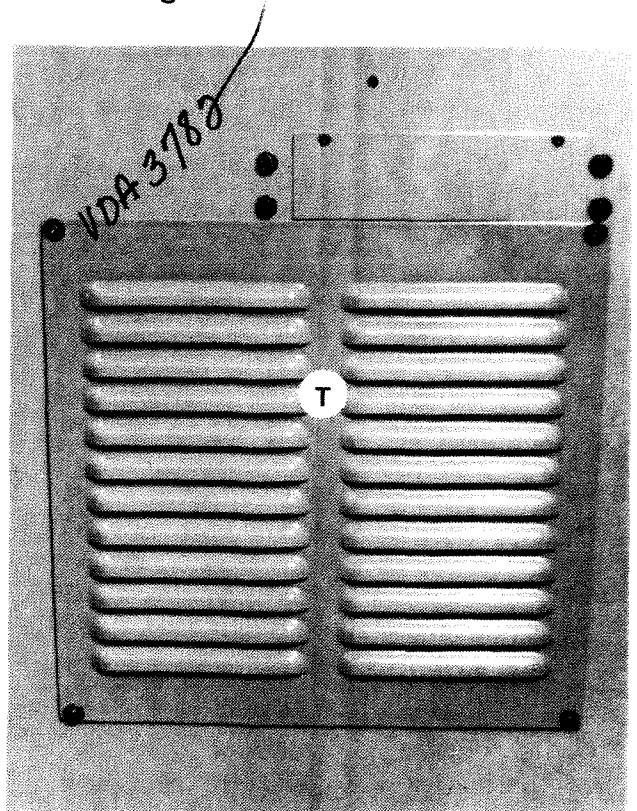


Figure 4.7 - Pedestal Rear Cover

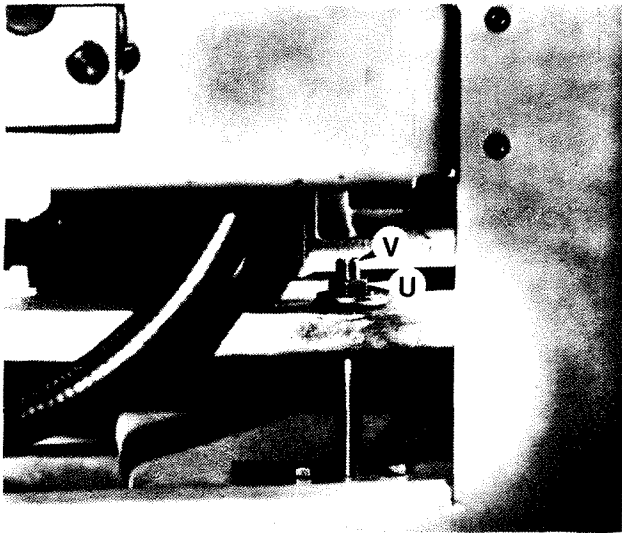


Figure 4.8 - Drive Belt Adjusting Screw

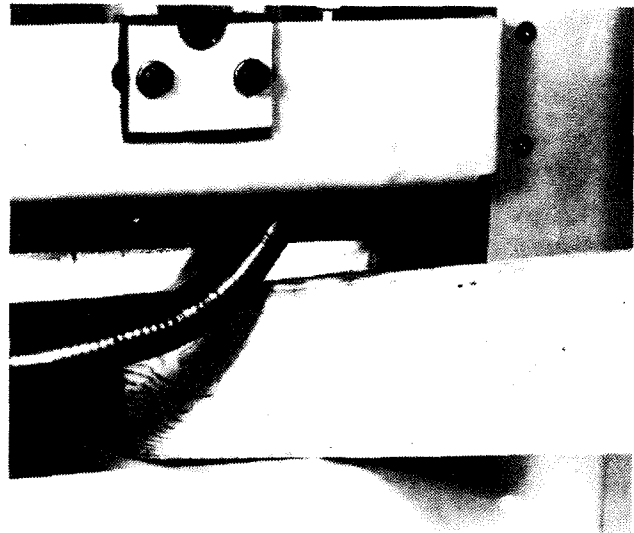


Figure 4.9 - Motor Plate Blocked in Position

15. Place lever "I", Figure 4.2, in range "3" and set speed selector "C", Figure 4.1, to 3000 rpm.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 3000 rpm.

16. Place lever "K", Figure 4.2, in the "Forward" or "Reverse" position to initiate spindle rotation.
17. Place lever "K" in the "Brake" position to stop the spindle.
18. Press "Start/Stop" pushbutton "A", Figure 4.1, IN to turn the machine OFF.
19. Turn main disconnect switch "C", Figure 4.15, OFF.
20. Slide countershaft assembly "X", Figure 4.10, to the extreme right and remove the headstock belt over the left end of the countershaft.
21. Remove the collet closer according to the procedure outlined under "Removal and Cleaning", Page 4-1.
22. Remove the headstock cover by loosening two set screws, as shown in Figure 4.11 .
23. Remove the cotter pin from the speed change pull rod, which passes through the headstock belt in the motor compartment.
24. Move the headstock belt around the end of the pull rod.
25. Pull the headstock belt off the spindle pulley, over the end of the spindle pulley, and out of the headstock, Figure 4.12 .

