

**monarch**  
**Sidney**



GEE-53154

## SAFETY

Metal cutting equipment is designed to change the shape of parts by removing metal. Accomplishing the metal cutting function requires high speeds, high horsepower, sharp tools, and moving elements. This in turn requires that an operator of this equipment be safety conscious to avoid an accident which could be crippling or fatal to the operator or persons standing nearby.

We cannot hope to anticipate all possible factors that could cause an accident to occur with this equipment, but are listing general safety considerations as an aid to the operator becoming safety oriented.

An operator should become completely familiar with all machine controls and corresponding movements before operating the machine. He should maintain a clear area surrounding the machine to be sure there are no obstacles to his movement and no slippery spots on the floor.

We suggest that snug fitting clothing and safety glasses be worn, and no attempt made to operate the machine while fatigued or ill. Do not operate the machine if it is malfunctioning in any way.

Persons other than the operator should stay at least 6 feet away from the machine while it is running so as not to distract the operator or accidentally move a control lever.

Do not stand on machine elements. Do not store wrenches or other items on machine surfaces.

Be sure that all guards and covers are properly in place and doors are closed and fastened while operating the machine.

The work holding device must be securely fastened to the spindle nose, workpiece properly held by work holding device (be sure to remove knock-out bar and all wrenches from spindle before running), tailstock (if needed) and tailstock spindle must be securely clamped before running part. The tailstock conveyor crank, if it is a removeable type, must be removed immediately after use. If a cylinder is used for power chucking, be sure pressure is adequate and speed is not excessive for the type chuck jaws being used.

Chucks must not be opened and tailstock members must not be unclamped while the workpiece is rotating.

Tools and holders must be securely fastened before attempting a cut.

A lathe is not designed for two-man operation. We recommend that the machine be turned off when another person is giving assistance in changing tooling, loading work, cleaning machine, or during maintenance work, as an accidental control actuation can cause an unexpected machine movement which could cause an accident.

Use a work loading assist to load heavy parts, but be sure the assist is clear of machine elements and will not obstruct operator movement before starting the machine.

The actual cutting operation can produce sharp edges and considerable heat. The operator should never touch the workpiece, and should keep all objects away from the tool and workpiece, while rotating. Also, never reach past the spindle or workpiece while it is rotating.

The movement of the carriage and bottom slide will create pinch points and the operator must avoid these points.

High voltage is used to power this machine. Authorized electricians only should correct an electrical component failure. Other maintenance must be performed by authorized personnel.

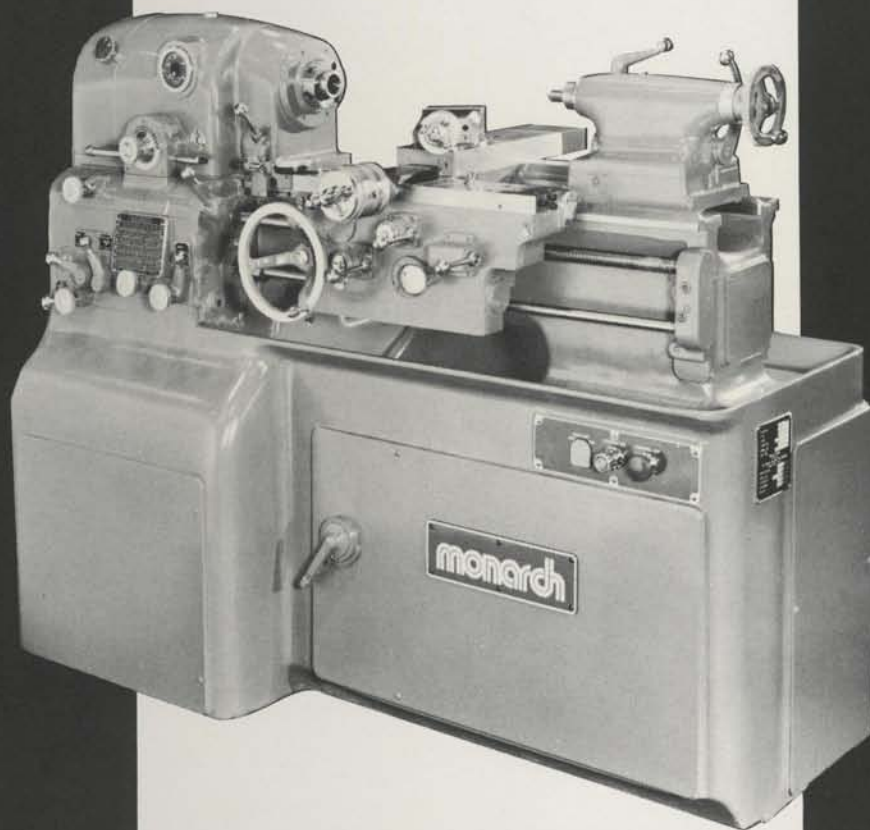
In conclusion, the operator must treat the machine with the utmost respect and observe all safety precautions.

## SPARE PARTS

## 10" EE LATHE

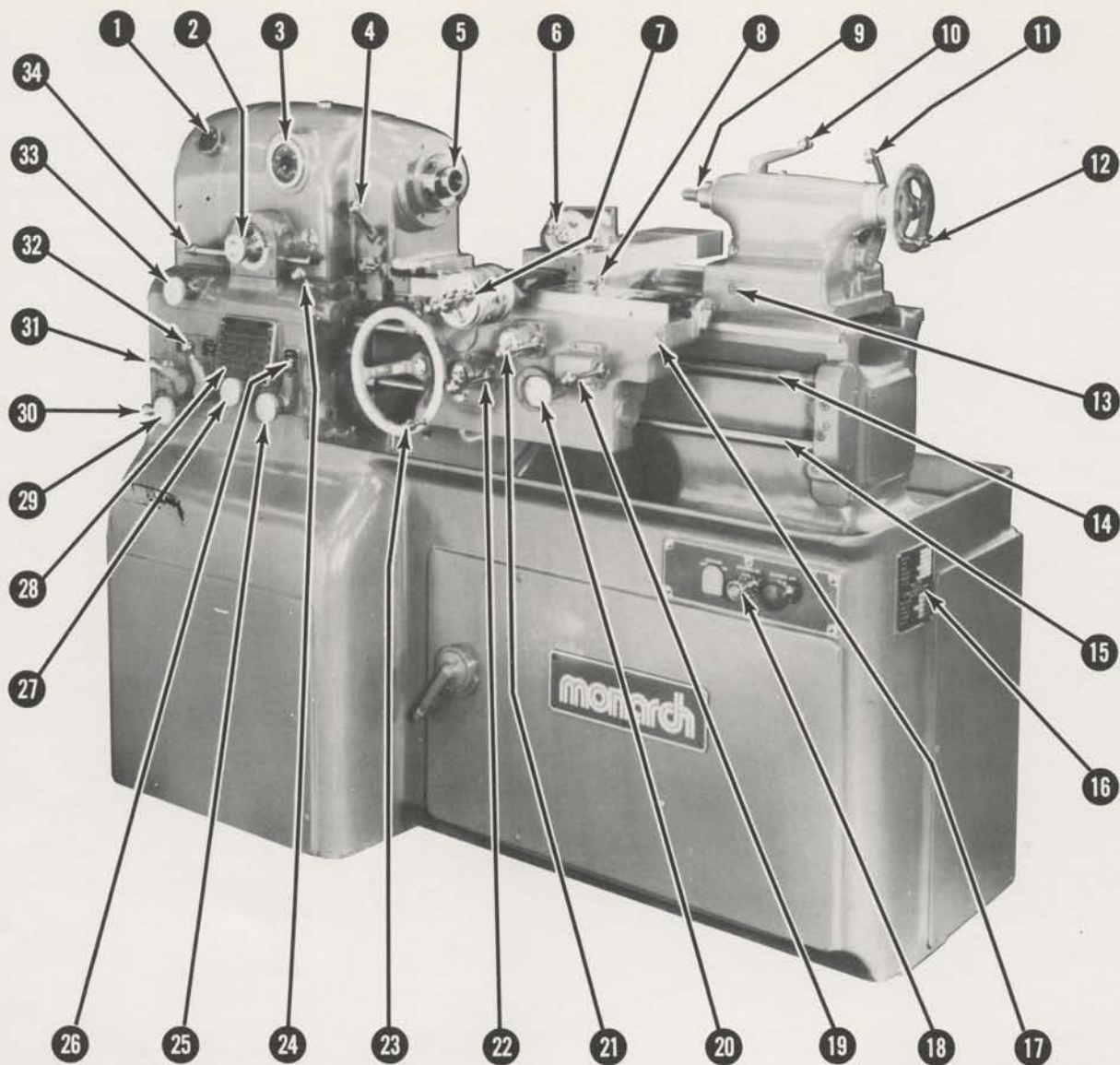
1	33173	Tandem Potentiometer	39.70
2	15635	Buss One Time Fuse 3 Amp. 250 Volt	1.30 ea.
8	20632	Silicon Diodes	4.40 ea.
1	24388	Transient Suppressors	29.30
1	24389	Transient Suppressors	56.10
2	22059	#ELC16J Rectifier Tube	311.50 ea.
1	22060	#ELC3J Rectifier Tube	73.50
1	61482	#44 Mazda Bulb	1.00
1	19890	Feed Belt	12.70
1	68295	Vee Belts (2/Set)	59.80 per set
6	EE-1845	Lower Wiper	.90 ea.
4	EE-1403	Flat Wiper	1.90 ea.
2	EE-1431	Carr. Vee Wiper	2.60 ea.
1	EE-2917	Wiper (Bottom Slide)	3.20
4	17016	Fuse FRN 2 1/4	4.40 ea.
1	50194-5	Timer 60 Sec.	118.80
1	25487-1	Dunco Anti-plugging relay	292.40
1	24328-1	Dunco Field ACC Relay	198.50
1	25486	Dunco Field Loss Relay	196.90
1	R-1899	Motor Brushes 2/Set	41.30 ea.

# Operator Manual



## 10" MODEL EE TOOLMAKERS AND MANUFACTURING LATHE

monarch  
Sidney



### Operating Levers and Controls

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

# 10" EE Toolmaker's 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 preventative 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 simplified leveling.

A sensitive precision machinist's level 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 20.

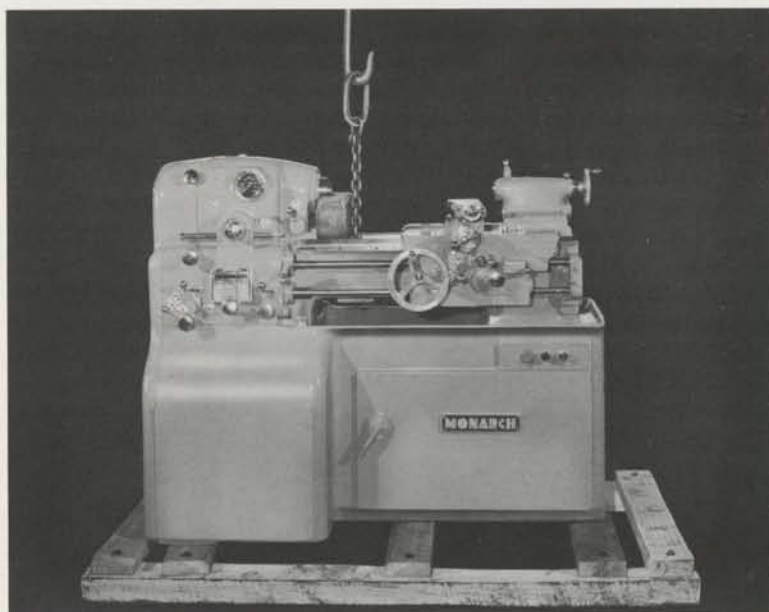


FIGURE 2. Lifting a Model 10" EE Lathe



# Toolmaker's Lathe

## General Description of Controls

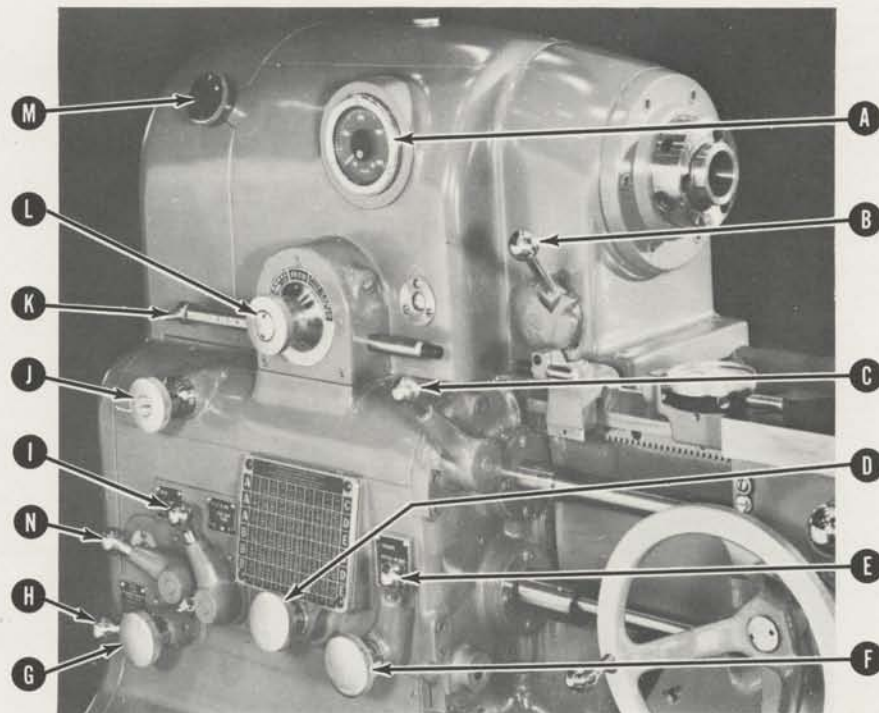


FIGURE 3. Headstock and Gear Box

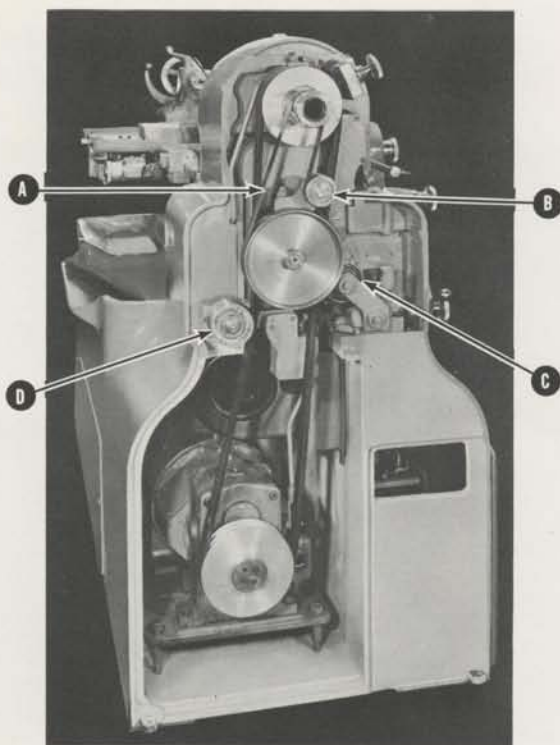


FIGURE 4. Headstock End Covers Removed

### 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 rotation 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.

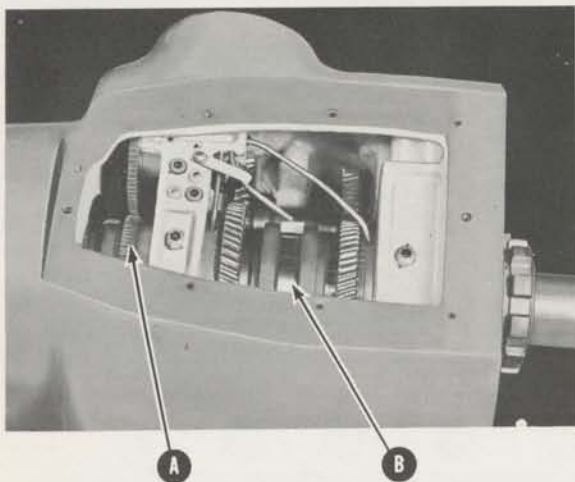


FIGURE 5. Headstock, Top Cover Removed

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.

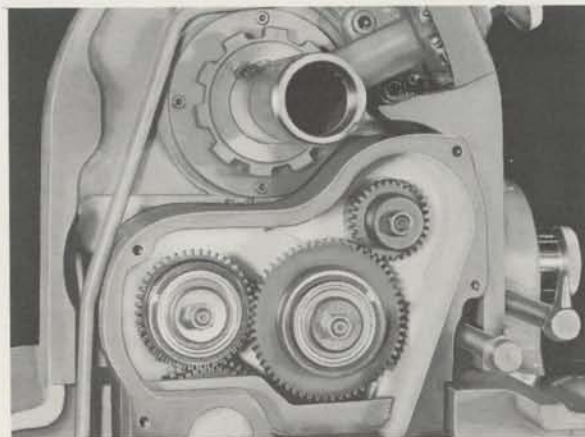
**CAUTION:** Be sure this lock is released before attempting to start spindle. An electrical interlock is provided to prevent starting with the spindle lock engaged.

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.

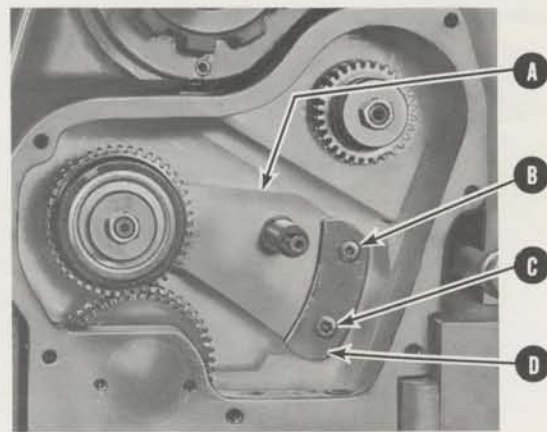


FIGURE 6. End Gear Train

## 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. Rotate knob (D) to the number corresponding 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, PITCH IN MM or THDS./INCH position.
6. Push down on ball handle of lever (I) and shift to either PITCH IN MM or THDS./INCH or FEEDS.
7. Push down on ball handle of lever (N) and shift to either FEEDS or THREADS.
8. Push down on ball handle of lever (H) and shift to either BACK GEAR or OPEN BELT.
9. Pull out and rotate knob (L) to LEFT HAND THREADS, FEED or RIGHT HAND THREADS.

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 3½, 4½, 13½ 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 3¼, 5¾, 6¾ the half nuts must be engaged at the same graduations each time.

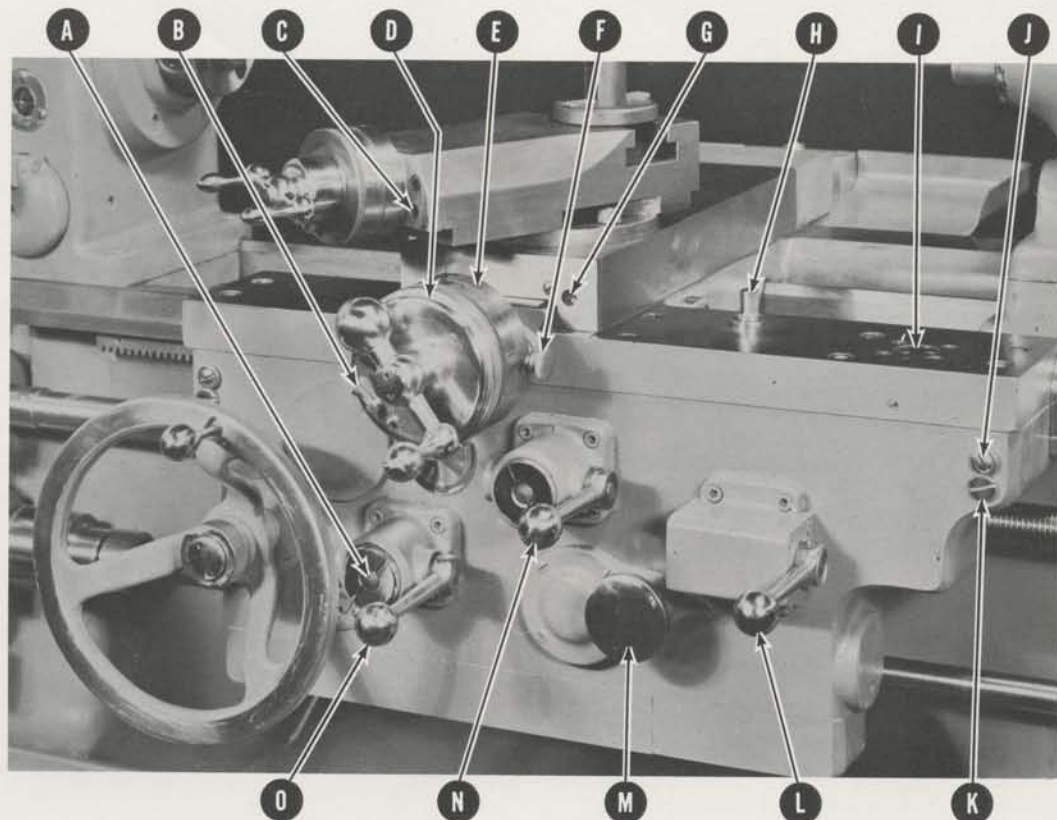


FIGURE 7. Apron and Carriage

- (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.

