7/84

ROTTLER
MANUFACTURING

F-2B

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

D E S C R I P T I O N

The model F-2B 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. F-2B machines can be readily tooled to rebore a wide range of engines including European and Asian engines as well as perform a wider variety of boring operations.

This machine is designed for two pruposes:

1. The alignment of cylinder bores relative to the pan rails and main bearing locations, as has been done in the original factory boring. This overcomes the many inaccuracies and out-of-alignment problems associated with clamping portable cylinder boring bars to blocks.

2. A considerable savings in hole to hole time is realized as a result of fast block clamping, inverted centering fingers, and air operated clamping and lifting devices.

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

All feeds and rapid travels are power operated. An auxilliary 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, 3Ø, totally enclosed motor with an outboard fan. (Optional electrical ratings are available.) A quick change lever selects two spindle speeds.

G U A R A N T E E

LIMITED

Rottler Manufacturing Company Model F-2B 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 warrenteed 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 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.

Boring Bar with the sharpening wheel located on the drive motor require you to keep arms and fingers well away from the rotating feed screw.

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 pin is engaged. On FA machine, 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 awarness of keeping your fingers and hands well clear of the rotating feed screw, and the rotating knobs on top of the feed screw and the spindle.

5. WORK LOADING & UNLOADING - carefully develop handling methods of loading and unloading work pieces, so that no injury can result if hoist equipment or lift connection should fail.

OPERATING SAFETY & EMERGENCY PROCEDURES, CON'T

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

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

EMERGENCY PROCEDURE

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

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

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

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

"REMEMBER" Metal cutting tools have the speed and torque to 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 the cylinder blocks can be lifted into the machine and flow evenly to and from other operations in your shop.

The proper loading arrangement and area location for your machine is extremely important. A slow travel (6' to 10' min.) power hoist, operated from either a bridge crane or jib crane arrangement works very satisfactorily. A 1,000 lb. hoist is generally adequate for lifting the engine block and V fixture combination. An air hoist with speed control makes an ideal method for fast, convenient loading.

If some production boring with this machine is anticipated and the cylinder blocks are not directly loaded and unloaded from a conveyor, we would recommend considerable attention to be given to the crane so that it covers an adequate area to allow the operator to back up and remove the 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 machine, being careful not to use force on any of the spindle unit.

Remove the tool box, parallels, and entire V fixture assembly located at the lower portion of the machine and completely clean these articles, as well as the machine base pads and upper table with solvent. Also clean thoroughly the cylinder block clamp arm assembly. Rust inhibitor is applied to the machine at the time of shipment, and any of 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.

SJ3 SHARPENING UNIT

Remove the SJ-3 sharpening fixture from the deck and preferably place at a bench area close to the machine. This fixture will require 110 or 220 volt single phase AC current. If it is necessary to mount this fixture on a 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.

M A C H I N E S E T U P

Remove the sheet metal cover, #502-2-13, on the lower portion of the spindle unit by removing the eight round headed screws.

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 of the control enclosure.

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 compatable, 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 name plate, as noted on inside of motor starter cover.

Attach 3 phase wiring to the L1, L2, and L3 terminal on the top of the motor starter in its enclosure.

NOTE: On boring machine without overload protection, connect 3 phase wiring, which has disconnect and motor overload protection, to terminal block in enclosure on back of machine base.

Make sure that the air regulator with the gauge is set up to approximately 90 to 95 PSI pressure after the air line is attached.

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. If adjustment is required to control ease of spindle movement, adjust the air regulator without gauge.

Now 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 the float.

Replace the sheet metal cover on the spindle unit.

MACHINE SET UP CON'T

Shift spindle speed selector into low range (up position) lightly hold in low range with selector knob pulled out, so that detent pin is not engaged, plug the motor switch. 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 two terminals. Shift the spindle lever into slow speed.

AIR SUPPLY IN "F" SERIES MACHINES

CAUTION:

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.

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 switch 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 engagement 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. FEED AND RAPID RETURN LEVER

The feed lever is the latching lever on the side of the bar. Press down until the lever latches to engage the cutting feed. To disengage, press the feed release arm which will unlatch the lever and allow it to return to the neutral position. Lift the feed lever until it latches to engage the rapid return travel. The bar will automaticlly return to neutral upon reaching the top of the travel. If you wish to return the bar to neutral while it is in rapid travel, again press feed release arm which will unlatch the lever and allow it to return to neutral position. You will note the stop rod that is held in the hand feed cap by the set screw, has a round shaped end which will release the cutting feed when it contacts the latching lever. This is most conveniently raised up and locked by its set screw in the proper position on the completion of the first bore cut. This rod should not be used to hold close tolerance shoulders.

3. FAST DOWN LEVER

The fast down travel lever is located to the right of the feed lever. Check the feed lever to see that it is in neutral position before actuating. LEVER SHOULD BE PULLED DOWN QUICKLY AND FIRMLY AND NOT ALLOWED RATCHET. Control is spring loaded and will release when you release the pressure.

To become familiar with the rapid down travel, we suggest that you place a tool holder 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.

CONTROLS, CON'T

4. SPINDLE CLUTCH CONTROL

Spindle clutch control is located to the left side of the feed lever. A pull release rapid down movement will engage the spindle rotation and a reverse action will disengage. In that this is a jaw clutch, we recommend stopping the motor or jogging the motor to engage the clutch on the HIGH SPINDLE RPM. Standard procedure is to throw out the clutch upon completion of the bore. Turn the cutter head around to the indexing detent to position the tool to the front, then reverse the travel. The lower knob on the spindle of the upper housing may be used for manually turning the spindle when necessary.

5. MANUAL HAND FEED

The 2-1/8" manual travel is actuated by rotating the handle attached to the spline at the top of the spindle base.

CAUTION: THIS TRAVEL SHOULD ALWAYS BE LEFT IN FULL UP POISTION AFTER USING, BEFORE THE SPINDLE IS RETURNED TO FULL UP POSTION.

Normal procedure is to rapid travel or feed bar to point requiring manual travel. If back feeding is necessary, run the hand travel down first and then rapid travel down to where the tool can be inserted.

This manual hand feed travel is available for facing sleeves and counterboring, etc. It is completely separate from the power 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.

