HARDINGE®

OPERATOR'S MANUAL

MODEL HLV-H

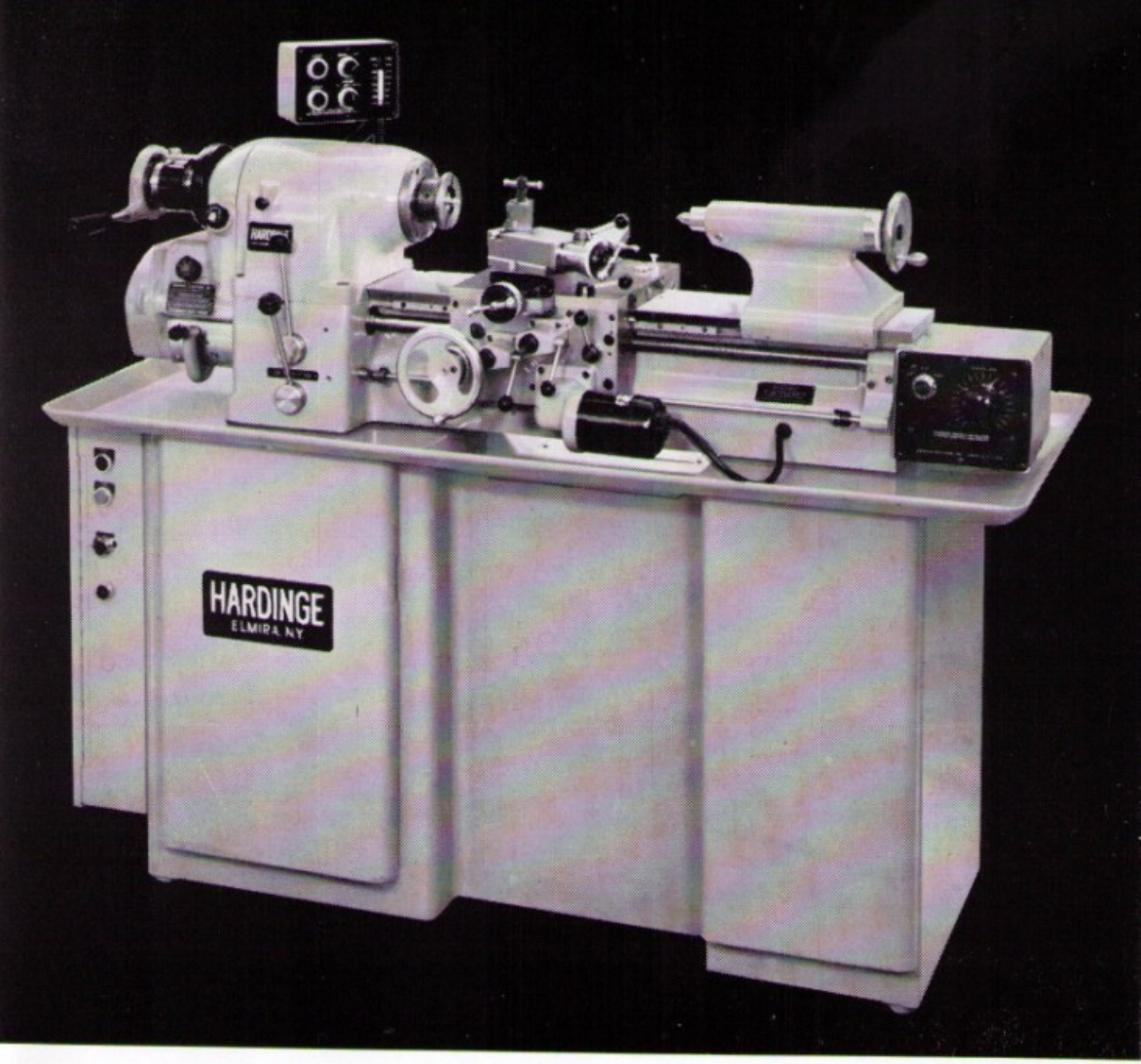
HARDINGE HIGH SPEED PRECISION TOOL ROOM LATHE

READ INSTRUCTIONS CAREFULLY

BEFORE USING MACHINE

When this instruction book was printed the information given was up-to-date. However, Hardinge is constantly improving the design of their machine tools and it is possible that the illustrations and descriptions may vary somewhat from the machine you received. This merely implies that the machine you received is the latest improved model to better fulfill your requirements.

