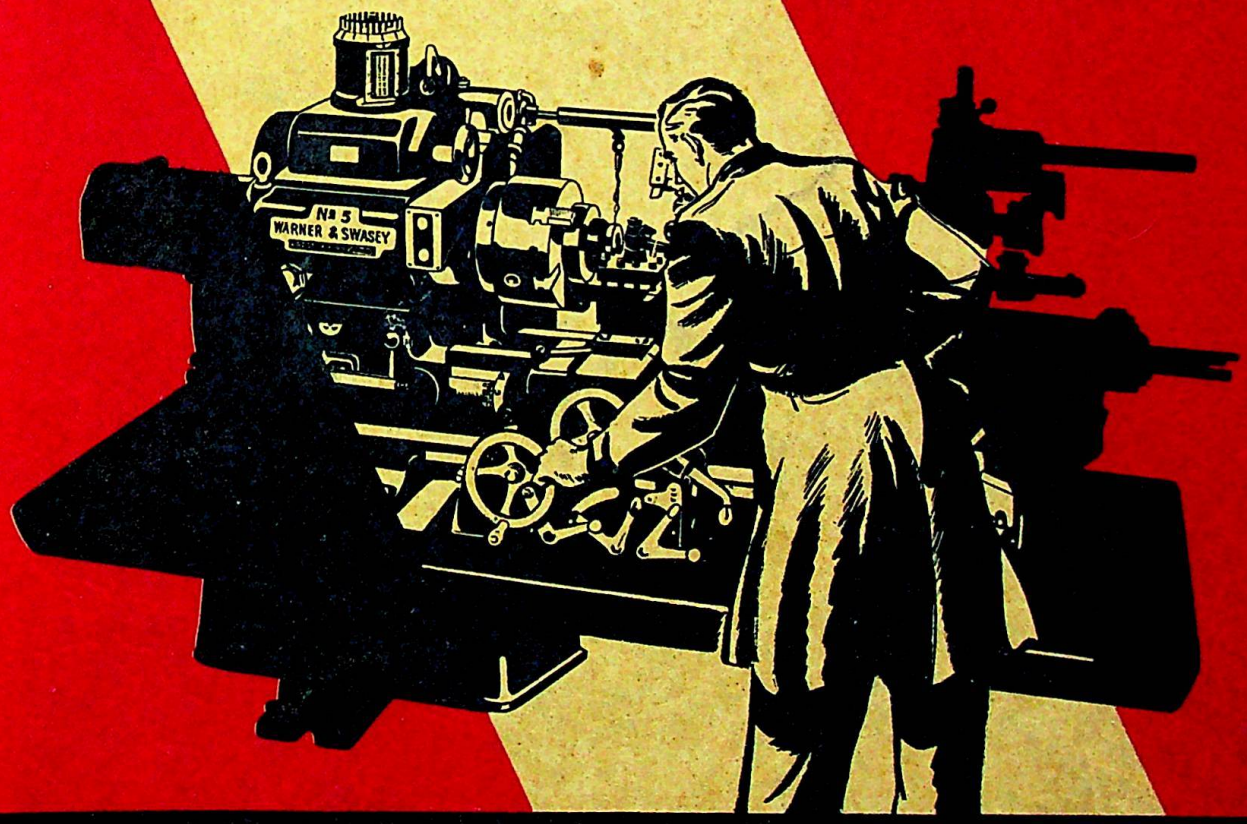
KNOW YOUR TURRET LATHE



WARNER & SWASEY "RAM" TYPE

CAUTION

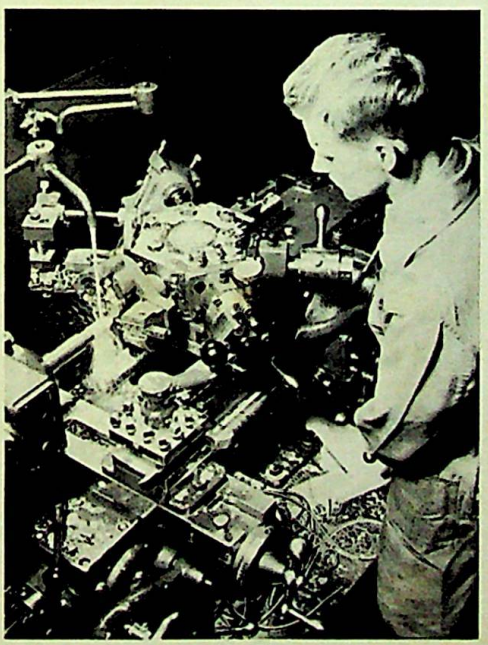
Do not order repair parts from this booklet . . . Consult your Service Manual.

SERVICE MANUAL

INSTALLATION MAINTENANCE REPAIR PARTS

WARNER & SWASEY
No. 3, No. 4, and No. 5
Universal Ram Type
TURRET LATHES

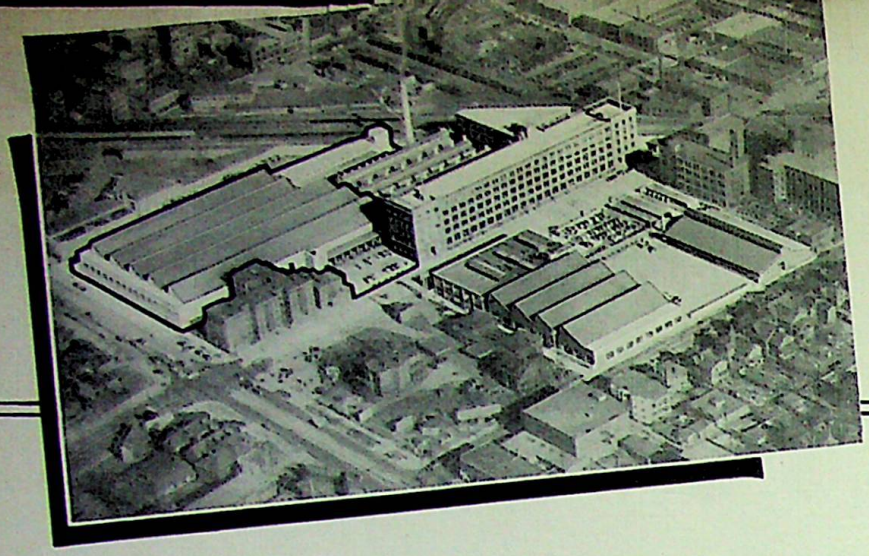
Warner & Swasey Turret Lathes are built to high standards of precision and accuracy and must pass rigid inspection before shipment. It is essential that the machine you purchase be properly installed and subsequently maintained to preserve its built-in accuracy, and to obtain its maximum productivity.



The purpose of this booklet is to instruct the maintenance foreman, millwright, and operator in these fundamentals. This manual should be kept available to these men at all times so that they may become familiar with lubrication and adjustment instructions, and construction details necessary to the best operation of the machine.

In addition to this service section, there is a section devoted to repair parts for this particular machine, serial number of which is given on the cover. The parts section should be used in connection with *this one machine only*. When a machine is transferred to another department or plant, the Service Manual and Parts List should accompany the machine.

Printed in U. S. A.



The factory where Warner & Swasey Turret Lathes are built, Cleveland, Ohio.
(Black outline shows the new factory addition)

SIZES AND TYPES OF TURRET LATHES

RAM TYPE

No. 1—ELECTRIC TURRET LATHE
(600 to 3600 R.P.M.) Bar Cap., 5/8"—Swing, 11"

No. 2—ELECTRIC TURRET LATHE
(600 to 3600 R.P.M.) Bar Cap., 1"—Swing, 14"

No. 2—SIX SPEED ALL GEARED HEAD TURRET LATHE
Bar Capacity, 1"—Swing, 14"

NO. 3—UNIVERSAL SIX SPEED ALL GEARED HEAD TURRET LATHE
Bar Capacity, 1½" . . . . . Swing, 15⅜"

No. 4—UNIVERSAL TWELVE SPEED ALL GEARED HEAD TURRET LATHE
Bar Capacity, 2" . . . . . Swing, 18⅛"

No. 5—UNIVERSAL TWELVE SPEED ALL GEARED HEAD TURRET LATHE
Bar Capacity, 2½" . . . . . Swing, 20"

SADDLE TYPE

1-A—UNIVERSAL HEAVY DUTY TURRET LATHE
Bar Capacity, 2½" . . . . . Swing, 16¼"

2-A—UNIVERSAL HEAVY DUTY TURRET LATHE
Bar Capacity, 3½" . . . . . Swing, 20"

3-A—UNIVERSAL HEAVY DUTY TURRET LATHE
Bar Capacity, 4½" or 6" . . . . . Swing, 23½"

4-A—UNIVERSAL HEAVY DUTY TURRET LATHE
Bar Capacity, 8" or 9" . . . . . Swing, 28¼"

5-A—UNIVERSAL HEAVY DUTY TURRET LATHE
Bar Capacity, 10" or 12" . . . Swing, 32" or 36"

LEAD SCREW FOR THREAD CUTTING can be furnished for No. 3, No. 4, No. 5 Universal Ram Type Turret Lathes—2-A, 3-A, 4-A, and is furnished as standard equipment on 5-A Heavy Duty Turret Lathes.

COMPOUND CROSS SLIDE can be furnished for No. 4, No. 5 and 1-A, (Hand Operated); 2-A, 3-A and 4-A Heavy Duty Turret Lathes, (Power Operated).

STANDARD TOOLS AND CHUCKS for all sizes of Turret Lathes carried in stock. Write for your copy of the New Warner and Swasey Tool Catalog.

WARNER & SWASEY *Turret Lathes*

BOSTON • SYRACUSE • NEWARK • PHILADELPHIA • PITTSBURGH • BUFFALO
DETROIT • CHICAGO • MILWAUKEE • DAYTON • HOUSTON • LOS ANGELES

FACTORY AND MAIN OFFICES: CLEVELAND, OHIO

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PRESELECTOR

CROSS SLIDE CARRIAGE

TURRET SLIDE AND SADDLE

FEED TRAIN

SPINDLE REMOVAL AND ASSEMBLY

ERECTING

When your turret lathe arrives, you will find an envelope containing the following data in the box with the wrenches and miscellaneous parts:

1. **PACKING LIST**—an itemized statement of all parts included in the shipment. The Receiving Clerk should check and account for each item on the list. Keep this PACKING LIST as a part of the permanent records of the machine.
2. **MACHINE TOOL DATA SHEET**—complete information necessary to the millwright when installing the machine. Also valuable data for production planning, such as speeds and feeds and specifications. Keep this sheet in the Production Planning records. A copy of this sheet is included in this Service Manual on page 37.
3. **ELECTRICAL EQUIPMENT SPECIFICATIONS**—Wiring diagrams and motor and starter specifications serve as a guide for the electrician. They should become a part of his permanent record file.

UNLOADING

Upon receipt of the machine, remove the crate and be careful that any small boxes attached to the crating are not destroyed. All loose parts, such as wrenches, tools, etc., are packed separately in wooden boxes nailed to the skids. Leave the skids under the machine until it has been moved to its final location or until it has been moved under a crane. Approximate weights of the machines are as follows:

No. 3 Universal	3550 lbs.
No. 4 Universal	4000 lbs.
No. 5 Universal	5000 lbs.

No. 3, No. 4 and No. 5 "Ram" Type Turret Lathes are equipped with eye-bolts to facilitate handling with a crane. Two eye-bolts are located on the headstock and one between the ways.

Cables or chains, adjusted to proper length for even lifting, may be used as shown in Fig. 1. Remove the eye-bolt between the bedways after the machine has been placed in position.

LOCATION

It is essential that the floor under the turret lathe be rigid. Ground floors are best. Ground level floors should have a concrete subfloor. On balconies and upper stories, the best construction is reinforced concrete, but even then, it is best to have the head end of the machine as near to a pillar as possible or close to a supporting wall. See Figures 2 and 3.

Wood floors swell and contract with atmospheric changes. A better foundation will be obtained if the wooden flooring is removed from the areas where the feet of the machine will rest. Remove an area for each leg several inches larger than the size of the foot. Fill the holes with concrete to floor level. Drill holes in the concrete for expansion nuts and lag screws to fit the particular pattern of the turret lathe leg. Refer to Machine Tool Data Sheet accompanying the turret lathe or see page 37 in this manual. See also (7), Fig. 9.

Place the turret lathe on ¼" thick steel plates so that the load on the concrete is not concentrated on the set screw area. Plates are shown as shaded areas in Fig. 9.

When it is absolutely necessary to place the machine on a balcony or upper story of *wood construction*, the weight must be distributed over as large a floor area as possible. Place four plates

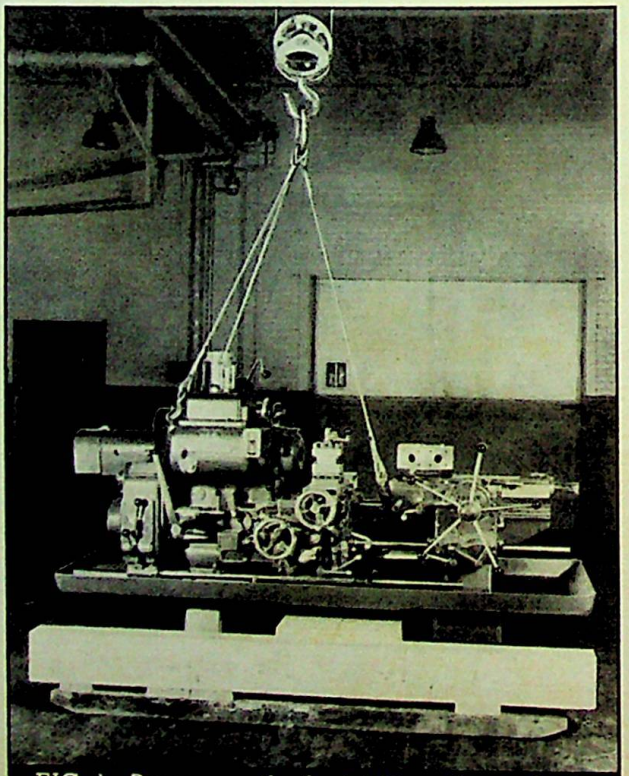


FIG. 1 *Proper method of lifting Turret Lathe with crane*

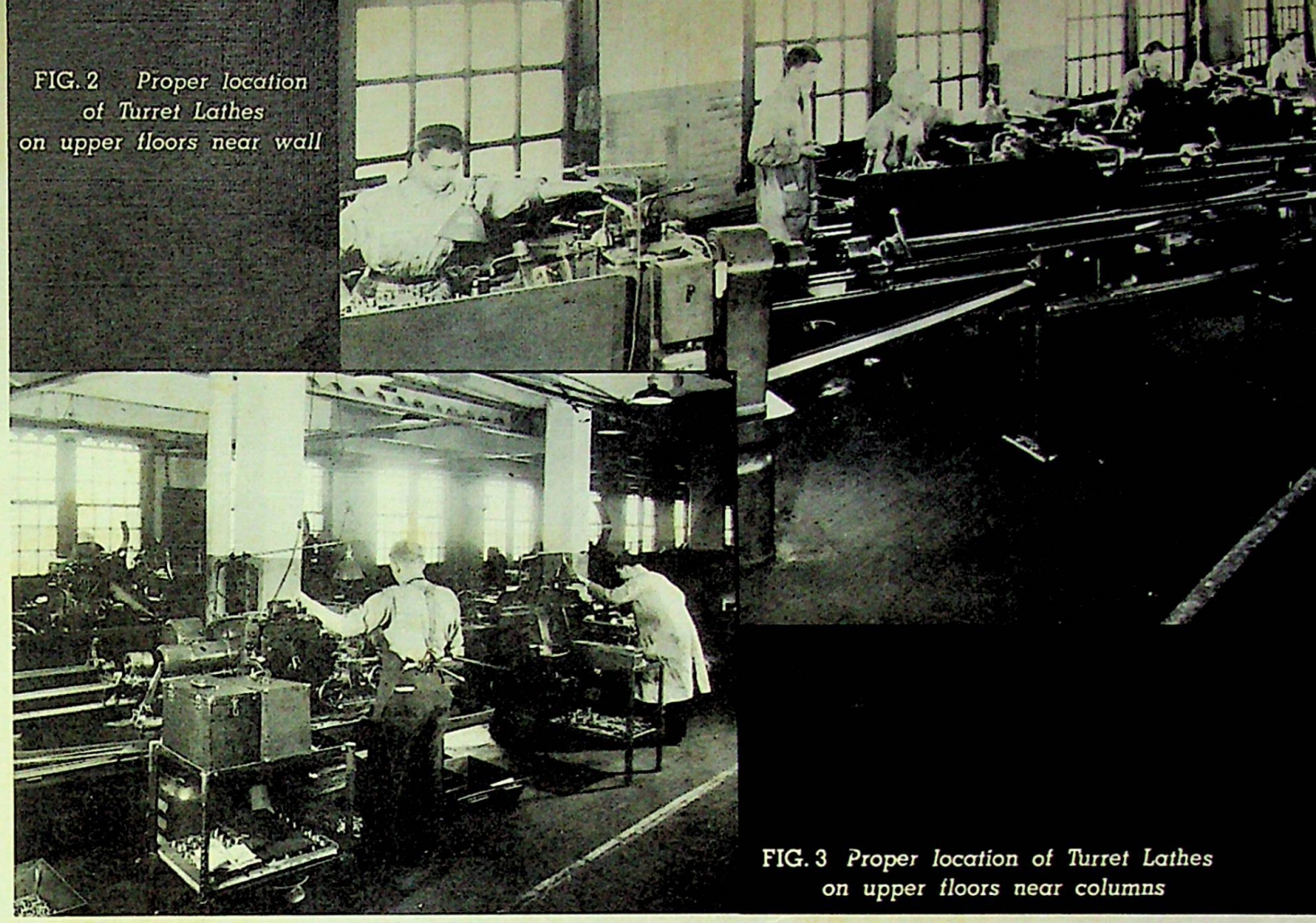


FIG. 2 *Proper location of Turret Lathes on upper floors near wall*

FIG. 3 *Proper location of Turret Lathes on upper floors near columns*

made from boiler plate about ½" thick, approximately 12" to 18" square to suit the need, one under each leg.

Oversize holes should be drilled in these plates for the lag screws (one for each leg) by means of which the machine is bolted to the floor. *All turret lathes should be bolted down regardless of their location.*

Don't embed floor legs in cement permanently. Machines must be periodically checked for level to give accurate performance.

CLEANING

1. *Do not operate the machine slides before cleaning and oiling,* for sludge will get into the bearing surfaces if this rule is not observed.

2. Use kerosene for cleaning. A stiff brush will get into the corners. Rags are better than waste because they leave no lint. *Do Not Use An Air Hose* – Pressure will drive grit and dirt into bearing surfaces.

3. After cleaning, rub machine oil over all bearing areas and make sure there is no grit left.

CAUTION: Warner & Swasey Turret Lathes are sprayed with a cellulose base lacquer, the highest grade paint available. Do not use caustic cleaners, they will injure the finish.

4. Periodic cleaning of the machine after installation is advisable. Prevent the development of permanent stains by wiping the machine off once a week with a rag soaked in new kerosene.

LUBRICATION

Do not operate the turret lathe before leveling and oiling, for all oil has been drained before shipment and the slides will bind unless the bed is level.

On some Warner & Swasey Turret Lathes there is an instruction plate, (2), Fig. 4 which gives complete information for proper lubrication of the machine. If your machine does not have a lubrication instruction plate, the following instructions should be used as a guide:

1. The headstock reservoir, located in the head end of the pan, should be filled with **turbine oil having 180 to 220 viscosity or engine oil having same viscosity, neutrality number .05 maximum; steam emulsion rate 60 maximum.** Red engine

oil having a high neutrality number is not satisfactory for use in a closed gear box because in case of condensation or moisture, will break down more quickly and start corrosion.

HEADSTOCK OIL RESERVOIR CAPACITY

No. 3 Universal	3¾ gallons
No. 4 Universal	3½ gallons
No. 5 Universal	4 gallons

The "Sight feed" oil gauge on the front of the head does NOT indicate the AMOUNT of oil in the head. It shows the FLOW of oil to indicate that the head lubricating pump and head lubricating system are functioning properly.

The disc type oil filter on the back of the headstock is provided with a handle for cleaning the sludge from the filter discs. To clean the discs, give the handle several turns.

The oil filter discs should be cleaned (several turns on the handle) as follows:

Once a week for one shift, twice a week for two shifts and three times a week for three shifts. Oil filter should be drained and cleaned at least twice a year. (See Lubrication Time Table).

2. Grease all fittings with an adhesive pressure lubricant such as Mobilgrease No. 1 or 2 or equivalent. Use grease gun furnished with machine or use a power grease gun if available. Be sure to grease the fitting inside of hexagon turret center hole (3), Fig. 4 and if bar equipment is furnished, look for two fittings (front and rear) on upper end of wedge shifter fork at left hand end of spindle (1), Fig. 4.
3. Grease three fittings located in round grease block below head on front of machine (10), Fig. 4. These carry grease to rear of machine to lubricate the coolant pump and headstock lubricating pump.
4. If the machine is equipped with an idler pulley for the motor drive, grease the fitting on the idler pulley bracket just inside the motor cabinet door. At the same time, fill the oil cup to lubricate the idler arm shaft.
5. Fill worm troughs (4), Fig. 4 generously in both aprons through oilers with same grade of oil as is used in headstock.
6. Move cross slide all the way in and then fill the plunger pump (5), Fig. 4 FOUR TIMES with oil. Force the oil down by inserting plunger and pushing it all the way down each time. This pump delivers oil to the front and rear bedways, the cross slide ways, and the cross feed screw and its nut.
7. Fill oil cups on front and rear of turret slide caps (6), Fig. 4.

