

NO. 7 SADDLE TYPE TURRET LATHES

**PARTS & SERVICE
MANUAL**

JONES & LAMSON
TEXTRON

Waterbury Farrel Division of Textron Inc.

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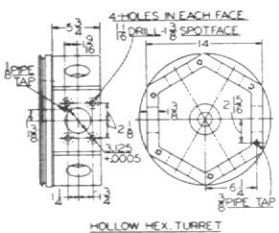
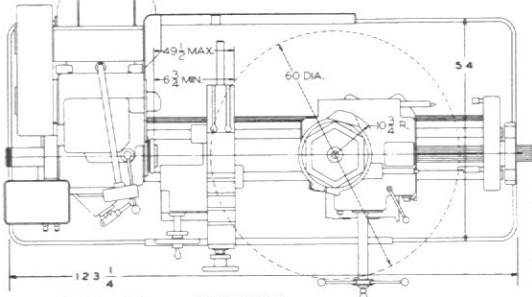
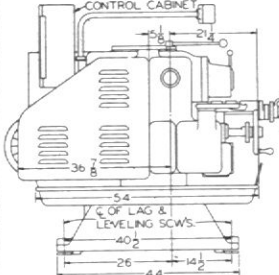
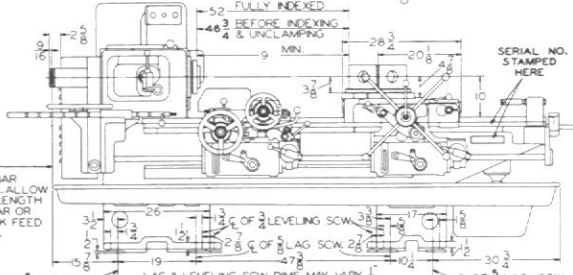
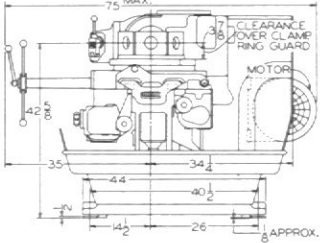
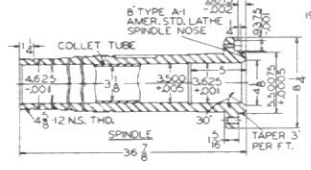
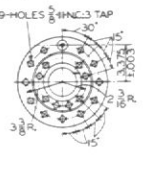
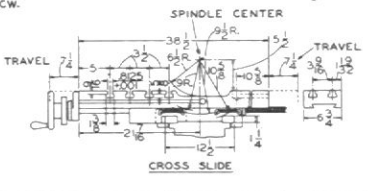
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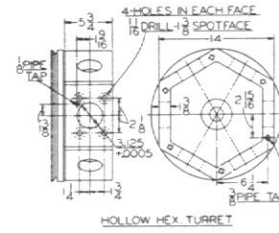
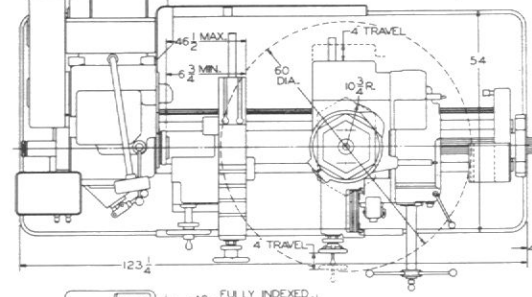
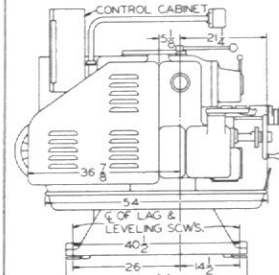
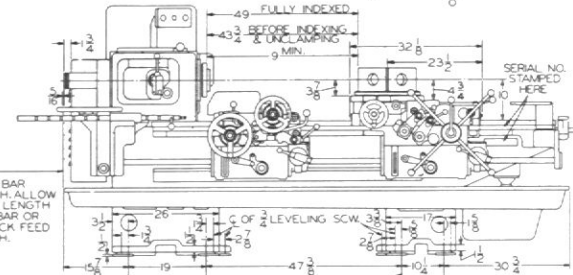
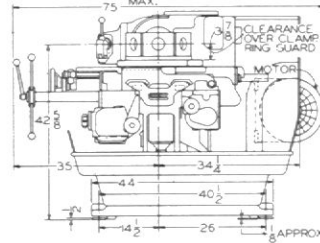
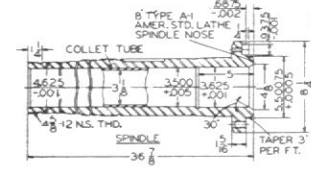
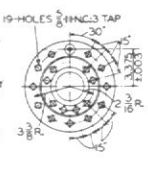
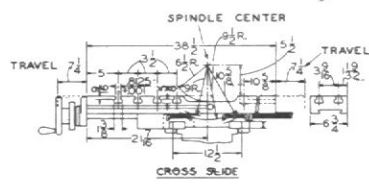
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GENERAL SPECIFICATIONS

MACHINE TOOL STD. DATA SHEET	JONES & LAMSON MACHINE COMPANY SPRINGFIELD VERMONT U.S.A.	BUILDERS SERIAL NUMBER	NO. 7A-3 SADDLE TYPE-FIXED CENTER UNIVERSAL TURRET LATHE	USERS MACHINE NUMBER
 <p>HOLLOW HEX TURRET</p>			SPINDLE SPEEDS-DRIVE SHAFT-1380 R.P.M. 30 44 63 90 123 178 253 365 510 734 1041 1500 SPINDLE SPEEDS-DRIVE SHAFT- 920 R.P.M. 20 29 42 60 82 119 169 243 340 489 694 1000 LONGITUDINAL FEEDS PER REV. OF SPINDLE .005 .007 .011 .015 .022 .033 .047 .069 .100 CROSS SLIDE FEEDS PER REV. OF SPINDLE .0025 .0035 .0055 .0075 .011 .0165 .0235 .0345 .050 SWING OVER WAY GUARD 19" DIAM. SWING OVER CARRIAGE GUIDE 18" DIAM. STANDARD BAR CHUCK CAPACITY-MIN. 1/2 -MAX. 2 ROUND STOCK 3" DIAM. - SQUARE STOCK 2 1/8 HEXAGONAL STOCK 2 3/8 SIZE OF CHUCK 12" O.D.	
			MACHINE SHOULD BE INSTALLED ON CONCRETE FLOOR OF AMPLE THICKNESS OR SEPARATE CONCRETE FOUNDATION	
 <p>CONTROL CABINET</p>	 <p>52 FULLY INDEXED 3 BEFORE INDEXING 4 & UNCLAMPING 9 MIN.</p> <p>SERIAL NO. STAMPED HERE</p> <p>FOR BAR MACH. ALLOW FOR LENGTH OF BAR OR STOCK FEED MECH.</p> <p>LAG & LEVELING SCW. DIMS. MAY VARY 1/2</p>		 <p>75 MAX.</p> <p>CLEARANCE OVER CLAMP RING GUARD</p> <p>MOTOR</p>	
 <p>COLLET TUBE</p> <p>8" TYPE A-1 AMER. STD. LATHE SPINDLE NOSE</p> <p>SPINDLE</p> <p>36 1/8</p> <p>48 12 N.S. THD.</p> <p>TAPER 3" PER FT.</p>	 <p>19-HOLES 5/8" #3 TAP</p> <p>LAG & LEVELING SCW.</p>		 <p>SPINDLE CENTER</p> <p>CROSS SLIDE</p>	
FIRST USED ON MACH. NO. 210114	SUPERSEDES 1913-A OF 6-16-50	H.P.	WT.	DRAWN BY D.M. DATE-10-2-52 DWG. NO. 1913-A

7A-3

MACHINE TOOL STD. DATA SHEET	JONES & LAMSON MACHINE COMPANY SPRINGFIELD, VERMONT, U.S.A.	BUILDERS SERIAL NUMBER	NO. 7B-3 SADDLE TYPE-CROSS SLIDING UNIVERSAL TURRET LATHE	USERS MACHINE NUMBER
 <p>HOLLOW HEX TURRET</p>			SPINDLE SPEEDS-DRIVE SHAFT-1380 R.P.M. 30 44 63 90 123 178 253 365 510 734 1041 1500 SPINDLE SPEEDS-DRIVE SHAFT- 920 R.P.M. 20 29 42 60 82 119 169 243 340 489 694 1000 LONGITUDINAL FEEDS PER REV. OF SPINDLE .005 .007 .011 .015 .022 .033 .047 .069 .100 CROSS SLIDE FEEDS PER REV. OF SPINDLE .0025 .0035 .0055 .0075 .011 .0165 .0235 .0345 .050 SWING OVER WAY GUARD 19" DIAM. SWING OVER CARRIAGE GUIDE 18" DIAM. STANDARD BAR CHUCK CAPACITY-MIN. 1/2 -MAX. 2 ROUND STOCK 3" DIAM. - SQUARE STOCK 2 1/8 HEXAGONAL STOCK 2 3/8 SIZE OF CHUCK 12" O.D.	
			MACHINE SHOULD BE INSTALLED ON CONCRETE FLOOR OF AMPLE THICKNESS OR SEPARATE CONCRETE FOUNDATION	
 <p>CONTROL CABINET</p>	 <p>49 FULLY INDEXED 43 BEFORE INDEXING & UNCLAMPING 9 MIN.</p> <p>SERIAL NO. STAMPED HERE</p> <p>FOR BAR MACH. ALLOW FOR LENGTH OF BAR OR STOCK FEED MECH.</p> <p>LAG & LEVELING SCW. DIMS. MAY VARY 1/2</p>		 <p>75 MAX.</p> <p>CLEARANCE OVER CLAMP RING GUARD</p> <p>MOTOR</p>	
 <p>COLLET TUBE</p> <p>8" TYPE A-1 AMER. STD. LATHE SPINDLE NOSE</p> <p>SPINDLE</p> <p>36 1/8</p> <p>48 12 N.S. THD.</p> <p>TAPER 3" PER FT.</p>	 <p>19-HOLES 5/8" #3 TAP</p> <p>LAG & LEVELING SCW.</p>		 <p>SPINDLE CENTER</p> <p>CROSS SLIDE</p>	
FIRST USED ON MACH. NO. 210167	SUPERSEDES 1918-A OF 2-15-51	H.P.	WT.	DRAWN BY D.M. DATE-10-6-52 DWG. NO. 1918-A

7B-3

INSTALLATION

SHIPMENT

Before shipment your machine was fully tested for proper operation at all feeds and speeds. It was correctly adjusted and brought into precision alignment.

For shipment, all unprotected parts were coated against corrosion. The machine was then properly blocked and skidded.

Carefully check on the condition of your shipment when it is received. Any damage should be reported immediately to the carrier as well as to our nearest sales office.

UNLOADING

When uncrating, check all boxes attached to the skids. These contain loose parts which must remain with the machine.

Keep the machine on skids until it is moved to its final location or to a crane.

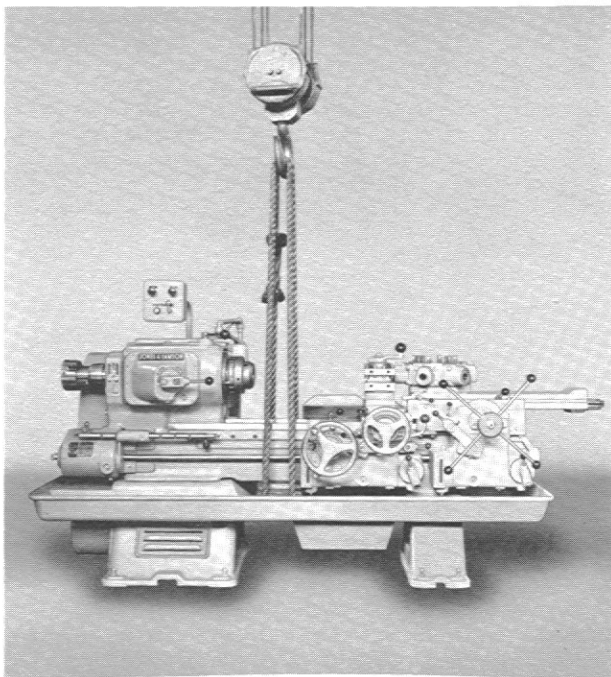


Figure 1 - Sling Method for Lifting Jones & Lamson Turret Lathes

CLEANING

Before moving any sliding member, remove all corrosion resistant coating and dirt from the machine. Use clean kerosene or solvent with clean, lint-free rags. Avoid the use of an air hose since its pressure may drive foreign matter between bearing surfaces.

After cleaning thoroughly, wipe a protective coat of good grade oil on all finished surfaces.

LIFTING

Figure 1 shows the proper method for lifting this machine. A lifting block shown in figure 2, a 9" x 9" x 1-1/2" hardwood spacer, and a 1-1/2" diameter x 20' long rope with its ends spliced together are required.

