

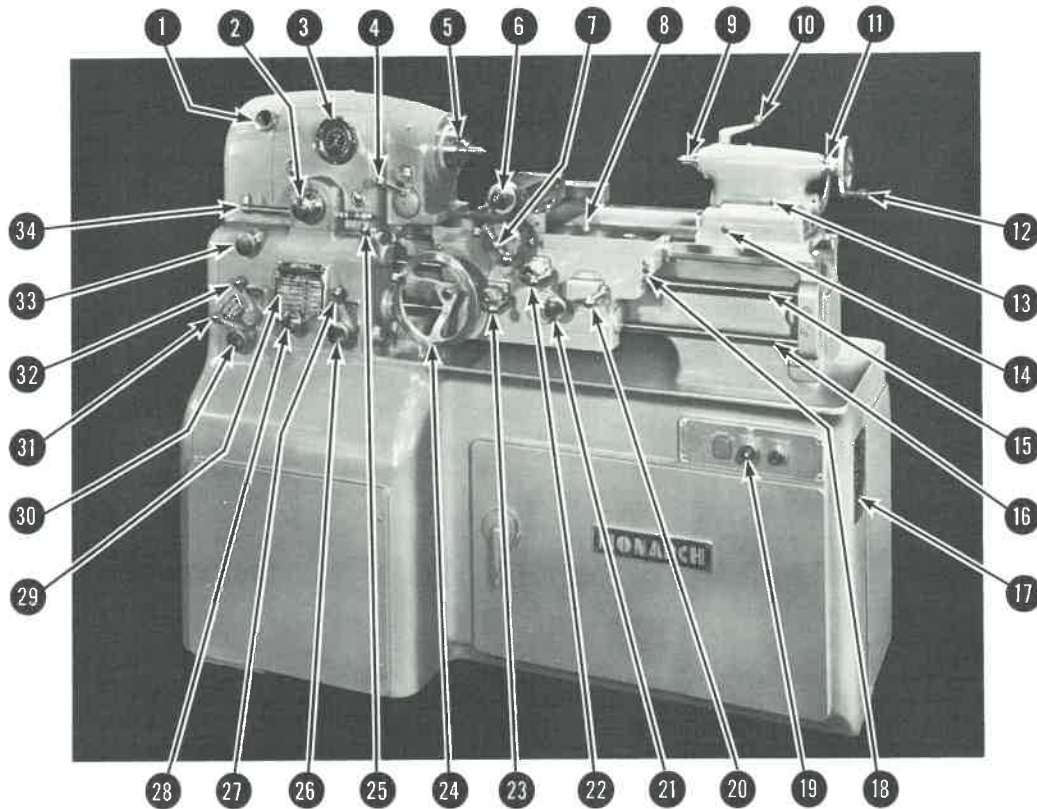
OPERATOR'S MANUAL



10" MODEL EE

PRECISION TOOLMAKER'S
AND
MANUFACTURING LATHES

MONARCH MACHINE TOOL CO.
SIDNEY, OHIO U. S. A.



OPERATING LEVERS AND CONTROLS

- | | | | |
|----|---|----|-----------------------------------|
| 1 | Spindle lock knob | 18 | Carriage gib adjusting screw |
| 2 | Headstock feed, R. H. and L. H. thread selector | 19 | Electric control push buttons |
| 3 | Tachometer | 20 | Half-nut lever |
| 4 | Spindle control lever | 21 | Apron feed reverse knob |
| 5 | Headstock spindle and center | 22 | Cross feed friction lever |
| 6 | Compound dial and handle | 23 | Longitudinal friction lever |
| 7 | Cross feed dial and handle | 24 | Apron handwheel |
| 8 | Carriage clamp | 25 | Tumbler lever |
| 9 | Tailstock spindle and center | 26 | C-D-E thread knob |
| 10 | Tailstock spindle clamp lever | 27 | Feed and thread slip gear lever |
| 11 | Tailstock bed clamp | 28 | Thread selector knob |
| 12 | Tailstock handwheel | 29 | Index plate |
| 13 | Tailstock center dauber | 30 | Spindle speed control knob |
| 14 | Tailstock set-over screw | 31 | Motor back gear lever |
| 15 | Leadscrew | 32 | Gear box feed and thread selector |
| 16 | Feed rod | 33 | A-B thread knob |
| 17 | Serial index plate | 34 | Micrometer stop bar |

10" EE TOOLMAKER'S AND MANUFACTURING LATHE

INTRODUCTION

To insure maximum productiveness and efficient operation it is important that the operator have a thorough understanding of the 10" Model EE machine.

This manual has been carefully prepared to help achieve this end.

Proper operation, adequate preventive maintenance and correct lubrication procedure will assure many years of accurate, trouble-free performance.

RECEIVING AND CLEANING

Upon arrival your 10" Model EE should be uncrated down to the skids, and the packing list checked against items received. Should any discrepancy appear, contact The Monarch Machine Tool Company, Sidney, Ohio immediately, giving the serial number of the lathe. The serial number appears on the packing list and is also stamped on the undercut between the front vee and flat at the tailstock end of the bed.

You will note that all finished surfaces of the machine are covered with an anti-rust compound. This compound is easily removed with a brush and solvent.

CAUTION: Do not move any part of the machine until the anti-rust compound has been removed.

LIFTING

The machine should be left on the skids and moved as close to the point of installation as possible. In lifting the machine from the skids make certain that the rope or cable sling is of sufficient size and strength to carry the load, which dependent upon equipment furnished, may approximate 4000 pounds. Figure 2 shows the recommended method of lifting.

Raise the machine just high enough to clear the skids and move into final position.

CAUTION: Be sure the load is balanced.

INSTALLATION

In order that the machine turn, bore and face accurately it must be leveled perfectly. A three-point suspension system consisting of two pads at the headstock end of the cabinet base and one at the tailstock end simplifies leveling.

A sensitive precision machinist's graduated .0005" to the foot should be used.

Using parallel blocks, place the level across the front and rear flat ways. Make sure with a machinist's square that the level is at a right angle to the lathe centerline. Follow this procedure at both the headstock and tailstock ends, shimming under the suspension pads until a level condition is observed at both points.

Level of the machine lengthwise is not as important but because of oil levels, a fairly level condition should be maintained.

It is not recommended that the machine be lagged to the floor.

Dependent upon the condition of the foundation, the lathe should be checked for level once a week for the first two months and once every two months thereafter.

LUBRICATION

Before starting the lathe, make sure all oil reservoirs are filled with correct lubricant as in the section on Lubrication beginning on Page 16.

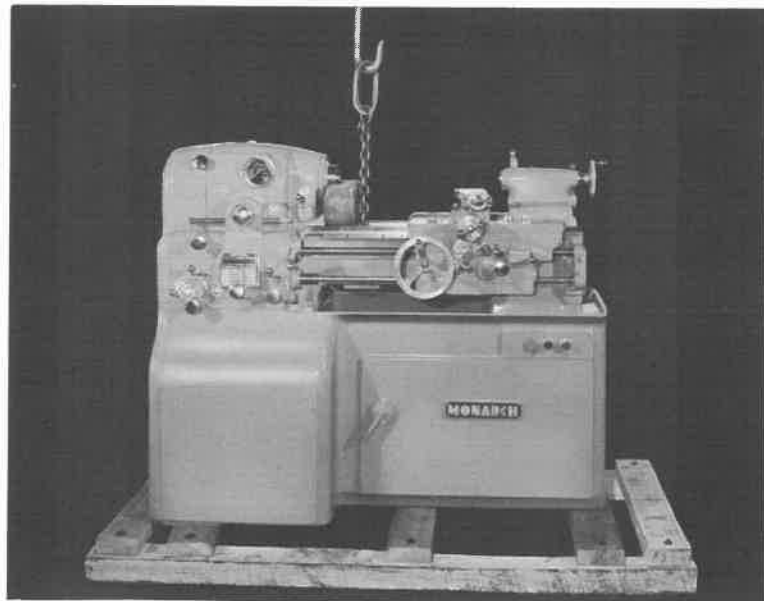


FIGURE 2. Lifting a Model 10" EE Lathe

**GENERAL DESCRIPTION OF
CONTROLS—TOOLMAKER'S LATHE**

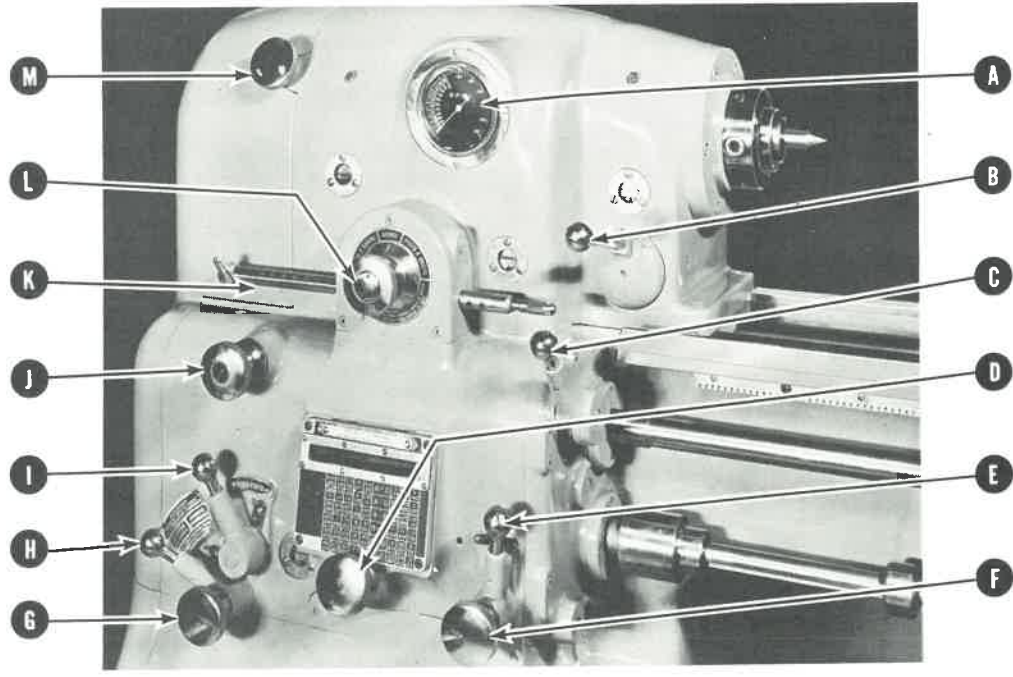


FIGURE 3. Headstock and Gear Box

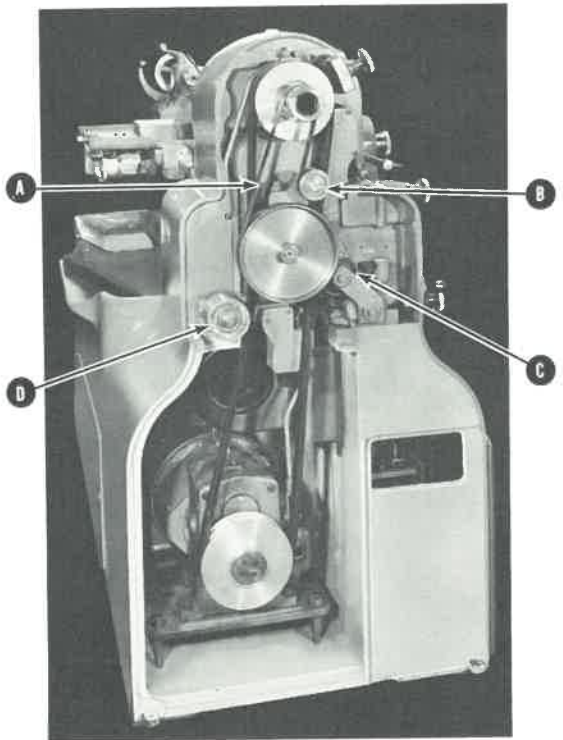


FIGURE 4. Headstock End Covers Removed

MAIN DRIVE MOTOR

The direct current main drive motor is mounted in the headstock end of the cabinet base. An integral part of the D. C. motor is a back gear unit. Lever (H) Figure 3 engages this unit. In the open belt position the motor sheave is driven directly by the motor armature. In the back gear position the armature drives the motor sheave thru a five to one reduction gear.

NOTE:

An electrical interlock is provided to prevent shifting while motor is rotating above 200 RPM.

The drive from the motor sheave to the headstock spindle is by vee belts.

HEADSTOCK

When the 10" EE is used for turning, facing or boring the only gearing rotating in the headstock is the tachometer drive (A) Figure 5. Power is supplied to the gear box for feed during these operations by the feed belt (A) shown in Figure 4. For threading operations knob (L) Figure 3 shifts jaw clutch (B) Figure 5 right or left, engaging the reverse gears which, in turn, drive the gearbox thru the end gear train for right or left hand threading. By using the reverse gearing in the headstock and the end gear train only for threading operations which are performed at relatively low spindle speeds, the accuracy of the gearing is preserved.

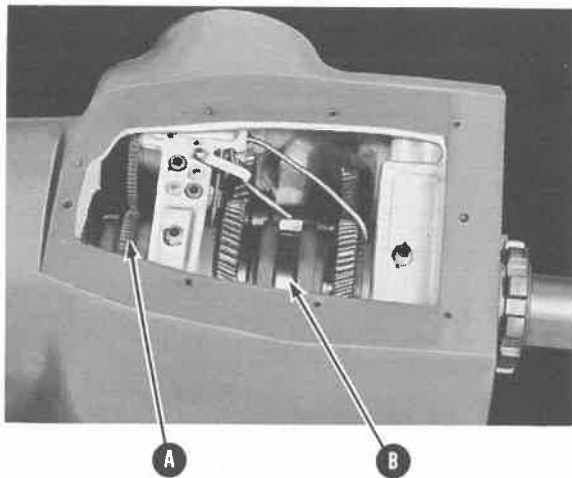


FIGURE 5. Headstock, Top Cover Removed

The tachometer (A) Figure 3 reads direct in spindle revolutions per minute.

Knob (M) Figure 3 is a spindle lock used to hold the headstock spindle stationary when tightening or loosening collets or step chucks. To lock the spindle, push knob in and rotate half a turn. To release rotate another half turn.

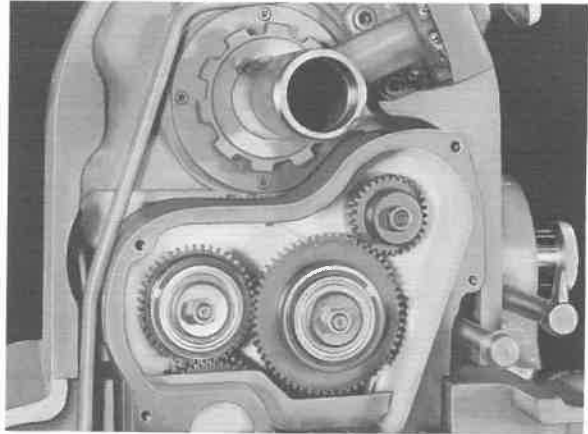
CAUTION: Be sure this lock is released before attempting to start spindle. An electrical interlock is provided to prevent starting with the spindle lock engaged.

Micrometer stop bar (K) Figure 3, is notched for positioning in half inch increments. To adjust bar rotate handle on left end to up position, slide to new location and rotate handle to forward position. The detent will drop into the notch with a definite snap when properly positioned. Lever (B) Figure 3 is the spindle Start-Stop-Reverse lever as furnished on the standard machine. Lathes with electric leadscrew reverse have this lever on the right side of the apron.

Variation of spindle speed over the entire range is obtained by rotation of knob (G) Figure 3.

END GEARS

Figure 6 shows the end gear train. Quadrant (A) is adjusted by loosening screws (B) and (C) on plate (D). Adjust so that gears have approximately .003 clearance between teeth.



NOTE: Idler gear and splash guard shown above must be removed to adjust end gearing.

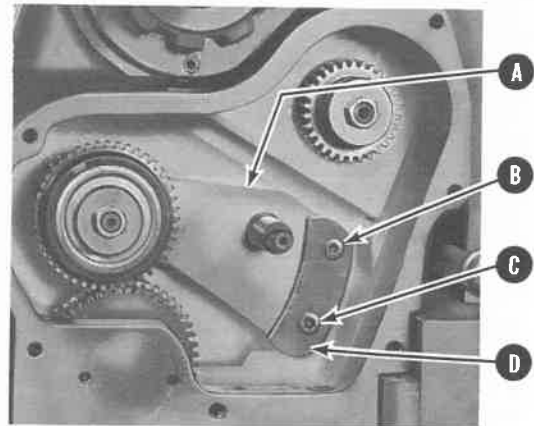


FIGURE 6. End Gear Train

GEAR BOX

To set the gear box for a required feed or thread, proceed as follows:

1. Pull out and lower tumbler lever (C) Figure 3.
2. Position indicator with knob (D) to the index plate column in which the required feed or thread appears.
3. Return tumbler lever to its locked position.
4. Set A-B knob (J) and C-D-E knob (F) as shown on the index plate.

NOTE: Pull out on A-B knob to turn.

5. Push down on ball handle of lever (E) and shift to either FEED or THREAD position.
6. Push down on ball handle of lever (I) and shift to either BELT FEED or GEAR THREAD position.
7. Pull and rotate knob (L) to LEFT HAND THREADS, FEED or RIGHT HAND THREADS as required.

NOTE: Lever (E) and knob (L) are interlocked. In going from thread to feed, knob (L) must be shifted first.

APRON AND CARRIAGE

Figure 7 shows the operating controls of the apron and carriage.

Lever (O) when pushed into the down position engages power feed to the carriage.

Lever (N) when pushed into the down position engages power cross feed.

Knob (M) is the feed reverse. In the "out" position carriage feed is toward the headstock and

cross slide feed is "out". In the "in" position carriage feed is toward the tailstock and cross slide feed is "in". The central position of the knob is neutral and in this position the half nuts can be engaged for threading.

Lever (L) in the down position engages the half nuts for threading.

Thread chasing dial (I) which has four graduations 90° apart is used in determining when to engage the half nuts during threading operations.

- (a) On any thread evenly divisible by 8 the half nuts may be engaged at any point without reference to the chasing dial.
- (b) On any full number of thread such as 7, 13, 26 the half nuts may be engaged on any graduation.
- (c) On any half thread such as 3-1/2, 4-1/2, 13-1/2 the half nuts must be engaged at opposite graduations, that is 1 and 3 or 2 and 4.
- (d) On any quarter thread such as 3-1/4, 5-3/4, 6-3/4 the half nuts must be engaged at the same graduations each time.

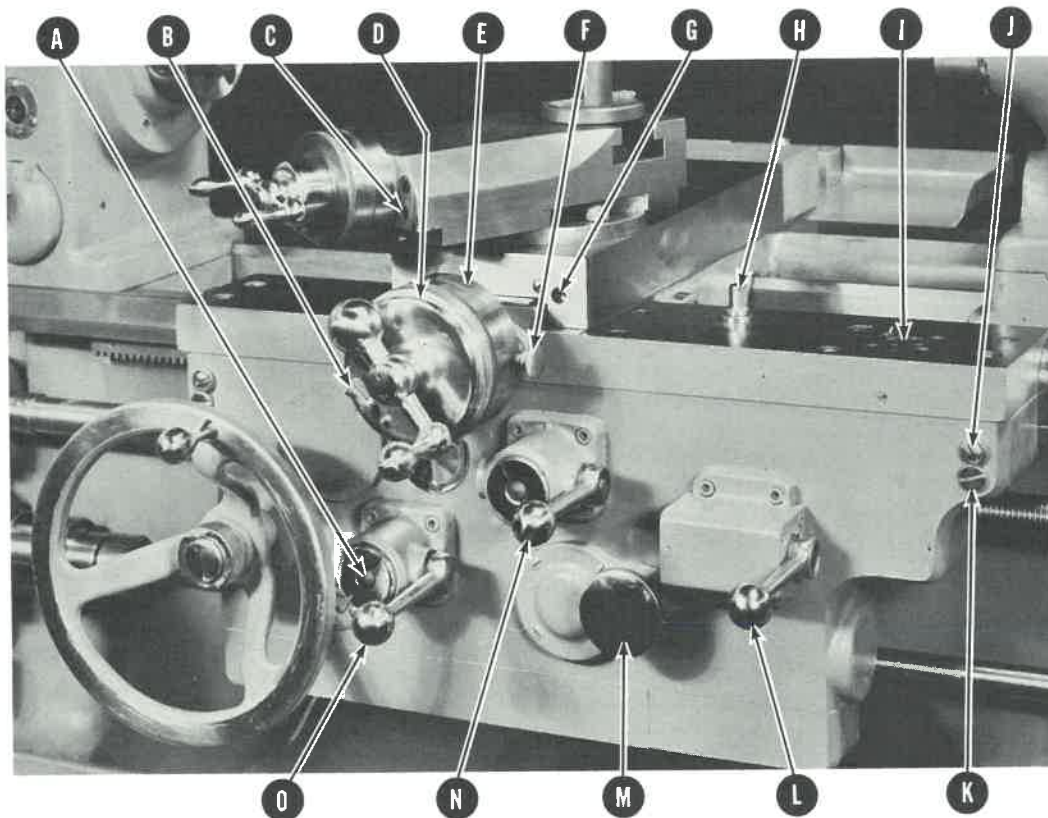


FIGURE 7. Apron and Carriage

- (e) On special leads or fractional threads other than those mentioned above the chasing dial should not be used. Leave the half nuts engaged and reverse the spindle.

Carriage binder clamp (H) locks the carriage in position during facing operations.

Cross feed dial (E) is graduated to read in one thousandths of an inch on diameter. Two sets of numbers are provided. Those nearest the operator are used when boring. The others are used when turning.

When thread chasing stop (F) is turned all the way in, the cross feed dial can be turned three revolutions in or out to a positive position. This stop is most useful when chasing threads with the compound offset at the conventional $29\text{-}1/2^\circ$ for 60° threads. The final pass on such threads can be made by loosening lever (B) and moving the tool straight in a few thousandths thus forming both flanks of the thread. Outer dial (D) is graduated for this purpose. This does not disturb the original setting of the thread chasing stop. It is only necessary to return outer dial (D) to its original position before starting to thread the next part.

TAILSTOCK

The tailstock on any lathe is primarily a work supporting device, but it may be used to perform other important functions such as drilling, reaming and tapping.

Tailstock hand wheel (E) Figure 8 is used to traverse or feed spindle (A) in or out.

To permit accurate drilling to depth, dial (D) graduated in thousandths is provided.

A tang slot is provided in the tailstock spindle to facilitate the removal of drills and reamers from the taper center hole.

To remove the center, rotate the handwheel counterclockwise. When spindle is fully retracted it will eject the center automatically. Clockwise rotation of spindle binder clamp (B) locks the spindle in position for between centers turning operations.

Eccentric clamping lever (C) when pushed to the rear locks the tailstock to the bed ways.

Aligning screw (G) is used to bring the tailstock to true center with the headstock. There are two of these screws, the other being at the rear of the tailstock.

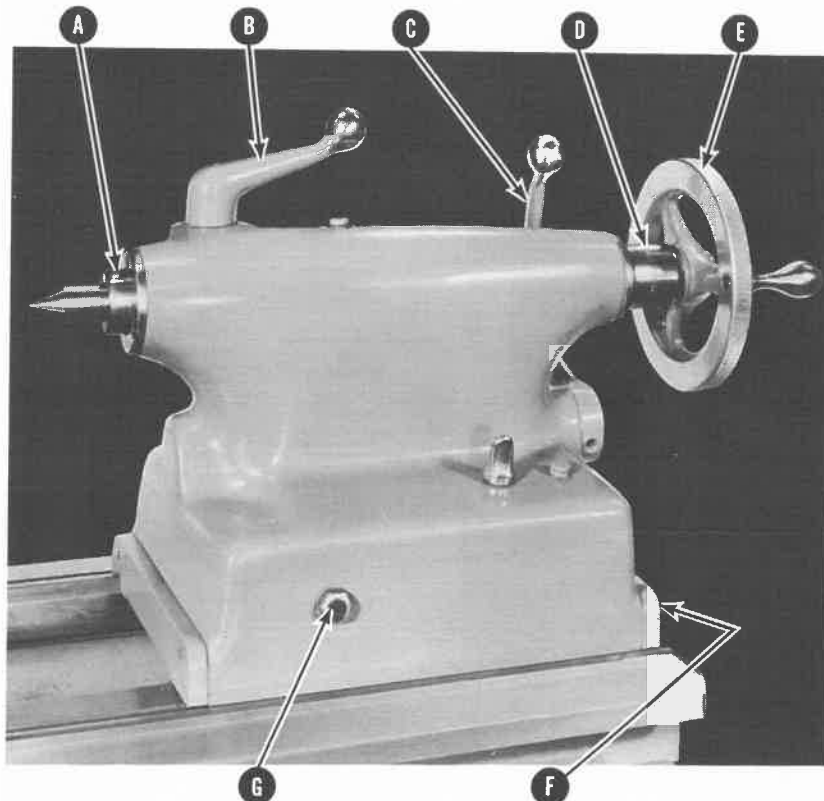


FIGURE 8. Tailstock

10" EE MANUFACTURING LATHE

MAIN DRIVE MOTOR

Same as toolmakers design.