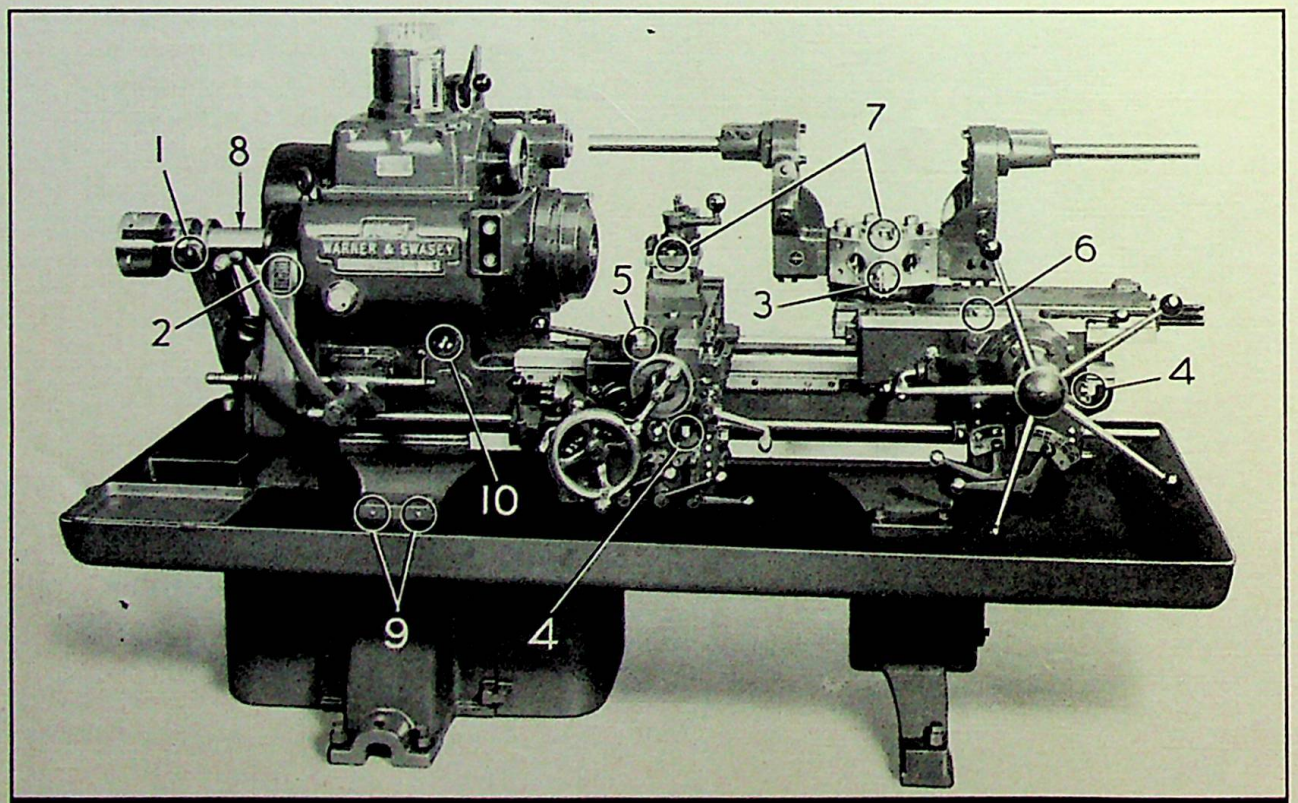


FIG. 4 *Lubrication*

8. Fill oil cups on top of hexagon turret and on the square turret (7), Fig. 4.

9. On machines with bar chucks, apply a mixture of graphite powder and machine oil to the left hand end of spindle where the hardened wedge (or spool) slides (8), Fig. 4. Do this for several days until these units are thoroughly burnished or "run in."

LUBRICATION TIME TABLE

1. DAILY

   a. Fill worm troughs generously. (See Note 5).

   b. Oil cross slide and bedways by giving pump four fillings and four full plunger strokes. (See Note 6).

   c. Fill oil cup on top of hexagon turret and on square turret. (See Note 8).

   d. Oil hexagon turret slide. (See Note 7).

2. WEEKLY

   Grease all fittings. (See Note 2).

   NOTE: The above schedule should be followed if the machine is operated for one shift; twice for two shifts, and three times for three shifts.

3. TWICE YEARLY

   Drain headstock oil reservoir in the pan, flush with clean oil and refill with turbine oil. *Drain and clean oil filter on back of headstock.*

MOTOR LUBRICATION

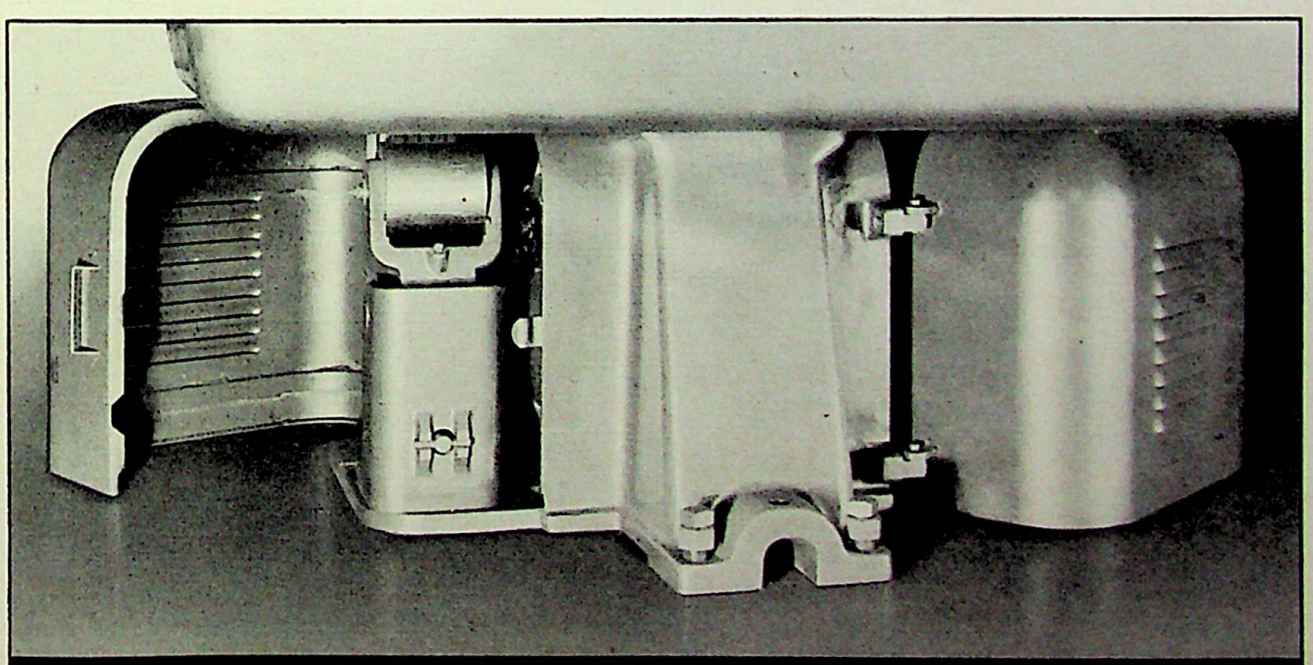
The motor and control are completely wired at the factory. The proper power supply should be connected to the starter through an acceptable disconnecting and branch circuit protective device. (See Electrical Equipment Specifications). Before operating the motor, it should be properly lubricated.

Motors with ball bearings should be greased *once a year only*. With motor stopped, remove the drain relief plug at the bottom of each bearing. Using the grease gun supplied with the machine, apply several shots of Mobilgrease No. 1 or 2 or equivalent in the grease fitting on top of the bearing.

When new grease starts to run out—run motor for about thirty seconds until surplus grease has stopped draining. This allows an air pocket to form inside the bearing and the grease room to expand under operation. When properly greased, replace each bearing drain plug.

CAUTION: *DO NOT PACK GREASE INTO BEARING.* A bearing tightly packed with grease will overheat and excess grease on the motor winding will cause the insulation to break down resulting in a short circuit.

Motors with sleeve bearings are oil lubricated. Before starting the motor, fill bearing chambers with a good grade of light mineral oil to 1/16th of an inch below the top of the overflow cup. Oil sleeve bearing motors *once a week.*



Ram Type Pedestal Motor Drive

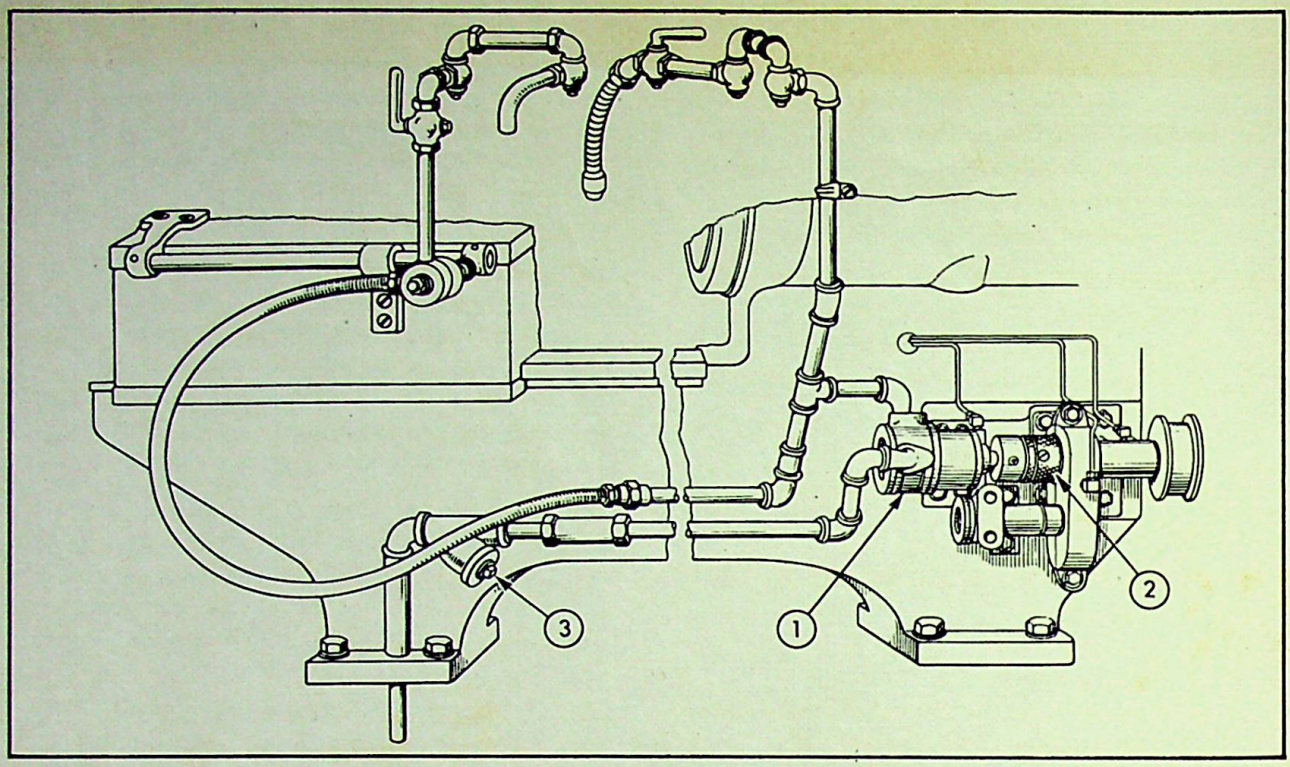


FIG. 5 *Coolant System and Lubricating Pump*

THE COOLANT SYSTEM

Fig. 5

The coolant pump (1) is self priming. In cases where the turret lathe is run without coolant, disconnect the pump at the coupling (2). *Do not remove the coolant pump driving belt*—this belt also drives the headstock lubricating pump.

The coolant strainer (3) should be removed occasionally and cleaned thoroughly. If the coolant ceases to flow freely the cause is generally a clogged strainer.

The coolant reservoir in the foot end leg should be drained and cleaned at least twice a year. On precision bar work using roller rest turners where high quality finish is demanded it is advisable to clean the reservoir every month.

COOLANTS AND COOLANT PUMPS

The water soluble oil coolants and cutting oils now marketed by the principal oil manufacturers do not injure the finish of the machine nor do they cause the bright metal parts to rust.

Occasionally a shop compounds its own coolant. This practice should be discouraged because any coolant of a caustic nature may attack the high grade lacquer finish of the machine and may also cause staining or rusting of the bright metal parts.

COOLANT LEAKAGE

The left hand (head end) leg of the bed is bolted to the floor leg directly, while the pan can slide a limited amount between the two to allow the pan to expand or contract without affecting the bed alignment. This slip joint is packed in waterproof grease and should not require attention. If, however, slight leaks should ever develop, remove the four ¼" pipe plugs in the bed leg near the pan (9), Fig. 4 , insert a grease fitting and apply waterproof automobile water pump grease, available in most automobile service stations.

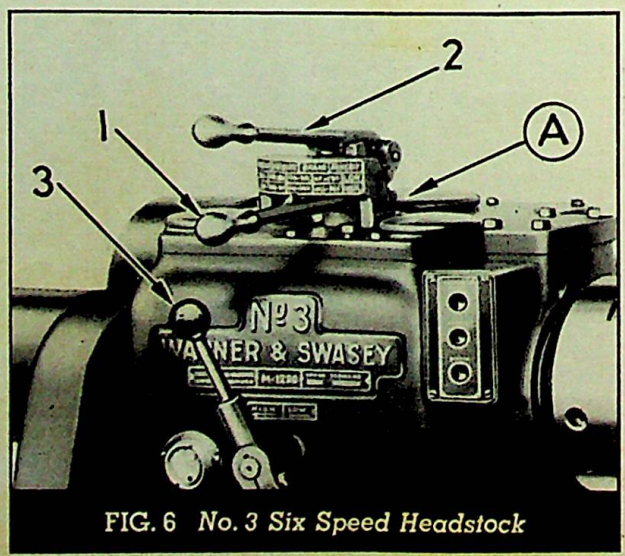


FIG. 6 *No. 3 Six Speed Headstock*

NOMENCLATURE

"A" HEADSTOCK (No. 3 Universal) Fig. 6

1. Triple Gear Shift
2. Forward and Reverse Clutches
3. High-Low Clutch

"B" HEADSTOCK (No. 4 and No. 5 Universal)

4. Surface Speed Preselector
5. Preselector Drum Housing
6. Spindle Control Lever
7. Preselector Handwheel

"C" CHANGE GEAR BOX
(For halving or doubling all feeds)

8. Feed Shaft

"D" UNIVERSAL CROSS SLIDE CARRIAGE UNIT

9. Cross Slide
10. Carriage
11. Square Turret
12. Square Turret Indexing and Binder Handle
13. Longitudinal Feed Handwheel
14. Cross Feed Handwheel
15. Carriage Clamp
16. Cross Feed Engagement Lever
17. Longitudinal Feed Engagement Lever
18. Carriage Apron
19. Feed Shift Levers
20. Feed Reverse Lever
21. Longitudinal Stop Rod
22. Master Stop Screw
23. Longitudinal Feed Stop Roll

"E" HEXAGON TURRET UNIT

24. Hexagon Turret
25. Circumference Binder Ring
26. Turret Slide
27. Saddle
28. Slide Binder Lever
29. Turnstile
30. Saddle Apron
31. Feed Shift Levers
32. Feed Engagement Lever
33. Stop Roll

"F" COLLET CHUCK

34. Bar Chuck Lever
35. Bar Chuck Wedge
36. Finger Holder

"G" RATCHET BAR FEED

37. Bar Feed Head
38. Ratchet Pawl Lever
39. Bar Feed Tube Clamp
40. Bar Feed Tube

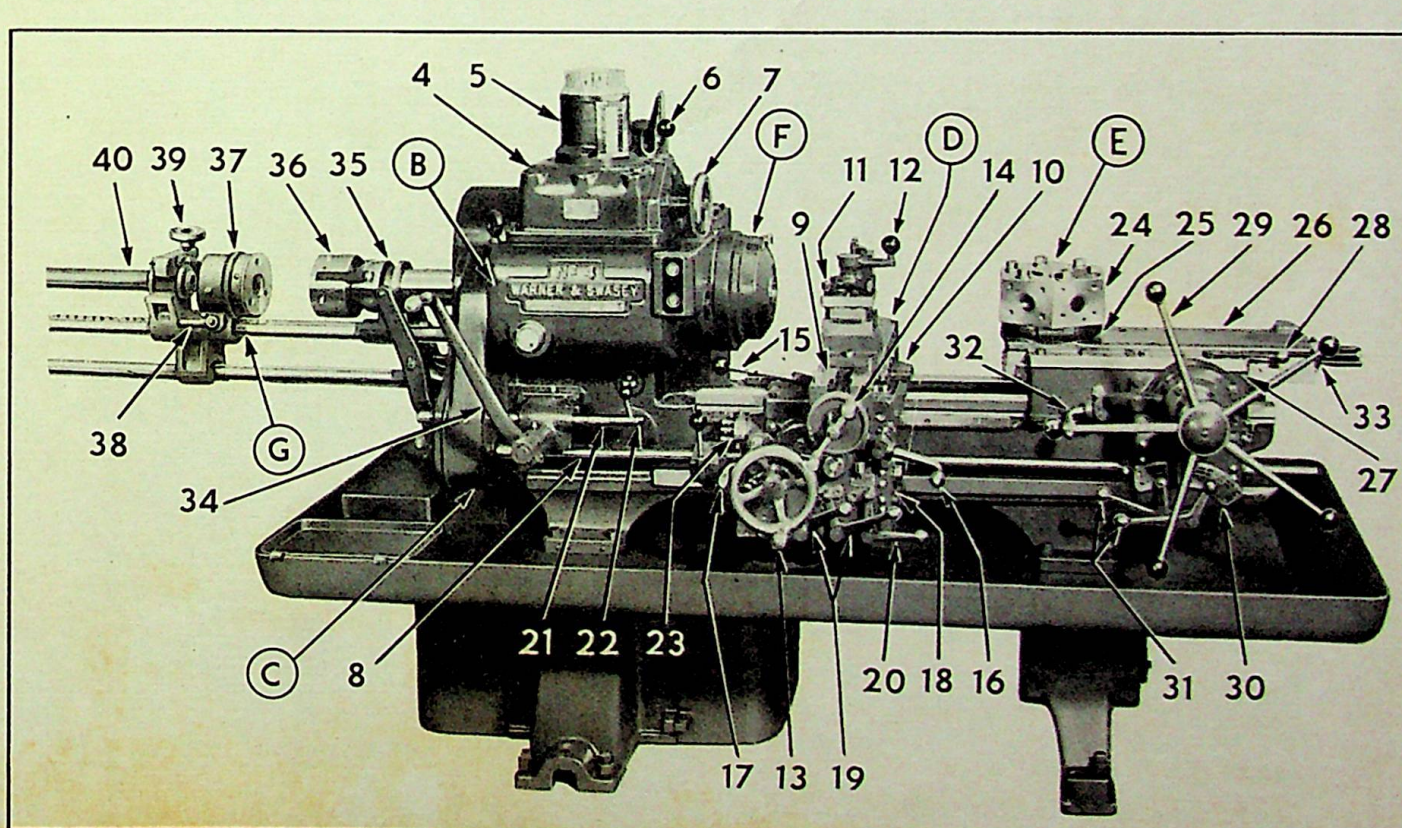


FIG. 7 *Nomenclature—No. 4 Universal Turret Lathe*

ALIGNMENT

The care exercised in the alignment of a turret lathe bed, determines the degree of accuracy obtained from the finished product turned out by the machine. Align the machine carefully when installing and periodically check the alignment to keep wear at a minimum and to obtain the accuracy built into the machine.

ALIGNMENT "DON'TS"

1. *Don't* use wooden wedges for leveling turret lathes. Wood expands and contracts with moisture changes. Use leveling screws.
2. *Don't* use a machinist's level. It's not accurate enough. Use sensitive spirit level (Fig. 8).
3. *Don't* disturb the bolts which hold the bed, pan and legs together. These bolts have been carefully adjusted at the factory to match the pan.
4. *Don't* try to level a turret lathe that has just been brought into the shop. It may have been exposed to the blazing sun or extreme cold. Give it 24 hours to take on room temperature.
5. *Don't* expect a turret lathe to line up accurately at once if it has been in storage on skids for an extended period of time, as in a warehouse or on shipboard. Under such conditions heavy strains may be set up and time is required for these strains to equalize. Level the machine as accurately as possible, at first, and ***after two weeks recheck the alignment.***
6. *Don't* expect a machine to remain level permanently. Buildings settle and floors warp. Machines placed on concrete floors or bases should be checked for alignment at least twice a year. The alignment of machines on wood floors should be checked every three months to maintain utmost precision.

ALIGNMENT INSTRUCTIONS

In the following instructions the use of the word "leveling" refers to the truing of the machine to an approximate level condition. The term "alignment" refers to a refinement of leveling for the purpose of removing all possible twist and strains from the machine elements in order to promote accuracy.

The alignment of the turret lathe falls into three distinct phases: 1. Leveling, 2. Alignment, 3. Precision Alignment.

FOR LEVELING, an ordinary level can be used.

FOR ALIGNMENT, a sensitive adjustable, graduated tube spirit level is required, reading to 10 seconds of arc per graduation (.0006" per foot). One provided with screw adjustment is best. Ordinary levels are not accurate enough for this type of leveling. A suitable level, with protective case, is listed on page 152 in the Warner & Swasey Turret Lathe Tool Catalog, Part No. SO-660 (Fig. 8).

If a non-adjustable level is used for alignment, paper shims can be used to center the bubble. The actual length of the level base has no bearing on its accuracy. The glass tube alone determines its sensitiveness. A short level with a long tube is best. It costs less and can be handled or stored with less danger of damage. When the frame is not long enough, an accurate parallel can be placed underneath it.

PRECISION ALIGNMENT is a refinement of leveling that requires work tests and may or may not be necessary as determined by the work handled over the machine. "Alignment" of the turret lathe should be periodically checked to assure safe operation and accuracy.

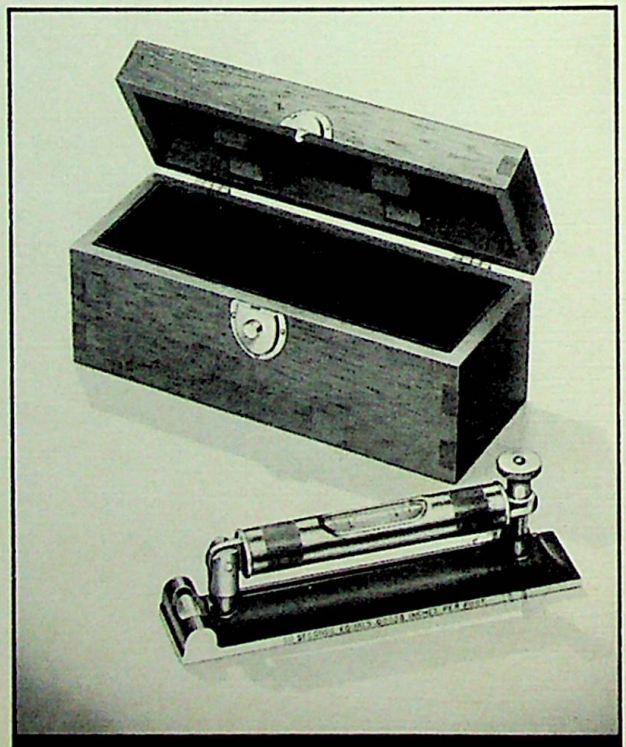


FIG. 8 *W. & S. Sensitive Spirit Level*

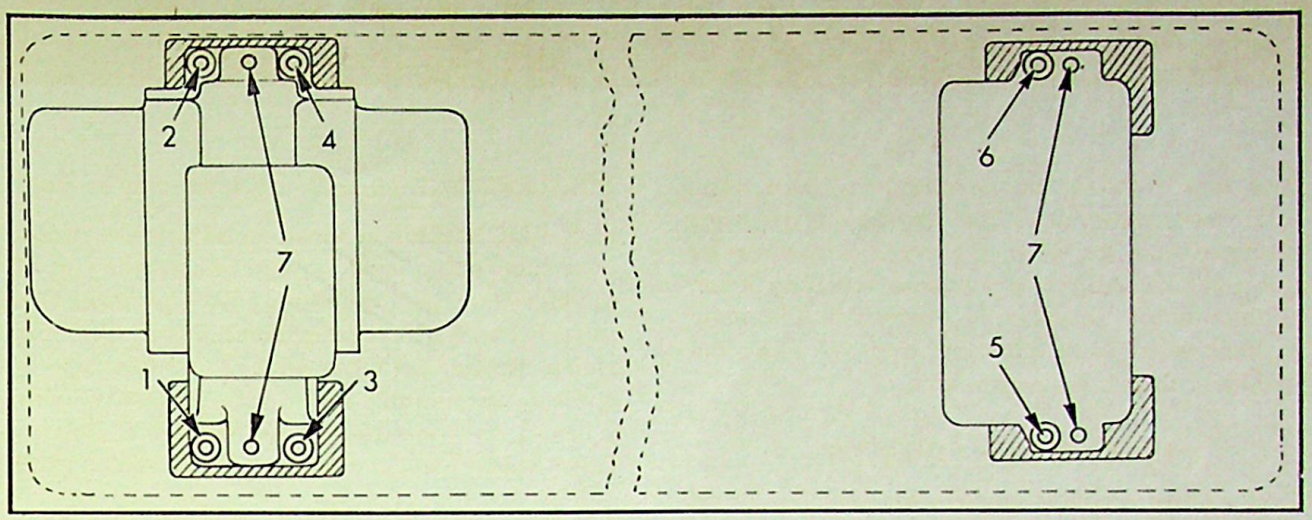


FIG. 9 *Leg Diagram showing leveling screws*

LEVELING

Fig. 9

Machines are leveled by raising the legs off the floor. Adjusting screws are provided for that purpose in the bottom of each leg (See 1 to 6, Fig. 9).