Place the lifting block between the bed and the pan, close to the head end as possible, and free from the carriage. Butt the attached board against the front side of the bed to prevent feed rod damage by the sling. Pass the rope under the lifting block so that both rope sections mate the block grooves. Place the 1-1/2" thick spacer on top of the block and under the rear of the bed. This lowers the lifting block in the rear to prevent coolant pipe damage.

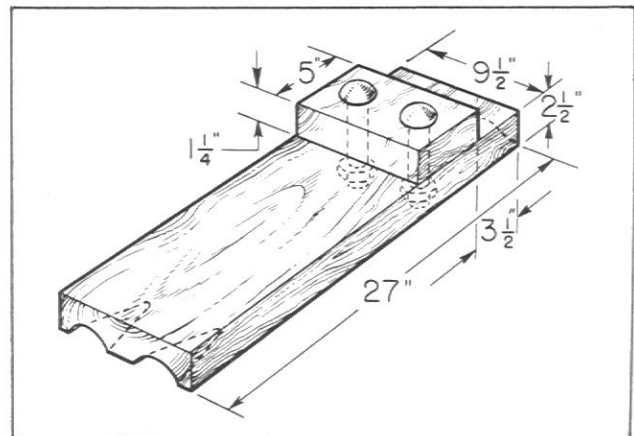


Figure 2 - Lifting Block

OPERATION

From a position at the cross slide hand-wheel all operator controls are within reach of the right or left hand. The work remains in full view.

Handwheels and levers move in a direction related to the operation they control. Red knobs identify power controls.

The following paragraphs describe these controls and provide instruction for their operation.

OPERATOR PENDANT

1. Start and Stop Buttons.

These buttons control the main drive motor. They also control the hydraulic motor on machines equipped with hydraulic collet chuck and bar feed.

2. Control for the Hydraulic Collet Chuck and Bar Feed.

This control is included on the operator pendant when the machine is equipped with the hydraulic collet chuck and bar feed. Figure 9 shows the self-centering lever switch A and the selector switch B.

Lever switch A controls the operation of the collet chuck and the stock feed. Selector switch B

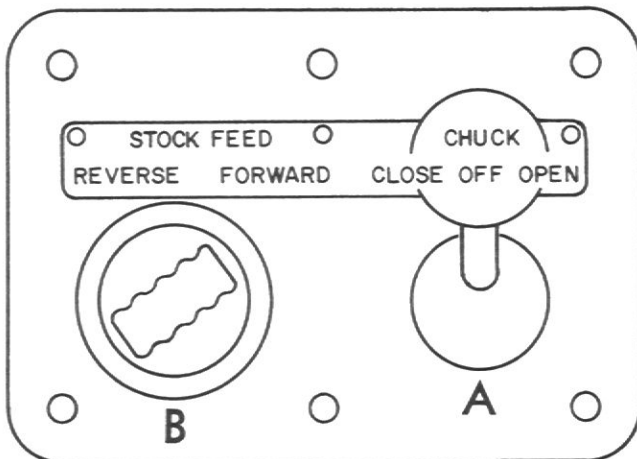


Figure 9 - Control for Hydraulic Chuck and Bar Feed

determines the operation of the stock feed return when lever switch A is moved to "close".

The stock, held in a 4-jaw scroll chuck, is moved through the open collet by the hydraulic stock feed. Two jaws are adjustable and two jaws have inbuilt eccentric drivers. For correct jaw pressure, close the scroll chuck until the eccentric drivers are tight on the stock. Centralize the stock with the adjustable jaws. Leave about .002-inch clearance between the adjustable jaws and the stock. This permits the return of the stock feed chuck over the stock for a new series of feeds.

The collet chuck is the push-out type with removable collet pads. The collet pads are held to the master collet by screws accessible through holes in the spindle nose piece. Collet pads are changed without removing the master collet.

A. To operate the hydraulic collet chuck and bar feed.

1. Set selector B at "forward".
2. Move lever A to "open".

The collet chuck is opened. The stock feed chuck then advances the stock to the stock stop. Its maximum advance is 30".

3. Move lever A to "close".

The stock feed chuck advance is stopped. The collet chuck is closed.

4. Release lever A.

The lever is returned by spring to "off". The collet chuck remains closed. Both operating cylinders are relieved.

5. Leave selector B at "forward" until the stock feed chuck can no longer be advanced.

OPERATION

B. To return the stock feed chuck for a new series of advances.

1. Set selector B at "reverse".

a. Move lever A to "close".

The collet chuck is closed. Then, the stock feed is returned.

NOTE: The stock feed can be returned, only when selector switch B is set at "reverse". The stock feed can be advanced when selector switch B is set at either "forward" or "reverse".

When operating, always advance the stock feed with selector switch B set at "forward". This prevents the stock feed chuck from stripping itself off short-length bars when lever A is moved to "close".

When idle, relieve the spring collet by leaving it in its open position in the following manner. Hold lever A at "forward" until the collet is opened. Then,

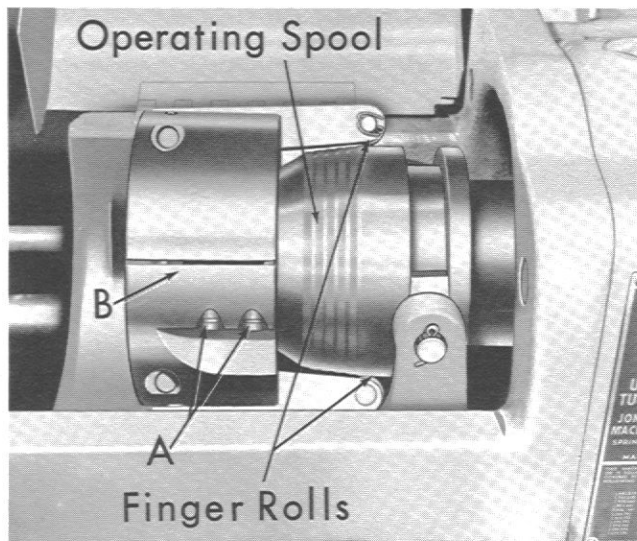


Figure 10 - Collet Chuck Operating Spool and Fingers

release the lever. Lever A returns by spring to "off" leaving the collet open and both operating cylinders relieved.

C. The collet chuck is properly adjusted when it provides the gripping pressure necessary to prevent work slippage under the existing cutting conditions. When the work is properly chucked, the finger rolls should bear on the top of the spool as shown in figure 10.

Adjust the collet operating mechanism in the following manner.

1. Open the collet chuck to remove the finger pressure from the spool. Loosen binder screws A in finger carrier B shown in figure 10.

2. To increase the collet chuck gripping pressure.

a. Use the spanner wrench to turn finger carrier B clockwise until the proper chucking pressure is obtained.

b. With the finger pressure removed from the spool, tighten screws A to lock finger carrier B to the spindle.

3. To decrease the required collet chuck gripping pressure for fragile work pieces or for light cuts.

a. Repeat steps 1 and 2, except turn finger carrier B counterclockwise until the proper chucking pressure is obtained.

OPERATION

HEADSTOCK

3. Forward and Reverse Lever for spindle control.

A. To operate the forward and reverse lever.

1. Move lever D to its center position as shown in figure 11 for spindle brake.

Forward clutch A and reverse clutch B (shown in figure 11) are disengaged leaving the main drive shaft free to turn without driving the transmission. Brake clutch C shown in figure 11 is engaged to stop the transmission and spindle rotation.

2. Move lever D clockwise from its center position for forward spindle rotation.

Brake clutch C and reverse clutch B are disengaged. Forward clutch A is engaged to drive the transmission.

3. Move lever D counterclockwise from its center position for reverse spindle rotation.

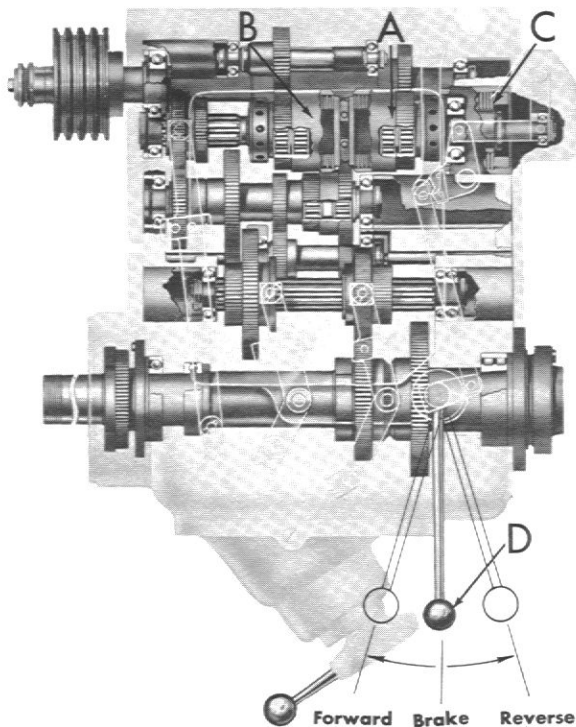


Figure 11

Forward and Reverse Lever for Spindle Control

Brake clutch C and forward clutch A are disengaged. Reverse clutch B is engaged to drive the transmission.

4. Reverse the direction of spindle rotation with the spindle stopped, or at speeds under 90 RPM.

It is customary to operate the forward and reverse lever with the right hand while engaging the speed selector with the left hand.

When the machine is idle, leave the forward and reverse lever in brake position.

4. Single Lever Dial Speed Selector.

The speed selector is located in front of the headstock with its entire dial visible to the operator. A single lever attains twelve spindle speeds, forward and reverse, through sliding gears mounted on multiple spline shafts. Neutral position disengages the spindle from the geared transmission so that it can be rotated by hand.

A. To operate the single lever speed selector.

- *1. Pull the selector lever out, with the machine cutting or idle.

The internal cams are disengaged from the selector yokes as shown in figure 12, while the shifter levers maintain the engagement of the transmission gears.

2. Turn the selector lever to preselect the next desired spindle speed with the machine cutting or idle.

The cams are rotated to proper position, ready for engaging the next spindle speed.

*NOTE: On heavy or intermittent cuts, delay the preselection of spindle speed by leaving the selector lever engaged until near the end of the cut.

OPERATION

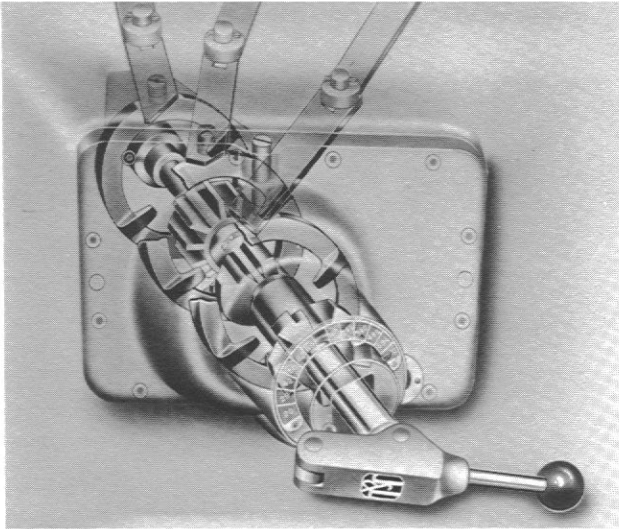


Figure 12
Single Lever Speed Selector in Preselect Position

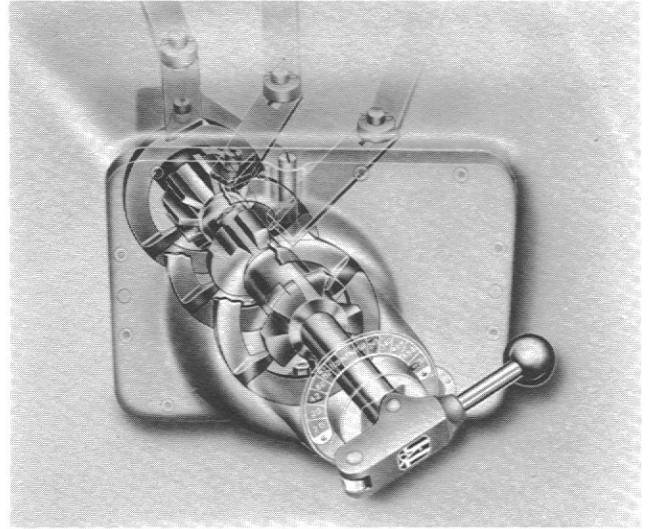


Figure 13
Single Lever Speed Selector in Engaged Position

3. Move the spindle forward and reverse lever into the brake position until the spindle rotation is reduced to slow speed.
4. Push the speed selector lever in, while the spindle turns slowly.

The cams pivot the selector yokes shown in figure 13 to shift the transmission gears through levers. The shifter levers are shown in phantom in figure 11.

Smooth, noiseless shifts should be made with rapidity and ease.

5. Manually Operated Collet Chuck and Bar Feed.

A single lever A shown in figure 14 operates the stock feed and the collet chuck.

