

MAY 1983

ROTTLER  
MANUFACTURING

**FA-4VB, FA-4B, 6FA-4B**  
BORING MACHINE

MACHINE SERIAL NUMBER

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OPERATIONS AND MAINTENANCE  
MANUAL



MANUFACTURED BY:

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**NOTE:** WHEN ORDERING REPLACEMENT PARTS,  
PLEASE GIVE THE MODEL AND SERIAL NUMBER.

ORDER BY PART NUMBER.

**THERE IS A MINIMUM ORDER OF \$25.00**

### DESCRIPTION

The Model FA-4 Boring Machine is a precision, single point tool, boring unit. It is equipped with tooling and accessories for reboring almost all American passenger car engines, many heavy duty diesel engines and transmission cases. Stub boring heads may be added for small engine cylinders and universal boring applications.

Insofar as cylinder reboring is concerned, this machine is designed for two purposes:

- (1) The locating of cylinder bores relative to the pan rails and main bearing location. As has been done in the original factory boring. This overcomes the many inaccuracies and out-of-alignment problems associated with clamping portable cylinder boring bars to blocks.
- (2) A considerable savings in hole-to-hole time is realized as a result of fast block clamping, inverted centering fingers, push button controls, and air operated clamping and lifting devices.

Changeover or resetting time required to set up V-type or in-line engines is a minimum, making this machine highly suited to the jobber shop where engines cannot be run through in model lots.

The added feature that the block can be bored with bearing caps on or off also increases the versatility and speed of set-up.

All feeds and rapid travels are power operated and controlled from the conveniently located push button station. An auxiliary hand feed travel is located at the base of the feed screw to be used for counterboring and facing sleeves, etc.

Power is furnished by a 3 phase totally enclosed motor, with a outboard fan. An air actuated variable pulley provides variable speed. A quick change shift lever selects two gear driven ranges to provide good torque at low speed. The small knob protruding from the upper housing provides fast and slow boring feed rates. An enclosure at the rear of the machine contains relays and valves that actuate mechanical controls on the machine to engage feeds and travels as well as clamping and floating of the spindle unit.

GUARANTEE

L I M I T E D

Rottler Manufacturing Company Model FA-4 parts and equipment are guaranteed as to workmanship and material. This Limited Guarantee remains in effect for one year from the date of delivery, provided the machine is owned and operated by the original purchaser and is operated and maintained as per instruction in this manual.

Standard air and electric components are warranted by their respective manufacturers.

Tools proven defective within the time limit will be remedied at the factory's option, either by replacement of parts and/or service by the factory.

We accept no responsibility for defects caused by external damage, wear abuse, or misuse. Neither do we accept any obligation to provide compensation for other direct or indirect costs in connection with cases covered by the warranty.

GUARANTEE DOES NOT COVER SHIPPING OR FREIGHT CHARGES.

## OPERATING SAFETY AND EMERGENCY PROCEDURES

ELECTRICAL POWER - Make sure all electrical equipment have the proper electrical overload protection.

MACHINE OPERATOR - Operator of this boring machine should be a skilled machinist craftsman, that is, well versed in the caution, care, and knowledge required to safely operate a metal cutting tool.

If the operator is not a skilled machinist, the operator must pay strict attention to the operating procedure outlined in this manual, and must get instruction from a qualified machinist in both the productive and safe operation of this boring bar.

Rottler Boring Equipment has the following areas of exposed moving parts, that you must train yourself to respect and stay away from when they are in motion:

1. TOOL SHARPENING - Must be done with care and dexterity. Light pressure is required for sharpening.

CAUTION: Exposed diamond wheel is a potential hazard to your hands, fingers, and face,

NOTE - Eye protection is necessary when working in this area.

2. CUTTING TOOL AREA - Any operation involving hand in the cutter head area, such as centering, changing centering fingers, tool insertion and removal, cutter head changes, size checking, etc., requires that both the drive motor be turned off and that the spindle clutch (spindle rotation) lever be disengaged, in it's full up position.

NOTE: Periodcally check this lever to make sure that the upper lever position will lock out the spindle clutch. Check to see if the upper indent will firmly hold the spindle clutch out of engagement.

3. BORING - Eye protection must be worn during this operation and hand must be kept completely away from cutter head.
4. UPPER HOUSING CONTROLS - Learn to identify and independently operate these control functions by habit while developing the awareness of keeping your fingers and hands well clear of the rotating feed screw and the knobs, both on top of the feed screw and the spindle.
5. WORK LOADING & UNLOADING - Carefully develop handling methods of loading and unloading work pieces, so that no injury can result if hoist equipment or lift connection should fail.

OPERATING SAFETY & EMERGENCY PROCEDURES, CON'T

Periodically check lift components for damage that may cause failure of block handle fixture. Lifting eye can eventually fail if the eye is reset in line with the 502-1-80 lift channel. Eye must be at right angle to this channel.

CAUTION: Cam pins must be fully engaged before lifting block.

6. MACHINE MAINTENANCE - Any machine adjustment, maintenance or part replacement absolutely requires a complete power disconnect to the machine. THIS MUST BE AN ABSOLUTE RULE.

EMERGENCY PROCEDURE

Assuming one of the following has occurred - Tool Bit is set completely off size, work or boring spindle is not clamped, spindle is not properly centered. These mistakes will become obvious the instant the cut starts. **TURN OFF MOTOR IMMEDIATELY.**

NOTE: You can keep your finger on the stop button, if you wish to insure instant shut down.

After finding out what the problem is, methodically organize the controls to return the spindle to its up position, without causing more problems.

Be alert to quickly stop the motor in the event of a serious disruption of the boring process either at the top or bottom of the bore.

"REMEMBER" Metal cutting tools have the speed and torque to severely injure any part of the human body exposed to them.

## MACHINE INSTALLATION LOCATION

The productivity of this machine will depend to a great extent on its proper initial installation, particularly the means by which cylinder blocks can be lifted into the machine and flow evenly to and from other operations in your shop.

The proper loading arrangement and area location for your FA-4 machine is extremely important. A slow travel (6' to 10' minimum) power hoist, operated from either a bridge crane or jib crane arrangement works very satisfactorily. A 1,500 lb. hoist is generally adequate for lifting the engine block. An air hoist with speed control makes an ideal method for fast, convenient loading.

If some production boring with this machine is anticipated and the cylinder blocks are not directly loaded and unloaded from a conveyor, we would recommend considerable attention to be given to the crane so that it covers an adequate area to allow the operator to back up and remove cylinder blocks without cluttering up his own area. If two machines are to be operated by one operator, we would recommend that the open faces be placed at right angles to each other, with the machines approximately three feet apart.

## UNPACKING

Use care in removing the crate from the FA-4 Machine, being careful not to use force on any of the spindle unit. This is particularly true of the square tube containing the limit-switches on the spindle unit.

Remove the SJ3 sharpening fixture from the deck and preferable place at a bench area close to the machine. This fixture will require 110 or 220 volt, single phase, AC current. If it is necessary to mount this fixture, on the base with an angle plate, mount it so that the sharpening wheel is below the top face of the machine base, and the sharpening grit will not be thrown on top of the base.

Remove the tool box, parallels, V fixture, located at the lower portion of the machine and completely clean these articles, as well as the machine base pads and upper table, with solvent. Also, clean thoroughly the cylinder block clamp arm assembly. Rust inhibitor is applied to the machine at the time of shipment, and any of the inhibitor left on the machine will result in considerable collecting of cast iron dirt and possible slipping of clamp arms.

## LEVELING

Four square head set screws, jam nuts, and chamfered washers are provided with the machine for leveling. Insert the screw and nut at the base support points, being careful that the screw point seats in the chamfered washers below.

### LEVELING CONT' D

Use a precision level and level the upper table within .003" per foot in both directions and make sure that the machine weight is equally supported at the four support points of the base.

### MACHINE SETUP

Remove cover, #502-9-36-A, on the rear portion of the spindle unit.

Pull out the cotter key through the slotted nut of the bolt assembly and loosen the nut, adjust the nut , so that the washer is loose and the spindle unit may be slid its full travel in and out without tending to drag and bind the 5/8" bolt assembly. Loosen the bolt only far enough to do this and no further, and reinsert the cotter key in the appropriate slot. Now slide the spindle unit from side to side and further clean the rust inhibitor from the table.

Attach an air source to the appropriate intake at the air filter on the side of the rear control enclosure.

### AIR SUPPLY IN "F" SERIES MACHINES

NOTE: It is very important that your air source for "F" Series Boring Machines be moisture free. Water and oil in the line will result in early valve failure. Our recommendation is the installation of a water trap at the machine.

CAUTION: Before attaching electrical power to the boring bar, check your electrical current and the electrical current rating on the nameplate on the rotter control enclosure on back of main base and on the motor nameplate on the side of the motor. If compatible, check to see if wiring on the inside of the motor wire connection box on the side of the motor is correct for the voltage you are going to use, as per connecting instruction on the motor wire connection box cover, or on side of motor. Also check to see that the correct "H" type heaters are in the motor starter that go with the amp reading on the motor nameplate.

Check to see if safety toggle switch at rear of the spindle unit is turned off.

Connect 220 volt, 3 phase wiring to the L-1, L-2, and L-3 terminals, as noted on the right hand upper portion of the motor starter, located in the upper right portion of the rear enclosures.



### MACHINE SETUP CONT' D

Check the gage on the air regulator in the lower portion of the enclosure to see if it is set to approximately 90 to 95 PSI pressure after the air line is attached.

Turn on safety toggle switch at the rear of the spindle unit and turn the clamp selector switch to the left float position, slide the spindle unit from side to side and in and out to make sure it slides freely. The necessary effort to slide this will decrease when the shipping oil is entirely removed from the machine base. (There is an adjustment noted - Control Function, Page 48 & 58 to adjust effort required to slide the spindle unit).

Turn the clamp selector to the right (clamp) and check proper operation of the clamp assembly and proper release and movement of the base when turned back to float.

Replace cover on back of spindle unit.

Shift spindle speed selector into low range. (Up Position) lightly hold in low range with selector knob pulled out. Plug the motor by pushing the feed button, along with the stop button. The feed screw should turn counterclockwise, looking from the top of the machine. If it turns in the wrong direction, or tends to ratchet and not drive at all, switch the wires on L.1 or L.2 terminals.



## CONTROLS

We suggest that before attempting any cylinder boring, the operator should actuate the controls to become familiar with the operation of the machine.

### 1. CLAMP (FLOAT) SWITCH

Turn the clamp switch to the right to energize the spindle hold down clamp. When this is turned to the left, air is exhausted from the bottom of the spindle unit, providing easy movement of the spindle.

CAUTION: Motor must be stopped when positioning bar, inadvertant spindle rotation could injure the operator's hands or damage the cutter head parts.

It is important to note that clamp switch may be left in the neutral straight up position so that the spindle unit is neither floated nor clamped. You will find it often useful to use this position on your machine for dial indicating purposes in bores and to make slight adjustment in order- either to correct or to introduce a desired total indicator runout reading.

### 2. FAST DOWN BUTTON

Press fast down button and you will notice that the machine<sup>s</sup> travels rapidly down until the button is released. To become familiar with the rapid down travel, we suggest that you place a tool into the holder slot and practice running this tool holder down rapidly (in a fast spindle speed) to an exact point, and returning it to the upper position. This can be done rapidly and very accurately with a little practice.

### 3. FEED BUTTON

Press the feed button and the machine will remain in slow down feed until either the stop button, lower stop limitswitch, or up botton, is pressed.

NOTE: Do not press the stop button or up button, when boring. See the procedure for this operation, in "UP BUTTON" Instruction.

### 4. UP BUTTON

The up button may be pressed any time EXCEPT WHEN BORING, then the following procedure must be used: First raise and hold the feed shift lever into neutral position, declutch the inner spindle, and then push the up button.

## CONTROLS CONT'D

This will allow the cutter to clear itself in the bore before retraction of the spindle, thereby eliminating the possibility of chipping the tool bit.

The up button will continue the travel upward on the machine until either the stop button is pressed or the machine contacts the upper limit switch and stops at the top of the travel.

You will often find it convenient to stop the up travel of the machine as soon as the spindle is clear of the cylinder bore, then slide to the next bore location. This is particularly useful when the cylinder is located well down from the upper limit of the travel.

### 5. STOP BUTTON

Stop button may be pressed anytime, but only in emergency cases, when boring.

### 6. SPINDLE CLUTCH CONTROL

The spindle clutch control, located at the upper right of the upper gear housing, is actuated by pulling down. This may be done on high speed then jogging or starting the unit, or when the machine is idle.

It may be necessary if the machine is idle, to turn the centering knob counterclockwise slowly to determine if the clutch is engaged. A light down pressure on the spindle clutch at the time you start the feed will assure that it is fully engaged for boring.

Lift the clutch knob at any time, EXCEPT WHEN BORING, to disengage clutch.

When boring, first raise and hold feed shift lever into neutral position then disengage the clutch.

### SPINDLE STOP

This machine is equipped with a spindle stop that engages as the spindle clutch is disengaged. (This is a spring located stop and can be overridden). It is positioned to stop the spindle with the tool directly facing the operator.

## CONTROLS CONT'D

### 7. SPINDLE SPEED CONTROL (High-Low)

The high, low geared spindle speed control is changed by pulling out, and raising or lowering the plastic knob at the lower right of the spindle unit. This control may be operated when the machine is running, but jog motor or hand turn drive to shift up to 200 spindle RPM or higher. DO NOT SHIFT WHEN BORING. This control is often used in positioning the spindle to secure instant higher or lower rapid travel.

### 8. TWO SPEED FEED CONTROL

The two feeds provided on your machine are controlled by a sliding key arrangement, operated by a small knob on the top of the upper housing. This knob is raised to engage a low speed feed rate and lowered to secure a higher feed rate. To operate this control, first lift the feed shift lever to its neutral position, then with the motor running, shift the two speed feed lever, then allow the feed shift lever to return to the feed position. It will take a moment for the sliding key to drop into the drive position. This control may be operated while the machine is actually in a boring operation, although the dwell of the tool may leave a witness mark in the bore.

### 9. CENTERING KNOB

The centering knob on the left side of the upper housing operates the centering fingers when turned clockwise. Be careful not to over-extend these fingers when the spindle is not in a cylinder or fingers will come completely out of the pinion drive.

CAUTION: Motor must be stopped when centering.  
Inadvertant spindle rotation engagement could injure the operator's hands or damage cutter head parts.

### 10. STOP ROD

The upper and lower limit switches located on the square tube control the upper and lower limits of travel of the bar. The lower limit switch is actuated by an adjustable stop rod. This stop rod is locked in place by the plastic knob on the back of the upper housing. The upper limit switch stop rod is set at the factory and should not be changed.

## CONTROLS CONT'D

### II. FEED LEVER

The feed lever is the knob in the center on the right side of the upper housing. It is operated automatically and is in feed when the machine is turned on, but can be placed in neutral by pivoting the neutral positioner handle (502-9-80), located on the side of the cover (500-38-4), forward. (See neutral position for hand feed.) To turn on machine when the feed lever is in neutral, press the feed button. Automatic feed will not operate.

### 12. MANUAL HAND FEED

The manual hand feed travel is available for facing sleeves and counterboring, etc.

It is completely separate from the powered spindle travel and should always be returned to the full up position after being used, before the power up travel returns the spindle to the top.

CAUTION: The automatic feed lever must be disengaged, when operating this short hand feed. To disengage feed lever, pivot neutral positioner handle forward, (See Control Illustration Page). All controls, except the automatic feed, will operate with the neutral positioner engaged (feed button turn on machine).

The standard procedure to operate the hand feed, is to power travel close to the feeding point, pivot neutral positioner handle forward, press feed button, engage spindle clutch, operate the hand feed, AND THEN RETURN FIRST THE HAND FEED, AND THEN THE POWER FEED TO THE TOP.

### 13. NEUTRAL POSITION FOR HAND FEED

This machine is provided with a neutral positioner assembly which is operated by pivoting a handle forward for neutral position, or back for feed position. The neutral position is used to hold the shift lever in neutral position when using the hand feed. It is mounted on the upper housing cover.

When the machine is held in neutral, all controls will operate as usual, with the exception of the automatic power feed.

CONTROLS Cont'd

14. VARIABLE SPEED DRIVE FA-4VB

Change spindle speed by pressing one of the two push buttons located on the speed control panel, green (Faster), yellow (Slower). Read RPM's on tachometer located just above push buttons.

An optimum boring speed for rapid stock removal and good tool life is 380 surface feet per minute on normal oversize cuts. A guideline to secure this surface speed is the following list of spindle RPM's of different bore diameters:

3" BORE	-	470 RPM
4" BORE	-	360 RPM
6" BORE	-	240 RPM

NOTE: Refer to the chart in back of the manual for speed recommendation.

14a. VARIABLE SPEED DRIVE FA-4B

A hand wheel on the right side of the spindle base operate a variable speed drive.

CAUTION: Do not rapidly change speed above #3 on variable drive unit. Rapid changing of speed above #3 can cause damage to variable control drive gears.

<u>VARIABLE DRIVE</u> Unit number	<u>SPINDLE</u>	
	Low	High
1	25	80
3	55	190
5	100	390
6	134	490

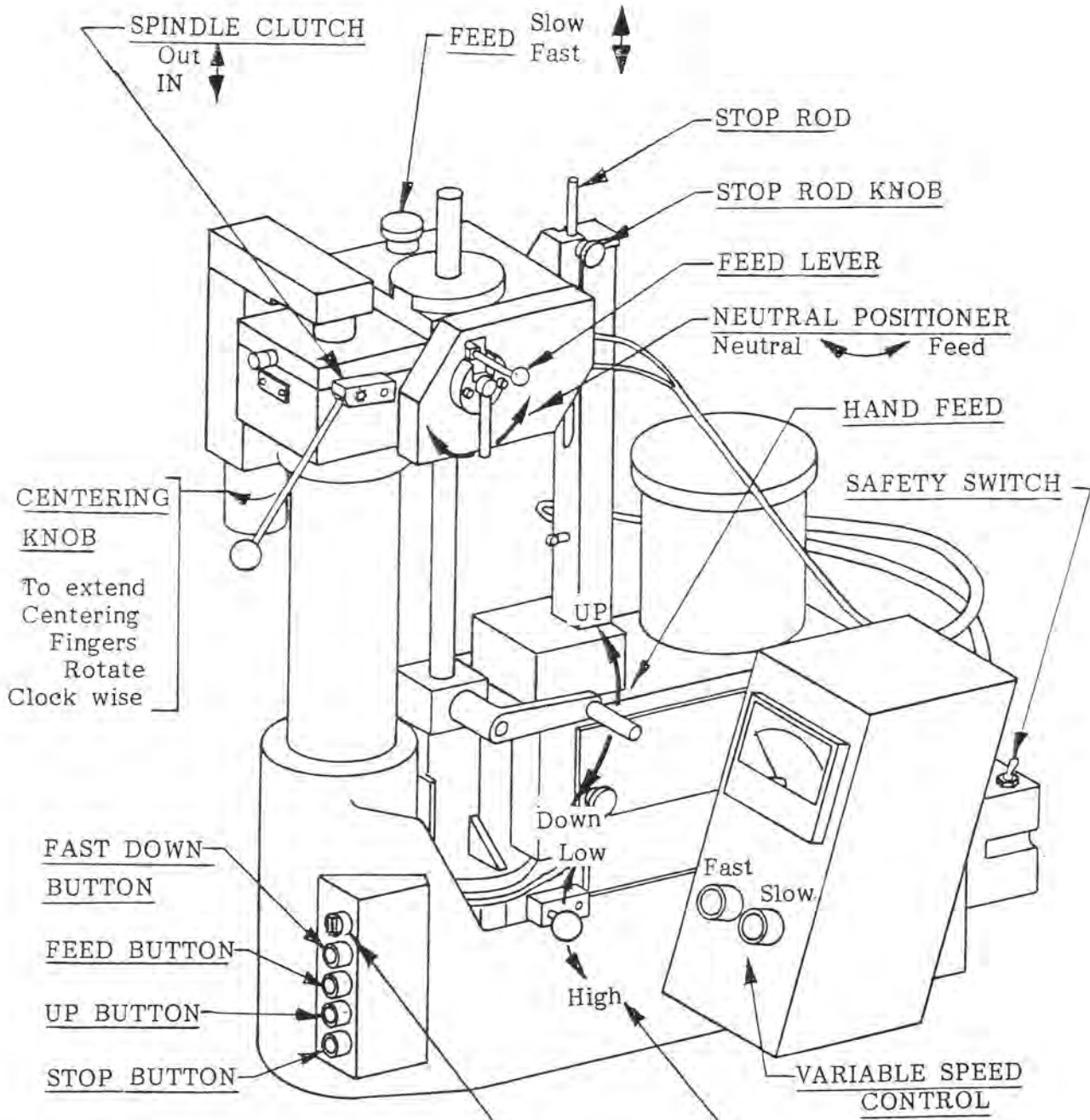
14b. 6 SPEED BELT DRIVE 6FA-4B

Changing speed in 3 speed V-belt case.

CAUTION: Disconnect power from boring bar.

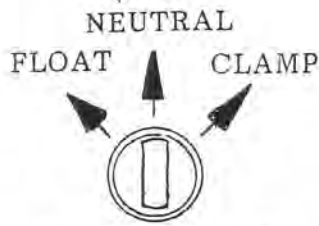
Pivot V-belt case side cover out of the way. Loosen the clamp handle on the side of the motor, pivot motor forward move the belt to a new groove location. Pivot motor back to tighten V-belt, and tighten clamp handle.

<u>V-BELT LOCATION</u>	<u>SPINDLE RPM</u>	
	Low	High
Top	20	80
Middle	50	200
Bottom	100	380



**CAUTION:**

Disengage spindle clutch and stop motor before placing hands near the cutter head.



CLAMP SWITCH

HIGH — LOW  
SPINDLE SPEED  
Pull to operate

CONTROLS



-B TYPE CUTTER HEADS

ALTERNATE CUTTER HEAD ARRANGEMENTS

Your FA-4 is equipped with a single draw bolt through the inner spindle assembly so that a number of different styles of cutter heads, tools, and indicators, may be rapidly interchanged. Two spanner wrenches are provided for locking and unlocking the cutter head, they are used on the two lower knobs on top of the spindle. When inserting alternate tools, make sure the socket is absolutely clean and while threading in place, make sure the spline is easily engaged without burring.

PRODUCTION CUTTER HEAD 600-8-4E

(This production cutter head will give the best all-around performance in this machine.)

The production cutter head with a standard bore capacity of 3.25" to 3" may be quickly attached to the FA-4 Machine by use of the draw bolt.

It is used in the FA-4 Machine to simplify and speed up the operation, eliminating the necessity of removing the tool every time you center the spindle in a new bore.

CAUTION: Care must be taken to determine that the lower body of this head does not interfere with lower extremities of the block such as bosses and hubs of main bearing bores.

The cutter head body is designed to clear most all obstructions in the U.S. passenger car and truck engines.

A dampener weight is also provided in the cutter head to improve performance of the boring spindle. This requires little or no maintenance as long as liquids or contamination do not enter the weight cavity. Should this occur, the operator will experience chatter problems with this head and it will have to be disassembled and cleaned. It is simply done by removal of the three flat head screws. Carefully disassemble, clean, and reassemble.

BLIND HOLE CUTTER HEAD (OPTIONAL) 600-20

This cutter head is attached and operates in the same manner as a production cutter head except the centering fingers are located above the cutter tool, requiring tool removal to center each bore. An offset tool bit is provided so that extreme blind bores may be processed. A dampener weight is also provided in the cutter head.



-B TYPE CUTTER HEAD, CONT'D

STUB BORING BAR (OPTIONAL 1.875 (48MM) 502-9

This stub boring head with a capacity of 1.875" to 4.1" (48MM to 104MM) diameter x 8" (203MM) depth, may be quickly attached to the FA-4 boring machine. At all times the work should be located in the machine so the end of the stub boring head is no further than 1" from the beginning of the work when the spindle is in the upper limit of travel.

Unlike the production cutter head, centering fingers are located above the cutting tool, requiring tool removal to center each bore.

Two sets of centering fingers are provided, the smaller has a 1.875" to 3.5" bore diameter range and the larger a 2.312" to 4.1" diameter bore range.

If centering fingers require dressing after a period of use, apply the same lapping procedure noted on Page 37 & 38. The micrometer may also be periodically calibrated as noted on Page 38.

An off-set tool bit is also provided in order to bore to the extreme bottom of blind holes.

IMPORTANT GENERAL INFORMATION  
FOR THE BEST USE OF  
THE MODEL 1.875 STUB BORING TOOLING

CATUION: Inner spindle adjustment (see page 43) Must be correct for precision use of stub boring heads.

Since the extended stub boring head design has considerable overhang with a small shaft diameter, the cutting tool "B" land must be kept very narrow, (.005" to .015") (.127MM to .381MM) wide. This will insure best results with no chatter at the bottom of the bore.

The small head will also be inclined to deflect with increasingly heavy cuts. You may expect, with properly sharpened tools, that after .040" (1.016MM) (on diameter) cut a second pass of the tool will remove close to .001" (.025MM) material on the diameter. A second pass following a lesser first cut will remove less metal.

The .040" (1.016MM) cut will also leave a light drag back mark in the cylinder that can in turn be eliminated by the second pass.

The drag back mark is generally eliminated in any event by finish honing. It may also be eliminated by repositioning the boring spindle away from the tool position on the return stroke.

You can use the second pass performance (second pass must be made without re-centering) to provide a most precise bore.

In general, size variations, in a typical cycle bore will approximate .0007" (.017MM). A second pass will reduce these variations to generally less than half and provide a fine finish. This finish will require very little stock removal with a hone in order to cross hatch for an excellent ring seating condition.

The boring head assembly as noted in stub bar illustration, is equipped with a dampening weight, Part 502-9-6A. This requires little or no maintenance as long as liquids or contamination do not enter the weight cavity. Should this occur, the operator will experience chatter problems with this head and it will have to be disassembled and cleaned.

Performance of the stub boring bar is also closely related to the proper lubrication and adjustment of the machine inner spindle bearing. Check the inner spindle adjustment two to three times per year to make sure clearance is correct.

1.5 (SHORT) STUB BORING BAR (OPTIONAL)      600-8-8A

This stub boring head, with a capacity of 1.5 to 4.1" diameter (38 to 104MM) x 3" depth (76MM), attaches and operates the same as the 502-9 cutter head. It is designed especially to be used with the production full width single cut V.W. head facing tool. It can also be used for general purpose boring head as required.

NOTE: When this cutter head is used for V.W. head facing, cutter head will require centering bushings and wide facing cutting tools, which are sold separate. See Page 88 for sizes.

V.W. HEAD FACING INSTRUCTION

Install 600-8-8A stub boring head. Select the size centering bushing you require for the size head you are finishing. Place it over the stub bar, raising it up until it engages the ball detent to hold it in its park position. Set a facing tool that is in the range you require. Set by loosening adjusting pin set screw, which will allow adjusting pin to slide back against micrometer anvil.

Insert facing tool into cutter head and lock with tool holder lock screw.

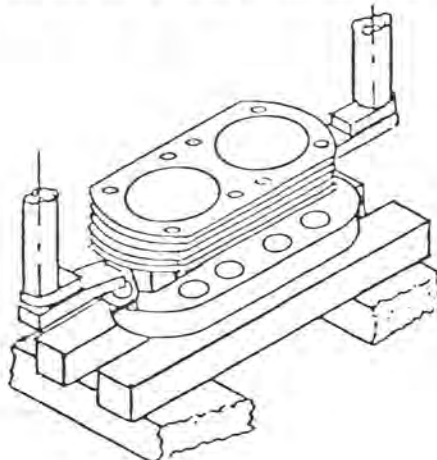
Place cylinder head on parallels as shown in sketch. Make sure mounting surface is reasonably flat. Shim to support properly if surface is exceptionally out of flat.

Clamp head with sufficient force to ensure holding in position when cutting.

NOTE: Excessive clamp force may warp or deflect head.

Use approximate 200 RPM spindle speed. Rapid travel head down until facing tool is just above cylinder head. Turn off boring bar. Move centering bushing down from its park position. Turn boring bar clamp switch to float. Center spindle with bushing, turn switch back to clamp. Raise bushing back to its park position.

Use the hand feed and dial depth indicator assembly, 503-14A, face head to the desired depth. Set dial indicator so that you can finish to the same depth in the next bore. Do not allow tool to dwell for more than a few revolutions at the finish depth or a wavy finish will result.



## OPERATING INSTRUCTIONS

We recommend, particularly for operators unfamiliar with the boring bar, to practice on a junk block in order to become acquainted with all controls and details connected with the use of the machine.

### BORING AUTOMOBILE AND SMALL TRUCK BLOCKS

#### LOADING IN-LINE CYLINDER BLOCKS

Place a Chevrolet, Ford, or Plymouth 6 cylinder block in the machine on top of the 5" parallels frame and apply weight to the top of the block at each end to determine that there is no burr or dirt under the pan rails that will result in the block not being clamped properly to all four points of the pan rails. (You will note it is necessary to properly deburr and clean pan rails at support points, as apposed to cleaning the top of the cylinder block for a portable bar.) You will find that some blocks will rock on parallels and should be shimmed at the proper front support to eliminate rock.

Place the block into the machine, so that the holes are in a position to approximately locate boring spindle in the middle of its 1-3/4" in and out travel, when centered.

You will note that it is possible to put engines in this machine in such a way that the spindle unit may be forced to the limits of either its in or out travel and not enable it to be centering properly.

Swing clamp arms out so that the toe of the shoe will contact the center of the ends of the cylinder block.

Lock clamp handles firmly and lower the toe firmly on the block with the cam handle straight up. Lock ball handles firmly and lower cam handle to clamp block. If the block is exceptionally long, such as straight 8's, operate the two cam handles simultaneously so that locking the first handle does not tend to rock the opposite side of block up.

CAUTION: The standard production-type cutter head 600-8-4 with centering fingers below the tool bit must be checked for interference with main bearing bosses or other protuberances on engines other than typical American passenger car and truck engines. FA-4 machines may have other cutter heads substituted to avoid this difficulty.

## OPERATING INSTRUCTIONS, CONT'D

### MICROMETER

Determine the cylinder bore size you wish to cut and place a tool bit into the tool holder and use the micrometer to set to size. Choose a tool holder that will allow minimum tool bit overhang, for the size you wish to bore. We recommend a maximum tool bit overhang of 5/8" outside of tool holder. Before setting, make sure the tool bit is properly sharpened. (See tool sharpening instructions.)

NOTE: This micrometer is .050 to a revolution rather than .025 as on a conventional micrometer.

Your boring bar micrometer, as with any other measuring tool, should be used DELICATELY and with care to be assured of great and continued accuracy. Particular attention should be paid to inserting the holder in the micrometer without allowing the spring loaded tool bit to snap against the micrometer anvil. Caution should be used to lightly lock the tool bit. Then turn the micrometer spindle away from reading and firmly lock the tool/bit. Then re-check the micrometer reading.

### BORING

Insert the tool holder into the boring bar spindle and push firmly back to the index point. Lightly lock the tool lock screw with plastic handled hex driver provided in your tool box.

Make sure spindle clutch is out (Lever in up position) and the spindle is placed near the center of the hole but slightly to the rear. Turn clamp selector to right (clamp position). Press fast-down button to travel the cutter down to within 1/8" of the cut. If you should travel the cutter into the bore, place fingers on UP and STOP buttons, and press the up button, immediately pressing stop button when the cutter is out of the bore.

### CENTERING WITH CENTERING FINGERS

Turn clamp selector to left (float position). Turn centering knob clockwise to extend centering fingers. Make sure they will extend and contact the cylinder wall. Continue to hold a firm rotary pressure on the centering knob and turn clamp selector to the right (clamp position.) When rotating clamp selector switch, a slight pause is required in the straight up or neutral position, to assure good centering. This pause will allow the float air to dissipate and the spindle to settle evenly before the clamp cylinders engage.

NOTE: Do not pull knob toward you during centering. This is the most common cause of centering error.

OPERATING INSTRUCTIONS, CON'D

Turn centering knob counter-clockwise to return fingers to "IN" Position. Apply light down pressure on the spindle clutch lever while pressing feed button to begin boring. If you wish to check the bore size, allow the machine to bore a sufficient depth above the ring travel. Raise and hold the feed shift lever in neutral position, disengage clutch push up button. Allow the machine to return to its full up position. Check bore diameter, adjust if necessary and re-insert tool rapid travel down to job again: engage spindle clutch and press feed button. Do not unlamp during this checking operation.

When cutter has completed boring operation, set down stop rod on the back of the upper gear housing to stop feed. The stop should be set promptly after machine finishes cutting as the inverted style of the cutter head does not have a large amount of end clearance above main bearing bosses on some engine models.

NOTE: If a cut of .005 or less, on diameter is to be taken, the following centering procedure is required - turn float clamp switch to its neutral position, then center spindle by using a dial indicator attached to the cutter head. Then turn clamp selector to the right (Clamp position).



AIR V-6/V-8 COMBINATION FIXTURE

502-1-72

CAUTION: Handle block and fixture with substantial care and guidance. A block hoist is required. Mishandling of the heavy engine block and fixture could result in the dropping of a heavy piece and possible personal injury. BE CAREFUL.

NOTE: F4 main base only, 2 1/2" (502-1-21-A) wear pads must be bolted on top of the 4" wear pads when using this fixture.

The Model 502-1-72 V-6/V-8 cylinder block air fixture is a fast, simple and universal system to properly and accurately hold most 60 degree and 90 degree V type engine blocks for cylinder boring.

The block is most effectively handled with the main bearing caps in place and at least the outboard caps torqued. Spacer blocks are furnished to allow for boring the block without bearing caps on.

V BLOCKS (Blocks with main bearing center lines no more than 1/2" higher than the pan rail plane) are mounted with the 502-3-8-B V block frame in place. Select 90 degree option placement with frame to suit block length, or interference of main bearing caps.

Y BLOCKS (Blocks with main bearing 2 3/8" to 3 1/2" higher than the pan rail plane) are mounted directly on the fixture.

The 502-1-21-AL & AR wear pads are used for most automotive blocks. The 502-1-21-AL & AR wear pads must be removed to accomodate large blocks including the Ford Super Duty Truck Series, the Caterpillar 3208 and the International V 401, 446, 549, and 550 Series.

The fixture may be easily repositioned on the machine wear pads (without a block in place) to shift from the 60 degree support surface to the 90 degree support surface.

CAUTION: Large blocks, requiring removal of wear pads, lift directly from the block bank surface, DO NOT USE the 502-1-95 block handler assembly on these blocks.

The normal operational procedure on smaller V blocks is to first attach the block handler assembly on to the block making sure the cam lifters are COMPLETELY engaged and that the lift hook is approximately centered in block lengthwise. Place the 502-1-82-A locator bar assembly thru the main bearings and hoist the block into the fixture, using the locator bar handle upright to help guide the locator bar into place. Pulling the block towards you, with the locator bar against the guides, will prevent jamming in the slot of the guides during loading and unloading operation. After locator is engaged in guides - pivot block as you lower it.



AIR V-6/V-8 COMBINATION FIXTURE Cont'd

Make sure the block is firmly seated in place and not resting on pan rail burrs or other interference points, accurate seating can also be a problem with extremely warped, distorted blocks or can be caused by failure to remove a main bearing insert. Locator bar has a relief for block with small main bearing.

Depress the valve button in the tube tower and push back into bore position using the guidebar provided to stay reasonably centered on the support ways. Lack of air float support will indicate you are moving off the center of the support ways.

Operate the block clamp arms, bore and pull fixture back out to the load position while depressing the valve button. Lift the block out with the block handler, turn the block 180 degrees and reload to duplicate the operation on the other bank.

For safety, the air float will also cease when the fixture is at it's outer limit of travel, when on the 502-1-21-A wear pads.

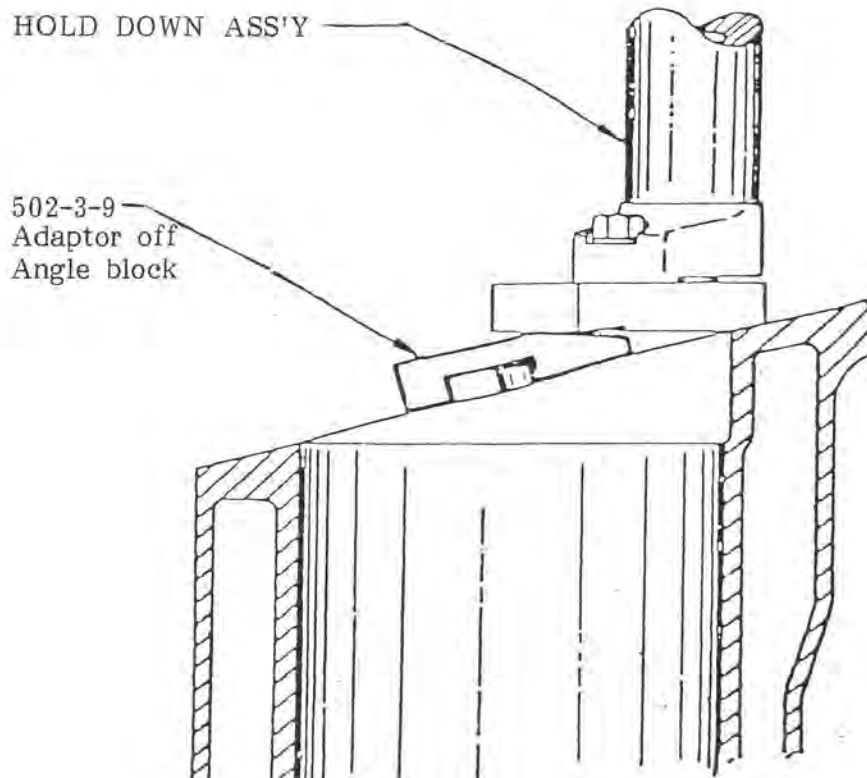
CAUTION: When wear pads 502-1-21-A are removed, watch guide bar to assure safe out travel.

Use lift hook 502-1-103 to lift V6/V8 fixture off of main base. You can lift block and fixture together if locator bar pins are inserted in bar positioner of fixture, and block has main bearing cap on.

ANGLE TOP BLOCKS

Place the optional small wedge shaped aluminum blocks (502-3-9) over dowels and apply clamp pressure to them as shown in sketch.

CLAMPING ANGLE TOP BLOCKS



### ANGLE TOP BLOCKS, CONT'D

When you are reboring angle top blocks, you will find it necessary to occasionally recounterbore the top of the block for proper piston and ring entry. We suggest that you regrind your tool bit for this with approximately a 30 degree entry angle. After boring a bank of cylinders, set to size and insert the chamfer tool.

In order to center for this operation, rapid travel down sufficiently far to center the spindle. Clamp and retract the spindle with the spindle clutch disengaged until you can freely rotate the cutter without striking back side of the cylinder.

Engage the spindle clutch press the feed button, put the speed change lever in lowest speed, and allow the machine to bore until chamfer is cutting 360 degrees of cylinder. Raise shift lever to neutral position and disengage spindle clutch. Depress up push button to return the spindle to the top.

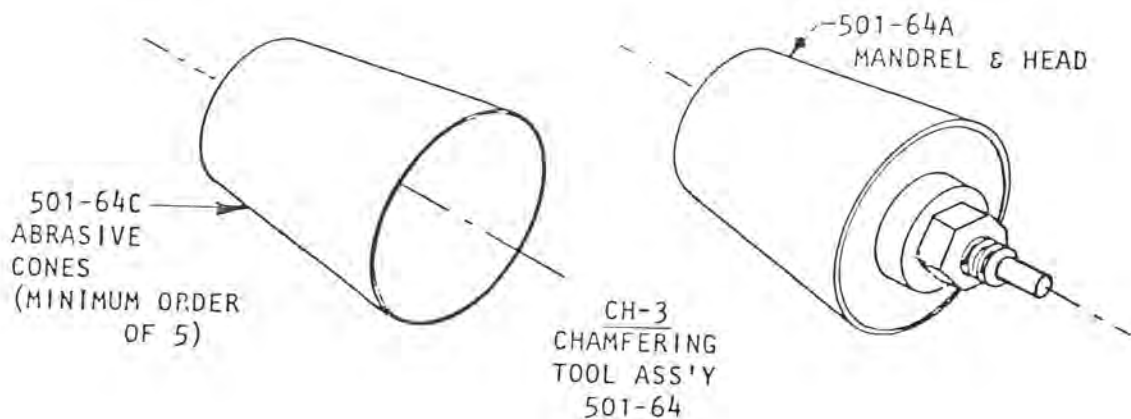
### BORING LARGE TRUCK BLOCK

The FA-4 Boring Machine has the capacity to bore truck engines such as the In-Line Mack and In-Line GMC Series 71. It is necessary when boring these large blocks to remove the wear pads (502-8-1) and place the block directly on the main base (502-8-2).

### CHAMFERING

A special tool is available for chamfering. Tool may be set by either inserting in the head and approximately setting or placing in a micrometer and set approximately .100 over the bore size. Chamfering can be done either by using slow feed and releasing when adequate chamfer has been developed or by use of hand feed.

Chamfering may also be simply done most effectively with an optional model CH-3 abrasive tool driven by a drill motor. This method will not require boring bar and develops a smooth burr free entry for rings.



## COUNTERBORING

Counterboring will often be required in re-sleeving large engine blocks on your model machine and frequently a close tolerance depth must be maintained in order to properly secure the sleeve installation.

NOTE: Use hand feed.