1. Back out leveling screws 1 to 6 so they do not support the machine.
2. Level the machine bed with ordinary level, using set screws 3, 4, 5 and 6 only. Be sure all four leg castings are free from the floor at least ⅛ inch. Do not bring screws 1 and 2 to bear as yet.

NOTE: In the further steps described for alignment operations, it is not necessary to attain greater accuracy of true level. These additional steps are merely for the purpose of removing all twist from the bed so that the slides will travel on the entire ways, in parallel relation to the spindle.

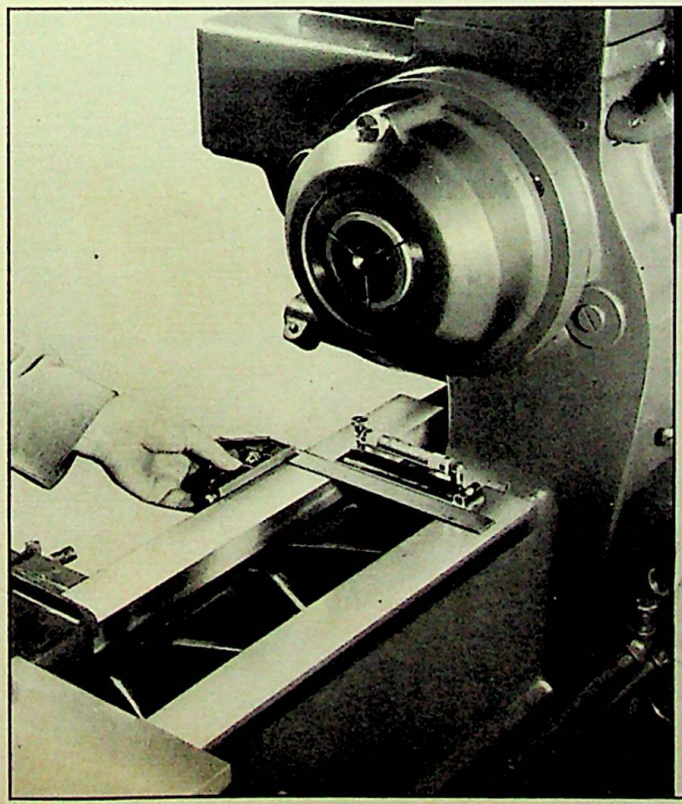
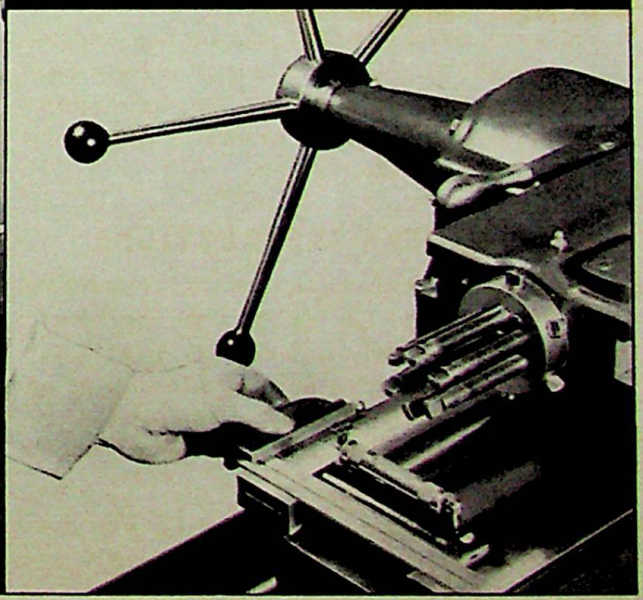


FIG. 10 *Level at left hand end of Bedways near headstock*

FIG. 11 *Level at right hand end of Bedways near outer end*



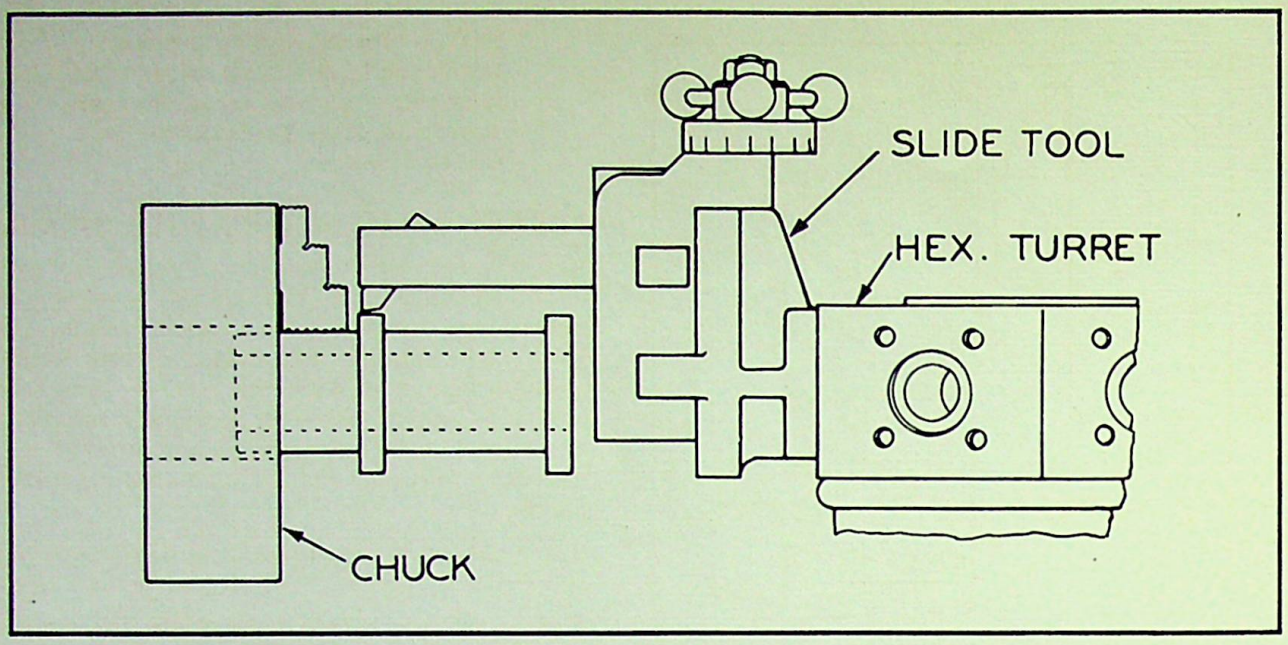


FIG. 12 *Vertical Parallel Alignment Test of Spindle with ways*

ALIGNMENT

1. Place the sensitive spirit level across the bed at right angles to the center line near the headstock as in Fig. 10. Use a combination square against the front of the bedway to make certain that the sensitive spirit level is at right angles to the bed. *This is very important* because any variation from square will result in an incorrect reading of the level. If level is too short, use a parallel underneath it. Adjust the level until the bubble is in the center, allowing at least one-half minute for the bubble to come to rest.

2. Without changing its adjustment, move the level and square to the outer end of the bed as in Fig. 11. Place it again at right angles to the center line. Now bring the bubble to center by adjusting the leveling screws on the right hand leg of the turret lathe. (See (5) and (6), Fig. 9).

3. Repeat operations 1 and 2 until the two readings are alike within one-half division or better on the glass tube.

4. Bring screws (1) and (2), Fig. 9 down to a solid bearing and recheck with the level as instructed in operations 1 and 2.

PRECISION ALIGNMENT

For most purposes the leveling operations described previously are sufficient. In exceptional case where work must be finished straight (without tapering) to very close limits, it will pay to carry the alignment process farther as described above:

Work Test for precision vertical parallel alignment. It is possible to adjust the relation of spindle to bed a limited amount in the vertical plane by means of screws (1) and (2), Fig. 9.

Turn or bore work with the hexagon turret, with the tool mounted vertically above the spindle in bar held in Vertical Slide Tool, Fig. 12.

Because the work farthest away from the collet chuck or chuck tends to spring away under tool pressure, it is advisable to take a fine finishing cut after roughing. The work test will be more accurate.

Bar stock should not be used for such testing purposes, for it bends downward of its own weight if projecting any distance at all. If the test is made on work of small diameter, tubing must be used, or else the work must be of sufficiently large diameter, relative to its length, to prevent sagging.

If right-hand end of work comes smaller turn adjusting screws (1) and (2) down Fig. 9. This will raise left-hand end of spindle.

If right-hand end of work comes larger, turn adjusting screws (1) and (2) up Fig. 9. This will drop left-hand end of spindle.

NOTE: Warner & Swasey factory inspection limit for this test is .0005 inch actual alignment, or .001 inch variation of work diameter in 6 inches of length.

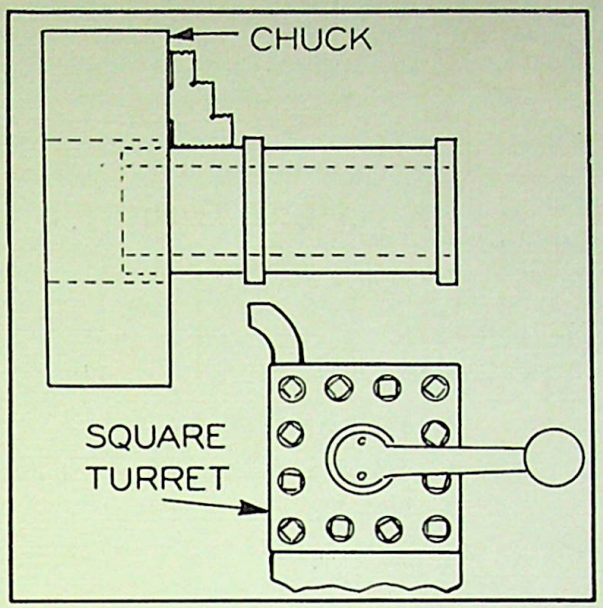


FIG. 13 *Horizontal Parallel Alignment Test of Spindle with ways*

Work Test for precision horizontal parallel alignment.

The final test of alignment, of course, consists of checking the accuracy of work being machined. To do this, chuck a piece of work and turn the outside diameter with the square turret (Tool in front of work and on center) Fig. 13.

If right-hand end of work comes smaller turn adjusting screw (6) Fig. 9 down slightly. This will raise the rear right-hand end of bed.

If right-hand end of work comes larger turn ad justing screw (5) Fig. 9 down slightly. This will raise the front right-hand end of bed.

NOTE: Warner & Swasey factory inspection limit for this test is .0005 inch actual alignment, or .001 inch variation of work diameter in 6 inches of length.

TURRET HOLES IN LINE WITH SPINDLE

At the Warner & Swasey Company's factory, after final inspection and after careful leveling, the turret holes and faces are finished from the machine's own spindle. This method assures highest possible accuracy. After the machine has been leveled in accordance with previous instructions, this alignment between spindle and turret is automatically reestablished and requires no further attention.

If it is desired to check the turret hole alignment, special tools are required as shown in Fig. 14.

A piece of tubing is held in the chuck. The micrometer head is mounted at the end of the tube. It revolves around a ground plug, which, in turn, must have a good fit in the turret hole.

The tubing does not have to run true and need not be straight. It has purposely been shown in the sketch with a bend in it and it is obvious that the micrometer will still travel around the center of revolution of the spindle and hence will give a true reading of the spindle location.

CAUTION: A dial indicator is not recommended because it will not read to the same zero point when rotated to several positions with the spindle. Use of the micrometer allows for more accurate reading.

Do not use solid bar stock in place of tubing because it sags of its own weight.

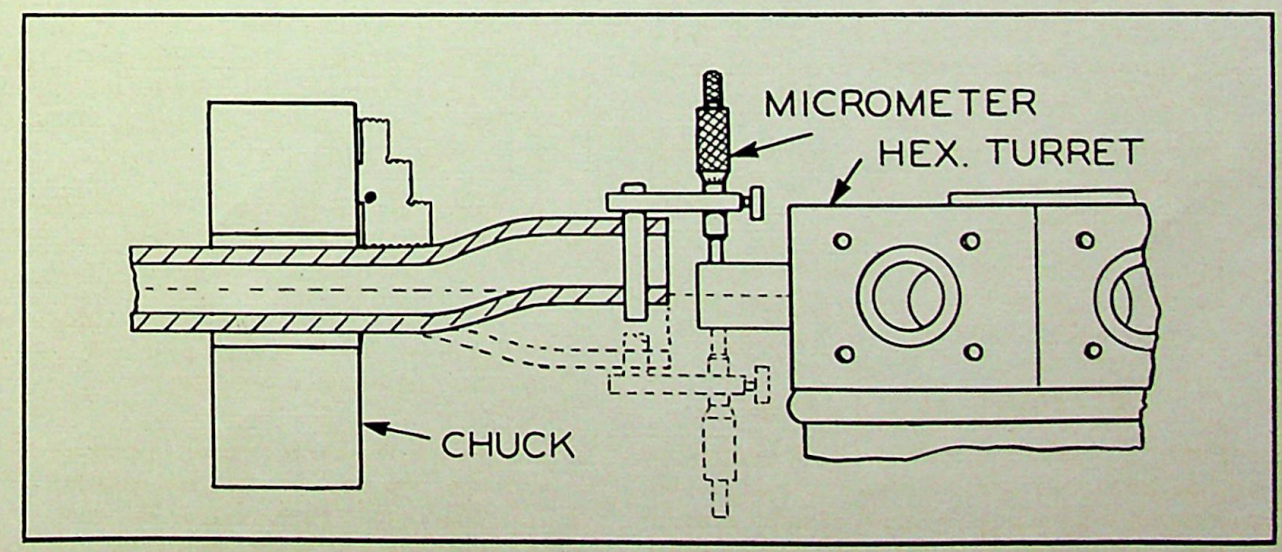
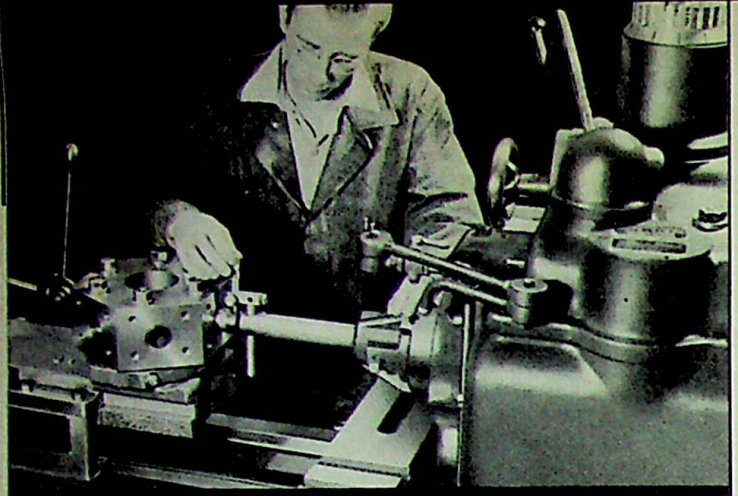


FIG. 14 *Alignment Test for Turret Holes*



Making a Turret Hole Alignment Test.

It must be appreciated that the turret hole alignment with the spindle varies with changing temperatures of the headstock. Consequently, turret holes are bored with head temperature as close to normal running condition in a machine shop as possible.

However, when making a turret hole alignment check on the machine, more accurate readings can be obtained when the machine is cold.

TURRET INDEX ACCURACY

The accuracy of index of the hexagon turret should not be confused with turret hole alignment.

Accuracy of index is dependent on the adjustment of the center bearing, fit of lockbolt, lockbolt sleeve, lockbolt bushing and lockbolt spring. A check of these parts will often show that what is thought to be index error or turret-hole misalignment, is a matter of renewing the lockbolt spring. *Do not use an ordinary or homemade lockbolt spring.* The lockbolt spring is made to our special specifications based on its particular requirements. These springs are always carried in stock at the factory.

When all leveling and precision alignment have been completed, the turret lathe should be bolted down. Lag screws provided with the machine should be screwed down solidly but not forcibly seated in such a manner as to disturb the alignment of the turret lathe. After bolting the turret lathe to the floor, it should be again checked with an accurate spirit level.

ALIGNMENT OF OVERHEAD PILOT BAR ATTACHMENT

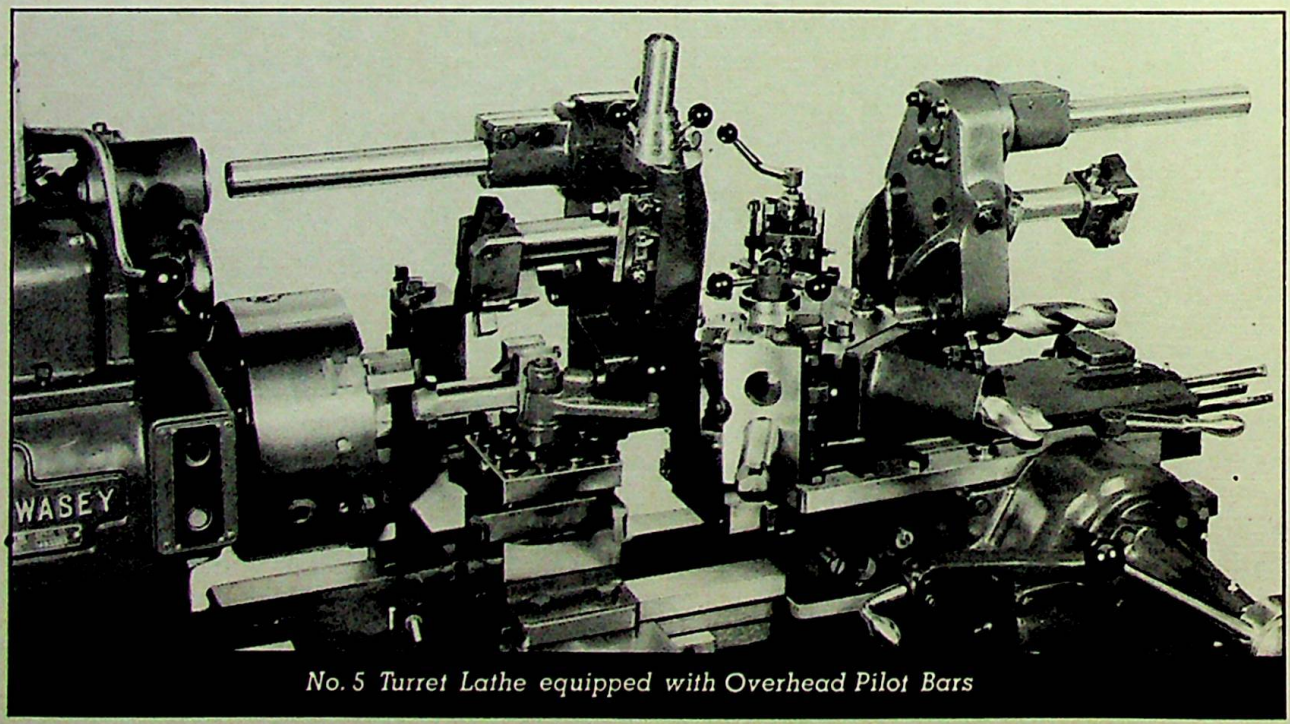
Fig. 15

When a machine is equipped with Overhead Pilot Bars at the factory it is not necessary to re-align the attachment. The factory alignment will be automatically reestablished when the machine is leveled and aligned.

If an Overhead Pilot Bar Attachment is to be installed after the turret lathe has been in operation for some time, it is first necessary to reestablish the alignment of the machine before proceeding.

TO INSTALL HEAD ATTACHMENT

1. Remove two cap screws and two screw plugs from head-cover just over spindle nose.
2. Assemble Overhead Pilot Bar Head Attachment and bolt to head with four cap screws (1).



No. 5 Turret Lathe equipped with Overhead Pilot Bars

TO ALIGN OVERHEAD PILOT BAR

1. Place pilot bar in bushing (2) allowing bar to project about 1 inch through far side of bushing.
2. With indicators mounted in square turret as shown in Fig. 15, adjust bushing for parallel and vertical alignment, using adjusting screws (3), (4) and (5).
3. Move the carriage along the bed to check alignment of the pilot bar over its entire protruding length. Tolerance allowed is .0005 inch horizontally and vertically.

TO ALIGN TURNING HEAD AND PILOT BAR

1. Use hollow screw (6) to open split section of bracket (7) and slide bracket over bar allowing it to extend about one inch. Release screw (6) and clamp bracket (7) to the pilot bar using screws (8).
2. Next, scrape a bearing surface (9) on the turning head perfectly parallel with surface (10) on the bracket. Leave the pilot bar and bracket in aligned position and as scraping is being done, move the turning head up to check the bearing.
3. When a good bearing has been obtained, insert pilot bar bushing (11) in turning head hole. By means of four floating bolts (12), clamp bracket and pilot bar to the turning head.
4. Adjust pilot bar bushing with four hollow screws (13) in bracket (6). Using indicators, check alignment of pilot bar to within .0005 inch.
5. Move turret slide away from head, then check alignment of pilot bar as it enters the bushing hole. Allowable vertical and horizontal movement is .0005 inch.
6. When pilot bar alignment has been correctly established, hand ream the taper pin holes (14), front and rear, and insert taper pins.

NOTE: No. 3 Turret Lathes use No. 7 taper pins and No. 4 and No. 5 Turret Lathes use No. 9 taper pins. The long taper pin goes in the rear of the head attachment.

