



**Lodge & Shipley Lathes  
Olofsson Lathes**

**OPERATORS MANUAL  
Model 50  
Lathe No. 49916**

***MONARCH Lathes, L.P.***

615 North Oak Avenue • P.O. Box 4609 • Sidney, Ohio 45365-4609 • USA

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# MONARCH MACHINE TOOL COMPANY

Sidney, Ohio - Area Code 514, 492-4111

Sold To: N. A. Woodworth Company  
1300 East Nine Mile Road  
Detroit, Michigan 48220

Serial No. 49916

Invoice No.

Order No. S 41771 Customer Data 3-14-69

Invoice Date

Ship To: N. A. Woodworth Company  
1300 East Nine Mile Road  
Detroit, Michigan

Entry Date 3-21-69

Order No. S 41771 Promised 3-28-69

Terms: Net 30 Days,  
FOR Sidney, Ohio  
Issue 2 Pages 1

Lathe Size 1610 x 54" Model "50" Swing 16" Speeds 30-1800 Q. No. Detroit

300.459-2	BED
300.612-4	PAN
300.611	CABINET
300.610-2	REAR OR END LEG
	CENTER LEG
300.616-2	HEADSTOCK
300.653	QUADRANT
300.620-1	GEAR BOX
300.602-0	APRON
300.603-1	CARRIAGE
300.715-1	BOTTOM SLIDE
201.753	SWIVEL AND TOPSLIDE WITH COMP. SCREW
	COMP. REST SCREW
201.763-1	CROSS FEED SCREW
201.754	TOOL POST
300.605-1	TAILSTOCK
	STEADY REST
	FOLLOW REST
	TAPER ATTACHMENT
300.454-1	CARRIAGE MICRO STOP
	PUMP AND PIPING
300.733-2	APRON CONTROL ROD
300.730-2	GUARDS
201.750-2	LEADSCREW
300.732-2	FEED ROD
300.619-2	MOTOR DRIVE
	SHEAVE
	BELTS
	FACE PLATE
201.759	DOG PLATE
	LEADSCREW REVERSE ROD
	LEADSCREW REVERSE
	HEADSTOCK LEADSCREW REVERSE
202.265-1	ELECTRICAL EQUIPMENT VOLTS-230 CYCLES-60-3Ph
300.623	PANEL CABINET
300.625-1	REAR LEADSCREW BOX
*200.459-2	IDENTIFICATION PLATE
300.617-1	PUSH BUTTON STATION
300.735-1	SPINDLE SPEED CONTROL
201.779	CARRIAGE STOP (MULTI-POS., 4-STA.)

\*Add Production Equipment Code #3416-23-22-01 to name plate

10-23-68 3-24-69

# SAFETY

There are many factors involved in the use of this lathe that could lead to or cause a personal injury accident. We at Monarch cannot anticipate and address all these factors, but we are providing some general safety considerations on this Safety sheet.

You must strive to eliminate factors that may contribute to an accident by strictly adhering to the following safety recommendations:

## CAUTION

Before operating this lathe, you must be familiar with the features, controls, and corresponding lathe movements that they produce. For more information, please consult the Programming and Operator's manuals.

## CAUTION

Always wear safety glasses and snug-fitting clothing when operating or standing near the lathe. Use extreme caution to keep hair, jewelry, and anything that may get caught, away from the spindle, workholding device, workpiece, or any other moving elements. Never operate this lathe if you are fatigued, ill, or under the influence of any medications or chemicals. Never operate this lathe if it is malfunctioning in any way.

## CAUTION

Metal-cutting machines use sharp tools and incorporate high-speed moving elements. Therefore, you must remain safety conscious at all times to avoid accidents that could result in crippling or fatal injury to anyone nearby.

## CAUTION

The cutting operation produces considerable heat and sharp edges on any part and any removed metal. You must never touch or reach past the workpiece while it is rotating.

## CAUTION

Maintain a clear area surrounding the lathe. Make sure that no obstructions exist to impede your movement and that no slippery spots exist on the floor.

## CAUTION

Do not stand on the machine elements. Keep all tools or other items clear of the machine surfaces.

## CAUTION

If the crank handle that is used to move the tailstock is removable, remove it after the tailstock has been relocated—before starting the next machining operation.

## CAUTION

While you are operating the lathe, minimize the possibility of distraction by keeping all observers a minimum of six feet away.

## CAUTION

Avoid any pinch points created by the movement of the carriage and slides.

## CAUTION

This lathe is powered by lethal voltage levels. Only authorized electricians may correct electrical component failures or perform electrical maintenance on this lathe.

**CAUTION**

Ensure that all shields, covers, and doors are in place, closed and latched, while operating this lathe.

**CAUTION**

Cutting tools and their associated holders must be securely fastened before attempting a cut.

**CAUTION**

Use a work-loading assist to help load heavy parts. Before starting the lathe, be certain that the assist is fully clear of the lathe elements.

Before running a part:

- Determine that the workholding device (chuck or collet) is securely fastened to the spindle nose.
- Ensure that the workpiece is secured within the workholding device and is stabilized with the tailstock and/or steady rest(s), if used.
- Remove the knockout bar and all wrenches from the spindle and/or chuck before running.
- If you are using a rotating cylinder for power chucking, be certain that the chucking pressure is adequate and the speed does not exceed the rating for the particular chuck that is being used.

**CAUTION**

Do not open the chuck or unclamp the tailstock while the workpiece is rotating.

**CAUTION**

This lathe is designed to be operated by one person at a time. Use the following precautions if a situation or condition exists where you are being assisted by another person:

**CAUTION**

- Depress the CONTROL OFF pushbutton before changing the workpiece and/or tools.
- During maintenance work or while cleaning the lathe, remove power from the lathe by placing and padlocking the main power disconnect switch in the OFF position.

**CAUTION**

Improper setup, programming, and/or operation may result in an accident when sufficient clearance is not provided between high-speed rotating and stationary elements. Rotating elements consist of, but are not limited to, the following: chucks, chuck jaws, fixture plate clamps, and drivers. Cutting tools, turret(s), slides, tailstock cut-off slide, and other lathe accessories are examples of stationary or near-stationary elements that must be considered.

**CAUTION**

All tools must be moved away from the rotating components to provide acceptable clearance before indexing to a new tool for another cutting operation.

**CAUTION**

Never defeat or bypass safety interlocks.

**CAUTION**

Bending or whipping material can cause serious injury. Material extending from the spindle or spindle-mounted device can bend or whip. Fully support, capture, and cover any material extending from the rear of the spindle or spindle-mounted device. Do not use wedges at the rear of the spindle, spindle-mounted device, or material support device. Their use can cause material to bend or whip.

## LOCKOUT/TAGOUT

This section covers the Lockout/Tagout safety procedures mandated by OSHA 1910.147. These procedures are for disabling machinery and equipment to prevent the release of hazardous energy. These procedures are necessary to protect anyone working on the equipment from injury or even death. There are many types of energy to be concerned with, such as electrical, hydraulic, and pneumatic, just to name a few. We cannot possibly cover the entire OSHA standard as written. Instead we do encourage the customer to obtain a copy of the standard to use when developing or enforcing compliance procedures.

- ◆ The term Lockout refers to the physical removing and locking out of energy or power to the equipment.
- ◆ The term Tagout refers to the placement of approved tags or signs on equipment. This alerts others that machine service or maintenance is being performed.

Monarch designed this lathe to be operated by one person at a time. The machine must be made safe before maintenance can be performed. Most servicing and/or maintenance requires system shutdown. Perform the following Lockout/Tagout procedures to make the lathe safe for maintenance:

1. Position the main power switch on the power cabinet to the OFF position.
2. Padlock the switch.

**NOTE:** Allow up to eight minutes for electrical energy to bleed down from servo drives, spindle drives, etc.

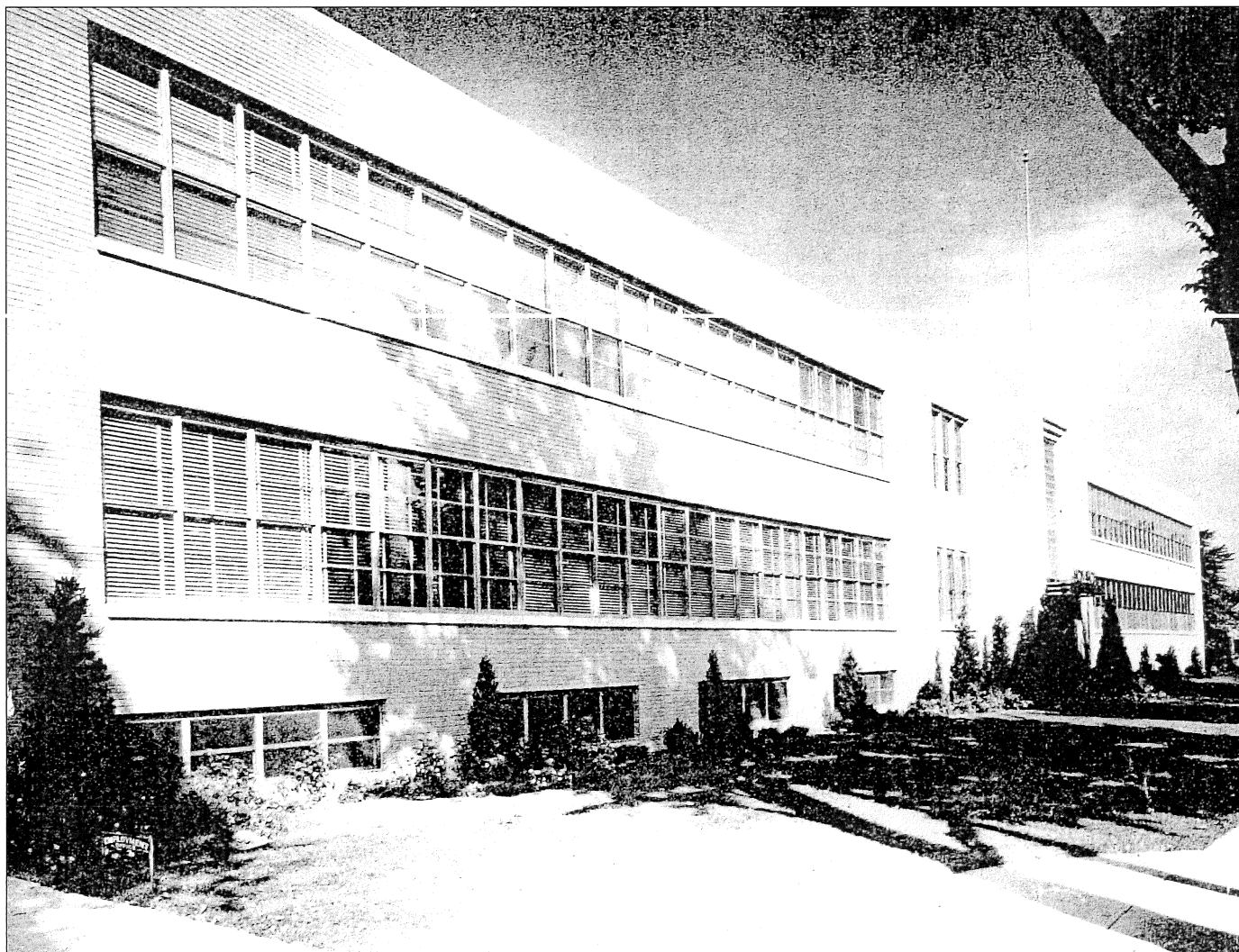
3. Bleed off any hydraulic and/or pneumatic systems energy.
4. Padlock or tag the control valves.
5. Install safety blocks if required. (Example: Vertical slide support during disassembly or vertical servo brake maintenance.)

If these procedures cover all the potential energy hazards present on your machine, then the machine should be safe.

Some service and/or maintenance procedures may require machine power. The Customer Safety Committee must establish a Tagout procedure or some other measures that will give effective protection to the employee while performing maintenance or servicing machinery with power applied.

Read and become familiar with all the safety precautions in this manual and the safety signs or placards affixed to the equipment.

## ALL LATHES



The Monarch plant at Sidney, Ohio. One of the most modern and best equipped machine tool plants in America.

***MONARCH***  
***Lathes***

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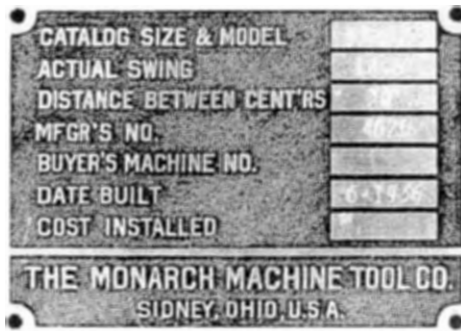
[www.monarchlathe.com](http://www.monarchlathe.com)

[monarchlathes@earthlink.net](mailto:monarchlathes@earthlink.net)

## HANDLING AND INSTALLATION

This Monarch lathe is a precision machine tool, built from the very finest materials, thoroughly tested for accuracy and performance, skidded and crated in the best manner to reach its destination in as near perfect condition as possible.

This lathe must be handled carefully to avoid injury. The photographs on the opposite page show the proper method of lifting the various models — check the model of the lathe on the identification plate shown below in order to select the picture for this particular lathe. Ropes are always better than chains. Please note that the skids should remain under the lathe until it is finally placed in its permanent location.



*Identification Plate*

This is the type of identification plate you will find on the front of the headstock on each Monarch lathe. It shows the correct catalog size and model number of the machine. Also the actual swing over the bed ways, as well as the exact distance between centers with the tailstock flush with the end of the bed. It also shows the manufacturer's number which is the Monarch serial number of the lathe, which number must positively be quoted on any order for repair parts, or any correspondence relating to service on this Monarch lathe. The next line on the identification plate is left blank for the buyer to insert his own plant ledger number or machine number. The next line indicates the month and the year this lathe was shipped from our factory at Sidney, Ohio. The next line may be filled in by the buyer if desired, showing the total cost of the machine. We recommend that this plate be always kept on the Monarch lathe, and full use made of it.

## PACKING LIST

The packing list in the box of parts shows its contents, and should be carefully checked against

the contents of the box or boxes, and any shortages or discrepancies should be immediately reported to the Monarch Machine Tool Co., Sidney, Ohio, of course mentioning the serial number of the lathe, which is clearly shown on the identification plate on the headstock.

## CLEANING

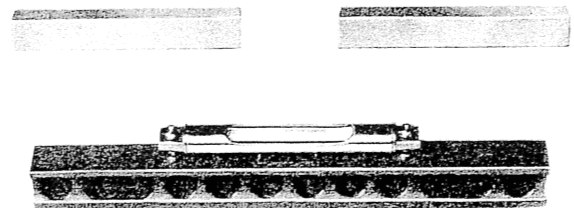
Before the carriage or tailstock are moved on the bed, the anti-rust slushing compound should be carefully wiped from all surfaces, preferably with rags dipped in gasoline or naphtha, to make sure that all grit or other foreign substance has been carefully removed. After this is done a thin film of oil should be applied to the bearing surfaces before these parts are moved along the bed. After the reservoir in the tailstock base, as well as the reservoir in the apron has been filled with the proper kind of oil, then the oiling of these flat way surfaces is taken care of automatically.

## THE INSTALLATION

Every lathe, in order to turn or bore accurately, must be installed on a solid foundation, and the bed must be kept level and without twist or distortion, otherwise the lathe will not turn or bore true, and it would be a positive injury to the lathe to be operated with the lathe bed distorted, or on a twist.

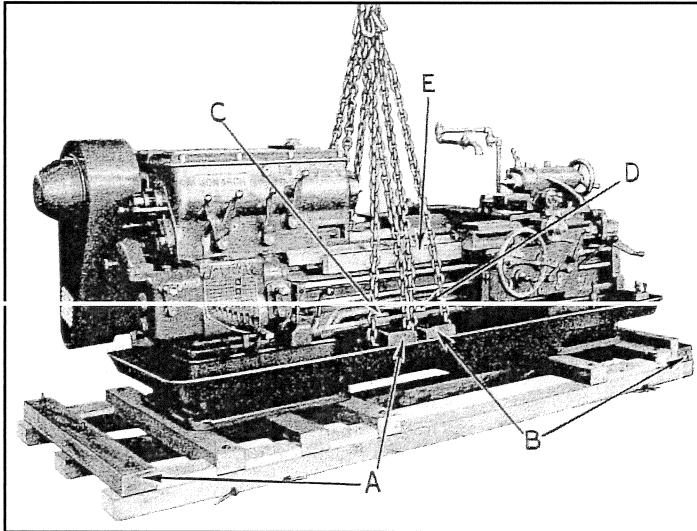
If it is not possible to provide a concrete foundation for the lathe, and if it must be installed on a wood floor, it should be installed at a point where the wood floor is properly supported from underneath. The importance of a solid foundation for a lathe or any other precision machine tool cannot be over-emphasized. Neither can the importance of frequent checking with a precision machinists' level be stressed too much.

## LEVELING TOOLS



*Machinists' Level*

This photograph shows the parallels and proper type of level to use for leveling the machine. Each graduation of this level equals .0005" The sensitivity is 10 sec.



Before the carriage or tailstock are moved, read paragraph "CLEANING" on page 2.

### MODELS M, N, and NN

Wood blocks A & B are taken from ends of skids — blocks C & D should be at least 2¼" high to clear the apron control rod. Place blocks E between sling and bedways.

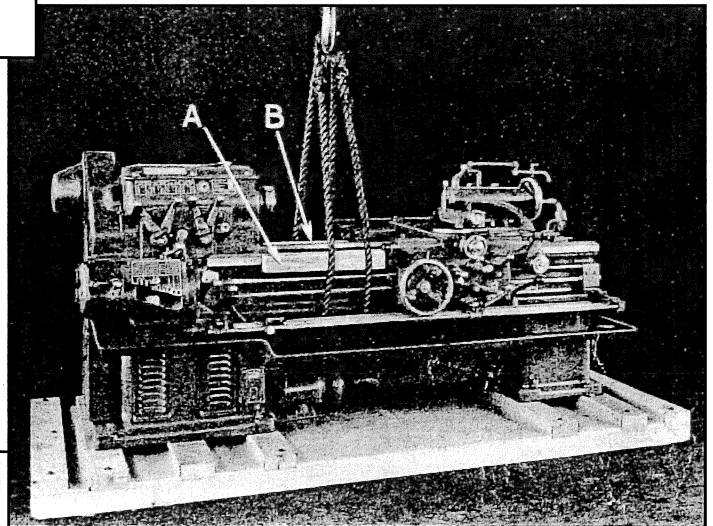
MAKE CERTAIN THAT LOAD IS ON BALANCE BEFORE LIFTING



### MODELS AA, W, and BB

Wood blocks A & B are pieces of 2 x 4 placed on each side of bed ways — to make sure that sling does not touch leadscrew and feed rod.

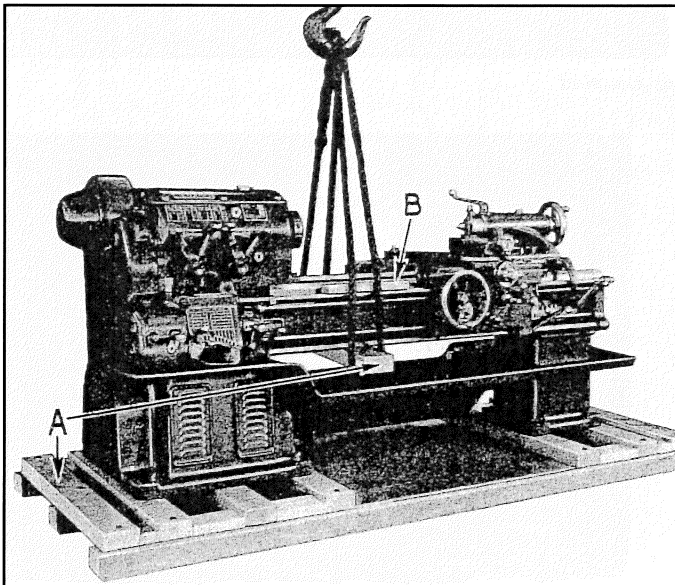
MAKE CERTAIN THAT LOAD IS ON BALANCE BEFORE LIFTING



### MODELS K, CK, C, CY, and CU

Wood block A is taken from the skid and blocks B should be wide enough to keep the sling clear of the leadscrew reverse rod.

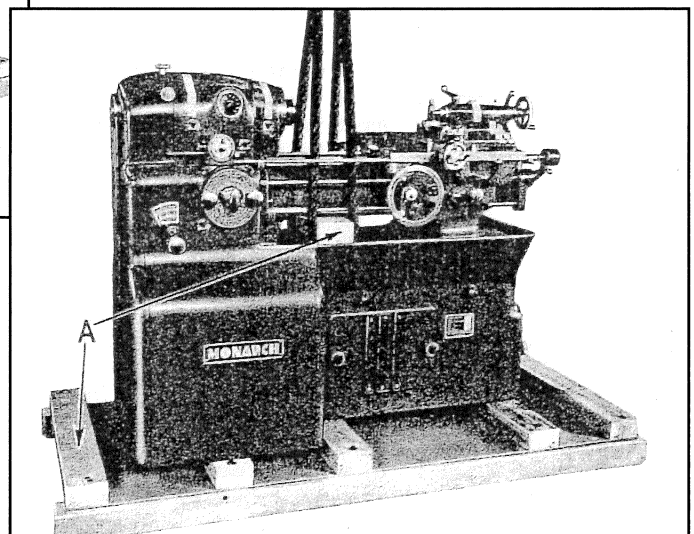
MAKE CERTAIN THAT LOAD IS ON BALANCE BEFORE LIFTING



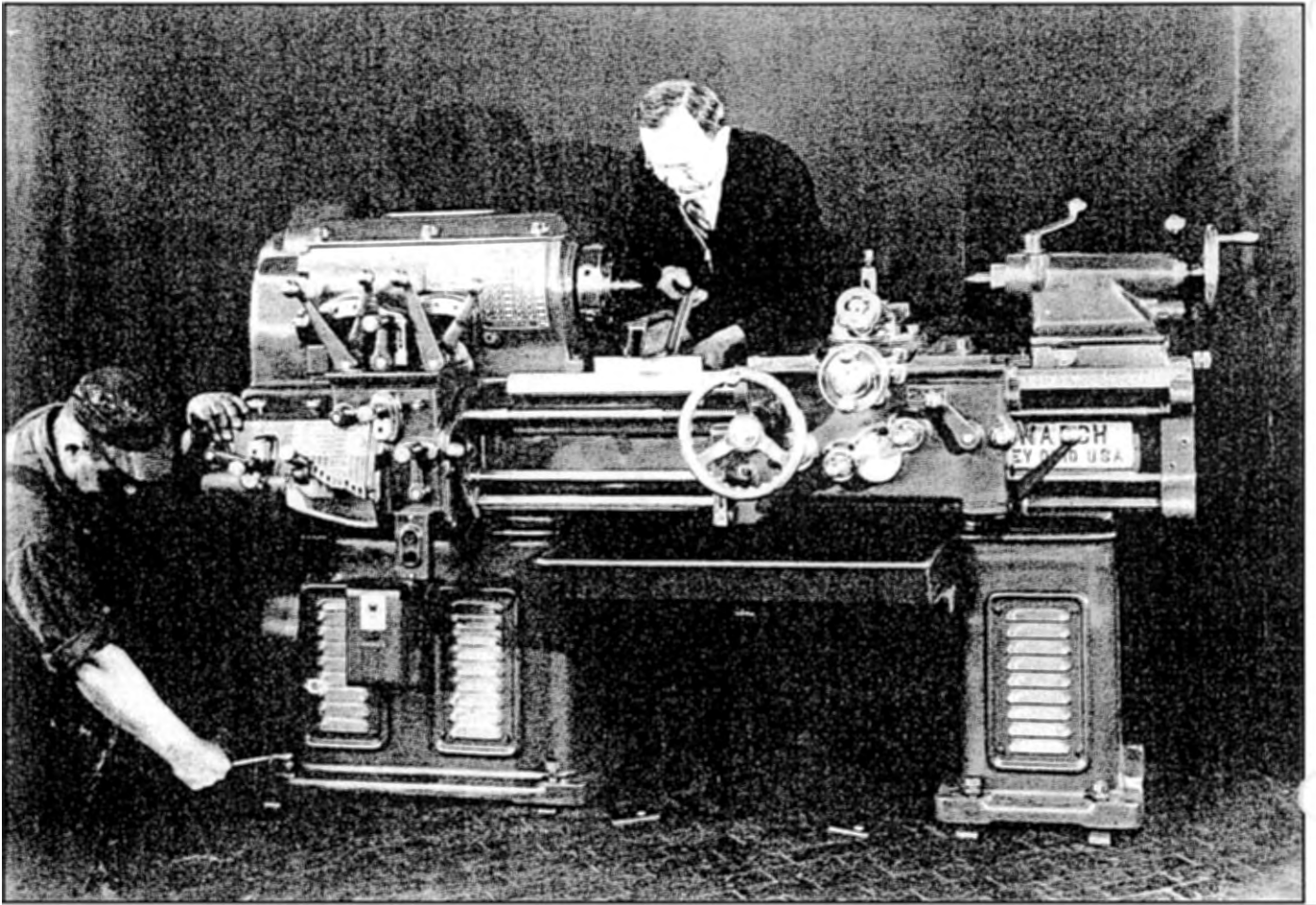
### MODEL EE

Wood block A is taken from the skid — note that the sling should go behind the leadscrew reverse rod on models that have this feature.

MAKE CERTAIN THAT LOAD IS ON BALANCE BEFORE LIFTING





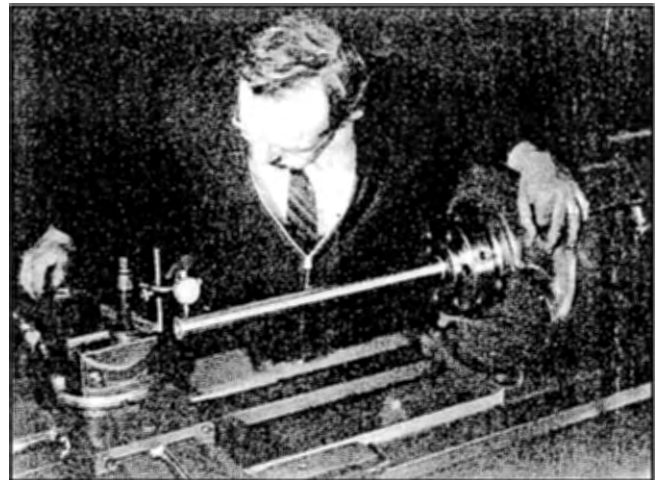


*Lathe Being Leveled*

## ACCURATE LEVELING

Leveling a lathe and keeping it level is one of the first essentials in proper lathe operation. It is not necessary to level the lathe bed lengthwise. Even though one end of the lathe may be considerably higher or lower than the other end, the lathe will still do accurate work providing the lathe bed itself is not on a twist. Nothing but an accurate machinist's level should be used for leveling the lathe bed. A set of parallels, one on the front flat of the bed, and the other on the rear flat of the bed, should be used, and the accurate machinist's level placed on top of these parallels. Level directly in front of the headstock, using the leveling screws in the leg, with a steel plate between the floor and the leveling screw. Level in front of the headstock, in front of the tailstock, and in the center of the bed. After all twist and strain has been removed from the lathe bed, and it checks perfectly level, then the legs should be lagged to the floor, and after the lagging to the floor is completed, then the leveling should be rechecked again as before.

During the first few weeks or months of operation of the lathe this leveling should be rechecked frequently. If at any time it is found that the lathe does not turn or bore true the first thing to do is to check the leveling of the lathe bed.



*Checking Alignment*

## TESTING THE ACCURACY OF ALIGNMENT

We find the most convenient means of testing the alignment of the spindle of a lathe with the bed ways is by having a ground test bar with a

taper shank accurately fitting the ground taper hole in the headstock spindle. This test bar on the ground cylindrical part extending beyond the spindle should be at least 25 to 30" in length, and the bar of course should be perfectly accurate and straight. By putting an accurate dial test indicator in the tool post and running it along the test bar, both on the top and on the side of the bar, will indicate just how much misalignment there is in the bed ways in relation to the spindle of the lathe.

At least once each week the wipers on the carriage wings and on the tailstock base should be removed and thoroughly cleaned of the accumulation of chips and foreign matter, which will be found. If this plan is followed the accurate life of the lathe bed will be prolonged indefinitely, and the possibility of any scoring of the bed ways will be greatly reduced.

The headstock is automatically lubricated both by the splash system and a plunger type pump, which supplies clean filtered oil to the Timken spindle bearings.

The tailstock base is provided with a reservoir filled from the outside, which provides lubrication between the tailstock base and the bed ways.

As shown by the bronze caution plate, the main driving clutch pulley should not be greased more often than once per year, and then only a small quantity of grease should be applied, for the reason that the anti-friction bearings on which the clutch pulley is mounted require only a slight amount of lubrication, and an excess of lubricant would impair the proper functioning of the clutch faces, causing them to drag and not release properly.

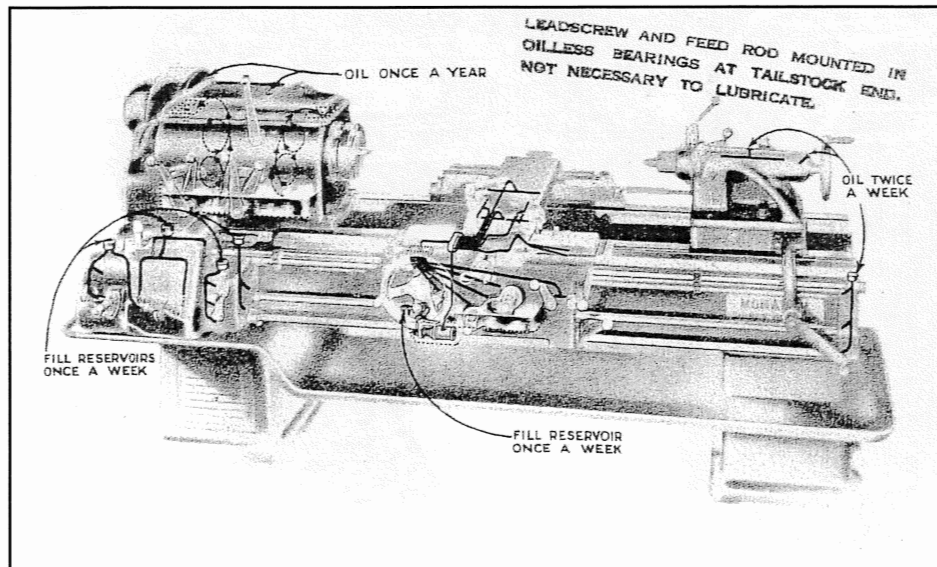
The bronze plate on the end gear train guard indicates that the end gearing should be oiled once per day.