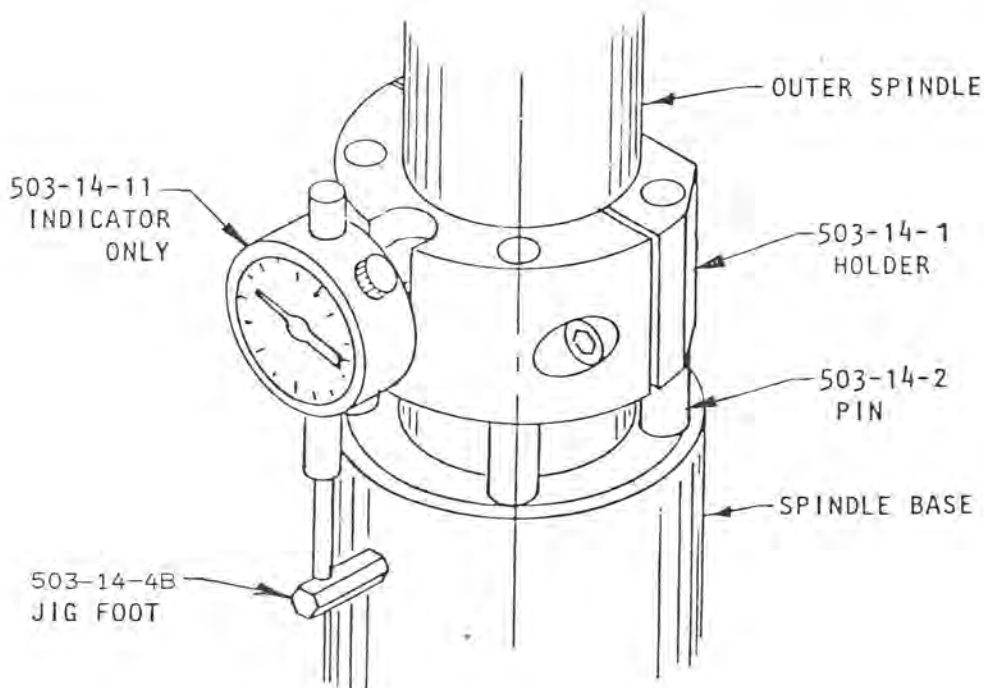
## UPPER AND LOWER DECK REPAIR OF DIESEL CYLINDER BLOCKS

Most diesel blocks use the cylinder head to clamp the lip of the wet sleeve against the counterbore and at the same time, location of the sleeve is determined by the upper and lower fit.

This requires a good deal of caution to determine that:

1. Counterbore is parallel to the top deck
2. Counterbore is exactly square with the concentric upper and lower deck bore fit diameters.

Counterboring may be best accomplished by the use of an optional 1" travel dial indicator assembly, 503-14A.



503-14A  
DEPTH DIAL INDICATOR

### COUNTERBORING, CONT'D

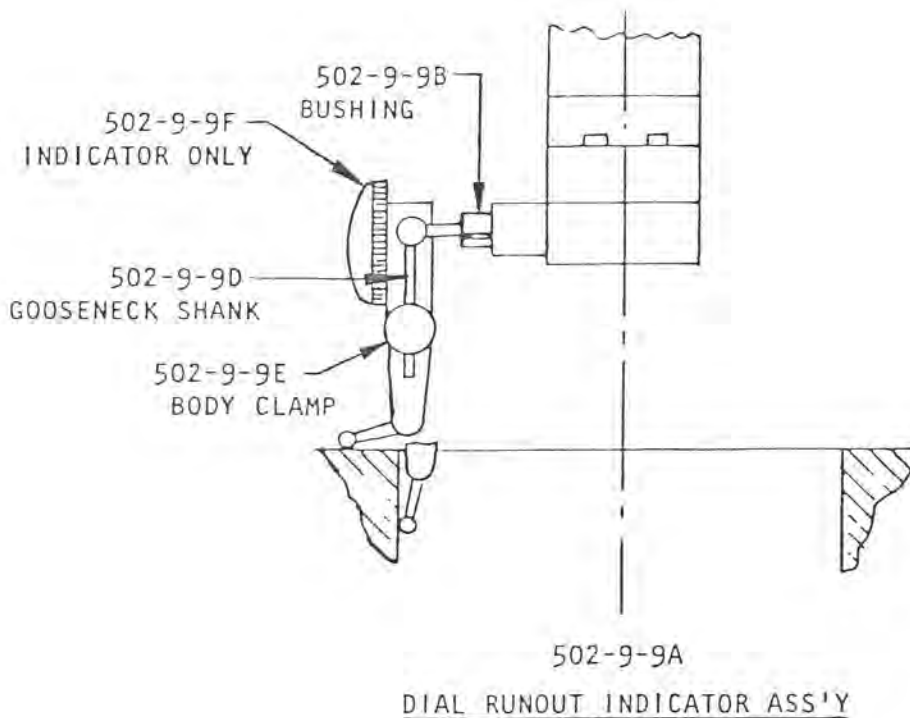
To counterbore to a close tolerance depth, carefully hand feed the RF type cutter bit down until the cutter is slightly touching the block surface. Adjust the dial reading to "0" and hand feed cut down to within .003" to .007" of desired depth. Check the exact depth of counterbore at this point with your depth micrometer and hand feed the remaining depth required by reading the proper number of graduations on the indicator.

The dial depth indicator clamp is manufactured with spring pins so it will compensate for the weight of the spindle and allow very accurate depth control. It may be clamped into any position within the machine's spindle travel.

NOTE: 1/4 turn of the right hand clamp screw is sufficient tightening force. This will allow the collar to slip on the column (after the pins retract into collar), if the collar is inadvertently left in wrong position during normal cycle boring operation.

MECHANICAL DIAL RUNOUT INDICATOR (OPTIONAL) - 502-9-9A

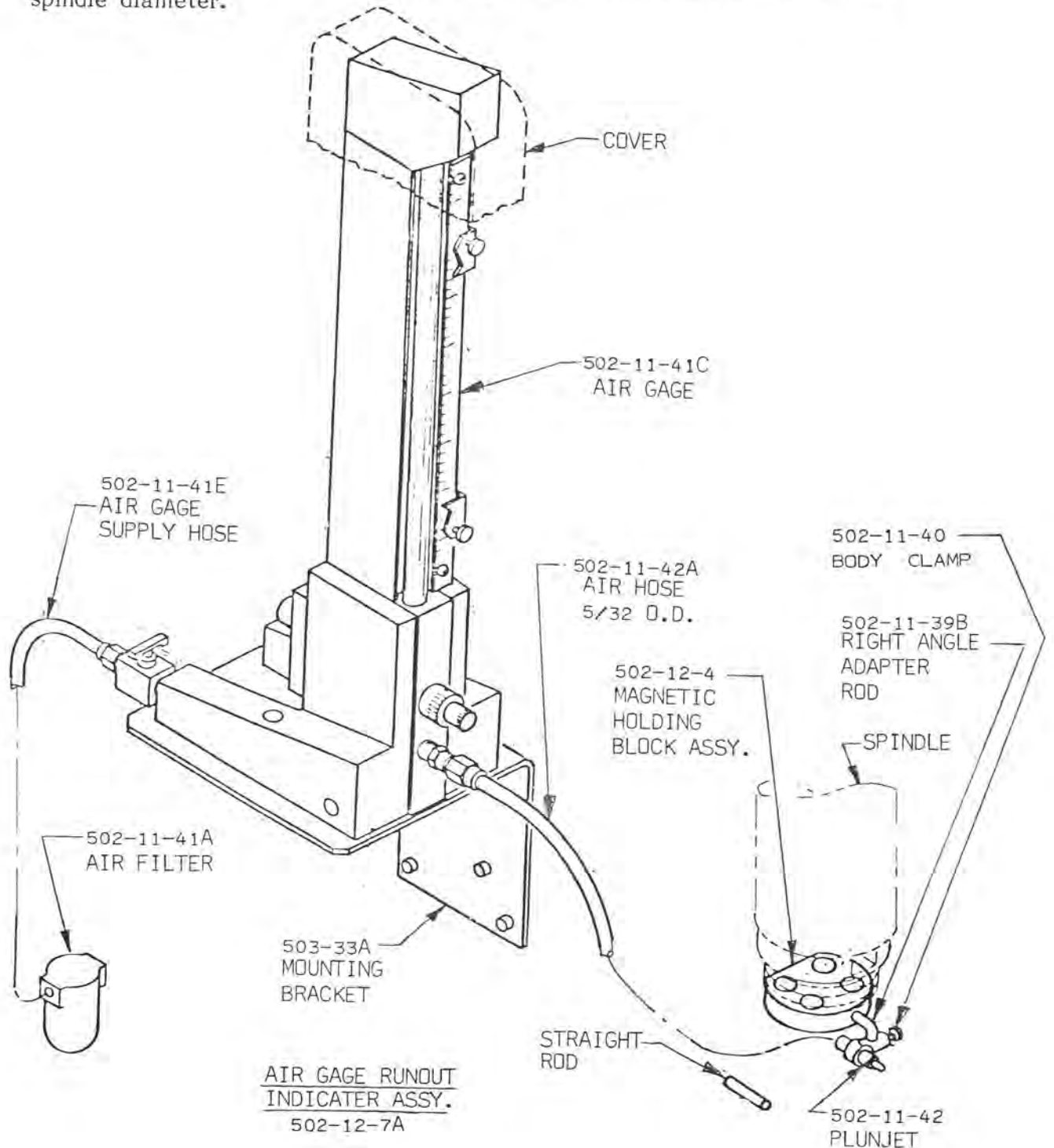
An indicator to check bore, as well as face runout, is available for the FA-4 Machine. This mechanical indicator should be used particularly where an upper or lower bore must be aligned perfectly with a matching bore. If the top of the block face runs out excessively, the block must be checked to see if the head surfacing has been done properly perpendicular to the center line of the cylinder. If it hasn't, it will be necessary to shim the block to secure a better indicator reading. This perpendicularity must be checked closely on block top surface to clamp the cylinder liner.



REMOTE RUNOUT INDICATING SYSTEM (OPTIONAL) 502-12-7A

An optional remote indication air probe and gauge system is also available to check bore and face runout.

The stationary indicator allows easier reading and can be used in lower bore extremities where the mechanical dial indicator cannot be seen. The air probe can be used in a considerably smaller bore size relative to the spindle diameter.



OPTIONAL

DIESEL "V" - BLOCK FIXTURE ASSEMBLY

OPERATING INSTRUCTIONS

MOUNTING OF FIXTURE -

Thread the three (3) socket head capscrews into the three (3) tapped holes in lower front of the main base. Leave a 1" gap behind the head of the capscrews. Place the center support (#502-11-51) over the heads of these three (3) screws, slide the support down until it engages all three (3) capscrews: tighten all three (3) capscrews.

Attach the yoke adjusting bracket (#502-11-55) by placing its dowel pins into the 3/4" diameter holes in main base. Lock one of the adjusting screws with it's lock nut on one of the yokes. Place all three (3) locator bars (#502-11-56) into the "V's" of the yoke. Attach the center adjusting bracket in the center of one of the banks of the block, using two (2) head mounting screw holes.

Lift the block onto the fixture so that the block mains are resting on the locator bars, and the adjusting screw of the center adjusting bracket is resting on the center support.

Locate and actuate the block clamps. Use max clamp force on sleeve cuts only.

BLOCK ALIGNMENT

Diesel block with head held sleeves must be aligned so that the cylinder counter bores are parallel to the head mounting surface. Cylinder bores must also be held perpendicular to this same surface within close limits.

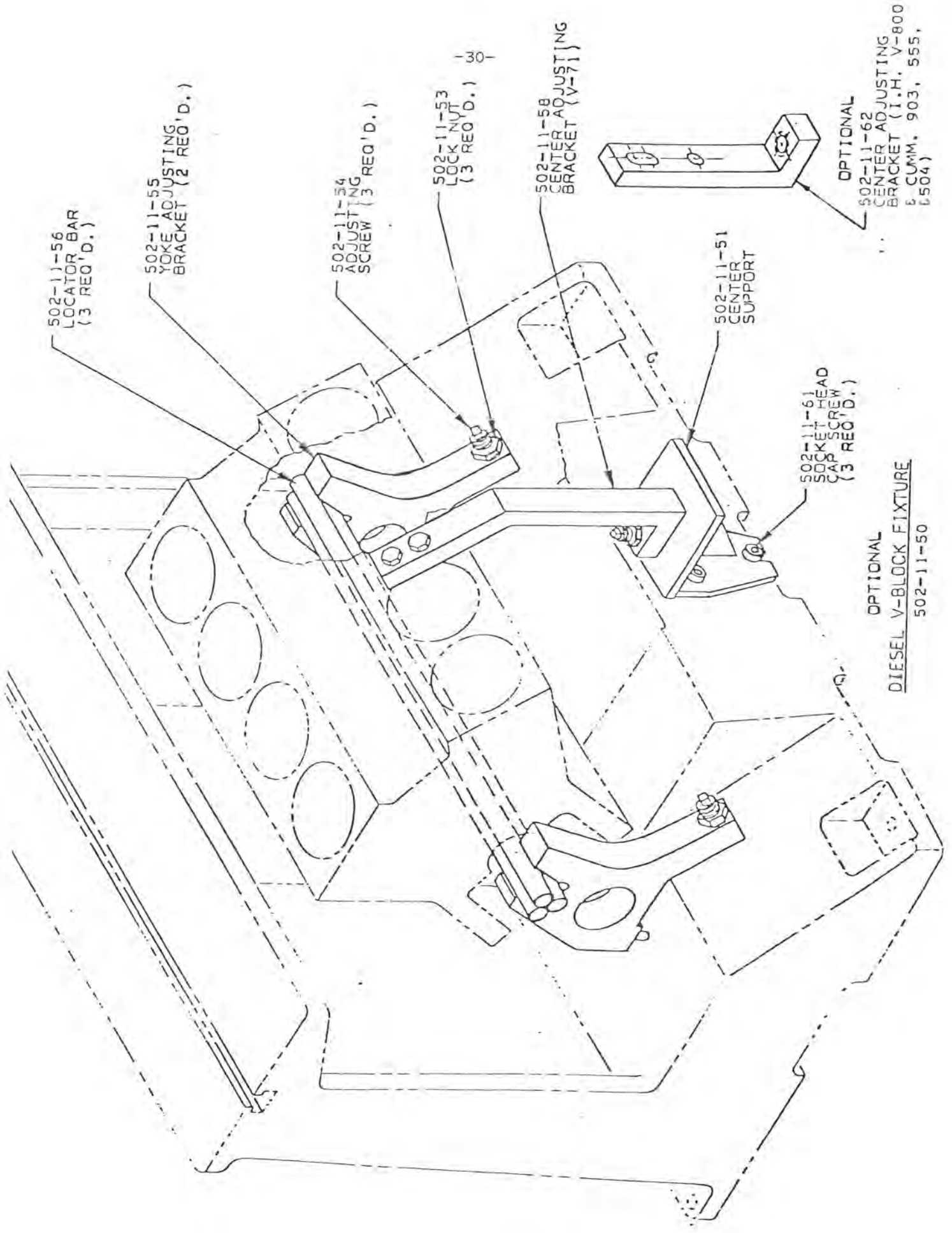
Check the block top surface first with a dial indicator or air gage probe mounted on the cutter head. Travel the spindle the length of the block to determine that the parallelism is as close to .0005 as possible.

If the block is not parallel, you can raise or lower the end of the block by turning one of the yoke adjusting screws. The other one should be locked. Locator bars may be deflected up to .003" with the clamps on working position. You may have to loosen the block clamps to make this adjustment. Lock the adjusting screw with its lock nut after this adjustment is made.

Rotate the cutter head to check the flatness front to back. If not within .0005 desirable limits, raise or lower front of the block by turning the center adjusting screw. Lock with its lock nut after adjusting.

NOTE: With all adjusting screws locked and block clamp actuated, recheck your readings. Remember some top-of-block surfacing processes create a wave-like condition along the block and will be higher at sections between cylinders and at ends of block. Dial indicator readings should be taken at those points and not at bore area.





OPTIONAL  
DIESEL V-BLOCK FIXTURE  
502-11-50

OPTIONAL  
OPERATING INSTRUCTIONS  
FOR FA-4 SPINDLE WHEN USED ON  
BLOCK MOUNTING ADAPTOR #502-8-60

To utilize the FA-4 spindle for off base boring you must place the block, you are going to work on, close enough to the boring machine base, so that the wiring air harness will not be twisted or stretched when boring bar is in use.

CLAMPING

Assemble hold down assembly by first selecting the proper length stud required. Screw stud into both the adjusting tube and the clevis. Lock stud to clevis with lock nut. In general the short 5-3/4" stud will accommodate a main bearing to top of block height of 6-1/2" to 11-1/2". These studs increase in length of 3" increments.

CAUTION: Make sure that the adjusting tube and the stud are threaded in at least 1/2".

Place subplate on the block next to the hole you are going to bore. Lower hold down assembly thru subplate and block.

Insert main bearing bar thru the main bearing bores of block and thru clevis. Insert sufficiently far so that the bar rests on the main bearing bores on both sides of clevis.

Rotate adjusting tube finger tight.

CAUTION: Turn off safety toggle switch at rear of spindle unit, before moving spindle.

Attach lift eye to top of feed screw. Remove cover to spindle clamp arms on rear of belt case. Remove cotter pin, nut, and washer from stud of roller key assembly. Carefully lift spindle unit off of stud and place over adjusting tube and subplate.

NOTE: Do not twist or stretch wiring air harness.

Place bolt with washer thru spindle clamp arm and thread into adjusting tube (Finger tight).

Center subplate and spindle over the hole you are going to bore.

Insert Rod (502-9-59) into adjusting tube. Tighten adjusting tube.

NOTE: Subplate must be clamped to block with no play in hold down assembly.

Turn on safety toggle switch of spindle unit. Turn clamp switch to float. Move spindle unit back and forth on subplate and adjust bolt so that it does not bind with the clamp arm of the spindle.

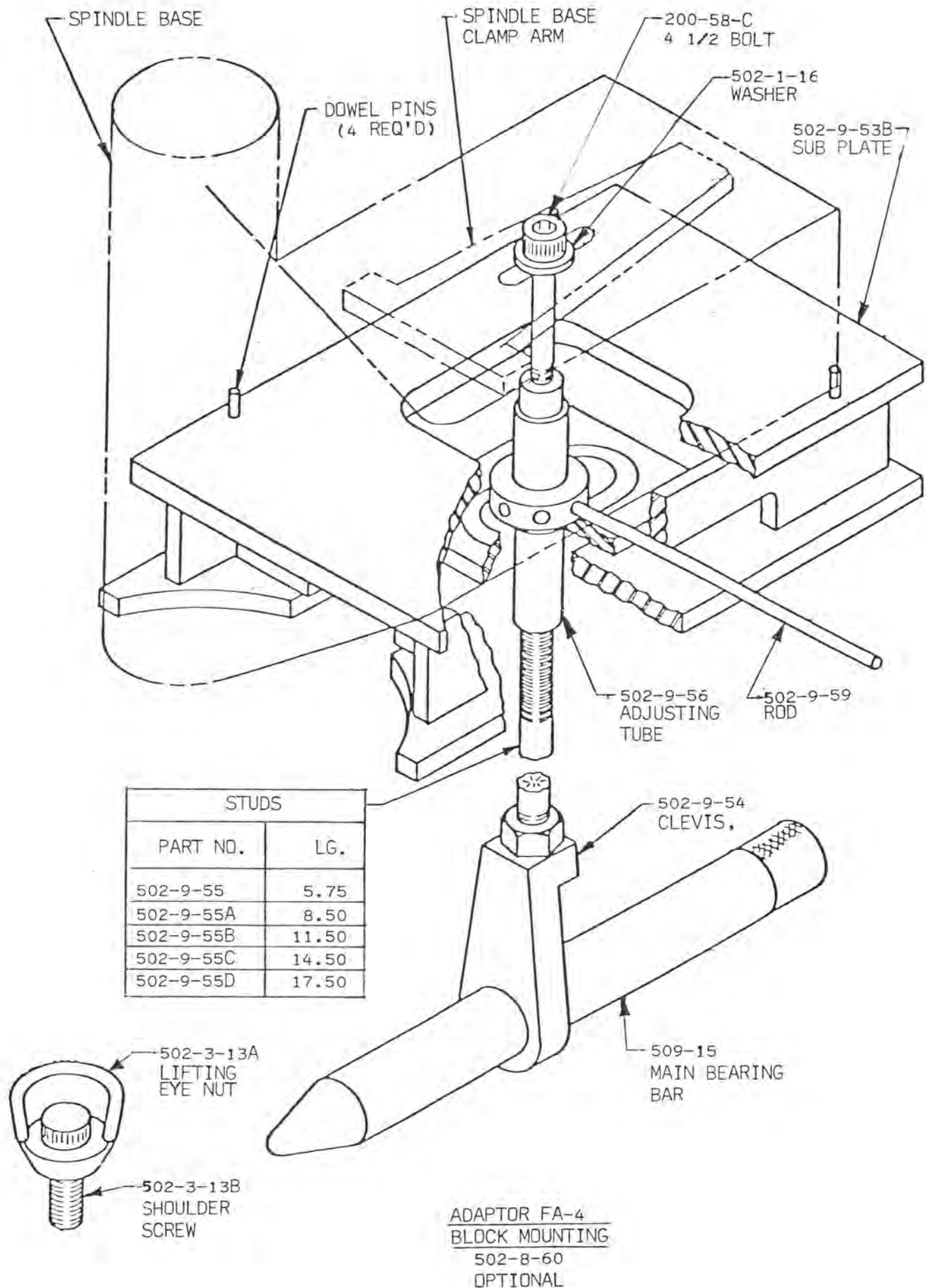
NOTE: Bolt should allow for free movement of spindle unit on subplate, but because of the limited movement of spindle clamp arm, and the necessity of having sufficient clamp pressure, no clearance above 1/32" can be allowed between the bolt and the arm.

CAUTION: Remove lifting eye before turning on spindle unit, so that the eye does not get entangled in hook.

Check to see if spindle is in center of hole you wish to bore and has free movement in all directions for center (check dowel pin on subplate for clearance).

Turn clamp switch to clamp and run spindle down for centering.

Proceed with standard centering and boring procedure.



### DEPTHS OF CUT

Precision finish bores may be cut in one pass with stock removal up to .060 in diameter, provided the suggested surface speeds of 380 feet per minute are used. Generally where the finest finishes are required and/or a heavy stock removal may be made, use the light feed rate. Extreme bore length jobs may require .040 finish cut.

Roughing cuts for sleeving or substantial stock removal can be made up to .200 on the diameter - using the fast feed rate and approximately 200 feet per minute surface speed.

### STUB BORING BAR

Heavy cuts up to .150 on the diameter can be made with the stub boring bar.

### TOOL BIT SHARPENING

CAUTION: Eye protection must be worn when sharpening tool bits!

The performance of your boring bar and quality of work it will do, is almost entirely dependent on the care of the cutting tool. It is the most frequent cause of size and finish problems in boring.

To sharpen the carbide bit, insert the tool holder in the sharpening jig slot. Place the jig over the pin provided on the top of the SJ3B and sharpen bits on the small diamond wheel provided on the motor shaft. Always make sure you sharpen the tool on the side of the diamond wheel that is running toward the top face of the bit. Sharpening the wrong side can readily chip the point. When sharpening, use very light pressure, moving the tool back and forth across the diamond wheel, to improve cutting and prevent grooving of the diamond wheel. After sharpening a number of times dress excess steel away from the carbide with a grinding wheel.

If a considerable amount of production is anticipated with your FA-4 Machine we would recommend locating a silicon carbide or green grit type of abrasive grinding wheel on a closely located bench. So operator may conveniently dress steel away from the carbide and grind away unused portions of the carbide lands to allow faster diamond wheel touch up. This will also be convenient in the event a small fracture occurs in carbide, and will reduce wear on diamond wheel. The top surface will crater .010 to .015 back of the tip with considerable boring, so the tip should be occasionally dressed back .020 to .025.

CAUTION: See sheet for tool sharpening requirement.

Diamond wheel is designed for carbide only and is not intended for rapid stock removal. Steel tends to load it. A tool bit used for aluminum boring should never alternately be used for cast iron or steel. Iron weld on top of the bit will cause a rough finish on aluminum work.

CAUTION: Do not attempt to dress or sharpen the top of the tool bit. Grind or dress the front and sides only.

The performance of your boring bar and the quality of work it will do is almost entirely dependent on the care of the cutting tool.

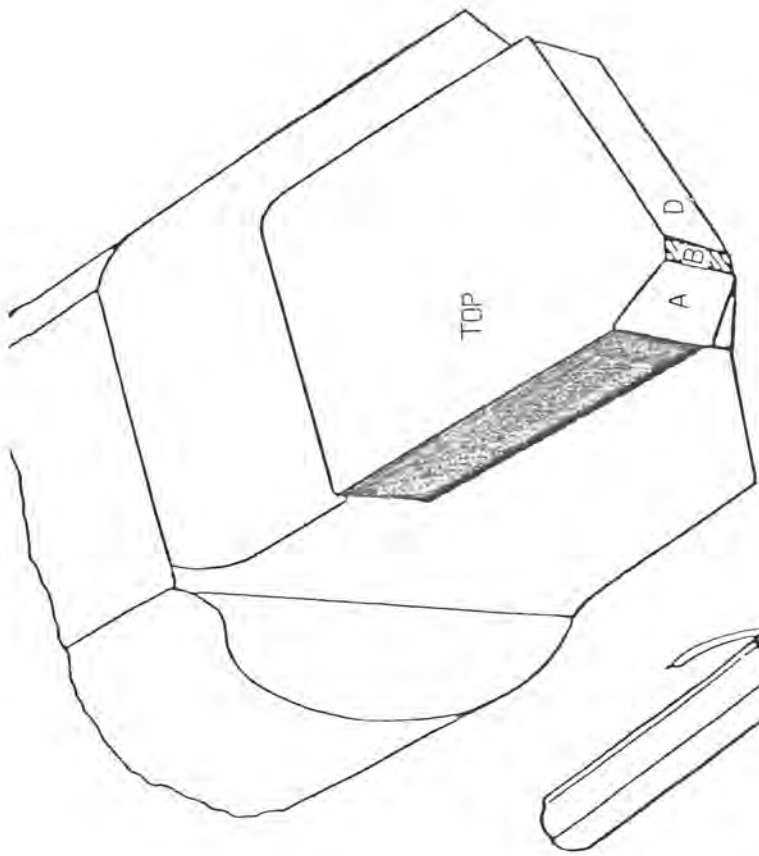
In the accompanying sketch, letters A,B,D, correspond to the letters indicated on your sharpening jig, in other words, when your jig is set in the A position it will sharpen the "A" land as shown in the sketch.

The most critical point of this sharpening is the width of the "B" land (as indicated by the diagonal line shading). This width should be maintained at about .015 to .025. This width is held by cutting back the "D" land as required. The "B" land must be reduced to .005 to .015 on all stub boring heads and long bore operations. See Page 36 for exact "B" land requirements.

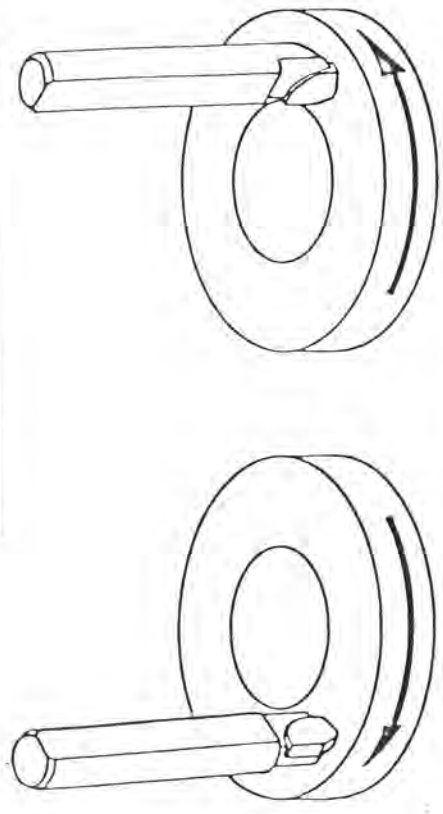
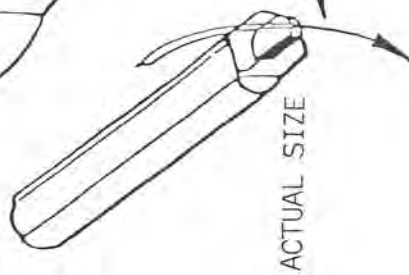
In the event your bar chatters or bores a rough finish at the bottom of the cylinder, it is very probable the "B" land is too wide.

The "A" cutting land is not critical to width but should be maintained in good condition to obtain free cutting, particularly on heavy cuts.

The top surface of the bit is finely finished at the factory and requires no further resurfacing. This also means no honing or in any way attempting to break off the chip that sometimes seems to be apparent. The practice of doing these things will inevitably result in poor surface finish and impair the accuracy of the machine.



THE TOOL MUST BE SHARPENED ON CORRECT SIDE OF DIAMOND WHEEL SO THAT THE WHEEL IS TURNING INTO TOP FACE OF TOOL.



## TOOL SHARPENING REQUIREMENTS

CAUTION: BORING DEPTH -VS- TOOL SHARPENING

The PA-4 7 boring bar tool sharpening does not require extremely close attention to "B" land width for the great bulk of passenger car boring up to 11" cylinder length, although a .025 width "B" land should not be exceeded.

Cylinder lengths longer than 11" require tool bit "B" lands to be .005 to .015 wide or chatter will result at the bottom of the hole.

To produce the best result at the extreme length capacity, use a RF facing tool, 501-29A, and do not sharpen an "A" land. This tool bit is particularly useful for heavy stock removal on long bores.



### CARE OF DIAMOND WHEEL

If the diamond wheel is handled with care it will provide many years of service.

An abrasive stone is furnished with your diamond wheel for use in honing the face of the wheel. You should use this stone frequently to remove the particles that tend to load this wheel, otherwise you will not produce the keen edge on the tool that allows the machine to bore accurate holes with a fine surface finish.

### TOOL LIFE

With tools sharpened to a precision edge, it should be possible to bore approximately 20 oversize cylinders on high speed.

This applies to most American passenger car bores under 4" provided no hard spots or foreign materials are in the cylinders. The same number of sleeving cuts can be made on low speed, without further sharpening. Provided the tool has an original keen edge.

Two grades of carbide tool bits are available:

R8 Tool Bit: A tough grade of carbide for heavy and interrupted cuts and general boring.

R1 Tool Bit: A harder carbide with better wear characteristics, to be used for normal boring with improved tool life. Suggested for production re-boring.

### CENTERING FINGERS

#### CHANGING OR INSTALLATION OF CENTERING FINGERS

CAUTION: Motor must be turned off and spindle clutch lever must be in the up detent position during any centering finger operation.

Centering fingers can be taken out by simply rotating the centering knob clock-wise until fingers can be removed. When they are replaced or reset in the cutter head, they should be replaced in the respective numbered slots and the centering knob first rotated clock-wise and then counter-clockwise to insure that fingers enter pinion teeth simultaneously.

### CENTER ACCURACY CHECK

Centering fingers should be kept adequately accurate to center the new bore within .002" of the center of the worn hole. Centering fingers can be lapped periodically to obtain near perfect centering.

Periodically check the centering fingers by boring a hole and then without unclamping the spindle unit, extend the fingers against the wall, checking to see that each finger tip will lock a .001" shim. If the fingers will not do this they should be lapped by rotating them back and forth in this test bore

## CENTER ACCURACY CHECK, CONT'D

while holding the fingers against the wall. If this does not quickly bring contact and pressure to all the fingers, it will be necessary to dress carefully the high finger or fingers with a file and repeat the lapping process.

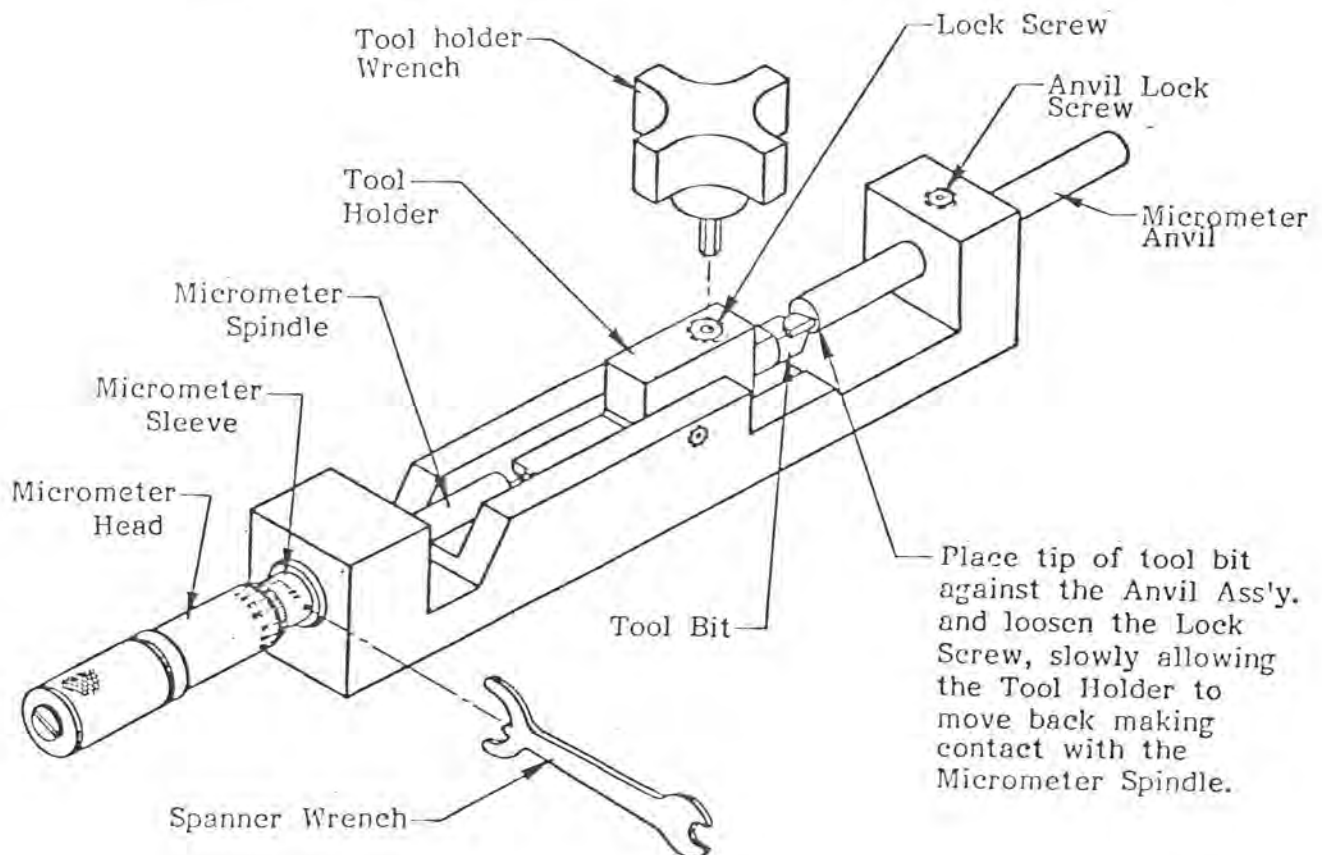
### MICROMETER

Your boring micrometer, as with any measuring tool, should be used delicately and with care to be assured of the greatest accuracy. Particular attention should be paid to inserting the tool in the micrometer without allowing tool bit to snap into micrometer anvil. Care should be used in the method of lightly locking the tool bit before tightening, move the micrometer spindle away from the tool holder, before tightening.

After a period of use, you will note that the tool bit tip will force a depression into the micrometer anvil. This, of course, will result in the inconsistent sizes, particularly after resharpening the bit. Periodically we recommend turning the anvil slightly and finally end for end so that a flat surface is exposed to the tool bit tip.

### CALIBRATING TOOL SETTING MICROMETER

1. Bore a hole.
2. Remove tool holder and bit and place in micrometer.
3. Adjust micrometer so that it reads the same size as the hole you have bored. Small variations may be made by turning the micrometer sleeve with spanner wrench provided. Larger changes should be made by moving the anvil.



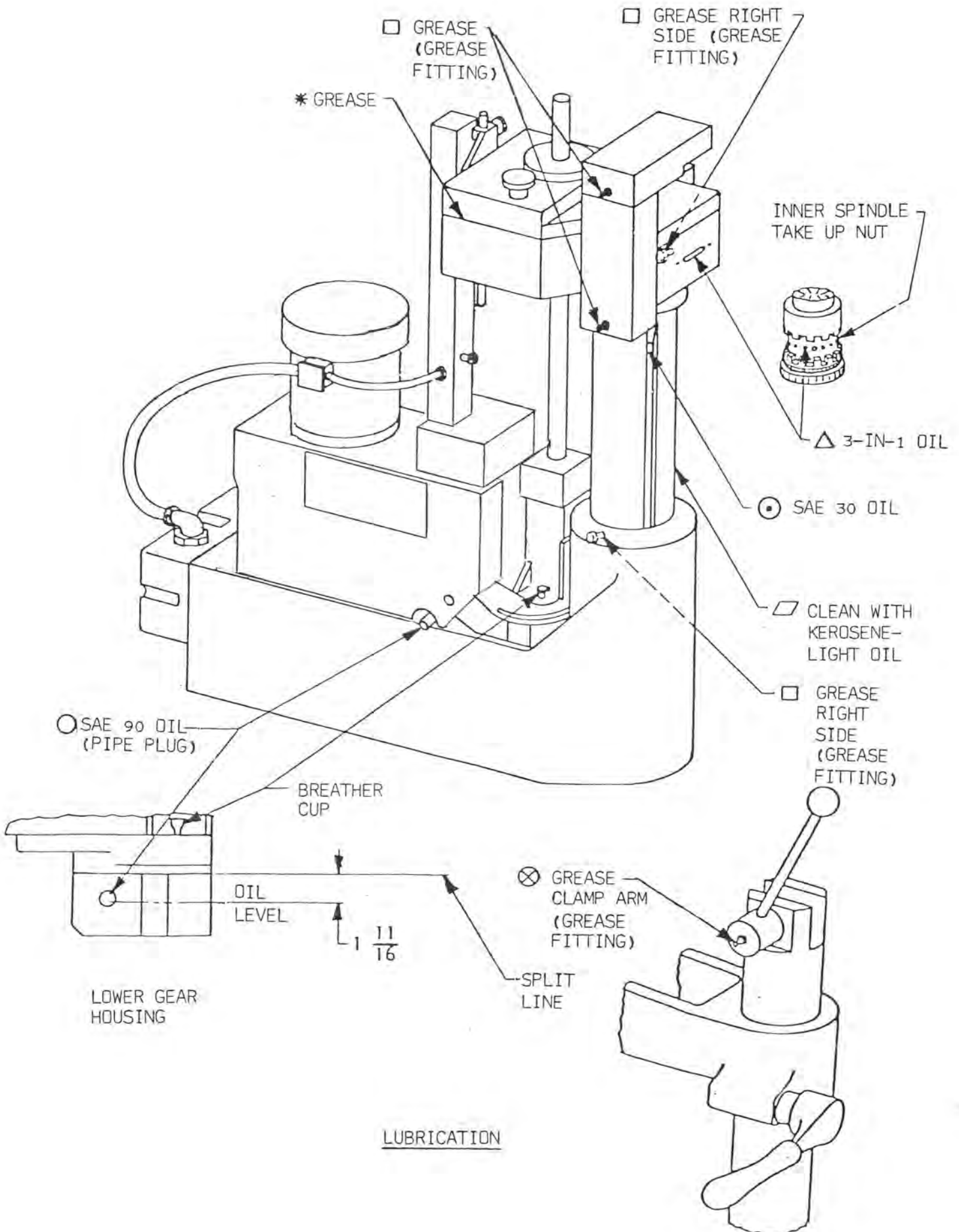
IMPORTANT  
MAINTENANCE  
LUBRICATION  
FA-4 STYLE

- \* The FA-4 style upper housing unit should be packed with union oil UNOBA F1 or F2 lube, approximately every 25,000 boring cycles. When this grease is changed, the upper housing lid should be removed and the original lubricant entirely removed.
- △ The upper housing spindle drive gear bearing should be lubricated monthly, by adding a few drops of three and one oil to it. Add by removing the small cover on the front of the upper housing and adding lubricant to the take up nut area between the clutching teeth.
- The lower motor housing units' oil level should be checked monthly. Check by removing the pipe plug on the left side of the lower gear housing, oil level should be just up to the bottom of this hole.

CAUTION: When adding oil or refilling, DO NOT OVER-FILL.

Change this gear lubricant every 40,000 boring cycles. Use Union SAE 90 Multipurpose Gear Lubricant or any equivalent S.A.E. 90 gear lubricant.

- If your FA-4 machine is operated on a continuous basis, grease fittings at the top of the spindle unit and at the bottom of feed screw drive, should be lightly lubricated daily, or less often if the machine is not used continuously. Lubricate with UNOBA F1 or F2 Lubricant (930 AAA lubricant could be an alternative). Grease fittings on the centering control should be lightly lubricated monthly.
- ⊙ Two or three drops of S.A.E. 30 machine oil can be added weekly to the breather hole at the top of the key way in the main spindle, to insure fluidity of main spindle bearing lubricant.
- ▭ Main spindle surface should be cleaned with kerosene weekly and occasionally a light weight oil applied to prevent excessive dryness.
- ⊗ Grease fitting located on the clamp arm cam body should be lubricated monthly.

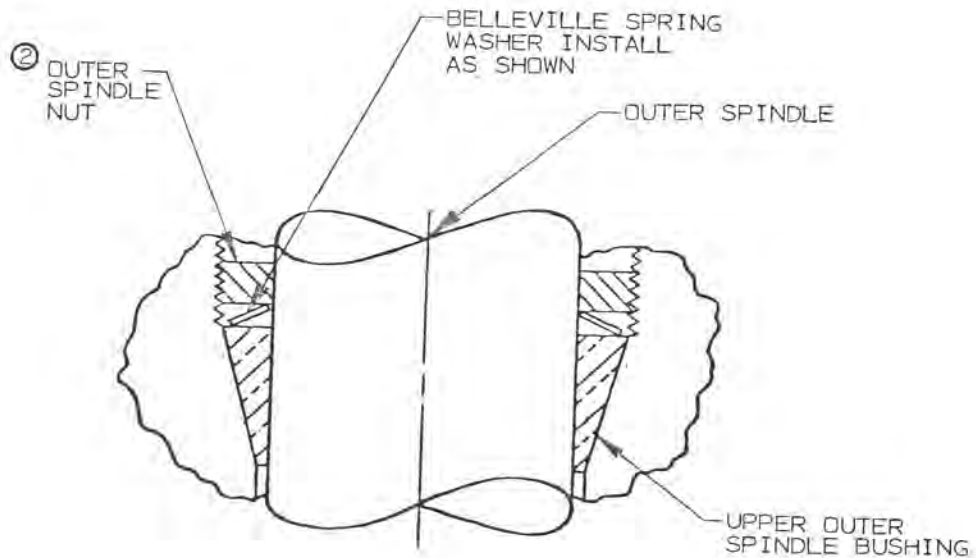


### ADJUSTMENT OF OUTER SPINDLE

Main spindle bearings are tapered split cast iron rings held in seat by the adjustment nut. Tension on the bearings is normally adequate requiring no adjustment for many boring cycles.