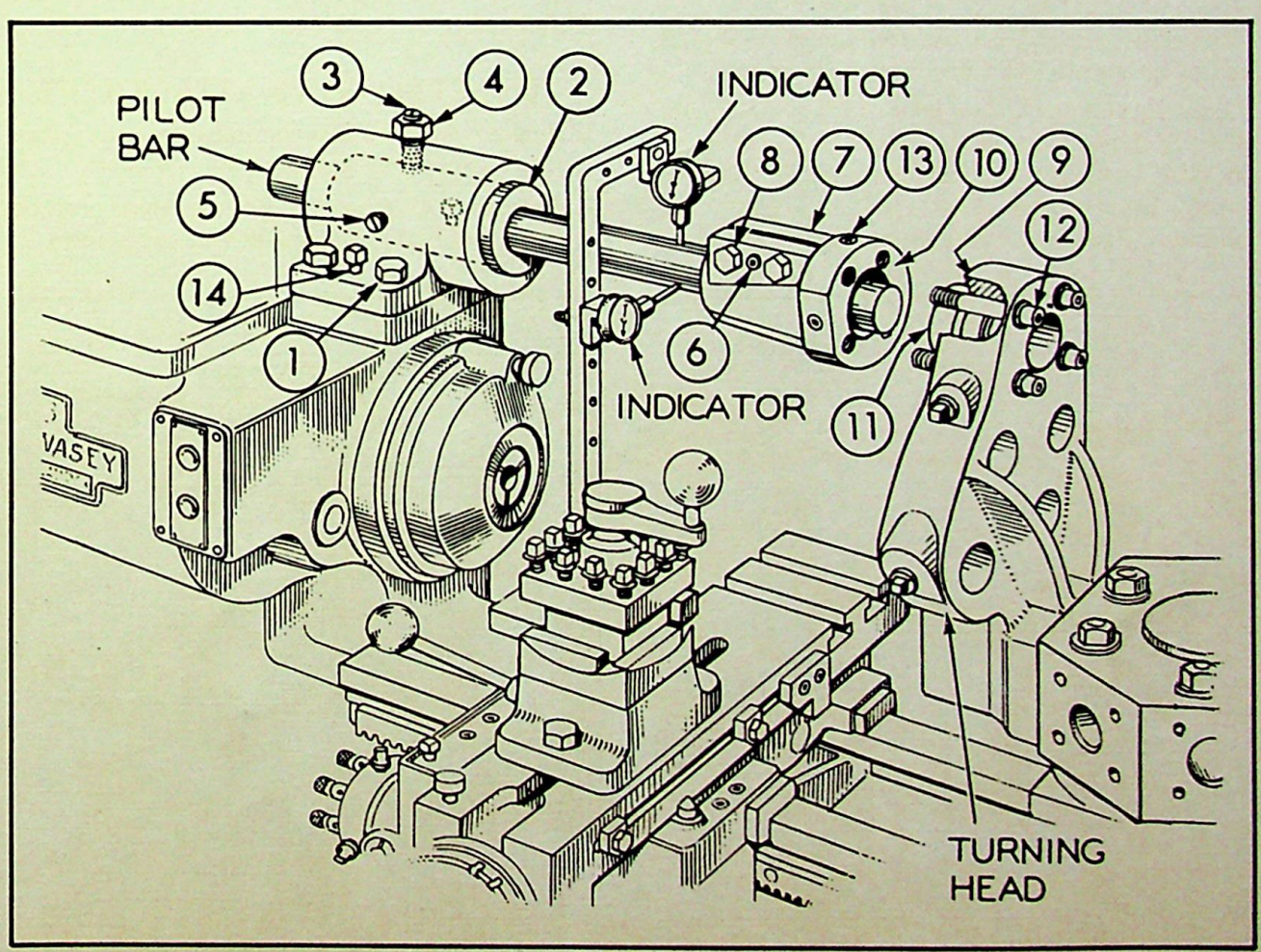


FIG. 15 *Alignment of Overhead Pilot Bar*

HIGH-LOW CLUTCH: NO. 3 TURRET LATHE ONLY;

Fig. 16

These two clutches are of the cone type. To adjust them loosen screws (4) which clamp the threaded and split collars. Rotate the latter and then clamp screws (4) again before trying the adjustment.

The linings of the two clutches have been developed through extensive experiments and tests with a variety of clutch facing materials. The low speed clutch has a metallic lining while the high speed clutch lining is of organic type.

To keep organic lining in the best possible condition for smooth action, even at the highest speeds, keep the high speed side of the clutch in engagement whenever the machine stands idle, such as during the night, etc. Both linings are renewable, but they will give years of satisfactory service. To replace the lining, return the drum to the factory. For export shipment it is advisable to order complete new drums.

TO ADJUST "TWIN DISC" FORWARD AND REVERSE CLUTCHES

Fig. 17

Disc type clutches will give longer service if kept in proper adjustment. A slipping clutch will wear rapidly.

To adjust the clutch, stop the drive shaft and place the clutch operating lever in neutral. Bring pins (1) to the top so they can be reached through the hand-hole in the head cover. Pull back pin (1) and turn collar (7) clockwise (R. H. thread) to tighten. Turn collar (7) to advance pin one hole (8) at a time and test adjustment by engaging the clutch with a steady pressure rather than a jerk. Instantaneous clutch engagement exerts a tremendous pull on the driving vee-belts, especially at high speeds.

TO TAKE APART TWIN DISC CLUTCH NO. 3 TURRET LATHE

Fig. 17

1. Remove gears, clutch shells and bearings from both ends of shaft.

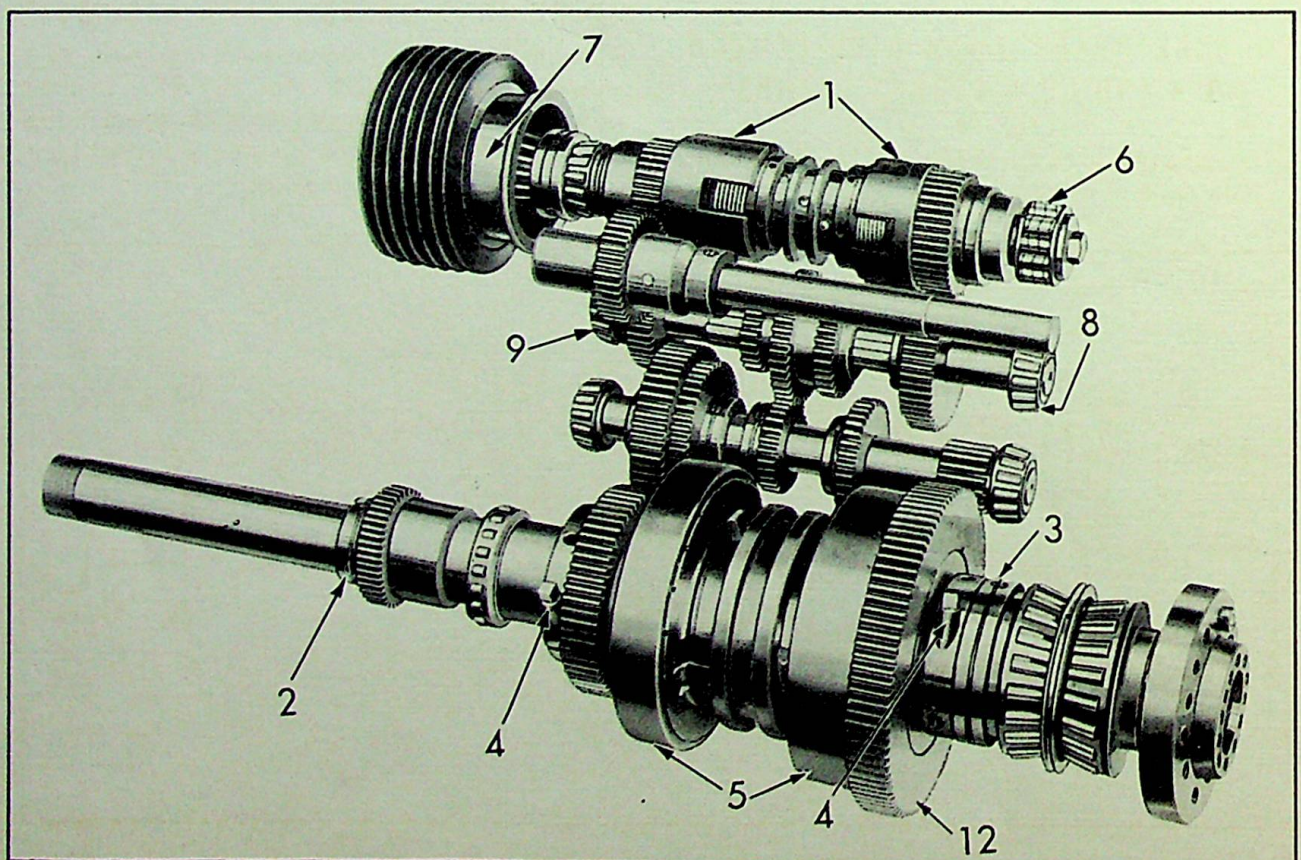


FIG. 16 *Six Speed Head for No. 3 Turret Lathe*

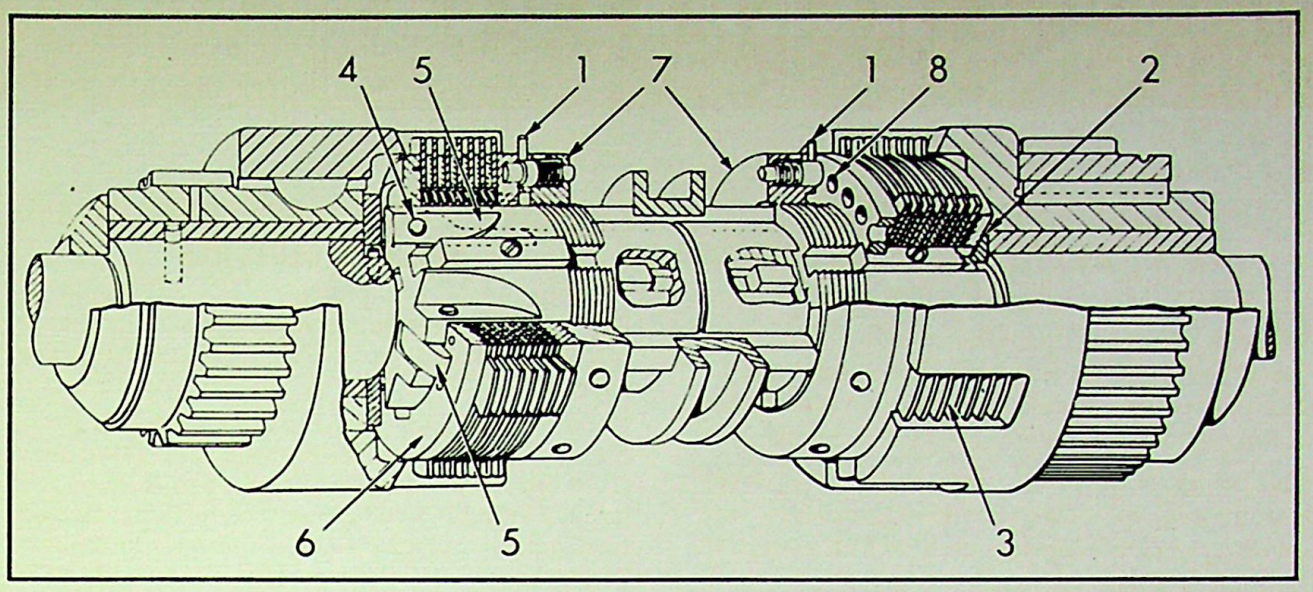


FIG. 17 *The Twin Disc Clutch for No. 3 Turret Lathes*

2. Remove split collar (2) from right hand end of drive shaft.
3. Remove entire clutch unit from the drive shaft.
4. Release clutch adjustments (1) on both sides.
5. Compress plate unit to expose finger lever pins (4). Drive out finger lever pins (4) and remove fingers (5). The floating plates (6) and clutch plates (3) can then be removed.

TO TAKE APART TWIN DISC CLUTCH NO. 4 AND NO. 5 TURRET LATHES

Fig. 18

1. Remove gears, clutch shells, and bearings from both ends of drive shaft.
2. Remove split collar (2) from right hand end of shaft.
3. Remove entire clutch unit from the drive shaft.
4. Release clutch adjustments (1) on both sides.
5. Compress plate unit, remove snap rings (4) on both sides and the floating plates (6) and clutch plates (3) can then be removed.

TO REMOVE DRIVE SHAFT ASSEMBLY

At right hand end, the drive shaft floats in a straight roller bearing (6), Figs. 16 and 19 to allow for elongation from heat developed by the clutches. A double row taper roller bearing at the left-hand end locates the shaft endwise.

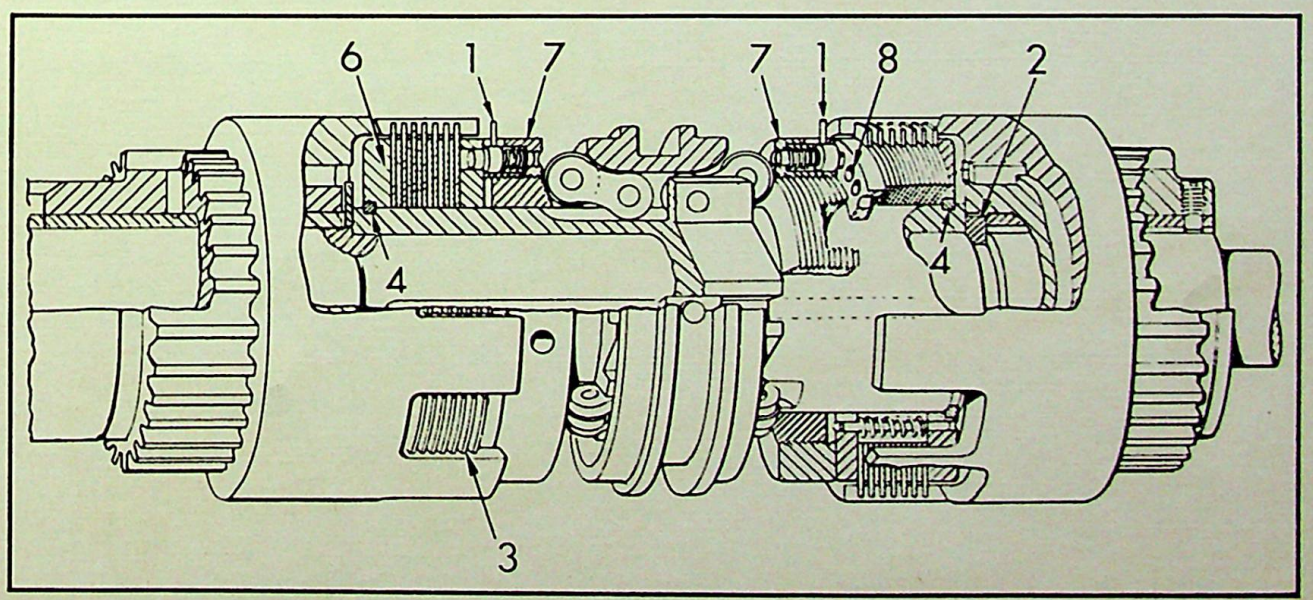


FIG. 18 *The Twin Disc Clutch for No. 4 and No. 5 Turret Lathes*

Before removing the drive shaft, it is first necessary to release the brake fork mechanism and remove the idler shaft. Proceed as follows,

1. REMOVE IDLER SHAFT (See Fig. 20)
   a. Remove head cover or Preselector.
   b. Remove drive sheave (7) Figs. 16 and 19.
   c. Remove the idler shaft lock screw (1). On No. 3 Turret Lathes this screw is located at the left-hand end of the shaft in the head. On No. 4 and No. 5 Turret Lathes it is located at the right-hand end.
   d. Remove the screw from the collar (2) and take out the cotter pin, screw and spring from the idler gear fork (3).
   e. Pull the idler shaft from the left-hand side by means of a screw threaded into the end of the shaft (4). Lift off fork, collar and gear as shaft is pulled out. Be careful not to lose the detent ball in the fork when withdrawing the idler shaft.
2. REMOVE THE BRAKE FORK MECHANISM (See Fig. 24)
   a. Disconnect oil line at coupling (9).
   b. Remove three screws (8).
   c. Pull entire brake fork mechanism away from head to withdraw fork (10) from clutch operating ring.
3. REMOVE THE ADJUSTING NUTS (See Fig. 21) that hold the bearings of the back shaft (8) and (9) Figs. 16 and 19. Remove the binder screws from the gears at both ends of the shaft. Drop right-hand end of this shaft assembly down into headstock.
4. LOOSEN THE ADJUSTING COLLAR SET SCREW located on the sheave and unscrew the collar.
5. REMOVE THE SCREW IN THE HEAD WALL which retains the housing for bearing (6). This housing *is not* threaded into the headstock. Do not remove housing immediately. It will serve as a pilot when pushing out the drive shaft.
6. BY STRIKING THE LEFT-HAND END of the drive shaft with a babbitt hammer, the entire assembled unit can be pushed out of the right-hand end of the headstock housing.

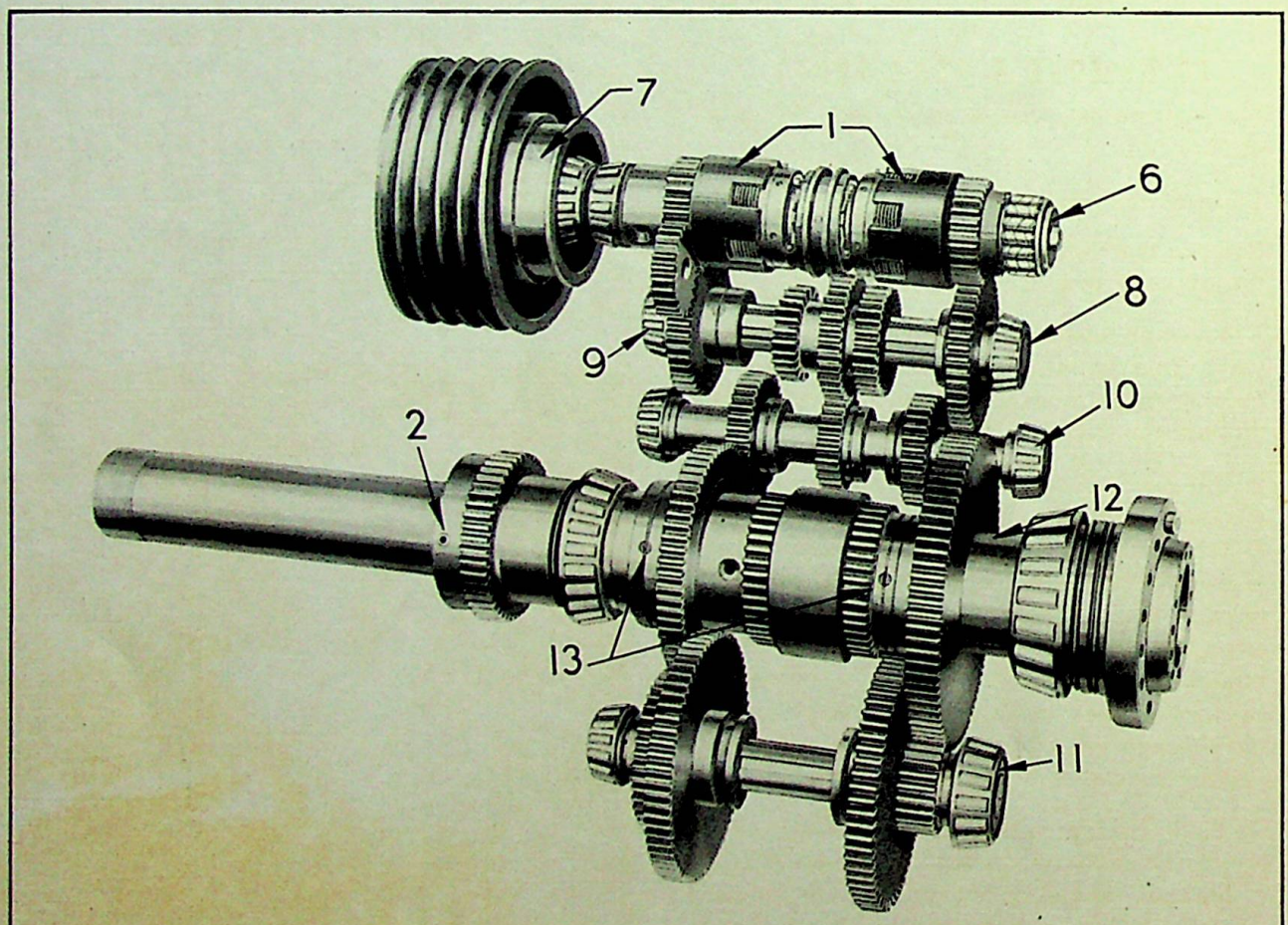


FIG. 19. *Twelve Speed Head for No. 4 and No. 5 Turret Lathes*

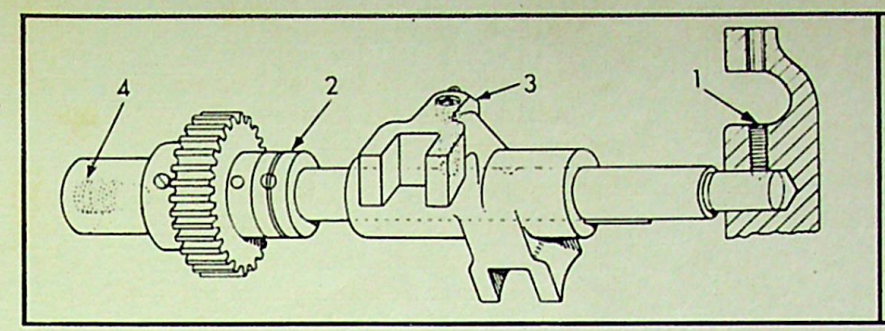


FIG. 20 *Idler Shaft— No. 3, No. 4, and No. 5 Turret Lathes*

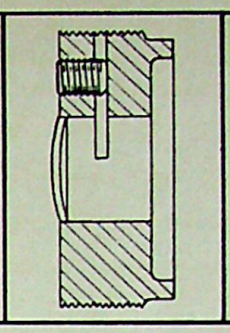


FIG. 21 *Adjusting Nut*

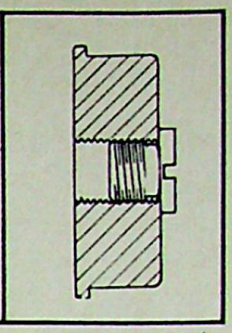


FIG. 22 *Screw Plug*

GEAR SHAFTS

The gear shafts are mounted on adjustable tapered bearings. These are adjusted by means of the bearing adjusting nuts in the headstock. These adjusting nuts, Fig. 21, are locked by tightening the set screw. The shafts should run free and without drag, but there also should be no lost motion.

Before removing the gear shafts it is first necessary to take out the Idler Shaft and Drive Shaft. (See instructions on pages 17 and 18). The front gear shaft on No. 4 and No. 5 turret lathes can be removed without removing the spindle or other shafts.

TO REMOVE A GEAR SHAFT

1. Remove the set screws which lock the gears on the shaft.
2. Unscrew the adjusting nut, Fig. 21.
3. Remove the center screw in the screw plug at the opposite end of the shaft, Fig. 22.
4. It is now necessary to move the gear shaft sideways. This requires sliding it through the inner bearing race (for instance 10 or 11, Fig. 19) and through the gears on the shaft.

   It will be necessary to insert spacers, cut to measured length from cold rolled steel stock, to hold the gears and the bearing race in their proper places while the shaft is being pushed through them. The actual pressure is best exerted by means of a screw fitting the inside thread of the screw plug, Fig. 22. It is also possible to advance the shaft by inserting a bronze rod through the tapped hole in the plug, and striking the end of this rod with a hammer.

   On the back shaft immediately beneath the pulley shaft, there is no screw plug similar to Fig. 22 in this shaft assembly, both ends having adjusting nuts like Fig. 21. Remove adjusting nuts and move shaft by striking the end of a bronze rod inserted in the hole.

CAUTION: When replacing gear shafts, completely assemble all shafts before any bearing adjusting is done. Tighten the screw in the head wall to hold the bearing housing (6), Figs. 16 and 19. With this starting point established, proceed with the bearing adjustment of all shafts, being careful to adjust back shaft bearings so that gears will not interfere with clutch shells on the drive shaft.

