

ROTTLER MANUFACTURING

**FA-1, FA-2, FA-1B,
FA-2B, FA-1A, FA-2A,
FA-1AB, FA-2AB, FA-2MA,
FA-2MAB, FA-2MAC,
FA-2MACB, FA-24-MAB**

BORING MACHINE

MACHINE SERIAL NUMBER

OPERATIONS AND MAINTENANCE
MANUAL

MANUFACTURED BY:



ROTTLER MANUFACTURING COMPANY
8029 South 200th Street
Kent Washington 98032, USA

Phone: (253) 872-7050
Fax: (253) 395-0230

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 boring machine is a precision, single point tool, boring unit. It is equipped with tooling and accessories for reboring most American passenger car and truck engines, both in-line, 90° and 60° V types. FA-B machines may be readily tooled to rebore a wide variety of engines including European and Asian engines as well as perform a wider variety of boring operations.

This machine is designed for two purposes:

- (1) The alignment of cylinder bores relative to the pan rails and main bearing locations, as have 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.

Change over 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.

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 230-460 volt, 3 phase, totally enclosed motor with an outboard fan. A quick change lever selects two spindle speeds. 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.

G U A R A N T E E

LIMITED

Rottler Manufacturing Company Model FA 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.

I M P O R T A N T

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 to get good bore results, be alert to the light pressure required for sharpening.

CAUTION: Exposed diamond wheel is a potential hazard to your hands, fingers, and face. NOTE - Eye protection is a necessity 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: Periodically check this lever to make sure that the upper lever position will lock out the spindle clutch when the detent is engaged. 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.

Periodiacally check lift components for damage that may cause failure of Block Handler Assembly. 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.

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.

E M E R G E N C Y P R O C E D U R E

Assuming one of the following has ocured - 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 fingers 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 severly 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 easily to and from other operations in your shop.

The proper loading arrangement and area location for your FA machine is extremely important. A slow travel (6' to 10' min.) power hoist, operated from either a bridge crane or a jib crane arrangement works very satisfactorily. A 1000-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 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 machine, being careful not to use force on any of the spindle unit. This is particularly true of the square tube containing the micro switches on the back of the machine.

Remove the SV4 sharpening fixture from the deck and preferably place at a bench area close to the machine. This fixture will require 115 volt single phase AC current. If it is necessary to mount this fixture on the FA 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 time of shipment, and any of this inhibitor left on the machine will result in considerable collecting of cast iron dirt and possible slipping of the 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.

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 sheet metal cover, #502-2-13 on the lower 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 now, 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.

NOTE: AIR SUPPLY IN "F" SERIES MACHINES

It is very important 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 motor nameplate on the side of the motor. If comparable, 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. 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 230-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 enclosure.

Machine Set-up con't

If the 460-volt current is used, reconnect the terminals on the transformer (502-11-2) as shown.

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 51, 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 sheet metal cover on the 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 counter-clockwise, 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. Shift the spindle speed lever back into the slow speed.

C O N T R O L S

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 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 the 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 microswitch, or up button is pressed.

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

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, con't

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 microswitch 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 when 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 loaded stop and can be over-ridden). It is positioned to stop the spindle with the tool directly facing the operator.

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, or being jogged. DO NOT SHIFT WHEN BORING. This control is often used in positioning the spindle to secure instant higher or lower rapid travel.

Controls con't

8 - CENTERING KNOB

The centering knob (upper knob) at the top of the upper spindle housing, operated the centering fingers when turned clockwise. Be careful not to over-extend these fingers when the spindle is not in the cylinder or they 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.

9 - 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.

10 - 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 manually lifting and holding it in neutral or middle position or by use of its adjusting screw. To turn on machine when the feed lever is in neutral, press the feed button. Automatic feed will not operate.

11 - 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.

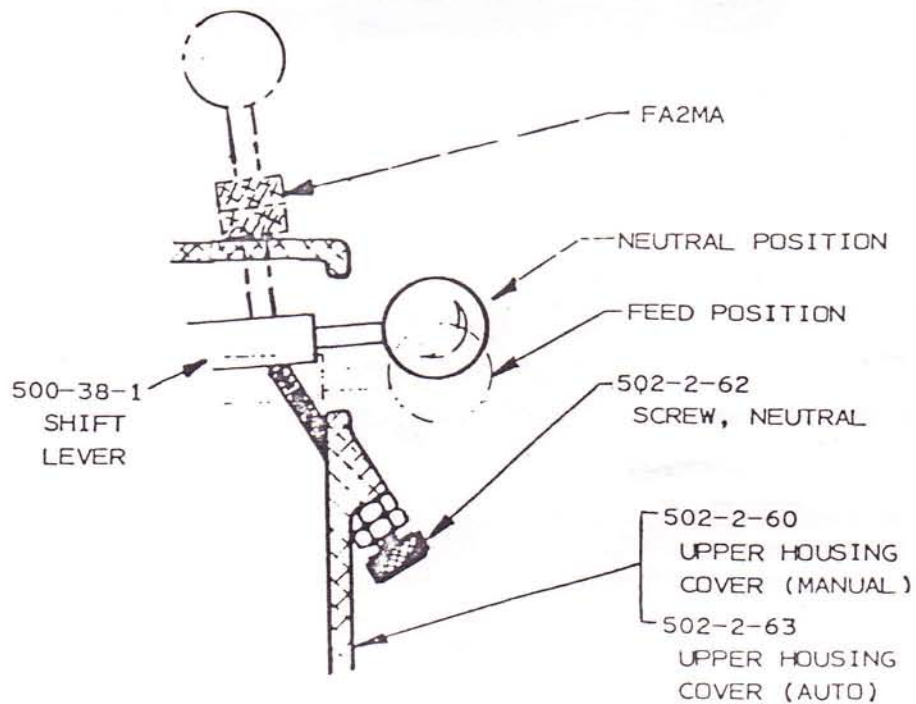
CAUTION: The automatic feed lever must be disengaged when operating this short hand feed. To disengage feed lever, raise knob and hold in the middle or neutral position or use adjusting screw to hold it in neutral position. All controls, excepting the automatic feed will operate with the neutral screw engaged (feed button turn on machine).

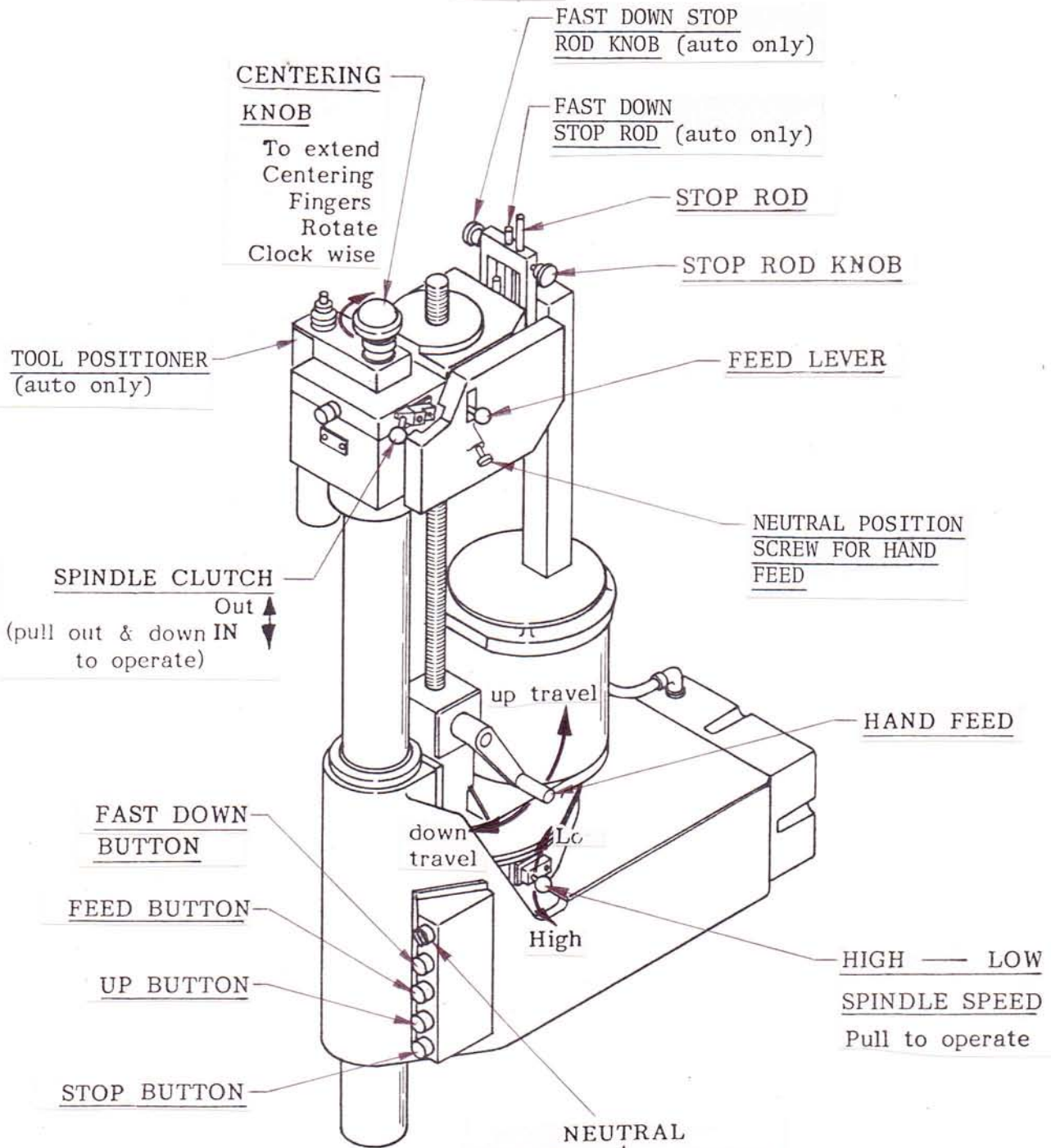
The standard procedure to operate the hand feed is to power travel close to the feeding point, press feed button, engage spindle clutch, operate the hand feed, (holding the feed lever where required), and then return first the hand feed, and then the power feed to the top.

NEUTRAL POSITION FOR HAND FEED

This machine is provided with an adjusting screw which is preset at the factory, to hold the shift lever (500-38-1) in neutral position when using the hand feed. The screw is inserted in the upper housing cover (502-2-60) as shown.

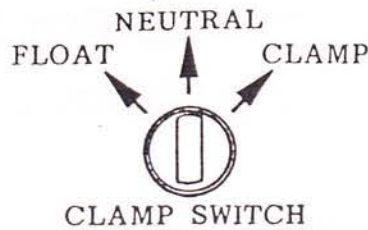
When the machine is held in neutral, all controls will operate as usual, with the exception of the automatic power feed.





CAUTION:
 Disengage spindle
 Clutch and stop
 Motor before
 Placing hands near
 The cutter head.

NOTE: Automatic
 FA machine shown
 here. Manual FA
 controls are the
 same except where
 noted (auto only).



CONTROLS

A U T O M A T I C M A C H I N E O N L Y

A U T O M A T I C F A S T D O W N S T O P

The purpose of the stop is to allow the operator to rapid travel the spindle down, without requiring strict attention to accurately stop the travel at the proper height for centering.

The stop consists of an added limit switch (FDLS) and mating adjustable stop rod. The rod is the middle stop rod (502-2-56) on the back of the upper housing and is adjusted to stop the spindle automatically when the middle limit switch is contacted.

The spindle down travel is started by depressing the FAST DOWN button and stopped by either releasing the button or allowing the automatic stop to actuate. To rapid down travel past the automatic stop, it is necessary to depress the feed button and "feed" the stop rod past the switch.

A U T O M A T I C M A C H I N E O N L Y

A U T O M A T I C S P I N D L E R A P I D R E T U R N

The purpose of this device is to completely eliminate the operator attention required to disengage the spindle clutch and return the spindle to the top of its travel.

The automatic return consists of a double pole, double throw lower limit switch (502-2-36); an air cylinder (502-2-59D) to disengage the spindle clutch; and air operated cylinder and cam mechanism to rotate the spindle to the return position (tool bit facing the operator); two time delay valves, in the control panel, control and time the air operation. A toggle switch on the side of the control panel select automatic or manual operation.

NOTE: Automatic FA machines prior to serial number 2188 utilize a time delay and sequence valve in the control panel to time the air operation. Machines after serial number 2188 utilize a time delay in the panel and series-type air cylinder on the upper housing to time the air operation. Machines after serial number 2229 utilize two time delay valves to provide a neutral dwell before automatic retraction.

The automatic spindle rapid return is operated with the toggle switch in the "auto" position. When the stop rod contacts the limit switch (502-2-36), the spindle clutch is first disengaged, then the spindle is rotated to the return position, and the spindle is returned to the top of its travel. With the toggle switch in the manual position the machine shuts off when the limit switch is contacted and is returned to the top of its travel by depressing the Up button.

NOTE: Machines after serial number 2188 are equipped with a lower safety-limit switch to protect the machine spindle from damage in the event of failure of air or electrical components in the panel or on the machine.

Automatic Spindle Rapid Return con't

The following caution note and following paragraph apply only to automatic FA machines before September 6, 1967, or serial number 2229.

CAUTION: When the Up button is depressed or the lower limit actuated, the time required to disengage the spindle clutch and rotate the spindle to the return position permits the spindle to feed down approximately 1/16" from the time the clutch is disengaged until the spindle starts its up travel. Therefore, neither the Up button should be depressed nor the lower limit contacted while the machine is cutting (including interrupted continuation of cut at bottom of cylinder) or when it is within 1/16" of beginning to bore unless the feed lever is manually lifted into the neutral position.

When you are test cutting at the top of a bore to check size or terminating a bore at a shoulder, such as required at the bottom of a bore for a sleeve stop, the feed lever must be lifted to the neutral position first and then the Up button depressed.

- B T Y P E C U T T E R H E A D S

ALTERNATE CUTTER HEAD ARRANGEMENTS

Your FA-B 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 600-8-4H or G

The production cutter head with a standard bore capacity of 2.875" to 6" (FA-2MAB 2.875 to 5) may be quickly attached to the FA-B machine by use of the draw bolt.

It is used in the FA-B 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 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 HOLD CUTTER HEAD (OPTIONAL) 600-8-5

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 which requires the same maintenance as a production cutter head.

1.5" (38mm) STUB BORING BAR (OPTIONAL) 600-2

This stub boring head with a capacity of 1.5" to 4.1" (38mm to 104mm) diameter x 6.5" (165mm) depth, may be quickly attached to the FA-B 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.

-B Type Cutter Heads, con't

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 1.5" to 2.625" bore diameter range and the larger a 2.625" to 4.1" diameter bore range.

If centering fingers require dressing after a period of use, apply the same lapping procedure noted on page 33 and 34. The micrometer may also be periodically calibrated as noted on page 34.

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

I M P O R T A N T G E N E R A L I N F O R M A T I O N
F O R T H E B E S T U S E O F
T H E M O D E L 1.5 S T U B B O R I N G T O O L I N G

CAUTION: Inner Spindle Adjustment (see page 41) 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 .3810mm) 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 a .040" (1.016mm) (on diameter) cut, a second pass of the tool will remove close to .001" (.0254mm) 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" (.01778mm). 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 #600-8-2. 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 disassemble 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.

CAUTION: It is very important that after inserting tool holder into the stub boring cutter head and pushing it firmly back to its indexing point, that you remove all finger pressure from the tool holder and tool bit, before locking it with its locking set screw. This is especially important when using the offset blind hole tool bit. Failure to follow the above instruction will result in size variation.

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 600-2 cutter head. It is designed especially to be used with the production full width single cut VW head facing tool. It can also be used for general purpose boring where a rigid stub boring head is required.

If you already have a 600-2 stub cutter head, you may use its tooling for this head.

NOTE: When this cutter head is used for VW head facing, cutter head will require centering bushings and wide facing cutting tools, which are sold separately. See page 87 for sizes.

VW HEAD FACING INSTRUCTION

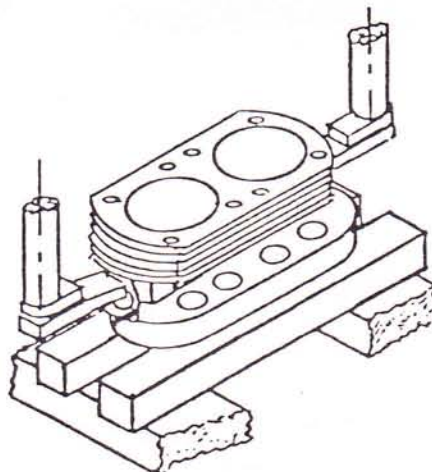
Install 600-8-8A Stub Boring Head. Select the size of centering bushing you require for the size head you are finishing. Place it over the stub bar, raising it up until it engages the ball detent to hold it in its park position. Set a facing tool that is in the range you require. Set by loosening adjusting 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.



VW Head Facing Instruction con't

Shift spindle speed to low -- "all operations to be in low 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.

Now using the hand feed and dial depth indicator assembly, 503-14B, 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.

O P E R A T I N G I N S T R U C T I O N S

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" parallel fixture, 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 opposed to cleaning the top of the cylinder block for a portable bar.) You will find that some blocks will rock on parallel fixture 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.

You will note that the parallel fixture is designed with an "L" shape. The purpose of this is to extend the back portion of the "L" outboard to prevent cylinder blocks from rocking when first clamp is applied.

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

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

Operating Instructions con't.

Micrometer

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. Press fast-down 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" button and press "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 clock-wise 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.

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 into neutral position, disengage spindle clutch, push up button. Allow the machine to return to its full up position. Check bore diameter, adjust if necessary and re-insert tool,

Operating Instructios con't
Centering with Centering Fingers

rapid travel down to job again; engage spindle clutch and press feed button. Do not unclamp 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.

After feed has stopped, lift spindle clutch lever, turn lower spindle knob, (600-18-2) clock-wise until detent is contacted, press the up button to return the spindle to the top.

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).

A I R V6/V8 C O M B I N A T I O N F I X T U R E

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 at elevated position. Remove only for largest V8 blocks and/or large in-lines.

The Model 502-1-72 V6/V8 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. Care must be taken to assure the side contact edge of the locator bar is above the cap split surface. split surface.

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 of 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.

CAUTION: Extreme care must be taken by operator whenever handling large blocks. Large blocks may cause fixture to tip when floated too far outward. We recommend leaving hoist attached when moving these blocks.

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.

AIR V6/V8 COMBINATION FIXTURE Cont'd

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 outwards as you lower it.

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. There is a guide block (502-1-105) attached to the right hand 90° air float pad to aid in guiding fixture along 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° 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.

Use lift hook 502-1-103 to lift V6/V8 fixture from 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.

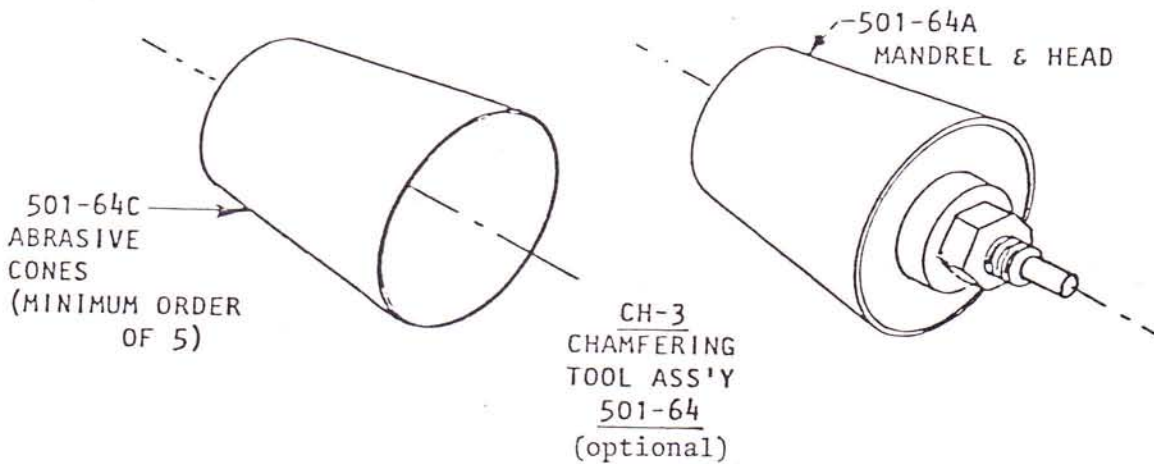
BORING LARGE TRUCK BLOCK

The FA 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 (502-1-21) and place the block directly on the main base (502-1-20). The blocks are then bored according to the instructions.

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 when 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.

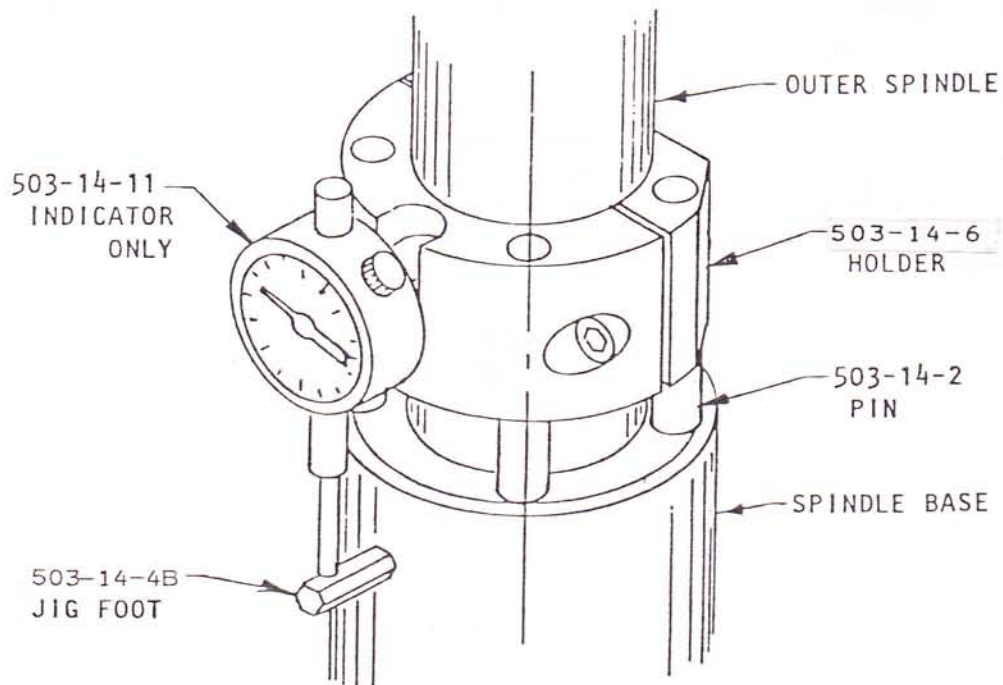
UPPER AND LOWER DECK REPAIR OF DIESEL CYLINDER BLOCKS

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, 503-14B.



503-14B
DEPTH DIAL INDICATOR
(optional)

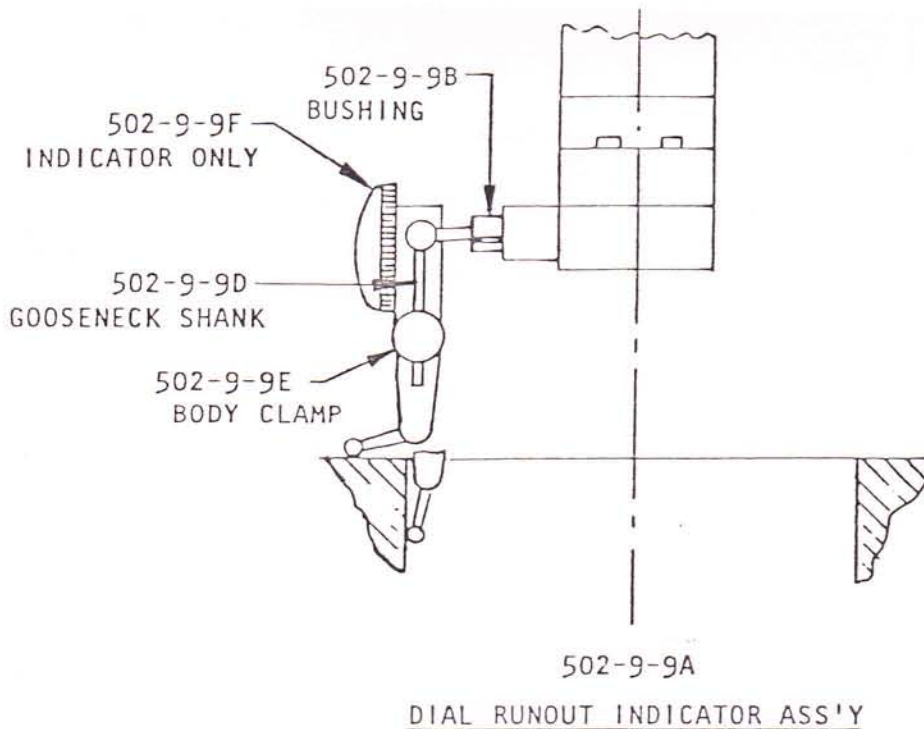
Counterboring con't

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 "zero" 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.

INSTRUCTIONS FOR USE OF OPTIONAL
MECHANICAL DIAL RUNOUT INDICATOR (#502-9-9A)



The #502-9-9A mechanical dial runout indicator may be used for checking and if necessary correcting the centering or bore concentricity. It may also be used for checking face squareness of the work piece to the boring spindle.

The principal use in checking centering will be for engines requiring an absolute minimum oversize, particularly when irregular wear and score areas can be found.

To use the indicator, simply place the gooseneck shank in the split bushing provided and insert in the appropriate size tool holder. The indicator may be used on any style of cutter head.

Center the spindle by normal use of the centering fingers.

Turn float clamp switch to neutral or straight up position.

Now raise the spindle out of the bore and insert the indicator. Make sure the indicator lever is set properly so the dial will travel in the right direction.

Lower the spindle and adjust the indicator mount with either gooseneck, or tool holder lock screw so the probe makes contact.

Turn the spindle, and the indicator now will read the total runout. This will be exactly double the distance the spindle is out of center.

Instructions for Use of Optional Mechanical Dial
Runout Indicator con't

To clean up a bore, it will be necessary to set the tool about the amount of this runout in addition to the basic bore size you measure. If you bump the spindle unit lightly with your hand, you will find you can easily reduce the reading to near "zero" for minimum stock removal.

Similarly if the bore is substantially out of round or has scored wear grooves, you may move the spindle so that you get two maximum equal dial readings at the opposed large portion of the out of round.

Achieving this you will find the bore will clean up on a slightly larger diameter than you measure at the maximum out of round area.

Turn switch to clamp when you have the proper dial reading, remove the indicator, and proceed with the boring as usual.

If you wish to check the squareness of the bore face, reset the dial indicator lever for the proper travel direction and adjust the spindle and indicator to contact the surface above the bore. Rotate the spindle then to check out of square.

Remember, if you wish to correct out of square with shims under the work piece, you will have to use a shim proportionately larger (as the support points are to the indicator travel extreme) than the out of square reading.

DEPTHS OF CUT

Proper cutting speeds are arranged so that the high speed range will rapidly take cuts up to .040" on the diameter - up to 4" diameters.

Cuts that are taken over this size should be run on low spindle speed to prevent excessive tool wear. Heavier cuts up to .200" on diameter may be taken on low speed.

STUB BORING BAR

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

T O O L B I T S H A R P E N I N G

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 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 the 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 32 for exact "B" land requirements.

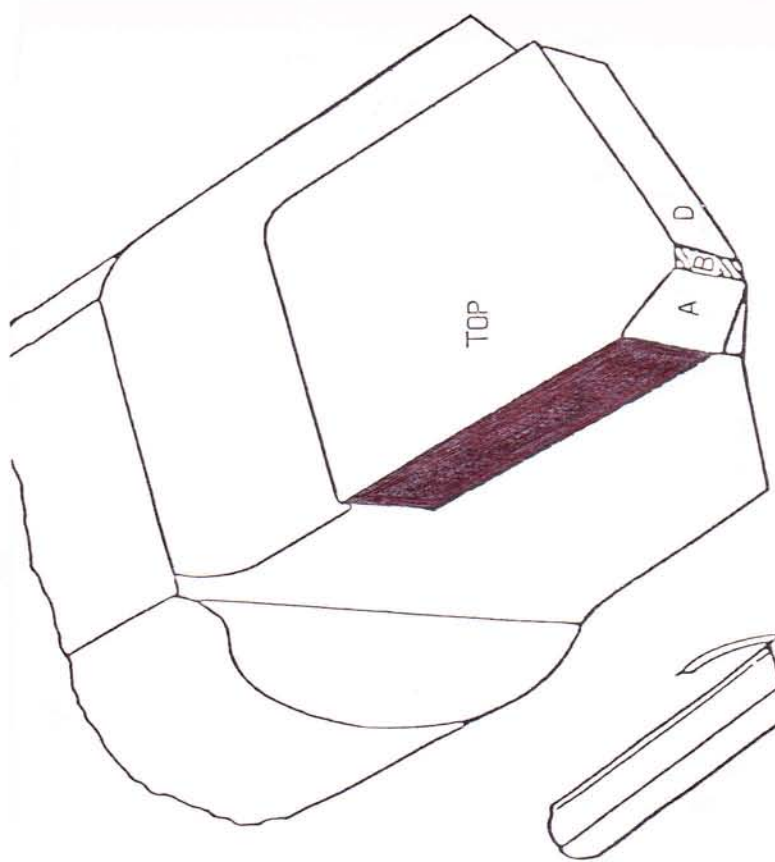
In the event your bar chatters or bores a rough finish at the bottom of the cylinder, it is very probable the "B" land is too wide.

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.

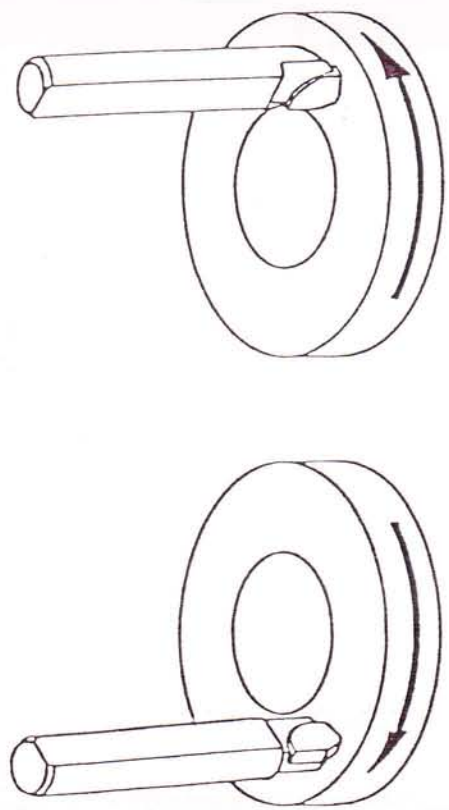
The frequency of sharpening the bit will vary depending on the type of iron being bored.

TOOL SHARPENING REQUIREMENTS



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

ACTUAL SIZE



TOOL SHARPENING REQUIREMENTS

CUTTING SPEEDS AND CUTTING DEPTH RECOMMENDATIONS

MODEL FA

PRODUCTION CUTTER HEAD AND BLIND HOLE CUTTER HEAD

ROUGHING CUTS FOR SLEEVING

FINISH CUT: TO 1 1/2" TRAVEL DEPTH

TO MAXIMUM TRAVEL DEPTH

SPINDLE SPEED

Maximum cut .200 on a diameter. Use low spindle speed only.
Maximum cut .040 on a diameter. Use a .015 to .025 "B" land.
Maximum cut .025 on a diameter. Use a .005 to .015 "B" land.
Bore diameter to 4" use high spindle speed.

Bore diameter above 4" use low spindle speed.

NOTE: TO PRODUCE BEST RESULTS AT EXTREME TRAVEL OR HEAVY STOCK REMOVAL USE AN RF FACING TOOL #501-29A
(DO NOT SHARPEN "A" LAND ON THIS TOOL).

STUB BORING BAR

ROUGHING CUTS FOR SLEEVING

FINISH CUT: TO 4" TRAVEL DEPTH

TO 8" TRAVEL DEPTH

SPINDLE SPEED

Maximum cut .150 on a diameter. Use low spindle speed only.
Maximum cut .040 on a diameter. Use .010 to .020 "B" land.
Maximum cut .025 on a diameter. Use .005 to .015 "B" land.
Bore diameters to 3 3/4" use high spindle speed.

Bore diameters above 3 3/4" use low spindle speed.

C A R E O F D I A M O N D W H E E L

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.

T O O L L I F E

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.

C E N T E R I N G F I N G E R S

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

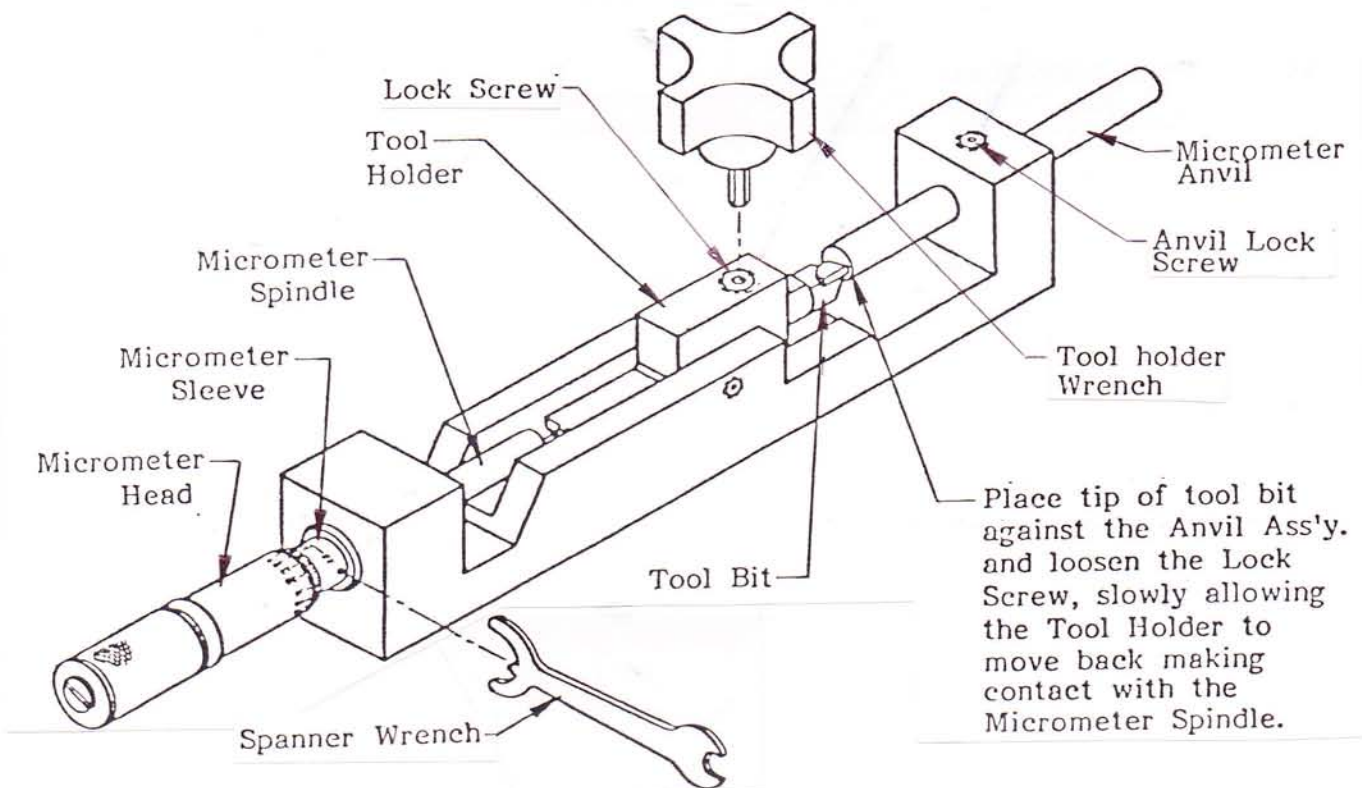
Centering Fingers con't
Center Accuracy Check

and forth in this test bore 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.