The stock, held in a four-jaw scroll chuck, is moved through the open collet by the stock feed. Two jaws are adjustable and two jaws have inbuilt spring pins for gripping. For correct jaw pressure, close the scroll chuck on the stock until the spring pins are compressed nearly flush with their

jaws. Centralize the stock with the adjustable jaws. Leave about .002-inch clearance between the adjustable jaws and the stock. This permits the return of the stock feed chuck over the stock for a new series of feeds.

A. To operate the collet chuck and bar feed.

1. Pull lever A to the outward end of its stroke to open the collet chuck and advance the stock feed chuck 4-1/2 inches.

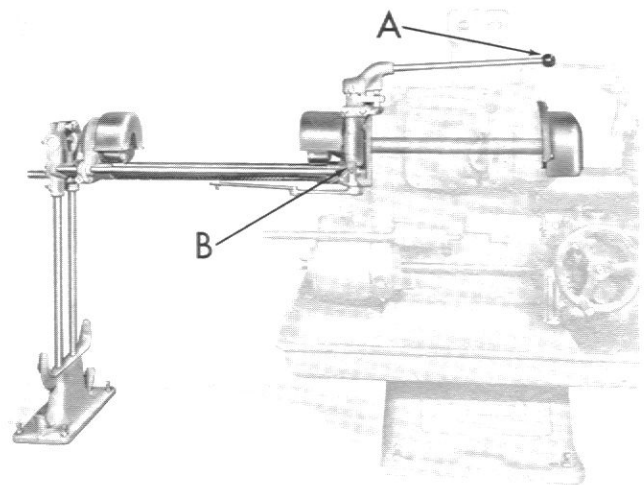


Figure 14 - Manually Operated Collet Chuck and Bar Feed

OPERATION

2. From the outward end of its stroke, move lever A back and forth (through a 30-degree swing) to advance the stock feed chuck up to 22-1/2 inches.
3. Push lever A to the forward end of its stroke to close the collet chuck. The stock feed chuck remains stationary.

B. To return the stock feed chuck for a new series of feeds while the collet chuck remains closed.

1. Push lever A to the forward end of its stroke to close the collet chuck.

The ratchet action is automatically reversed for the return of the stock feed chuck.

2. Lift, then pull lever A free from the collet chuck operating mechanism.
3. From the outward end of its stroke, move lever A back and forth (through a 30-degree swing) to return the stock feed chuck up to 22-1/2 inches.

C. To return the stock feed chuck with the collet open when the stock has been advanced further than desired.

1. Pull lever A from the forward end of its stroke to open the collet chuck.
2. Hold lever B down with the left hand to keep the ratchet action reversed for the return of the stock feed chuck. (See figure 14.)
3. From the outward end of its stroke, move lever A back and forth (through a 30-degree swing) to return the stock up to 22-1/2 inches.

D. The collet chuck is properly adjusted when it provides the gripping pressure necessary to prevent work slippage under the existing cutting conditions. When the work is properly chucked, the finger rolls should bear on the top of the spool as shown in figure 10.

Adjust the collet operating mechanism in the following manner.

1. Open the collet chuck to remove the finger pressure from the spool. Loosen binder bolts A in finger carrier B shown in figure 10.
2. To increase the collet chuck gripping pressure.
 - a. Use the spanner wrench to turn finger carrier B clockwise until the proper chucking pressure is obtained.
 - b. With the finger pressure removed from the spool, tighten screws A to lock finger carrier B to the spindle.
3. To decrease the required collet chuck gripping pressure for fragile work pieces or for light cuts.
 - a. Repeat steps 1 and 2, except turn finger carrier B counterclockwise until the proper chucking pressure is obtained.

CARRIAGE AND CROSS SLIDE

6. Square Turret Lever.

The four-position, quick-indexing square turret for the cross slide presents four faces for holding tools or tool blocks.

A. To index the square turret.

1. Push lever A counterclockwise to the forward end of its stroke. (Movement number 1, figure 15.)

The following automatic sequence takes place. (a) The turret is unclamped. (b) The locking pin is pulled from its turret seat. (c) The turret is indexed. (d) The locking pin is released into a new turret seat.

2. Pull lever A to the outward end of its stroke. (Movement number 2, figure 15.)

The internal ratchets are repositioned for the next index and the turret is bound.

OPERATION

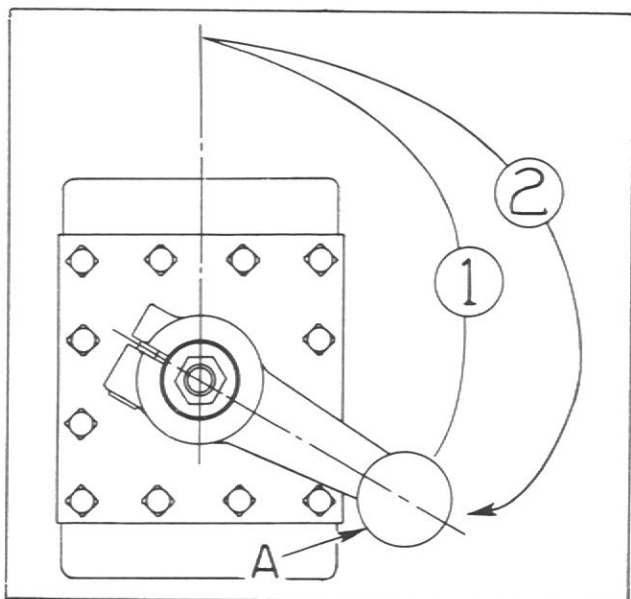


Figure 15 - Motion Sequence for Operating Square Turret

The index is completed by the rhythmic advance and return of the operating lever.

B. To skip index the square turret.

1. Push the lever (part of movement number 1 in figure 15) to start the index.
2. Turn the turret by hand until the required face is nearly positioned.
3. Continue movements numbers 1 and 2 in figure 15 to complete the index.

When idle, leave the square turret in its locked position to relieve the compression on the locking pin spring.

7. Carriage Handwheel.

A. To operate the handwheel.

1. Rotate the handwheel counterclockwise for longitudinal carriage travel toward the headstock.
2. Rotate the handwheel clockwise for longitudinal carriage travel away from the headstock.

Position the carriage by the graduated dial on the handwheel. (The dial may be unclamped from the handwheel and repositioned for convenient reading.) One dial graduation equals 1/64 inch of carriage travel. One complete revolution of the handwheel moves the carriage 2 inches. Carriage positions may be repeated to within 1/64 inch by numbered clips placed at the required dial reading.

8. Carriage Feed Lever.

The feed lever controls longitudinal power feed of the carriage along the bed rails.

A. Operate the feed lever in the following manner.

1. Raise the carriage feed lever until its latch pin engages the knockoff bushing.

A serrated-tooth clutch is engaged for positive feed.

2. Lower the carriage feed lever manually to disengage the carriage feed.

The latch pin is withdrawn into the feed lever by cam action. The feed lever then drops by spring load to disengage the serrated-tooth clutch.

9. Directional Feed Selector Lever.

This lever selects the direction of the power feed for the carriage and cross slide.

A. To select the direction of carriage power feed.

1. Lock the lever in the upper position for carriage power feed toward the headstock.
2. Lock the lever in the lower position for carriage power feed away from the headstock.

B. To select the direction of cross slide power feed.

1. Lock the lever in the upper position for power cross feed toward the front of the machine.

OPERATION

stop spool back into the advancing carriage. The carriage then butts the stop spool for a metal-to-metal stop against the stop rod. At the same instant the stop spool triggers the positive feed-knockoff mechanism to drop the spring-loaded feed lever.

12. Carriage Binder Lever.

This lever clamps the carriage to the front bed rail to prevent longitudinal movement when operating from the cross slide only.

A. To clamp the carriage to the rails, push the lever clockwise.

The clamping screw pivots a clamping gib against the underside of the front rail to bind the carriage.

13. Cross Slide Handwheel.

A. To operate the cross slide handwheel.

1. Rotate the handwheel clockwise for cross travel toward the rear of the machine.
2. Rotate the handwheel counterclockwise for cross slide travel toward the front of the machine.

Position the cross slide by the graduated dial on the handwheel. (The dial may be unclamped from the handwheel and repositioned for convenient reading.) One dial graduation changes the work diameter .002 inch. One complete revolution of the handwheel moves the cross slide 1/2 inch across the ways. Cross slide positions may be repeated to within .001 inch by numbered clips placed at the required dial readings.

14. Cross Feed Lever.

This lever controls the power cross feed in either direction across the rails.

A. Operate the feed lever in the following manner.

1. Raise the cross feed lever until its latch pin engages the knockoff bushing for cross feed.
2. Lower the feed lever manually to disengage the cross feed.

15. Cross Feed Stops and Stop Spool for the Cross Slide.

Cross feed stop dogs A and B and stop spool C are shown in figure 17. They provide positive feed knockoff and positive stops for power cross feed in either direction.

The spool has four adjustable stop screws D. The spool is rotated manually to align any single stop screw with dog A.

Dog A knocks off power feed toward the rear of the machine. Dog B knocks off power feed toward the front of the machine. Both dogs can be moved on the cross slide to the approximate knockoff position. They can also be raised to override the spool.

As the cross slide advances under feed, Dog A contacts a stop screw in the spring-loaded spool. Dog B contacts the spool. This contact pushes the spool into its bracket on the carriage apron. The carriage dog then butts the spool for a metal-to-metal stop within the spool bracket. At the same instant, the spool triggers the positive feed-knock-off mechanism to drop the spring-loaded feed lever.

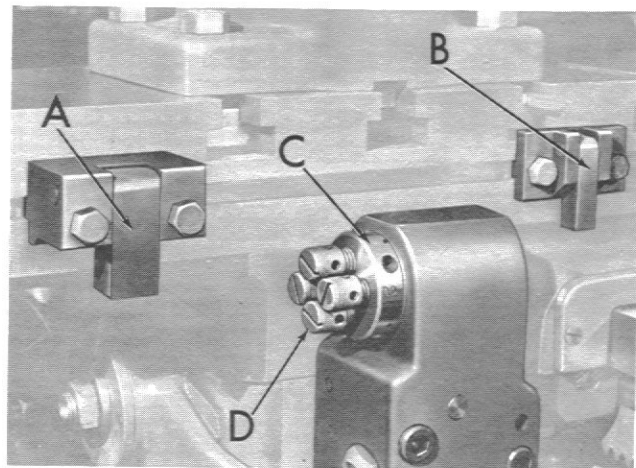


Figure 17 - Cross Feed Stop Dogs and Stop Spool

OPERATION

For close tolerances under varying cutting conditions, set the stops to knock off the cross feed at two or three dial graduations over the desired finish dimension. Then, hand feed the cross slide to the desired dial readings.

16. Power Rapid Traverse Lever.

The power rapid traverse provides rapid cross travel in either direction for the cross slide. Power from the main drive is supplied by a spline shaft through an independent apron mounted on the rear of the carriage.

A. To operate the power rapid traverse.

1. Push the lever toward the rear of the machine for rapid cross slide travel toward the rear.
2. Pull the lever toward the front of the machine for rapid cross slide travel toward the front.
3. Release the lever for spring return to its neutral position and the disengagement of the rapid traverse.

17. Cross Slide Binder Lever.

Turn the lever clockwise to remove any looseness between the cross slide and the carriage for turning or boring from the carriage.

Turn the lever counterclockwise to release the bind for all cross feed operations.

18. Cross Slide Lead Screw Binder.

This knurled screw binds the cross slide lead screw against rotation when turning or boring from the carriage.

SADDLE

The #7A Saddle Type Machines are equipped with a Fixed Center Hexagon Turret. The #7B Saddle Type Machines

are equipped with a Cross Sliding Hexagon Turret.

19. Saddle Starwheel and Power Rapid Traverse Lever.

A. Manual Operation of the Saddle.

1. Rotate starwheel A, figure 18, counterclockwise for saddle travel towards the headstock.
2. Rotate starwheel clockwise for saddle travel away from the headstock and automatic index of the hexagon turret.

The following automatic sequence takes place during the last part of travel away from the headstock.

1. The locking pin is pulled from its turret seat.
2. The clamp ring is unbound.
3. The hexagon turret is indexed.
4. The locking pin is released into a new turret seat.

The clamp ring binds the turret during the first part of travel towards the headstock after the turret index. The ring must be fully clamped before cuts are taken from the hexagon turret.

When idle, leave the hexagon turret in its locked position to relieve the compression on the locking pin spring.

B. Power Operation of the Saddle.

1. Rotate power rapid traverse lever B, figure 18, counterclockwise for power travel towards the headstock.
2. Rotate power rapid traverse lever clockwise for power travel away from the headstock and automatic index of the hexagon turret.

ADJUSTMENTS

under spring load. This load is set at the factory by a torque weighing device to permit the clutch to slip at 40 foot-pounds.

A setting of more than 40 foot-pounds removes the necessary safety factor from the carriage or turret slide power feed. This may cause serious machine damage.

Excessive slippage under feed indicates a loss of driving torque from a weakened spring or from worn clutch discs. If a new spring fails to correct this slippage, install a set of new clutch discs. (See key 12, 42 and 43, plate 13, and key 14, 45 and 46, plate 24.) For exploded views of the complete clutch shafts refer to shaft H-H, plate 13, and shaft F-F, plate 24.