HARDINGE BROTHERS, INC.
ELMIRA, NEW YORK



Model HLV-H

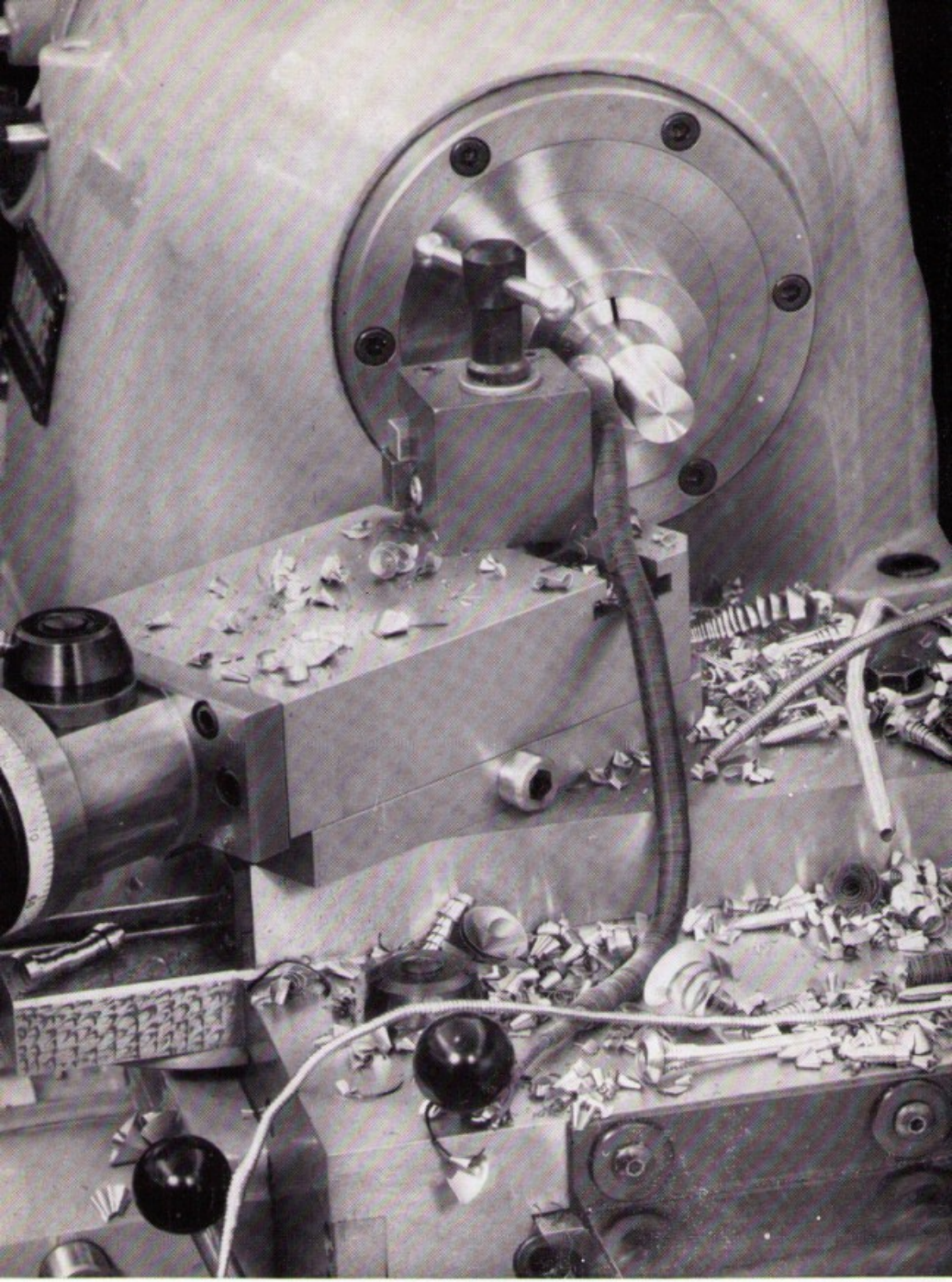
Hardinge High Speed Tool Room Lathe

with

HARDINGE

DOVETAIL BED

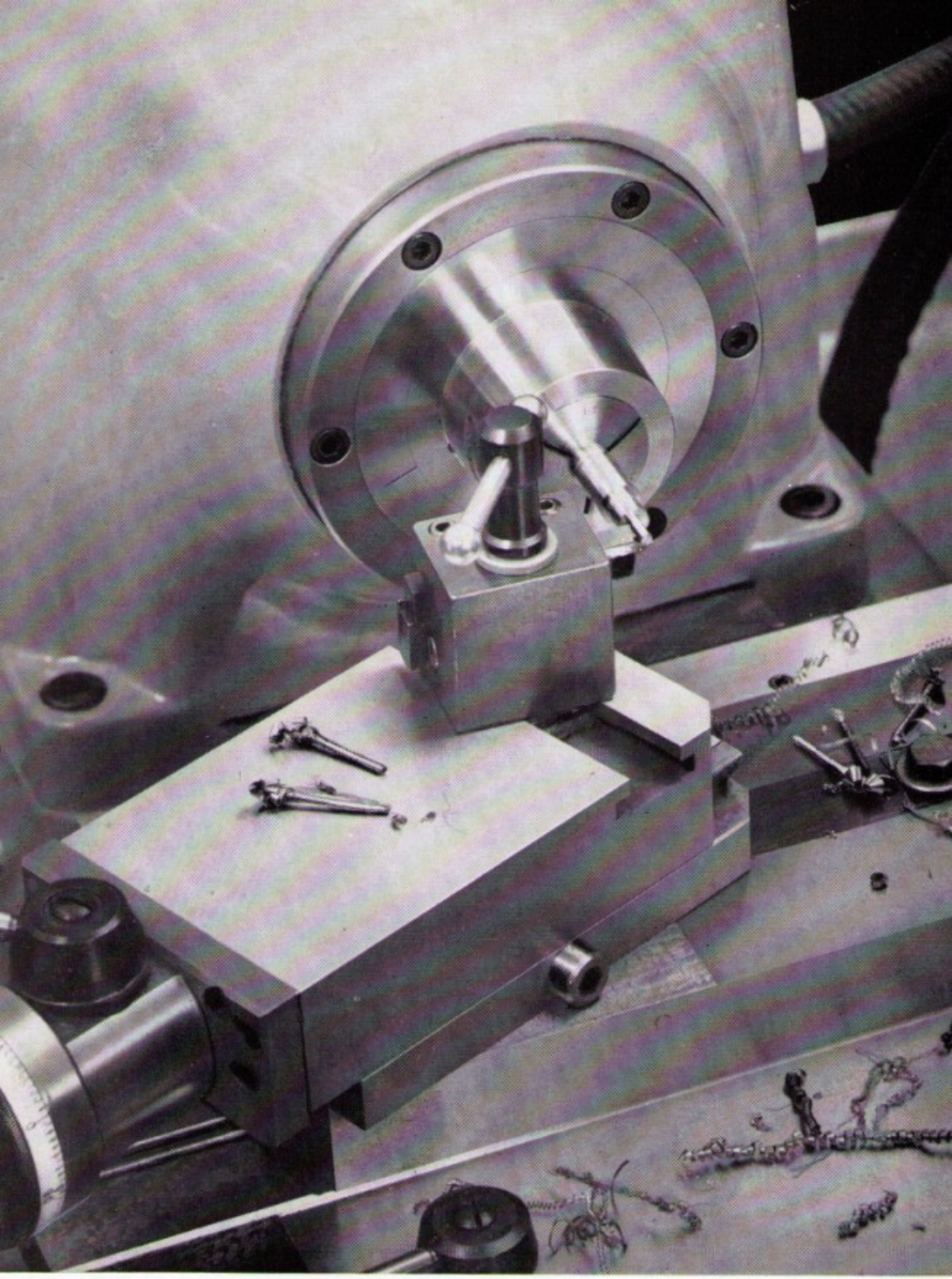
SOLID HARDENED AND GROUND STEEL



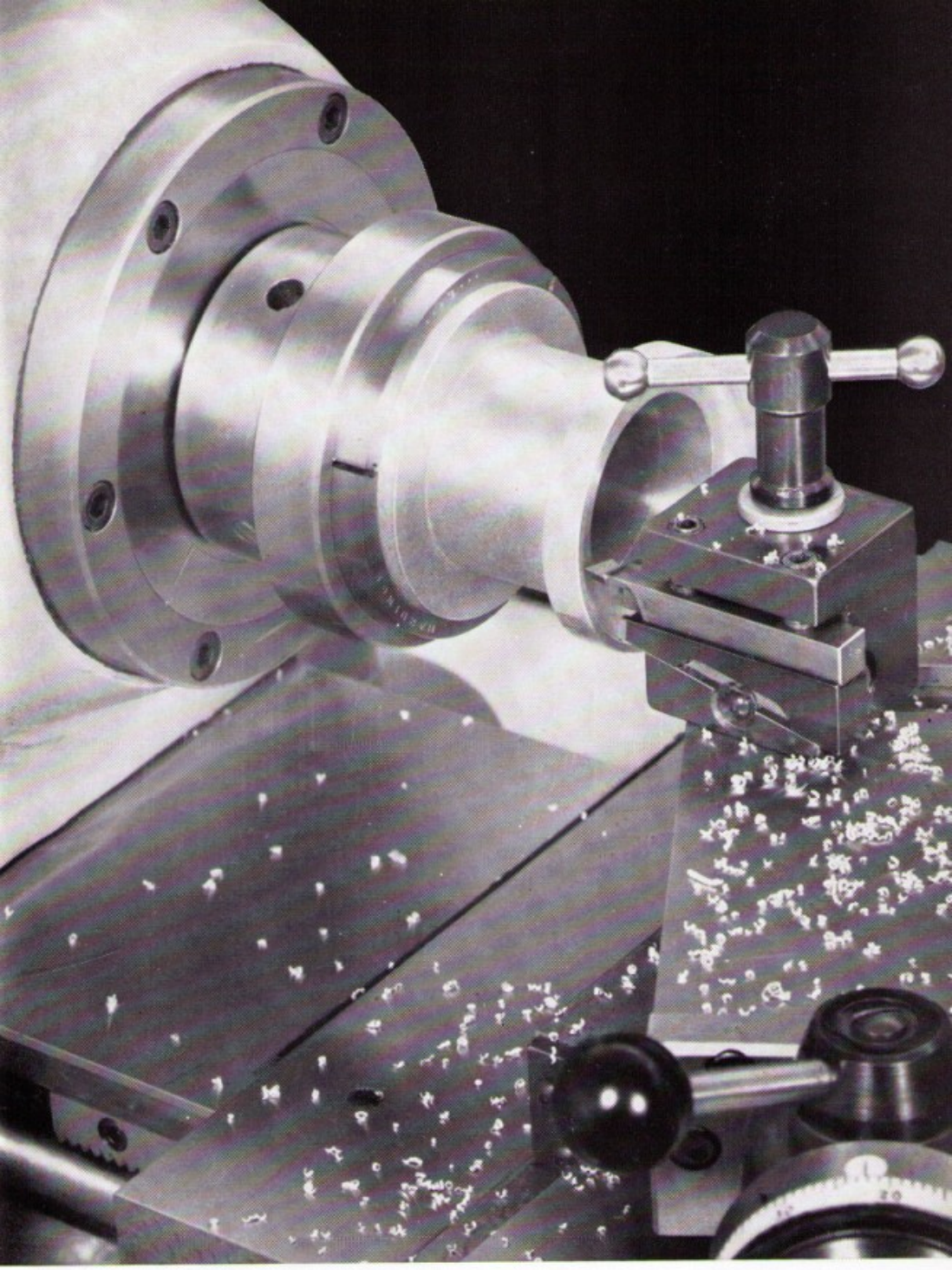
An example of modern turning with work held in a collet. With the Hardinge HLV-H Lathe the collets seat directly in the spindle for maximum accuracy and rigidity. For fast, accurate, easy chucking, use collets to hold your work — available in round, hexagon and square fractional sizes from collet stocks in Elmira, New York, and sixteen principal cities.