Note: The right end bearings on Models EE, K, CK, C, CY, AA, W and BB, have oilless bearings and require no attention.

## CARE AND OPERATION OF THE LATHE

Most of the features of ease and convenience of operation of this machine have been suggested from time to time by lathe operators, and we always welcome suggestions and criticisms. This lathe is built of the very finest materials obtainable, all the steel operating parts are made of nickel alloy steel electric furnace hardened, and the lathe is built to stand high speeds and heavy cuts, and with reasonable care and attention will stand up indefinitely to maximum service. "A good workman always takes pride in his tools," and we have tried in the building of this lathe to make it not only easy and convenient to operate, but also to *look well*. A weekly cleaning with a kerosene rag will give the finish a longer life.

This picture shows a typical Monarch lathe, naming the principal parts and levers used for operating the machine, and naming also the principal assembly units.



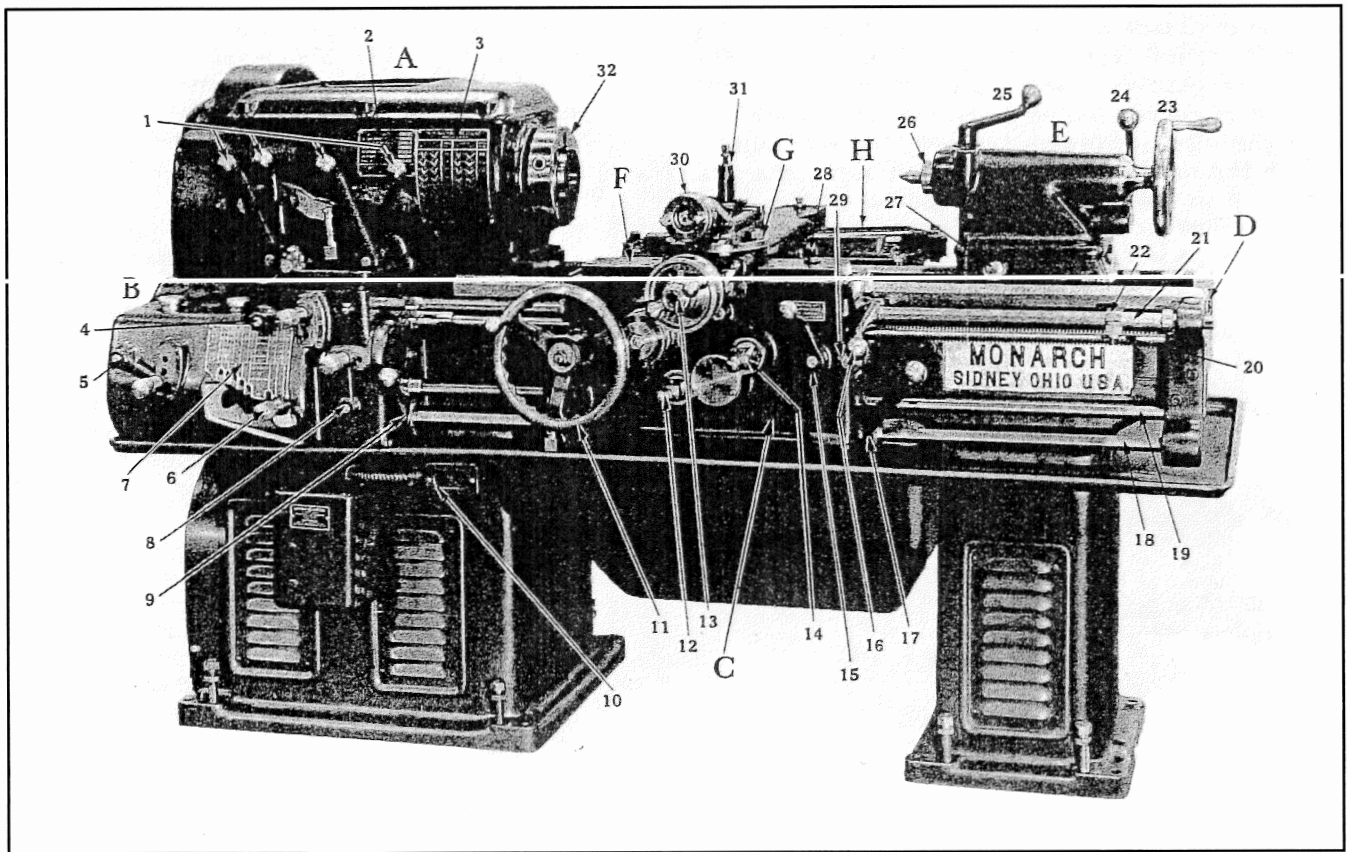
*Force Feed Lubrication*

## LUBRICATION

Before this lathe was shipped, all oil was drained from the headstock and apron. Before the lathe is operated the headstock and apron must be filled to the proper level as indicated by the gauges and the lathe should be thoroughly oiled thruout. In the headstock and apron we recommend the use of a high grade oil the equivalent of SAE-30. The photograph shown illustrates how easy it is to keep this Monarch lathe properly lubricated and shows the thought which has been put into providing proper lubrication. The degree of service and satisfaction this machine provides in the future will depend in no small extent to the care it receives in proper lubrication.

Before this lathe was shipped from the factory the headstock was operated for a period of not less than four hours under a forced system of oil circulation, the oil being automatically cleaned by a Centrifuge machine, to make absolutely sure that every particle of dirt and foreign matter has been completely removed from the entire headstock mechanism. We recommend that once yearly all oil should be drained from the headstock and the headstock flushed out with kerosene, and clean, preferably filtered oil, used to refill it.

At least once yearly the Bijur circulating pump on the apron should be removed, and the apron reservoir, as well as the pump reservoir, be thoroughly cleaned of all dirt and sediment.



Assemblies and Operating Parts

### PRINCIPAL ASSEMBLY UNITS

- |               |                      |
|---------------|----------------------|
| A. Headstock. | E. Tailstock.        |
| B. Gearbox.   | F. Carriage.         |
| C. Apron      | G. Compound rest.    |
| D. Bed        | H. Taper attachment. |

### NAMES OF LEVERS AND PARTS USED IN OPERATION

- |   |                                     |
|---|-------------------------------------|
| 1. Headstock spindle speed change levers. | 17. Apron control lever.            |
| 2. Identification plate.                  | 18. Control rod.                    |
| 3. Spindle speed index plate.             | 19. Feed rod.                       |
| 4. Upper compound lever.                  | 20. Leadscrew.                      |
| 5. Lower compound lever.                  | 21. Reverse rod.                    |
| 6. Tumbler lever.                         | 22. Reverse rod stop collar.        |
| 7. Feed thread index plate.               | 23. Tailstock handwheel.            |
| 8. Feed thread lever.                     | 24. Tailstock clamping lever.       |
| 9. Spindle control lever.                 | 25. Tailstock spindle binder lever. |
| 10. Motor switch.                         | 26. Tailstock spindle.              |
| 11. Apron handwheel.                      | 27. Tailstock setover screw.        |
| 12. Longitudinal friction lever.          | 28. Carriage binder clamp.          |
| 13. Crossfeed handle and dial.            | 29. Chasing dial.                   |
| 14. Crossfeed friction lever.             | 30. Compound dial and handle.       |
| 15. Halfnut closure lever.                | 31. Tool post.                      |
| 16. Reverse lever.                        | 32. Headstock spindle.              |

## CHANGING SPINDLE SPEEDS

The levers on the front of the headstock are of course for changing spindle speeds. The levers move heavy jaw clutches inside the headstock in changing spindle speeds. In changing to slower speeds it is not necessary to disengage the driving clutch, but we do always recommend disengaging the driving clutch before changing to higher speeds. This is especially advisable if there is a heavy chuck or heavy work on the spindle or between centers. With a collet chuck or with light work between centers on the lathe, it is not necessary to disengage the driving clutch in changing to higher speeds. In changing spindle speeds, the thing to watch is to avoid the sudden shock that would be imposed on the headstock mechanism in changing from low to higher speeds, with the driving clutch engaged and with a load on the spindle. With just a little care and practice in changing spindle speeds any operator can soon learn to select any desired spindle speed and secure it almost instantly, even without referring to the spindle speed chart on the front of the headstock.

## SPINDLE START AND STOP LEVERS

These levers, one located at the right hand wing of the apron, and the other at the headstock end of the lathe, in the upward position disengages the driving clutch, and by applying pressure in the upward position engages the cone brake inside the headstock to bring the spindle to a quick stop. The cone brake should function indefinitely without adjustment. Should it ever fail to properly serve as a brake to stop the spindle, it should be examined by removing the top cover plate of the headstock to discover the cause.

## QUICK CHANGE GEAR BOX

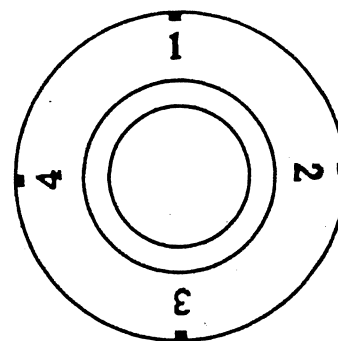
Since the index plate on the gear box clearly indicates all lever positions to secure any desired thread or rate of feed, no special instructions for its operation are required. At the right end of the quick change gear box is what is termed a slip-gear lever which is used to engage either the feed rod or the leadscrew.

## THE APRON

The apron is anti-friction bearing thru out and is automatically lubricated by means of a cam which operates as the carriage traverses along the bed. If the lathe is to be used for a considerable period of time on facing work with the carriage clamped to the bed, the automatic force feed lubrication in the apron and to the compound rest will not function. In this case it is well to unclamp the carriage and occasionally move the carriage along the bed five or six turns of the apron handwheel to again force oil to all apron parts, as well as to the compound rest in its bearing on the carriage, so that proper lubrication will be given these parts.

The chasing dial on the front of the apron may be used in the following manner:

On any even thread where the lead being chased is divisible by four the operator may engage the halfnut at any point without paying attention to the chasing dial. For any even thread not divisible by four, such as 22 threads per inch, as well as any full odd thread, the halfnut may be engaged at any graduation. In other words, in chasing such threads the halfnut may be engaged when the chasing dial is at any one of the four graduation marks.



*Chasing Dial*

For half threads engage the halfnut at opposite graduations, as for instance No. 1, or No. 3, or No. 2, or No. 4. For quarter threads engage the halfnut at the same graduation each time. For other fractional threads the use of the thread chasing dial is not recommended.

## LEADSCREW REVERSE MECHANISM

This feature is standard equipment on Model C toolroom lathes of 12", 14", 16" and 18" sizes; it is optional equipment on the EE model. Here are six of the many advantages of this device:

1. Chasing threads to a shoulder.
2. Chasing internal threads in a blind hole.
3. Chasing threads that have fractional leads.
4. Chasing odd leads of short lengths (in long lengths of odd leads it is faster to use the thread chasing dial).
5. Chasing odd leads in a sub-headstock.
6. Can be used as an automatic stop for feeds or threads in either direction by setting the stop collars.

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## SOME COMMON TURNING TROUBLES

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### Lathe Chatter

Should this Monarch lathe ever develop chatter, first make sure it is not work chatter, caused by springing of the work, or by an improperly set or an improperly ground tool. If after experiment you are convinced that the chatter may be caused by the lathe itself, we recommend the following procedure:

First examine the lathe bed to see if it is level and not on a twist. Then test the spindle in its anti-friction bearings to make sure that the bearings are properly adjusted. If they require adjustment they can be quickly adjusted by means of the lock nuts provided and shown on the headstock assembly sheet in this manual. The carriage gibs and compound rest gibs should be properly adjusted to remove lost motion and play. The headstock must of course be bolted tightly to the bed, and the tailstock base should fit firmly on the bed ways without any accumulation of dirt between the bed ways and the tailstock base. By making a careful analysis of the cause of the chatter, should chatter ever develop, we feel sure you will have no trouble in locating the cause and removing it.

### Drunken Thread

A drunken thread is an alternately thick and thin thread, caused when the leadscrew thrust adjustment is improperly made. Proper adjustment of the leadscrew thrust eliminating lost motion will usually remedy this trouble.

### The Lathe Turns Taper Between Centers

First see that the lathe bed is perfectly level, on a firm foundation, and that the bed is not on a twist, which would render it inaccurate. Make sure the tailstock center is correctly aligned with the headstock center. Of course the carriage and compound rest gibs should be properly adjusted.

### If the Lathe Turns Taper on Work Held in a Chuck

First see that the lathe bed is properly leveled as described above and elsewhere in this manual. It will be well also to test the accuracy of the gripping surface and the face of the chuck jaws to see if they are accurate. It is well also to test the alignment of the spindle with the bed ways of the lathe as described elsewhere in the manual.

### If the Lathe Bores Taper, or Faces Convex or Concave

The same procedure as above should be followed.

Every possible precaution to assure long trouble free service of this lathe has been taken by us, and the lathe should give satisfactory performance with reasonable care and attention for many years to come. If, however, you should ever experience difficulty in the successful operation of this lathe, that you cannot quickly correct yourself, we urge you to report your trouble to the dealer or agent who sold you the lathe, or to us direct, because every Monarch lathe must give complete satisfaction to the purchaser.

### BULLETINS

The "Feature Bulletin" and the "Accessories Bulletin" have been sent with this operator's manual. By studying these bulletins, you will become more familiar with Monarch lathes.

The "Feature Bulletin" explains very thoroughly the construction of the machine, unretouched photographs being used for illustrations. We feel this bulletin will present you with a much clearer understanding of the machine.

The "Accessories Bulletin" shows the attachments and accessories which may be installed on a Monarch lathe, making it adaptable for almost any type of turning. A study of this bulletin may be the means of solving many of your turning problems.

**We Believe that the Use of Compressed Air, for Cleaning Lathes, is the Cause of Future Troubles**

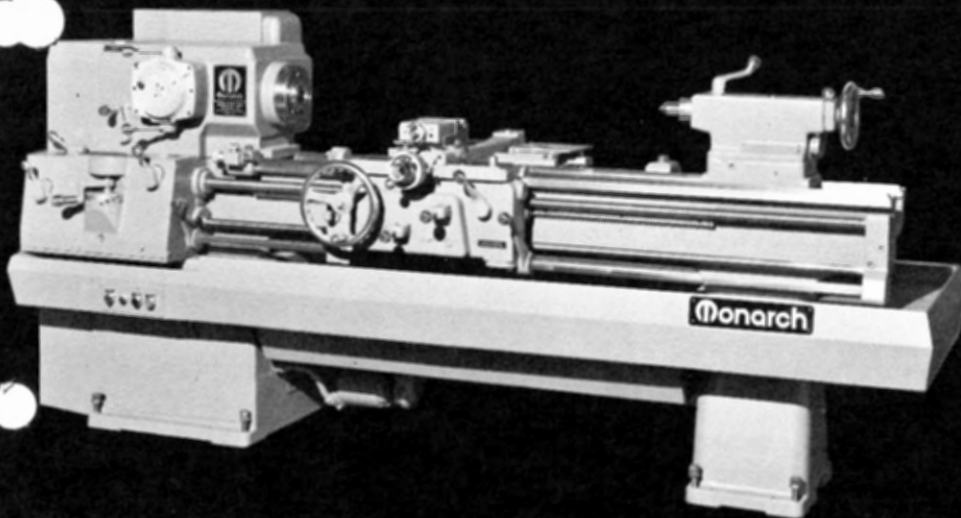


SERIES

50

LATHES

**OPERATOR'S  
MANUAL**



MONARCH MACHINE TOOL COMPANY • SIDNEY, OHIO



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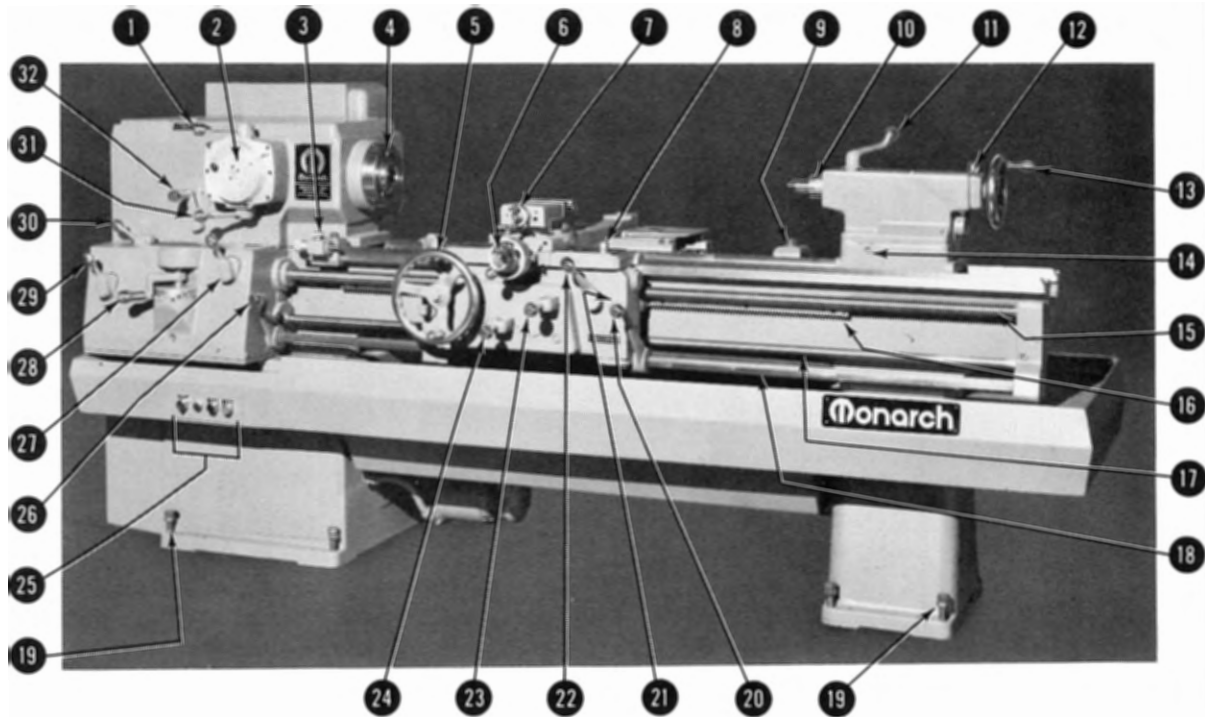
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## ELECTRONIC AND ELECTRICAL SERVICING

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**OPERATING LEVERS AND CONTROLS**

- |                                     |   |
|-------------------------------------|---|
| 1. Range Shifter Lever              | 17. Feed Rod                            |
| 2. Spindle RPM Dial                 | 18. Control Rod                         |
| 3. Carriage Stop                    | 19. Leveling Screws                     |
| 4. Headstock Spindle                | 20. Spindle Control Lever               |
| 5. Apron Handwheel                  | 21. Chasing Dial                        |
| 6. Cross Feed Dial and Handle       | 22. Half Nut Control Lever              |
| 7. Compound Rest Dial and Handle    | 23. Power Cross Feed Lever              |
| 8. Carriage Binder Clamp            | 24. Carriage Power Feed Lever           |
| 9. Taper Attachment Bed Clamp Screw | 25. Operators Control Station           |
| 10. Tailstock Spindle               | 26. Spindle Control Lever               |
| 11. Tailstock Spindle Binder Lever  | 27. Feed-Thread Lever                   |
| 12. Tailstock Clamp Lever           | 28. Feed-Thread Selector Lever          |
| 13. Tailstock Handwheel             | 29. Lower Compound Lever                |
| 14. Tailstock Set-over Screws       | 30. Upper Compound Lever                |
| 15. Leadscrew                       | 31. Surface Speed Control Lever         |
| 16. Rack                            | 32. Longitudinal Feed Directional Lever |

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## INTRODUCTION

The Monarch Series 50 is a solidly built engine lathe with design features that make it a popular as well as profitable addition to shops both large and small.

Here is Monarch's answer to the need for an economical turning machine with the reliability and accuracy needed to compete for today's metalworking business.

### MODEL 16

16-inches swing over the bed and carriage wings. 10-inches swing over the cross slide. 54, 78-inches distance between centers.

With proper operation and maintenance, the high quality design and construction of your Series 50 lathe assures you top performance over a long machine life.

## RECEIVING YOUR LATHE

When your Series 50 lathe is delivered, uncrate it down to the skid and check the packing list against the items received. Report any discrepancy at once to the Order Department, Monarch Machine Tool Company, Sidney, Ohio. At that time, you should provide the lathe serial number that appears on the packing list that came with the machine. This same number is stamped on your lathe, between the front vee and flat bedway at the tailstock end of the machine.

You will find that all finished surfaces of your lathe are covered with an anti-rust compound that can be easily removed with a brush and solvent.

**CAUTION:** All of the anti-rust compound should be removed before operating any moving parts of the lathe.

After cleaning them, apply a thin film of oil to the bedways.

## LIFTING YOUR SERIES 50 LATHE

Leave your lathe on the skid until after it has been moved as close as possible to its permanent location.

**CAUTION:** Due to its off-center point of balance, extreme care should be used when lifting the machine from the skid. By whatever lifting method employed, the headstock and tailstock ends of the lathe must be uniformly lifted.

Depending upon the lathe model and accessories, the total weight of your lathe will approximate 4500 pounds.

## INSTALLATION

The accuracies you obtain will be dependent to a great degree upon the care taken when leveling your lathe. The leveling screws provided in each leg should contact metal plates or similar pads on solid location.

Use only a precision level, graduated in .0005-inches each foot. Place parallels on the two flat ways and set the level on the parallels. Do this at both ends of the lathe bed. Adjust the leveling screws until the machine is level at both ends of the bed.

Check the level of the bed again in about a week, and every two months thereafter.

The importance of establishing and maintaining machine level cannot be stressed too highly, since performance of your lathe will be largely dependent on alignment of the bed.

## LUBRICATION

First, another word of caution concerning the anti-rust compound applied to protect the machined surfaces of your Series 50 during shipment. Be certain that this anti-rust compound is completely removed before moving the carriage, tailstock or taper attachment. As stated before, a thin film of oil should be applied to the bedways after cleaning off the anti-rust compound.

Since your lathe will be shipped without oil in the various reservoirs, they must be filled with the recommended lubricant prior to machine start-up. Refer to the lubrication chart on page 11 of this booklet for a listing of correct lubricants and filling intervals. The headstock, gearbox, apron and tailstock each have their own filler caps and sight gage.

Machines equipped with taper attachment also have a filler cap under one of the cover plates. It is important to periodically check all the sight gages provided, especially during the first weeks of operation. Care should also be taken that oil reservoirs are not overfilled.

**IMPORTANT:** The headstock oil level gage is located on the front toward the left end of the headstock. A filler cap (H) (figure 2) on top of the headstock cover provides a means of filling oil reservoir. By opening the upper end guard a pipe cap can be seen directly below the headstock belt sheave. This provides a means of draining the headstock reservoir.

## HEADSTOCK

The rugged headstock of your Series 50 lathe has three geared ranges designated as "H" (high), "I"

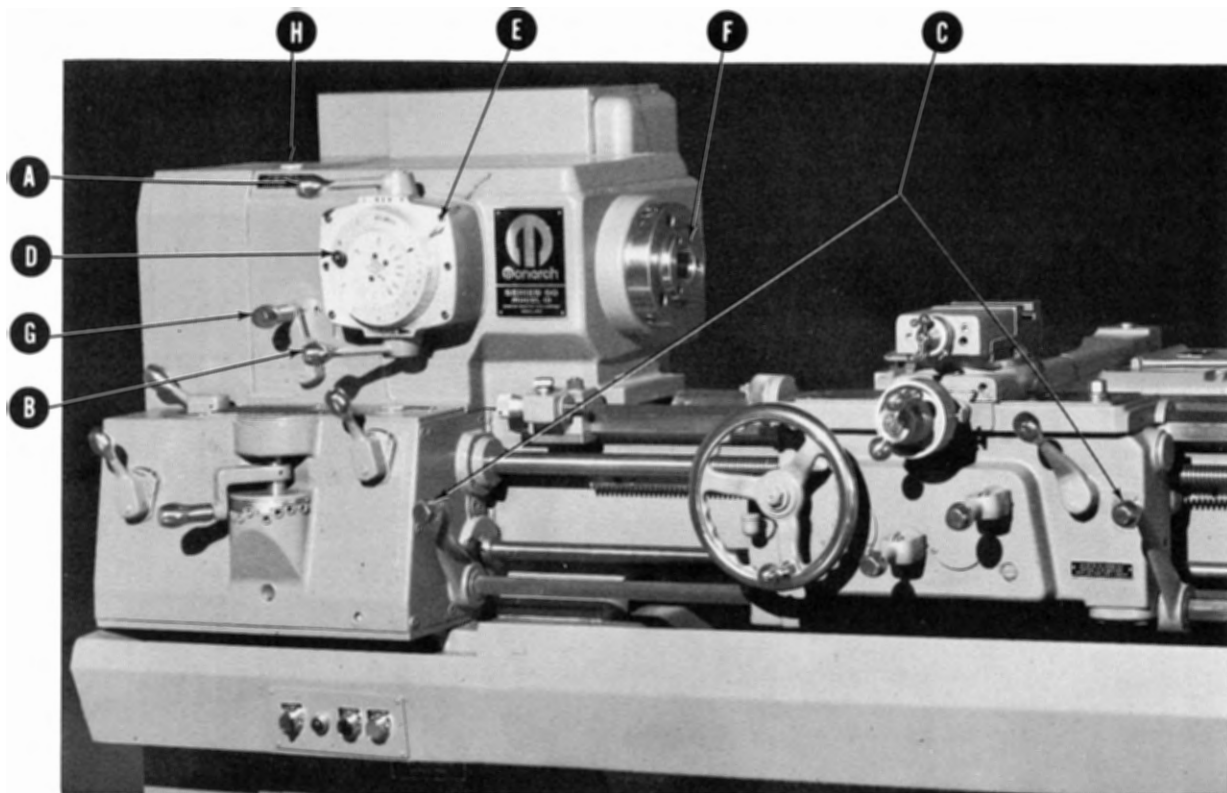


Figure 2. HEADSTOCK

**HEADSTOCK** (Continued)

(intermediate) and "L" (low) as shown on the RPM dial (Fig. 2).

The upper shifter lever "A" is used for shifting ranges and the lower lever "B" is used to select the exact RPM. Note that the boundaries of the speed ranges are indicated by the breaks in the black and red color bands at the top of the RPM dial.

The following procedure is recommended when shifting ranges to select a desired RPM.

1. Move the Forward-Stop-Reverse lever "C" to Stop position (Fig. 2) stopping the spindle.
2. Using the upper shifter lever "A" shift to the desired range jogging the spindle as required with lever "C" by moving it lightly in and out for Forward position.
3. Move lever "B" to the right to increase or to the left to decrease the RPM to the desired value.
4. Restart the spindle with lever "C".

To add to the usefulness of the infinitely variable speed range of the Series 50, a surface speed calculator can be built into the top of the RPM dial. This calculator is used as follows:

- (a) Loosen clamp knob "D" and rotate the diameter dial, lining up the black arrow opposite the desired surface speed. If the diameter to be turned on the black diameter scale is over an RPM on the black RPM scale, tighten clamp knob "D". If the diameter lines up over the red portion of the RPM scale, move the red arrow to the desired surface speed on the red surface speed scale and tighten knob "D".

Note: When using the black scales and black arrow no values of diameters overlapping the red RPM scale may be used. The same is true of values of diameters on the red diameter scale which overlap the black portion of the RPM scale when using the red scales and red arrow.

- (b) Noting the range opposite the desired diameter, shift the headstock to the range indicated using the upper lever "A".
- (c) Using the lower lever "B" line up the diameter to be machined opposite the RPM dial arrow "E". This will automatically set the headstock to the correct RPM

Using the lower lever "B" the operator can retain a constant surface speed simply by moving the diameter dial to the diameter to be cut for each operation.

The ASA camlock 6" type D-1 spindle nose (F) (Figure 2) affords a solid mount for chucks and face plate, by locating these units as closely as possible to the front anti-friction spindle bearings. Mounting procedure is as follows:

1. Wipe the spindle nose, the locating holes and the studs on the chuck with a clean rag, to remove any dirt that could cause misalignment.

2. Insert the studs into the spindle nose and, with a tee wrench, turn the camlocks in the direction indicated by the arrows. Tighten the camlocks evenly, for a secure mounting.

The lever marked (G) (Figure 2) slides a single jaw clutch in the headstock. When set to the right, it causes carriage motion toward the tailstock, for feeding or threading. When set to the left, carriage motion is toward the headstock

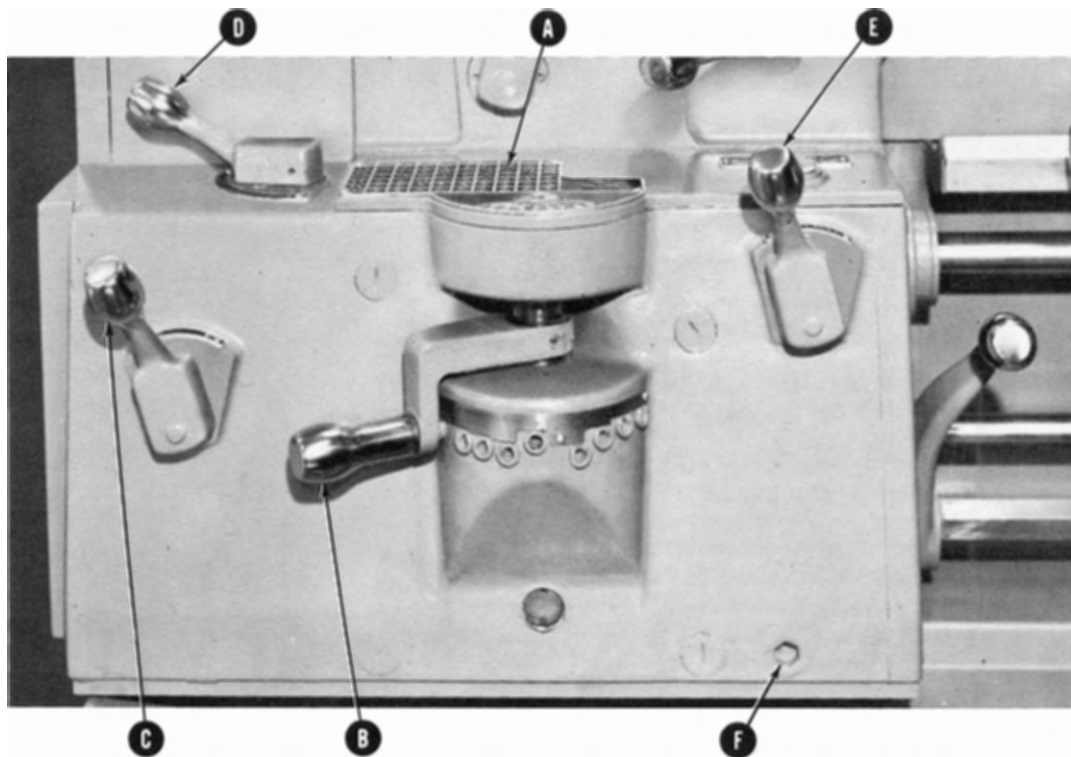


Figure 3. GEARBOX

## GEARBOX

Your Series 50 lathe has a separate leadscrew and feed rod. The feed rod is engaged for standard turning. Thus the leadscrew accuracy is retained for threading only.