ELECTRONIC POWER UNIT

Same as toolmakers design.

HEADSTOCK

The headstock on the manufacturing design of 10" EE is the same as the toolmakers except that no reverse gearing is provided. This gearing is unnecessary since the machine is not arranged for thread chasing.

END GEARS

No end gears. Belt drive from spindle to gear-box.

GEAR BOX

A simplified gear box providing 6 feeds is furnished on the manufacturing design of 10" EE. Set lever (A) Figure 9 for the column in which the required feed appears and set knob (B) for the line in which the required feed appears.

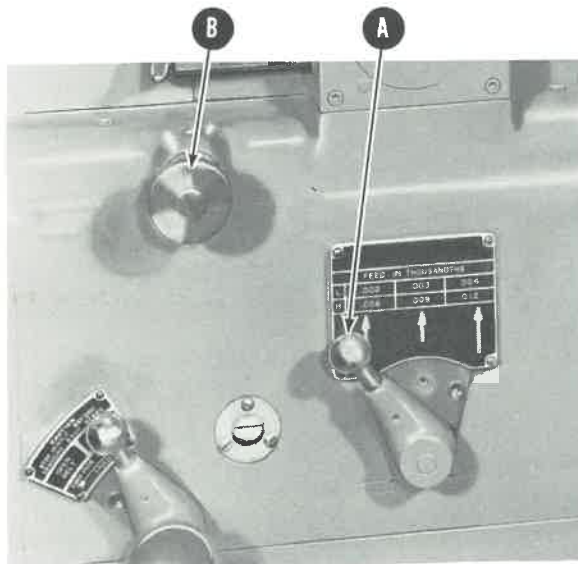


FIGURE 9. Gear Box

APRON AND CARRIAGE

Same as toolmakers design except no leadscrew, half nuts, chasing dial or chasing stop.

TAILSTOCK

Same as toolmakers design.

ACCESSORY EQUIPMENT

TAPER ATTACHMENT

The following are the steps in setting up the Monarch anti-friction taper attachment.

1. Position the carriage so that the tool is about 1" from the end of the work piece.
2. Loosen drawbar clamp (H) Figure 10.
3. Push slide (K) all the way toward the headstock.
4. Position bed bracket (B) and tighten clamp screw (A).
5. Tighten knurled nuts (P).
6. Loosen lock nuts (C) and (L).
7. Set swivel for required taper by turning knob (I) and observing graduations in magnifying lens (O). Scale is graduated in both degrees and taper per foot. For fine adjustment use vernier dial (J) which is graduated in minutes.
8. Tighten lock nuts (C) and (L).
9. Tighten drawbar clamp screw (F).

To disconnect taper attachment for straight turning, loosen clamp screw (F), tighten drawbar clamp (H) and remove bed bracket (B).

ELECTRIC LEADSCREW REVERSE

The electric leadscrew reverse is an accessory item particularly useful in thread chasing. It provides an automatic stop in both directions so that threads may be chased in blind holes or up to shoulders.

The following are the steps in setting up the electric leadscrew reverse.

1. Set knob (G) Figure 11 for right hand or left hand threads as required.
2. Rough position stops (A) and (F) for the start and finish position of the carriage.
3. Loosen lock (D).

4. Knob (C) provides final position adjustment for the carriage stop bars (E).

5. Tighten lock (D).

In chasing right hand threads the down position of lever (B) gives spindle rotation forward and carriage movement toward the head. When stop bar (E) contacts stop (A) lever (B) is returned to the neutral position and the spindle stops.

The cross slide is then retracted to clear the tool and lever (B) raised to the up position. The spindle then operates in reverse and the carriage moves toward the tailstock. When stop bar (E) contacts stop (F) lever (B) returns to neutral and the spindle stops. In chasing left hand threads the process is reversed, that is, the up position of lever (B) gives forward rotation of the spindle and carriage movement toward the tailstock.

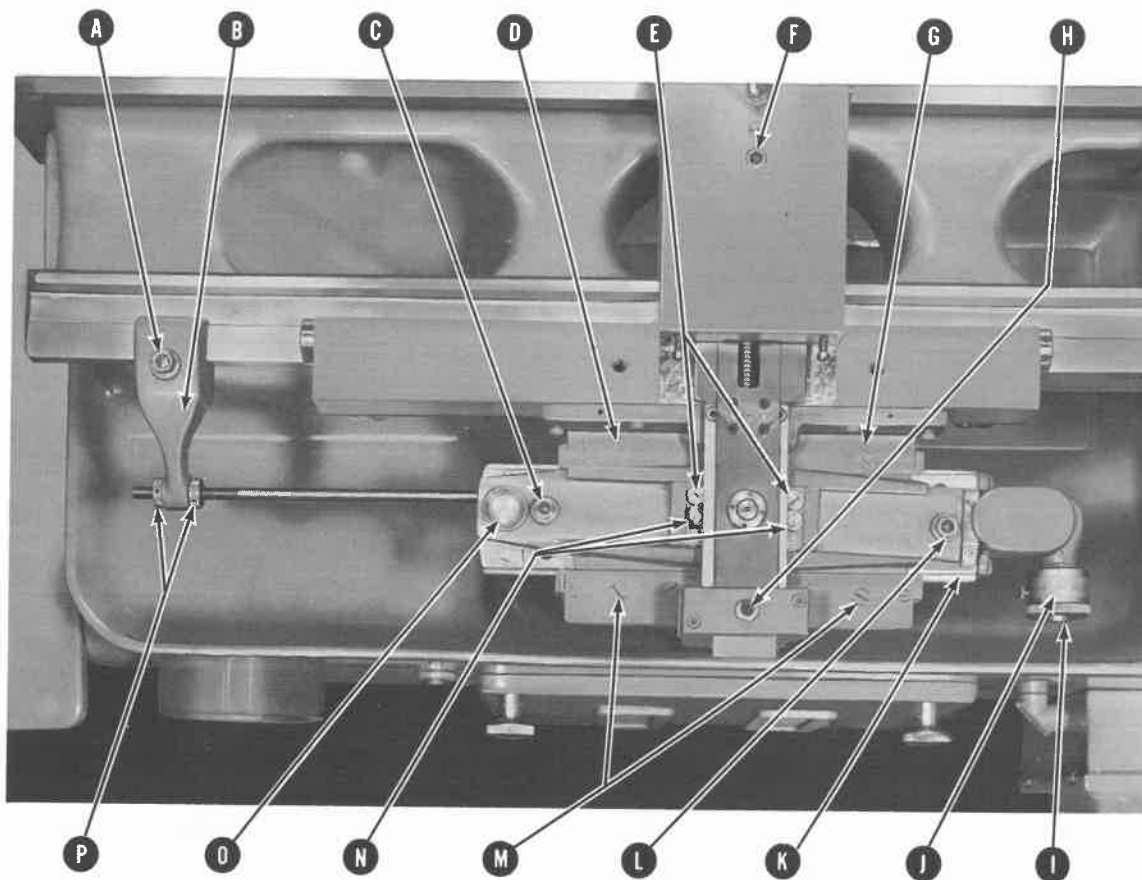


FIGURE 10. Taper Attachment

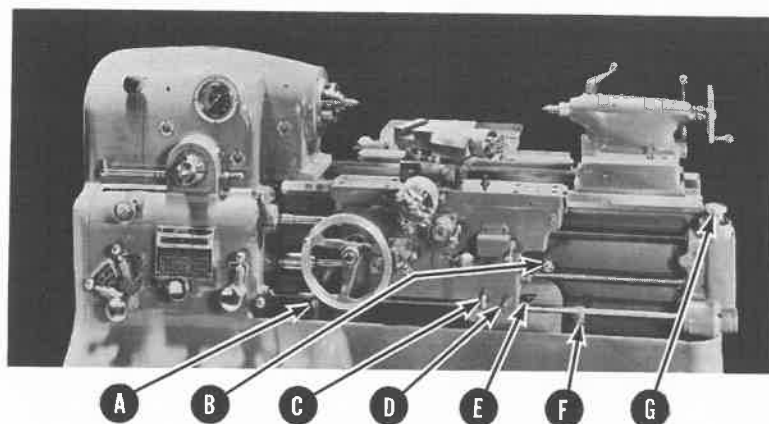


FIGURE 11. Electric Leadscrew Reverse

ADJUSTMENTS

<p>1. Vee and flat belt tension.</p>	<p>Install spindle drive vee-belts and flat feed belt as shown in Figure 4, Pg.4. Two idlers (C) and (D) tighten the spindle drive belt and a single idler (B) tightens the feed belt. Adjust the vee belt idlers so that a reasonable pressure with one finger on a single belt will move it approximately 1/8" from idler (D). Adjust the flat belt idler so that a reasonable pressure with one finger at point (A) Figure 4 will deflect the belt approximately 1/4".</p> <p>NOTE: Be sure motor base and motor leg hold down screws are tight before attempting to adjust belt tension.</p>
<p>2. Apron Frictions</p>	<p>Clockwise rotation of nut (A) Figure 7, Page 6, tightens the friction. It should be adjusted so that the lever becomes tight at about a 45° angle down. The cross feed friction is adjusted in the same manner.</p>
<p>3. Cross slide and Compound Slide Gibs</p>	<p>Screws (G) and (C) Figure 7 are for adjustment of the cross slide and compound gibs. There is a similar screw adjustment at the rear of each slide.</p> <p>The gibs should be adjusted to give a slight drag to the slides. If the adjusting screws are drawn too tightly against each end of the gib, they may create a bad bearing surface by throwing the gibs out of alignment.</p>
<p>4. Tailstock Eccentric Clamp Lever</p>	<p>An upper and lower lock nut, at point (F) Figure 8 beneath the tailstock, adjusts the clamp lever. Clockwise rotation of the nuts tightens the clamp.</p>
<p>5. Anti-Friction Carriage Gibs</p>	<p>Loosen lock screw (J) Figure 7 and turn eccentric stud (K) until anti-friction bearing just rolls as carriage is moved along bedways. Do not adjust too tight. Retighten lock screw.</p>

TAPER ATTACHMENT

Excessive back lash or lost motion in the taper attachment is usually caused by the anti-friction bearings being out of adjustment. To adjust proceed as follows:

1. Loosen drawbar clamp (H) and set swivel at (E).
2. Loosen locknuts (N) Figure 10.
3. Rotate eccentric studs (E) until the 4 shoe bearings will just roll as the slide is pushed back and forth.

4. Retighten lock screws (N).
5. Loosen lock nuts on the bottom of eccentric studs (G) and (M).
6. Straight stud (D) is used with eccentric stud (G) to obtain parallel alignment of slide (K) with the back of the carriage. A surface gage with dial indicator may be used to check the parallelism.
7. Tighten locknut on eccentric stud (G).
8. Adjust eccentric studs (M) so that bearings will just roll as slide is moved back and forth.
9. Tighten locknuts on eccentric studs (M).

ELECTRICAL MAINTENANCE

To properly maintain the electronic equipment on the 10" EE lathe the electrician should use an electronic or high ohms per volt multi-meter.

When checking for continuity, the disconnect switch should be placed on the "Off" position.

Extreme care should be used in making voltage or current checks since voltages as high as 575 volts may be encountered.

It takes but little time to replace or repair an electrical or electronic part.

Unfortunately too much time is spent in finding the part that is at fault. A considerable amount of this lost time can be eliminated if the electrician will follow a few rules as follows:

1. Inquire of the machine operator what is the trouble with the machine.
2. If the electrician is not familiar with the machine operation he should study the schematic diagram included in this manual and go through the sequence of operation with the machine operator.
3. Some time spent studying the schematic diagram should make it possible for the electrician to observe in what part of the circuit the trouble lies. For example, assume the operator states the lathe spindle is coasting

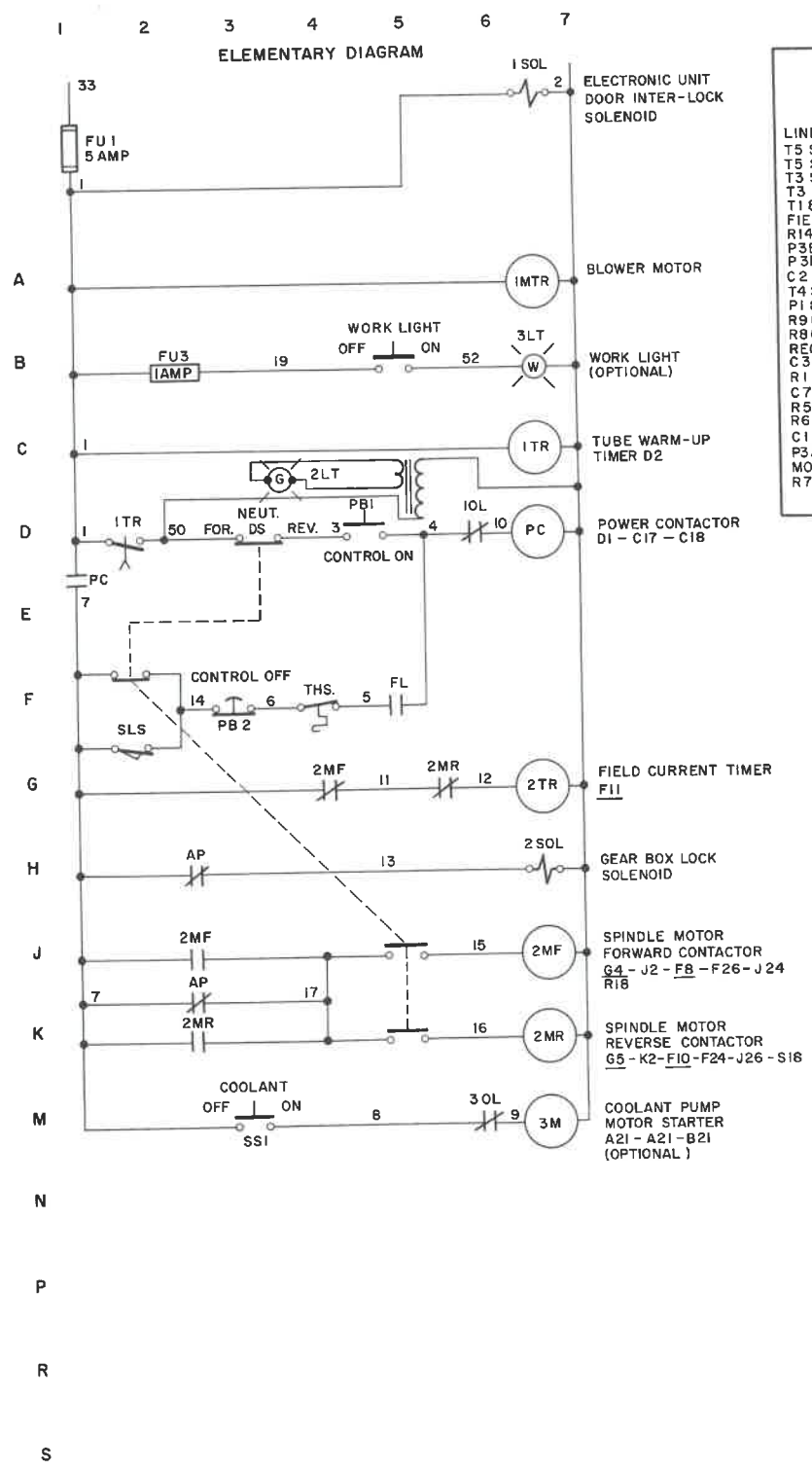
instead of braking when he moves the spindle control lever to the off position. The electrician not being familiar with the machine does not know what type of braking is used. He therefore refers to the wiring diagram and notes immediately that the machine is powered by a shunt wound D. C. motor, and that dynamic braking is employed. He can now see that there may be one of three things that is causing the trouble, the dynamic brake resistors are open, the contacts placing the resistors across the armature are not making contact, or the contacts that place a full field on the motor by short circuiting the field control potentiometer are not making contact. Now with an ohmmeter he can check for continuity and ascertain which of the three possibilities is at fault.

4. If a fuse is opening, it should never be replaced with a higher amperage fuse. This only leads to more serious trouble as the fuse rating was chosen to protect some electrical unit which may be ruined by higher current. Find out what is causing the correct size fuse to open.

SEQUENCE OF OPERATIONS

When the disconnect switch is placed in the "On" position, the filament transformers (T6) and (T7) and the control transformer (T3) are energized. The filament transformers (T6) and (T7) secondaries supply power to their respective C16J tubes (ET2) and (ET3). The control transformer (T3) secondaries, of which there are three, supply power to the filament of the C3J tube (ET1), the C3J grid circuit, and the control circuit. Therefore, when the disconnect switch is placed in the "On" position, the electronic compartment blower revolves, the tube filament timer (1TR) is energized and starts to time out. After 60 seconds, the green light on the operator's control panel glows; and the timer contacts (1-50) close. If the control "On" button is depressed, contacts (3-4) close and the Power Contactor (PC) coil receives current from Line 1 through the Timer contacts (1-50), Drum Switch contacts (50-3), Control On contacts (3-4), Overload Relay contacts (4-10) through the Power Contactor coil (PC) to Line 2. The Power Contactor closes and is electrically interlocked from Line 1, through PC contacts (1-7), Spindle Lock Switch (SLS) contacts (7-14), Control Off contacts (14-6), Temperature Switch (THS) contacts (6-5), Field Failure Relay contacts (5-4), Overload Relay (OL1) contacts (4-10), through the Power Contactor coil to Line 2.

When the Power Contactor closes, the Gear Box Lock Solenoid (ISOL) is energized through the Anti-Plugging Relay (AP) contacts (7-13), making it possible to shift the gear box on the Spindle Motor. The Field Current Timer (2TR) is energized through the Forward Contactor (F) contacts (7-11), and through the Reverse Contactor (R) contacts (11-12). After 2TR times out (60 sec.), its contacts (37-35) open and place a resistor (R2) in the field control circuit to reduce the current through the Spindle Motor Field during stand-by periods. The power Contactor (PC) contacts (L1-1-23), (L3-1-24) close and energize the large Anode Transformer (T5), placing voltage on the anodes of (ET1), (ET2), and (ET3).



VOLTAGE READINGS

ACROSS	SPINDLE SPEED	
	200 RPM	2000 RPM
LINE (L1 - L3)	230/460 V.A.C.	230/460 V.A.C.
T5 SEC. (20 - 21)	600 V.A.C.	600 V.A.C.
T5 SEC. B. CENT. TAP	300 V.A.C.	300 V.A.C.
T3 SEC. (34 - 36)	46 V.A.C.	46 V.A.C.
T3 SEC. (2 - 33)	120 V.A.C.	120 V.A.C.
T1 & T2 SEC. (25 - 26)	13 V.A.C.	15 V.A.C.
FIELD (18 - F2)	120 V.D.C.	57 V.D.C.
R14 (-29 + 29A)	26 V.D.C.	26 V.D.C.
P3B & TAP (-22 + 27)	62 V.D.C.	250 V.D.C.
P3B (-22A + 29)	205 V.D.C.	205 V.D.C.
C2 (-22 + 42)	53 V.D.C.	240 V.D.C.
T4 SEC. (31 - 32)	270 VAC	270 V.A.C.
P1 & TAP (-42 + 28)	8 V.D.C.	22 V.D.C.
R9 (-44 + 42)	35 V.D.C.	35 V.D.C.
R8 (-43 + 44)	72 V.D.C.	46 V.D.C.
REC. 2 (-43 + 42)	105 V.D.C.	105 V.D.C.
C3 (-44 + 51)	19 V.D.C.	8 V.D.C.
R1 (35 - 39)	14 V.A.C.	14 V.A.C.
C7 (39 - F2)	7 V.A.C.	5 V.A.C.
R5 (46 - 48)	4.5 V.A.C.	6.5 V.A.C.
R6 (45 - 47)	4.5 V.A.C.	6.5 V.A.C.
C1 (34 - 35)	46 V.A.C.	32 V.A.C.
P3A & P2 (36 - 37)	0 V.A.C.	34 V.A.C.
MOTOR ARM (-S1 + 51)	36.5 V.D.C.	235 V.D.C.
R7 (54 - 2)	115 V.A.C.	115 V.A.C.

SEE NOTE AT RIGHT

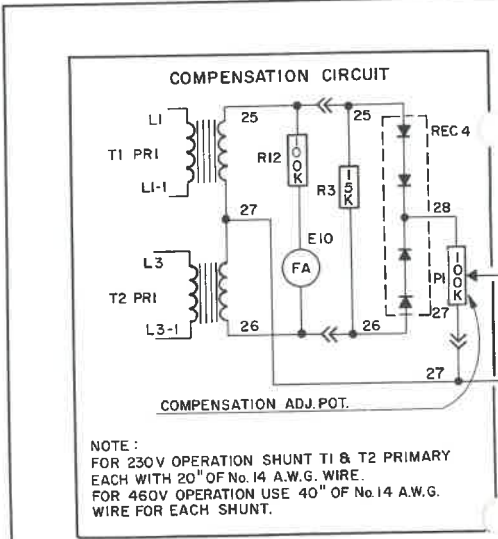
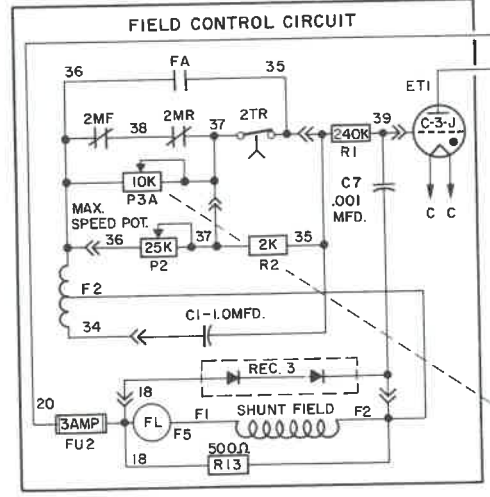
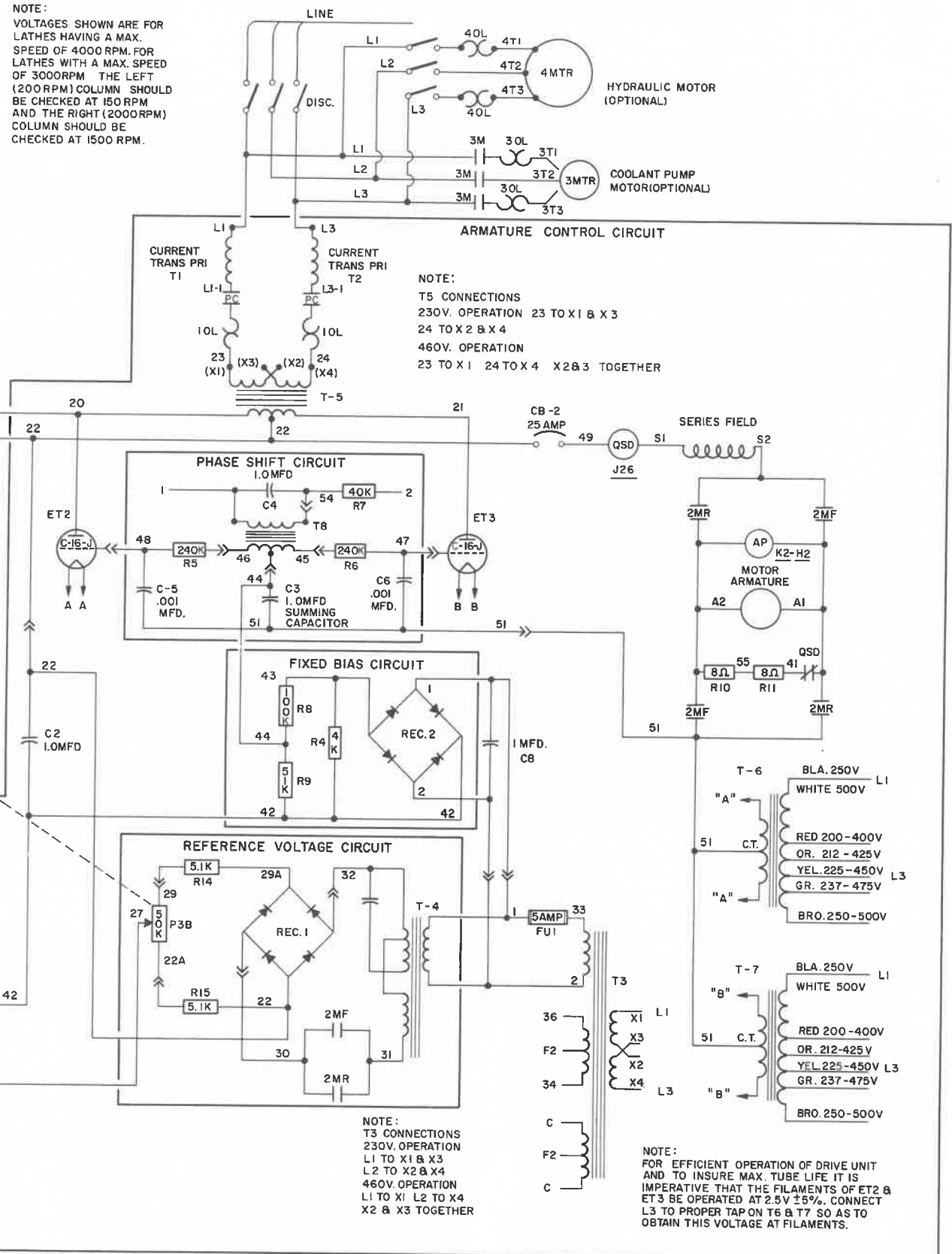


FIGURE 12. Schem

14 15 16 17 18 19 20 21 22 23 24 25 26

NOTE:
VOLTAGES SHOWN ARE FOR LATHES HAVING A MAX. SPEED OF 4000 RPM. FOR LATHES WITH A MAX. SPEED OF 3000 RPM THE LEFT (200 RPM) COLUMN SHOULD BE CHECKED AT 150 RPM AND THE RIGHT (2000 RPM) COLUMN SHOULD BE CHECKED AT 1500 RPM.