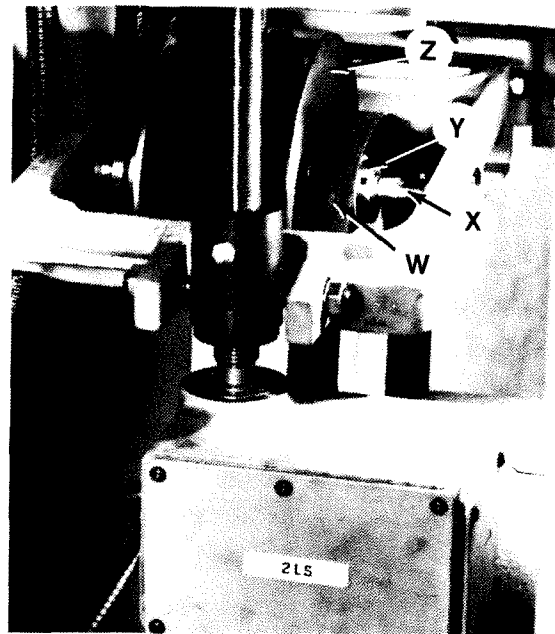


Figure 4.10 - Motor Belt on Pulley Hub

26. Remove the automatic threading unit if the machine is equipped with this option.

Refer to the maintenance manual (M-11) for the automatic threading unit.

27. Loosen set screw "E", Figure 4.1, and remove the control head from the headstock.
28. Remove four screws "L" and limit switch cover "M", Figure 4.2 .
29. Remove two screws "B" and pull limit switch "A", Figure 4.13, out of the headstock to gain access to the wire terminals on the limit switch.
30. Tag the wires for reconnection; then disconnect the three wires from limit switch "A".
31. Remove conduit nut "F", Figure 4.2, and pull the wires out of the headstock.
32. Loosen five screws "J".

- CAUTION -

Position the sling around the front outside cap of the headstock, as shown in Figure 4.14 . DO NOT position the sling around the machine spindle; damage to the spindle bearings may result.

- NOTE -

Do not misplace the seal under the headstock.

33. Using a hoist and sling, as shown in Figure 4.14, slide the headstock OFF and UP.

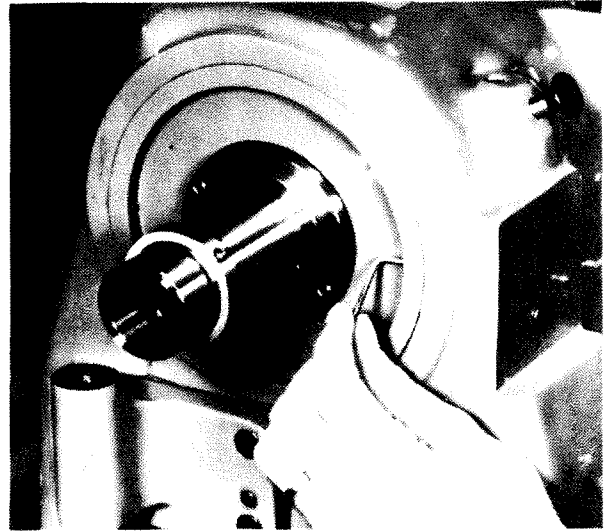


Figure 4.11 - Headstock Cover Removal

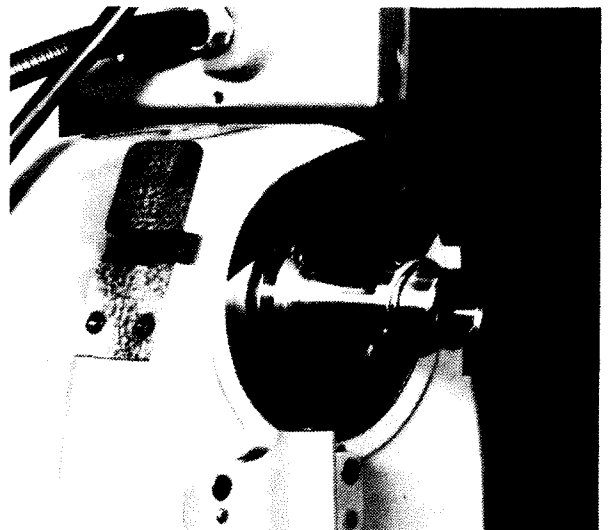


Figure 4.12 - Headstock Belt Removal

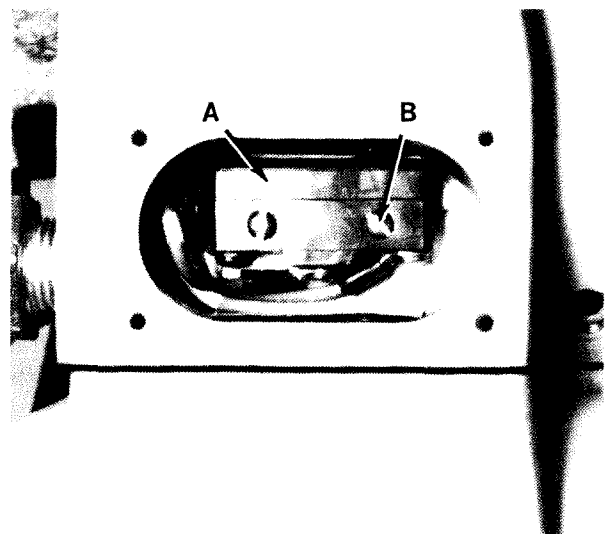


Figure 4.13 - Spindle Lock Pin Limit Switch

REPLACEMENT

- CAUTION -

Position the sling around the front outside cap of the headstock, as shown in Figure 4.14 . DO NOT position the sling around the machine spindle; damage to the spindle bearings may result.