The cross feed dials (E) are geared together to read in both inch and metric systems. The inch dial is graduated to read in one thousandths of an inch on diameter. The metric dial is graduated to read in two hundredths of a mm. on diameter.

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  $29\frac{1}{2}^\circ$  for  $60^\circ$  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 drilling up to a depth of three and one-half inches, dial (D) is graduated in both inch and metric systems. One sixteenth of an inch per graduation in the inch system and one millimeter per graduation in the metric system.

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 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.

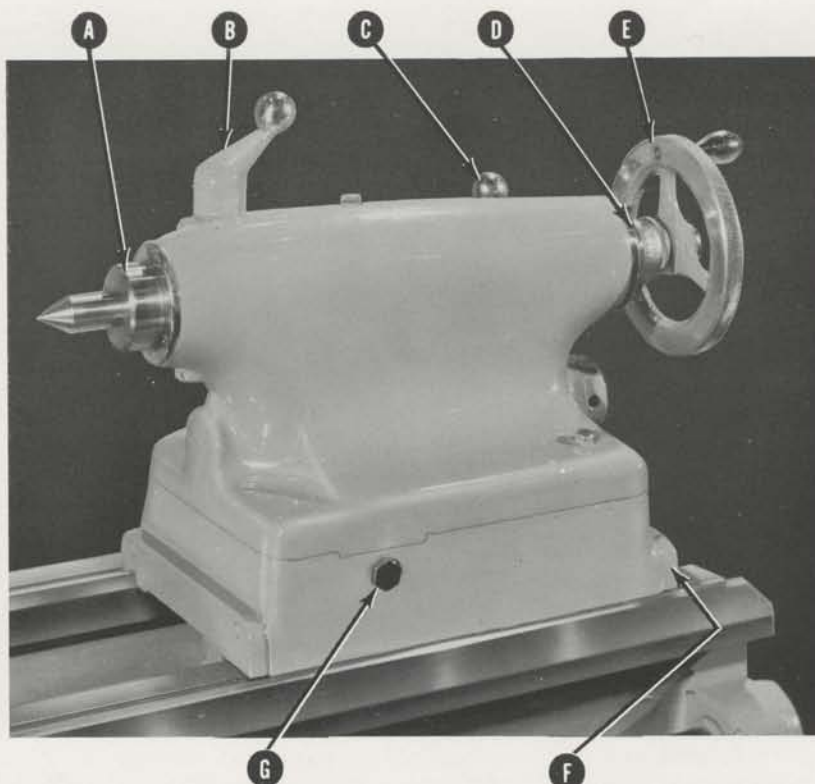


FIGURE 8. Tailstock

## 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 degrees, inches per ft., and mm per dm. 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) .

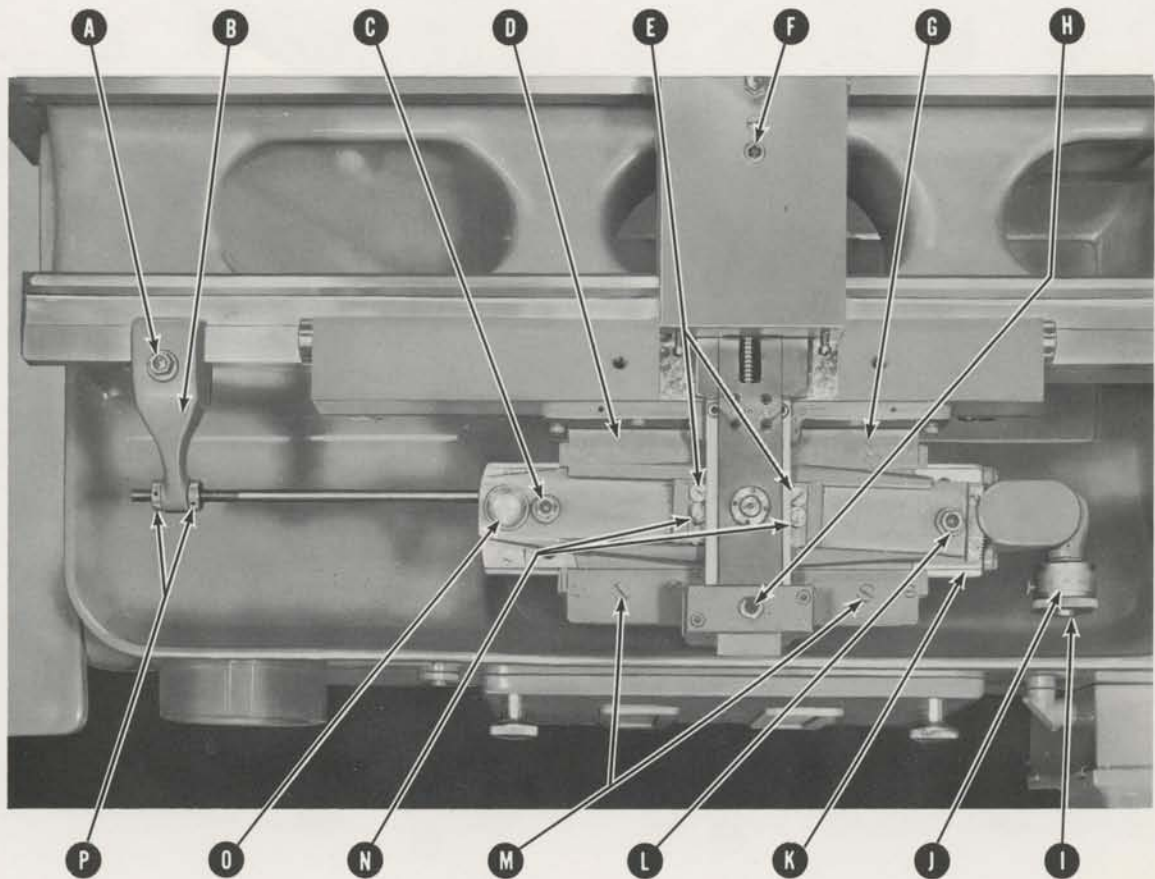


FIGURE 10. Taper Attachment

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.

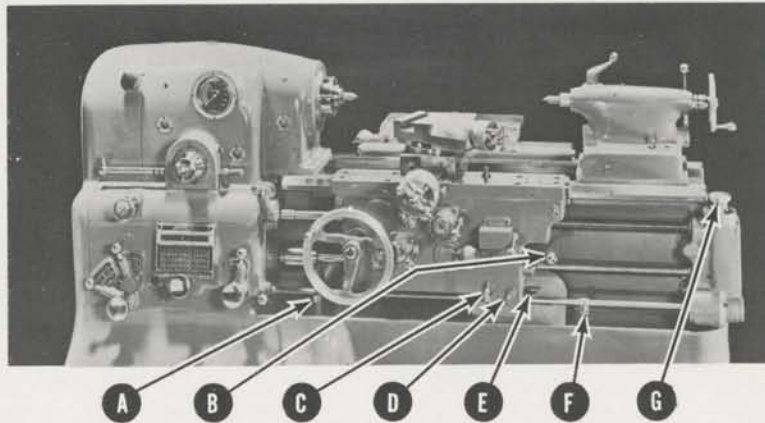


FIGURE 11. Electric Leadscrew Reverse

## 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 <math>\frac{1}{8}</math>" 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 <math>\frac{1}{4}</math>".</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 <math>45^\circ</math> 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. Tighten lockscrew.</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).
2. Loosen lock screws (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. Tighten 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 schematic 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 determine 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 115 V ac control circuit. Therefore, when the disconnect switch is placed in the "On" position, the electronic unit door interlock solenoid (1 sol.) is

## Sequence of Operations (Continued)

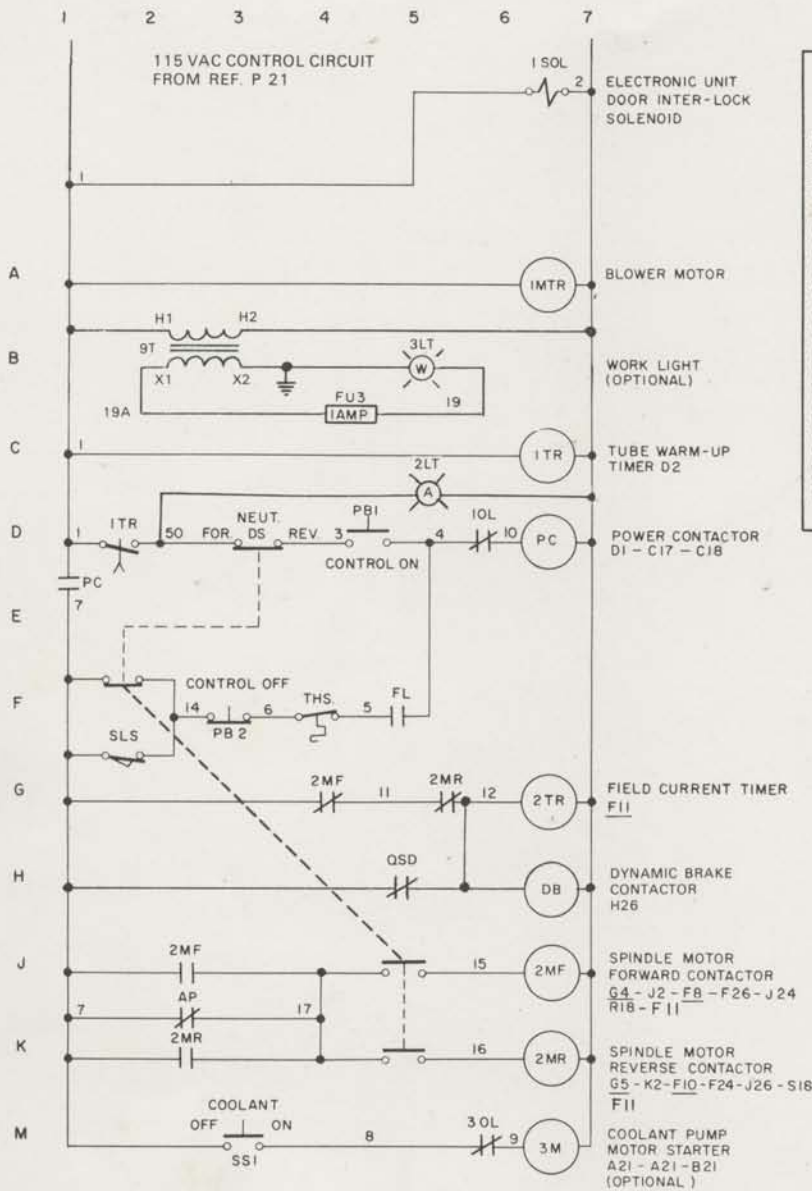
energized, locking the electronic unit compartment door, the electronic compartment blower revolves, the tube warm up timer (1TR) is energized and starts to time out. After 60 seconds, the timer (1TR) contact (1-50) closes, and the amber light on the operator's panel glows. If the control "On" button is depressed, contact (3-4) closes and the Power Contactor (PC) coil receives current from Wire 1 through the Timer (1TR) contact (1-50), Drum Switch (DS) contact (50-3), Control On (PB1) contact (3-4), Overload Relay (10L) contact (4-10) through the Power Contactor coil (PC) to Wire 2. The Power Contactor (PC) closes and is electrically interlocked from Wire 1, through PC contact (1-7), Spindle Lock Switch (SLS) contact (7-14), Control Off (PB2) contact (14-6), Temperature Switch (THS) contact (6-5), Field Loss Relay (FL) contact (5-4), Overload Relay (10L) contact (4-10), through the Power Contactor (PC) coil to Wire 2.

When the Power Contactor (PC) closes, the Gear Box Lock Solenoid (2SOL) is energized through the Anti-Plugging Relay (AP) contact (18-13), making it possible to shift the gear box on the Spindle Motor. The Field Current Timer (2TR) is energized through the Forward Contactor (2MF) contact (7-11), and through the Reverse Contactor (2MR) contact (11-12). After 2TR times out (60 sec.), its contact (37-35) opens and places 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).

The Spindle Motor can now be started by operating the Spindle Control Lever which is connected mechanically to a Drum Switch (DS) 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 tailstock 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 (2MF) coil receives current from Wire 7 through the Anti-plugging Relay (AP) contact (7-17), the Drum Switch (DS) contact (17-15), the Forward Contactor (2MF) coil to Wire 2. Therefore, the Forward Contactor (2MF) closes and the Spindle Motor Armature is energized from Wire 22, through the 25 ampere Circuit Breaker (CB2) contact (22-49), the Spindle Motor Series Field (S1-S2), the Forward Contactor (2MF) contact (S2-A1), the Spindle Motor Armature (A1-A2), the Forward Contactor (2MF) contact (A2-51), to Wire 51. When the Armature is energized, the Anti-Plugging (AP) coil shunted across the Armature is also energized; and AP contact (7-17) opens, but (2MF) contact (7-17) has closed and the Forward Contactor coil is electrically interlocked. (2MF) contact (30-31) connects the Constant Voltage Transformer (T4) to the reference voltage circuit. (2MF) contact (7-11) opens and deenergizes field current timer (2TR) coil, 2TR contact (37-35) closes, shunting resistor R2. The (2MF) contact (35-37) closes, also shunting resistor R2. (2MF) contact (36-38) opens and places the Motor Field Control Potentiometer (P3A) in the field control circuit. The AC ripple voltage across the spindle motor is sensed by Quick Slow Down Relay (QSD), (QSD) contact (7-12) deenergizes DYNAMIC BRAKE RELAY (DB); DB contact (41-A1) opens and removes the Dynamic Brake Resistors (R10)(R11) from the armature circuit.





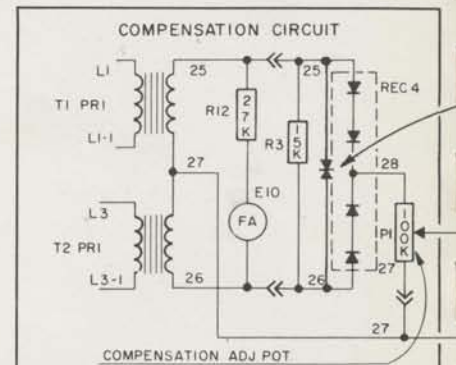
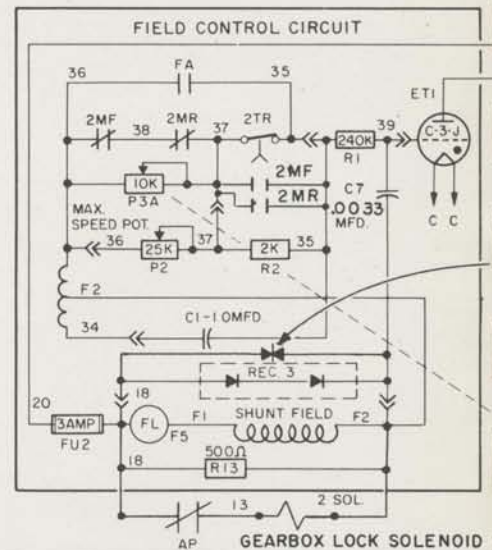
**NOTE:**

The alpha-numeric notations adjacent to the relay coils designate contact locations on this diagram. Those underlined denote normally closed contacts.

On machines having the spindle controlled at the apron, the switching circuits are slightly different than shown. Refer to large machine prints.

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

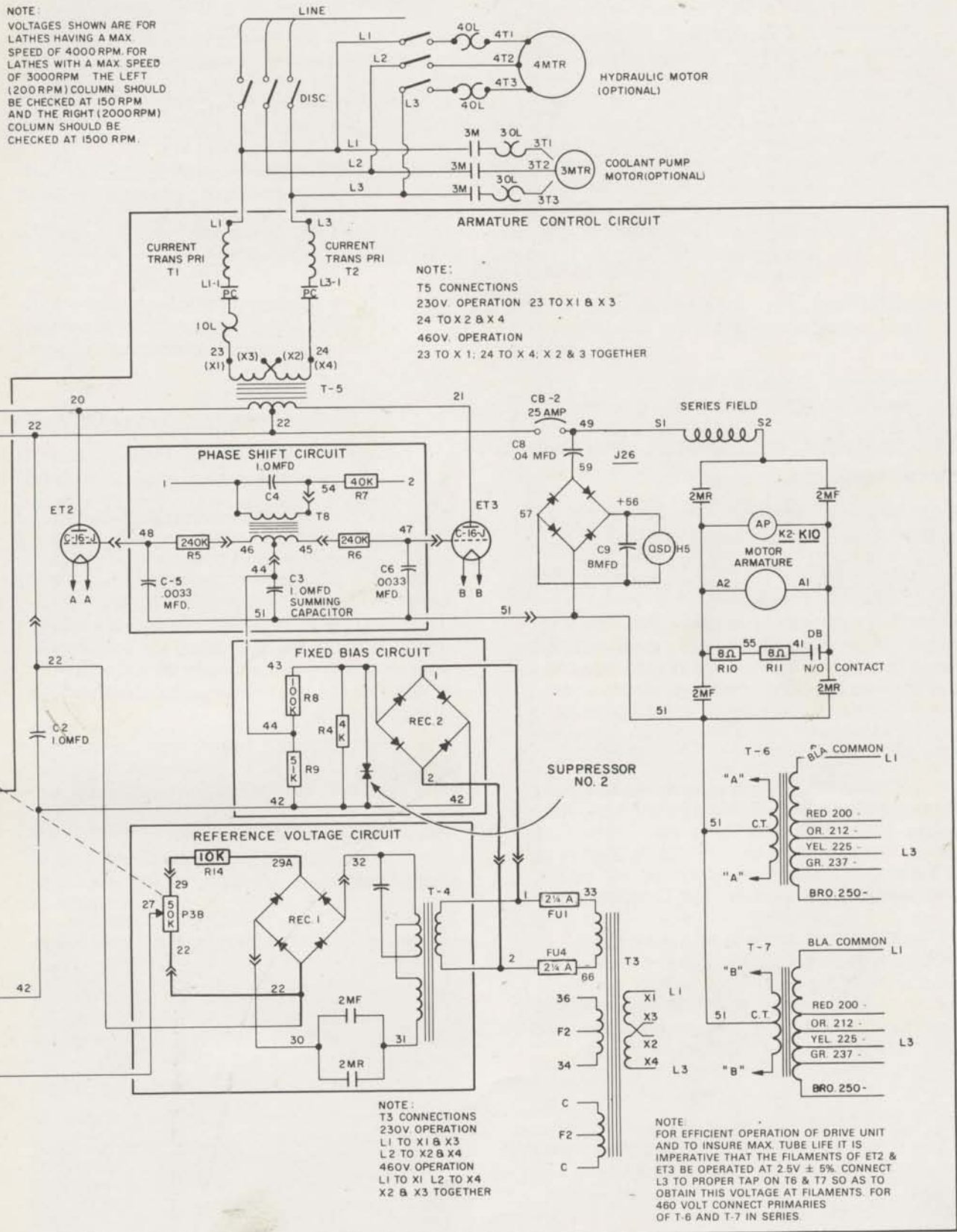
SEE NOTE AT RIGHT



**NOTE:**  
FOR 230V OPERATION SHUNT T1 & T2 PRIMARY EACH WITH 20" OF NO. 14 A.W.G. WIRE.  
FOR 460V OPERATION USE 40" OF NO. 14 A.W.G. WIRE FOR EACH SHUNT. THESE SHUNTS ARE INSTALLED AT MONARCH.