M I C R O M E T E R

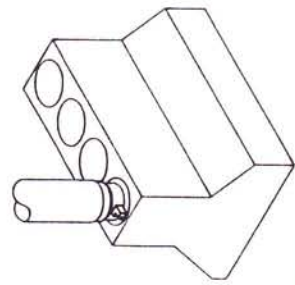
Your boring micrometer, as with any other measuring tool, should be used delicately and with care to be assured of the greatest accuracy. Particular attention should be paid to inserting the tool in the micrometer without allowing tool bit to snap into the micrometer anvil. Care should be used in the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

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

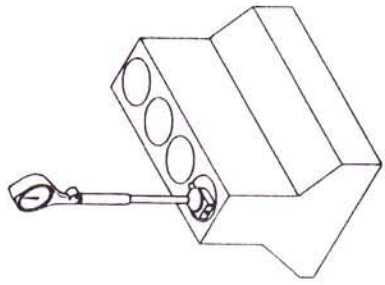


PROCEDURE FOR CALIBRATING MICROMETER

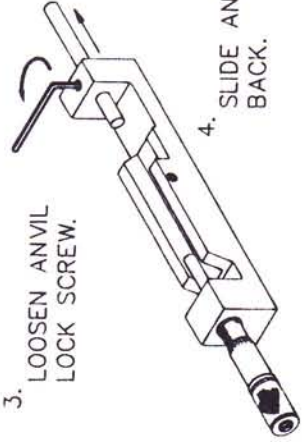
1. USE THE BORING MACHINE TO BORE A HOLE IN A SCRAP BLOCK. WITHOUT CHANGING ANY SIZE SETTING REMOVE TOOL HOLDER.



2. MEASURE THE HOLE THAT YOU BORED.

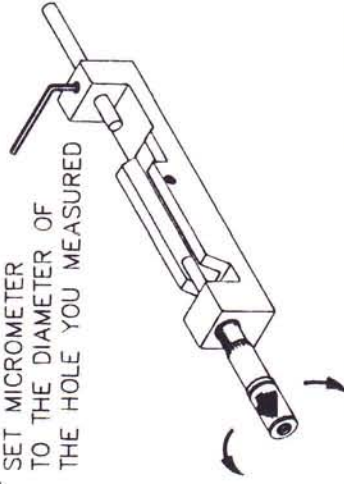


3. LOOSEN ANVIL LOCK SCREW.

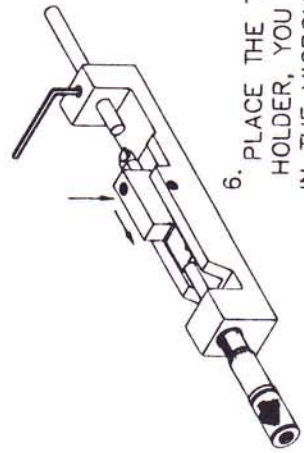


4. SLIDE ANVIL BACK.

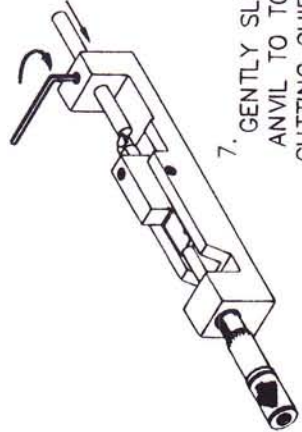
5. SET MICROMETER TO THE DIAMETER OF THE HOLE YOU MEASURED



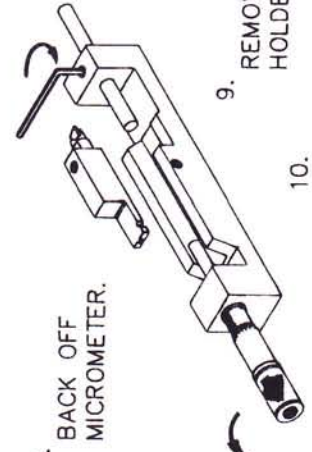
6. PLACE THE TOOL HOLDER, YOU USED, IN THE MICROMETER FRAME.



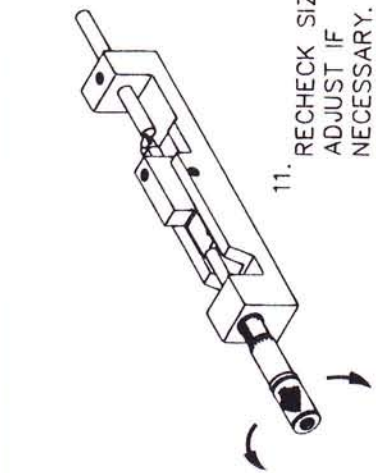
7. GENTLY SLIDE ANVIL TO TOUCH CUTTING CHIP. AND LIGHTLY TIGHTEN LOCK SCREW.



8. BACK OFF MICROMETER.



9. REMOVE TOOL HOLDER.
10. TIGHTEN LOCK SCREW.



11. RECHECK SIZE. ADJUST IF NECESSARY.



SPECIAL MICROMETER INSTRUCTIONS

(For optional capacity to 8" diameter)

For setting FA micrometer to high and low reading using micrometer with a 2.9" to 6.00" reading.

CAUTION: The standard for your FA bar is set. Do not change it, except when it is necessary to recalibrate the micrometer, then the standard should be reset to match the micrometer.

To bore from 2.9 to 6.00, place standard in micrometer and adjust the mike anvil so that the mike reads 6.0".

NOTE: Read directly as shown on the micrometer sleeve.

To bore from 4.9" to 8.0" place the standard in the micrometer and adjust the mike anvil so that the mike reads 4.0". The mike reading is 2.9" to 6.0" and will now actually guage tool from 4.9" to 8.0". When the mike is set for larger bores, remember that bar will bore 2" larger that mike reads.

I M P O R T A N T
M A I N T E N A N C E

LUBRICATION

F STYLE

- * The F style Upper Housing Unit should be packed with Union Oil - UNOBA F1 or F2 lube, Lubriplate #930 AAA, Mobil oil - Mobilith A.W. Grades 1 or 2, Chevron Duroolith EP1 or EP2, or any equivalent Lithuim Barium Grease, 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, or Union Oil - Union 75, or a very light spindle or sewing machine oil (less than S.A.E. 5) to the bearing. Add by removing the small cover on the front of the Upper Housing and add lubricant to the take up nut area between the clutching teeth.
- The lower gear box oil level should be checked MONTHLY. Check by removing 7/8" diameter snap plug and pipe plug on the right side of spindle base, oil level should be just up to the bottom of this hole (see illustration).

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

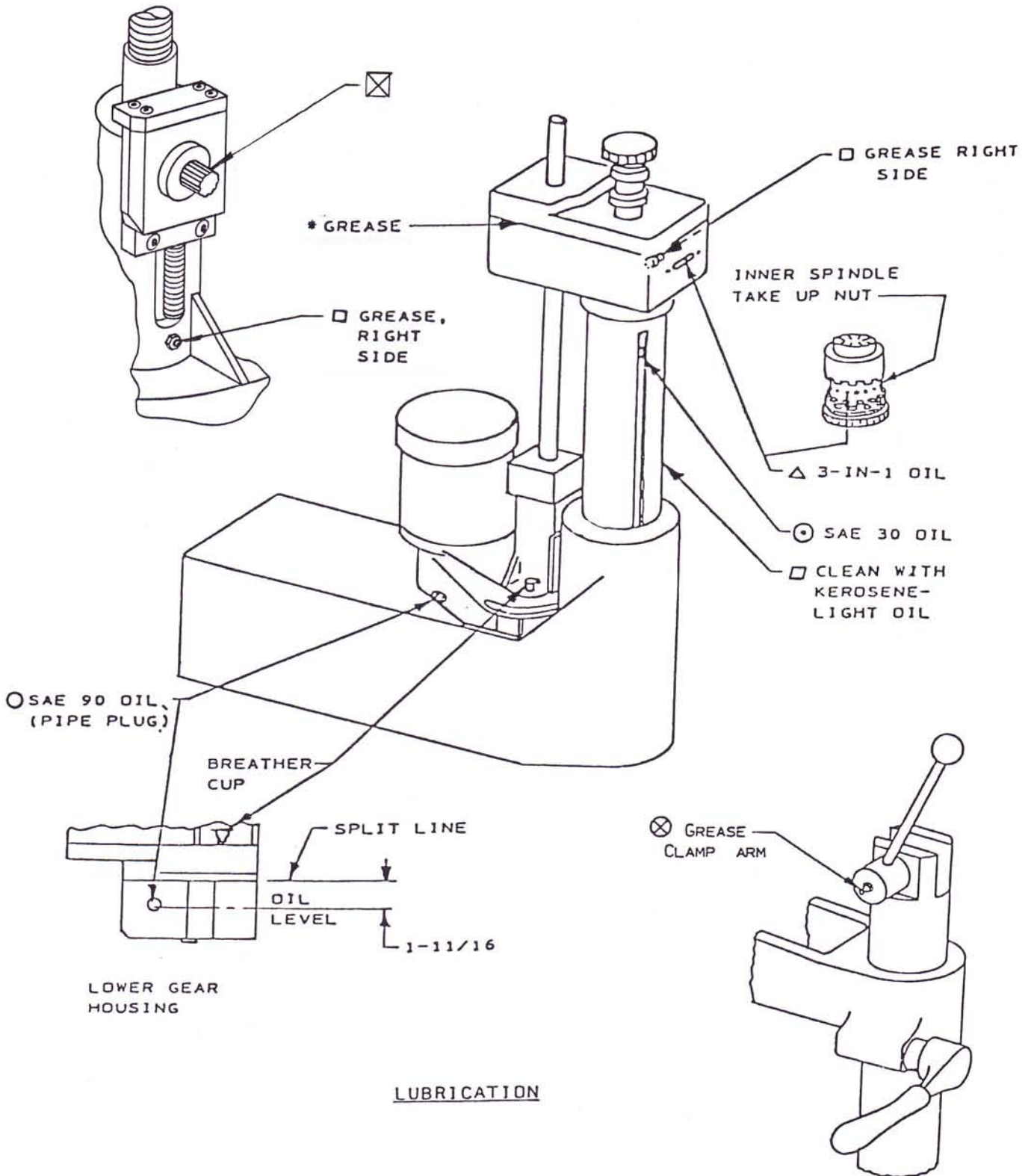
Change this gear lubricant every 40,000 boring cycles. Use Union SAE 90 Multipurpose gear lubricant or any equivalent SAE 90 gear lubricant.

NOTE: On older machines, which do not have oil breather cup on left side of lower gear housing, require grease in this housing. This grease should be kept at the same level as the oil gear housing above. Add, when needed, 3 parts Union Oil - UNOBA F1 or F2 lube, Mobil oil - Mobilith A.W. Grades 1 or 2, Chevron Duroolith EP1 or EP2, to 1 part SAE 90 multipurpose gear lubricant.

- If your F style 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, Lubriplate #930AAA, Mobil oil - Mobilith A.W. Grades 1 or 2, Chevron Duroolith EP1 or EP2, or any equivalent Lithuim Barium Grease.

LUBRICATION, F STYLE, CON'T

- ⊙ Two or three drops of Union Oil -315 Turbine Oil, or Union Oil 315 Klondyke Oil, or any SAE 20 Oil (nondetergent Motor Oil) can be added weekly to the breather 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.
- ⊗ Disassemble hand feed assembly and lubricate bronze bushing and bevel gear shaft with UNOBA F1 or F2 lubricant, lubriplate #930 AAA, Mobil oil - Mobilith A.W. Grades 1 or 2, Chevron Durolith EP1 or EP2, or any equivalent Lithium Barium grease. This should be done once every 6 months.

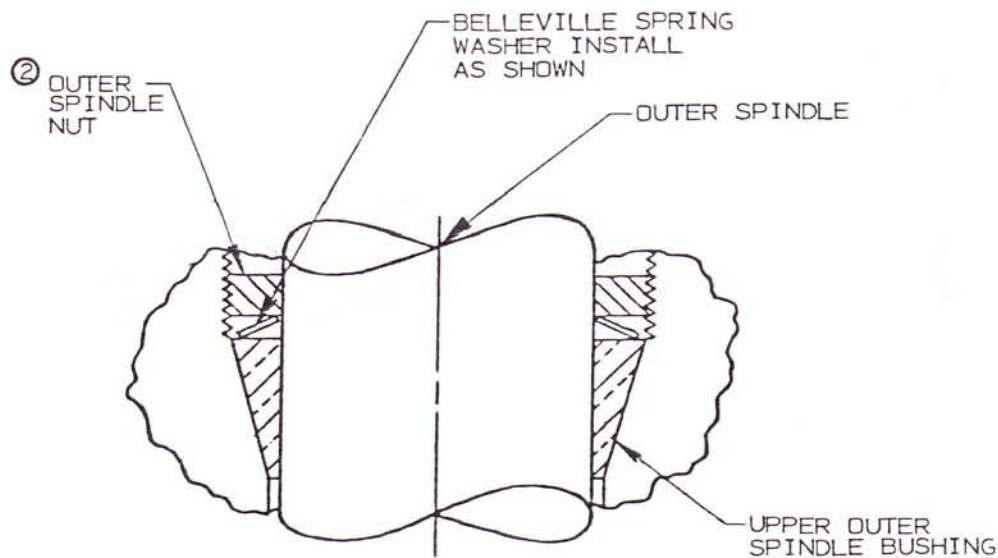


A D J U S T M E N T O F O U T E R S P I N D L E

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 40.

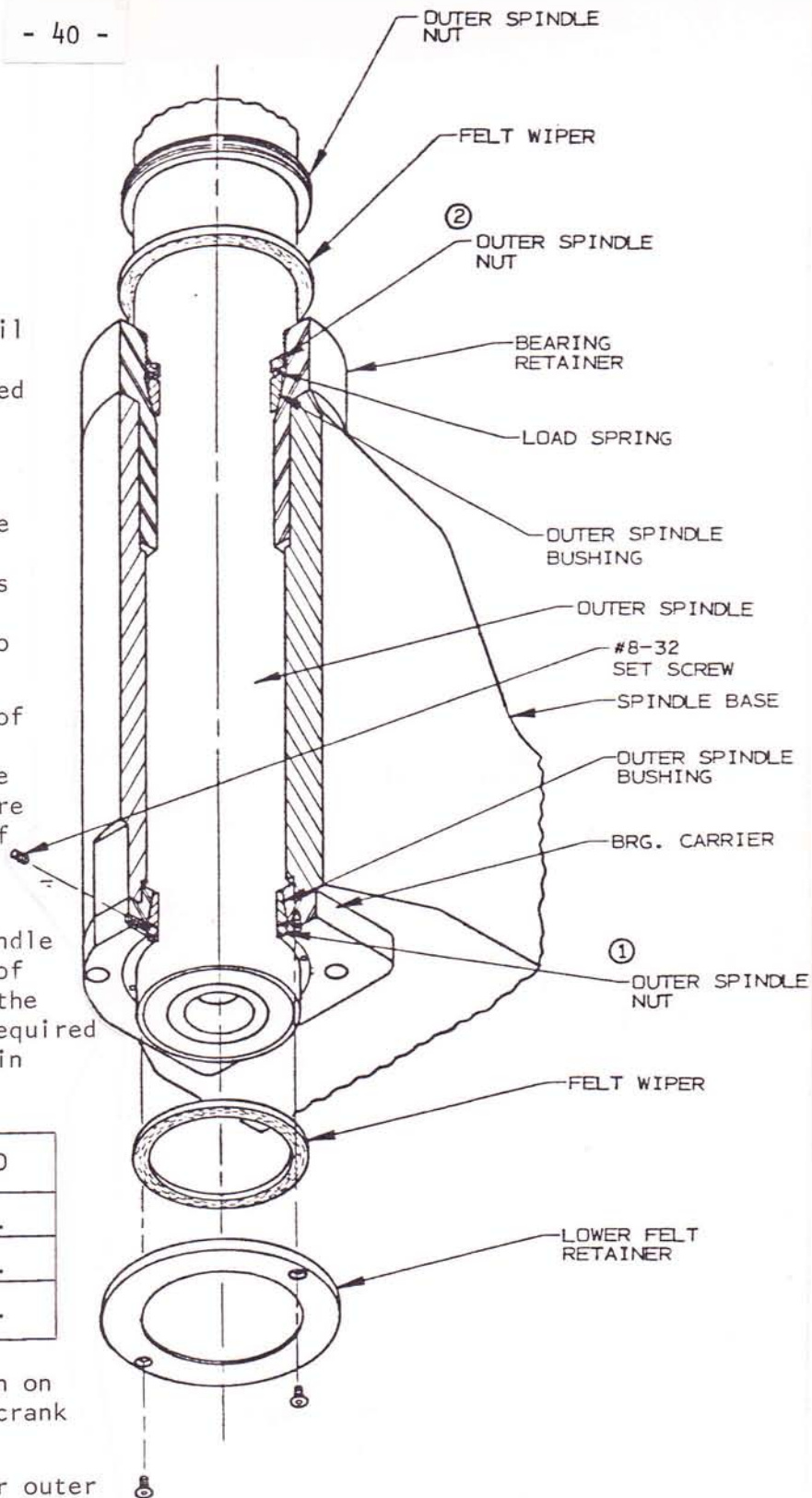


1. Run spindle down approx. 4" to 6" loosen the #8-32 set screw and loosen all outer spindle nuts (500-77).
2. Tighten the lower bushing (500-76-2) by tightening the outer spindle nut marked ①, until 10 to 15 lbs. of effort is required to operate the hand feed handle. Lightly tighten #8-32 set screw.
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.	PRESS. REQ'D
DA0, -0B, -0C	30 - 50 lbs.
FA & F2B	50 - 75 lbs.
FA4EB, 1DA4, DA5, & 6IDA6B	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.



A D J U S T M E N T O F I N N E R S P I N D L E

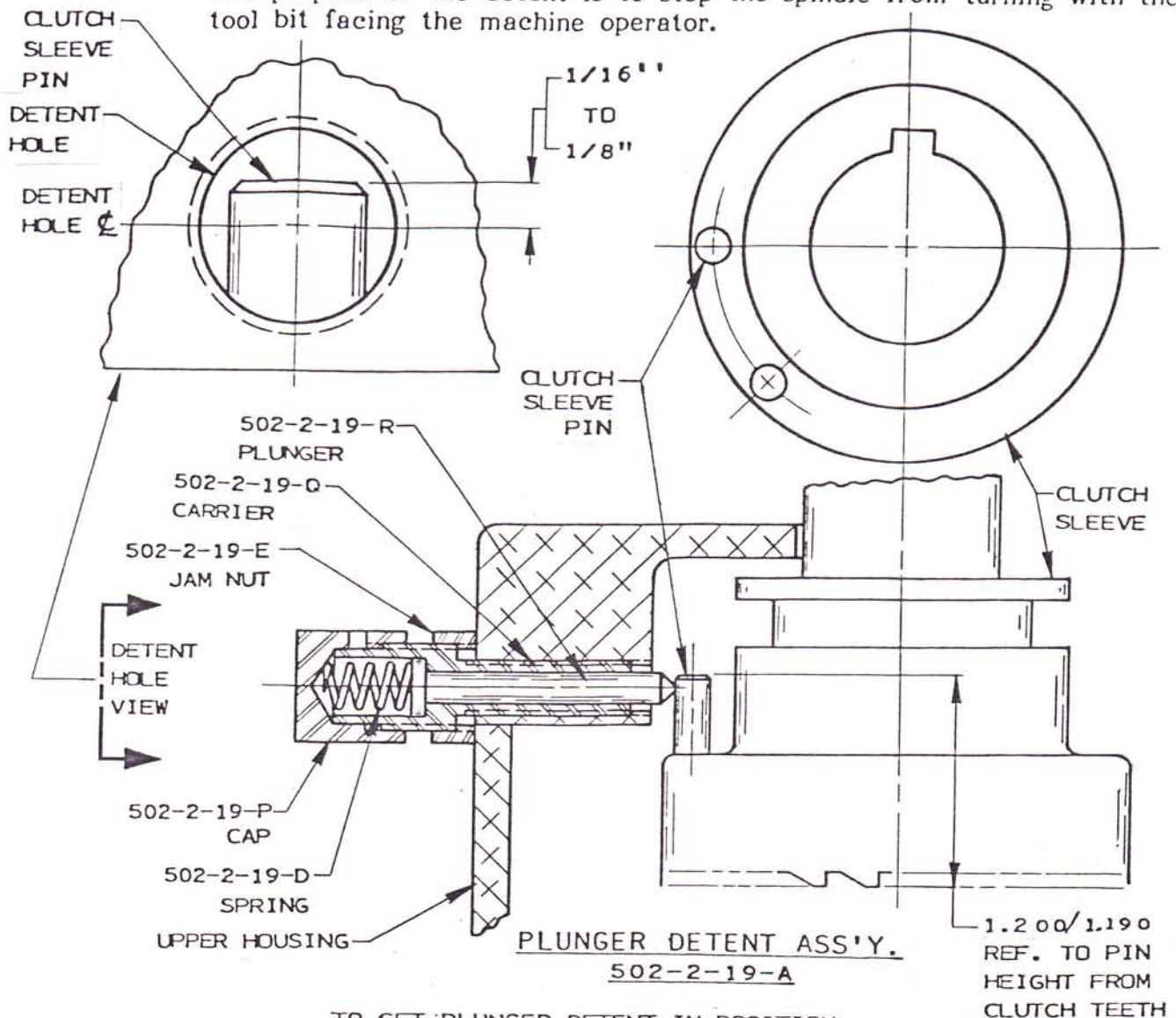
1. Remove two screws and small cover on the front side of the upper housing.
2. Remove the stop screw restricting the up travel of the spindle clutch lever and move the lever to full up position (see detail J). Rotate the spindle approximately 1/2 turn away from the detent spring. Position the tool holder 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 the spindle is tight and back off 3/4 to 1 1/2 notches. 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.

SPINDLE STOP DETENT ADJUSTMENT

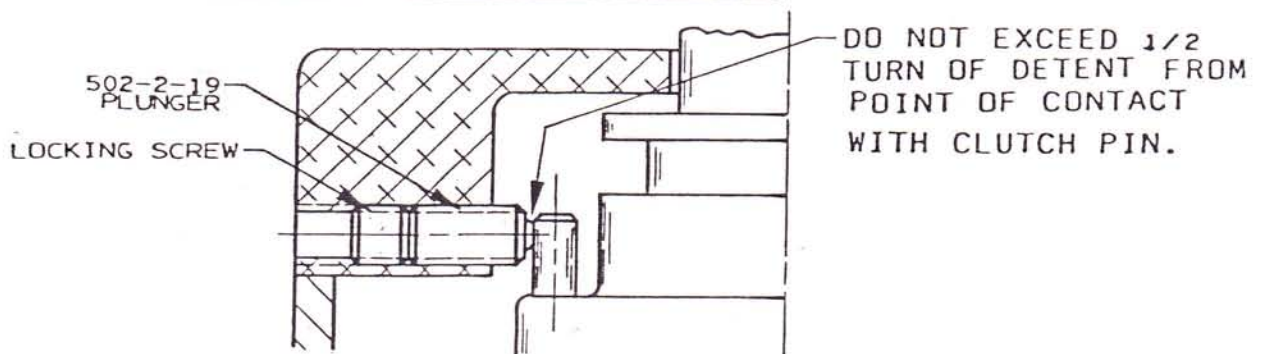
The purpose of the detent is to stop the spindle from turning with the tool bit facing the machine operator.



TO SET PLUNGER DETENT IN POSITION

- (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 ϕ
- (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 DETENT 502-2-19



UPPER HOUSING BACK FEED ADJUSTMENT

TO ADJUST THE FEED SCREW PLAY IN THE UPPER HOUSING

First loosen and back off approximately 1/16" the three round head head screws around the feed screw, in the upper housing. Then loosen the three adjusting screw lock nuts, then 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.

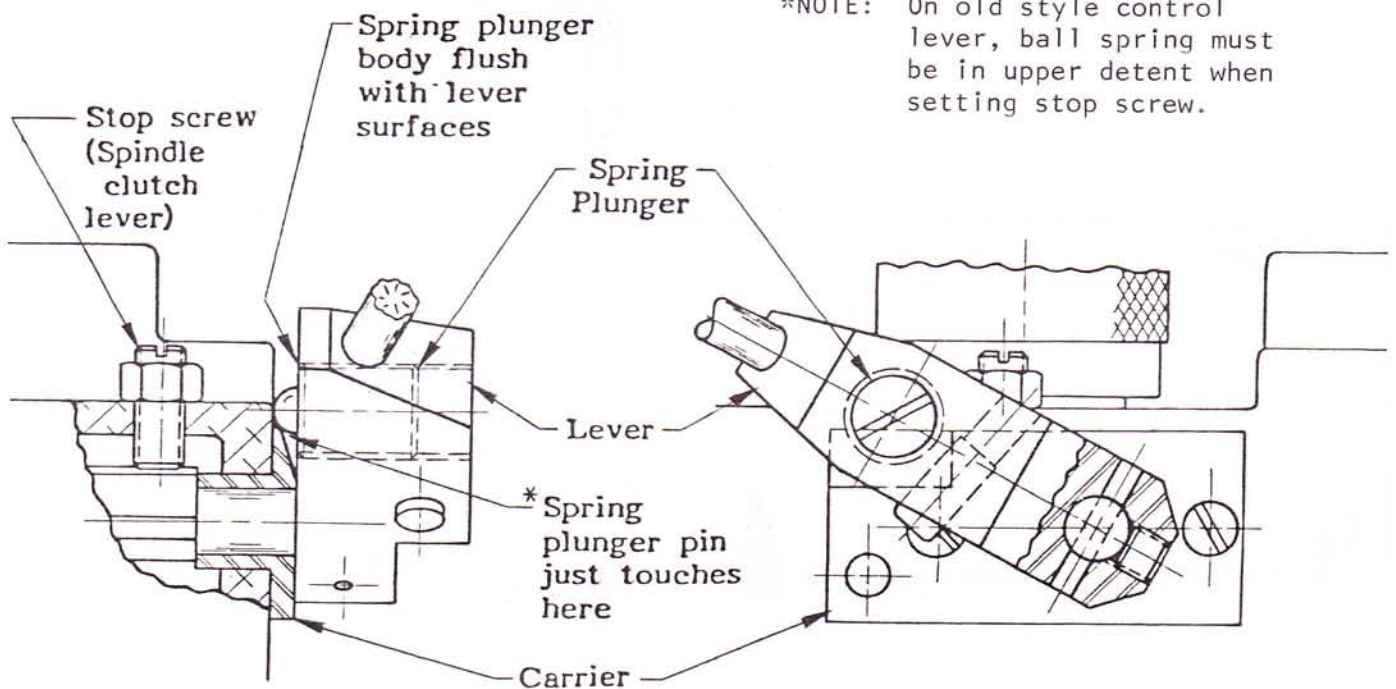
Turn adjusting screw back 1/4 turn to allow for running clearance. Hold adjusting screw with an allen wrench and lock them with lock nut.

Run motor with lower gear box engaged, so that the feed screw is turning, to center bearing retainer. Turn off motor, tighten evenly the three upper round head screws.

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.

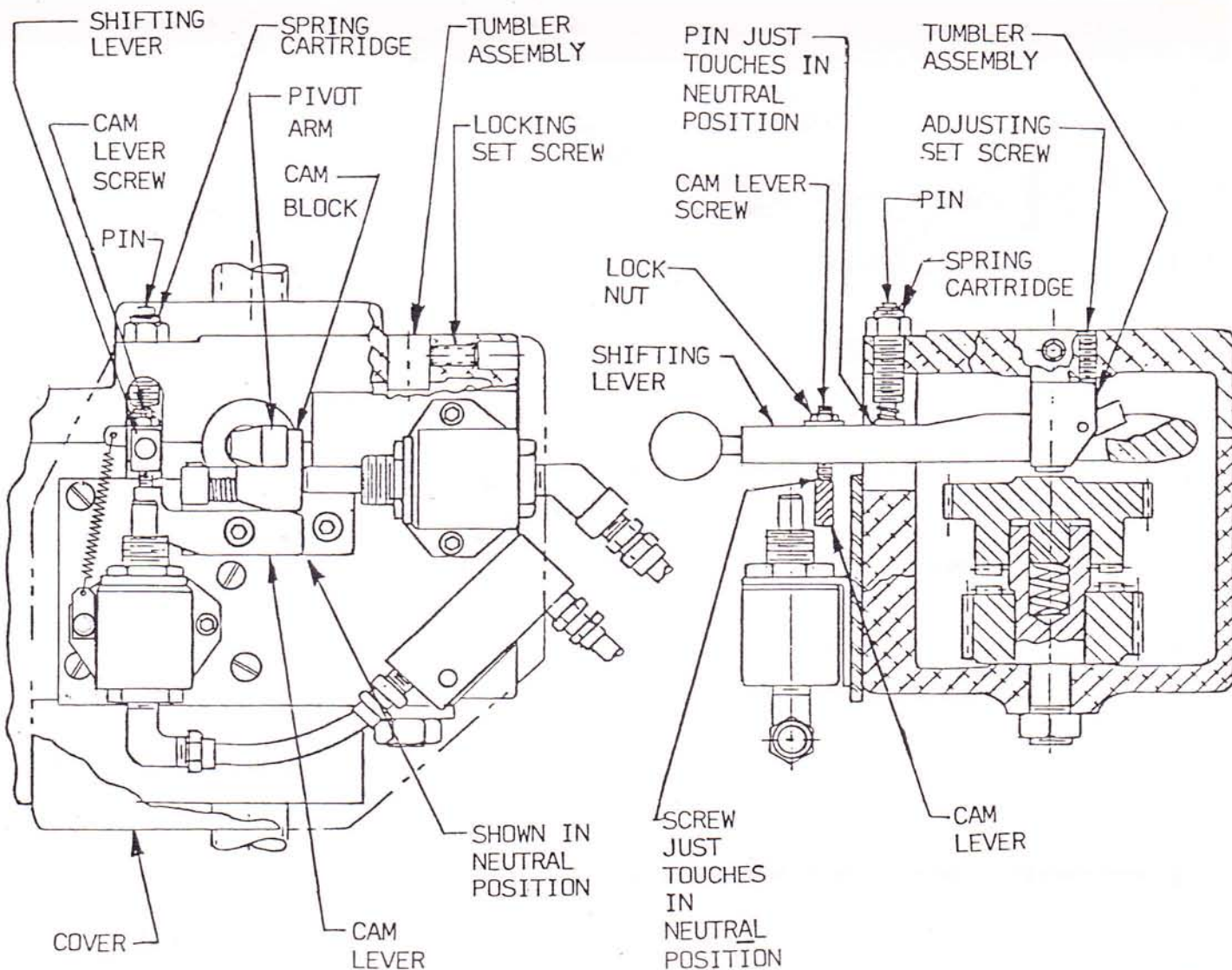
*NOTE: On old style control lever, ball spring must be in upper detent when setting stop screw.



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).



Rapid Return Adjustment con't.

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 shift 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.

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 is in neutral, lock with it's lock nut.

E X C E S S I V E L O A D S

NOTE: If excessive loads are imposed on your boring bar the following occurs:

1. THRUST LOADS

If the bar is fed or rapid traveled into an object that imposes an excessive thrust load on the spindle, the bronze thrust nut, #500-41, will probably be sheared and require replacing. This accident could happen with spindle either rotating or stationary.

The effect of this will be for the bar to continue to run but no feed or down travel. If the bar is left in feed or down travel; drive spline will be pulled completely out of mesh at which point the motor will continue to run but feed screw will not turn at all. For replacement of the bronze thrust nut, 500-41, see Removal of Feed Sleeve and Bearing.

2. RADIAL LOADS

If the bar has a tool in the cutter head that turns into an object, an excessive radial shock will be imposed on the spindle and will probably shear the motor drive key, 500-62. This would likely happen only when spindle drive clutch is in.

The immediate effect of this will be for the motor only to run without turning any visible parts of the boring bar. A movement of the speed change lever will indicate the lower gear box is entirely inoperative. For replacement of the motor drive key, 500-62, see Removal of Motor Field Assembly. Less abrupt loads that will stall motor may cause the motor overload protection to drop out and can be corrected simply by pressing the reset button in the rear of the machine.

R E M O V A L O F M O T O R F I E L D A S S E M B L Y

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

NOTE: This is the only disassembly required to replace micarta motor drive key in cases of excessive radial load on the machine spindle.

SECTION B-B

Remove fan shroud cover and shroud.

CAUTION: Avoid damage to limit switches and connections. Remove (4) long motor screws and lift off the motor field assembly. Be careful not to lose spring washer on top bearing, and replace properly in reassembly.

Lay blocks or shims on bottom end bell (flat surface of gear box) and pry up rotor unit of drive to remove rotor.

D I S A S S E M B L Y O F M O T O R H O U S I N G

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

1. REMOVAL OF HAND FEED HOUSING

SECTION A-A

Remove 2 hex socket screws on bottom 500-97-2 hand feed bracket and 2 screws holding 500-96-4 plate to 500-70-1 housing. Turn out (counter-clockwise) 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 feed screw counter-clockwise until feed screw is clear of motor unit. On reassembly, it may be necessary to rotate motor and feed screw, using care in aligning spline in gear to match screw spline. Make sure hand feed pinion threaded shaft and threaded boss of feed sleeve does not jam in entering slot of motor housing.

2. REMOVAL OF FEED SLEEVE AND BEARING

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

SECTION A-A

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

3. REMOVAL OF MOTOR HOUSING

To remove motor housing, remove sheet metal cover over spindle base, loosen 2 side screw in the spindle base, then take out 4 bolts in housing flange.

NOTE: In reassembly, motor alignment must be checked after screw sleeve is in place before flange bolts are permanently locked. Use surface plate over feed screw and spindle. Lightly tighten the 2 side screws in the spindle base after alignment is checked. Do not over tighten as this will cause the motor housing to be mis-aligned.

4. MOTOR HOUSING DISASSEMBLY

To disassemble motor housing, remove speed shift lever by removing its roll pin and set screws, then remove 2 pins and 6 screws and bottom screw in the middle of bottom of gear pot.

Tap lightly with mallet on motor pinion, 500-64, and feed 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 bottom of the gear pot.

FAILURE DUE TO LOW AIRLINE PRESSURE

A pressure switch PS2 (located in the center top of the control panel) has normally open contacts that close when the air line 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 control 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.

CENTERING ROD & -B DRAW BAR & ROD ASSEMBLY
REMOVAL

Should it be necessary to remove the top cover of the upper housing, it will be necessary to remove the draw bar and/or centering rod.

Remove the center rod on FA-1 & FA-2 machines by loosening the set screw in knob 500-17 and forcing the knob up. Lower spline will be disengaged and the rod will come out. Replace carefully.

Remove the Draw Bar assembly on FA-B machine, by first removing the cutterhead, then loosen the set screw in knob 600-18-2 and forcing the knob up.

CENTERING ROD & -B DRAW BAR & ROD ASSEMBLY
REMOVAL ON -A & -AB (AUTOMATIC) TYPE MACHINE

Automatic type machines require the removal of the tool positioner drive chain in order to remove the sprocket knob. Remove the chain guard and then the connecting link of the chain.

Reassembly of the chain requires the correct timing of the stop indent to the tool positioner cam (see page 55 & 56) of the supplement for auto type FA-A machine.

Then loosen the set screw in sprocket 502-2-80 or 600-18-3. (If "-B" machine, remove cutter head) and forcing sprocket up to remove Draw Bar and/or centering rod.