- NOTE -

Be sure the headstock seal is in place.

1. Using a hoist and sling, as shown in Figure 4.14, slide the headstock onto the bed plate.
2. Tighten five screws "J", Figure 4.2 .
3. Feed the headstock limit switch wires into the headstock and reconnect according to the tags.
4. Tighten conduit nut "F".
5. Mount limit switch cover "M" using four screws "L".
6. Mount the control head on the headstock and tighten set screw "E", Figure 4.1 .
7. Mount the automatic threading unit if the machine is equipped with this option.

Refer to the maintenance manual (M-11) for the automatic threading unit.

8. Insert the headstock belt into the headstock and onto the spindle pulley
9. Slide the headstock belt over the speed change pull rod, which should pass through the headstock belt in the motor compartment.
10. Slide the headstock belt over the left end of countershaft assembly "X" and onto the left pulley on pulley assembly "Z", Figure 4.10 .
11. Remount the countershaft assembly by sliding the left end of the countershaft assembly back into countershaft support bracket.
12. Reconnect the pull rod and insert the cotter pin removed in step 23 of the headstock removal procedure.
13. Install headstock cover and tighten two set screws, as shown in Figure 4.11 .
14. Remount the collet closer according to the procedure outlined under "Replacement", Page 4-1.
15. Turn main disconnect switch "C", Figure 4.15, ON.
16. Pull "Start/Stop" pushbutton "A", Figure 4.1, OUT to turn the machine ON.

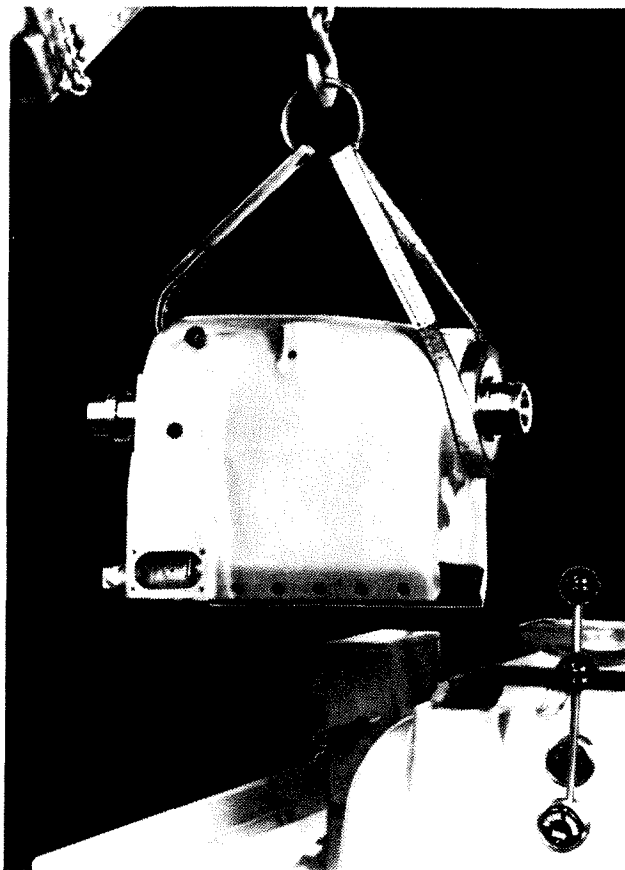


Figure 4.14 - Headstock Removal

17. Place lever "I", Figure 4.2, in range "1" and set speed selector "B", Figure 4.1, to 125 rpm.

- NOTE -

Leave the spindle running until the spindle speed stabilizes at 125 rpm.

18. Place lever "K", Figure 4.2, in the "Forward" or "Reverse" position to initiate spindle rotation.
19. Place lever "K" in the "Brake" position to stop the spindle.
20. Press "Start/Stop" pushbutton "A", Figure 4.1, IN to turn the machine OFF.
21. Install motor belt "W" on the right pulley on pulley assembly "Z", Figure 4.10 .
22. Remove the block and rotate adjusting screw "V", Figure 4.8, to lower the front of the motor mounting plate until proper belt tension is attained.
23. Install and tighten lock nut "U".
24. Install pedestal rear cover "T", Figure 4.7 .
25. Close door "S", Figure 4.6 .

SPINDLE

LOCK PIN

The electrical interlock between lock pin "H", Figure 4.2, and the main drive motor is controlled by limit switch "A", Figure 4.13 . The limit switch is located under name plate "M" and is actuated by a plunger moved by lock pin "H", Figure 4.2 .

LIMIT SWITCH REPLACEMENT

1. Turn main disconnect switch "C", Figure 4.15, OFF.
2. Remove four screws "L" and cover "M", Figure 4.2 .
3. Remove two screws "B" and pull limit switch "A", Figure 4.13, out of the headstock to gain access to the wire terminals on the limit switch.
4. Tag the three wires connected to limit switch "A" for reconnection; then disconnect the wires.
5. Connect the three wires to the new limit switch.