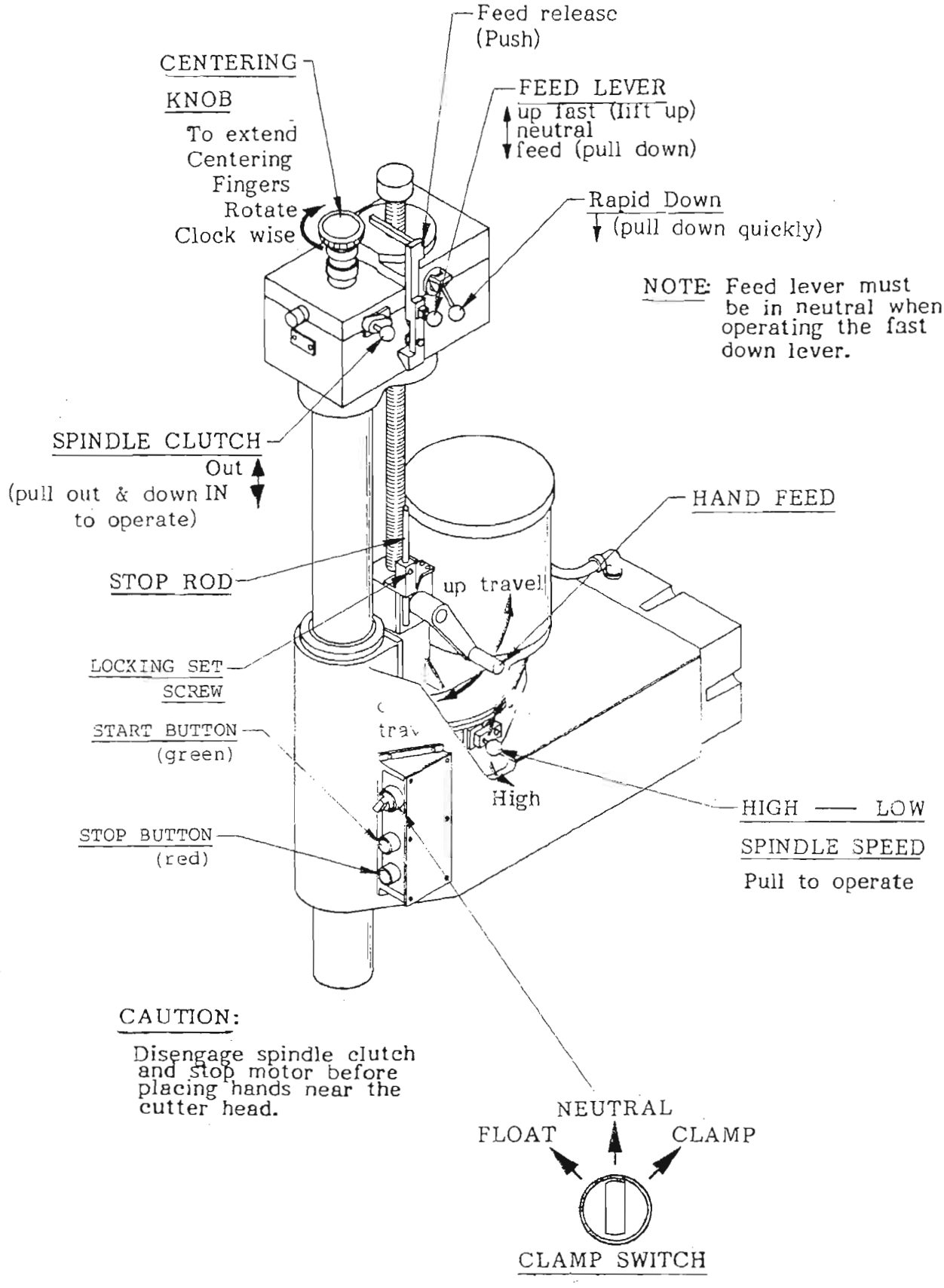
6. SPEED CONTROL

The speed control is changed by pulling out and raising or lowering the plastic knob at the lower right of the spindle unit. This may be operated when the machine is running or being jogged, and will not suffer any damage, but do not shift when boring. High speed is in the bottom position and low speed is in the upper position.

7. CENTERING KNOB

The centering knob (upper knob) at the top of the upper spindle housing, operates 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.


Feed release
(Push)
CENTERING
KNOB
To extend
Centering
Fingers
Rotate
Clock wise
FEED LEVER
up fast (lift up)
neutral
feed (pull down)
Rapid Down
(pull down quickly)
NOTE: Feed lever must be in neutral when operating the fast down lever.
SPINDLE CLUTCH
Out
(pull out & down IN
to operate)
HAND FEED
STOP ROD
up travel
LOCKING SET
SCREW
START BUTTON
(green)
High
HIGH —— LOW
SPINDLE SPEED
Pull to operate
STOP BUTTON
(red)
CAUTION:
Disengage spindle clutch and stop motor before placing hands near the cutter head.
NEUTRAL
FLOAT
CLAMP
CLAMP SWITCH

CONTROLS

-B TYPE CUTTER HEADS

ALTERNATE CUTTER HEAD ARRANGEMENTS

Your F-2B is equipped with a single draw bolt through the inner spindle assembly so that a number of different styles of cutter heads, tools, and indicators, may be rapidly interchanged. Two spanner wrenches are provided for locking and unlocking the cutter head, they are used on the two lower knobs on top of the spindle. When inserting alternate tools, make sure the socket is absolutely clean and while threading in place, make sure the spline is easily engaged without burring.

PRODUCTION CUTTER HEAD 600-8-4E

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

It is used in the F-2B 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 proolems 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 disassemole, clean and reassemble.

OPTIONAL BLIND HOLD CUTTER HEAD 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 production cutter head.

-B TYPE CUTTER HEADS, CON'T

OPTIONAL
1.5" (38mm) STUB BORING BAR 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 F-2B boring machine. At all times the work should be located in the machine so the end of the stub boring head is no further than 1" from the beginning of the work when the spindle is in the upper limit of travel.

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

Two sets of centering fingers are provided, the smaller has a 1.5" 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 28 . The micrometer may also be periodically calibrated as noted on page 28 and 29.

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

IMPORTANT GENERAL INFORMATION FOR THE BEST USE OF THE MODEL 1.5 STUB BORING TOOLING

CAUTION: Inner Spindle adjustment (see page 35) 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 disassembled and cleaned.

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

OPTIONAL

1.5 (SHORT) STUB BORING BAR 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 V.W. 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 V.W. head facing, cutter head will require centering bushings and wide facing cutting tools, which are sold separately. See page 73 for sizes.

V.W. 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.

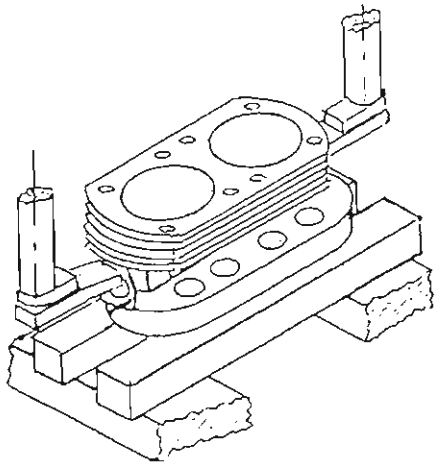
Place cylinder head on parallels as shown in sketch. Make sure mounting surface is reasonably flat. Shim to support properly if surface is exceptionally out of flat.

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

NOTE: Excessive clamp force may warp or deflect head.

Shift spindle speed to low--"ALL OPERATION 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.



OPERATING INSTRUCTIONS

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

BORING AUTOMOBILE AND SMALL TURCK BLOCKS
LOADING IN-LINE CYLINDER BLOCKS

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

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

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

Now in order to clamp block securely, 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 bearing bosses or other protuberances on engines other than typical American passenger car and truck engines. F-2B 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 holder that will allow minimum tool bit overhang, for the size you wish to bore. We recommend a maximum tool bit overhand of 5/8" outside of tool holder. Before setting, make sure the tool bit is properly sharpened. (See tool sharpening instructions.)

OPERATING INSTRUCTIONS, CON'T

MICROMETER

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. Operate fast-down to travel the cutter down to within 1/8" of the cut. If you should travel the cutter into the bore, operate return lever to properly reposition tool, STOP motor.

CENTERING WITH CENTERING FINGERS

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. Engage spindle clutch, start motor and engage feed lever. If you wish to check the bore size, allow the machine to bore a sufficient depth above the ring travel. Disengage feed, disengaging spindle clutch, turn the centering knob counter-clockwise until the inner spindle contacts the spring detent, which will index the cutting tool toward the front of the machine, lift feed lever to rapid return position and allow the machine to return to its full up position.
TURN OFF MOTOR
Check bore diameter, adjust if necessary and re-insert tool then rapid travel down to job again; then engage spindle clutch and feed. Do not unclamp during this checking operation.

When cutter has completed boring operation, set stop rod 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.

OPERATING INSTRUCTIONS, Cont'd

CENTERING WITH CENTERING FINGERS

After feed has stopped, lift spindle clutch lever, turn lower spindle knob, (600-18-2) clock-wise until detent is contacted then engage rapid return 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).

AIR V6/V8 COMBINATION FIXTURE

502-1-72

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

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

The Model 502-1-72, 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.

A pair of 1/2" and 1 3/16" spacers are provided for blocks with large main bearing bores to enable the locator bar to locate above the main bearing split line.

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

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

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

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

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

The normal operational procedure on smaller V blocks is to first attach the block handler assembly on to the block making sure the cam lifters are **COMPLETELY** engaged and that the lift hook is approximately centered in block lengthwise. Place the 502-1-82-A locator bar assembly thru the main bearings and hoist the block into the fixture using the locator bar handle upright to help guide the locator bar into place. Pulling the

AIR V6/V8 COMBINATION FIXTURE Cont'd

block towards you, with the locator bar against the guides, will prevent jamming in the slot of the guides during loading and unloading operation. After locator is engaged in guides-pivot block as you lower it.

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 or seal. If there are two toggle switches on control tower use the upper switch to activate locator bar clamp fingers.

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 degree 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 degrees and reload to duplicate the operation on the other bank. If there are two toggle switches on control tower use upper one to release locator bar clamp fingers.

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.