To obtain a particular feed or thread, follow this procedure:

1. Select the desired feed or thread from the index plate (A) on top of the gear box.
2. Engage the pin of selector arm (B) in the hole at the front of the gearbox as indicated by the numbered column on the index plate having the desired feed or thread.
3. Position levers (C) and (D) to correspond with the

two letters at the extreme left of the horizontal column containing the desired feed or thread.

4. Engage lever (E) in either "feed" (left) or "thread" (right) position.

It may be necessary to jog the spindle to engage the gearing in the gear box.

**CAUTION:** Shifting lever (C) completes a major gear shift in the gearbox. This lever should be shifted only in the lower spindle speeds.

Lubrication to the gearbox and end gearing is provided by a positive pump. A filler cap on top of the gearbox cover provides means of adding oil to the reservoir. The gearbox oil level gage is located on the front, near the bottom of the gearbox. A convenient drain plug (F) is located to the right of the level gage.

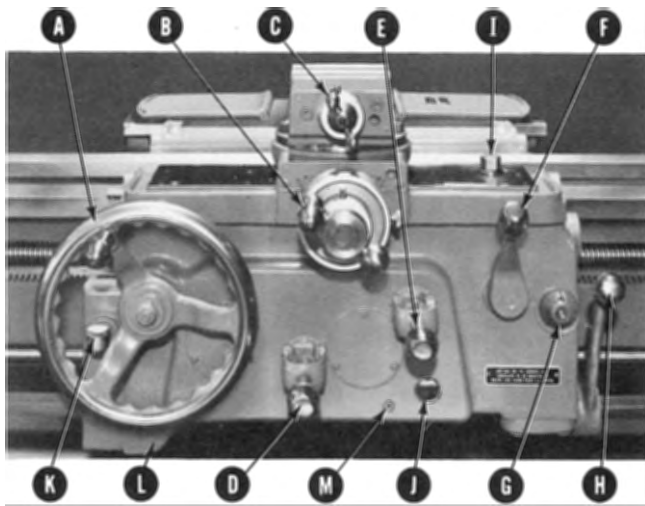


Figure 4. APRON

### APRON

The apron handwheel (A) provides manual movement of the cutting tool parallel to the bedways.

The cross slide handwheel (B) moves the cutting tool perpendicular to the bedways. The cross slide dial is graduated in .001-inch of work diameter. The compound rest handwheel (C) is mounted on a swivel, and provides tool movement at any angle to the bedways.

Lever (D) provides power feed to the carriage.

Lever (E) provides power feed to the cross slide.

Lever (D) and (E) may be engaged separately or simultaneously.

Lever (F) is the half nut control lever, and is rotated clockwise to engage the leadscrew for threading. A mechanical interlock prevents engagement of the half nut when the carriage power feed lever (D) is engaged. Chasing dial (G) is used to pick up odd leads when chasing threads. Disregard this dial when chasing any thread number divisible by four. Steady, downward motion on forward-stop-reverse lever (H) starts forward (normal) spindle rotation.

Carriage clamp screw (I) is used only when taking heavy facing cuts. Lubrication to the working parts of the apron, as well as to the carriage and cross slide ways, is through a positive pump in the apron. This pump operates when the carriage is traversed by hand or power.

Sight gage (J) on the front of the apron indicates the oil level of the reservoir.

The oil reservoir is filled by means of oil cup (K). The worm cavity is filled by overflowing access hole (M). Proper oil level should be maintained at all times. But again a word of caution, do not overfill the oil reservoirs. A drain plug (L) is located at the bottom of the apron near the pump case.

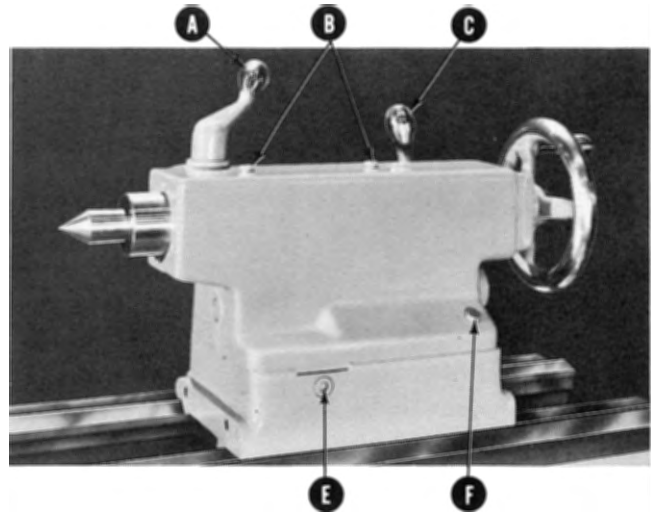


Figure 5. TAILSTOCK

### TAILSTOCK

The tailstock of your Series 50 lathe is mounted on flame-hardened ways, for long-term service and accuracy of alignment with the headstock spindle.

Lever (A) clamps the tailstock spindle in place.

Two oil caps (B) are provided for lubrication of the tailstock spindle.

Lever (C) provides quick clamping of the tailstock to the bedways.

The tailstock spindle is hardened and ground, with a tang slot for holding drill tangs and for the easy ejection of tools. When the spindle has been extended for turning, the tang slot should be checked for chips before the spindle is retracted.

Set-over of the spindle can be accomplished by alternately loosening and tightening two Allen-head screws. One screw (E) is located at the front of the tailstock base. Another is at the rear of the tailstock base.

The oil reservoir in the tailstock base is filled through cap (F).

## TAPER ATTACHMENT

The following procedure should be followed to set up the anti-friction taper attachment on Series 50 lathes that are so equipped.

1. Position the carriage so that the cutting tool is about 1-inch beyond the right end of the work-piece.
2. Loosen studs (A) and (B).
3. Push slide (C) all the way toward the headstock, to use the full length capacity of the attachment.
4. Position bed clamp (D) as shown.
5. Tighten lock nuts (E) and hex nut (F).
6. Before attempting to set the swivel, you must loosen two hex nuts. One of these (K) is located beneath the cover plate that is nearest the headstock. The other nut (L) is located directly beneath stud (H).

7. After loosening nuts (K) and (L), set swivel (G) at required taper, by turning stud (H) and reading vernier dial (J).
8. After setting swivel at the desired taper, tighten nuts (K) and (L).
9. Tighten stud (B).
10. Fill oil cup (M) each time before using the taper attachment.

Your lathe is now arranged for taper turning, by feeding to depth with the compound slide. Maximum taper turning is 4-inches per foot, which is approximately equal to 18° included angle. Maximum turning length on one setting is 12-inches. To disconnect the taper attachment for conventional turning:

1. Loosen stud (B).
2. Tighten stud (A).
3. Loosen nuts (E) and (F) and remove bracket (D). Store this bracket in a safe place until you once again need it for taper turning.

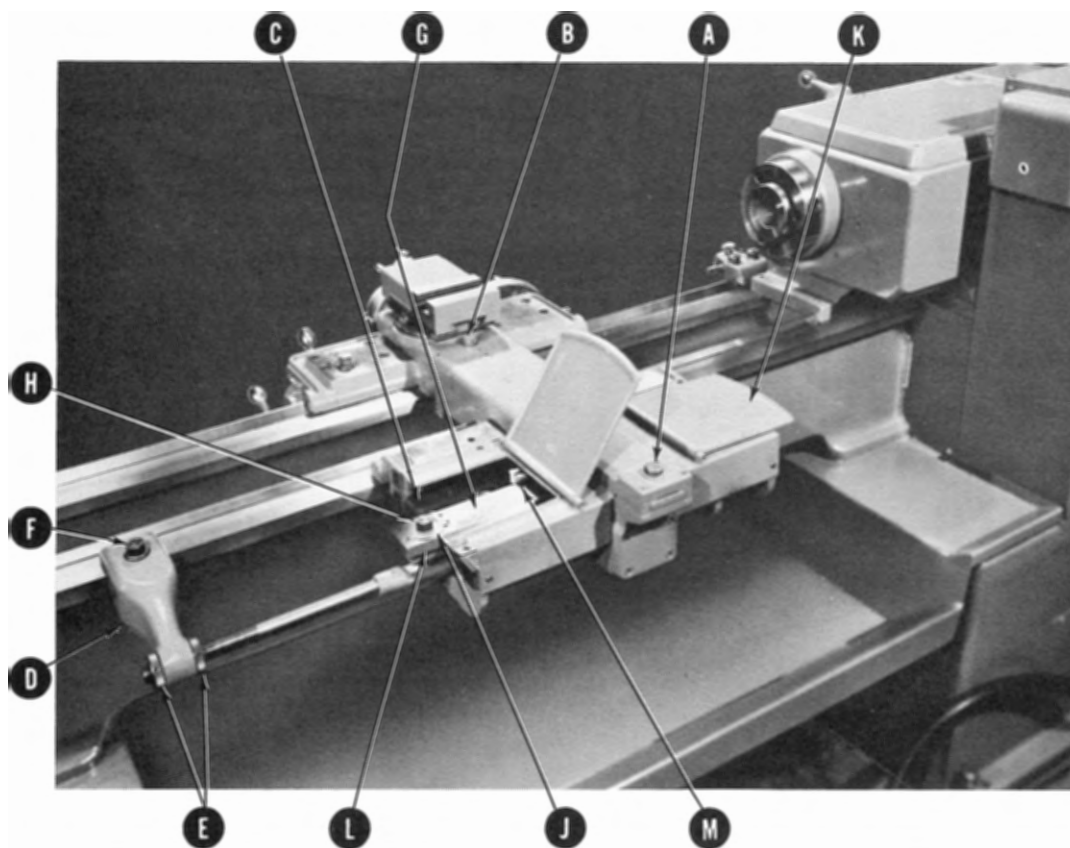
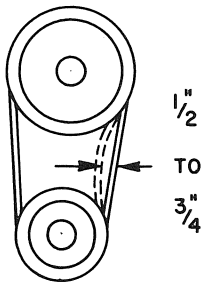


Figure 6. TAPER ATTACHMENT



### MAIN DRIVE MOTOR

The main drive motor is mounted in the head end leg. To adjust Vee belt tension: open access plate at the rear of the head end leg. Loosen nut (A). Adjust nut (B) clockwise - to loosen belt tension; or counterclockwise - to tighten belt tension. Tighten nut (A). Vee belt tension should be maintained as follows:



Light hand pressure against a single belt should move it 1/2" to 3/4".

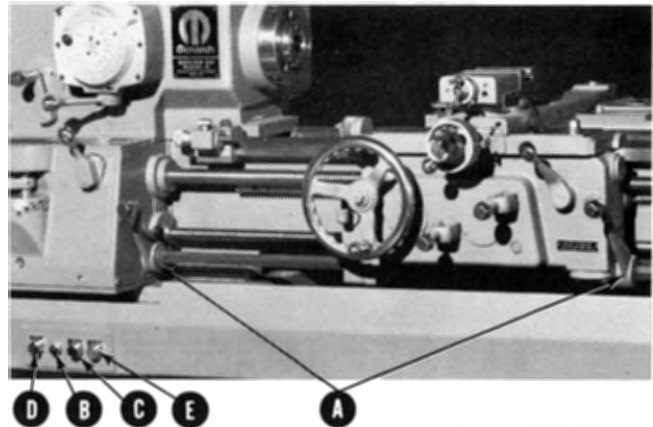


Figure 8. STARTING OF MAIN DRIVE MOTOR AND SPINDLE

### STARTING OF MAIN DRIVE MOTOR AND SPINDLE

NOTE: In the Series 50 D.C. drive system, the motor is directly connected to the spindle through belts and gears. Stopping and starting the spindle is accomplished by stopping and starting the main drive motor. Dynamic braking is provided for a rapid and smooth stopping action.

1. Place the spindle forward - stop/reverse levers (A), Figure 8 in the middle or stop-position.
2. Place the disconnect switch (mounted on the door of the electrical cabinet) in the "on" position. Red pilot light (B) on pushbutton station will glow.
3. Depress the control-on button (C) to energize the control cabinet. Start the spindle by placing lever (A) in down or forward-position. Stop the spindle by placing lever (A) in middle or stop-position. Reverse the spindle by placing lever (A) in up or reverse-position.
4. When coolant is furnished on machine the coolant pump motor is controlled by an on/off selector switch (D).
5. Depress the control-off button (E) and the control cabinet is de-energized. The red pilot light continues to glow. This is a warning to the operator that the power supply is still on and will continue to be so until disconnect switch is placed in the "off" position.

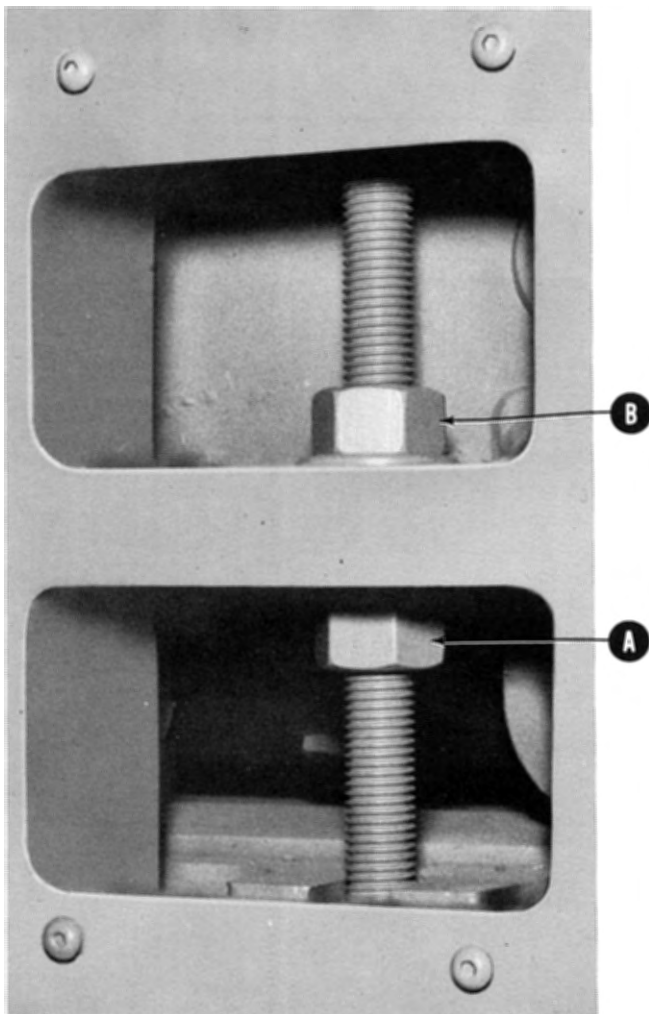


Figure 7. MAIN DRIVE MOTOR

## LUBRICATION INSTRUCTIONS

	<u>Lubricant* and Capacity</u>	<u>Schedule</u>
<u>HEADSTOCK</u>	Mobile Vactra Oil Heavy Medium 2 gallon capacity	Check oil level daily. Always turn off the main drive motor when checking. Drain every six months, then flush and refill with fresh oil.
<u>APRON</u>	Sunoco Way Lubricant #80 3 pints capacity	Check oil level daily. Drain every six months, then flush and refill with fresh oil.
<u>GEARBOX</u>	Mobil Vactra Oil Heavy Medium 2 Quarts Capacity	Check oil level daily. Drain every six months, then flush and refill with fresh oil.
<u>MOTOR</u>	General Electric Grease #D6A2C5	Those motors having grease fittings should be greased every twelve months.
<u>TAPER ATTACHMENT</u>	Sunoco Way Lubricant #80	Oil every four hours when in use.
<u>TAILSTOCK</u>	Sunoco	Oil reservoir and tailstock barrel daily when in use.

\*Use the lubricants recommended, or their equivalent.

## ELECTRONIC AND ELECTRICAL SERVICING

SERIES 50 MODEL

### ELECTRICAL INSTALLATION

The machine has been thoroughly tested and checked before shipment; but due to the treatment it receives in transit, it is advisable to observe the following suggestions:

1. Check that all connections on terminal strips are tight.
2. With an ohmmeter, check between the base of the machine and all terminals for ground.
3. See that the printed circuit cards are secure in the proper receptacle.
4. Place the headstock gear shift lever in neutral and check for free spindle.
5. Connect the three phase lines to the panel disconnect switch, place the headstock in low gear, turn the speed control lever to 30 RPM, place the spindle forward-stop-reverse lever in the stop position, place the disconnect switch in the on position; if the power lines are energized the

red pilot light will glow. Depress the control on button, start the spindle by placing the spindle control lever in the down or forward position. The speed control unit is phase sensitive and if the spindle starts smoothly the three phase lines are connected to the disconnect switch correctly. If the spindle starts with a jerk and revolves unsteady at low speeds, and the minimum speed is high, reverse any two incoming line leads at the disconnect switch.

### EXPLANATION OF THE SPINDLE MOTOR CONTROL

This motor control system has the following features:

#### 1. Undervoltage Protection

If a loss of line voltage or an undervoltage occurs, the master control relay (CRM) drops open, stopping the spindle of the machine. The spindle will not start on resumption of voltage, and the CRM coil cannot be energized until the control on button is depressed. This feature is for operator safety.





## 2. Overload Protection

The motor is protected against an overload by the overload relay (IOL).

## 3. Anti-Plugging

If a DC motor is reversed while it is rotating by reversing the armature leads, a very high current is drawn by the motor. This causes detrimental arcing between the brushes and the commutator, contributing to very short motor life. Therefore, this control system dynamically brakes the motor down in speed to almost zero before the armature leads are reversed. This is accomplished by the anti-plugging relay.

## 4. Field Loss

If the spindle motor field loses its excitation, the motor will revolve at very high speed. To eliminate this possibility a field loss relay is employed. Its coil is placed in series with the motor field, therefore, if the motor field loses its excitation, so will the relay. The relay will become de-energized, drop open, and as its contacts are in series with the master control relay coil (CRM), the control circuit is switched off and the machine stops.

## 5. Current Limit

Included in this spindle speed control is the current limit circuit. It is used to set a limit of current that can be drawn by the spindle motor armature. This circuit is arranged so that it has no effect until a set current point is reached. At this point, this circuit takes over, and no more torque or current can be drawn from the motor. The motor, under this condition, will decrease in speed as more load is applied to its shaft. This protects the motor, the control, and the headstock gears against damaging overloads.

## 6. IR Drop Compensation

This circuit is used to compensate for the voltage drop across the motor armature. As more current is drawn by the motor, the speed drops in proportion to this voltage drop. To compensate for this IR drop of the armature, the voltage from the rectifier must rise above the no-load value an amount equal to the IR drop. This circuit automatically raises the voltage in proportion to the armature current and the motor speed remains practically constant from an unloaded to a loaded condition.

## 7. Constant Speed With Changing Line Voltage

The reference voltage used in this speed control system is regulated, in other words, it remains constant with a changing line voltage, a portion

of the output voltage is compared with the reference voltage, and the sum is used to control the speed of the motor. The reference voltage is positive, the feedback voltage is negative, and the feedback voltage is negative when compared to a speed increase. If the reference voltage is increased, the motor armature voltage increases and the motor speed increases. As the reference voltage increases, so does the negative feedback voltage; and the sum of these voltages, which is always positive, controls the motor speed. If the line voltage tends to increase, this normally would tend to increase the armature voltage; but by feeding back a portion of the output into the control, the output voltage remains constant with changing line voltage.

## 8. Individual Phase Control

The rectifier for the armature is of the three phase full wave type, employing three controlled sections and three non-controlled sections. Each controlled section has an individual pulse forming circuit. These circuits are identical, and are controlled by one signal developed across the summing capacitor (C4). This method eliminates false firing of the silicon controlled rectifiers (SCR1, SCR2, and SCR3).

## 9. Transient Voltage Suppression

In employing pulse type control of SCR's particular care must be exercised to eliminate transient voltages. These high spikes of voltage can cause failure of solid state components, and cause mis-firing of unijunction transistors, as well as silicon controlled rectifiers. Every precaution has been taken in the design of this spindle speed control to remove all transient voltages. This is accomplished by employing surge suppressors, and resistor capacitor circuits.

## 10. Solid State Electronic Components

All circuits comprising this spindle speed control are of the solid state type. No electron tubes of any type are used.

## RESISTORS

### R1 Current Limiting Resistor

Limits current through rectifier No. 1 when voltage is applied to the input and C1 in charging appears as a short circuit.

### R2 Power Absorbing Resistor

When the spindle motor is started, capacitors C2 and C13 are placed across the reference voltage. At this instant all the reference voltage appears across R2. The capacitors charge at an expo-

tention rate, and the motor speed follows this rise of reference voltage.

R3 Current Limiting Resistor

Limits current through contacts 1MF (39-40) and 1MR (38-39) when C2 and C13 are discharged. These capacitors must be discharged for operation on the next starting cycle.

R4 Bleeder Resistor

Dissipates charge stored in the summation capacitor C4. Without this resistor the response of the control would be sluggish.

R5 Voltage Dropping Resistor

Reduces the negative feedback voltage to the feedback potentiometer P3.

R6 Dynamic Brake Resistors

Used to dissipate the mechanical stored energy in the motor and dynamically brake it.

R7 Voltage Dropping Resistor

Reduces the output voltage to the anti-plugging relay coil AP.

R8-R11-R14 Voltage Dropping Resistors

Used in conjunction with D6, D7, D8; 3 zener diodes to clip and regulate each phase control voltage.

R9-R12-R15 Base Current Limiting and Isolation Resistors.

Used to protect the transistors Q1, Q3, Q5, and to isolate their bases.

R10-R13-R16 Temperature Compensating Resistors

The characteristics of the unijunction transistors change with temperature, (Q2, Q4, and Q6). These resistors compensate for this change.

R17-R18-R19 Emitter Resistors

Used with potentiometers P4, P5, and P6 to load the emitters and stabilize transistors Q1, Q3, and Q5.

R20 Emitter Resistor

Stabilizes and loads transistor Q7, the current limit transistor.

R21 Minimum Speed Resistor

Used with potentiometer P9 to set the minimum

speed of the spindle motor.

R22 Voltage Dropping Resistor

Used in conjunction with R26 and D14. A zener diode to clip and regulate the motor field control circuit.

R23 Spindle Motor Field Maximum Voltage Resistor

Used to set the maximum voltage on the motor field (70 volts).

R24 Emitter Resistor

Used to stabilize and load transistor Q8.

R25 Speed Control Shunting Resistor

Used to shunt the field section of the speed control potentiometer, P1.

R26 Constant Voltage Resistor

Used to hold the spindle motor field voltage constant with a changing line voltage.

R27 Minimum Field Voltage Resistor

Limits the minimum field voltage that can be set with maximum speed potentiometer P8.

R28 Base Resistor

Used to complete circuit between the emitter and base. Also affords a discharge path for C11, the current limit control voltage filter capacitor.

R30 Spindle Motor Starting Resistor

Used to limit the motor armature current, when the motor is started.

R31 to R42 Voltage Dividing Resistors

The reverse resistance of the diodes and silicon controlled rectifiers varies considerably. Resistors are placed across each individual unit to be sure the reverse voltage is equally divided across each unit in the series string.

## CAPACITORS

C1 Filter Capacitor

Used to remove the 120 cycle ripple voltage from the reference voltage.

C2-C13 Spindle Motor Starting Capacitors

Used with R2 to provide a slow rising reference voltage. As the armature voltage follows the reference voltage, this assures a smooth accelera-



tion of the motor when starting by producing low starting current.

**C3 IR Drop Compensation Filter Capacitor**

Used to remove the AC component from the IR drop compensation voltage.

**C4 Summing Capacitor**

Used to add and filter the voltages from the reference circuit, feedback circuit, and the compensation circuit.

**C5 Blocking Capacitor**

Used to block the DC current, but pass the AC component of the motor armature circuit.

**C6 Filter Capacitor**

This capacitor filters the output of the quick slow down circuit.

**C7-C8-C9 Unijunction Transistor Firing Capacitors**

These capacitors determine the time after the start of each phase cycle where the unijunction transistors fire. (Q2, Q4, and Q6)

**C10 Current Limit Filter Capacitor**

This capacitor filters the output of the current limit circuit.

**C11 Base Capacitor**

This capacitor filters the base voltage of transistor Q7.

**C12 Unijunction Firing Capacitor**

Determines at what point in the cycle the unijunction transistor Q9 fires.

**C14-C17-C20 Transient Voltage Suppression Capacitors**

These capacitors by-pass any conducted transient voltage that would cause the uni-junction transistors Q2, Q4, and Q6 to misfire.

**C16-C19-C22 Transient Voltage Suppression Capacitors**

These capacitors tend to by-pass any radiated transient voltage that would cause the silicon controlled rectifiers SCR1, SCR2, or SCR 3 to misfire.

**C23 Transient Voltage Suppression Capacitor**

This capacitor eliminates transient voltages that

would misfire the unijunction transistor Q9.

**C24-C25 Transient Voltage Suppression Capacitors**

Used to suppress any radiated transient voltage that would misfire the unijunction transistor Q9.

**C26-C-27 Transient Voltage Suppression Capacitors**

Used to suppress any radiated transient voltage that would cause the silicon controlled rectifiers (SCR4) (SCR5) to misfire.

**TRANSFORMERS****T1 Control Transformer**

Supplies voltage for the relays, contactors, coolant pump motor, etc. The primary is wound for 220, 230V; 440, 460 volt; 50/60 cycle, 240/480V, 60 cycle. Secondary wound for 110, 115, 120 volts.

**T2-T6 Current Transformers**

The primaries of these transformers are in series with 2 of the line leads to the motor armature power rectifier. When the spindle motor is loaded, they produce in their secondaries a voltage proportional to the line current. The voltage from T2 is rectified, and introduced into the control circuit to increase the armature voltage to compensate for the IR drop of the motor armature. (Note: IR drop equals current X armature resistance. The voltage from T6 is rectified, filtered, and introduced into the control circuit to limit the maximum current that can be drawn by the motor armature.

**T3-T4-T5 Phase Control Transformers**

These transformers furnish control voltage for each of the 3 phase pulse forming circuits. The primaries are wound for 220, 230/440, 460 volt, 50/60 cycle or 240/480 volt, 60 cycle. The secondaries are wound for 110, 115, or 120 volt.

**T7 Field Control Transformer**

This transformer supplies control voltage to the field control pulse forming circuit. Identical to T3, T4, or T5.

**T8 Field Anode Transformer**

Used to supply power to a bridge type controlled rectifier circuit. Primary is wound for 220, 230/440, 460 volt, 50/60 cycle or 240/480 volt, 60 cycle. Secondard wound for 110, 115, or 120 volts.

## PT1-PT2-PT3-PT4 Pulse Transformers

These transformers couple the pulse forming circuits to the gates of the SCR's.

## POTENTIOMETERS

### P1 Spindle Speed Control Potentiometer

This is a three section potentiometer. The sections marked A and B on the diagrams are used when the headstock is shifted into low, and section C is used when the headstock is shifted into high, or intermediate. Section C produces a resistance change over its entire rotation, and controls the field voltage of the spindle motor. Section A has a resistance change over the first half of rotation, and no resistance change over the last half of rotation. Section B has no resistance change over the first half of rotation, and resistance change over the last half of rotation. Section A controls the voltage output of the armature circuit and section B controls the output of the field circuit.

### P2 IR Drop Compensation Potentiometer

This potentiometer is used to adjust the amount of armature voltage rise with load so as to hold the no-load to load speed fairly constant.

### P3 Feedback Potentiometer

This potentiometer is used to adjust the maximum armature voltage, 420 volt when line voltage is 440, 220 volts when line voltage is 230 volts.

### P4-P5-P6 Stabilizing Potentiometers

Used to equally divide the total spindle motor armature current between the three sections of the three phase bridge rectifier. They also stabilize each phase control circuit by controlling the amount of emitter voltage introduced into each phase forming circuit.

### P7 Current Limit Potentiometer

Used to adjust the maximum current that can be drawn by the motor armature.

### P8 Maximum Speed Potentiometer

Used to adjust maximum speed of the spindle motor, 2875 RPM.

### P9 Minimum Speed Potentiometer

Used to adjust the minimum speed of the spindle motor, 287 RPM. This represents 30 RPM spindle speed.

## SEMI-CONDUCTORS

REC1 Four silicon diodes in a single phase full wave bridge rectifier circuit. Used to convert 115 volts AC to 150 volts DC to be used as the reference voltage.

REC2 Four silicon diodes in a single phase full wave bridge rectifier circuit. Used to convert the AC output voltage from T2, the IR drop compensation transformer, to a DC voltage proportional to motor armature current.

REC3 Four silicon diodes in a single phase full wave bridge rectifier circuit. Used to convert the AC voltage passed by C5 into DC voltage for the quick slow down relay, QSD.

REC4 Four silicon diodes in a single phase full wave bridge rectifier circuit. Used to convert 115 volts AC to 110 volts DC. This is used as a supply voltage for the field pulse forming circuit.

### D1-D2-D3-D4 Zener Diodes

Used to supply a constant voltage to be used as a reference, so that the armature voltage will not change with a line input voltage change.

### D5 Silicon Diode

Used to eliminate any negative voltage appearing across the summing capacitor, C4. This protects Q1, Q3, and Q4 from an excessive negative base voltage.

### D6-D7-D8 Zener Diodes

Used to rectify and clip the three phase control voltages.

### D9 Current Limit Silicon Diode

This diode rectifies the output of the current limit current transformer T6.

### D10 Zener Diode

Used to block out any current limit control voltage until the current limit is reached.