FIGURE 12. Sch m

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



PPRESOR NO. 3

PPRI SOR NO.

## Sequence of Operations (Continued)

The sequence of the braking cycle is the opposite of the starting cycle. The (2MF) contact (S2-A1) (51-A2) open, disconnecting the Motor Armature from the power lines. The (2MF) contact (36-38) closes placing full voltage on the Motor Field for dynamic braking. The (2MF) contact (35-37) opens to make resistor (R2) effective after 2TR has timed out. The (2MF) contact (7-11) closes to start 2TR to time out and reduce the current through the Motor Field; The (2MF) contact (30-31) opens, disconnecting the reference voltage, causing the armature power tubes (ET2) and (ET3) to be turned off. The (2MF) contact (7-11) energizes (DB) contactor, (DB) contact (41-A1) connects Dynamic Brake Resistors (R10) (R-11) 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 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 its 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 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 customers line voltage is 460V, the primaries are connected in series and the filament voltages are adjusted by juggling the primary taps, (see note on wiring diagram).

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.

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 phases 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) coil.

R13 — Spindle motor field by-pass resistor. Limits any voltage spikes that might damage the back rectifier REC3.

R14 — Voltage dividing resistor for the reference voltage output. R14 limits the maximum 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.

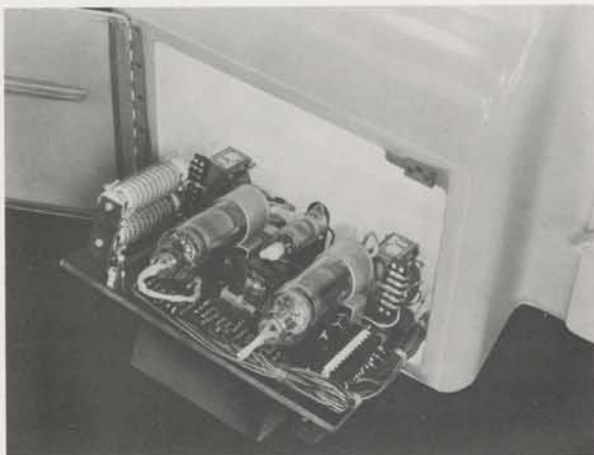


FIGURE 13. Electronic Unit (Tilted)

P3 — Spindle Speed Control Potentiometer  
This is a two section tandem potentiometer. One section marked P3B is used to control the motor armature voltage, and the other section marked P3A is used to control the motor field voltage. Rotating this potentiometer from the counterclockwise position, the resistance in the armature control section P3B changes over the first half of rotation with zero change in the last half of rotation. The field control section P3A 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.

#### SUPPRESSORS

Suppressors 1, 2, 3 - Used to protect diodes against transient peak voltages.

#### 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 connected 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. ET1.

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 circuit is a very short duration.

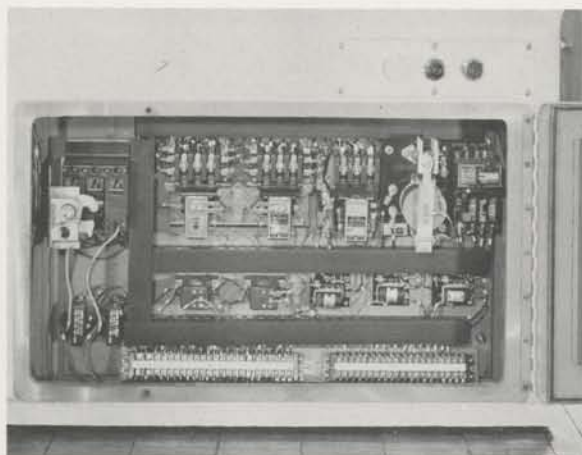


FIGURE 14. Relay Starter Compartment

## 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 restoration of supply voltage unless the control on 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 fed power through the main contactor (PC) contacts (L1-1-23) and (L3-1-24). 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 (2MF & 2MR)

This contactor causes the spindle motor to revolve when its coil is energized. 2MF contacts (S2-A1) (51-A2) close, completing the circuit to the motor armature. 2MF contact

(7-11) opens resetting timer 2TR. 2MF contact (36-38) opens placing the field control potentiometer in the circuit to control the speed of the motor in the field range. 2MF contact (35-37) closes shunting resistor (R2). 2MF contact (30-31) connects constant voltage transformer to the reference voltage circuit. 2MF contact (7-17) closes electrically latching the Forward Contactor 2MF. When the reverse contactor 2MR 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 2MF 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 contact (7-17) opens. As 2MF contact (7-17) has closed, the 2MF coil remains energized even though the AP relay contact (7-17) has opened. If the spindle start lever is moved from the forward to the reverse position, the forward contactor 2MF opens but the reverse contactor 2MR cannot close as the AP contact (7-17) is 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 contact (7-17) closes the reverse contactor coil 2MR is energized and closes its contact (7-17). This same cycle would take place if the reverse contactor 2MR had been initially closed, and the lever moved to the forward position.

Contact (18-13) on this relay energizes the gear box lock solenoid when the motor is revolving below 250 rpm so the gear box may be shifted.

### 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). This contact short circuits the field control section P3A of the tandem spindle speed control potentiometer, placing full voltage on the spindle motor field. Therefore, in accelerating, if the motor armature current reaches 25 amperes, the FA contact (35-36)

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

#### Field Loss Relay (FL)

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 FL contact (4-5) opens, dropping out the power contactor (PC) stopping the complete machine.

#### Dynamic Brake Contactor (DB)

This contactor is used to dynamically brake the spindle motor. It is operated by deenergizing forward or reverse contactor or QSD relay. DB contact (41-A1) closes to place dynamic brake resistors R10 and R11 across the armature causing the motor to brake by generator action.

#### Quick Slow Down Relay (QSD)

When the spindle speed control potentiometer (P3-A-B) adjustment is changed to reduce the spindle speed the controlled rectifier tubes cease conduction and no voltage with an AC ripple is applied to the armature until the motor "back voltage" drops below the new "reference" voltage. During this time (QSD) deenergizes and picks-up (DB) contactor; (DB) contact (41-A1) closes placing dynamically braking the motor to the new speed.

#### Tube Warm Up 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 (3M)

This starter starts the coolant pump motor.

## **Spindle Motor Specifications**

5 Horsepower Machine Tool Duty  
Armature Voltage 240  
Field Voltage 120  
Field Current Hot 1.1 - .25

Speed 60 to 1150 R.P.M. by armature control  
1150 to 3450 R.P.M. by field control.  
Frame 218

## 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	490E-58	15K Ohm 10 Watt Axial Lead Resistor
R4	490E-45	4K Ohm 10 Watt Axial Lead Resistor
R7	490E-71	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	516E-15	8 Ohm 385 Watt Resistor
R13	480E-14	500 Ohm 100 Watt Resistor
R14	502E-24	10K Ohm 2 Watt Resistor
C1-C2-C3-C4	23209	1 Mfd. 600 V.D.C.W. Capacitor
C5-C6-C7	23735	.0033 Mfd 400 V.D.C.W. Capacitor
P1	522E-9	100K Ohm 2 Watt Potentiometer
P2	522E-6	25K Ohm 2 Watt Potentiometer
P3-A-B	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-2TR	50194-5	Timer 1 Min.
CB2	19638	25 Amp. Circuit Breaker
T1-T2	22138	Current Transformer
T3	24052	Control & Filament Trans.
T4	22136	Constant Voltage Trans.
T5	22106	Anode Trans.
T6-T7	22133	Filament Trans. 230 Volt Pri.
T8	22070	Grid Transformer
PC	25484-1	Size 0 Starter
F-R	25482-1	Size 0 Reversing Starter
QSD	50293	Quick Slow Down Relay
AP	25487-1	Anti-Plugging Relay
FL	25486	Field Failure Relay
FA	24328-1	Field Accelerating Relay
1OL	26071-37	Heater Coils 230 Volt
1OL	26071-32	Heater Coils 460 Volt
2OL	25659-52	Heater Coils 230 Volt
2OL	25659-2	Heater Coils 460 Volt
1 SOL.	23177	Solenoid
2 SOL.	20308	Solenoid
THS	27397	Temperature Switch
SLS	19574	Limit Switch
PB1-2LT	26124 & 26125	Amber Ill. Push Button
PB2	74959 & 26126	Push Button
DS	21111	Drum Switch
PLUG & RECEPT.	24342	24 Contact Varicon Connector
DISC.	23900	Main Disconnect Switch
3M	25485-2	Size 00 Starter
SS1	26123 & 26125	Selector Switch
SUPP. No. 1 & 2	24388	Suppressor
SUPP. No. 3	24389	Suppressor

## MODULE MAINTENANCE

The brain of the electronic controlled spindle motor power supply is contained in a black box called a Module. In this module are 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.



FIGURE 15. Plug-in Module.

As the diodes and 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.

NOTE: On some multimeters the polarity of the leads are reversed when switched to ohms.



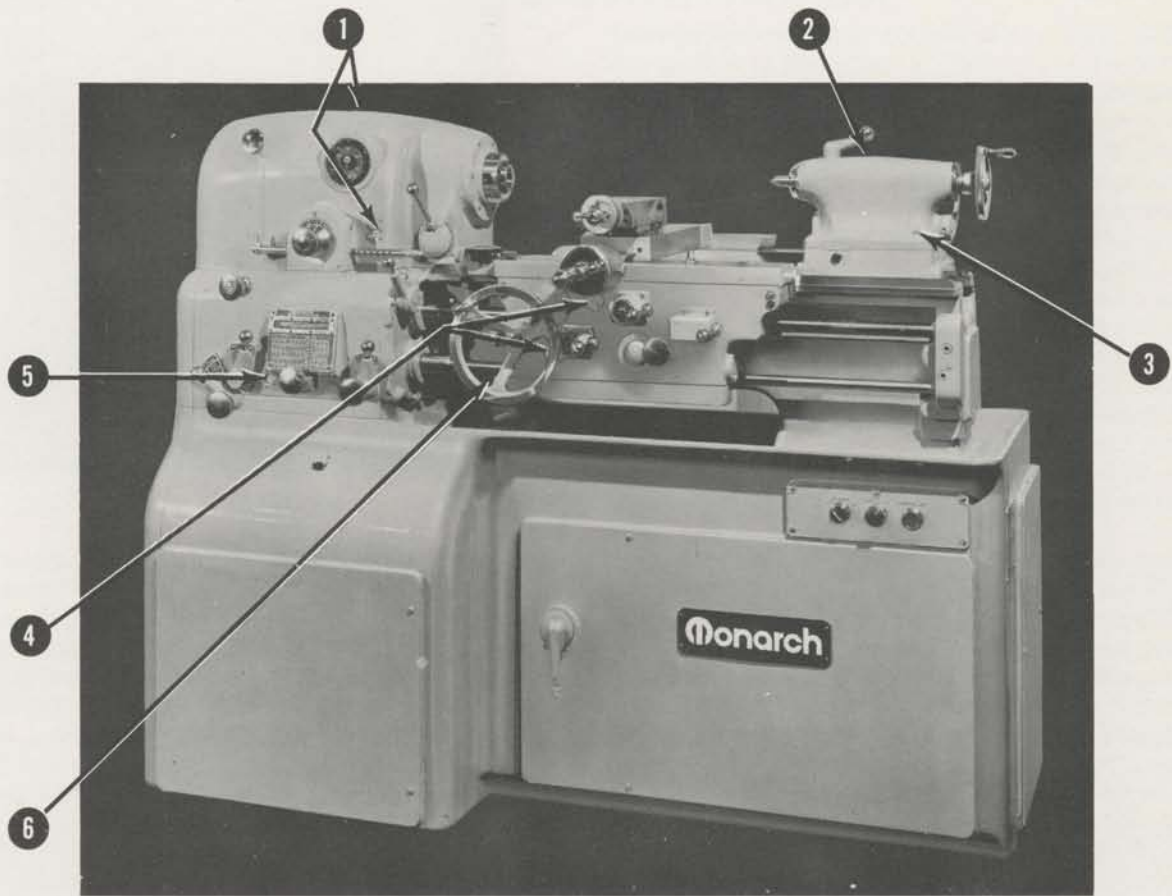


FIGURE 18. 10" Model EE Lathe

Reference Number	Part	Capacity	Lubricant	Schedule
1	Headstock Reservoir Filling Point and Oil Level Gauge	3 Qts.	MO-11	Check level weekly. Drain every 6 months at point (8), flush and refill with fresh oil.
2	Tailstock Spindle		MO-12	Oil each shift.
3	Tailstock Ways		MO-12	Oil each shift.
4	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.

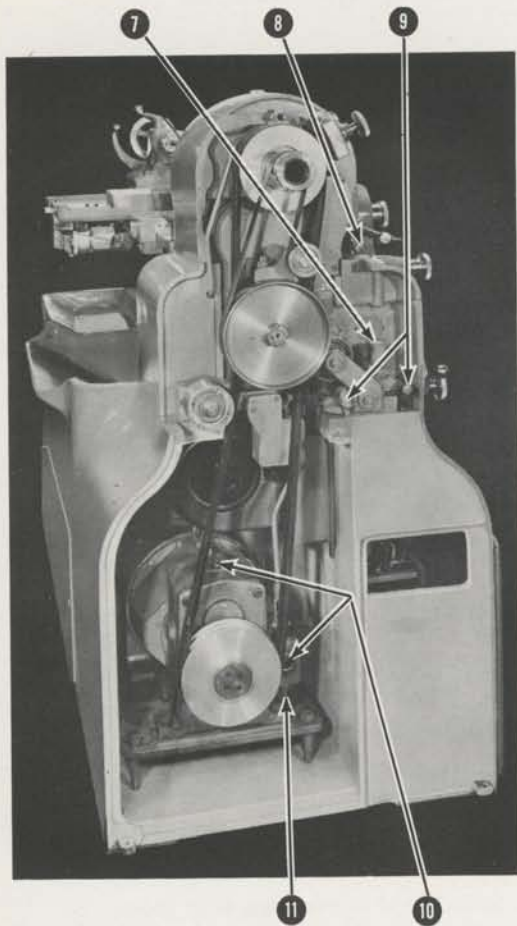


FIGURE 19. 10" Model EE Lathe,  
End Covers Removed

### SPECIFIC LUBRICANTS

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

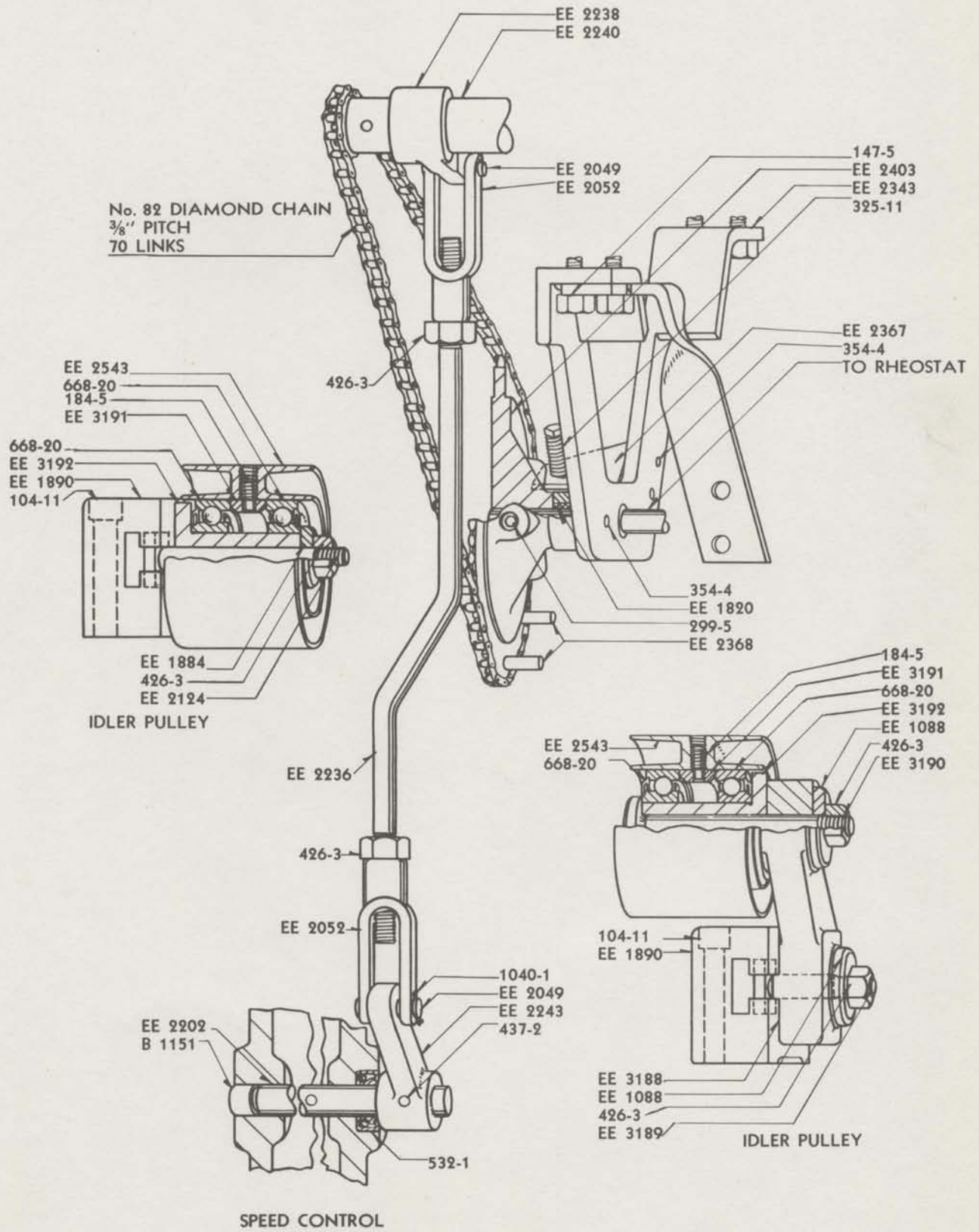
SPEC.	SOURCE	LUBRICANT
MO-11	Socony-Mobil Oil Co. Shell Oil Co. Sun Oil Co.	Vactra Light Hydraulic Oil 27 Solnus 150
MO-12	Socony-Mobil Oil Co. Shell Oil Co. Sun Oil Co.	Vactra Heavy-Medium Hydraulic Oil 33 Solnus 300
MO-14	Mobil Corp.	Vactra #2

Reference Number	Part	Capacity	Lubricant	Schedule
5	Gearbox - Oil Level Gauge			Check level each shift. See reference to point (7).
7	Gearbox - Reservoir Filling Point	1 Qt.	MO-12	Drain every 6 months at point (9), flush and refill with fresh oil.
10	Speed Reducing Unit - Reservoir Filling Point and Level Gauge	¼ Pt.	MO-12	Check oil level once weekly or every 50 hours of operation. Every 6 months drain at point (11), flush and refill with fresh oil.