DISCONNECTING MACHINE SPINDLE UNIT
FROM CONTROL PANEL

NOTE: Before attempting this procedure, disconnect incoming electrical and air supply.

Disconnecting Machine Spindle Unit con't.

Disconnect the ten out-going wires on the right hand side of the twelve pole terminal strip. Disconnect all air lines in the control panel leading to the machine spindle.

NOTE: Before disconnecting any electrical wires or air lines, make certain they are properly coded for easy replacement.

Disconnect umbilical cord from control panel, feeding all disconnected wiring and air lines out of control panel. The machine spindle may now be separated from the control panel.

The following procedure is required for old style machines (1966 to 1975) with Cannon plug 502-11-24. In order to disconnect air and electrical connections, disconnect the Cannon plug (502-11-24) at rear of machine and remove the enclosure (502-2-24). You may now disconnect the Cinch Jones connector (502-11-22) inside the enclosure. The air lines within the spindle base are provided with poly-flow disconnect fittings that are accessible with the removal of the cover (502-2-13) over the clamp assembly. Poly-flow disconnect fittings are also provided at the entry of air lines to upper housing cover.

D I S A S S E M B L Y O F U P P E R H O U S I N G A N D
S P I N D L E R E M O V A L

Remove cutter head on -B machine. Remove cover 502-2-60 on manual and cover 502-2-63 on automatic. Remove on, automatic only, the tool positioner - chain guard, connecting link of chain, chain, and tool positioner housing. For reassembly, see pages 55 & 56.

Remove 600-18-2 knob, 500-17 knob, 502-2-80 sprocket, or 600-18-3 sprocket by releasing socket set screw. You may then remove the draw tube and/or center rod.

Unscrew the spindle clutch lever stop pin, raise lever to extreme top, which will allow removal of the countersunk screw, then the lever assembly may be removed.

Remove 502-2-48 spring, 502-2-47 bracket, 500-47 base plate, 502-2-51 or 502-2-52 stop bracket. Remove 6 screws holding upper housing sections together and lift off the 500-22F upper lid.

Remove 500-38-1 shifting lever along with 500-25 upper fast return gear with plunger and spring, 500-3 spindle clutch and key, 500-14 ball bearing and take up spring, (be sure spring is reassembled properly), 500-1 sleeve gear, 500-2 feed nut, and 500-8 or 500-8-1 feed gear with its thrust washer.

If bar is in a vertical spindle position, we suggest you place something under the spindle nose to prevent the inner spindle from falling out, then remove 500-5 spindle nut. Nut can be started off through adjusting access hole and then hand turned.

Disassembly of Upper Housing and Spindle Removal con't.

500-6-1 drive gear may be worked off along with 500-4 spacer woodruff key.

Inner spindle may be removed now.

CAUTION: Lubrication will run out when spindle is removed.

If upper housing is to be removed from spindle, the hex cap screws in upper housing should be removed and housing driven off spindle.

Heat on housing will simplify removal of this sweat fit.

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

500-7 long gear with radial and thrust bearings may be removed along with oil seals. Extreme care should be taken when removing long gear out of seal and 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.

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

C O N T R O L F U N C T I O N

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

The Air Electric Control is described in capital type, and the resulting mechanical function in lower case, so a difficulty may easily be isolated.

TOGGLE SWITCH

THE TOGGLE SWITCH, 502-2-25, (SECTION BB) OPENS AND CLOSSES THE 110 VOLT CONTROL CIRCUIT. WHEN OPENED, THIS SWITCH DEACTIVATES THE ENTIRE UNIT EXCEPT THE CURRENT TRANSFORMER.

CLAMP SELECTOR SWITCH

THE CLAMP SELECTOR SWITCH TURNED TO LEFT CLOSSES THE CIRCUIT TO FSV (FLOAT SOLENOID VALVE) (PANEL LOCATION, UPPER VALVE, RIGHT SIDE). THIS NORMALLY CLOSED VALVE IS OPENED, ALLOWING AIR TO FLOW THROUGH REGULATOR, 502-27-17 (UPPER REGULATOR IN PANEL), AND THEN OUT THE ORIFICE ON BOTTOM OF SPINDLE UNIT. (REGULATOR MAY BE ADJUSTED UP OR DOWN TO FURNISH PROPER LIFT FOR EASY MOVEMENT OF SPINDLE UNIT).

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

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

FAST DOWN PUSH-BUTTON

THE FAST DOWN BUTTON DEPRESSED CLOSSES 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, 502-2-59A, (VIEW EE) 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.

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

FEED PUSH-BUTTON

DEPRESSING THE FEED BUTTON CLOSSES 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 (MS) MOTOR STARTER.

Mechanically, the FA is normally in the in-feed position. The lever, 500-38-1, is spring loaded in the down position, with the key, 500-35, 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.

THE AUTOMATIC MODEL INCORPORATES A DOUBLE POLE, LOWER LIMIT SWITCH, TO BOTH ENGAGE THE UP AND TO DROP FEED CIRCUIT OUT.

UP PUSH-BUTTON

THE UP BUTTON DEPRESSED, CLOSSES THE CIRCUIT TO (UR) UP RELAY, SEALING IN AND CLOSING CIRCUIT TO (MS) MOTOR STARTER 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 502-2-59B ON THE UPPER HOUSING.

AUTOMATIC MODEL FA MACHINES INCORPORATE THE FOLLOWING SYSTEM STARTING WITH SERIAL NO. 2229 (SEE PAGE 65 OF THE AUTO SUPPLEMENT FOR EARLIER MODELS). THE UP BUTTON DEPRESSED OR THE (LLS) LOWER LIMIT SWITCH DEPRESSED CLOSSES THE CIRCUIT TO THE UP RELAY; MOTOR STARTER AND UP SOLENOID VALVE. THE NORMALLY CLOSED VALVE OPENS TO ALLOW AIR TO TRAVEL TO THE (LOWER) NEUTRAL DWELL POSITION OF THE CENTER VERTICAL UP CYLINDER, 502-2-88, ON THE UPPER HOUSING AND THE TIME DELAY VALVES IN THE CONTROL PANEL. THE CYLINDER STOPS THE FEED OF THE SPINDLE AND THE TOP (LOOKING FROM THE REAR OF THE MACHINE) TIME DELAY VALVE IN 1.5 SECONDS OPENS ALLOWING AIR TO FLOW TO THE SPINDLE CLUTCH DISENGAGEMENT CYLINDER OPERATING THE CLUTCH OUT. THIS CYLINDER IS PORTED AT THE TOP OF THE STROKE SO THAT UPON OPERATION IN TURN AIR FLOWS TO THE TOOL POSITIONER CYLINDER (SEE PAGE 81) ROTATING THE CUTTING TOOL TO THE FRONT.

THEN AFTER A 2.0 SECOND DELAY, AFTER THE ORIGINAL SOLENOID VALVE ACTUATION, BOTTOM TIME DELAY VALVE OPENS SUPPLYING AIR TO THE 2ND PORT OF THE UP VERTICAL CYLINDER, 502-2-88, LIFTING THE SHIFT LEVER TO THE EXTREME UP POSITION. THE -A & AB MODEL MACHINE ALSO INCORPORATES A LOWER SAFETY LIMIT SWITCH (SLS) THAT WILL OPEN MACHINE CIRCUIT AT BOTTOM OF TRAVEL SHOULD AN INITIAL ELECTRIC OR AIR COMPONENT FAIL.

The cylinder raises the shift lever, 500-38-1, (section DD) to an extreme up level or in the case of the automatic model to neutral dwell first and then extreme up, 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, (section DD & FF) raises the arm of the

Up Push-Button con't.

tumbler assembly, 300-37, 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 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 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 two keys, 300-35, to raise or lower clutch.

C O M M O N C A U S E S O F T R O U B L E

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

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

It is possible dirt or lubricant used to clean outer spindle may enter lower cutter, and the assembly containing a chatter dampening device, (detail K, 502-2-43). The result of this would be to encounter spindle chatter at bottom of bore, particularly long bores.

Clean the inside of this assembly extremely cautiously and thoroughly, leaving completely dry. Tolerances on these parts are extremely close and much care should be used.

Holes with inconsistent patterns and excessive chipping of tool bits in interrupted cuts at bottom of bore are an indication of a loose inner spindle bearing.

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

CUTTING TOOL DRAG BACK LINES

Standard "F" & "D" series Rottler cylinder reboring equipment is designed to minimize tool return drag back lines by bringing the tool bit to the front of the machine so that the offset return thrust of the feed screw can slightly deflect the spindle away from the cylinder wall.

It is common for machines to make a faint withdrawl mark particularly at the bottom of the cylinder. Very light honing (.0005") should remove all traces of the mark.

Tool marks can, of course, be completely eliminated by off setting the spindle away from tool bit while returning the spindle.

Here are the maintenance steps you can take to minimize tool drag back:

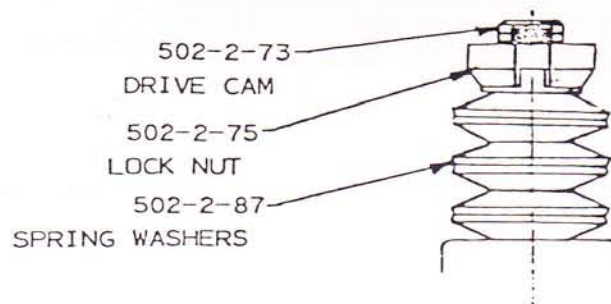
1. Check tool bit for sharp free cutting ability. A too wide "B" land and negative rakes will cause drag back particularly on stub boring heads.
2. Check inner spindle bearing adjustment in accordance with manual.
3. Check outer spindle bearing adjustment in accordance with manual. A slightly heavier drag on the lower outer spindle bearing and freer upper adjustment will improve tool drag marks. It may be necessary, if problems persist, to rotate the upper sleeve bearing approximately 90 degrees in order to reseal the bearing for better up stroke relief.

TORQUE LIMITER, AUTOMATIC SPINDLE RAPID RETURN

A torque limiting device is provided in the spindle rotation mechanism drive sprocket. So that, in the event an operator engages the spindle clutch just as the spindle returns to the top and is still rotating with the cam still engaged, or if for any reason the spindle clutch was engaged with the cam engaged, the torque limiter will release.

To reset the torque limiter after it has released; grasp the spindle clutch nose to keep it from rotating, and with a wrench applied to the flats on the end of the drive cam (502-2-73), rotate the drive cam until the torque limiter "clicks" into its operation position.

If, for any reason, the torque limiter is disassembled, make certain the sprockets are marked so that the exact timing can be maintained when reassembling (see adjustment of the spindle positioner cam if they have to be reset). When reassembling the torque limiter, make certain the spring washers (6) are assembled on the shaft as shown below.



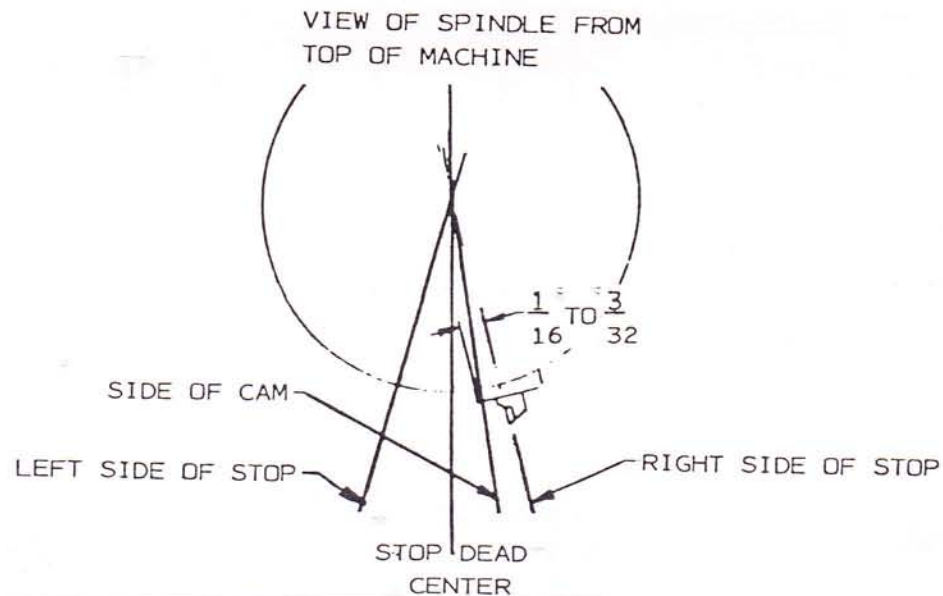
Tighten the lock nut (502-2-75) until the slack is taken out of the springs and then tighten an additional 1 to 1 1/4 turns.

A D J U S T M E N T O F T H E S P I N D L E P O S I T I O N E R C A M

The spindle positioner cam (502-2-73) has to be set in relation to the spindle stop. The spindle stop is engaged as the spindle clutch is disengaged and it positions the tool as shown in the diagram, on the following page.

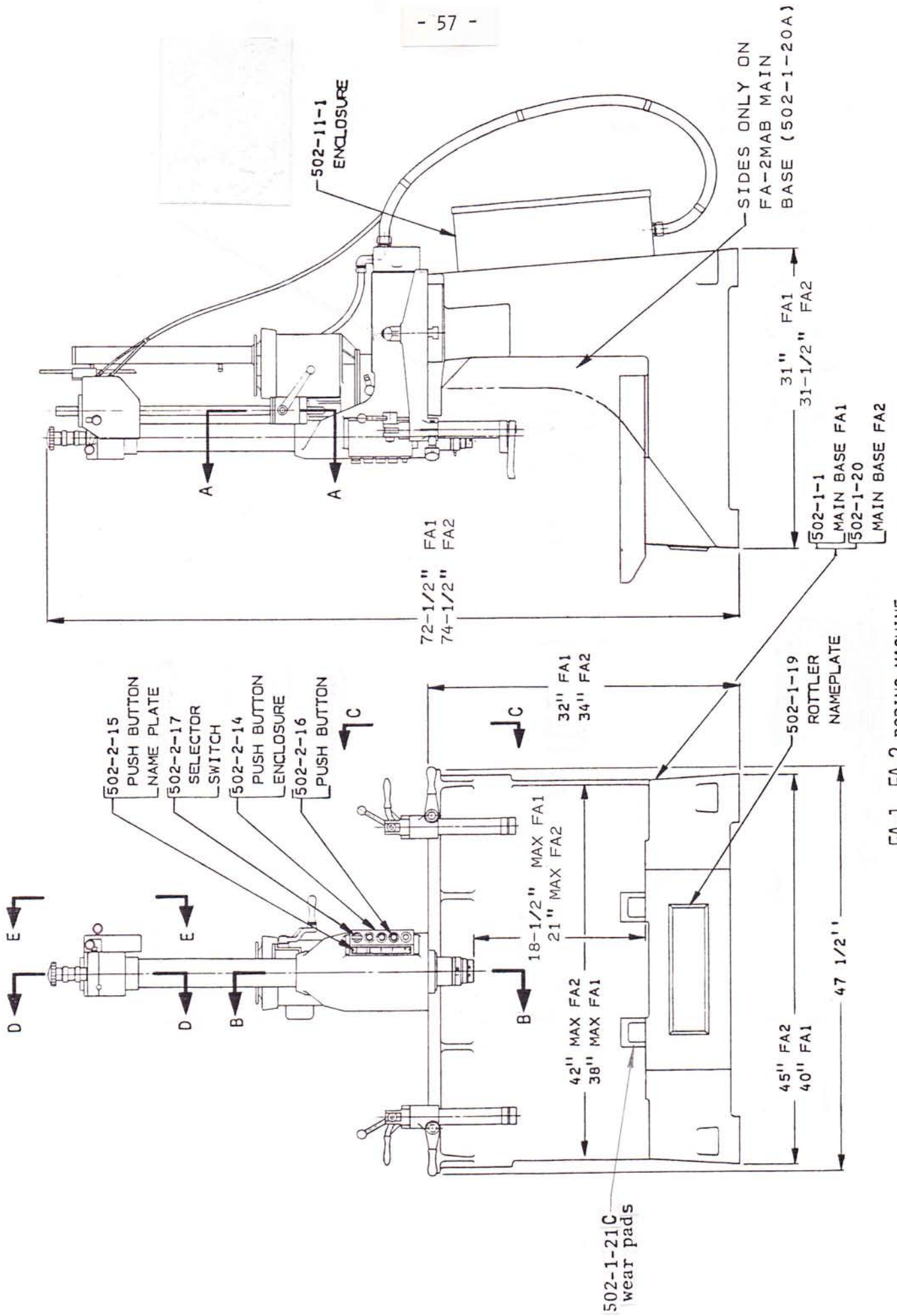
When the spindle positioner cylinder is energized, the rod (502-2-68) is extended, causing the drive pin in the rod to drive the cam (502-2-73) and rotate the spindle clockwise to the return position. To check the relationship of the cam and spindle stop, travel the spindle down close to the lower limit and then depress the Up button. As the spindle returns,

Adjustment of the Spindle Positioner Cam con't.

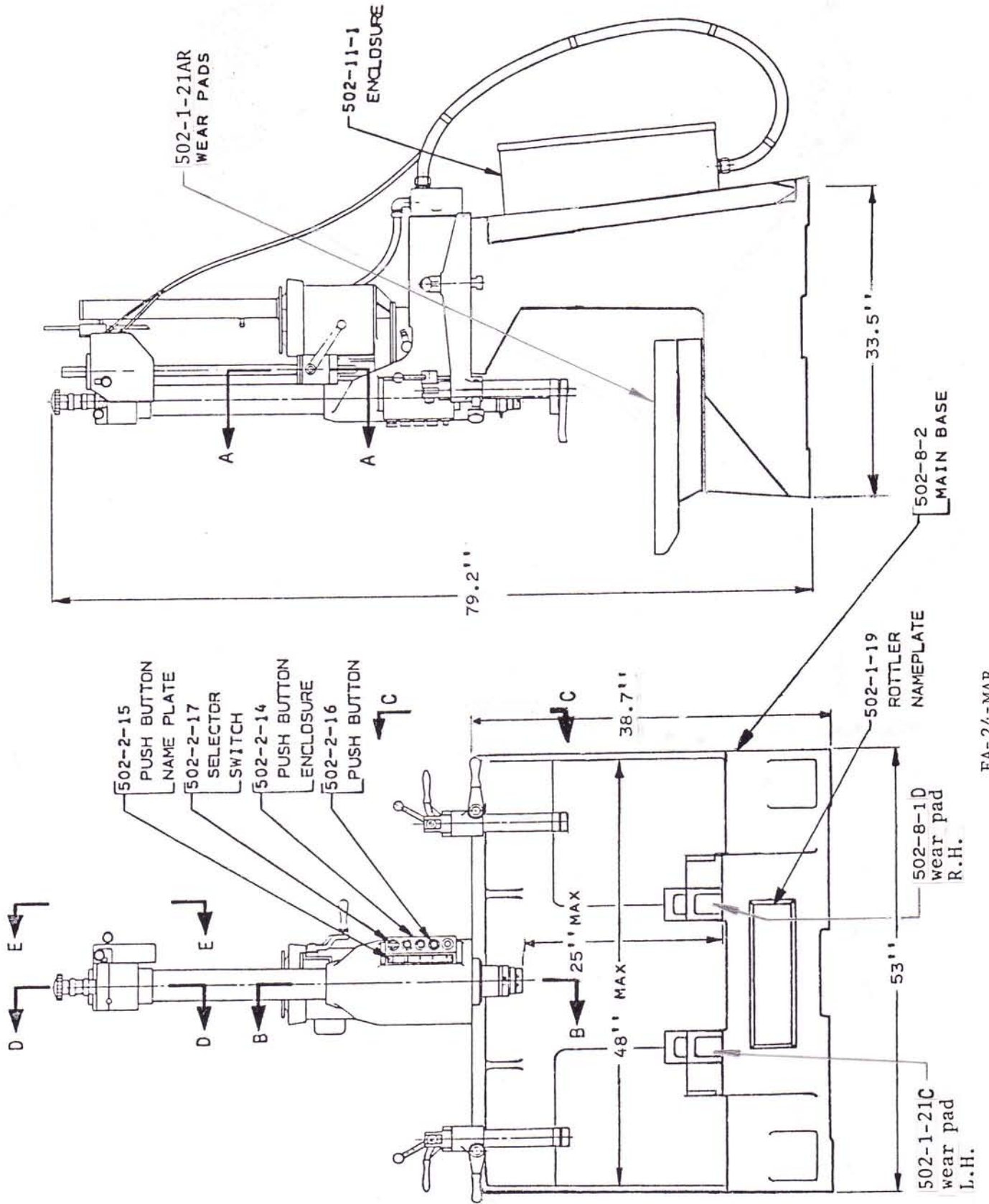


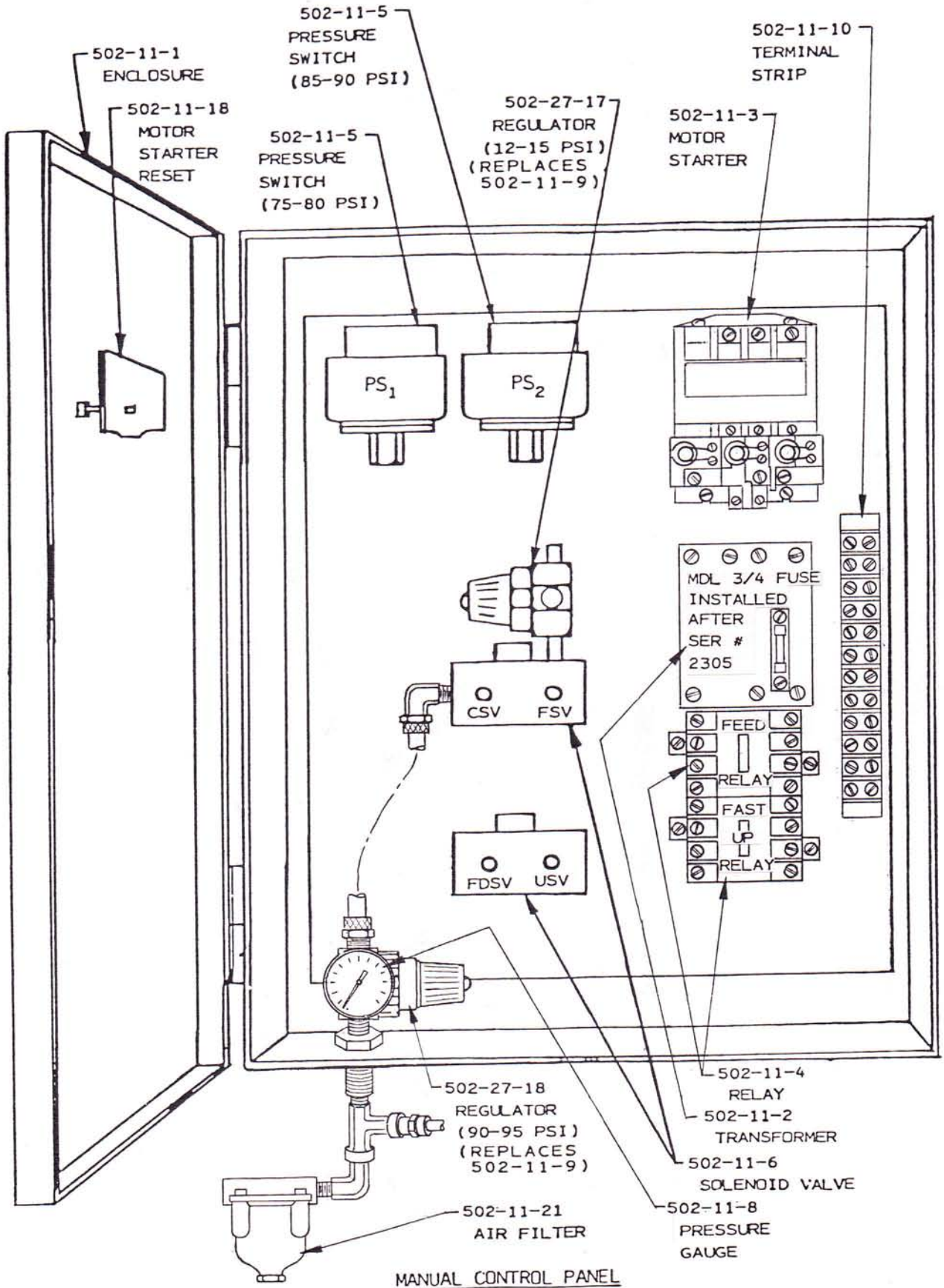
grasp the cutter and rotate it counter-clockwise far enough to clear the stop. Now rotate it clockwise, first contacting the right side of the stop and riding up on the stop, and then contacting the side of the cam. The amount of travel from the point that the right side of the stop is contacted to the cam should be approximately $\frac{1}{16}$ " to $\frac{3}{32}$ " on the periphery of the cutter head. The cutter should never rotate past dead center on the stop before contacting the cam.

To make this adjustment, loosen the (3) Allen head cap screws on the air cylinder rod end (502-2-66). This allows the air cylinder to be rotated several degrees; rotating the cylinder clockwise (viewed from the top) will increase the distance from the right side of the stop to the cam, and rotating it counter-clockwise will decrease it. The drive pin in the rod (502-2-68) and the cam (502-2-73) can be inspected by removing the round snap-out cover on the front of the housing (502-2-65).



FA-1, FA-2 BORING MACHINE

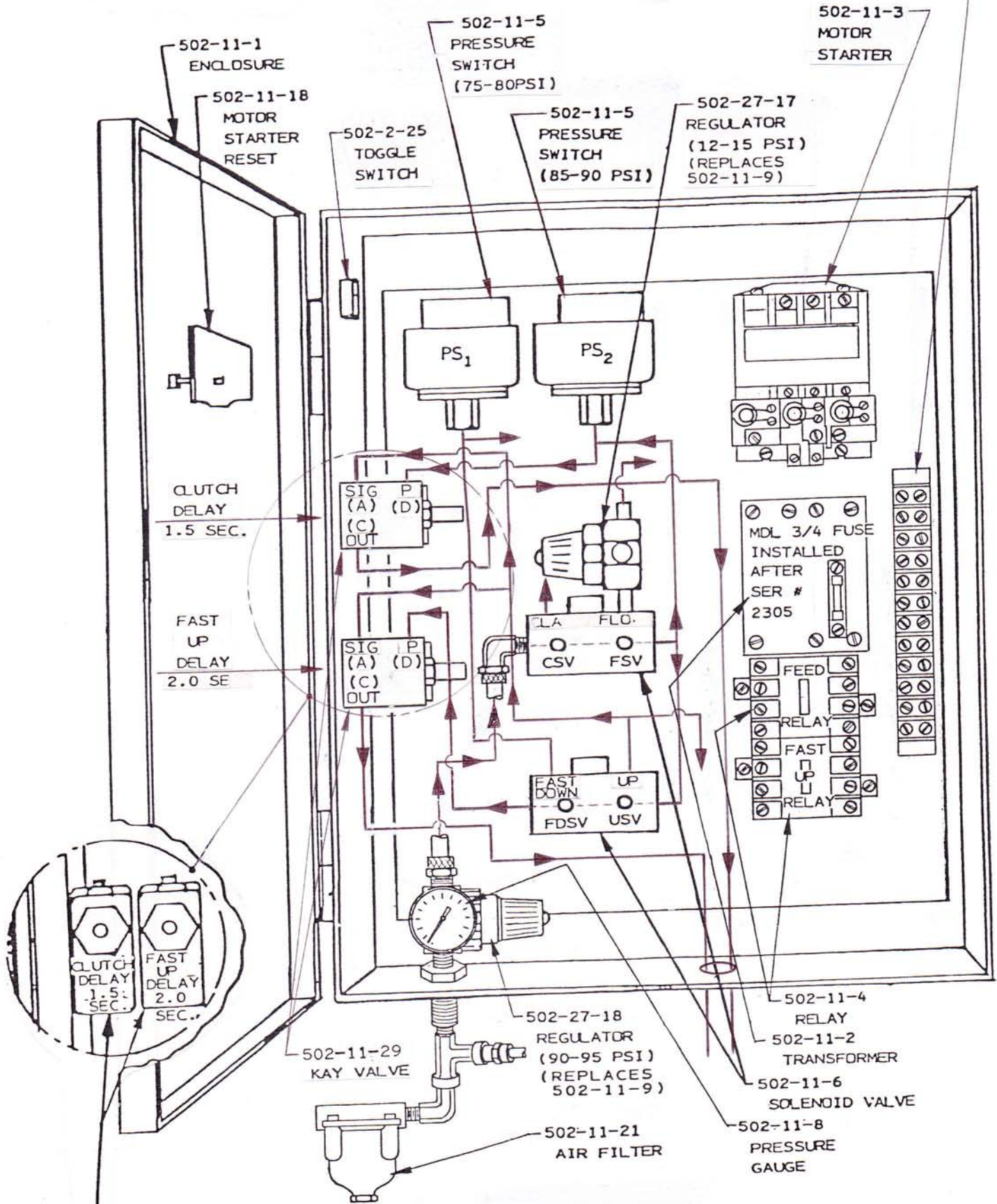




KAY VALVE ONLY:

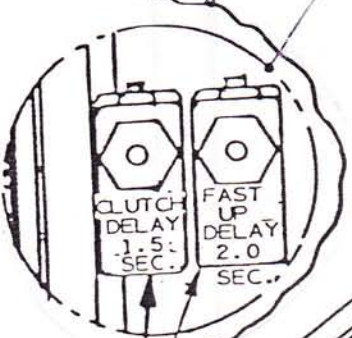
SIG (A)- SIGNAL PRESSURE
 P (D)- LINE PRESS.
 OUT (C)- CYL PRESS.

502-11-10
 TERMINAL
 STRIP



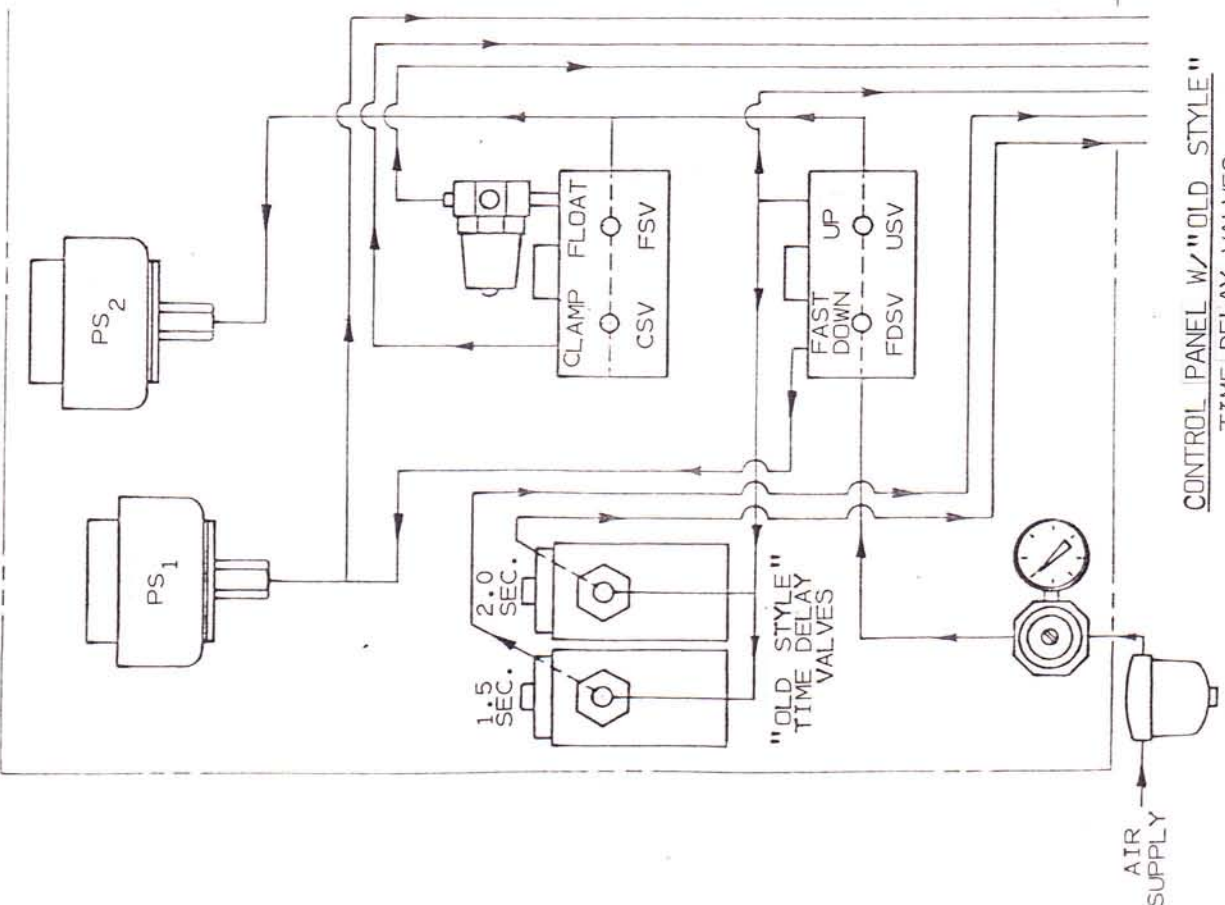
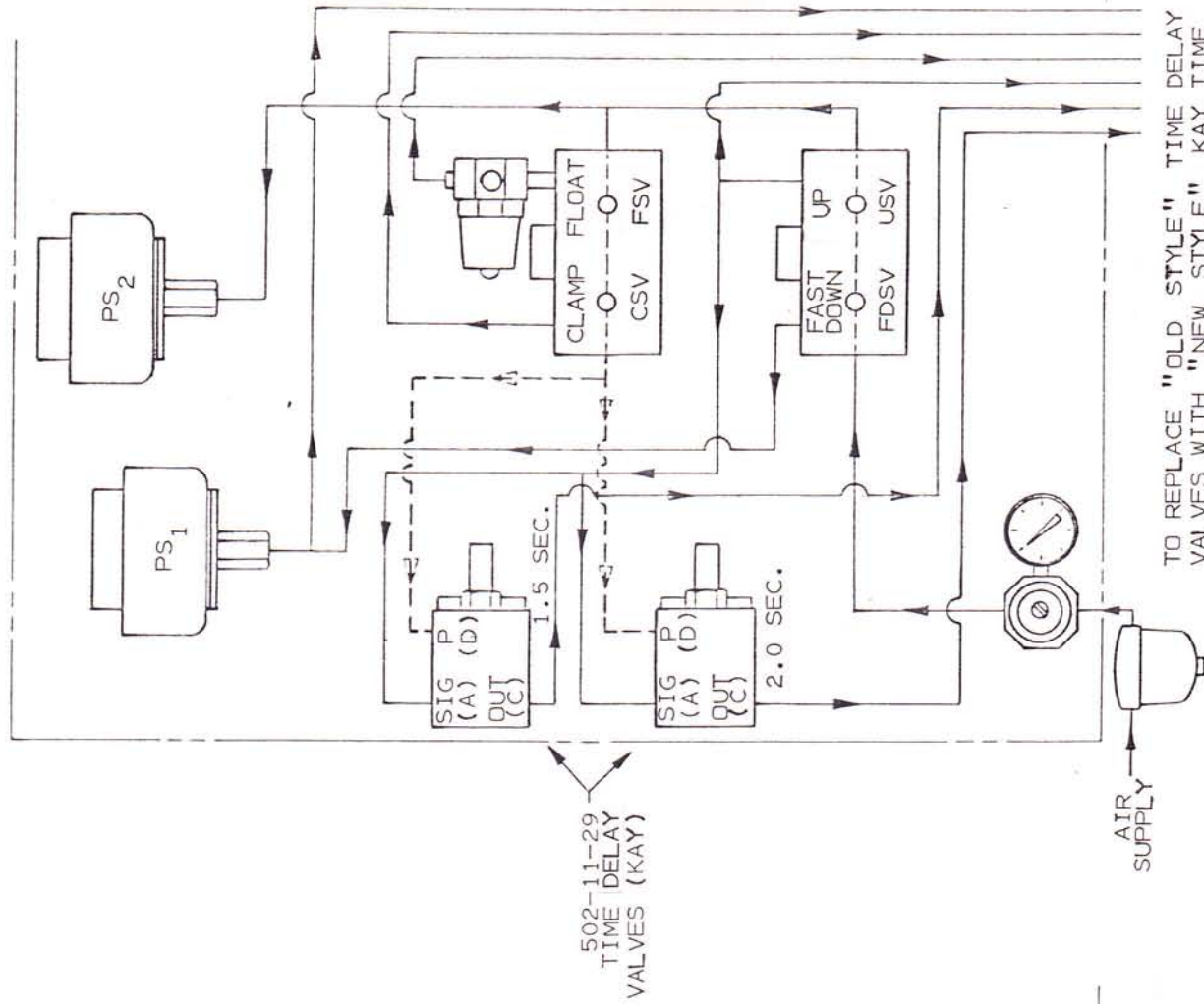
CLUTCH
 DELAY
 1.5 SEC.