NOTE:
T5 CONNECTIONS
230V. OPERATION 23 TO X1 & X3
24 TO X2 & X4
460V. OPERATION
23 TO X1 24 TO X4 X2 & 3 TOGETHER

NOTE:
T3 CONNECTIONS
230V. OPERATION
L1 TO X1 & X3
L2 TO X2 & X4
460V. OPERATION
L1 TO X1 L2 TO X4
X2 & X3 TOGETHER

NOTE:
FOR EFFICIENT OPERATION OF DRIVE UNIT AND TO INSURE MAX. TUBE LIFE IT IS IMPERATIVE THAT THE FILAMENTS OF ET2 & ET3 BE OPERATED AT 2.5V ± 5%. CONNECT L3 TO PROPER TAP ON T6 & T7 SO AS TO OBTAIN THIS VOLTAGE AT FILAMENTS.

Wiring Diagram

SEQUENCE OF OPERATIONS (Continued)

The Spindle Motor can now be started by operating the Spindle Control Lever which is connected mechanically to a Drum Switch having contacts (15-17) and (16-17). (On lathes with electrical lead screw reverse, the Drum Switch is replaced by three small switches located at the tail-stock end of the lathe.) These contacts are used to energize either the Forward or Reverse Contactor coil.

As the control sequence is the same whether the Spindle Control Lever is placed in the forward or reverse position, only the forward sequence will be given. With the Spindle Control Lever moved to the "Forward" position, the Forward Contactor (F) coils receive current from Line 7 through the Anti-plugging Relay (AP) contacts (7-17), the Drum Switch contacts (17-15), the Forward Contactor coil to Line 2. Therefore, the Forward Contactor closes and the Spindle Motor Armature is energized from Line 22, through the 25 ampere Circuit Breaker (CB2) contacts (22-49), the Quick Slow Down Relay (QSD) coil, the Spindle Motor Series Field (S1-S2), the Forward Contactor (F) contacts (S2-A1), the Spindle Motor Armature (A1-A2), the Forward Contactor contacts (A2-51), to Line 51. When the Armature is energized, the Anti-Plugging (AP) coil shunted across the Armature is also energized; and AP contacts (7-17) open, but F contacts (7-17) have closed and the F coil is electrically interlocked. F contacts (30-31) connect the Constant Voltage Transformer (T4) to the reference voltage circuit. F contacts (7-11) open and reset the Field Current Timer (2TR). F contacts (36-38) open and place the Motor Field Control Potentiometer (P3A) in the field control circuit.

The sequence of the braking cycle is the opposite of the starting cycle. The F contacts (S2-A1) open, disconnecting the Motor Armature from the power lines. The F contacts (36-38) close placing full voltage on the Motor Field for dynamic braking. The F contacts (7-11) close to start 2TR to time out and reduce the current through the Motor Field. The F contacts (30-31) open, disconnecting the reference voltage, causing the armature power tubes (ET2) and (ET3) to be turned off. As there is now zero current flowing through the (QSD) coil, the (QSD) contacts (41-A1) close, placing the Dynamic Brake Resistors (R10) (R11) across the armature to accomplish Dynamic Braking.

ELECTRONIC COMPONENT FUNCTIONS

TRANSFORMERS

T1 and T2 - These transformers are of the current type. Their primaries are placed in series with the primary leads of the large Anode Transformer (T5). When the Spindle Motor is loaded, they produce in their secondaries a voltage output proportional to the armature current. This voltage is rectified and introduced into the control circuit to raise the armature voltage enough to overcome the IR drop of the armature, and thus maintain the spindle speed constant from

an unloaded condition to a loaded condition.

T3 - This is the Control Transformer and it has three functions. It supplies 115 volts for the relays, contactors, pilot lights, etc., 2.5 volts c.t. for the filament of the Motor Field Rectifier Tube (ET1) and 44 volts c.t. for the Spindle Motor field control grid circuit. The primary is wound for 230 or 460 volts.

T4 - This transformer is of the constant voltage type. It possesses characteristics that tend to hold the secondary voltage constant with a varying voltage across the primary. It is used to supply voltage to be rectified and used as a reference voltage for the electronic powered spindle motor armature supply. The primary is wound for 115 volts and its secondary 275 volts.

T5 - This is the large Anode Transformer used to supply voltage to be rectified by ET2 and ET3 tubes, this rectified voltage is applied to the armature of the Spindle Motor. It also supplies voltage to the field rectifier tube ET1. The primary of this transformer is wound for 230 and 460 volts, and the secondary is wound for 575 volts c.t.

T6 and T7 - These transformers are identical, one supplies filament voltage for ET2 and the other one supplies filament voltage for ET3. The primaries are wound for Black Common, Brown 250V, Green 237V, Orange 225V, Yellow 212V, and Red 200V. When the customer's line voltage is 460, the primaries are wound for White Common, Brown 500V, Green 475V, Orange 450V, Yellow 425V and Red 400V. The transformers are connected at the factory for 230 or 460 volts, but if the customer's voltage is lower than 230 or 460, the leads should be changed from Brown to the color nearest the line voltage.

T8 - This is the grid transformer for the grid circuits of ET2 and ET3. The primary is wound for 9 volts and the secondary for 27 volts c.t.

RESISTORS

R1-R5-R6 - These resistors limit the grid current that can be drawn by the power tubes ET1-ET2-ET3.

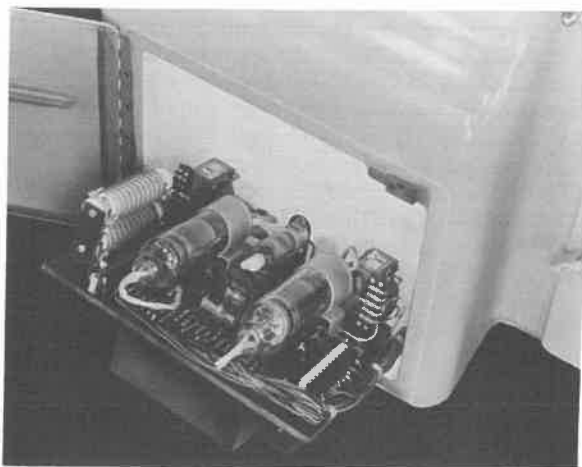


FIGURE 13. Power Panel Pulled Forward.

R2 - This resistor is used to reduce the current through the spindle motor field during stand-by periods. When it is introduced into the grid circuit, it phrases back the field rectifier tube ET1 to reduce the output voltage.

R3 - Current transformer by-pass resistor. It prevents transient voltages from appearing across the current transformer secondaries. It also loads the current transformer to arrive at the proper volts per ampere to hold the motor speed constant under load.

R4 - Negative grid bias loading resistor. It prevents a changing current through R9 from affecting the negative bias output voltage.

R7 - Used in conjunction with C4 to shift the grid transformer T8 output voltage approximately 75 degrees lagging the plate voltage of the ET2 and ET3 rectifier tubes.

R8-R9 - Negative bias voltage divider resistors.

R10-R11 - Dynamic brake resistors. Used to dissipate the spindle motor's stored energy and dynamically brake the spindle motor.

R12 - Used to limit the current through the field accelerating relay FA.

F13 - Spindle motor field by-pass resistor. Limits any voltage spikes that might damage the back rectifier REC3.

R14-R15 - Voltage dividing resistors for the reference voltage output. R14 limits the maximum armature voltage. R15 limits the minimum armature voltage.

CONTROLLED RECTIFIER TUBES

ET1 - Electrons Inc. No. C3J. Zenon filled grid controlled rectifier tube. Filament voltage 2.5, current 10 amp., max. average anode current 2.5 amperes.

ET2-ET3 - Electrons Inc. No. C16J. Zenon filled grid controlled rectifier tube. Filament voltage 2.5, current 31 amp., max. average anode current 16 amperes.

POTENTIOMETERS

P1 - Compensation Potentiometer

Used to adjust the amount of IR drop compensation voltage so the spindle speed will remain constant under load.

P2 - Spindle Maximum Speed Potentiometer

Used to adjust the maximum speed of the Spindle Motor to get the proper maximum spindle speed.

P3 - Spindle Speed Control Potentiometer

This is a two section tandem potentiometer. One section marked B is used to control the motor armature voltage, and the other section marked A is used to control the motor field voltage. Rotating this potentiometer from the counter-clockwise position, the resistance in the armature control section B changes over the first half of rotation with zero change in the last half of rotation. The field control section A is the reverse of the above, zero change for the first half of rotation, and resistance change in the last half of rotation.

CAPACITORS

C1 - This capacitor is used in the field control circuit as the reactance in the phase shift bridge.

C2 - This capacitor is used to afford a time constant in the armature control. It causes the armature voltage to be zero on the completion of the armature circuit and to rise to maximum over a certain time.

C3 - Summing capacitor. It integrates the reference voltage, armature feedback voltage, compensation voltage, and the negative grid bias voltage, and applies the sum to the grids of the ET2 and ET3 controlled rectifier tubes.

C4 - This capacitor in conjunction with (R7) shifts the grid transformer (T8) output voltage approximately 75 degrees lagging the plate voltage applied to the controlled rectifier tubes ET2 and ET3.

C5-C6-C7 - These capacitors are used to bypass any transient voltage that appears on the grids of the controlled rectifier tubes, ET1-ET2-ET3.

C8 - This capacitor is used to absorb any spikes of voltage appearing across the input to rectifier No. 2.

SILICON RECTIFIERS

REC1 - This is a full wave single phase bridge rectifier employing four silicon diodes. It is employed to rectify the voltage supplied by the constant voltage transformer (T4), this voltage is used for the reference voltage on the spindle motor electronic control.

REC2 - This is a full wave single phase bridge rectifier employing four silicon diodes, it is used to rectify the voltage used for the fixed negative grid bias on the ET2 and ET3 controlled rectifier tubes.

REC3 - This is a back rectifier for the motor field. It is composed of two silicon diodes con-

nected in series to rectify the stored energy in the field causing continuous current to flow through the field even though a single phase half wave rectifier circuit is used. EL1

REC4 - This is a full wave single phase rectifier employing four silicon diodes. It is used to rectify the voltage produced by current transformers T1 and T2.

NOTE: Silicon diodes are ruined if a short circuit is placed across the output of a rectifier in which they are employed even though the short is of a very short duration.

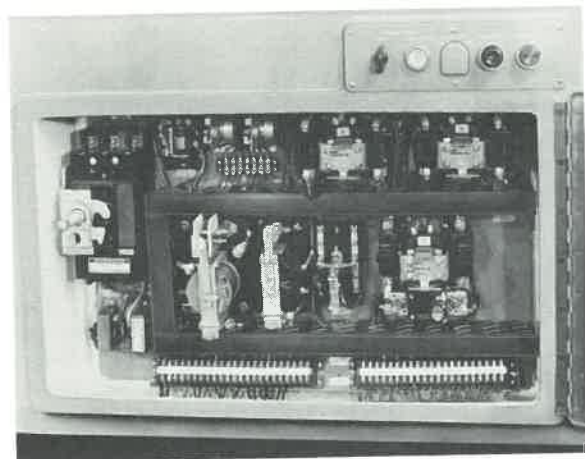


FIGURE 14. Relay and Starter Compartment.

TIMER, RELAY AND CONTACTOR FUNCTIONS

Power Contactor (PC)

1. Used to provide under voltage protection. This contactor falls open on low or zero supply voltage stopping the complete machine. The machine will not start on the resumption of supply voltage unless the start button is depressed.
2. Used to provide a time delay for tube filament heating. This contactor cannot be energized until the timer 1TR has timed out. Therefore, the anode transformer T5 cannot be energized as its primary is feed power through the main contactor (PC) contacts (L1-1-23) and (L3-1-23). The filament transformers are not controlled by (PC), they are energized when the disconnect switch (disc) is placed in the "On" position. Therefore, the tube filaments are heated for one minute before power can be drawn through the controlled rectifier tubes.

Forward and Reverse Contactor (F & R)

This contactor causes the spindle motor to revolve when its coil is energized. F contacts (S2-A1) (51-A2) close, completing the circuit to the motor armature. F contacts (7-11) open resetting timer 2TR. F contacts (36-38) open,

placing the field control potentiometer in the circuit to control the speed of the motor in the field range. F contacts (7-17) close, electrically interlocking the Forward Contactor F. When the reverse contactor R is operated, the same procedure takes place with the exception that the current through the spindle motor armature is reversed in direction, and the motor revolves in the opposite direction.

Anti-Plugging Relay

This relay prevents the spindle motor from being reversed until it has been dynamically braked to a safe reversing speed. When the motor is initially started, the circuit to the forward contactor coil F is completed through the anti-plugging relay contacts (7-17). As the armature is energized, the AP relay coil which is connected across the armature is energized and AP contacts (7-17) open. As F contacts (7-17) have closed, the F coil is energized even though the AP relay contacts (7-17) have opened. If the spindle start lever is moved from the forward to the reverse position, the forward contactor F opens but the reverse contactor cannot close as the AP contacts (7-17) are still open, and will remain open until the spindle motor speed has dropped to approximately 250 R.P.M. When the motor has braked to this speed, the voltage across the AP relay coil has dropped to the value that AP contacts (7-17) close, the reverse contactor coil R is energized and closes its contacts (7-17). This same cycle would take place if the reverse contactor R had been initially closed, and the lever moved to the forward position.

Field Accelerating Relay (FA)

This relay is used to limit the spindle motor armature current when the motor is accelerated. The coil of this relay is placed across the secondaries of the current transformers T1 and T2. When the motor is started, this relay is adjusted to close when a current of 25 amperes flow through the motor armature, closing the FA contacts (35-36). These contacts short circuit the field control section A of the tandem spindle control potentiometer, placing full voltage on the spindle motor field. Therefore, in accelerating, if the motor armature current reaches 25 amperes, the FA contacts (35-36)

close, the current decreases, and the relay falls open. This cycle is repeated until the motor has reached the preset speed.

Field Failure Relay (FFR)

This relay is employed to prevent the spindle motor from revolving at an excessive speed if there is low or zero field current. In other words, the coil of this relay is placed in series with the spindle motor field; and if the power to the field fails, or the field opens, the FFR contacts (4-5) open, dropping out the power contactor (PC) stopping the complete machine.

Quick Slow Down Relay (QSD)

This relay is used to dynamically brake the spindle motor. Its coil is in series with the motor armature; and if the power to the spindle motor is disconnected by the opening of either the forward or reverse contactor F or R, the QSD coil is de-energized and the contacts (41-A1) close, placing the dynamic brake resistors R10 and R11 across the armature causing the motor to brake by generator action. This relay serves another purpose. If the motor speed is changed from a higher to lower value, the controlled rectifier tubes ET2 and ET3 cease firing and no current is drawn by the motor even though the circuit is closed to its armature. With zero current flowing through the armature, the QSD contacts (41-A1) close, dynamically braking the motor down to the new lower speed. As soon as this speed is reached, the tubes ET2 and ET3 fire again; and the current through the QSD relay coil opens up the QSD contacts (41-A1), removing the dynamic brake resistors from across the armature.

Filament Heating Timer (1TR)

This timer is used to afford a one minute time delay before power can be drawn through the grid controlled rectifier tubes ET1, ET2, and ET3.

Field Current Timer 2TR

This timer reduces the spindle motor field current during stand-by periods.

Coolant Pump Motor Starter (CP)

This starter starts the coolant pump motor.

SPINDLE MOTOR SPECIFICATIONS

GENERAL ELECTRIC

5 Horsepower Machine Tool Duty
Armature Voltage 240
Armature Resistance 2.2 Ohms
Field Voltage 120
Field Resistance Cold 78 Ohms-Hot 100 Ohms
Field Current Hot 1.19 - .272
Speed 60 to 1150 R.P.M. by armature control
1150 to 3450 R.P.M. by field control.
Frame 218

SPINDLE MOTOR PARTS LIST

Armature Complete	#882A131-G1
Main Field Coil	#895A305AC-G1
Comm. Field Coil	#895A306AE-G1
Bearing FE	#894A605-P5
Bearing DE	#894A605-P6
Brush Holder	#894A627-G1
Brush Holder Spring	#626B202-G1
Brush Yoke	#625B132-P1
Brush	#894A500-P1

ELECTRICAL AND ELECTRONIC PARTS LIST

PART	PART NO.	DESCRIPTION
R1-R5-R6	502E-12	240K Ohm 2 Watt Resistor
R2	502E-3	2K Ohm 2 Watt Resistor
R3	503-24	15K Ohm 10 Watt Axial Lead Resistor
R4	503-10	4K Ohm 10 Watt Axial Lead Resistor
R7	503-33	40K Ohm 10 Watt Axial Lead Resistor
R8-R12	502E-11	100K Ohm 2 Watt Resistor
R9	502E-9	51K Ohm 2 Watt Resistor
R10-R11	516F-15	8 Ohm 385 Watt Resistor
R13	509E-14	500 Ohm 100 Watt Resistor
R14-R15	502E-5	5.1K Ohm 2 Watt Resistor
C1-C2-C3-C4	22069	1 Mfd. 1000 V.D.C.W. Capacitor
C5-C6-C7	22066	Type 600 UF .001 Mfd. Capacitor
P1	522E-9	100K Ohm 2 Watt Potentiometer
P2	522E-6	25K Ohm 2 Watt Potentiometer
P3	33173	10K & 50K Ohm 2 Watt Tandem Potentiometer
REC1-2-3-4	20632	Silicon Diode Rectifier
ET1	22060	Grid Controlled Rectifier Tube C3J
ET2-ET3	22059	Grid Controlled Rectifier Tube C16J
1TR	18157	Timer Type 90 1 Min.
2 TR	18157	Timer Type 90 1 Min.
CB2	19638	25 Amp. Circuit Breaker
T1-T2	22138	Current Transformer
T3	22105	Control & Filament Trans.
T4	22136	Constant Voltage Trans.
T5	22106	Anode Trans.
T6-T7	22133	Filament Trans. 230 Volt Pri.
T8	22134	Filament Trans. 460 Volt Pri.
PC & 3M	22070	Grid Transformer
F-R	21901-1	Size 1 Starter
QSD	22116-1	Size 1 Reversing Starter
AP	22119	Quick Slow Down Relay
FFR	22120	Anti-Plugging Relay
FA	22117	Field Failure Relay
O.L.1	24328-2	Field Accelerating Relay
O.L.1	10177H1044	Heater Coils 230 Volt
O.L.2	10177H1038	Heater Coils 460 Volt
O.L.2	10177H1020	Heater Coils 230 Volt
1 SOL.	10177H1010	Heater Coils 460 Volt
2 SOL.	23177	Solenoid
TSW	23094	Solenoid
SLS	13822	Temperature Switch
PB1-2LT	19574	Limit Switch
PB2	23110	Green Ill. Push Button
DRUM SW.	15718	Push Button
PLUG & RECEPT.	21111	Drum Switch
C8	23793	24 Contact Varicon Connector
DISC.	23209	1. MFD. 600 V.D.C.W.
	23900	Main Disconnect Switch

MODULE MAINTENANCE

The brain of the electronic controlled spindle motor power supply is contained in a black box and called a Module. In this module is located the necessary resistors, capacitors, diodes, etc., to control the thyatron rectifier tubes. This module is easily replaced and it is suggested that a spare module is purchased so that if the module is suspected of being the cause of a malfunction it can be replaced with one known to be good. Therefore, in a very short time, it can be proven whether the trouble lies in the electronic control. If a spare module is not available, the parts in the one thought to be bad can be repaired by removing the module from the electronic control panel. The cover can then be removed by removing the two screws from the back of the module nearest the edge.

The silicon diodes may be removed from their clips and checked with an ohmmeter. When the positive lead of the ohmmeter is placed on the positive terminal of the diode, and the negative lead on the negative terminal, the ohmmeter reading should be high. When the positive lead of the ohmmeter is placed on the negative terminal of the diode, and the negative lead placed on the positive terminal of the diode, the ohmmeter reading should be low. If both readings are low, the diode is shorted. If both readings are high, the diode is open. In either case, the diode should be replaced. As the diodes and

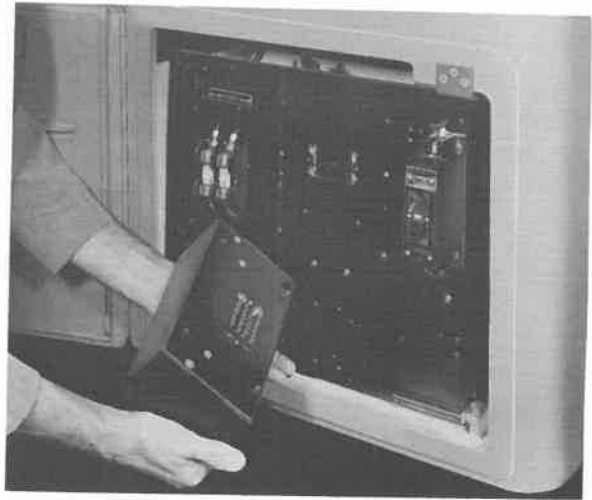


FIGURE 15. Plug-in Module.

diode clips are polarized, care should be taken not to try to force the diode into the clip in the wrong direction. Care should be taken not to short the output of any of the diode rectifiers as the diodes can be ruined in a fraction of a second. Inside the module cover is a schematic diagram of the module, instructions for adjustment of the potentiometers and a diagram of the location of the silicon diodes.