The setup illustrated above is given to show the range of the Hardinge HLV-H Lathe. Compare it to the illustration on Page 4.

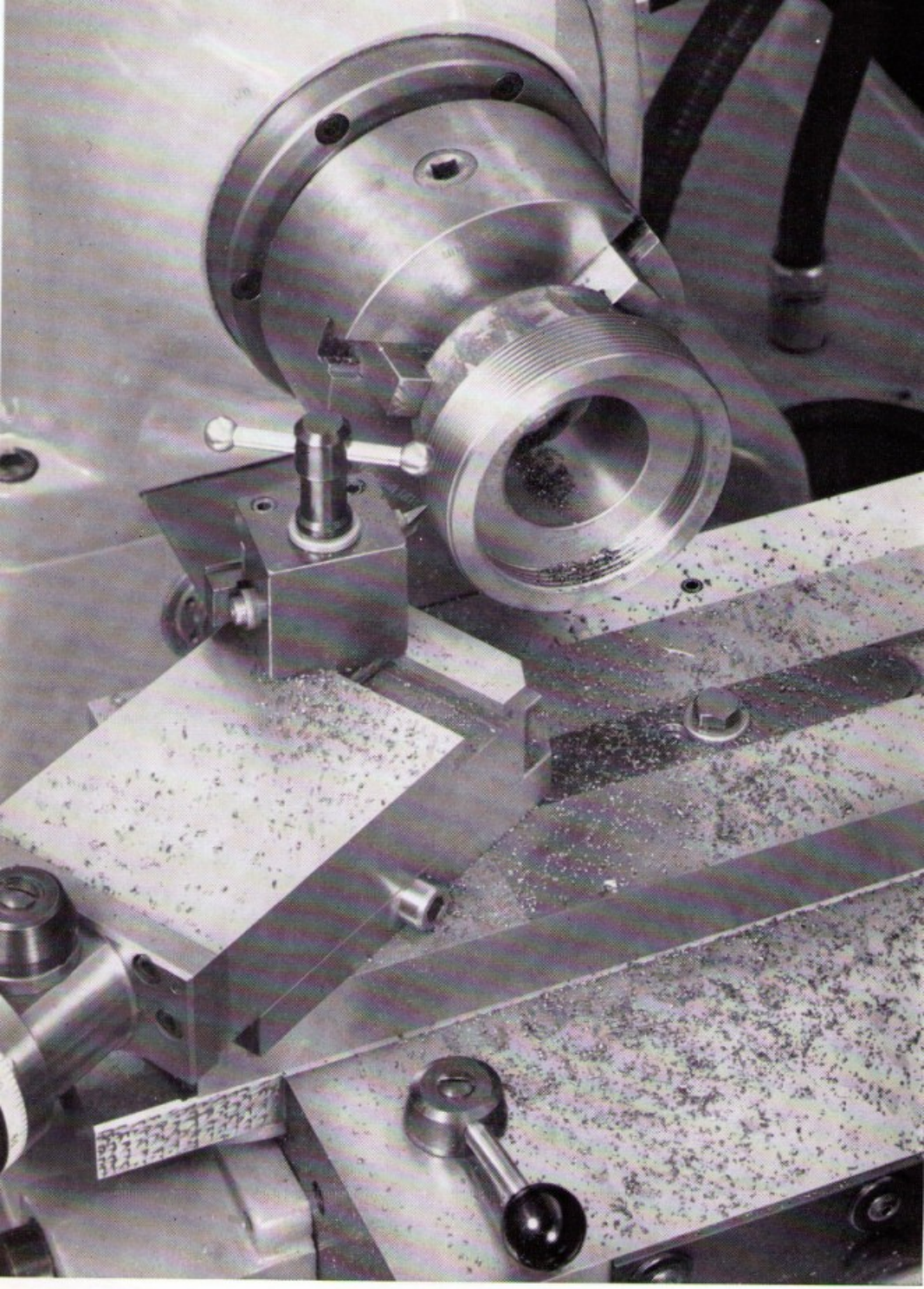
Precision taper turning is easy when done on the Hardinge HLV-H Lathe equipped with a taper turning attachment.



The smooth, powerful endless V-belt drive of the Hardinge HLV-H Lathe, coupled with the high speeds obtained, make small diameter work easy and efficient.



An example of proper holding of an instrument part for accurate, high speed machining by holding the part in a standard step chuck. See Pages 50, 51, 52 and 53 for full information on step chucks and closers.



The setup illustrated above shows the use of a three jaw chuck to hold a forged steel part. Jaw chucks are shown on Page 48.

CONTENTS

INSTALLATION INSTRUCTIONS

Remove crating, but do not remove machine from skid. Move machine to the location in your plant where it is to be used and then remove machine from skid. See instructions below for lifting machine from skid.

LIFTING MACHINE. Remove the four bolts which hold the machine to the shipping skids. There are two bolts at the extreme left-hand end of the pedestal and two at right-hand end.

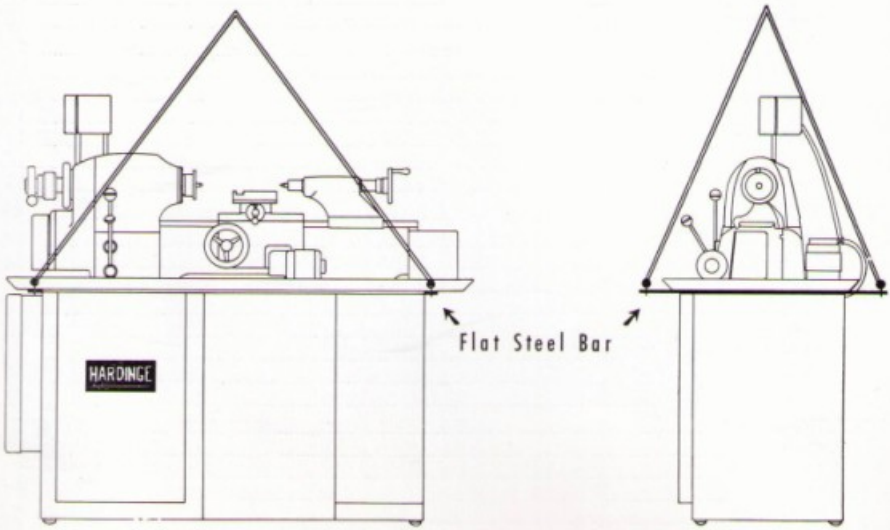
The machine may be removed from the skid by either a crane or fork lift truck. Lifting with a crane, the rope or cable sling should be arranged as shown on this page. **NEVER LIFT MACHINE WITH ROPE OR CABLE AROUND SPINDLE, BED OR TAILSTOCK.**

The rope or cable must be capable of withstanding a weight of 2000 pounds. When using a lift truck, adjust forks to go in between top planks of skid and bottom of pedestal base. Lift machine slowly, checking to see that the correct balance is obtained. Use caution, as machine has somewhat more weight at the front and it is more easily tipped using the lift truck method than the crane and sling method.

After skid has been removed place machine directly on location where it is to be used.

MACHINE FOUNDATION. The Hardinge HLV-H Precision Lathe is designed to operate without the need of special foundations. A substantial wood or concrete floor is satisfactory. It must, however, be fairly flat and have sufficient strength to support machine properly.

Do not locate machine near other equipment that causes vibration which will transmit to this machine, as poor work finish will result.



INSTALLATION INSTRUCTIONS (Continued)

LEVELING MACHINE. The Hardinge HLV-H Precision Lathe is designed with a three point bearing arrangement between bed and pedestal base. The three point bearing arrangement makes accurate leveling unnecessary. Leveling should be such as to be reasonable and so that coolant will properly drain back into sump from ends of pan.

There is an adjustable foot at back right-hand corner of the pedestal base to compensate for uneven floor conditions. To adjust, loosen the socket set screw and raise or lower the foot with a pin wrench so that all four feet rest firmly on the floor. Tighten socket set screw to retain setting. Should floor conditions be such that adjustable foot does not take care of the leveling, use shims under feet of pedestal.