### D11-D12-D13 D18-D19-D20-D21-D22-D23

These silicon diodes are used with SCR1, SCR2, and SCR3 to make up a three phase full wave rectifier circuit, to supply armature voltage, and current for the spindle motor.



D14 Zener Diode

Used to clip the pulsating DC pulse forming circuit supply voltage.

D15 Free Wheeling Diode

This diode is used to dissipate the stored electrical energy of the spindle motor field.

D16-D17 These silicon diodes are used in conjunction with SCR4 and SCR5 to form a single phase full wave controlled bridge rectifier. This rectifier supplies power to the motor field rectifier.

Q1-Q3-Q5 NPN Type Transistors

These transistors amplify the signal collected in the summing capacitor C4. They also make it possible to control three separate pulse forming circuits with one control signal.

Q2-Q4-Q6 Unijunction Transistors

When the emitters of these unijunction transistors see a positive voltage approximately one-half their interbase voltage, the resistance between Base 1 and the emitter is reduced from a high value to a low value. This releases the charge stored in capacitors C7-C8 and C9, through pulse transformers PT1-PT2 and PT3, firing SCR's 1 - 2 and 3 in order, 120 electrical degrees apart.

Q7 NPN Silicon Transistor

When the current limit signal reaches a preset value, the zener diode D10 conducts. This turns on Q7 and Q7 shorts out the voltage across the summing capacitor C4. This action tends to stop the spindle motor.

Q8 NPN Silicon Transistor

This transistor is used in an emitter follower circuit, and acts as a variable resistor in series with a capacitor C12. It controls the charging rate of the capacitor.

SCR1-SCR2-SCR3 Silicon Controlled Rectifiers

Used to control the armature voltage and current.

SCR4-SCR5 Silicon Controlled Rectifiers

Used to control the field voltage and current.

THY1-THY2-THY3 Surge Suppressors

Used to clip any high voltage generated in the supply lines.

THY4 Surge Suppressor

Used to clip any transient high voltage generated in the IR drop compensation transformer T2.

THY5 Surge Suppressor

Used to clip any high voltage transient generated in the current limit transformer T6.

THY6 Surge Suppressor

Used to clip any high voltage transient generated by the spindle motor field.

**TIMER, RELAY AND CONTACTOR FUNCTIONS**

Master Control Relay (CRM)

Used to provide under voltage protection. This relay is de-energized on low or zero voltage, disconnecting the power lines to the machine. The machine will not start on resumption of supply voltage unless the control on button is depressed. This relay will also stop the machine if the SCR heat sinks are overheated, or if the spindle motor field loses its excitation.

Forward and Reverse Contactor (1MF-1MR)

This contactor is used to start, stop and reverse the spindle motor. It is arranged with two sets of contacts, two coils, and a mechanical interlock so that both sets of contacts cannot be closed at the same time. When 1MF coil is energized the spindle motor revolves in the forward direction 1MF contacts (A1-S2) (48-124) close, completing the circuit to the motor armature. 1MF contacts (34-38) close, connecting the reference voltage to the summing capacitor C4. 1MF contacts (39-40) open, removing the short circuit from the starting capacitors (C2 and C13). 1MF contacts (8-9) close, electrically interlocking the forward contactor (1MF). 1MF contacts (46-56) close, completing the quick slow down circuit. When the reverse contactor coil 1MR is energized the same procedure takes place, with the exception that the current through the 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 started, the circuit to the forward contactor coil 1MF is completed through the anti-plugging relay AP contacts (8-9). As the armature is energized, the AP relay coil connected across the armature is energized and AP contacts (8-9) open. As 1MF contacts (8-9) have closed, the 1MF coil is energized even though the AP relay contacts (8-9) have opened. If the spindle start lever is moved from the forward position, to the reverse position, the forward contactor 1MF opens but the reverse contactor cannot close as the AP contacts (8-9) are still open, and will remain open until the spindle motor has dynamically braked to a low speed. When the motor has reached this speed the voltage across the AP coil has reduced in value so that the AP relay is de-energized, and the AP relay contacts (8-9) close. This energizes 1MR coil, this closes 1MR contacts (8-9). The reverse contactor is energized, and electrically interlocked. The same procedure would take place if the reverse contactor 1MR had been initially closed and the lever moved to the forward position.

### 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 in series with the motor field; and if the power to the field fails, or the field opens, the (FL) coil is de-energized, its contacts (8-24) open dropping out the master relay (CRM), stopping the machine completely.

### Field Weakening and Starting Relays, Motor Starting Timer, (FW) - (SR) - (TR).

As all of these units are associated with the starting of the spindle motor they are listed together. .75 seconds after the motor has started, (TR) times out, energizing the starting relay (SR), and the field weakening relay (FW). Contacts (A2-124) on (SR) close, shorting out the starting resistor (R30), and FW relay contacts (104-98) close, (95-98) open, removing full field voltage from the spindle motor.

### Quick Slow Down Relay QSD And Dynamic Brake Relay (DB)

The quick slow down relay is energized as long as the spindle motor is revolving under power. Across the output of the armature supply is placed a capacitor C5 in series with the input of

a bridge rectifier (REC3), which is connected to the QSD coil. When the motor is being driven by the power supply there is a pulsating DC voltage present. This voltage will cause an AC current to pass through the capacitor, and energize the QSD coil. If the motor speed is reduced by the speed control, the back voltage generated by the motor becomes greater in amplitude than the output of the power supply. This back voltage, generated by the motor is not pulsating, therefore, the capacitor ceases to pass current and the QSD relay is de-energized. A N/O contact on QSD relay (8-18) in series with the dynamic brake relay coil opens, de-energizing DB. The N/C contacts on DB (A1-54) close, placing the dynamic brake resistor (R6) across the motor armature. The motor dynamically brakes to the new set speed, the motor then accepts power from the rectifier, the pulsating voltage again appears across the QSD circuit; the QSD relay is energized, and the dynamic brake resistor is removed from across the armature circuit. The QSD relay is de-energized when the motor is switched off by contacts on 1MF (46-56), or 1MR contacts (46-56) and braking of the motor takes place whenever the spindle control lever is placed in the off position.

### High Range Relay (1CR)

This relay switches the speed control from section C of the speed control potentiometer P1, to sections A and B, when the headstock is shifted from high or intermediate to the low gear range. The spindle motor operates by field control when shifted to the high or intermediate gear range, producing constant horse power in these two ranges. When shifted to low, both the field and armature are controlled and the motor develops constant horse power and constant torque.

## **SEQUENCE OF OPERATION**

When the disconnect is placed in the on position the control transformer is energized. If the control on button is depressed, contacts (5-6) close and the master control relay CRM coil receives current from Line 3 through the control off button contacts (3-5), control on button contacts (5-6), spindle control lever switch contacts (6-27), plug in board interlock contacts (27-28) (28-29) (29-30), 10L contacts (30-7), through the CRM coil to Line 2. CRM closes, and is electrically interlocked from Line 3 through the control off button contacts (3-5), CRM interlock contacts (5-8), field loss relay FL contacts (8-24), heat sink thermal switch contacts (24-25) (25-26) (26-27), plug in board interlock contacts (27-28) (28-29) (29-30), 10L contacts (30-7), through the CRM coil to Line 2.

**SEQUENCE OF OPERATION** (Continued)

When the master control relay closes, the three phase power lines are connected to the spindle motor rectifier circuit, the three phase pulse forming circuit transformer T3, T4, and T5 are energized, the field phase control transformer T7 is energized. The field is then supplied current, the field loss relay FL closes and the reference circuit is energized.

The spindle motor can now be started by operation of the spindle control lever, connected mechanically to a tap switch having contacts (6-27) (9-10) (9-12). These contacts are used to energize either the forward or reverse contactor coils, and to interlock the lever so that it must be placed in the off position, before the control on button is operative.

As the sequence of operation 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 or down position, the forward contactor 1MF coil receives current from Line 8, through the anti-plugging relay AP contacts (8-9), the forward switch contacts (9-10), through the 1MF coil to Line 2. The forward contactor 1MF closes and the spindle motor armature is energized from Line 46, through the overload relay heater coil 10L, 1MF contacts (A1-S2), through the motor armature (A1-A2), the starting resistor R30, 1MF contacts (48-124), to Line 48. When the armature is energized, the anti-plugging AP coil shunted across the armature is energized, but 1MF contacts (8-9) have closed, electrically interlocking the 1MF coil. 1MF contacts (34-38) close, completing the reference voltage circuit, 1MF contacts (39-40) open, removing the bleeder circuit from the starting capacitors C2 and C13, and 1MF contacts (46-56) close, energizing the QSD relay. When AP relay was energized contacts (9-14) closed, energizing the timer TR, after .75 seconds TR contacts (8-15) close, energizing the starting relay SR, and the field weakening relay FW. SR contacts (A2-124) close, shorting out the starting resistor R30, FW contacts (95-98) (104-98) operate, changing the field voltage from maximum, to the voltage selected by the speed control potentiometer P1.

The sequence of the braking cycle is the opposite of the starting cycle. The 1MF contacts (A1-S2) and (48-124) open, disconnecting the motor armature from the power lines. 1MF contacts (34-38) open, disconnecting the reference voltage from the control circuit, turning off the silicon controlled rectifiers SCR1, SCR2, and SCR3. 1MF contacts (39-40) close, discharging the starting capacitors C2 and C13, 1MF contacts (46-56) open, de-energizing QSD and DB, DB contacts (A1-54) close, dynamically braking the spindle motor. AP contacts (9-14) open, de-energizing TR, FW, and SR relays, resetting the control for the next motor starting cycle.

**OPERATION OF THE SPINDLE MOTOR**

The shunt wound D.C. motor used on this machine operates on the following principle. Base speed of the motor occurs when the maximum field and armature voltage is applied to the motor. To revolve below base speed the field voltage remains constant at maximum and the armature voltage is reduced. To revolve above base speed the armature voltage is held constant at maximum, and the field voltage is decreased. In the range of speed below base speed, the motor develops constant torque, and in the range above base speed, constant horse power. In the high and intermediate gear range the motor is operated in the constant horse power range. In the low gear range the motor is operated in both the constant horse power, and constant torque range. The total constant horse power range of the spindle is 1800 RPM to 120 RPM. The constant torque range is 120 RPM to 30 RPM.

**OPERATION OF THE TRANSISTORS**

All transistors used in this control are identical. They are the silicon NPN type, No. 2N2925. They are used as emitter followers and are biased positive at the collector, negative at the emitter, positive at the base, and negative at the emitter. An emitter follower has no voltage gain, but does have considerable current gain, a few microamperes change in emitter to base current will produce milliamperes of current change in emitter to collector current. The principle use of these transistors is to control the charging rate of the pulse forming capacitors (C7-C8-C9 and C12).

**OPERATION OF THE UNIJUNCTION TRANSISTORS**

All unijunction transistors used in this control are identical (No. 2N1671) but one, which is used as a temperature control (2N2646). There are three control elements contained in a unijunction transistor, Base 1, Base 2, and the emitter. They are biased in the following manner; negative at base 1, positive at Base 2, negative at Base 1, positive at the emitter. The resistance between Base 1 and Base 2 varies between 4000 and 8000 OHM in individual units. When the emitter voltage increases to approximately half of the Base 1 to Base 2 voltage, current flows between Base 1 and the emitter and the resistance between the emitter and Base 1 decreases to a low value. This releases the electrical charge stored in the pulse forming capacitors (C7-C8-C9-C12). This action forces a current of short duration through the primaries of the pulse transformers (PT1-PT2 and PT3),

this fires each phase SCR at some definite angle of each cycle, of each phase. The unijunction transistor has the characteristic of increasing resistance with an increase in temperature. The unijunction transistor (Q10) (2N2646) is connected in series with the field control circuit to compensate for the increase in speed with field temperature increase. The emitter of the unijunction transistor is not used in this application.

## OPERATION OF THE SILICON CONTROLLED RECTIFIERS

In this speed control system an SCR is placed in each phase of the three phase power supply. An SCR has 3 elements, the cathode, the anode, and the gate. Each SCR sees an AC voltage between its cathode and anode, and it can be turned on only when the anode is positive. If a pulse of a few volts positive at the gate is applied, current is passed through the SCR from cathode to anode for the remainder of the positive half cycle. Therefore, the average current and voltage can be controlled by firing the SCR at some time in the positive half cycle. If the SCR's are turned on at some time late in the positive half cycle, low voltage will be present at the output of the rectifier; if the SCR's are fired early in the positive half cycle, high voltage will be present at the output of the rectifier. The power amplification of an SCR is very high as an average gate power of a few milliwatts can control kilowatts of power in the output circuit.

## POTENTIOMETER ADJUSTMENTS

All potentiometer adjustments on this spindle speed control are set at the factory and should not be changed. If there is a malfunction of the control it cannot be corrected by adjusting these control setting potentiometers. If these potentiometers have to be reset use the following procedure:

1. Loosen the locknuts and turn maximum speed and compensation controls completely counter-clockwise.
2. Turn the feedback completely clockwise.
3. On printed circuit card No. 3 is located the 3 stabilizing trim-pots. Turn each potentiometer using a counter-clockwise rotation until the end stop is reached.
4. On printed circuit card No. 2 is located the current limit trim-pot. at the top, and minimum speed trim-pot. at the bottom. Turn each pot. using a counter-clockwise rotation until the end stop is reached.
5. Place a DC volt meter across A1 and A2 on the contactor panel.
6. Rotate each stabilizing trim-pot. 5 complete turns clockwise.
7. Shift the headstock to the low gear range and move speed control lever to maximum speed (300 RPM). Place the disconnect switch in the on position, depress the control on button, and start spindle with the spindle control lever.
8. Rotate feed back control counter-clockwise until voltage between A1 and A2 equals (420 volts DC on machines powered by 460 volt AC line) (220 volts DC on machines powered by 230 volt AC line).
9. Turn compensation control approximately 50 degrees clockwise.
10. Turn speed control lever to lowest speed 30 RPM. Adjust minimum speed control trim-pot. located at the bottom on printed circuit card No. 2 until spindle speed reads 30 RPM; stop spindle.
11. Shift headstock to the high gear range, set maximum speed of spindle (1800 RPM) by rotating max. speed potentiometer clockwise.
12. Stop Spindle. Start spindle and observe the 3 ammeters located on the power module. These three meters should read approximately the same current upon starting. If not, adjust the stabilizing controls on printed circuit card No. 3 until all three are approximately equal. To decrease phase current add more stabilizing by rotating controls clockwise.
13. Set current limit control located at the top on printed circuit card No. 2 by rotating the trim-pot. clockwise. This should be set so the motor holds speed up to a 150% load or 18 amperes on each meter for a 230 volt spindle motor and 9 ampere load on a 460 volt spindle motor. At this reading the speed will drop off and the amperes stay somewhat constant with increasing load.
14. If the spindle speed drops off excessively with a load less than 125% increase the compensation by turning the comp. control clockwise. If speed increases with load, turn comp. control counter-clockwise.
15. If the quick slow down and dynamic brake relay continually oscillate reduce compensation.



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## Attachment to Series 50 DC Spindle Drive Adjustment Instructions

This note is applicable only to a drive with the newer design printed circuit board #3. If your board #3 has the three pulse forming circuits not laid out identically and the three trim potentiometers are not equally spaced, it is of the older design and the spindle drive adjustment instructions for these trim pots should be followed as written in the *Series 50 Lathes Operator's Manual*.

### NOTE:

If printed circuit board #3 is laid out so that the three pulse forming circuits are arranged identically on the board with the three trim potentiometers equally spaced, the board is of the newer design. On this newer board #3, the trim pots are in series with the base 2 leads of unijunction transistors 2Q, 4Q, and 6Q rather than in series with the emitters of NPN transistors 1Q, 3Q, and 5Q. They are then GAIN pots rather than STABILIZING pots. That is, clockwise rotation of the pot adjustment increases the gain of the pulse forming circuit rather than increasing the stability (and decreasing the gain) of the pulse forming circuit.

Clockwise rotation of the pot adjustments on the newer board #3 moves the wipers toward wires 65, 73, and 81 and increases the amount of resistance in series with the base 2 leads. With the wipers fully counterclockwise, resistance is zero between wires 61 and 65, 69 and 73, and 77 and 81. This is the most stable setting of the trim pots and the drive can be operated like this without difficulty except that the circuits might not be balanced and the gain might not be enough. With the wipers fully clockwise, 10,000 ohms is placed between wires 61 and 65, 69 and 73, and 77 and 81. This is the most unstable setting of the trim pots and the drive should never be operated like this.

With this newer board #3: In step 6, rotate each gain (stabilizing) trim pot 2 turns clockwise rather than 5 turns. In step 12, decrease phase current by rotating the pot adjustment counterclockwise and increase phase current by rotating the pot adjustment clockwise. Normal setting of the trim pots when properly adjusted is usually less than 5 turns clockwise from the counterclockwise end. More than 5 turns clockwise tends to introduce too much gain and reduce stability of the pulse forming circuit operation.



## MAINTENANCE

To properly maintain the electronic and electrical equipment on this machine the electrician should use an electronic or high ohms per volt meter. When checking for continuity the disconnect switch should be placed in the off position. Extreme care should be exercised when making voltage or current checks since high voltage may be encountered.

It takes a small amount of time to replace or repair an electrical or electronic part. Unfortunately, in most cases, 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 wrong with the machine's operation.
2. If the electrician is not familiar with the sequence of operation of the machine, he should read the sequence of operation included in this manual.
3. Some time spent studying the manual and the diagrams 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 to a stop. 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 observes from the diagram that there could be one of three situations that may be causing the trouble. The dynamic brake resistance open R6, the FW relay contacts (98-101) not making contact, the QSD relay not being de-energized. Now with a multi-meter, he can check for continuity and voltage and determine which of the three possibilities is causing the trouble.
4. If a fuse is opening, it should be replaced with one of the same type and ampere rating. Some of the fuses used are for diode and controlled rectifier protection, they are of the current limiting type and if a standard fuse is used and the diodes or SCR's are subjected to a short circuit, they will be ruined before the standard fuse will clear the short circuit.

The electronic control of this spindle drive is contained on 3 printed circuit plug in cards. Card No. 1 is located to the left when facing the card holder. Card No. 2 is located in the center, and card No. 3 to the right. Card No. 1 contains the field control circuit and the IR drop compensation circuit. Card No. 2 contains the reference voltage circuit, the current limit circuit, and the quick slow down circuit. Card No. 3 con-

tains 3 identical pulse forming circuits, one used in each phase of the three phase power. This arrangement makes service of the electronic control quite easy. If spare cards are purchased, and it is known what functions each card performs, the card thought to be at fault can be replaced with one known to be good; then it can be ascertained immediately if the trouble lies in the control card. If it is the card at fault, it can be returned to Monarch for repair or repaired by the user's electrical department. For example, if the speed of the spindle cannot be controlled in the high or intermediate range, and the electrician has studied this manual, he knows that in the high and intermediate range the motor speed is changed by field control only. Therefore, knowing the field control is located on Card No. 1, he replaces this card and the machine is in operating condition again. If the card is replaced and the trouble still exists, it is apparent that the malfunction is not caused by a faulty card, but would have to be in the contactor panel or the speed control potentiometer.

## ELECTRICAL AND ELECTRONIC SERVICE SUGGESTIONS

1. Red light does not glow 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 (FU4) open.
2. Master control relay (CRM) will not close when the control on button is depressed.
  - (A) Spindle control lever not in the off position.
  - (B) Printed circuit boards not plugged into the correct receptacle.
  - (C) Overload relay (10L) tripped to off position.
3. Master control relay (CRM) will close when the control on button is depressed but falls open when the button is released.
  - (A) CRM contacts (5-8) not making good contact.
  - (B) Field loss relay (FL) contacts (8-24) not making contact.
  - (C) Spindle motor field not energized, therefore, FL relay not energized. This could be caused by a defective printed circuit card (No. 1) or FU5, or FU6, open.
4. Master control relay closes but spindle will not

revolve when the control lever is placed in either the forward or reverse position and 1MF or 1MR do not close.

- (A) Anti-plugging relay (AP) contacts (8-9) not making contact.
  - (B) Forward or reverse switches not making contact. Contacts (9-10) (9-12).
  - (C) 1MF or 1MR coil open.
5. Forward or reverse contactors close, but spindle motor will not revolve.
- (A) No reference voltage. Voltage between lines 32 and 38 should be approximately 88 volts, positive at 34.
  - (B) Contacts(34-38) on 1MF or 1MR not making contact.
  - (C) Printed circuit card No. 2 faulty.
  - (D) Speed control potentiometer (PIA) open.
  - (E) Starting capacitor (C2) shorted.
6. Spindle coasts to a stop.
- (A) Dynamic brake resistor open.
  - (B) Field weakening relay contacts (95-98) not making contact.
  - (C) QSD relay contacts (8-18) not opening when spindle motor is stopped.
  - (D) DB contactor contacts (A1 - 117) (117 - 127) (127-54) not making contact.
7. Spindle stops when revolving at maximum speed.
- (A) Field loss relay spring tension too great.
  - (B) Speed control potentiometer P1C or P1B defective.
8. Spindle speed drops off a considerable amount under load.
- (A) Compensation potentiometer (P2) set to low. Increase compensation by revolving control clockwise.
  - (B) Current limit control set so circuit operates before the maximum ampere rating of the motor is reached.
9. Spindle speed increases with load especially in the low gear range of the headstock.
- (A) Reduce the compensation by turning the com-

pensation control (P2) counter - clockwise.

10. Main fuses FU1, FU2, and FU3 open.
- (A) SCR or diode or both defective.
  - (B) Overload on spindle motor.
  - (C) Short circuit in wiring of machine.
  - (D) Shorted thyrector (THY1-THY2-THY3).
11. QSD and DB relays oscillate. Spindle increases and decreases in speed.
- (A) QSD relay spring tension to high.
  - (B) Compensation control potentiometer (P2) set too high. Reduce by turning counter-clockwise.
12. No speed control in the high or intermediate gear range but control in the low gear range.
- (A) Contacts (104-98) on FW relay not making contact.
  - (B) Defective speed control potentiometer (PIC).
  - (C) Printed circuit Card No. 1 faulty.
  - (D) Timer (TR) contacts (8-15) not making contact.
13. Spindle speed varies at the maximum speed of each gear range.
- (A) Adjust stabilization potentiometers (P4-P5 and P6). Increase stabilization by turning the 3 small potentiometers on printed circuit Card No. 3 clockwise. Turn all potentiometers an equal amount.
  - (B) Reduce feedback voltage slightly with feedback potentiometer (P3). Revolve counter-clockwise.

## MOTOR MAINTENANCE

Inspect the spindle motor at regular intervals, depending on service conditions. Check all brushes for ample remaining wear length. Be certain that ventilating openings are not obstructed. Keep motor clean.

## LUBRICATION

Ball-bearing housings are packed with grease at the factory. Greasing is not required before motor is put into service. Since the oil in the grease will ultimately become depleted, it is necessary to relubricate ball bearing motors periodically depending on



size and type of service. For best lubrication results, regrease with G-E grease No. D6A2C5. Avoid mixing different kinds of grease. Lubricate motor at standstill. Be sure lubrication fittings are clean and free from dirt. Remove lower grease relief plug. Free the relief hole from any hardened grease. Use only a hand-operated grease gun. Pump in grease until new grease appears at lower grease hole. After greasing, allow motor to run about 10 minutes before replacing grease relief plug. Recommended regreasing period, every 5 years.

BRUSHES

For brush removal:

- 1. Unfasten pigtail.
2. Push spring down and forward toward brush-holder stud to disengage lock tab.
3. Brush pigtails are provided with wear indicator markers. When marker reaches the top of brush-holder box, brush should be discarded. Continued use of worn-out brushes will result in damage to commutator and impaired performance.
4. Lift spring out. Spring can either be completely removed from brush holder or left attached with outside bottom loop engaged in lock tab slot. Remove brush.

SPINDLE MOTOR PARTS LIST

NOTE: When ordering specify Model No. and Serial No. of motor. (Complete nameplate data is desirable.) Give reference No. and description.

Table with 2 columns: REF. NO. and DESCRIPTION. Rows include Coil, main and pole; Coil, comm. and pole; Armature; Bearing, ball, antifriction; Cap, bearing; Gasket, bearing cap; Rigging, Brush; Yoke, brush holder; Brush holder (With pressure spring); Brush holder spring; Brush, carbon.

\*Specify whether for drive end or front end.

BRUSH INSTALLATION

- 1. Place brush in holder. Brush should move freely in holder with no appreciable side play.
2. Push spring into position until lock tab engages slot and locks.
3. Connect pigtail.
4. Fit brush to commutator contour using strip of coarse sandpaper. Do not use emery cloth. Keep the sand side turned to the brush face. After fitting brushes, clean dust from commutator, brush holders, and adjacent parts.

COMMUTATOR

Keep the commutator clean. Ordinarily, the commutator will require only occasional wiping with a piece of canvas or other non-linting substance. Do not use oil on the commutator. Avoid unnecessary use of sandpaper or stones on the commutator surface.

SPINDLE MOTOR SPECIFICATIONS

MOTOR FOR 460 VOLT, 3 PHASE, 50/60 CYCLE LINE

- 1. Dripprooffully guarded.
2. Ball bearings
3. 10 HP
4. 1150/3000 RPM
5. 480 volt armature
6. 70 volt field
7. 1 hour 90° C rise
8. DC motor
9. 18.3 amps. full load
10. Field amps. 7.42/1.98
11. Mod. 5CY 930 E 1

MOTOR FOR 230 VOLT, 3 PHASE, 50/60 CYCLE LINE

- Same specs. as above except:
1. 230 volt armature
2. 36.6 amps. full load

## ELECTRICAL AND ELECTRONIC PARTS LIST

Part	Part No.	Description
R1	499E-14	100 OHM 1/2 W Resistor
R2-R21-R23	499E-5	10 K 1/2 W. Resistor
R3	502E-1	1K 2W Resistor
R4	499E-1	51K 1/2 W. Resistor
R5	490E-71	40K 10W Resistor (460 V. Line)
R5	502E-24	10K 2W Resistor (230 V. Line)
R6	28932	27 OHM 350 W Resistor (460 V Line)
R6		15 OHM 420 W Resistor (230 V Line)
R7	490E-58	15K 10W Resistors
R8-R11-R14-R22	490E-45	4 KW Resistors
R9-R12-R15	499E-8	100K 1/2 W Resistors
R10-R13-R16	499E-3	330 OHM 1/2 W Resistor
R17-R18-R19	499E-15	1K 1/2 W Resistor
R20	497E-28	1.2 K 1 W Resistor
R23	499E-11	2.7 OHM 1/2 W Resistor
R24	499E-22	5.1K 1/2 W Resistor
R25	499E-19	20K 1/2 W Resistor
R26	499E-14	100 OHM 1/2 W Resistor
R27	499E-6	15K 1/2 W Resistor
R28	499E-6	15 K 1/2 W Resistor
R30	516E-15	8 OHM W Resistor
R31-R32-R33	502E-9	51 K 2 W Resistor
R34 to R42	499-1	51 K 1/2 W Resistor
C1-C4	28412	8 MF 250 WVDC Electrolytic Cap.
C6-C11	28412	8 MF 250 WVDC Electrolytic Cap.
C2-C13	29221	100 MFD 150 WVDC Electrolytic Cap.
C3	28411	2MFD 450 WVDC Electrolytic Cap.



SERIES

**50****OPERATOR'S MANUAL****ELECTRICAL AND ELECTRONIC PARTS LIST (Continued)**

Part	Part No.	Description
C5	28023	.04 MFD 600 WVDC Capacitor
C7-C8	28408	.47 MFD 35 WVDC Tantalum Capacitor
C9-C12	28408	.47 MFD 35 WVDC Tantalum Capacitor
C14-C17	28052	.47 MFD 400 Volt Capacitor
C20-C23	28052	.47 MFD 400 Volt Capacitor
C16-C19	28037	.1 MFD 200 Volt Capacitor
C22-C25	28037	.1 MFD 200 Volt Capacitor
C26-C27	28037	.1 MFD 200 Volt Capacitor
C24	29250	.01 MFD 200 Volt Capacitor
T1	29666	220,230/440, 460 volt, 50/60 cycle, or 240/480 volt 60 cycle, primary, 110, 115, 120 volt secondary 500 VA
T2-T6	22138	Current Trans
T3-T4-T5-T7	28046	220, 230/440, 460 volt, 50/60 cycle, or 240/480 volt 60 cycle primary, 110, 115, 120 volt secondary, 25 VA
T8	28403	220, 230/440, 460 volt, 50/60 cycle or 240/480 volt 60 cycle primary, 110, 115, 120 volt secondary, 750 VA
P1A-B-C	34966	Spindle speed control potentiometer 3 section 20k, 20k, 20k
P2	522E-13	10K, U taper, 1/8 inch shaft, 2W
P3	522E-6	25K, U taper, 1/8 inch shaft, 2W
P4, P5, P6	28396	10K, 1W Trim pot.
P7	522E-13	10K, U taper, 1/8 inch shaft, 2W
P8	522E-9	100K, U taper 1/8 inch shaft, 2W
P9	28396	10K, 1 W, Trim pot.
REC1	28402	4 No. A13D2 Silicon Diodes
REC2	28402	4 No. A13D2 Silicon Diodes
REC3	28402	4 No. A13D2 Silicon Diodes
REC4	28402	4 No. A13D2 Silicon Diodes
D1-D2-D3-D4-D6 D7-D8-D10-D14	34552	20 volt, 1 W Zener Diode
D5-D9	28402	No. A13D2 Silicon Diode

## ELECTRICAL AND ELECTRONIC PARTS LIST (Concluded)

Part	Part No.	
D11-D12-D13 D21-D22-D23	28400	No. 1N2160 Power Rectifier
D18-D19-D20	28401	No. 1N2160 R Power Rectifier
D15-D16-D17	28018	No. A40D Rectifier
Q1-Q3-Q5-Q7-Q8	28024	No. 2N2925 Transistor
Q2-Q4-Q6-Q9	28025	No. 2N1671 Unijunction Transistor
SCR1-SCR2-SCR3	28019	No. 2N692 Silicon Controlled Rectifier
SCR4-SCR5	28017	No. C20D Silicon Controlled Rectifier
THY1-THY2-THY3	28050	No. 6RS21SA20D20 (460 volt line)
THY4-THY5	28041	No. 6RS5SP4B4 Thyrector
THY6	24388	No. 6RS21SA5D5 Thyrector
CRM	28399	Relay
1MF-1MR	28056	Reversing Contactor
AP	25487	Anti-Plugging Relay
FL	24506	Field Loss Relay
FW and 1CR	29227	FLD Weakening and High Range Relays
DB	28055	Dynamic Brake Contactor
QSD	24328-2	Quick Slow Down Relay No.
TR	28463	75 Second Timer
SR	28054	Starting Relay No.
DISC	23900	Disconnect Switch
OLI	28398	Overload Relay
Heater	28417-67	Heater Element (230 Volt Line)
Heater	28417-47	Heater Element (460 Volt Line)
FU1-FU2-FU3	29229	Buss Limitron Fuse Type KAB 40, 40AMP. 250V (230 Volt Line)
FU1-FU2-FU3	29228	Buss Limitron Fuse Type KAC 20, 20AMP. 500V (460 Volt Line)
FU4	15636	Buss Non 5, 5 AMP. 250 Volt
FU5-FU6	28653	Buss Limitron Fuse Type KAB 10, 10 AMP. 250 Volts
FU7	27016	Buss Fusetron 2 1/4 AMP.