ANGLE TOP BLOCKS

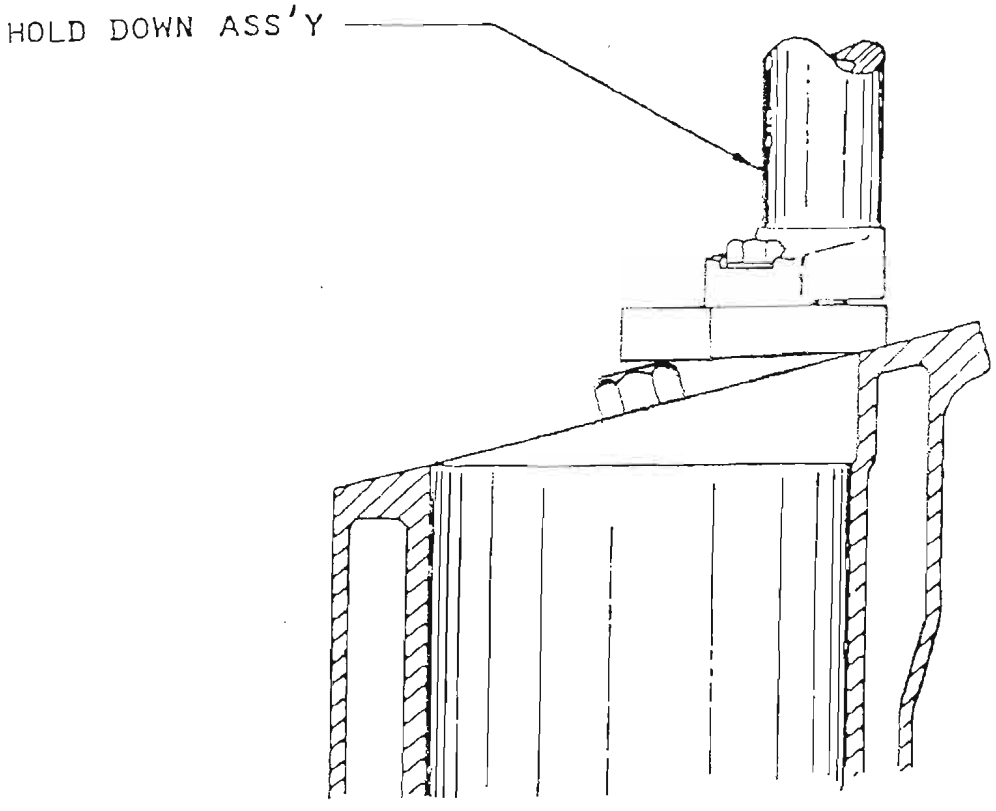
To hold down angle top blocks use an appropriate bolt in the head surface. Apply clamp pressure to bolt head as shown in sketch.

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

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

Engage feed, engage the spindle clutch, put the speed change lever in lowest speed, and allow the machine to bore until chamfer is cutting 360° of cylinder. Disengage feed and spindle clutch, engage rapid return to return the spindle to the top.

CLAMPING ANGLE TOP BLOCKS



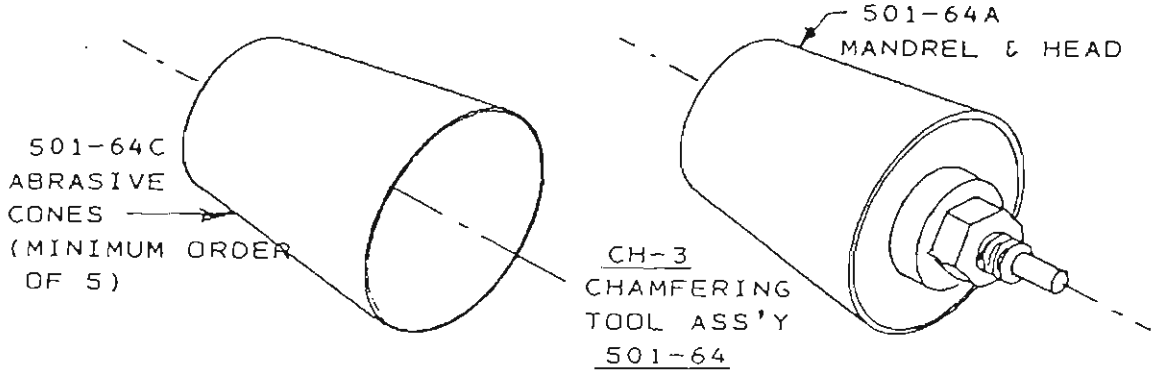
BORING LARGE TRUCK BLOCK

The F-2B 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 (502-1-21AL & AR) 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 feed and releasing when adequate chamfer has been developed or by use of hand feed.

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



COUNTERBORING

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

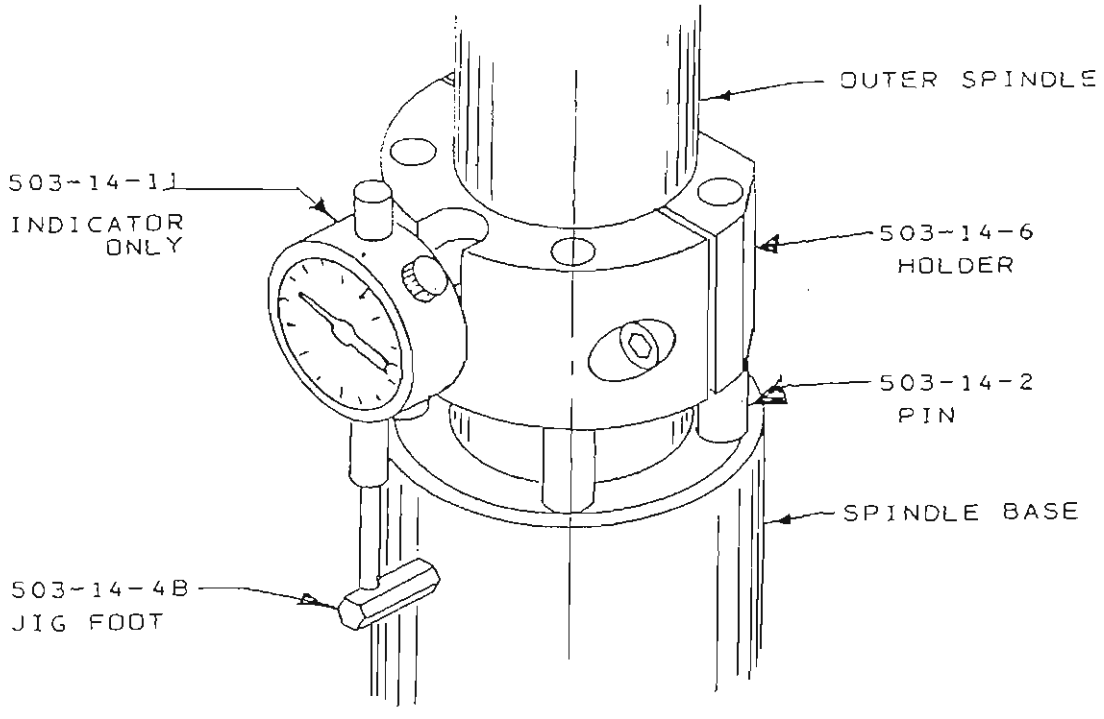
NOTE: Use hand feed.

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

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

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

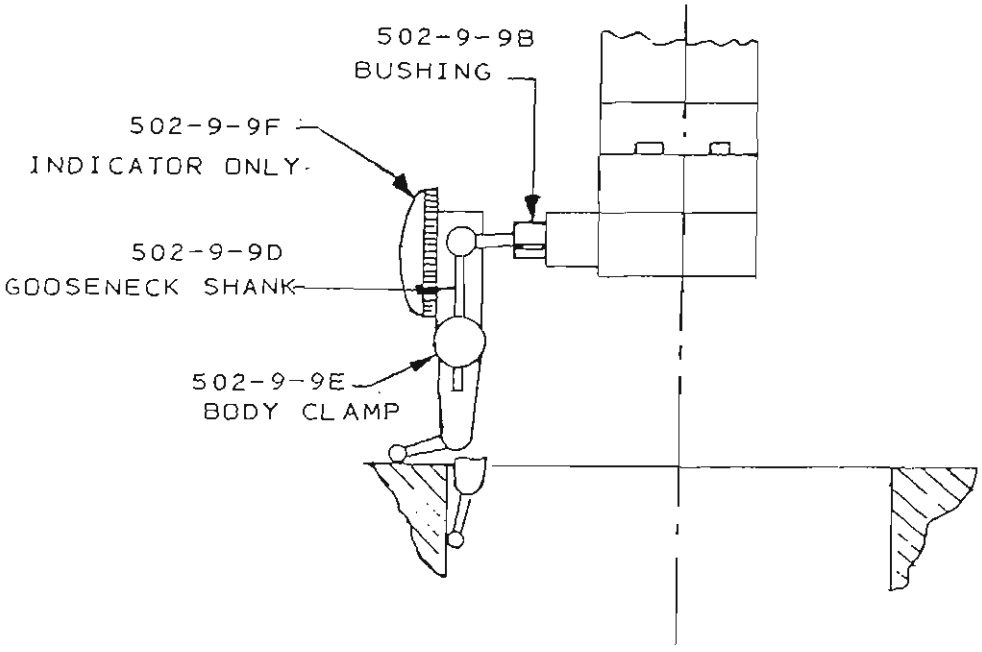
NOTE: 1/4 turn of the right hand clamp screw is sufficient tightening force. This will allow the collar to slip on the column (after the pins retract into collar) if the collar is inadvertently left in wrong position during normal cycle boring operation.