CLEANING MACHINE. Use a cloth or brush to clean this precision machine. **DO NOT CLEAN MACHINE WITH COMPRESSED AIR.** The use of compressed air for cleaning a machine reduces the precision life of the machine. Small particles of dirt and foreign matter can be forced past seals and wipers into the precision slides and bearings. **USE ONLY CLOTH OR BRUSH TO CLEAN MACHINE.** This also applies to daily cleaning of unit after it is in operation.

After machine has been properly located, leveled and bolted to floor, clean off all anti-rust shipping grease and dirt accumulated in transit with a good grade of grease solvent. Remove wood shipping retainer block and wire binding from variable speed countershaft pulley assembly. Using a ¾" socket wrench remove and discard shipping hold down clamps located up inside motor compartment over the top of the pulley assembly.

Remove all shipping grease from variable speed vertical screw **"A"**, Figure 1, pulleys and brake drum, with cloth dampened with solvent. **Do not saturate belts with solvent.** Lubricate nut at grease fitting **"B"** and oil vertical screw with light oil for first "run-in" only. Keep vertical screw lubricated by greasing at fitting **"B"** using a good grade of grease such as Houghton absorbed oil #L-4½. LUBRICATE ONCE A MONTH or oftener if necessary. Add a few drops of light oil to brake drum **"C"**. Clean motor compartment and tool storage compartment. Put bottom tool shelf in place.

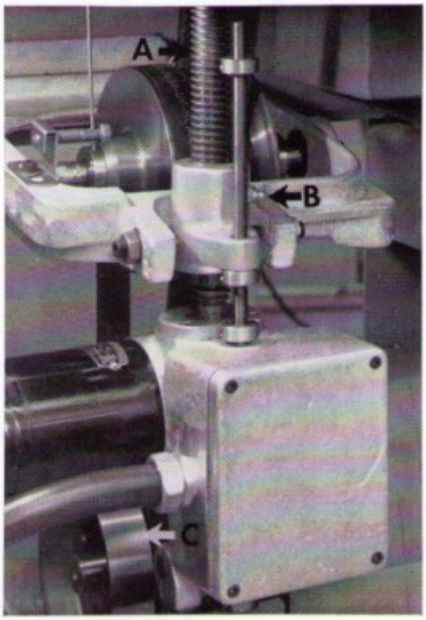


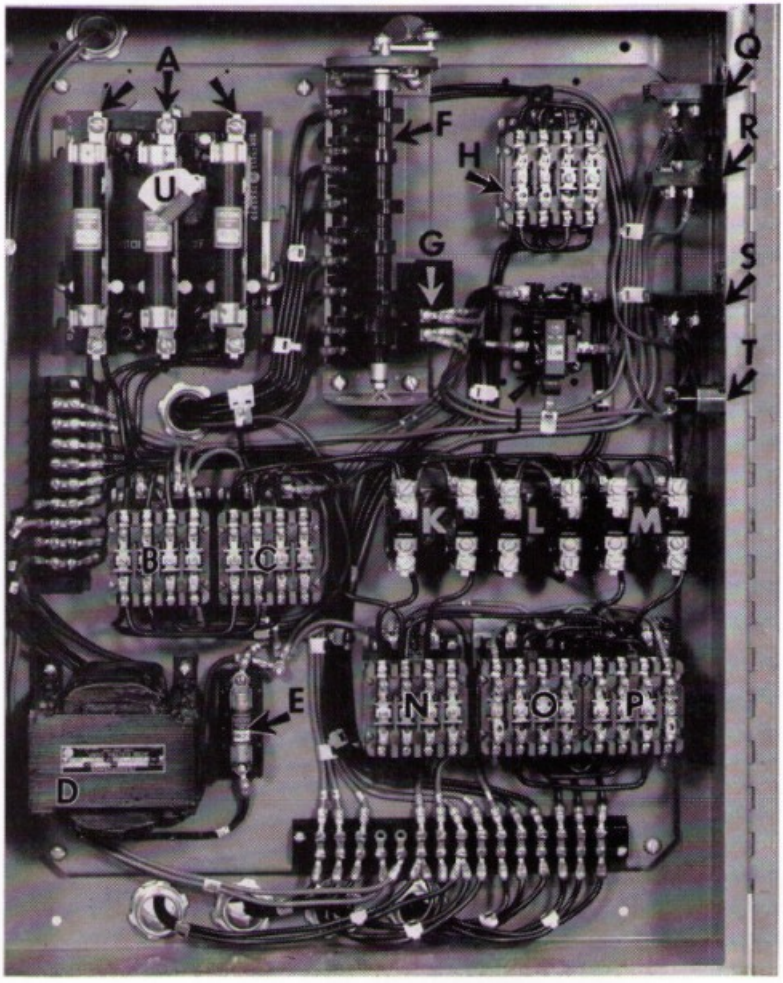
Figure 1

ELECTRICAL CONNECTIONS

The machine is shipped completely wired and assembled. It is only necessary to run the electric power line to the top of the control panel, Figure 2, and attach the wires to the three terminals in the panel shown at **"A"**, Figure 2. Electric power feed for carriage is connected to main control panel and does not require a separate power line. **BEFORE CHECKING ROTATION APPLY COLLET, WITH STOCK IN PLACE, TO HEADSTOCK SPINDLE AND TIGHTEN.** Also check that collet closer latch **"A"**, Figure 11, Page 22, is in closed position and spindle lock **"D"**, Figure 3, Page 12, is in **"out"** or released position.

Make sure switch **"B"**, Figure 5, Page 14 is set at **FORWARD. JOG SPINDLE SLIGHTLY USING LEVER "A"**, Figure 3, Page 12. The spindle should rotate counterclockwise or forward when viewed from tailstock end of machine.

Figure 2



ELECTRICAL CONNECTIONS (Continued)

If rotation is not correct, disconnect power and reverse any two of the incoming wires which connect at points **"A"**, Figure 2. If the power should be connected incorrectly and the speed changing mechanism operated, the drive will run all the way to the top or bottom and trip a safety limit switch. To back the drive off the safety limit switch, push **"STOP"** button **"C"**, Figure 5, Page 14. Turn the variable speed operating screw **"A"**, Figure 1, Page 9, by hand three full turns to raise or lower driving unit off the safety limit switch.

Switch **"A"**, Figure 4, Page 13, is brake release switch. During normal operation of the machine, keep set at **"BRAKE"** position and the brake will go **"ON"** and **"OFF"** automatically when starting or stopping machine with control lever **"A"**, Figure 3, Page 12.

Coolant pump switch **"B"**, Figure 4, Page 13, should be set at **"OFF"** unless using coolant supply. When coolant pump switch **"B"** is set to **"ON"** position, coolant pump will run continuously. If pump switch is set at the **"AUTO"** position coolant will flow only when machine is running.

— SEE FIGURE 2 —

Contactor **"B"** is main line contactor and provides low voltage protection.

Contactor **"C"** is safety interlock for spindle stop pin.

Transformer **"D"** supplies 110 volts at control buttons **"A"** and **"C"** shown in Figure 5, Page 14.

Fusetron **"E"** provides overload protection for carriage power feed motor and secondary protection for transformer.

Main control switch **"F"** operates main drive motor and gives selection of **ON-OFF — HIGH-LOW** and **BRAKE.**

Switch **"G"** is safety interlock and cuts off power feeds when machine spindle is stopped.

Contactor **"H"**, Figure 2, is **FORWARD-REVERSE** of main drive motor.

Contactor **"J"** controls brake.

Thermal overload protectors **"K"** are for coolant pump motor.

Thermal overload protectors **"L"** are for main drive motor.

Thermal overload protectors **"M"** are for speed change motor.

Contactor **"N"** controls coolant pump.

Contactor **"O"** controls variable speed motor for going **"FASTER".**

Contactor **"P"** controls variable speed motor for going **"SLOWER".**

Connection at **"Q"** is for the **"START"** button — at **"R"** the **"STOP"** button — at **"S"** the **"REVERSE"** switch and at **"T"** the pilot light.

Disconnect switch **"U"** is operated by lever **"D"**, Figure 5, Page 14 and must be returned to **"OFF"** position to open switch panel.