J. I. C. CONTROLS ON 10" MODEL EE LATHES

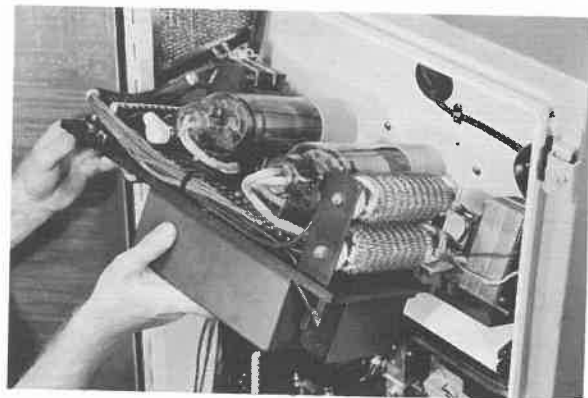
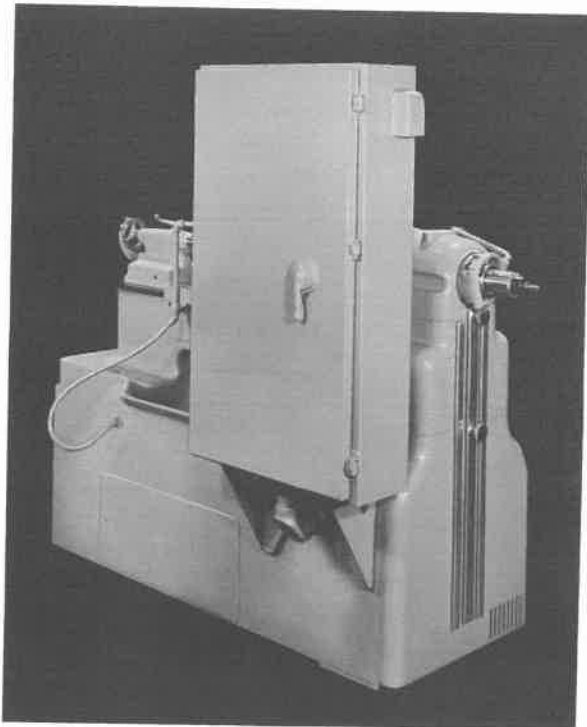


FIGURE 16. Above — Power Panel Pulled Forward.

FIGURE 17. Left — Mounting of J. I. C. Controls.

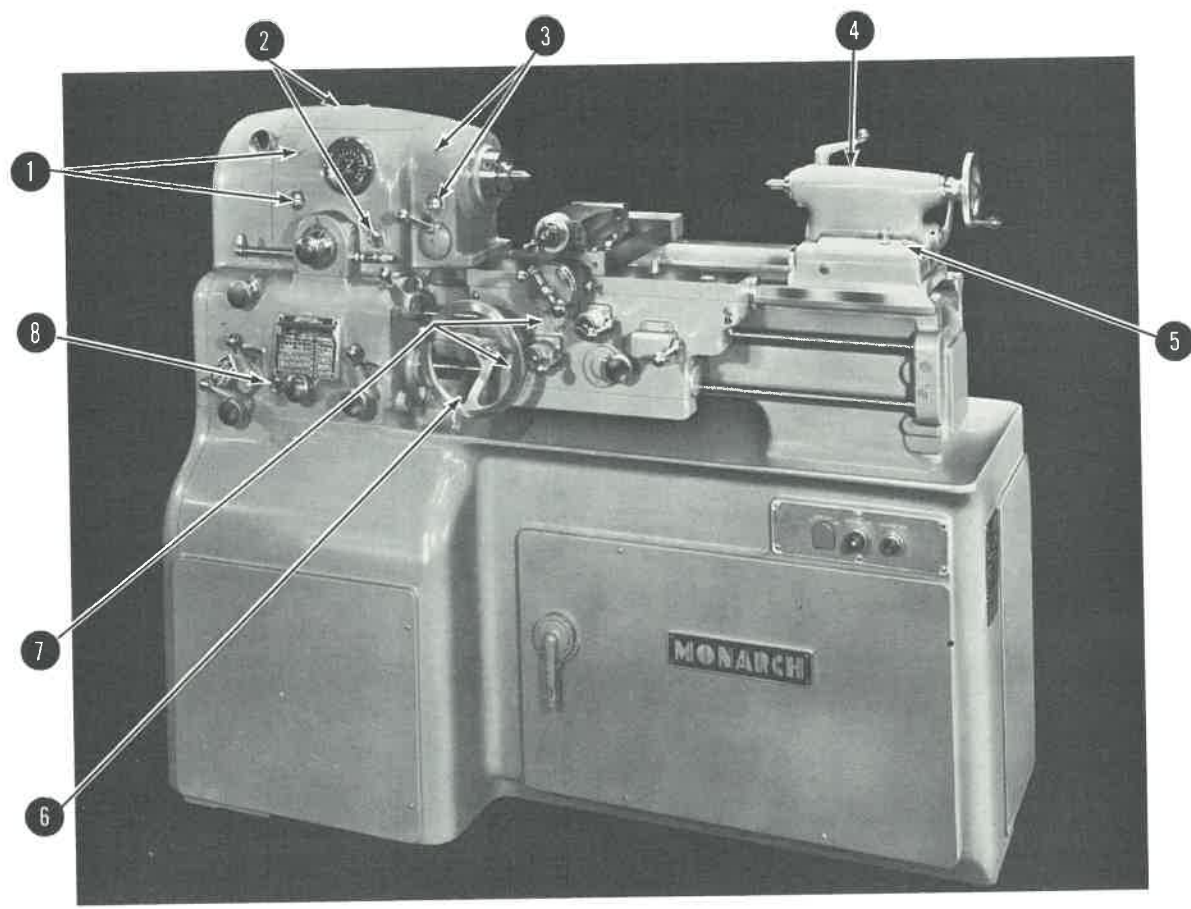


FIGURE 18. 10" Model EE Lathe

Reference Number	Part	Capacity	Lubricant	Schedule
1	Rear Spindle Bearing Reservoir Filling Point and Oil Level Gauge	1 Pt.	MO-11	Check level each shift.
2	Headstock Reservoir Filling Point and Oil Level Gauge	3 Qts.	MO-11	Check level weekly. Drain every 6 months at point (10), flush and refill with fresh oil.
3	Front Spindle Bearing Reservoir Filling Point and Oil Level Gauge	1 Pt.	MO-11	Check level each shift.
4	Tailstock Spindle		MO-12	Oil each shift.
5	Tailstock Ways		MO-12	Oil each shift.
7	Apron - Reservoir Filling Point and Oil Level Gauge	1 Pt.	MO-14	Check level each shift. Drain every 6 months at point (6), flush and refill with fresh oil.

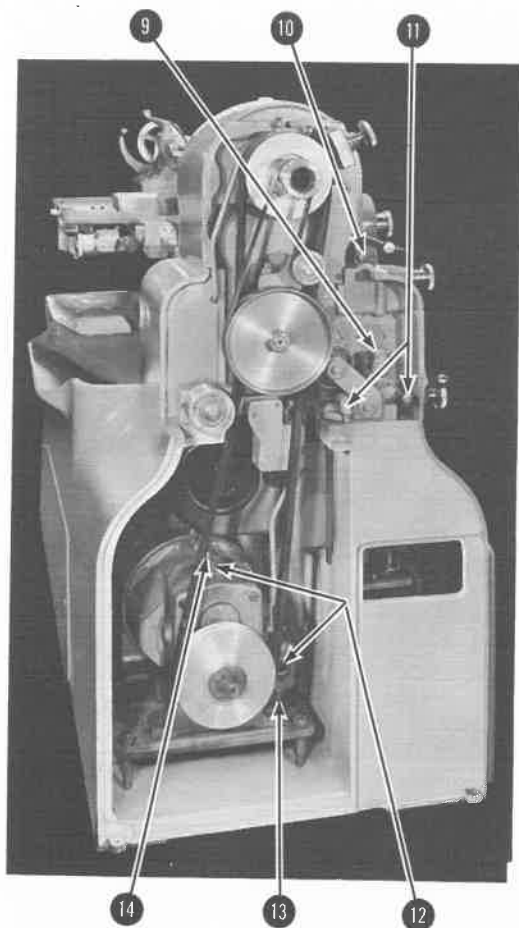


FIGURE 19. 10" Model EE Lathe,
End Covers Removed

SPECIFIC LUBRICANTS

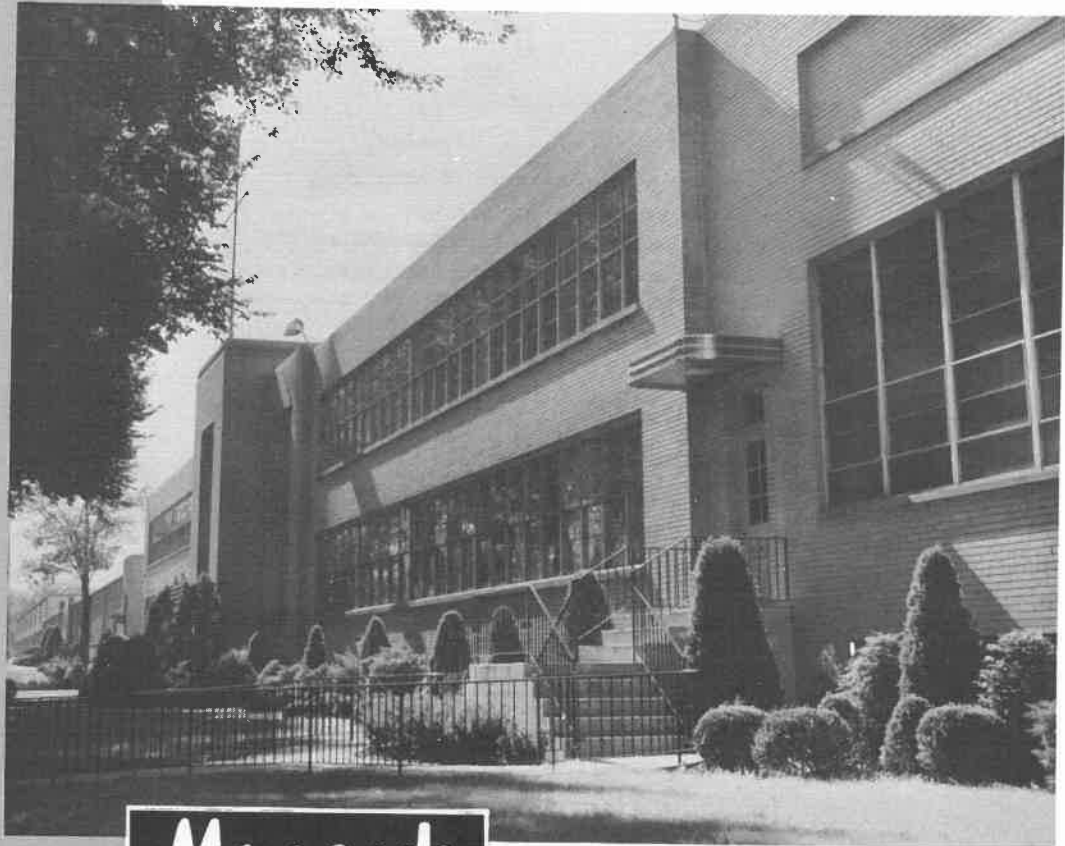
The below listed lubricants are satisfactory for the applications shown on the lubrication charts.

SPEC.	SOURCE	LUBRICANT
MG-2	Socony-Mobil Oil Co.	Mobilux #2
	Shell Oil Co.	Alvania #2
	Standard Oil Co.(Ohio)	Sohiotran #2
	Sun Oil Co.	Prestige #42
MO-11	Socony-Mobil Oil Co.	Vactra Light
	Shell Oil Co.	Hydraulic Oil 27
	Sun Oil Co.	Solnus 150
MO-12	Socony-Mobil Oil Co.	Vactra Heavy-Medium
	Shell Oil Co.	Hydraulic Oil 33
	Sun Oil Co.	Solnus 300
MO-14	Sun Oil Co.	Sunoco Way Lubricant #80

Reference Number	Part	Capacity	Lubricant	Schedule
8	Gearbox - Oil Level Gauge			Check level each shift. See reference to point (9).
9	Gearbox - Reservoir Filling Point	1 Qt.	MO-12	Drain every 6 months at point (11), flush and refill with fresh oil.
12	Speed Reducing Unit - Reservoir Filling Point and Level Gauge	3 Pts.	MO-12	Check oil level once weekly or every 50 hours of operation. Every 6 months drain at point (13), flush and refill with fresh oil.
14	Main Drive Motor		MG-2	Grease every 12 mos. Sealed bearings - use caution to prevent seal blowout.

ELECTRICAL AND ELECTRONIC SERVICE SUGGESTIONS

1. Green light does not glow after 60 seconds when the Disconnect Switch (DISC) is placed in the "On" position.
 - A. Incoming power lines dead.
 - B. Bulb in pilot light burnt out.
 - C. 5 Ampere fuse open.
2. Power Contactor (PC) will not close when the Control On button is depressed.
 - A. Filament heating timer (1TR) defective.
 - B. Spindle Control Lever not in the stop position.
 - C. Control On push button defective.
 - D. Overload Relay (1OL) tripped open.
 - E. Power Contactor coil defective.
3. Power Contactor (PC) will close when Control On button is depressed but falls open when the Control On button is released.
 - A. Control Off button defective.
 - B. Temperature Switch (THS) defective.
 - C. Field Loss Relay (FL) defective.
 - D. Diodes in REC. No. 3 defective. Note: This opens the 3 amp. fuse (FU2).
 - E. C3J Tube (ET1) defective.
4. Power Contactor (PC) closes but spindle does not revolve when the Forward-Stop-Reverse Lever is moved to the forward or reverse position.
 - A. Spindle Lock in locked position opening the Spindle Lock Switch (SLS).
 - B. Anti-plugging relay contacts (7-17) not making contact.
 - C. Defective Drum Switch or Micro-switch on lathes with electrical leadscrew reverse.
 - D. Diodes in Rectifier No. 1 defective.
 - E. 25 ampere circuit breaker in the "Off" position.
 - F. Defective Speed Control Potentiometer (P3A or P3B).
5. Spindle coasts to a stop or to lower speed.
 - A. Dynamic Brake Resistors (R10-R11) open.
 - B. Quick Slow Down Relay contacts (41-A1) not closing.
 - C. Contacts on Forward Contactor (F) contacts (36-38) or contacts (37-38) on the Reverse Contactor (R) not making contact.
6. Spindle stops when revolving near maximum speed.
 - A. Field Failure Relay spring tension too great.
 - B. Speed Control Potentiometer (P3A) defective.
7. Speed drops off under load.
 - A. Compensation Potentiometer set too low.
 - B. Field Acceleration relay (FA) adjusted to close at too low a value of armature current. Should be set to close at 25 amperes.
8. Motor gear box cannot be shifted.
 - A. Solenoid (1SOL) defective.
 - B. Anti-plugging relay contacts (13-7) not making contact.
9. Spindle speed increases with load, especially at low speeds.
 - A. Reduce compensation with compensation potentiometer.
10. Frequent replacement of diodes in Rectifier No. 4.
 - A. Jumpers not connected across Current Transformers (T1 & T2).
 - B. Incorrect Jumper length. Should be 20 inches of No. 14 wire for 230 volts, 40 inches of No. 14 wire for 460 volts.
 - C. 15K Resistor (R3) defective.
11. Frequent replacement of diodes in Rectifier No. 2.
 - A. 1 Mfd. capacitor (C8) open or not in circuit.
12. Frequent replacement of diodes in Rectifier No. 3.
 - A. 500 ohm resistor (R13) open.



THE



STORY

With industry confronted by costs that continue to climb, manufacturers everywhere are demanding machines capable of working metals faster, more accurately and more economically. Providing turning equipment that will answer these requirements is Monarch's constant aim.

To develop and manufacture lathes that will solve the latest problems of industry, Monarch has built up one of the best equipped shops in the nation, manned by skilled machine tool craftsmen.

Of equal importance is the research, development and experimental division. From the drawing boards and machines of the men in this group, new machines are always emerging . . . machines to meet new needs or to better fulfill existing requirements.

This involves the development of machine tools with higher machining speeds, greater operating convenience, improved electrical and electronic controls and automatic features that will provide ever-improved output. New development at Monarch is conducted as a separate year-round research program. It is established in its own building located adjacent to the main plant.

Through research and development, and through constant improvement of manufacturing facilities and maintenance of rigid quality control, Monarch will continue to furnish the industrial field with the very finest in turning machines.

Small and Medium Swing Lathes

Precision Toolmaker's Lathe — 10" Model EE

Precision Manufacturing Lathe — 10" Model EE

Precision Lathe — Series EE, Model 1000

612 Lathes — for manufacturing and toolroom use

Dyna-Shift Lathes — Series 62 — for manufacturing and toolroom use

Heavy Duty Lathes

Dyna-Shift Lathes — Series 80

Dyna-Shift Lathes — Series 91

Missile Master Lathes — Series 170

Production Lathes

Mona-Matic — Model 20-H

Mona-Matic — Model 21-H

Pathfinder Numerical Control

For a good turn FASTER — turn to



Tracer Controls

Air-Tracer Pak

"Air-Gage Tracer"