(NOTE: Use only fuse specified.)



SERIES

**50**

**OPERATOR'S**

**MANUAL**

INSTRUCTIONS FOR ORDERING PARTS

When identifying parts from these drawings, list

1. Lathe serial number. This is located on the bed between front vee and flat on tailstock end.
2. Quantity required.
3. Number and name of part.
4. Number of assembly drawing where part is shown.

Example:

1. - Part No. 11939 gear for lathe No. 47828 as shown on drawing.No. 200,842, sheet 1.

LATHE	16 X 54
TYPE	ENGINE
SPECS.	16" SWING
STOCK NO.	
SERIAL NO.	47828
P.E.C. NO.	3416-23-22-01
<b>MONARCH MACHINE TOOL CO.</b> SIDNEY, OHIO, U.S.A.	
DATE OF MFG.	66
MODEL NO.	50
CONTRACT	
INSPECTED	
WEIGHT	1400

An Identification Plate Like This  
Is On Each Series 50 Lathe



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**NOTES**

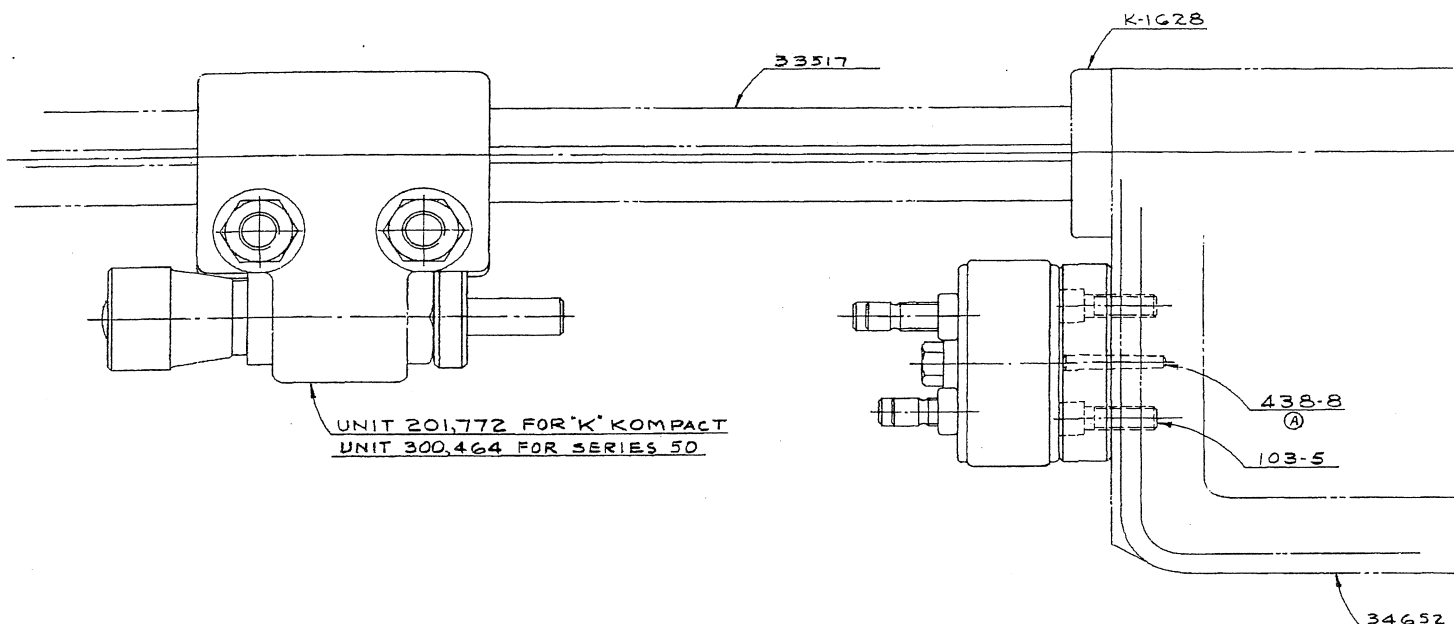
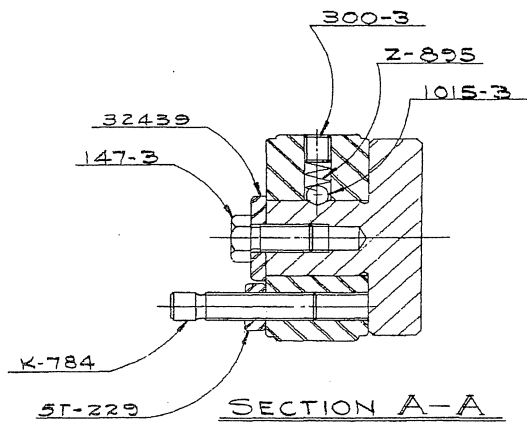


MONARCH MACHINE TOOL COMPANY  
SIDNEY, OHIO

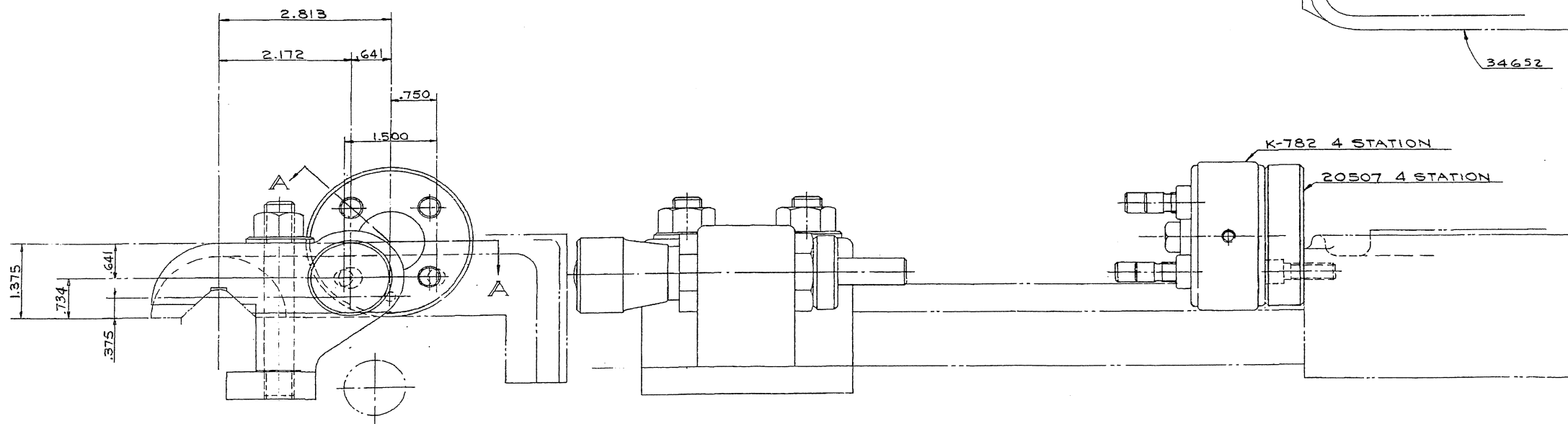


FRACTIONAL DIMENSIONS & DECIMAL DIMENSIONS  $\pm .015$  UNLESS OTHERWISE SPECIFIED  
BREAK SHARP EDGES .001 TO .011

PART NO. 201779



UNIT 201,772 FOR "K" KOMPACT  
UNIT 300,464 FOR SERIES 50



K-782 4 STATION  
20507 4 STATION

NOTES

FINISH ALL OVER  
MACHINE SURFACES NO. FINISH  
GROUND SURFACES NO. FINISH  
UNLESS OTHERWISE SPECIFIED

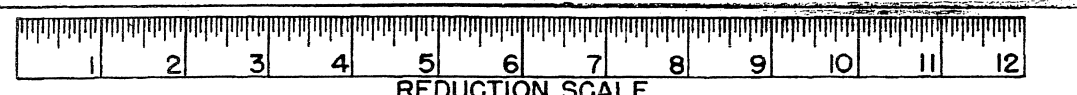
PART NO. 201779

GEAR DATA  
 TEETH  
 DIAMETRAL PITCH  
 PRESSURE ANGLE  
 HELIX ANGLE  
 PITCH DIAMETER  
 BASE CIRCLE DIAMETER  
 NORMAL DIAMETRAL PITCH  
 NORMAL PRESSURE ANGLE  
 TOOTH THICKNESS  
 PIN DIAMETER  
 MEASUREMENT OVER PINS  
 MATES WITH  
 ON CENTERS  
 BACKLASH ALLOWED  
 SHAVE TEETH  
 DRIVER CROWN SHAVE  
 DRIVEN GRIND TEETH  
 HEAT TREATMENT

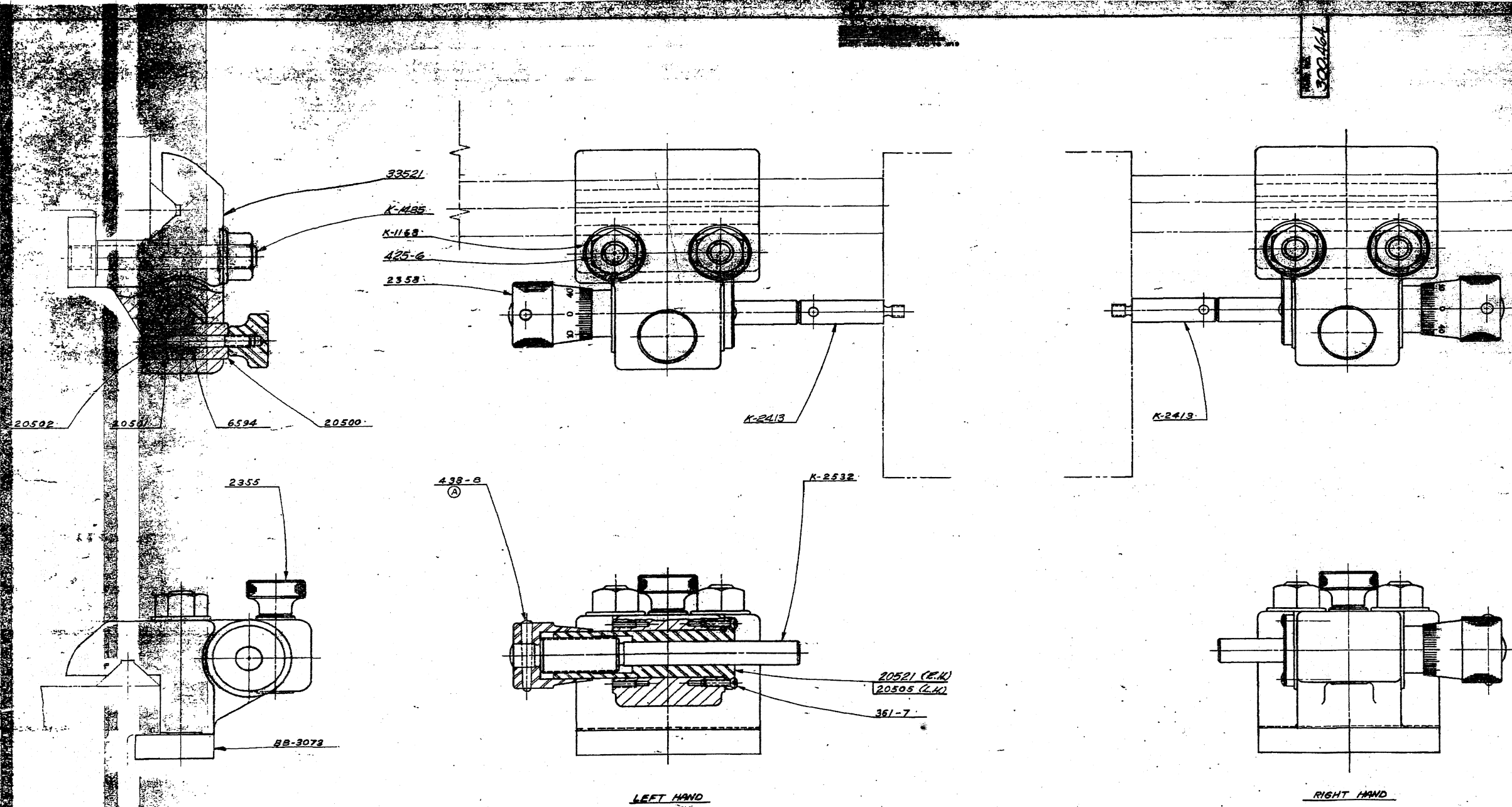
USE CASTING  
 USE FORGING  
 ALTER PATTERN  
 REWORK FIN. PC.  
 OUTSIDE INSIDE  
 MATERIAL  
 REPLACES REPLACED BY  
 PART NO. 201779

ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	DRAWN	CHECKED	APPROVED	DATE	SCALE
A WAS 438-5	G.D.	9/4/47	F			K.M.C.			8-23-60	FULL
B			G							
C			H							
D			I							
E			J							

PART NAME ASSEMBLY  
 UNIT MULTI-POS. CARRIAGE STOP  
 FIRST USED ON "K" KOMPACT  
 ENGINEERING DEPARTMENT  
 THE MONARCH MACHINE TOOL CO.  
 SIDNEY, OHIO, U. S. A.



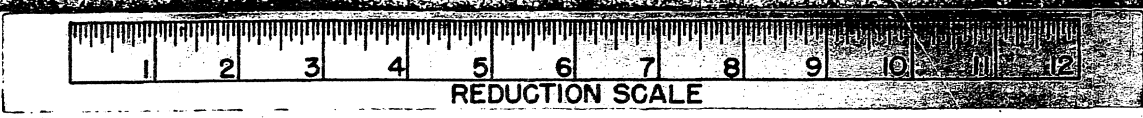
REDUCTION SCALE



REV	DATE	DESCRIPTION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

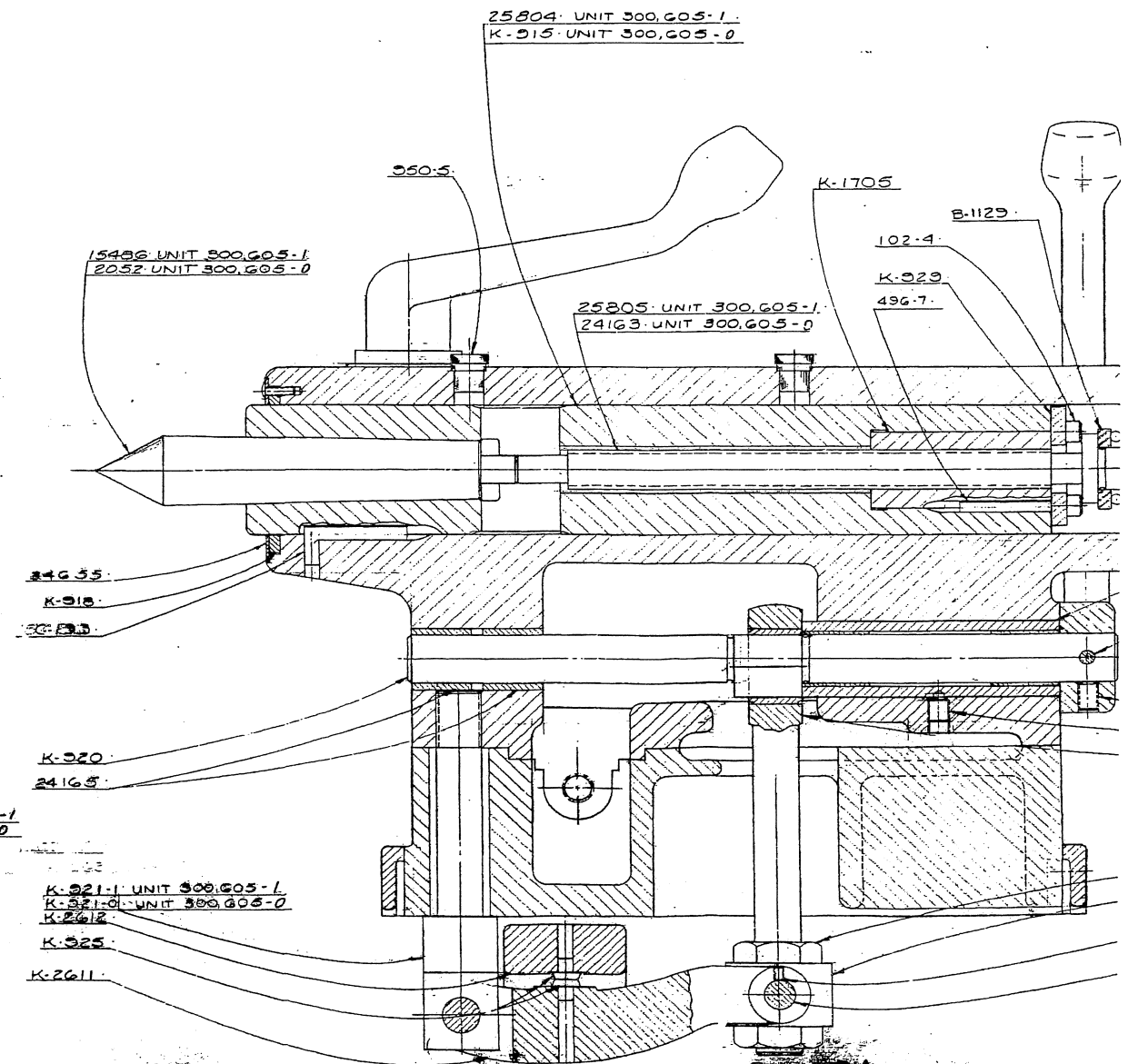
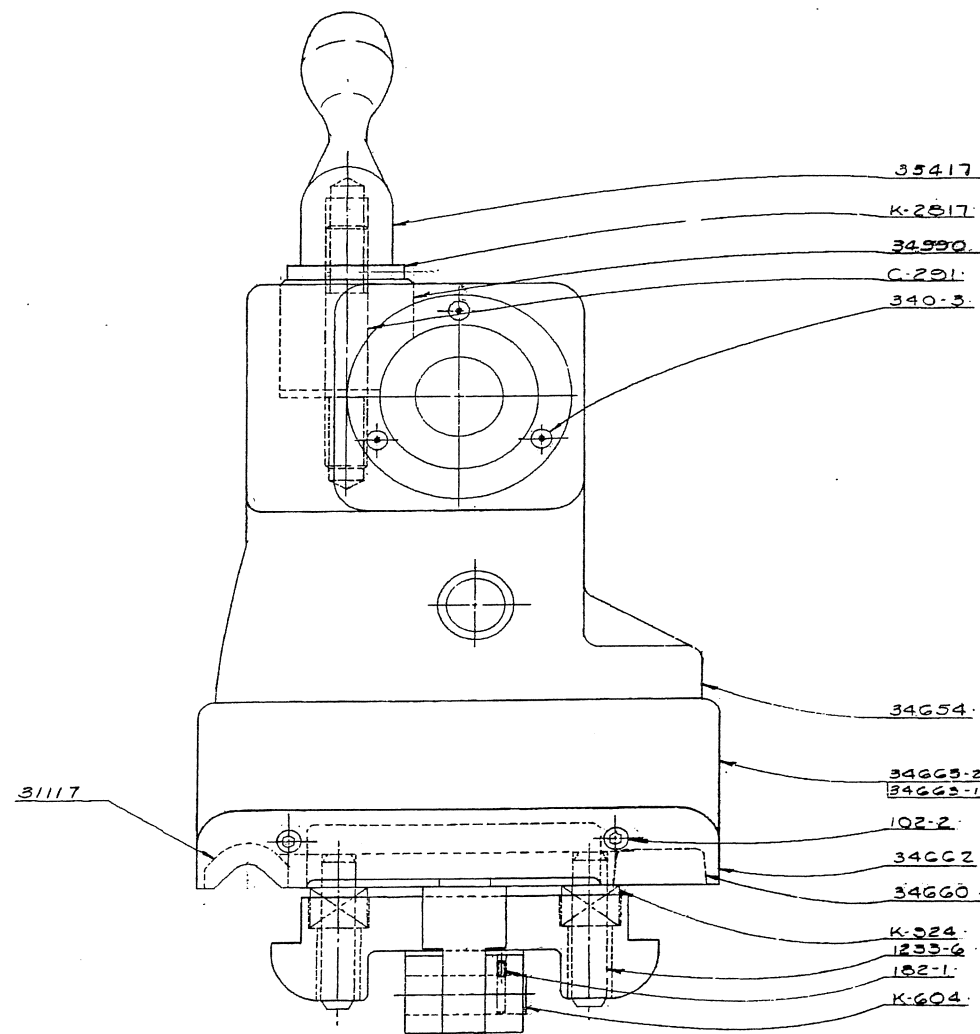
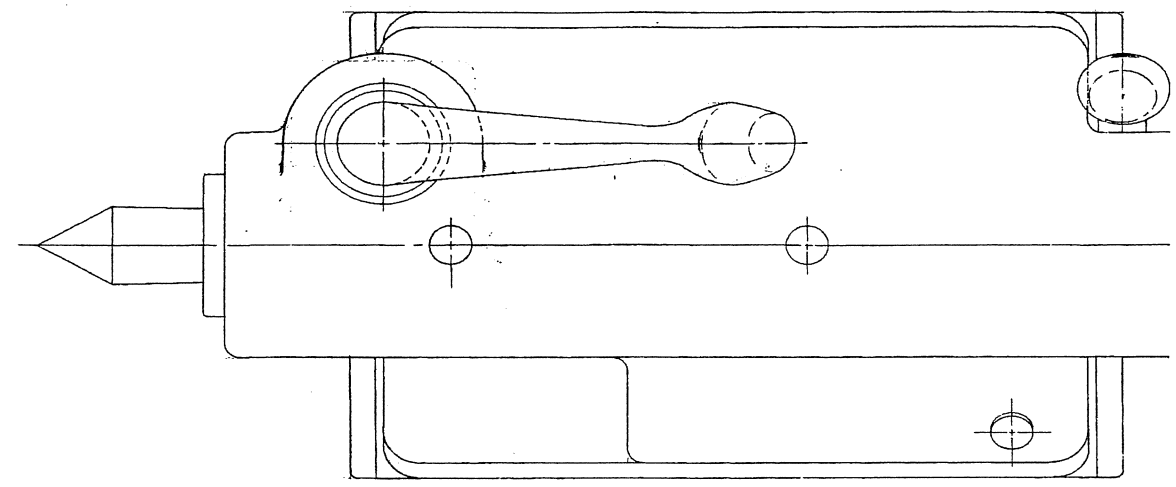
300,464  
 PART DATA

300,464  
 K COMPACT  
 201772  
 300,464





FRACTIONAL DIMENSIONS =  
DECIMAL DIMENSIONS = .010  
UNLESS OTHERWISE SPECIFIED  
BREAK SHARP EDGES .005 TO .015

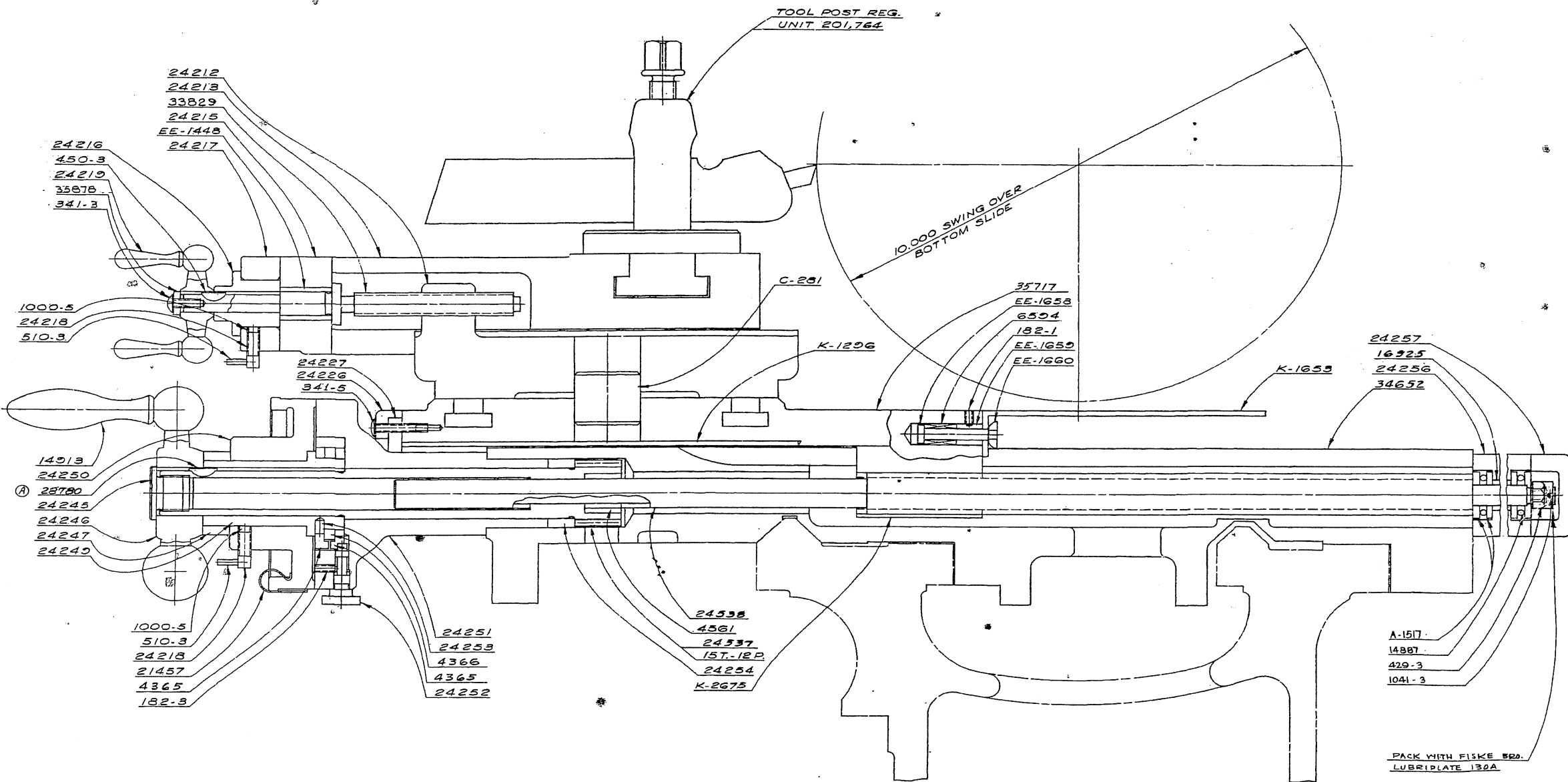


FRI

FRACTIONAL DIMENSIONS &  
DECIMAL DIMENSIONS  $\pm .015$   
UNLESS OTHERWISE SPECIFIED  
BREAK SHARP EDGES .04 TO .011

PART NO. 201,753

NOTES

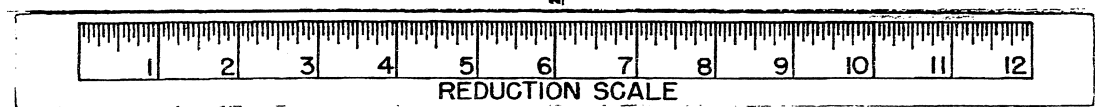


MACHINE SURFACES NO.	FINISH
GROUND SURFACES NO.	FINISH
UNLESS OTHERWISE SPECIFIED	
PART NO.	201,753
GEAR DATA	
TEETH	
DIAMETRAL PITCH	
PRESSURE ANGLE	
HELIX ANGLE	
PITCH DIAMETER	
BASE CIRCLE DIAMETER	
NORMAL DIAMETRAL PITCH	
NORMAL PRESSURE ANGLE	
TOOTH THICKNESS	
PIN DIAMETER	
MEASUREMENT OVER PINS	
MATES WITH	
ON	CENTERS
BACKLASH ALLOWED	
DRIVER	SHAVE TEETH
DRIVEN	CROWN SHAVE
	GRIND TEETH
HEAT TREATMENT	

USE CASTING	
USE FORGING	
ALTER PATTERN	
REWORK FIN. PC.	
OUTSIDE	INSIDE
MATERIAL	
REPLACES	REPLACED BY
201745	
PART NO.	
201,753	

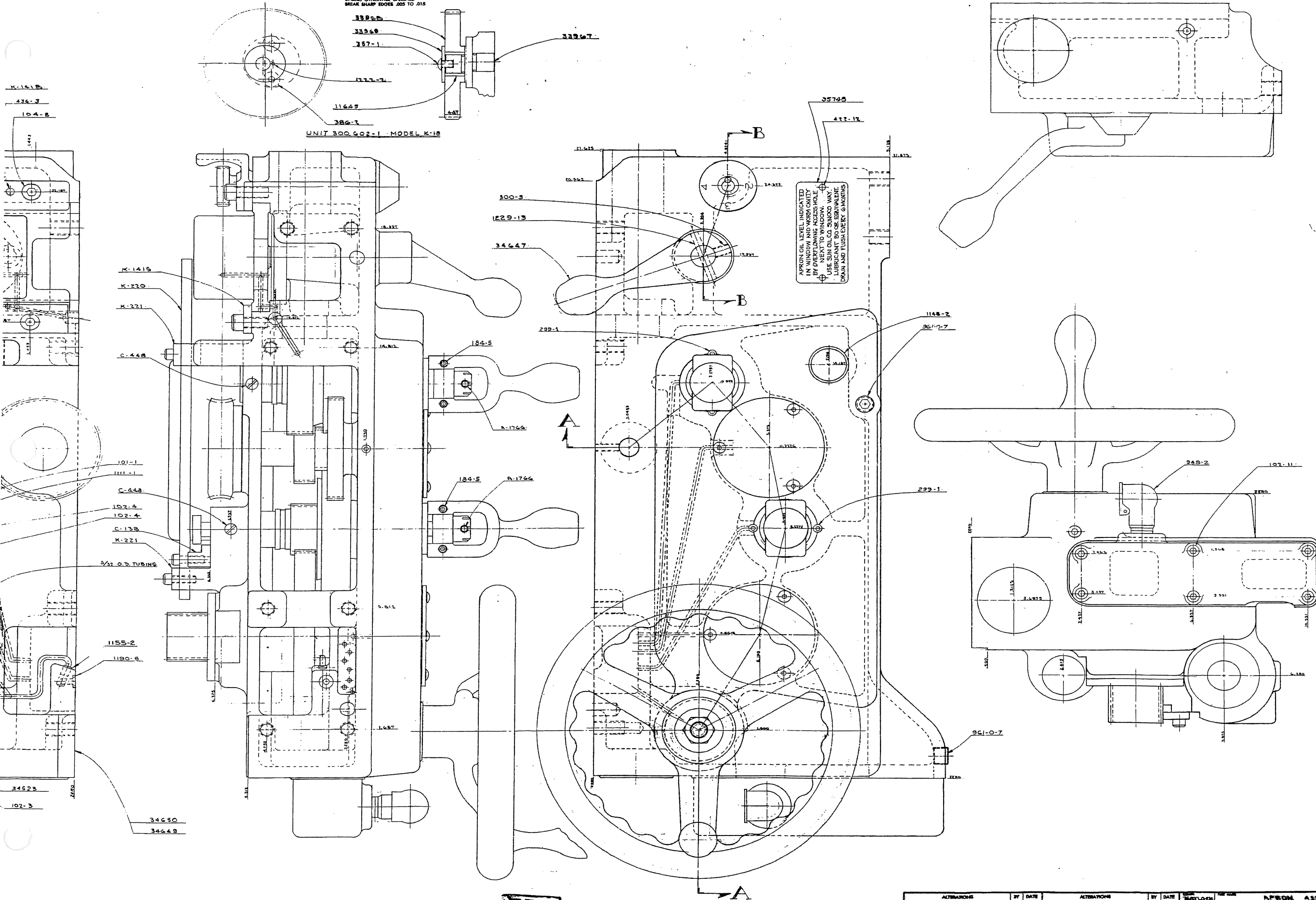
ALTERATIONS	BY	DATE	APPROVED	DATE	BY	DATE	APPROVED
A WAS 450-3	JF	2-3-45	F				
B			G				
C			H				
D			I				
E			J				

ASSEMBLY  
UNIT  
FIRST USED ON  
K-1 LATHE  
ENGINEERING DEPARTMENT  
THE MONARCH MACHINE TOOL CO.  
SIDNEY, OHIO, U. S. A.