OPERATING INSTRUCTIONS

SPINDLE CONTROL LEVER — Figure 3

CONTROL LEVER "A", Figure 3, is the main control lever for the spindle. When moved to the extreme left the brake is released and the main drive motor is on the **"LOW"** side. When moved to the extreme right the brake is released and the main motor is on the **"HIGH"** side. The center or **"STOP"** position stops the motor and applies the brake.

Direction Control Lever For Carriage — Figure 3

Control lever **"B",** Figure 3, reverses direction of carriage for threading only. Always place this lever in center position before starting machine.

SEE PAGE 30 FOR COMPLETE INSTRUCTIONS ON THREADING

Disconnect For Gearbox — Figure 3

Knob **"C"** is used to connect or disconnect the gearbox from the headstock spindle by means of a sliding gear. **ALWAYS SHUT OFF MACHINE BEFORE ENGAGING OR DISENGAGING.** Turn knob clockwise to **"FEED"** position to disconnect gearbox. See Page 30 for instructions on positioning for threading.

Spindle Lock Pin — Figure 3

The spindle lock pin **"D",** Figure 3 is located at the front of the headstock. The pin is held in the **"OUT"** or released position by a spring and ball plunger. The spindle lock pin is used to hold the headstock spindle stationary when applying or removing spindle nose attachments, adjusting collet closer, tightening draw spindle or when applying and removing work from fixtures. To engage lock pin turn spindle by hand and hold lock pin "in" until it engages in one of the notches of the spindle assembly. **RELEASE BRAKE** by setting switch **"A",** Figure 4, Page 13, to **"OFF"** position. The spindle lock pin is interlocked electrically with the main drive motor and must be withdrawn before machine will start.

Figure 3

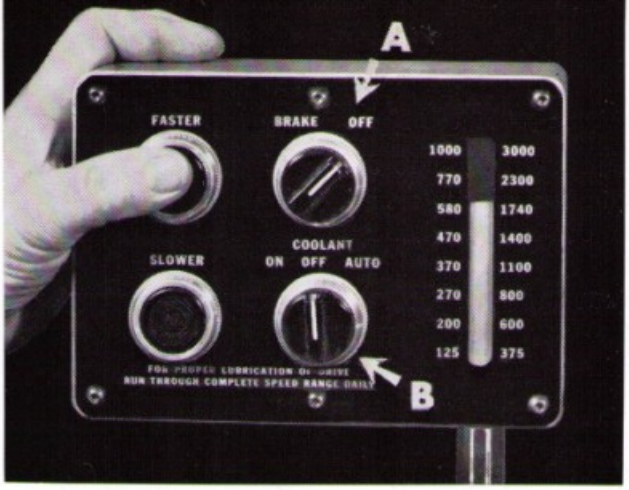


Figure 4

To Turn Spindle By Hand

FREE SPINDLE. To obtain a "free spindle" for easy turning of the spindle by hand, place operating lever **"A"**, Figure 3, in **"STOP"** position and turn brake switch **"A"**, Figure 4, to **"OFF"** position.

To Start and Stop Spindle — Figure 3

Pull out spindle lock pin **"D"**, Figure 3, Page 12. Lever **"A"** and lever **"B"**, Figure 3, must be in center position. Place knob **"C"**, in **"FEED"** position. Set switch **"B"**, Figure 5, Page 14, at **"FORWARD"**. Put collet in spindle with correct size stock in place or use headstock center and tighten with collet closer. Press **"START"** button **"A"** on front of control panel, Figure 5, Page 14, which energizes panel and is indicated by pilot light **"E"**, Figure 5, Page 14. The machine is now ready to start. Use main control lever **"A"**, Figure 3, to start and stop the spindle. Move to extreme left to start spindle on **"LOW"** side of motor. Move to extreme right to start spindle on **"HIGH"** side of motor. Center position shuts off the main motor and applies the brake.

To make the spindle go **"FASTER"** push the top button as shown in Figure 4, above, until the speed indicator shows desired speed and then remove finger from button. To make spindle go **"SLOWER"** push lower button as shown in Figure 4, above.

The speed indicator moves up or down to indicate in the left column speed figures for the **"LOW"** side of the motor and in the right column for the **"HIGH"** side of the motor.

Control Panel — Figure 5

"START" button **"A"**, Figure 5, controls main contactor to energize switch control panel. **BEFORE PUSHING "START"** button see instructions on Page 13, to **"START AND STOP SPINDLE"**. Push **"STOP"** button **"C"** when finished using lathe.

Switch **"B"**, Figure 5, is **FORWARD-REVERSE** for spindle.

Switch **"A"**, Figure 4, releases brake when set at **"OFF"** to give "free spindle".

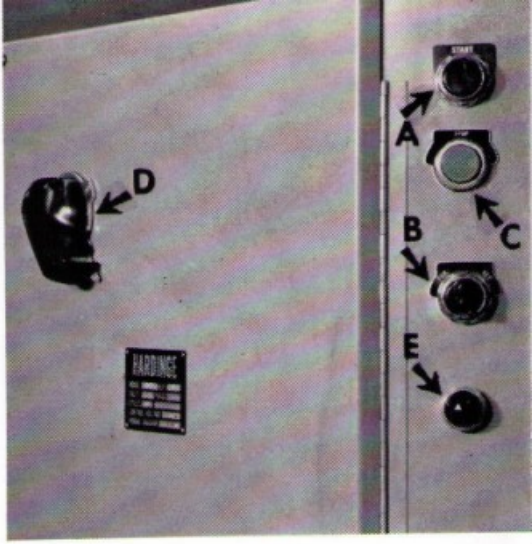


Figure 5

When set at **"BRAKE"** the brake automatically goes **"ON" or "OFF"** when using control lever **"A"**, Figure 3, Page 12. Coolant switch **"B"**, Figure 4, Page 13, should be at **"OFF"** unless using coolant supply.

Spindle Driving Unit — Figure 6

The driving unit provides infinitely variable spindle speeds from 125 to 3000 R.P.M. by push button control as illustrated on Page 13. Speed changes can be made while the tool is actually "under cut" with the operator watching the chip and tool to obtain fastest chip removal and longest tool life.

Push button controlled motor **"A"**, Figure 6, is a reversing motor and actuates speed changing screw **"B"** which in turn raises or lowers frame **"C"**. Frame **"C"** carries the countershaft pulley assembly **"D"**.

Countershaft Pulley Assembly — Figure 6

The entire countershaft pulley assembly including the shaft **"F"**, Figure 6, is free to float from side to side. The center sheave of the assembly is independent of the two outer sections which are in a fixed position on the shaft.

The pulley frame **"C"**, Figure 6, is hinged at point **"E"** and when the front end is raised or lowered, belt tension will move the center sheave sideways and change the ratio between the driven and the driving pulley which changes the headstock spindle speed.

The variable speed pulleys have a built-in lubricating system. Run the machine, each day, through a complete cycle from 125 to 3000 R.P.M. to lubricate the pulleys and keep them operating efficiently.