Rotary Profile Tracer Lathe

Monarch-Keller Contour Turning Lathes

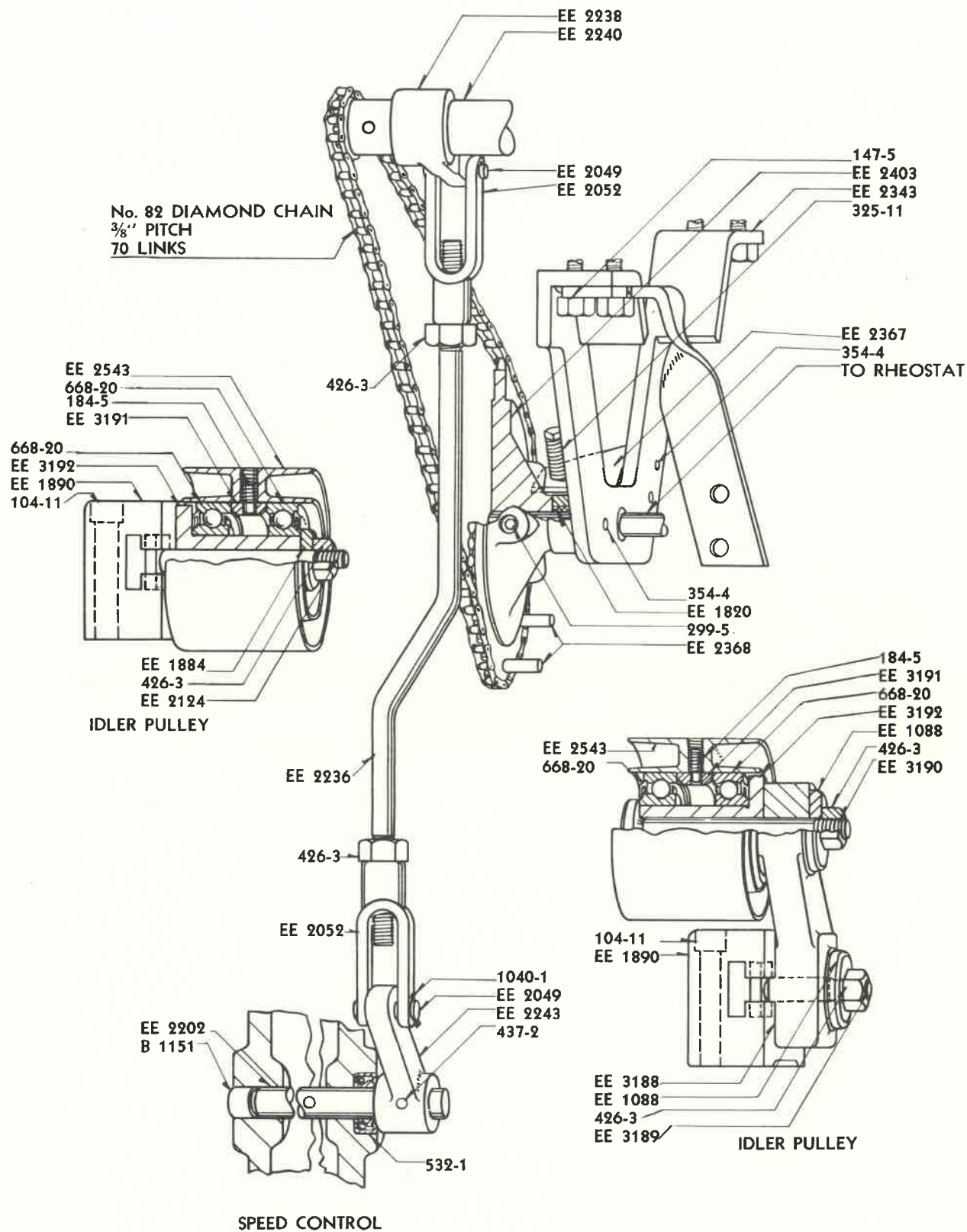
Electro-Gage Tracer

Special Purpose Lathes

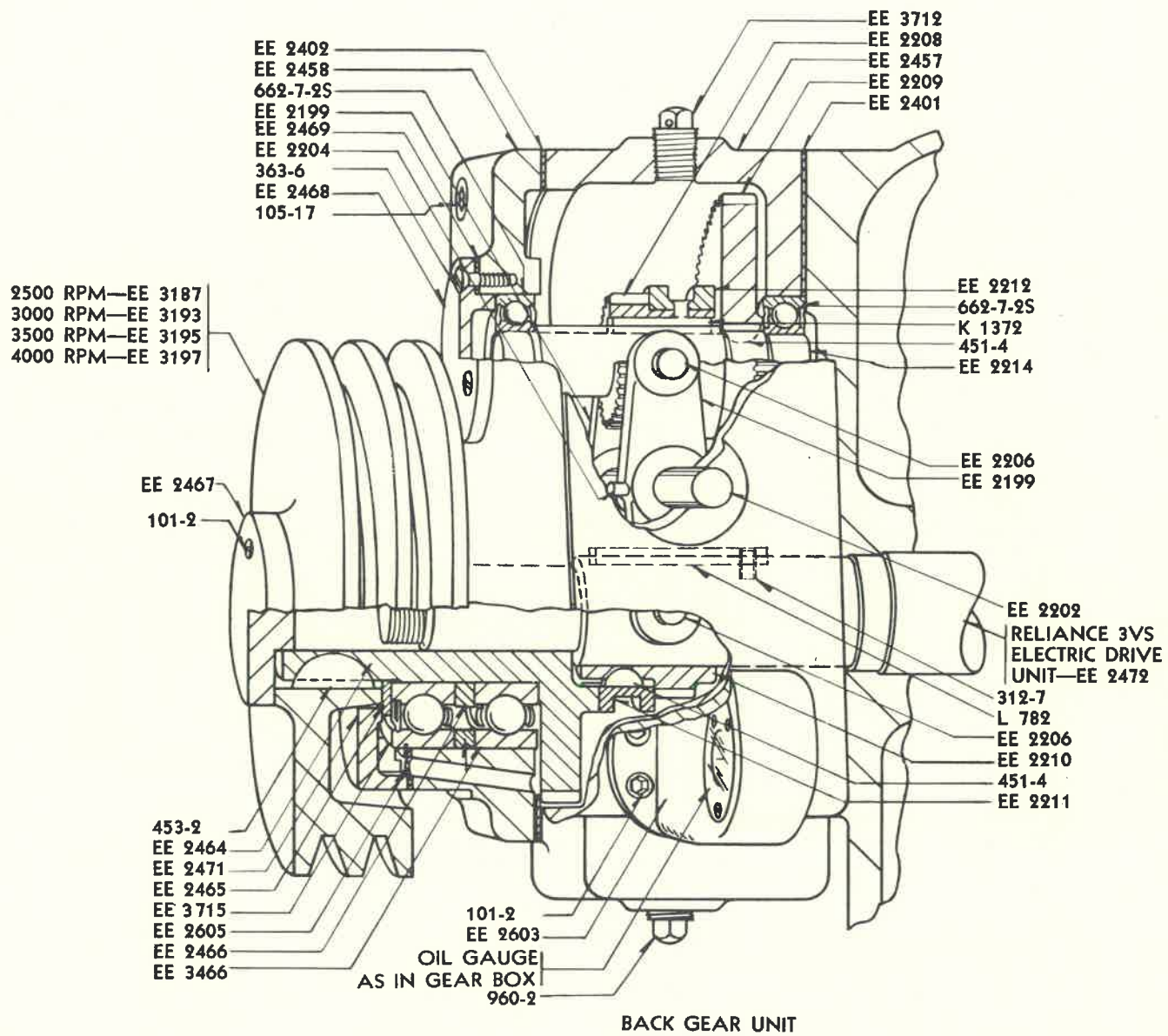
Speedi-Matic — Model B

Heavy Duty Roll Turner

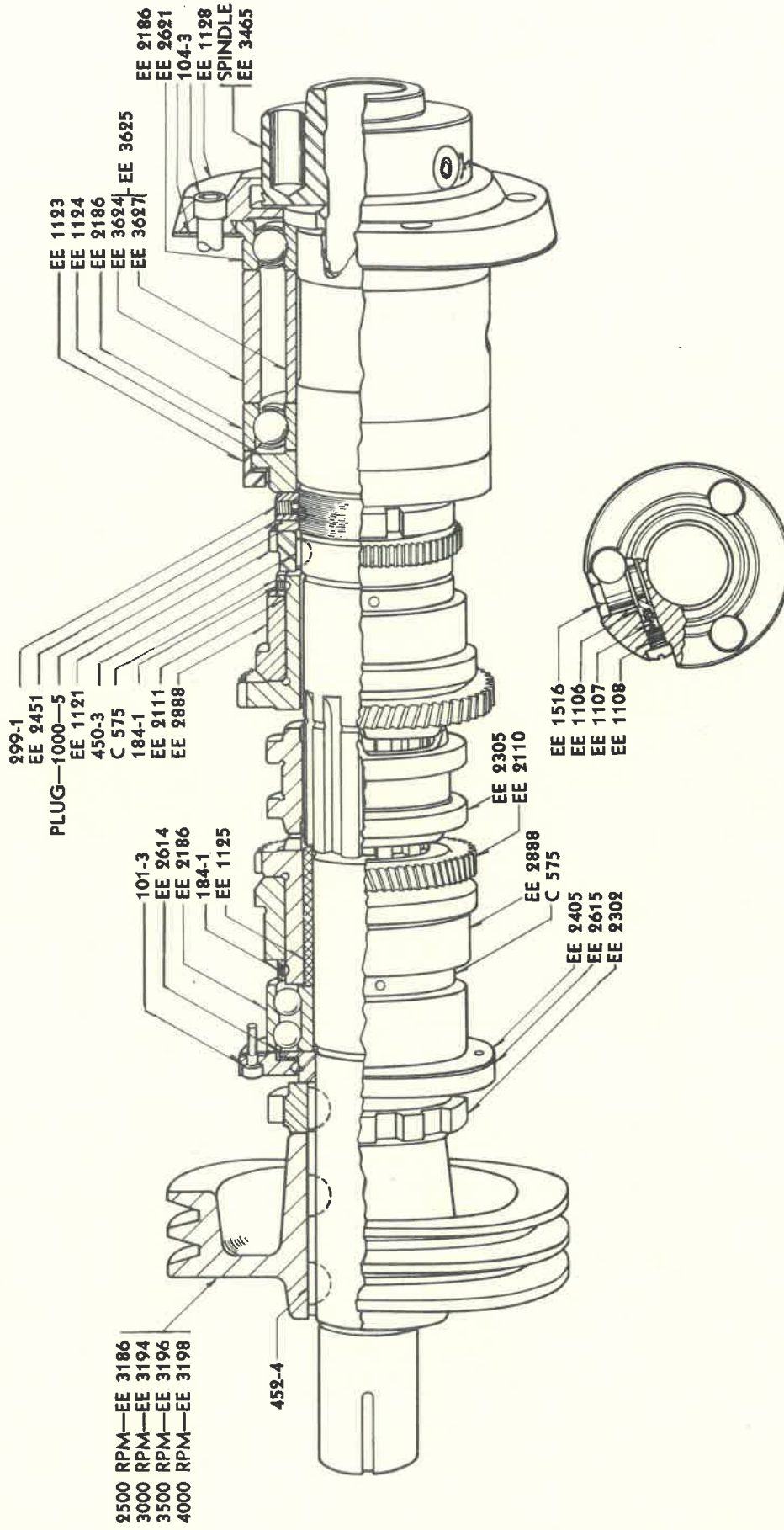
Machinability Test Lathes



ELECTRICAL DRIVE
 UNIT EE 3
 SHEET 100

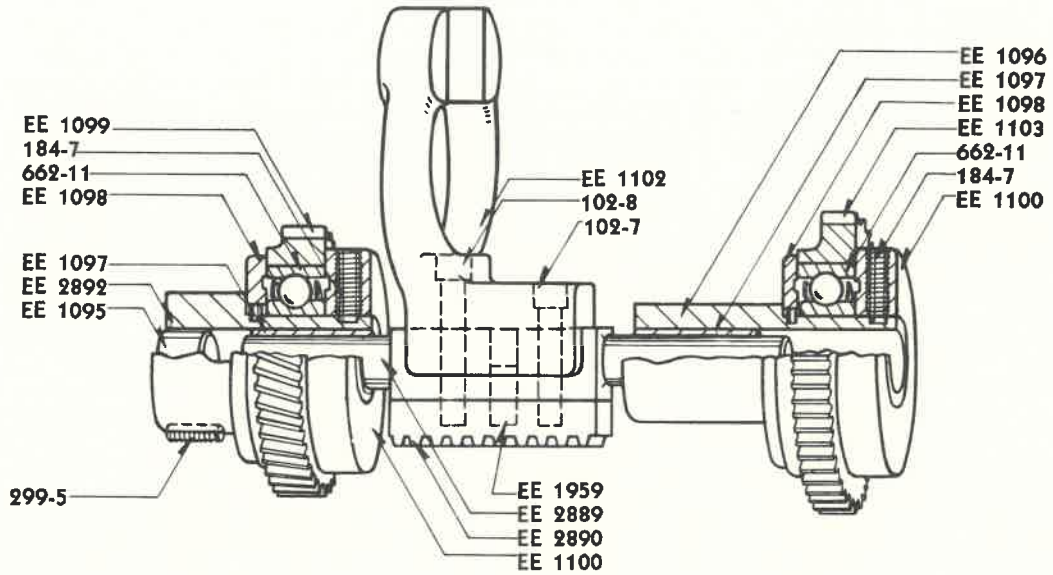


ELECTRICAL DRIVE
 UNIT EE 3
 SHEET 101

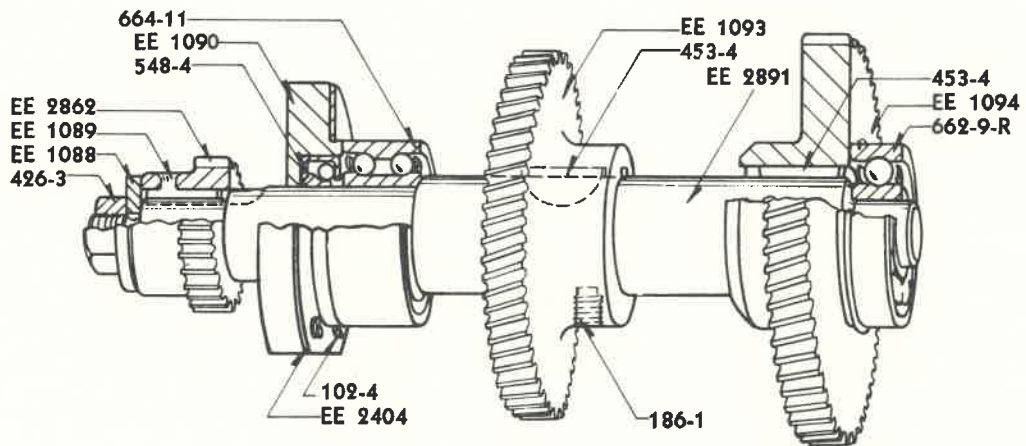


HEADSTOCK
UNIT EE 4
SHEET 153

- 2500 RPM—EE 3186
- 3000 RPM—EE 3194
- 3500 RPM—EE 3196
- 4000 RPM—EE 3198

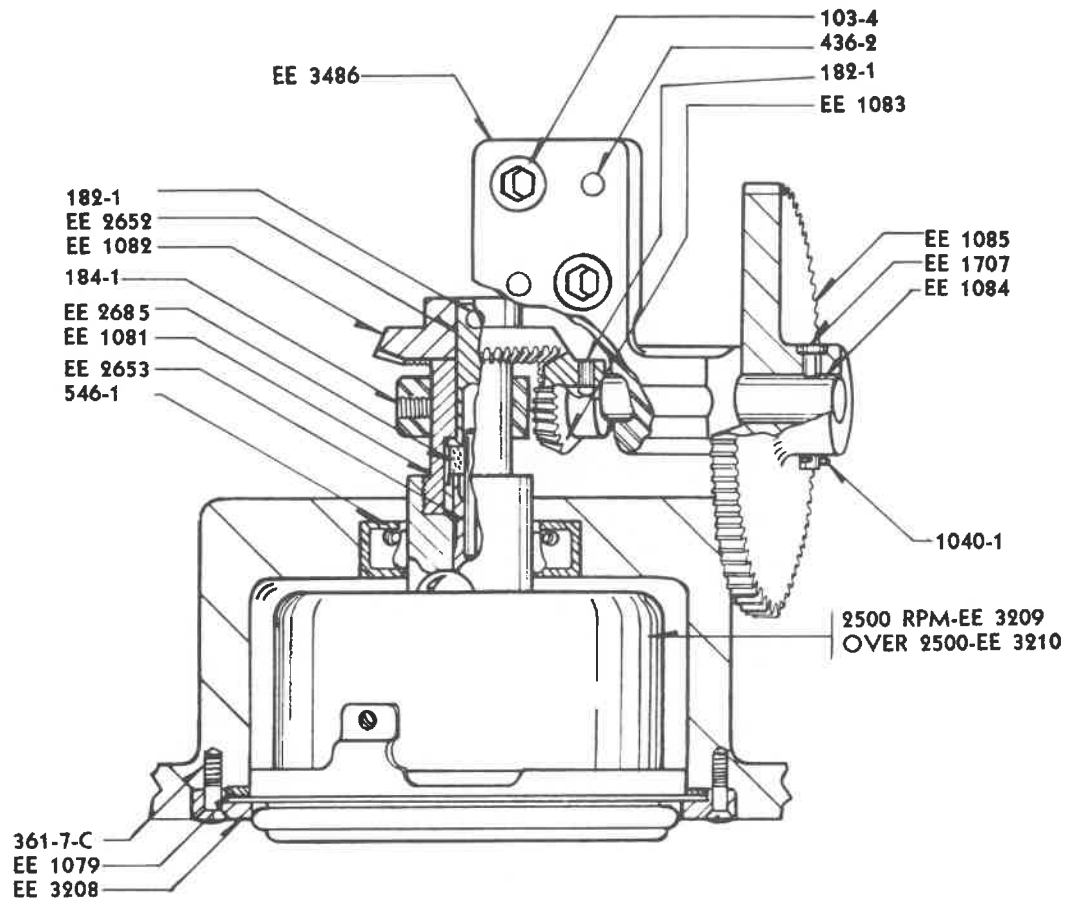


REVERSE IDLER GEAR & SPINDLE CLUTCH SHIFTER

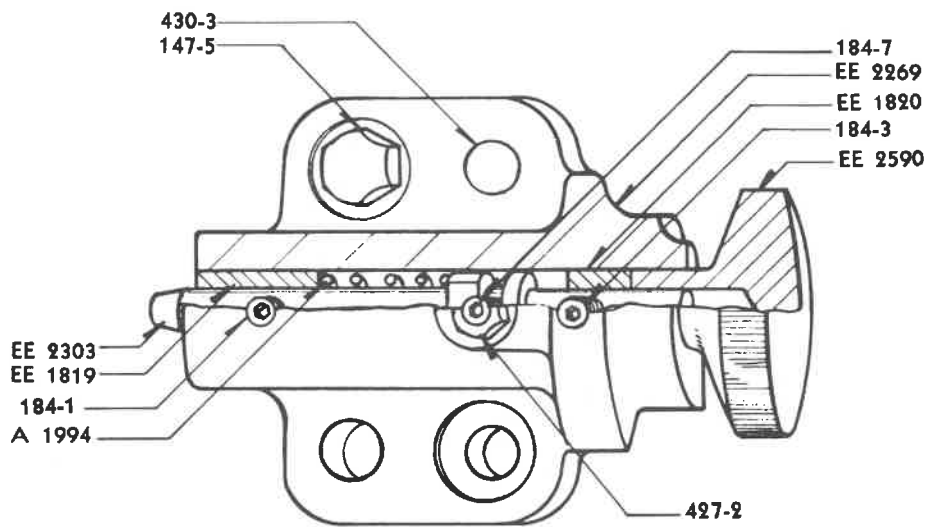


REVERSE SHAFT

HEADSTOCK
 UNIT EE 4
 SHEET 154



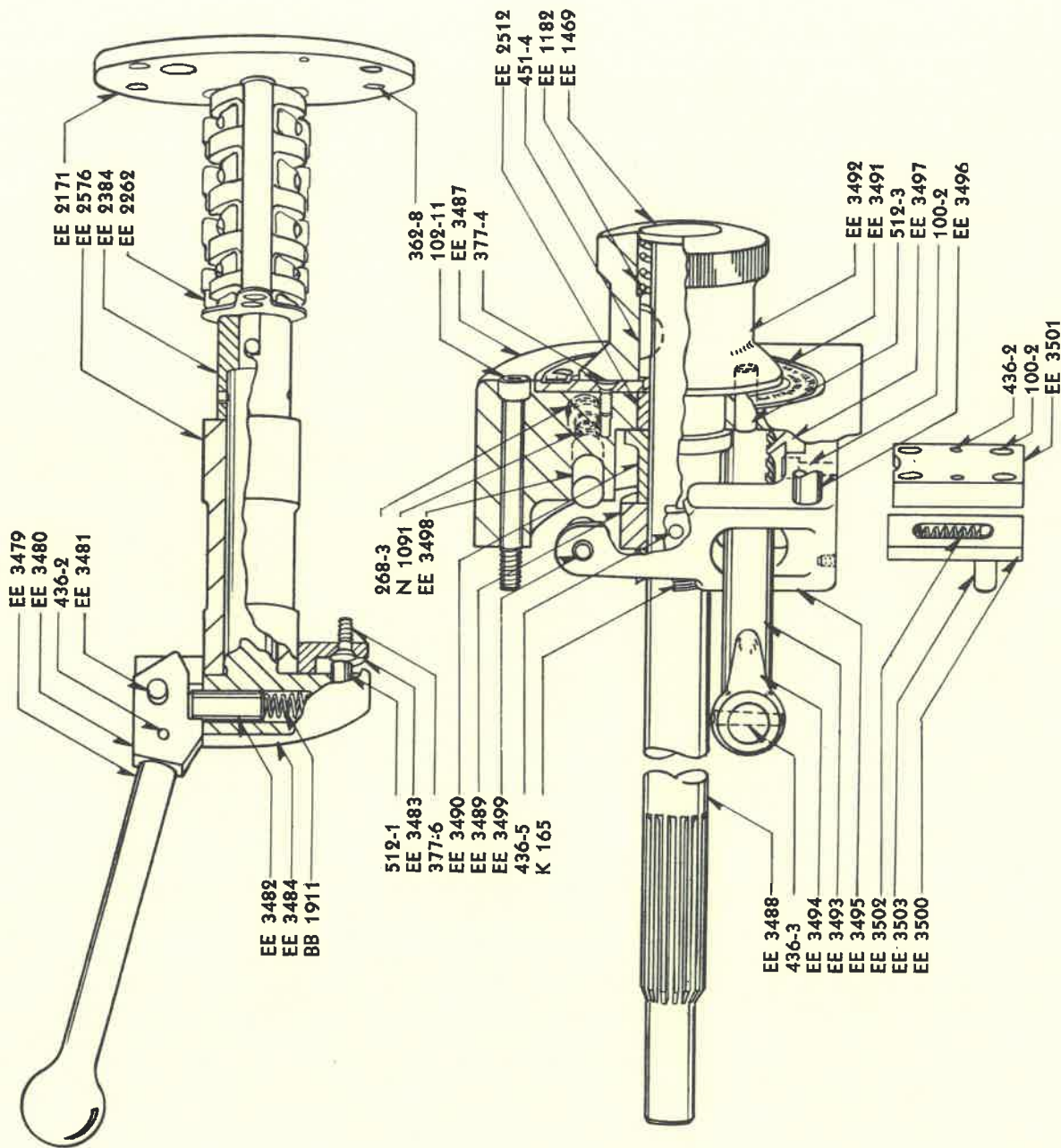
TACHOMETER

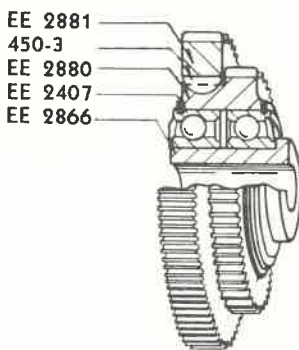
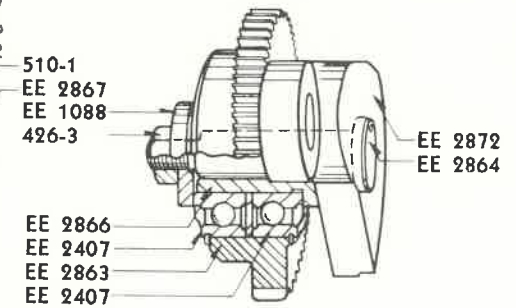
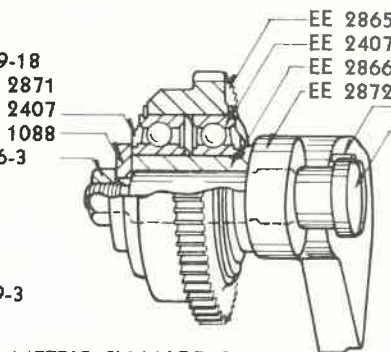
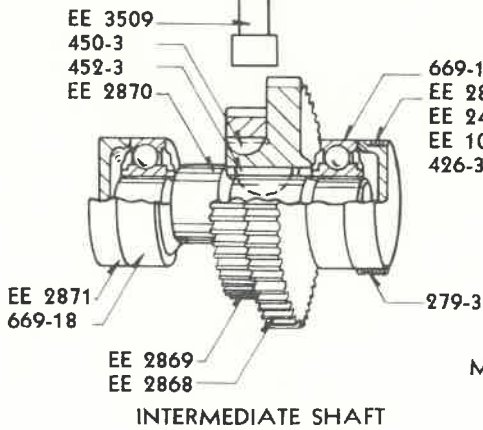
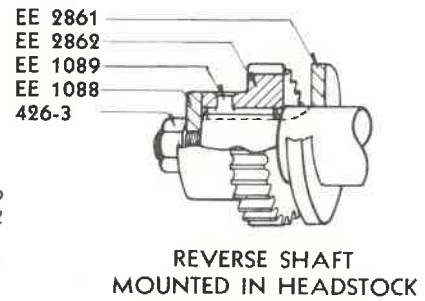
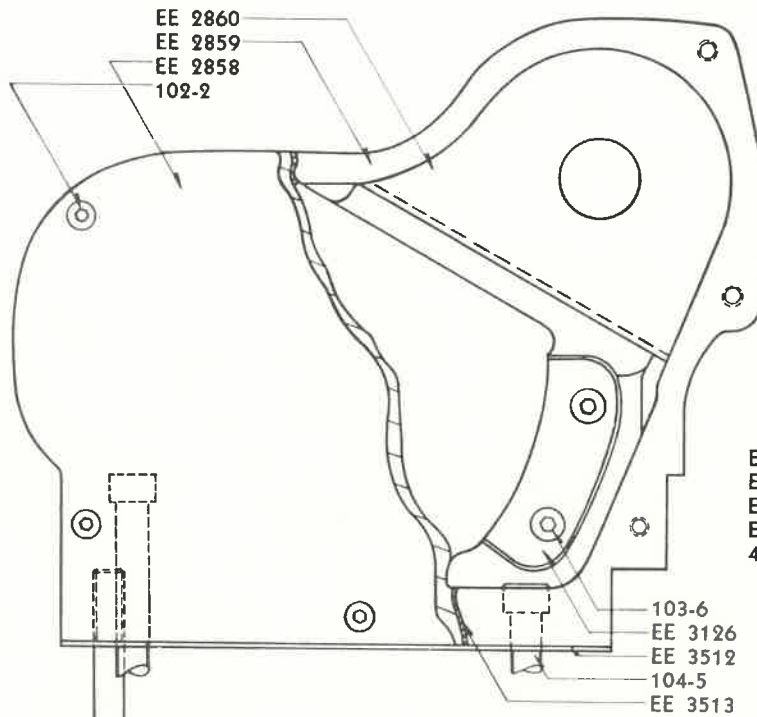


SPINDLE LOCK

HEADSTOCK
 UNIT E E 4
 SHEET 156

HEADSTOCK
UNIT EE 4
SHEET 157





METRIC CHANGE GEARS

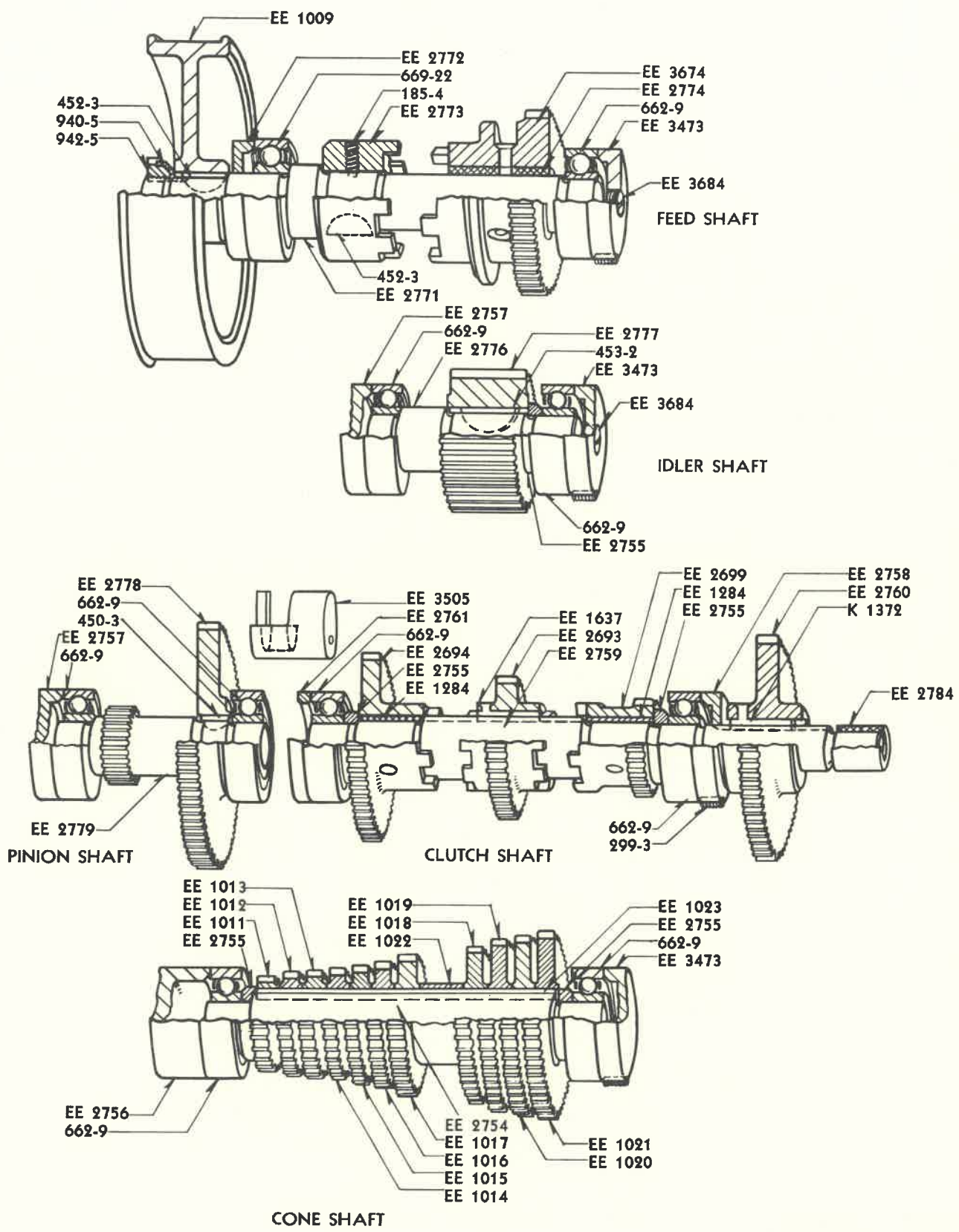
45 TEETH	EE 3690
50 TEETH	EE 3691
55 TEETH	EE 3692
60 TEETH	EE 3693
65 TEETH	EE 3694
70 TEETH	EE 3695
75 TEETH	EE 3696
80 TEETH	EE 3697