503-14B
DEPTH DIAL INDICATOR
ASS'Y

INSTRUCTIONS FOR USE OF OPTIONAL

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



502-9-9A
DIAL RUNOUT INDICATOR ASS'Y

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.

INST. FOR USE OF OPTIONAL MECHANICAL DIAL RUNOUT INDICATOR, CON'T

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.

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 0 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.

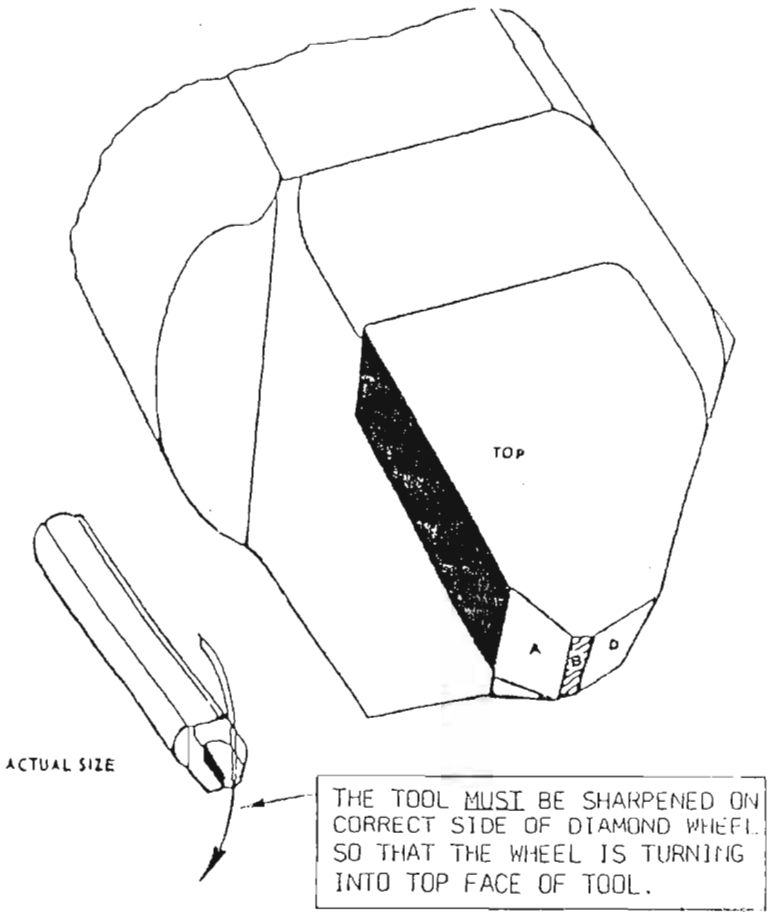
T O O L B I T S H A R P E N I N G

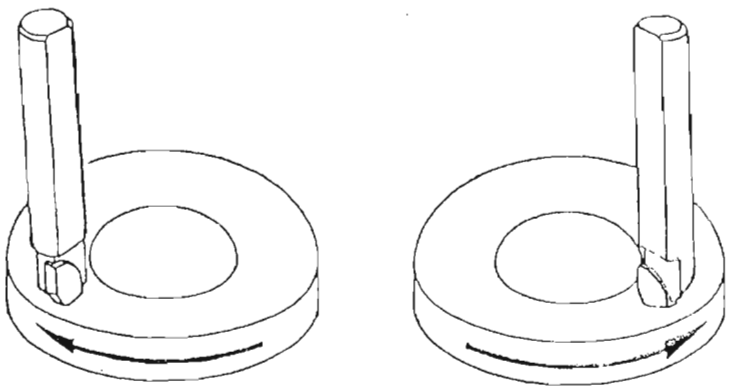
CAUTION: EYE PROTECTION MUST BE WORN WHEN SHARPENING TOOL BITS!

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 SJ3 sharpening unit 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 F-2B 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.





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 postion 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 25 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 to 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

CUTTING SPEEDS AND CUTTING DEPTH RECOMMENDATIONS

MODEL F-2B

PRODUCTION CUTTER HEAD AND BLIND HOLE CUTTER HEAD

ROUGHING CUTS FOR SLEEVING - Maximum cut .200 on a diameter. Use low spindle speed only.

FINISH CUT: TO 11" TRAVEL DEPTH -Maximum cut .040 on a diameter. Use a .015 to .025 "B" land.

TO MAXIMUM TRAVEL DEPTH -Maximum cut .025 on a diameter. Use a .005 to .015 "B" land.

SPINDLE SPEED- Bore diameter to 4" use high spindle speed.

Bore diameter to above 4" use low spindle speed.

NOTE: To product 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- Maximum cut .150 on a diameter. Use low spindle speed only.

FINISH CUT: TO 4" TRAVEL DEPTH -Maximum cut .040 on a diameter. Use .010 to .020 "B" land.

TO 8" TRAVEL DEPTH -Maximum cut .025 on a diameter. Use .005 to .015 "B" land.

SPINDLE SPEED - 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 the face of the wheel. You should use this stone frequently to remove the particles that tend to load this wheel, otherwise you will not produce the keen edge on the tool that allows the machine to bore accurate holes with a fine surface finish.

TOOL BIT SHARPENING, CON'T

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.

TOOL LIFE

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

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

Two grades of carbide tool bits are available:

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

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

CENTERING FINGERS

CHANGING OR INSTALLATION OF CENTERING FINGERS

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

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

CENTER ACCURACY CHECK

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

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

CENTER ACCURACY CHECK, CONT'D

be lapped by rotating them back 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.

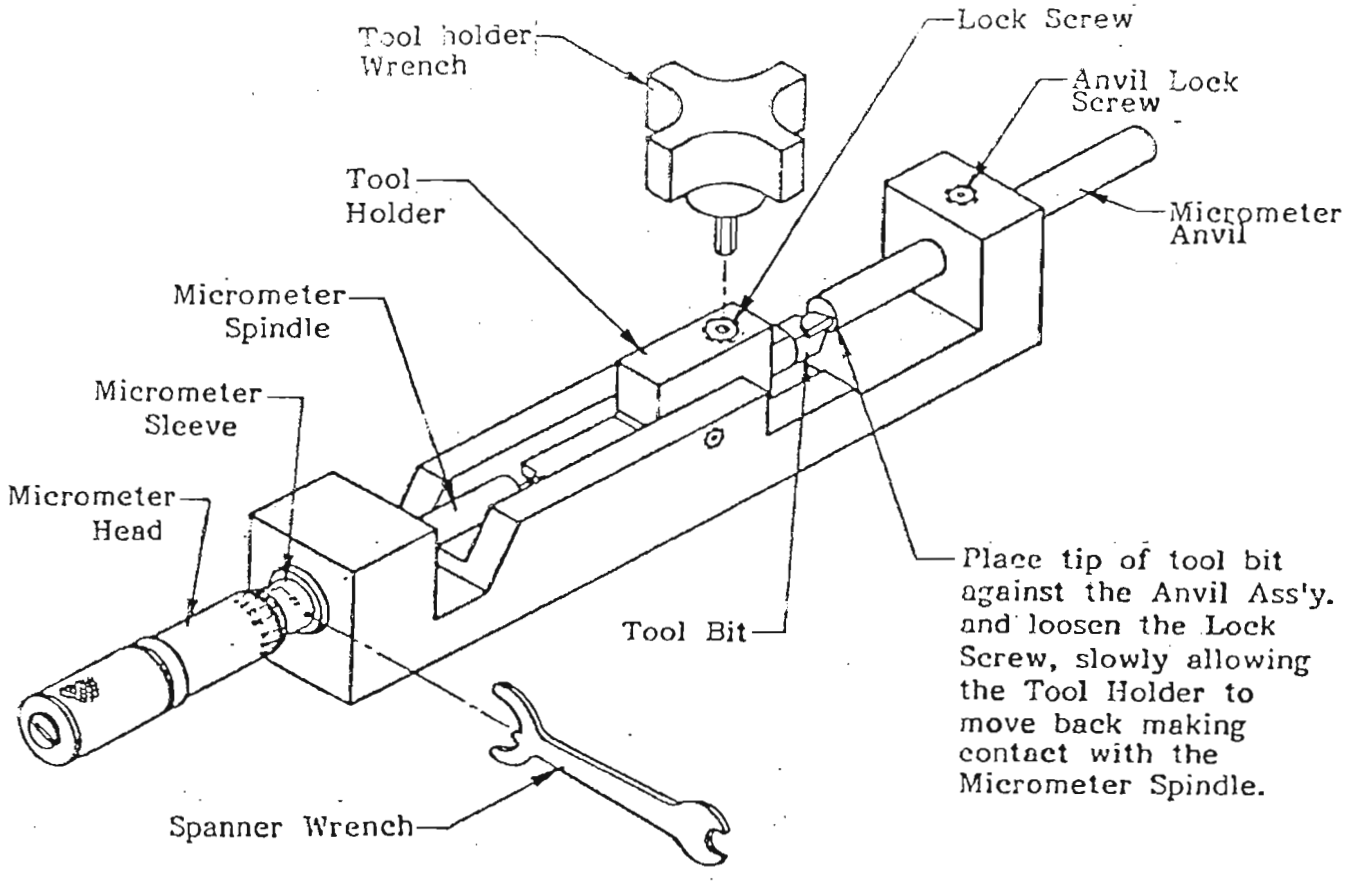
M I C R O M E T E R

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 turing the anvil slightly and finally end for end so that a flat surface is exposed to the tool bit tip.