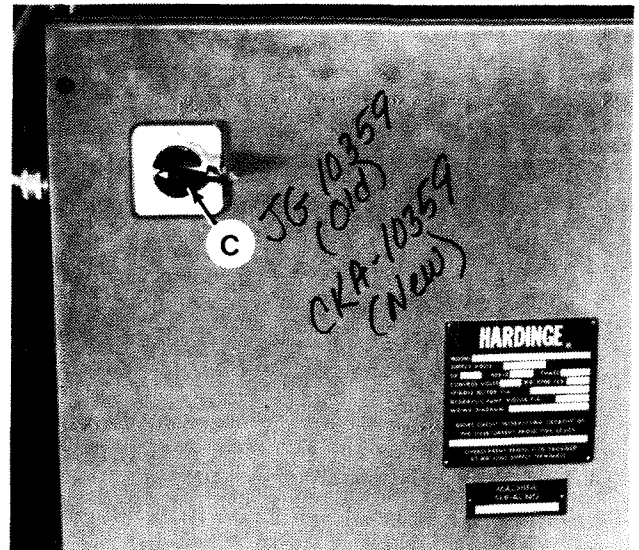


Figure 4.15 - Main Disconnect Switch

- NOTE -

Clearance in the limit switch mounting holes will allow the position of the limit switch to be adjusted to ensure that the limit switch works properly.

6. Mount the new limit switch using screws "B".
7. Check the limit switch to be sure it functions properly.
8. Mount limit switch cover "M" using four screws "L", Figure 4.2 .

LUBRICATION

The headstock spindle is mounted on precision preloaded ball bearings. The preloading and the resulting load-carrying capacity is engineered to take radial thrust, end thrust, or a combination of both.

The precision preloaded ball bearings are grease packed for life and require no further lubrication. The entire bearing assembly is housed as a unit and is properly sealed to exclude dirt and foreign matter. The spindle bearings are designed to operate at high speed without wear or friction.

- NOTES -

- NOTES -

CHAPTER 5 - ELECTRICAL

POWER CASE

ACCESSING THE POWER CASE

- WARNING -

Be sure disconnect switch "F", Figure 5.2, is turned OFF before opening the power case door.

1. Press "Start/Stop" pushbutton "A", Figure 5.1, IN to turn the machine OFF.
2. Turn main disconnect switch "F", Figure 5.2, to the OFF position.
3. Loosen two screws "G" and open the power case door.