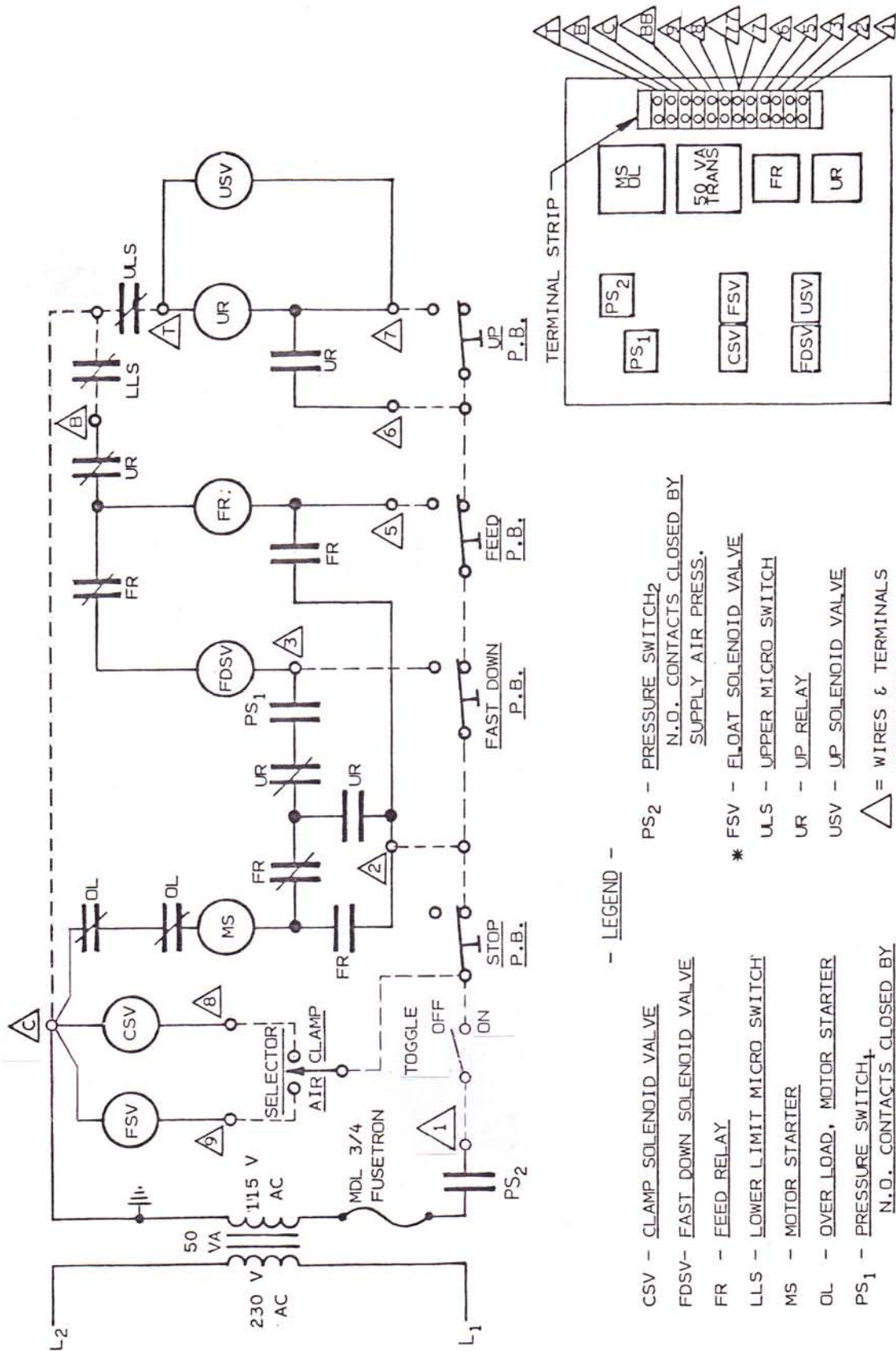
FAST
 UP
 DELAY
 2.0 SE



OLD STYLE 502-11-26 TIMAC VALVE
 OLD STYLE -26 ADDED SER #2229
 502-11-25 SEQ. VALVE WAS USED PRIOR
 PRIOR TO SER # 2188

AUTO CONTROL
 PANEL



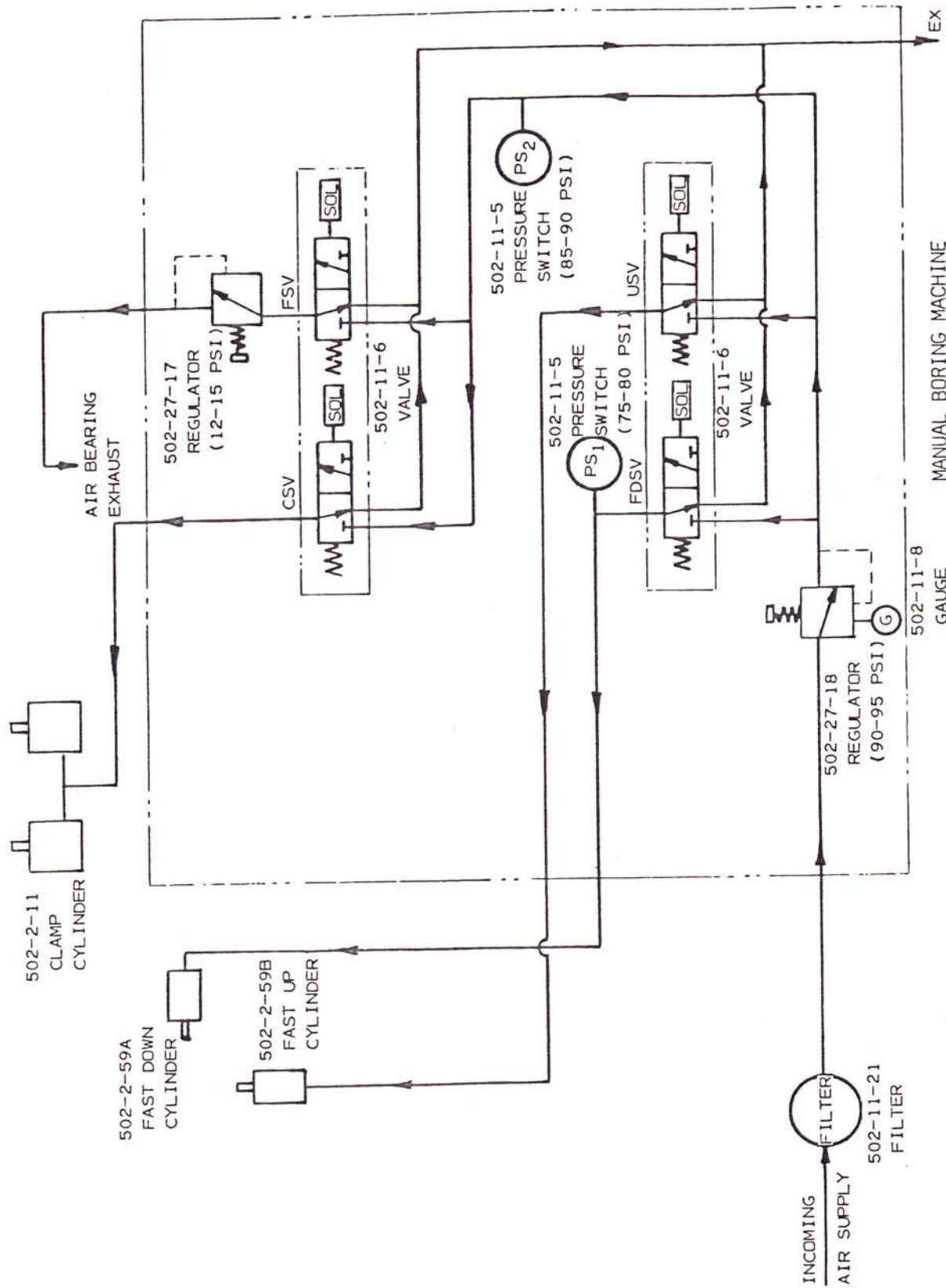


- LEGEND -
- CSV - CLAMP SOLENOID VALVE
 - FDSV - FAST DOWN SOLENOID VALVE
 - FR - FEED RELAY
 - LLS - LOWER LIMIT MICRO SWITCH
 - MS - MOTOR STARTER
 - OL - OVER LOAD, MOTOR STARTER
 - PS1 - PRESSURE SWITCH, N.O. CONTACTS CLOSED BY AIR PRESS. WHEN FDSV IS ENERGIZED
 - PS2 - CLAMP SOLENOID VALVE N.O.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

SCHEMATIC LAYOUT CONTROL PANEL

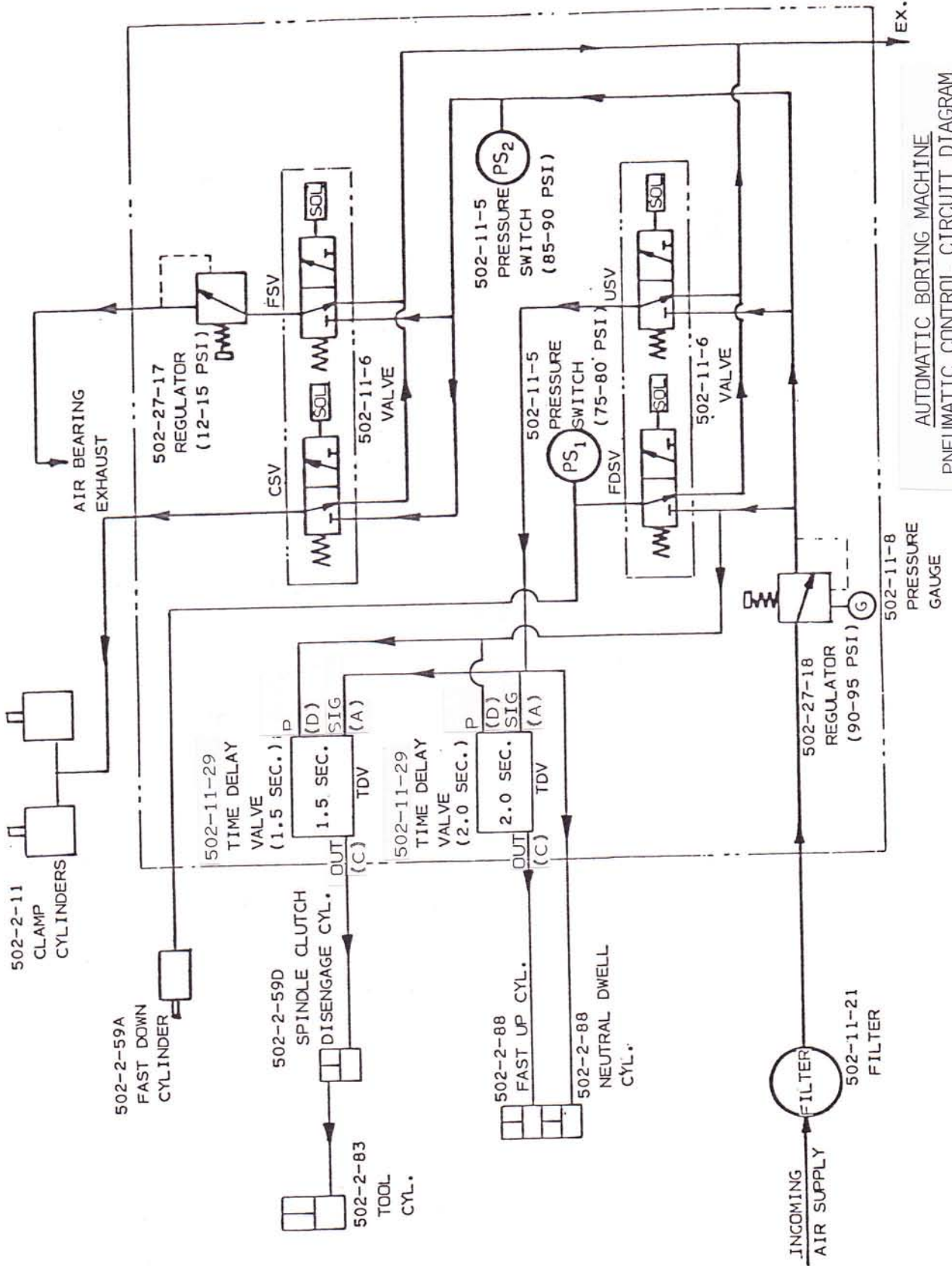
* FOR OLDER MACHINES FSV IS REFERRED TO AS LSV - LIFT SOLENOID VALVE

FA-1, FA-2 BORING MACHINE CONTROL CIRCUIT DIAGRAM

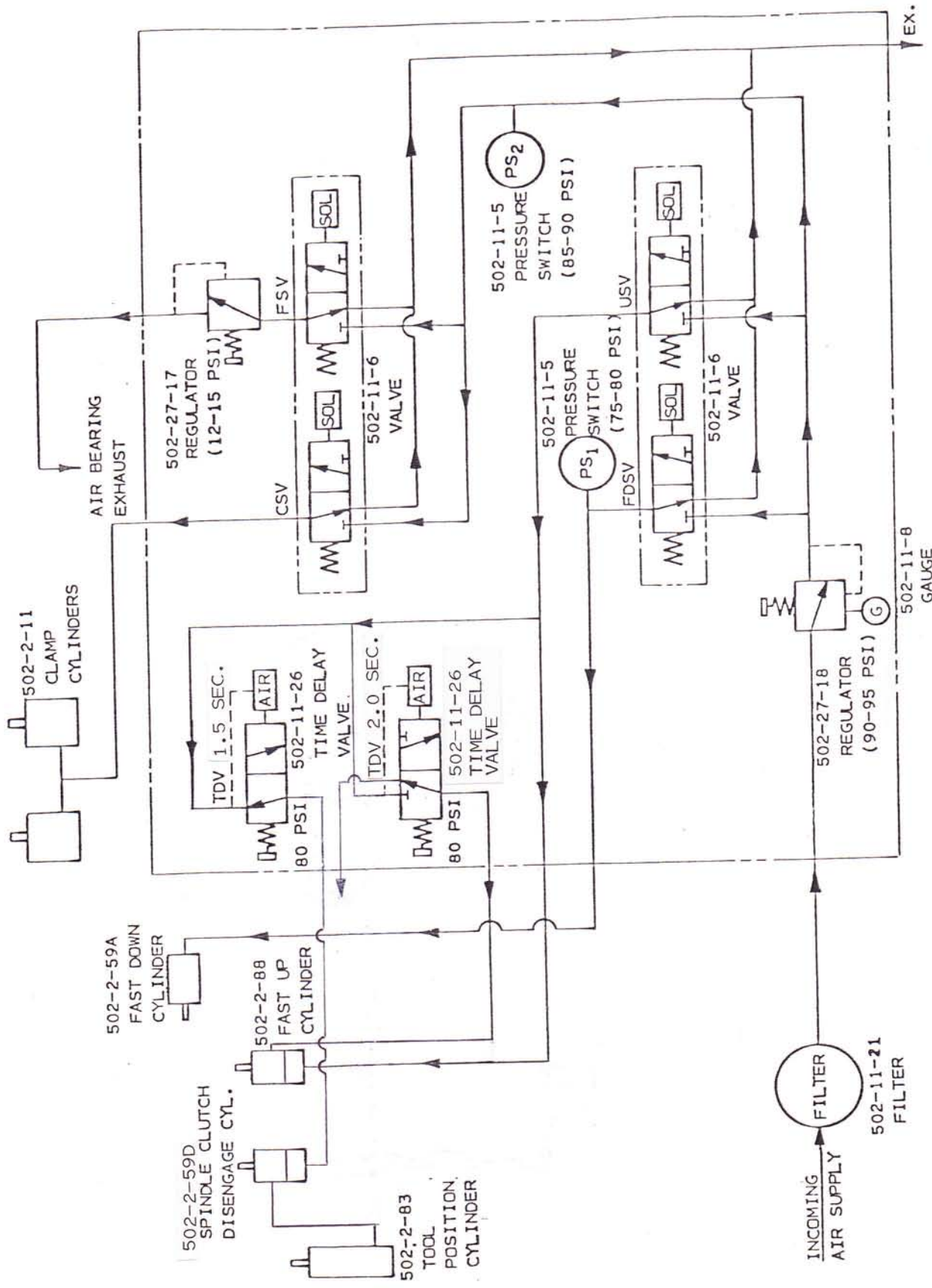


MANUAL BORING MACHINE

PNEUMATIC CONTROL CIRCUIT DIAGRAM

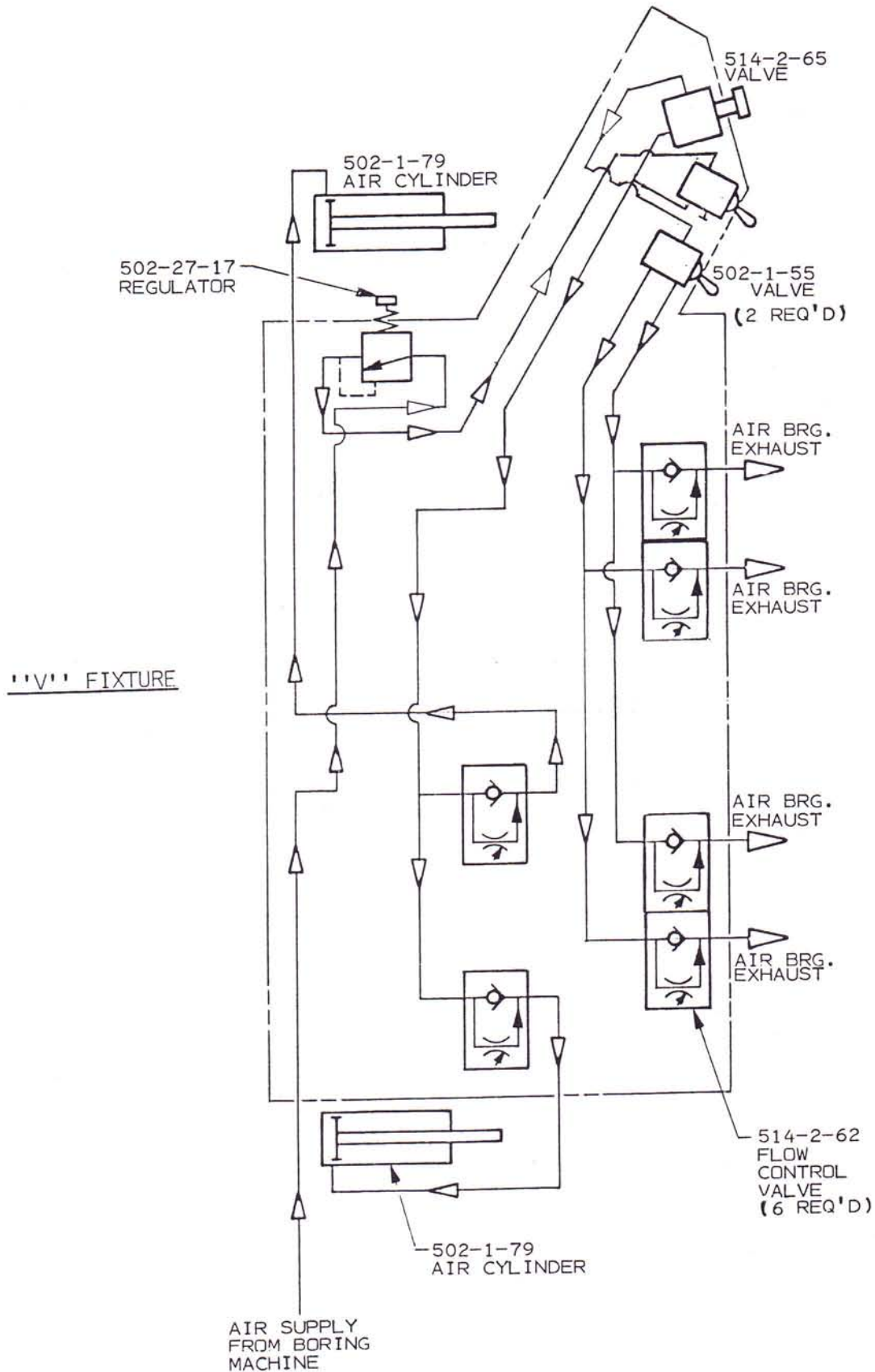


AUTOMATIC BORING MACHINE
PNEUMATIC CONTROL CIRCUIT DIAGRAM
WITH KAY TIME DELAY VALVES

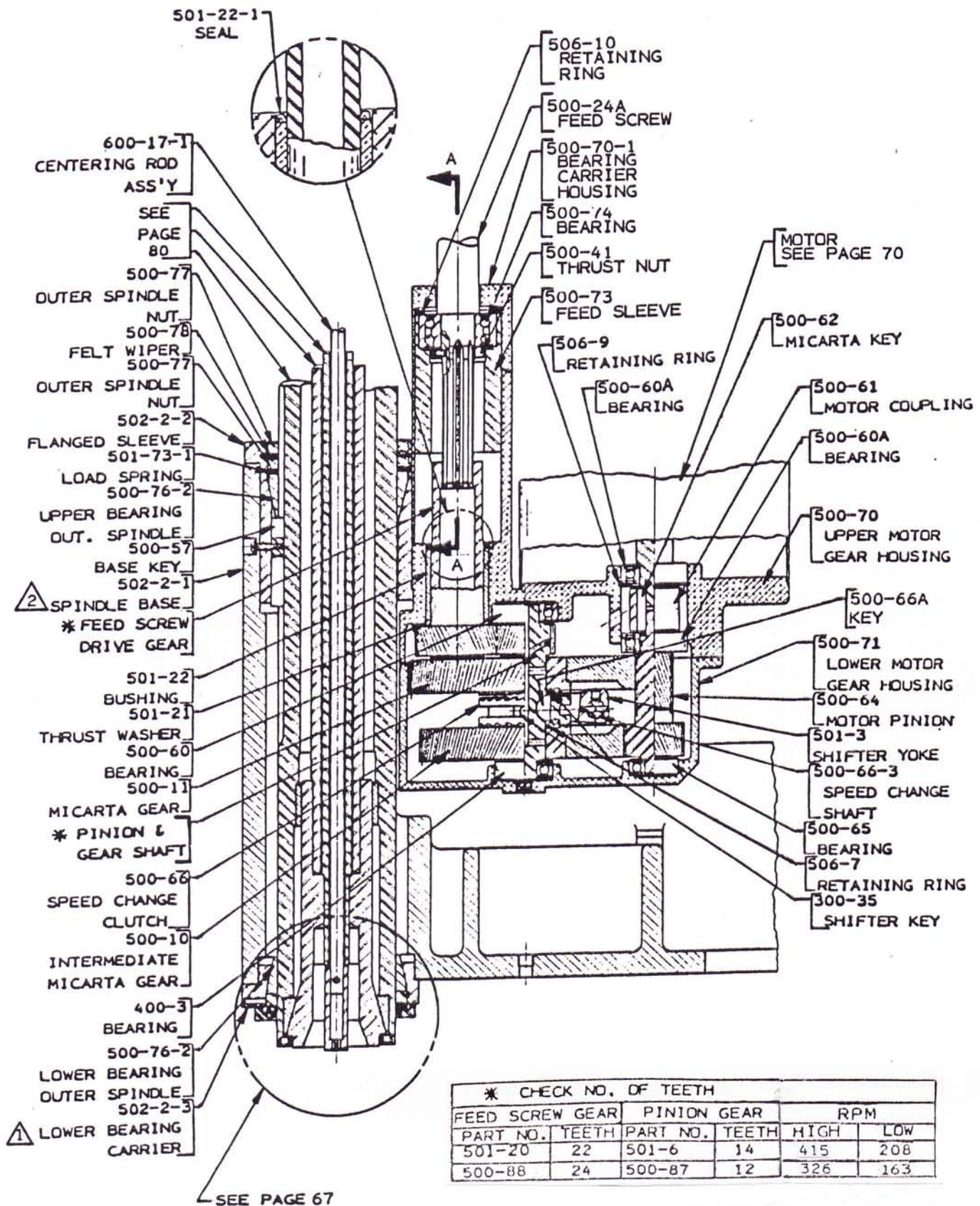


AUTO BORING MACHINE "OLD STYLE"
PNEUMATIC CONTROL CIRCUIT DIAGRAM

SYSTEM USED AFTER
SER. 2229 & PRIOR
TO KAY TIME VALVE.



'V' FIXTURE
PNEUMATIC CONTROL
CIRCUIT DIAGRAM



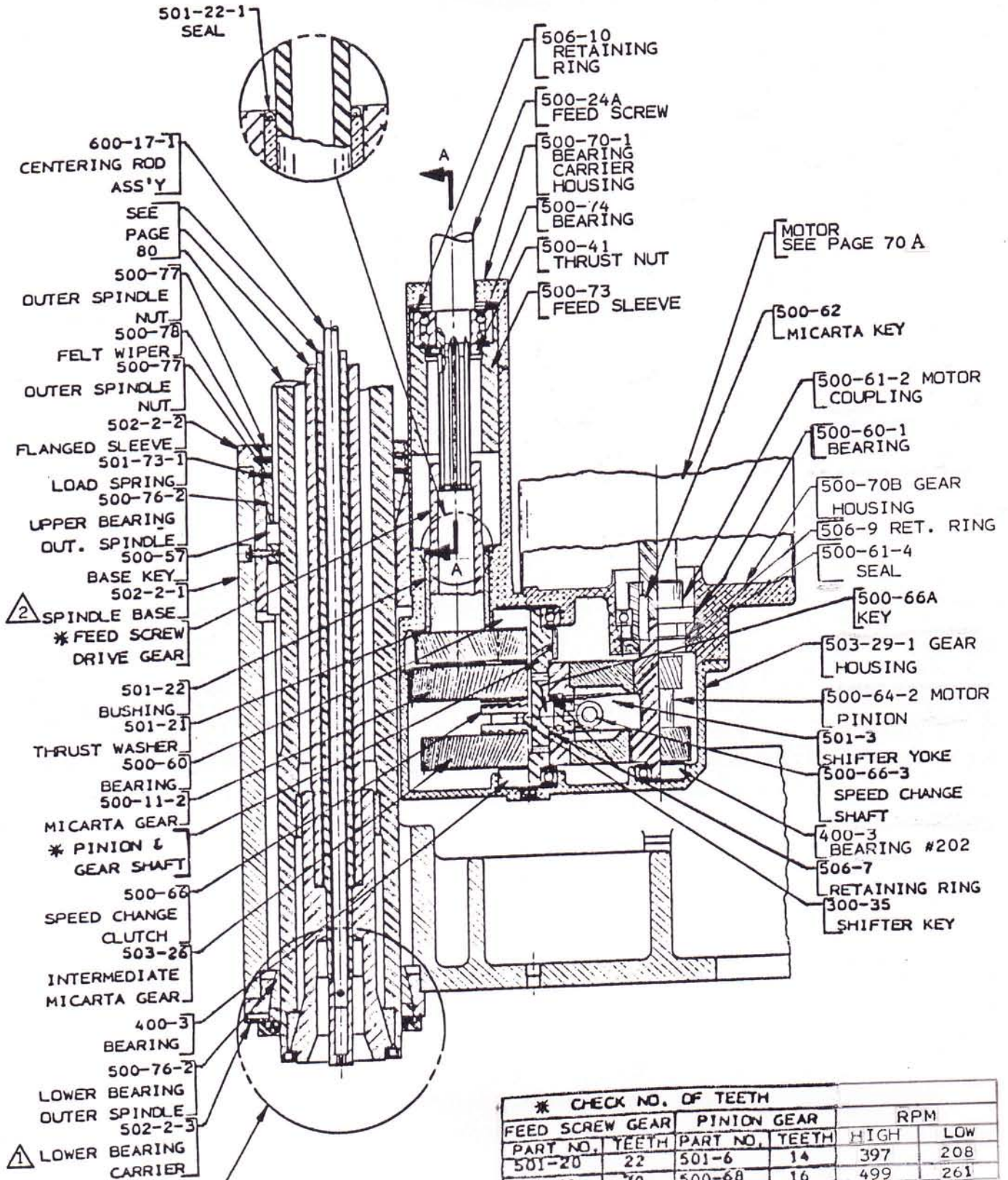
△ USE (502-2-3AR) BEARING CARRIER FOR RIGHT HAND FA-2MACB & (502-2-3AL) BEARING CARRIER FOR LEFT HAND FA-2MACB.

△ 2 LEFT SPINDLE BASE FOR FA-2MACB USE 502-2-1B.

SECTION B-B

FA-1B, FA-1AB,
FA-2B, FA-2AB,

FA-2 MAB (WITH 3450 R.P.M. GEAR BOX)
FA-2MACB



SEE PAGE 67

⚠ USE (502-2-3AR) BEARING CARRIER FOR RIGHT HAND FA-2MACB & (502-2-3AL) BEARING CARRIER FOR LEFT HAND FA-2MACB.

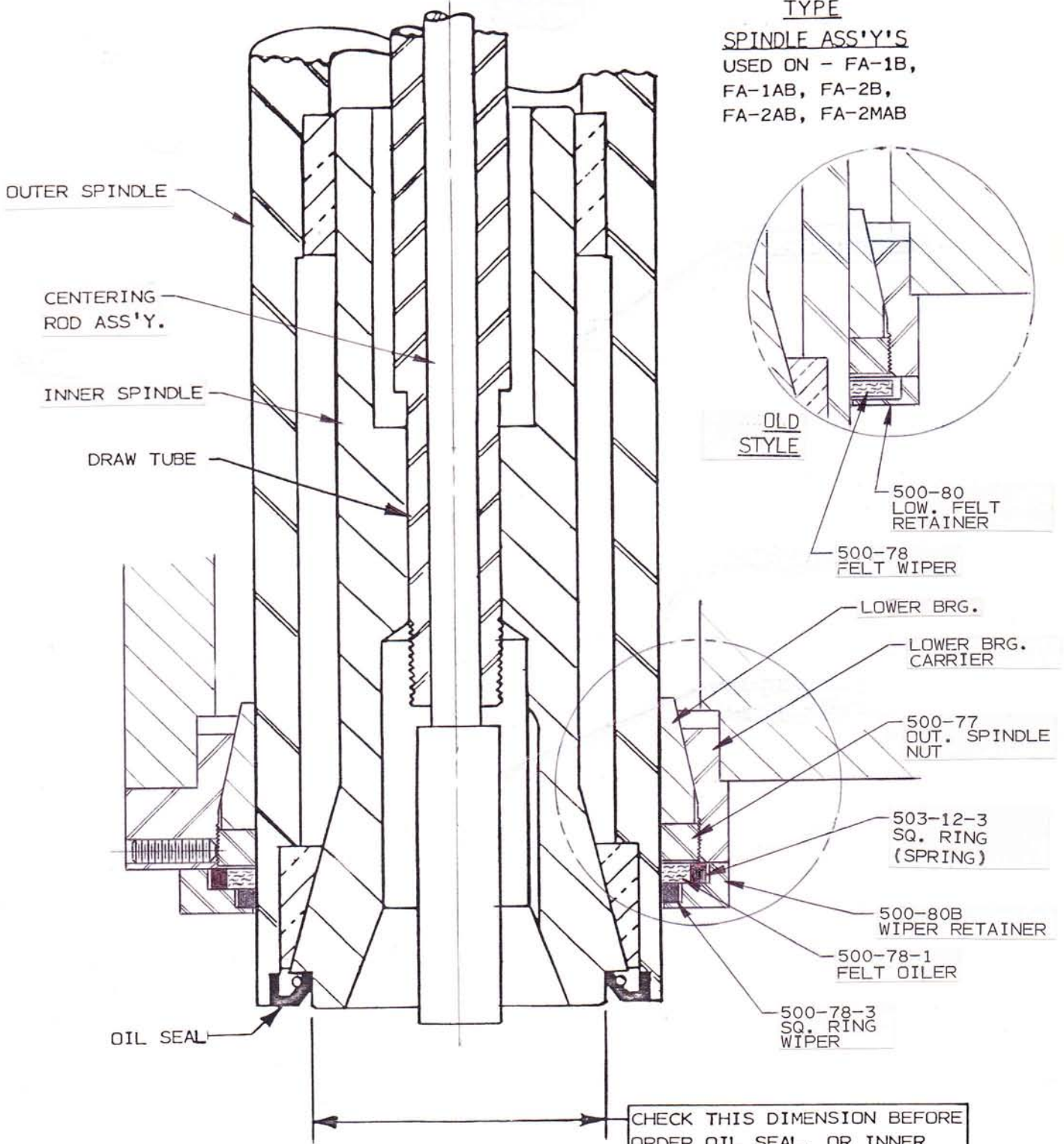
⚠ LEFT SPINDLE BASE FOR FA-2MACB USE 502-2-1B.