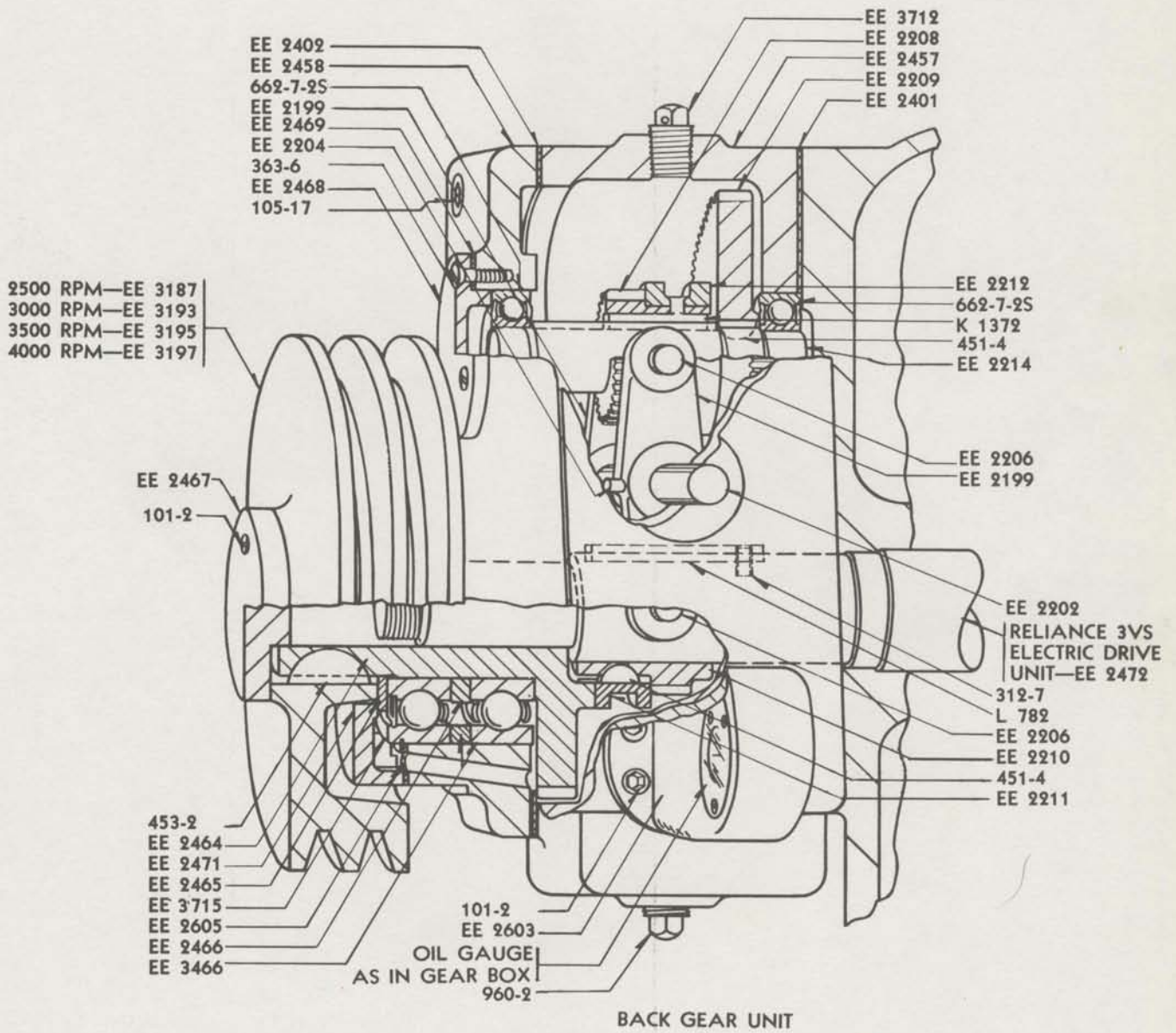
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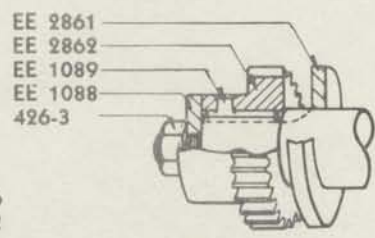
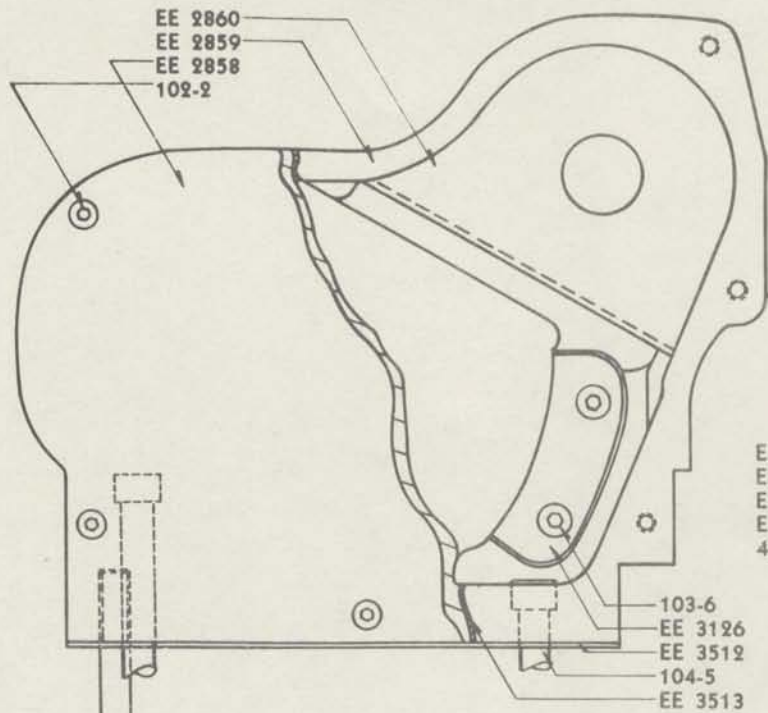
## Electrical and Electronic Service Suggestions

1. Amber 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. 2½ Ampere fuse open.
  - D. Tube Warm-Up Timer (1TR) defective.
2. Power Contactor (PC) will not close when the Control On button is depressed.
  - A. Tube Warm-Up timer (1TR) defective.
  - B. Spindle Control Lever not in the stop position.
  - C. Control On (PB1) push button defective.
  - D. Overload Relay (1OL) tripped open.
  - E. Power Contactor (PC) coil defective.
3. Power Contactor (PC) will close when Control On button is depressed but falls open when the Control On (PB1) button is released.
  - A. Control Off (PB2) 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.
  - F. Temperature Switch (THS) open due to overheating of electronic unit . . . caused by a defective blower motor or by dirt in the air filter. The air filter is accessible for replacement by removing the retaining bolt in the upper corner of the electronic panel, and tilting the unit forward.
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 (AP) relay contacts (7-17) not making contact.
  - C. Defective Drum Switch (DS) or Micro-switch on lathes with electrical leadscrew reverse.
  - D. Diodes in Rectifier No. 1 defective.
  - E. 25 ampere circuit breaker CB2 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. Dynamic Brake Contactor DB contacts (41-A1) not closing.
  - C. Contacts on Forward Contactor (2MF) contacts (36-38) or contacts (37-38) on the Reverse Contactor (2MR) not making contact.
6. Spindle stops when revolving near maximum speed.
  - A. Field Failure Relay (FL) spring tension too great.
  - B. Speed Control Potentiometer (P3A) defective.
7. Speed drops off under load.
  - A. Compensation Potentiometer (P1) set too low.
  - B. Field Acceleration relay (FA) contacts adjusted too 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 (2SOL) defective.
  - B. Anti-plugging relay (AP) contacts (13-18) not making contact.
9. Spindle speed increases with load, especially at low speeds.
  - A. Reduce compensation with compensation potentiometer (P1).
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.
  - D. Suppressor No. 1 defective.
11. Frequent replacement of diodes in Rectifier No. 2.
  - A. Suppressor No. 2 defective.
12. Frequent replacement of diodes in Rectifier No. 3.
  - A. 500 ohm resistor (R13) open.
  - B. Suppressor No. 3 defective.

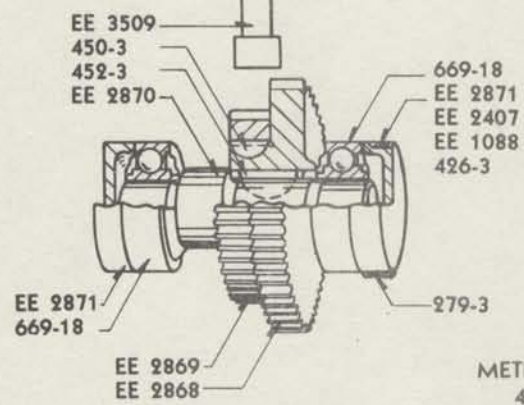


ELECTRICAL DRIVE  
 UNIT EE 3  
 SHEET 100

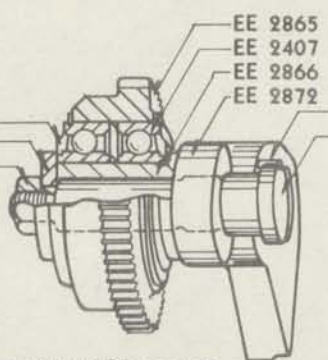




REVERSE SHAFT MOUNTED IN HEADSTOCK

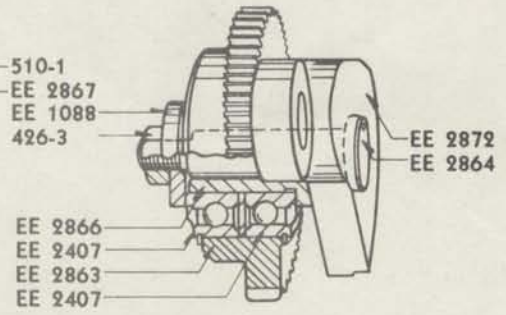


INTERMEDIATE SHAFT

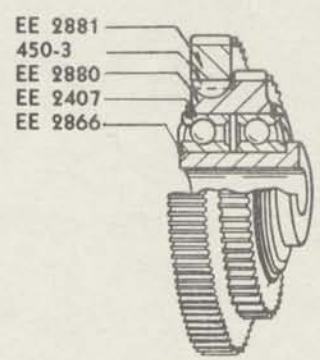


METRIC CHANGE GEARS

- 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



QUADRANT



METRIC TRANSPOSING GEARS

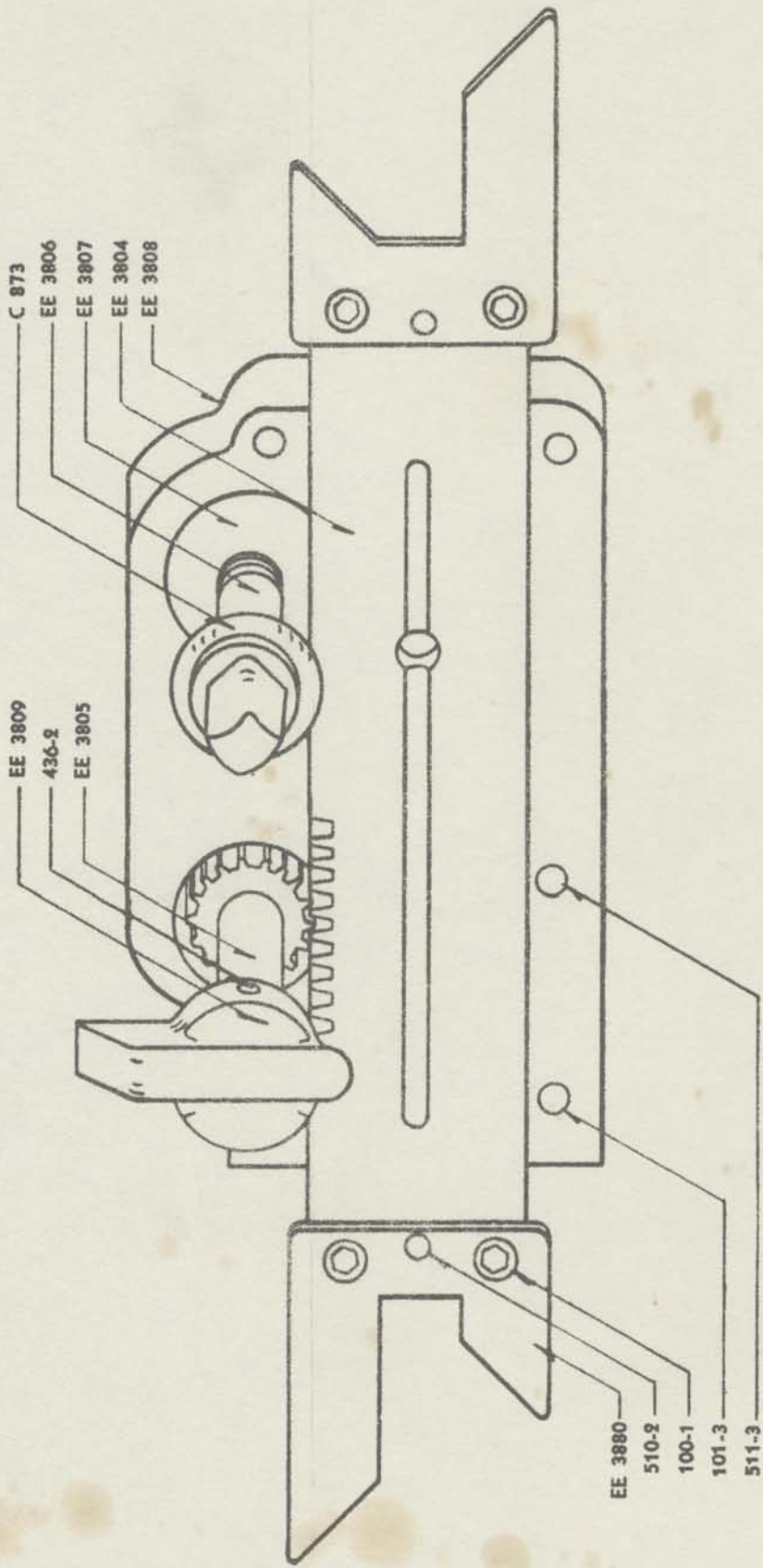


KEYED INTO HEADSTOCK REVERSE SHAFT

PITCH IN MILLIMETERS		STUD GEARS							
SET BOX FOR THD.	COMP	45	50	55	60	65	70	75	80
80	127 60	225	25	275	30	325	35	375	40
40		45	50	55	60	65	70	75	80
20		90	100	110	120	130	140	150	160
16		1125	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

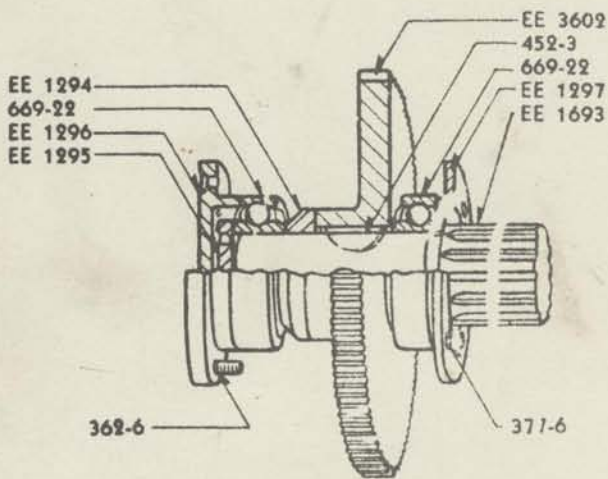




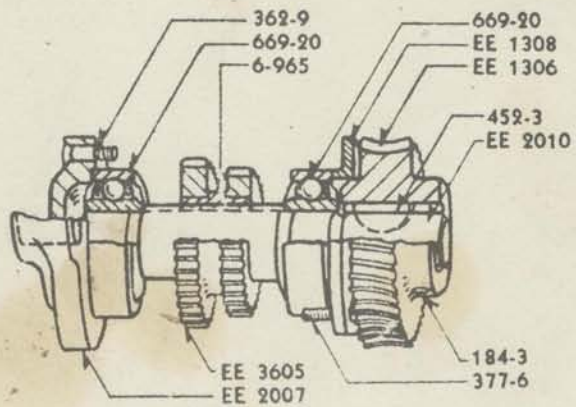
**FEED ROD AND  
 ELECTRICAL LEADSCREW  
 SHEET 177**

(E9)