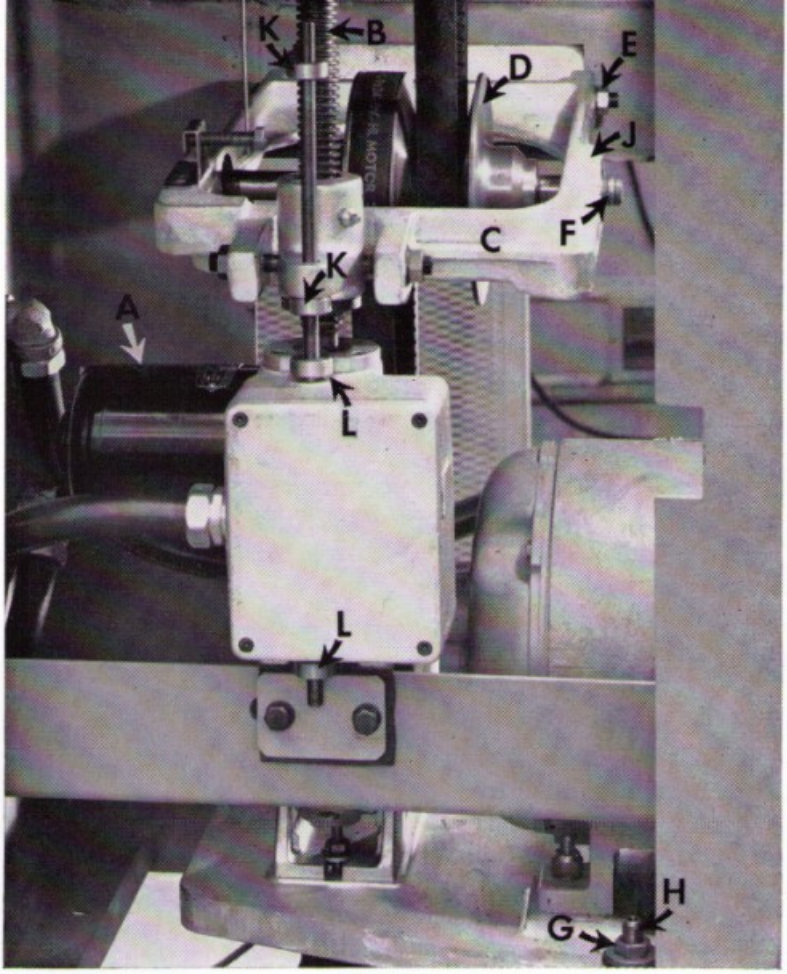


Figure 6

Belt Adjustment — Figure 6

By raising or lowering the motor plate, proper belt tension can be obtained. Due to the construction of the driving unit the tension of the motor belt and spindle belt are automatically equalized. **BELT TENSION SHOULD BE CHECKED ONCE A WEEK,** especially when the machine is new.

To check belt tension, first set brake switch to **"OFF".** Start machine spindle — shut off and allow to coast to a stop. **THE BELTS SHOULD NOT BE STRETCHED, YET ADJUSTED SO THERE IS NO LOOSENESS.**

To tighten belts, loosen nut **"G",** Figure 6, and turn set screw **"H"** clockwise. Make adjustment in small amounts and run machine between each setting to permit belts to "equalize".

IF BELTS SLIP WHEN ADJUSTED TO PROPER TENSION, THE MACHINE IS BEING OVERLOADED. Centrifugal force tends to tighten belts when running.

Belt Adjustment — Continued

After proper setting, lock nut **"G"**, Figure 6, and reset brake switch to **"BRAKE"**.

Drive shaft bearings located at **"J"**, Figure 6, are precision ball bearing type, grease packed and sealed and require no further attention. Drive shaft **"F"**, Figure 6, is coated with **"MOLYLUBE"** so it will slide freely.

The belts and driving unit are protected from "overtravel" by a set of stops **"K"**, Figure 6. The two stops **"K"** are set at the factory and actuate electric limit switches and automatically shut off the speed changing mechanism when it reaches the low speed of 125 or the high speed of 3000. The two stops **"L"**, Figure 6, are also set at the factory and are positive mechanical stops in case the electric limit switches fail. **NOTE:** If the speed changing mechanism does not work, check instructions on Pages 10 and 11.

Spindle Driveshaft Brake
Figure 7

The spindle driveshaft brake is designed for rapid but gradual stopping of the precision headstock spindle. The brake is "tied in" with the control lever **"A"**, Page 12, and is released when the machine is turned on and applied when the machine is turned off.

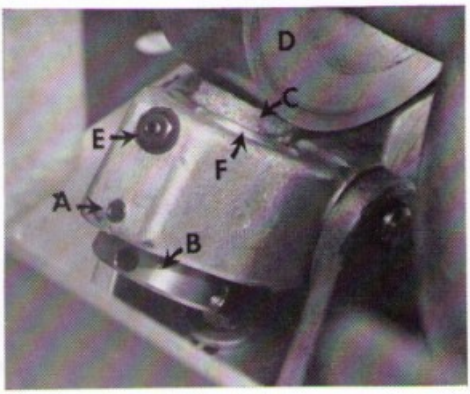


Figure 7

TO RELEASE BRAKE for a **"FREE SPINDLE"** turn brake switch to **"OFF"** as shown on Page 13. The brake drum **"D"**, Figure 7, is located directly on the main motor drive shaft. The brake is actuated by a solenoid located under cover **"A"**, Figure 8, Page 17 and is accessible from rear of machine by removing motor ventilator screen.

The brake shoe insert **"C"**, Figure 7, is forced against the brake drum by means of a powerful spring. The spring automatically compensates for brake wear. However, after considerable use it may be necessary to adjust.

To Adjust Brake — Figure 7

With brake in released or **"OFF"** position, loosen set screw **"A"**, Figure 7 and turn adjusting screw **"B"** to the right with a pin wrench until there is .003" to .005" clearance between the insert **"C"** and drum **"D"**.

After adjustment relock set screw "A", Figure 7

DO NOT ADJUST "E", Figure 7, which has been set at the factory to hold alignment key for the brake shoe housing.

DO NOT RUN BRAKE DRY. Add a few drops of light oil to the brake drum periodically which will keep the brake insert pliable. If machine is braked often — oil daily. Braking time is from 2 to 3 seconds.

CAUTION: Do not allow brake insert to become worn enough to allow insert housing **"F",** Figure 7, to score brake drum.

TO REPLACE BRAKE INSERT, loosen set screw **"A",** Figure 7, and unscrew nut **"B",** Figure 7, and remove housing **"F",** Figure 7. Knock out old insert. Trim off small end of new insert until it bottoms and is a snug fit in tapered hole of housing. When reassembling, line up keyway of housing with key before starting adjusting nut **"B",** Figure 7. Set clearance to .003" to .005" as explained before and relock set screw **"A",** Figure 7.

Main drive motor **"B",** Figure 8, and variable speed motor **"C",** Figure 8, have grease sealed ball bearings and need no further attention.

Adjusting screws **"D"** and **"E",** Figure 8, are set at the factory and are for alignment of the countershaft in relation to main drive motor and spindle headstock pulley.

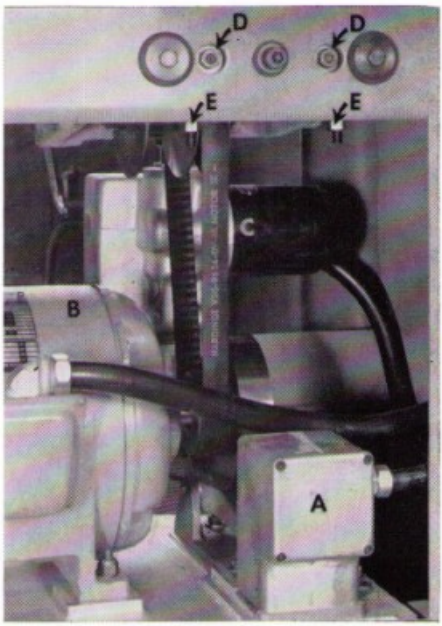


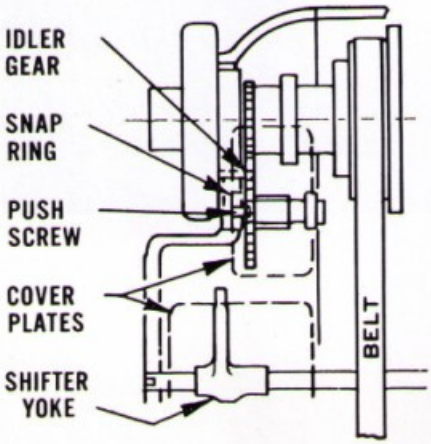
Figure 8

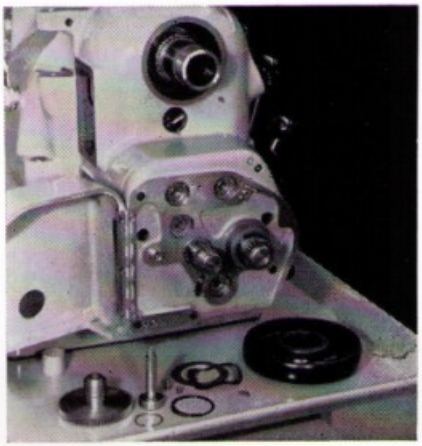
TO REMOVE MOTOR BELT

1. Run countershaft carrier bracket to top position (highest spindle speed setting).
2. Turn brake control selector switch to "OFF".
3. Remove nut and steel washer from motor plate hold down bolt and raise motor plate 2" to 3" and block.
4. Remove brake drum from motor shaft by taking out four lock screws and set screws. The four keyways in the pulley brake drum are numbered. When removing pulley note the keyway number that the motor shaft key is in so it can be assembled in the same location.
5. Roll head belt off of countershaft pulley then slide countershaft pulley assembly to extreme right.
6. Pass head belt and motor belt around and off end of shaft.
7. Put new motor belt in place.
8. Replace head belt on countershaft and reassemble. FOR PROPER BELT ADJUSTMENT REFER TO PAGE 15.