SPINDLE BEARINGS

Spindle bearings are carefully set at the factory to suit the speed range in which it is intended to operate the machine. If at any time the spindle is to be speeded up considerably beyond its original range, a man from our factory should be called in to make the proper alterations. Beyond this the bearings require no attention on the part of the user.

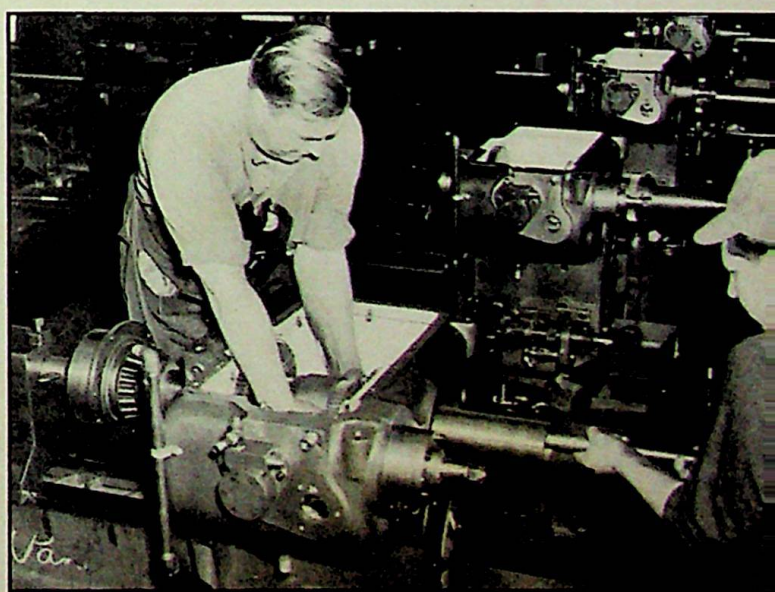


FIG. 23. *Installing the spindle and gears in a No. 5 Turret Lathe Head*

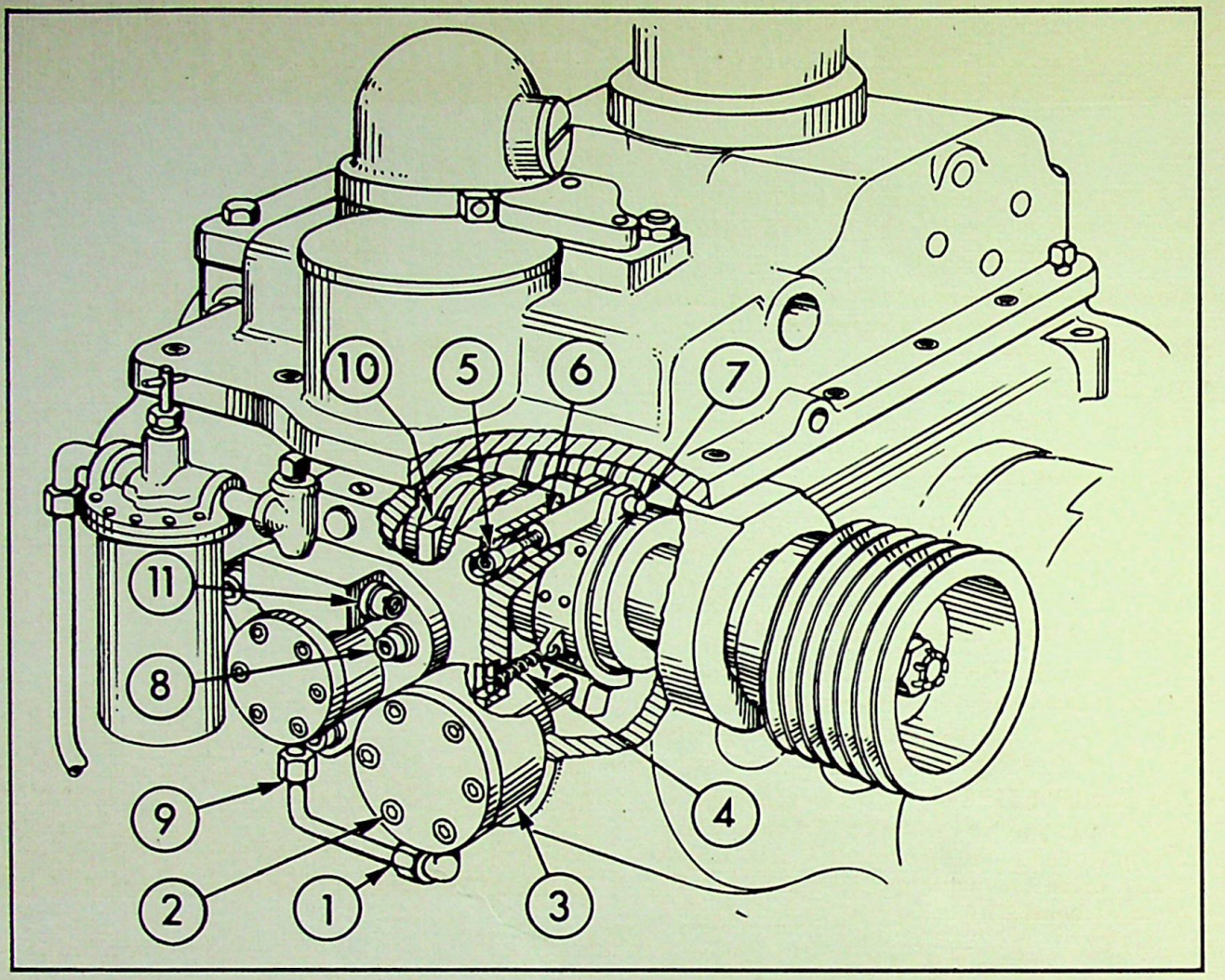


FIG. 24 *Spindle Brake Removal*

SPINDLE BRAKE

Fig. 24

The hydraulic spindle brake is controlled from the forward and reverse clutch lever and operates under 15 to 18 pounds oil pressure. This pressure is established at the factory and the adjustment (11) is sealed. No further adjustment of oil pressure is required.

TO RE-NEW BRAKE LINING

1. Remove Preselector or head cover.
2. Disconnect oil line (1), remove three long cap screws (2), holding cylinder (3) and pull out entire cylinder unit.
3. Disconnect spring (4).
4. Chip out sealing filler and remove binder screw (5).
5. Remove pin (7), withdraw brake stud (6) and take off brake shoe.
6. Replace brake lining. Do not use ordinary brake lining. Proper functioning of the brake can be easily destroyed through faulty lining. The brake lining is very inexpensive and should be purchased at the factory.

NOTE: When the brake shoe is reassembled, adjust the brake stud (6) to allow 1/32" clearance between the brake shoe and the brake surface on the clutch just below pin (7).

PRESELECTOR
OPERATING INSTRUCTIONS

The Preselector on your turret lathe will make the machine easier to operate, and figure for you the correct speeds in surface feet.

Number tabs make it easier to change speeds used on a job without having to remember a complicated series of lever positions.

A single lever operates the entire unit and all speeds are equally easy to obtain regardless of the number of gears to be moved in changing from one speed to another.

The Preselector consists of these main parts:

1. **The CHART and DRUM DIAL** (1) Fig. 25, which shows surface speeds for all work diameters for the capacity of the machine, and which is rotated by the hand wheel (4) Fig. 25.
2. **The NUMBER TABS** (2) Fig. 25, on top of the drum, which show the correct speeds for each cut. After the machine is set up, the operator simply follows the number tabs.
3. **The SINGLE LEVER** (3) Fig. 25, which shifts all gears and operates the clutch and head brake. The operation of the Preselector is very simple. Study these instructions carefully to get the greatest benefit from the unit.

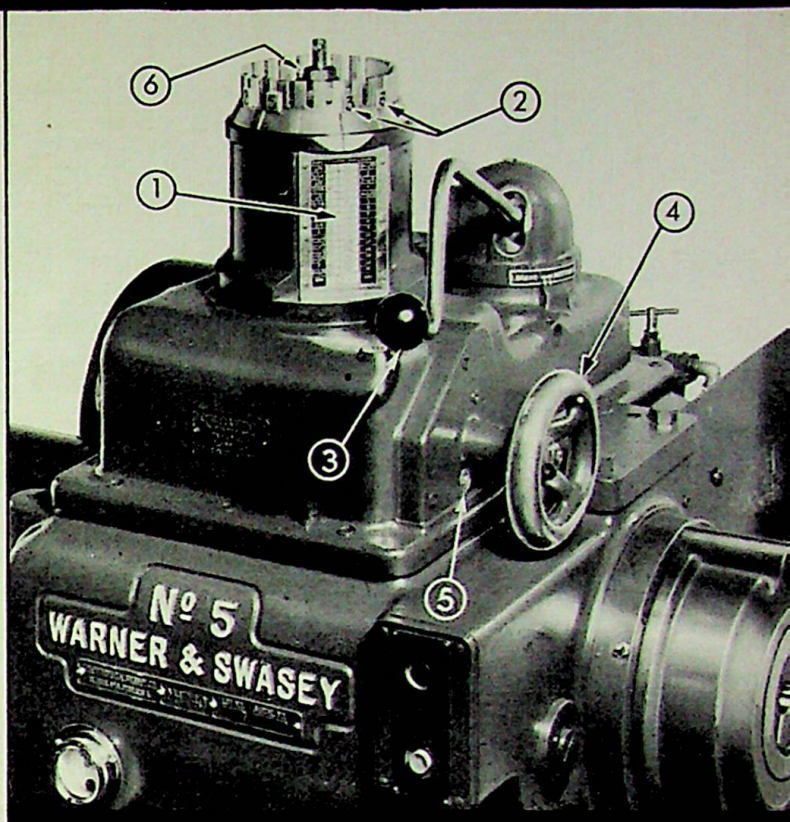


FIG. 25 *The Preselector*

IMPORTANT

The r. p. m. for every cut should be determined by the surface feet per minute at which the material can be cut. Surface feet per minute means the number of feet that passes the cutter in one minute. The r. p. m. simply denotes the number of revolutions of the spindle, while surface feet or speed takes into consideration the diameter being cut.

The Preselector is designed so that the operator can quickly select the correct r. p. m. to produce the proper surface feet per minute for any diameter to be cut by simply turning the handwheel (4) Fig. 25.

HOW TO SELECT SPEEDS

The proper surface speeds are selected by turning the handwheel (4) Fig. 25, which rotates the drum dial. The surface speed chart mounted on the drum dial, (shown in detail at (4) Fig. 26), gives surface speeds in *feet per minute* for the diameters shown on a stationary chart in the window (2) Fig. 26.

Knowing the correct surface feet per minute at which the material you are using can be cut, turn the drum dial (by means of the handwheel) until this surface feet figure or the one nearest to it appears in the window opposite the diameter to be cut.

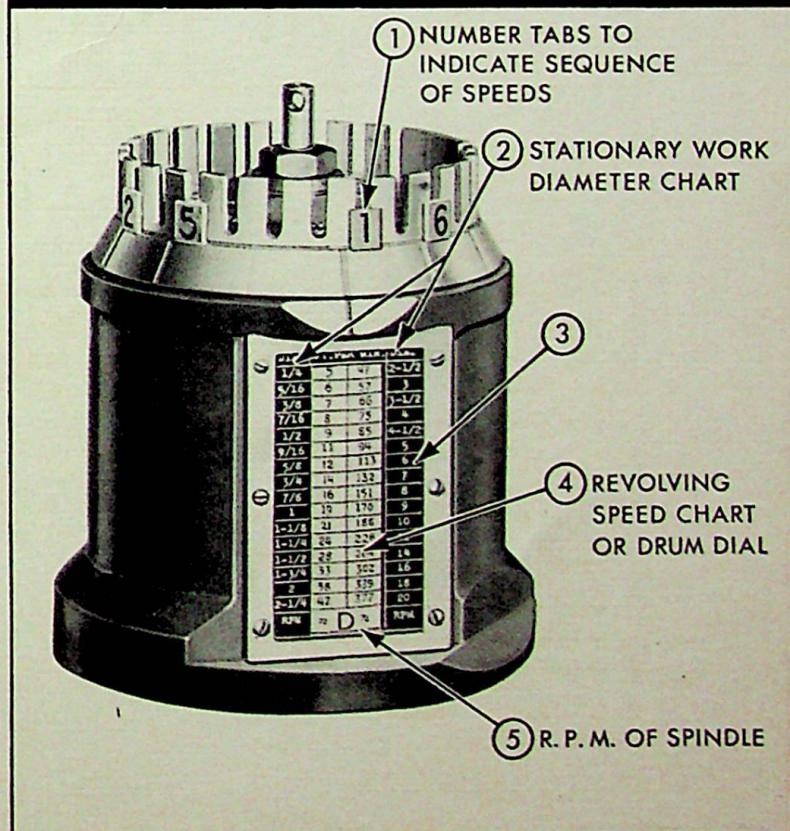


FIG. 26 *The Drum Dial, Number Tabs and Stationary Work Diameter Chart*

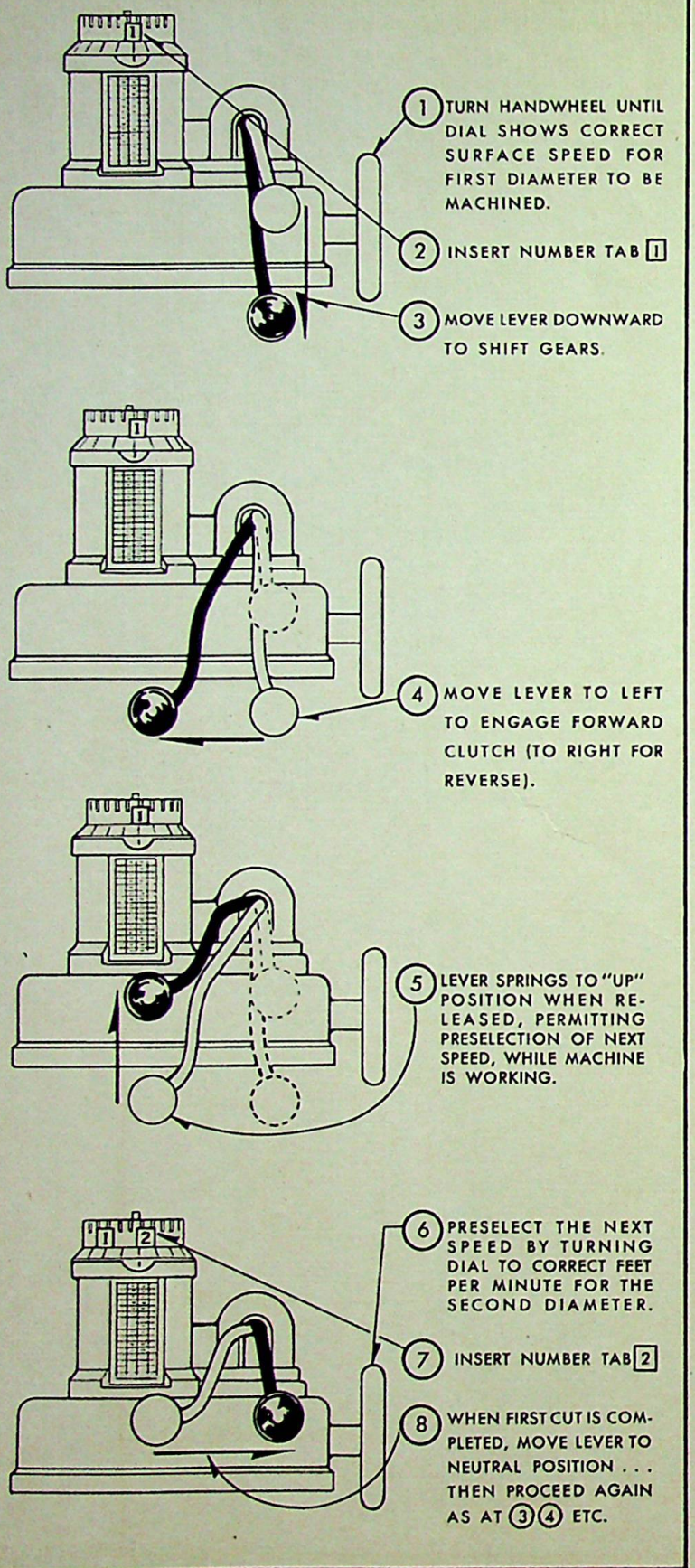


FIG. 27 *Preselector Operation Diagram*

For example, if you are finish turning a 6" diameter on a piece made of SAE 1035 steel using high speed steel cutters, you know that 90 to 120 feet per minute would be the correct cutting speed.

Turn the drum dial until a surface speed figure within this range appears in the window opposite the 6" diameter on the stationary chart as at (3) Fig. 26. In this particular case it would be 113 feet per minute. Insert the number tab [1] in the slot in the drum as shown (1) Fig. 26 (see also Fig. 28). In doing this you have selected and numbered the correct speed for the first cut.

For another diameter the drum is again turned until the correct surface speed figure appears opposite the diameter to be cut and the number tab [2] is inserted for the next speed. (See and study diagram Fig. 27).

All other surface speeds for the job are obtained in this way and numbered [3] , [4] , [5] , etc. When this has been done for each operation on the first piece, all of the speed changes used on the job are numbered. The numbers are then followed on all the other pieces in the lot. In case one speed is used twice on the same job for different operations, two number tabs may be placed in the slot, one above another.

In actual practice you should *"preselect"* the next speed by turning to the next number tab while the machine is cutting.

Between the highest and lowest speeds on the chart there is a neutral position which disengages the spindle gears completely, permitting easy spindle rotation for inspection purposes.

The capital letter in the r. p. m. column, (5) Fig. 26, makes it easy to note for future reference the correct speeds used on a particular job.

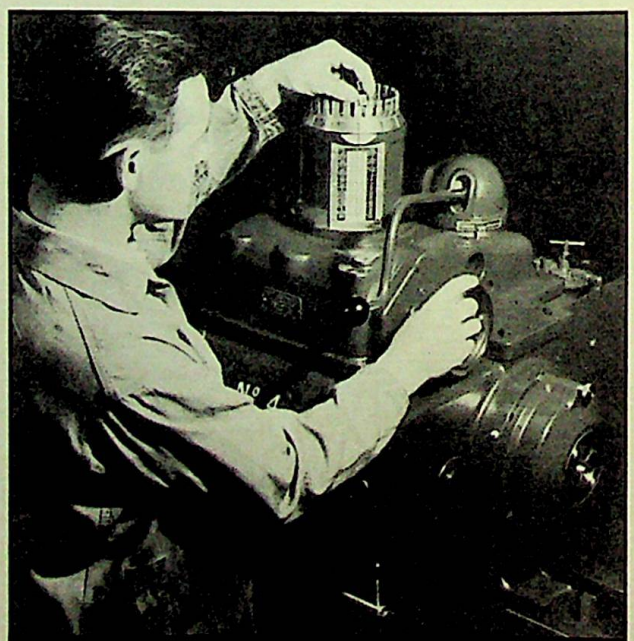


FIG. 28. *Tabs Number The Sequence of Speeds*

EXAMPLE

Figs. 29 and 30 illustrate a typical job which will require several speed changes. The part, a Threaded Guide Sleeve, is made of cast iron and carbide cutters are to be used.

Knowing that the cast iron can be rough turned between 180 and 200 surface feet per minute, and finish turned between 350 and 400 feet per minute, with carbide tools, we turn the drum dial until a surface speed figure nearest to what we want appears in the window opposite the diameter to be cut.

On this piece the first operation after chucking the casting is to start bore the 1" diameter to a depth of about ½" to get a true hole for the core drill which follows. We turn the drum dial until the 200 surface feet per minute figure appears in the window opposite the 1" diameter on the stationary chart and insert number tab [1] in the slot in the drum dial. When the control lever is moved down and to the left, the machine will operate at the correct speed for the first operation.

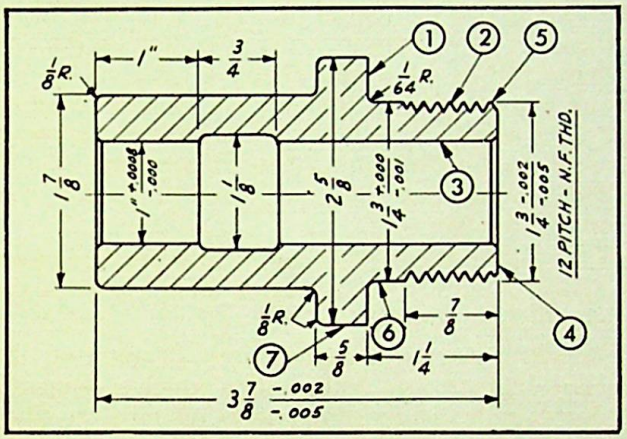


FIG. 29 *Threaded Guide Sleeve*

In the next operation (II) we core drill and rough turn from the hexagon turret, and rough face and turn from the square turret. The core drill, which is High Speed Steel, operates at approximately 60 feet per minute, and controls the speed to be used for operation II as shown in the setup, (Fig. 30). We turn the dial until a surface feet figure of approximately 60 feet appears in the window opposite the 1" diameter to be core drilled. In this case 61 appears opposite the 1" on the chart, and we insert number tab [2].

This procedure is repeated for the remaining operations. The following table gives an outline for selecting speeds for the entire job. All tools are carbide except the core drill, reamer and chaser. Refer to Figs. 29 and 30.

I Start Bore (3)
200 f. p. m.—Insert tab [1]

II Core Drill (3), Rough Turn (6), Rough Face (1) (4). Turn (7)
61 f. p. m.—Insert tab [2]

III Chamfer (5)
106 f. p. m.—Insert tab [3]

IV Semi Fin. Bore (3)
200 f. p. m.—Insert tab [4]

V Fin. Turn (6), Chamfer (3) Fin. Face (1) (4)
351 f. p. m.—Insert tab [5]

VI Ream (3)
46 f. p. m.—Insert tab [6]

VII Thread (2)
25 f. p. m.—Insert tab [7]

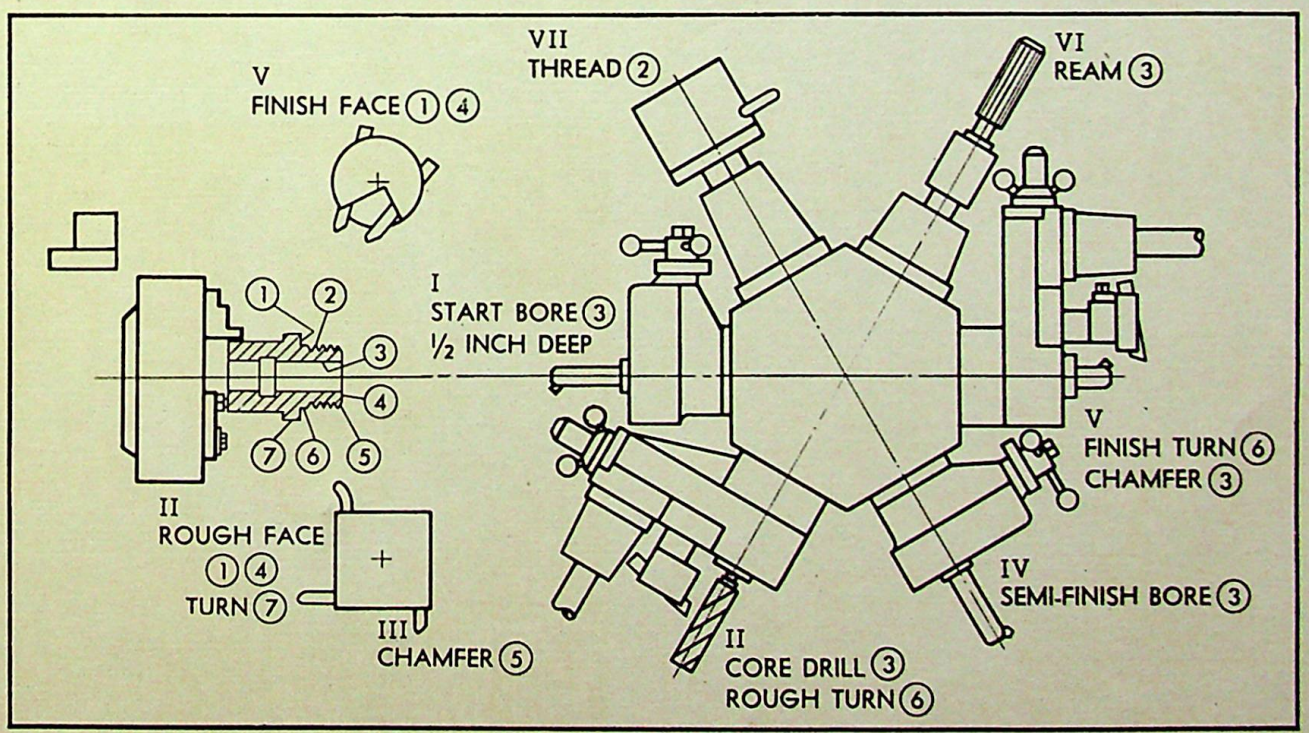


FIG. 30 *First Chucking for Guide Sleeve*

HOW TO SHIFT GEARS

The single lever shifts the gears and operates the clutch and head brake. The gear shifting is done by a downward movement of the lever, and the clutch is engaged forward by moving the lever to the left, and reverse by moving the lever to the right. (Study Fig. 27).