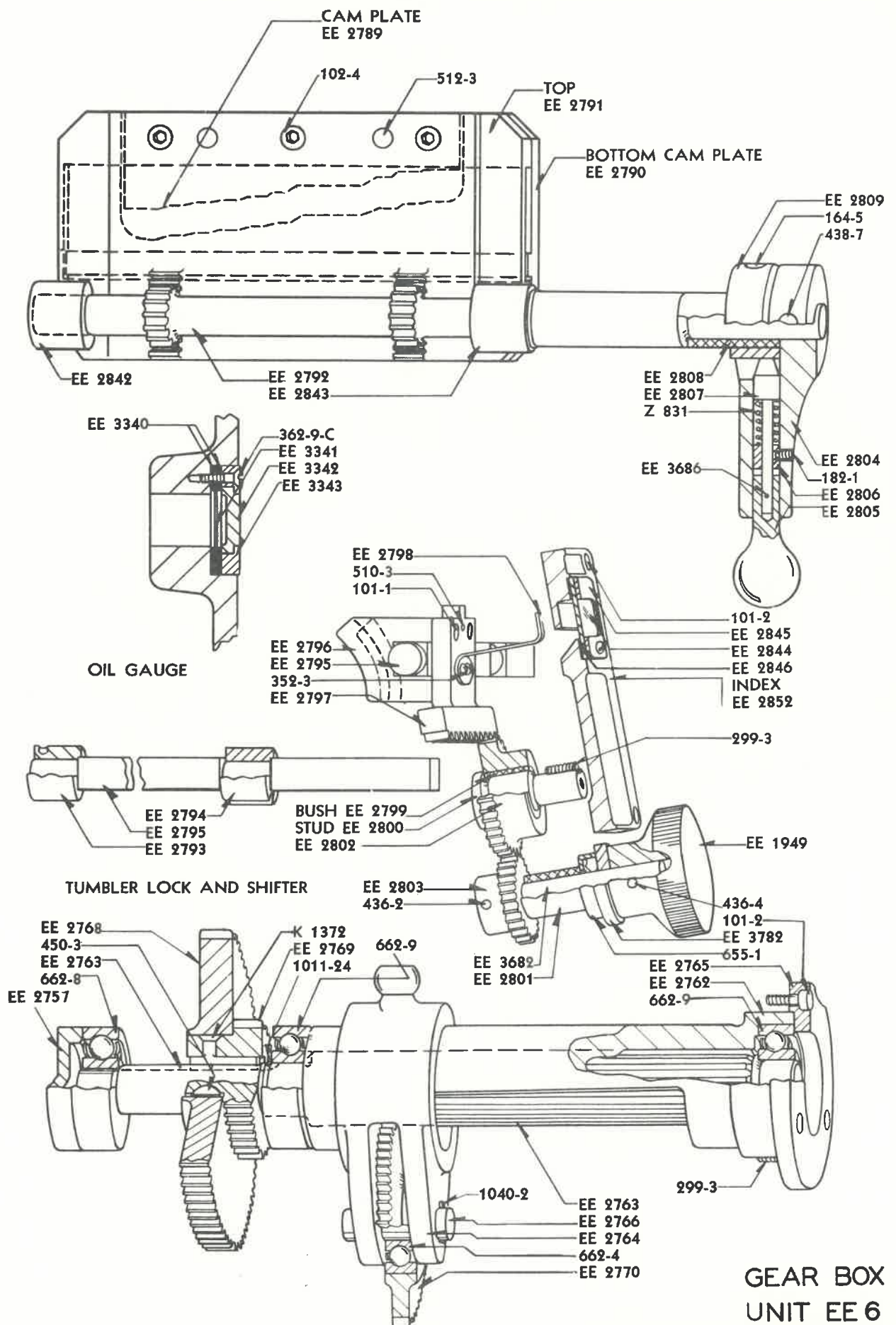
SET BOX FOR THD.		PITCH IN MILLIMETERS							
COMP	STUD GEARS	45	50	55	60	65	70	75	80
80	127	225	25	275	30	325	35	375	40
40	60	45	50	55	60	65	70	75	80
20		90	1.00	1.10	1.20	1.30	1.40	1.50	1.60
16		1.25	1.25	1.375	1.50	1.625	1.75	1.875	2.00
10		1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20
8		2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00

EE 3125
361-5

END GEARING
UNIT EE 5
SHEET 142

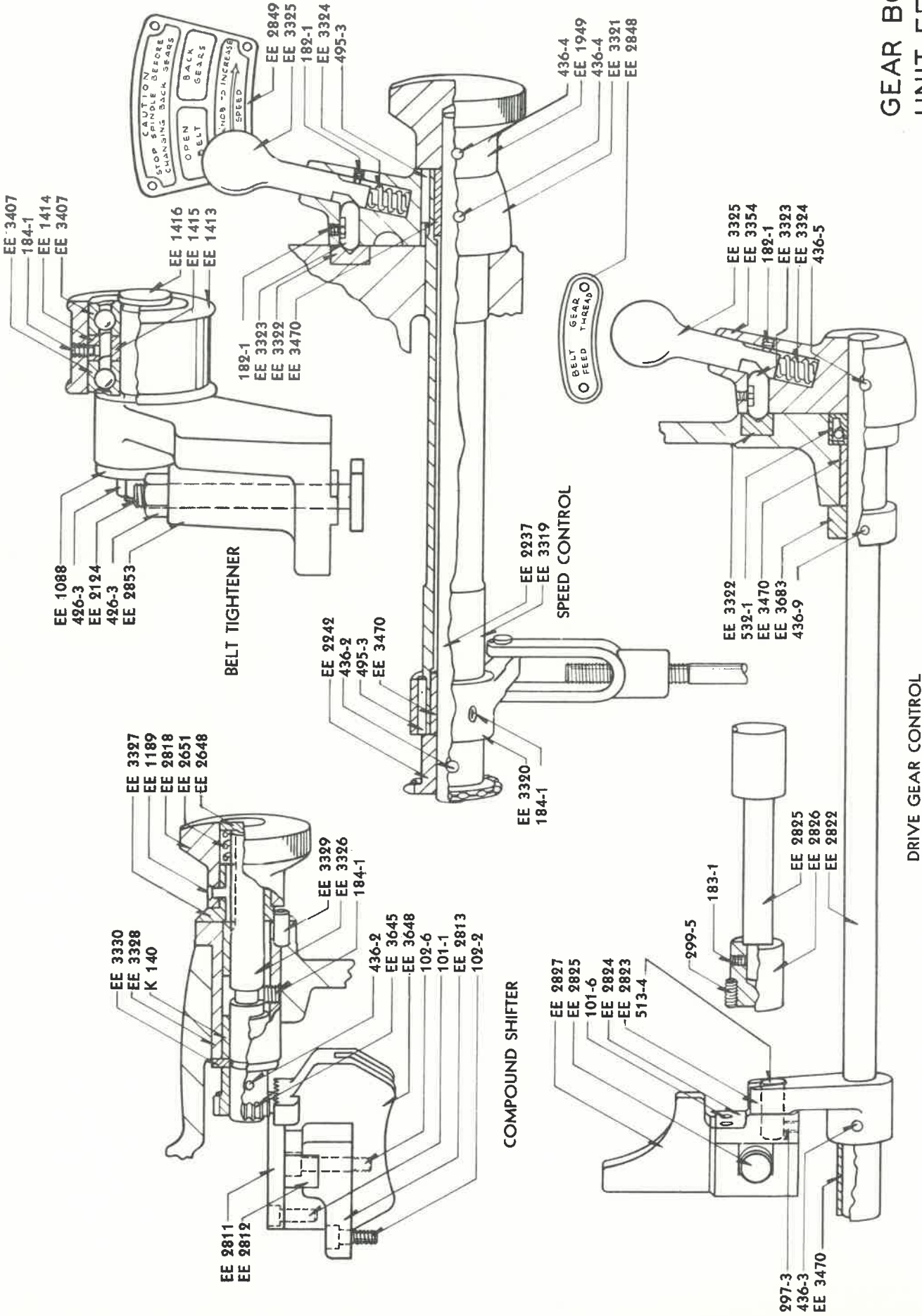


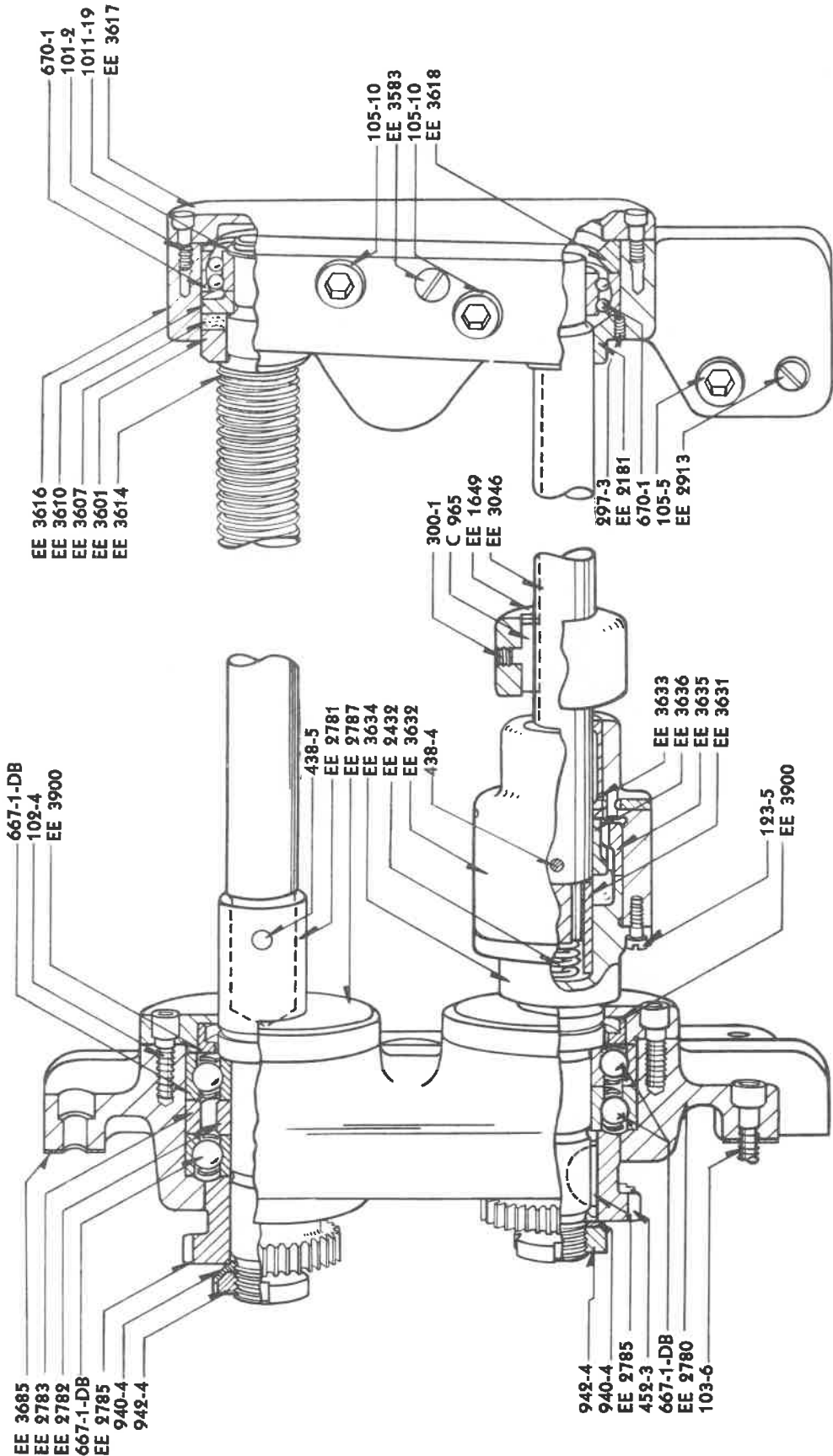
GEAR BOX
 UNIT EE 6
 SHEET I33



GEAR BOX
 UNIT EE 6
 SHEET 134

GEAR BOX
UNIT EE 6
SHEET 135



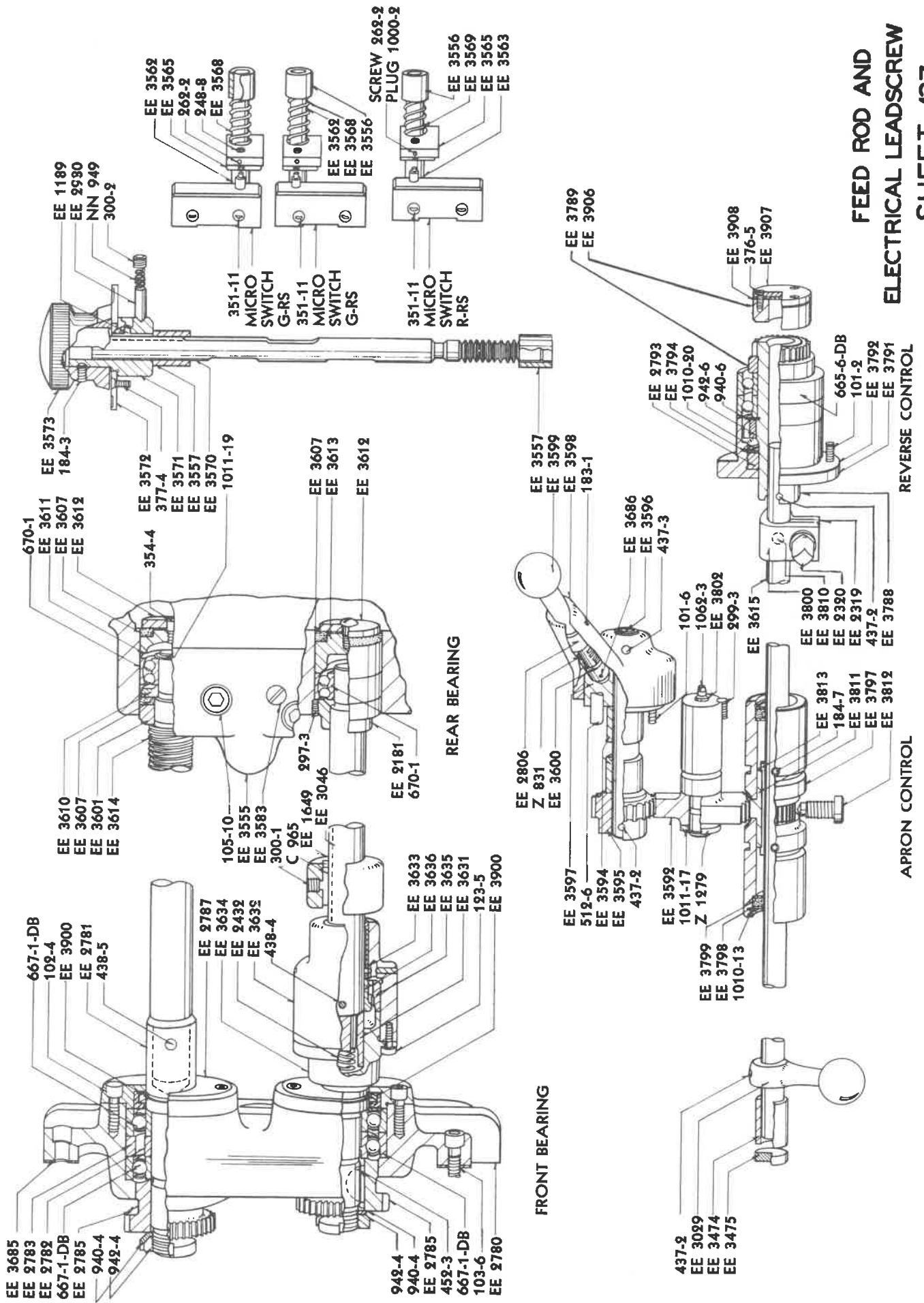


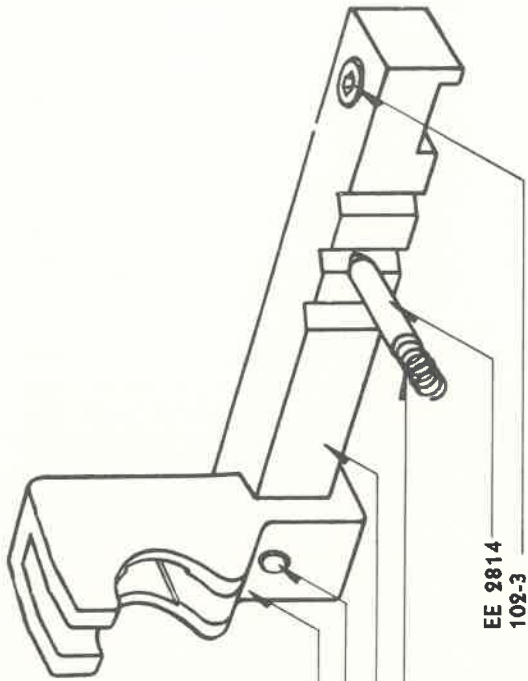
FRONT BEARING

REAR BEARING

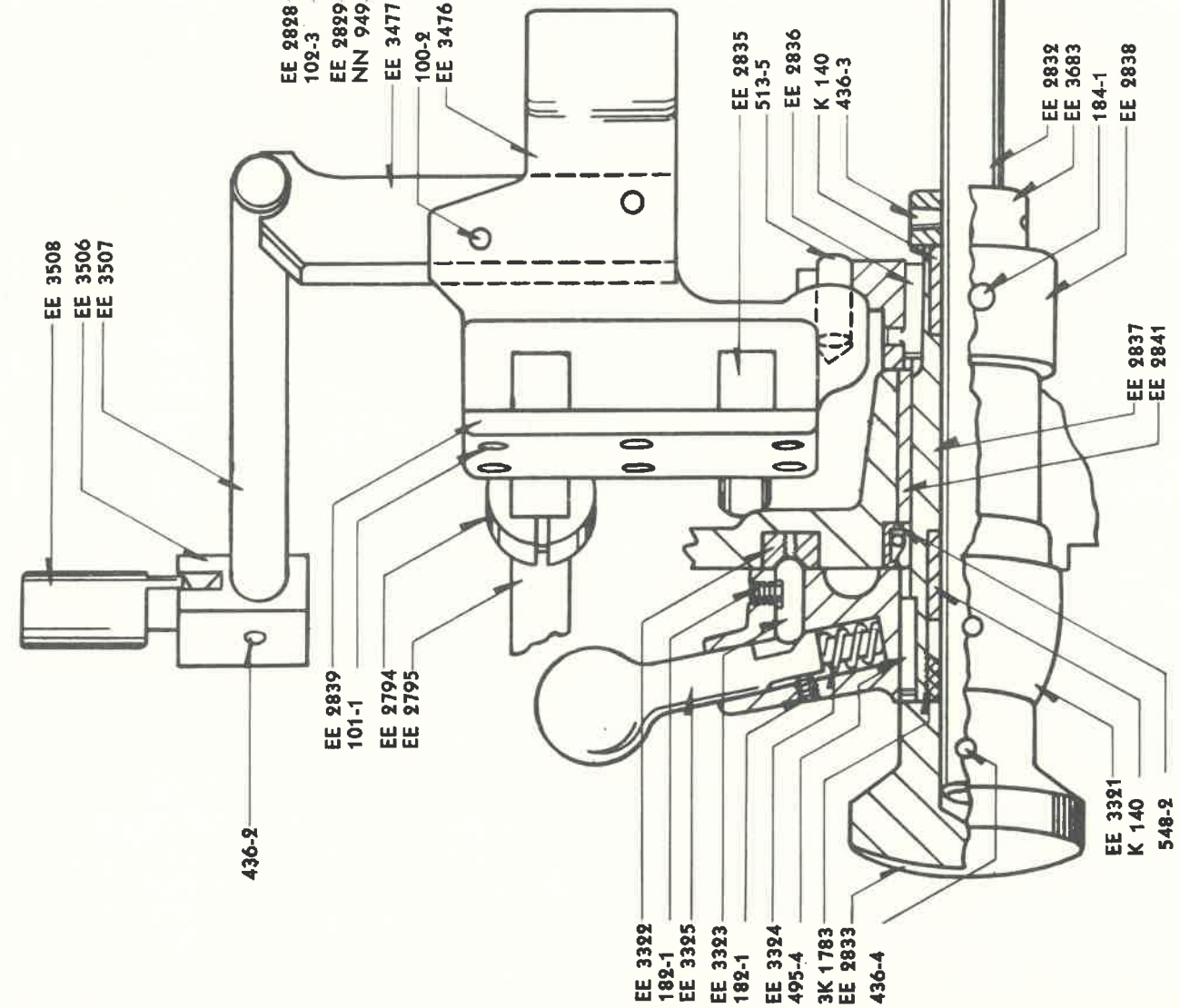
FEED ROD &
LEADSCREW
SHEET 136

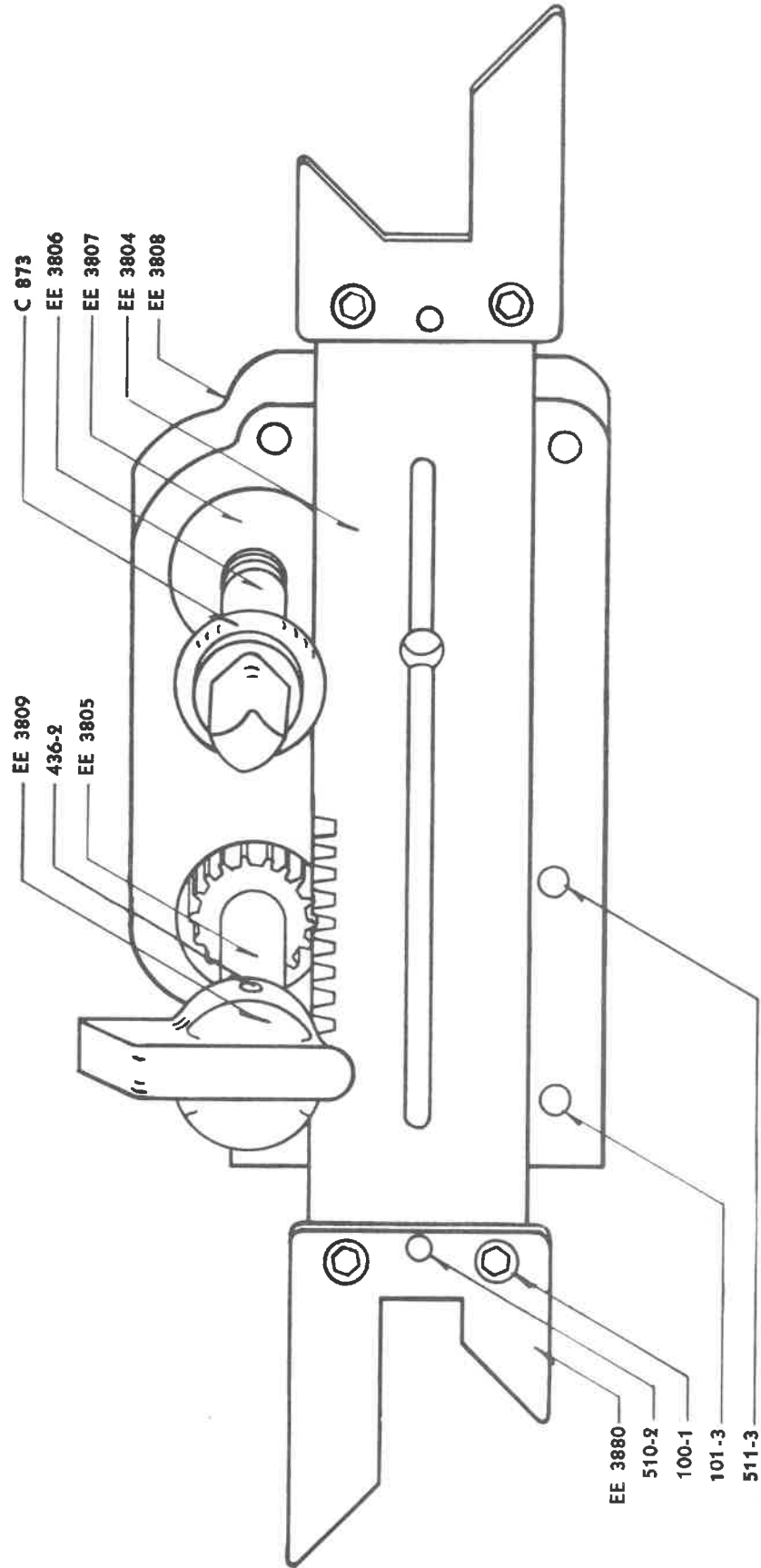
FEED ROD AND ELECTRICAL LEADSCREW SHEET 137