The upper bearing is preloaded in place by a Belleville spring washer, below the adjustment nut. This adjustment should be checked after the shipment of the machine, since shock to the machine during shipment may result in some set of the spring.

CAUTION: Caution should be used in adjusting these bearings in order to avoid a too tight spindle which only serves to wear out the machine and make control operation difficult. If it should be necessary to adjust, see Page 42

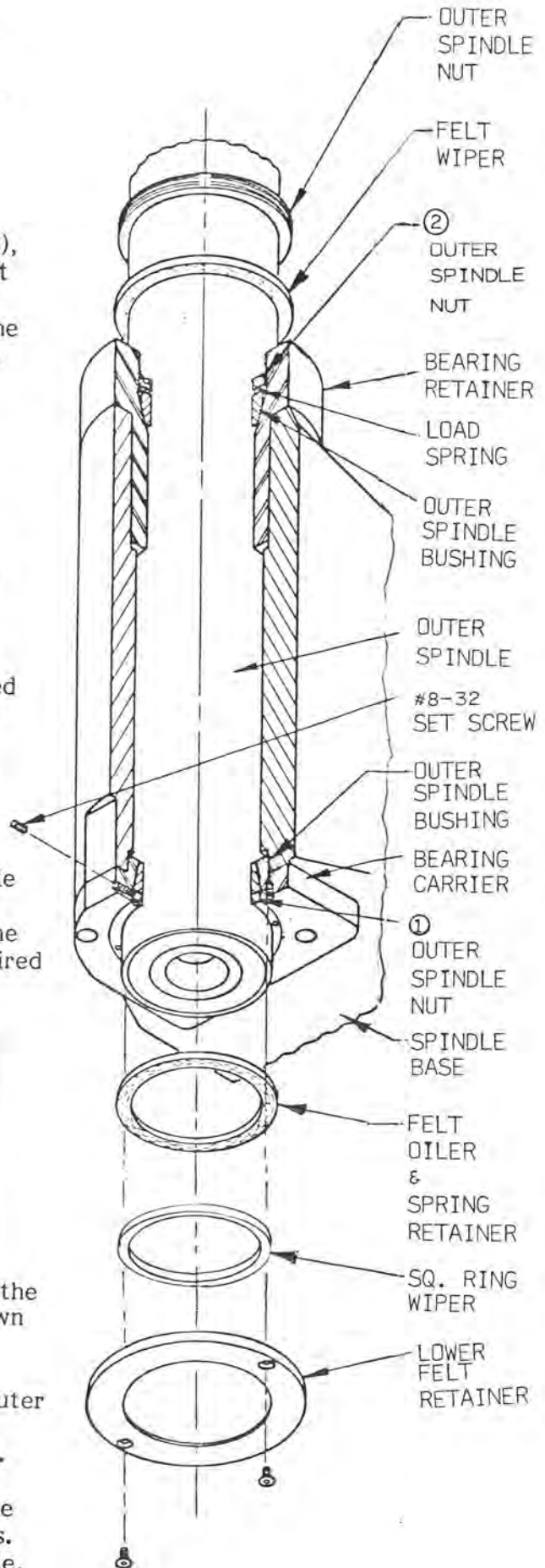


1. Run spindle down approx. 4" to 6" loosen the #8-32 set screw & loosen all outer spindle nuts (503-18).
2. Tighten the lower bushing (503-11B), by tightening the outer spindle nut marked 1, until 10 to 15 lbs. of effort is required to operate the hand feed handle. Lightly tighten #8-32 set screw.
3. Repeat this sequence (2) on the upper bushing, by tightening the outer spindle nut mark 2, Take care that the hand feed operates only slightly tighter or 15 to 20 lbs. of effort is required to operate the hand feed handle.
4. Traverse the bar at all points of travel and make sure the hand feed works easily. Spindles are ground slightly tapered to secure max. rigidity at lower limits of travel.
5. Spindle adjustment may also be checked by hand feeding the spindle down and pulling the slack out of feed mechanism by pulling down the upper gear housing. Pressure required at tightest point is indicated in chart below.

STYLE MACH.	PRESSURE REQUIRED
DA-0, -0B & -0C	30 - 50 lbs.
FA & F-2B	50 - 75 lbs.
FA-4 , IDA-4 DA-5 & 6IDA-6B	60 - 80 lbs.

In order to recheck the friction on the spindle it is necessary to crank down again to create backlash.

6. Avoid excessive tension on upper outer spindle nut 2, otherwise tool bit dragback marks will appear in bore.
7. Excessive tightening of outer spindle nuts will cause strain on feed gears, and cause spindle to have an audible, excess resistance.



VITAL OUTER SPINDLE ADJUSTMENT



### ADJUSTMENT OF INNER SPINDLE

1. Remove two screws and small cover on the front side of the upper housing.
2. Remove the stop screw restricting the up travel of the spindle clutch lever and move the lever to full up position. Rotate the spindle approximately 1/2 turn away from the detent spring. Position the tool holder slot to the rear.
3. Insert a pin (Diameter .180 or less) in one of the holes provided in the O.D. of the take up nut. (see Inner Spindle Nut). Hold the spindle knob with one hand and turn the take up nut to the left (clockwise). You will note the nut ratchets in notches as you take up. Take up until all end play is taken out, then add 2-3 notches preload. Run the bar on high speed making sure there is only slight heating at the bottom spindle. If the heat is excessive, back off one notch further.

CAUTION: Be sure the detent is in a notch, not midway between the notches.

4. Replace the cover, readjust the spindle clutch control stop screw.

### CORRECTION

#### OF

### TOOL CHATTER

#### AT LOWER EXTREMITIES OF BORES

Chatter at lower end of bores likely has nothing to do with spindle adjustments.

It is primarily caused by tool sharpening that inadequately narrows the tool "B" land. (See tool sharpening requirements).

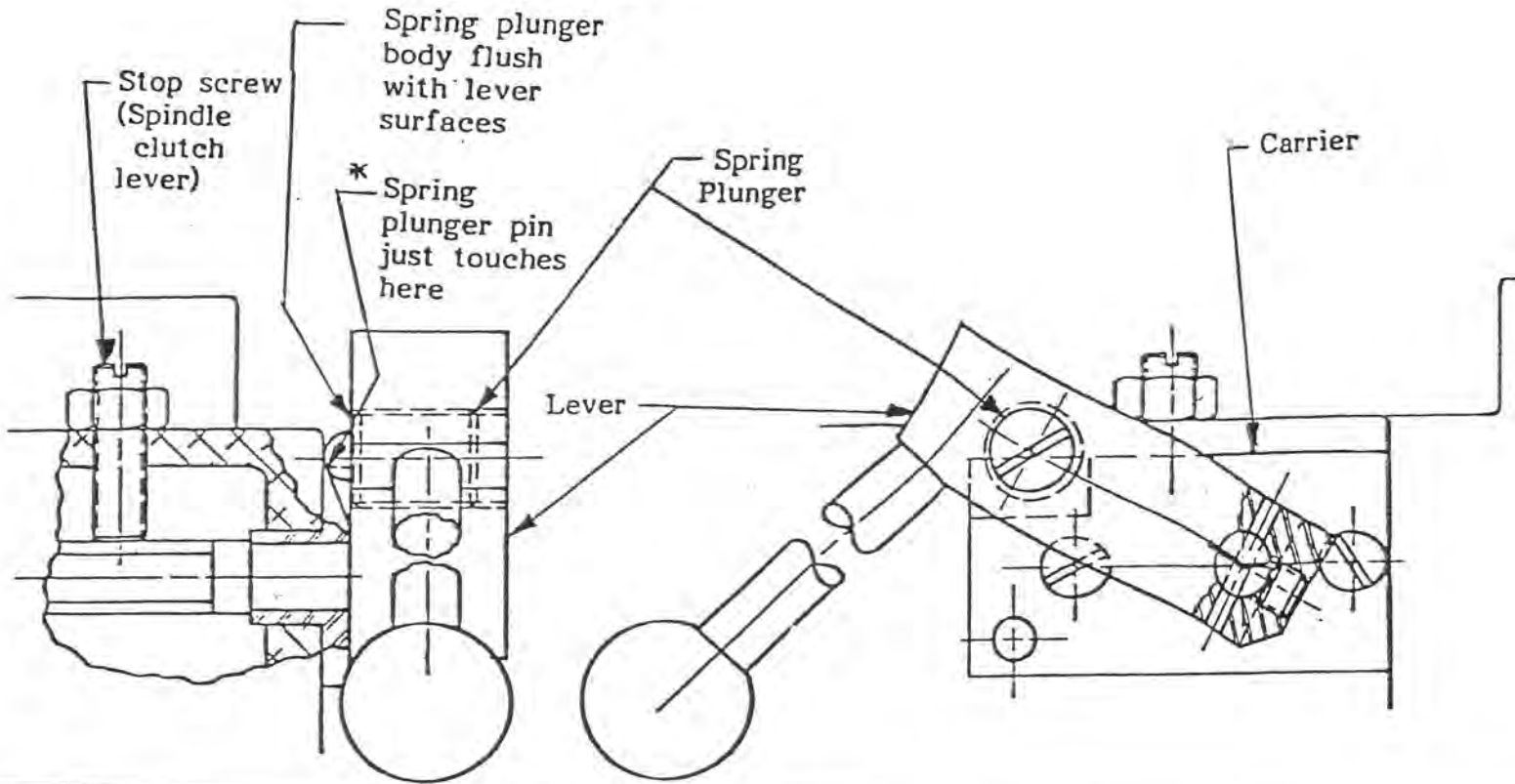
FA-4 cutter heads are equipped with heavy metal dampener weights. These precisely machined weights help prevent chatter at bore extremities. They must however, occasionally be cleaned and reassembled to operate properly.



### SPINDLE CLUTCH CONTROL LEVER ADJUSTMENT

Check spring plunger body to see if it is flush with lever (See Illustration below) Loosen the stop screw lock nut then the stop screw. \* Raise the control lever till the pin in the spring plunger is just touching the edge of the carrier as shown in illustration. Set stop screw so that the lever will not go any higher. Lock with lock nut.

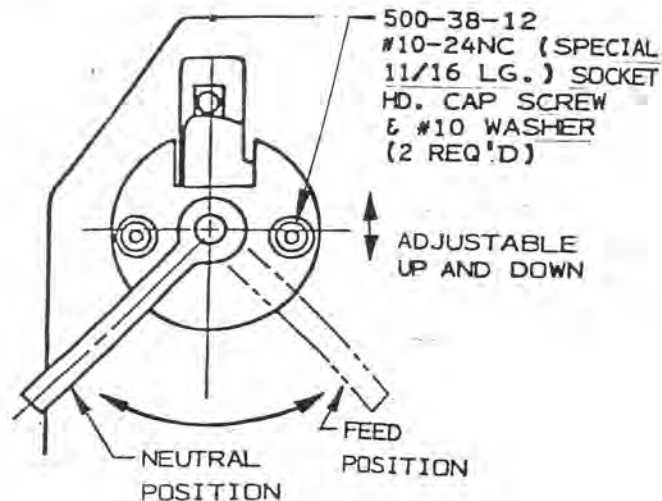
\*NOTE-On old stype control lever pin must be in upper detent when setting stop screw.



### NEUTRAL POSITIONER ASS'Y ADJUSTMENT (500-38-11)

Adjust the neutral positioner so that it holds the shift lever in neutral when the handle is in the forward position.

(Neutral position of the shift lever is found by observing the position of the lever during fast down operation.)



## UPPER HOUSING BACK FEED ADJUSTMENT

### TO ADJUST THE FEED SCREW PLAY IN THE UPPER HOUSING

First loosen the three round head screws around the feed screw, in the upper housing. Then loosen the three (3) adjusting screw lock nuts, then the adjusting screws.

Alternating between each screw, turn the adjusting screws, evenly in, until you have compressed the spring washer. (All screws must be turned in the same amount.)

NOTE: A light touch is required in adjusting this bearing clearance. Spring should be flat, but no pressure above that which is required to flatten spring should be used.

Turn adjusting screw back 1/4 turn to allow for running clearance. Hold adjusting screw with an Allen Wrench and lock them with lock nut.

Run motor with lower gear box engaged, so that the feed screw is turning, to center bearings retainer. Turn off motor. Tighten evenly the three (3) upper round head screws.

## RAPID RETURN ADJUSTMENT

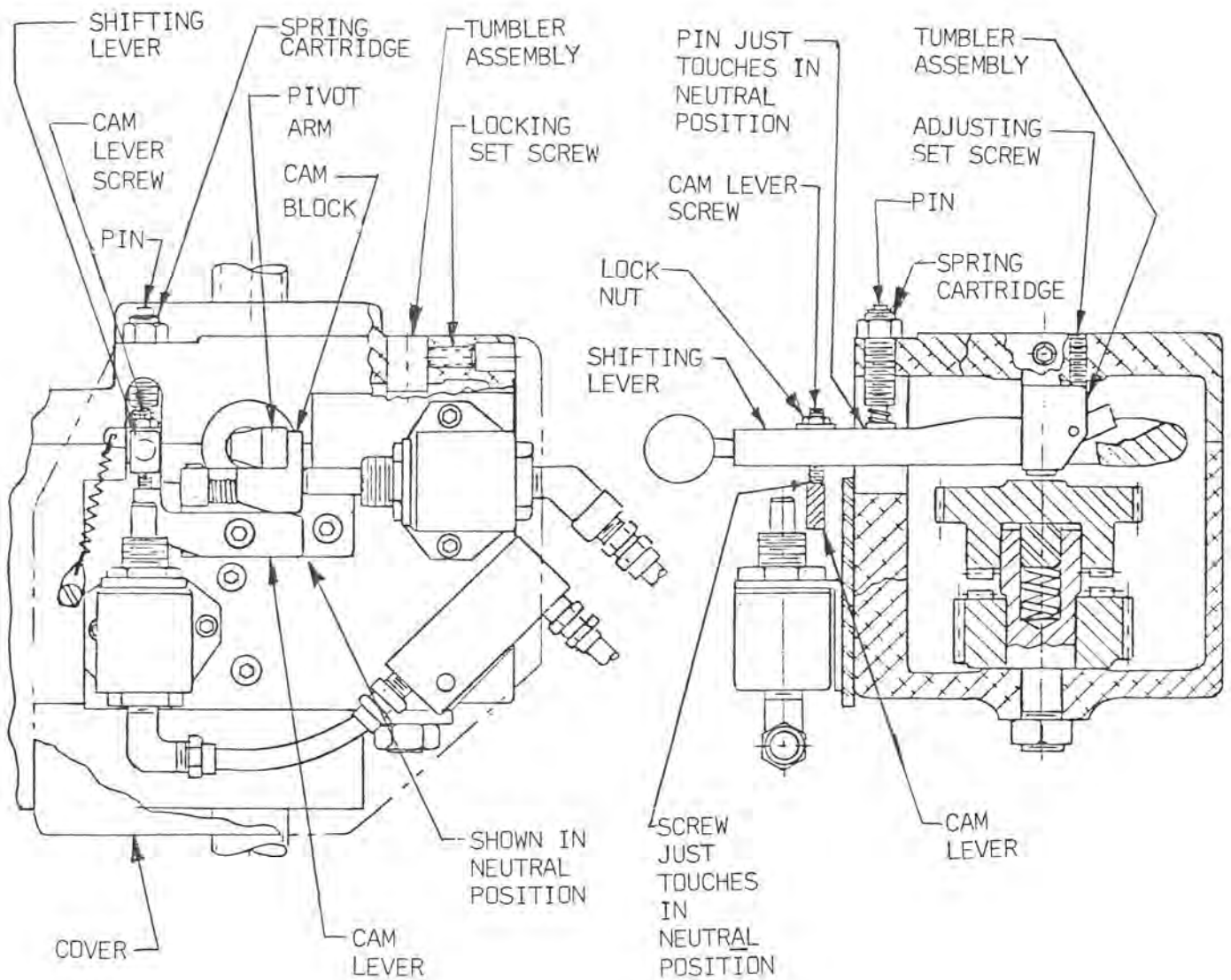
If the spindle unit should ever fail or hesitate to return to the top of it's travel with the up travel engaged, the following procedure may be used to adjust the return travel clutches.

1. Remove side cover on upper gear box
2. Run boring spindle down approximately 6 inches or more
3. Loosen lock nut of cam lever screw in shift lever, back off screw.
4. Find neutral position of shifting lever by rotating feed screw, while holding in cam block. Neutral position must have fast down cam block pivot arm fully engaged with fast down pin and pin at full depth in 500-1 clutch sleeve gear.
5. Pin in spring cartridge assembly should just touch shift lever, when shift lever is in neutral. Adjust by loosening lock nut and turning cartridge.
6. Loosen horizontal locking set screw of tumbler assembly at top and back of upper housing (See Illustration.)
7. Adjust tumbler shaft so that clutches do not chatter when shift lever is in neutral. Clutches should start to ratchet as the pin in spring cartridge is raised approximately 1/32, when lifting the shifting lever. If clutches ratchet after the pin is raised more than 1/32, reset tumbler lower, by turning vertical set screw inward, which will result in a deeper engagement of clutches.

### RAPID RETURN ADJUSTMENT CONT'D

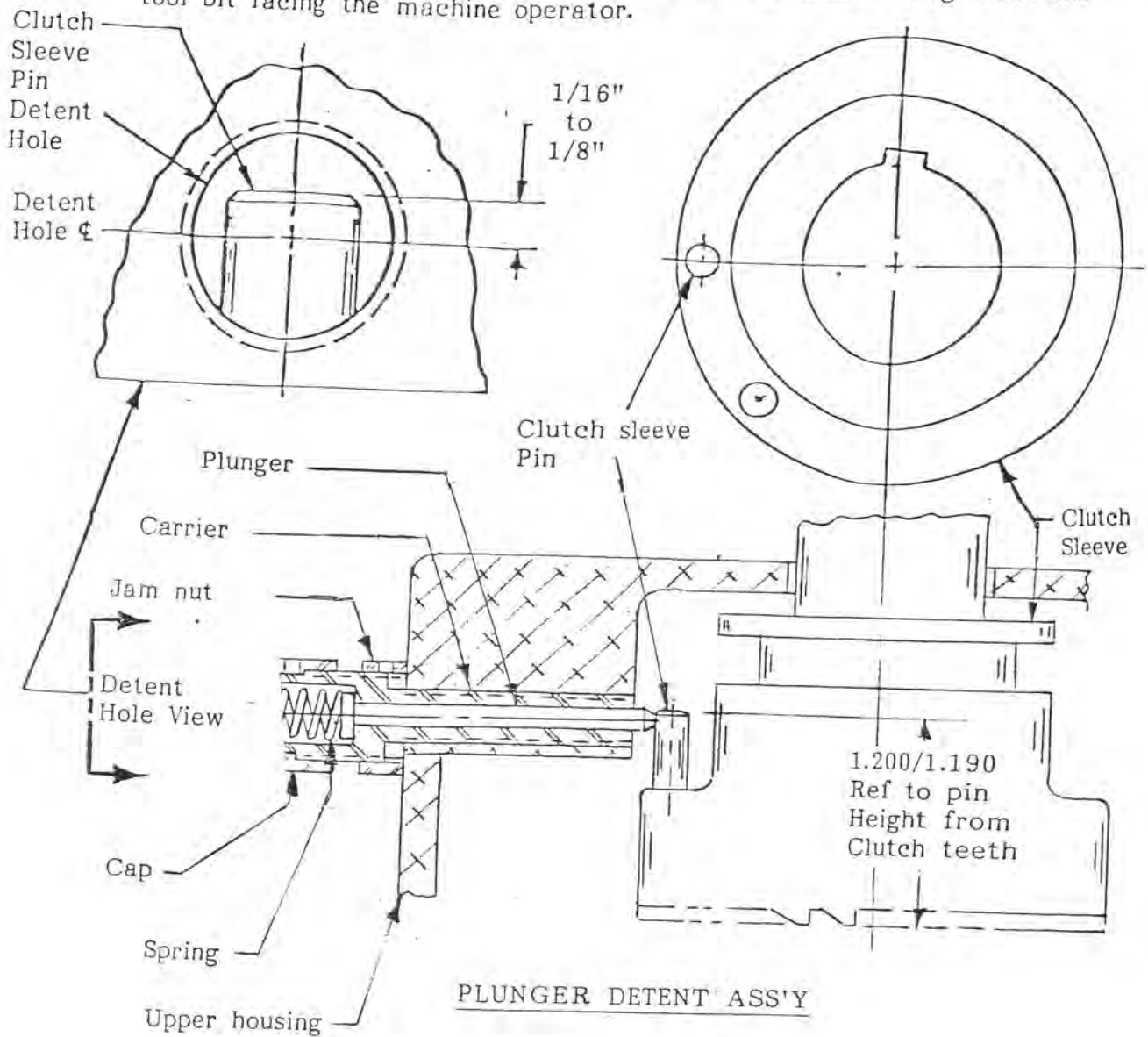
If clutches ratchet in neutral or before pin is raised 1/32" reset tumbler higher, by first backing off the vertical set screw in the top of the gear housing, then force the tumbler up with shift lever. Use the adjusting set screw to reset tumbler.

8. Tighten locking set screw to relock shaft. Check to see that adjustment has not been changed by the locking set screw.
9. Readjust cam lever screw in shift lever so it just touches the cam lever when shift lever is in neutral, lock with it's lock nut.



-47-  
SPINDLE STOP DETENT ADJUSTMENT

The purpose of the detent is to stop the spindle from turning with the tool bit facing the machine operator.

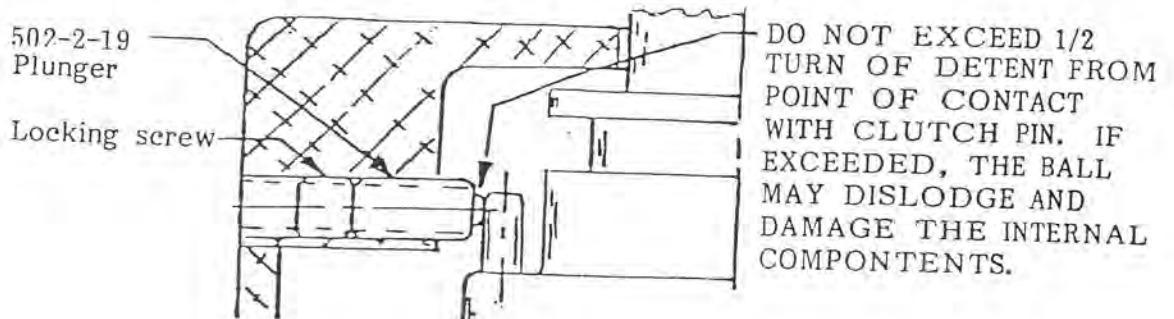


PLUNGER DETENT ASS'Y

TO SET PLUMGER DETENT

- (1) Remove plunger detent
- (2) Raise clutch lever to upper detent position.
- (3) Inspect clutch pin thru detent hole to be sure top of pin is above center of hole (see above view). Replace pin if it is below
- (4) Screw in plunger detent until it touches pin.
- (5) Turn plunger 3/4 to 1 turns beyond touch position.
- (6) Tighten jam nut against gearbox.

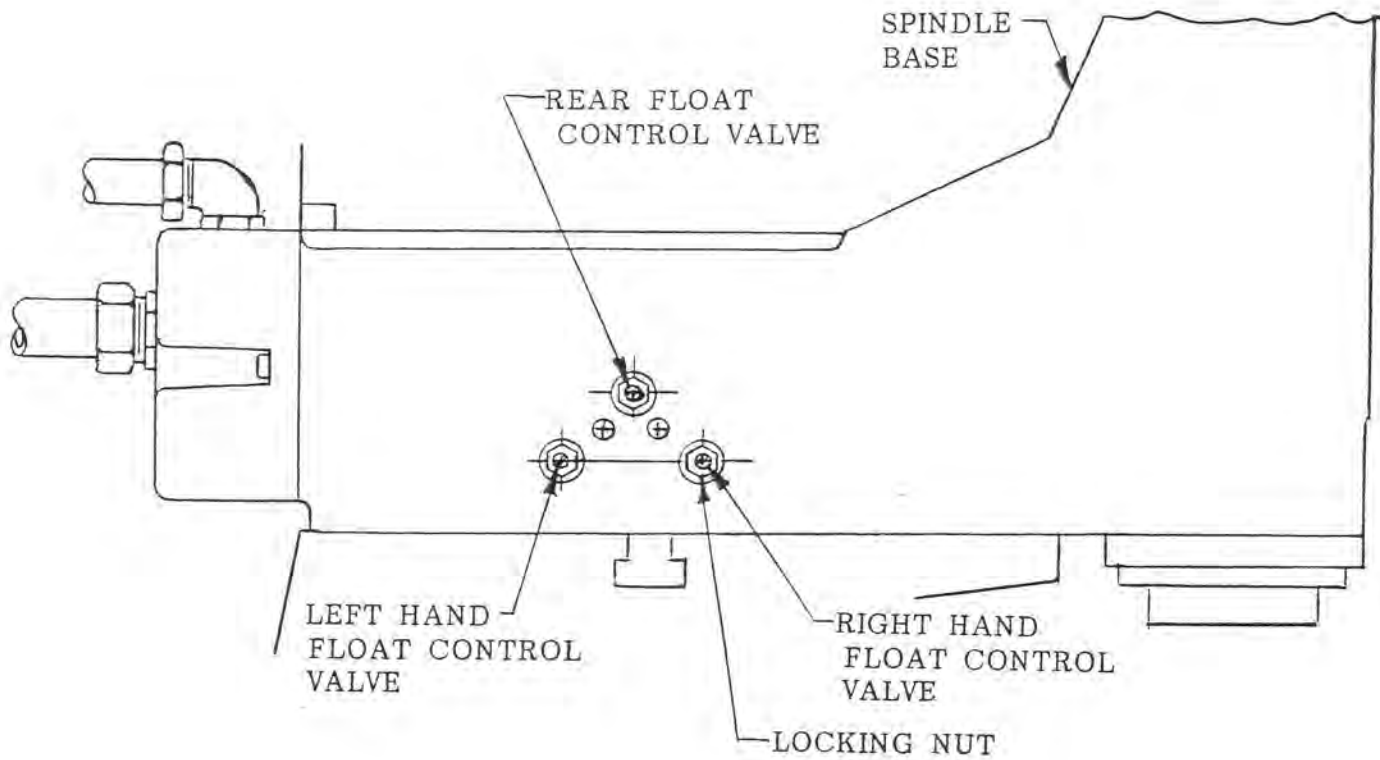
OLD STYLE PLUNGER DENTENT 502-2-19



## SPINDLE BASE      FLOAT BALANCE ADJUSTMENT

Spindle base should float easily without pulsating. If it does not, the following procedure should be used to correct the float.

Set float regulator to approximately 45 lbs., it is the one in the center of the control panel on the back of the main base. Open all three float control valves, on lift side of spindle base approximately 1/8 of a turn to achieve float. Adjust individual float valves, starting with the rear float valve, the top valve. Bar should float easily and smoothly, without pulsating. Pulsating is an indication to much air is being applied.



FA-4VB only

VARIABLE SPEED DRIVE ADJUSTMENT

The three small knobs on the back of the speed control enclosure will adjust the rate of speed change.

The knob to the left looking from the back of the machine, adjusts the release of the holding clamp. It should be adjusted so that when you increase RPM, that the RPM does not drop before it increases.

The right knob adjusts the rate of decrease in RPM. It should be adjusted so that the RPM does not drop, but goes down GRADUALLY.

The middle knob adjusts the rate of increase in RPM, and should be adjusted to have the same rate of increase as the decrease has.

If the high or low RPM needs adjustment see Belt Adjustment on Pages 50 and 51.



## BELT REPLACEMENT & ADJUSTMENT

### BELT REMOVAL            FA-4VB only

Reduce spindle RPM to its lowest.

CAUTION: Disconnect all power before proceeding.

Remove left side cover of belt case. Remove the four socket head capscrews in the motor plate.

Carefully lift the motor straight up. Care must be taken when removing the motor because the upper half of the pulley must slide out of the lower half at this time and can bind.

Remove the RPM sender and it's mounting block from belt case top cover, by removing it's two mounting screws.

Remove belt case top cover, by removing it's 4 button head cap screws.

CAUTION: Be careful not to damage switch tower or limit switches.

Slip the belt under the lower half of the driven pulley. Loosen the draw-bolt located on top of the proximity wheel and tap lightly on the bolt to loosen it's collet.

Remove the driven pulley then the belt.

### BELT INSTALLATION AND ADJUSTMENT            FA-4VB only

Place the belt in the belt case so it goes around the driven pinion shaft and around the hub of the lower drive pulley half. Slid the driven pulley onto the pinion shaft.

NOTE: Leave at least 1/16 to 1/8 gap between the hub of the driven pulley and the hub of the gear case. Lightly lock in place with it's collet bolt. Slip the belt onto the driven pulley. Pull the top half of the driven pulley up and move the belt into the "V" as far as possible.

Check the distance from the bottom of the motor mounting plate to the upper pulley outside surface (See illustration), should be 55/64. Adjust pulley half by loosing the bolt on end of the pulley shaft, then lightly tap on bolt to loosen it's collet.

NOTE: Tighten the collet bolt to 112 inch lbs. (10 ft. lbs)

Carefully lower the motor, upper pulley half with key into the lower pulley half. Secure motor mounting plate to the case with it's 4 capscrews.

Check height of driven pulley, by rotating the pulleys, and seeing if the belt run parallel with the back surface of the pulleys or the top of the case.



## BELT INSTALLATION AND ADJUSTMENT CONT'D

Adjust height of the driven pulley by loosening its collet then moving the pulley. Retighten bolt of collet to 112 inch. lbs. (10 ft. lbs.)

NOTE: If case vibrates severely or if belt does not run all the way out on pulleys in high and low RPM, check belt alignment.

### BELT CASE REMOVAL      FA-4VB only

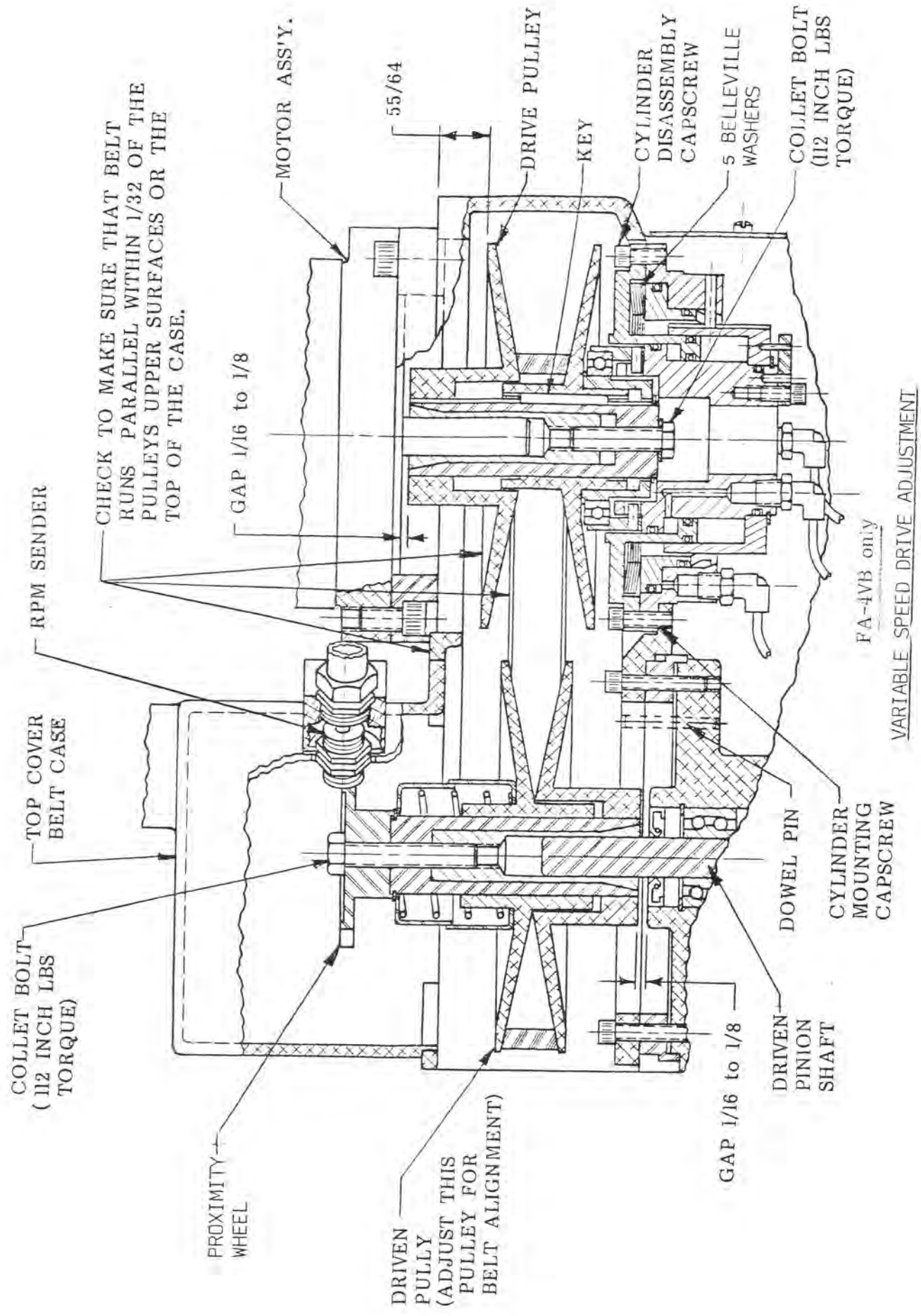
Remove the motor assembly, top, side, end, belt case covers, driven pulley, and belt as described in belt replacement instruction. Open the speed control enclosure by removing its 6 screws in the cover. Disconnect air line S3, F3, and C2 (See Illustration on Page 54 on how to disconnect lines from this type of fitting.) Remove 2 socket head capscrews inside of enclosure.

Remove the 4 socket head capscrews that attach the case to the gear housing, and the two socket head capscrews in the rear case support. Press out the two dowel pins between the case and the gear housing.

### BELT CASE INSTALLATION      FA-4VB only

Place the adaptor then the belt case onto the gear housing. Tap the dowel pin back into place. Secure the bolt case to the gear housing, with its 4 socket head capscrews.

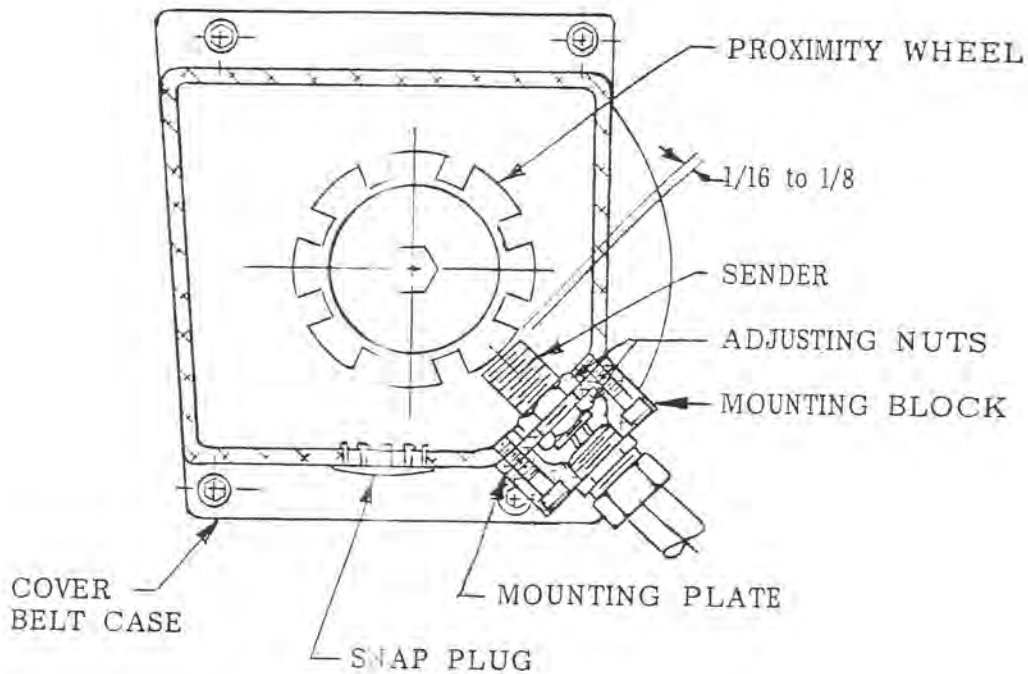
Install the motor assembly, driven pulley, belt, belt case top cover and speed control enclosure as previously instructed. Loosen the jacking set screw in the rear case support, until they are not touching the spindle base. Turn them back in until they lift the case slightly. Lock the rear case support to the spindle base with its two socket head capscrews.



R.P.M. SENDER ADJUSTMENT

FA-4VB only

Remove snap plug from belt case cover. Check clearance between proximity wheel and sender, by sighting thru snap plug hole. Clearance should be 1/16 to 1/8 inch. If not adjust the clearance by moving the nut of the sender on the mounting plate after removing the mounting, plate and block from the belt case cover.



## PULLEY ACTUATOR CYLINDER - REMOVAL & DISASSEMBLY

### REMOVAL

Remove the motor assembly as described in belt removal. Lift the belt over the lower half of the drive pulley and move to the side. Rotate the lower half of the drive pulley and lift up to remove.

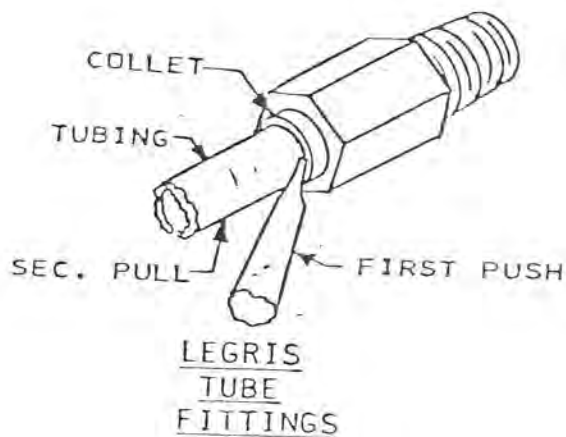
Open the speed control enclosure and disconnect air line S3, F3 and C2 (See illustration on how to disconnect lines from this type of fitting.) Remove the (3) cylinder mounting socket head capscrews. The one in the center front position of the case and the two 120 degrees away from it. Lift the pulley actuator cylinder out of the belt case.

### CYLINDER DISASSEMBLY

Remove the rotational lock and the retaining ring on the bottom of the piston. Lift the piston out of the top of the cylinder. Remove the (3) socket head capscrews in the cylinder. Disassemble the cylinder, lock piston, lock drum and (5) Belleville spring washers from lock housing.

NOTE: That the (5) Belleville spring washers must be installed saucer shape up as shown in illustration.

Care must be taken not to damage any of the "O" rings when reassembling.



TO DISCONNECT  
TUBING FROM LEGRIS  
FITTING - PUSH  
COLLET WITH  
A SCREWDRIVER  
THEN PULL TUBING.

TO CONNECT TUBING  
TO LEGRIS FITTINGS  
JUST PUSH TUBING  
INTO FITTING.

NOTE-TUBING MUST  
BE ALL THE WAY IN  
TO SEAL TUBING.  
FIRST PAST A GRIPPING  
RIDGE THEN THRU  
AN O-RING.

CHANGING THE VARIABLE SPEED DRIVE BELT

FA-4B ONLY

VARIABLE SPEED UNIT ONLY

(Reliance drive)

With variable speed drive adjusted for high speed, remove side plate on speed adjuster side. Remove speed change, mechanism, 502-11-38, Sec. AA. Twist belt around end of driving pulley shaft. After belt is clear of the shaft, push the belt as far as possible toward the front of the machine which will relieve the tension on the spring loaded pulley.

Now remove the upper bearing retainer 502-9-11, being careful to avoid damage to limit switches and connections. Remove the retaining ring and pulley from the driven pulley assembly 502-11-37 and remove belt.

NOTE: Use CAUTION in removing retaining ring, as spring will be under compression.

To install new belt reverse the above procedure.

To remove case - first remove the lower half of the driven pulley assembly 502-11-37, then the (4) motor gear housing screws inside the case support under the motor side of the case. Now lift off case and motor.

CHANGING THE THREE SPEED BELT AND CASE

6FA-4B ONLY

TO CHANGE V-BELT: V-BELT DRIVE UNIT ONLY

Disconnect power from boring bar, pivot cover to gain access to V-belt. Loosen clamp handle and pivot motor forward, pass V-belt under the motor sheave and over driven sheave.

TO REMOVE MOTOR:

Remove locking nut of clamp handle stud, remove the stud, clamp and clamp handle.

Remove pivot screw locknut on the opposite side of motor. This will allow you to remove the motor sheave and adjusting plate.

TO REMOVE V-BELT CASE:

First remove cover, 502-9-21, being careful to avoid damage to limit switches and connections.

Then the driven sheave, then the 4 motor gear housing screws, (inside the V-belt case) and then the 2 screws in the support 502-9-26.