In changing speeds, shift before the spindle comes to a dead stop. This will eliminate unnecessary clashing. Do not attempt to shift from an extremely high speed to a low speed, without using the brake to slow the spindle. However, when shifting at slow speeds the shift should be made quickly without applying the brake so as to mesh the gear teeth before the gears have come to a complete stop. It is a good rule to keep your eye on the chuck while making this shift, so as to have a visual control of the speed at which the spindle is rotating.

Like your automobile as it leaves the factory, a new Preselector unit may be somewhat stiff. This stiffness will disappear as the machine is broken in.

CHANGING THE DRUM DIAL

When a turret lathe is equipped with a two speed motor, two sets of charts are furnished. One set is for bar work and covers the bar diameter range of the machine. The other is for chucking jobs and covers the chucking diameter range of the machine. On these charts, the low speed range is in the left column and the high speed range is in the right column in the window. In numbering the speeds, a number tab can be inserted to the left or right of the line on the drum to indicate low or high speed range for any given operation.

The procedure for changing the chart on the drum dial is as follows:

Remove the nut (6) Fig. 25, which holds the drum dial, and lift the drum out of its housing. Remove the wire spring clip inside the drum and a new chart can be slipped in place.

In reassembling, the chart must be synchronized with the Preselector mechanism. This is accomplished by turning the handwheel (4) Fig. 25, until the line on the end of the spool shaft (5) Fig. 25, matches the line on the side of the head cover. Then pull the shifter lever down to lock the drum shaft. Rotate the drum until the neutral position on the chart is centered in the window. With the shifter lever still down, tighten the nut (6) Fig. 25, securely. Now, test the drum for lost motion. The line on the drum should move an equal amount to the left or right of the line on the housing. If this is not the case, loosen the nut and readjust the drum to centralize the location.

Caution: When tightening the nut (5) Fig. 25, be careful not to strike the prongs of the drum with your wrench. The drum is made of aluminum alloy and might easily be broken.

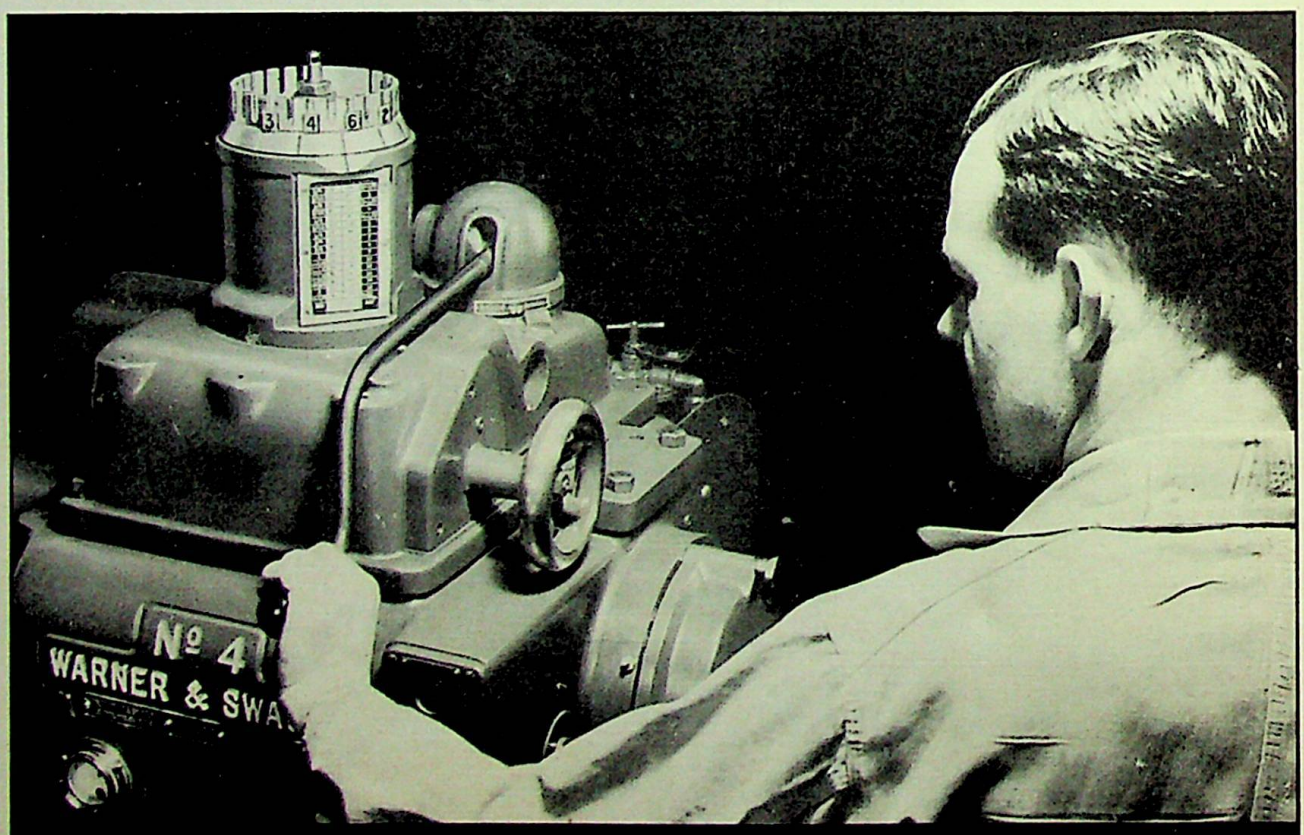


FIG. 31 *A Single Lever Shifts the Gears and Operates the Clutch and Head Brake*

CROSS SLIDE CARRIAGE

ADJUSTMENTS AND ASSEMBLIES

The Cross Slide Carriage, Fig. 33, is gibbed to the inside of the front rail of the bed with a taper gib (6) Fig. 32. In addition, caps are fitted to the front and rear, which bear on the under side of the bed rails.

TO REMOVE THE CROSS SLIDE

Fig. 32

1. Loosen gib screw and remove gib (9) at the rear.
2. Loosen the nut (4) in front and remove handle and dial.
3. Pull cross slide off by hand. If cross feed screw is to be removed, replace handle and unscrew it separately.

TO ASSEMBLE THE CROSS SLIDE

Proceed in the reverse order for removing it. This procedure makes it easier to engage the key in the feed screw driving pinion with the keyway in the feed screw without damaging the thread of the latter.

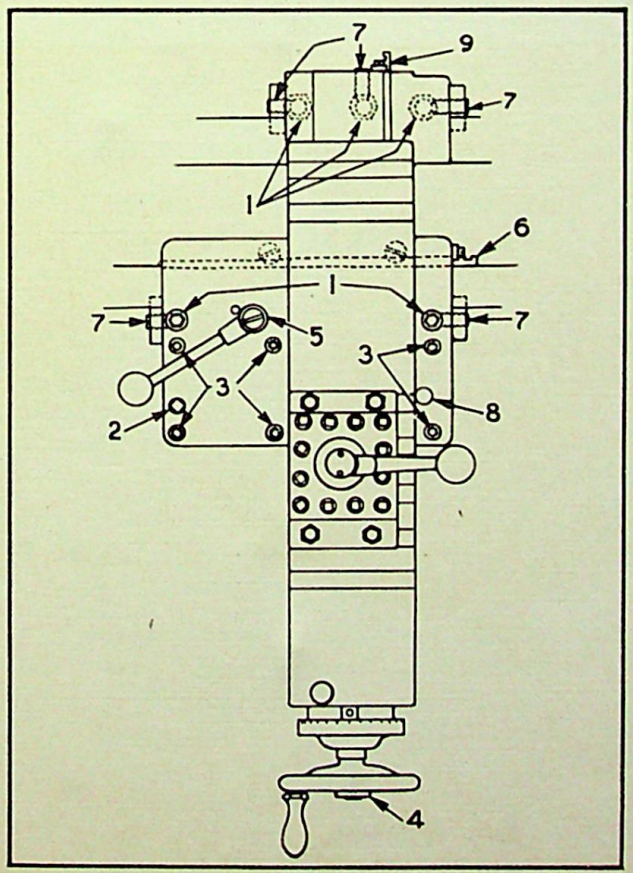


FIG. 32 *Top View of Cross Slide*

TO REMOVE THE CARRIAGE

Fig. 32

1. Support the apron from the pan with wooden blocks and wedges.
2. Release the bed clamp, remove its handle and unscrew the bolt (5).
3. Remove the taper gib (6).
4. Remove the five cap screws (1), taking care to loosen first the slotted head set screws (7) which lock cap screws in place.
5. Remove the cross slide to reduce the weight to be handled. (See instructions).
6. Loosen dowel (2), by turning its head.
7. Remove the six socket head cap screws (3), which hold the apron to the carriage, and the latter can then be lifted off. Be sure to raise carriage high enough to avoid bending the cross feed knockout plunger (8).

TO ASSEMBLE THE CARRIAGE

Fig. 32

Proceed in the reverse order of instructions for removing it. Clean out the oil channels carefully before doing so and finally be sure to lock the bolts (1), after adjusting the caps. In lowering the carriage on the apron, be careful not to bend the cross feed knockout plunger (8).

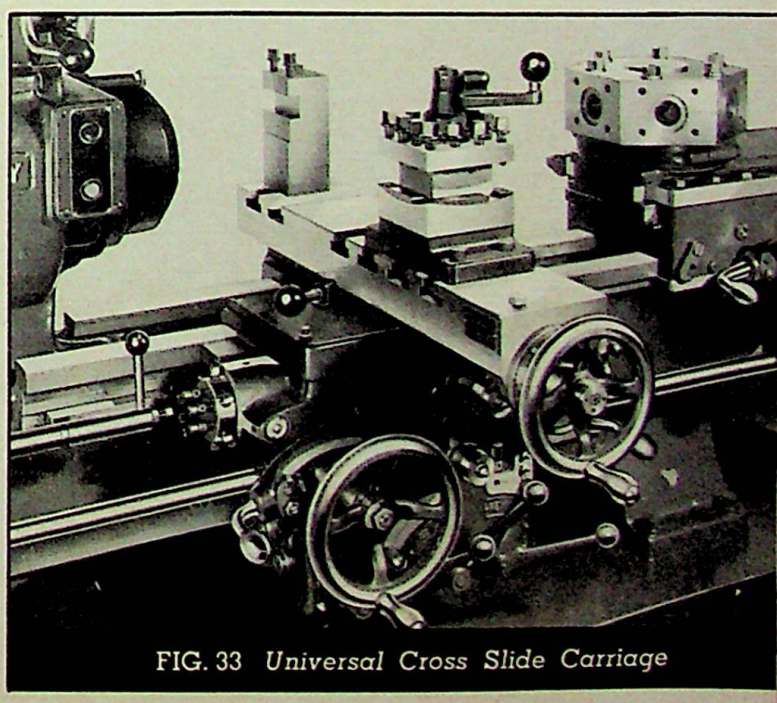


FIG. 33 *Universal Cross Slide Carriage*

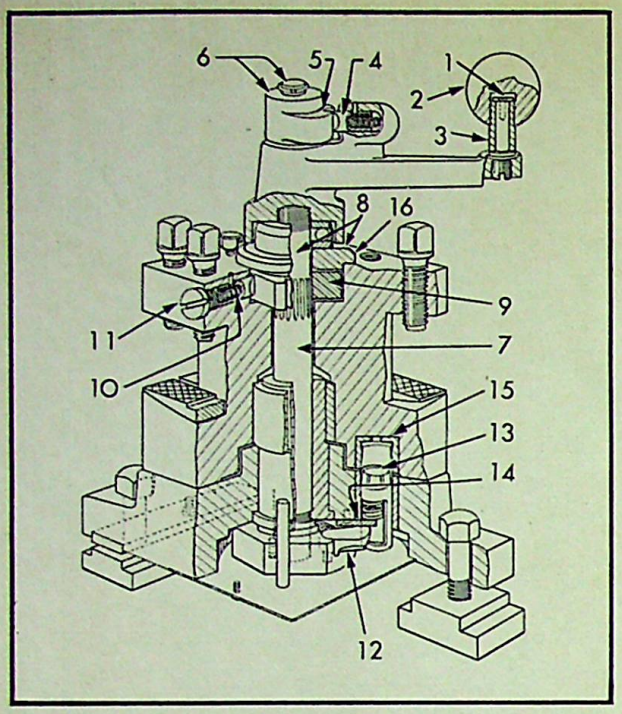


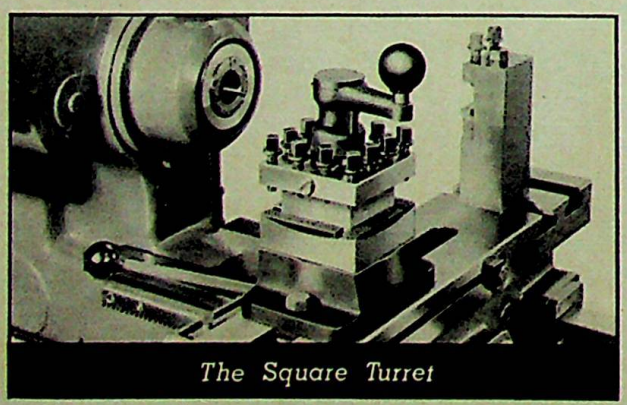
FIG. 34 *Automatic Indexing Square Turret*

THE SQUARE TURRET

The square turret is the automatic indexing type. Units recently made have the timed relation of the members marked so that they can be assembled speedily. Look for these marks at (6) and (8) Fig. 34, on shaft and collars.

CAUTION: Some of the earlier units were not marked and it is advisable to punch four marks as shown at (6) and (8) *before taking the unit apart*, to facilitate proper timing on assembly.

The Indexing Mechanism (Fig. 34) functions as follows: Pawl (4) acting on collar (5) disconnects the handle from stud (7) during the operation of clamping the turret to its seat, but at all other times holds collar and handle in timed relation to each other. Collar (9) has ratchet teeth which, through pawl (10) make indexing of the turret possible. Latch (12) drops the lockbolt (13), out of the lockbolt bushing (15). The lockbolt spring is retained by plate (14).



The Square Turret

TO TAKE SQUARE TURRET APART

Lift off collar. (5) Fig. 34, and unscrew the handle. Release set screw (11) and lift turret off, together with cap (16) and collar (9). The lockbolt bushing (15) can be pushed out of its seat by inserting a screw into the thread in the head. The lockbolt should be lubricated with light oil, not machine oil, before assembling. It has a close, ground and lapped fit in the bushing and may stick if machine oil is used on a new assembly.

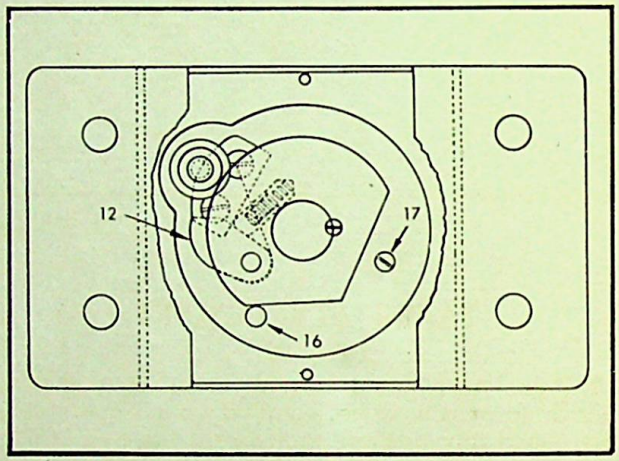


FIG. 35 *Bottom of Square Turret Showing Arrangement for Hand Indexed Unit*

NOTE: The automatic indexing feature can be locked, making a hand indexed turret out of the unit. To do this, consult Fig. 35 and text below.

Pin (16) is already in place, and hole for screw (17), though not used, has been tapped into the base. Insert into it a ⅜ x 16 per inch ½ inch long screw with ½ inch diameter head. This screw can be obtained from the W & S Company or can be quickly made in the tool room.

Remove set screw (11) Fig. 34, withdraw plunger and spring (10) and return set screw.

NOTE: Some of the first automatic indexing turrets made did not have the auxiliary hole tapped into the base. If it is desired to convert one of these turrets, ask for instructions for locating the tapped hole from the Warner & Swasey Company, giving the serial number of the machine the turret is used on.

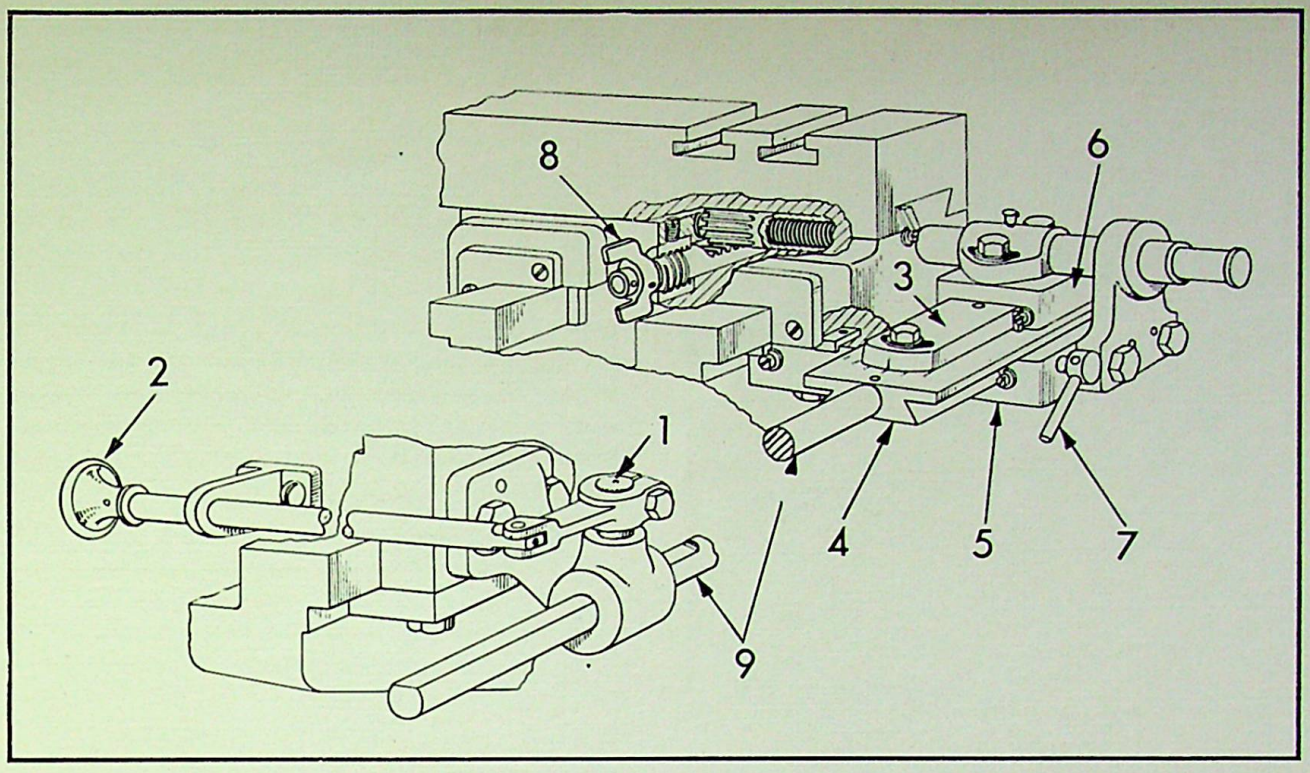


FIG. 36 *Taper Attachment*

TAPER ATTACHMENT

Fig. 36

A Taper Attachment can be furnished with the machine or it may be installed later. Tapers can be cut at any desired point along the bed of the machine and operation of the Taper Attachment does not interfere with the normal operation of the cross slide unit.

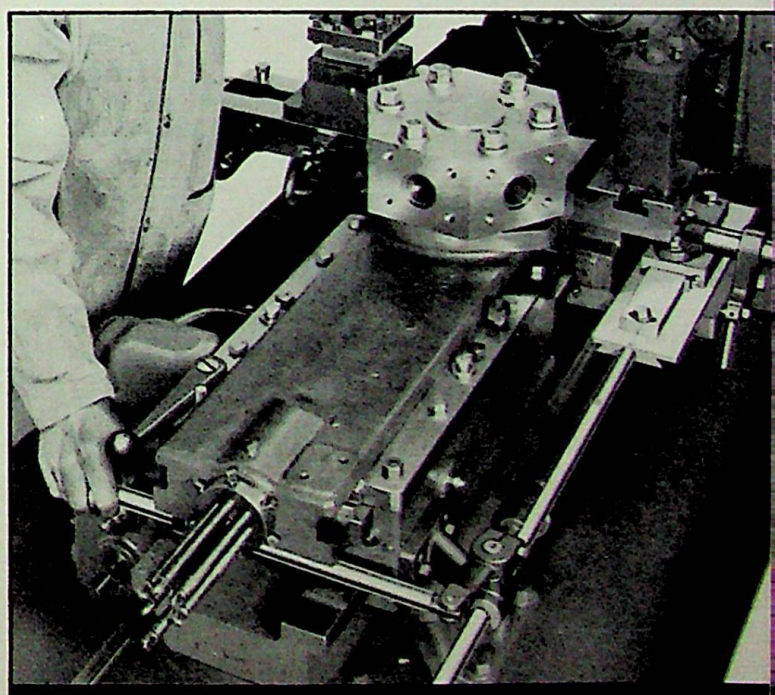
The Taper Attachment for No. 3, No. 4 and No. 5 "Ram Type" turret lathes is mounted at the rear of the carriage. When not in use, the taper attachment travels with the carriage unit.