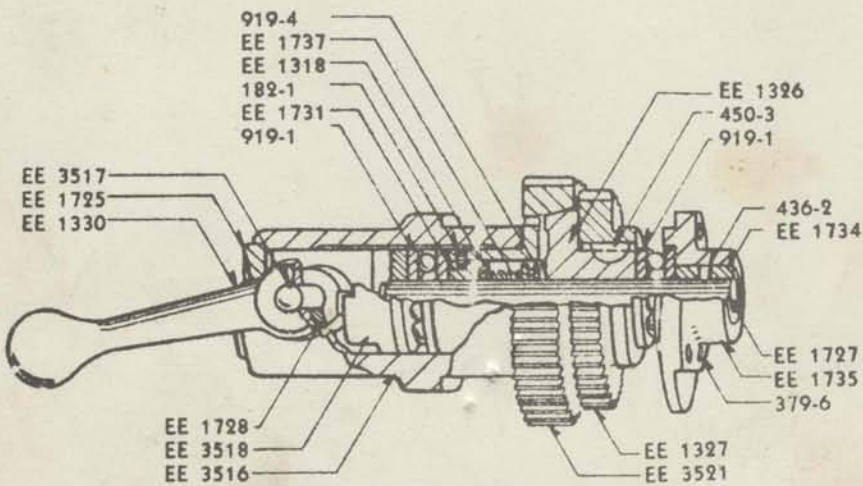




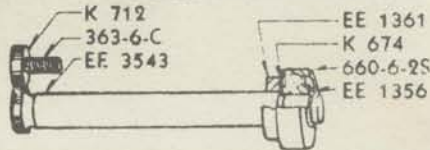
RACK PINION



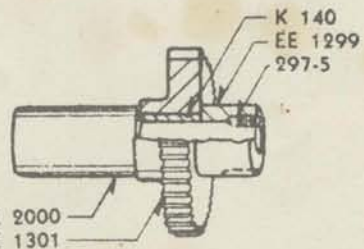
WORM WHEEL SHAFT



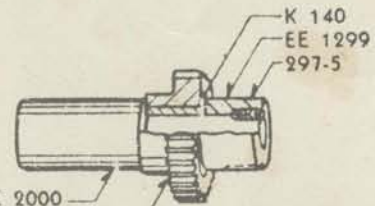
CROSS FEED FRICTION STEM



CROSS FEED INTERMEDIATE GEAR STEM

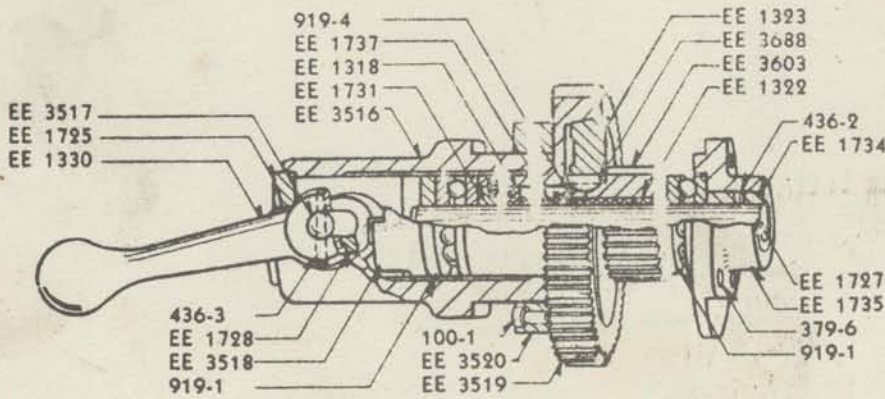


EE 2000  
EE 1301

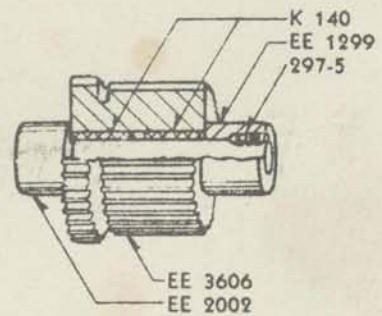


EE 2000  
EE 3604

IDLER GEAR

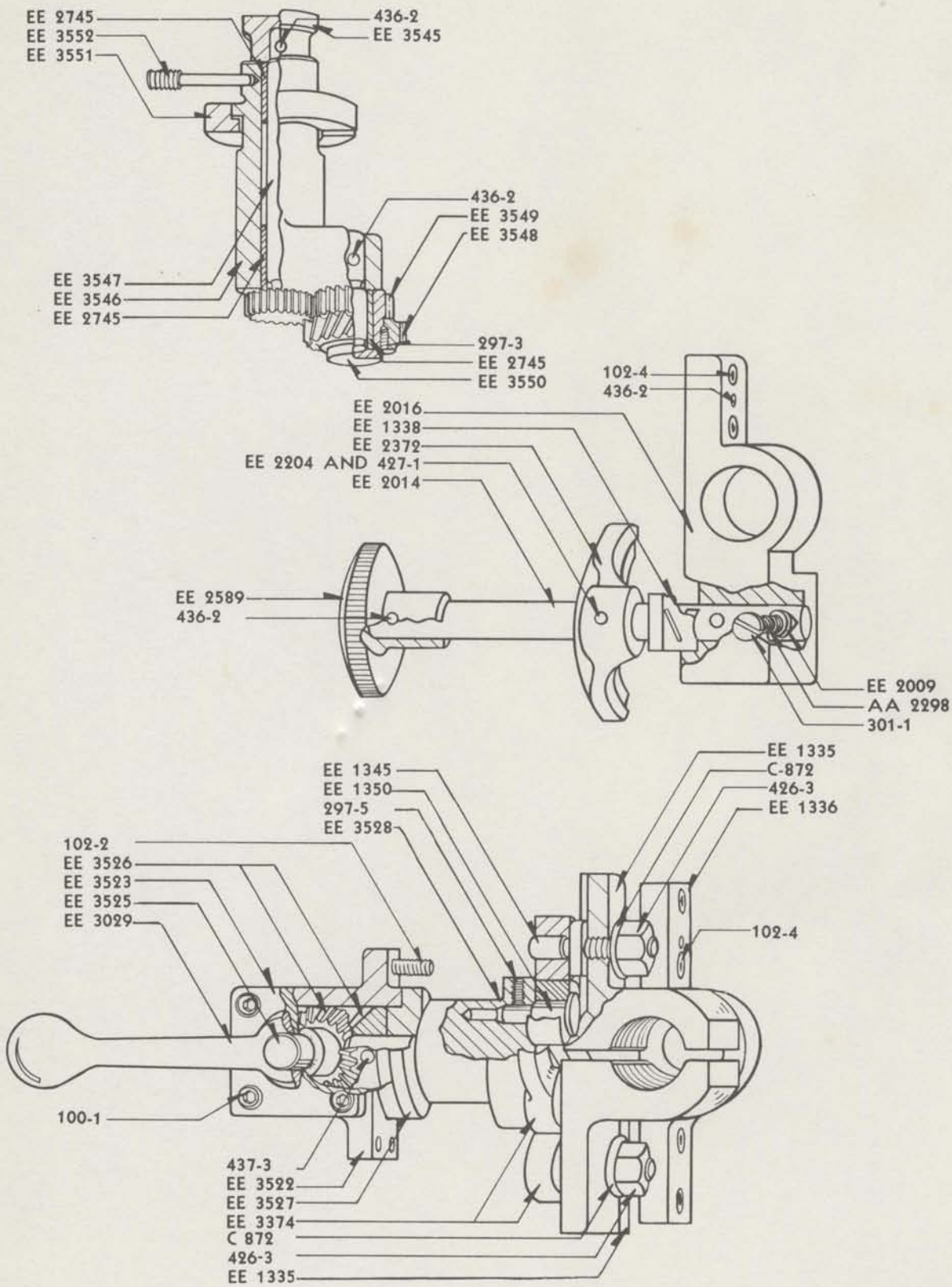


LONGITUDINAL FRICTION STEM

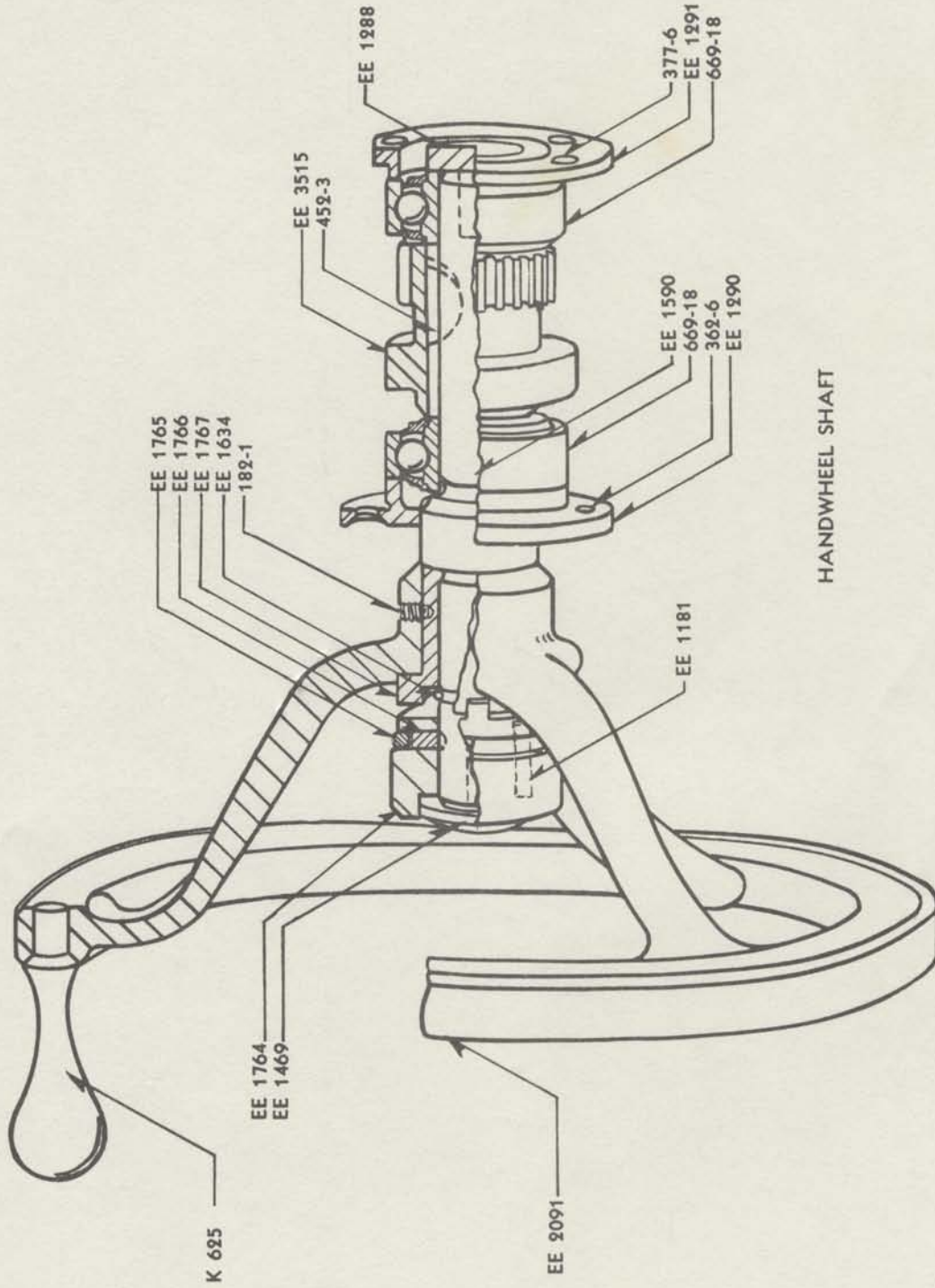


COMPOUND GEAR

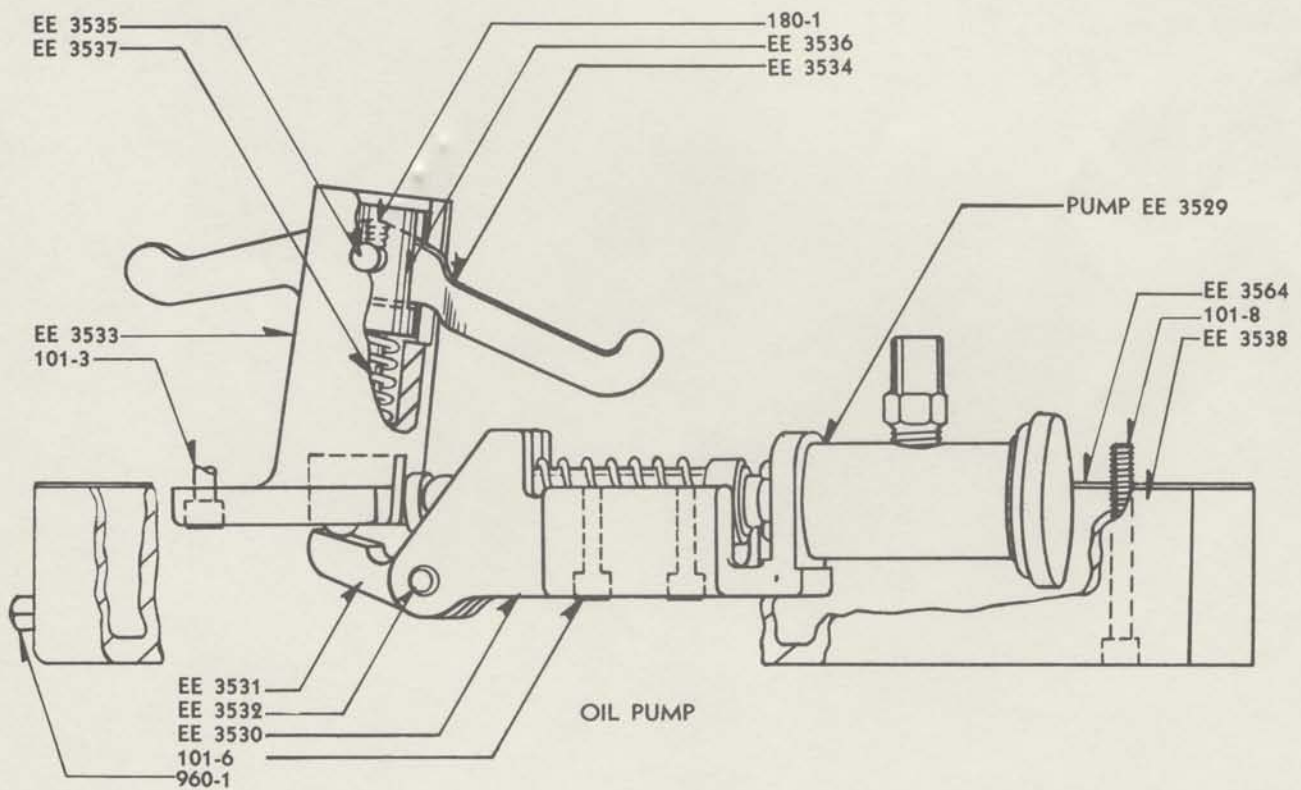
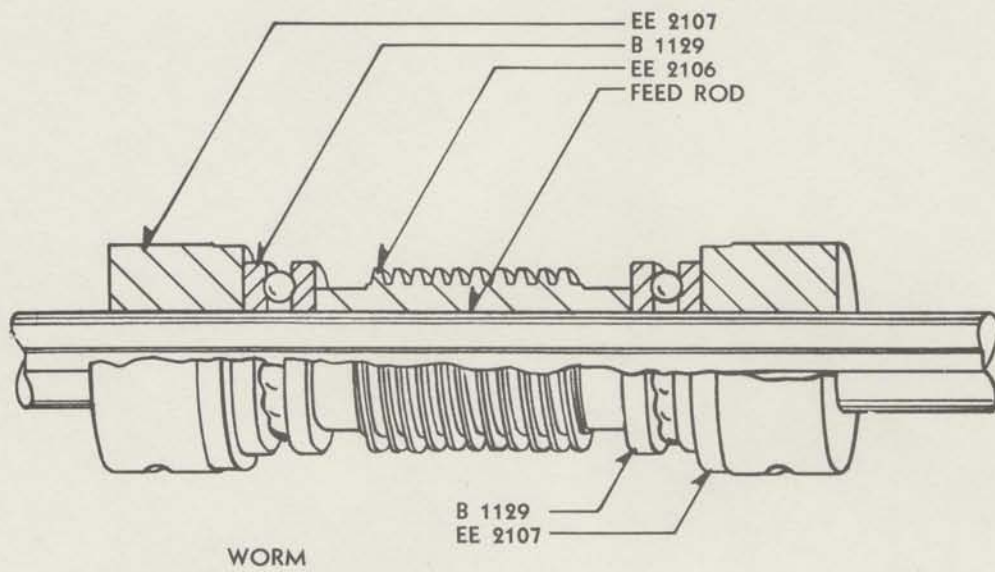
APRON  
UNIT EE 7  
SHEET 143



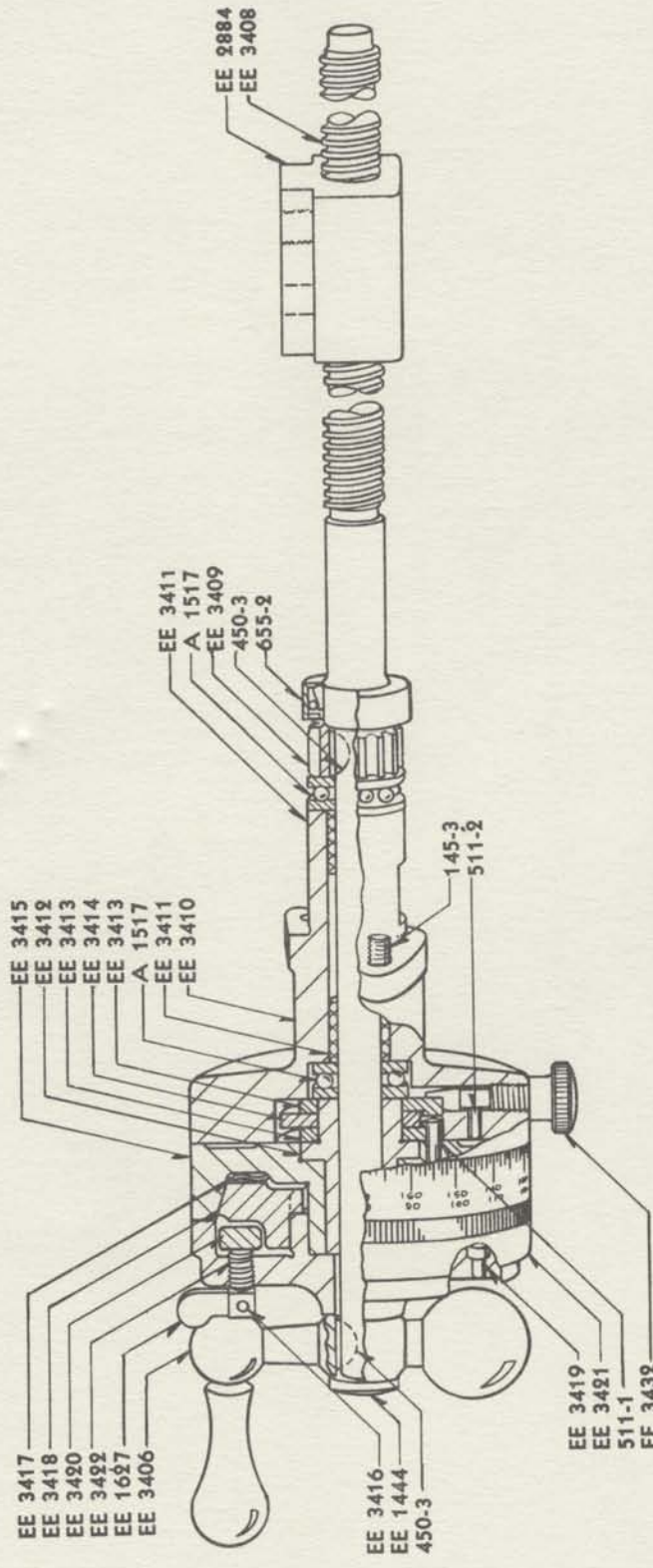
APRON  
 UNIT EE 7  
 SHEET 145



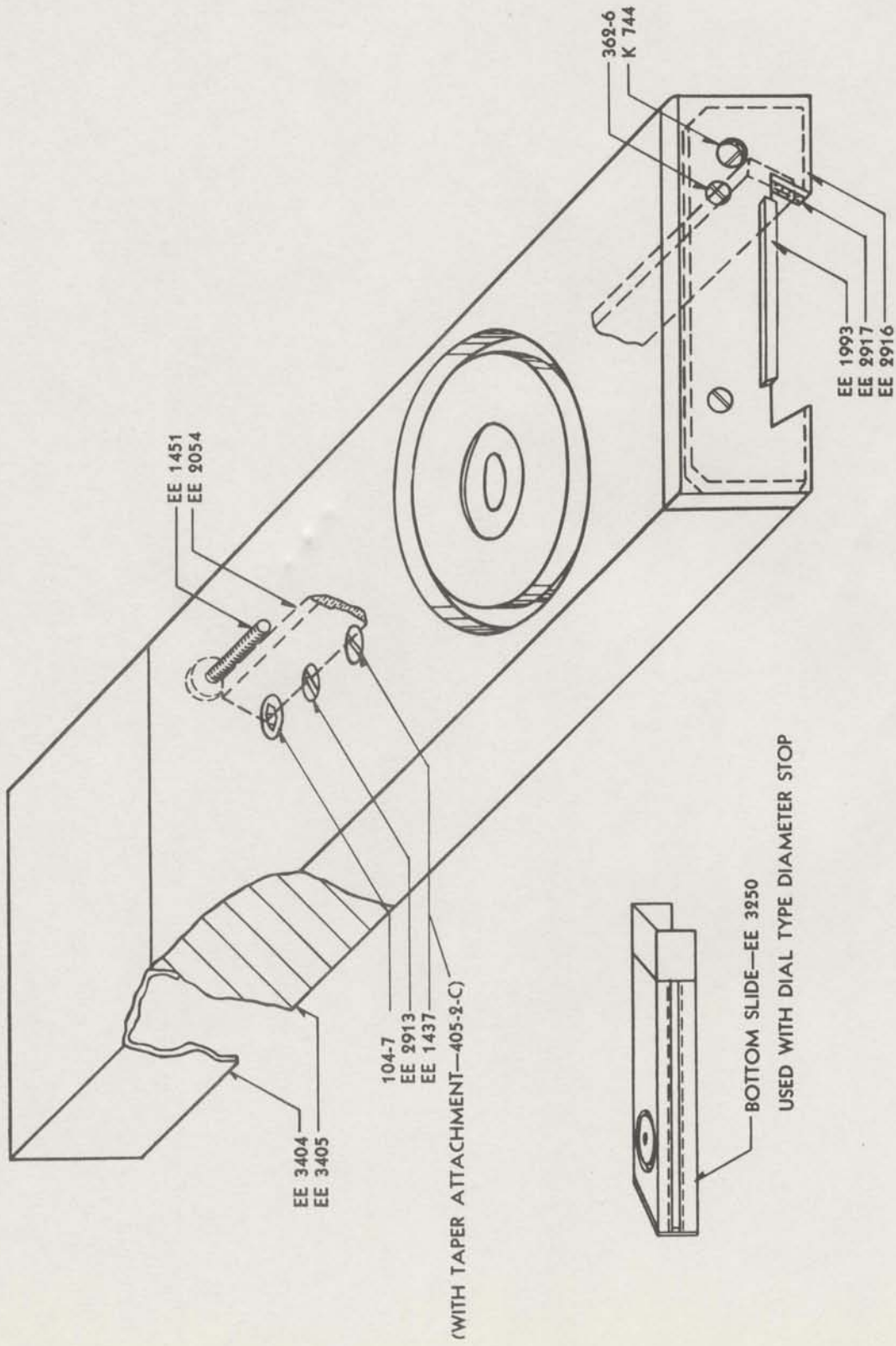
(E9)