TO REMOVE HEADSTOCK BELT

1. Follow instructions "How To Remove Motor Belt" steps 1 through 5.
2. Pass head belt around and off end of shaft.
3. Remove switch pull rod that goes through belt.
4. Remove collet closer, see Page 23.
5. Remove handwheel snap ring and handwheel.
6. Remove handwheel spindle key, spring spacer and washer.
7. Remove both back covers from gear box.
8. Remove snap ring in front of idler gear bearing.
9. Screw push screw "in" to remove gear, shaft and bearing.
10. Remove lock screws in shifter yoke, unscrew shaft with 1/4"





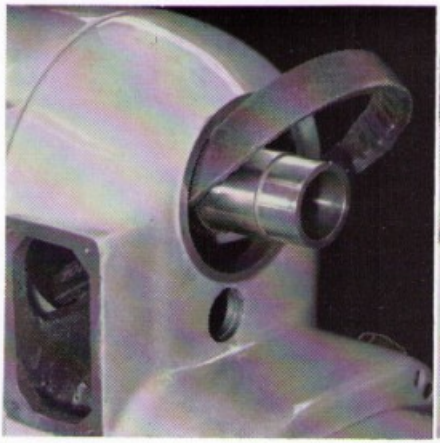


Figure A

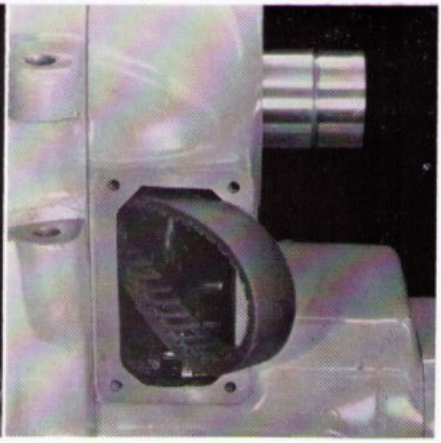


Figure B

hex key wrench in end of shaft and pull shaft part way out (approx. 5").

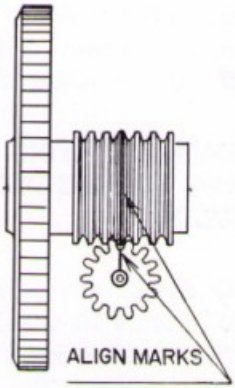
11. Use switch pull rod as hook and bring belt part way out opening and around end of spindle, as shown in "A" above, and then out through top opening in rear of gear box, as shown in Figure "B" above.

12. Tie weighted string around new belt and drop through opening for belt, to guide it down through gear box and pedestal. Install new belt as shown in Figure "A". Use switch pull rod to lift belt up on to spindle pulley.

13. Push shifter back in and screw in place. (Lever must be in vertical position).

14. Locate shifter yoke on shaft by lining up screw holes.

15. Replace idler gear, shaft, bearing and snap ring. Line up gears as shown in sketch at right.



16. Replace head belt on countershaft and reassemble. FOR PROPER BELT ADJUSTMENT REFER TO PAGE 15.

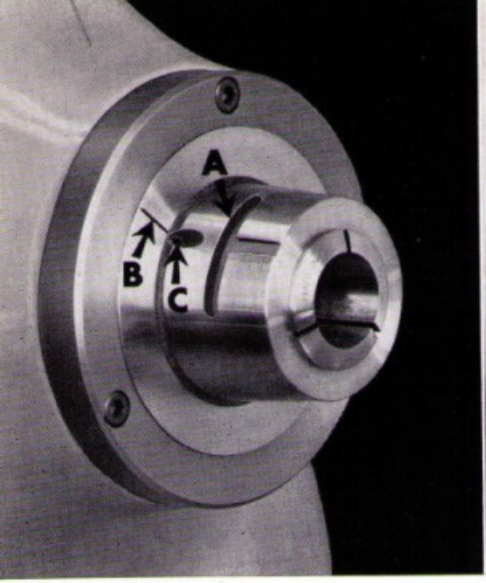


Figure 9

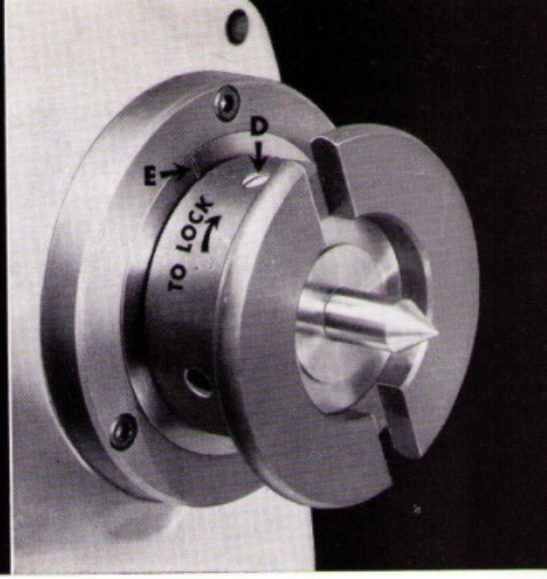


Figure 10

HOW TO APPLY AND REMOVE SPINDLE NOSE TOOLING

Figures 9 and 10

The Hardinge Taper Nose spindle construction is time-proven for accuracy, durability and for fast, easy application and removal of spindle nose tooling. The precision ground slow taper holds and aligns all tooling. The pin in all headstock spindle nose tooling engages the bayonet slot **"A"**, to draw the attachment securely on the taper. Once securely drawn up, the spindle nose attachment is actually driven by the locking action of the tapered surface.

BEFORE APPLYING ANY ITEM OF TOOLING TO THE SPINDLE NOSE WIPE THE SPINDLE NOSE AND ATTACHMENT MATING SECTION CLEAN.

TO APPLY the drive plate for driving dog, for example, align key **"D"**, Figure 10, with bayonet slot and slide drive plate on spindle nose. When it is back as far as it will go turn the drive plate clockwise to lock in place. This is determined by the relation of the key **"D"** and spindle reference line **"E"**. Final tightening should be done with a standard pin type spanner wrench. (Use Williams or Armstrong spanner wrench No. 460. Do not use hammer and punch.)

TO REMOVE the drive plate, turn counterclockwise with spanner wrench to loosen. Continue to turn until key **"D"** is in line with reference mark **"E"**, then remove from spindle by sliding to right off end of spindle.

IMPORTANT — to obtain accurate results from precision spindle nose attachment always be sure the spindle nose and mating section in attachment are **CLEAN BEFORE THEY ARE ASSEMBLED TOGETHER.**

DO NOT REMOVE KEY "D" TO REMOVE SPINDLE NOSE TOOLING. IT IS THE SLOW WAY AND WILL INTERFERE WITH FUTURE ACCURATE OPERATION OF THE ATTACHMENT.

SPINDLE COLLET KEY — Figure 9

The spindle collet key **"C"**, Figure 9, is threaded into the spindle and can be removed and replaced, in the event of wear or damage, without removing the headstock, spindle or spindle bearings. Use a 3/32" hexagon pin wrench to remove lock screw; then remove collet key screw with same hexagon pin wrench.

LUBRICATION OF HEADSTOCK SPINDLE BEARINGS

The headstock spindle is mounted on precision preloaded ball bearings. The preloading and resulting load carrying capacity is engineered to take radial thrust or 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 bearing seals are designed to operate at high speed without wear or friction.

There are occasions on a new machine when some of the excess grease in the spindle bearings will work its way out of the opening at the bottom of the front bearing cap. The appearance of this excess grease does not affect the spindle bearings nor the fact that they are grease packed for life.