FRACTIONAL DIMENSIONS IN DECIMAL DIMENSIONS ± .010 UNLESS OTHERWISE SPECIFIED  
 BREAK SHARP EDGES .005 TO .015



APRON OIL LEVEL INDICATED IN WINDOW AND WORK CAVITY BY PEEK TO WINDOW. USE SUN OIL CO. SINOCD WAX LUBRICANT 80 OR EQUIVALENT. DRAIN AND PUSH EVERY 6 MONTHS.

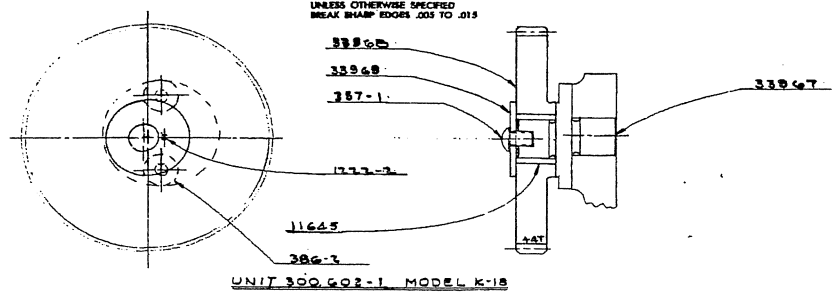
NOTES	
FINISH ALL OVER	
MACHINED SURFACES NO. F	
GROUND SURFACES NO. R	
(UNLESS OTHERWISE SPECIFIED)	
300.602	
GEAR DATA	
TEETH	
DIAMETRAL PITCH	
PRESSURE ANGLE	
HELIX ANGLE	
PITCH DIAMETER	
BASE CIRCLE DIAMETER	
NORMAN DIAMETER	
NORMAN PRESSURE ANGLE	
TOOTH THICKNESS	
FIN DIAMETER	
MEASUREMENT OVER MATES WITH	
ON BACKLASH ALLOWED	GRADE
	SHAPE TEETH
DRIVEN	CROWN DIA
DRIVEN	GRIND TEETH
	MEAT MEASUREMENT
USE CASTING	
USE FORGINGS	
ALUM. OR STEEL	
BRASS OR P.C.	
GRADE	FINISH
MATERIAL	
REPLACE	REPLACE
PART NO.	
300.602	
OF 1	

FR2

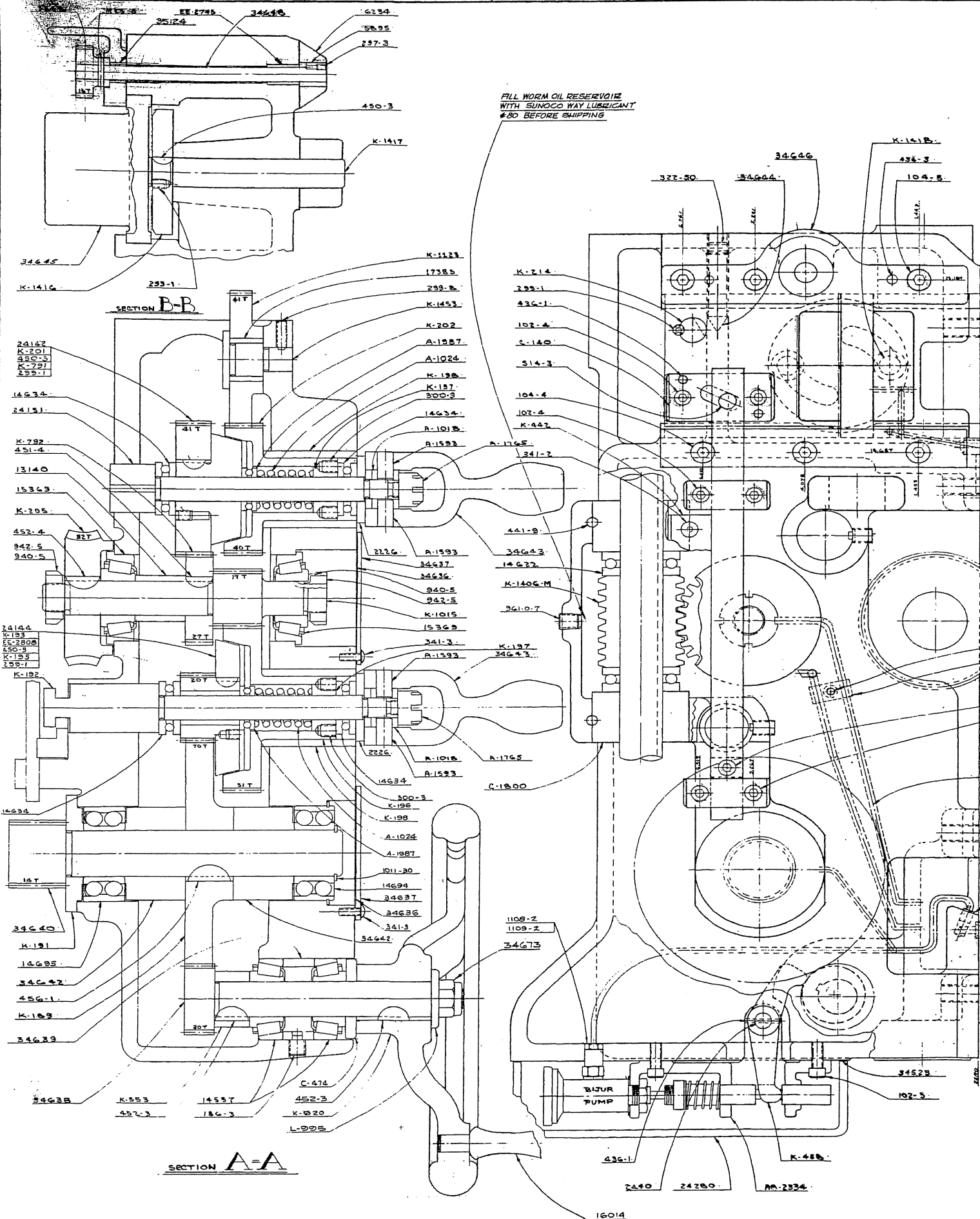
ALTERNATIONS	BY	DATE	DESCRIPTION	BY	DATE	DESCRIPTION
A						
B						
C						
D						
E						

APRON ASSY  
 SERIES 60  
 PART NO. 300.602

FRACTIONAL DIMENSIONS =  
DECIMAL DIMENSIONS = .010  
UNLESS OTHERWISE SPECIFIED  
BREAK SHARP EDGES .005 TO .015

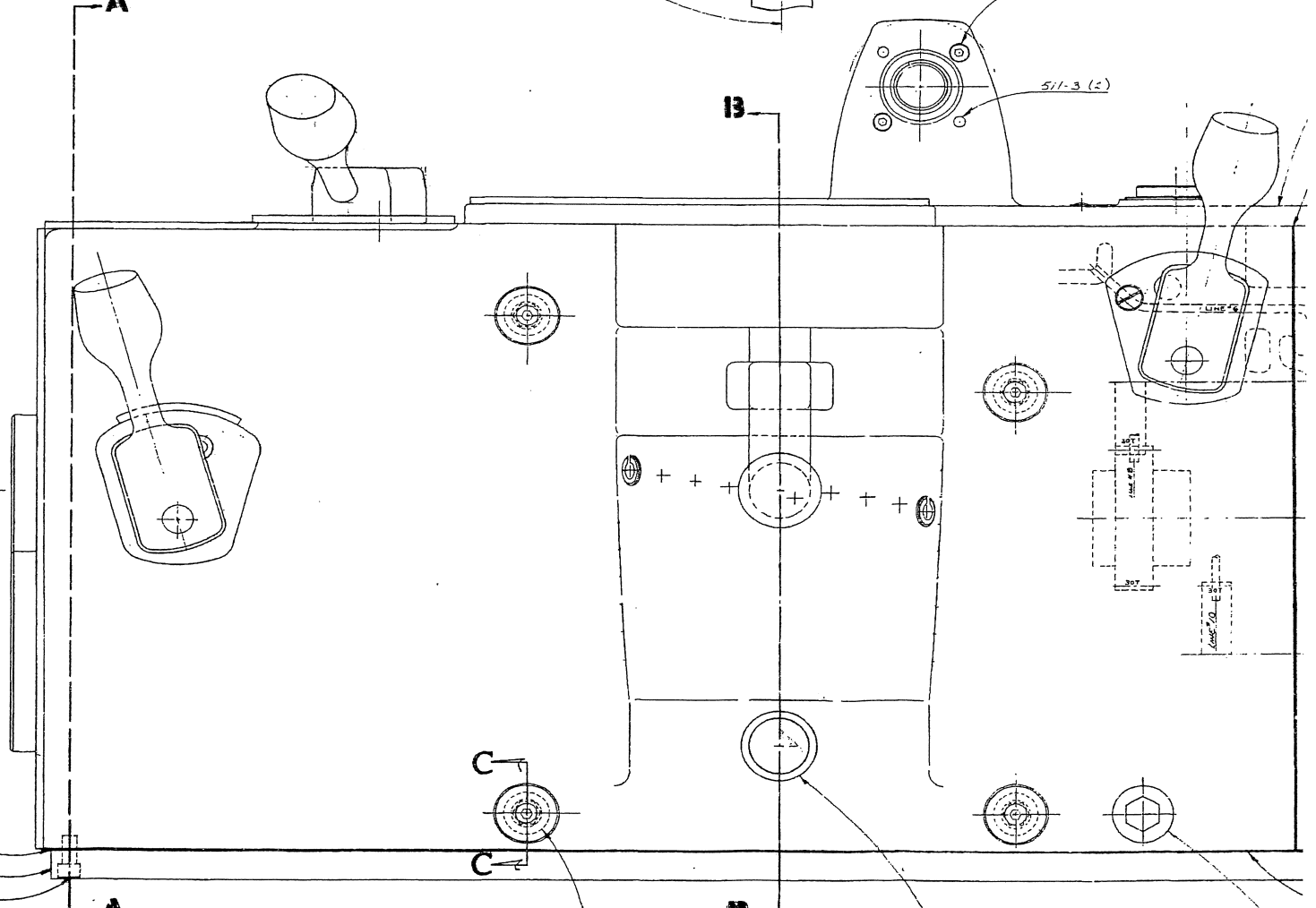
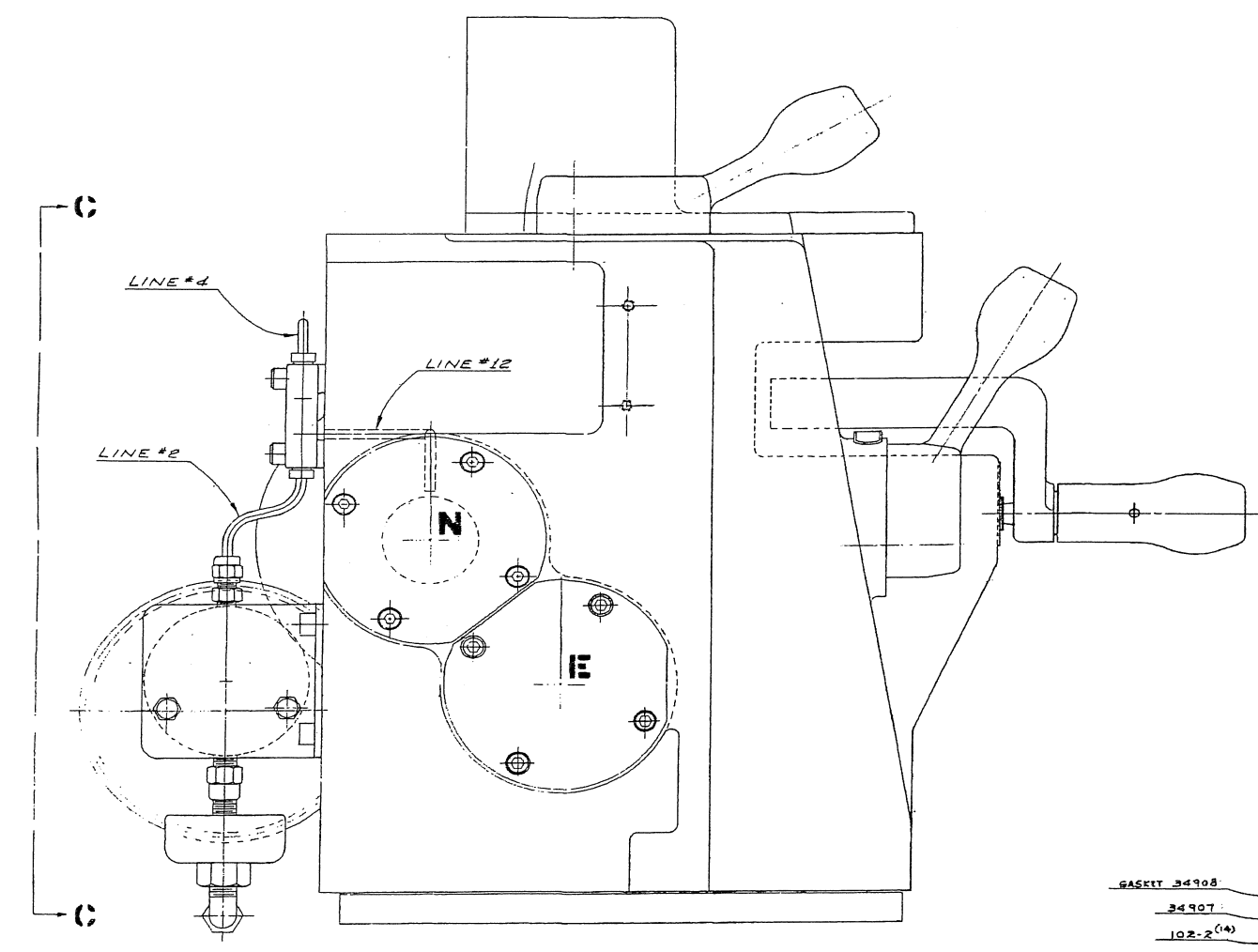
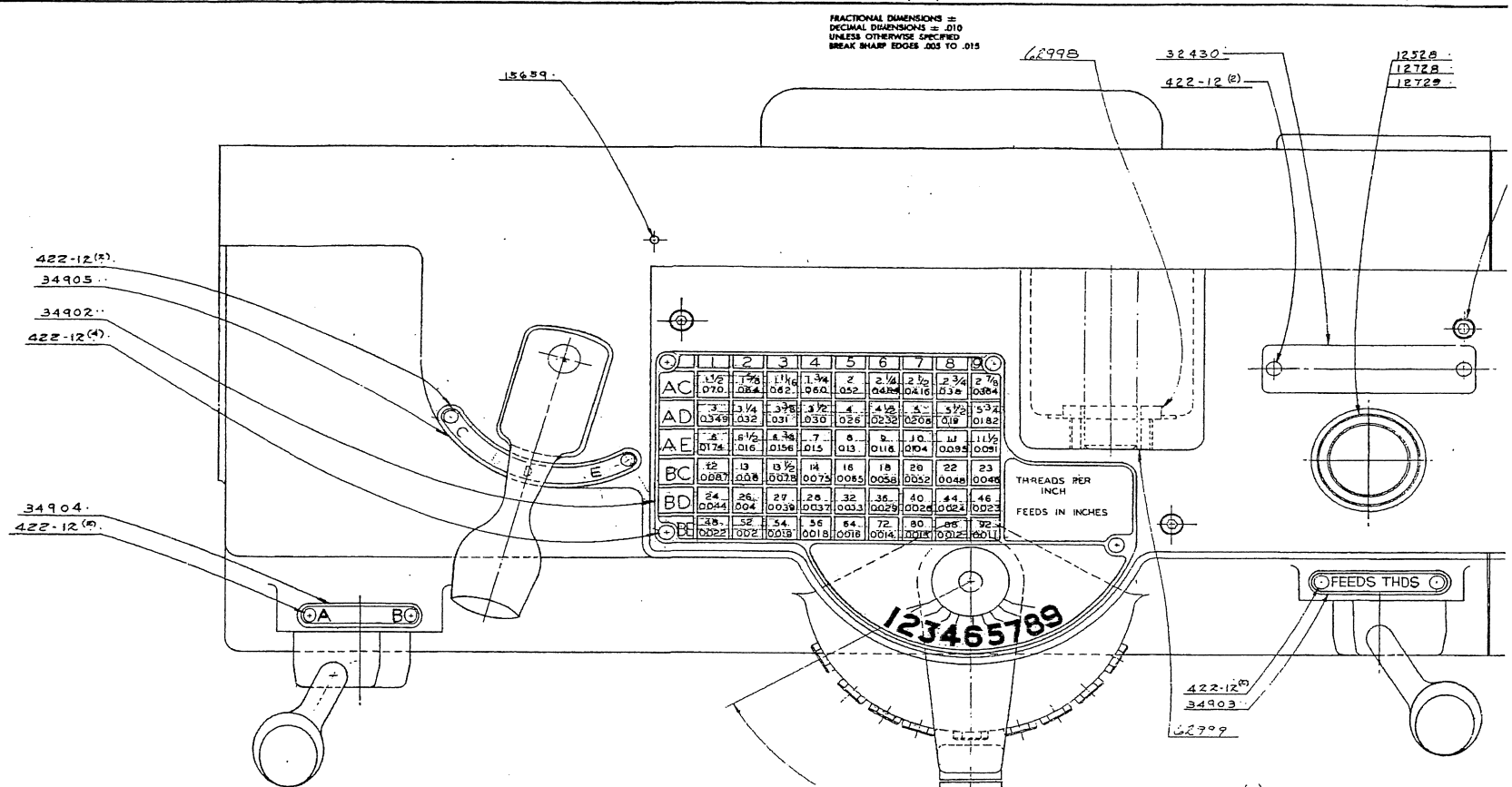
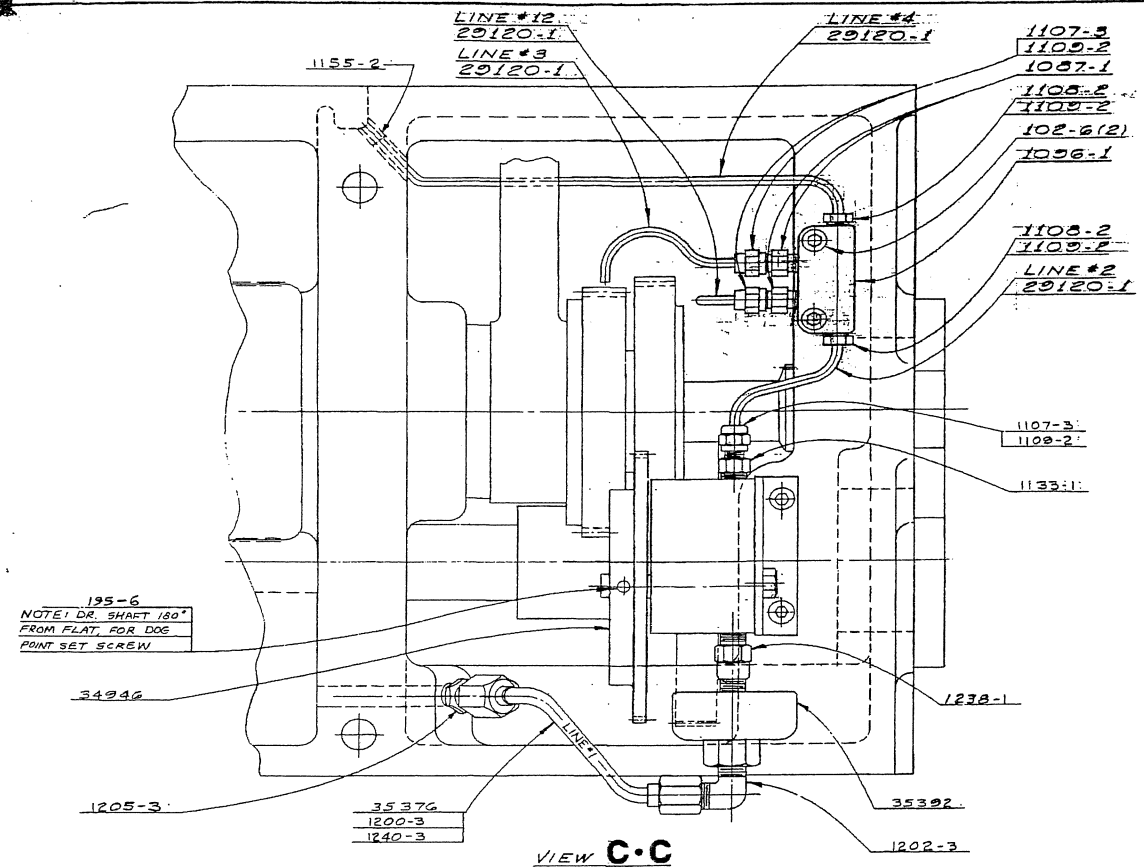


FILL WORM OIL RESERVOIR  
WITH SUNOCO WAY LUBRICANT  
#80 BEFORE SHIPPING





FRACTIONAL DIMENSIONS =  
DECIMAL DIMENSIONS = .010  
UNLESS OTHERWISE SPECIFIED  
BREAK SHARP EDGES .003 TO .015

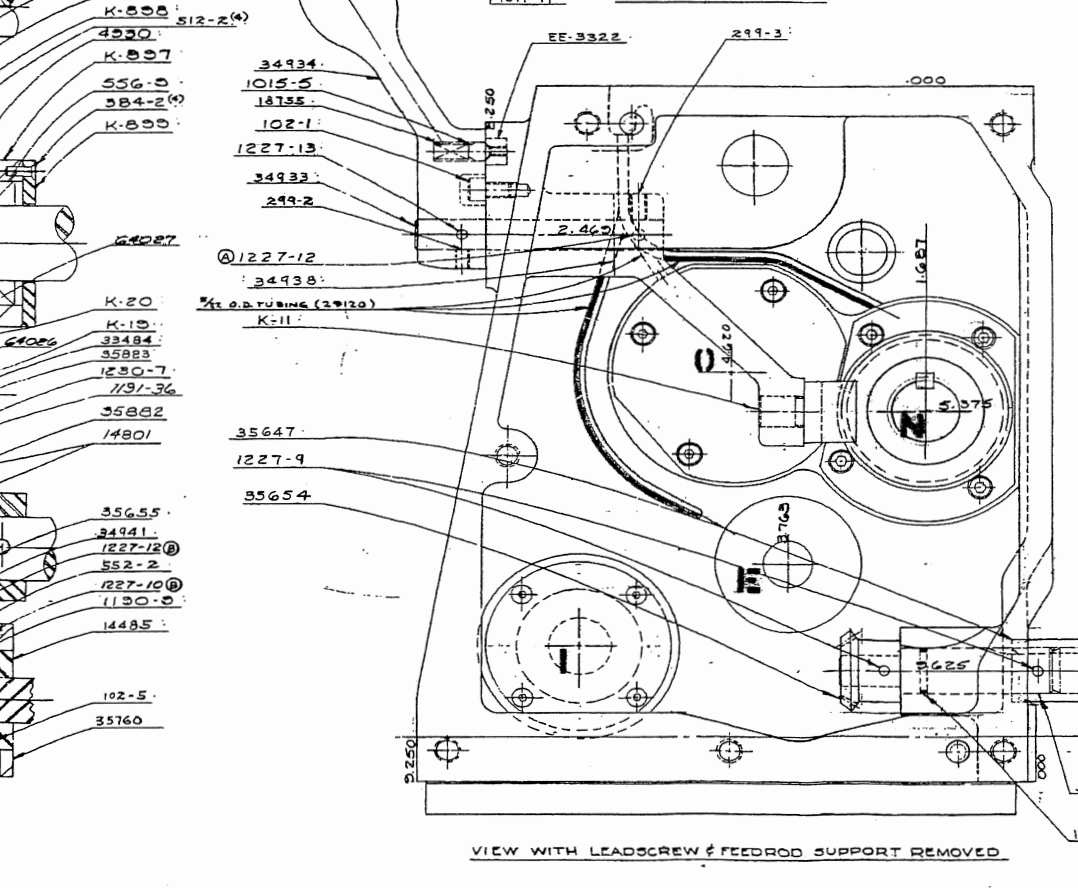
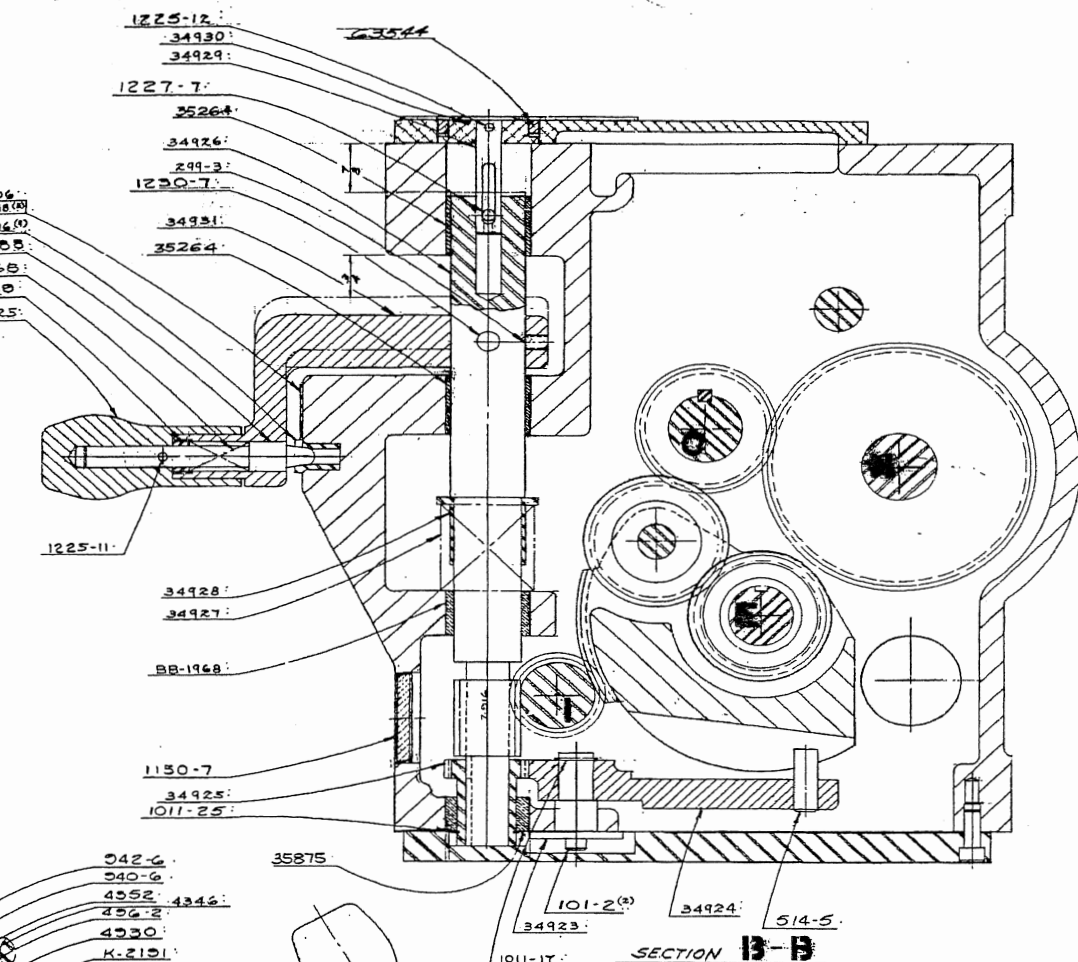
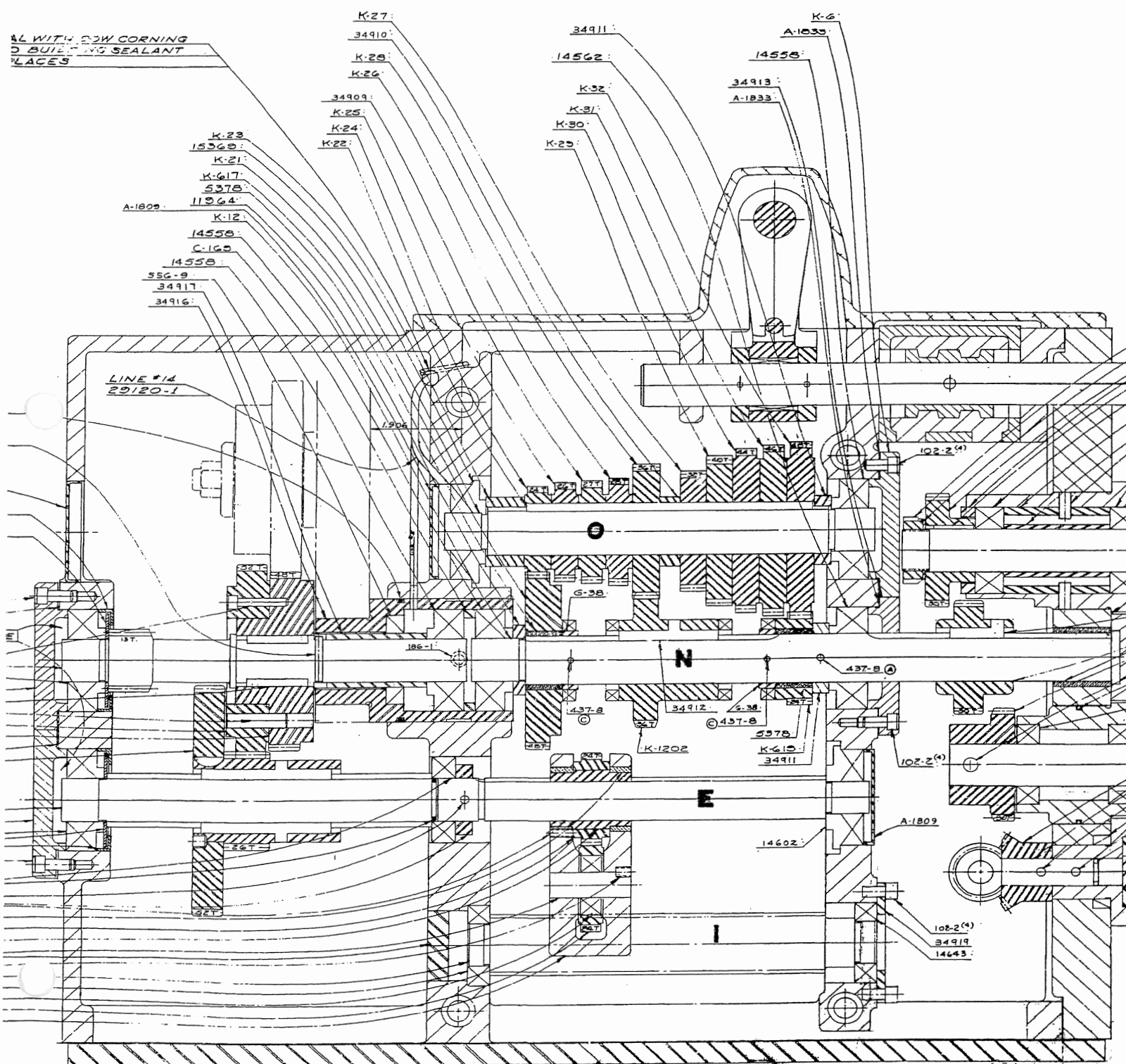


**FRI**

FRACTIONAL DIMENSIONS ±  
DECIMAL DIMENSIONS ± .010  
UNLESS OTHERWISE SPECIFIED  
BREAK SHARP EDGES .005 TO .015

ASSEMBLY NOTE FOR TUMBLER SWITCHER (REF. SECTION B-B)  
POSITION TUMBLER (34920) SO THAT TUMBLER  
IDLER GEAR SET (34922) IS IN MESH WITH  
EXT. GEAR (K-24) ON CONE SHAFT. ROTATE  
SWITCHER SHAFT (34926) TO ESTABLISH VERTICAL  
DIMENSION INDICATED. POSITION LEVER (34931)  
TO VERTICAL DIMENSION AND ANGLE (SEE SHEET  
NO. 1) INDICATED. USE SET SCREW TO LOCK  
POSITIONS FOR BOTH FREE AND MESHED  
CLEARANCE BEFORE FINAL PINNING TO SHAFT.