RE-INSTALLATION OF V-BELT CASE:

Re-install the 4 motor gear housing screws. Then insert the 2 socket head cap screws in the end support, install cover sheave 502-9-21, motor and etc. Loosen the socket head cap screws and jacking set screws in end support. Turn the jacking set screw in until you raise the motor slightly. Tighten the 2 socket head cap screws.

TO INCREASE CLAMP HANDLE PRESSURE:

Loosen stud's lock nut on the inside of the V-belt case, then, using a screw driver, turn the stud in or out to adjust pressure, retighten the lock nut.

CAUTION: Disconnect all electrical and air power to boring bar before making any repairs on boring machine.

### THRUST OVERLOAD

If an excessive thrust load of approximately 3,000 pounds is imposed on your FA4-VB machine spindle, the threads of the nut (500-41 SEC.CC) will shear. This load could typically occur by either rapid traveling or feeding the spindle into the top of the block, This accident could happen with the spindle either rotating or stationary.

The effect of this will be for the motor to continue to run, but with no feed or down travel. If the machine continues to run in down travel, the drive spline will be completely pulled out of mesh and feed screw will not turn. A spare nut, 500-41, is provided in the tool box, in the event an excessive load occurs.

### DISASSEMBLY NECESSARY FOR REPLACEMENT IS:

1. Remove two socket head screws at the bottom of the hand feed housing (500-97-2, SEC. CC) and the two socket head screws on the top plate (500-96-4), turn out (counter-clockwise) the bevel gear shaft (500-95) and remove the four countersunk screws and the end cap housing (500-70-1).
2. Now, to raise the assembly, remove the side cover (502-8-52-B) at upper housing view FF, and hold cam block (500-43) to the left while hand rotating feed screw counter-clockwise. This will raise the lower assembly out of the spline and allow replacement of the nut after removal of the snap ring (506-10). Be sure to replace the snap ring with bevel side up and make sure you bolt bevel gear housing back in place without binding the gear action.

### MACHANICAL FAILURE DUE

#### TO OVERLOAD

Rotary deceleration loads which stall the motor will cause the motor overload protection to drop out and can be corrected simply by pressing the reset button in the rear of the machine.

### VARIABLE SPEED DRIVE

#### FA-4B ONLY

If an extreme rotary deceleration of the machine is caused by striking an object, the micarta drive key, 500-62, in the shaft coupling (500-61, Sec.BB) will shear, causing the drive to fail. This would only occur if extreme radial shock were imposed on the rotating spindle or feed screw.

It is replaced by removing the upper bearing retainer (502-9-11, Sec. AA), the pulley assembly and shaft driven pulley (502-9-12), in which the micarta key operates. Use caution in reassembling this unit to make sure the micro switches are properly operated before further machine operation.



## FAILURE DUE TO LOW

### AIRLINE PRESSURE

A pressure switch PS (2) located in the center top of the control panel, has normally open contacts, that close when the airline pressure reaches 80 to 85 PSI. As long as the line pressure is above this, the machine will operate. If the line pressure should fall below this value, the switch contacts open, de-energizing the entire circuit and thereby stopping the machine.

This is a protective device to prevent the machine from operating when there is insufficient air pressure available to operate the air clamp and air controls.

### DISASSEMBLY OF MOTOR HOUSING

NOTE: Motor housing may be removed without disassembly of the upper housing and feed screw.

#### SECTION C-C

Remove hex socket screws (2) on the bottom of 500-97-2 feed bracket, and 2 screws holding 500-96-4 plate to 500-70-1 housing. Turn out (counterclockwise) bevel gear.

Remove 4 socket head cap screws in 500-70-1 housing. Lift out feed screw, or if upper housing is still intact hold cam block (500-43) to left, and rotate screw counterclockwise, until the feed screw is clear of the motor unit. On re-assembly it may be necessary to rotate motor and screw, using care in aligning spline in gear to match the screw spline. Make sure threaded key does not jam on entering the slot.

#### REMOVAL OF FEED SLEEVE AND BEARING

NOTE: For removal of brass nut only. (This disassembly is not necessary to remove motor housing.)

#### SECTION C-C

Remove snap ring 506-10, and press sleeve assembly, 500-73, off bearing. Back out socket set screw from brass thrust nut and screw off nut. Bearing may now be removed from shaft.

#### REMOVAL OF MOTOR HOUSING

To remove the motor housing, first remove belt case as per previously instructed. Loosen the two set screws in the side of the spindle base. Take out the 4 bolts in the housing flange.

NOTE: In reassembly, motor alignment must be checked after feed screw is in place before the flange bolts are permanently locked. Use surface plate over screw and spindle. Lightly tighten the two set screws in the spindle base after aligning the motor housing.

To disassemble the housing, remove two pins and six screws and bottom screw in the middle of bottom of the gear pot. Remove set screw and pin on speed shifter lever.

TAP LIGHTLY ON MOTOR PINION.

502-9-28 pinion, and screw drive gear 501-20 and housing will come apart. Pinion shaft, 501-6 with clutch and gears may be tapped out with small punch through center hole in the bottom of the gear pot.



DISASSEMBLY OF UPPER HOUSING  
AND SPINDLE REMOVAL

Remove cutter head. Remove cover 500-38-4, and cover 502-8-30 remove centering rod. Remove centering housing by removing its 4 screws. Remove 502-10-11 knob by removing its screw. Remove 600-18-2 knob by releasing socket set screw. You may then remove the draw tube. Unscrew the spindle clutch lever stop pin. Raise the lever to the extreme top, which will allow the removal of the countersunk screw, and lever assembly, remove the spring 502-2-48, bracket, 502-2-47-A, base plate, 502-2-92, stop bracket, 502-2-52. Remove 6 screws holding upper housing sections together and lift off the upper lid, 502-9-14.

The shifting lever, 500-38-1 may be removed along with 500-25, upper fast return gear, with plunger and spring, spindle clutch and key 500-3, ball bearing with take up spring, 500-14, (be sure spring is reassembled properly) sleeve gear, 500-1, feed nut 500-2, and feed gear 502-10-12-A with its thrust washer.

Remove the snap ring 502-10-16 from the two speed feed shafts, upper feed drive gear 502-10-8-A, thrust washer 501-21, lower feed drive gear, 502-10-9-A, then remove the retainer, 502-9-15, bend lockwasher, now press the feed shaft and gear 502-10-10, out of bearing, 500-74.

If the bar is in a vertical spindle position we suggest you place something under the spindle nose to prevent the inner spindle from falling out and then remove 500-5 spindle nut. Nut can be started off through adjusting access hole and then hand turned. Now drive gear 503-6-1, may be worked off along with 500-4, spacer, woodruff key and two Belleville washer 502-9-72A. Inner spindle may be removed.

Press off tapered roller bearing 502-9-67. When reassembling make sure cone and cup are solidly seated against their shoulders.

NOTE: Do not hit or damage bearing case.

Press off thrust ball bearing 502-9-72 out of outer spindle.

NOTE: Direction of thrust and reassembly the same way.

Hex cap screws in upper housing should be removed and housing may be driven off spindle. Heat on housing will simplify removal of this sweat fit.

Lift off of feed screw.

Nut should be removed from 500-29 shaft and shaft may be pressed, out of with gear.

500-7 long gear with radial and thrust bearings may be removed along with oil seal.

NOTE: On reassembly, thrust bearing has one race with a small I.D. which is mounted "UP" in gear housing.

Extreme care should be taken when removing long gear out of seal or seal out of housing. Seal is fragile and garter spring will come out easily. When reassembling, open seal as long gear is pushed in to prevent spring from snapping out.

### CONTROL FUNCTION

To provide a most convenient guide in the event of a control failure of your FA-4 , the following information describes the sequence of control actions.

AIR ELECTRIC CONTROL is described in CAPITAL TYPE and the resulting MECHANICAL FUNCTION IN LOWER CASE, so a difficulty may be easily isolated.

### TOGGLE SWITCH

TOGGLE SWITCH 502-2-25, SEC. JJ, OPENS AND CLOSES THE 110 VOLT CONTROL CIRCUIT. WHEN OPENED, THIS SWITCH DEACTIVATES THE ENTIRE ELECTRICAL CONTROL CIRCUIT EXCEPT THE CURRENT TRANSFORMER .

### CLAMP SELECTOR SWITCH

THE CLAMP SELECTOR SWITCH TURNED TO THE LEFT CLOSES THE CIRCUIT TO LSV (LIFT SOLENOID VALVE, PANEL LOCATION, UPPER VALVE, RIGHT SIDE). THIS NORMALLY CLOSED VALVE IS OPENED, ALLOWING AIR TO FLOW THROUGH THE REGULATOR (502-27-17, UPPER REGULATOR IN PANEL), AND THEN OUT THE ORIFICES ON THE BOTTOM OF THE SPINDLE UNIT. (REGULATOR MAY BE ADJUSTED UP OR DOWN TO FURNISH PROPER LIFT FOR EASY MOVEMENT OF THE SPINDLE UNIT). FURTHER BALANCING OF FRONT LEFT AND RIGHT AND REAR LIFT IS ADJUSTED BY THE FLOW CONTROL VALVES LOCATED ON THE LEFT SIDE OF THE SPINDLE BASE.

THE CLAMP SELECTOR SWITCH, TURNED TO THE RIGHT, CLOSES THE CIRCUIT TO CSV (CLAMP SOLENOID VALVE, PANEL LOCATION, UP PER VALVE, LEFT SIDE). THIS NORMALLY CLOSED VALVE IS OPENED TO ALLOW THE AIR TO FLOW DIRECTLY TO THE TWO CLAMP CYLINDERS.

The cylinders lift two lever arms 502-2-5, SEC. JJ), pivoting on the casting rib to lift the arm 502-2-4 which exert effort through washers and nut to the stud 502-2-10.

### FAST DOWN PUSH BUTTON

THE FAST DOWN BUTTON DEPRESSED, CLOSES THE CIRCUIT TO THE FDSV (FAST DOWN SOLENOID VALVE, PANEL LOCATION, LOWER VALVE, LEFT SIDE). THIS NORMALLY CLOSED VALVE OPENS, ALLOWING AIR TO FLOW TO THE HORIZONTALLY MOUNTED CYLINDER 502-2-59-A, VIEW FF) ON UPPER HOUSING.

The cylinder moves the cam (500-43) forward, allowing the lever (500-44) to lift the shift lever (500-38-1) upward to neutral position. The spring cartridge (500-40) is adjusted slightly above the neutral position so the lever will not easily raise further into up travel, further forward movement of the cam (500-43) hinges the pivot (500-30-2) forcing the pin (500-30-3) into the slot of the sleeve gear, braking the feed nut so the machine will rapid travel down.

FAST DOWN PUSH BUTTON CONT'D

THE ABOVE MECHANICAL ACTION TAKES PLACE AS AIR PRESSURE BUILDS IN THE AIR CIRCUIT, AND UPON REACHING 75 PSI, CLOSES PRESSURE SWITCH #1 (PANEL LOCATION, UPPER LEFT) WHICH ENERGIZES (CR) CONTROL RELAY. FAST DOWN BUTTON MUST BE HELD TO MAINTAIN CONTACT AND WHEN RELEASED WILL DROP OUT CIRCUIT.

FEED PUSH BUTTON

DEPRESSING THE FEED BUTTON CLOSES THE CIRCUIT TO THE (FR) FEED RELAY WHICH SEALS IN THE FEED CIRCUIT AND ALSO LOCKS OUT THE FAST DOWN CIRCUIT. THE FEED RELAY ENERGIZES THE (CR) CONTROL RELAY.

Mechanically, the FA-4 is normally in the in-feed position, with the key, (300-35) holding the sleeve gear (500-1) down into the clutch, causing the differential rotation to turn the nut (500-2) on the screw. If necessary, the shift lever (500-38-1) can be manually lifted to raise the sleeve gear out of feed position into the neutral or fast return.

WHEN IN-FEED, THE STOP BUTTON OR THE LLS (LOWER LIMIT SWITCH) WILL OPEN THE CIRCUIT. THE UP PUSH BUTTON WILL CAUSE THE UP CIRCUIT TO GO IN AND DROP THE FEED CIRCUIT OUT.

UP PUSH BUTTON

THE UP BUTTON DEPRESSED, CLOSES THE CIRCUIT TO (UR) UP RELAY, SEALING IN AND CLOSING CIRCUIT TO (CR) CONTROL RELAY AND THE USV (UP SOLENOID VALVE, PANEL LOCATION, LOWER VALVE RIGHT SIDE.) THE NORMALLY CLOSED VALVE OPENS TO ALLOW AIR TO TRAVEL TO THE LOWER VERTICALLY MOUNTED AIR CYLINDER (502-2+59+C) (VIEW FF) ON THE UPPER HOUSING.

The cylinder raises the shift lever (500-38-1), View FF) to an extreme up level, depressing the spring cartridge, 500-40. The lever (500-38-1) through the key (300-35) lifts the sleeve gear 500-1 out of the clutched feed position, and the lug, on the extreme right of the shift lever (500-38-1), raises the arm of the tumbler assembly (300-37), forcing the pin of the tumbler assembly down into the gear (500-25) engaging it with the gear (500-26) to turn the feed nut and retract the spindle, the spindle can be manually retracted by starting the motor IN-FEED and manually lifting the lever (500-38-1) ALTHOUGH CARE MUST BE EXERCISED TO AVOID BYPASSING THE UPPER LIMIT SWITCH. If the return fails to completely engage or tends to ratchet a simple clutch adjustment can be made. (See Rapid Return Adjustment.)

THE UP CIRCUIT IS OPENED BY EITHER THE STOP PUSH BUTTON OR THE OPENING OF THE NORMALLY CLOSED ULS (UPPER LIMIT SWITCH).

STOP PUSH BUTTON

The stop push button opens any motor operated circuit of the machine.

### TWO SPEED GEAR DRIVE

The lower, speed shifter is pulled out and lowered for high speed, or raised for low. Care should be exercised to make sure the pin is in, after shifting, otherwise, the clutch may creep into a neutral position. As shown (Section BB) the arm, 501-3, is rotated, causing the two keys (300-35) to raise or lower the clutch.

#### FA-4VB

### VARIABLE SPEED PUSH BUTTON

DEPRESS THE FEED, UP, OR FAST DOWN PUSH BUTTON TO OPEN SOLENOID VALVE. DEPRESS THE YELLOW BUTTON WHICH OPENS AIR VALVE TO ALLOW AIR THRU A SHUTTLE VALVE, THEN THRU A FLOW CONTROL VALVE and to a cylinder which releases lock piston. It also allows air thru a flow control valve to a cylinder which opens the drive pulley to decrease RPM. DEPRESS THE GREEN BUTTON WHICH OPENS AIR VALVE TO ALLOW AIR THRU A SHUTTLE THEN THRU A FLOW CONTROL VALVE and to a cylinder which releases the lock piston. IT ALSO ALLOWS AIR THRU A NEEDLE VALVE to a cylinder which closes the drive pulley to increase RPM.

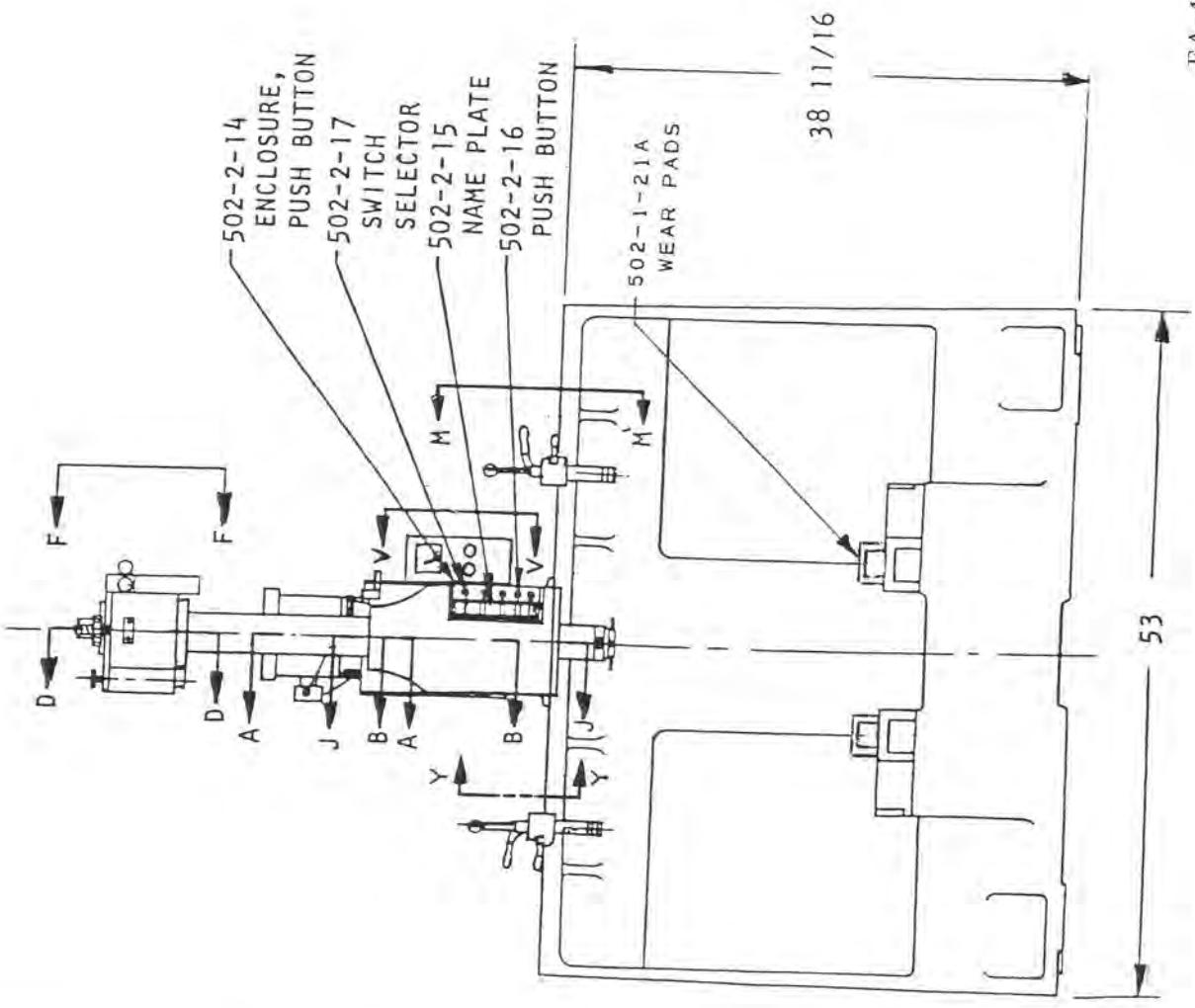
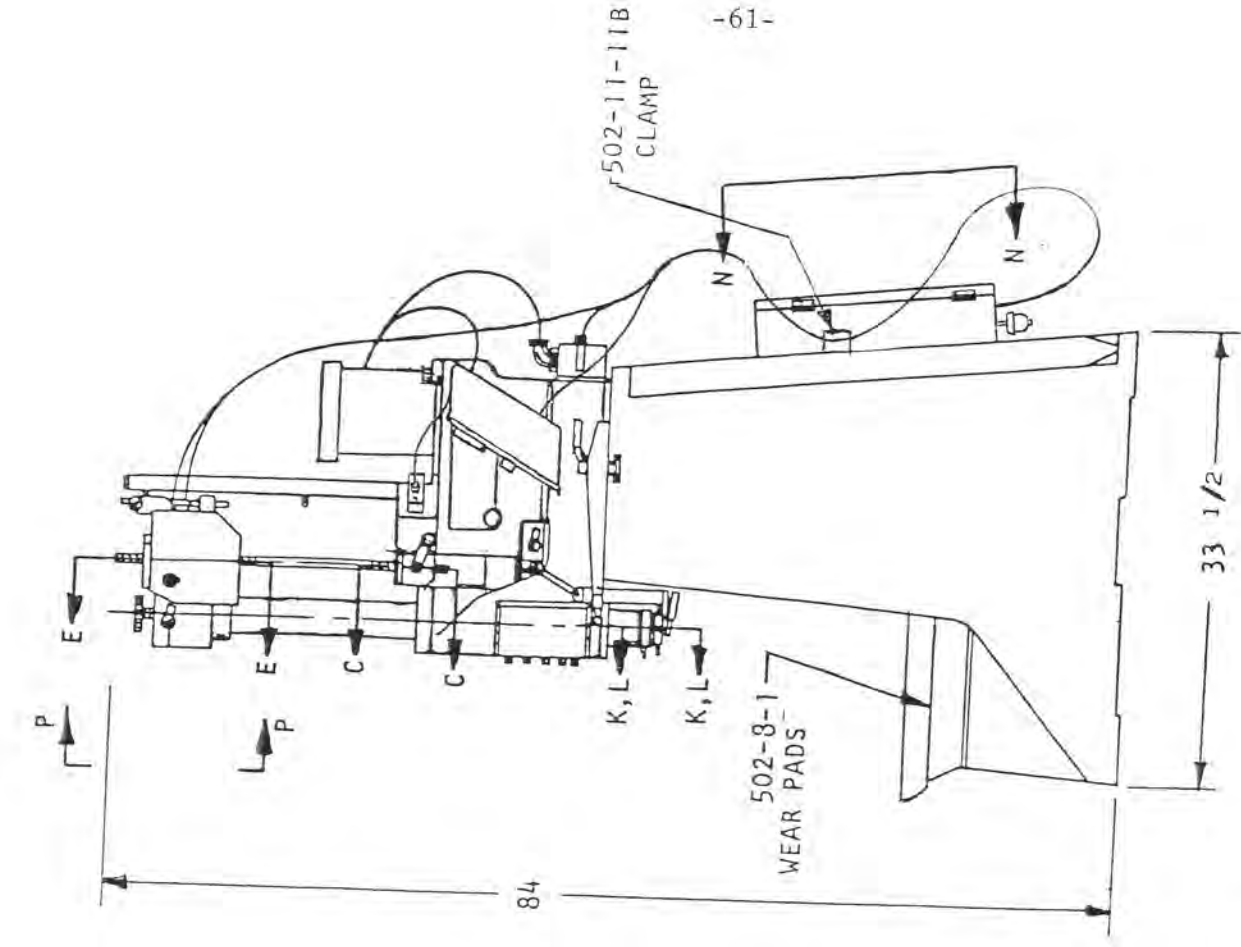
### COMMON CAUSES OF TROUBLE

(Poor finish, inaccurate holes, excessive tool bit heat, excessive tool drag back lines, etc.)

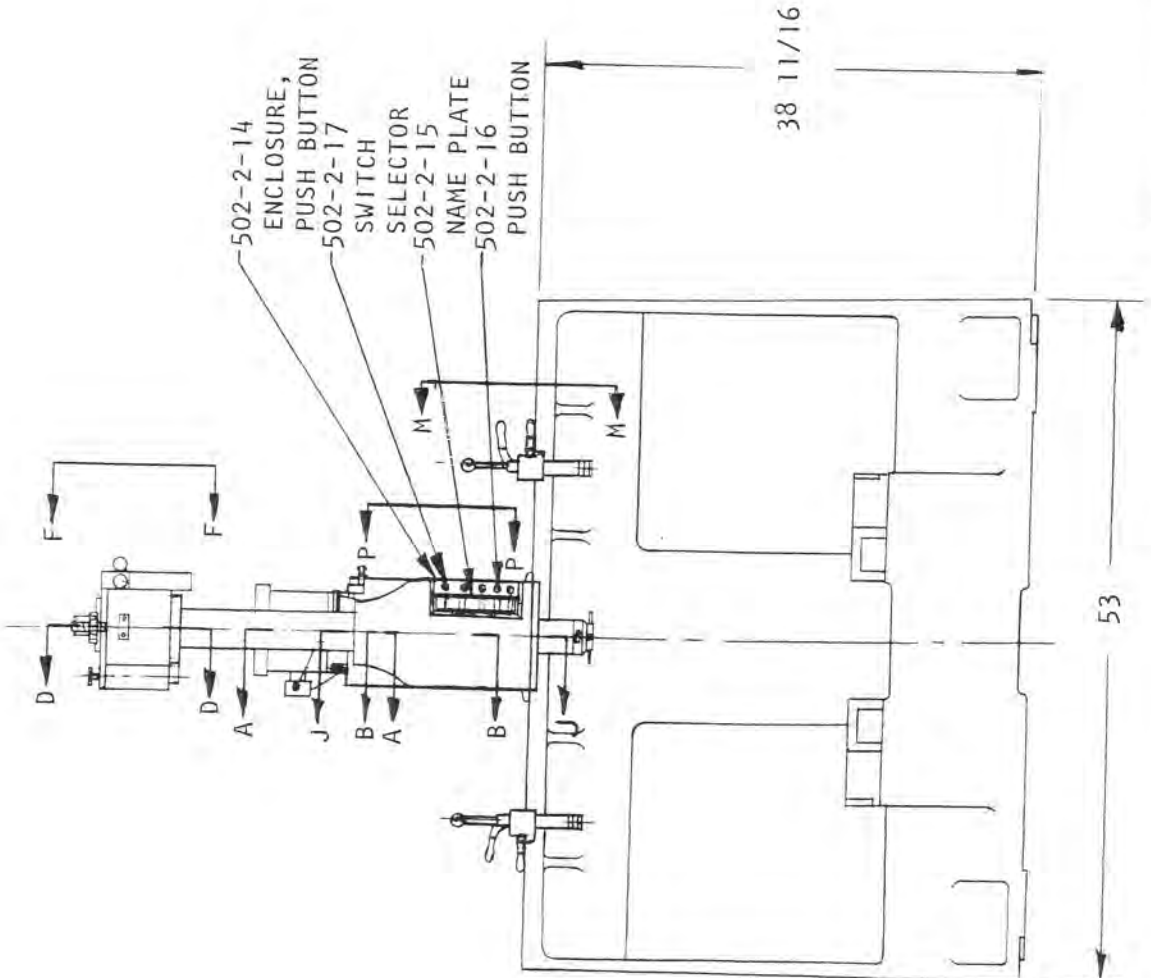
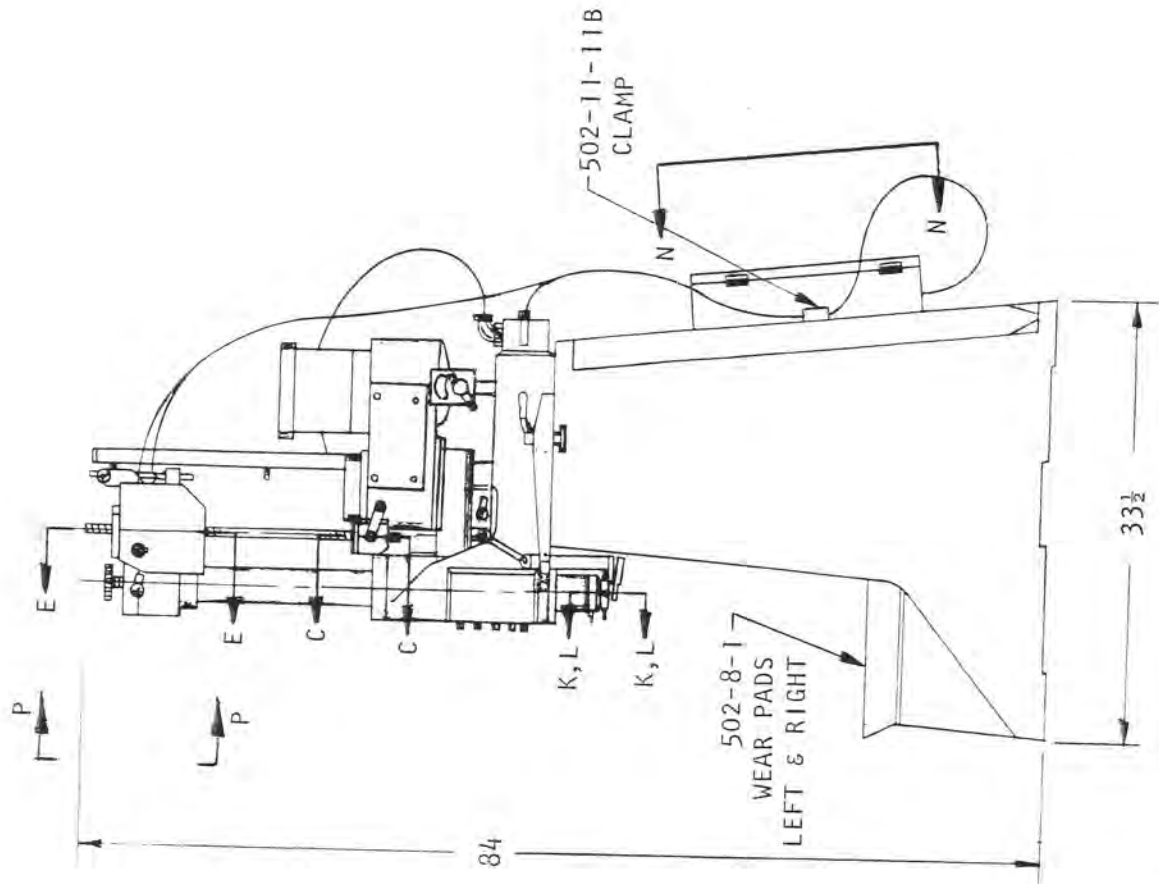
The majority of these problems are a result of tool bit sharpening. Check to make sure the tool bit "B" land is of proper width, with keen sharp faces and that top of bit is free from flaws, with the original rake angle and smooth finish. Frequently, a minute flaw, not visible to the naked eye, will prevent a fine finish.

A loose outer spindle bearing will not generally result in taper or inaccurate bores, but can allow spindle to drop slack in the feed nut, resulting in a mark in the cylinder.

When the sizes are inconsistent, check the finish on the micrometer anvil, distorted and worn out tool holders and tool bits that have been ground on the top surface and have inconsistent heights when placed in the tool holder. Make sure the tool holder slot is clean.



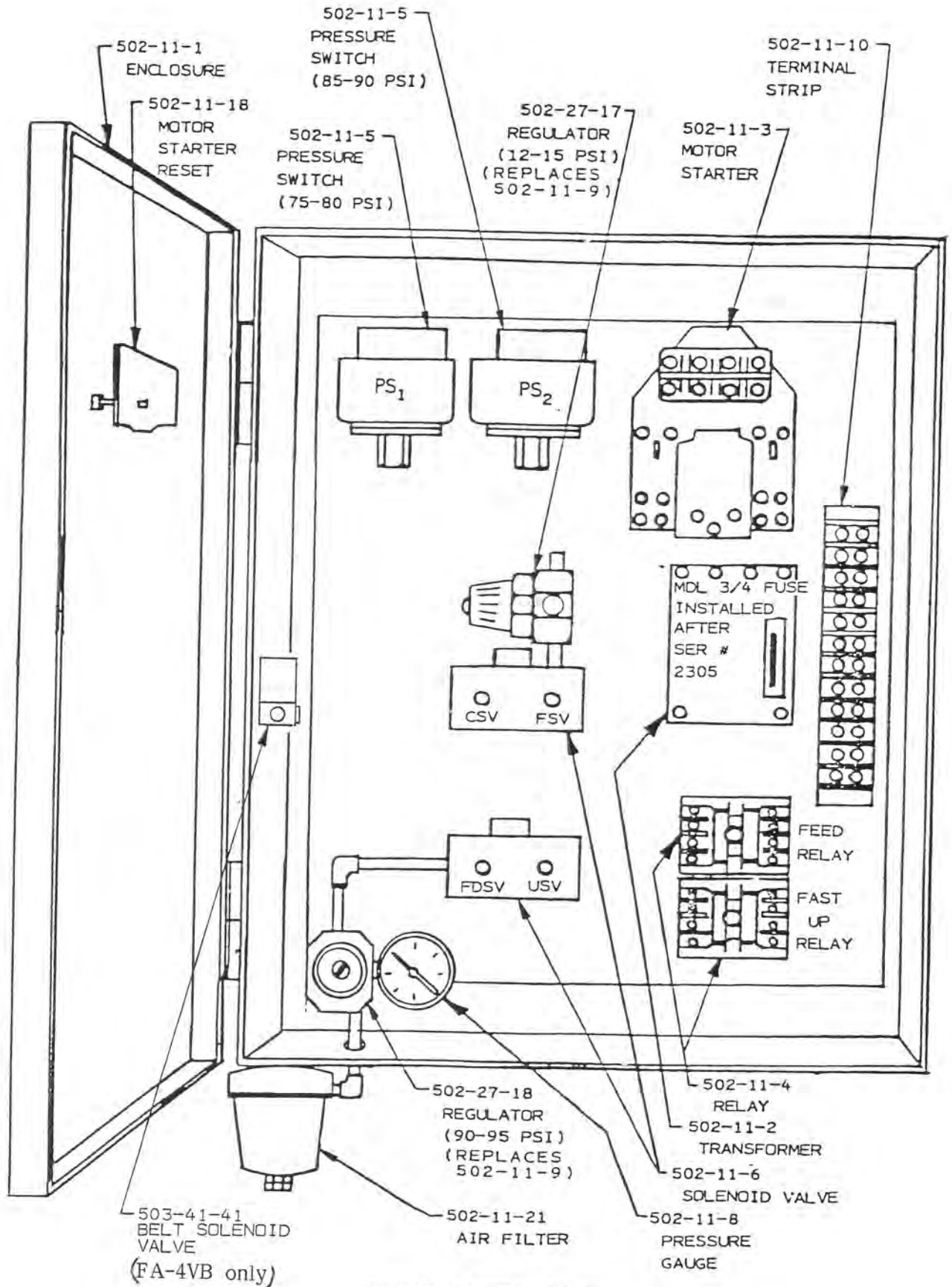
TA-4VB  
BORING MACHINE



FA-4B BORING MACHINE

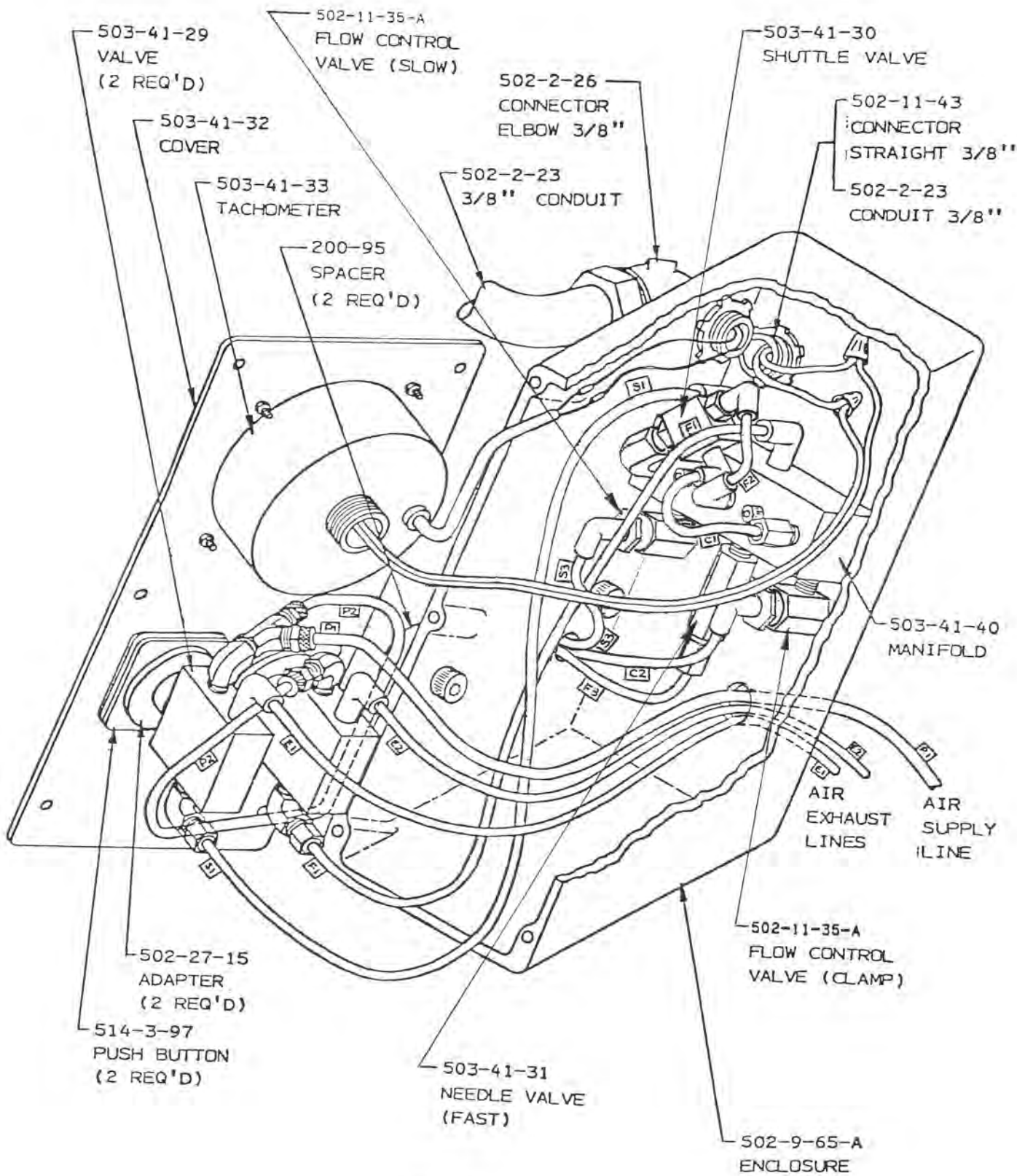
VARIABLE SPEED



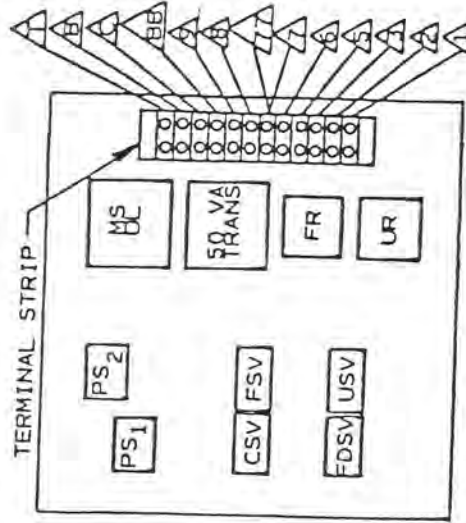
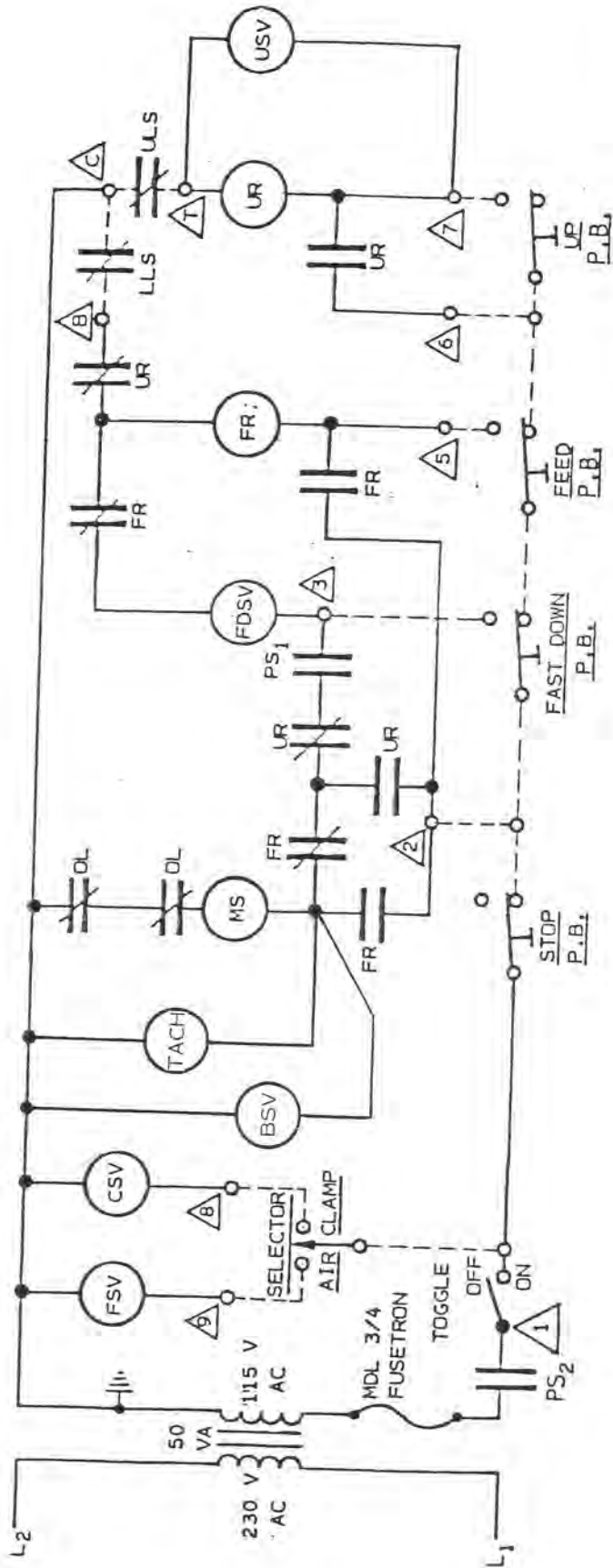