SECTION B-B
FA-2 MAB, FA-2MACB

w/ 1725 RPM motor

ALTERNATE "B"

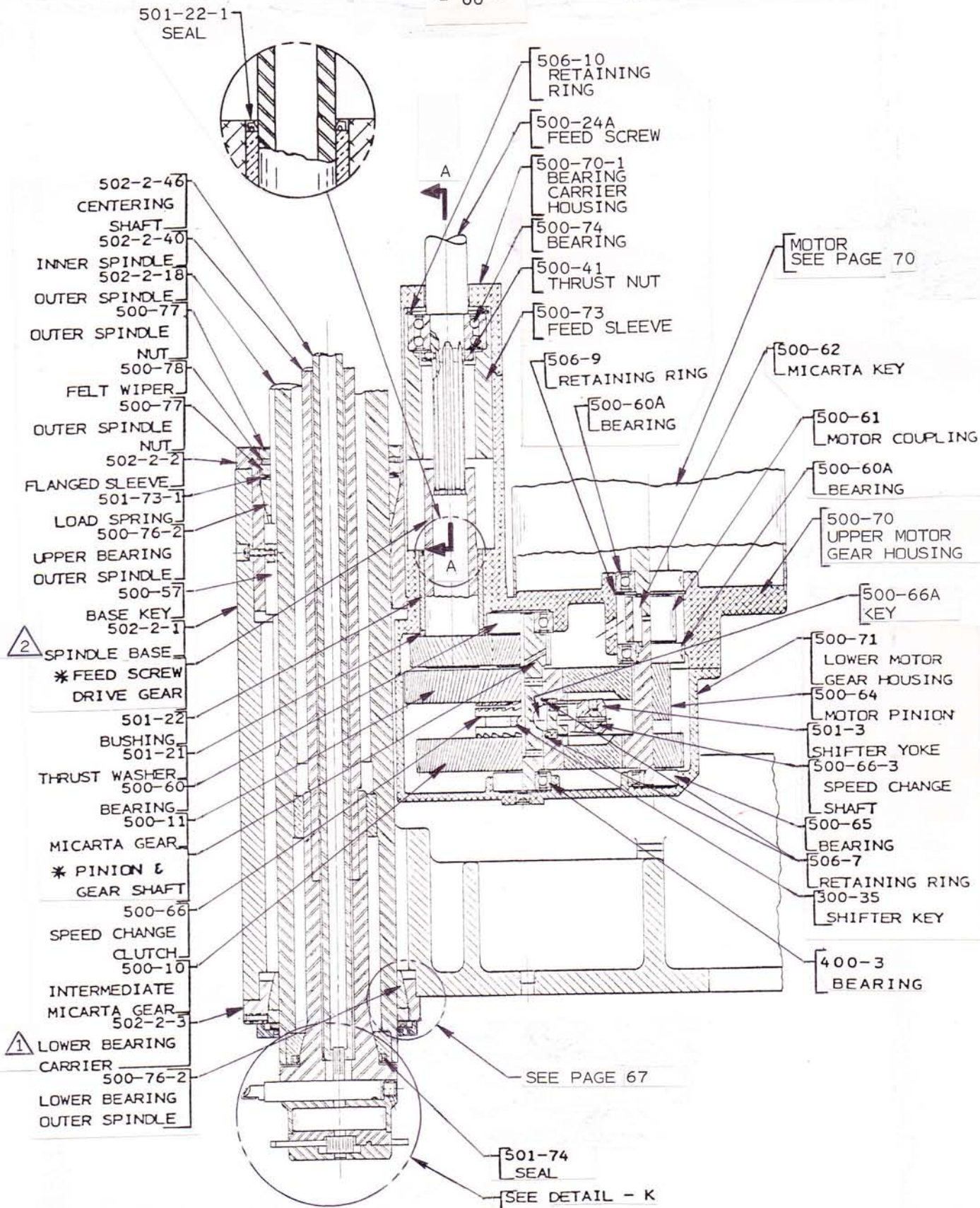
TYPE
SPINDLE ASS'Y'S
USED ON - FA-1B,
FA-1AB, FA-2B,
FA-2AB, FA-2MAB



CHECK THIS DIMENSION BEFORE ORDER OIL SEAL, OR INNER SPINDLE, OR OUTER SPINDLE, OR DRAW TUBE-

IF DIMENSION IS 2.066"
ORDER FROM THE FOLLOWING PARTS LIST=
OIL SEAL - 501-74A
INNER SPINDLE - 502-8-22
OUTER SPINDLE - 502-8-23
DRAW TUBE - 600-19C

IF DIMENSION IS 1.880"
ORDER FROM THE FOLLOWING PARTS LIST=
OIL SEAL - 501-74
INNER SPINDLE - 600-3
OUTER SPINDLE - 502-2-18
DRAW TUBE - 600-19



- 502-2-46 CENTERING SHAFT
- 502-2-40 INNER SPINDLE
- 502-2-18 OUTER SPINDLE
- 500-77 OUTER SPINDLE NUT
- 500-78 FELT WIPER
- 500-77 OUTER SPINDLE NUT
- 502-2-2 FLANGED SLEEVE
- 501-73-1 LOAD SPRING
- 500-76-2 UPPER BEARING OUTER SPINDLE
- 500-57 BASE KEY
- 502-2-1 SPINDLE BASE
- * FEED SCREW DRIVE GEAR
- 501-22 BUSHING
- 501-21 THRUST WASHER
- 500-60 BEARING
- 500-11 MICARTA GEAR
- * PINION & GEAR SHAFT
- 500-66 SPEED CHANGE CLUTCH
- 500-10 INTERMEDIATE MICARTA GEAR
- 502-2-3 LOWER BEARING CARRIER
- 500-76-2 LOWER BEARING OUTER SPINDLE

- 506-10 RETAINING RING
- 500-24A FEED SCREW
- 500-70-1 BEARING CARRIER HOUSING
- 500-74 BEARING
- 500-41 THRUST NUT
- 500-73 FEED SLEEVE
- 506-9 RETAINING RING
- 500-60A BEARING
- 500-62 MICARTA KEY
- 500-61 MOTOR COUPLING
- 500-60A BEARING
- 500-70 UPPER MOTOR GEAR HOUSING
- 500-66A KEY
- 500-71 LOWER MOTOR GEAR HOUSING
- 500-64 MOTOR PINION
- 501-3 SHIFTER YOKE
- 500-66-3 SPEED CHANGE SHAFT
- 500-65 BEARING
- 506-7 RETAINING RING
- 500-35 SHIFTER KEY
- 400-3 BEARING

MOTOR SEE PAGE 70

SEE PAGE 67

501-74 SEAL
SEE DETAIL - K
PAGE 69

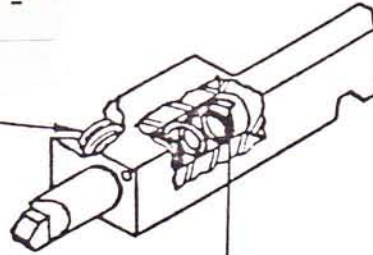
① USE (502-2-3AR) BEARING CARRIER FOR RIGHT HAND FA-2MAC & (502-2-3AL) BEARING CARRIER FOR LEFT HAND FA-2MAC.

② LEFT SPINDLE BASE FOR FA-2MAC USE 502-2-1B.

SECTION B-B
FA-1, FA-1A,
FA-2, FA-2A,
FA-2MA, FA-2MAC

* CHECK NO. OF TEETH					
FEED SCREW GEAR		PINION GEAR		RPM	
PART NO.	TEETH	PART NO.	TEETH	HIGH	LOW
501-20	22	501-6	14	415	208
500-88	24	500-87	12	326	163

502-25-1
TOOL BIT
LOCKING
SCREW



200-1-6C (1 ⁷/₁₆)

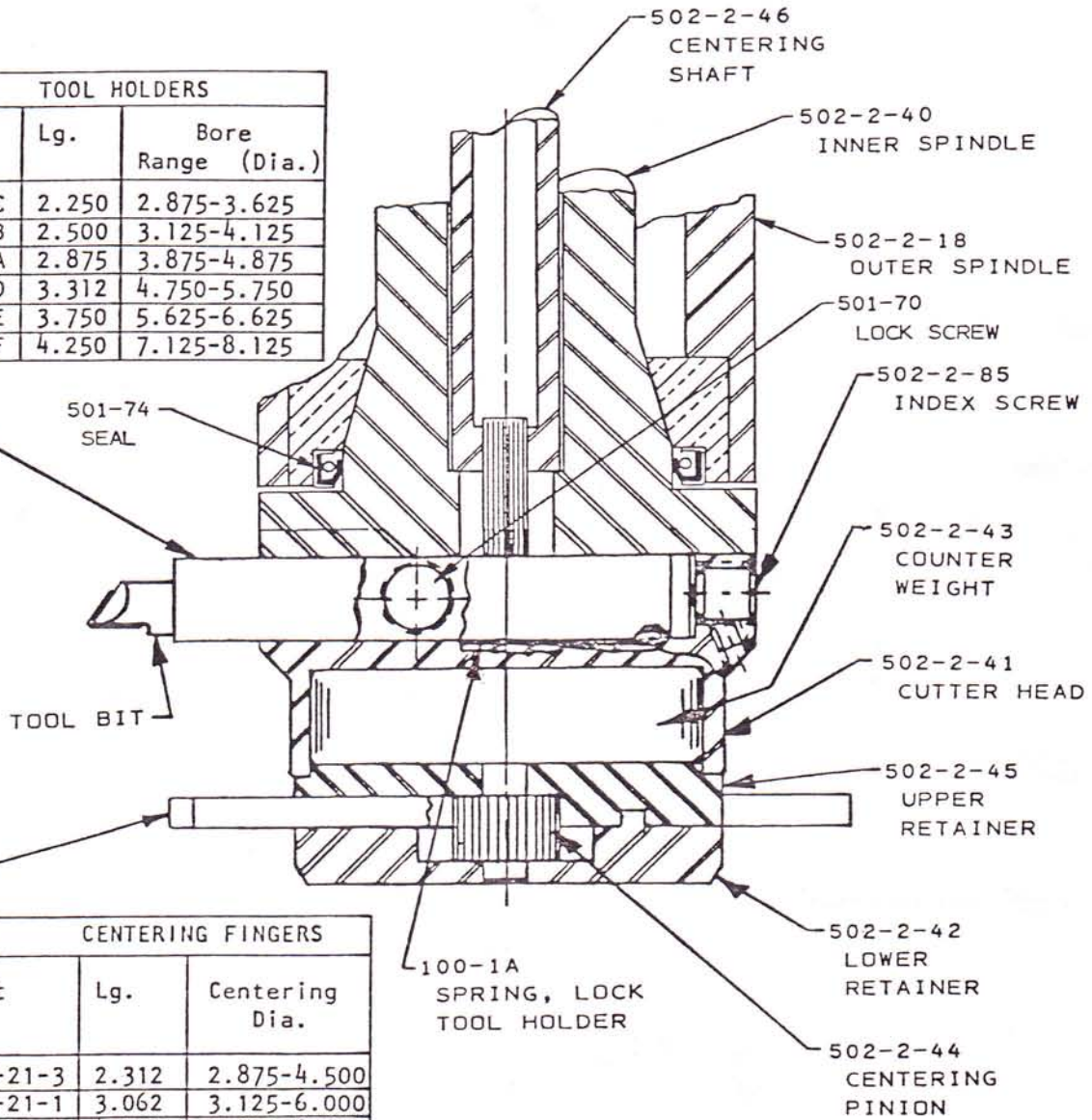
200-1-6D (3/4)

SPRING TOOL
BIT

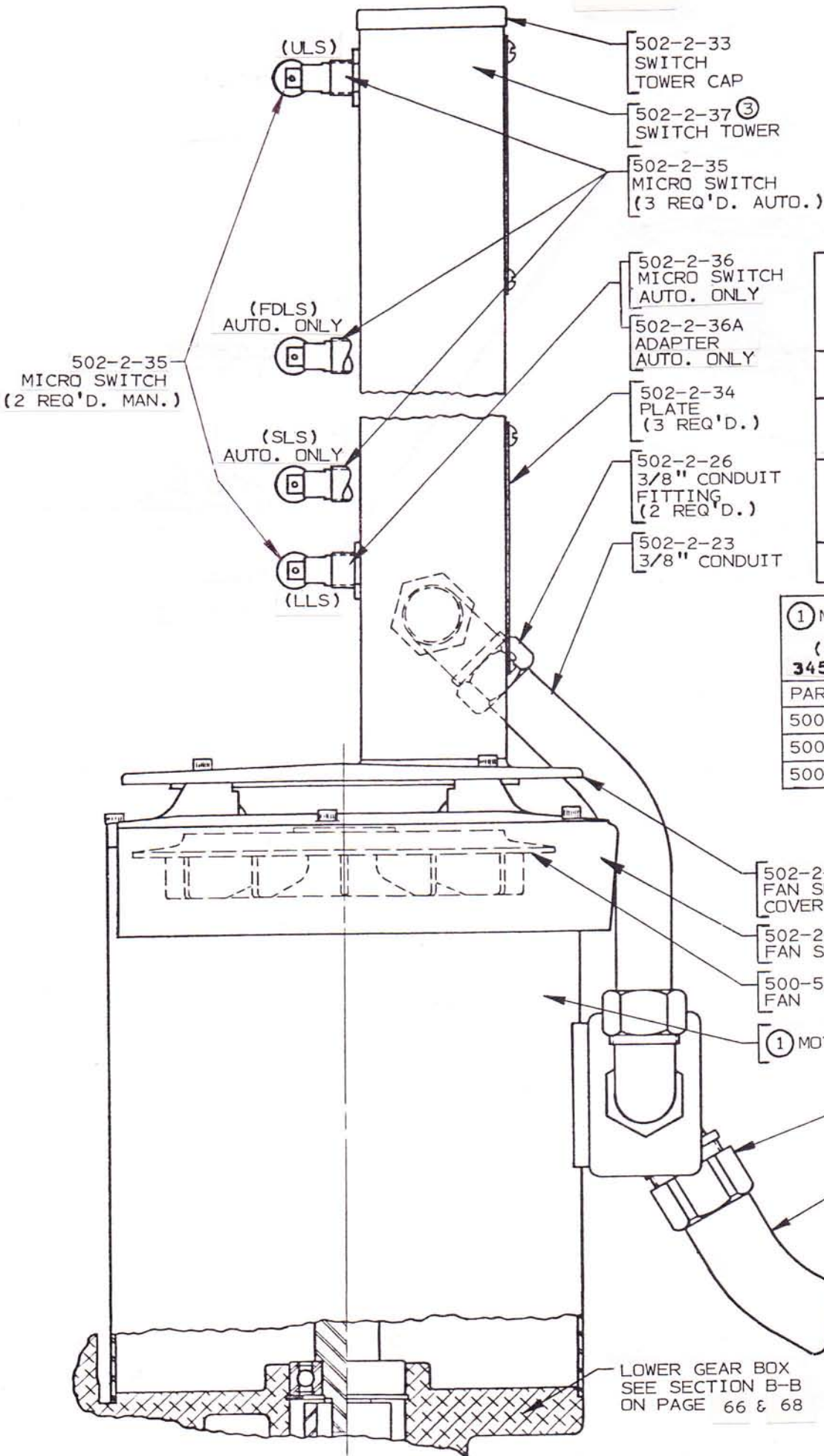
NOTE:
USE WITH MICROMETER
ASSEMBLY
900-2-5

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



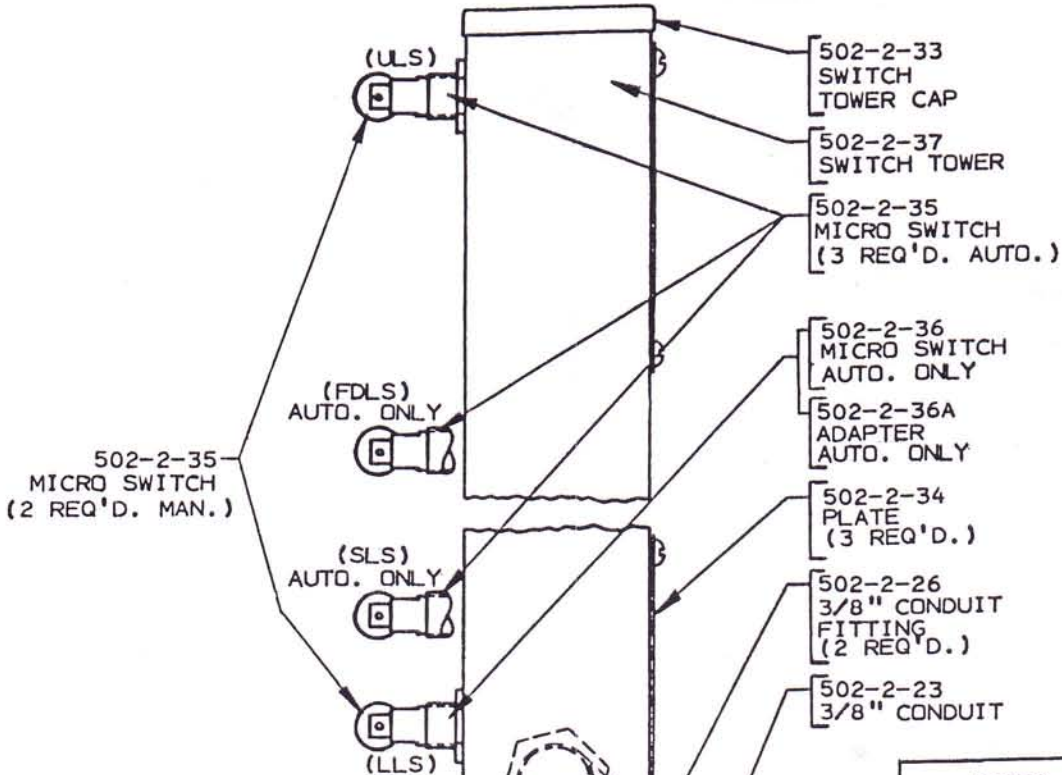
CENTERING FINGERS		
Part No.	Lg.	Centering Dia.
200-21-3	2.312	2.875-4.500
200-21-1	3.062	3.125-6.000
200-21-2	4.125	5.000-8.250



RELIANCE MOTOR & PARTS USED WITH RELIANCE MOTOR ONLY	
(2)	RELIANCE MOTOR 507-8
(3)	SWITCH TOWER 504-32-1 W/SPACER 500-96-1
(4)	FAN COVER 507-8-1A W/REINFORCEMENT PLATE 504-32-3
(5)	FAN 507-8A

NOTE: CHECK HP, VOLTS, & PH. BEFORE ORDERING.			
(1) MOTOR (G.E.) 3450 R.P.M.			
PART NO.	HP	VOLTS	PHASE
500-55	1	230/460	3
500-55-2	1-1/2	230/460	3
500-55K	1-1/2	200	3

MOTOR & SWITCH TOWER



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

(FDLS)
AUTO. ONLY

(SLS)
AUTO. ONLY

(LLS)

502-2-33
SWITCH
TOWER CAP

502-2-37
SWITCH TOWER

502-2-35
MICRO SWITCH
(3 REQ'D. AUTO.)

502-2-36
MICRO SWITCH
AUTO. ONLY

502-2-36A
ADAPTER
AUTO. ONLY

502-2-34
PLATE
(3 REQ'D.)

502-2-26
3/8" CONDUIT
FITTING
(2 REQ'D.)

502-2-23
3/8" CONDUIT

MOTOR (G.E.)	NOTE: CHECK HP, VOLTS, & PH. BEFORE ORDERING.			
PART NO.	HP	VOLTS	PHASE	RPM
500-55 E	1	230/460	3	1725

502-2-31
FAN SHROUD
COVER

502-2-30
FAN SHROUD

500-55-5
FAN

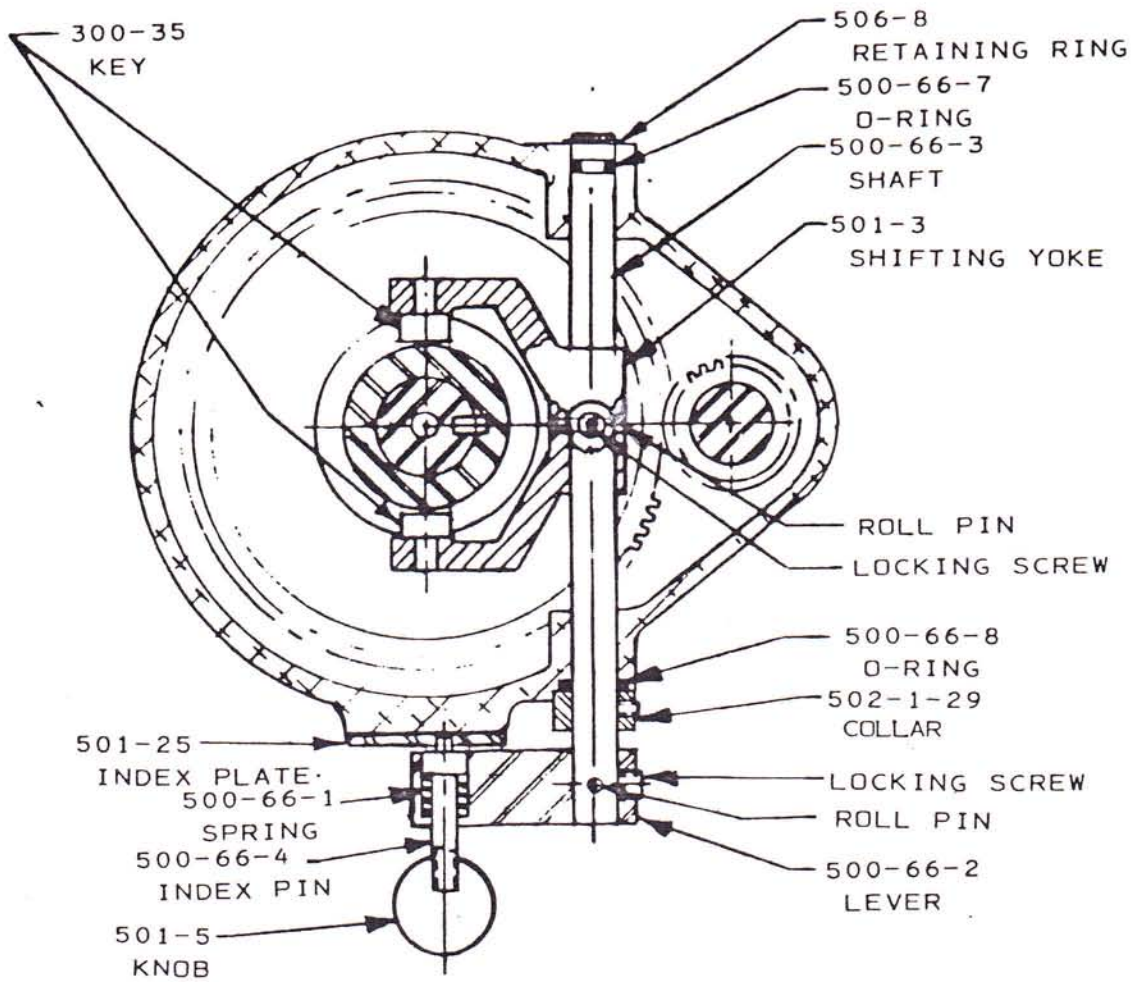
① MOTOR

514-3-94
1/2" CONDUIT
FITTING

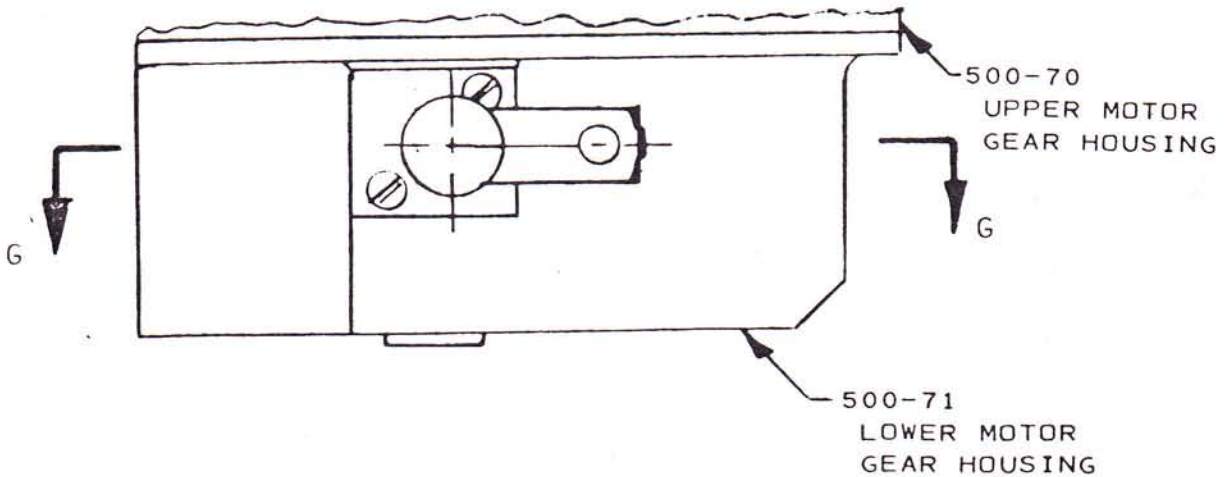
502-2-23A
1/2" CONDUIT

LOWER GEAR BOX
SEE SECTION B-B
ON PAGE 66 & 68

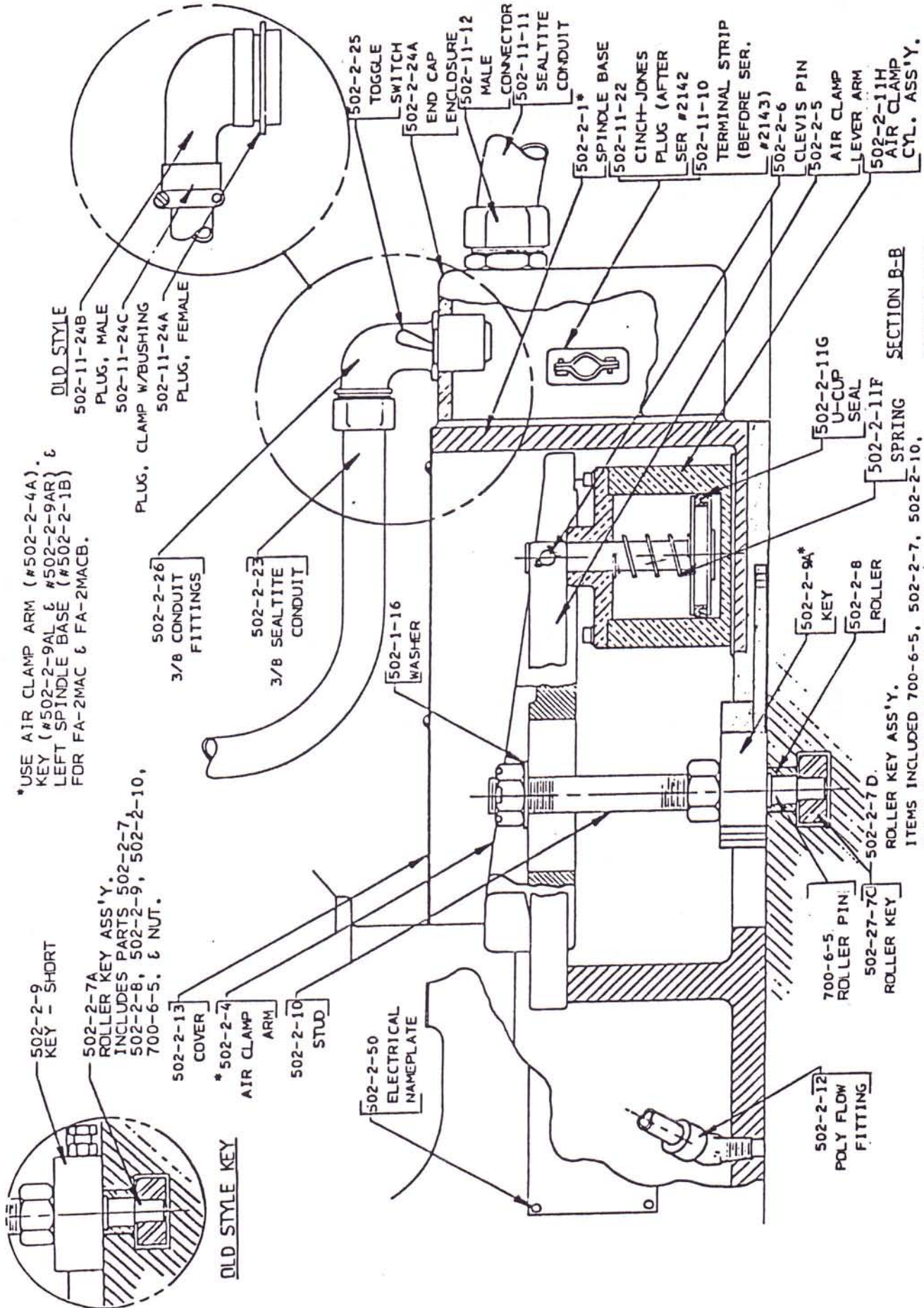
MOTOR & SWITCH TOWER



SECTION G-G



SPEED CONTROL
LOWER MOTOR HOUSING

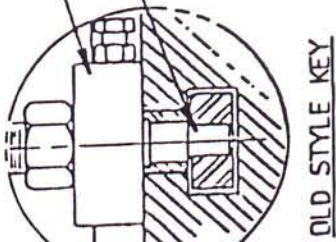


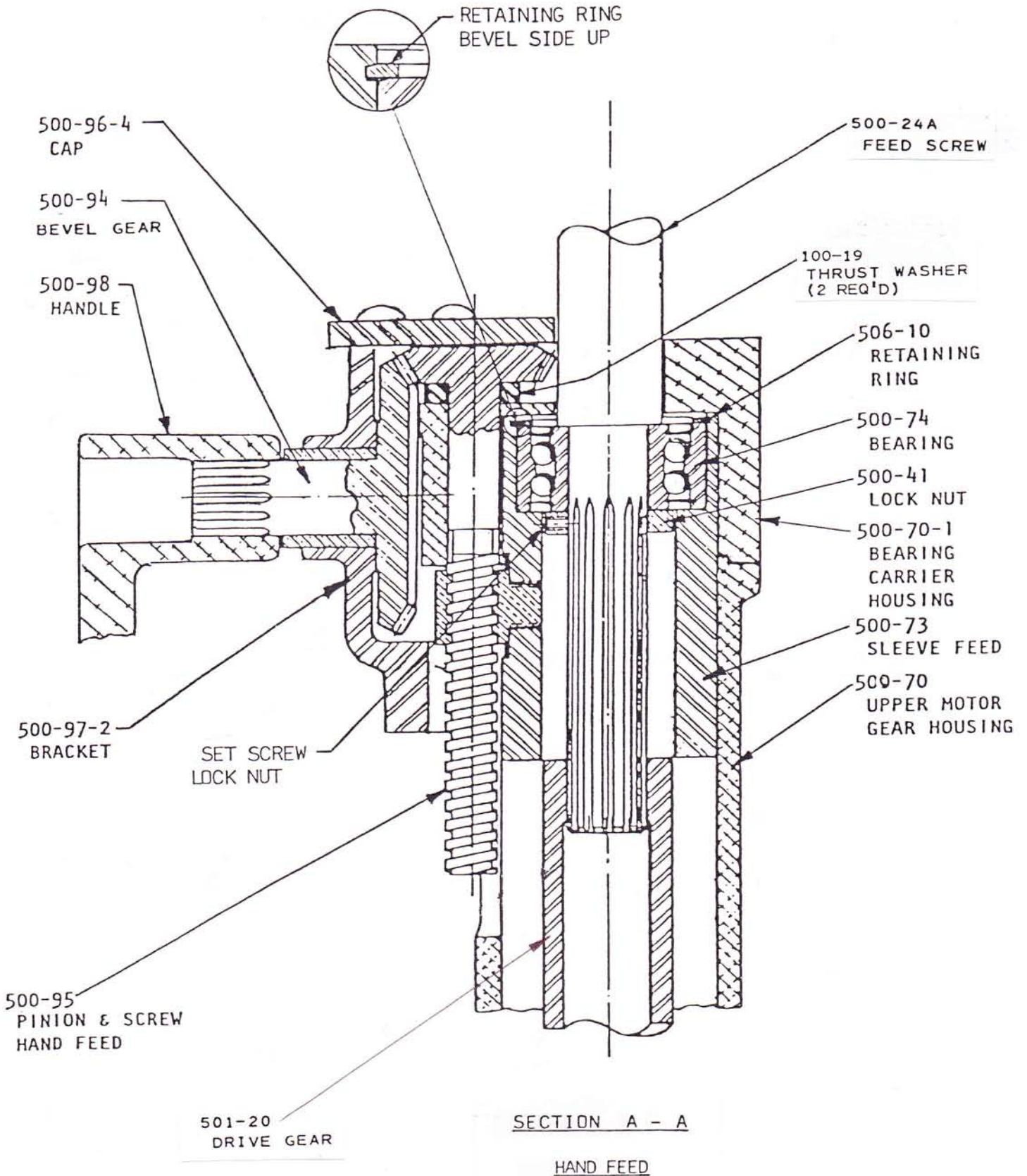
SECTION B-B

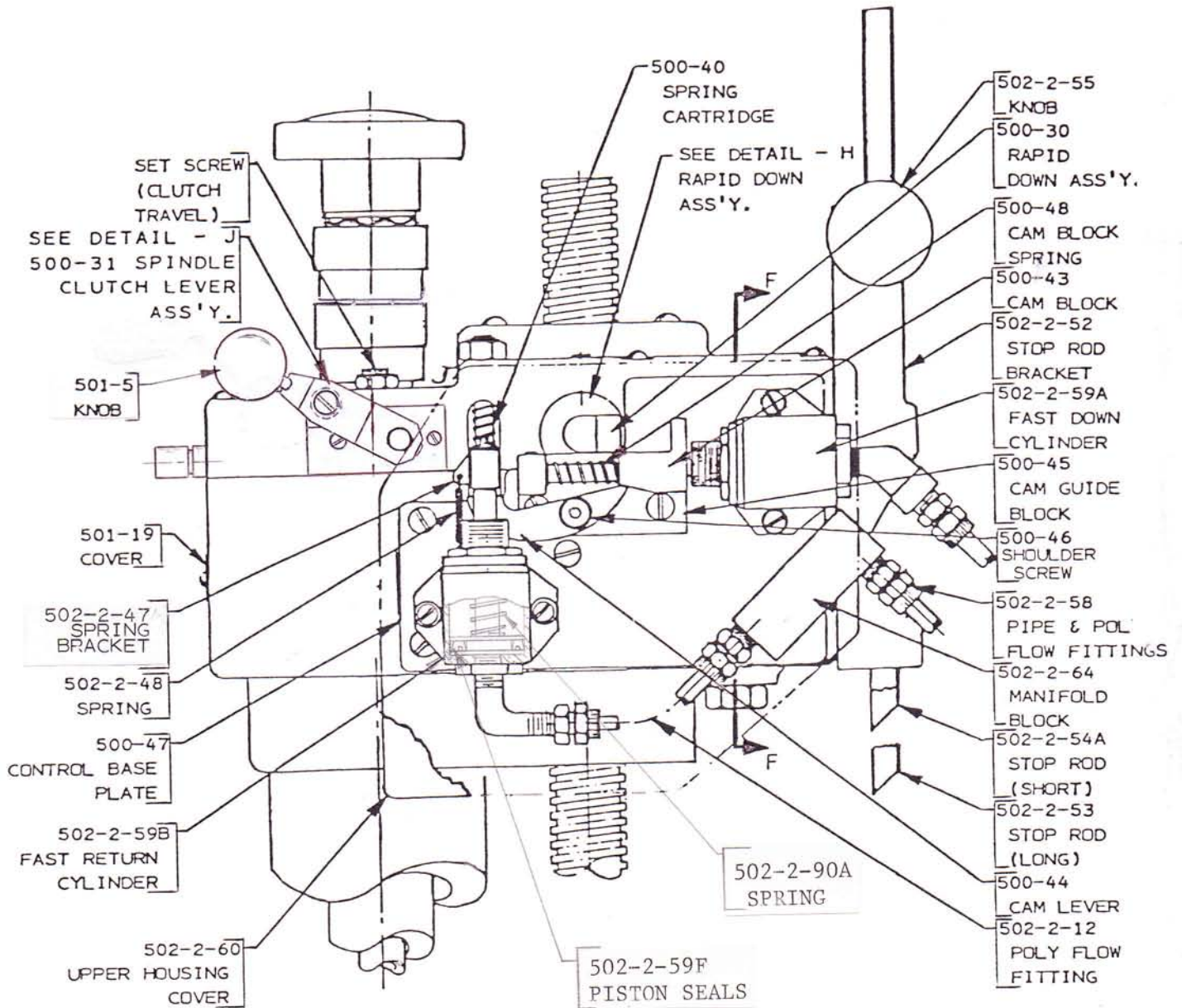
SPINDLE BASE

FA-24-MAB
BORING MACHINE

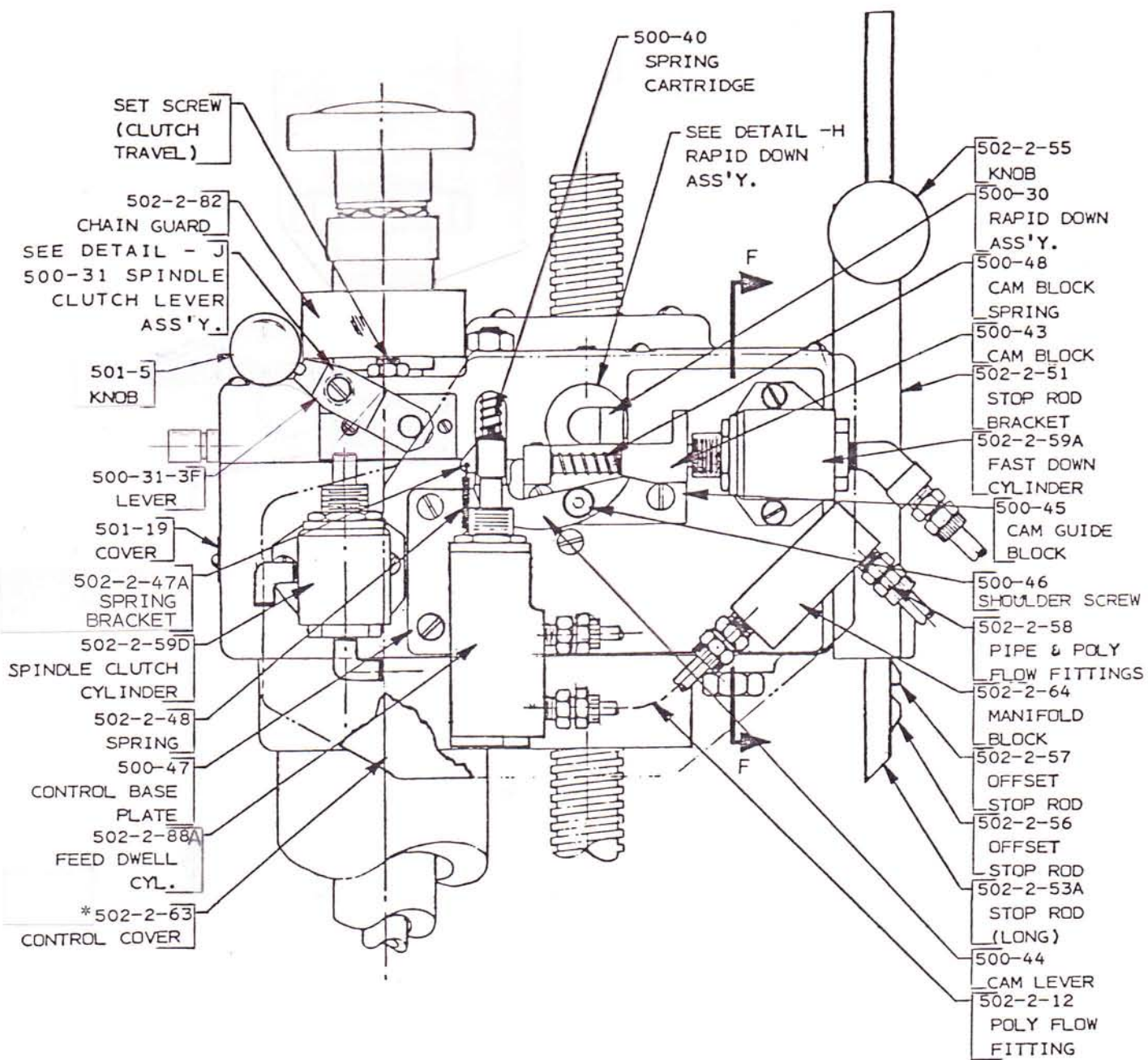
*USE AIR CLAMP ARM (#502-2-4A), KEY (#502-2-9A) & #502-2-9AR) & LEFT SPINDLE BASE (#502-2-1B) FOR FA-2MAC & FA-2MACB.