AL WITH .02W CORNING  
D BUILDING SEALANT  
PLACES



**NOTES**

FINISH ALL ON  
MACHINED SURFACES  
GROUND SURFACES N  
UNLESS OTHERWISE SP

**300,62**

**GEAR DATA**

TEETH  
DIAMETRAL PITCH  
PRESSURE ANGLE  
HELIX ANGLE  
PITCH DIAMETER  
BASE CIRCLE DI  
NORMAL CHAM  
NORMAL PITCH  
TOOTH THROCK  
PIN DIAMETER  
MEASUREMENT  
MATES WITH

ON BACKLASH AMONG  
SHAFT  
DRIVEN GEAR  
DRIVEN GEAR  
HEAT TREATING

USE CASTING  
USE FINISH  
ALUM. FINISH  
BRONZE FIN. PC  
STEEL

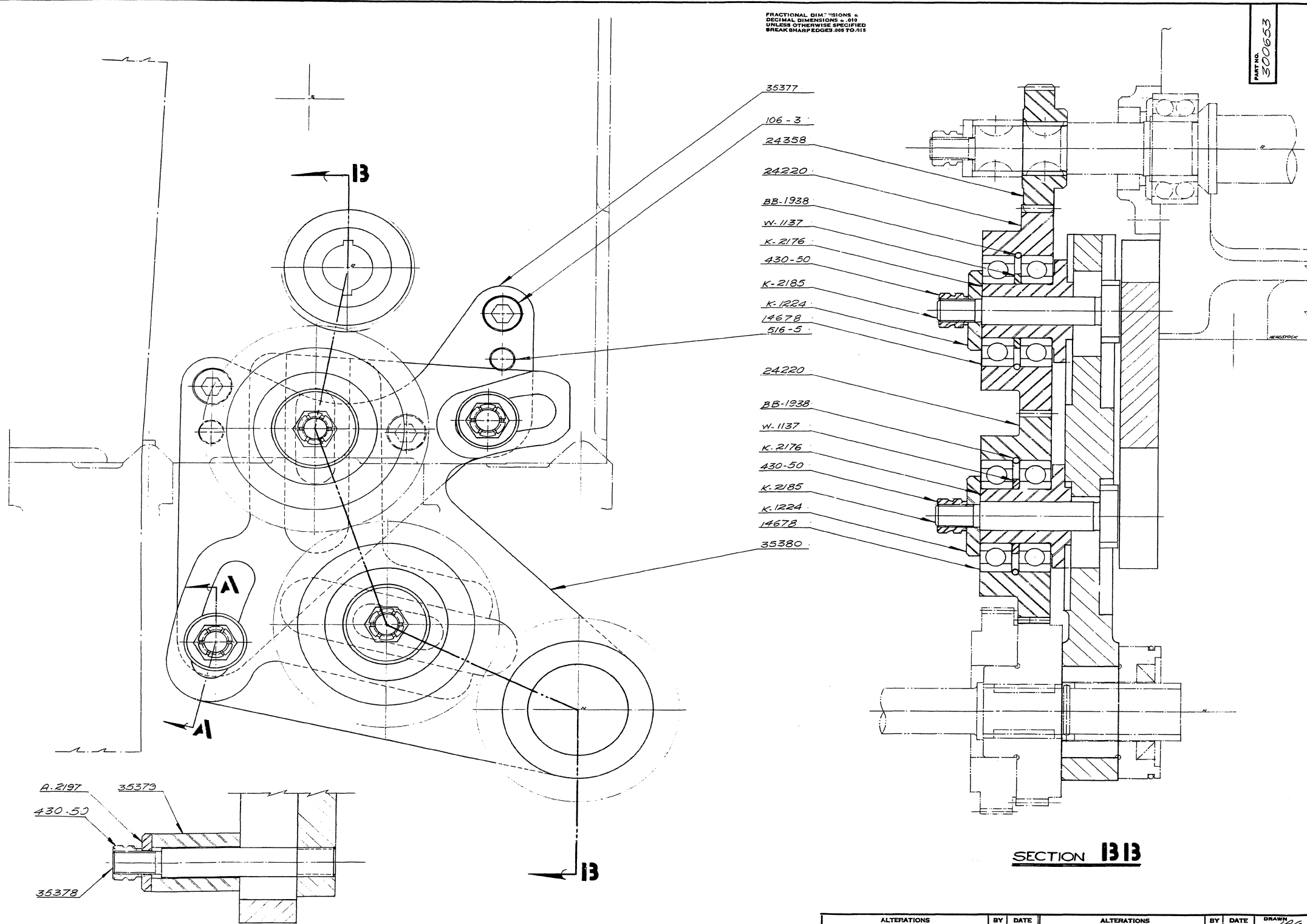
REVISION	BY	DATE	DESCRIPTION
A	WAS TAKER	2/25/50	REVISED
B	WAS TAKER	2/25/50	REVISED
C	WAS TAKER	3/8/50	REVISED
D			
E			



REVISION	BY	DATE	DESCRIPTION	REVISION	BY	DATE	DESCRIPTION
A	WAS TAKER	2/25/50	REVISED				
B	WAS TAKER	2/25/50	REVISED				
C	WAS TAKER	3/8/50	REVISED				
D							
E							

FRACTIONAL DIMENSIONS  $\pm$  .015  
 DECIMAL DIMENSIONS  $\pm$  .015  
 UNLESS OTHERWISE SPECIFIED  
 BREAK SHARP EDGES 90 TO .115

PART NO. 300653



SECTION 1313

SECTION AA

NOTES

PAINT SPEC. NO.	FINISH ALL OVER
MACHINE SURFACES NO.	FINISH
GROUND SURFACES NO.	FINISH
UNLESS OTHERWISE SPECIFIED	

PART NO. 300653

GEAR DATA

TEETH	
DIAMETRAL PITCH	
PRESSURE ANGLE	
HELIX ANGLE	
PITCH DIAMETER	
BASE CIRCLE DIAMETER	
NORMAL DIAMETRAL PITCH	
NORMAL PRESSURE ANGLE	
TOOTH THICKNESS	
PIN DIAMETER	
MEASUREMENT OVER PINS	
MATES WITH	

ON	CENTERS
BACKLASH ALLOWED	
DRIVER	SHAVE TEETH
DRIVEN	CROWN SHAVE
	GRIND TEETH

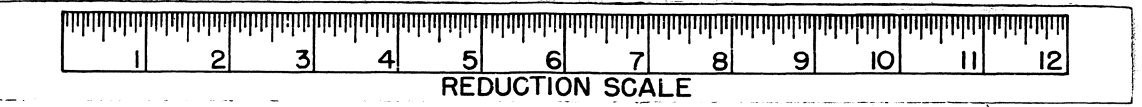
HEAT TREATMENT

USE CASTG. OR FORG.  
 SIMILAR TO  
 ALTER PATTERN  
 REWORK FIN. PC.

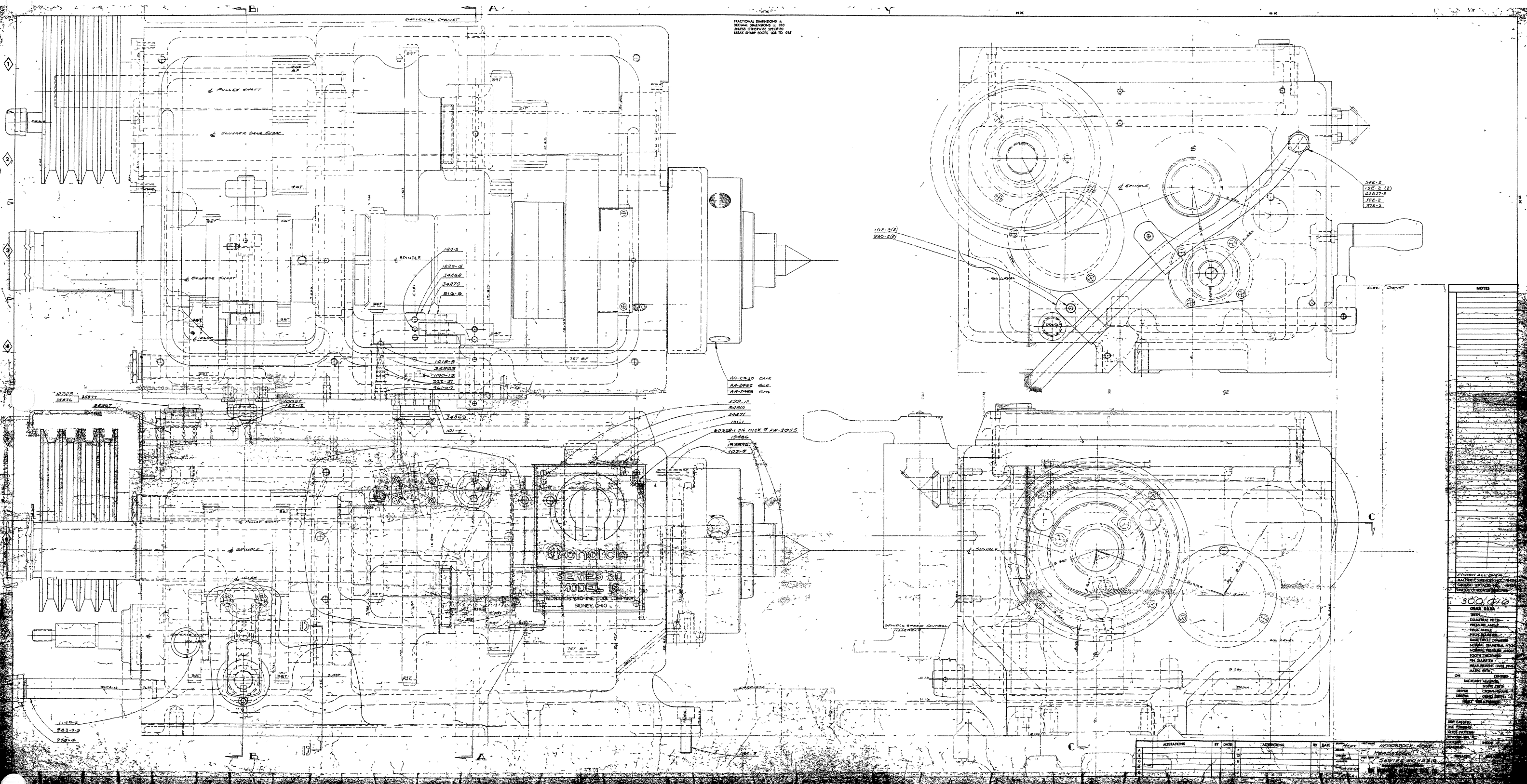
MATERIAL	OUTSIDE	INSIDE

REPLACES REPLACED BY  
 PART NO. 300653

ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	DRAWN	PART NAME
A			F			10/10	ASSY.
B			G			TRACED	UNIT
C			H			CHECKED	END GEARING
D			I			APPROVED	FIRST USED ON
E			J			DATE	SERIES 50 MODEL 13 & 16
						10-12-65	ENGINEERING DEPARTMENT
						SCALE FULL	THE MONARCH MACHINE TOOL CO.
							SIDNEY, OHIO, U. S. A.



FRACTIONAL DIMENSIONS IN DECIMAL DIMENSIONS  $\pm$  .010 UNLESS OTHERWISE SPECIFIED BREAK SHARP EDGES GO TO 010



**Monarch**  
**SERIES 30**  
**MODEL 16**  
MONARCH MACHINE TOOL COMPANY  
SIDNEY, OHIO

REVISIONS			
NO.	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			

ITEM	DESCRIPTION
1	STATION AND OVER
2	BEARING HOLES
3	GROUND SURFACES
4	THREADS OTHER THAN

300 dia

ITEM	DESCRIPTION
1	GRAN DIA
2	DEPTH
3	TAPERED HOLES
4	HEAT TREAT
5	POCKET
6	FACE CHAMFER
7	ROCKWELL C45
8	ROCKWELL C30
9	ROCKWELL C20
10	ROCKWELL C15
11	ROCKWELL C10
12	ROCKWELL C5
13	ROCKWELL B12
14	ROCKWELL B8
15	ROCKWELL B4
16	ROCKWELL A12
17	ROCKWELL A8
18	ROCKWELL A4

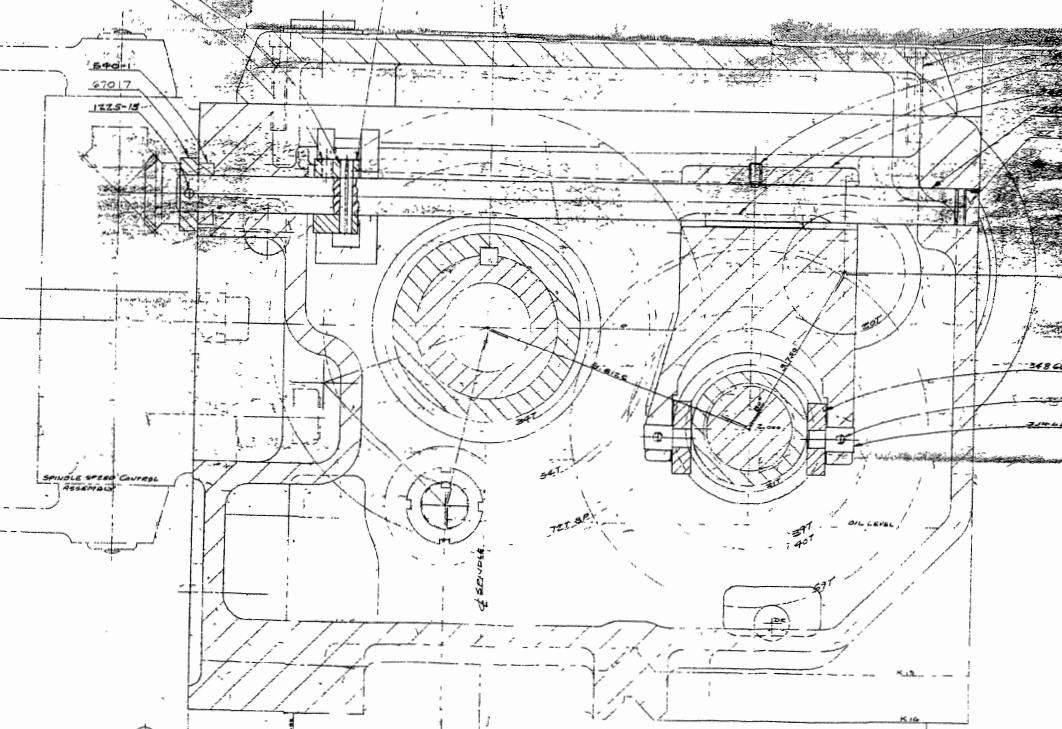
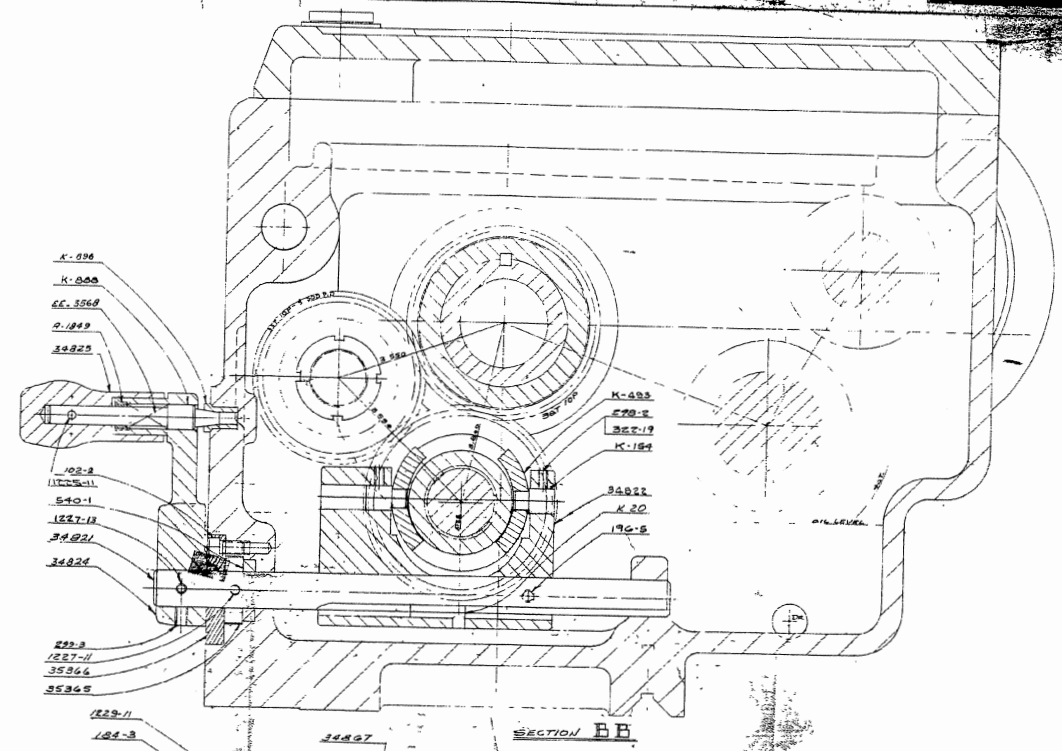
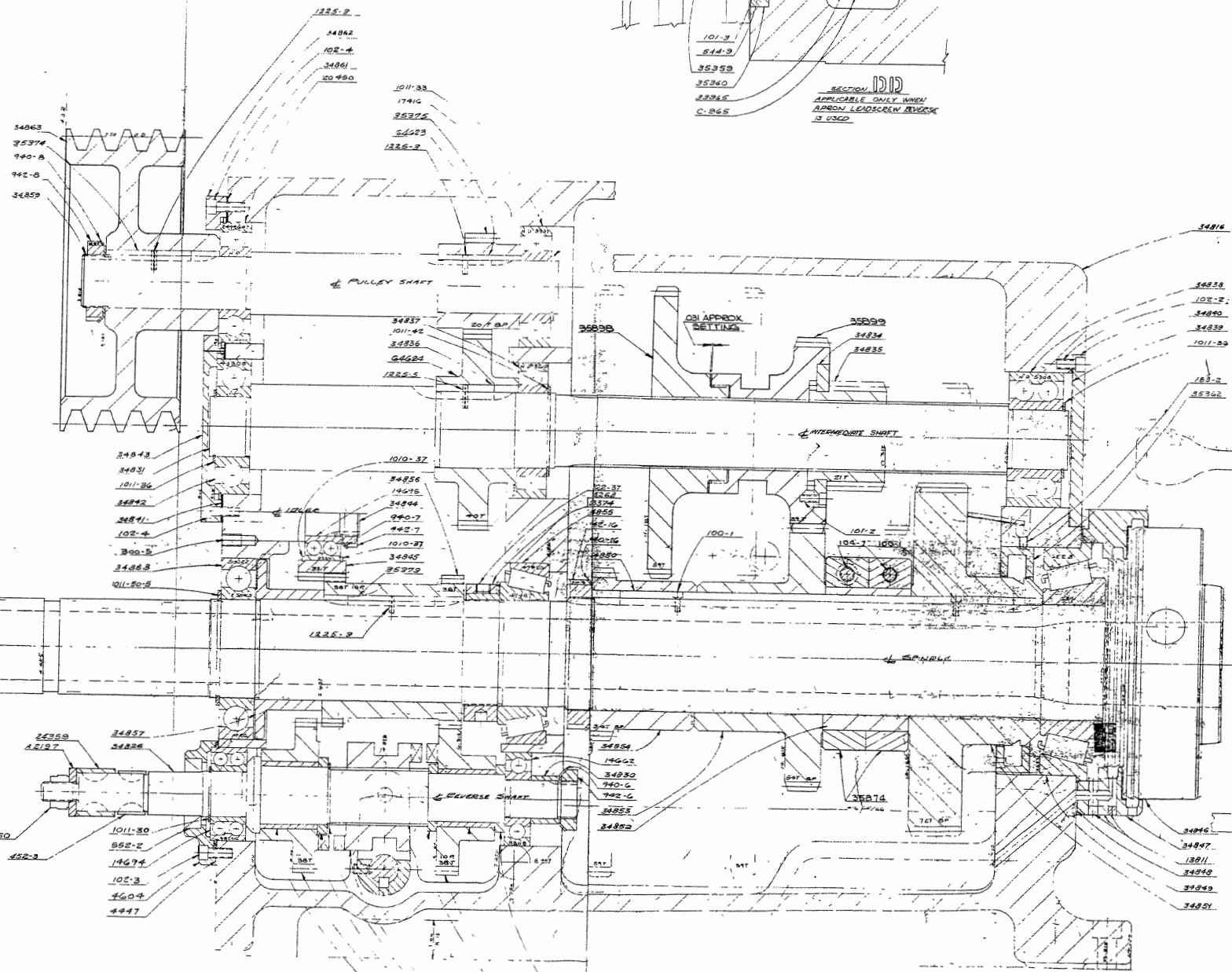
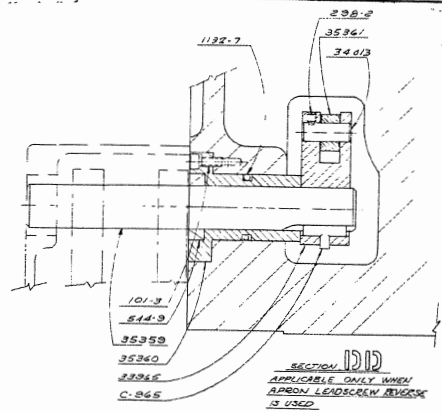
  

ITEM	DESCRIPTION
1	ON BACKLASH ALLOWANCE
2	SKIDY TRENCH
3	DRIVE CHAIN DRIVE
4	DRIVE CHAIN DRIVE
5	DRIVE CHAIN DRIVE
6	DRIVE CHAIN DRIVE
7	DRIVE CHAIN DRIVE

ITEM	DESCRIPTION
1	DRIVE CHAIN DRIVE
2	DRIVE CHAIN DRIVE
3	DRIVE CHAIN DRIVE
4	DRIVE CHAIN DRIVE
5	DRIVE CHAIN DRIVE
6	DRIVE CHAIN DRIVE
7	DRIVE CHAIN DRIVE

TRANSITIONAL DIMS  
 DECIMAL DIMENSIONS  
 UNLESS OTHERWISE  
 SPECIFIED



EXPLODED SECTION CC

SECTION	NO.	DATE	REVISION	BY	CHKD.	APP'D.
AA	1					
BB	1					
CC	1					
DD	1					

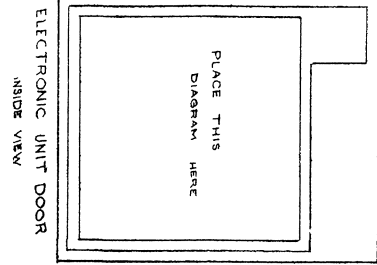
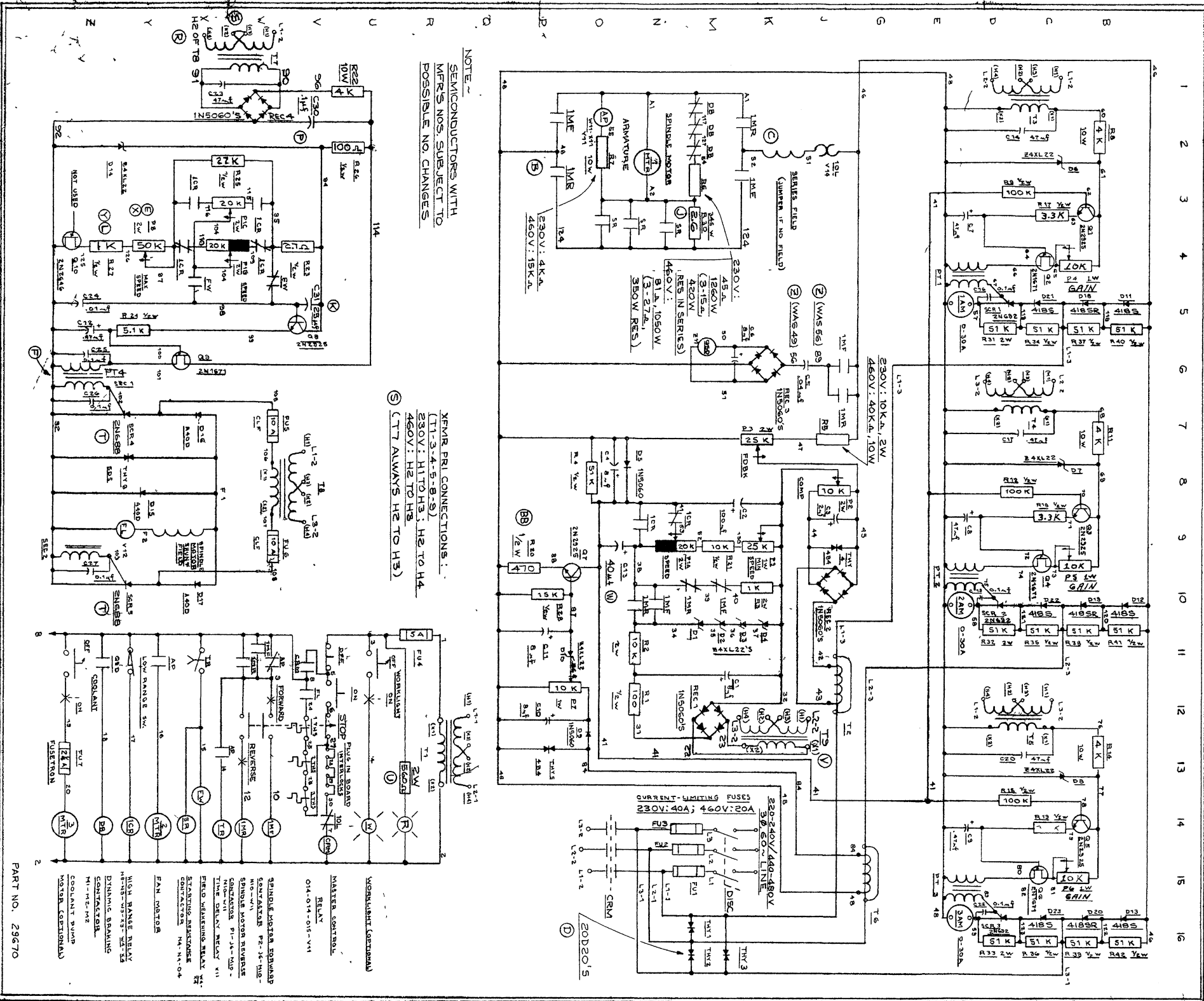
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FRACTIONAL DIMENSIONS & DECIMAL DIMENSIONS ± .010 UNLESS OTHERWISE SPECIFIED BREAK SHARP EDGES OFF TO .011