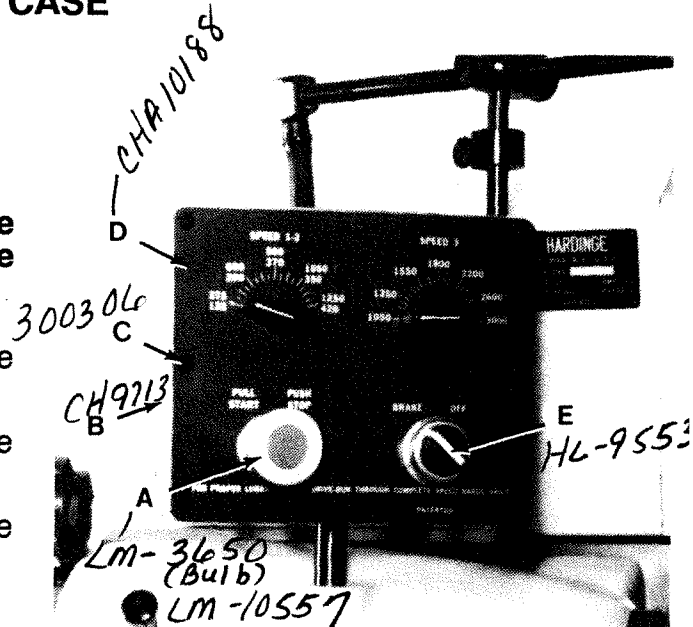


Figure 5.1 - Variable Speed Control Box

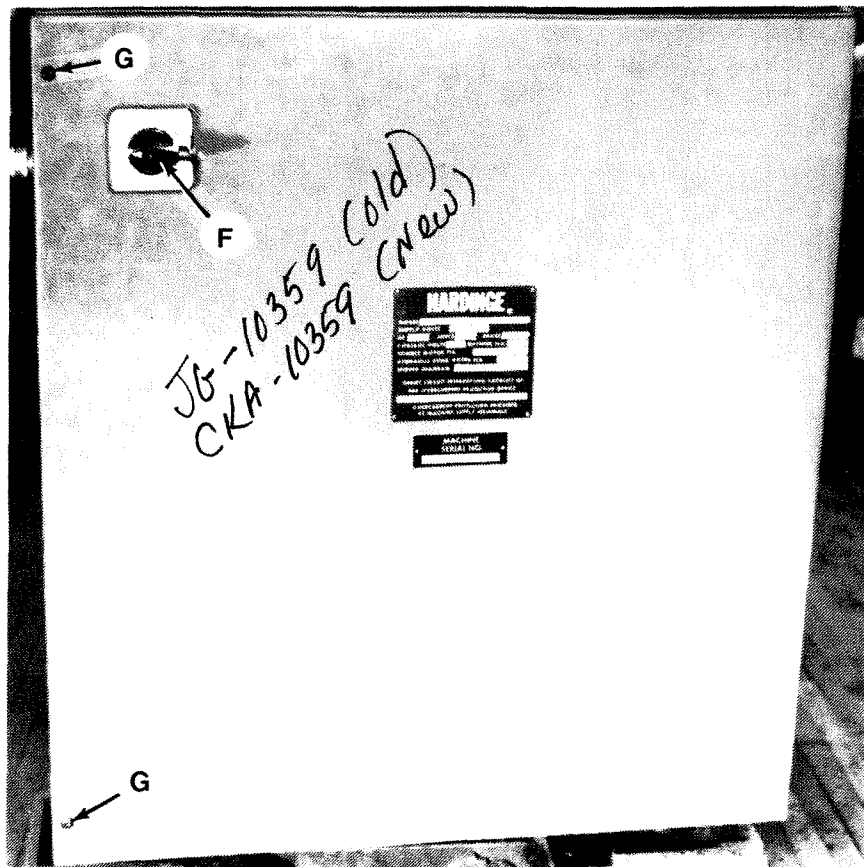


Figure 5.2 - Power Case (External View)

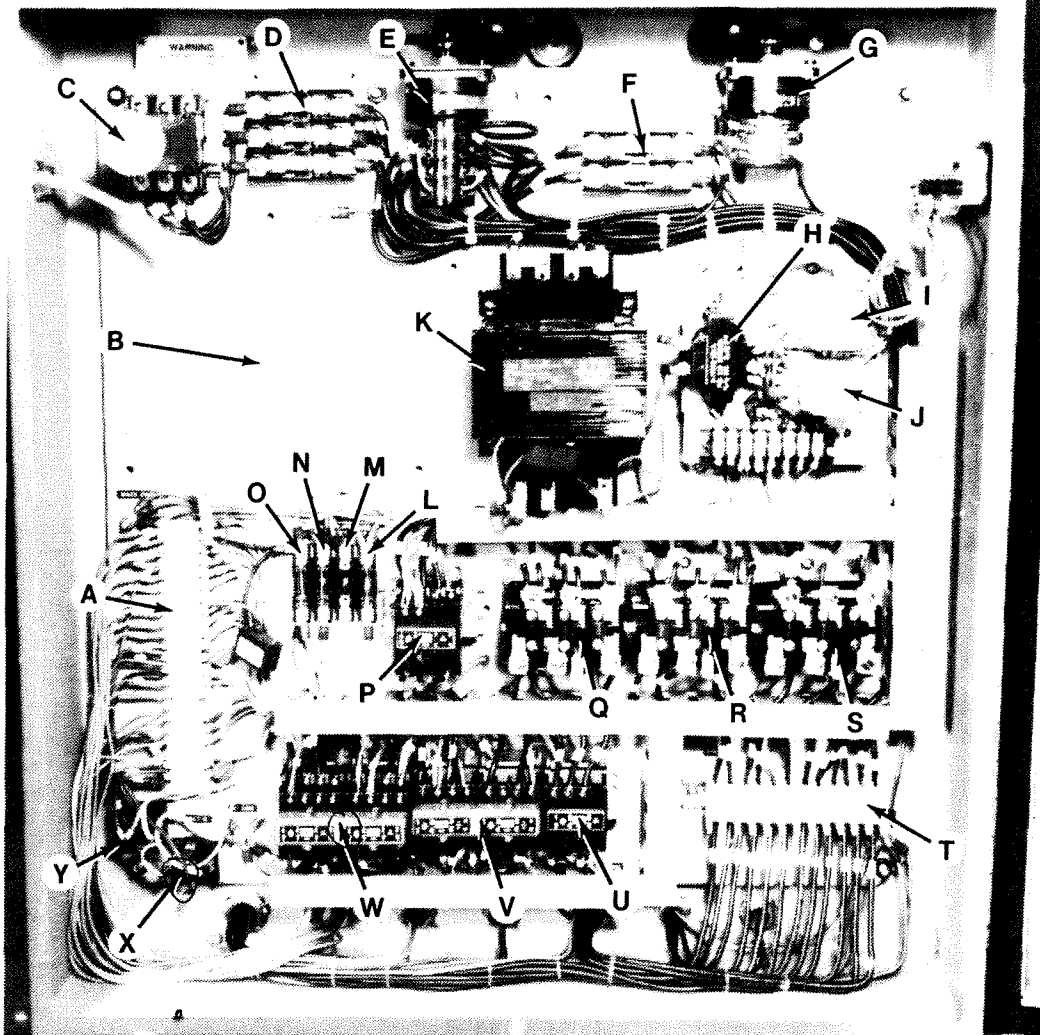


Figure 5.3 - Power Case (Internal View)

COMPONENT DESCRIPTION

Refer to Figure 5.3 .

A - Terminal block #1 (1TB)

B - Autotransformer mounting location (3T)
(Autotransformer not shown)

The autotransformer is used only on machines configured for the following voltages:

208V and 575V - 60Hz

200V, 380V, and 415V - 50Hz

C - Disconnect switch (DISC.)