APRON  
 UNIT EE 7  
 SHEET 147



SCREW WITH ADJUSTABLE CHASING STOP

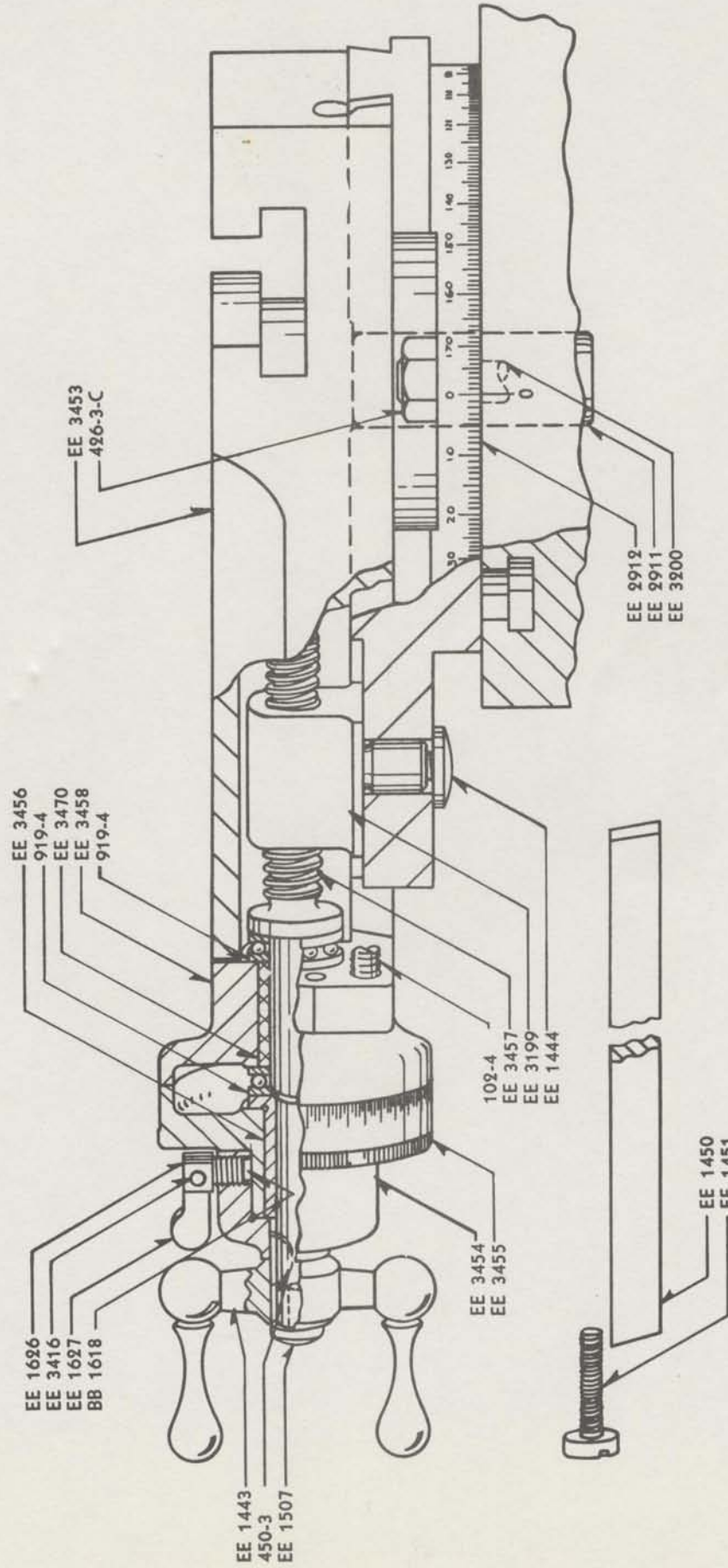


CARRIAGE & COMPOUND  
 UNIT EE 8  
 SHEET 148

BOTTOM SLIDE

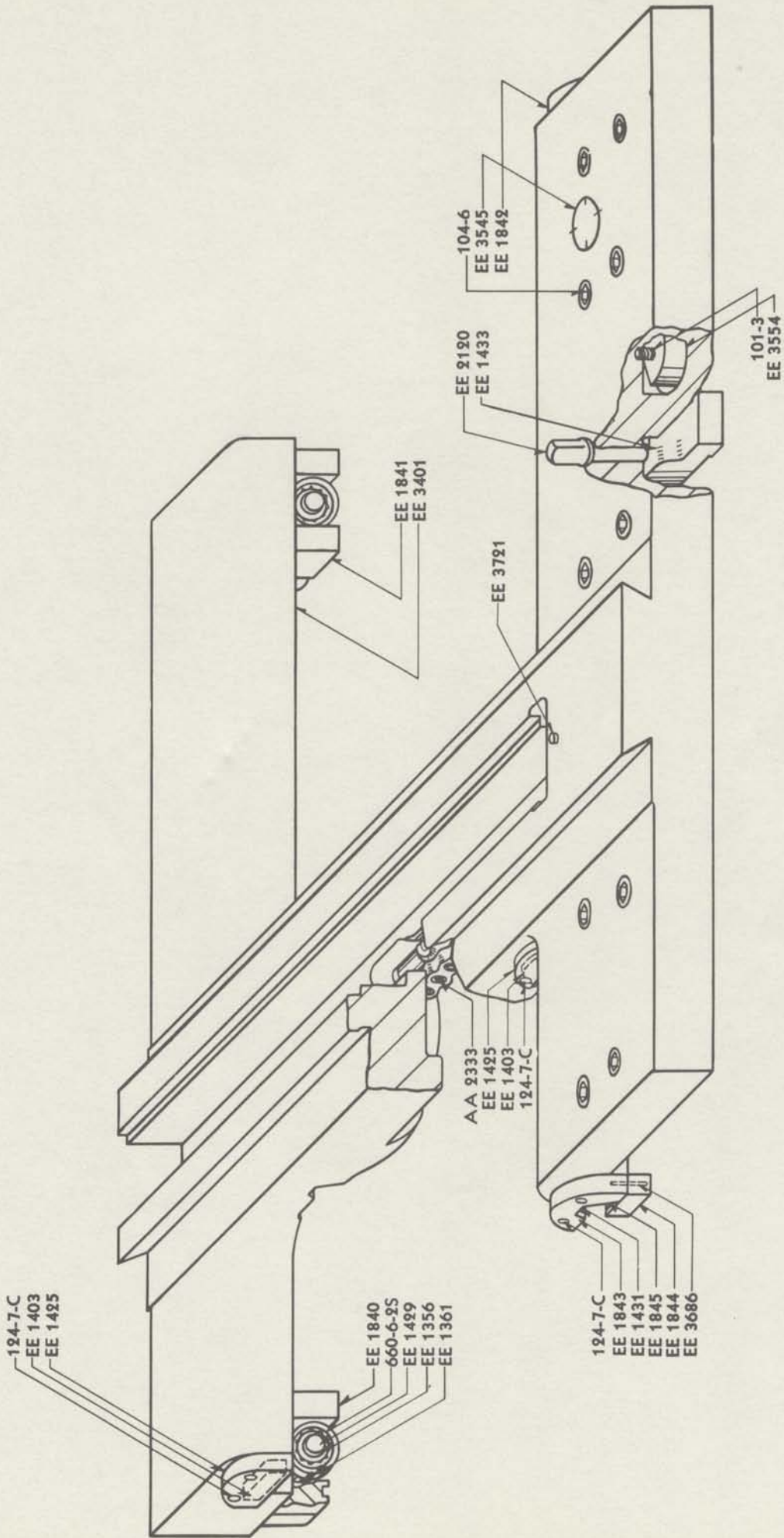
# MONARCH MACHINE TOOL COMPANY

Sidney, Ohio • Area Code 513, 492-4111



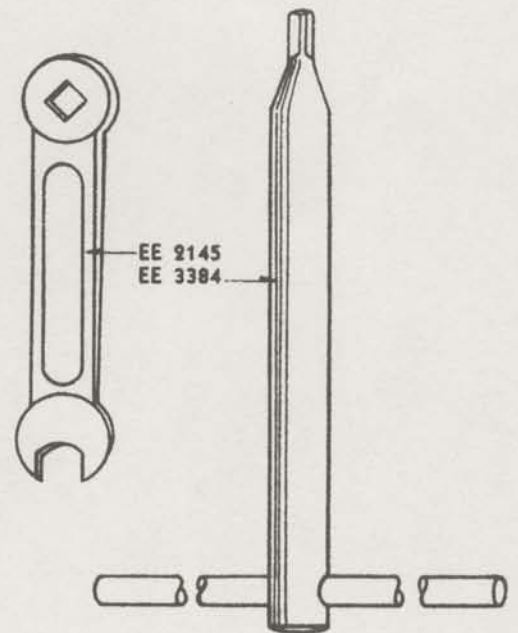
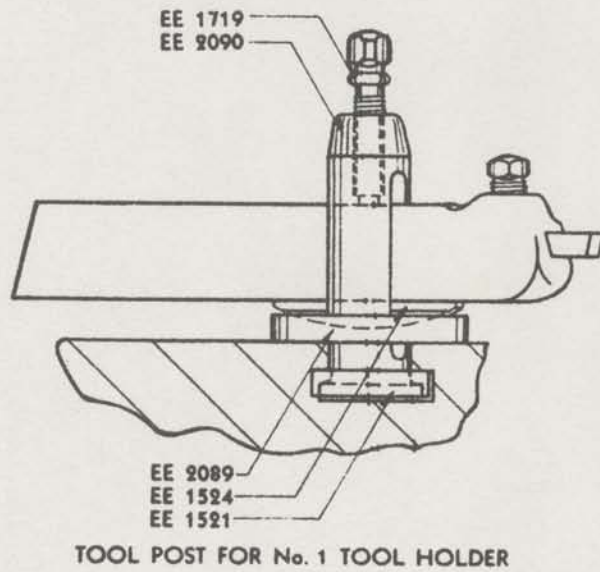
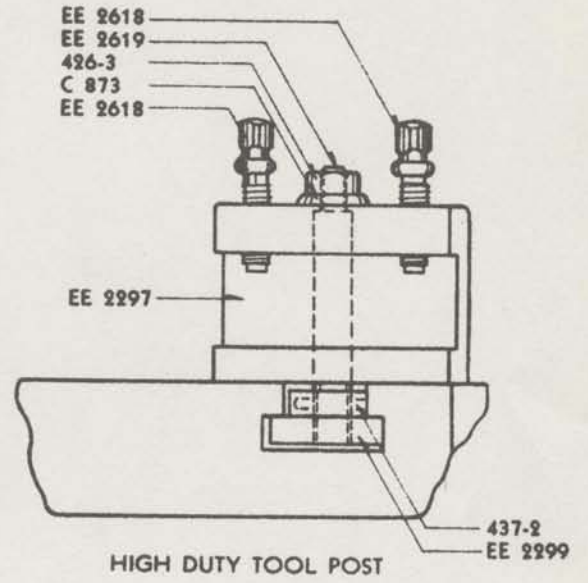
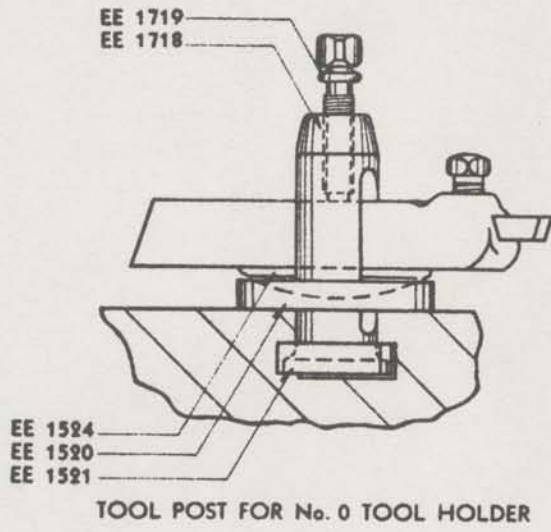
COMPOUND SCREW AND TOP SLIDE