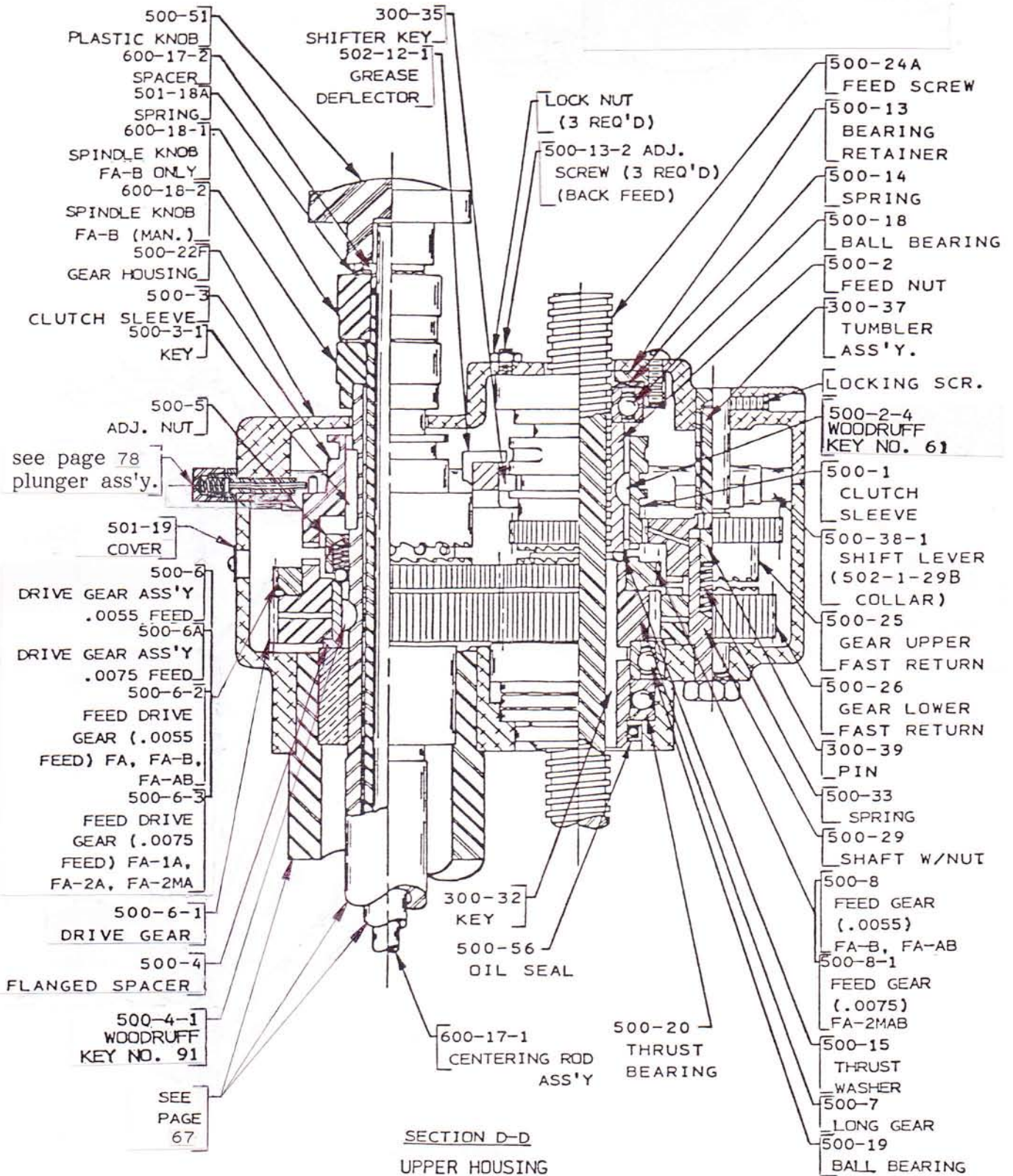
VIEW E-E
UPPER HOUSING CONTROLS
(MANUAL) FA-2B SHOWN

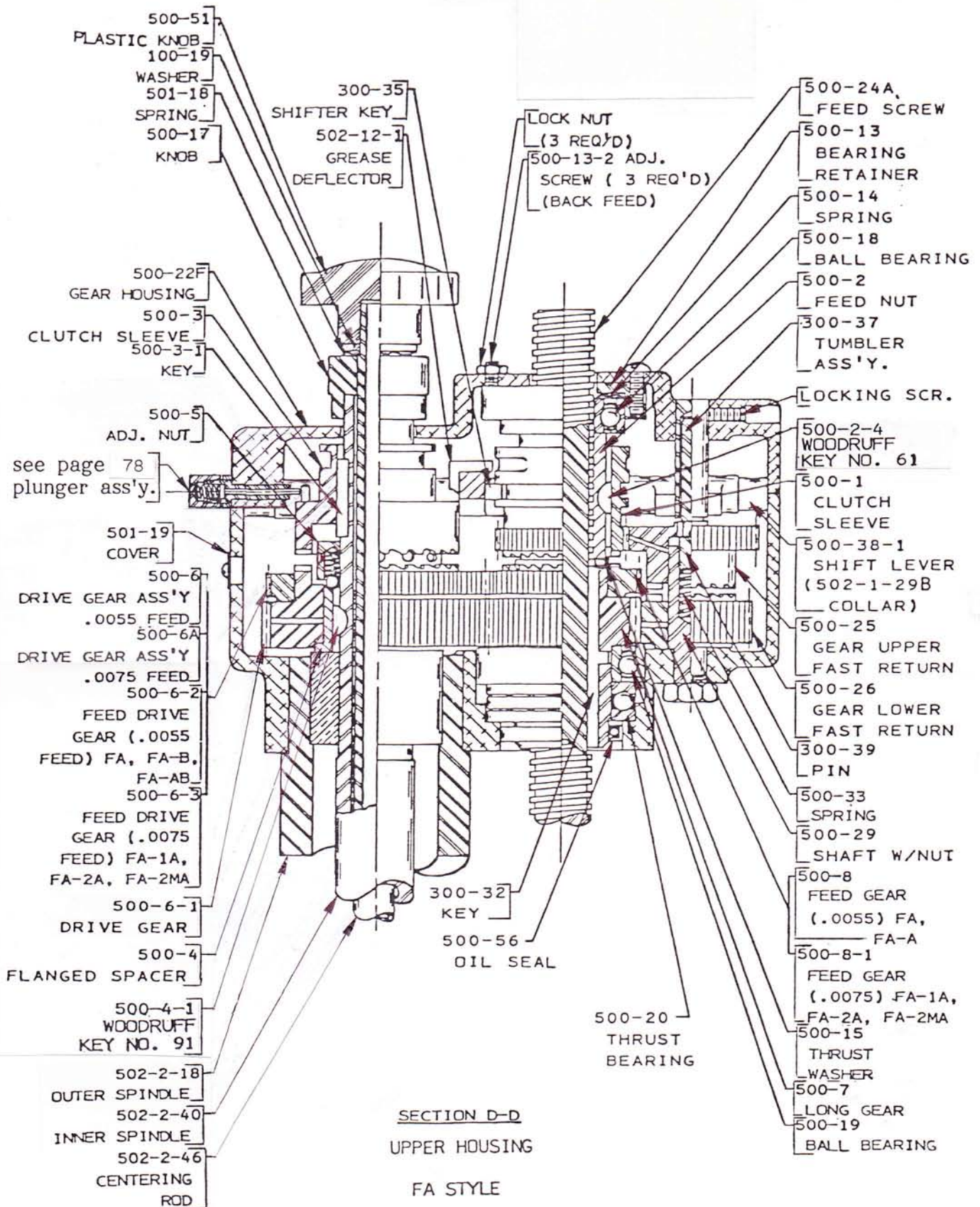


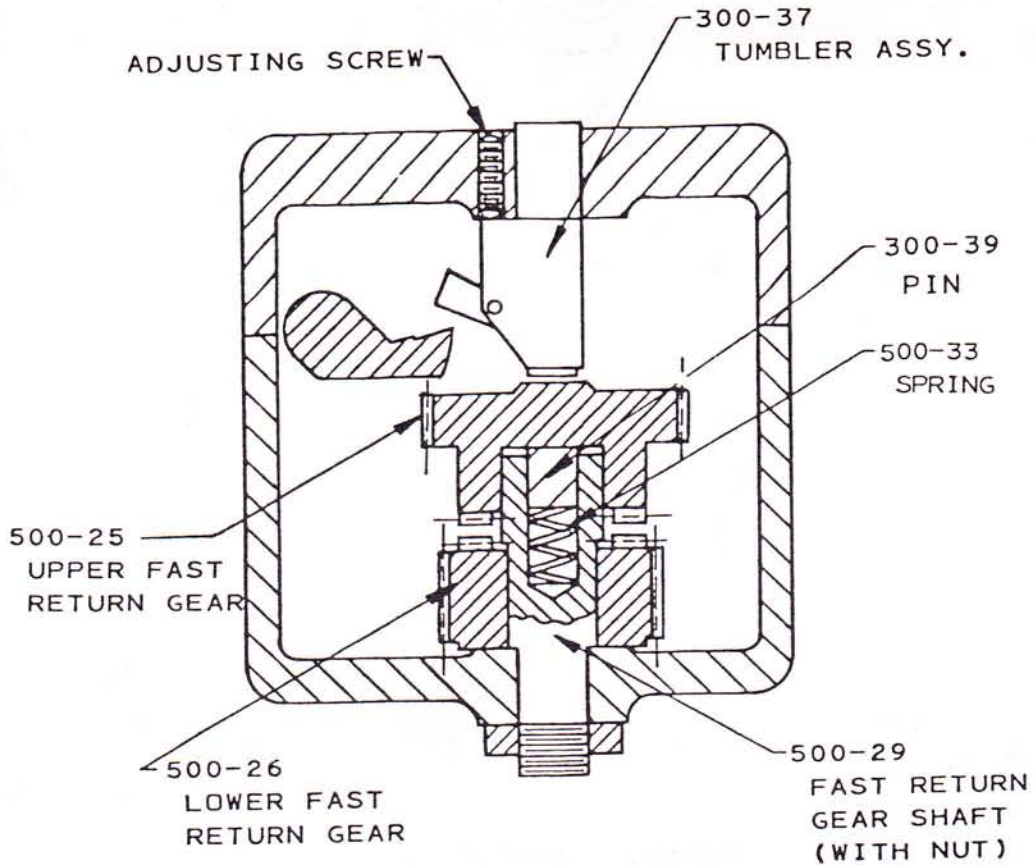
VIEW E-E

UPPER HOUSING CONTROLS,
(AUTO.) FA-2AB SHOWN

*USE CONTROL COVER (#502-2-63B)
FOR LEFT HAND FA-2MAC &FA-2MACB.

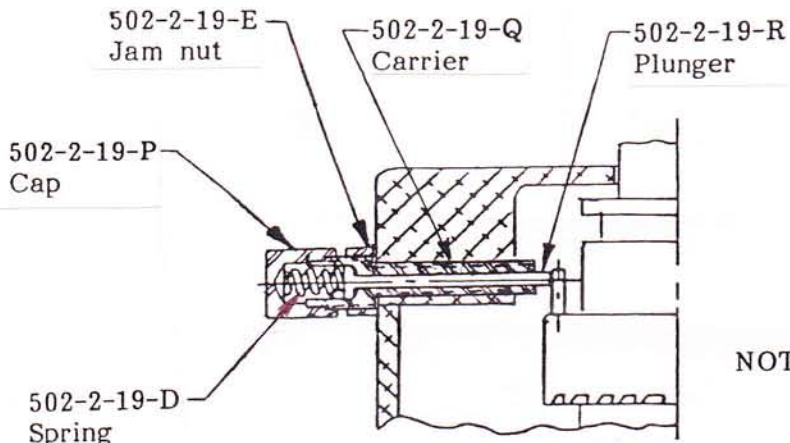






SECTION F - F

ASSEMBLY #502-2-19 V

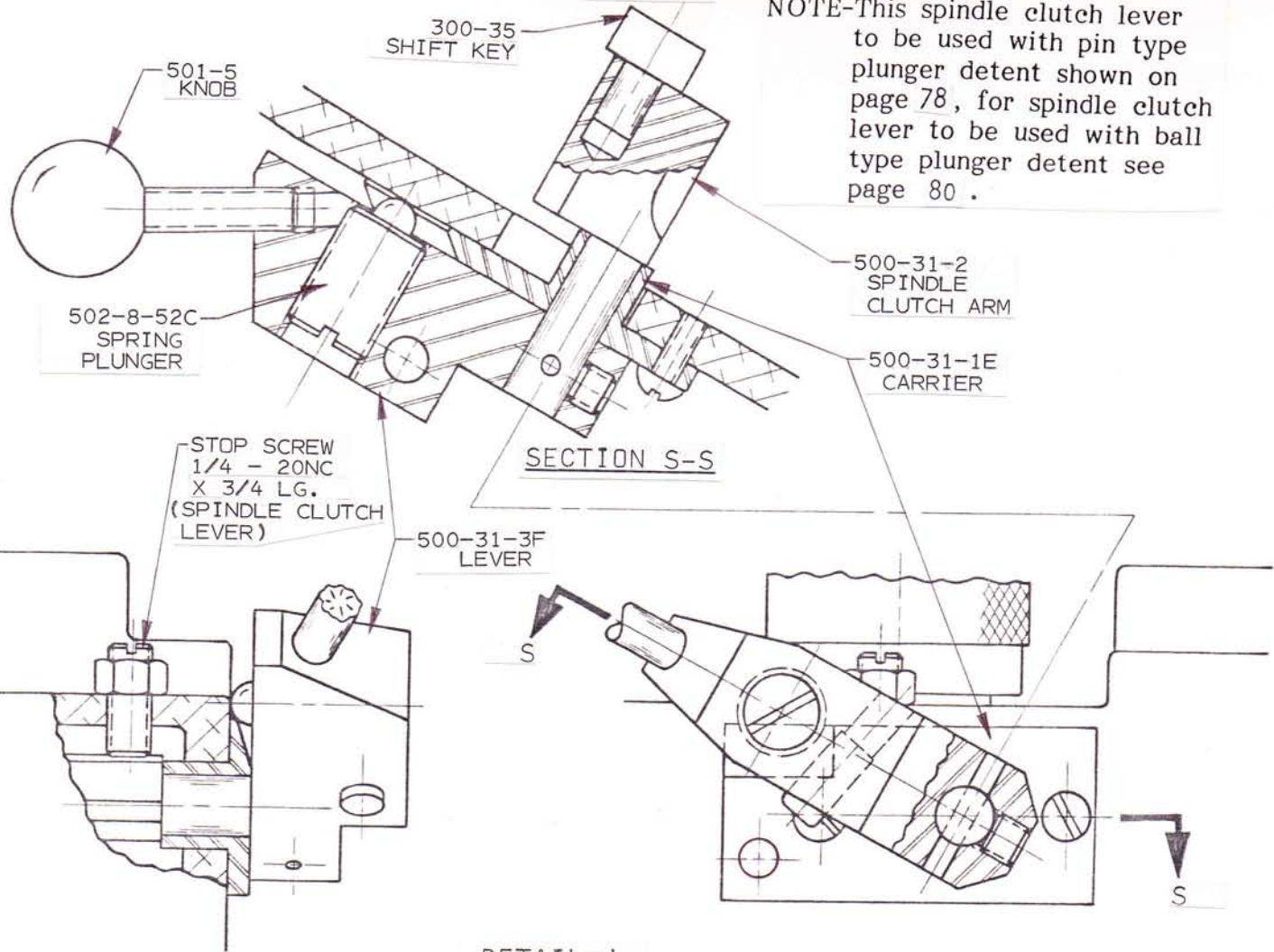


PLUNGER DETENT ASS'Y.,

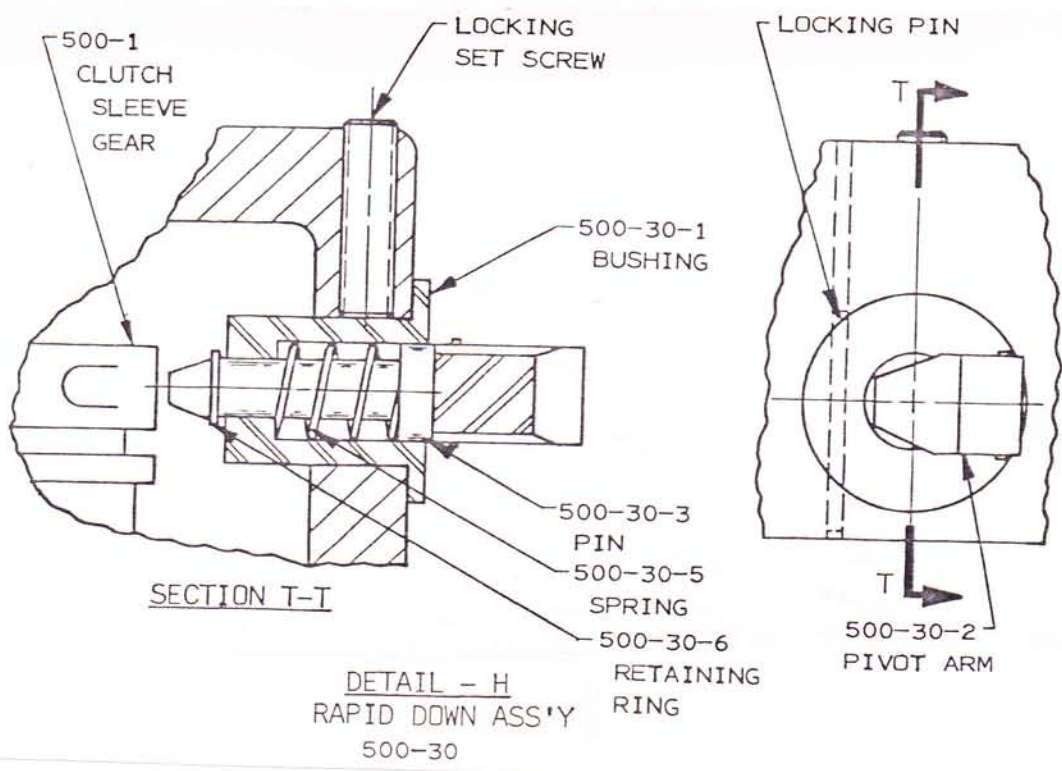
Pin type

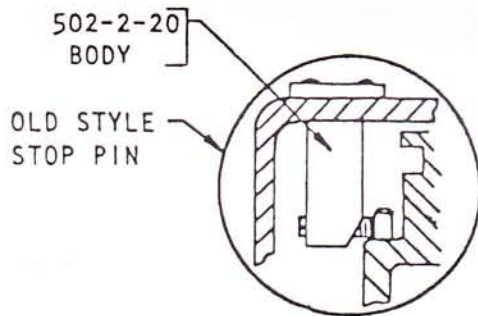
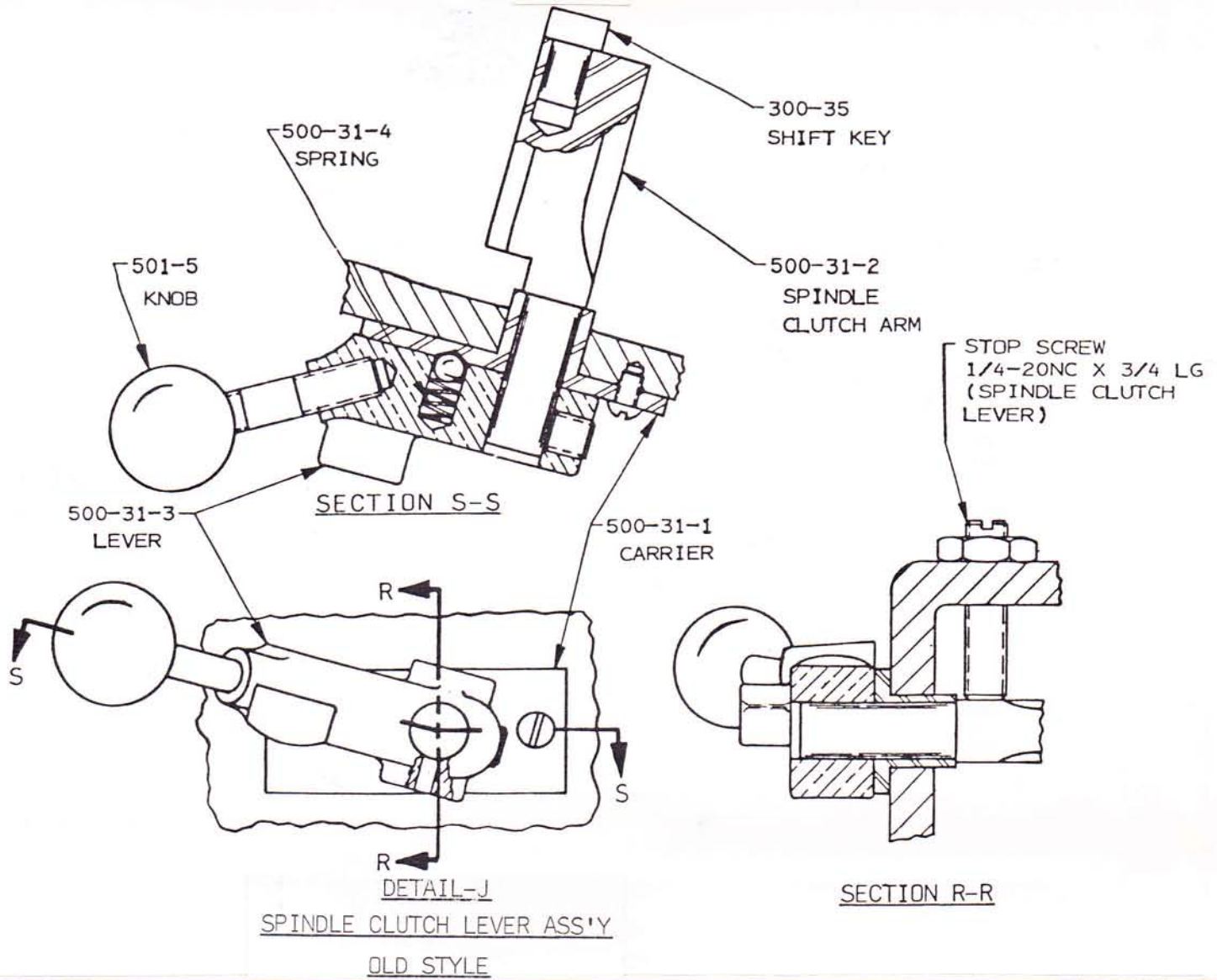
NOTE- For ball type
plunger detent
ass'y see pg 80

NOTE-This spindle clutch lever to be used with pin type plunger detent shown on page 78, for spindle clutch lever to be used with ball type plunger detent see page 80.

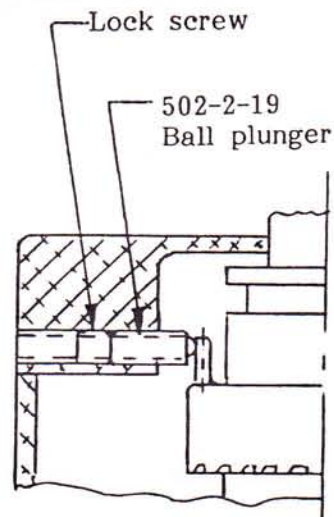


DETAIL-J
SPINDLE CLUTCH LEVER ASS'Y. # 500-31-B



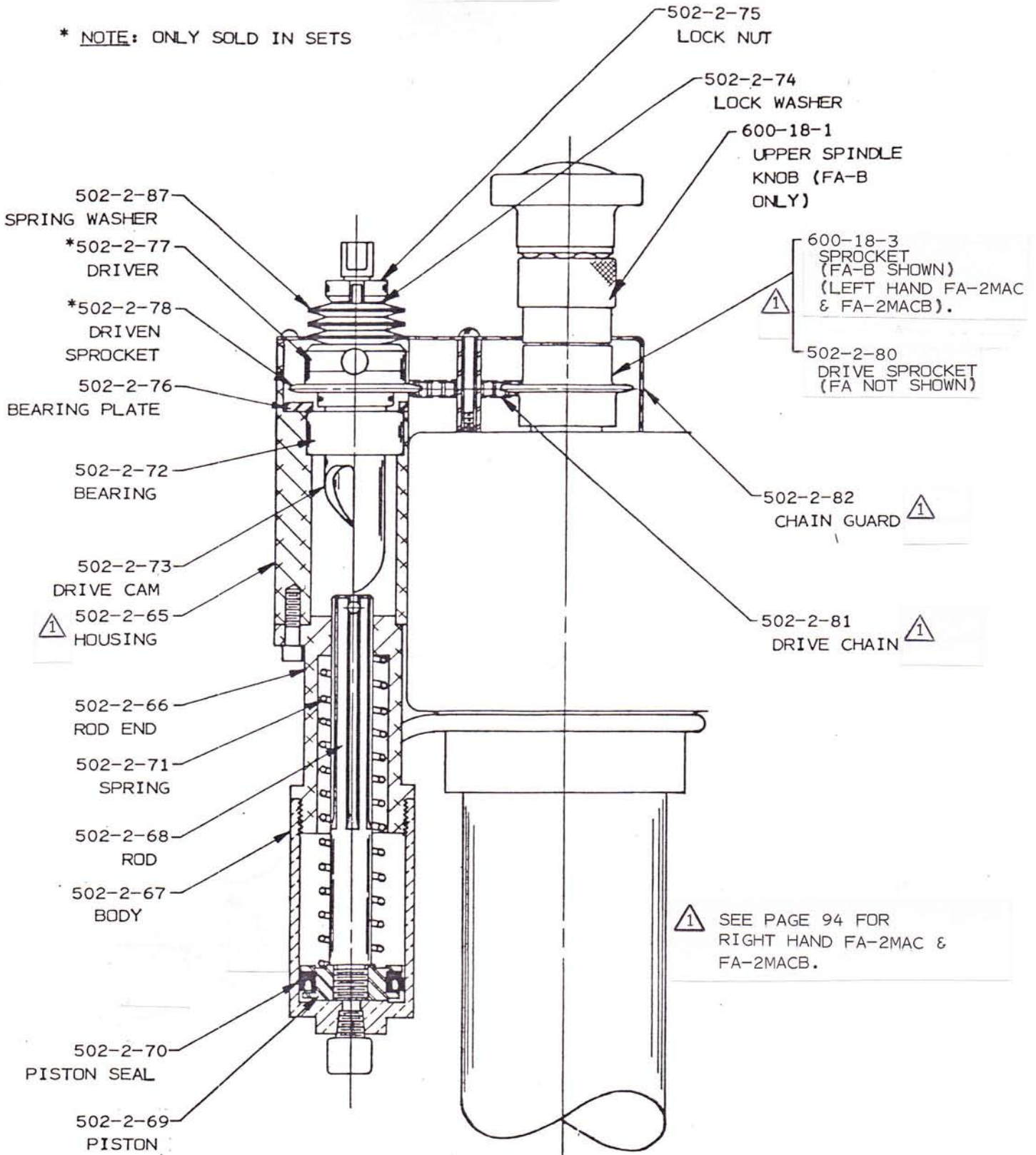


NOTE-See page 78 for pin type plunger detent

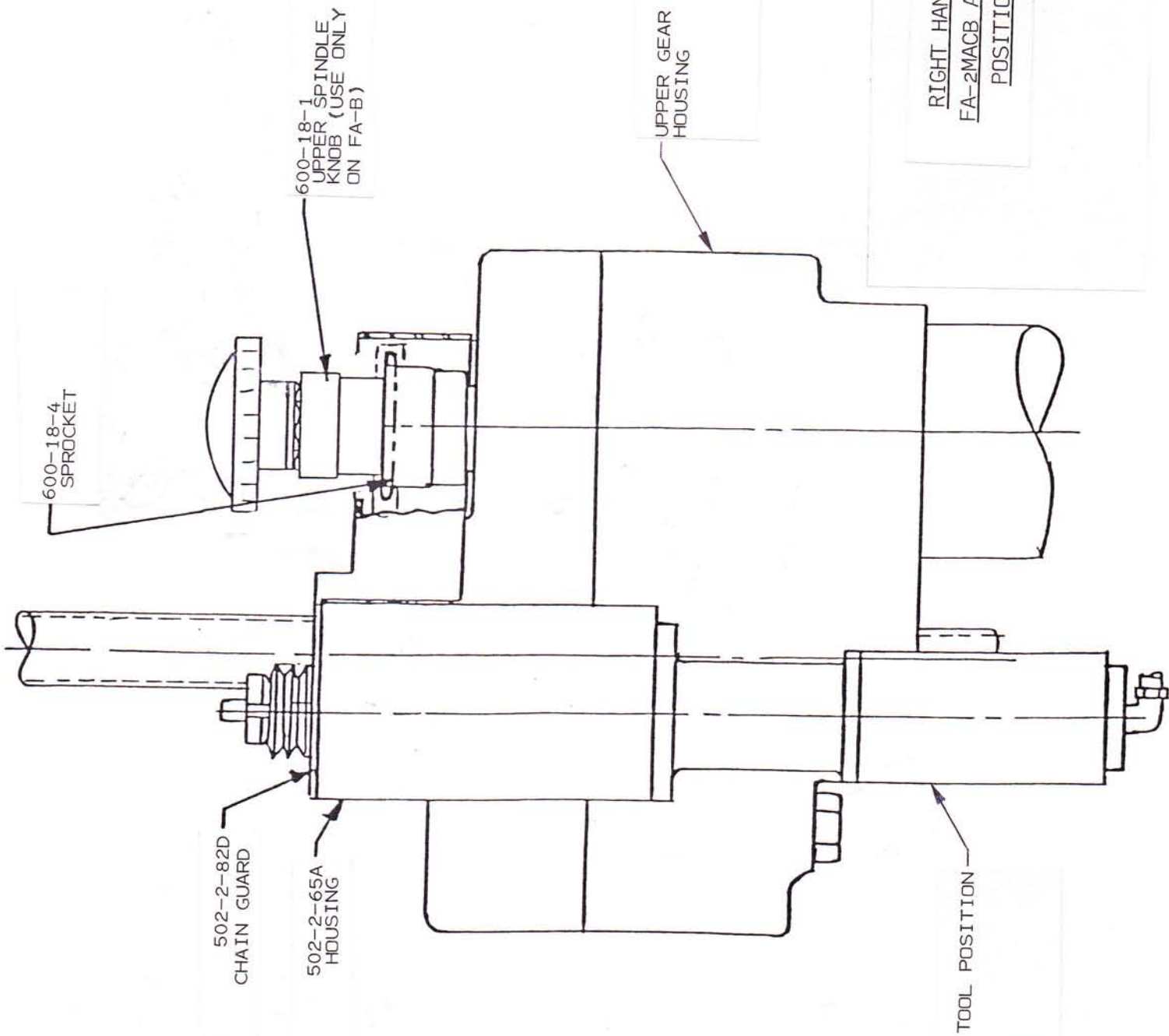


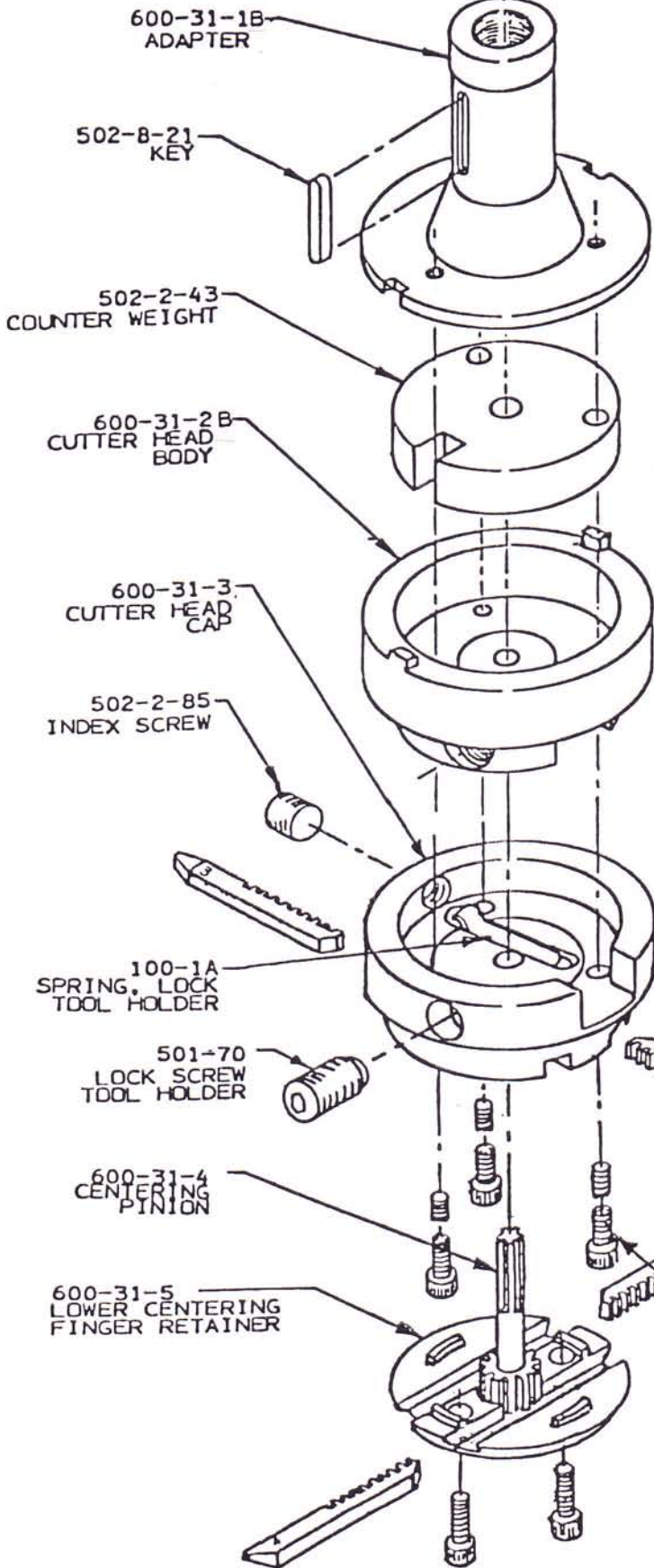
Ball type plunger

* NOTE: ONLY SOLD IN SETS



FRONT VIEW UPPER HOUSING
FA-A, FA-AB & LEFT HAND
FA-2MAC & FA-2MACB
AUTOMATIC TOOL POSITION ASS'Y.