FORWARD AND REVERSE DRIVE CLUTCH ADJUSTMENT

Round nuts A and B shown in figure 31 adjust the forward and reverse clutches respectively. Each nut turns on a threaded portion of the shaft. Locking holes pierce the outside of the adjusting nut. One of the four spring pins, in a collar keyed to the shaft, extends into a locking hole to lock the nut. The locking holes and the four spring locking pins are spaced for fine clutch adjustment. A slight turn of the nut in either direction, when unlocked, always aligns a locking hole with one of the spring pins.

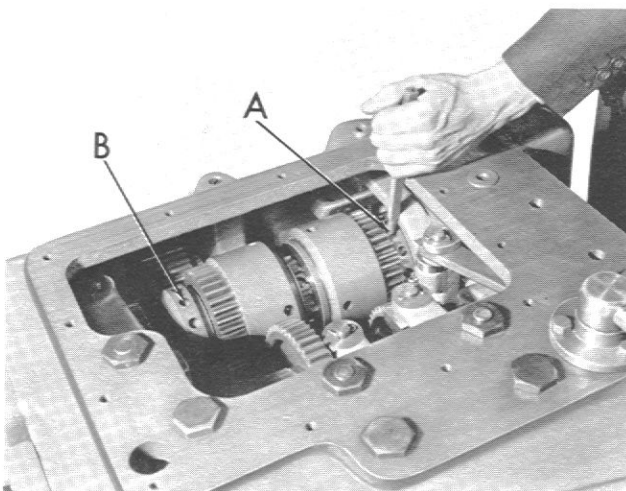


Figure 31 - Forward and Reverse Drive Clutch Adjustment

A. To adjust the Forward Drive Clutch.

1. Disconnect the power supply. (Throw the main switch on the rear of the control panel.)
2. Remove the top cover from the headstock (12 screws). (See key 18 and 19, plate 6.)
 - a. When attachments interfere with the top cover, remove the two large pipe plugs provided in the top cover for access to the clutch adjusting nuts.
3. Position the forward and reverse lever in reverse.
4. Engage the spindle speed selector at the highest spindle speed. (The clutch shaft can now be turned from the spindle.)
5. Turn the spindle by hand to rotate the clutch shaft until the engaged spring pin in the locking hole at A is accessible. (Refer to figure 31.)
6. Insert a screw driver or suitable pin to compress the engaged spring pin in the locking hole so that the nut can be turned.
7. Take up the clutch in the following manner.
 - a. With the spring pin depressed, tighten nut A (right-hand thread) until a locking hole engages the next spring pin.
 - (1) Continue this adjustment until a definite resistance is felt in the forward and reverse lever when the clutch is engaged. This force carries the operating mechanism over a cam high-point for a positive drive.
8. Loosen the clutch in the following manner.

ADJUSTMENTS

- a. With the spring pin depressed, loosen nut A (right-hand thread) until a locking hole engages the next spring pin.

B. To adjust the Reverse Drive Clutch.

Proceed as indicated under A with the following exceptions. In step 3, position the clutch lever in forward. In steps 6, 7 and 8, adjust nut B in place of nut A shown in figure 31.

BRAKE ADJUSTMENT

When the forward and reverse lever is brought to its center position, a spring expands to brake the spindle. This spring is compressed to release the brake as the control lever is moved toward forward or reverse. If the spindle is slow in stopping, the brake must be adjusted.

The brake is properly adjusted under the following conditions.

1. The spindle must decelerate uniformly to a stop.
2. The free movement at the extremity of the forward and reverse lever when in the brake position, should be approximately $3/4$ to 1 inch in length. This free movement is determined by adjusting nut C as shown in figure 32.
 - a. Excessive free movement may not release the brake completely when the forward or reverse clutch is engaged. It also produces no significant improvement in brake operation.
 - b. If the brake is ineffective when the free movement is correctly adjusted, it may be caused by a weakened spring or by worn brake discs. If a new spring fails to improve braking, install a set of new brake discs. (See key 14, plate 5, also key 32 and 33, plate 4.)

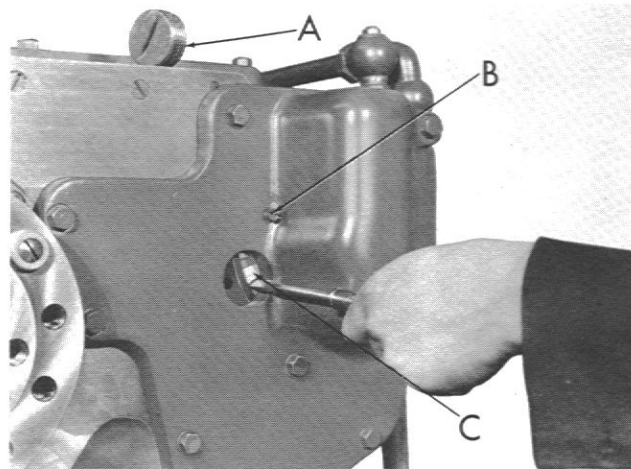


Figure 32 - Brake Adjustment

A. To adjust the Brake.

1. Engage the forward or reverse clutch.
 2. Remove threaded plug A located in the end of the headstock near the spindle face. (See figure 32.)
 3. Withdraw the small locking screw B shown in figure 32 on 2-1/2" and 3" spindle headstocks. 3-1/2" and 4-1/2" spindle headstocks have a spring loaded pin inside plug A. Withdraw this pin with a pair of pliers and proceed as in step 4.
 4. Increase braking in the following manner.
 - a. Insert a screw driver into one of the slots in adjusting nut C (shown in figure 32) and turn the nut clockwise.
 - b. When adjustment is complete, nut C must be in position to permit the return of locking screw B until its head is flush with the casting.
- NOTE: Locking screw B must locate in a slot of nut C without bottoming.
5. Decrease braking, as in step 4, except turn adjusting nut C counterclockwise.

ADJUSTMENTS

RAPID TRAVERSE OPERATING LEVER ADJUSTMENT

Figure 33 shows operating lever D on the rapid traverse apron. It engages the angular tooth clutches within the apron for rapid travel on the cross slide. When operation becomes difficult, adjust lever D to obtain maximum tooth engagement.

A. To obtain maximum clutch engagement for rapid travel toward the rear of the machine.

1. Loosen binder screws B and back off both adjusting screws A and C.
2. Push the rapid traverse operating lever counterclockwise to the end of its stroke. At the same time, turn the handwheel to insure full clutch tooth engagement.
3. Have assistant hold the operating lever in the above position.
 - a. Advance adjusting screw A until it contacts the stop pin.

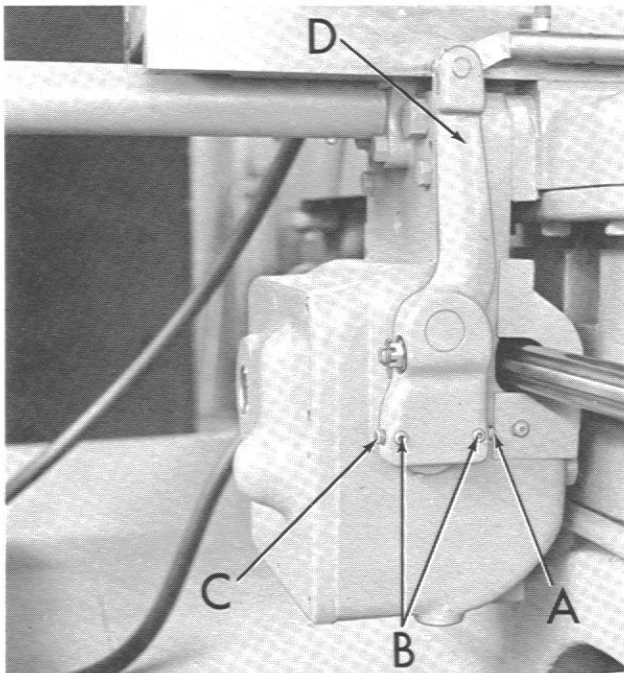


Figure 33 - Rapid Traverse Operating Lever Adjustment

B. To obtain maximum clutch engagement for rapid travel toward the front of the machine.

1. Follow the method described above but reverse the position of the operating lever. Then, advance screw C until it contacts the stop pin.
2. Tighten binder screws B to lock adjusting screws A and C.

BELT ADJUSTMENT FOR RAPID TRAVERSE DRIVE UNIT

Figure 34 shows the rapid traverse drive. Sheave A powers the fast motion drive shaft through housing B.

A. To adjust the Belt for the Rapid Traverse Drive.

1. Loosen screws C and D.
2. Pivot housing B counterclockwise to tighten the V-belt.

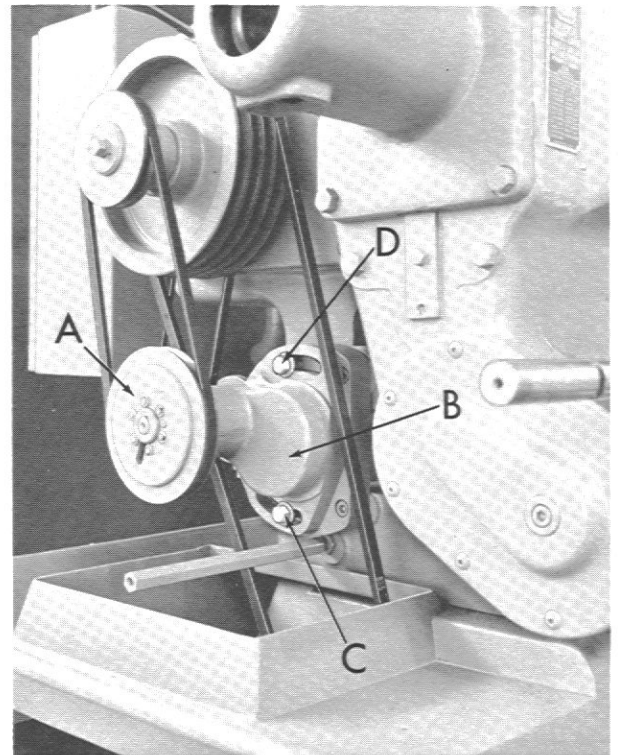


Figure 34 - Belt Adjustment for Rapid Traverse Drive

ADJUSTMENTS

3. Tighten screws C and D to bind the housing.

OIL PUMP ADJUSTMENT

The lubricating pumps, within the independent reservoirs located on the feed aprons, are adjusted at 7/16-inch stroke for normal use.

Earlier systems without check valves may pump more oil than needed when the machine is operated continuously at advanced speeds and feeds. Check valves should be installed to correct this condition. (See key 44, plate 17 and key 43, plate 27, for the check valve.)

As a temporary measure, the oil flow may be decreased by reducing the length of the pump stroke to not less than 1/4 inch. A 1/4-inch pump stroke is necessary for minimum lubrication.

SPINDLE BEARING ADJUSTMENT

Spindle bearings are adjusted only after all other possible causes of chatter on the work have been eliminated. It is seldom advisable to change the preload on bearings which have had long service. Such bearings should be replaced when they become the source of trouble. The following method is prescribed for checking and adjusting bearing preload. (Brief paragraphs discuss the function and preload of these bearings on pages 58, 61 and 64 of the Maintenance Section.)

A. To check and adjust the Preload of the Rear Spindle Bearings.

(Refer to figure 36 for parts identified by letter unless indicated otherwise.)

1. The spindle and headstock must be at room temperature for checking and adjusting the bearing preload.
2. Disconnect the power supply. (Throw the main switch on the rear of the main control panel.)

3. Pull out both shafts F to drop the intermediate gears within the gear case free from gear H. (3/8"-16 screws may be inserted in the tapped holes in shafts F for their removal.)
4. Remove all chucks and attachments from the spindle nose and the spindle rear.
5. Fasten a thin flexible cable or chain to the rear end of the spindle.
6. Wrap the cable around the spindle two or three times and hang a "No Go" weight from its free end. See page 67 for appropriate weight.
7. Remove plug E from the gear train.
8. Turn the spindle slightly to overcome static friction.
 - a. If the "No Go" weight turns the spindle, proceed with steps 9 through 14.
 - b. If the "No Go" weight fails to turn the spindle, proceed with steps 12 through 14.
9. Rotate the spindle until access can be made to the teeth in gear H which engage one of the spring locking pins.
 - a. Withdraw the spring locking pin from the gear teeth, then insert a wire through the hole in the locking pin to prevent engagement.
10. Advance nut H (right-hand thread) toward the adjacent gear until the next pin drops into engagement between the gear teeth.
 - a. Withdraw the wire inserted in step 9a from the hole in the locking pin.
 - b. Tap the spindle endwise, both front and rear, with a lead hammer to seat the nut.