COMPOUND  
UNIT EE 8  
SHEET 150

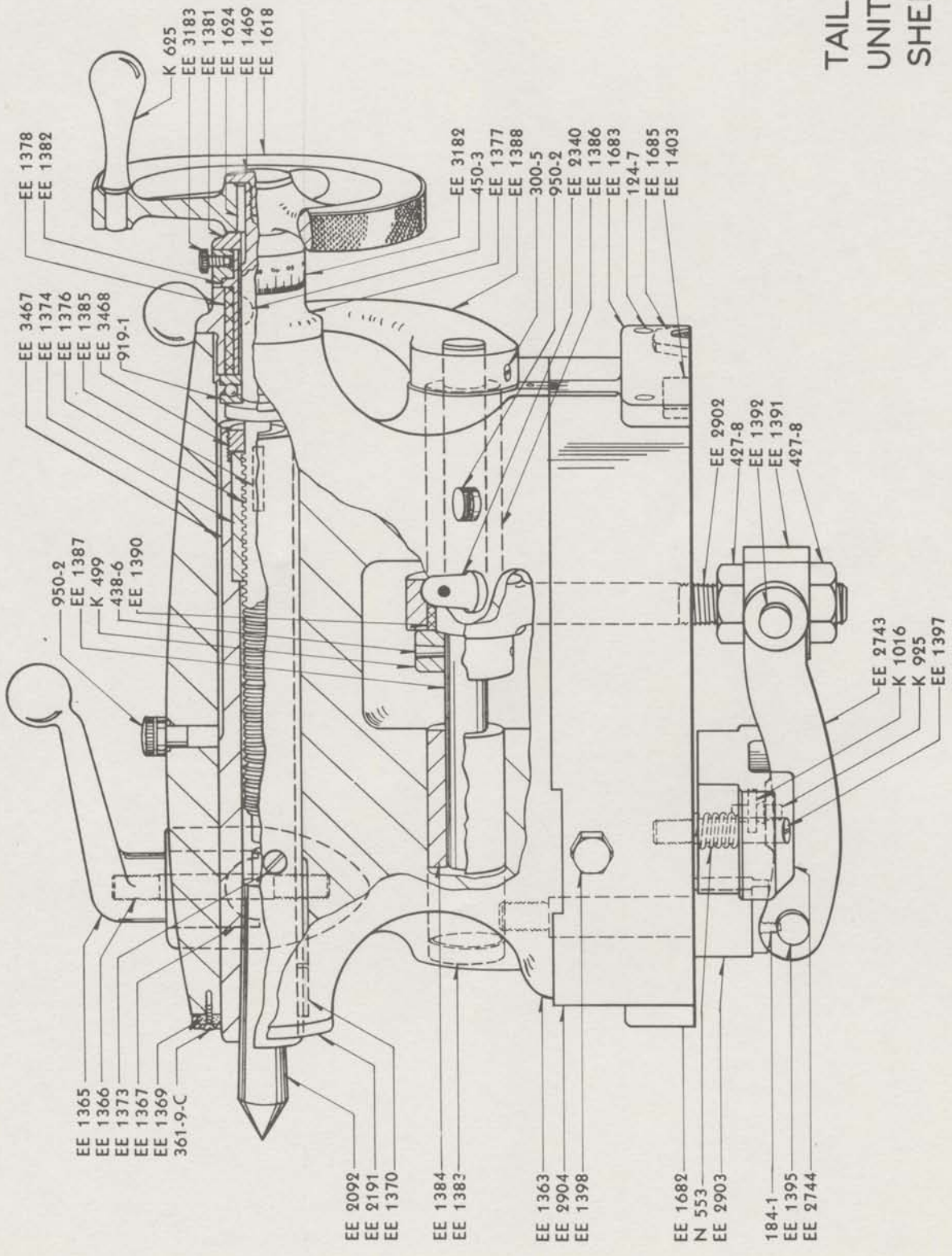


CARRIAGE  
 UNIT EE 8  
 SHEET 151

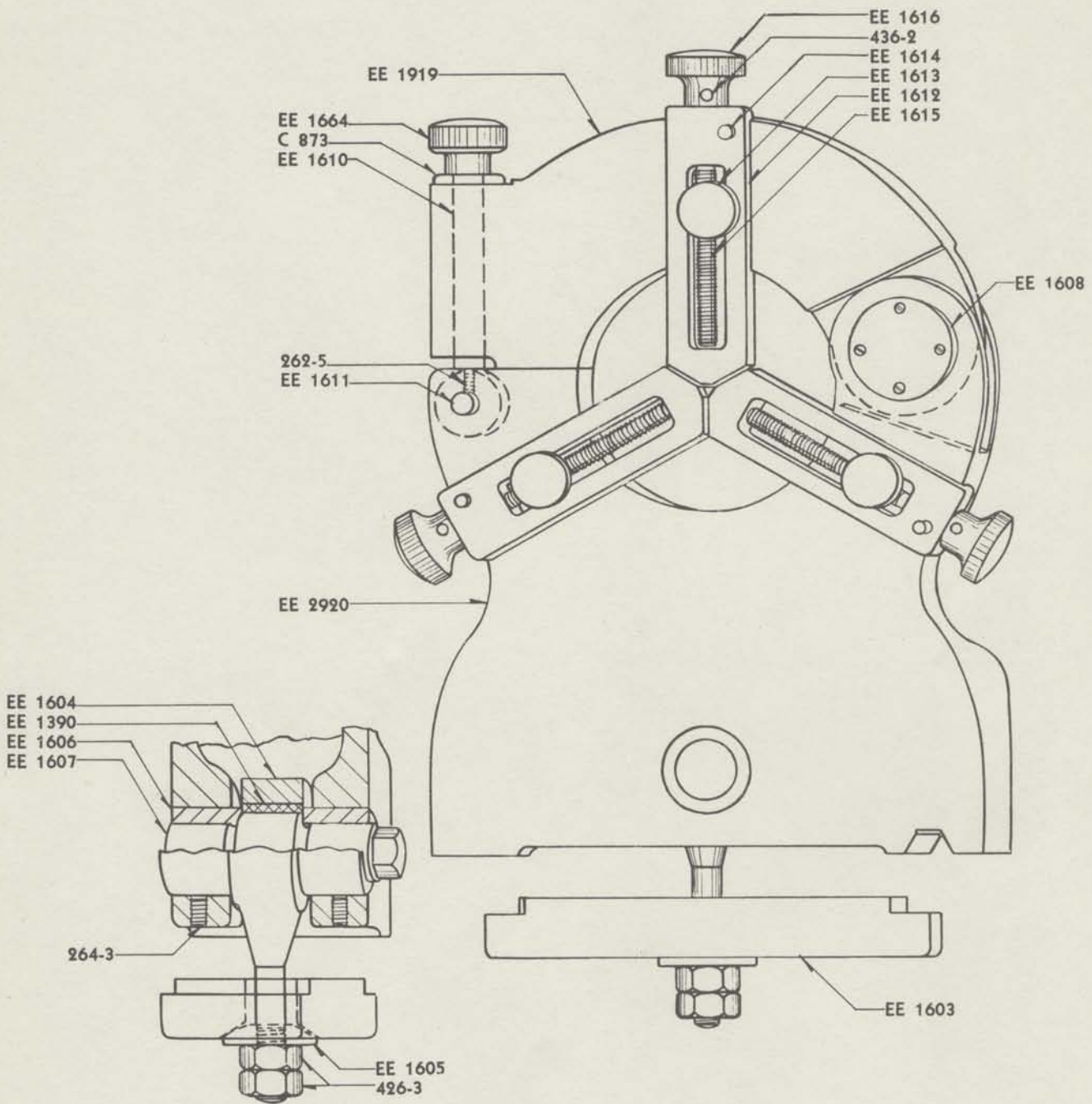




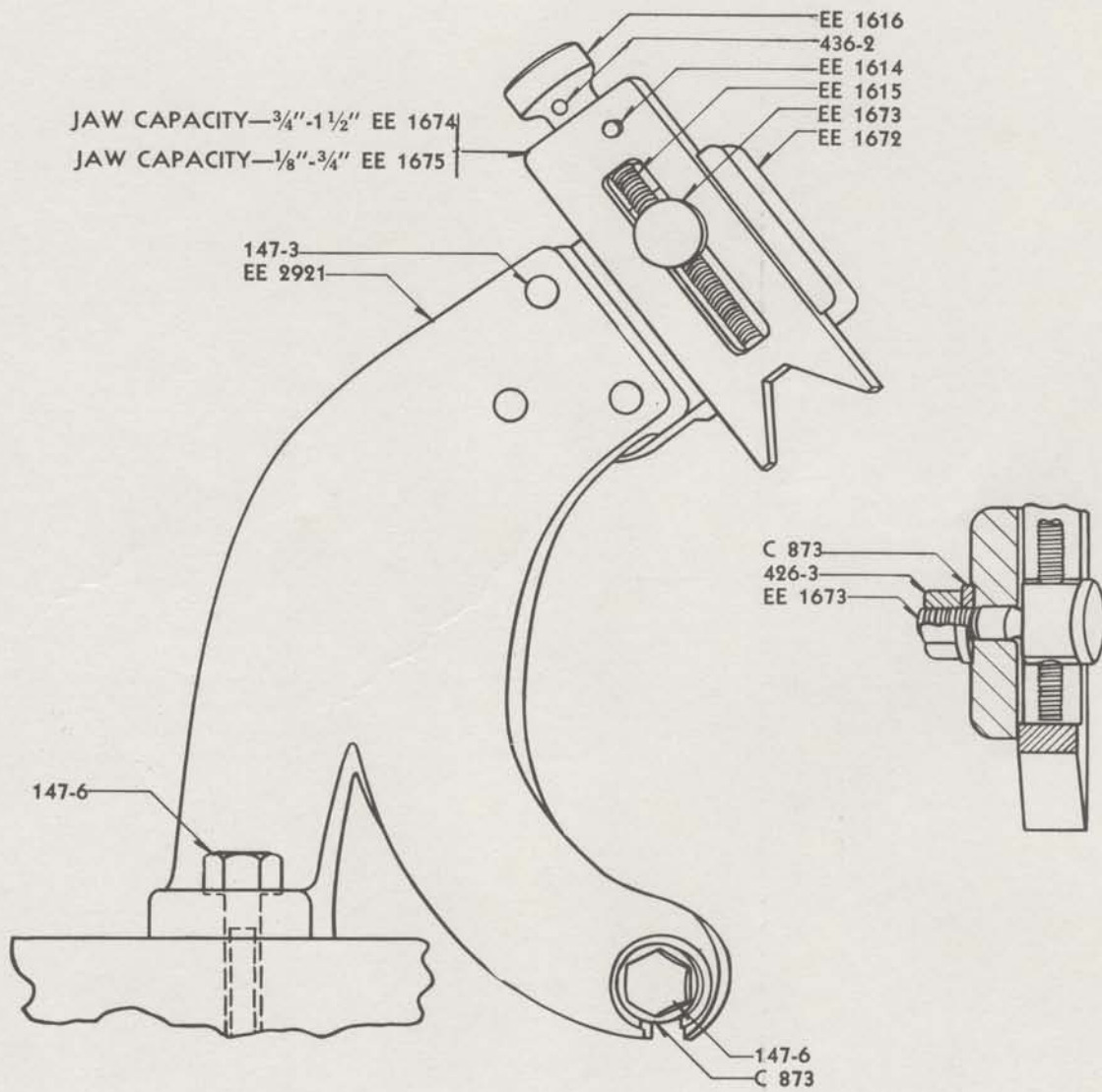
TOOL POSTS  
UNIT EE 11  
SHEET 110



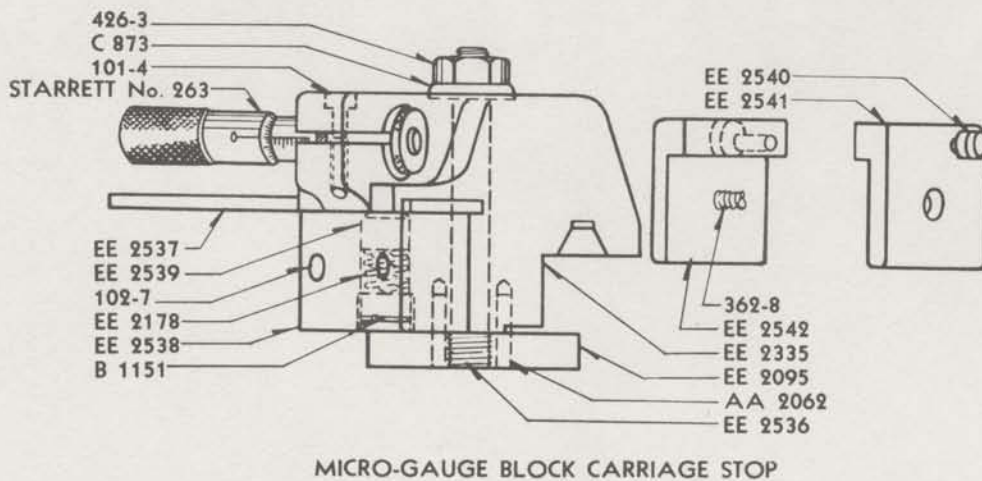
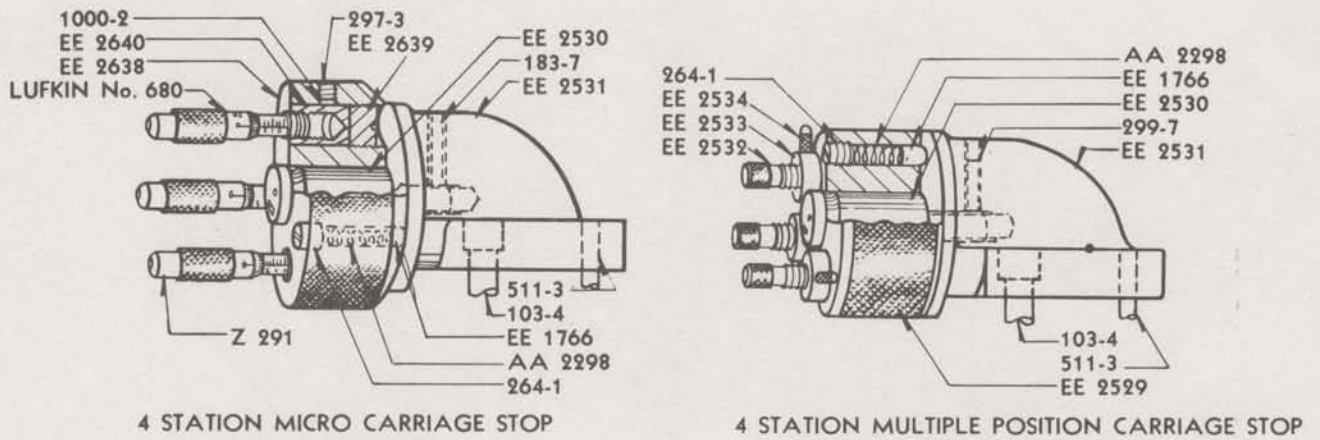
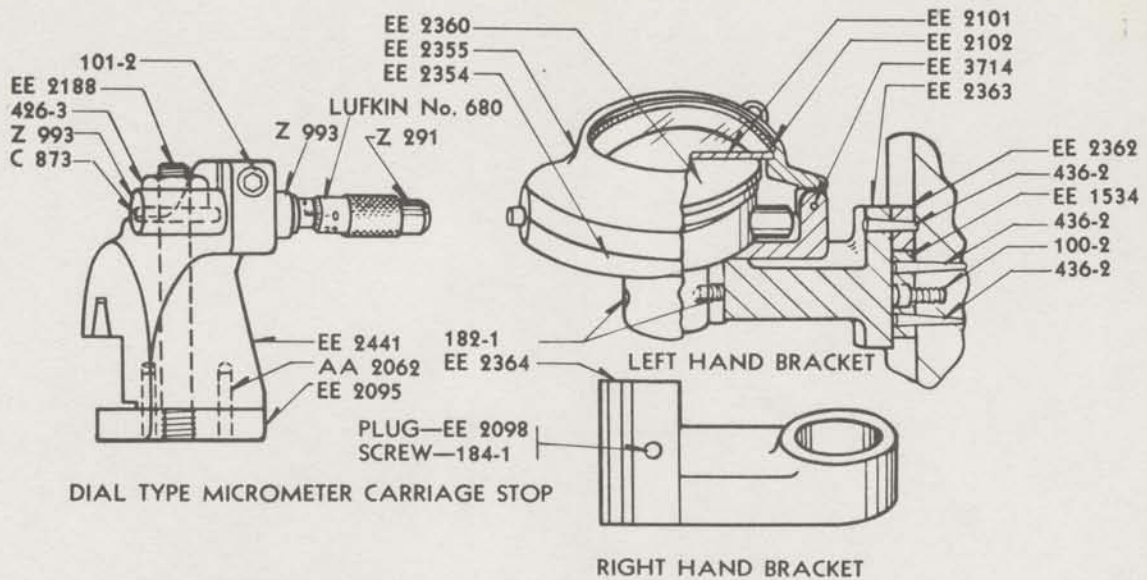
TAILSTOCK  
 UNIT EE12  
 SHEET 115



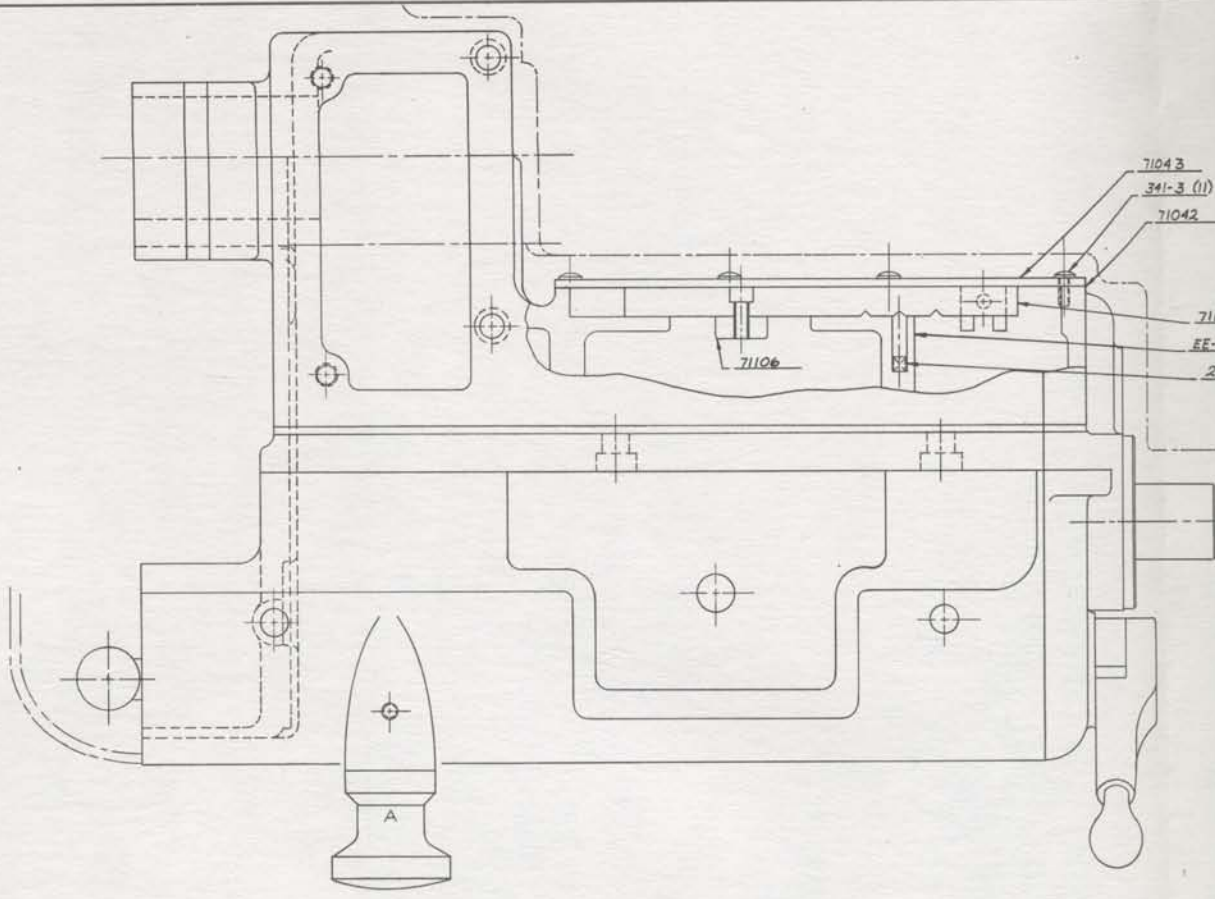
STEADY REST  
 UNIT EE 13  
 SHEET III



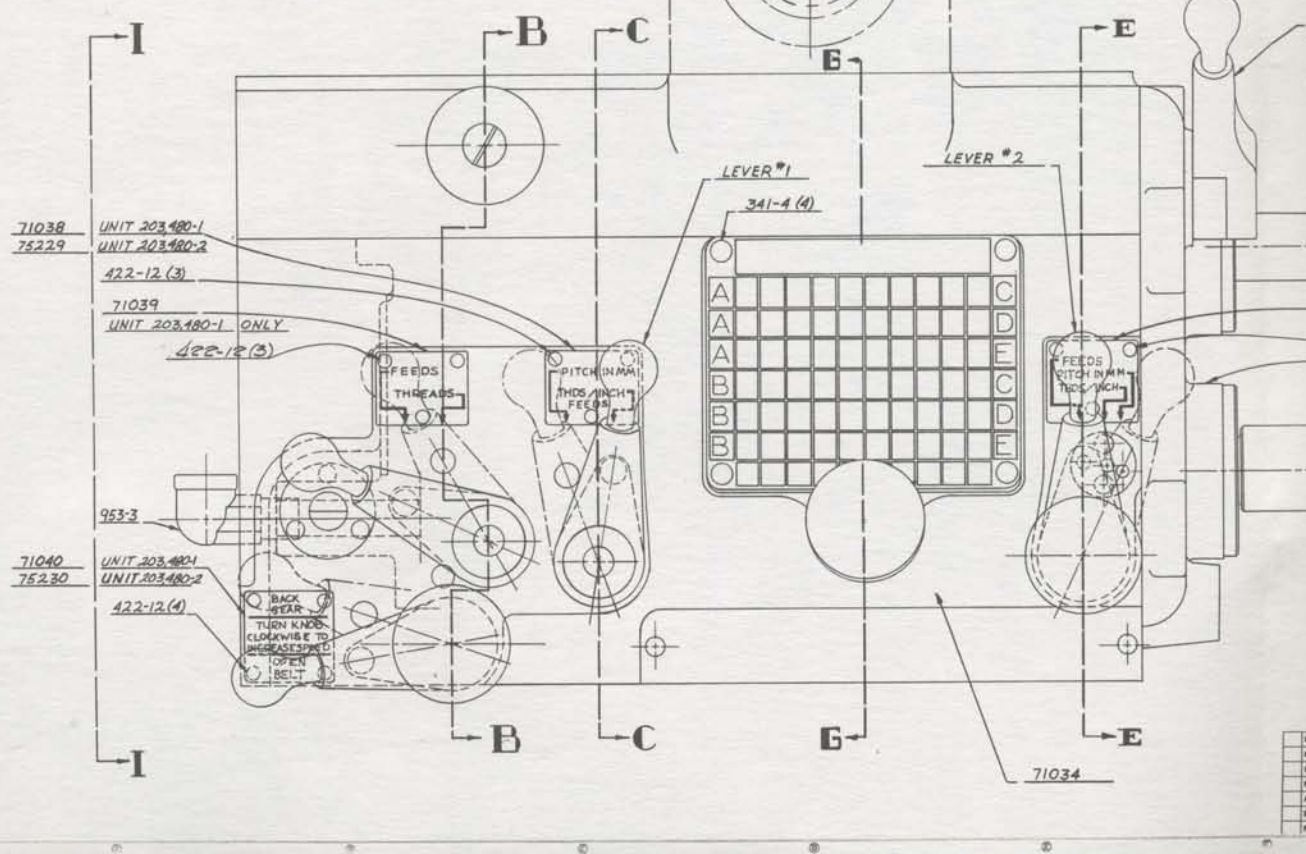
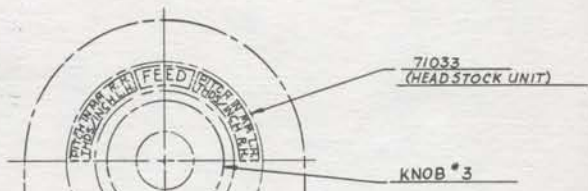
FOLLOW REST  
 UNIT EE 14  
 SHEET 112



CARRIAGE STOPS  
UNIT EE 20  
SHEET 117



NOTE:  
SHIFT LEVER #1 BEFORE SHIFTING LEVER #2.  
SHIFT LEVER #2 TO 'PITCH IN MM', OR  
'THD'S./INCH' BEFORE SHIFTING KNOB #3  
TO 'PITCH IN MM', OR 'THD'S./INCH.'  
SHIFT KNOB #3 TO 'FEED' BEFORE SHIFTING  
LEVER #2 TO 'FEEDS'!

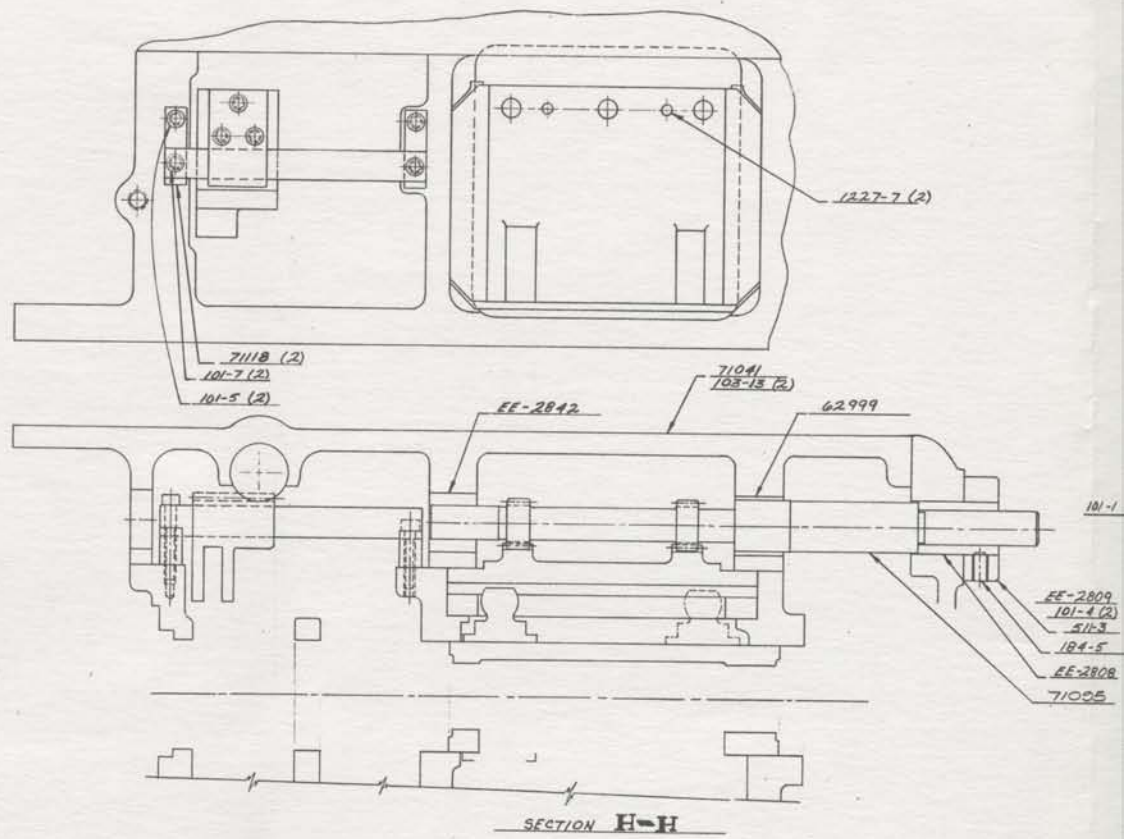
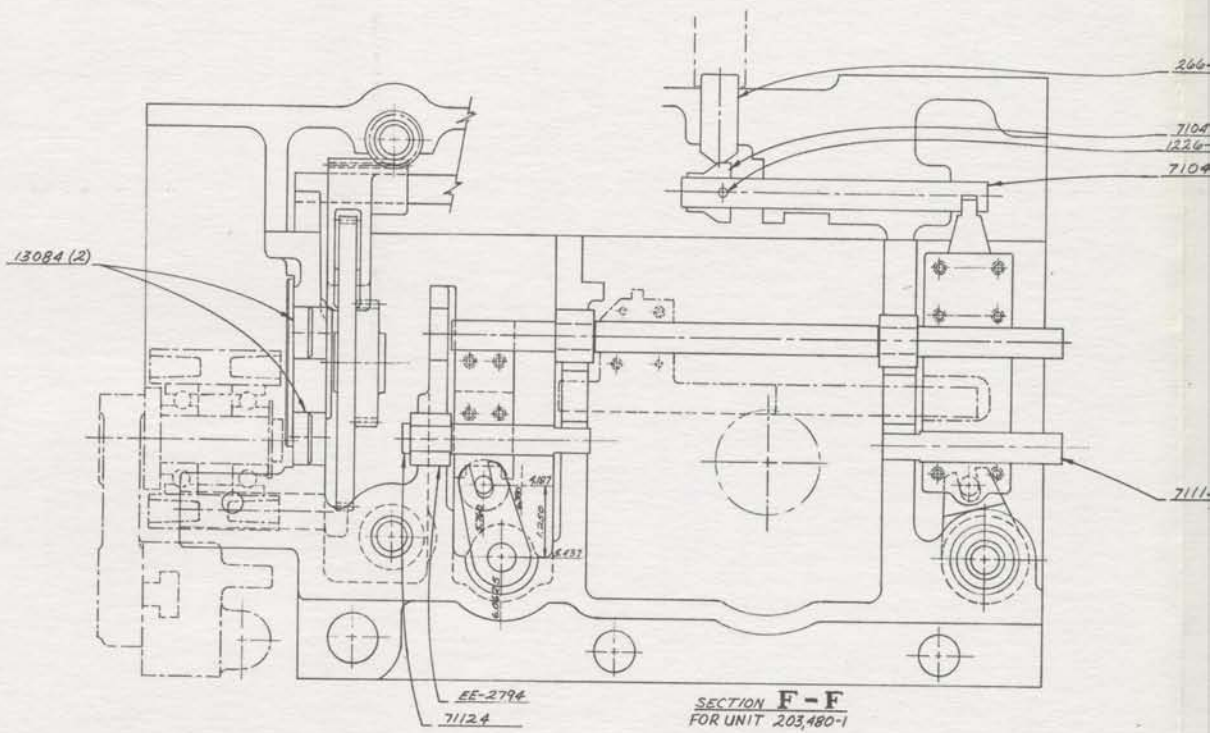