MANUAL CONTROL PANEL  
VIEW N-N





FA-4VB only  
 SPEED CONTROL ENCLOSURE  
 VIEW V-V



SCHEMATIC LAYOUT CONTROL PANEL

\* FOR OLDER MACHINES FSV IS REFERRED TO AS LSV - LIFT SOLENOID VALVE

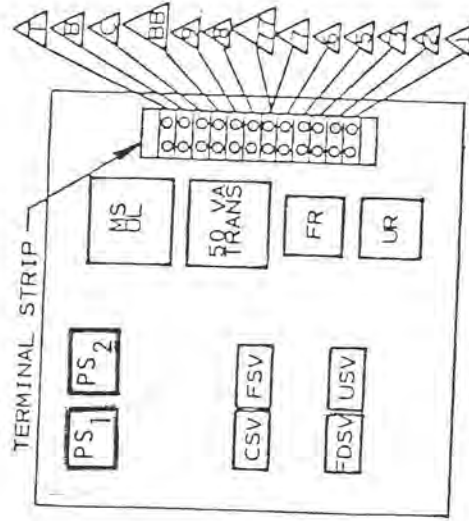
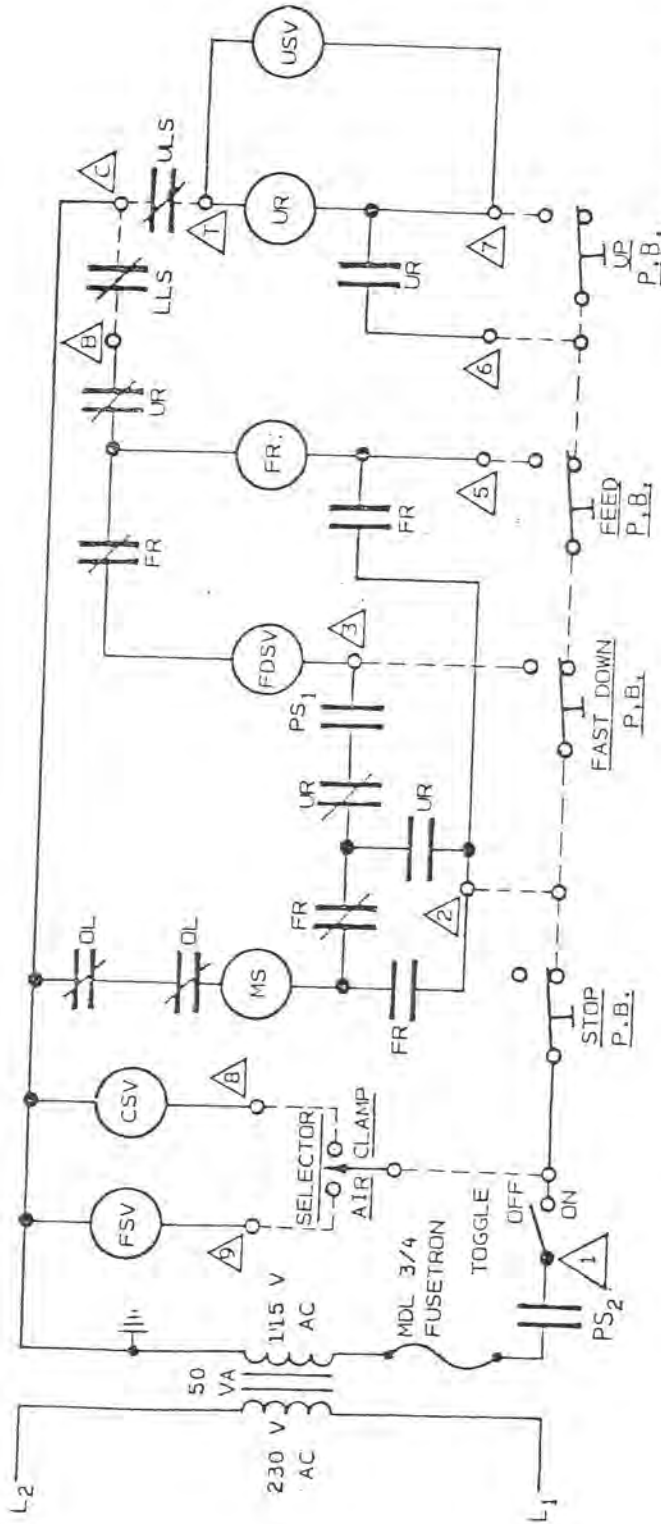
- LEGEND -

- CSV - CLAMP SOLENOID VALVE
- FDSV - EAST DOWN SOLENOID VALVE
- FR - FEED RELAY
- LLS - LOWER LIMIT MICRO SWITCH
- MS - MOTOR STARTER
- OL - OVER LOAD, MOTOR STARTER
- PS1 - PRESSURE SWITCH  
N.O. CONTACTS CLOSED BY AIR PRESS. WHEN FDSV IS ENERGIZED

- PS2 - PRESSURE SWITCH  
N.O. CONTACTS CLOSED BY SUPPLY AIR PRESS.
- \* FSV - FLOAT SOLENOID VALVE
- ULS - UPPER MICRO SWITCH
- UR - UP RELAY
- USV - UP SOLENOID VALVE

- △ = WIRES & TERMINALS INDICATORS
- TACH - TACHOMETER
- BSV - BELT SOLENOID VALVE

FA-4VB BORING MACHINE  
CONTROL CIRCUIT DIAGRAM



SCHMATIC LAYOUT CONTROL PANEL

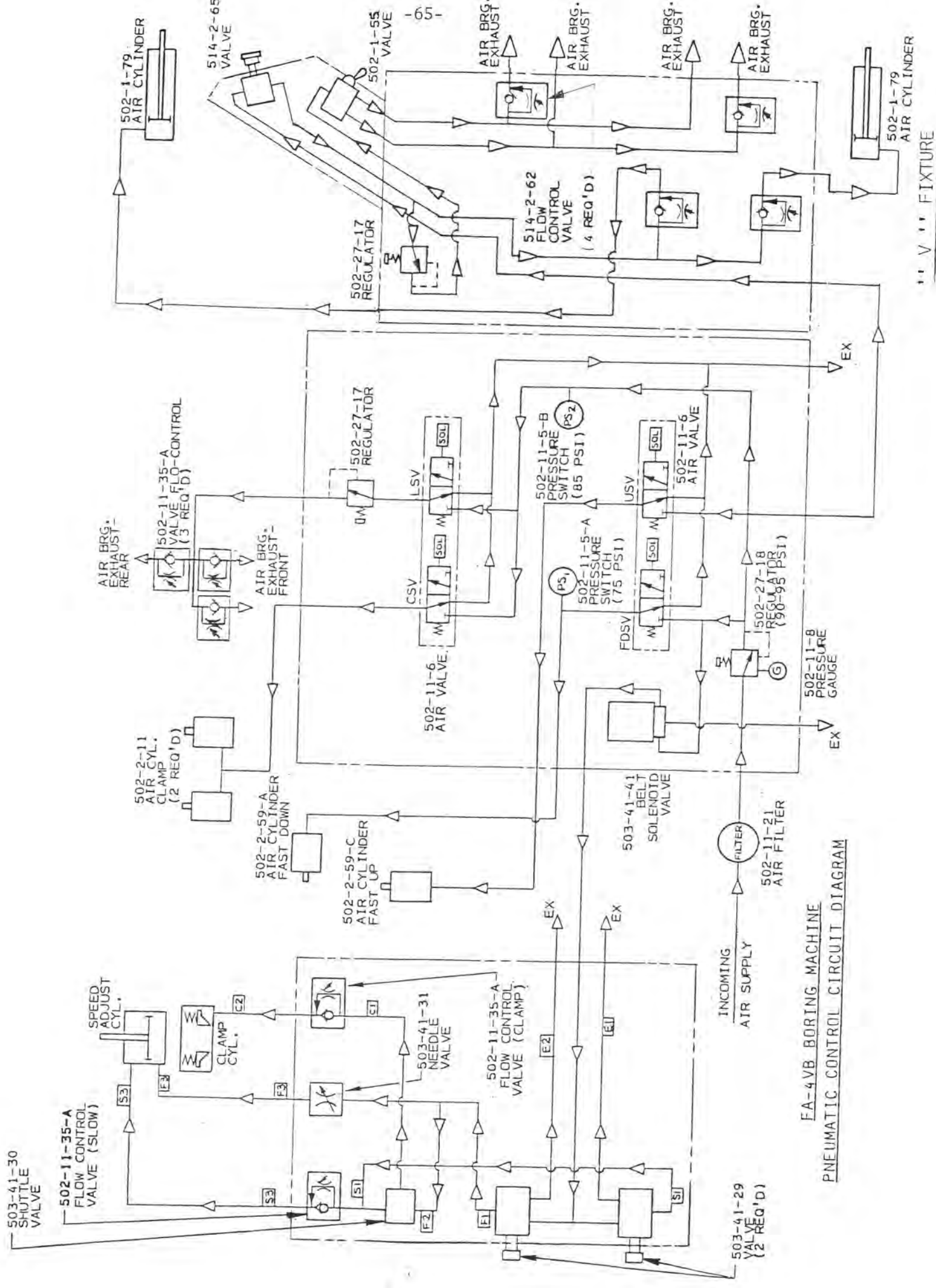
\* FOR OLDER MACHINES FSV IS REFERRED TO AS LSV - LIFT SOLENOID VALVE

- LEGEND -

- CSV - CLAMP SOLENOID VALVE
- FDSV - FAST DOWN SOLENOID VALVE
- FR - FEED RELAY
- LLS - LOWER LIMIT MICRO SWITCH
- MS - MOTOR STARTER
- OL - OVER LOAD, MOTOR STARTER
- PS1 - PRESSURE SWITCH, N.O. CONTACTS CLOSED BY AIR PRESS. WHEN FDSV IS ENERGIZED
- PS2 - PRESSURE SWITCH2 N.O. CONTACTS CLOSED BY SUPPLY AIR PRESS.
- FSV - FLOAT SOLENOID VALVE
- ULS - UPPER MICRO SWITCH
- UR - UP RELAY
- USV - UP SOLENOID VALVE
- △ = WIRES & TERMINALS INDICATORS

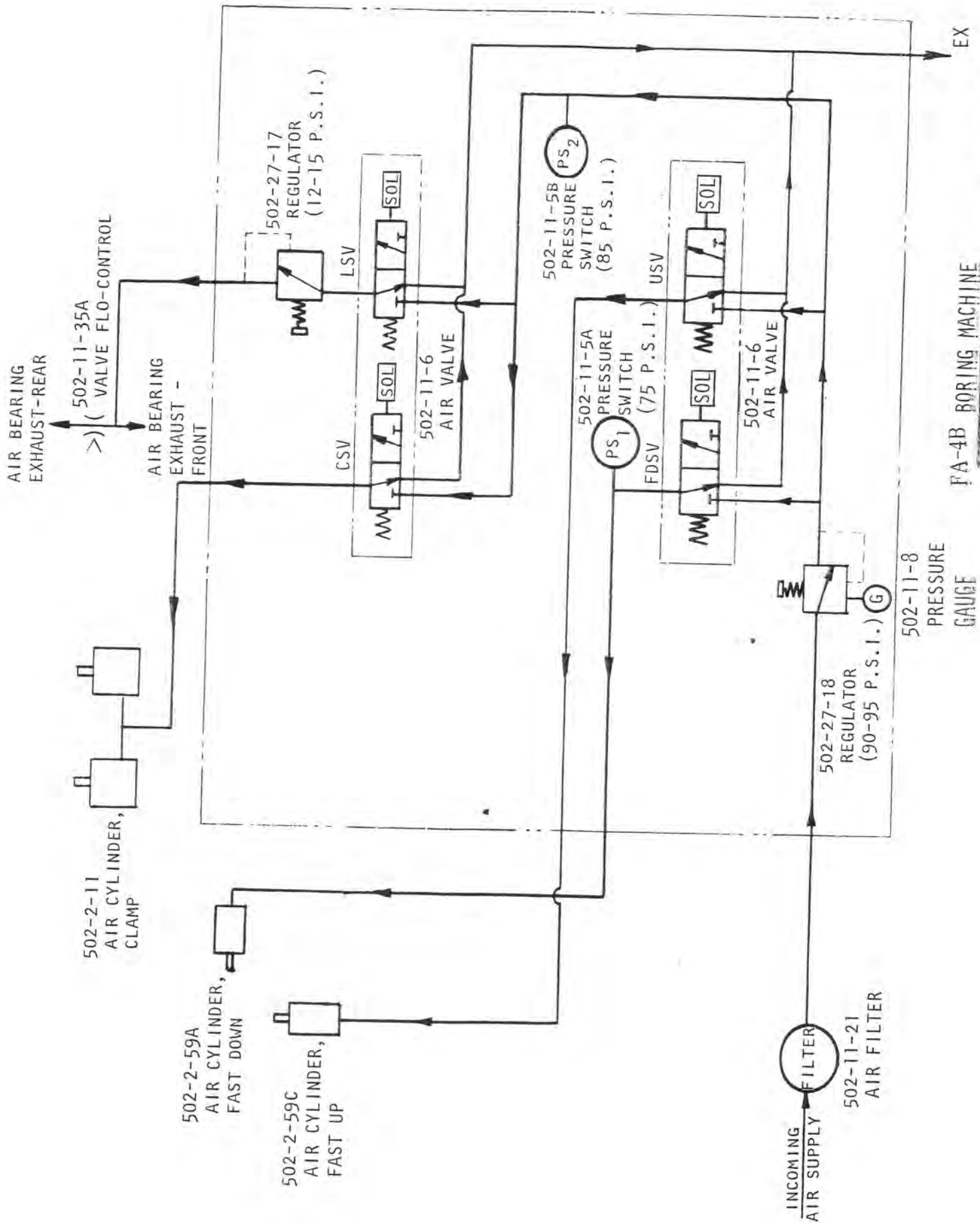
FA-4B BORING MACHINE

CONTROL CIRCUIT DIAGRAM

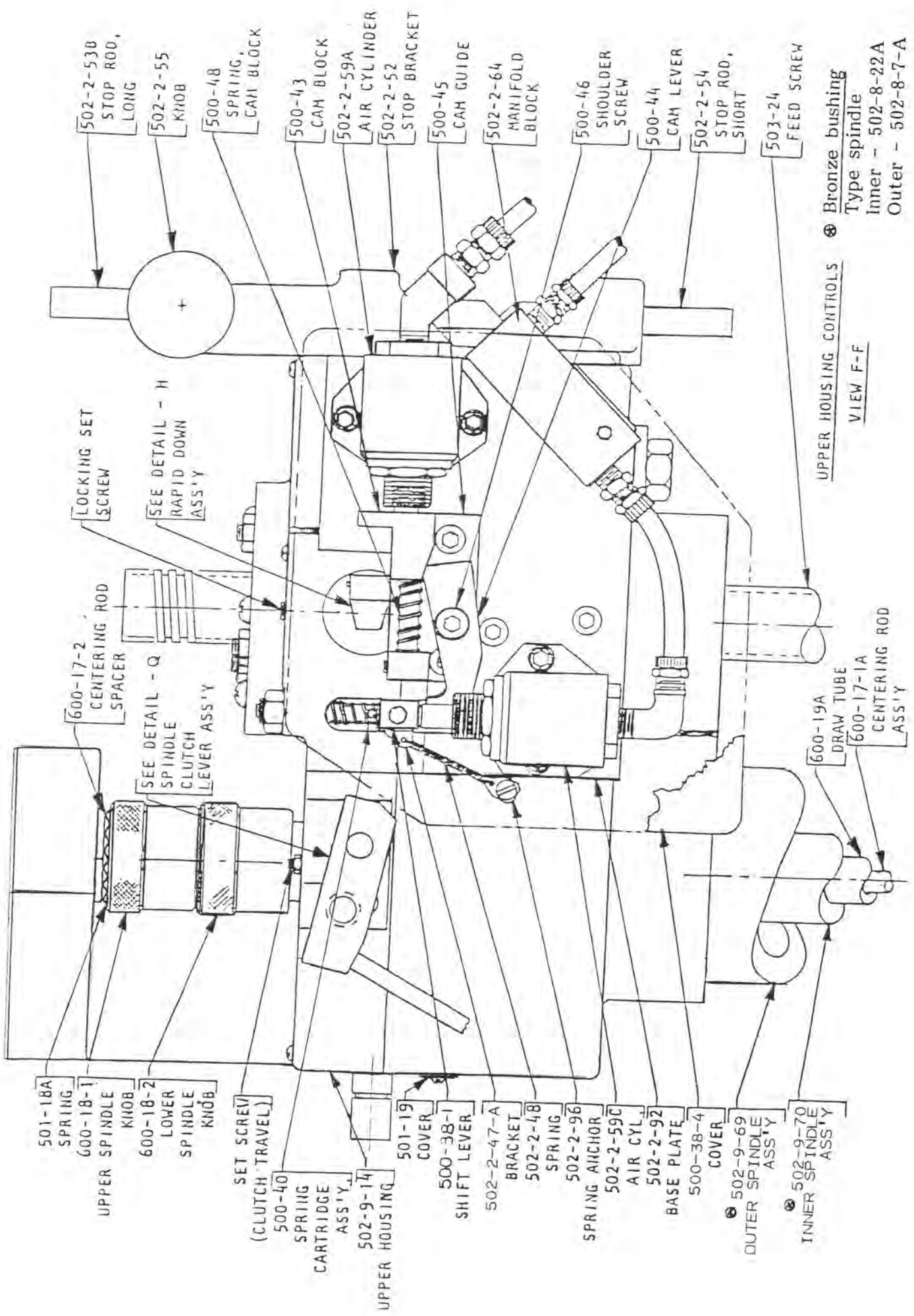


FA-4VB BORING MACHINE  
PNEUMATIC CONTROL CIRCUIT DIAGRAM

11 V 11 FIXTURE



FA-4B BORING MACHINE  
PNEUMATIC CONTROL CIRCUIT DIAGRAM



501-18A  
SPRING  
600-18-1  
UPPER SPINDLE  
KNOB  
600-18-2  
LOWER SPINDLE  
KNOB

600-17-2  
CENTERING ROD  
SPACER

LOCKING SET  
SCREW

SEE DETAIL - Q  
SPINDLE  
CLUTCH  
LEVER ASS'Y

SEE DETAIL - H  
RAPID DOWN  
ASS'Y

SET SCREW/  
(CLUTCH TRAVEL)  
500-40  
SPRING  
CARTRIDGE  
ASS'Y

502-9-14  
UPPER HOUSING

501-19  
COVER

500-38-1  
SHIFT LEVER

502-2-47-A  
BRACKET

502-2-48  
SPRING

502-2-96  
SPRING ANCHOR

502-2-59C  
AIR CYL.

502-2-92  
BASE PLATE

500-38-4  
COVER

502-9-69  
OUTER SPINDLE  
ASS'Y

502-9-70  
INNER SPINDLE  
ASS'Y

600-19A  
DRAW TUBE

600-17-1A  
CENTERING ROD  
ASS'Y

502-2-53B  
STOP ROD,  
LONG

502-2-55  
KNOB

500-48  
SPRING,  
CAM BLOCK

500-43  
CAM BLOCK

502-2-59A  
AIR CYLINDER

502-2-52  
STOP BRACKET

500-45  
CAM GUIDE

502-2-64  
MANIFOLD  
BLOCK

500-46  
SHOULDER  
SCREW

500-44  
CAM LEVER

502-2-54  
STOP ROD,  
SHORT

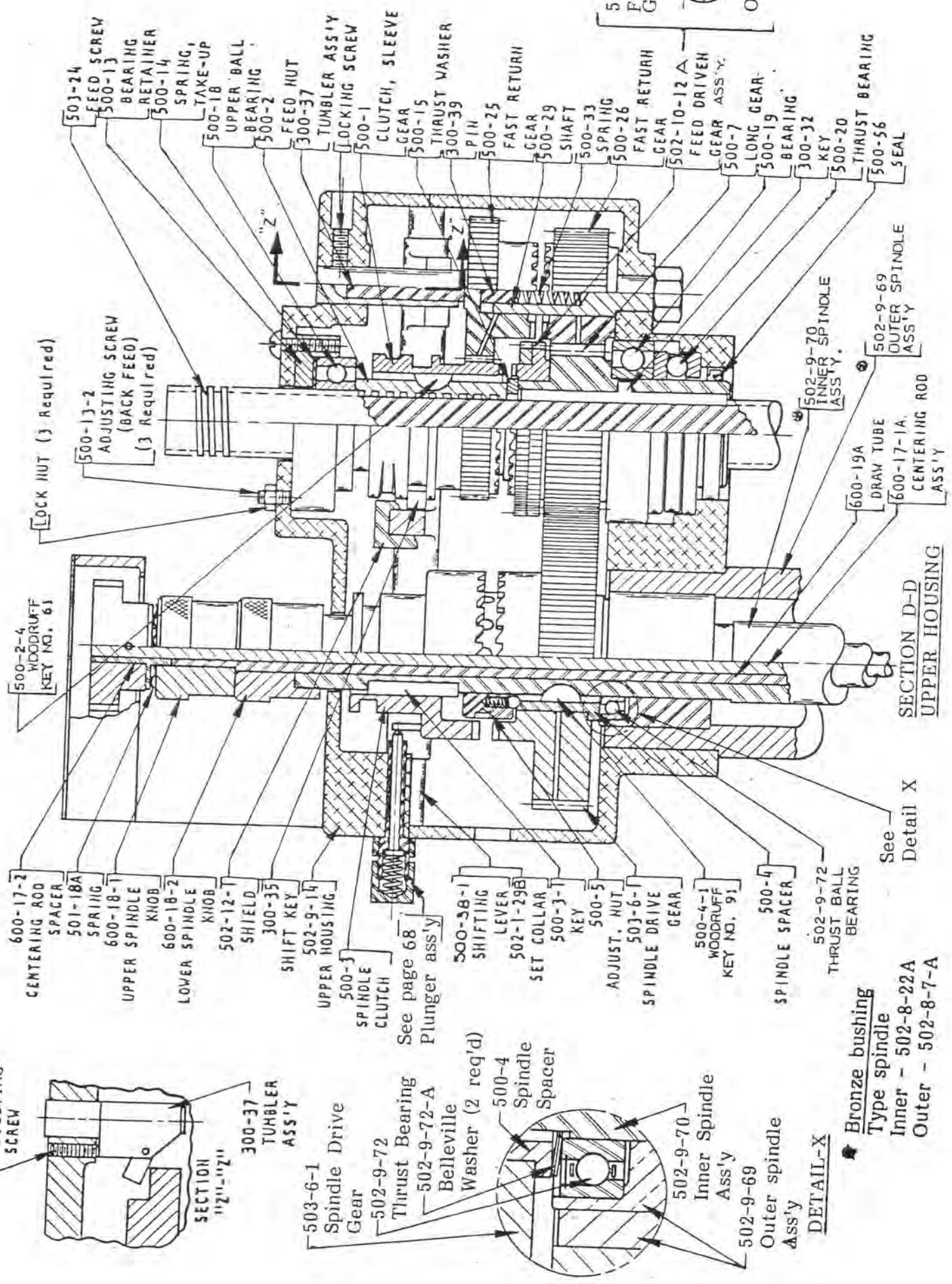
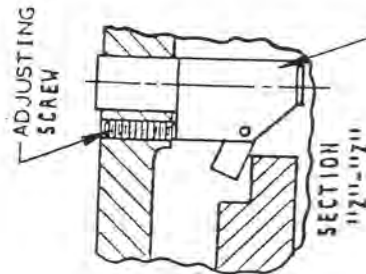
503-24  
FEED SCREW

UPPER HOUSING CONTROLS

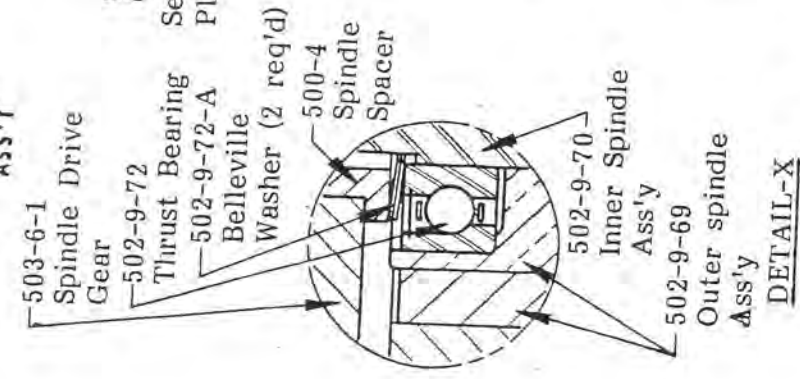
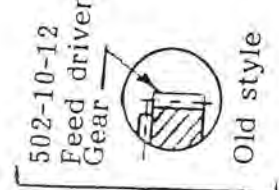
VIEW F-F

⊕ Bronze bushing  
Type spindle  
Inner - 502-8-22A  
Outer - 502-8-7-A

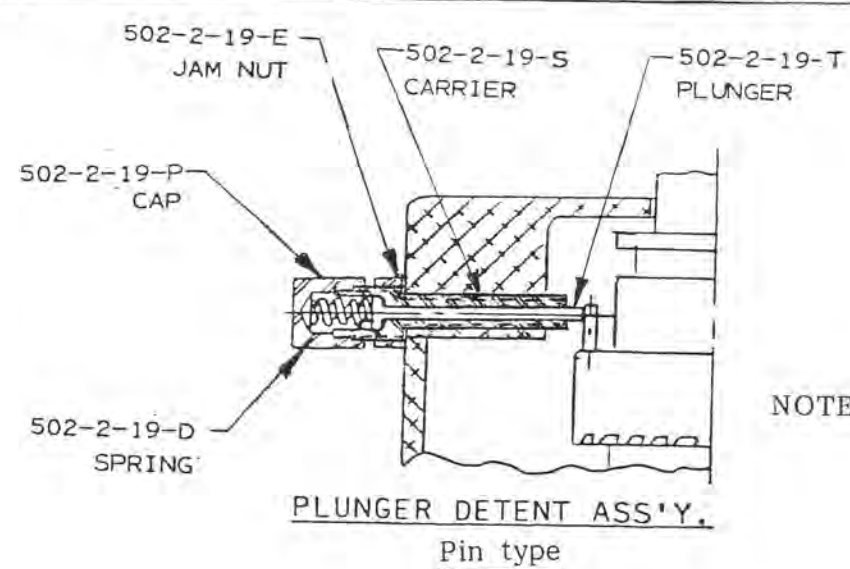
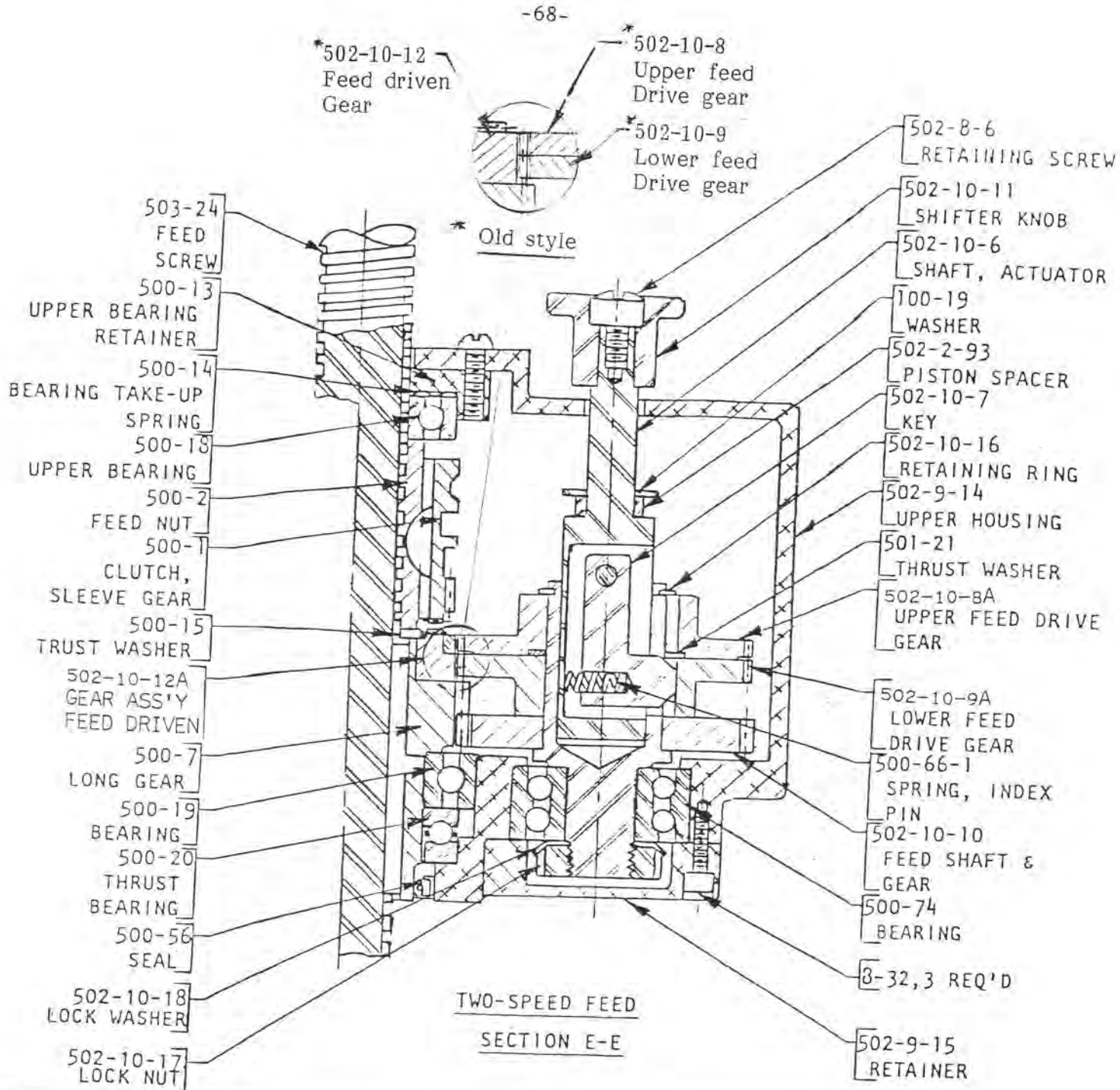




- 600-17-2 CENTERING ROD
- 501-18A SPACER
- 501-18B SPRING
- 600-18-1 UPPER SPINDLE
- 600-18-2 LOWER SPINDLE
- 502-12-1 KNOB
- 502-12-2 SHIELD
- 300-35 SHIFT KEY
- 502-9-14 UPPER HOUSING
- 500-3 SPINDLE CLUTCH
- 500-38-1 SHIFTING LEVER
- 502-1-29B SET COLLAR
- 500-3-1 KEY
- 500-5 ADJUST. NUT
- 503-6-1 SPINDLE DRIVE GEAR
- 500-4-1 WOODRUFF KEY NO. 91
- 500-4 SPINDLE SPACER
- 502-9-72 THRUST BALL BEARING
- 500-2-4 WOODRUFF KEY NO. 61
- 500-13-2 ADJUSTING SCREW (BACK FEED) (3 Required)
- 503-24 FEED SCREW
- 500-13 BEARING
- 500-14 RETAINER
- 500-14 SPRING
- 500-14 TAKE-UP
- 500-18 UPPER BALL BEARING
- 500-2 FEED NUT
- 300-37 TUMBLER ASS'Y
- 500-1 LOCKING SCREW
- 500-1 CLUTCH, SLEEVE
- 500-15 GEAR
- 300-39 THRUST WASHER
- 500-25 PIN
- 500-25 FAST RETURN
- 500-29 GEAR
- 500-29 SHAFT
- 500-33 SPRING
- 500-26 FAST RETURN GEAR
- 502-10-12 A FEED DRIVER GEAR ASS'Y
- 500-7 FEED DRIVER GEAR ASS'Y
- 500-19 LONG GEAR
- 500-19 BEARING
- 300-32 KEY
- 500-20 THRUST BEARING
- 500-56 SEAL
- 502-9-70 INNER SPINDLE ASS'Y.
- 502-9-69 OUTER SPINDLE ASS'Y.
- 600-19A DRAW TUBE
- 600-17-1A CENTERING ROD ASS'Y.

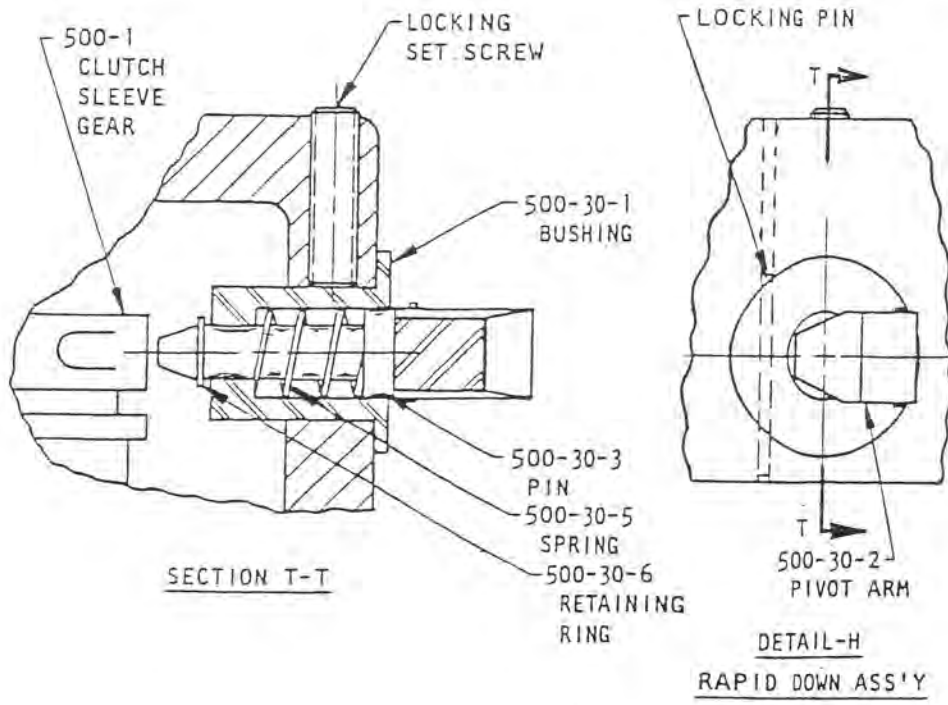
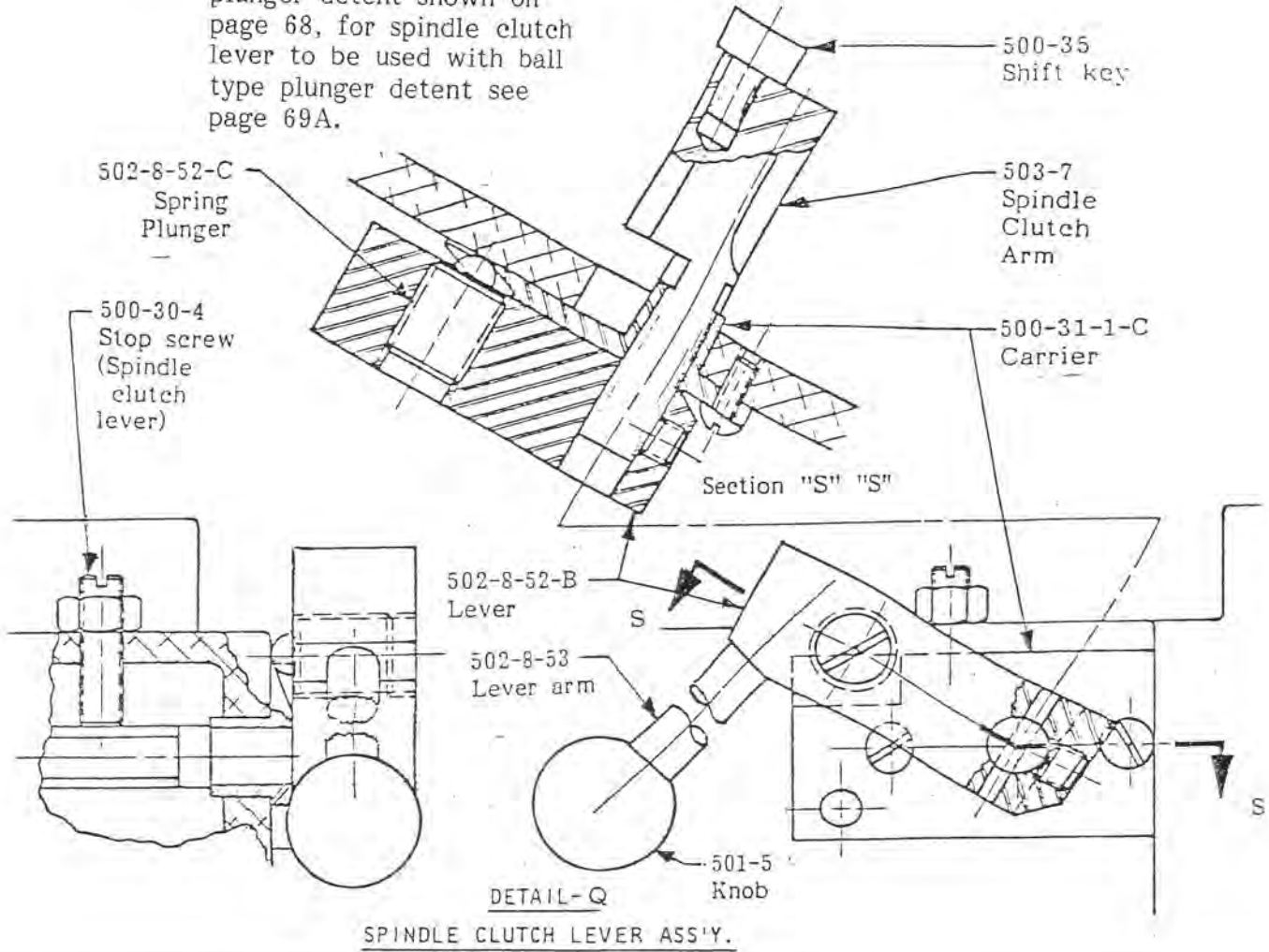


◆ Bronze bushing  
Type spindle  
Inner - 502-8-22A  
Outer - 502-8-7-A

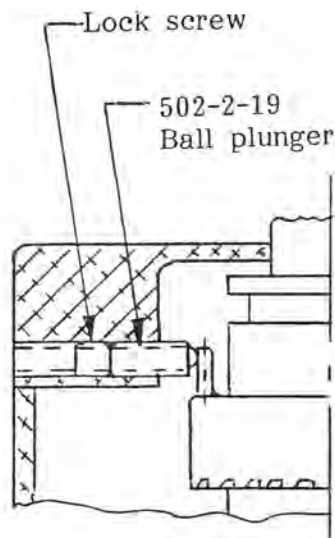
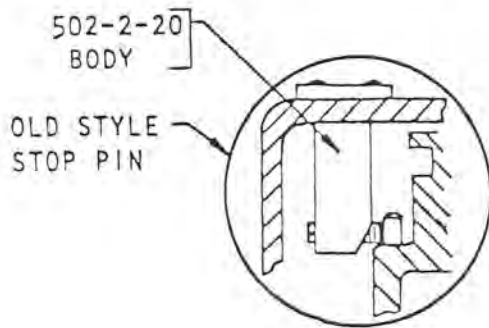
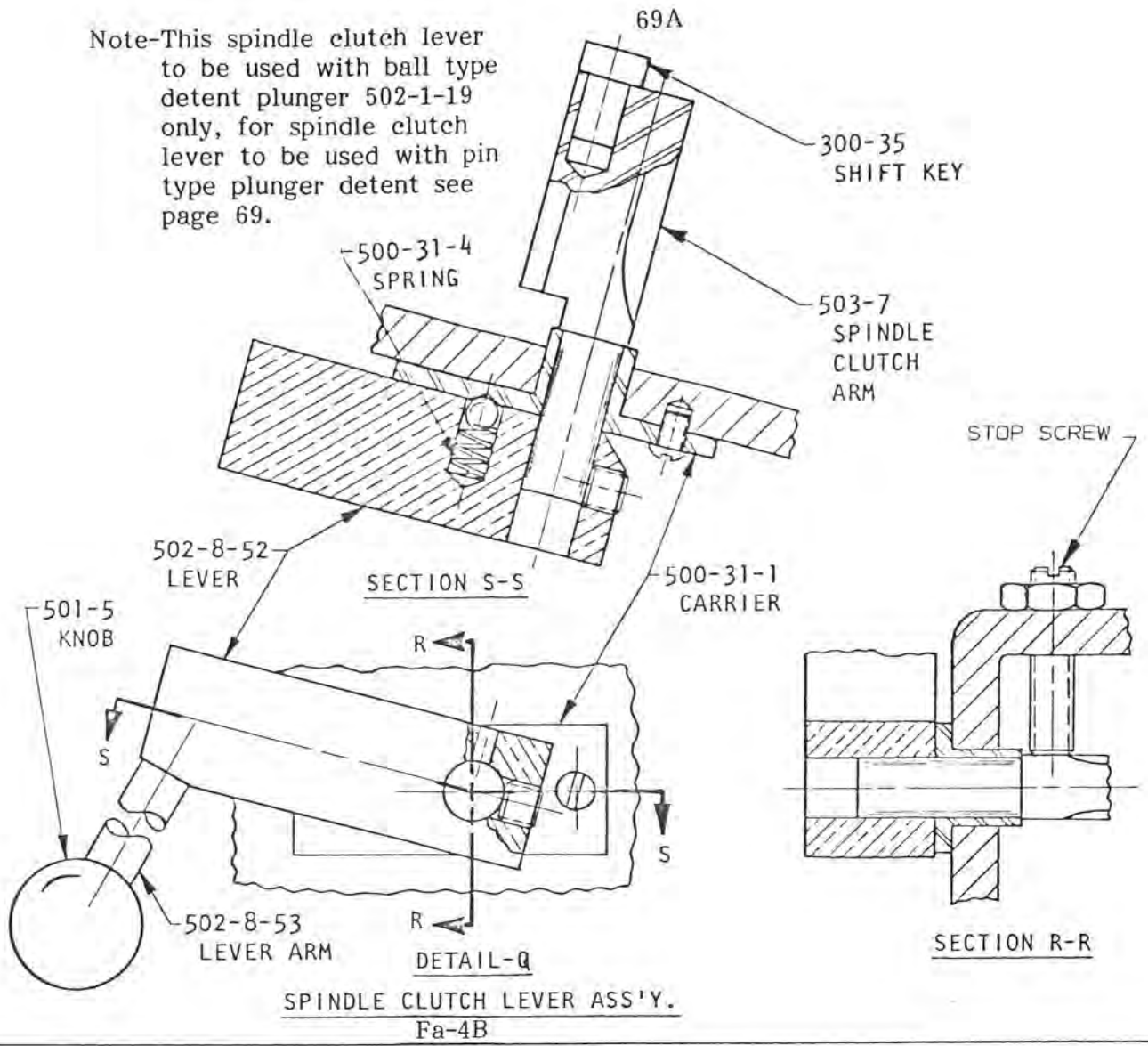


NOTE- For ball type plunger detent ass'y see pg 69A

NOTE-This spindle clutch lever to be used with pin type plunger detent shown on page 68, for spindle clutch lever to be used with ball type plunger detent see page 69A.