For straight cuts, the pivoting guide plate (3) must be set on zero point and centered under the block (6). In this position, heavy cutting strains on the carriage during other turning and facing cuts will not disturb the accurate setting of the guide plate. It is also necessary to clamp the base plate (4) to the carrier bracket (5) so that the entire unit will move with the cross slide carriage. Binder screw (1) must be released to allow rod (9) to pass through the bracket.

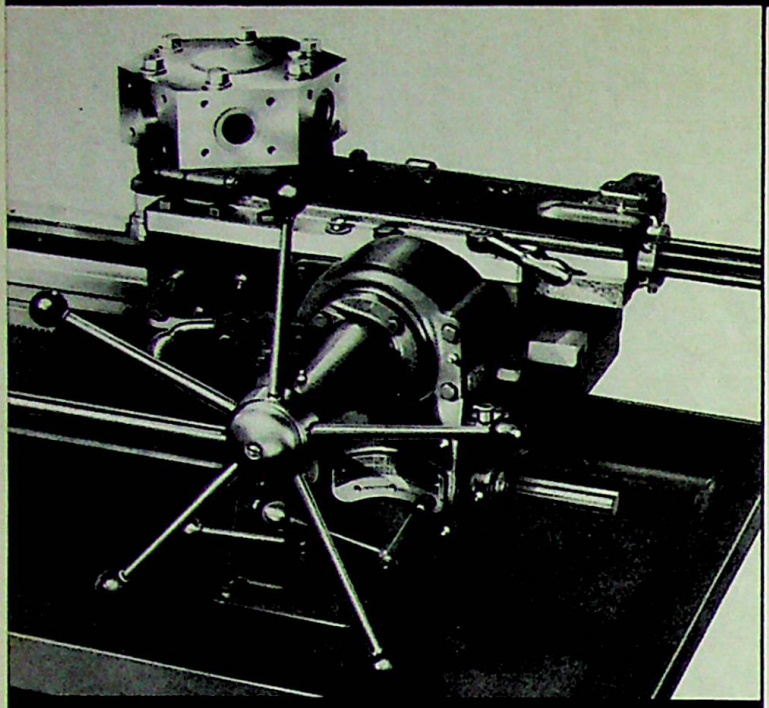
For taper cuts, the pivoting guide plate (3) must be accurately set for the desired angle of taper. The binder lever (7) is released so that the carrier bracket (5) can move along the base plate (4). The base plate (4) which carries the pivoting guide plate (3) is held stationary by the binder screw (1) which clamps rod (9). Knob (2) at the front of the machine operates this binder screw.

As the carriage moves longitudinally along the bed, block (6) which is fastened to the cross slide screw, follows the angle of the pivoting guide plate (3) thereby producing the taper.

The looseness between the cross feed screw and the cross slide nut is known as "backlash." The accuracy of the taper cut depends upon the elimination of backlash. The Backlash Eliminator (8) is used to take up the backlash between the cross feed screw and the cross slide nut.



Ram Type Taper Attachment



Hexagon Turret Slide and Saddle Unit

TURRET SLIDE AND SADDLE

The Saddle is clamped to the bed with four bolts on each side (1), Fig. 37. It is aligned against the side of the bed by two shoes backed up by set screws and lock nuts (2). These shoes should be adjusted to a sliding fit and locked. Then they require practically no further attention, as the saddle is moved along the bed only when setting up the machine for a new job. However, when these screws are not properly adjusted the turret saddle is not parallel with the bed, causing inaccuracy in the work.

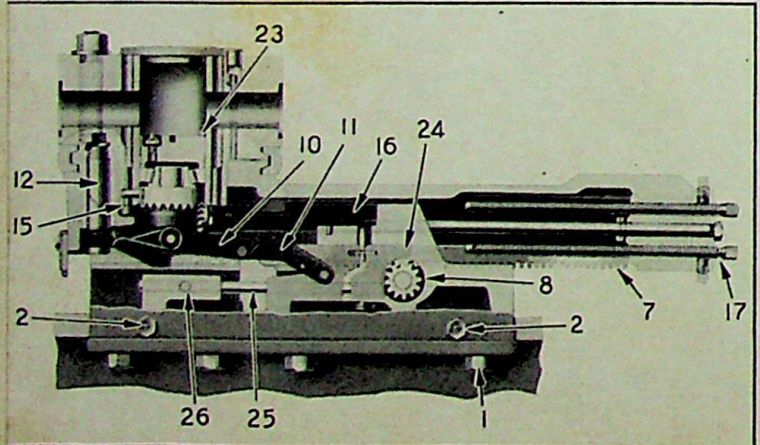


FIG. 37 *Phantom View of Turret Slide and Saddle*

Hardened and ground steel wear-strips on which the slide rides (3), Fig. 38, are anchored in the saddle. These are replaceable and can be supplied thicker than standard for repair purposes.

Side alignment is obtained through two taper gibs (4), Fig. 38. Care should be used and both sides moved the same amount, to keep the turret in alignment with spindle. In case of doubt, an alignment check should be made. (See chapter on alignment).

CAUTION: When making alignment check, be sure to test the bed first, because the turret may be "out" because of bed twist (See Pages 10, 11, 12 and 13). Such an error obviously should not be corrected by gib adjustment.

The top caps (5), Fig. 38, are provided with taper gibs (6) for adjusting vertical play.

The Turret Slide is operated through rack (7), and pinion (8) Fig. 37 and Fig. 38, on the turnstile shaft.

The rack screws (9), Fig. 39, should at all times be kept well tightened. Two dowel pins take the feeding thrust load, relieving the screws of all side strain.

INDEXING MECHANISM

1. Beginning with the slide in its forward position, moving it to the rear causes lock bolt lever (10), Fig. 37, to strike the rising angle of tumbler (11). This action lowers the lock bolt (12) and frees the turret.
2. At the same time the turret binder ring has been released, because toggle (13), Fig. 40 has been swung to the unlatched position by its passing over stud (14) on the rear top cap.

   The turret is now free to rotate and can be rotated by hand in either direction.
3. As the turret slide moves farther to the rear, one of the six index pins (15), Fig. 37 and Fig. 39, contacts with pawl (16), Figs. 37 and 38, holding the pin against further movement and thus causing the turret to rotate one-sixth turn.
4. In the meantime the rear end of lock bolt lever (10), Fig. 37, has reached the rear corner of tumbler (11), causing the lock bolt lever to snap the lock bolt into the lock bolt bushing in the hexagon turret.
5. During this turret rotation the stop roll unit (17), Fig. 37, has also been rotated one-sixth of a

turn through a bevel gear connection with the turret, bringing the next stop screw (bottom screw) into operative position.

6. As the turret slide travels forward again, the binder ring is clamped and the tumbler (11), Fig. 37, rises, allowing the lock bolt lever to pass, then drops back to its seat, completing the cycle.

TO REMOVE THE TURRET

Move the turret slide to its rearmost position to free the binder ring. Then unscrew the two nuts and the front screw that holds the two halves of the binder ring together (18) and (19), Fig. 39. The ring can then be taken off and the turret lifted off its seat.

TO ADJUST THE BINDER RING

1. Place turret slide in extreme rear position.
2. See that the slot between the two ring halves at the front is ⅛ inch wide. Lock the front screw with its lock nut (19), Fig. 38. This screw should not be disturbed thereafter.
3. For hand grip, insert and clamp a piece of cold rolled stock or a tool in a turret hole so that it projects about 8 inches.
4. Rotate turret so that one of its corners (instead of a face) points toward the spindle. In this position the lock bolt cannot enter into the lock bolt bushing and the turret can be rotated by hand.
5. Advance turret slide so that toggle (13), Fig. 41, has risen to within ⅛ inch from the top on the angular surface of the toggle actuating stud (14) as indicated in the cut.
6. In this position, clamp turret slide in its saddle with clamp handle (20), Fig. 39.
7. Now adjust nut (18), Fig. 40, so that it is possible to just barely rotate the turret when pulling steadily and firmly with one hand on the bar projecting from the turret hole. (See item (3) in left column).
8. Lock this adjustment with cotter pin through castellated nut (18) Fig. 40.
9. When the turret is now advanced farther, the corner of tumbler will rise the additional ⅛ inch and clamp the turret the correct amount for satisfactory performance.

The toggle actuating stud (14), Fig. 41, is threaded into the top cap. It is locked with set screw (21). The setting should not be disturbed. It has been adjusted properly in assembly. If it is necessary to remove the stud, measure its projection (A), Fig. 41, from the cap and re-establish this height on assembly.

BINDER RING BREAKAGE

1. It is apparent that the toggle lever is a very powerful clamp. Therefore it is possible to exert sufficient force through this toggle to *actually break the binder ring* if the above instructions are not carried out.
2. On the other hand, if binder ring is not clamped tightly enough there is no strain on the toggle when the turret is working and vibration will cause the toggle to fall down to its loose position. This also can cause ring breakage, because the toggle will then bump into stud (14), Fig. 40, on its return stroke instead of rocking over it.
3. **When fitting a new ring, scrape the taper surfaces for good contact with turret and slide.**

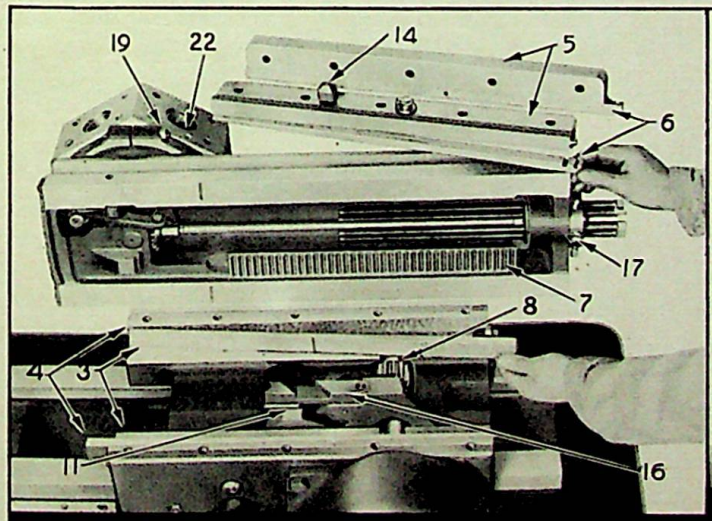


FIG. 38 *Bottom of Turret Slide*

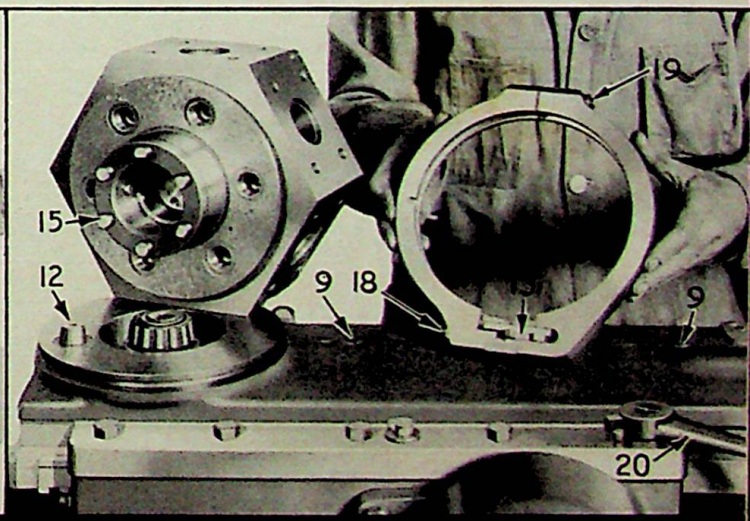


FIG. 39 *Turret Seat and Circumference Binder Ring*

TO ADJUST CENTER BEARING OF TURRET

1. Bring turret slide to extreme rear position.
2. Loosen set screw (22), Fig. 38, which locks the bearing adjusting plug (23), Fig. 37.
3. Unscrew the latter a fraction of a turn until free.
4. Advance turret and check binder ring adjustment as described in previous chapter.
5. Advance turret farther to fully clamped position.
6. Bring bearing adjusting plug (23), Fig. 37, down forcefully to a solid and firm seat.
7. Tighten set screw to lock plug.

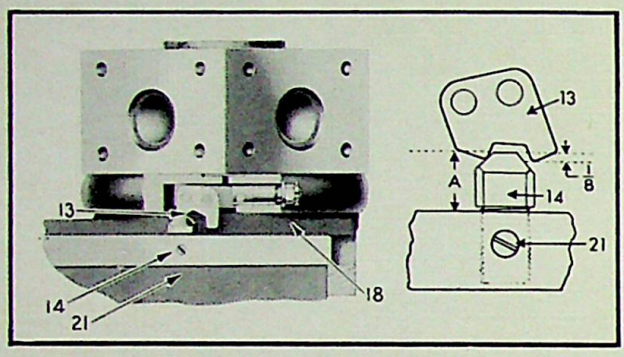
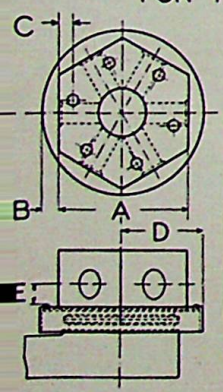


FIG. 40 *Turret Binder Mechanism*

FIG. 41 *Stud Adjustment*

NOTE: When adjustment has been made as described above, the turret will be off its seat a slight amount when the binder ring is free. This condition facilitates indexing and prolongs the accurate alignment of the turret. The powerful clamping action of the binder ring pulls the turret on to its full seat by loading the bearing.

TOOL CLEARANCE CHART
FOR TURRETS WITH BINDER CLAMP CHIP GUARDS



MACH. NO.	UNIT NO.	A	B	C	D	E
NO. 3 M-1200	M-1204	$8\frac{1}{2}$	$1\frac{3}{16}$	$1\frac{1}{32}$	$5\frac{7}{16}$	$1\frac{13}{32}$
NO. 4 M-1320	M-1324	$9\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{32}$	$5\frac{7}{8}$	$1\frac{3}{4}$
NO. 4 M-1420	M-1324	$9\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{32}$	$5\frac{7}{8}$	$1\frac{3}{4}$
NO. 5 M-1240	M-1244	11	$1\frac{3}{8}$	$1\frac{1}{32}$	$6\frac{7}{8}$	$1\frac{27}{32}$
NO. 5 M-1740	M-1244	11	$1\frac{3}{8}$	$1\frac{1}{32}$	$6\frac{7}{8}$	$1\frac{27}{32}$

FIG. 43 *Tool Clearance Chart for Turrets with Chip Protectors*

CHIP PROTECTOR FOR HEXAGON TURRET

A Chip Protector, to prevent flying chips from clogging the hex turret mechanism, can be furnished for binder ring. This attachment is designed for machines where brass and aluminum chips are constantly bombarding the turret binder and turret slide mechanisms. Protection of these functions will prolong the active life of the unit and makes a dismantling operation for cleaning purposes unnecessary.

If, however, it is desired to remove the chip protector guard (1), Fig. 42, rotate guard until spring clips (2) will pass through slots in guard (1). Lift guard over turret.

To take off the Chip Protector, first remove all tools from the hex turret, then remove guard (1) as instructed.

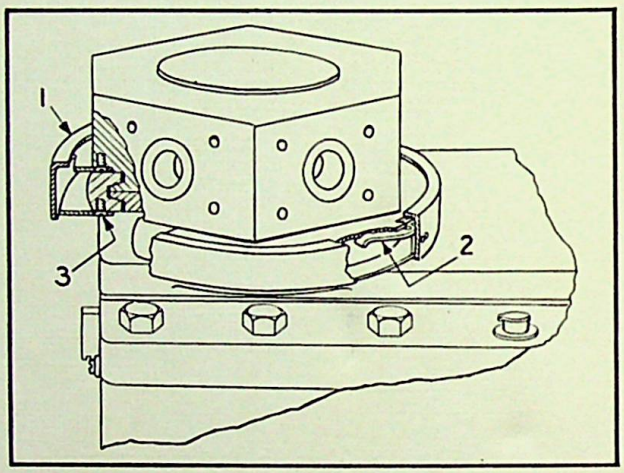


FIG. 42 *Chip Protector for Hexagon Turret*

It is then necessary to remove the hexagon turret and binder ring. (See instructions on page 29). Guard plates can now be removed by loosening screws (3) in the hex turret and binder ring.

CAUTION: Do not clean a turret lathe with an air hose. The air pressure will drive the chips and dirt into remote corners and impair the efficiency of the unit. It is better to clean with a hand brush.

Because of the added extension and width of the Chip Protector, machines with this attachment have limited tool clearances. The chart (Fig. 43) gives clearances for No. 3, No. 4, and No. 5 turret lathes equipped with hexagon turret chip protector. Filler plates or flanged tool holders can be provided to overcome this limitation. When ordering the Chip Protector, give serial number of machine and list tools to be attached to hex turret.

The Feed Train consists of:

1. The Head End Gear Box, Fig. 7 (C).
2. The Feed Shaft (8).
3. Carriage Apron (18).
4. Hexagon Turret Saddle Apron (30).

HEAD END GEAR BOX

Removable change gears, Fig. 44, of ratio 1 to 1 are furnished with the standard machine giving standard catalog feeds. For special requirements, the feeds can be doubled or halved, changing thereby all feeds of the aprons in proportion. A special set of gears is available for this purpose.

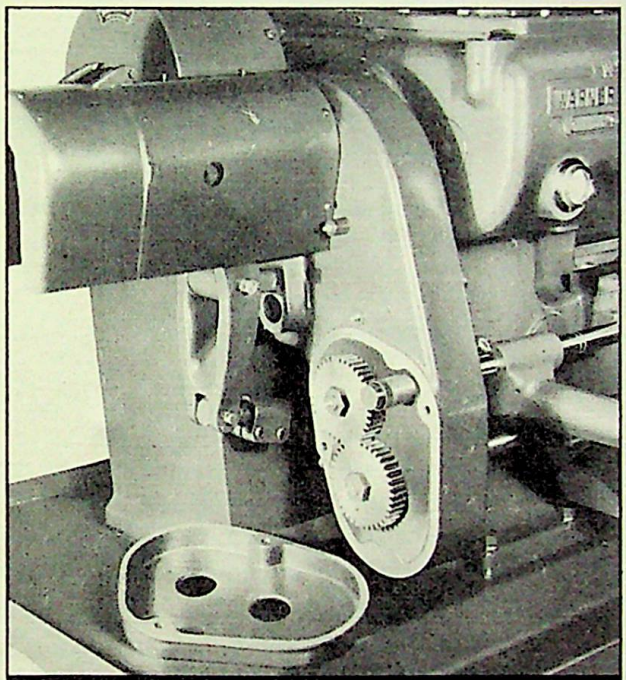


FIG. 44 *Head End Change Gear Box*

TO REMOVE THE ENTIRE GEAR BOX

Disconnect the feed shaft coupling, remove bar chuck operating units, remove two dowel pins by twisting them by their square heads, and then unscrew the four bolts which hold the box to the headstock.

CARRIAGE APRON

The action of the carriage apron is similar in principle to the hexagon turret apron, except that a second clutch (6), Figs. 45 and 46, is incorporated for cross feeding, clutch (4) being for longitudinal travel.

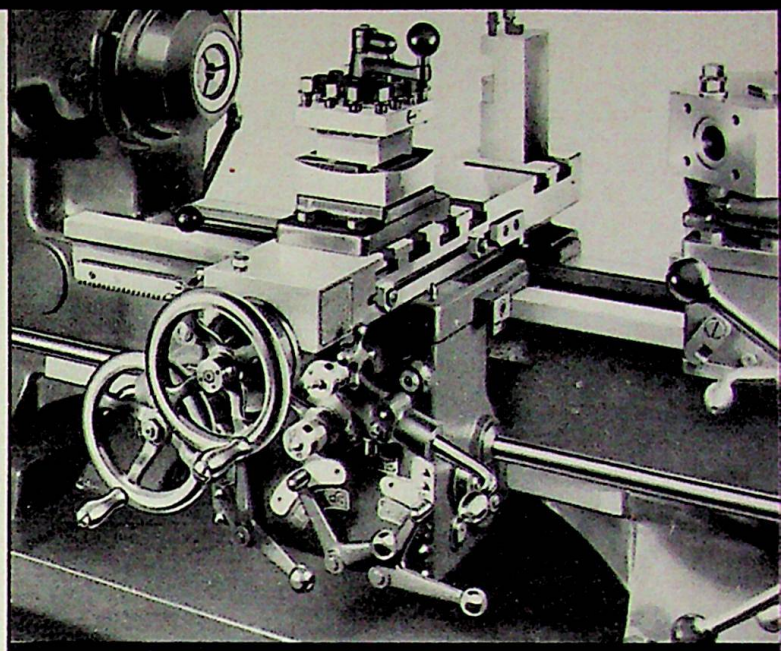


FIG. 45 *Universal Carriage Apron*

TO REMOVE THE APRON

1. Remove feed shaft coupling pin at head end gear box.
2. Turn Feed Shaft until keyway is on the bottom to prevent key falling out of gear. Withdraw feed shaft from carriage apron only, and support the right-hand end of shaft projecting from the hex turret apron on a horse or box.
3. Support the apron in the pan with wooden blocks and wedges.
4. Remove dowel pin (2), Fig. 32, by twisting its square head.
5. Remove the six hollow head screws that hold the apron on to the carriage (3) Fig. 32.
6. The apron can now be dropped until the alignment keys are free from the carriage and it is then free to slide away from the bed. Be very careful to lower apron far enough to clear cross feed knockout plunger (8) Fig. 32.

If it is desired to remove the clutches for cleaning or repair, it is not necessary to remove the feed gear train, as the clutches can be reached from above.

TO REMOVE THE CLUTCH UNITS

1. Remove dog screw (4) Fig. 47.
2. Unscrew collar (5).
3. Pull off all outside parts.

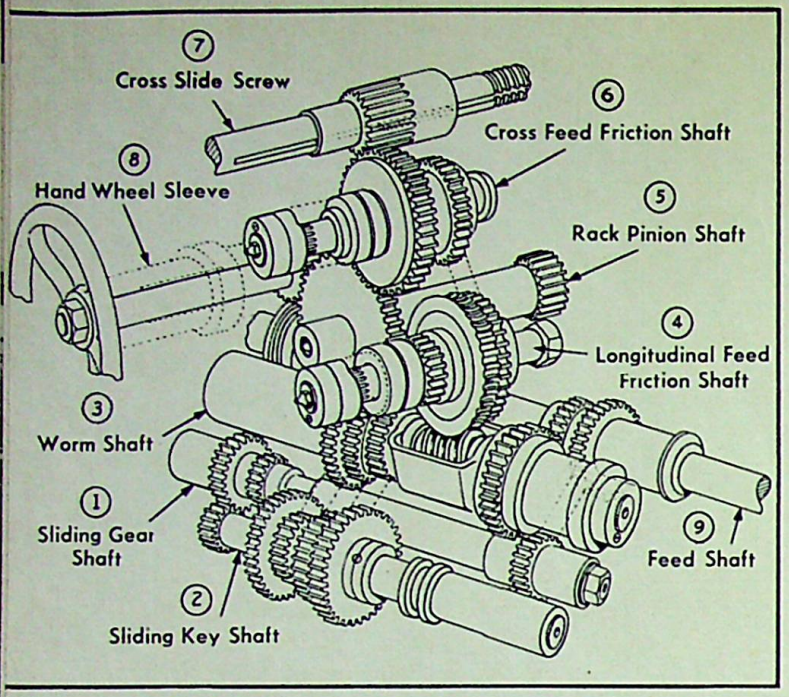


FIG. 46 *Carriage Apron Gear Train*

4. Cross feed clutch shaft (6) Figs. 45 and 46, can now be pushed out toward the rear while longitudinal feed clutch shaft (4) slides out to the front.