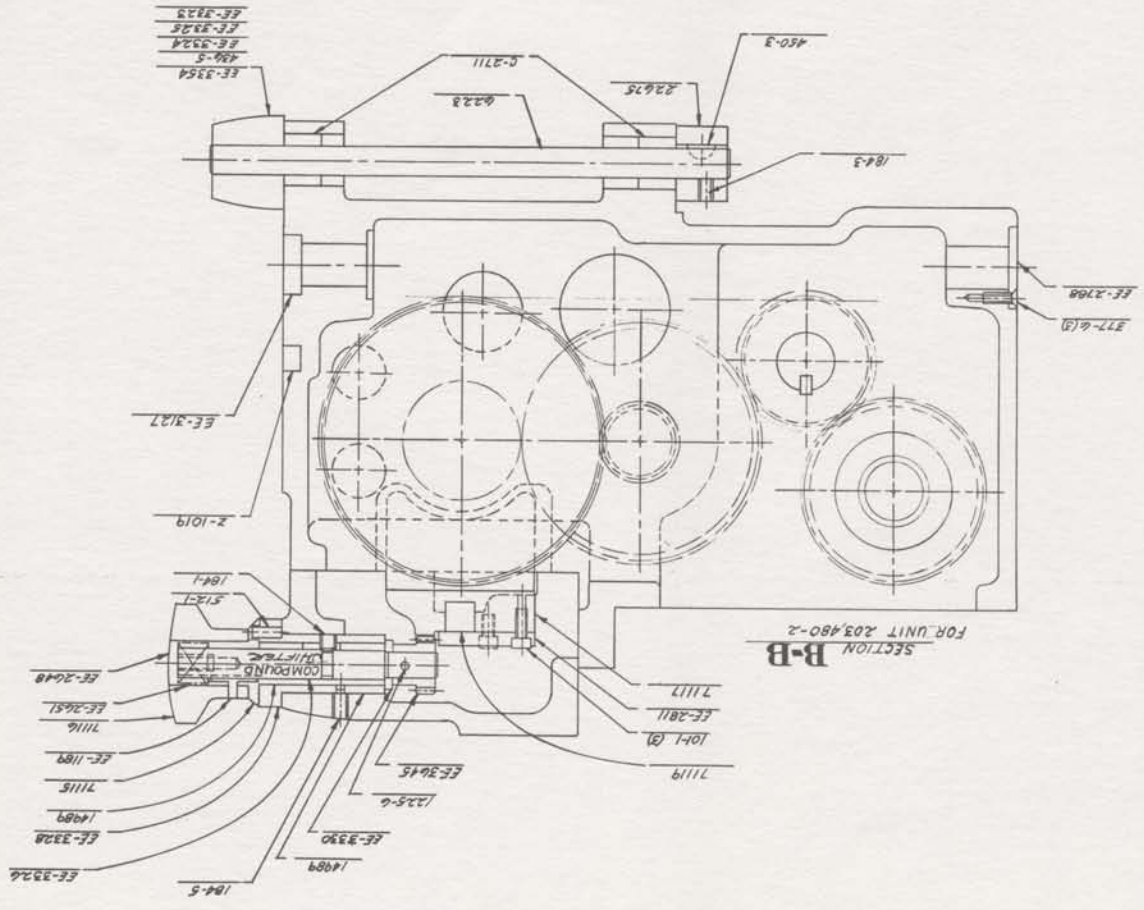
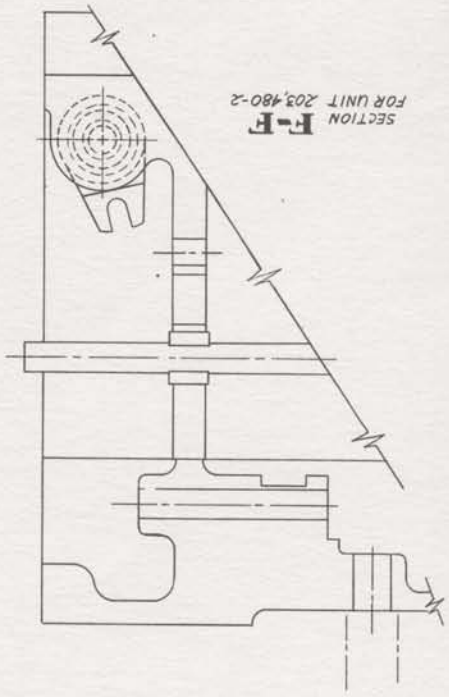




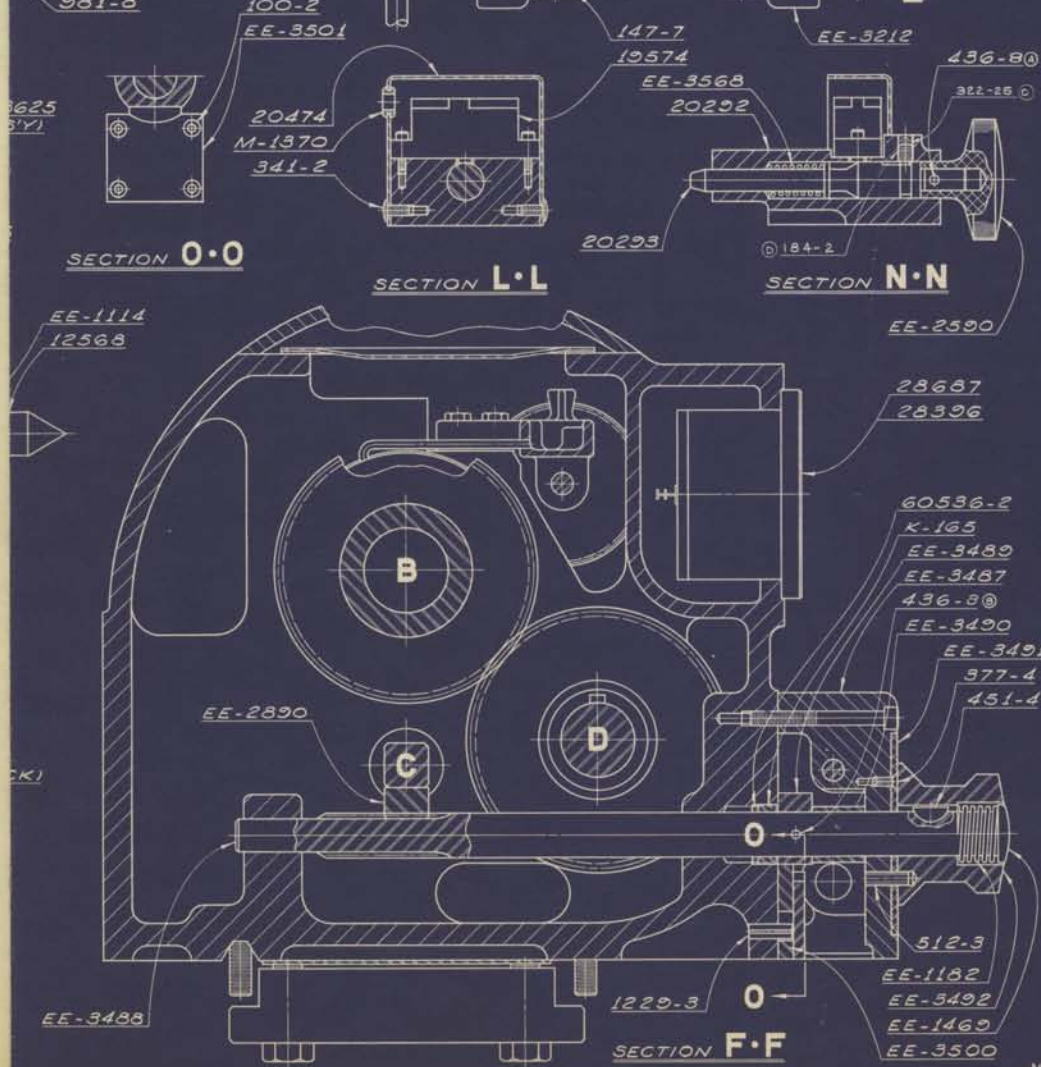
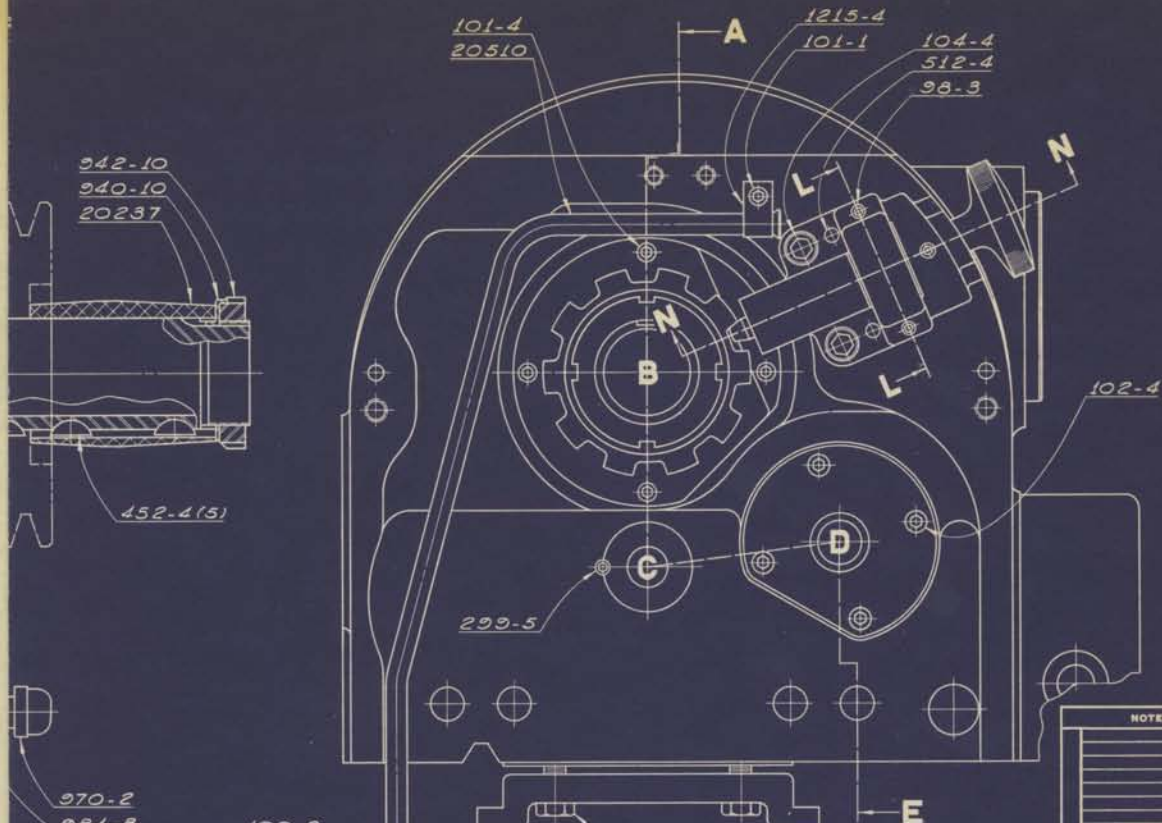


0.0000 DIMENSIONS  
 DIMENSIONS SHOWN UNLESS  
 OTHERWISE SPECIFIED  
 UNLESS ALL DIMENSIONS  
 ARE TO THE 100.000  
 UNLESS OTHERWISE  
 SPECIFIED

3K-1703  
 476-8  
 FE-2823  
 495-4  
 FE-3324  
 FE-3321  
 FE-3323  
 76048  
 FE-3325  
 339-1(2)







NOTES

PAINT SPEC. NO.

FINISH ALL OVER

MACHINED SURFACES NO. FINISH

GROUND SURFACES NO. FINISH

UNLESS OTHERWISE SPECIFIED

PART NO. **202,268**

GEAR DATA

TEETH

DIAMETRAL FITCH

PROBING ANGLE

MOLD ANGLE

PITCH DIAMETER

BASE CIRCLE DIAMETER

NORMAL DIAMETRAL FITCH

NORMAL PRESSURE ANGLE

TOOTH THROATNESS

PIN DIAMETER

MEASUREMENT OVER PINS

MATCH WITH

OR

CENTERS

BACSLASH ALLOWED

SHAPE TEETH

DRIVEN

CROWN SHAPE

DRIVEN

GRIND TEETH

HEAT TREATMENT

LINK CTRL. OR FORM.

SIMILAR TO

ALTER PATTERN

REWORK PBL. FC.

OUTSIDE

MATERIAL

INSIDE

REPLACES

REPLACED BY

PART NO. SHZ #1 OF 2 SHZ

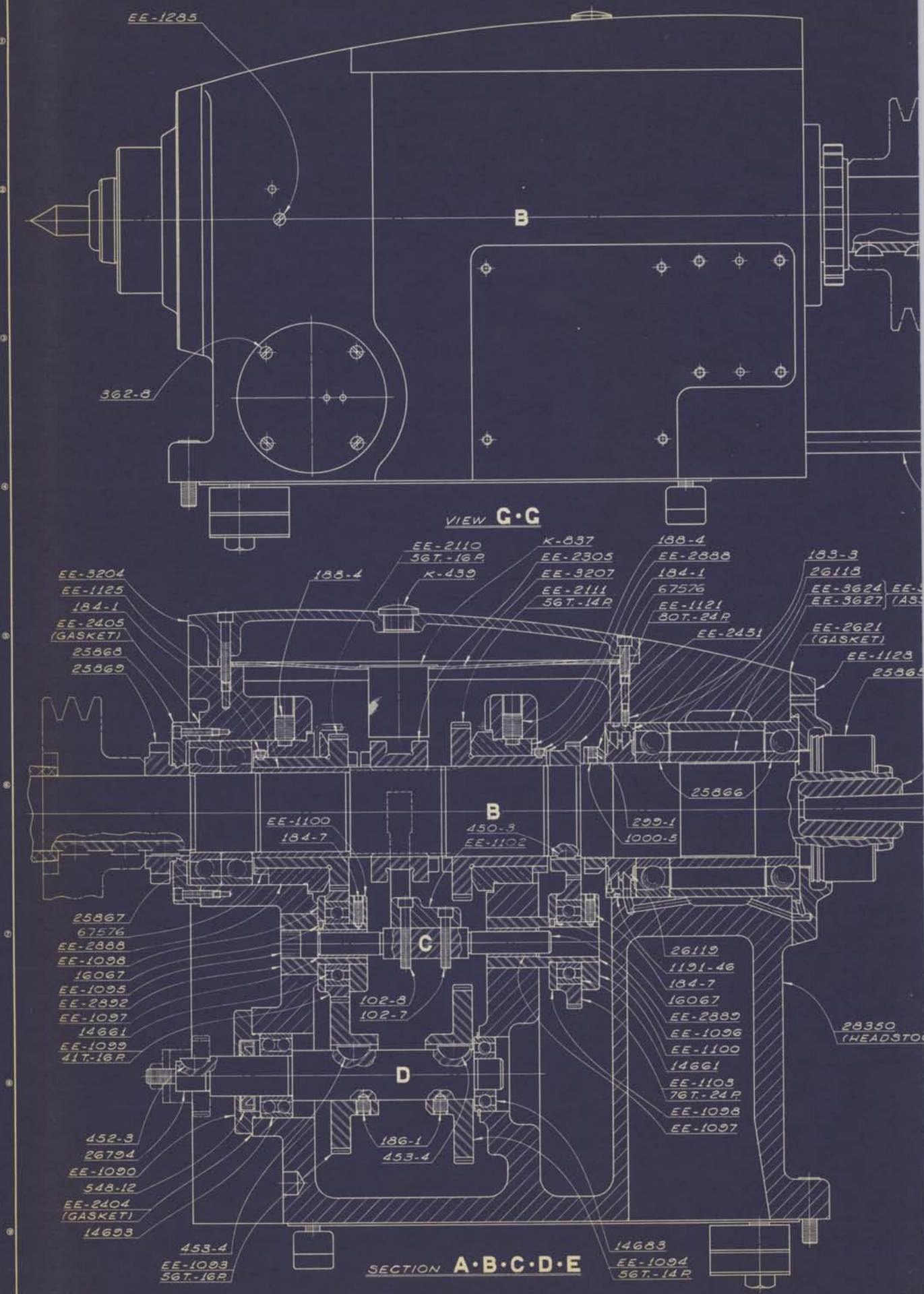
**202,268**

ALTERNATION	BY	DATE	APPROVED	DATE	REVISION	DESCRIPTION
A	WAS	432-2	6.0	9-15-48	F	
B	WAS	432-5	6.0	9-15-48	B	
E	WAS	427-2	6.0	8-24-48	H	
D	WAS	184-7	6.0	8-26-48	I	
E					J	

UNIT	PART NAME	UNIT	DESCRIPTION
ASSEMBLY	HEADSTOCK ASSY		
	TO MODEL 'EE'		
	THE HOWARTH MACHINE TOOL CO.		
	SIENY, OHIO, U. S. A.		



FRACTIONAL DIMENSIONS & DECIMAL DIMENSIONS & ANGULAR TOLERANCES & PITCH DIMENSIONS SHOWN UNLESS SPECIALLY NOTED



FRACTIONAL DIMENSIONS IN  
DECIMAL EQUIVALENTS AND  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE TO BE HOLE  
DRILLING CODES, NOTE 11