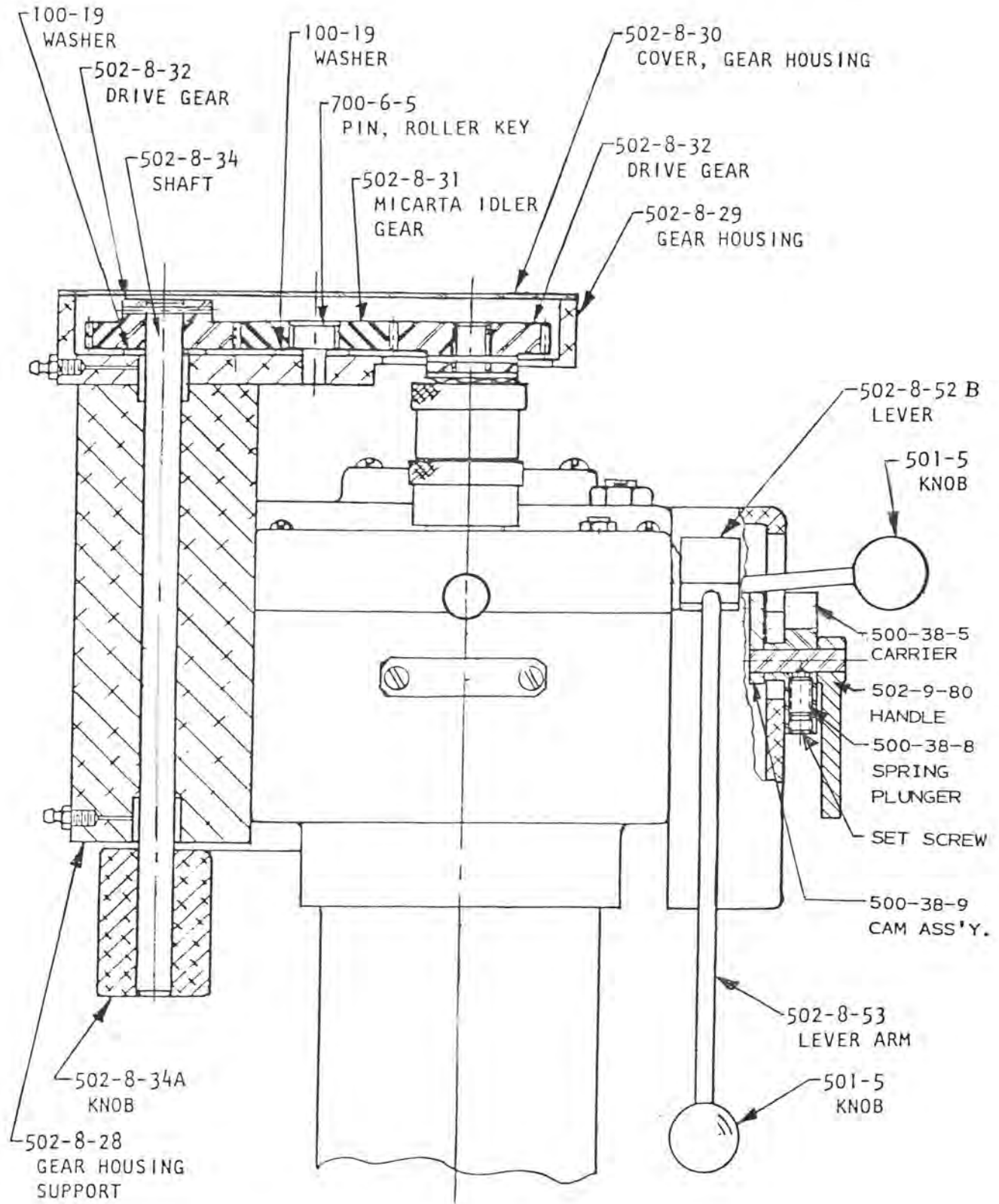
Note-This spindle clutch lever to be used with ball type detent plunger 502-1-19 only, for spindle clutch lever to be used with pin type plunger detent see page 69.



NOTE-See page 68 for pin type plunger detent

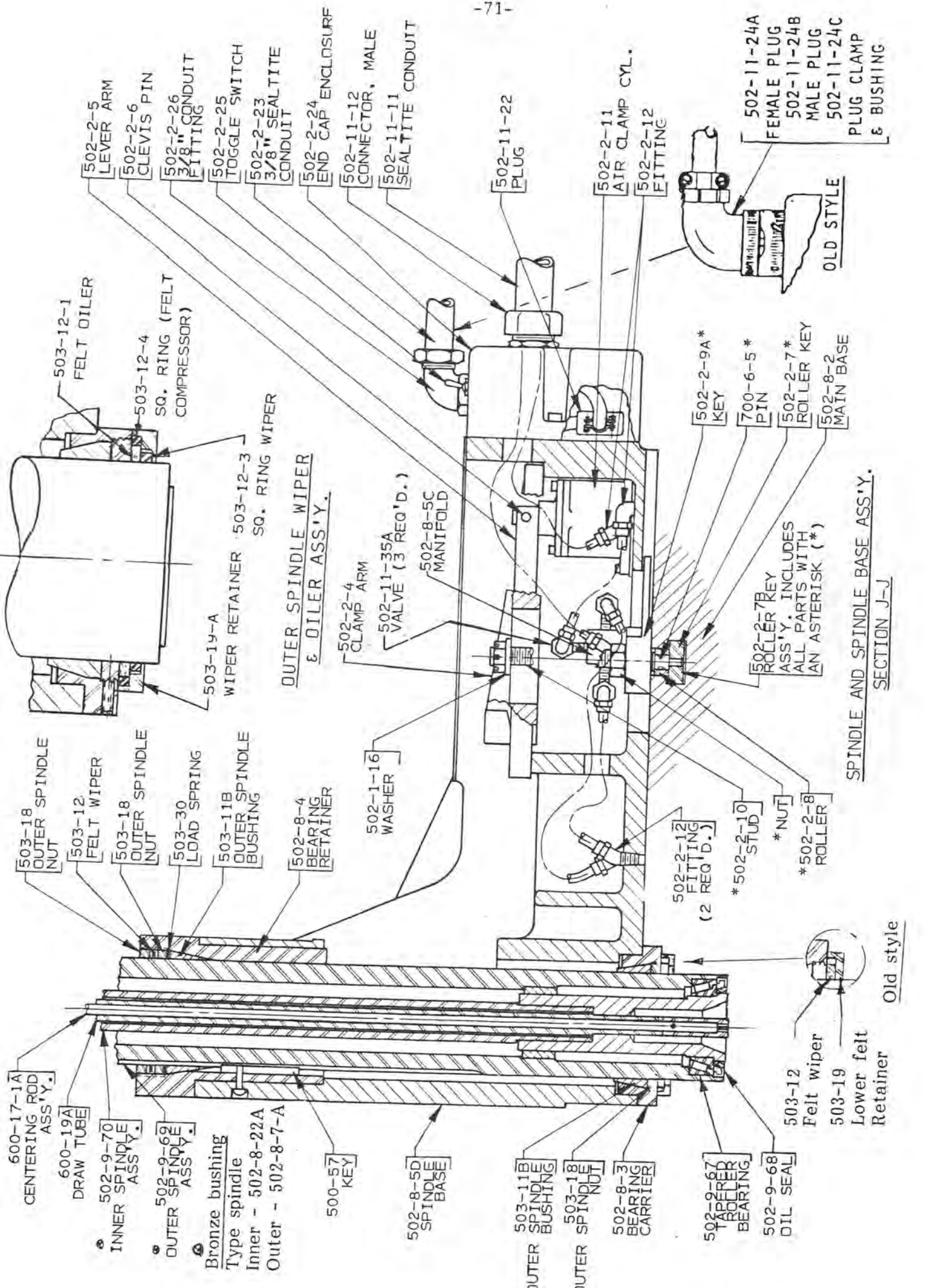
Ball type plunger

FA-4B



CENTERING CONTROL  
VIEW P-P





600-17-1A  
CENTERING ROD  
ASS'Y.

600-19A  
DRAW TUBE

502-9-70  
INNER SPINDLE  
ASS'Y.

502-9-69  
OUTER SPINDLE  
ASS'Y.

Bronze bushing  
Type spindle  
Inner - 502-8-22A  
Outer - 502-8-7-A

500-57  
KEY

502-8-5D  
SPINDLE  
BASE

503-11B  
OUTER  
SPINDLE  
BUSHING

503-18  
OUTER SPINDLE  
NUT

502-8-3  
BEARING  
CARRIER

502-9-67  
TAPERED  
ROLLER  
BEARING

502-9-68  
OIL SEAL

503-12  
Felt wiper

503-19  
Lower felt  
Retainer

Old style

503-18  
OUTER SPINDLE  
NUT

503-12  
FELT WIPER

503-18  
OUTER SPINDLE  
NUT

503-30  
LOAD SPRING

503-11B  
OUTER SPINDLE  
BUSHING

502-8-4  
BEARING  
RETAINER

502-1-16  
WASHER

503-12-1  
FELT OILER

503-12-4  
SQ. RING (FELT  
COMPRESSOR)

503-19-A  
WIPER RETAINER

503-12-3  
SQ. RING WIPER

OUTER SPINDLE WIPER  
& OILER ASS'Y.

502-2-4  
CLAMP ARM

502-11-35A  
VALVE (3 REQ'D.)

502-8-5C  
MANIFOLD

502-2-5  
LEVER ARM

502-2-6  
CLEVIS PIN

502-2-26  
3/8" CONDUIT  
FITTING

502-2-25  
TOGGLE SWITCH

502-2-23  
3/8" SEALTITE  
CONDUIT

502-2-24  
END CAP ENCLOSURE

502-11-12  
CONNECTOR, MALE

502-11-11  
SEALTITE CONDUIT

502-11-22  
PLUG

502-2-11  
AIR CLAMP CYL.

502-2-12  
FITTING

502-11-24A  
FEMALE PLUG

502-11-24B  
MALE PLUG

502-11-24C  
PLUG CLAMP  
& BUSHING

OLD STYLE

502-2-9A\*  
KEY

700-6-5\*  
PIN

502-2-7\*  
ROLLER KEY

502-8-2  
MAIN BASE

502-2-7B  
ROLLER KEY  
ASS'Y. INCLUDES  
ALL PARTS WITH  
AN ASTERISK (\*)

502-2-12  
FITTING  
(2 REQ'D.)

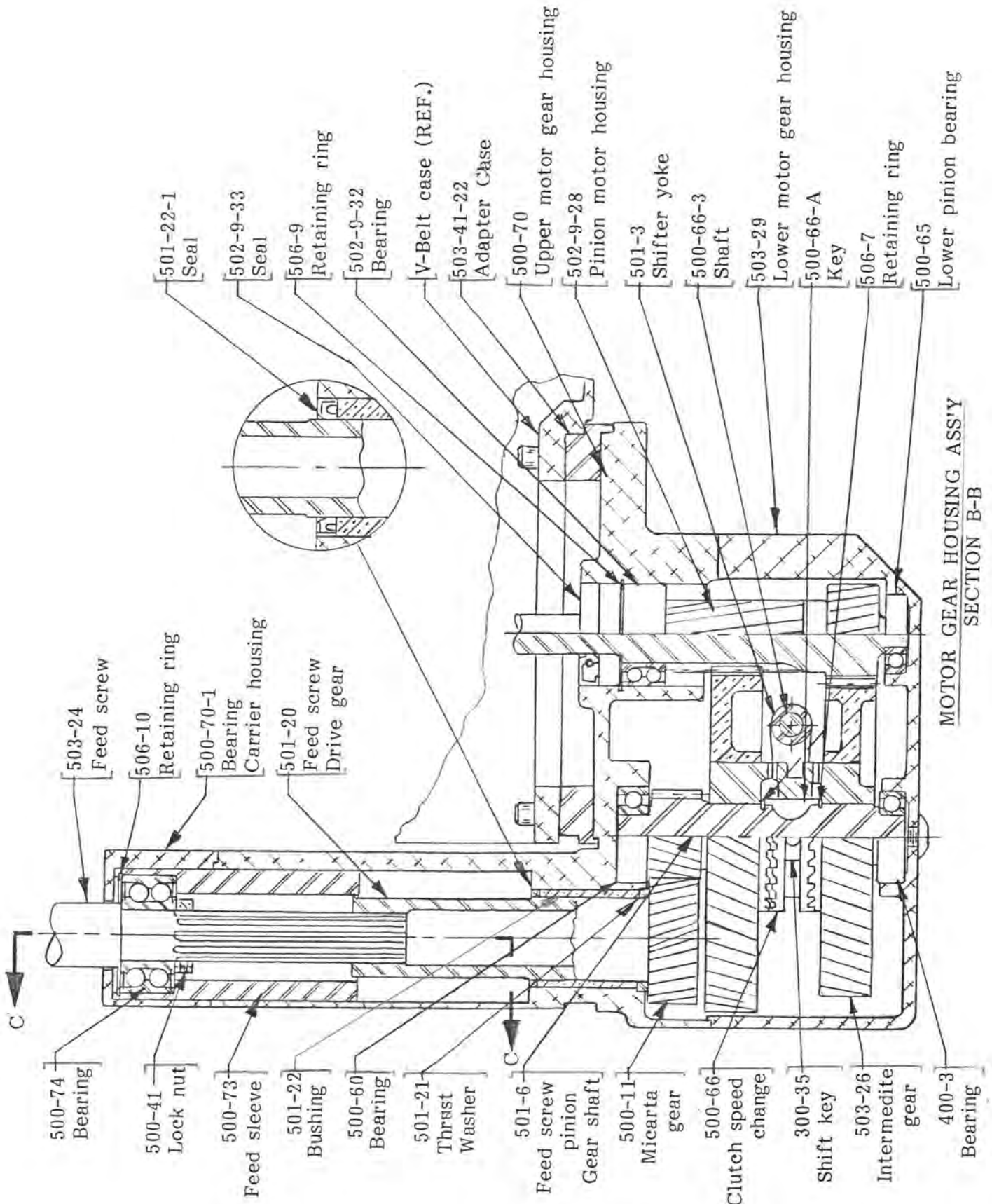
\* 502-2-10  
STUD

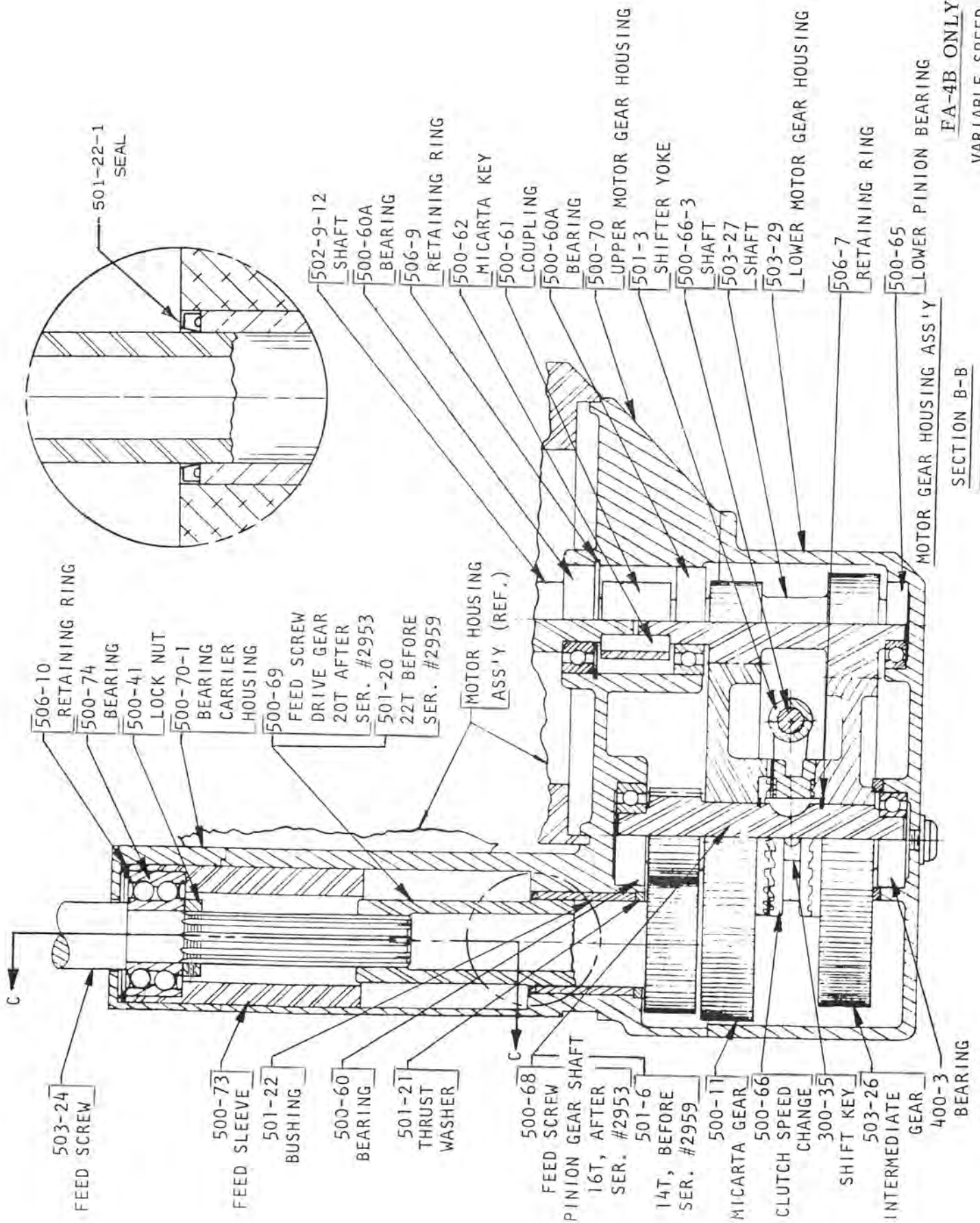
\* NUT

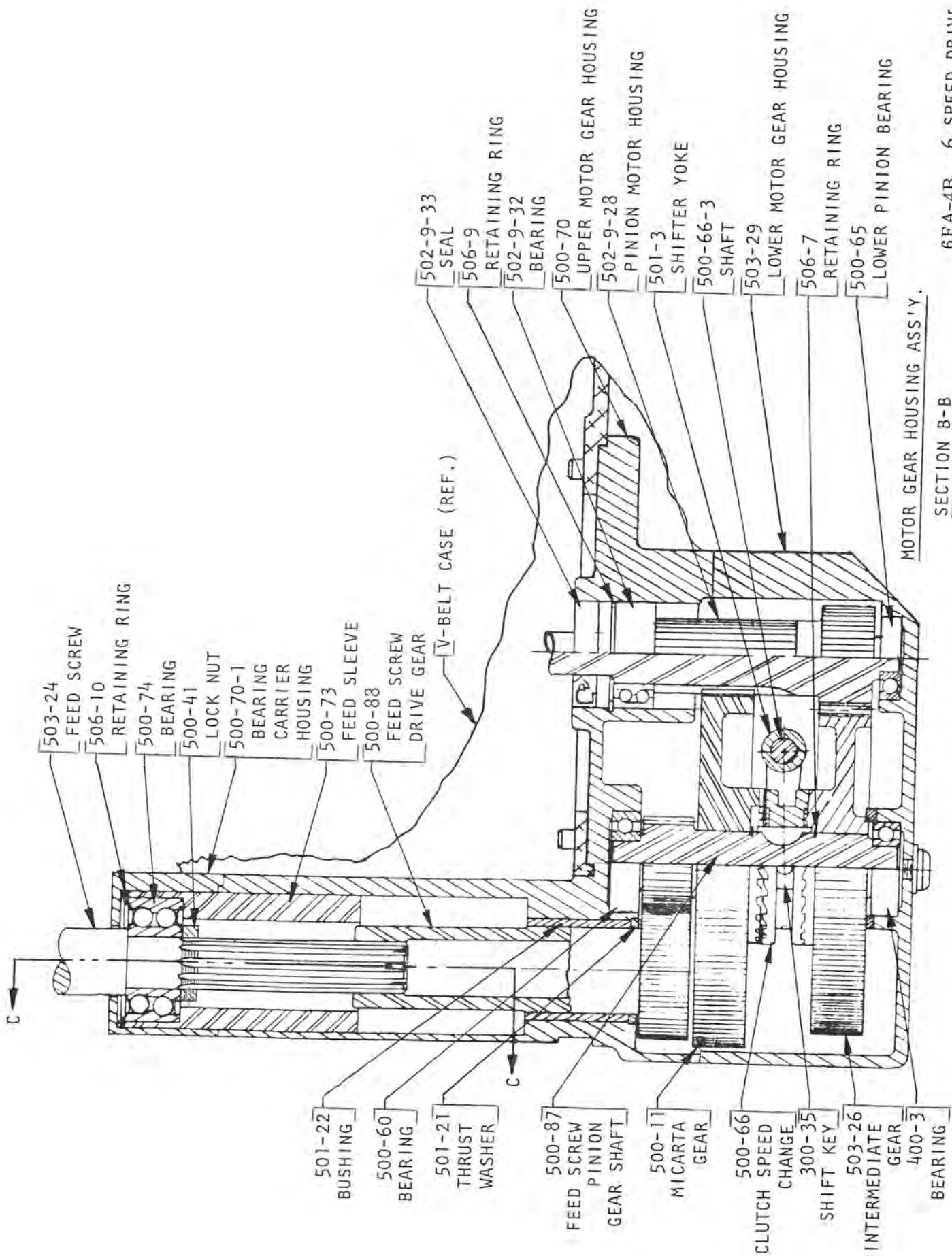
\* 502-2-8  
ROLLER

SPINDLE AND SPINDLE BASE ASS'Y.  
SECTION J-J









- 503-24 FEED SCREW
- 506-10 RETAINING RING
- 500-74 BEARING
- 500-41 LOCK NUT
- 500-70-1 BEARING CARRIER HOUSING
- 500-73 FEED SLEEVE
- 500-88 FEED SCREW DRIVE GEAR

V-BELT CASE (REF.)

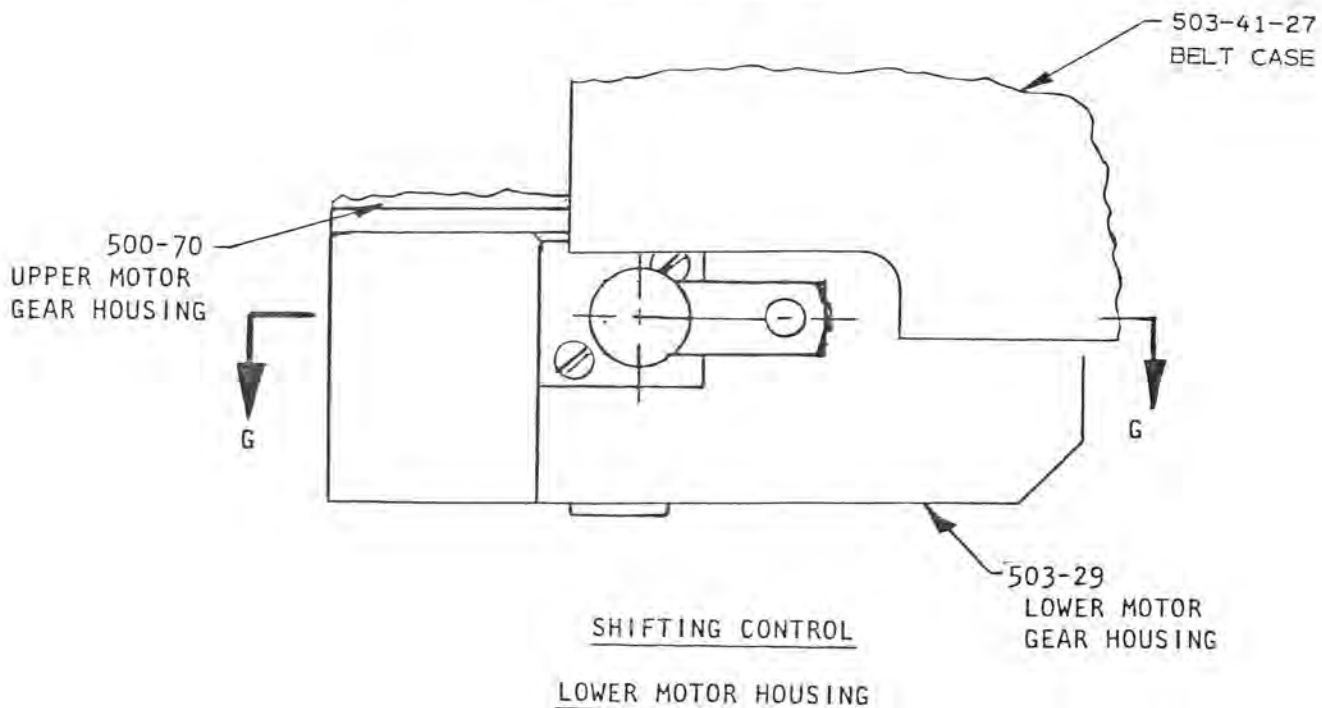
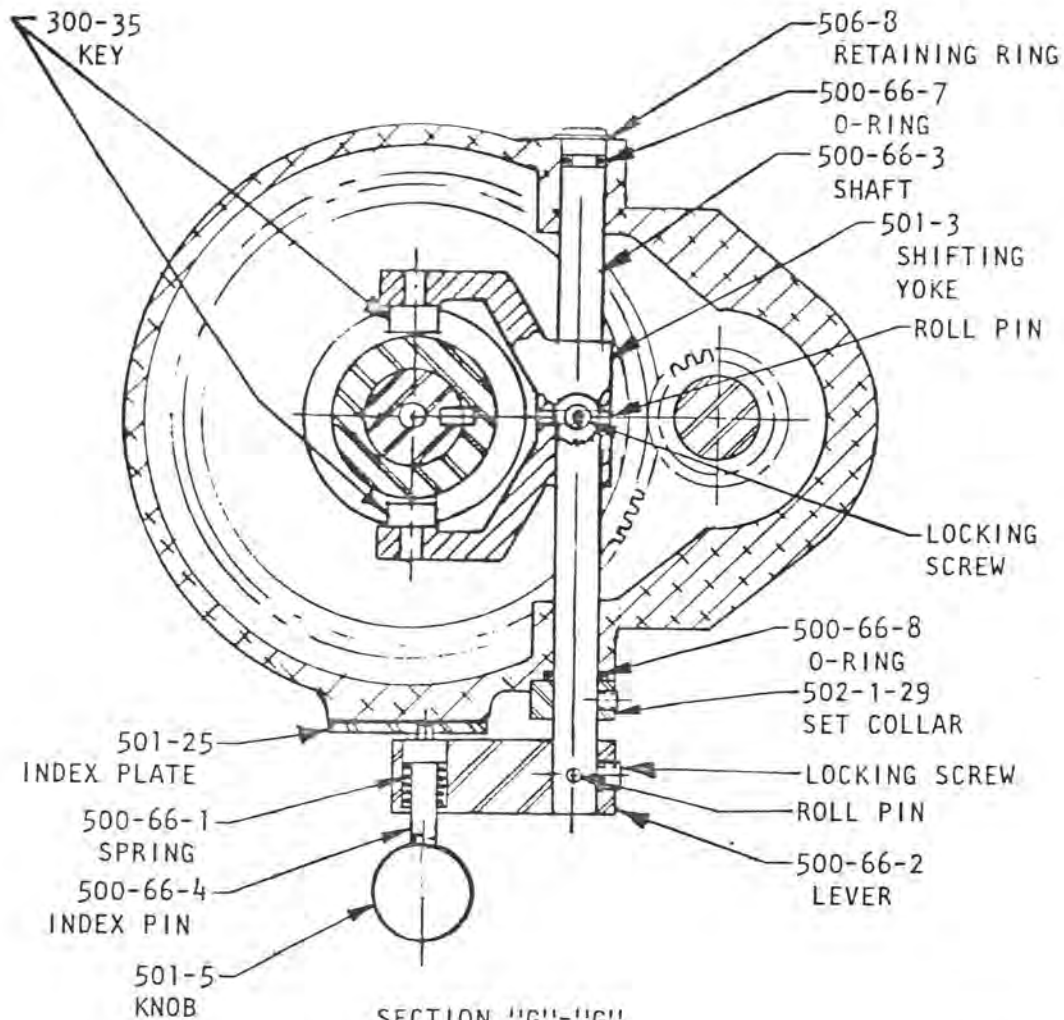
- 501-22 BUSHING
- 500-60 BEARING
- 501-21 THRUST WASHER
- 500-87 FEED SCREW PINION GEAR SHAFT
- 500-11 MICARTA GEAR
- 500-66 CLUTCH SPEED CHANGE
- 300-35 SHIFT KEY
- 503-26 INTERMEDIATE GEAR
- 400-3 BEARING

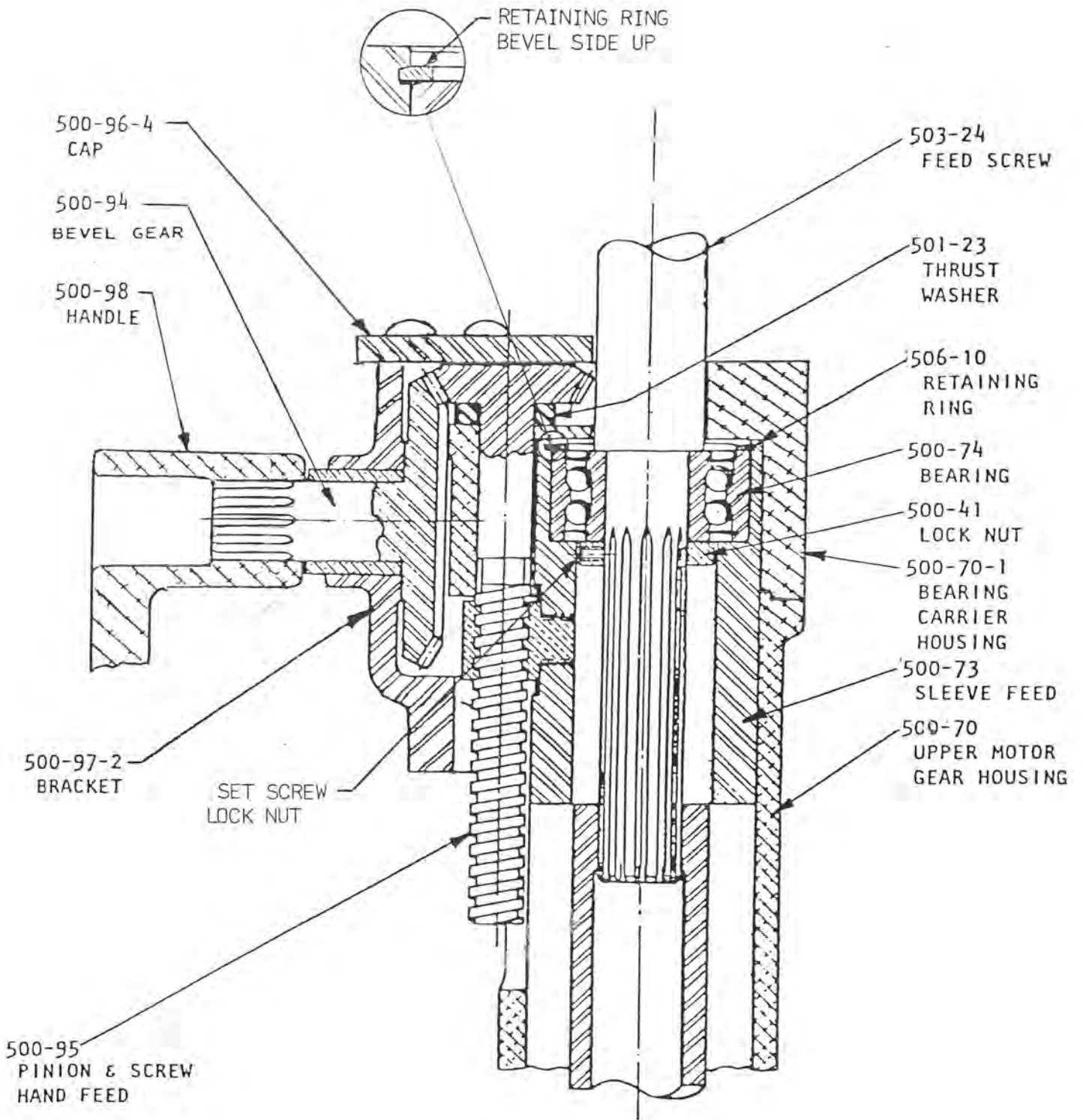
- 502-9-33 SEAL
- 506-9 RETAINING RING
- 502-9-32 BEARING
- 500-70 UPPER MOTOR GEAR HOUSING
- 502-9-28 PINION MOTOR HOUSING
- 501-3 SHIFTER YOKE
- 500-66-3 SHAFT
- 503-29 LOWER MOTOR GEAR HOUSING
- 506-7 RETAINING RING
- 500-65 LOWER PINION BEARING

MOTOR GEAR HOUSING ASS'Y.