ADJUSTMENTS

- c. Turn the spindle several revolutions by hand.
11. Repeat steps 6, 8, 9 and 10 until the "No Go" weight no longer turns the spindle.
 12. Apply a "Go" weight to the spindle in place of the "No Go" weight. See page 67 for appropriate "Go" weight.
 13. Give the spindle a slight rotation.
 - a. If the "Go" weight does not turn the spindle, proceed as follows:
 - (1) Repeat step 9.
 - (2) Loosen nut H past two locking pin engagements and tap the spindle endwise from both ends. Rotate the spindle several times.
 - (3) Repeat step 11.
 - b. If the "Go" weight turns the spindle, and the "No Go" weight does not turn the spindle, the nut is properly adjusted.
 14. Run the bearings in at 200 to 300 RPM spindle speed for about 2 hours. After that time, the high spindle speeds can be used.
 - a. Running the bearings in will reduce the torque required to rotate the spindle. A subsequent adjustment may be necessary.

If the rear bearing adjustment does not eliminate chatter, check and if necessary, adjust the preload of the front spindle bearing in the following manner.

B. To adjust the Preload of the Front Spindle Bearing.

(Refer to figure 36 for parts identified by letter unless indicated otherwise.)

1. The spindle and the headstock must be at room temperature for adjusting the bearing preload.
2. Disconnect the power supply. (Throw the main switch on the rear of the control panel.)
3. Drain the oil from the headstock.
4. Remove all chucks or attachments from the spindle nose.
5. Remove the speed selector assembly from the headstock in the following manner.
 - a. Remove the top cover from the headstock (12 screws). (See key 18 and 19, plate 6.)
 - b. Remove from the headstock the 3 threaded ball-spring retainers which operate on the shifter levers. (See key 15, plate 6.)
 - c. Lift the shifter levers against the inside top of the headstock by screwing out on their pivot studs. Do not shear the stud cotter pins when the levers make contact with the inside top of the headstock. (See key 1, 20 and 21, plate 6.) (See key 3, 22 and 24, plate 6.)
 - d. Remove the speed selector assembly from the headstock (10 screws). (See key 11, plate 7.)
6. Withdraw the spring locking pin in nut K from its seat in the adjacent gear. Then, insert wires through the holes in all locking pins to prevent further engagement. (Nut K was wire locked on earlier machines.)
7. Mount nose piece J on the spindle.
8. Block nut K against rotation by a soft-steel block held between a slot in the nut and the bottom of the headstock casting.

ADJUSTMENTS

- a. A convenient block is 1" x 1-1/4" x 4".
 9. Turn nose piece J counterclockwise with a bar to loosen nut K about 1 turn.
 10. Unseat the inner roller bearing race in the following manner.
 - a. Remove nose piece J.
 - b. Insert two soft-steel spacers followed by jack screws through two opposite holes 0 in the spindle flange. The soft spacers prevent burrs on the face of the split ring. (See key 34, plate 2.) Refer to hole 0 shown in figure 38.
 - c. Advance both screws in equal amounts until the split ring is loosened. Remove the jack screws and soft-steel spacers.
 - d. Remove the split ring (4 screws).
 - e. Replace the nose piece.
 11. Remove all clearance from the front roller bearing in the following manner.
 - a. Mount a .0001-inch dial indicator, or preferably an electrolimit gage, on the headstock over the spindle flange. Use a rigid bracket mount. The ordinary indicator stand is not rigid enough for dependable readings.
 - b. Place the indicator in contact with the spindle flange O.D. on its vertical center line. Maintain a minimum overhang from the support bracket to the indicator.
 - c. Lift the spindle upward from beneath the spindle gears in the following manner.
 - (1) Pass a three-foot bar through the lower right corner of the speed selector opening.
 - (2) Rest the bar at its fulcrum point in the groove located in the lower wall of the opening.
 - (3) Position the end of the bar against the underside of the V-shaped groove between the spindle gears.
 - (4) Push downward on the outer end of the bar to lift the spindle.
 - d. Note the indicator reading during the spindle lift per step c, while observing the following conditions.
 - (1) To avoid a false reading, the spindle must not rotate during the lift reading.
 - (2) The indicator shows a positive reading when there is clearance in the bearing.
 - (a) Excessive lifting force may stress a small spindle to introduce a negative reading after a positive reading has been obtained. In this case, negative readings are ignored, since they are a function of unreasonable load and not clearance in the bearing.
 - (3) Frequent indicator readings must be made while advancing nut K to obtain the controlled preload of the roller bearing. Insufficient indicator readings during the advance of nut K may force the bearing beyond its no-clearance position on the spindle for a sudden zero, or negative indicator reading.
- If this occurs, unseat the inner bearing race in the following manner.

ADJUSTMENTS

- (a) Back off spindle nut K one turn.
 - (b) Insert jack screws at 0 as shown in figure 38.
 - (c) Insert shims between outer labyrinth P and the jack screws to prevent burrs on the labyrinth.
 - (d) Advance the jack screws to move labyrinth P and the inner bearing race about 1/32 inch away from the spindle flange. Remove the jack screws.
 - e. Rotate the spindle several times to assure that the bearing rolls are aligned and not sticking.
 - f. Block nut K and carefully turn the nose piece clockwise a small amount.
 - (1) When the inner roller bearing race becomes seated on its mating spindle taper, 8 degrees of nut rotation expands the inner race .0001 inch.
 - g. Repeat steps c, d, e and f, until the moment that the indicator reading during the lift ceases to read plus, but becomes zero or negative.
 - h. Take lift readings at each quarter turn of the spindle to check that all readings have become zero or negative.
 - (1) If necessary, repeat steps c, d, e and f, until all lift readings become zero or negative.
- The final location of the inner race on the spindle is determined by a split ring ground at assembly and inserted between the spindle flange and the outer labyrinth P.
12. Grind the split ring to the correct thickness in the following manner.
 - a. Push outer labyrinth P away from the spindle flange until stopped by the inner roller bearing race as follows: (Refer to figure 38.)
 - (1) Insert jack screws at 0 in the spindle flange.
 - (2) Insert shims between the outer labyrinth P and the jack screws to prevent burrs.
 - (3) Advance the jack screws to seat the labyrinth.
 - b. Measure the space between the outer labyrinth P and the rear of the spindle flange using feelers at two opposite points close to the jack screws.
 - c. Remove the jack screws at 0.
 - d. Grind both halves of the split ring .005 ±.001 inch thinner than the space measured in step b. Hold both halves of the split ring parallel within .0002 inch.
 13. Bring the front cylindrical roller bearing to correct preload in the following manner.
 - a. Clean and burr the split ring. Clean the mating surfaces between the inner labyrinth and the spindle flange.
 - b. Mount the split ring in position on the spindle (4 screws). (See key 34 and 36, plate 2.)
 - c. Turn spindle nut K for roller bearing preload by clamping the split ring in the following manner.
 - (1) Block nut K.

ADJUSTMENTS

- (2) Turn nose piece J clockwise using a hammer on the bar if necessary until the split ring is clamped.
 - (3) Check that the split ring is tightly clamped all around.
 - (4) Release the spring locking pins in nut K.
 - (5) If no locking pin drops into engagement in step 4, tighten nut K until the first pin drops into engagement.
- d. Test the spindle runout with an indicator on the face of the spindle flange, also on the spindle nose.
- (1) The runout must be less than .0003 inch on both surfaces in one revolution of the spindle.
 - (2) To correct for excessive runout, tap the outside of nut K with a lead hammer in line with the low point of the indicator reading. This brings the nut to a uniform bearing against the adjacent gear to equalize the pressure in bearing assembly.
 - (3) Excessive spindle runout which cannot be corrected indicates the presence of foreign matter between the outer labyrinth and the back face of the spindle. Remove the split ring. Check and clean all possible burrs and foreign matter between the outer labyrinth and the back face of the spindle.

CARRIAGE TAPER ATTACHMENT ADJUSTMENTS

Poor tapers may be caused by looseness, between the former shoe and former, the former slide and side gibs and the cross-feed screw and nut. (Refer to plate 63 for parts identified by key numbers.)

A. To remove looseness between the former shoe (key 6) and the former (key 21), when the shoe is in the position shown on plate 63.

1. Turn binder screw (key 9) counter-clockwise, two or three turns.
2. Turn adjusting screw (key 8) clockwise until the former shoe (key 6) seats to a bearing.
3. Turn binder screw (key 9) clockwise to a firm bearing.

NOTE: It is permissible for the former shoe to be installed at 180° from the position shown on plate 63. In this case the adjusting screws (key 8 and key 9) will be located in opposite positions to that shown on plate 63.

B. To take up the side gibs for removing looseness from the taper slide.

1. Loosen the two clamp screws (key 62).
2. Turn the two adjusting screws (key 55) clockwise until the gibs seat to a bearing.
3. Tighten the two clamp screws (key 62) to a firm but not excessive bearing.
4. Turn the two adjusting screws (key 55) counterclockwise against the back of the gib slot. This prevents wedging of the gibs should the clamp screws (key 62) accidentally loosen.

C. To reduce backlash between the cross-feed screw (key 2) and the backlash-eliminating nut (key 1).

1. Position the cross slide toward the operator side of the machine to locate its nut on the least used section of the lead screw.
2. Loosen the binder screw (key 7).

ADJUSTMENTS

3. Turn the adjusting tube (key 4) clockwise to a light bind. Then, turn the tube counterclockwise a small amount to relieve excessive pressure between the mating surfaces of the nuts and the lead screw.
4. Tighten the binder screw (key 7).

CARRIAGE THREAD CHASING ATTACHMENT ADJUSTMENTS

Poor threads may be caused by the improper engagement between the followers and lead screw, misalignment between the attachment and feed rod, also end play in the feed rod.

A. To obtain the proper engagement between the followers and the lead screw. (Refer to figure 35.)

1. Unbind the lead screw from the feed rod.
2. Position the lead screw so that its split shoulder is approximately one inch from the body of the thread chasing attachment.
3. While lifting lever A, rotate the lead screw manually until the lever engages in its latched position. This insures proper engagement of the followers with the lead screw.
4. Back off set screws C and D and adjusting screw B.
5. Advance adjusting screw E to a firm bearing. Properly adjusted, when engaged, the followers should cause a slight drag on the lead screw when it is turned manually.
6. When the followers are adjusted, advance adjusting screw B to a firm bearing.
7. Engage the followers several times. After each engagement, turn the lead

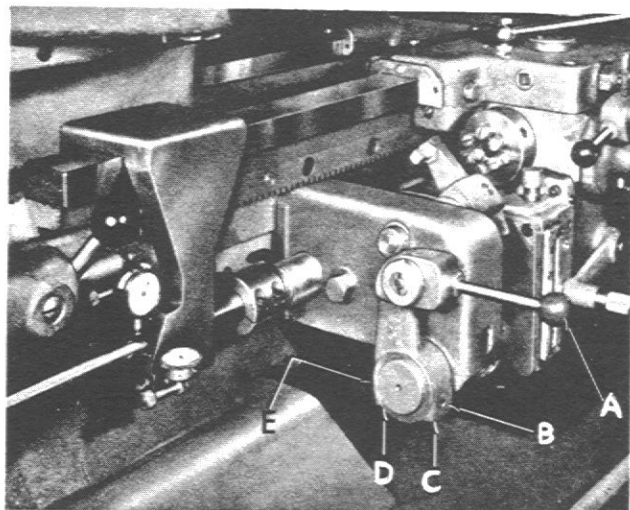


Figure 35

Carriage Thread Chasing Attachment Adjustments

- screw manually to check for proper lead screw drag against the followers.
 8. When the adjustment is complete, advance set screws C and D to a firm bearing.
- #### B. To align the thread chasing attachment with the feed rod.
1. Remove screws from each end of front way guard and slide the way guard away from the headstock.
 2. Place two indicators so that they contact the feed rod between the carriage and the feed gear train. Position one indicator against the top and the other indicator against the side of the feed rod as shown in figure 35. These will measure vertical and horizontal deflection respectively.
 3. With the followers disengaged from the lead screw, set both indicators at zero reading.
 4. Engage the followers to the lead screw. Note the amount and the direction that the feed rod has been deflected.
 5. Loosen, to a light bind, the 2 screws and 3 nuts which hold the attachment on to the carriage apron.

ADJUSTMENTS

6. Align the attachment with the feed rod by tapping it with a soft hammer in the direction necessary for obtaining zero indicator readings.
7. When both indicators read zero, tighten to a firm bearing, the 2 screws and 3 nuts which hold the attachment.

C. To reduce end play in the feed rod.

1. Mount a dial indicator against the screw in the end of the feed rod. (See key 9, plate 44.)
2. With the spindle stopped, engage the followers. Then, oscillate the carriage handwheel to move the feed rod within

the limits of the end play. Note the amount of movement shown on the dial indicator.

3. Remove the cover and bearing. (See key 13 and 21, plate 8.) Increase the thickness of the shim (key 23, plate 8) leaving a small amount of end play in the feed rod, not to exceed .002 inch. Then, replace the bearing and the cover.

NOTE: On machines with a four-speed gear box, proceed in the same manner as indicated above. The cover and bearing to be removed are in line with the feed rod at the outer extremity of the gear box.