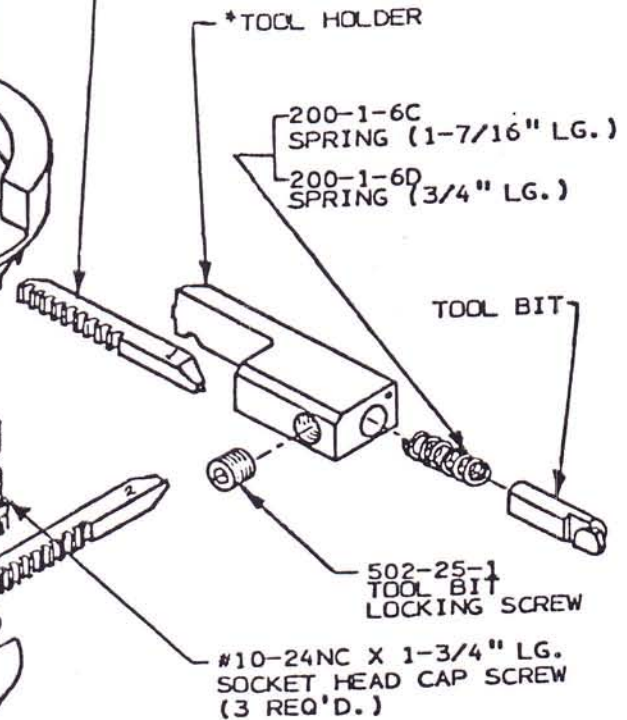


* TOOL HOLDERS

PART NO.	LG.	BORE RANGE (DIA.)
502-25R	2.125	2.875-3.375
502-25B	2.500	3.125-4.125
502-25A	2.875	3.875-5.000
502-25D	3.312	4.750-5.750

CENTERING FINGERS

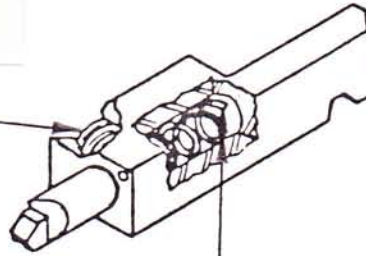
PART NO.	LG.	CENTERING DIA.
200-21-3B	2.105	2.875-4.062
200-21-1	3.062	3.125-6.000



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.
 600-8-4-G W/ TOOLING
 600-8-4-H W/OUT TOOLING

502-25-1
TOOL BIT
LOCKING
SCREW



200-1-6C (1 ⁷/₁₆)

200-1-6D (³/₄)

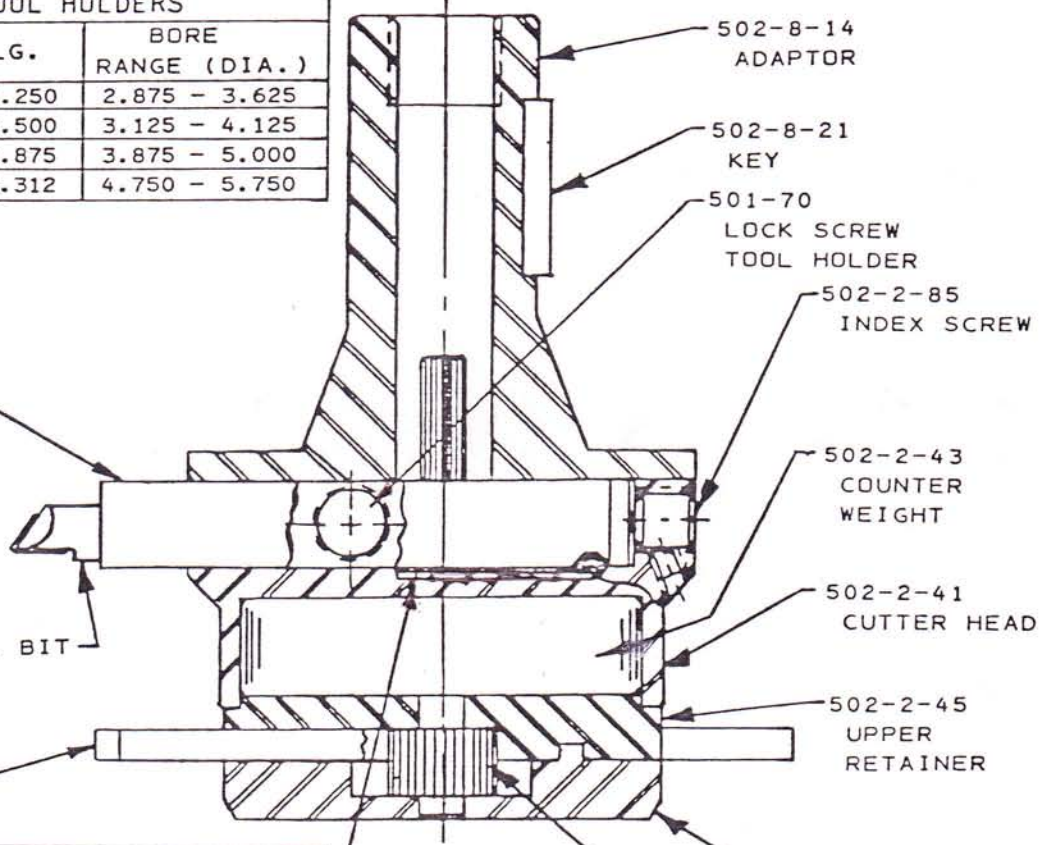
SPRING TOOL
BIT

NOTE:

USE WITH MICROMETER
ASSEMBLY 900-2-4 OR
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 - 5.000
502-25D	3.312	4.750 - 5.750

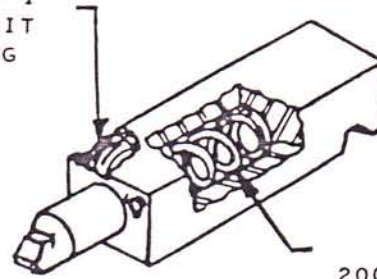


CENTERING FINGERS		
PART NO.	LG.	CENTERING DIA.
200-21-3	2.312	2.875 - 4.500
200-21-1	3.062	3.125 - 6.000

PRODUCTION CUTTER HEAD
600-8-4
OLD STYLE

NOTE: USE WITH
MICROMETER ASS'Y
900-2-7

502-25-1
TOOL BIT
LOCKING
SCREW



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

CENTERING FINGERS		
PART NO.	LG.	CENTERING DIA.
200-21-3	2.312	2.500 - 4.500
200-21-1	3.062	3.125 - 6.000

TOOL HOLDER
(DA STYLE)

502-8-21
KEY
502-2-44A
CENTERING PINION

200-74-2
SHANK

502-2-43
COUNTER
WEIGHT

200-74-1
UPPER
CENTERING
FINGER
RETAINER

200-75B
CUTTER
HEAD

200-76A
CUTTER
HEAD
CAP

100-1A
TOOL
LOCK
SPRING

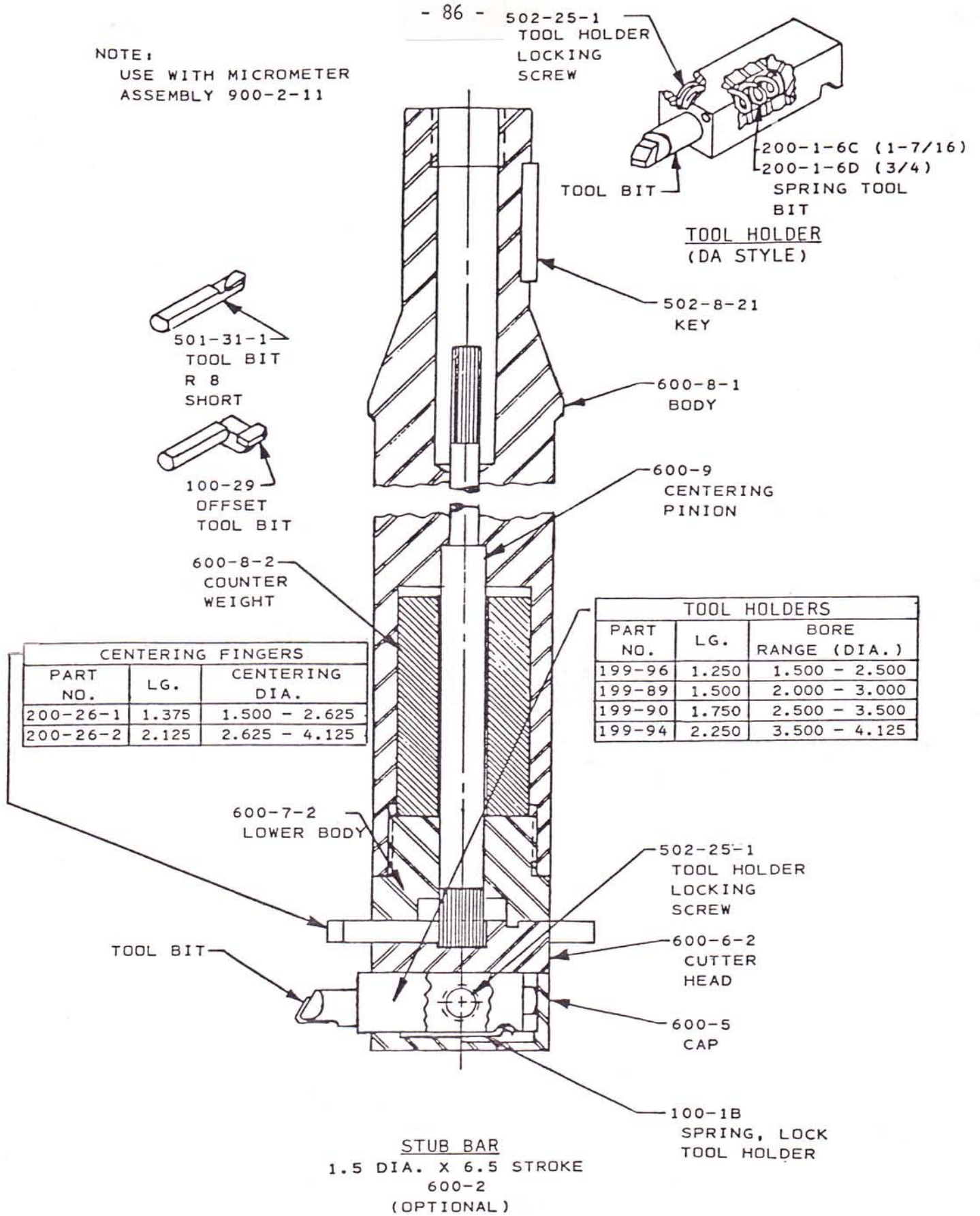
TOOL
BIT

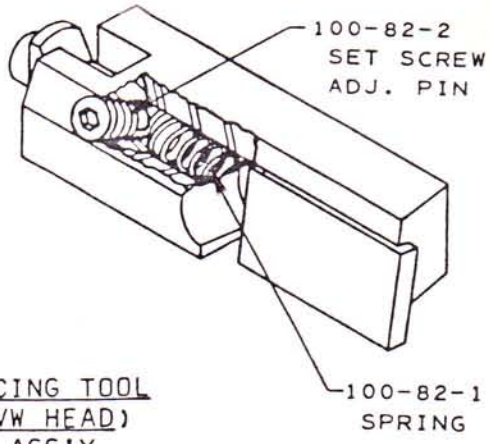
501-70
LOCK SCREW
TOOL HOLDER

TOOL HOLDERS		
PART NO.	LG.	BORE RANGE (DIA.)
199-94	2.250	2.500 - 3.375
200-1	2.500	2.875 - 3.875
200-2	3.000	3.875 - 4.875
200-3	3.562	4.875 - 5.750

BLIND HOLE
CUTTER HEAD
600-8-5
(OPTIONAL)

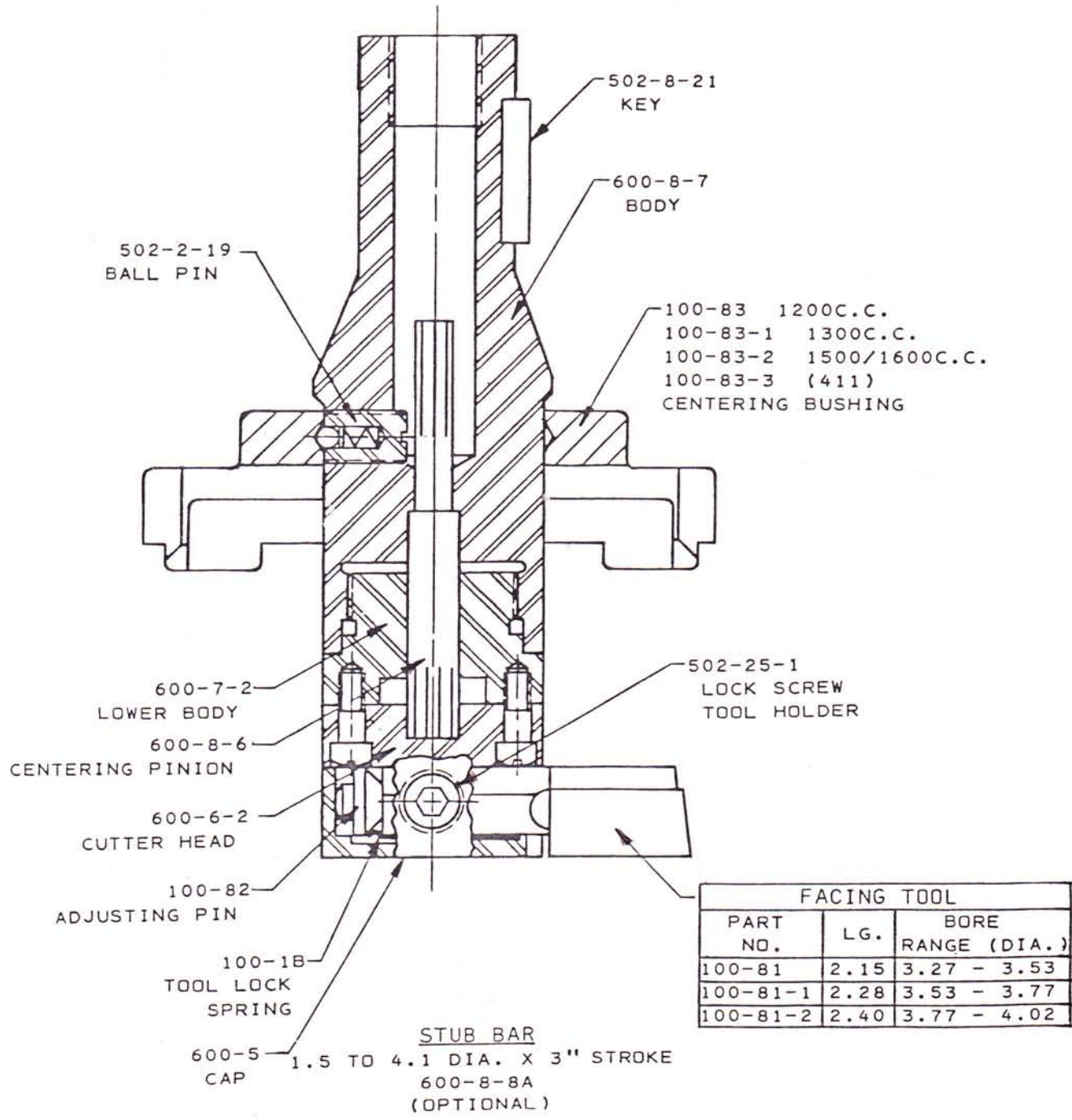
NOTE:
USE WITH MICROMETER
ASSEMBLY 900-2-11



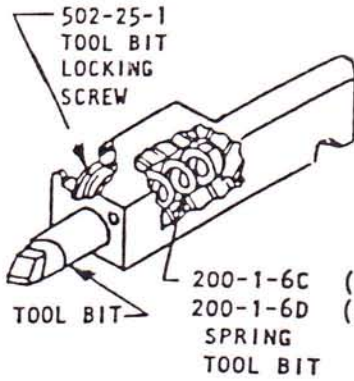


FACING TOOL
(VW HEAD)
ASS'Y.

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

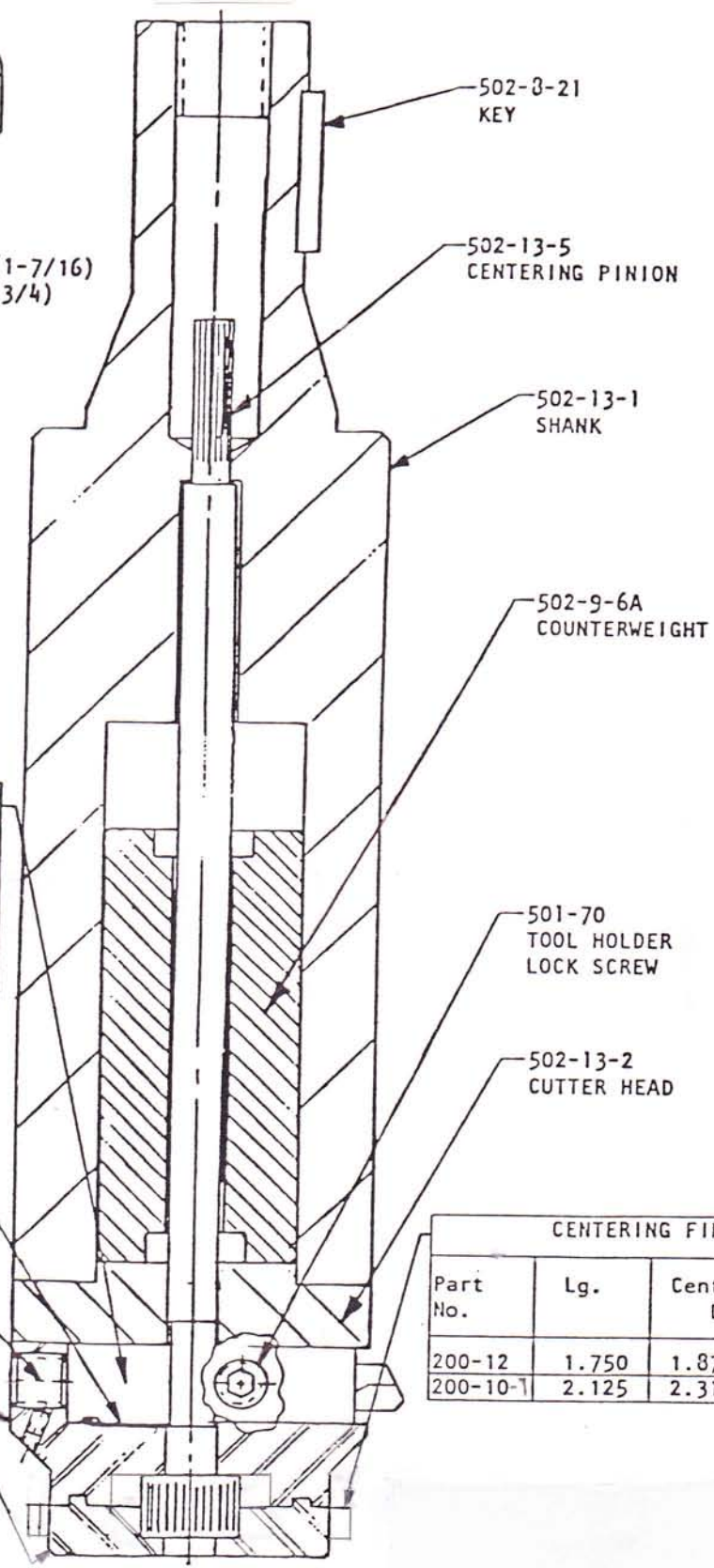


TOOL HOLDER
(FA STYLE)

NOTE:
USE WITH
MICROMETER
ASSEMBLY
900-2-9

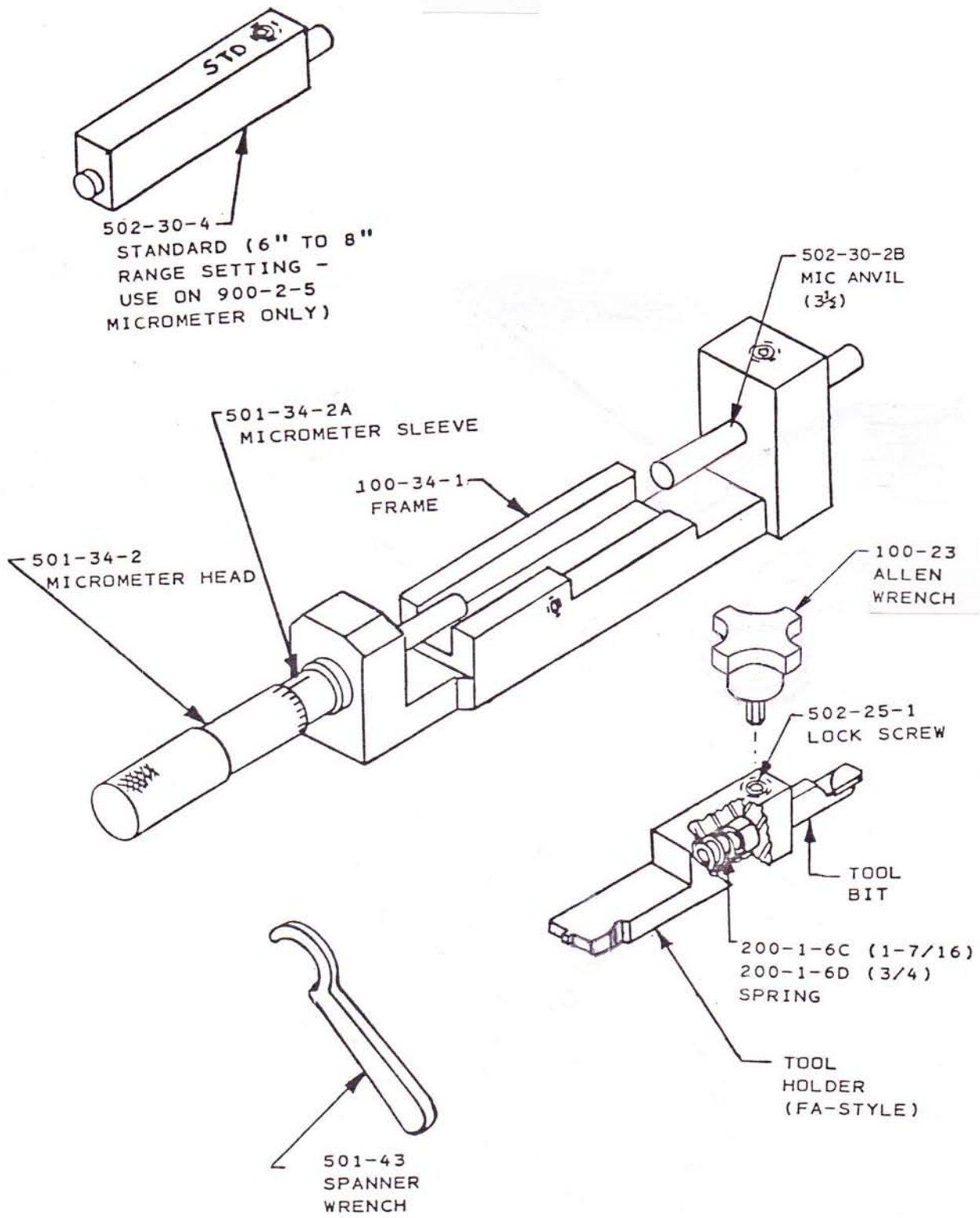
TOOL HOLDER		
Part No.	Lg.	Bore Range (Dia.)
502-25H	1.656	2.250-3.000
502-25I	1.844	2.375-3.375
502-25J	2.094	2.875-3.875
502-25K	2.469	3.625-4.625

- 100-1B TOOL LOCK SPRING
- 502-2-85 INDEX SCREW
- 502-13-3 CUTTER HEAD BODY
- 502-13-4 LOWER CENTERING FINGER RETAINER



CENTERING FINGERS		
Part No.	Lg.	Centering Dia.
200-12	1.750	1.875-3.500
200-10-1	2.125	2.312-4.125

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

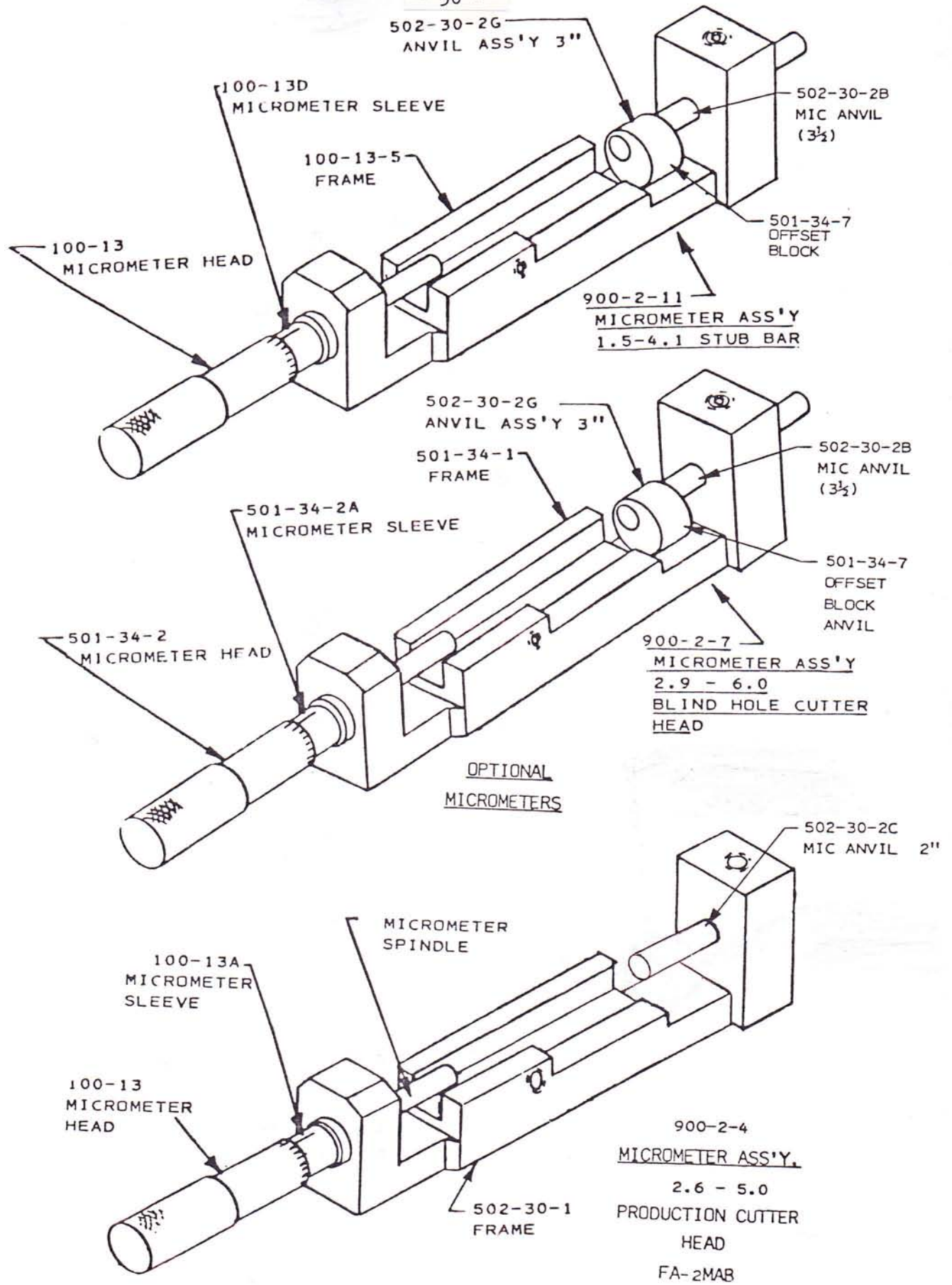


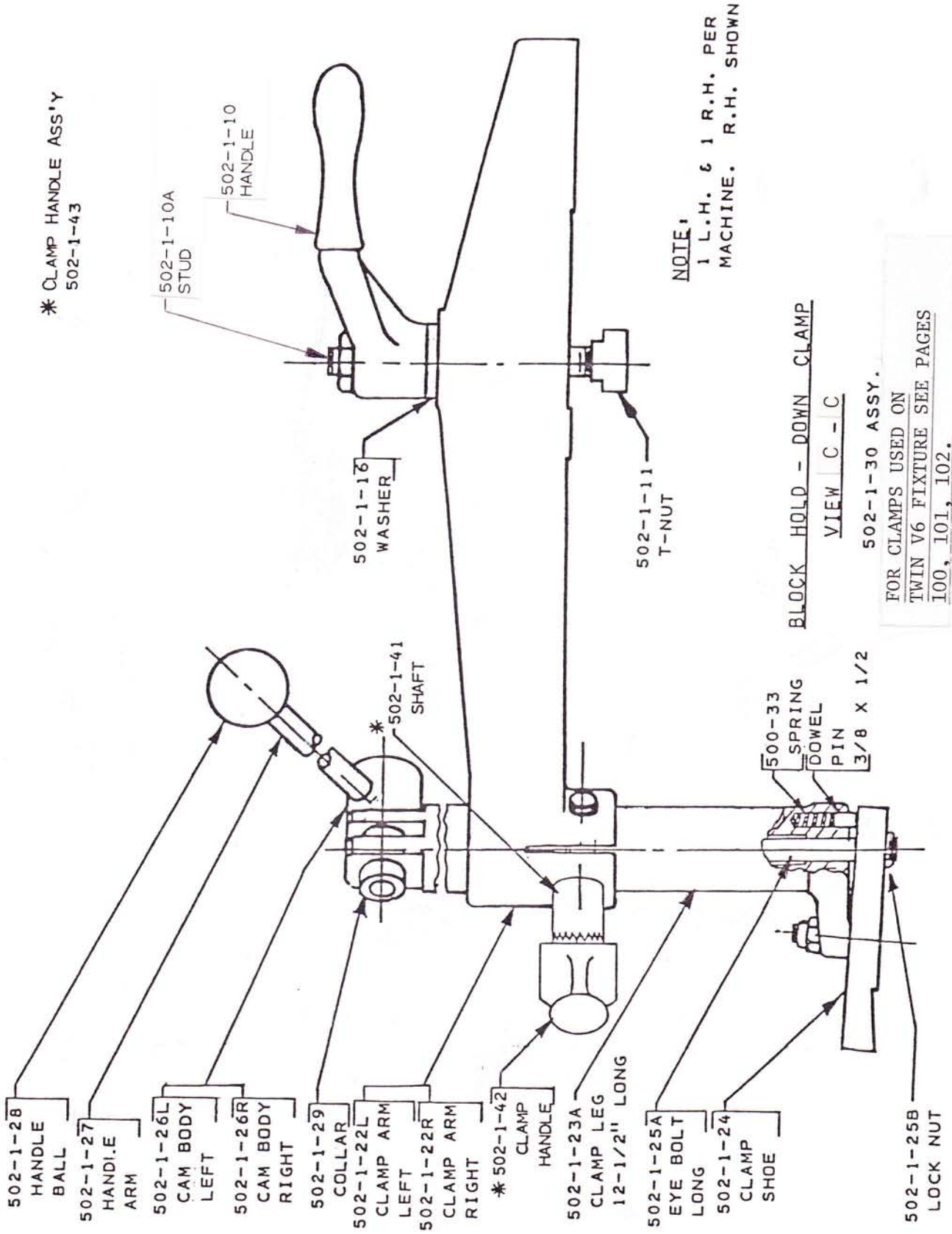
MICROMETER ASS'Y.