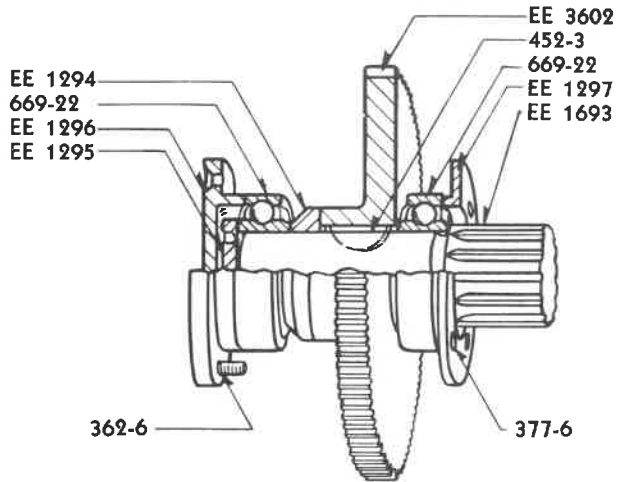


CLUTCH AND SLIP GEAR CONTROL

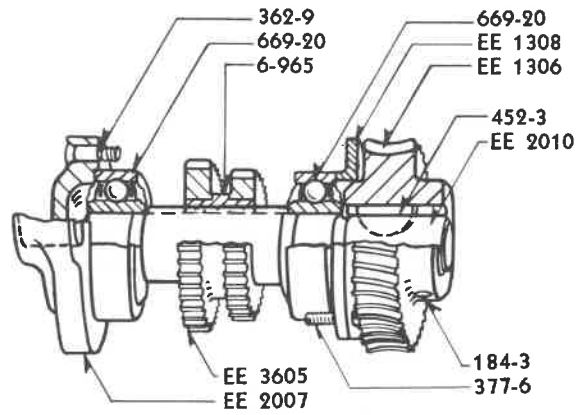




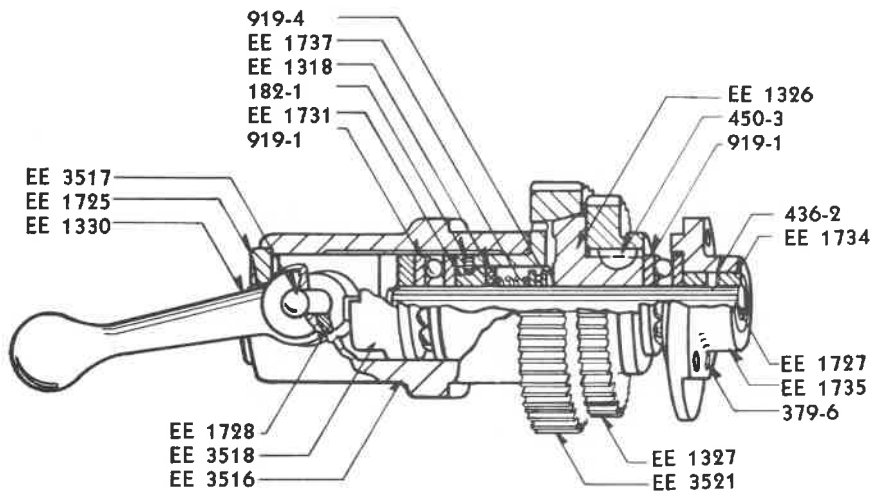
**FEED ROD AND
 ELECTRICAL LEADSCREW
 SHEET 177**



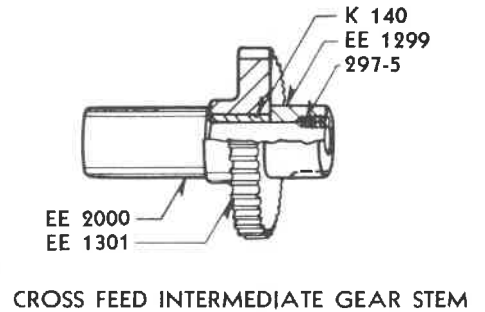
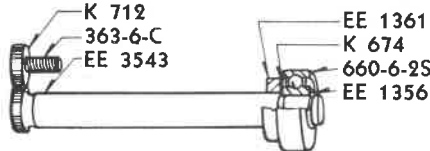
RACK PINION



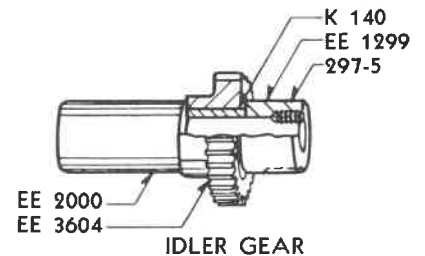
WORM WHEEL SHAFT



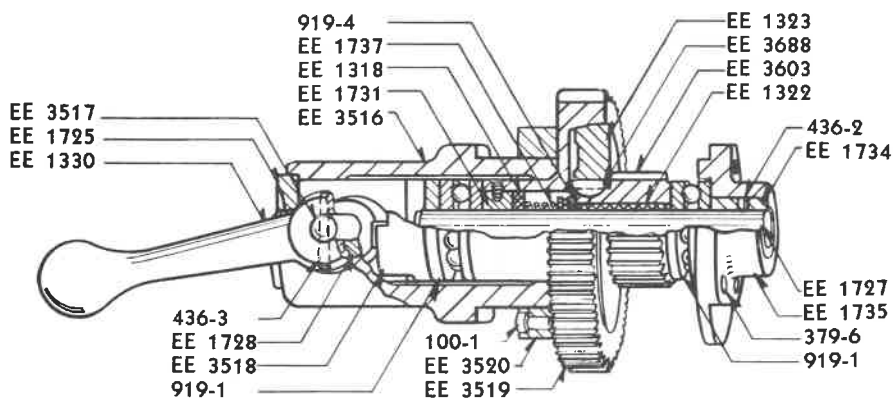
CROSS FEED FRICTION STEM



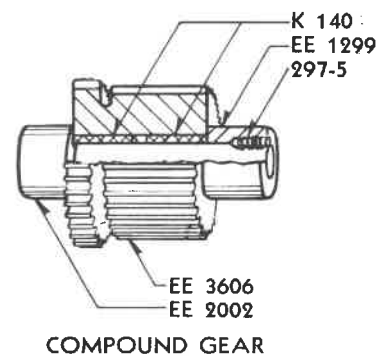
CROSS FEED INTERMEDIATE GEAR STEM



IDLER GEAR

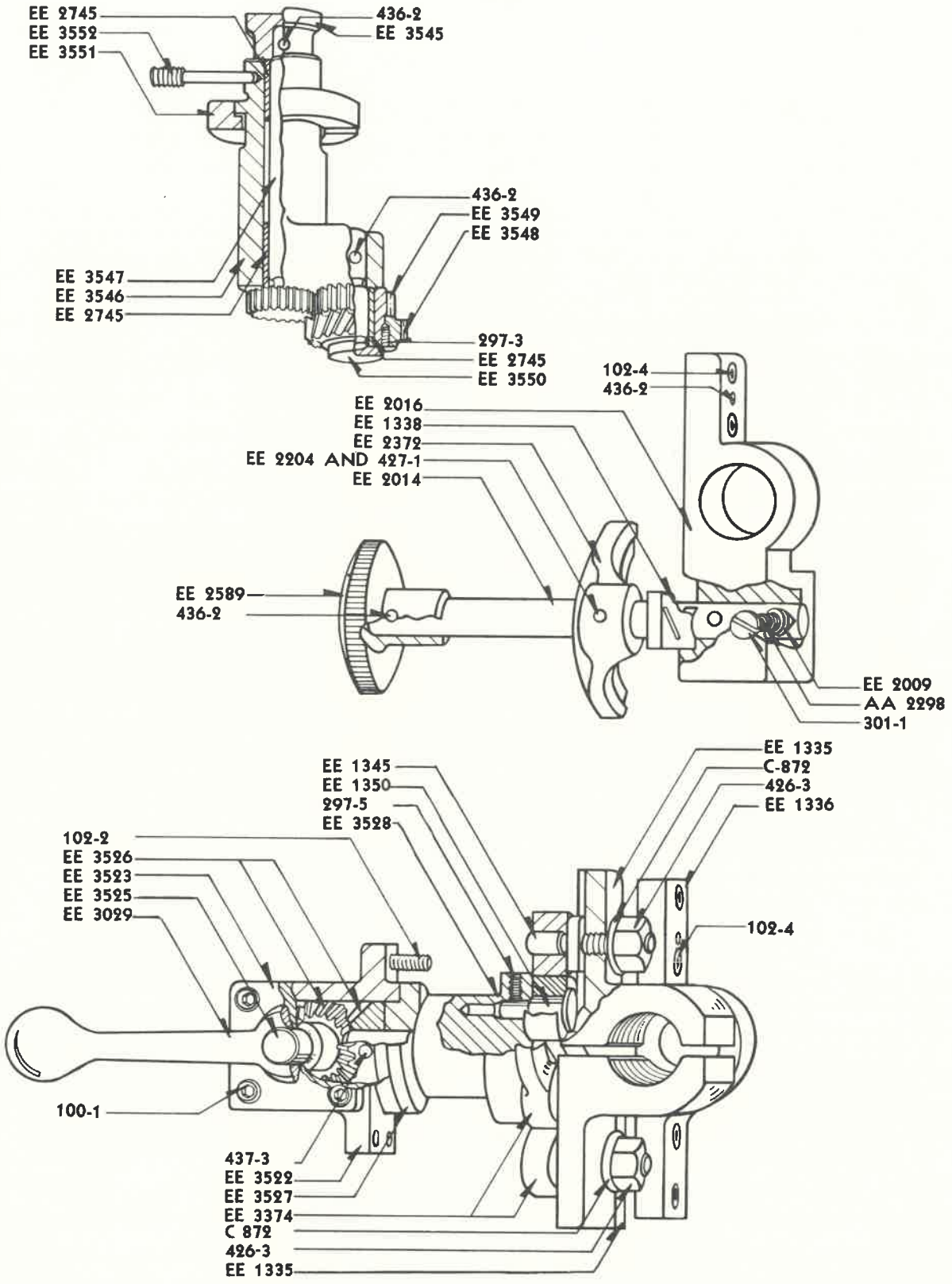


LONGITUDINAL FRICTION STEM

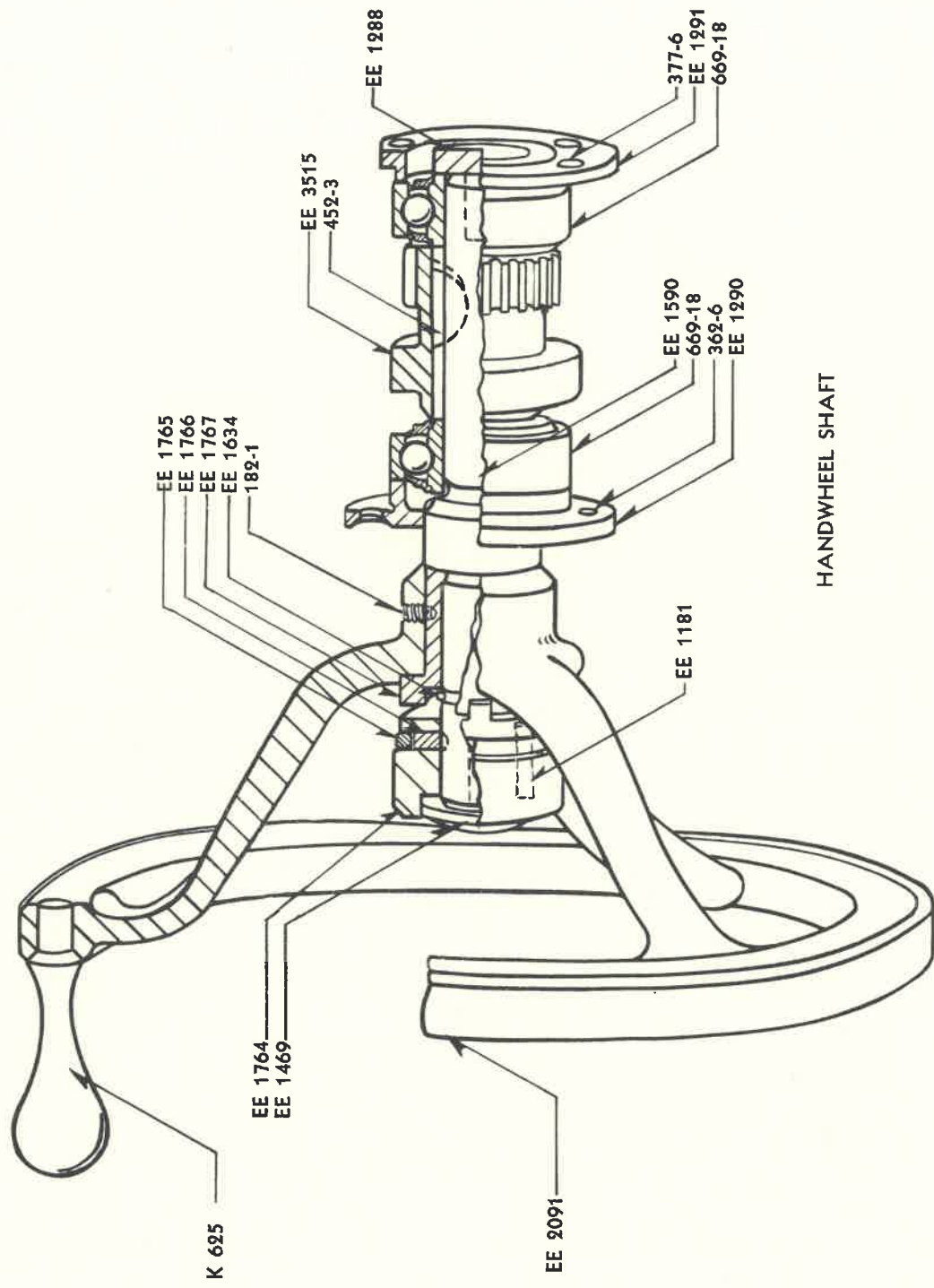


COMPOUND GEAR

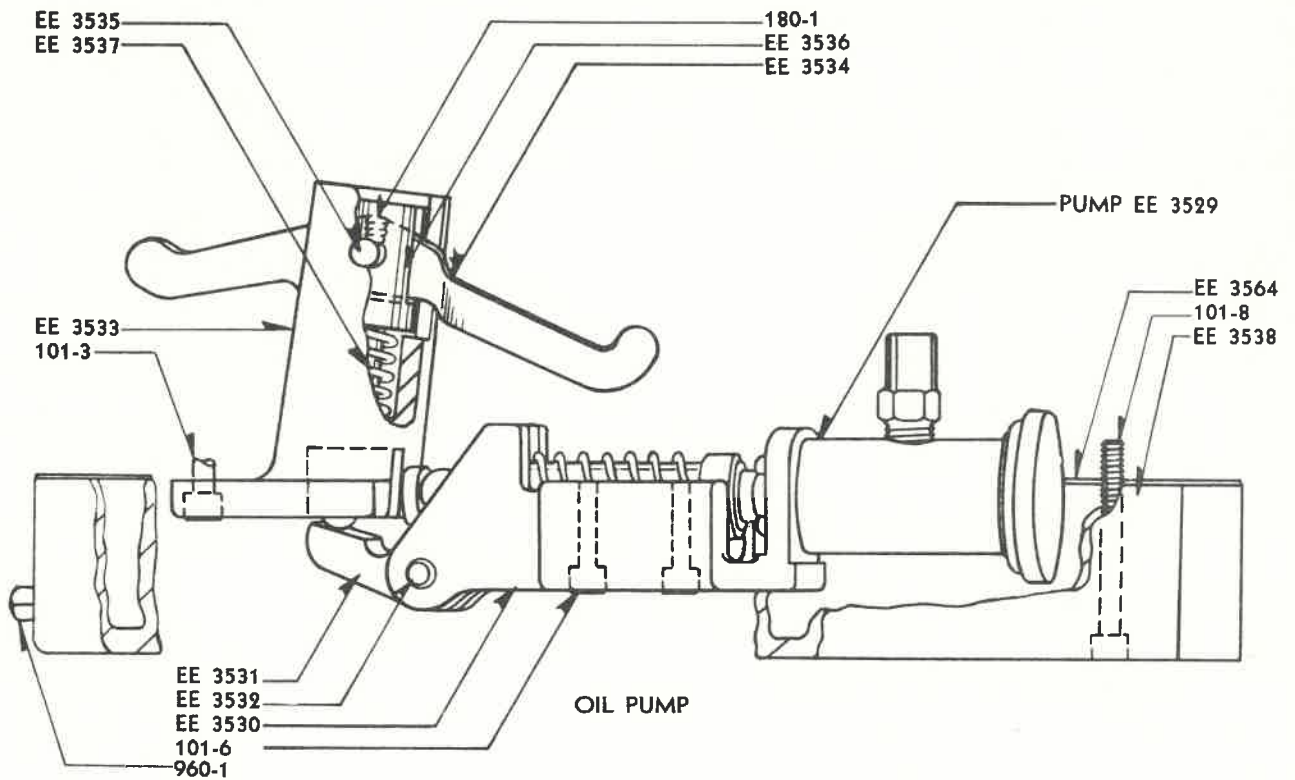
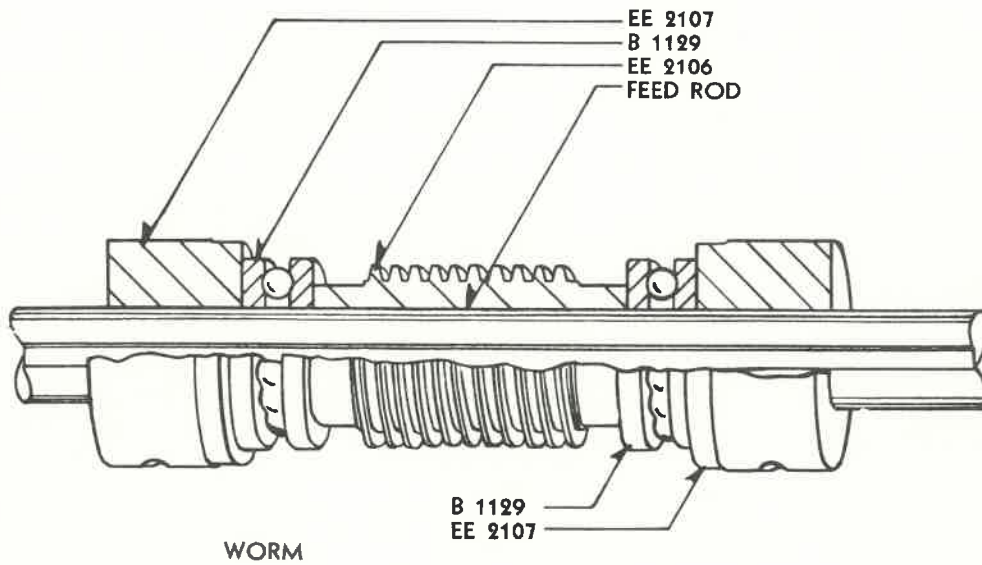
APRON
UNIT EE 7
SHEET 143