NOTES

MAINTENANCE

TO REMOVE FEED ROD FROM APRONS OR ATTACHMENTS

1. Engage the spindle speed selector in a low speed. With the spindle stopped, remove the screw from the end of the feed rod. (See key 9 and 16, plate 44.) Remove cap (key 28, plate 44) to avoid bind between bushing (key 26) and burrs on the feed rod.
2. Engage the speed selector in neutral position.
 - a. Turn the spindle by hand to rotate the feed rod until the keyway is on the bottom.

This prevents the key in both feed gears from dropping out. (See key 18, plate 12, and key 18, plate 23.)

- b. Pull the feed rod out of the feed gear train to remove its key and collar. (See key 14 and 13, plate 44.) Continue pulling the feed rod through the end bracket (key 24, plate 44) until it clears the unit to be removed.

TO REMOVE CARRIAGE FEED APRON

1. Remove the feed rod as instructed above.
2. Remove 4 screws (key 9, plate 10) to detach the bracket (key 8, plate 10) from the end of the cross slide (key 22).
3. Tighten the cross slide binder lever (key 41, plate 9) to lock the cross slide against movement.
4. Turn the handwheel counterclockwise until the bracket is pulled free from its doweled position on the cross slide.

5. Release the cross slide binder. Then, loosen the cross slide taper gib.
6. Push the cross slide toward the rear of the machine until the apron assembly screws are exposed. (See key 22, plate 16.)
7. Place a wooden support under the apron.
8. Support the apron by a wooden lever while removing the assembly screws. When detached, carefully lower the apron onto its wooden support. (See key 1 and 22, plate 16.)

TO REMOVE SADDLE FEED APRON

1. Remove the feed rod as instructed.
2. Place a wooden support under the apron.
3. Support the apron by a wooden lever while removing the assembly screws. When detached, carefully lower the apron onto its wooden support. (See key 12, plate 26 and key 1, 18 and 19, plate 41.)

TO MOUNT FEED SELECTOR ON CARRIAGE AND SADDLE FEED APRONS

This unit may be attached with the apron on or off the machine. For ease of assembly, attach the feed selector with the apron removed from the machine.

A. To attach the feed selector to the apron. (Refer to plate 15.)

1. Pull the two shifter rods extending from the side of the apron to their outer extremity.
2. Engage the feed selector at a feed of .005 inch per revolution.

MAINTENANCE

3. During steps 4 through 7, position and support the feed selector from the bottom using the right hand. This leaves the left hand free to guide the shifter shoes, and later pull the selector lever.
4. Place the lower shifter shoe (key 61) in the slot of the lower shifter rod.
5. Position the upper shoe (key 56) on the front side of the upper shifter rod.
6. Carefully rock the upper shifter shoe into engagement with the slot of the shifter rod.
7. Pull the selector lever out. Then, push the feed selector against the apron.
8. Bring up the assembly screws loosely (key 76 and 77).
9. With the feed apron and feed rod assembled on the machine, position the feed selector to clear the feed rod. Tighten the assembly screws.
4. Assemble the following square turret parts. Key numbers 14 through 21, 30, 31, 33, 34, 35 and 37 through 42.
5. Time the locking pin in the following manner.
 - a. Place the lever on the splined clamping screw (key 31).
 - b. Turn the clamping screw counterclockwise until the locking pin extends about 1/4 inch above the bearing surface of the turret base.
 - c. Locate and lock the collar (key 11) by tightening the set screw (key 12) against the drilled spot in the clamping screw (key 31).
 - d. Turn the clamping screw counterclockwise until the locking pin (key 19) is depressed as far as possible.
 - e. In step d, the top of the locking pin must be at a minimum distance below the top surface of the turret base.

TO CLEAN SQUARE TURRET BEARING AND TIME LOCKING PIN

1. Disassemble the square turret per plate 11 by removing the following as assembled units.
 - a. The handle assembly.
 - b. The square turret with its 4 pressed-in locking-pin seats.
 - c. The turret base with its pressed-in center bushing and pressed-in locking-pin bushing.
2. Clean all parts thoroughly.
3. Apply Molycote on the center pin bushing (key 20), the bearing between the turret and the base, and the index pin (key 19).
 - (1) If the locking pin is above the surface, remove the stop collar (key 11) and turn the binding screw (key 31) clockwise one revolution. Repeat steps c and d.
 - (2) If the locking pin is too low, remove the stop collar (key 11) and turn the binding screw (key 31) counterclockwise one revolution. Repeat steps c and d.
- f. Continue the assembly.
- g. The turret-turning ratchet (key 1) assembles onto the six-tooth spline of the binding screw (key 31) in six possible positions. Only two of these positions will index the square turret. Select one of these two positions by trial and error. (The remaining ratchet system is self-timed.)

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- h. Complete the assembly. Adjust the binding nut by the procedure outlined on page 42 in the adjustment section.
 - i. Mount the square turret on the cross slide with the locking pin toward the spindle.
- a. Tap lightly on the outside race of the bearing to move it off the shaft. At the same time move the forward and reverse lever toward neutral position to prevent the clutch yoke (key 17, plate 5) from cramping the bearing on the shaft.

TO REMOVE CLUTCH SHAFT

A. 2-1/2" and 3" Spindle Machines.

1. Disconnect the power supply. (Throw the main switch on the rear of the control panel.)
2. Drain the oil from the headstock.
3. Remove the V-belts and the main drive shaft pulley (key 39, plate 49).
4. Remove the top cover plate (key 19, plate 6).
5. Remove the rear cover plate (key 7, plate 5).
6. Keep the forward and reverse lever in reverse position.
7. Remove the front cover plate (key 22, plate 5) in the following manner.
 - a. Remove all assembly screws (key 23 and 27, plate 5) and the brake nut locking screw (key 24, plate 5).
 - b. Remove pivot pin upward (key 18, plate 5).
 - c. Remove the front cover and dowel pins from the headstock (key 22 and 25).
8. Remove the bearing lock nut and the bearing lock washer from the clutch. (Key 55 and 56, plate 4.)
9. Remove the bearing (key 57, plate 4) in the following manner.
 - a. Tap lightly on the outside race of the bearing to move it off the shaft. At the same time move the forward and reverse lever toward neutral position to prevent the clutch yoke (key 17, plate 5) from cramping the bearing on the shaft.
10. Remove the cotter pin (key 20, plate 5). Then, remove the clutch yoke (key 17, plate 5).
11. Remove the brake-spring plunger (key 28, plate 5) in the following manner.
 - a. Turn the brake-spring plunger (key 28, plate 5) with a screw driver until the cotter pin (key 4, plate 5) is accessible for removal from the plunger pin (key 5, plate 5).
 - b. Insert a suitable push rod between the brake-spring plunger (key 28, plate 5) and the face of the hexagon turret.
 - c. Advance the turret slide to push the brake-spring plunger until the plunger pin (key 5, plate 5) is free for removal. Remove the plunger pin.
 - d. Back off the turret slide, then remove the brake-spring plunger (key 28, plate 5) and the brake spring (key 14, plate 5).
12. Remove the set screw (key 15, plate 5), then remove the brake-yoke stud (key 1, plate 5).
13. Remove the third shifter-lever (key 3, plate 6).
14. Remove bearing lock nut (key 58, plate 4) and lock washer (key 54, plate 4).
15. Remove the brake housing (key 27, plate 4) as an assembled unit. If necessary, tap the housing endwise with a brass rod.

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16. Move the sliding gear (key 40, plate 4) toward the front of the headstock.
17. Remove the ball bearing (key 36, plate 4).
18. Move the entire clutch shaft toward the saddle end of the machine until its trailing end is free from the headstock casting.
19. Tip the end of the shaft upward to clear the rear of the headstock casting. Then, remove the shaft from the headstock.
20. Reverse the above procedure for re-assembly.

NOTE: Insert the brake housing into the headstock less its internal components. Align its keyway with the mating dowel key in the headstock. Install the brake components, then proceed with the remaining assembly.

NOTE: At assembly, the brake locking screw (key 24, plate 5) must locate in the slot of the brake adjusting nut (key 53, plate 4) without bottoming. (The head of the locking screw is approximately flush with the cover plate when it has entered the adjusting nut slot.)

B. 3-1/2" and 4-1/2" Spindle Machines.

1. Repeat steps A-1 through A-6.
2. Remove the front cover plate (key 22, plate 5) in the following manner:
 - a. Remove all assembly screws (key 23 and 27, plate 5).
 - b. Remove the front cover and dowel pins from the headstock (key 22 and 25). When removing the front cover, note that a bearing collar and spacer rod (key 66 and 67, plate 3) are located behind this cover.
3. Repeat steps A-8 and A-9.

4. Remove cotter pin (key 20, plate 5). Remove screws (key 30, plate 5) and work clutch connecting lever bracket (key 29, plate 5) out of its counterbore.
5. Repeat steps A-11 through A-13.
6. Remove dowel key and set screw (key 36 and 64, plate 4).
7. Remove lock nut, lock washer, and bearings from both ends of the main drive shaft and allow it to drop (key 26, 52, 56, and 58, plate 3).
8. Remove lock nuts, lock washers, and bearings from both ends of the third transmission shaft and allow it to drop (key 18, 19, 20, 62, 63 and 64, plate 3).
9. The assembled clutch shaft may now be worked out of the headstock towards the saddle end of machine.
10. Reverse the above procedure for re-assembly.

NOTE: When proceeding with re-assembly, make sure that the spacer rod seats properly in both the front cover and bearing collar (key 66 and 67, plate 3). A hole is provided on the inside of the cover for this rod location.

SPINDLE REPAIR

BEARING SYSTEM. At the front of the spindle, a double-row, cylindrical, staggered roller bearing supports radial load. The inner race has a tapered seat on the spindle. At the rear of the spindle a ball thrust bearing carries thrust load. An angular contact ball bearing carries radial load on 2-1/2" and 3" spindles. A roller bearing carries radial load on 3-1/2" and 4-1/2" spindles.

A. To remove the Spindle and the Bearings.

(Refer to figure 36 for parts identified by letter unless indicated otherwise.)

MAINTENANCE

1. Disconnect the power supply. (Throw the main switch on the rear of the control panel.)
2. Drain the oil from the headstock.
3. Remove the feed gear train case in the following manner.
 - a. Remove the screw and washer D.
 - b. Remove the screw and plate G.
 - c. Pull out both shafts F to drop the intermediate gears within the gear case free from gear H. ($3/8$ "-16 screws may be inserted in the tapped holes in shafts F for their removal.)
 - d. Remove 3 screws from the stop bracket.
 - e. Remove the feed gear case A (8 screws at B). (See key 34 and 36, plate 8.)
4. Remove the speed selector assembly from the headstock in the following manner.
 - a. Remove the top cover from the headstock (12 screws). (See key 18 and 19, plate 6.)
 - b. Remove from the headstock the 3 threaded ball-spring retainers which operate on the shifter levers. (See key 15, plate 6.)
 - c. Lift the shifter levers against the inside top of the headstock by screwing out on their pivot studs. (Do not shear the stud cotter pins when the levers make contact with the inside top of the headstock.) (See key 1, 20 and 21, plate 6.) (See key 3, 22 and 24, plate 6.)
 - d. Remove the speed selector assembly from the headstock (10 screws). (See key 11 and 35 plus assembly, plate 7.)
5. Remove nut H, the adjacent gear, and the key in the following manner. (See key 16, 17 and 27, plate 2.)
 - a. Withdraw the spring locking pin in nut H from the gear teeth. Then, insert wires through the holes in all locking pins.
 - b. Back off nut H. Remove the adjacent gear and the key.
6. Remove rear cover plate Q (6 screws).
7. Back off nut K free from the spindle threads in the following manner. (See key 6, plate 2.)
 - a. Withdraw the spring locking pin in nut K free from the hole in the gear face. Then, insert wires through the holes in all locking pins. (Nut K was wire locked on earlier machines.)
 - b. Attach nose piece J to the spindle.
 - c. Block nut K from rotation by a soft-steel block held between a slot in the nut and the bottom of the headstock casting.
 - (1) A convenient block is $1" \times 1-1/2" \times 4"$.
 - d. Turn nose piece J counterclockwise using a long bar to start the nut. (The nut has a right-hand thread.)
 - (1) A hammer blow on the bar may be required to start the nut.
8. Detach labyrinth L from the headstock (6 screws.) (See key 49 and 50, plate 2.)
9. Remove spindle nose piece J.
10. Pull the spindle in the following manner.
 - a. Unseat the inner roller bearing as follows:

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- (1) Insert two soft-steel spacers followed by jack screws through two opposite holes O in the spindle flange. The soft spacers prevent burrs on the face of the split ring. (See key 34, plate 2.) Refer to hole O shown in figure 38.
 - (2) Advance both screws in equal amounts until a 1/32" feeler can be inserted between the split ring and the spindle flange. Remove the jack screws and the soft-steel spacers.
 - b. Attach spindle puller M to the spindle nose as shown in figure 38.
 - c. Insert shims between screws N shown in figure 38 and the machined face of the headstock for protection.
 - d. Carefully tighten screws N in equal amounts, to draw the spindle forward without cramping.
 - e. As the spindle is being pulled, remove the thrust collar and the adjacent race of the ball thrust bearing S shown in figure 36 as follows: (See key 4, 5, plate 2.)