For the removal of the remaining gear shafts, no special instructions are required. The worm shaft thrust collar adjustment is the same as that shown in Fig. 52.

TO ADJUST WORM THRUST COLLARS

(3) Fig. 45

Remove dog screw (1) in collar (2), Fig. 52. By turning threaded collar (2) and entering screw in next hole in thrust washer (3), adjustment of one-eighth of a revolution is possible.

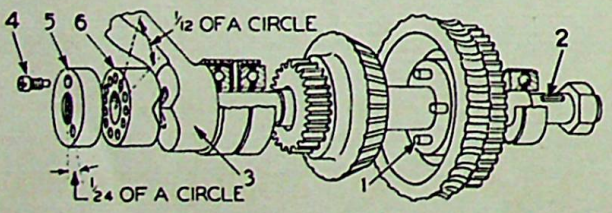


FIG. 47 *Longitudinal Feed Clutch Assembly*

TO ADJUST THE FEED KNOCKOFF BUSHING

Fig. 48

1. Loosen set screw (4).
2. Advance carriage along bed toward the left by rotating the handwheel by hand. Bring it to a solid stop. This will push feed knockoff rod (2) to its extreme out position.
3. Adjust bushing (1) until rod (2) projects approximately 1/64 inch.
4. Pull carriage back a small amount, engage longitudinal power feed and allow it to trip off.
5. It should now be possible to advance the slide by hand 1/64 inch more. If this amount is more or less than the above, adjust bushing (1) until corrected, being mindful of the caution note given below.
6. Lock bushing (1) by tightening screw (4).

CAUTION: Extreme care must be used not to engage power feed until step (3) has been carried out, for if the rod (2) did not project, it could not knock off the feed, and the power feed would pull against the dead stop with its full feeding pressure!

TO REMOVE LONGITUDINAL FEED STOP ROLL

(6) Fig. 48

Loosen screw (4), unscrewing bushing (1) and withdrawing knockoff rod (2).

Remove screw (7) to relieve spring pressure on ball (8). Turn stop roll slightly so that ball (8) will be pushed back into hole. Stop roll may now be pulled out. Be careful that ball (8) does not fall into apron.

When assembling the apron, be certain that the key in the longitudinal feed clutch shaft (2) Fig. 47, is in line with the keyway in the casting. It would be well to chalk the shaft end and mark the position of the keyway on it.

The lower gib should be released before mounting the apron and adjusted after completing the assembly.

NOTE: When assembling the apron, give all parts, including the gear teeth, a generous coating of the proper grade of grease. (See chapter on lubrication).

TO ADJUST FEEDING FRICTIONS

Friction adjustment collar (5) Fig. 47, has two holes, the lower hole being one-twenty-fourth of the circumference out of line with top hole. The cam next to it (6) Fig. 47, has 12 holes. By entering screw (4) alternately in upper and lower hole, adjustment of one-twenty-fourth of a revolution is possible.

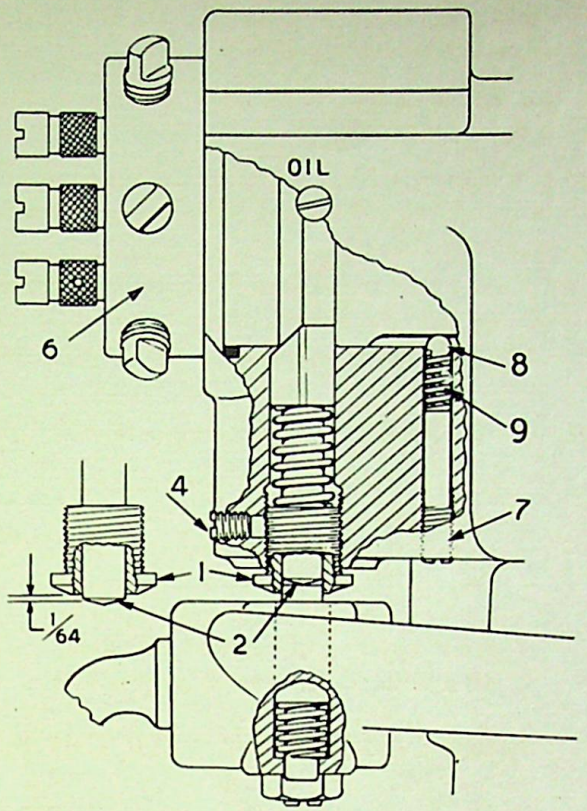


Fig. 48 *Longitudinal Stop Roll and Feed Knockoff, Adjustment*

HEXAGON TURRET SADDLE APRON

Fig. 50

The power is transmitted through the feed shaft (1) to the gear shaft (2). The final reduction is through a worm on shaft (3) to the worm gear and friction clutch (4) mounted directly on the turnstile shaft where a pinion operates the rack shown at (5). See also (7) and (8) Fig. 37.

The feed clutch (4) is shown in Fig. 50. It is engaged through raising handle (6) Fig. 49, whereby its trip pin (7), Figs. 49 and 51, is made to fall into bushing (8), Fig. 49. See also (8), Fig. 51. Inside of this bushing slides the feed knockoff rod shown at (9), Figs. 49 and 51.

When the turret slide stop screw (17) strikes stop (24) Fig. 37, the latter moves forward and imparts this motion also to rod (25) Fig. 37 (See also (10) Fig. 49), which in turn through an angular flat or cam surface pushes out the feed knockoff rod (9) Figs. 49 and 51, thereby disengaging the feed clutch handle and the feed clutch.

TO ADJUST THE FEED CLUTCH

Fig. 50

1. Loosen set screw (11).
2. Adjust clutch with threaded plug (12).
3. Lock collar by tightening set screw (11).

TO REMOVE THE HEXAGON TURRET APRON

1. Remove top saddle caps (13) Fig. 50.
2. Lay board across ways between saddle and carriage.
3. Tip turret slide up on its end and let it rest on the board.
4. Set triple shift feed lever (14) to position shown in Fig. 49.
5. Remove feed shaft coupling pin at head end gear box.
6. Withdraw feed shaft.
7. Support the apron in the pan with wooden blocks and wedges.
8. Remove four bolts (15) Fig. 49.
9. Apron with turnstile shaft can now be withdrawn. Before withdrawing the turnstile shaft, push forward on stop (16) Fig. 50 (see also (24) Fig. 37). This allows clearance for the pinion on the turnstile shaft to pass under the stop.

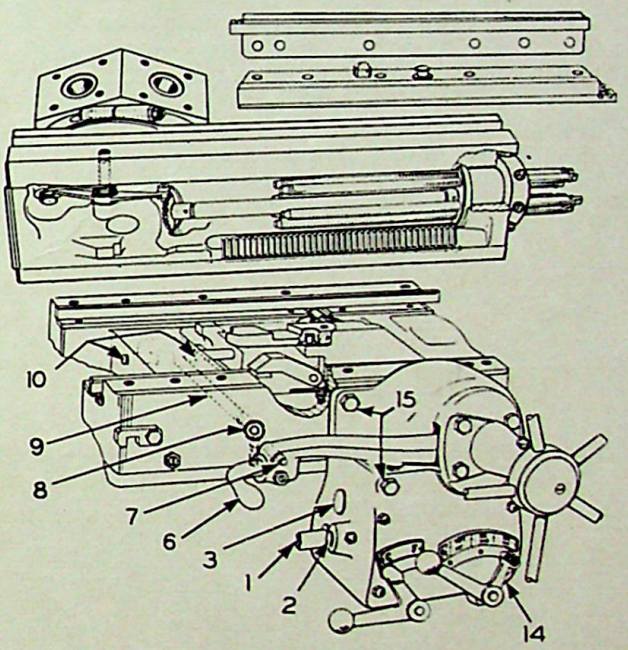


FIG. 49 *Hexagon Turret Saddle and Apron*

TAKE APART AND ASSEMBLE THE APRON

Figs. 49 and 50

This requires no special instructions. To reach the friction clutch, the worm and gear shafts must be removed first. The clutch is similar to that shown in Fig. 47. When assembling it, make sure that the four plungers (1) Fig. 47, and the small springs behind them are in their proper places. These should move quite freely and should be cleaned from all gum when the clutch is apart.

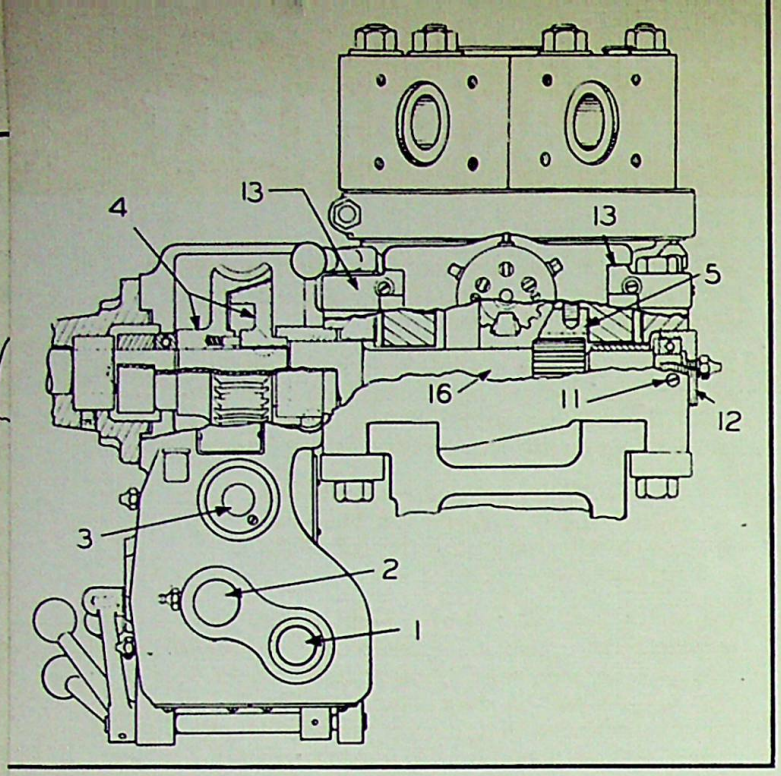


FIG. 50 *End View of Saddle and Apron Unit*

When mounting the hex turret apron on the machine, leave bottom plate off until assembly is completed. This is necessary in order to make sure that feed shaft is properly entered into triple gear cluster with its key. Insert feed shaft with keyway facing down. Make sure gear cluster is assembled with small gear to the right.

NOTE: When assembling the apron, give all parts, including the gear teeth, a generous coating of the proper grade of grease. (See chapter on lubrication).

TO ADJUST FEED KNOCKOFF BUSHING

(8) Figs. 49 and 51

1. Loosen set screw (4), Fig. 51.
2. Advance turret slide toward spindle by rotating the turnstile by hand and bring it to a solid stop. This will push feed knock-off rod (9), Fig. 51, to its extreme out position.
3. Adjust bushing (8) until rod (9) projects approximately 1/64 inch.
4. Pull turret slide back a small amount, engage power feed and allow it to trip off.
5. It should now be possible to advance the slide 1/64 inch more by hand. If this amount is more or less than 1/64 inch, adjust bushing (8) until corrected, being mindful of the caution note given below.

CAUTION: Extreme care must be used not to engage power feed until steps (2) and (3) have been carried out, for if the rod (9) does not project, it cannot knock off the feed, and the power feed will pull up to the dead stop with its full feeding pressure!

TO ADJUST WORM THRUST COLLARS

(3) Figs. 45 , 50 and 52

Remove dog screw (1) in collar (2) Fig. 52. By turning threaded collar (2) and entering screw in next hole in thrust washer (3), adjustment of one eighth of a revolution is possible.

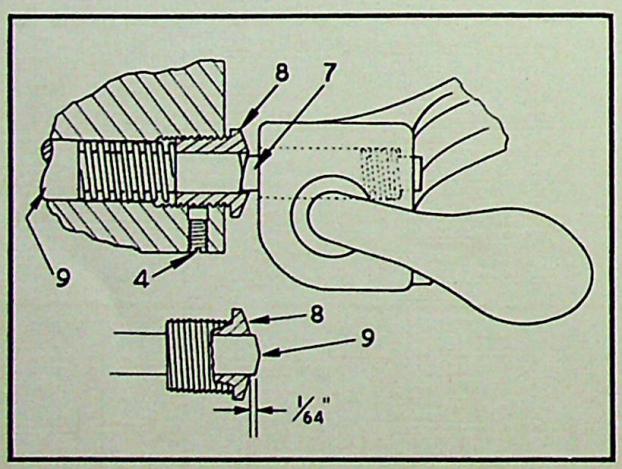


FIG. 51 *Power Feed Knockoff Adjustment*

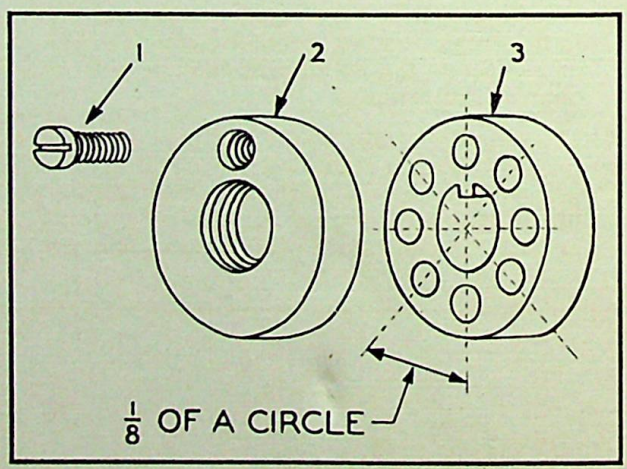


FIG. 52 *Worm Shaft End Play Adjustment Collar*

SPINDLE REMOVAL AND ASSEMBLY

The spindle on the No. 3 Turret Lathe runs on double row precision bearings at the right-hand end, while the left-hand end has a straight roller bearing. The No. 4 and No. 5 Turret Lathes have a single row precision bearing on both ends.

All bearings are of the ultra-precision type, inspection being 100%. Because turret lathe spindles must have large center holes, the bearings have greater capacity than is required in service. Therefore, they should give accurate service for many years. If, however, due to neglect or other causes, it should be necessary to replace a bearing, the installation of a new unit will at once re-establish new machine accuracy.

TO REMOVE THE SPINDLE

Figs. 16, 19 and 53

1. Remove head end gear box from end of head as a unit (See Page 31).
2. Remove collar (2) Figs. 16 and 19, and the gear next to it from the spindle.
3. Remove the spindle bearing cover plate on the right-hand end of head stock immediately behind spindle nose.
4. On the No. 3 Turret Lathe, remove clutch adjusting screw (4) Fig. 16 on the front collar only.
5. On No. 3 Turret Lathe, sling a wire around bottom of clutch assembly and fasten it to a bar laid across the top of the head stock to hold this complete assembly in suspension, while the spindle is being withdrawn.
6. On the No. 4 and No. 5 Turret Lathes, remove set screws (13) Fig. 19. There are three of these around each circumference.
7. On the No. 3 Turret Lathes remove set screw in the front bearing adjusting collar (3) Fig. 16 and unscrew the collar just enough to free the bearing adjustment.
8. The spindle is now free to be pushed out, but proper blocking must first be provided to hold the inside members in place, without straining. Block the entire gear or clutch assembly against the head stock walls by inserting pieces of square or flat cold rolled stock between the bull gear (12) and the head wall on the right-hand end. The head casting has a finished ring for this specific purpose.
9. On the No. 3 Turret Lathe, the spindle can now be easily driven out by laying a block of hard wood against the left-hand end of the spindle and striking on the wood with a heavy hammer.

   CAUTION: Do not strike spindle end with babbitt hammer, as the local blows will distort the thread of the spindle.

10. On No. 4 and No. 5 Turret Lathes more force is required to push the spindle out, and while this can be exerted through heavy blows on the spindle end as described in paragraph 9, there is danger of distortion of the spindle, even when care is used.

    To proceed properly, thread a ¾ inch bar at both ends (14), Fig. 53.

    NOTE: Make this bar long enough, so it can also be used for installing the spindle (See item 4, and Fig. 54).

Lay a block of steel (15) Fig. 53, drilled for the bar, against the back end of spindle. Use a similar, but longer bar (17) across the front end and prop it against the head stock with pieces of maple flooring (16) of proper length. By tightening the nut at the front end and striking on the back end at the same time, the spindle can now be pushed out of the head.

TO INSTALL THE SPINDLE

Figs. 16, 19 and 54

1. Remove rear spindle bearing cover plate at left end of head stock.
2. Remove inner race and roller assembly. Use a combined rotary and pulling motion of the hand and the bearing will slide out readily.

   Do not get the bearing cocked by tapping the race on the end to remove it, as cramping will score the outer race.

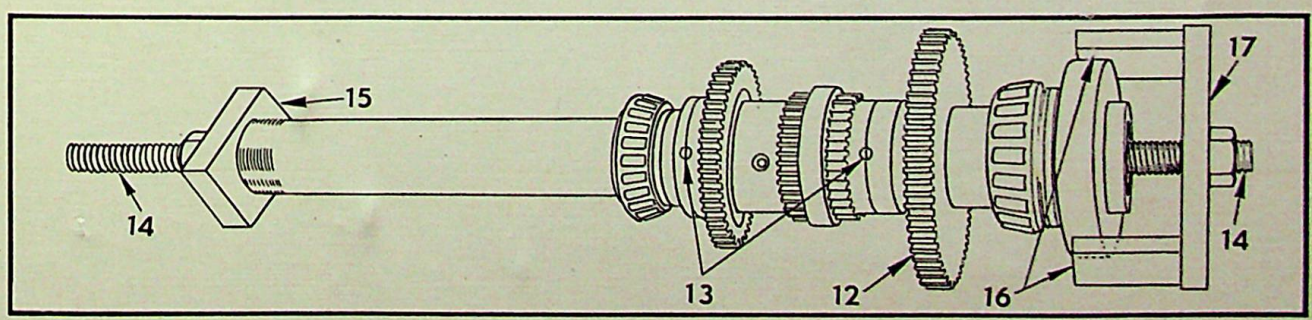


FIG. 53 *Recommended Method—Spindle Removal*

3. Partly insert the spindle into headstock and assemble the gear or clutch members to it, bearing in mind that keyways must line up properly.
4. Bolt the spindle to the turret face with a long threaded rod (14), (Fig. 54) to hold it in an approximately square position.
5. Make a collar to fit freely on the spindle rear end and to fit the headstock bore just outside the rear bearing race. This will support the spindle in line.
6. On No. 4 and 5 Turret Lathes, after inserting this collar and checking once more the alignment of the keyways, drive the gears on the spindle by hitting on a bronze rod, rested against the middle collar (18) Fig. 54.

   The turret slide should be free in its ways, and by striking on the right hand bolt end (14) Fig. 54 in time with the blows on the gear, the spindle will gradually enter its seat. Loosen the long threaded rod several times to give the spindle a chance to align itself naturally.
7. On No. 3 Turret Lathes, the spindle will slide easily into the clutch assembly. Proceed as above, but driving is required only for the forcing of the front bearing outer races into the housing.
8. Tighten bearing adjusting collar (3) Fig. 16, to a snug fit on No. 3 Turret Lathes.
9. Insert the rear roller bearing unit, being sure that the bearing does not cock and bind. Lift the spindle slightly to take out all sag and rotate the spindle while pushing the bearing unit home.
10. Attach outer gear and collar (2) Figs. 16 and 19.
11. Proceed with assembly of other spindle and head parts.

TO ADJUST PRECISION BEARING

1. Tighten Collar (3) on No. 3 Turret Lathes, Fig. 16, or Collar (2) on No. 4 and No. 5 Turret Lathes, Fig. 19, until the spindle begins to rotate with some resistance.
2. Insert thermometer into threaded hole (1) Fig. 55, or pack it against the head with putty, as shown at (2).
3. Start head from cold condition and run for one-half hour at top speed.

   For standard catalog speed, the top r. p. m. is as follows:

   No. 3 Turret Lathe ..... 740 r.p.m.

   No. 4 Turret Lathe ..... 766 r.p.m.

   No. 5 Turret Lathe ..... 658 r.p.m.

   For double catalog speeds, the top r. p. m. is as follows:

   No. 3 Turret Lathe ..... 1480 r.p.m.

   No. 4 Turret Lathe ..... 1532 r.p.m.

   No. 5 Turret Lathe ..... 1316 r.p.m.
4. Observe temperature reading.
5. The reading should be the following degrees above room temperature if the bearing has been adjusted to proper loading:

   (a) For standard catalog speed, 30 degrees Fahrenheit.

   (b) For double standard catalog speed, 30 degrees Fahrenheit.

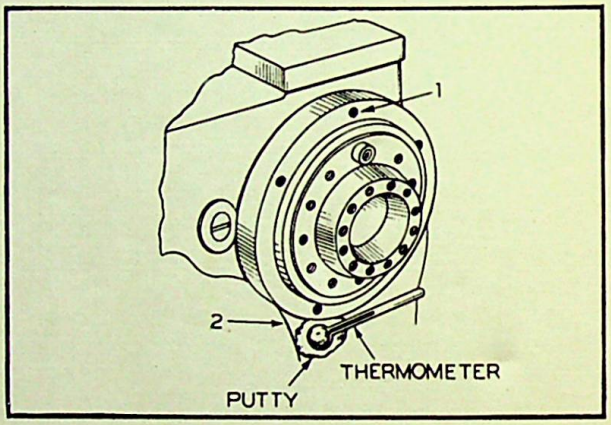


FIG. 55 *Heat Test for Spindle Bearing Adjustment*

If temperature is too high or not high enough, change bearing adjusting collar setting and repeat test, being sure that machine has cooled off completely before starting it.

The machine will run warmer than the above temperatures when operated at top speed all day. (This is a normal condition.) The temperatures given above are standards for bearing adjusting purposes only.

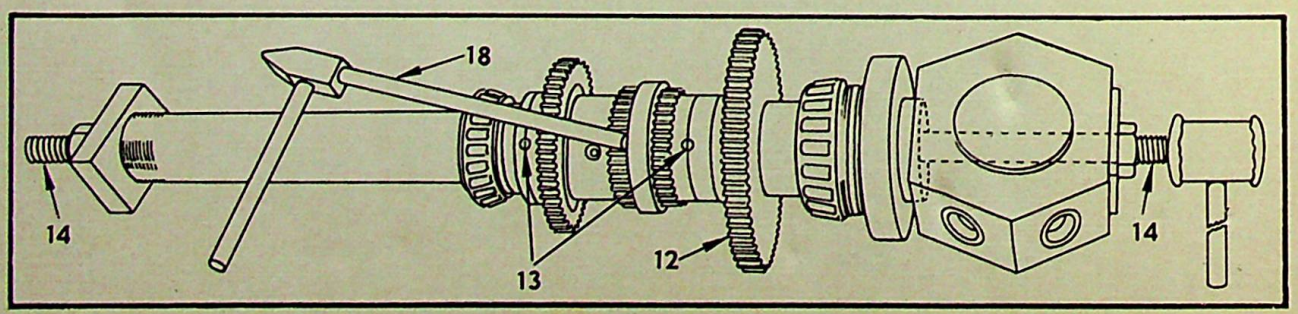


FIG. 54 *Recommended Method—Spindle Assembly*