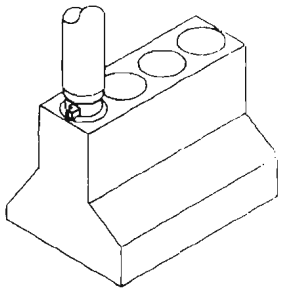
C A L I B R A T I N G M I C R O M E T E R

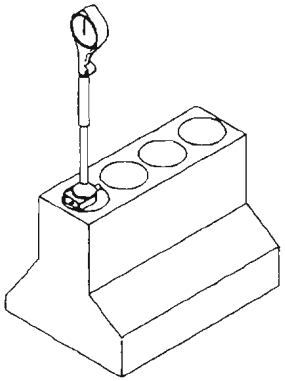
1. Bore a hole.
2. Remove tool holder and bit and place in micrometer.
3. Adjust mike so that it reads the same size as the hole you have bored. Small variations may be made by turning the mike sleeve with spanner wrench proveded. Larger changes should be made by moving the anvil.



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.

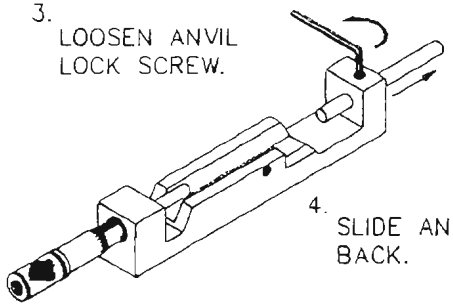




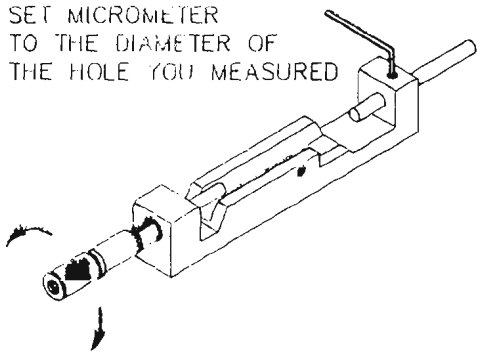
2. MEASURE THE HOLE THAT YOU BORED.

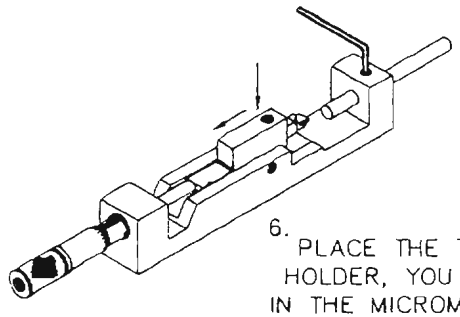
3. LOOSEN ANVIL LOCK SCREW.

4. SLIDE ANVIL BACK.

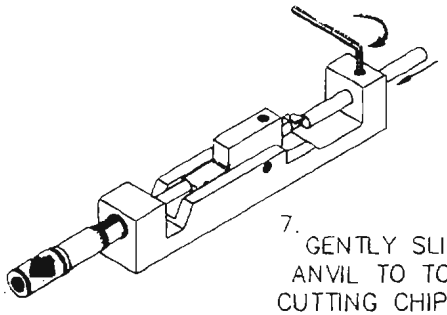


5. SET MICROMETER TO THE DIAMETER OF THE HOLE YOU MEASURED



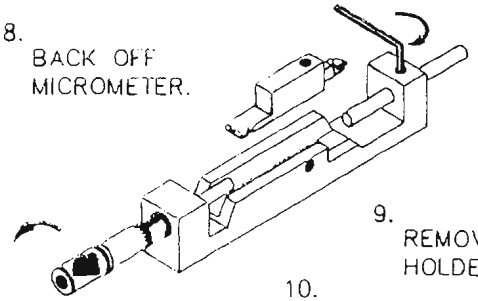


6. PLACE THE TOOL HOLDER, YOU USED, IN THE MICROMETER FRAME.



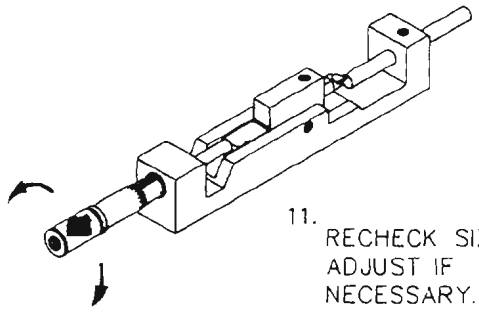
7. GENTLY SLIDE ANVIL TO TOUCH CUTTING CHIP. AND LIGHTLY TIGHTEN LOCK SCREW.

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 F-2B micrometer to high and low reading using micrometer with a 2.9" to 6.00" reading.

CAUTION: The standard for your F-2B 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 than 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 Durolith 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 Durolith EP1 or EP2, to 1 part SAE 90 multipurpose gear lubricant.

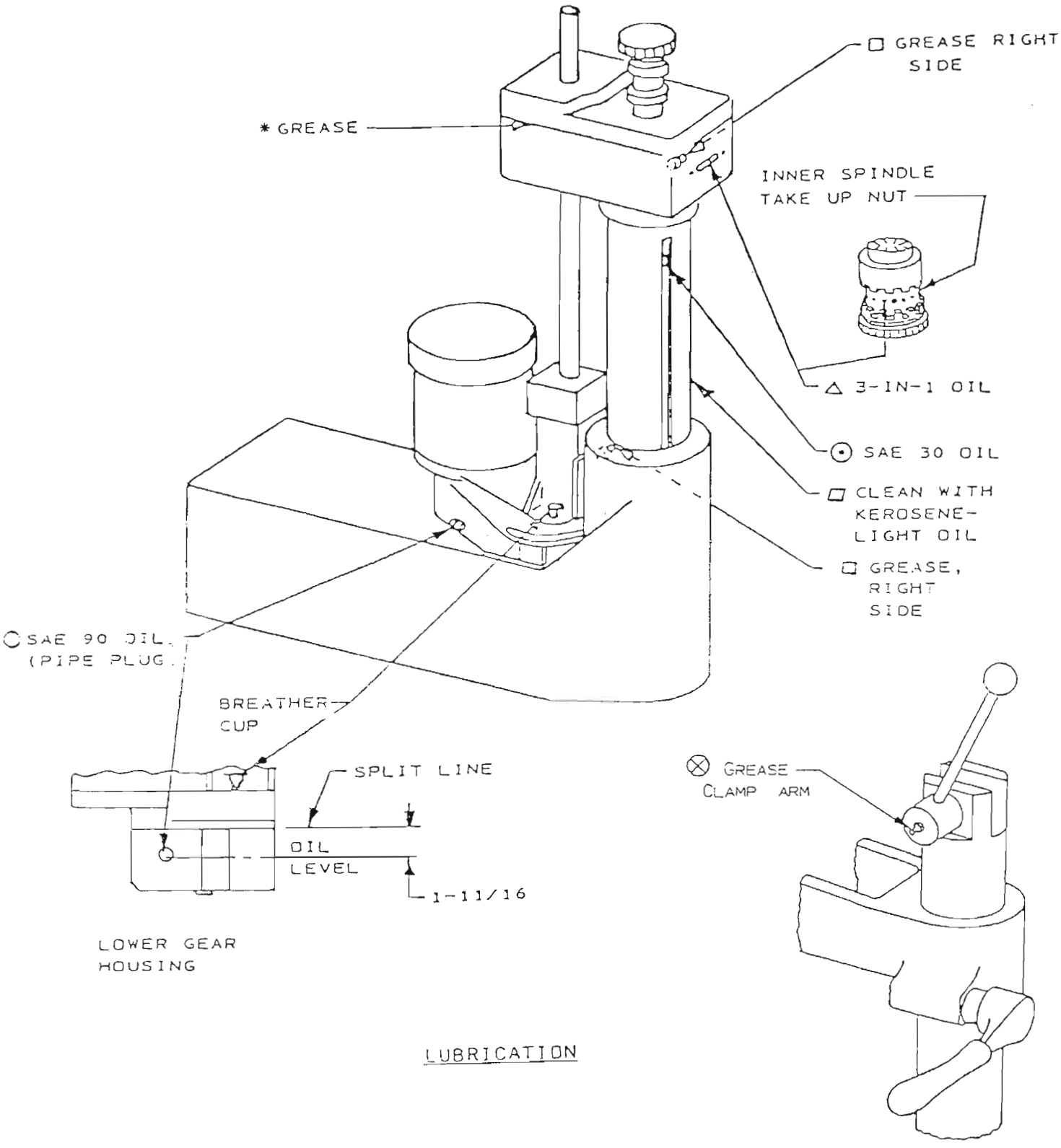
□ If your F style machine is operated on a continuous basis, grease fittings at the top of the Spindle Unit and at the bottom of Feed Screw Drive, should be lightly lubricated daily, or less often if the machine is not used continuously. Lubricate with UNOBA F1 or F2 lubricant, Lubriplate #930 AAA, Mobil oil - Mobilith A.W. Grades 1 or 2, Chevron Durolith 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.