Tap the face of the thrust collar at diametrically opposite points using a brass hammer. This moves the collar toward the rear of the spindle to prevent interference with its nearest shifter lever.
 11. Remove the angular contact ball bearing from the headstock in the following manner.
 - a. Insert four soft-steel pins, of uniform length, against the side of the outer race through ejector holes W. Clamp against the pins at W as shown in figure 39.
 12. Remove the remaining race of the ball thrust bearing from the headstock in the following manner.
 - a. Insert a soft-steel pin against the side of the race through each of the four ejector holes. Tap the pin lightly at each hole to move the race in equal amounts without cramping.
 13. Remove the outer race of the cylindrical roller bearing from the front of the headstock in the following manner.
 - a. Insert three 1/2"-13 x 5" jack screws against the side of the race through the three tapped ejector holes in the headstock.
 - b. Carefully advance the jack screws in equal amounts to move the race without cramping.
- B. To replace the Spindle and the Bearings.
- (Refer to figure 37 for parts identified by letter unless indicated otherwise.)
1. Clean the headstock in the following manner.
 - a. Clean the interior thoroughly, including all oil feeds and oil drains.
 - b. Remove, clean, and replace wicks which carry oil to the rear ball bearing and to the front roller bearing on 2-1/2" and 3" machines only.
 2. Clean the spindle and remaining parts including the bearings. (Maintain absolute cleanliness of all mating surfaces during assembly.)
 3. Apply light machine oil on the bearings for protection.
 4. Check all parts for burrs, especially the outer labyrinth, the split ring, and the machined bearing seats in the headstock.

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5. Wipe micronized graphite or Molycote on all bearing seats in the headstock, on the spindle, and on the I.D. and O.D. of the bearings.
6. Press the outer race of the roller bearing tightly in place into the headstock. Use the clamp as shown in figure 37.
7. Install labyrinth L to determine the thickness of gasket required in the following manner. (See key 50 and 52, plate 2.)
 - a. Draw labyrinth L firmly but without distortion against the outer roller bearing race.
 - b. Use a feeler gage to measure the required gasket thickness. Select a gasket approximately .005 inch thicker than this measurement.
 - c. Remove labyrinth L and attach the gasket.
8. Tap into place, in the rear of the headstock, the race of the thrust bearing which has the larger inside diameter. Slip both races onto the spindle to check for the larger inside diameter. (See key 4, plate 2.)
9. Stand the spindle on end.
 - a. Place onto the spindle with care, the outer labyrinth with gasket, the oil flinger, the inner race of the roller bearing, the spacer and the key. (See key 28, 29, 48, 50, 51, 52, 53 and 54, plate 2.)
10. Arrange the following parts inside the headstock in their approximate actual position in the assembly; the large and small spindle gears, nut, rear thrust collar and the remaining thrust bearing. (See key 4, 5, 6, 7 and 8, plate 2.)
 - a. Position the large spindle gear between the forward headstock wall and the pinion gear which meshes the small spindle gear.
11. Start the spindle into the headstock.
 - a. Place onto the spindle the items as listed in step 10.
 - b. Protect the outside spindle surface by carefully guiding it through the headstock, also by lifting the parts as they are moved forward over the spindle.
 - c. Tap the large spindle gear forward, evenly and without cramping, to overcome its light drive fit on the spindle.
 - d. Move the spindle into the headstock until it is supported by one row of the cylindrical roller bearings.
 - e. Slide the angular contact bearing by hand onto the rear of the spindle. Place the thrust side toward the headstock.
12. Mount the following equipment on the spindle; nose piece J, sleeve T, the internal drawbar and two nuts as shown in figure 37.
 - a. Start the assembly screws loosely, in labyrinth L. (See key 49 and 50, plate 2.)
 - b. Tighten drawbar nuts to seat the angular contact bearing.
 - (1) Advance the large and small spindle gears by tapping with a soft hammer if necessary.
13. Tighten the screws in labyrinth L. (See key 49 and 50, plate 2.)
14. Check the required gasket thickness for rear cover plate Q in the same manner as in step 7. (See key 19 and 21, plate 2.)

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15. Mount the gasket and the rear cover plate Q on the headstock. 6 screws.
16. Assemble onto the spindle the rear key, gear and nut. (See key 16, 17 and 27, plate 2.)

PRELOAD OF THE FRONT ROLLER BEARING. When correctly adjusted, the double-row cylindrical bearing in front of the spindle must not have any radial play nor excessive preload. Radial play causes chatter when a tool is allowed to dwell in a cut after the feed is knocked off. Excessive preload causes high operating temperature and a reduction in bearing life.

Bearings of this type require a preload of from .0003 to .0005 inch interference fit on diameter. Greater preload does not improve cutting performance.

The taper of the inner bearing seat is 1 inch in 12 inches on diameter. However, the inner race expands at a lesser rate when forced upon the mating spindle seat. The thickness of a split ring behind the spindle flange locates the inner race longitudinally on its taper seat. A .001 inch variation in split ring thickness produces a .00005 to .00007 inch variation in preload on diameter of the bearing.

The nut K behind the spindle gears has 12 threads per inch. This nut must be turned 8 degrees to expand the inner race .0001 inch.

C. To preload the Front Roller Bearing.

(Refer to figure 36 for parts identified by letter, unless indicated otherwise.)

1. Loosen rear thrust bearing S in the following manner.
 - a. Back off the rear bearing nut H, 1/16 inch away from the face of the adjacent gear.
 - b. Drive the spindle forward. Strike the rear end of the spindle endwise

with a lead hammer until thrust bearing S is loose. When moved by a hand held scratch awl, the balls and cage must rotate freely between the bearing races.

2. Remove looseness from the rear thrust bearing S and the angular thrust bearing in the following manner.
 - a. Carefully tighten nut H a small amount against the adjacent gear.
 - b. Check for bearing looseness. Hold a scratch awl against the bearing cage or balls while rotating the spindle slowly.
 - c. Tap the rear end of the spindle endwise with a lead hammer to seat the nut.
 - d. Repeat steps a, b and c until the moment that rotation of the ball cage can no longer be prevented by the hand held scratch awl.

NOTE: Step 2 does not tighten the bearings to their final preload. They are tightened only enough to support the rear of the spindle rigidly and without play. Any clearance in the rear bearing produces false indicator readings when preloading the front roller bearing.

3. Remove all clearance from the front roller bearing in the following manner.
 - a. Mount nose piece J on the spindle.
 - b. Mount a .0001-inch dial indicator, or preferably an electrolimit gage, on the headstock over the spindle flange. Use a rigid bracket mount. The ordinary indicator stand is not rigid enough for dependable readings.
 - c. Place the indicator in contact with the spindle flange O.D. on its vertical center line. Maintain a minimum overhang from the support bracket to the indicator.

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- d. Block nut K against rotation by a soft-steel block held between a slot in the nut and the bottom of the headstock casting.
- (1) A convenient block is 1" x 1-1/2" x 4".
- e. Check that all spring pins in nut K are locked out by the wire inserts.
- f. Turn nose piece J clockwise by hand to bring up nut K.
- g. Lift the spindle upward from beneath the groove located between the spindle gears in the following manner.
- (1) Pass a three-foot bar through the lower right corner of the speed selector opening.
- (2) Rest the bar at its fulcrum point in the groove located in the lower wall of the opening.
- (3) Position the end of the bar against the underside of the V-shaped groove between the spindle gears.
- (4) Push downward on the outer end of the bar to lift the spindle.
- h. Note the indicator reading during the spindle lift per step g, while observing the following conditions.
- (1) To avoid a false reading, the spindle must not rotate during the lift reading.
- (2) The indicator shows a positive reading when there is clearance in the bearing.
- (a) Excessive lifting force may stress a small spindle to introduce a negative reading after a positive reading has been obtained. In this case, negative readings are ignored, since they are a function of unreasonable load and not clearance in the bearing.
- (3) Frequent indicator readings must be made while advancing nut K to obtain the controlled preload of the roller bearing. Insufficient indicator readings during the advance of nut K may force the bearing beyond its no-clearance position on the spindle for a sudden zero, or negative indicator reading.
- If this occurs, unseat the inner bearing race in the following manner.
- (a) Back off spindle nut K one turn.
- (b) Insert jack screws at 0 as shown in figure 38.
- (c) Insert shims between outer labyrinth P and the jack screws to prevent burrs on the labyrinth.
- (d) Advance the jack screws to move labyrinth P and the inner bearing race 1/32 inch away from the spindle flange. Remove the jack screws.
- i. Rotate the spindle several times to assure that the bearing rolls are aligned and not sticking.
- j. Block nut K and carefully turn nose piece J clockwise a small amount using a bar.
- (1) When the inner roller bearing race becomes seated on its mating spindle taper, 8 degrees of nut rotation expands the inner race .0001 inch.

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- k. Repeat steps g, h, i and j, until the moment that the indicator reading during the lift ceases to read plus, but becomes zero or negative.
- l. Take lift readings at each quarter turn of the spindle. Each position must have a zero or negative reading.
 - (1) If necessary, repeat steps h, i and j, until all lift readings become zero or negative.

The final location of the inner race on the spindle is determined by a split ring ground at assembly and inserted between the spindle flange and outer labyrinth P.

4. Grind the split ring to the correct thickness in the following manner.
 - a. Push outer labyrinth P away from the spindle flange until stopped by the inner roller bearing race in the following manner. (Refer to figure 38.)
 - (1) Insert jack screws at 0 in the spindle flange.
 - (2) Insert shims between outer labyrinth P and the jack screws to prevent burrs.
 - (3) Advance the jack screws to seat labyrinth P.
 - b. Measure the space between outer labyrinth P and the rear of the spindle flange using feelers at two opposite points close to the jack screws.
 - c. Remove the jack screws.
 - d. Grind both halves of the split ring .005 \pm .001 inch thinner than the space measured in step b. Hold both halves of the split ring parallel within .0002 inch.

5. Bring the front cylindrical roller bearing to correct preload in the following manner.
 - a. Clean and burr the split ring. Clean the mating surfaces between outer labyrinth P and the spindle flange.
 - b. Mount the split ring in position on the spindle (4 screws). (See key 34 and 36, plate 2.)
 - c. Turn spindle nut K for roller bearing preload by clamping the split ring in the following manner.
 - (1) Block nut K.
 - (2) Turn nose piece J clockwise using a hammer on the bar if necessary until the split ring is clamped.
 - (3) Check that the split ring is tightly clamped all around.
 - (4) Release the spring locking pins in nut K.
 - (5) If no locking pin drops into engagement in step 4, tighten nut K until the first pin drops into engagement.
 - d. Recheck the spindle for lift. If the indicator reads zero or negative, ignore the following steps (1) through (5) and proceed with step e. Should the indicator fail to read zero or negative, unseat the inner race in the following manner.
 - (1) Withdraw the spring locking pin in nut K free from the hole in the gear face. Then, insert wires through holes in all locking pins.
 - (2) Back off nut K one turn.
 - (3) Insert two soft-steel spacers followed by jack screws through

MAINTENANCE

two opposite holes 0 in the spindle flange. The soft spacers prevent burrs on the face of the split ring. (See key 34, plate 2.) Refer to hole 0 shown in figure 38.

- (4) Advance both screws in equal amounts until a 1/32-inch feeler can be inserted between the split ring and the spindle flange. Remove the jack screws and the soft-steel spacers.

- (5) Repeat the bearing preload procedure starting with step 3.

e. After the roller bearing has been properly preloaded, check the spindle runout by an indicator on the spindle flange, also on the spindle nose.

- (1) The runout must be less than .0003 inch on both surfaces in one revolution of the spindle.
- (2) To correct for excessive runout, tap the outside face of nut K with a lead hammer in line with the low point of the indicator reading. This brings nut K to a uniform bearing against the adjacent gear to equalize the pressure in the bearing assembly.
- (3) Excessive spindle runout which cannot be corrected indicates the presence of foreign matter between one or more mating surfaces from nut K to the back face of the spindle. The spindle must be dismantled, cleaned and reassembled.

PRELOAD OF THE REAR SPINDLE BEARINGS. The preload of the rear spindle bearings is established by the torque required to turn the spindle.

Normal preload in the front roller bearing and the ball thrust bearing have little effect

on this torque. Variation in torque load is related to the variation in angular thrust bearing preload. The spindle must turn freely during the torque test. Tight spots indicate misalignment or foreign matter in the bearings. The bearings must be cleaned or realigned before proceeding further.