SECTION B-B

6FA-4B 6 SPEED DRIVE only

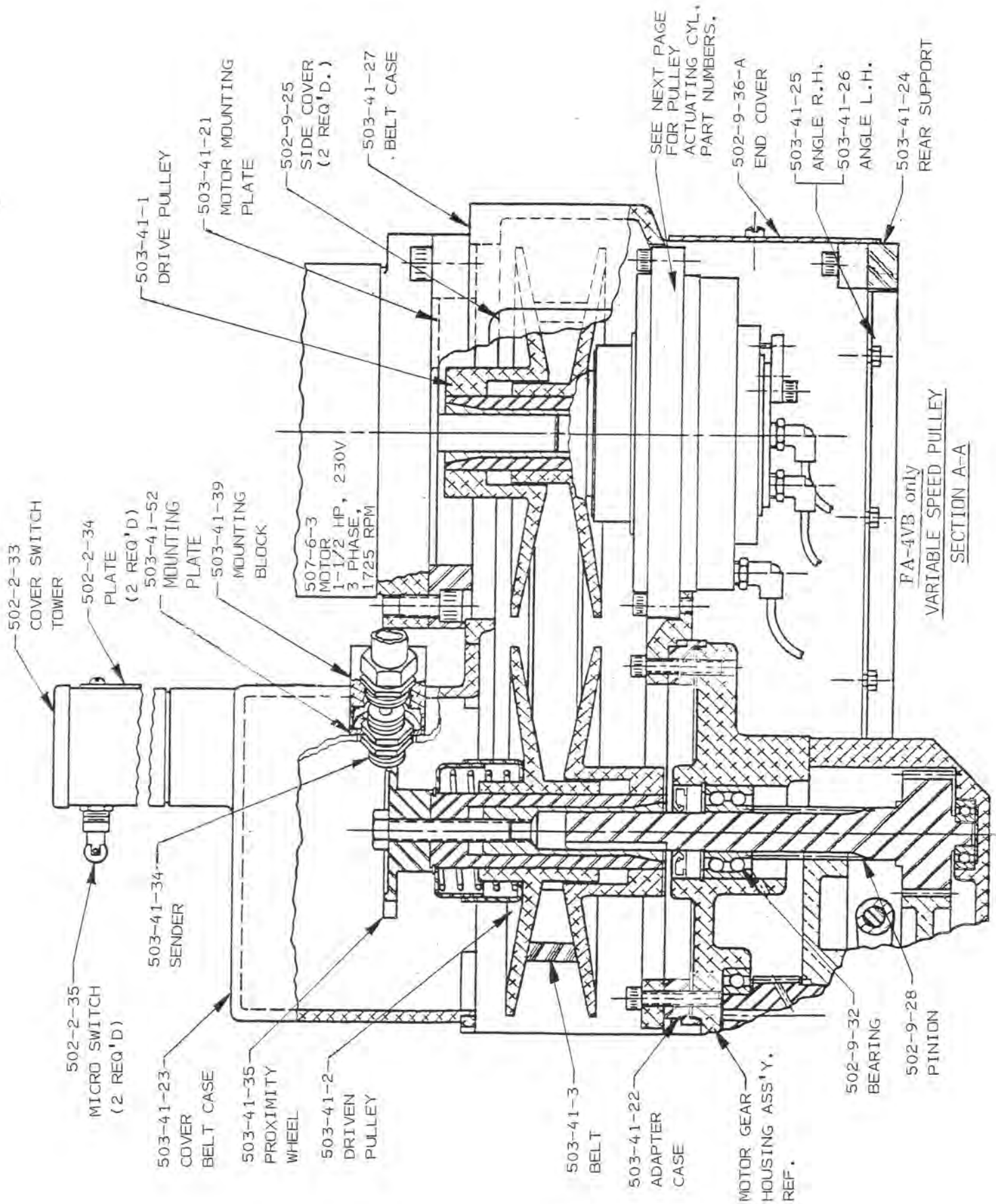




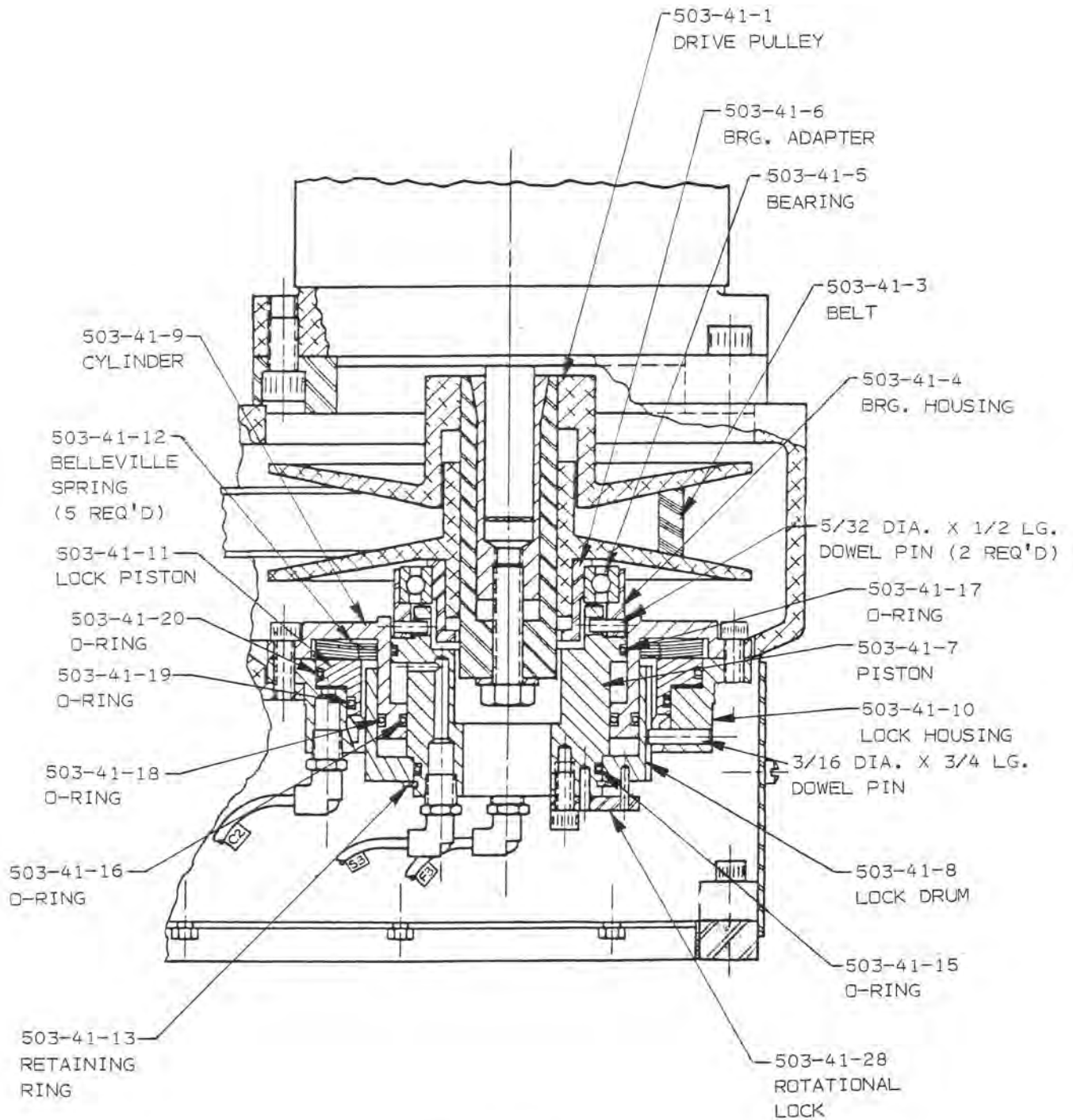
SECTION - C-C

HAND FEED

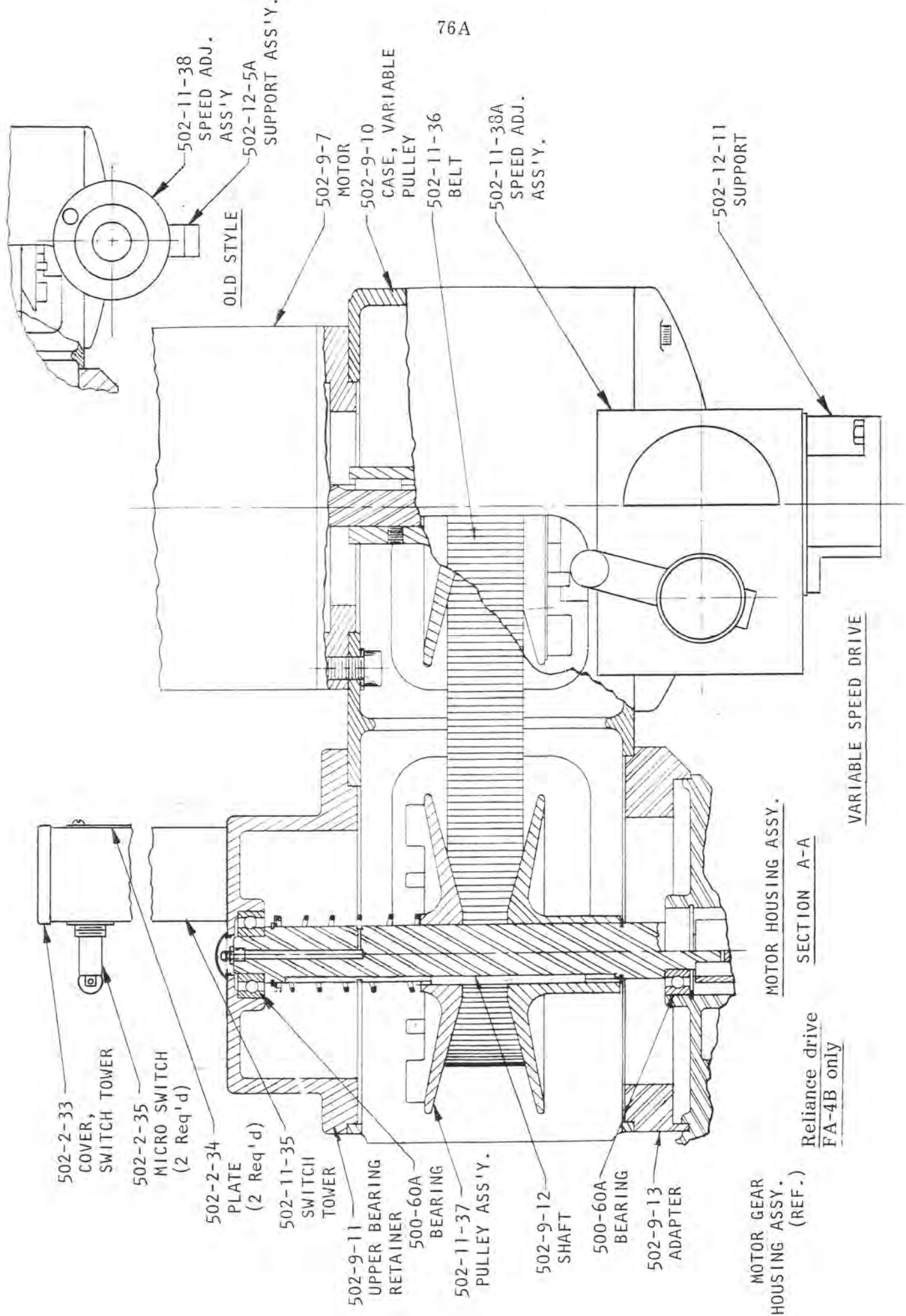


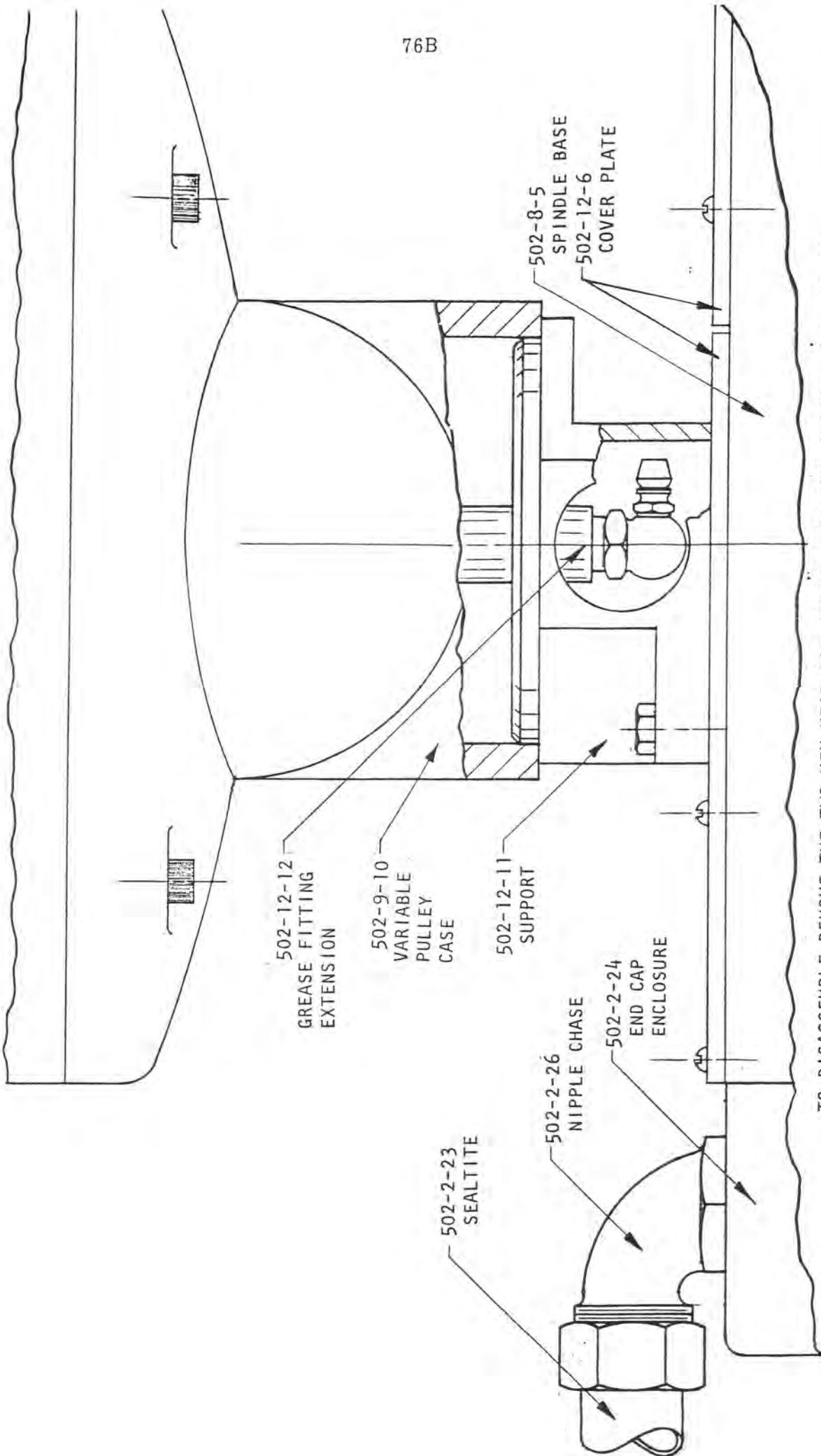






FA-4VB only  
VARIABLE SPEED PULLEY  
ACTUATING CYLINDER



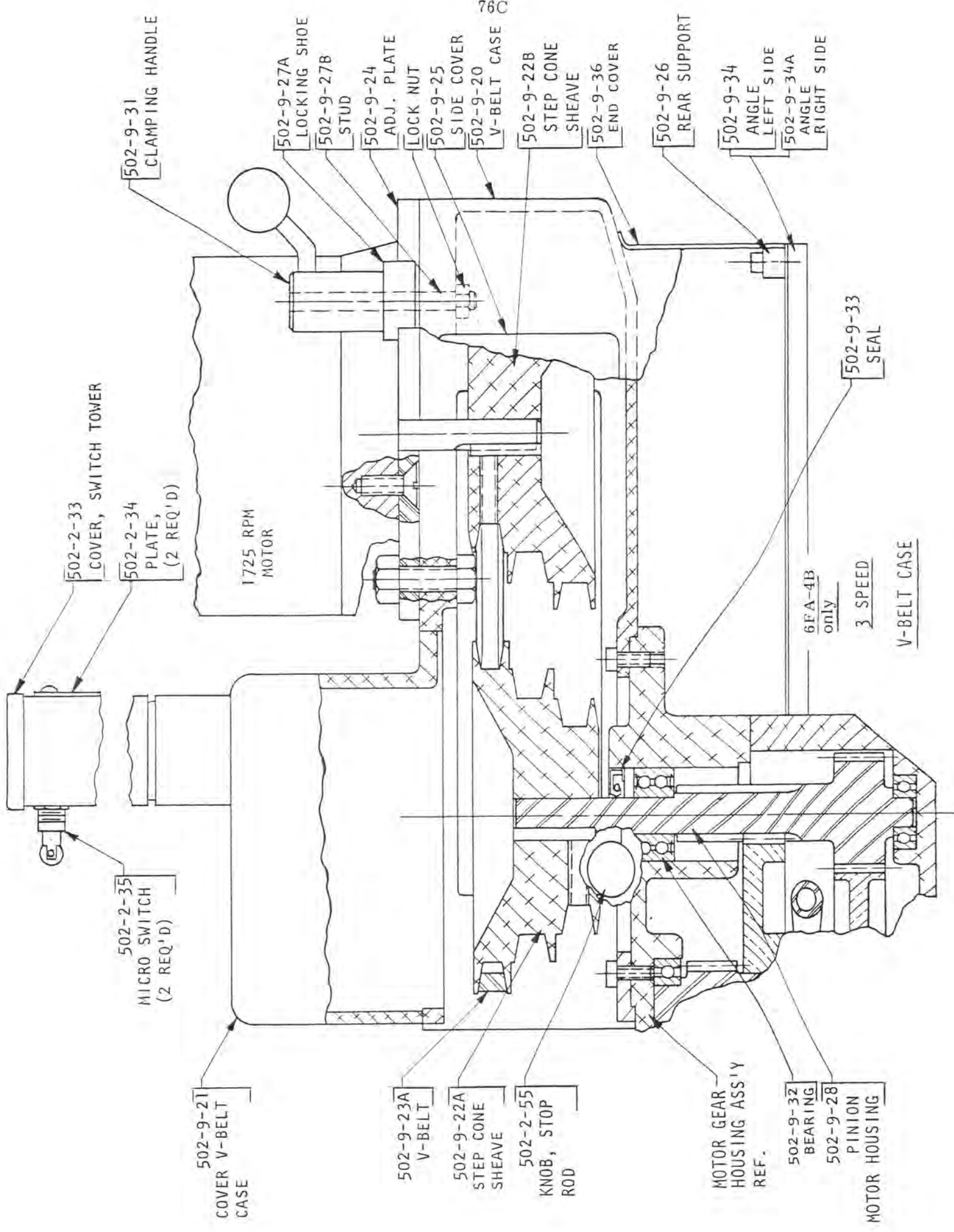


TO DISASSEMBLE, REMOVE THE TWO HEX HEAD CAP SCREWS FROM THE SUPPORT (502-12-11). THEN REMOVE THE FOUR ROUND HEAD SCREWS FROM THE REAR COVER PLATE (502-12-6). THEN LIFT THE SUPPORT AND THE RELIANCE CASE (502-9-10) ENOUGH TO SLIDE THE COVER PLATE OUT FROM UNDERNEATH THE SUPPORT. NOW THE SUPPORT MAY BE REMOVED.

FA-4B ONLY

USED ON MACHINE WITH  
RELIANCE MOTOR DRIVE  
SER. #3007 AND HIGHER.

RELIANCE MOTOR DRIVE  
SUPPORT



502-2-33  
COVER, SWITCH TOWER

502-2-34  
PLATE,  
(2 REQ'D)

502-2-35  
MICRO SWITCH  
(2 REQ'D)

1725 RPM  
MOTOR

502-9-21  
COVER V-BELT  
CASE

502-9-23A  
V-BELT

502-9-22A  
STEP CONE  
SHEAVE

502-2-55  
KNOB, STOP  
ROD

MOTOR GEAR  
HOUSING ASS'Y  
REF.

502-9-32  
BEARING

502-9-28  
PINION  
HOUSING

MOTOR HOUSING

502-9-31  
CLAMPING HANDLE

502-9-27A  
LOCKING SHOE

502-9-27B  
STUD

502-9-24  
ADJ. PLATE

LOCK NUT

502-9-25  
SIDE COVER

502-9-20  
V-BELT CASE

502-9-22B  
STEP CONE  
SHEAVE

502-9-36  
END COVER

502-9-26  
REAR SUPPORT

502-9-34  
ANGLE  
LEFT SIDE

502-9-34A  
ANGLE  
RIGHT SIDE

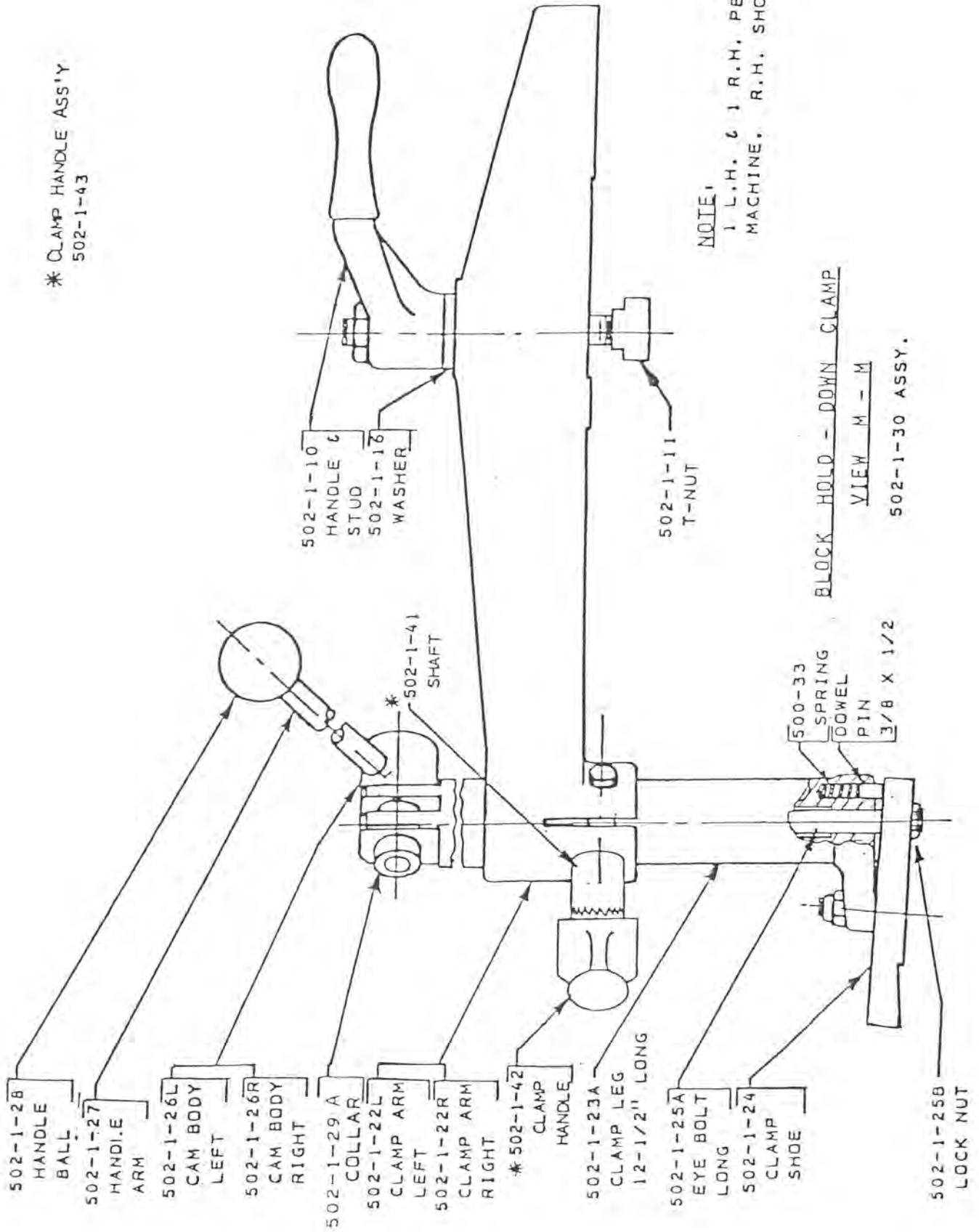
502-9-33  
SEAL

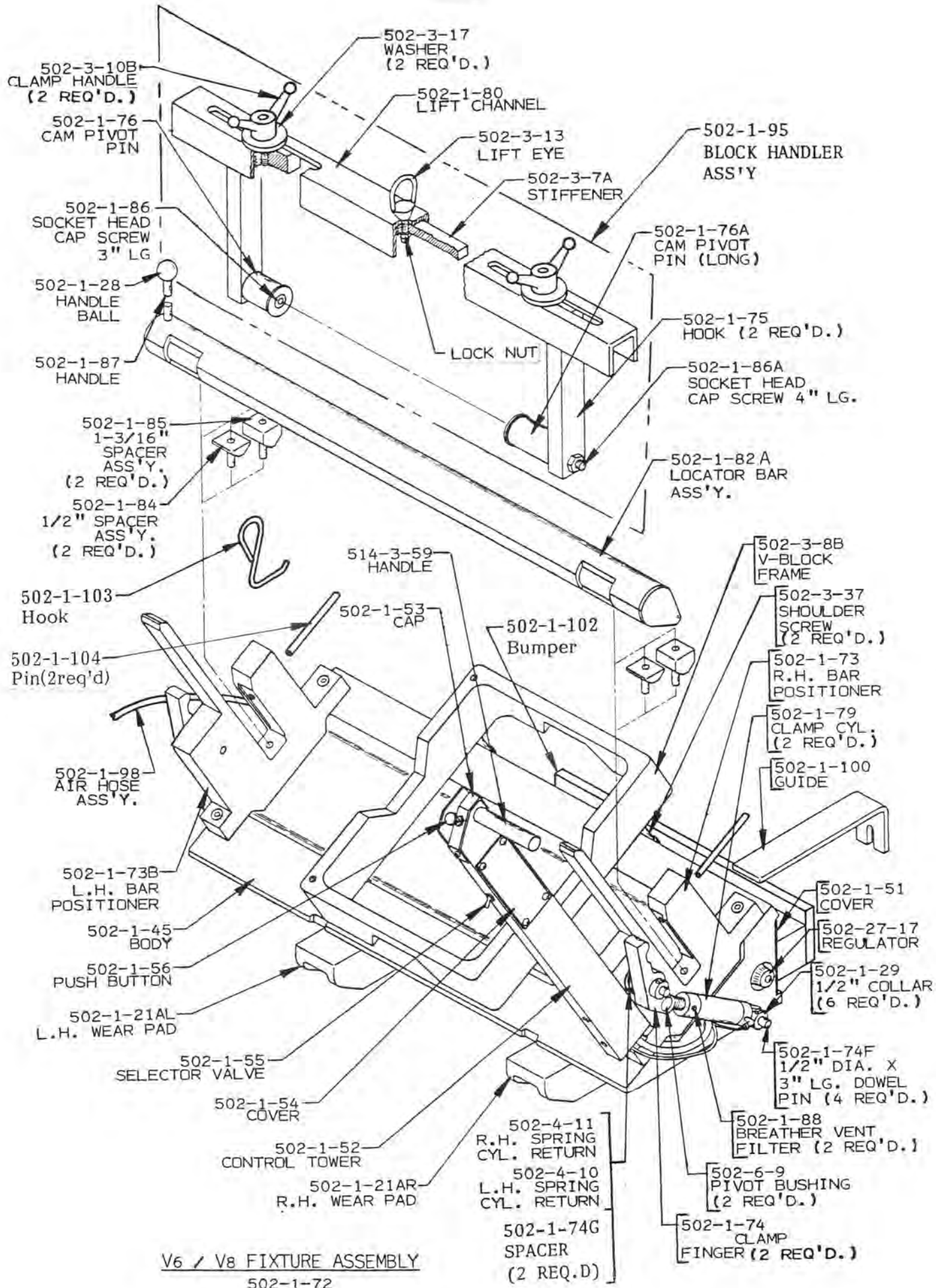
6FA-4B  
only

3 SPEED

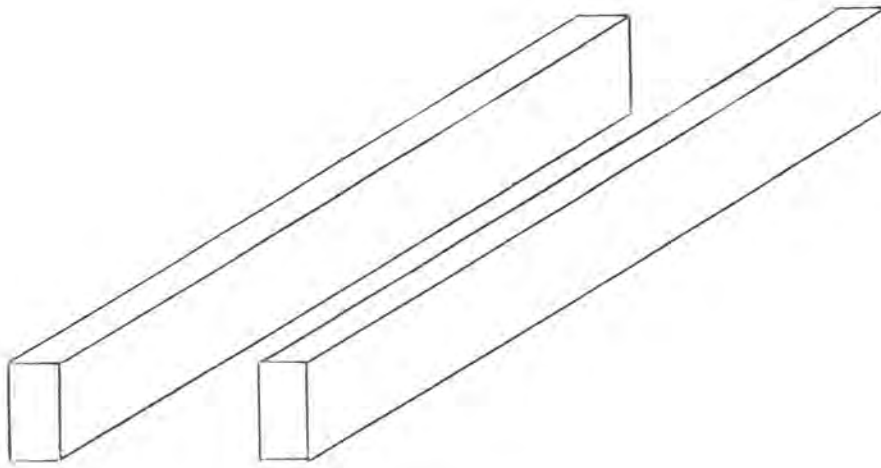
V-BELT CASE

\* CLAMP HANDLE ASS'Y  
502-1-43

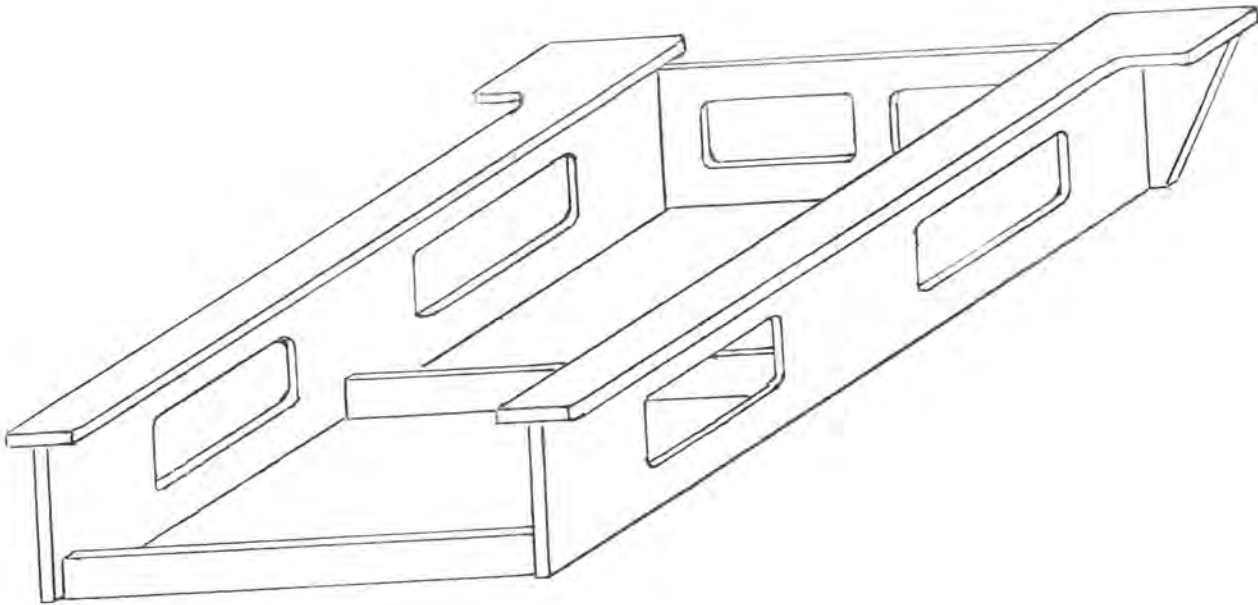




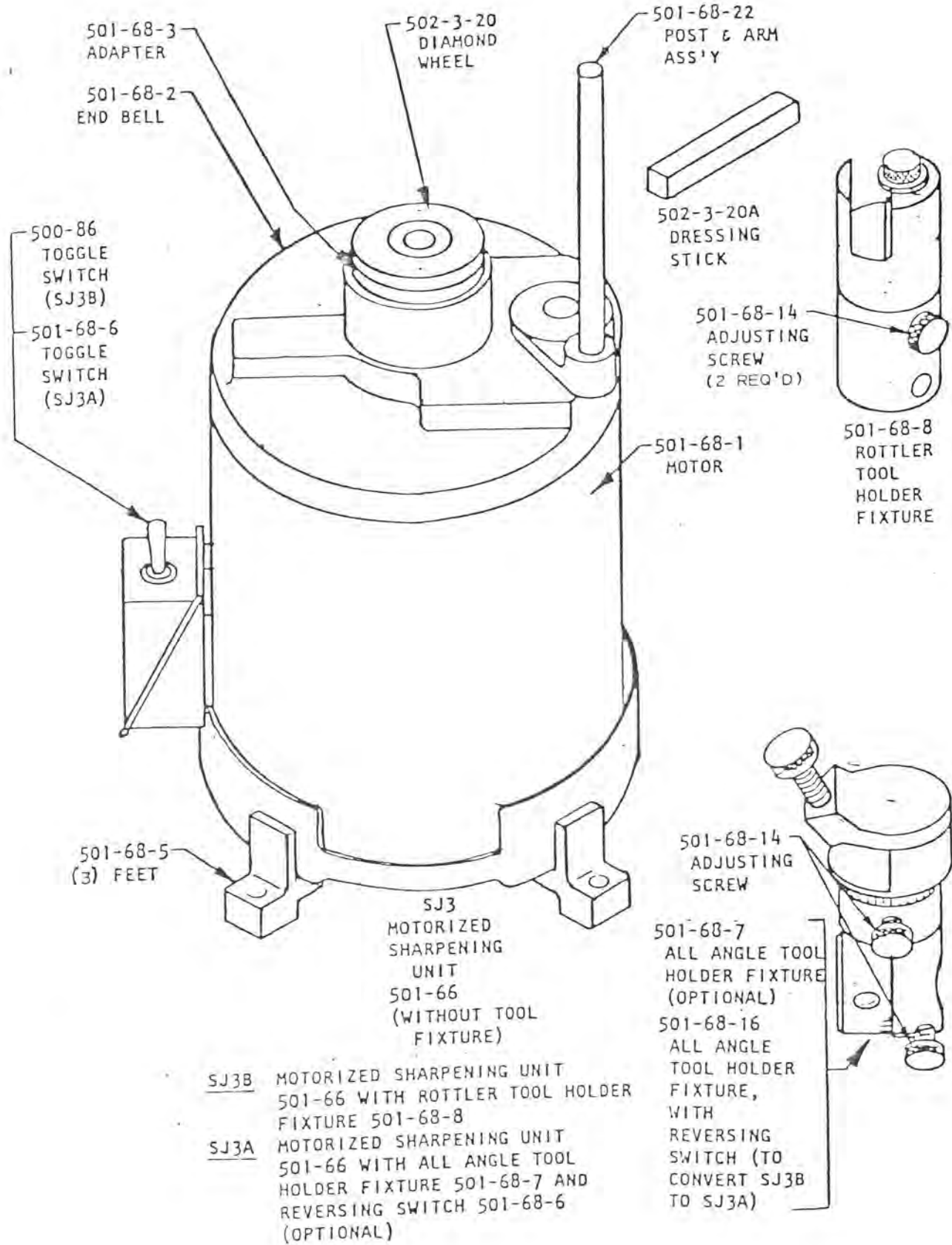




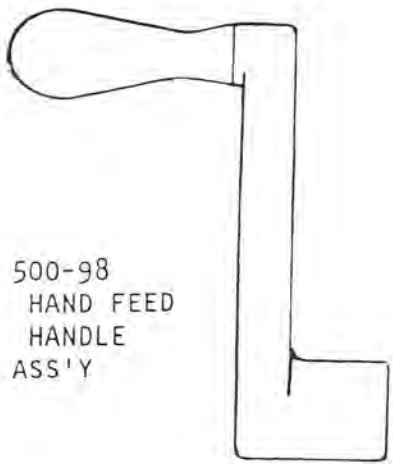
502-1-15C  
PARALLELS  
1 1/4" X 3"  
(MATCHED PAIR)



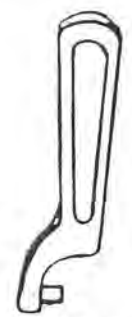
502-1-14B  
5" PARALLEL  
FIXTURE



SJ3 SHARPENING UNIT



500-98  
HAND FEED  
HANDLE  
ASS'Y



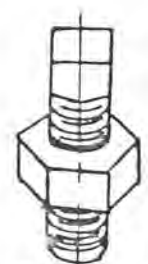
502-12-2  
SPANNER  
WRENCH  
(2 REQUIRED)



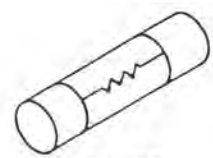
100-24  
TOOL  
PULLER



501-72  
(7/32) HEX  
DRIVER



502-1-12A  
JACKING  
SCREW &  
LOCK NUT  
(4 REQUIRED)

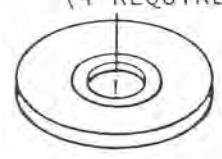


502-11-2F  
FUSETRON  
MDL 3/4

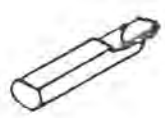


500-41  
LOCK NUT  
FEED SCREW

501-72A  
(5/32) HEX  
DRIVER



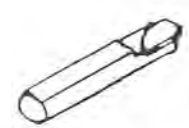
502-1-12  
LEVELING  
PAD  
(4 REQUIRED)



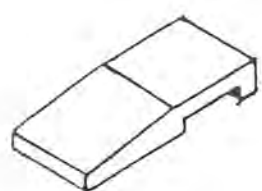
501-31-1  
TOOL BIT  
R8 (1")



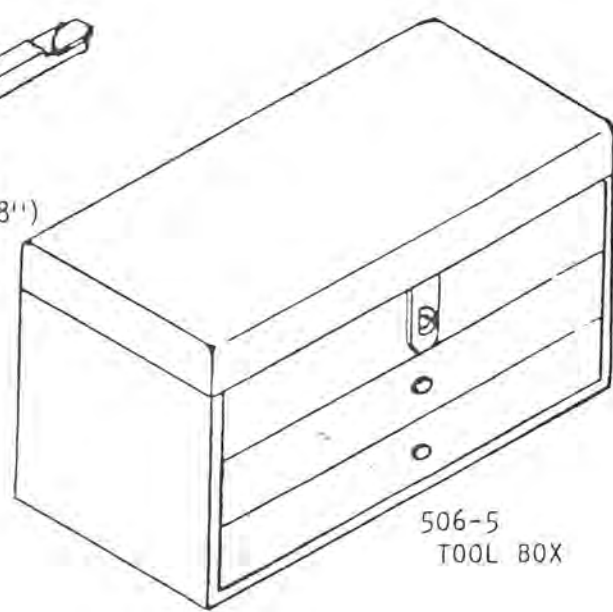
500-62  
KEY  
MICARTA-  
(VARIABLE  
DRIVE ONLY)



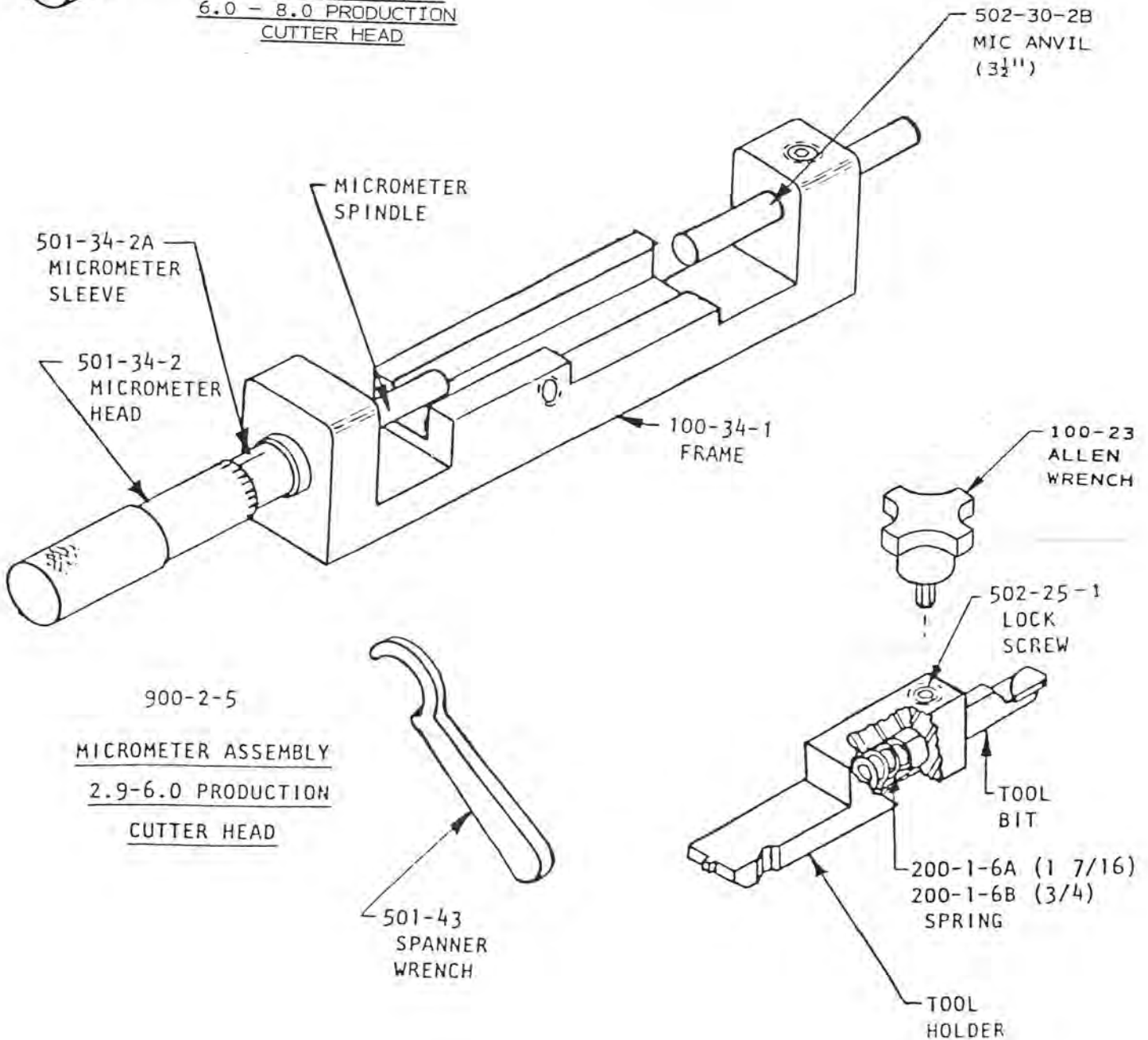
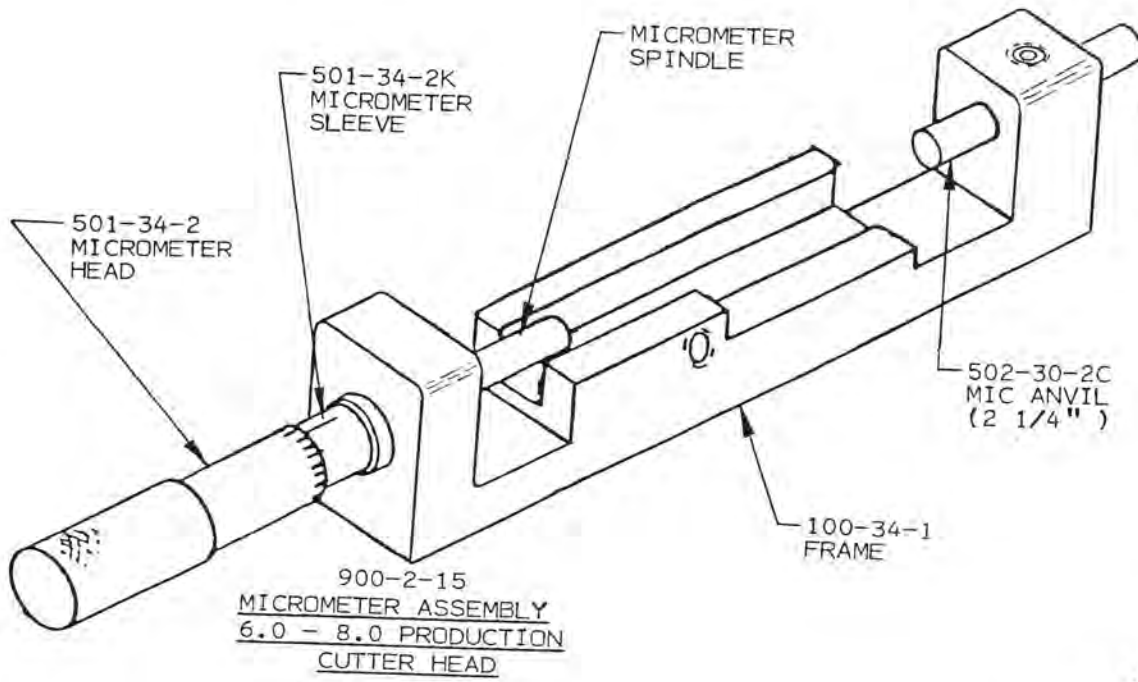
501-31-2  
TOOL BIT  
R3 (1-3/8")