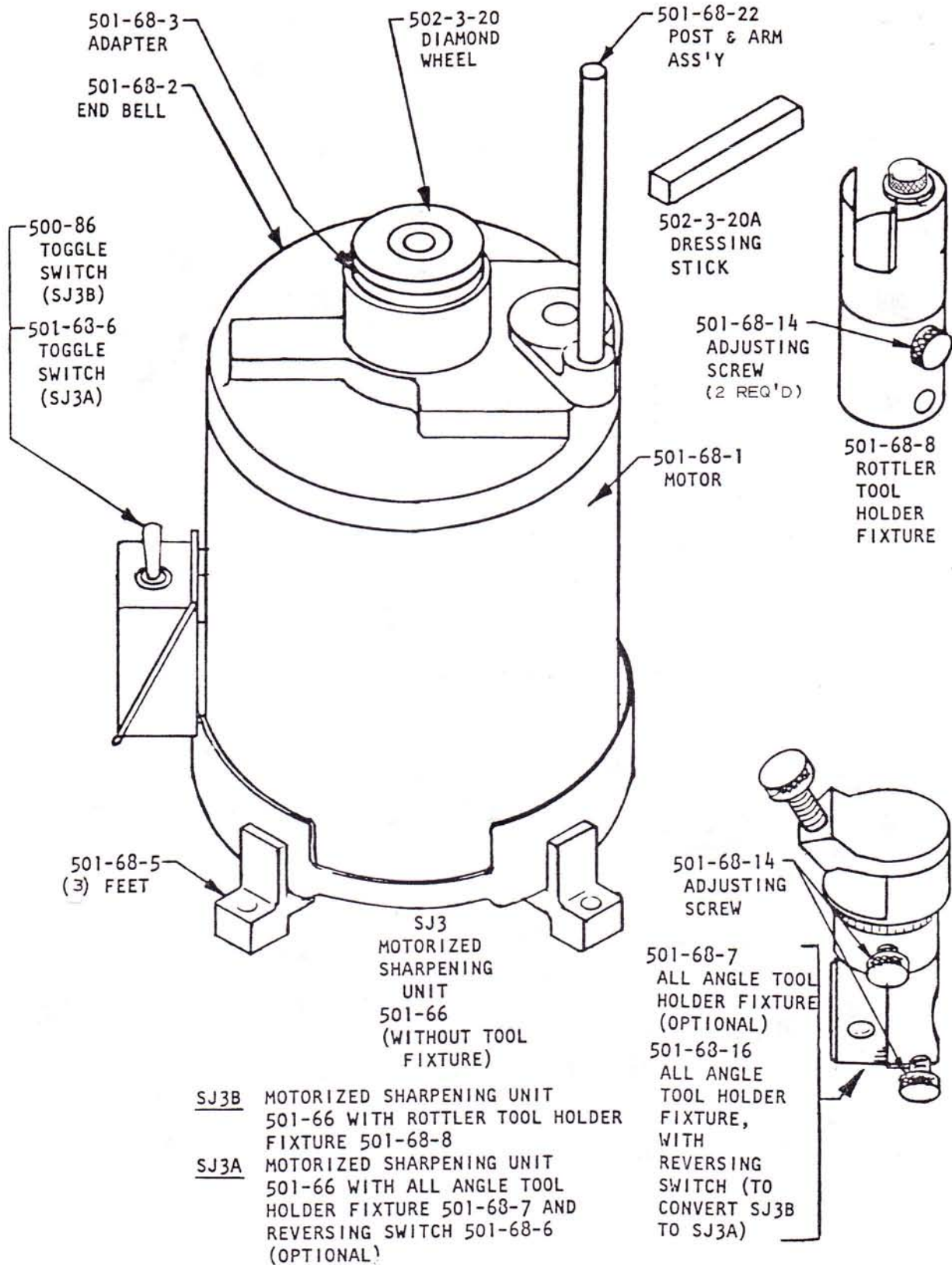
900-2-5
2.9-6.0

PRODUCTION CUTTER HEAD

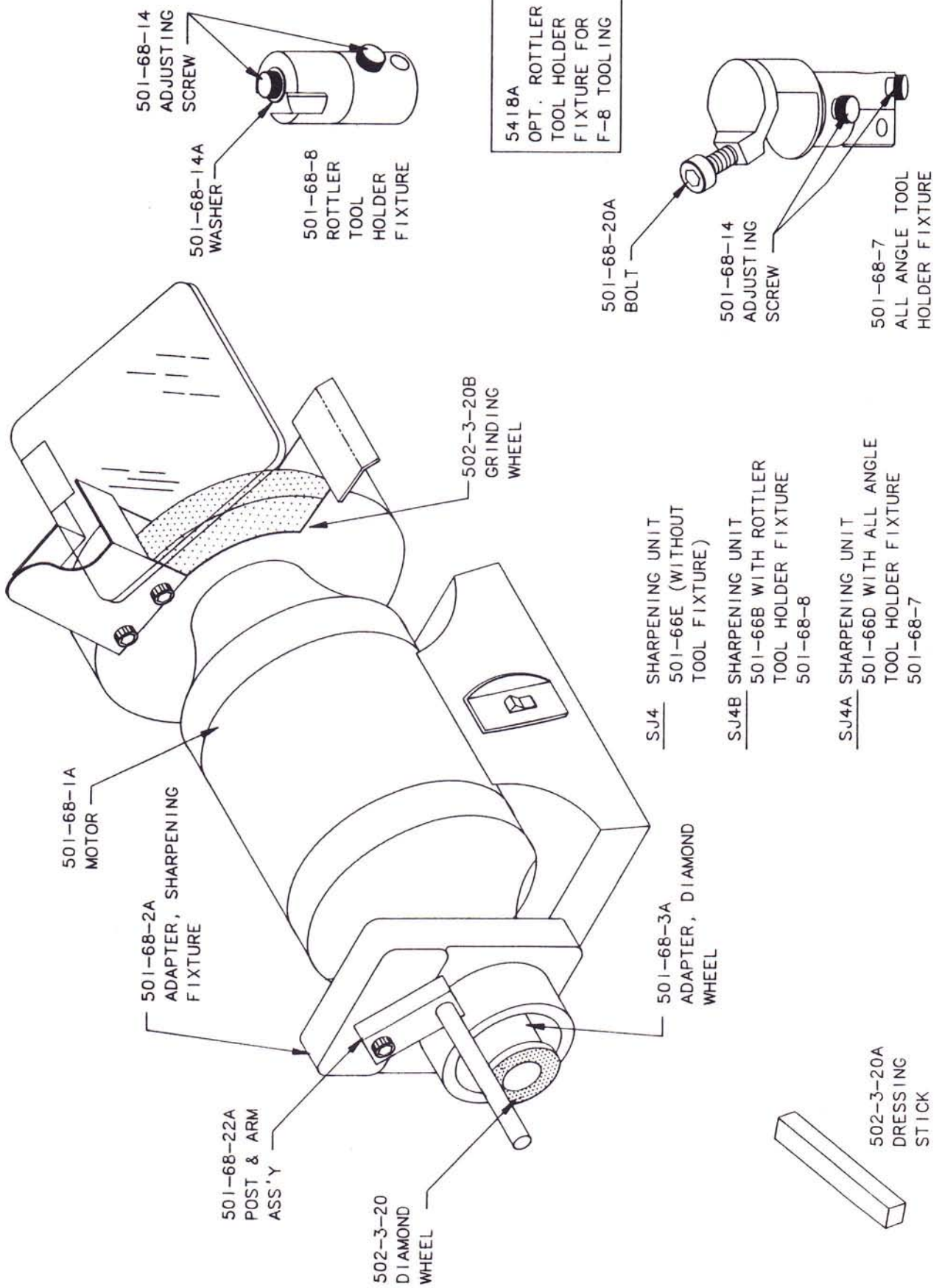
FA-2B & FA-2AB

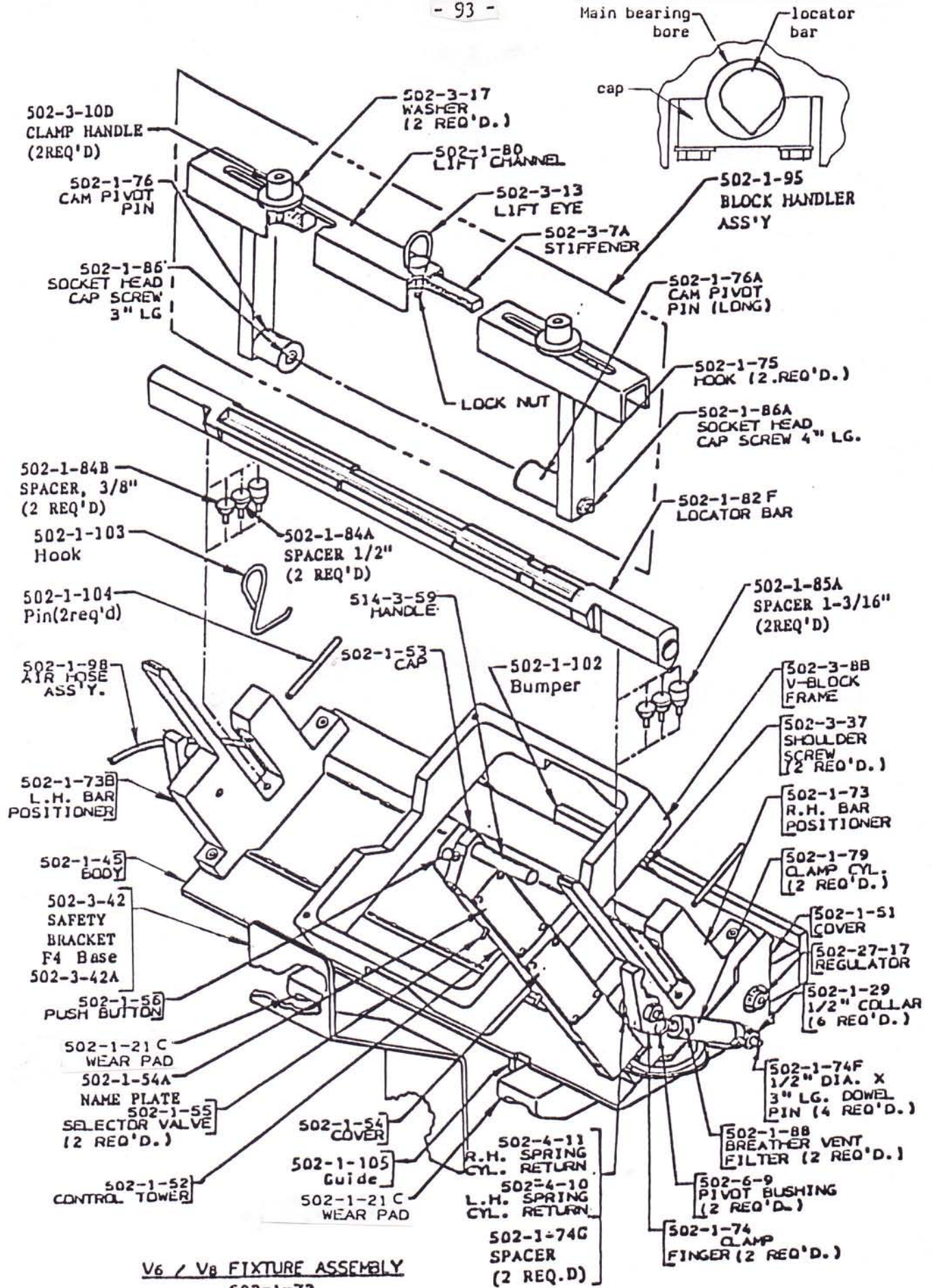


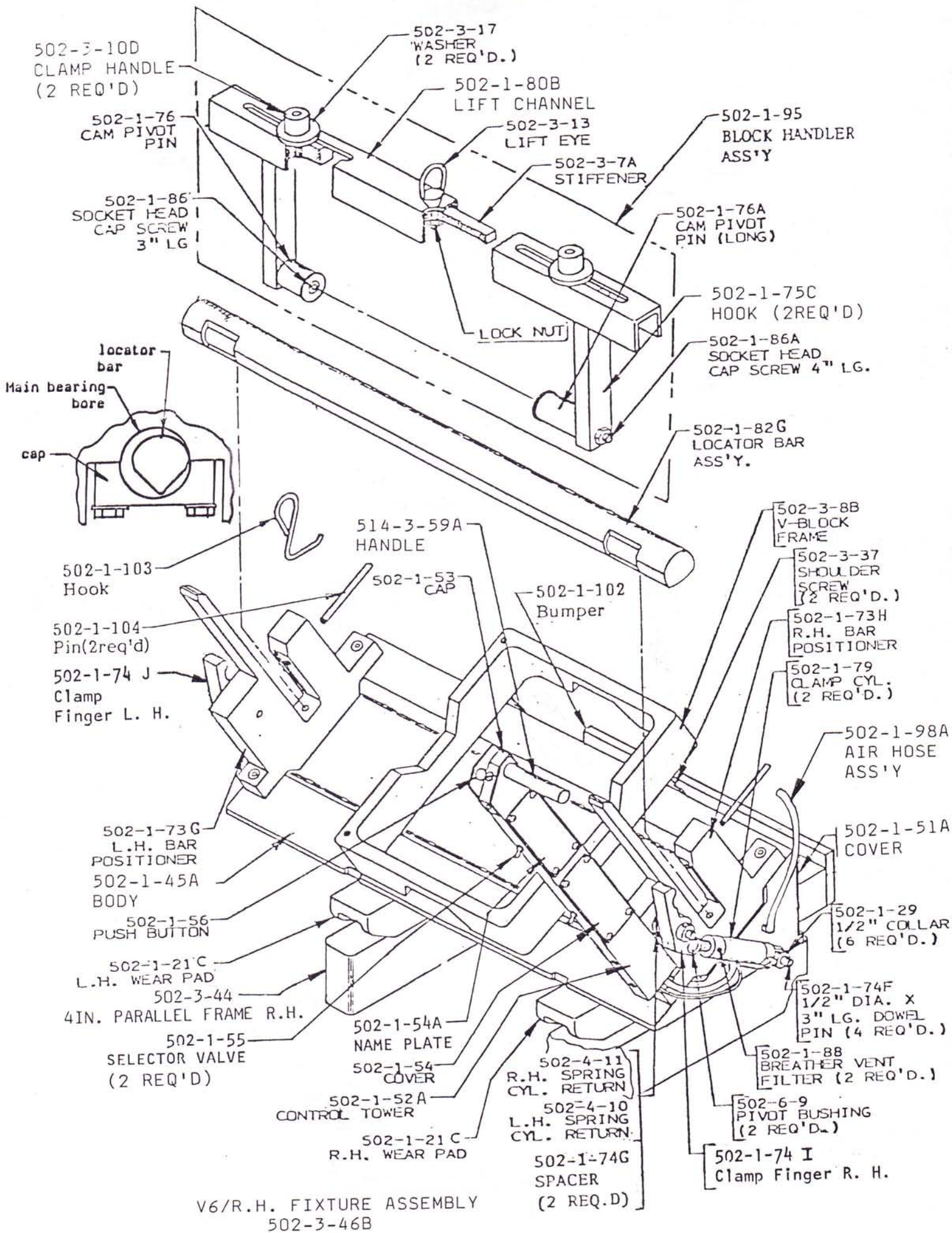


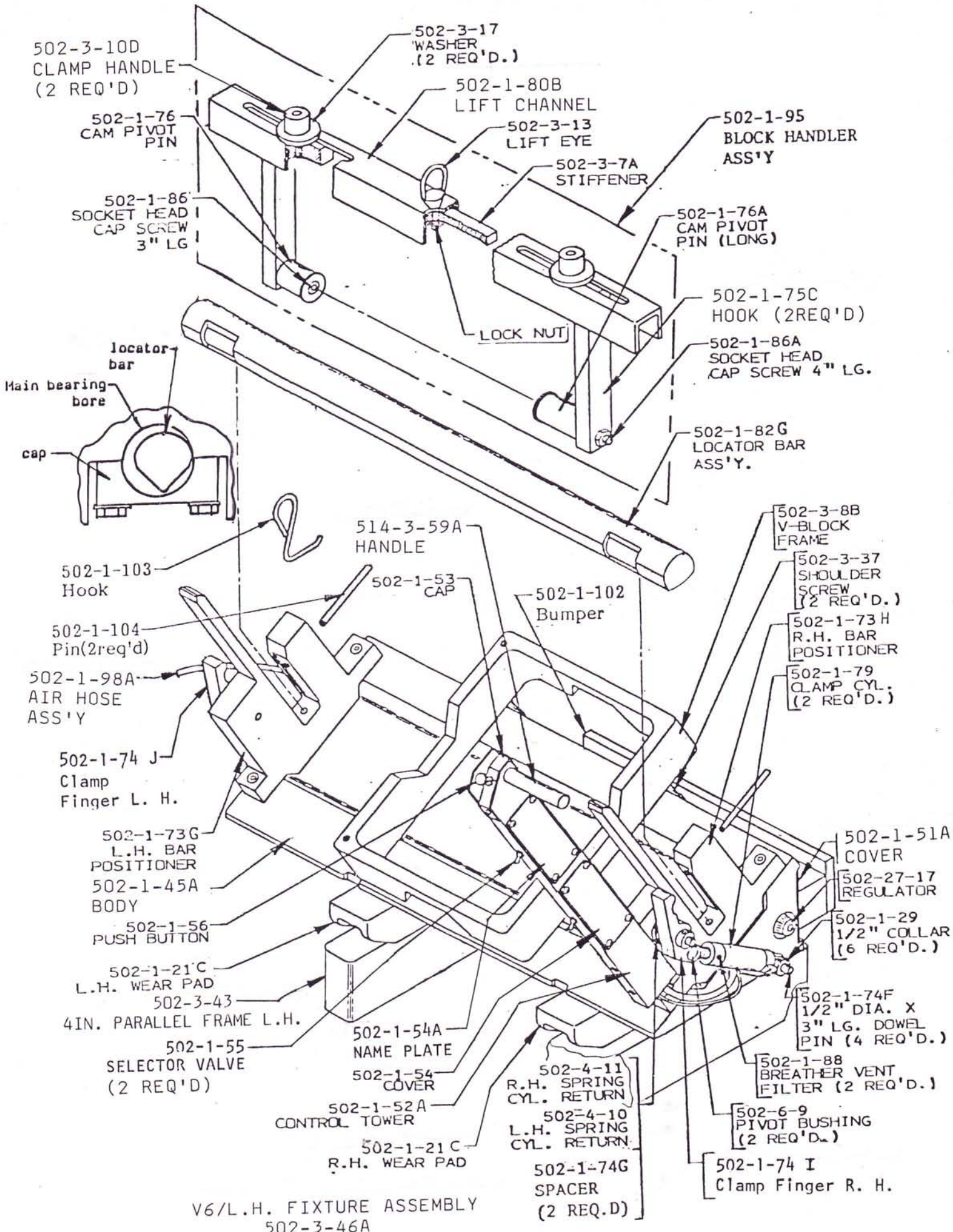


SJ3 SHARPENING UNIT
OLD STYLE

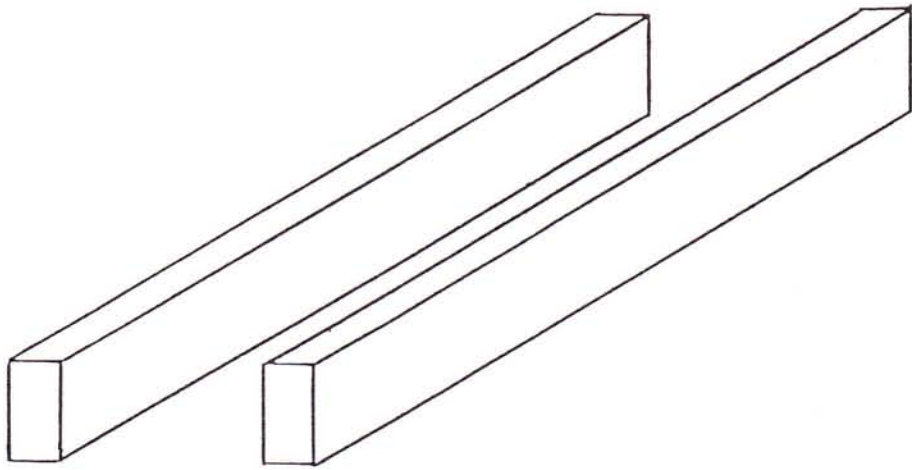




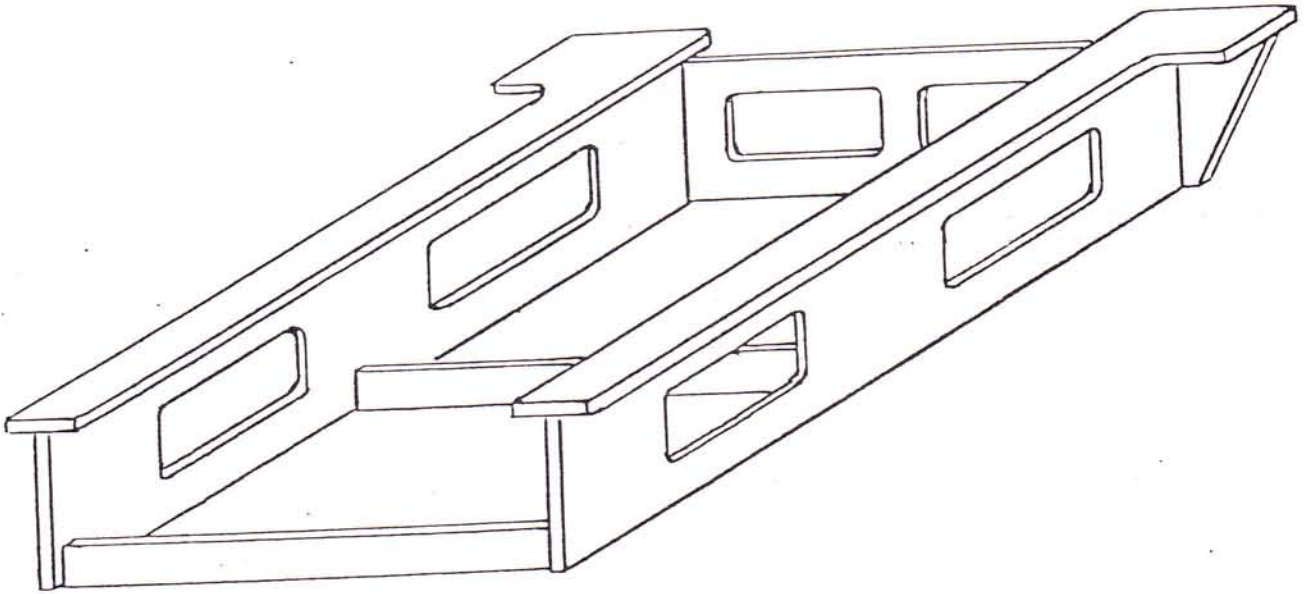




V6/L.H. FIXTURE ASSEMBLY
502-3-46A



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



502-1-14B
5" PARALLEL
FIXTURE

OPTIONAL
OPERATING INSTRUCTION FOR OLD STYLE
V-6 FIXTURE

502-3-35

FOR

FORD 2800 C.C. V-6 - GM V-6 CITATION - GMC 305 V-6

* * * * *

PROCEDURE FOR FORD 2800 C.C. V-6
AND GM V-6 CITATION:

TO BORE THESE BLOCKS WITH THIS FIXTURE WILL REQUIRE THE LOCATOR BAR AND PARALLEL FRAME FROM THE V-8 FIXTURE.

CUTTER HEADS THAT CLEAR MAIN BEARING BOSSES OF THESE BLOCKS ARE:

- PART # 600-2 -STUB BAR 6 1/2" LONG
- PART # 600-8-3-STUB BAR 3" LONG
- PART # 600-8-5-BLIND HOLE CUTTER HEAD
- PART # 600-8-4E-PRODUCTION CUTTER HEAD

NOTE: PRODUCTION CUTTER HEAD, PART # 600-8-4, WILL NOT CLEAR MAIN BOSSES OF THIS BLOCK.

IF 6 1/2" LONG STUB BAR IS USED, REMOVE THE WEAR PADS AND PLACE FIXTURE ON MAIN BASE.

IF 3" LONG STUB BAR OR BLIND HOLE CUTTER HEAD IS USED, PLACE FIXTURE ON WEAR PADS.

ATTACH (2) SHOULDER SCREWS TO THE PARALLEL FRAME. HOOK SHOULDER SCREWS OVER THE TOP OF THE FIXTURE. PLACE LOCATOR BAR ON BAR POSITIONERS OF FIXTURE OR INTO MAIN OF BLOCK, IF MAIN BEARING CAPS ARE ON. LOAD BLOCK, POSITION AND CLAMP. - REMOVE SHOULDER SCREWS FROM PARALLEL FRAME WHEN IT IS USED ON V-8 FIXTURE.

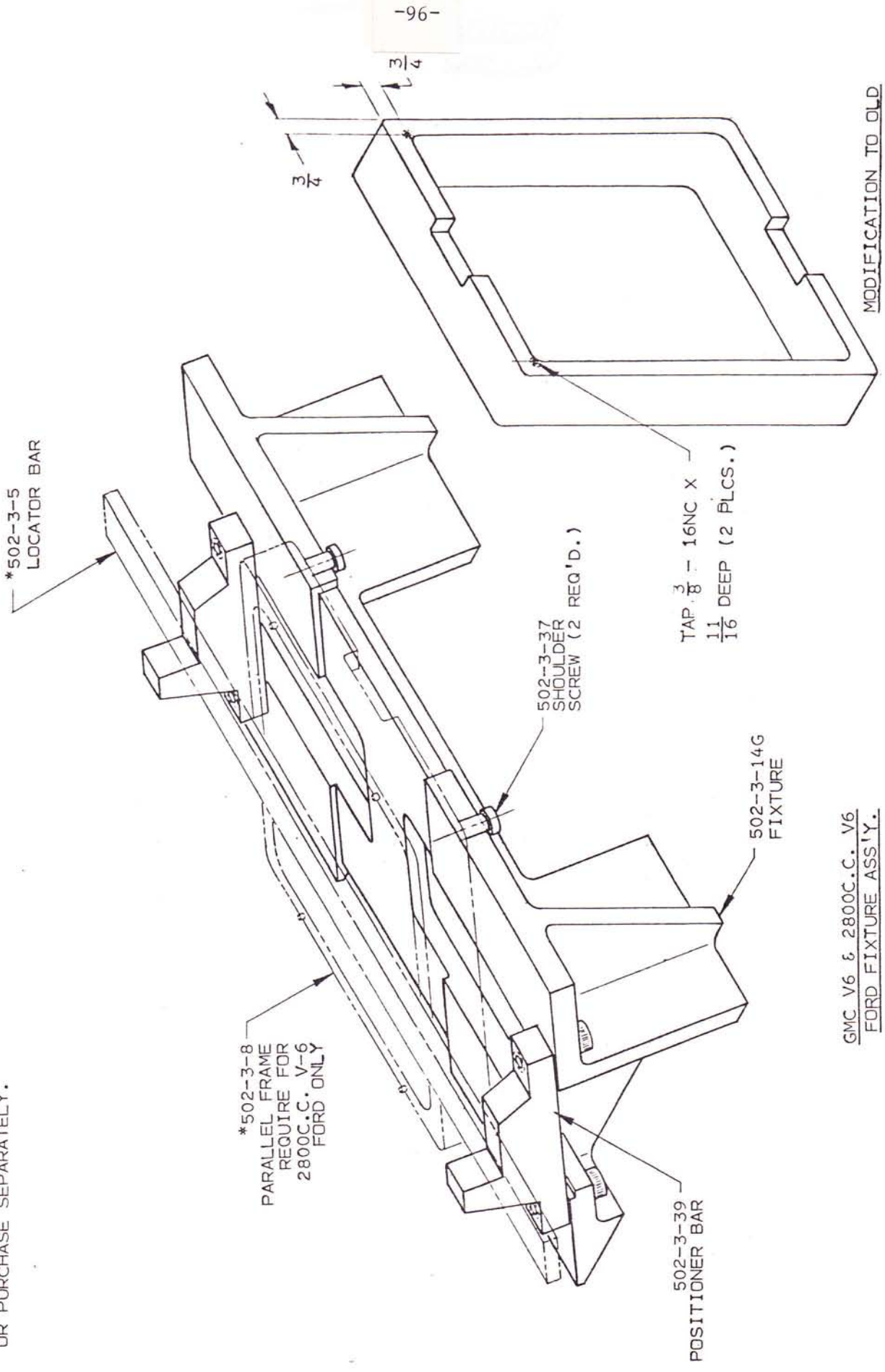
PROCEDURE FOR GMC 305 V-6:

TO BORE THIS BLOCK WITH THIS FIXTURE WILL REQUIRE THE LOCATOR BAR FROM THE V-8 FIXTURE ONLY. THE PARALLEL FRAME IS NOT USED.

PLEASE NOTE

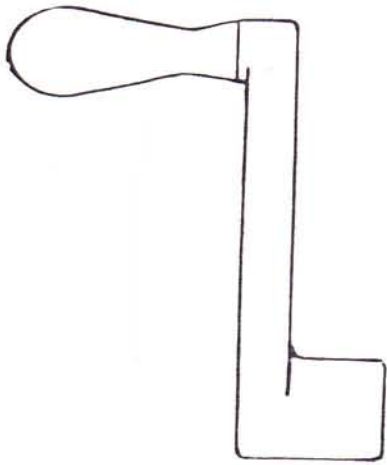
600-8-4 PRODUCTION CUTTERHEAD CAN BE USED ON THIS
BLOCK. PLACE LOCATOR BAR ON BAR POSITIONERS OR INTO MAIN OF BLOCK IF MAIN BEARING CAPS ARE ON. MOVE BORING SPINDLE TO ONE SIDE. LOAD BLOCK, POSITION FIXTURE AND CLAMP.

*USE FROM V-8 FIXTURE #502-3 OR PURCHASE SEPARATELY.



MODIFICATION TO OLD
STYLE PARALLEL FRAME
502-3-8

GMC V6 & 2800C.C. V6
FORD FIXTURE ASS'Y.
502-3-35
(OPTIONAL)



500-98
HAND FEED
HANDLE ASS'Y



502-12-2
SPANNER
WRENCH
(2 REQUIRED)
B TYPE
SPINDLE
ONLY



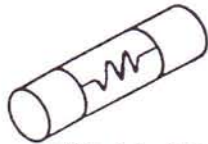
100-24
TOOL
PULLER



501-72
7/32" HEX
DRIVER
(OPTIONAL
501-72A
(5/32) HEX
DRIVER)



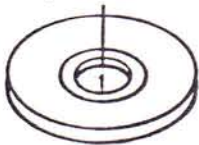
502-1-12A
JACKING
SCREW &
LOCK NUT
(4 REQUIRED)



502-11-2F
FUSETRON
MDL 3/4



500-41
LOCK NUT
FEED SCREW



502-1-12
LEVELING
PAD
(4 REQUIRED)



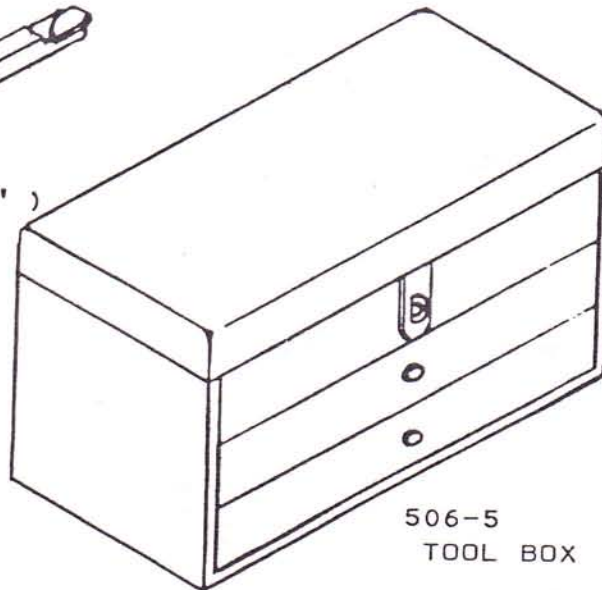
501-31-1
TOOL BIT
R 8 (1")



500-62
KEY MICARTA



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



506-5
TOOL BOX

T O O L B I T S

PART NUMBER

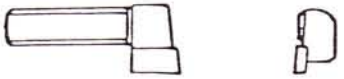
DESCRIPTION

100-29



OFFSET TOOL BIT
(for boring blind cylinder holes)

100-76



OFFSET TOOL BIT
(for boring blind cylinder holes)

501-28



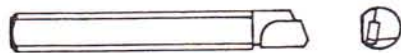
C.C. Steel Cutting Tool Bit w/chip
curler to break up chips while boring

501-29-A



RF Facing & Counterboring Tool Bit for
facing & counterboring of cylinder block,
for cutting off sleeve.

501-30



R1 Carbide Tool Bit, long 1 3/4" (for
high speed finishing) (recommended for
non-interrupted cut)

501-30-2



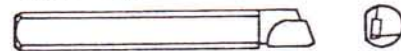
R1 Carbide Tool Bit, medium 1 3/8"

501-30-1



R1 Carbide Tool Bit, short 1"

501-31



R8 Carbide Tool Bit, long 1 3/4" (for
general purpose & heavy cuts, cast iron)
(recommended for interrupted cuts)

501-31-2



R8 Carbide Tool Bit, medium 1 3/8"

501-31-1



R8 Carbide Tool Bit, short 1"

TOOL BITS

EA

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



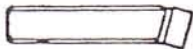
.072 GROOVING TOOL BIT

501-32-4



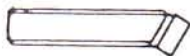
.152 GROOVING TOOL BIT

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



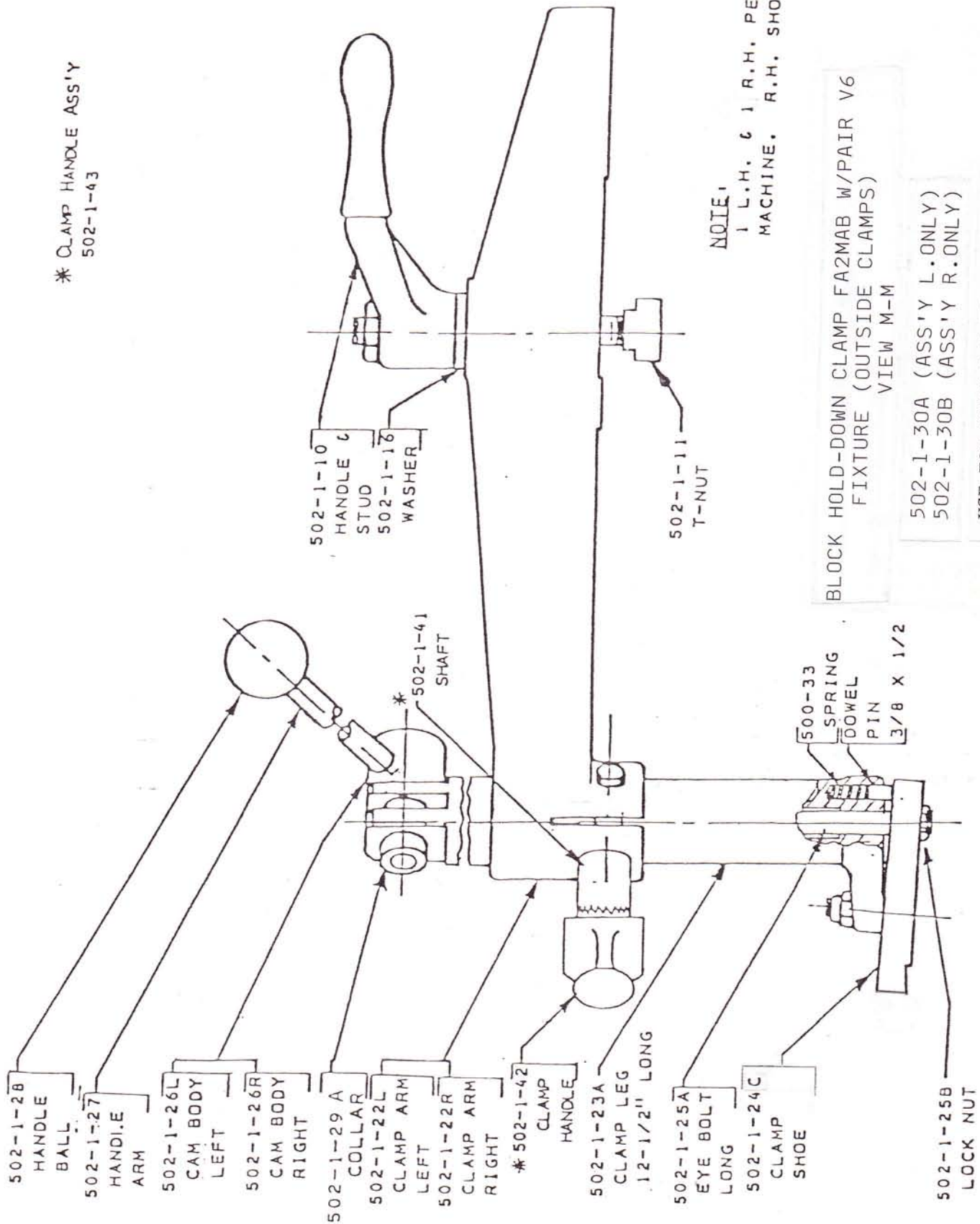
R8 (12° RAKE) LONG ROUGHING CUT

501-33-2



R1-VEGA (12° RAKE)

* CLAMP HANDLE ASS'Y
502-1-43



NOTE:

1 L.H. & 1 R.H. PER MACHINE. R.H. SHOWN

BLOCK HOLD-DOWN CLAMP FA2MAB W/PAIR V6
FIXTURE (OUTSIDE CLAMPS)
VIEW M-M

502-1-30A (ASS'Y L. ONLY)
502-1-30B (ASS'Y R. ONLY)

USE FOR TWIN V-6 FIXTURE ONLY