D. To preload the Rear Spindle Bearings.

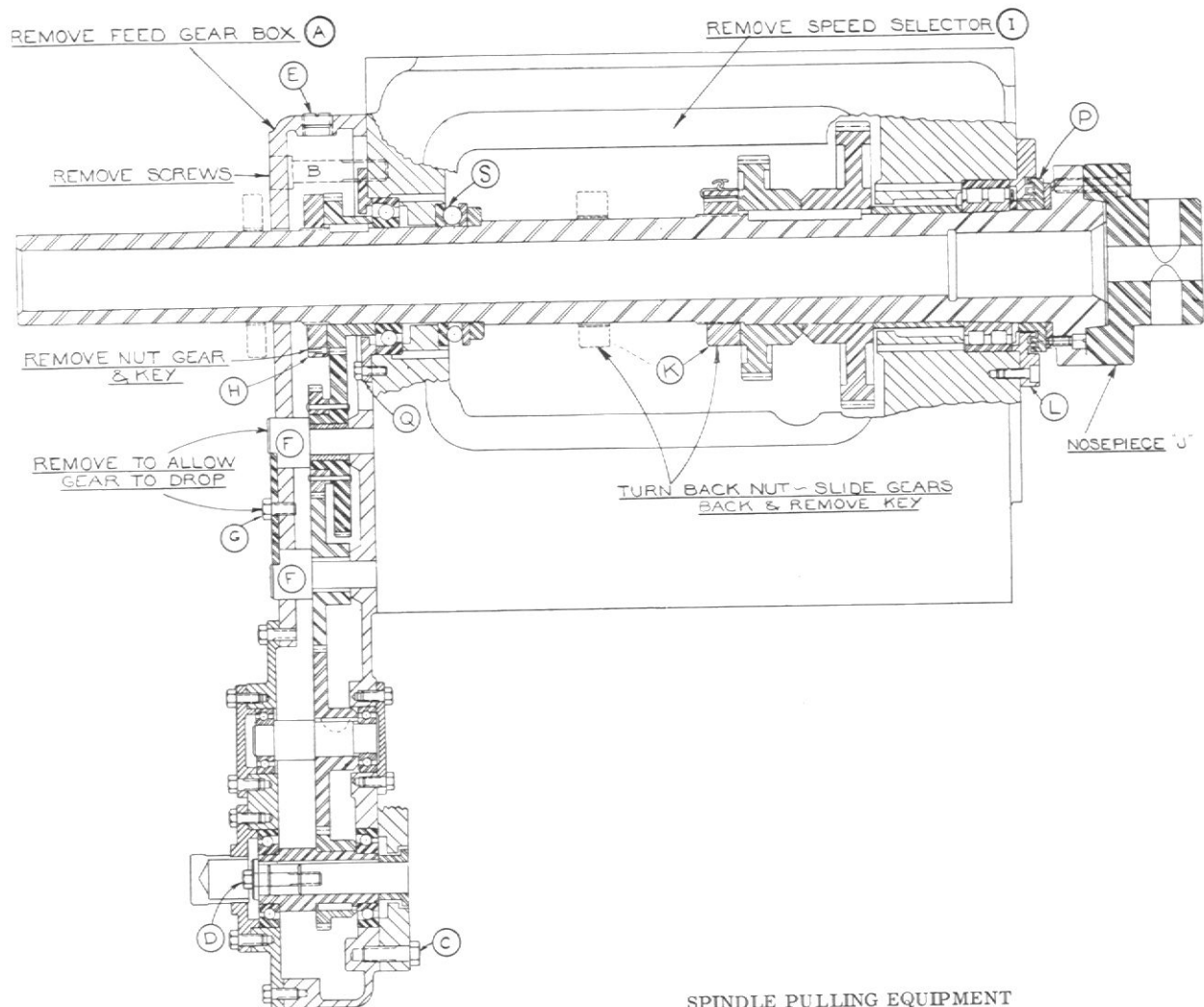
(Refer to figure 36 for parts identified by letter unless otherwise indicated.)

1. Remove all chucks and attachments from the spindle.
2. Fasten a thin flexible cable or chain to the rear end of the spindle.
3. Wrap the cable around the spindle two or three times and hang a "No Go" weight from its free end. See page 67 for appropriate "No Go" weight.
4. Turn the spindle slightly to overcome static friction.
5. If the "No Go" weight turns the spindle in step 4, proceed as follows:
 - a. Tighten rear spindle nut H shown in figure 36 a small amount.
 - b. Tap the spindle endwise, both front and rear with a lead hammer to seat the nut.
 - c. Turn the spindle several revolutions by hand.
6. Repeat steps 3, 4 and 5 until the "No Go" weight no longer turns the spindle.
7. Apply a "Go" weight to the spindle in place of the "No Go" weight. See page 67 for appropriate weights.
8. Give the spindle slight rotation.
 - a. If the "Go" weight does not turn the spindle, proceed as follows:

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- (1) Loosen nut H past two locking pin engagements and tap the spindle endwise from both ends. Rotate the spindle several times.
 - (2) Repeat steps 3 through 8.
- b. If the "Go" weight turns the spindle, proceed as follows:
- (1) Release spring locking pins in nut H.
 - (2) If no locking pin drops into engagement in step 1, tighten nut H until the first pin drops into engagement.
9. Run the bearings in after assembly at between 200 and 300 R.P.M. spindle speed for about 2 hours. After that time the high spindle speeds can be used.
- a. Running the bearings in will reduce the torque required to rotate the spindle. A subsequent adjustment of the rear bearings may be necessary.

MAINTENANCE



SPINDLE PULLING EQUIPMENT

LIST OF PARTS FOR SPINDLE PULLING & MOUNTING ROLLER BEARING SPINDLE - UNIVERSAL TURRET LATHES

<u>MACHINE</u>	<u>7-2 1/2</u>	<u>7-3</u>	<u>7-3 1/2</u>	<u>7-4 1/2</u>
Assembly	A-11332	A-11329	A-11330	A-11331
Nose Piece	11530-4-2	11530-4-2	14318-7-2	14318-7-2
Universal Lifter Rod	127SP	127SP	127SP	127SP
Spindle Puller	10625-11-1	10625-11-1	126SP	126SP
Screws for Spindle Puller	10625-11-2	10625-11-2	10625-11-2	10625-11-2
Universal Draw-In Rod	123SP	123SP	123SP	123SP
Sleeve	15245-8-1	15248-8-1	131SP	131SP
Sleeve Adapter	15211-10	15245-8-2	136SP	137SP
Screw	(4) 8568	(4) 8568	(4) 8596	(4) 8590
Screw	(4) 8513	(4) 8513	(2) 8505	(2) 8505
Nut	-----	-----	(4) 8807	-----
Washer	-----	-----	(8) 8887	-----

SPINDLE "GO" - "NO GO" WEIGHTS

<u>SPINDLE DIAMETER</u>	<u>"GO" WEIGHT (POUNDS)</u>	<u>"NO GO" WEIGHT (POUNDS)</u>
2 1/2"	12	10
3"	10	8
3 1/2" & 4 1/2"	20	15

Figure 36 - Removing Spindle from Roller Bearing Headstock

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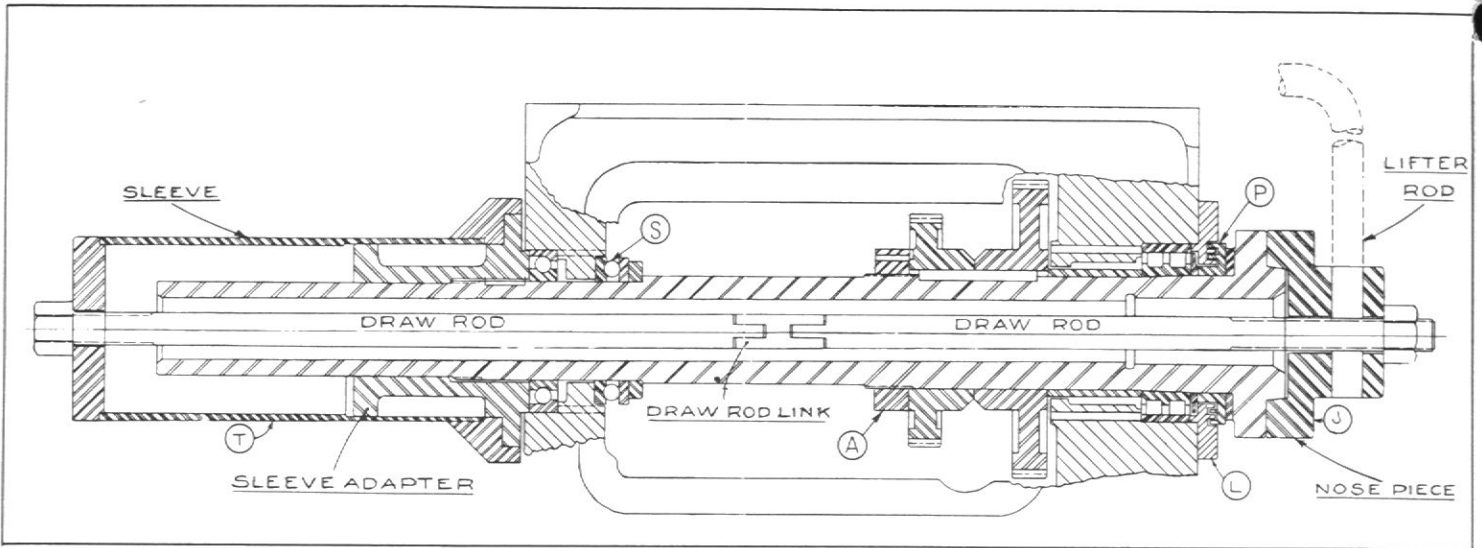


Figure 37 - Mounting Spindle and Bearing in Headstock

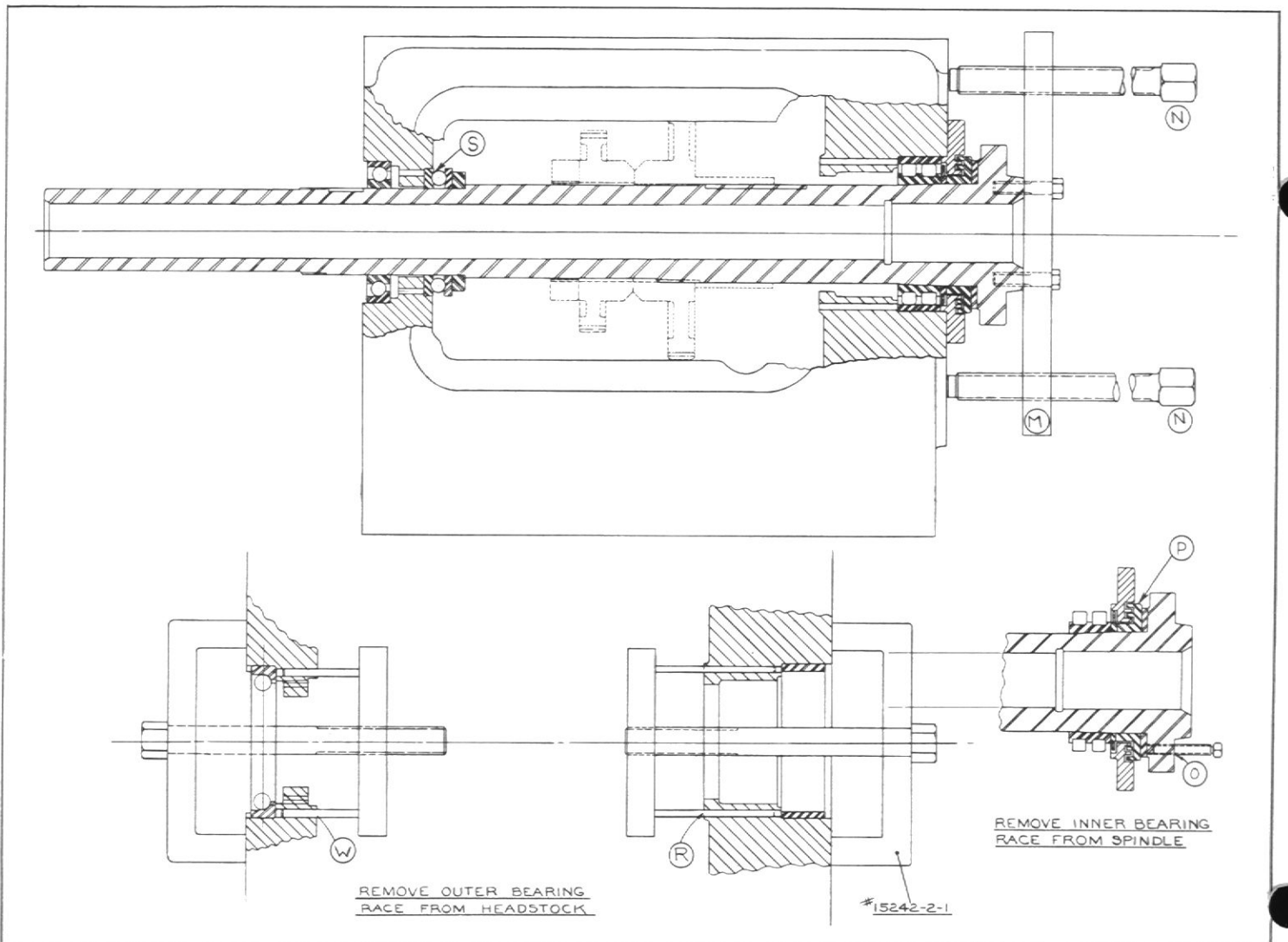


Figure 38 - Removing Spindle with Roller Bearings