D - Fuses, main line (1FU)

E - Drum switch, spindle direction (1DS)

F - Fuses, control transformer primary (2FU)

G - Drum switch, speed selector (2DS)

H - Transformer, speed change (Mounted on the Power Supply and Relay Assembly)

COMPONENT DESCRIPTION (Continued)

- I - Relay, spindle "Raise Speed" (Mounted on the Power Supply and Relay Assembly)
- J - Relay, spindle "Lower Speed" (Mounted on the Power Supply and Relay Assembly)
- K - Control transformer (1T) *KL-8776*
- L - Fuse, optional thread chasing attachment (6FU)
- M - Fuse, optional worklight (5FU)
- N - Fuse, power feed module (4FU)
- O - Fuse, Control transformer secondary (3FU)
- P - Main Contactor (4M)
- Q - Overload relay for coolant pump motor (OL1)
- R - Overload relay for spindle motor (OL2)
- S - Overload relay for speed change motor (OL3)
- T - Terminal Block #2 (2TB)
- U - Coolant pump motor contactor (5M)
- V - High/Low speed change contactor for spindle motor (3ML-3MH)
- W - Forward/Reverse speed change contactor for speed change motor (2MR-2ML)
- X - Rectifier for spindle motor brake (RECT G)
- Y - Rectifier for speed change motor brake (RECT A)

Refer to Figure 5.4 . (Power Supply and Relay Assembly)

- A - Smoothing capacitors for DC voltage to the rheostats
- B - Rectifiers providing DC voltage for the rheostats

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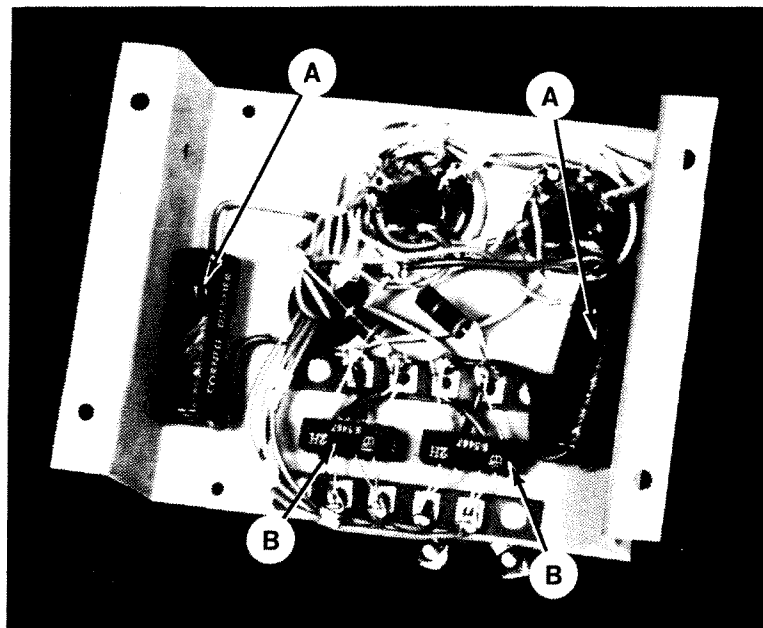


Figure 5.4 - Power Supply and Relay Assembly

POWER FEED CONTROL PANEL

- WARNING -

Be sure disconnect switch "A", Figure 5.1, is turned OFF before attempting to service the power feed control panel.

1. Press "Start/Stop" pushbutton "A", Figure 5.1, IN to turn the machine OFF.
2. Turn main disconnect switch "F", Figure 5.2, to the OFF position.
3. Remove six screws "C", Figure 5.5.
4. Remove power feed control panel "D" from housing "E".

POWER FEED MODULE

Power feed module "F", Figure 5.6, serves two purposes:

The power feed module converts 110 volts A.C. to 90 volts pulsating D.C. for the power feed drive motor.

Through the use of potentiometer "H", Figure 5.7, the power feed module controls SCR "G", Figure 5.6, to vary the effective D.C. voltage level to the power feed drive motor, controlling the motor speed.



Figure 5.5 - Power Feed Control Panel
(Front View)

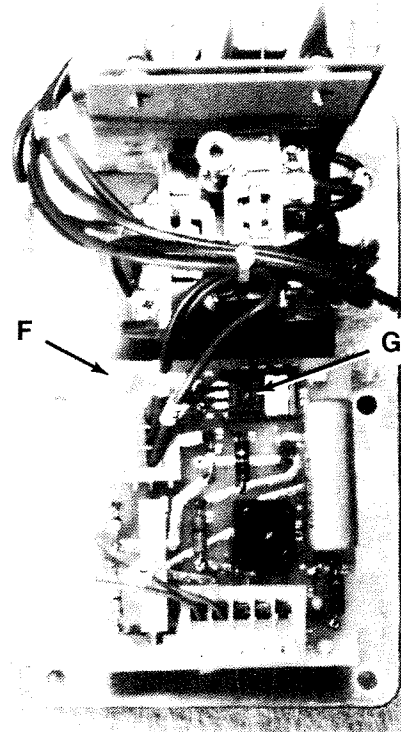


Figure 5.6 - Power Feed Module

RESISTOR MODULE

Resistor module "J", Figure 5.7, contains three 25 watt resistors and a 6 position terminal block.

Resistor "K" is a 47Ω 25 watt resistor used for dynamic braking of the power feed drive motor.

Resistor "L" is a 1500Ω 25 watt resistor used as a load resistor for SCR "G", Figure 5.6, on power feed module "F".

Resistor "M", Figure 5.7, is a 470Ω 25 watt resistor in series with the field windings in the power feed drive motor. This resistor reduces the voltage to the field windings, allowing higher motor speeds.