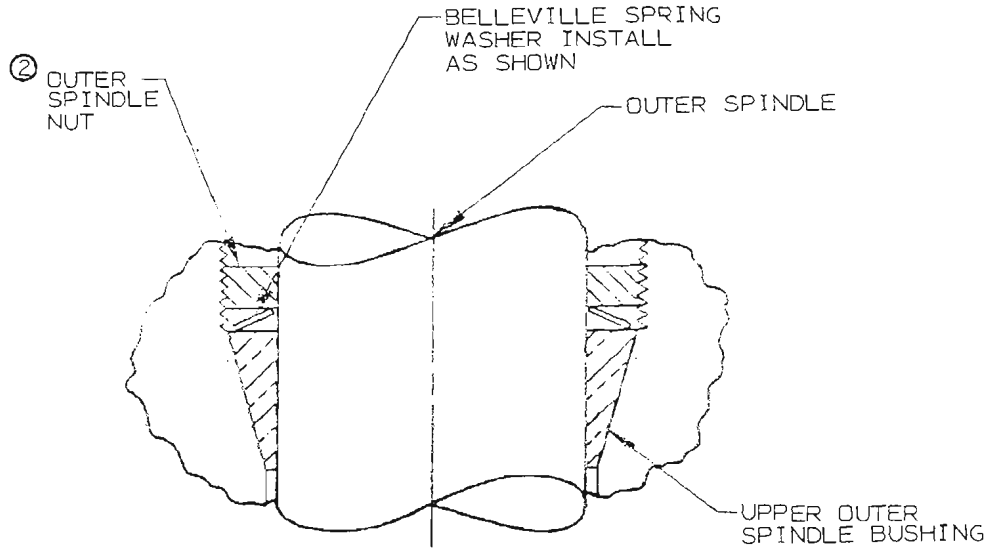
LUBRICATION

ADJUSTMENT OF OUTER SPINDLE

Main spindle bearings are tapered split cast iron rings held in seat by the adjustment nut. Tension on the bearings is normally adequate requireing 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 34.



1. Run spindle down approx. 4" to 6" loosen the #8-32 set screw & loosen all outer spindle nuts (500-77)

2. Tighten the lower bushing (500-76-1) by tightening the outer spindle nut marked ①, until 10 to 15 lbs. of effort is required to operate the hand feed handle. Lightly tighten #8-32 set screw.

3. Repeat this sequence (2) on the upper bushing, by tightening the outer spindle nut mark ②, take care that the hand feed operates only slightly tighter or 15 to 20 lbs. of effort is required to operate the hand feed handle.

4. Traverse the bar at all points of travel and make sure the hand feed works easily. Spindles are ground slightly tapered to secure max. rigidity at lower limits of travel.

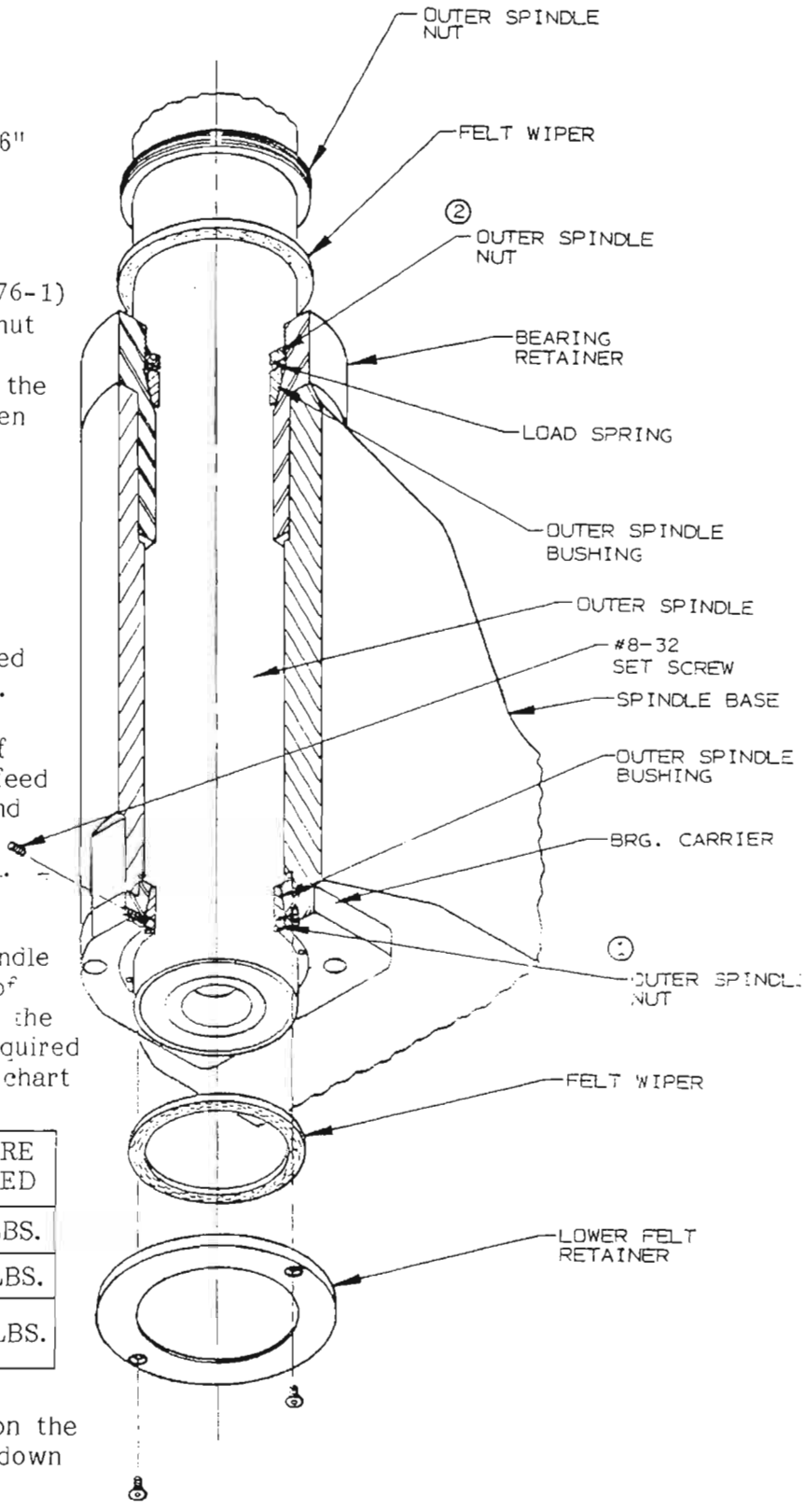
5. Spindle adjustment may also be checked by hand feeding the spindle down and pulling the slack out of feed mechanism by pulling down the upper gear housing. Pressure required at tightest point is indicated in chart below.