PART NO. 29670



1. COAT BACK OF DIAGRAM WITH "LIQUIDOR"
2. POSITION DIAGRAM ON DOOR AS SHOWN.
3. RUB OUT ALL AIR POCKETS WITH A CLEAN CLOTH.
4. COAT ENTIRE FRONT SURFACE WITH "LIQUIDOR"

CUT ALONG THIS LINE

NOTE: SEMICONDUCTORS WITH MFR'S NOS. SUBJECT TO POSSIBLE NO. CHANGES

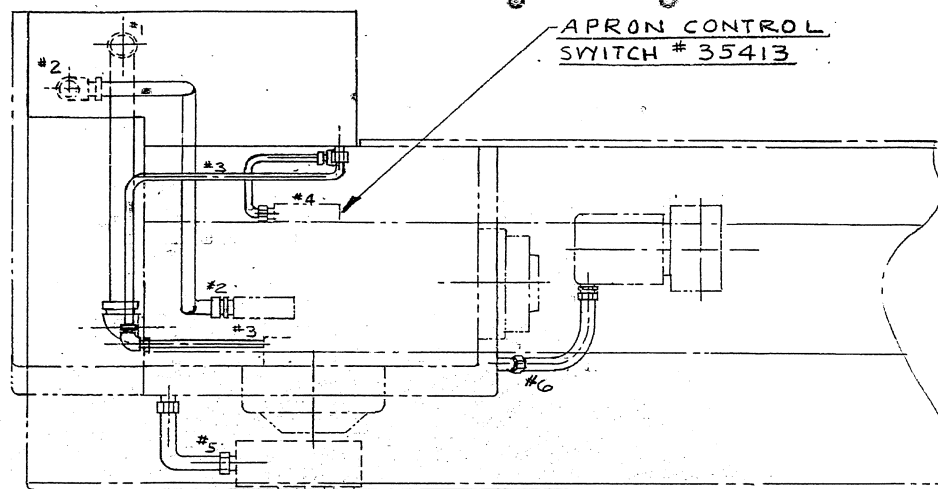
XEMR. PRL CONNECTIONS: (T1-3, A-5, B-9) 230V: H1 TO H3, H2 TO H4 460V: H2 TO H3 (T7 ALWAYS H2 TO H3)

ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE
BB R20 WAS 1.2 KΩ, 1W	RS	8-7-68	C13 WAS 100 MF.	RS	8-24-67	H4 OF T7 WAS L3-2	RS	8-4-67	C31 ADDED.	RS	3-6-67	R23 WAS 10K, R27 WAS 30Ω, R28 WAS 10K	RS	3-23-67
CC R183 WAS IN 2160	RS	3-10-65	P8 WAS 100 KΩ.	RS	8-24-67	T7 WAS JUMPED SAME AS OTHER XEMRS.	RS	8-4-67	R27 WAS 15 KΩ.	RS	3-7-67	INTER-CHANGED MFR'S MR. BOTTOM LINE OF LEFT SECTION WAS WIRE 33	RS	1-24-67
DD ADD'D 10 50 10 2 3	TW	4-24-72	R27 WAS 10 KΩ.	RS	9-8-67	SCR 4 & 5 WERE C20D'S.	RS	8-4-67	RETURNED TO 2 FROM 30.	RS	8-4-67	" " " " " "	RS	2-9-67
EE			WIRE B3 WAS WIRE 30.	RS	11-1-67	RESISTOR ADDED IN SERIES WITH WIRE 33.	RS	8-4-67	RETURNED TO 8 FROM 31.	RS	8-15-67	WERE 10D10'S FOR 230V.	RS	2-9-67
FF			IN5060'S WERE GE A13D2'S	RS	11-7-67	3 ADD'D WIRES 22 & 23 WERE 8 Ω OR 30 Ω 31.	RS	8-21-67	C30 ADDED.	RS	8-4-67	P8 WAS 10 KΩ, THEN 25 KΩ	RS	3-6-67

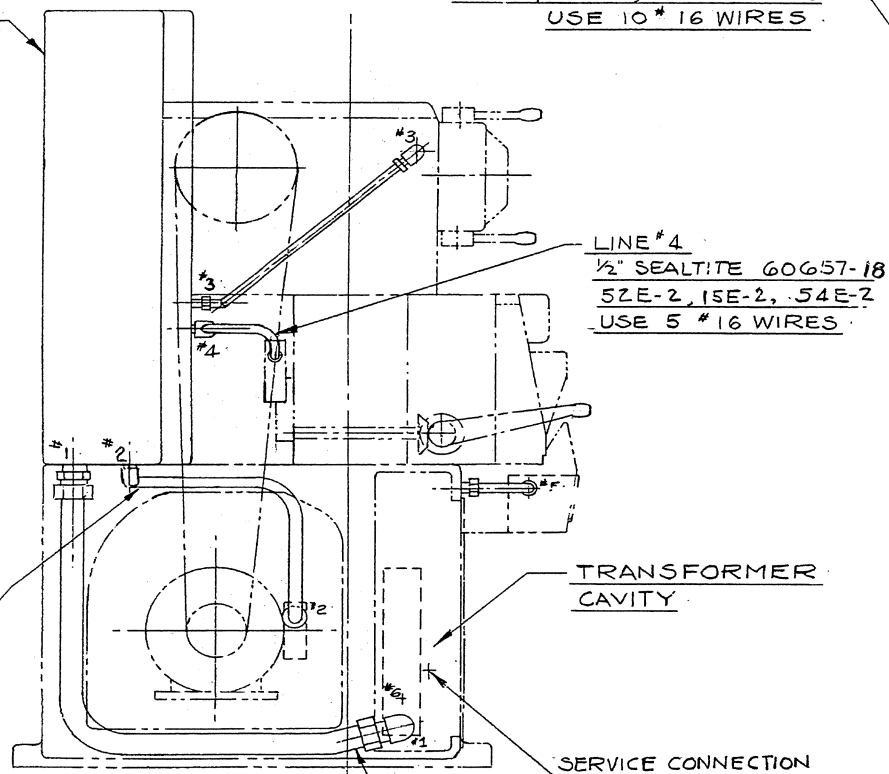
PAINT SPEC. NO.		FINISH ALL OVER	
MACHINE SURFACES NO.		FINISH	
GROUND SURFACES NO.		FINISH	
UNLESS OTHERWISE SPECIFIED			
PART NO. 29670			
GEAR DATA			
TEETH			
DIAMETRAL PITCH			
PRESSURE ANGLE			
HELIX ANGLE			
PITCH DIAMETER			
BASE CIRCLE DIAMETER			
NORMAL DIAMETRAL PITCH			
NORMAL PRESSURE ANGLE			
TOOTH THICKNESS			
PIN DIAMETER			
MEASUREMENT OVER PINS			
MATES WITH			
ON CENTERS			
BACKLASH ALLOWED			
DRIVER		SHAVE TEETH	
DRIVEN		CROWN SHAVE	
		GRIND TEETH	
HEAT TREATMENT			
USE CSTG. OR FORG.			
SIMILAR TO			
ALTER PATTERN			
REWORK FIN. PC.			
OUTSIDE		INSIDE	
MATERIAL BLUE LINE			
REPLACES		REPLACED BY	
PART NAME: DOOR ELEMENTARY DIAGRAM			
UNIT: ELECTRICAL EQUIPMENT			
FIRST USED ON			
SERIES 50			
ENGINEERING DEPARTMENT			
THE MONARCH MACHINE TOOL CO.			
SIDNEY, OHIO, U.S.A.			
PART NO. 29670		ORIGINAL	

LINE	DESCRIPTION
1	FROM TRANSFORMER CAVITY TO ELECTRICAL CABINET, WIRING FROM PANEL, COOLANT PUMP, & PUSH BUTTON STATION
2	FROM MOTOR TO ELECTRICAL CABINET
3	FROM TERMINAL BLOCK ON SPEED CONTROL ASS'Y TO ELECTRICAL CABINET
4	FROM APRON CONTROL SWITCH TO ELECTRICAL CABINET
5	FROM PUSH BUTTON STATION IN PAN TO TRANSFORMER CAVITY
6	FROM COOLANT PUMP TO TRANSFORMER CAVITY

FRACTIONAL DIMENSIONS ± DECIMAL DIMENSIONS ± .010 UNLESS OTHERWISE SPECIFIED BREAK SHARP EDGES .005 TC .015



ELECTRICAL CABINET #34986



LINE #2  
3/4 SEALTITE 60658-40  
54E-3, 15E-3, 52E-3  
USE 2 \* 8 & 2 \* 14 WIRES

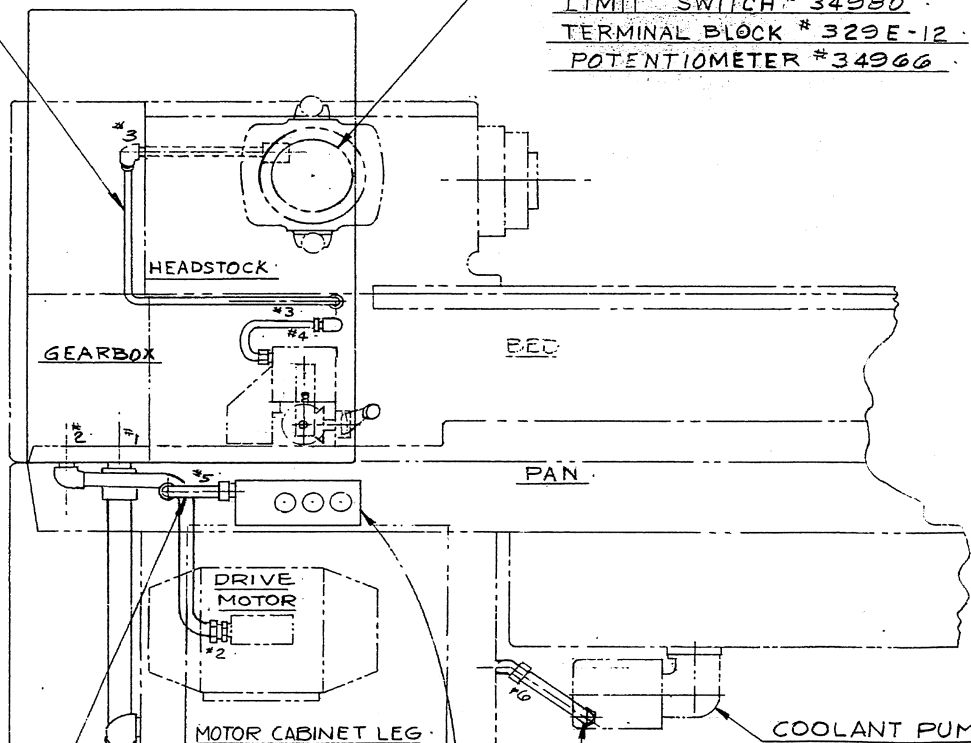
LINE #3  
1/2 SEALTITE 60657  
37E-2, 54E-2, 52E-2, 15E-2  
USE 10 \* 16 WIRES

LINE #4  
1/2 SEALTITE 60657-18  
52E-2, 15E-2, 54E-2  
USE 5 \* 16 WIRES

LINE #1  
1" SEALTITE 60659-31  
52E-4, 15E-4, 32E-3  
USE 15 \* 16 & 9 \* 14 WIRES  
WITH COOLANT ADD 2 \* 16 WIRES

APRON CONTROL SWITCH #35413

SPINDLE SPEED CONTROL LIMIT SWITCH #34980  
TERMINAL BLOCK #329E-12  
POTENTIOMETER #34966



LINE #5  
1/2" SEALTITE 60657-20  
15E-2, 52E-2  
USE 6 \* 16 WIRES

LINE #6  
1/2 SEALTITE 60657-8  
56E-2, 52E-2  
USE 2 \* 16 WIRES

NOTES

PAINT SPEC. NO.  
FINISH ALL OVER  
MACHINE SURFACES NO. FINISH  
GROUND SURFACES NO. FINISH  
UNLESS OTHERWISE SPECIFIED

PART NO. 35605

GEAR DATA

TEETH  
DIAMETRAL PITCH  
PRESSURE ANGLE  
HELIX ANGLE  
PITCH DIAMETER  
BASE CIRCLE DIAMETER  
NORMAL DIAMETRAL PITCH  
NORMAL PRESSURE ANGLE  
TOOTH THICKNESS  
PIN DIAMETER  
MEASUREMENT OVER PINS  
MATES WITH

ON CENTERS

BACKLASH ALLOWED

DRIVER	SHAVE TEETH
DRIVEN	CROWN SHAVE
DRIVEN	GRIND TEETH

HEAT TREATMENT

USE CSTG. OR FORG.  
SIMILAR TO  
ALTER PATTERN  
REWORK FIN. FC.

OUTSIDE INSIDE  
MATERIAL

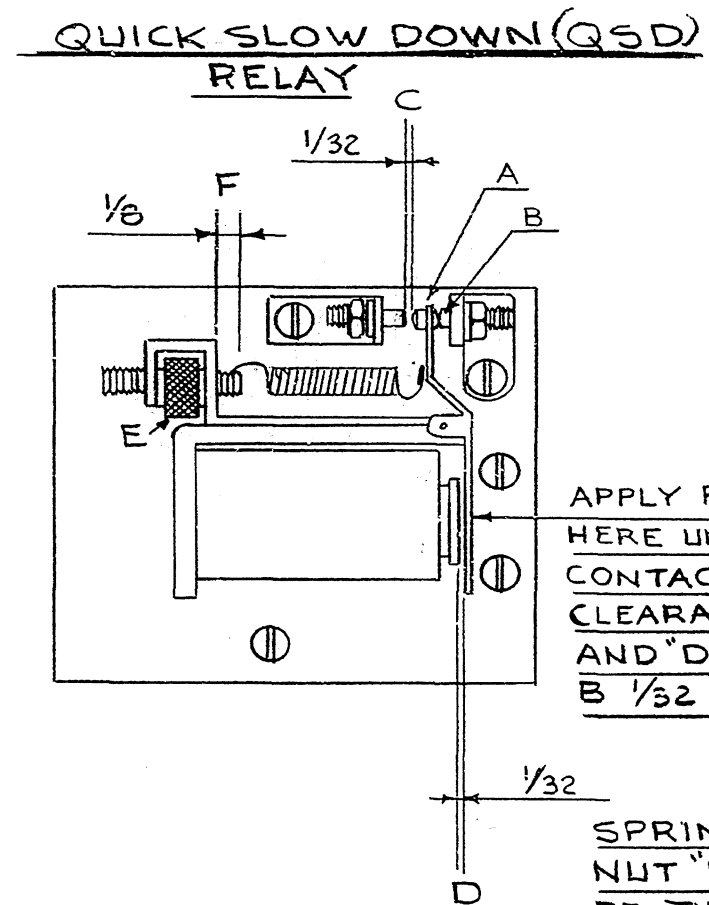
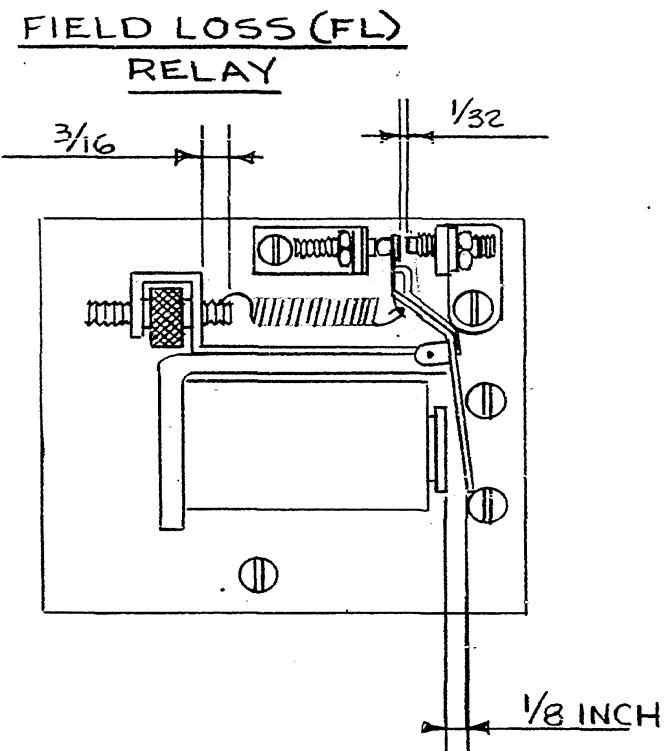
REPLACES REPLACED BY

PART NO. 35605

ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	DRAWN	PART NAME
A WAS 54E-4	JH	8-15-66				BELLWARE	ELECTRICAL CONDUIT LAYOUT
B WAS -18	JH	8-15-66				TRACED	UNIT
C ADDED	JH	8-15-66				CHECKED	SERIES 50 MODEL 16
D CHANGED #18 WIRES TO #16	WA	9-27-74				R.F.	FIRST USED ON
E						APPROVED	
						DATE	ENGINEERING DEPARTMENT
						4-12-66	THE MONARCH MACHINE TOOL CO.
						SCALE	SIDNEY, OHIO, U. S. A.

FRACTIONAL DIMENSIONS ±  
DECIMAL DIMENSIONS ± .010  
UNLESS OTHERWISE SPECIFIED  
BREAK SHARP EDGES .005 TO .015

PART NO.  
61472



PROPER ADJUSTMENT OF FIELD LOSS AND QSD RELAYS USED ON  
SPINDLE SCR DRIVES ON EC-MERIT-50 SERIES & 220 LATHES

NOTE: MERIT DOES NOT HAVE QSD

NOTES

EAR DATA

TEETH
DIAMETRAL PITCH
PRESSURE ANGLE
HELIX ANGLE
PITCH DIAMETER
DIAMETER WIRE
DIA. OVER WIRE
GRIND TEETH
DRIVER
SHAVE TEETH
DRIVEN

HEAT TREATMENT

USE CASTING
USE FORGING
ALTER. PATTERN
REWORK FIN. PC.

OUTSIDE	INSIDE
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MATERIAL B.L.

REPLACES	REPLACED BY
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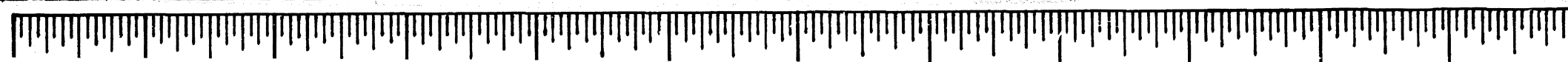
PART NO.  
61472

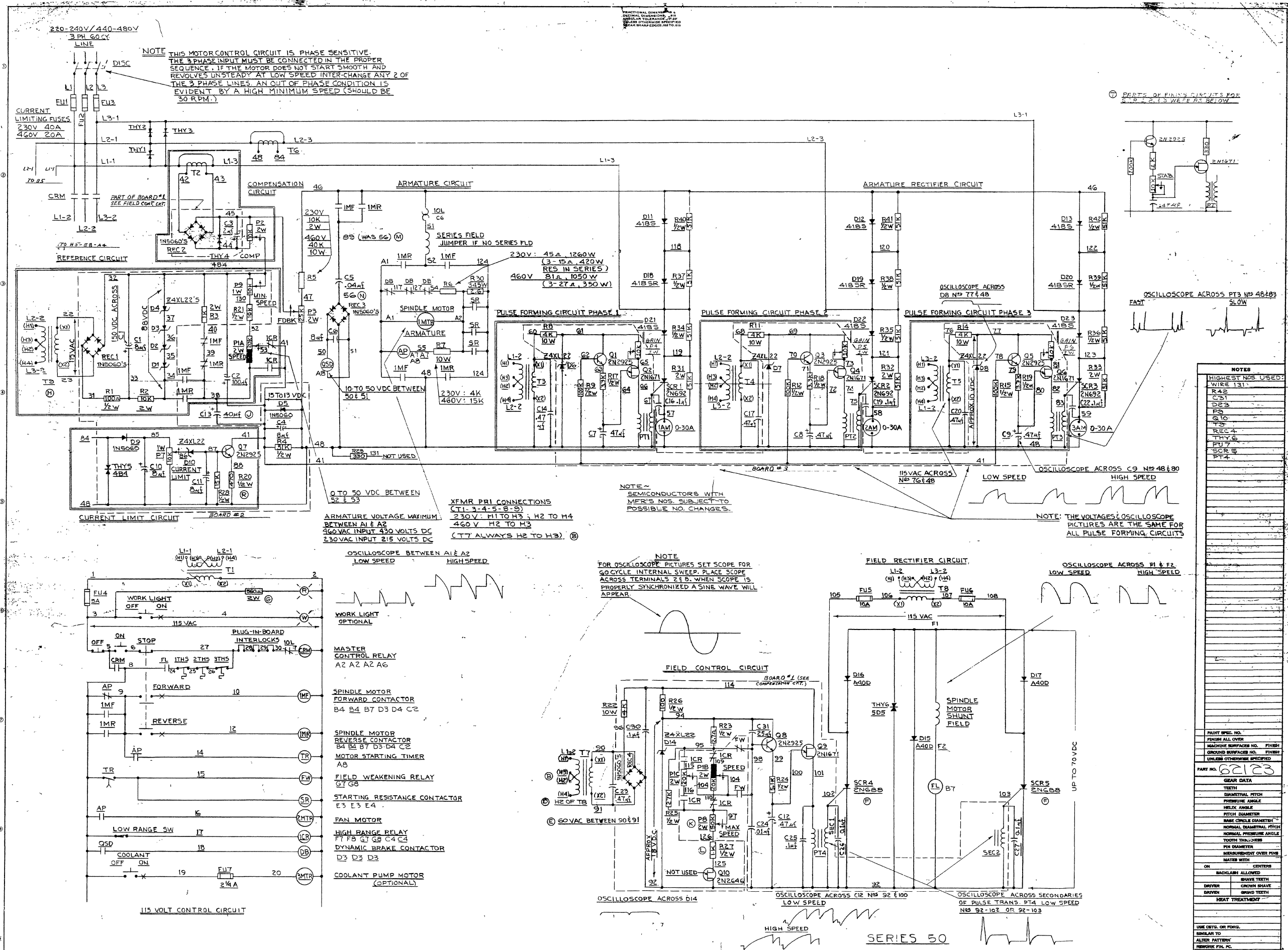
ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE
A			F		
B			G		
C			H		
D			I		
E			J		

DRAWN  
CEG  
TRACED  
CHECKED  
APPROVED  
DATE  
NOV. 23, 66  
SCALE

PART NAME  
RELAY ADJ. FL-QSD  
UNIT  
ELECTRICAL EQUIPMENT  
FIRST USED ON

ENGINEERING DEPARTMENT  
**THE MONARCH MACHINE TOOL CO.**  
SIDNEY, OHIO, U. S. A.





**NOTE** THIS MOTOR CONTROL CIRCUIT IS PHASE SENSITIVE. THE 3 PHASE INPUT MUST BE CONNECTED IN THE PROPER SEQUENCE. IF THE MOTOR DOES NOT START SMOOTH AND REVOLVES UNSTEADY AT LOW SPEED INTERCHANGE ANY 2 OF THE 3 PHASE LINES. AN OUT OF PHASE CONDITION IS EVIDENT BY A HIGH MINIMUM SPEED (SHOULD BE 30 RPM.)

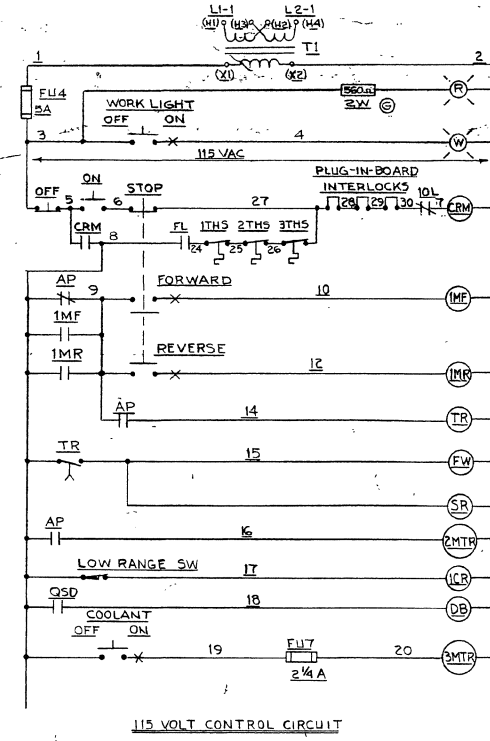
PARTS OF FINISH CIRCUITS FOR S.P. 1, 2, 3 WERE AS BELOW

ARMATURE VOLTAGE MAXIMUM BETWEEN A1 & A2  
 460VAC INPUT 430 VOLTS DC  
 230VAC INPUT 215 VOLTS DC

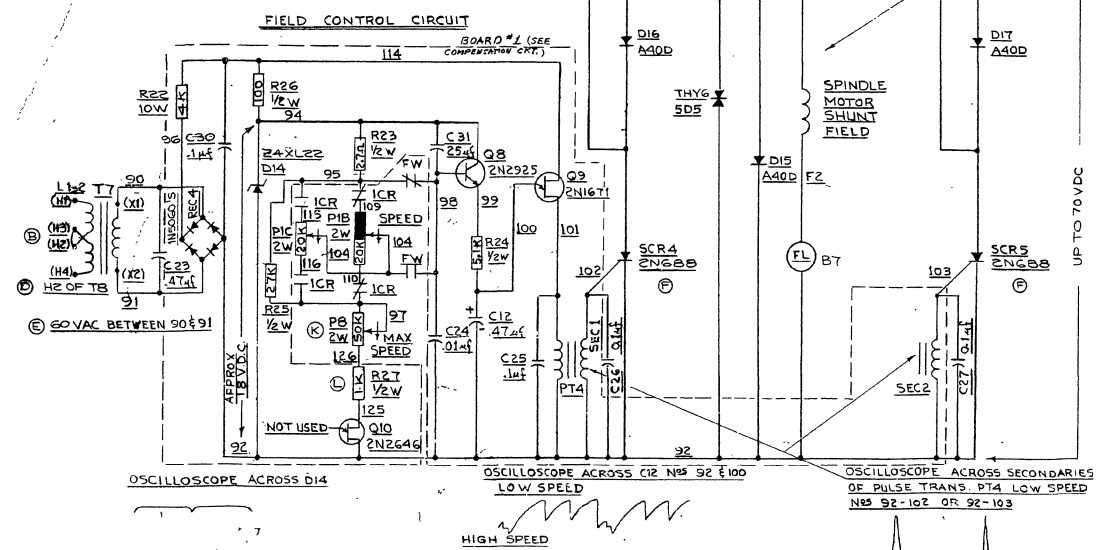
**NOTE** - SEMICONDUCTORS WITH MFR'S NOS. SUBJECT TO POSSIBLE NO. CHANGES.

**NOTE** THE VOLTAGES & OSCILLOSCOPE PICTURES ARE THE SAME FOR ALL PULSE FORMING CIRCUITS

**NOTE** FOR OSCILLOSCOPE PICTURES SET SCOPE FOR 60 CYCLE INTERNAL SWEEP. PLACE SCOPE ACROSS TERMINALS 2 & B. WHEN SCOPE IS PROPERLY SYNCHRONIZED A SINE WAVE WILL APPEAR



OSCILLOSCOPE BETWEEN A1 & A2  
 LOW SPEED HIGH SPEED



OSCILLOSCOPE ACROSS D14  
 OSCILLOSCOPE ACROSS C12 NBS 92 & 100  
 LOW SPEED HIGH SPEED  
 OSCILLOSCOPE ACROSS SECONDARIES OF PULSE TRANS. PT4 LOW SPEED NBS 92-102 OR 92-103

NOTES	
HIGHEST NOS USED:	
WIRE 131	
R42	
C31	
D23	
PS	
IS	
REC 4	
THY 6	
SCR 5	
PT 4	
PAINT SPEC. NO.	
FINISH ALL OVER	
MACHINE SURFACES NO. FINISH	
GROUND SURFACES NO. FINISH	
UNLESS OTHERWISE SPECIFIED	
PART NO. 02123	
GEAR DATA	
TEETH	
DIAMETRAL PITCH	
PRESSURE ANGLE	
HELIX ANGLE	
PITCH DIAMETER	
BASE CIRCLE DIAMETER	
NORMAL DIAMETRAL PITCH	
NORMAL PRESSURE ANGLE	
TOOTH THICKNESS	
PIN DIAMETER	
MEASUREMENT OVER PINS	
MATER WITH	
ON	CENTERS
BACKLASH ALLOWED	
DRIVER	SHAVE TEETH
DRIVEN	CROWN SHAVE
	BRIND TEETH
HEAT TREATMENT	
USE CITS. OR FORG.	
SIMILAR TO	
ALLEN PATENT	
REPRODUCED FROM P.C.	
OUTSIDE	
INSIDE	
MATERIAL	
BL	
REPLACES	REPLACED BY
ELECTRICAL DIAGRAM	
PART NO. 02123	
THE MONARCH MACHINE TOOL CO.	
SIDNEY, OHIO, U.S.A.	

ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE	ALTERATIONS	BY	DATE
R30 WAS 10K, 1W.	RS	8-7-60	R3 WAS 100K.	RS	8-24-60	C30 ADDED.	RS	8-24-60	SCR 4 & 5 WERE CROD'S	RS	8-4-67
R31 WAS 10K.	RS	8-24-60	R37 WAS 10K.	RS	8-24-60	TT WAS JUMPED	RS	8-24-60	RECEPTOR ADDED IN SERIES	RS	8-4-67
WIRE 90 WAS WIRE 50.	RS	11-1-67	WIRE 96 WAS WIRE 50.	RS	11-1-67	SAME AS OTHER XIMERS	RS	8-24-60	REPLACED WITH 30 & 85.	RS	8-24-67
WIRE 50 WAS WIRE 43.	RS	11-1-67	H4 OF T7 WAS L3-2.	RS	8-24-60		RS	8-24-60		RS	8-24-67
ADDED BOARD NOS.	RS	11-7-67	IN 2060'S WERE GE AT 202'S	RS	11-7-67	WAS 115 VAC.	RS	8-24-67		RS	8-24-67