SWITCHES

Potentiometer "H", Figure 5.7, varies the effective D.C. voltage level to the power feed drive motor to control the motor speed.

Three position switch "I" controls the direction of travel for the power feed - left, right, or stop.

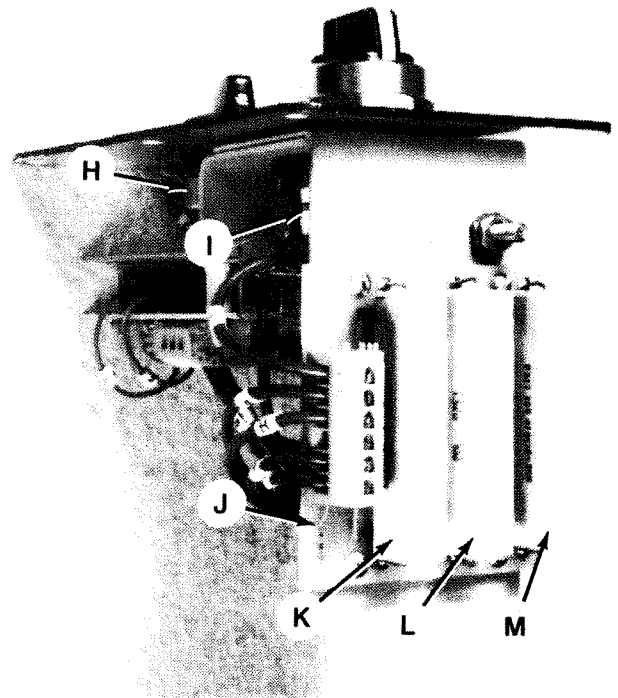


Figure 5.7 - Resistor Module

VARIABLE SPEED CONTROL PANEL

- WARNING -

Be sure disconnect switch "F", Figure 5.2, is turned OFF before attempting to service the variable speed control panel.

1. Press "Start/Stop" pushbutton "A", Figure 5.1, IN to turn the machine OFF.
2. Turn main disconnect switch "F", Figure 5.2, to the OFF position.
3. Remove eight screws "C", Figure 5.1 .
4. Remove variable speed control panel "D" from control housing "B".

COMPONENT DESCRIPTION

Internal Adjustments

Speed trimming rheostat "N", Figure 5.8, is used to adjust top speed after changing belts or repairing the speed change drive. Refer to " Speed Change Mechanism Replacement", in Chapter 3.

Sensitivity rheostat "O", Figure 5.8, is used to stabilize transistors "V" and "W", Figure 5.11 . When the ambient temperature exceeds 100°F (37.8°C), the speed change drive may hunt for the selected speed. Turn the adjusting knob on rheostat "O", Figure 5.8, clockwise or counter-clockwise, as needed, with a screwdriver to stabilize the speed change drive.

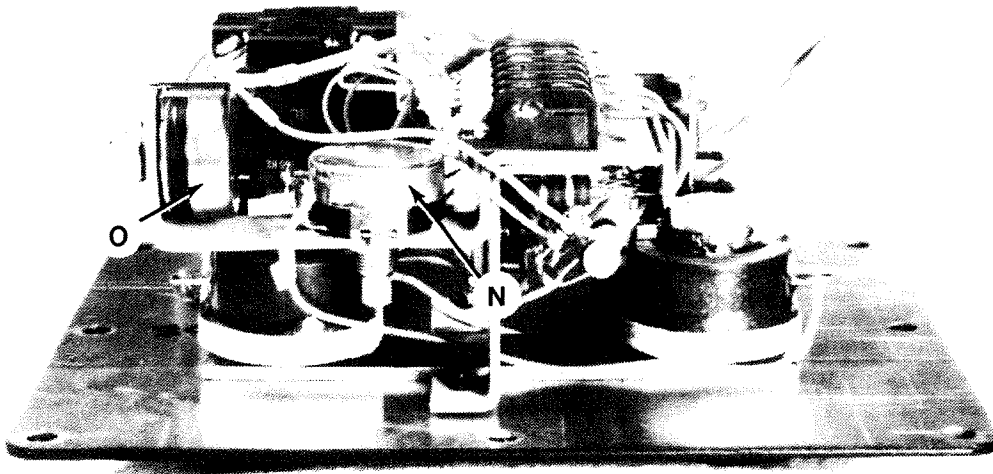


Figure 5.8 - Variable Speed Control Panel (Side View)

Operator Controls

SPINDLE SPEED ADJUSTMENT

Rheostat "P", Figure 5.9, controls spindle speed in ranges 1 and 2. Rheostat "Q" controls spindle speed in range 3. If the speed change drive fails to operate or hunts for speed, the rheostat fields may be dirty and should be cleaned with electrical contact cleaner. Refer also to "Internal Adjustments", page 5-5, for information on transistor sensitivity adjustment.

- NOTE -

Spindle direction lever "T", Figure 5.10, must be in the "Brake" position before the machine can be turned ON with switch "R", Figure 5.9 .

ON/OFF SWITCH

When main disconnect switch "F", Figure 5.2, is turned ON, switch "R", Figure 5.9, turns the machine ON when pulled OUT and turns the machine OFF when pushed IN.

SPINDLE BRAKE

Selector switch "S" is a two position switch that enables the spindle brake when set to the "BRAKE" position and disables the spindle brake when set to the "OFF" position.