STYLE MACH.	PRESSURE REQUIRED
DA-O, -OB & -OC	30 - 50 LBS.
FA & F-2B	50 - 75 LBS.
FA-4EB, IDA-4, DA-5 & 6IDA-6B	60 - 80 LBS.

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

6. Avoid excessive tension on upper outer spindle nut ②, otherwise tool bit dragback marks will appear in bore.

7. **Excessive tightening of outer spindle nuts will cause strain on feed gears. and cause spindle to have an audible, excess resistance.**



VITAL OUTER SPINDLE ADJUSTMENT

ADJUSTMENT OF INNER SPINDLE

1. Remove two screws and small cover on the front side of the upper housing.

2. Remove the stop screw restricting the up travel of the spindle clutch lever and move the lever to full up position (see detail G). Rotate the spindle approximately 1/2 turn away from the detent spring. Position the tool holder slot to the rear.

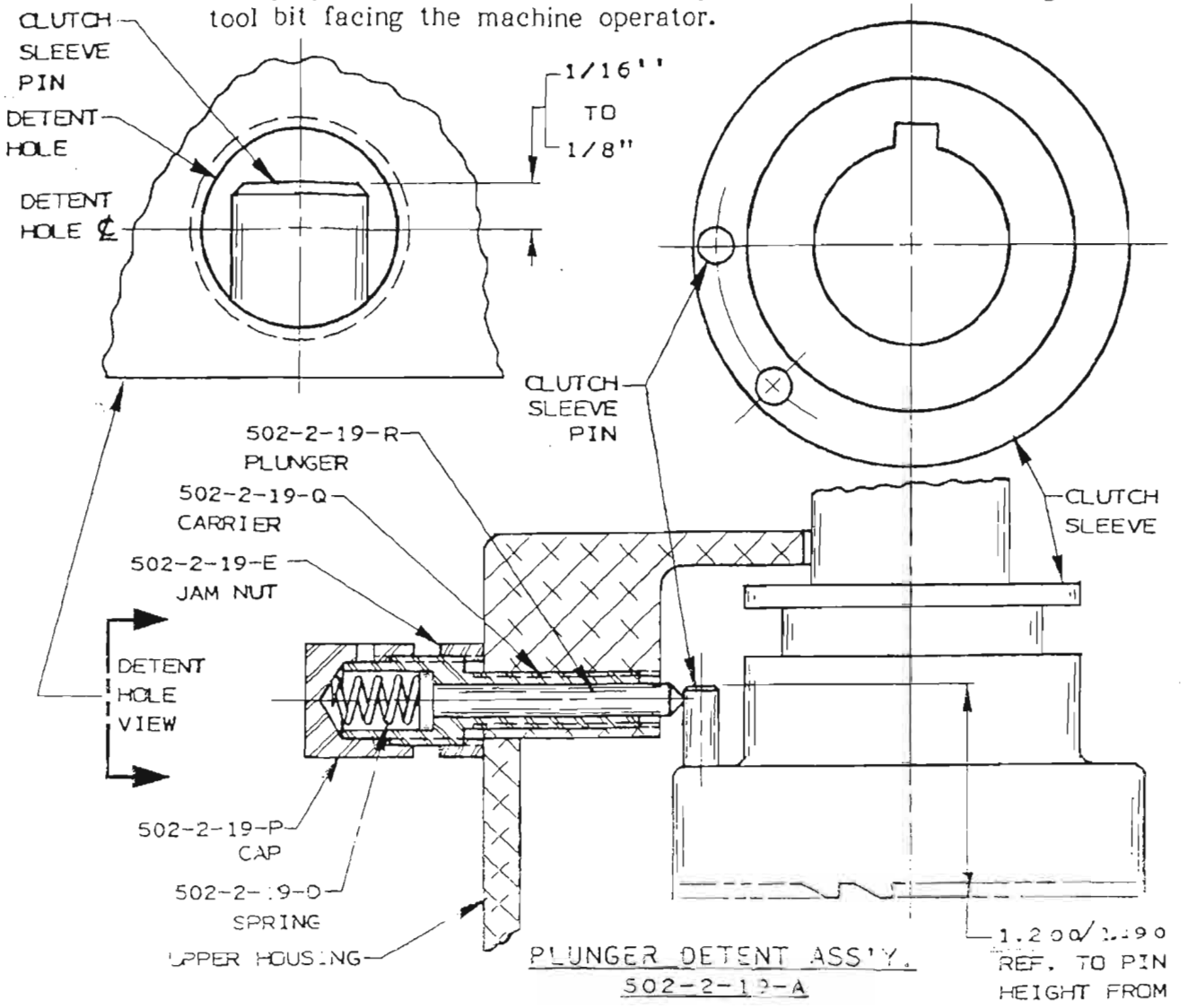
3. Insert a pin (diameter .180 or less) in one of the holes provided in the O.D. of the take up nut, (See inner spindle nut). Hold the spindle knob with one hand and turn the take up nut to the left (clockwise). You will note the nut ratchets in notches as you take up. Take up until the spindle is tight 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.

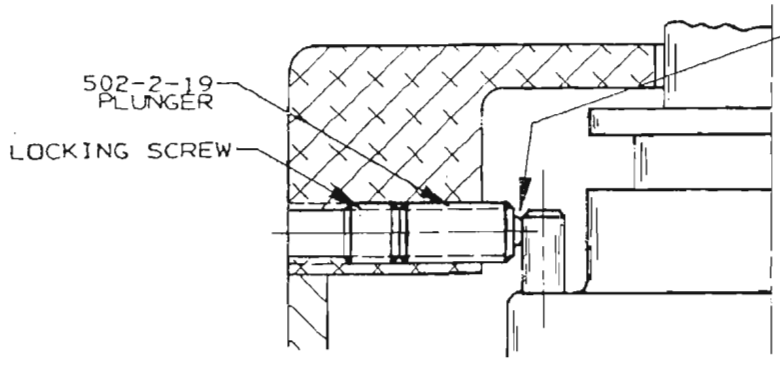


PLUNGER DETENT ASS'Y. 502-2-19-A

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 ℄
(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 screws around the feed screw, in the upper housing. Then loosen the three (3) 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.

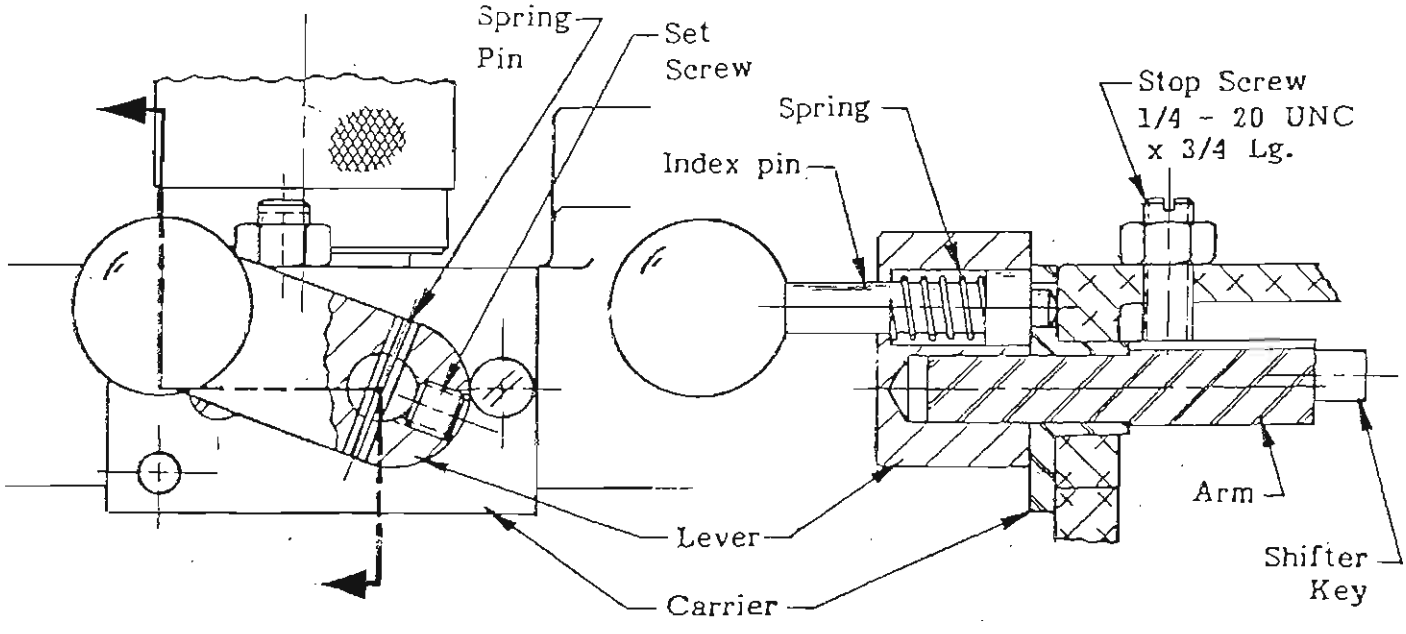
Turn adjusting screw back 1/3 turn to allow for running clearance. Hold adjusting screw with and allen wrench and lock them with lock nut.