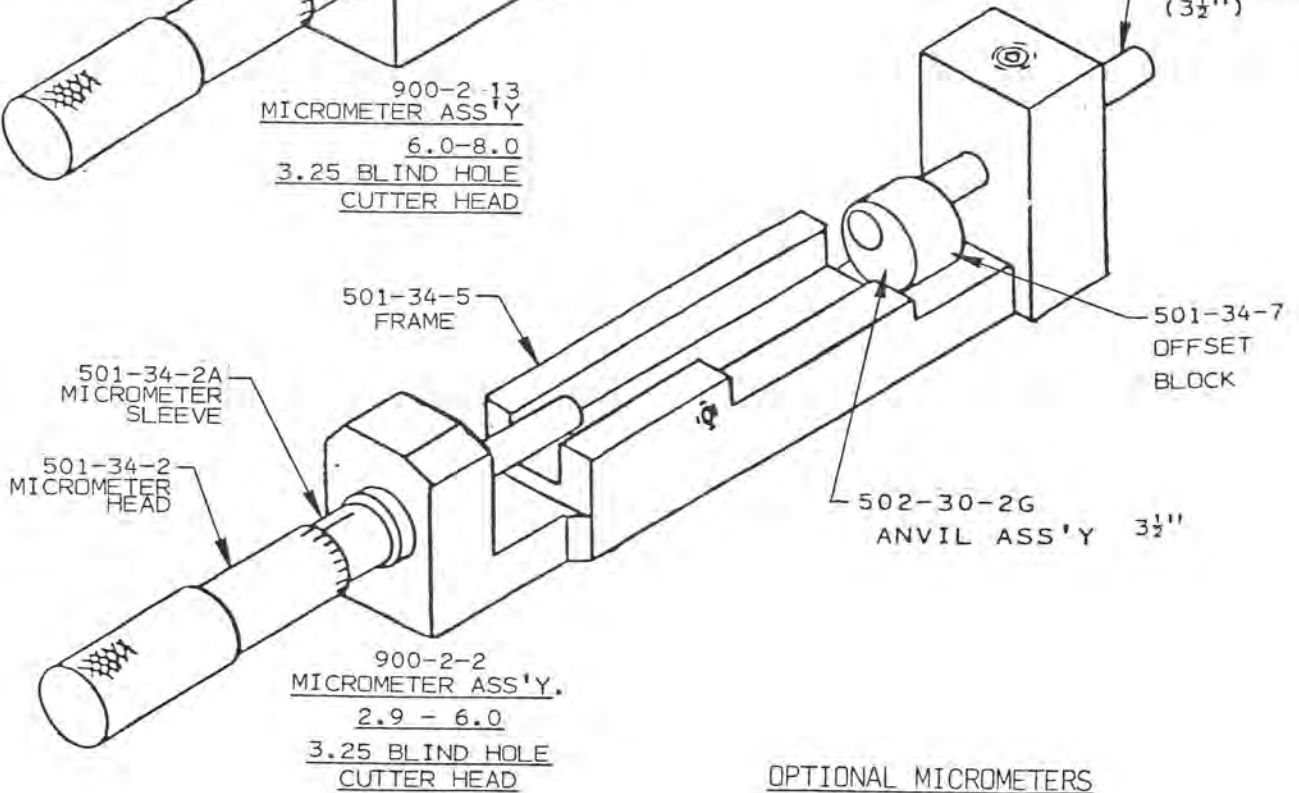
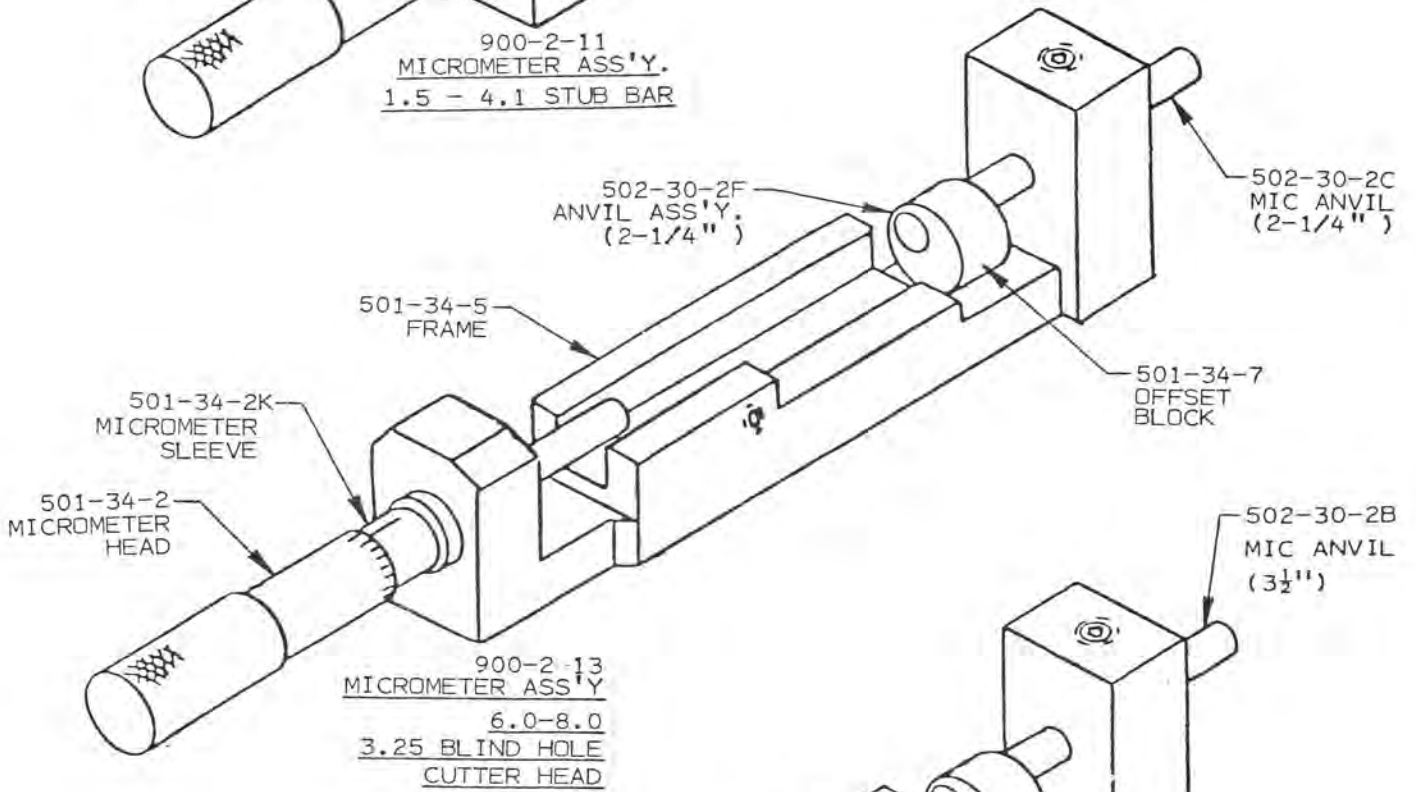
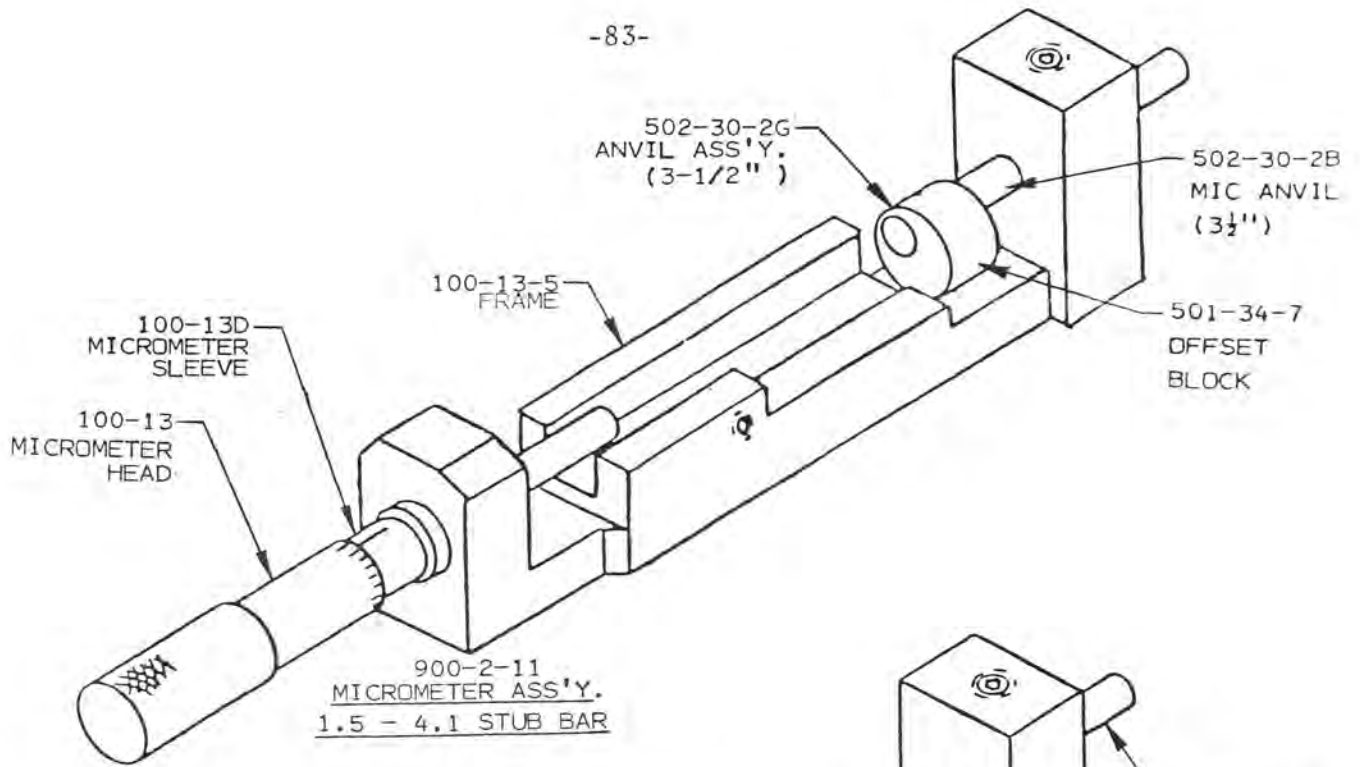


502-3-9  
OFF-ANGLE  
BLOCK ADAPTER  
(2 REQUIRED)  
OPTIONAL

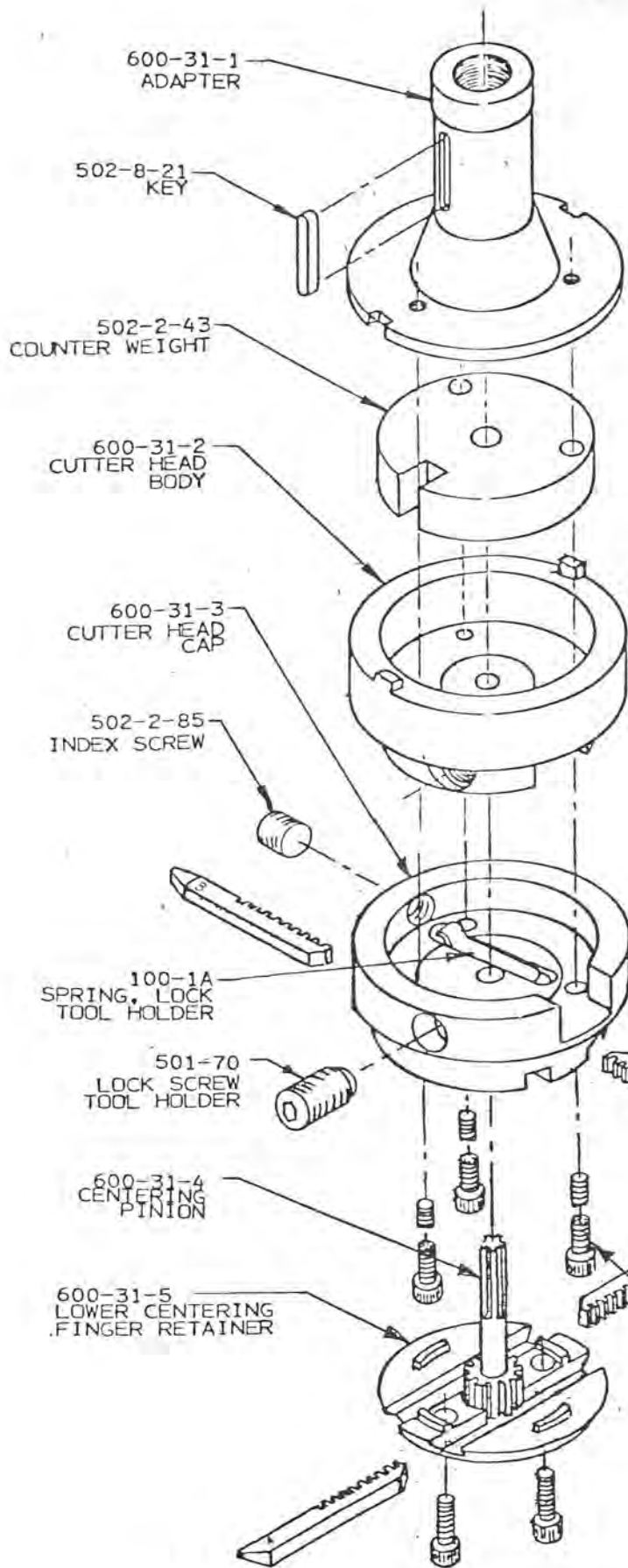


506-5  
TOOL BOX



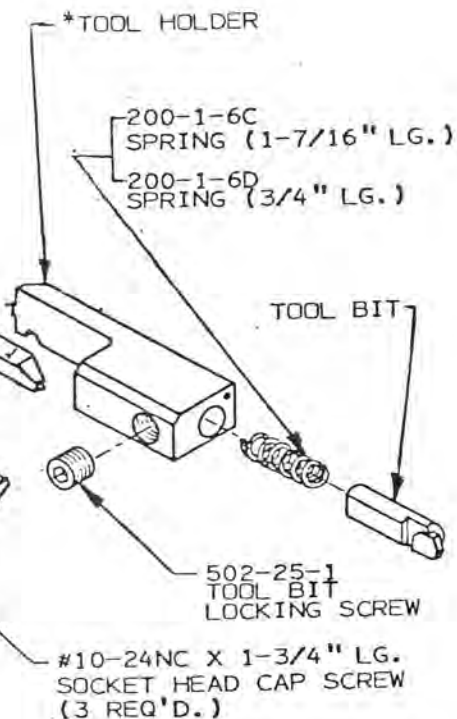


OPTIONAL MICROMETERS



* TOOL HOLDERS		
PART NO.	LG.	BORE RANGE (DIA.)
502-25C	2.250	2.875-3.625
502-25B	2.500	3.125-4.125
502-25A	2.875	3.875-5.000
502-25D	3.312	4.750-5.750
502-25E	3.750	5.625-6.625
502-25F	4.250	7.125-8.125

CENTERING FINGERS		
PART NO.	LG.	CENTERING DIA.
200-21-3B	2.105	2.875-4.062
200-21-1	3.062	3.125-6.000
200-21-2	4.125	5.000-8.250

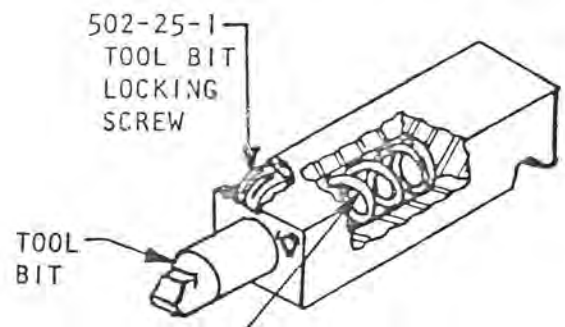


CAUTION: VERIFY STYLE OF PRODUCTION CUTTER HEAD BY MEASURING ITS OVERALL LENGTH. THE LENGTH OF THIS STYLE CUTTER HEAD SHOULD BE 4-15/16.

PRODUCTION CUTTER HEAD #2 ASS'Y.



NOTE:  
USE WITH  
MICROMETER  
ASSEMBLY  
900-2-2

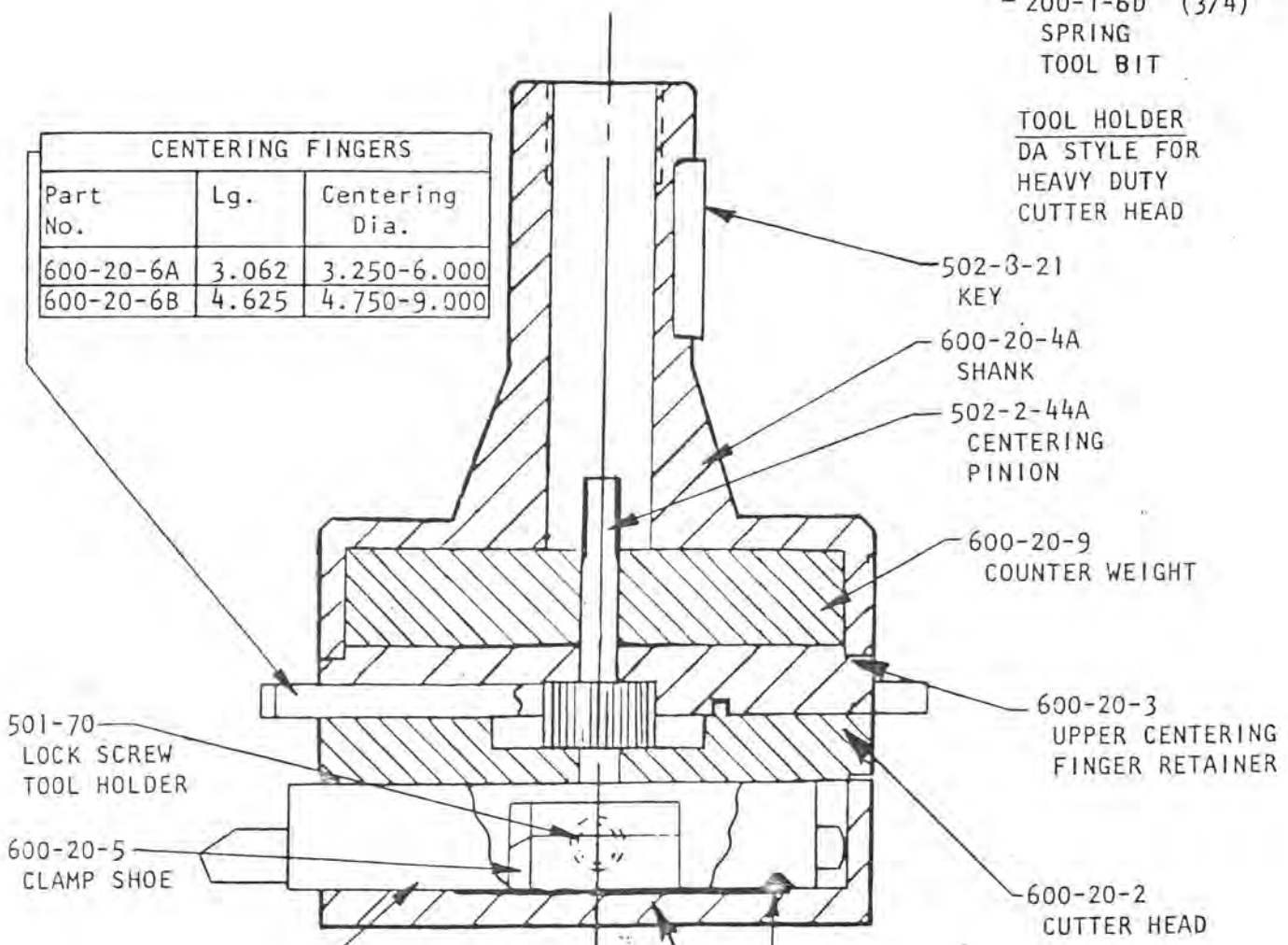


502-25-1  
TOOL BIT  
LOCKING  
SCREW

200-1-6C (1-7/16)  
200-1-6D (3/4)  
SPRING  
TOOL BIT

TOOL HOLDER  
DA STYLE FOR  
HEAVY DUTY  
CUTTER HEAD

CENTERING FINGERS		
Part No.	Lg.	Centering Dia.
600-20-6A	3.062	3.250-6.000
600-20-6B	4.625	4.750-9.000



502-3-21  
KEY

600-20-4A  
SHANK

502-2-44A  
CENTERING  
PINION

600-20-9  
COUNTER WEIGHT

600-20-3  
UPPER CENTERING  
FINGER RETAINER

600-20-2  
CUTTER HEAD

501-70  
LOCK SCREW  
TOOL HOLDER

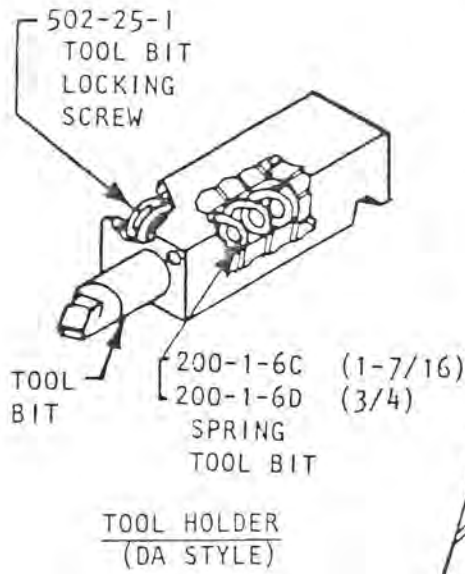
600-20-5  
CLAMP SHOE

100-1-A  
TOOL LOCK  
SPRING

600-20-1  
CUTTER HEAD CAP

TOOL HOLDERS		
Part No.	Lg.	Bore Range (Dia.)
600-20-7A	3.000	3.250-4.263
600-20-7B	3.562	4.250-5.312
600-20-7C	4.125	5.312-6.500
600-20-7D	4.688	6.500-7.562
600-20-7E	5.250	7.562-8.750
600-20-7F	5.812	8.750-9.875

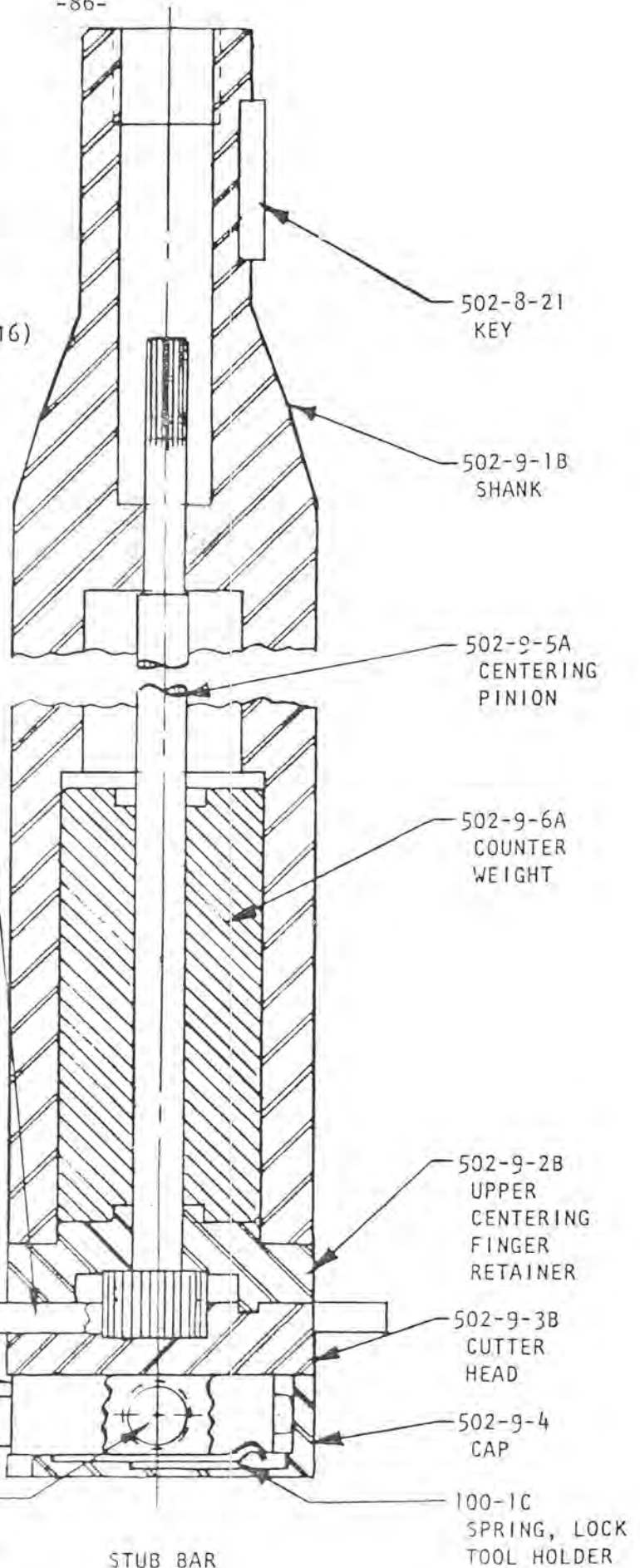
BLIND HOLE CUTTER HEAD ASS'Y.  
HEAVY DUTY 3 1/4 DIAMETER  
600-20  
(Optional)



NOTE:  
USE WITH  
MICROMETER  
ASSEMBLY  
900-2-11

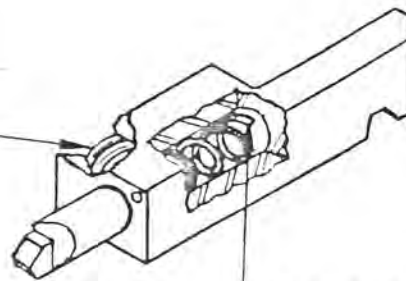
CENTERING FINGERS		
Part No.	Lg.	Centering Dia.
200-12	1.750	1.875-3.500
200-10	2.125	2.312-4.125

TOOL HOLDERS		
Part No.	Lg.	Bore Range (Dia.)
199-89	1.500	1.875-2.625
199-90	1.750	2.250-3.250
199-94	2.250	3.250-4.250



-87-

502-25-1  
TOOL BIT  
LOCKING  
SCREW



200-1-6C (1 <sup>7</sup>/<sub>16</sub>)

200-1-6D (3/4)

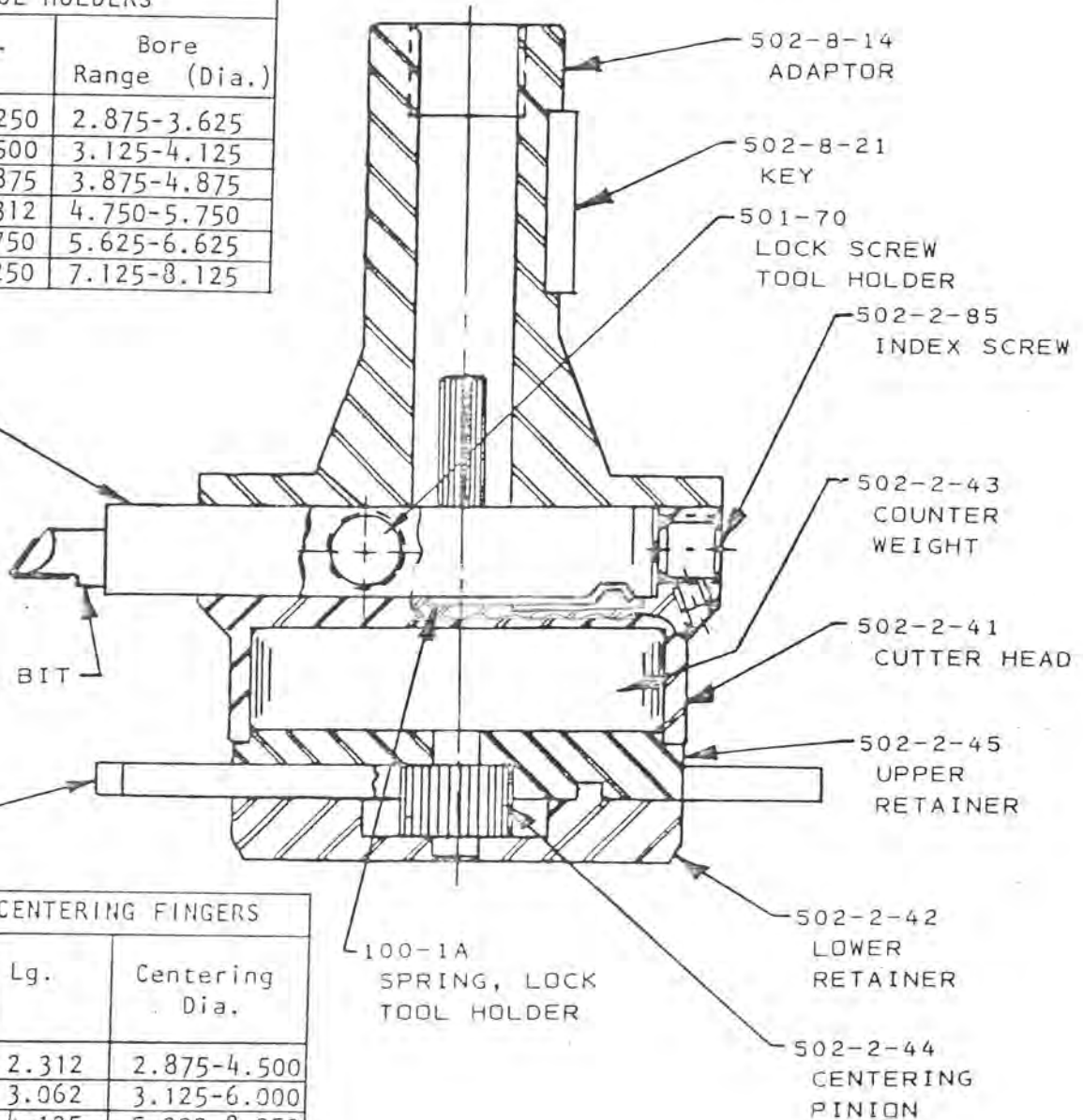
SPRING TOOL  
BIT

NOTE:

USE WITH MICROMETER  
ASSEMBLY  
900-2-5

TOOL HOLDER  
(FA STYLE)

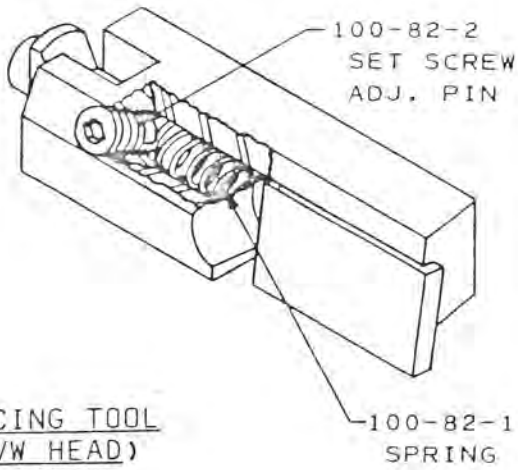
TOOL HOLDERS		
Part No.	Lg.	Bore Range (Dia.)
502-25C	2.250	2.875-3.625
502-25B	2.500	3.125-4.125
502-25A	2.875	3.875-4.875
502-25D	3.312	4.750-5.750
502-25E	3.750	5.625-6.625
502-25F	4.250	7.125-8.125



CENTERING FINGERS		
Part No.	Lg.	Centering Dia.
200-21-3	2.312	2.875-4.500
200-21-1	3.062	3.125-6.000
200-21-2	4.125	5.000-8.250

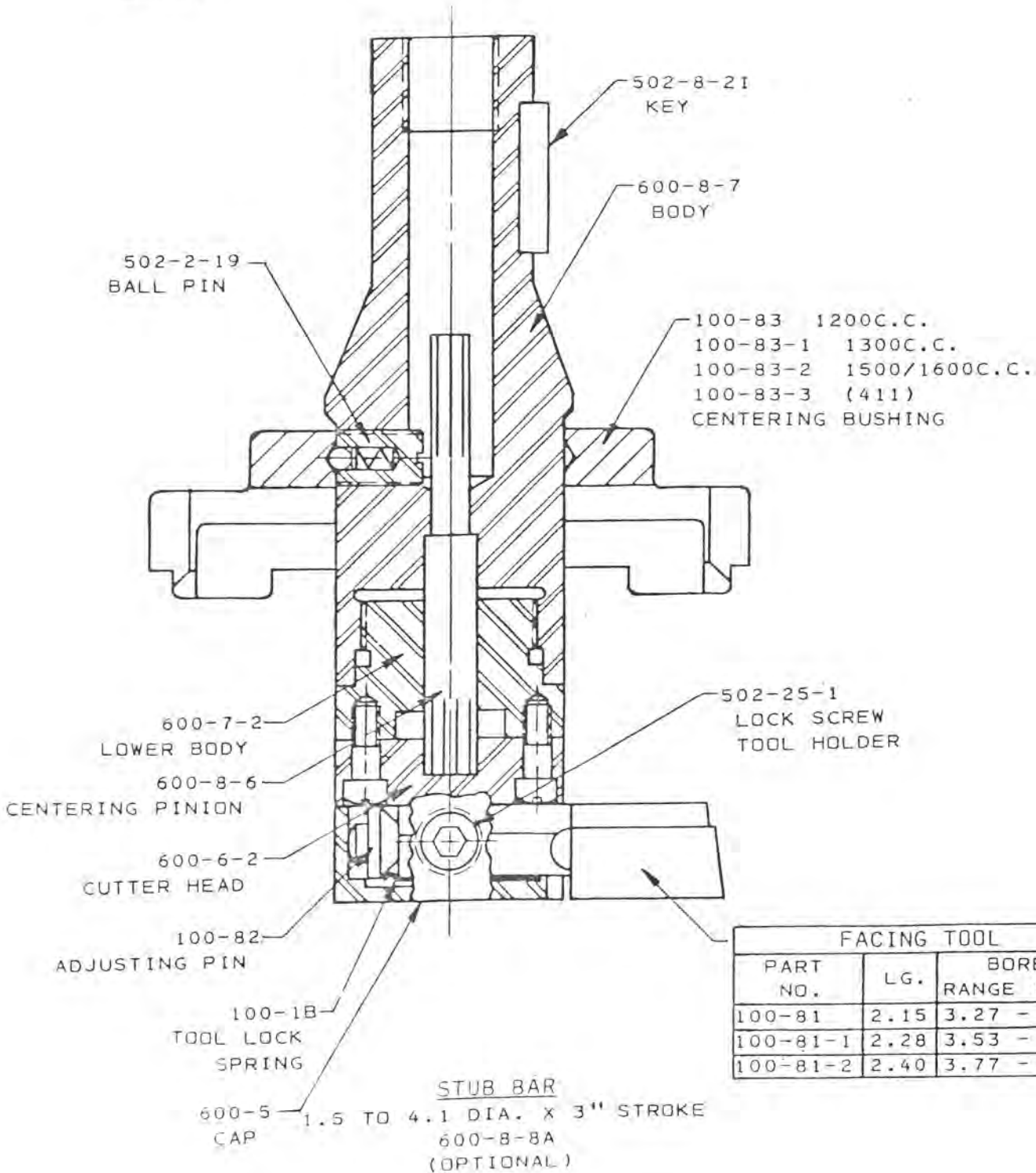
PRODUCTION CUTTER HEAD

600-8-4  
OLD STYLE

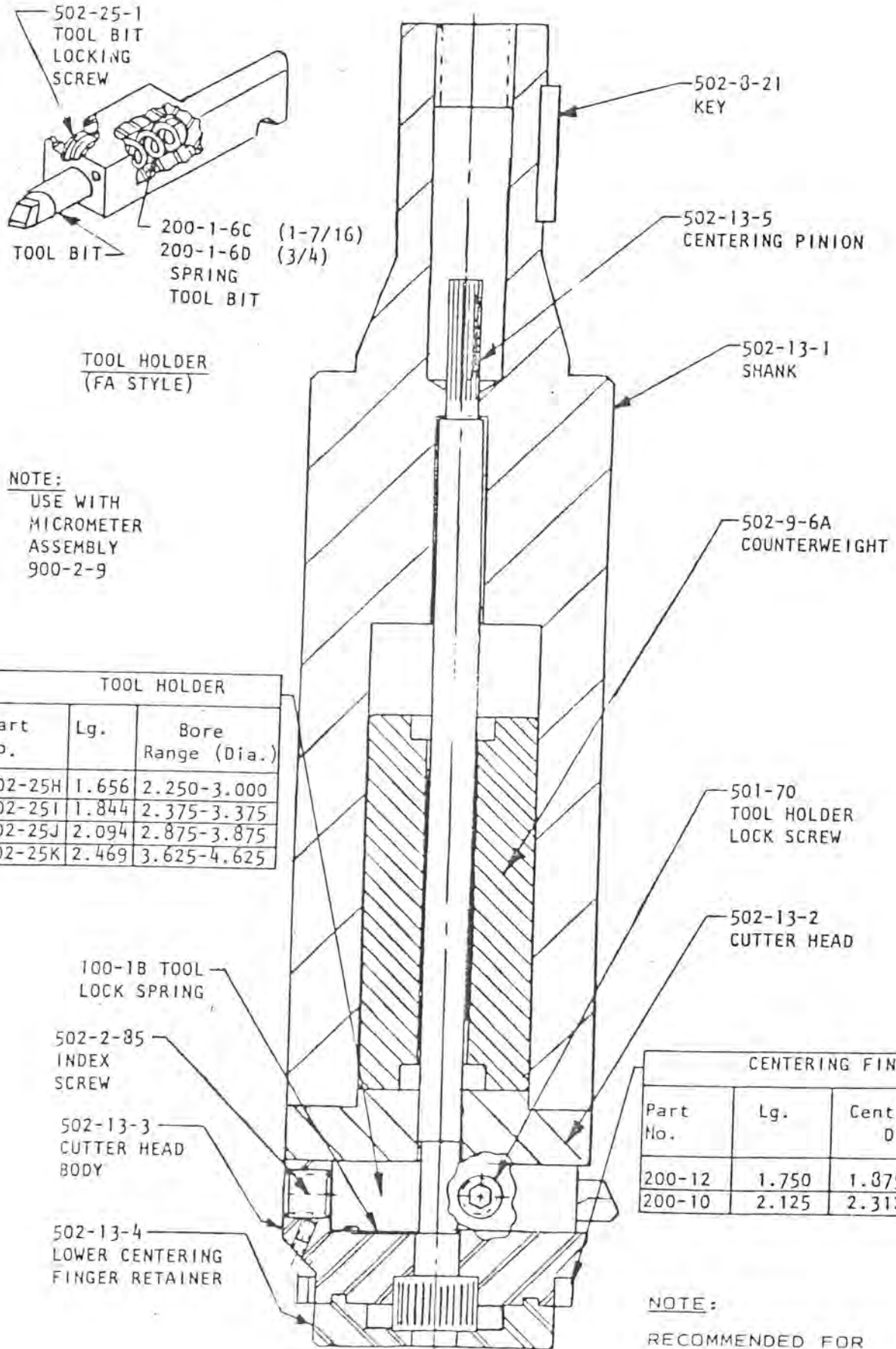


FACING TOOL  
(VW HEAD)  
ASS'Y.

NOTE:  
USE WITH MICROMETER  
ASSEMBLY 900-2-11



FACING TOOL		
PART NO.	LG.	BORE RANGE (DIA.)
100-81	2.15	3.27 - 3.53
100-81-1	2.28	3.53 - 3.77
100-81-2	2.40	3.77 - 4.02



NOTE:  
USE WITH  
MICROMETER  
ASSEMBLY  
900-2-9

TOOL HOLDER		
Part No.	Lg.	Bore Range (Dia.)
502-25H	1.656	2.250-3.000
502-25I	1.844	2.375-3.375
502-25J	2.094	2.875-3.875
502-25K	2.469	3.625-4.625



















CENTERING FINGERS		
Part No.	Lg.	Centering Dia.
200-12	1.750	1.875-3.500
200-10	2.125	2.312-4.125

NOTE:  
RECOMMENDED FOR  
EFFICIENT PRODUCTION  
ON V-6 MUSTANG & CAPRI

PRODUCTION STUB BAR ASSY.  
502-13  
2.23 to 4.1 DIA. X 6 LG.  
(OPTIONAL)

TOOL BITS


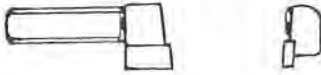


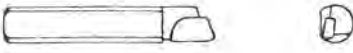

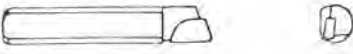

FA-4VB

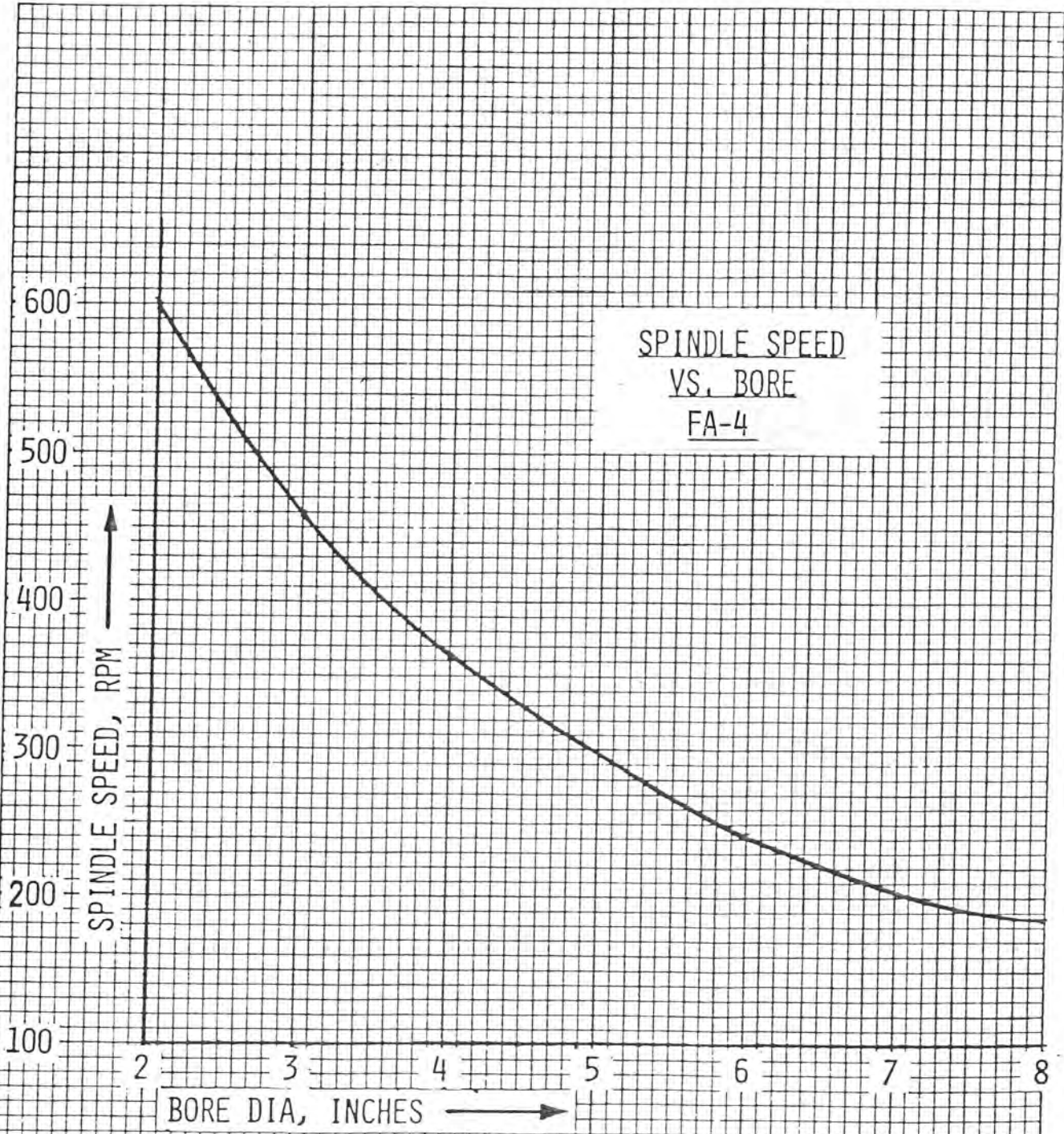
PART NUMBER		DESCRIPTION
501-31A		 C.C.B. CUMMINS COUNTER BORING TOOL BIT FOR COUNTERBORING OF CUMMINS DIESEL CYLINDER BLOCK
501-32-3		 .037 GROOVING TOOL BIT
501-32-1		 .048 GROOVING TOOL BIT
501-32-2		 .072 GROOVING TOOL BIT
501-32-4		 .152 GROOVING TOOL BIT
501-33B		 15° CUMMINS CHAMFER TOOL BIT (CHAMFERING CUMMINS BLOCKS)
501-33D		 30° CHAMFER TOOL BIT (FOR GENERAL PURPOSE CHAMFERING CAST IRON)
501-33-1		 R8 (12° RAKE) LONG ROUGHING CUT
501-33-2		 R1-VEGA (12° RAKE)



TOOL BITS

FA-4VB

PART NUMBER	DESCRIPTION
100-29	<u>OFFSET TOOL BIT</u> (FOR BORING BLIND CYLINDER HOLES)
	
100-76	<u>OFFSET TOOL BIT</u> (FOR BORING BLIND CYLINDER HOLES)
	
501-28	<u>C.C. STEEL CUTTING TOOL BIT w/CHIP</u> <u>CURLER TO BREAK UP CHIPS WHILE BORING</u>
	
501-29A	<u>R.F. FACING &amp; COUNTERBORING TOOL BIT</u> FOR FACING & COUNTERBORING OF CYLINDER BLOCK, FOR CUTTING OFF SLEEVE.
	
501-30-2	<u>R1 CARBIDE TOOL BIT, LONG 1 3/8"</u> (FOR HIGH SPEED FINISHING) (RECOMMENDED FOR NON-INTERRUPTED CUT)
	
501-30-1	<u>R1 CARBIDE TOOL BIT, SHORT 1"</u>
	
501-31-2	<u>R8 CARBIDE TOOL BIT, 1 3/8" LONG</u> (FOR GENERAL PURPOSE & HEAVY CUTS, CAST IRON). (RECOMMENDED FOR INTERRUPTED CUTS).
	
501-31-1	<u>R8 CARBIDE TOOL BIT, 1" SHORT</u>
	



SPINDLE SPEED  
VS. BORE  
FA-4

NOTE:

SPINDLE SPEEDS SHOWN WILL YIELD BEST RESULTS  
FOR NORMAL CUTS ON CAST IRON.

USE 2/3 SPEED FOR HEAVY CUTS.

USE 1/4 SPEED FOR HARD MATERIAL (RC 35-50,  
BHN 327-475).