Transistor Assembly

Transistor assembly "U", Figure 5.11, contains transistors "V" and "W". If the speed change drive operates in only one direction, interchange transistors "V" and "W" to check for a faulty transistor. Transistor "V" works in the control circuit to raise the speed change drive and transistor "W" to lower the speed change drive.

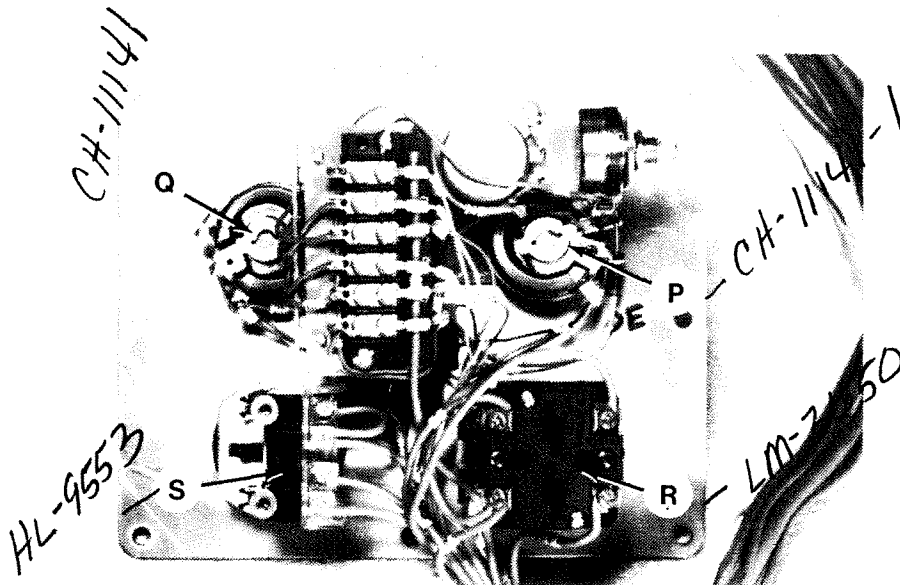


Figure 5.9 - Variable Speed Control Panel (Rear View)



Figure 5.10 - Headstock Levers

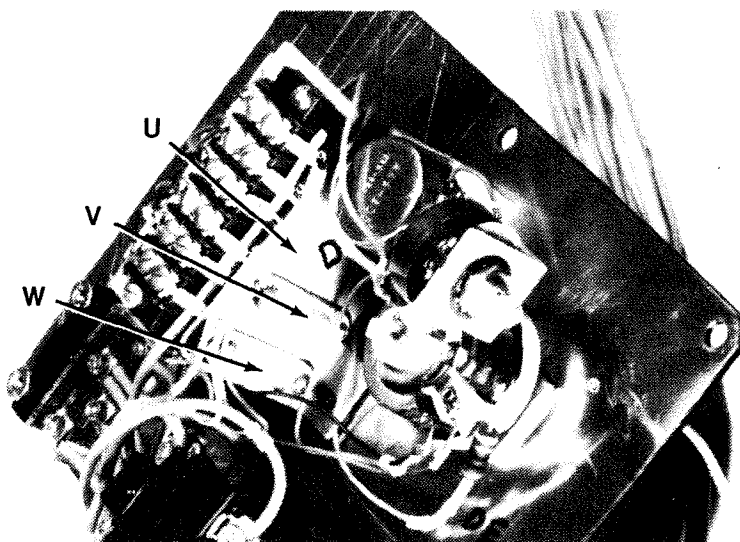


Figure 5.11 - Transistor Assembly

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- NOTES -

APPENDIX

This section contains the following information for the Hardinge HC™ Super-Precision® Chucker and Bar Machine:

- Preventative maintenance schedule
- Lubricant and Sealer Listing

Preventative maintenance should be performed at the prescribed time intervals to ensure the proper operation and accuracy of the machine.

PREVENTATIVE MAINTENANCE SCHEDULE

DAILY

	PAGE
Run the drive through the entire speed range	3-14
Operate the carriage pressure oiler	1-13

WEEKLY

Lubricate the carriage gear rack	1-19
Remove, clean, and lubricate the collet closer	4-1

MONTHLY

Check spindle and motor belt tension	3-1
Lubricate the variable speed drive	3-14
Lubricate the turret indexing mechanism	2-15
Lubricate the cross feed screw nut	2-8

BI-MONTHLY

Change the oil in the carriage apron	1-14
--	------

QUARTERLY

Clean and lubricate the cross slide ways	2-5
--	-----

DEPENDING ON USE

Keep the carriage oil reservoir full	1-14
Keep oil in the sight window of the carriage apron	1-14
Keep the power feed reservoir full	3-29
Clean the coolant sump	4-2
Oil the spindle brake insert	3-7

LUBRICANT AND SEALANT LISTING

Product	Manufacturer
Alvania #3 Grease	Shell Oil Company
Andok "B" Grease	Humble Oil and Refining Company
Automatic Transmission Fluid - Mobilfluid® 350	Mobil Oil Corporation
Cosmolube No. 2	E.F. Houghton and Company
Molylube® (Anti-Seize)	Bel Ray Company, Inc.
Permatex (3D Sealer)	Permatex Company, Inc.
Vactra® Oil No. 2	Mobil Oil Corporation
Velocite® No. 6	Mobil Oil Corporation

- NOTES -

- NOTES -



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