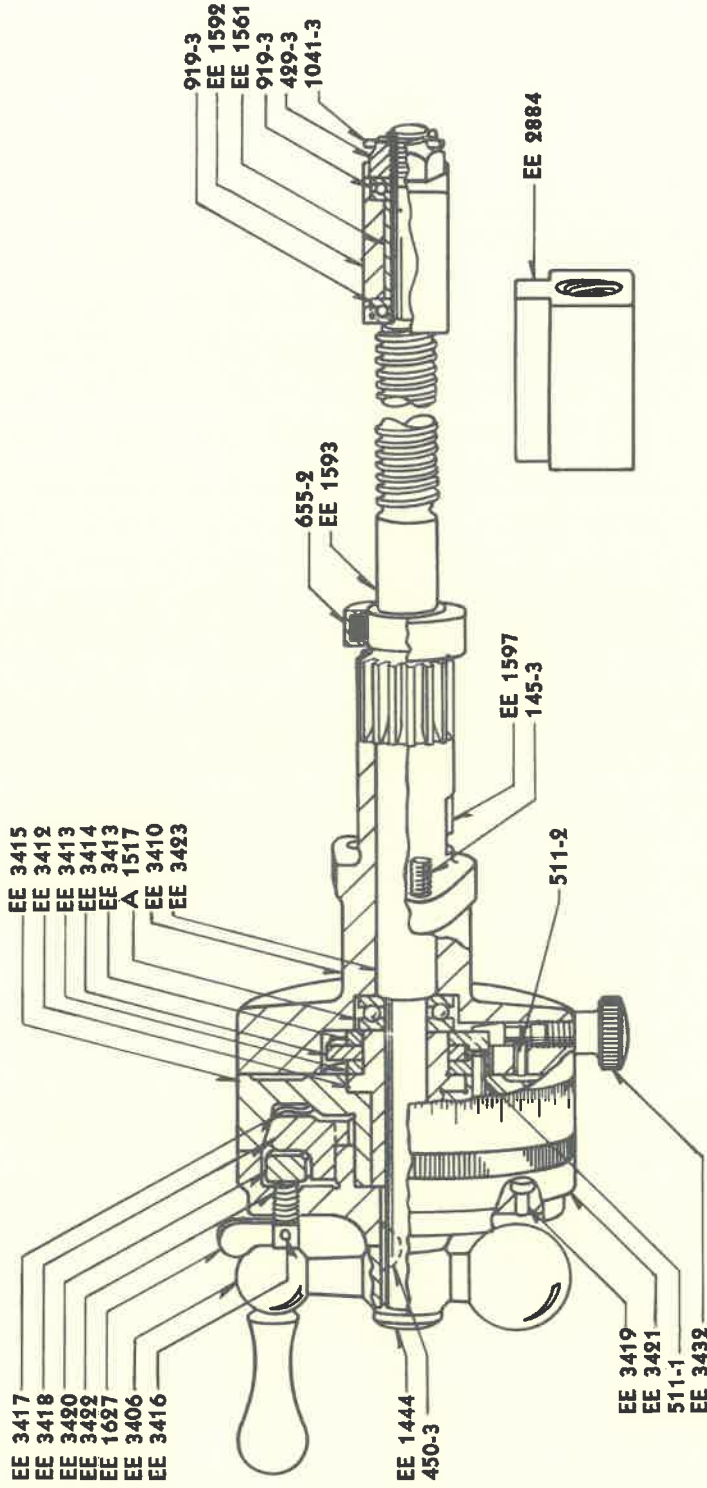
APRON
 UNIT EE 7
 SHEET 145



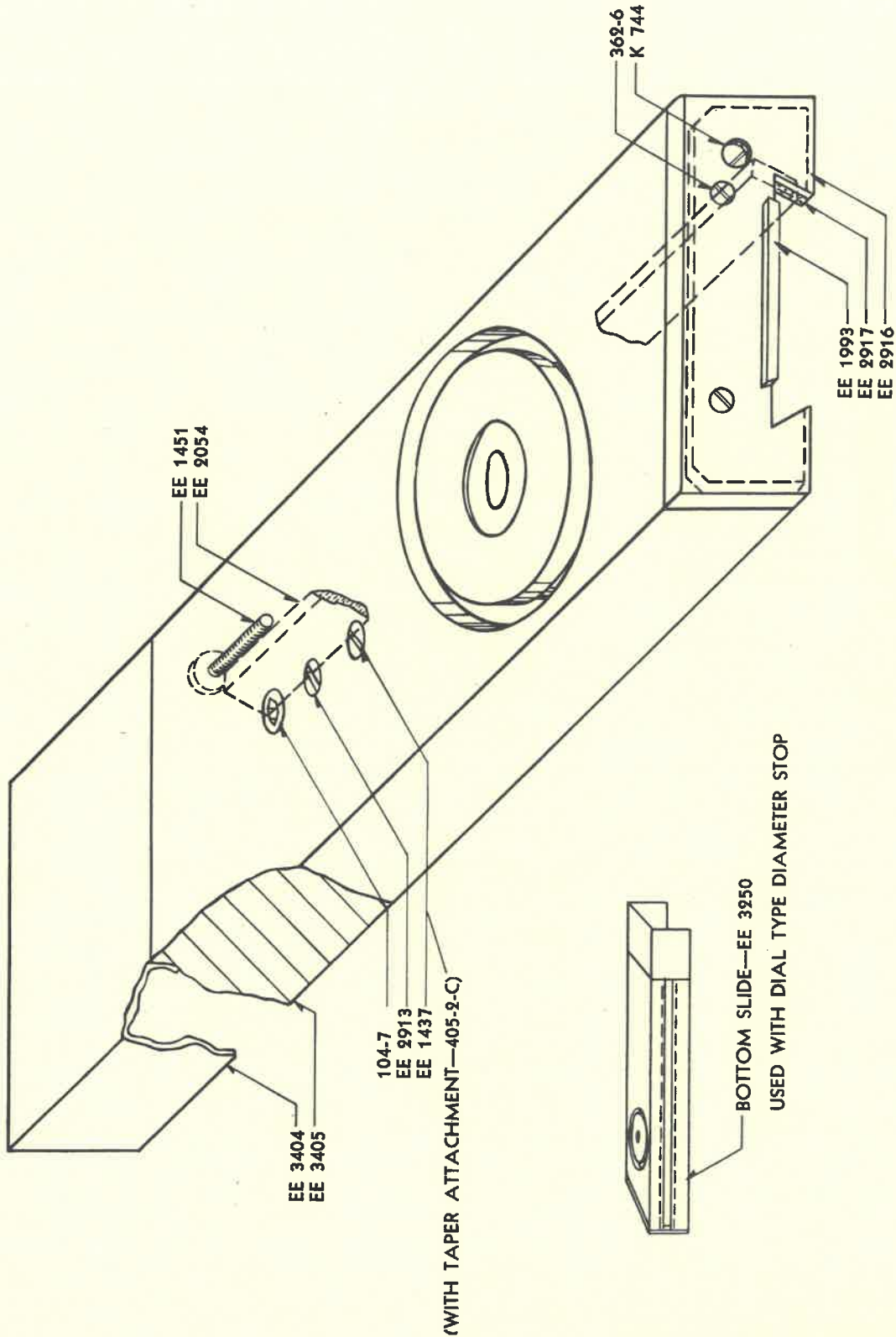
HANDWHEEL SHAFT



APRON
UNIT EE 7
SHEET I47



TELESCOPIC SCREW WITH ADJUSTABLE CHASING STOP

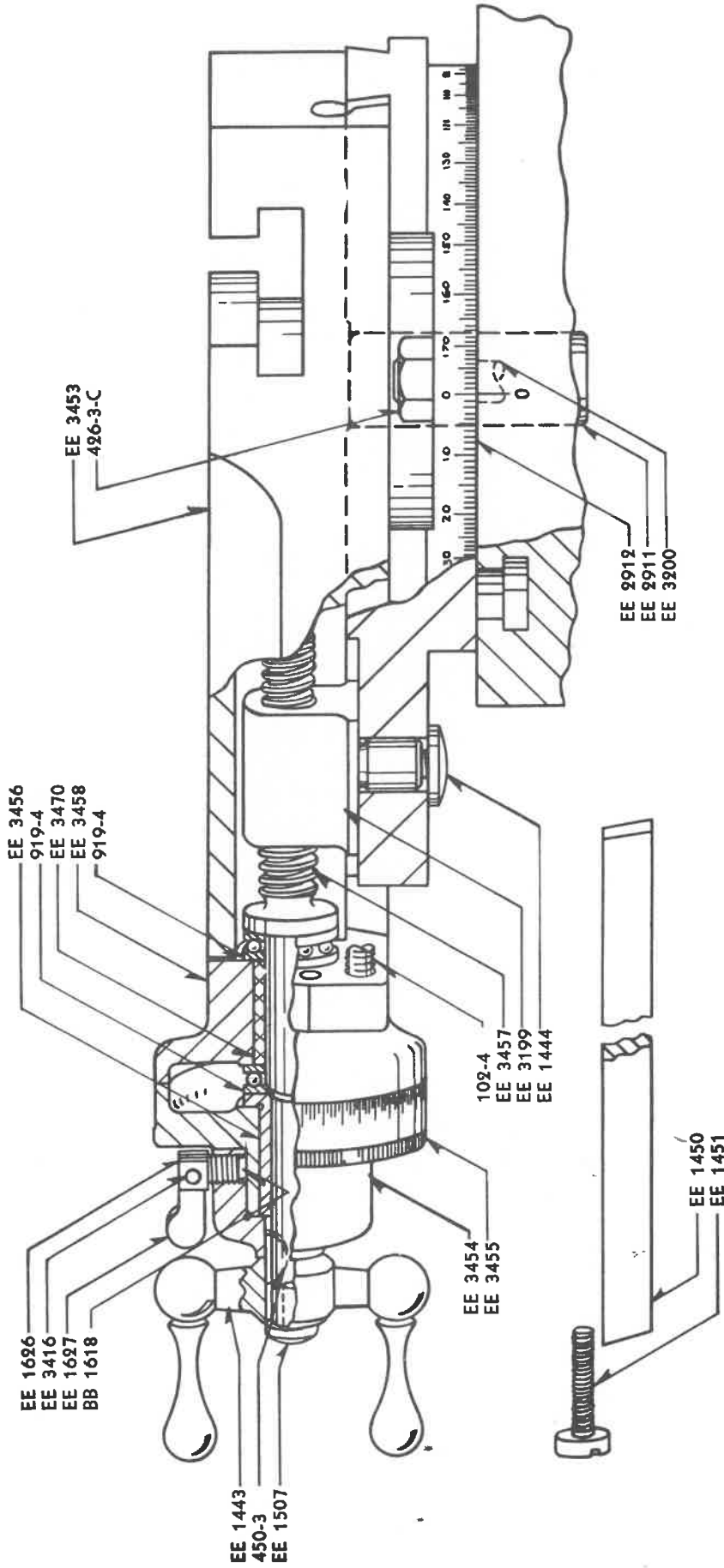


CARRIAGE & COMPOUND
 UNIT EE 8
 SHEET 148

BOTTOM SLIDE

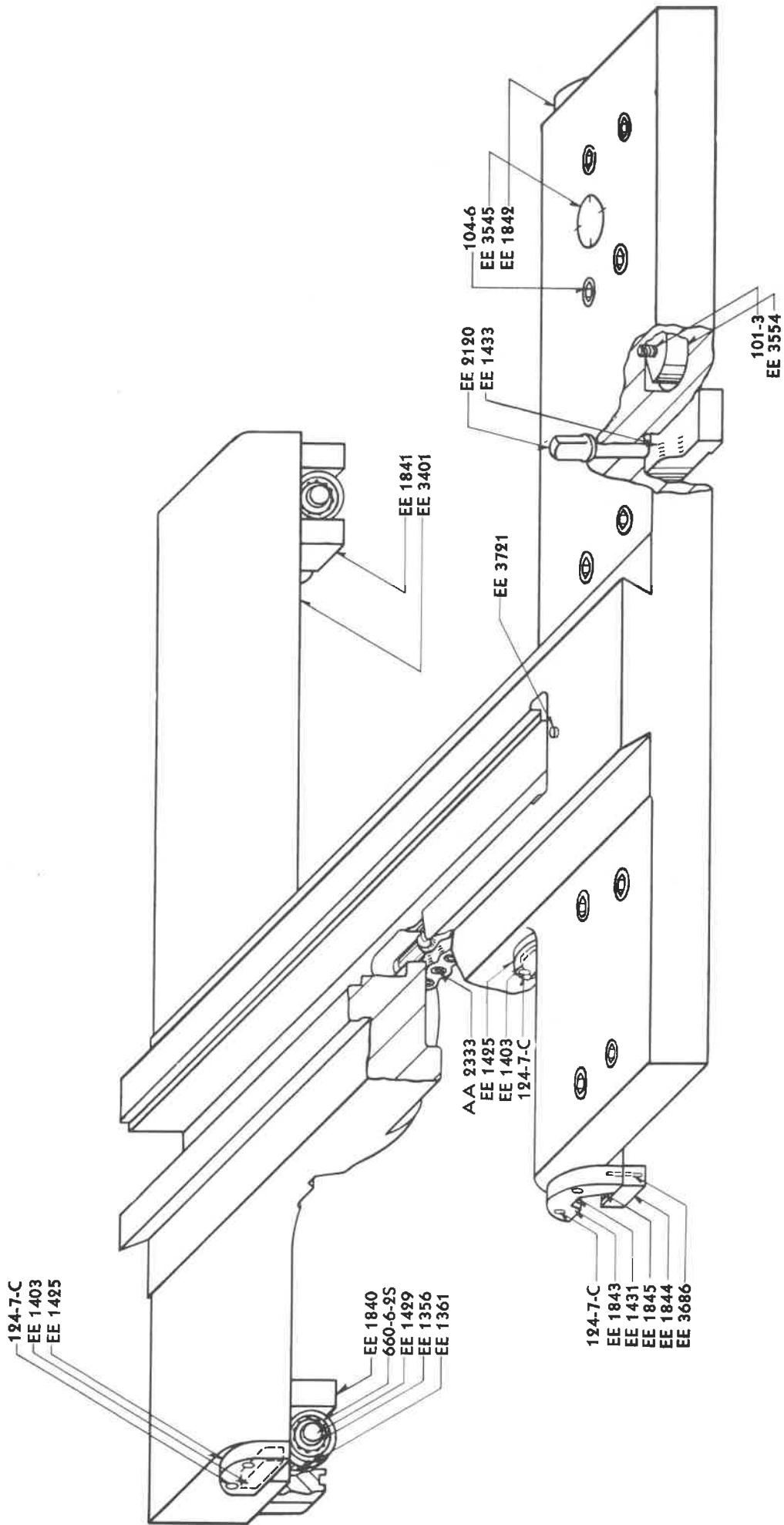
BOTTOM SLIDE—EE 3250
 USED WITH DIAL TYPE DIAMETER STOP

(WITH TAPER ATTACHMENT—405-2-C)

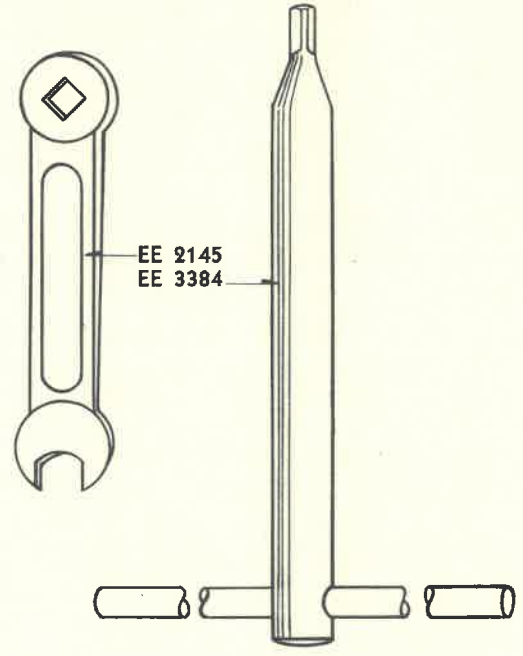
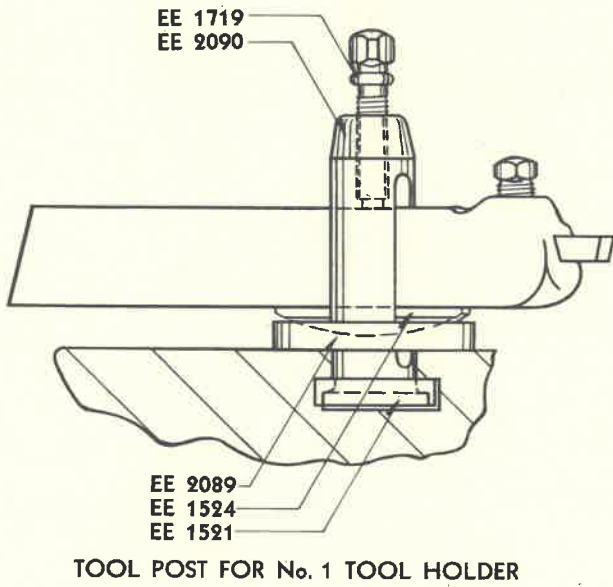
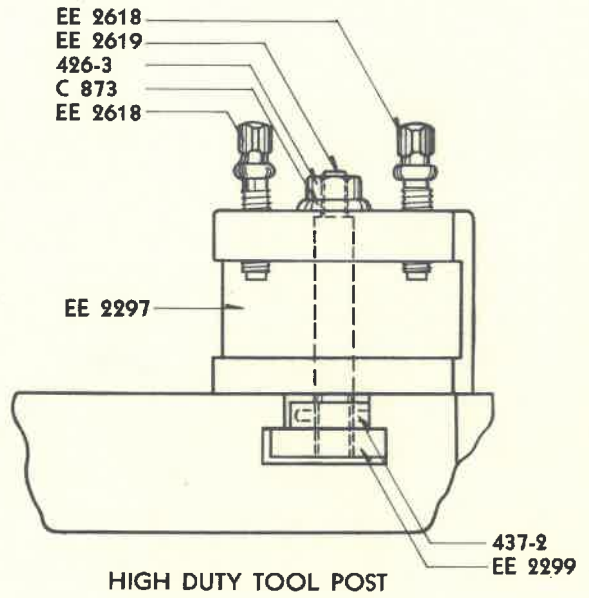
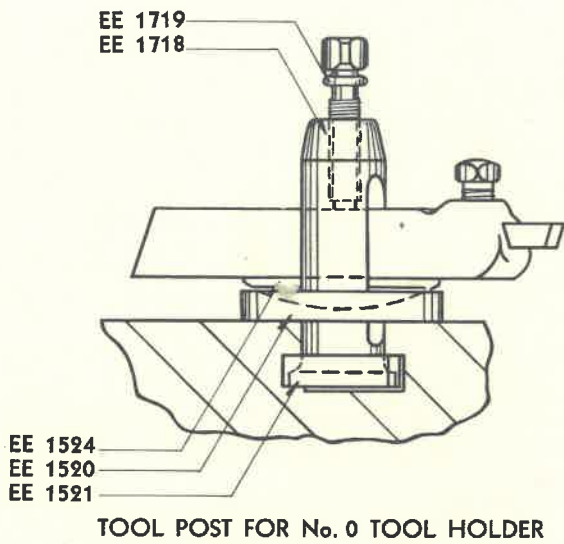


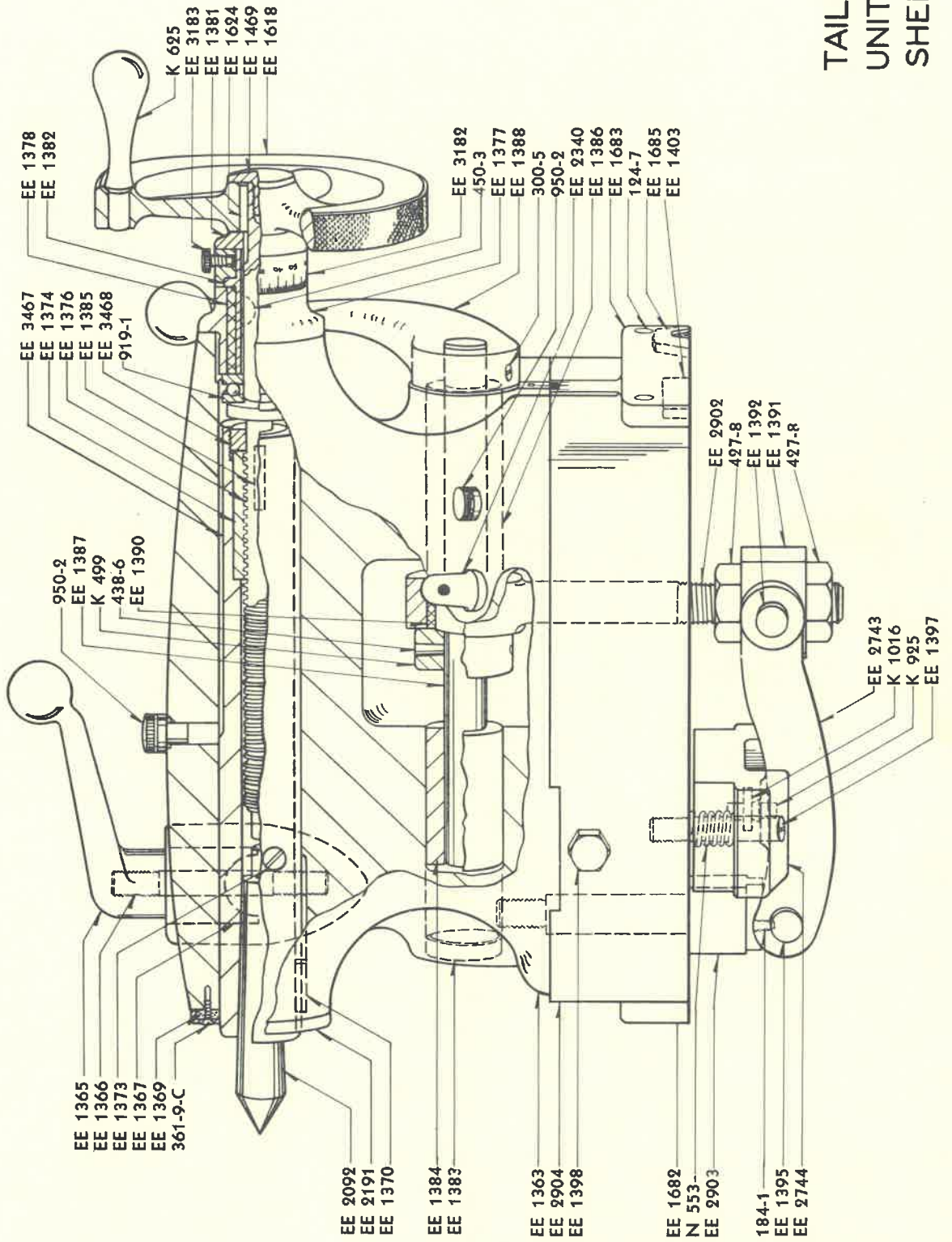
COMPOUND SCREW AND TOP SLIDE

COMPOUND
 UNIT EE 8
 SHEET 150

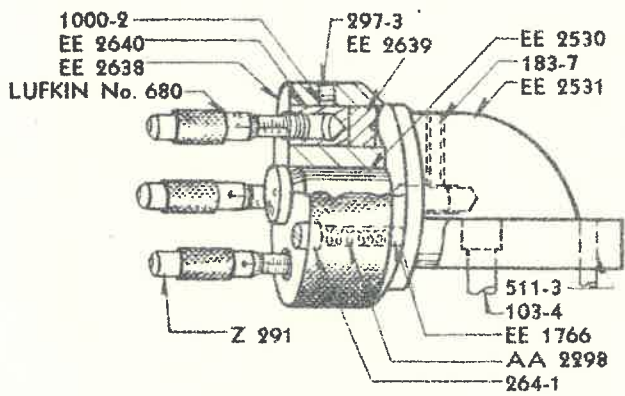
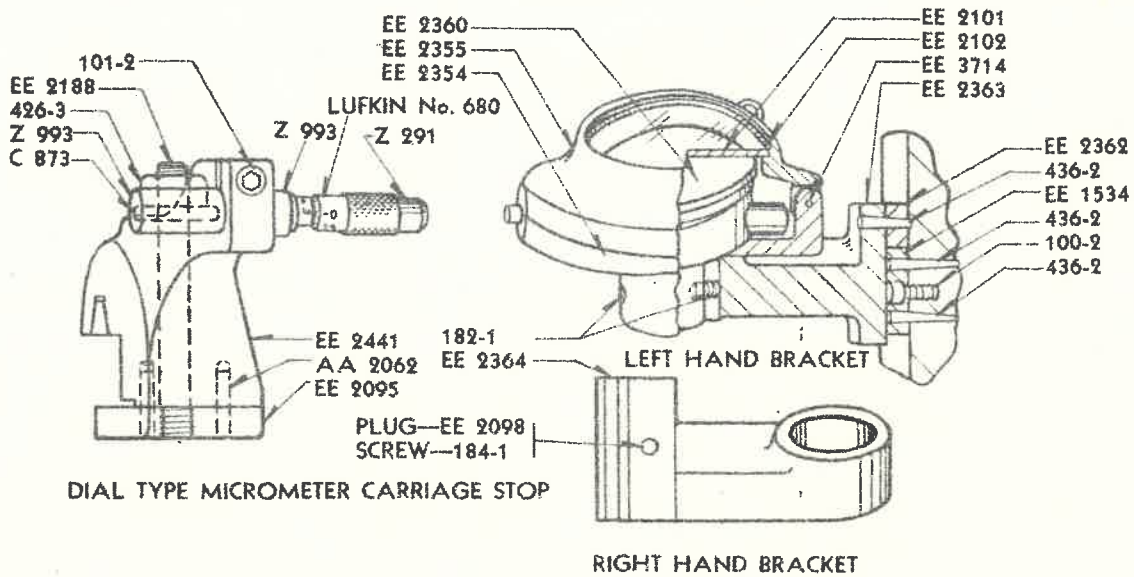


**CARRIAGE
 UNIT EE 8
 SHEET 151**

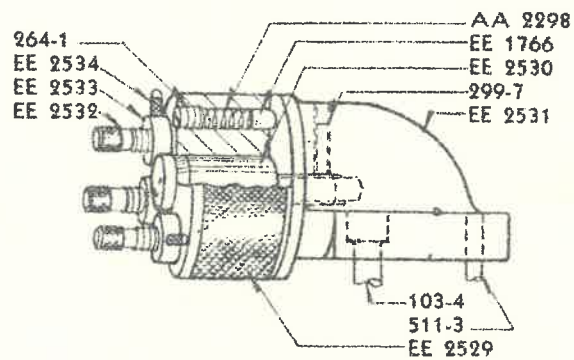




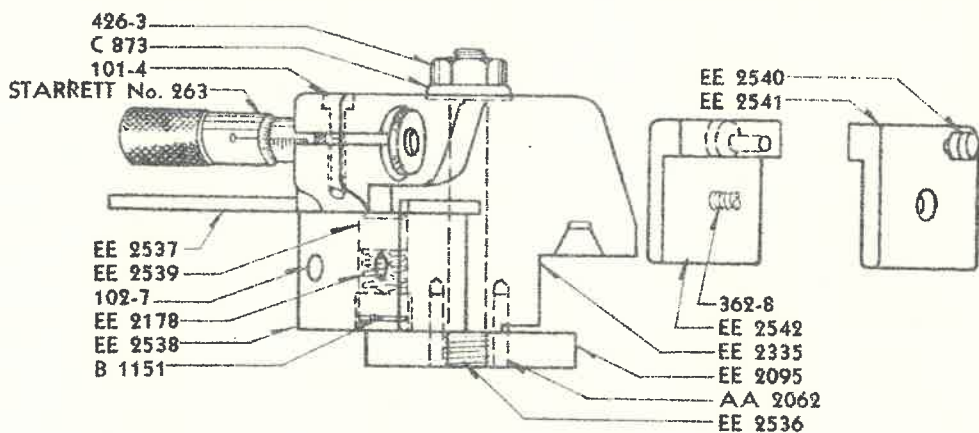
TAILSTOCK
 UNIT EE12
 SHEET 115



4 STATION MICRO CARRIAGE STOP



4 STATION MULTIPLE POSITION CARRIAGE STOP



MICRO-GAUGE BLOCK CARRIAGE STOP