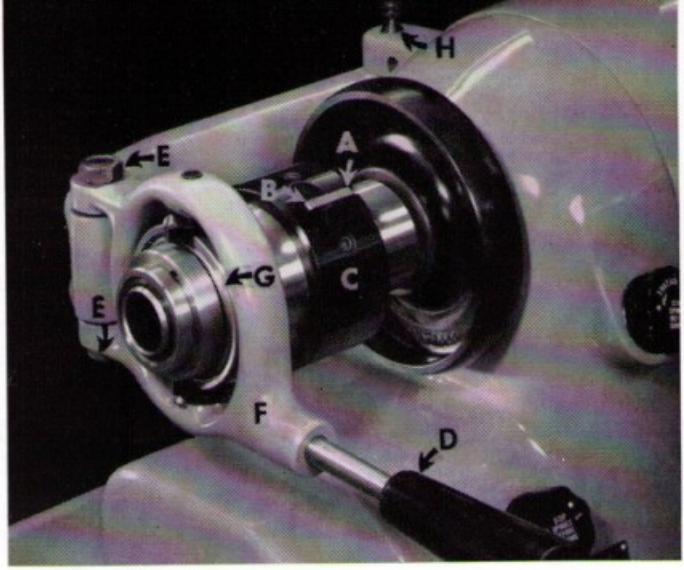


Figure 11

ADJUSTING COLLET CLOSER — Figure 11

1. Apply the desired size collet or step chuck to the machine spindle. Be sure the collet or step chuck and spindle are clean.
2. Open collet closer latch **"A"**, Figure 11, by pressing down at point **"B"**.
3. Engage the collet closer tube on the collet or step chuck and thread about two turns only. To turn the collet closer tube, the operator, using his left hand, turns the black shell guard **"C"**, Figure 11, forward while he holds the collet or step chuck in place with his right hand.
4. Place a work piece in the collet or step chuck.
5. Move lever **"D"**, Figure 11, to the extreme left or closed position and then turn shell guard **"C"** toward the operator until it is drawn up as far as it will go by hand. If headstock spindle should turn, lock spindle by pressing in spindle lock pin **"D"**, Figure 3, Page 12. To engage lock pin into notches provided, turn the spindle by hand until pin enters notch to lock.
6. Move lever **"D"** forward to the released position and turn shell guard **"C"** toward operator so that latch **"A"** advances two notches on the adjusting nut.
7. Close latch **"A"** and test collet closer for tension on work. Should additional gripping pressure on the work be required, open latch **"A"** and turn shell guard **"C"** toward operator. For less gripping pressure, turn shell guard **"C"** away from operator.

   The two adjusting screws and lock nuts located at **"E"**, Figure 11, are set at the factory. By adjustment of lock nuts **"E"**, lever yoke **"F"** is raised or lowered so there is no pressure on bearing **"G"**.

HOW TO REMOVE COLLET CLOSER — Figures 11 and 12

The collet closer should be removed from the machine when using jaw chucks, face plates, fixture plates or other nose type fixtures.

Running the machine with the collet closer in place **without a collet** will cause damage to the collet closer.

To remove the collet closer remove link pin **"H"**, Figure 11. This pin is easily removed by the use of a mallet and brass punch, striking pin at bottom.

CAUTION: DO NOT REMOVE COLLET CLOSER BY REMOVING SCREW "E", Figure 11. This screw is adjusted properly at the factory for proper operation of collet closer. Remove link pin **"H"**, Figure 11, only. After removing pin **"H"** remove collet closer as shown in Figure 12. It is then necessary to remove adjusting nut **"A"**, Figure 12. This is done by pulling nut straight off end of spindle. **DO NOT TURN ADJUSTING NUT — IT IS NOT THREADED TO SPINDLE.**

The collet closer should be removed periodically for cleaning to prevent loading of chips between collet closer tube and inside of spindle at rear end.

APPLYING COLLET CLOSER — Figure 12

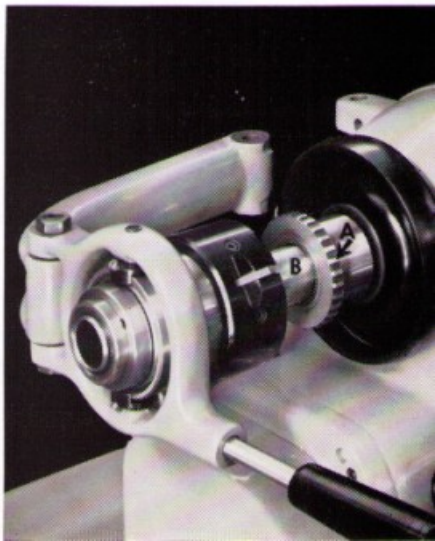
Clean the inside of the headstock spindle before applying collet closer. Also, clean outside diameter at rear of spindle where adjusting nut locates. Clean collet closer tube inside and out.

Apply a film of light oil on rear of headstock spindle and apply adjusting nut **"A"**, Figure 12. Apply a film of light oil on bearing section **"B"**, Figure 12, of collet closer tube and slide closer on machine and insert link pin **"H"**, Figure 11.

SLIDE COLLET CLOSER TUBE INTO HEADSTOCK SPINDLE CAREFULLY. DO NOT FORCE. If it does not go in easily, remove and check for dirt, chips or burrs.

CAUTION: When threading draw tube onto collet and it does not turn freely by hand, remove it at once and check collet threads and draw tube threads, looking for dirt, chips or damaged threads. Also check inside diameter at rear end of headstock spindle and outside rear bearing diameter of draw tube.

Figure 12



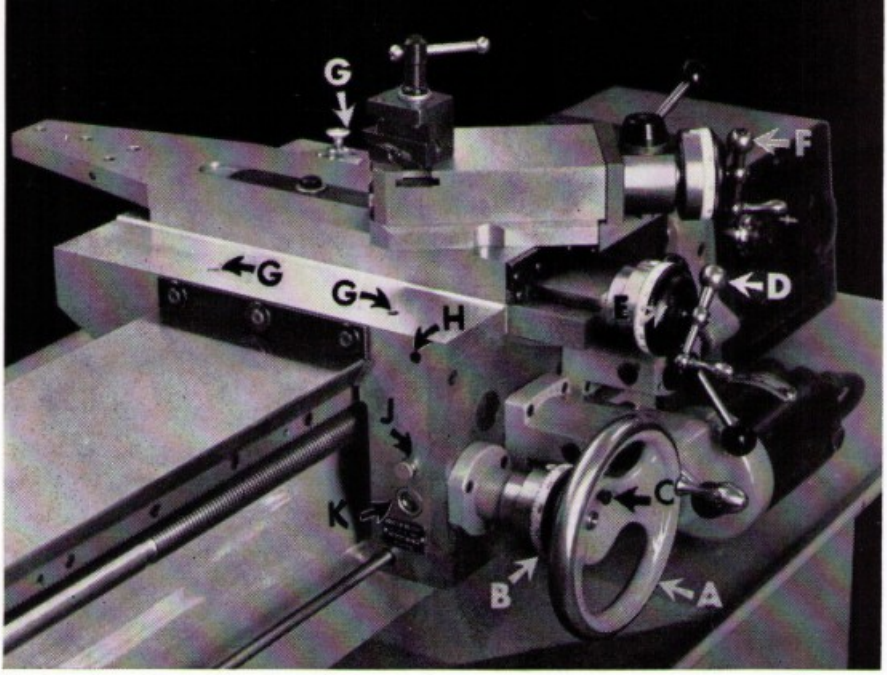


Figure 13

CARRIAGE AND APRON — Figure 13

Carriage handwheel **"A"** is used to move carriage along bed — longitudinal movement. The adjustable white dial **"B"** is divided in increments of .010" and has a positive lock **"C".**

Cross Feed Screw Ball Crank Handle **"D"** is used for hand feeding cross slide. The black and white dial is adjustable and has positive lock **"E".** The dial is divided in increments of .001" and is **DIRECT READING.** Direct reading means that when cross slide is moved one graduation or .001" the cutting tool will remove .001" from diameter of work.

Compound Slide (tool post slide) Ball Crank Handle **"F"** is used to feed the compound slide. The adjustable black and white dial is divided in increments of .001" and has a positive lock.