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

SPINDLE CLUTCH CONTROL LEVER ADJUSTMENT

To re-adjust the spindle control lever, first loosen the stop screw lock nut, then the stop screw.

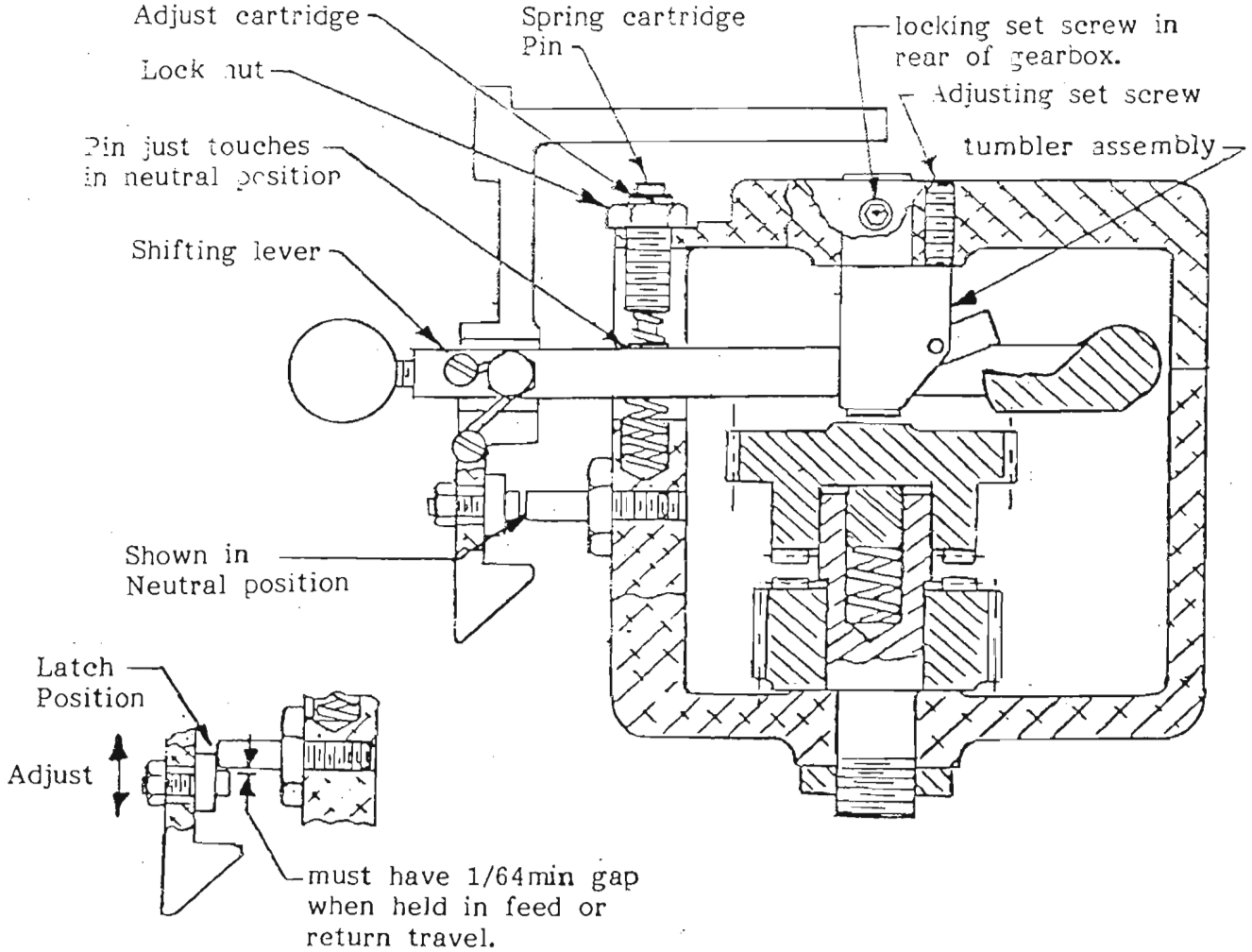
Raise the control lever to its neutral (up) position (detent pin engaged) adjust the stop screw so that the lever will not go any higher, lock with the lock nut.



RAPID RETURN ADJUSTMENT

If the boring machine should ever fail or hesitate to return to the top of travel when shift lever is lifted and latched, the following procedure may be used to adjust return traverse clutches.

1. Run boring spindle down approximately 6 inches or more.
2. Loosen horizontal locking set screw at top and back of upper housing. (See below)
3. Find neutral position of shifting lever by rotating feed screw, while engaging fast down lever. Neutral position must have fast down lever fully engaged with fast down pin at full depth in 500-1 clutch sleeve gear.
4. Pin in spring cartridge assembly should just touch shift lever, when shift lever is in neutral. Adjust by loosening lock nut and turning cartridge.
5. Adjust tumbler shaft so that clutches do not chatter when shift lever is in neutral. Clutches should start to ratchet as the pin in spring cartridge is raised approximately 1/32", when lifting the shifting lever. If clutches ratchet after the pin is raised more than 1/32", reset tumbler lower, by turning vertical set screw inward, which will result in a deeper engagement of clutches.
   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 housing, then force the tumbler up with the shift lever.
6. Tighten locking set screw to relock shaft. Check to see that adjustment has not been changed by the locking set screw.



EXCESSIVE LOADS

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, part number 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 with no 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 the object, an excessive radial shock will be imposed on the spindle and will probably shear 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 break.

REMOVAL OF MOTOR FIELD ASSEMBLY

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 shround cover and shroud. Remove (2) set screws holding fan to motor shaft and remove fan, (for old style with diamond wheel, hold fan and unscrew diamond mounting adaptor). 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.

To remove rotor, lay blocks or shims on bottom end bell (flat surface of gear box) and pry up rotor unit of motor.

DISASSEMBLY OF MOTOR HOUSING

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 500-96-3A plate to 500-70 housing. Turn out (counter-clockwise) bevel gear.

Remove 4 socket head cap screws in 500-70 housing. Lift out feed screw, or if upper housing is still intact, hold in rapid down lever, 502-27-11, 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.

DISASSEMBLY OF MOTOR HOUSING, CON'T

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 screws 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 disassembly motor housing, remove speed shifter 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 or 500-64-2, 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 box.

CENTERING ROD AND DRAW BAR REMOVAL

The centering rod and draw bar can be removed after the cutter head is removed, simply by drawing the rod and draw bar assembly up through the top of the spindle upper housing. REPLACE CAREFULLY.

DISASSEMBLY OF UPPER HOUSING AND SPINDLE REMOVAL

After removing cutter head, centering rod and draw bar, loosen set screws in lower spindle knob, 600-18-2 and remove.

Remove 502-27-22 knob by releasing its socket set screw. Unscrew spindle clutch lever stop screw. Raise lever to extreme top, which will allow removal of countersunk screw and lever assembly. Remove cap screw to disassemble trip lever, 500-35A.

CAUTION: Do not lose trip spring.

Remove 6 screws holding upper housing sections together, and lift off upper lid, 500-22.

Now shifting lever, 500-38-A, with spring may be removed along with 500-25 upper fast return gear with plunger and spring, spindle clutch (and key) 500-3. Remove ball bearing (with take up spring) 500-18, (be sure spring is reassembled properly), sleeve gear, 500-1, feed nut, 500-2, thrust washer, 500-15, and feed gear, 500-8.

If the bar is in a vertical spindle position, we suggest you place something under the spindle nose to prevent inner spindle from falling out and then remove 500-5 spindle nut. Nut can be started off through adjusting access hole and then hand turned. Now drive gear assembly, 500-6, may be worked off along with 500-4, spacer and Woodruff key.

Inner spindle may now be removed.

CAUTION: Lubrication will run out when spindle is removed.

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

Lift off of feed screw.

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

DISASSEMBLY OF UPPER HOUSING & SPINDLE REMOVAL, CON'T

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

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

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

COMMON CAUSES OF TROUBLE

(POOR FINISH, INACCURATE HOLES, EXCESSIVE TOOL BIT HEAT, EXCESSIVE TOOL DRAG LINES, ETC.)

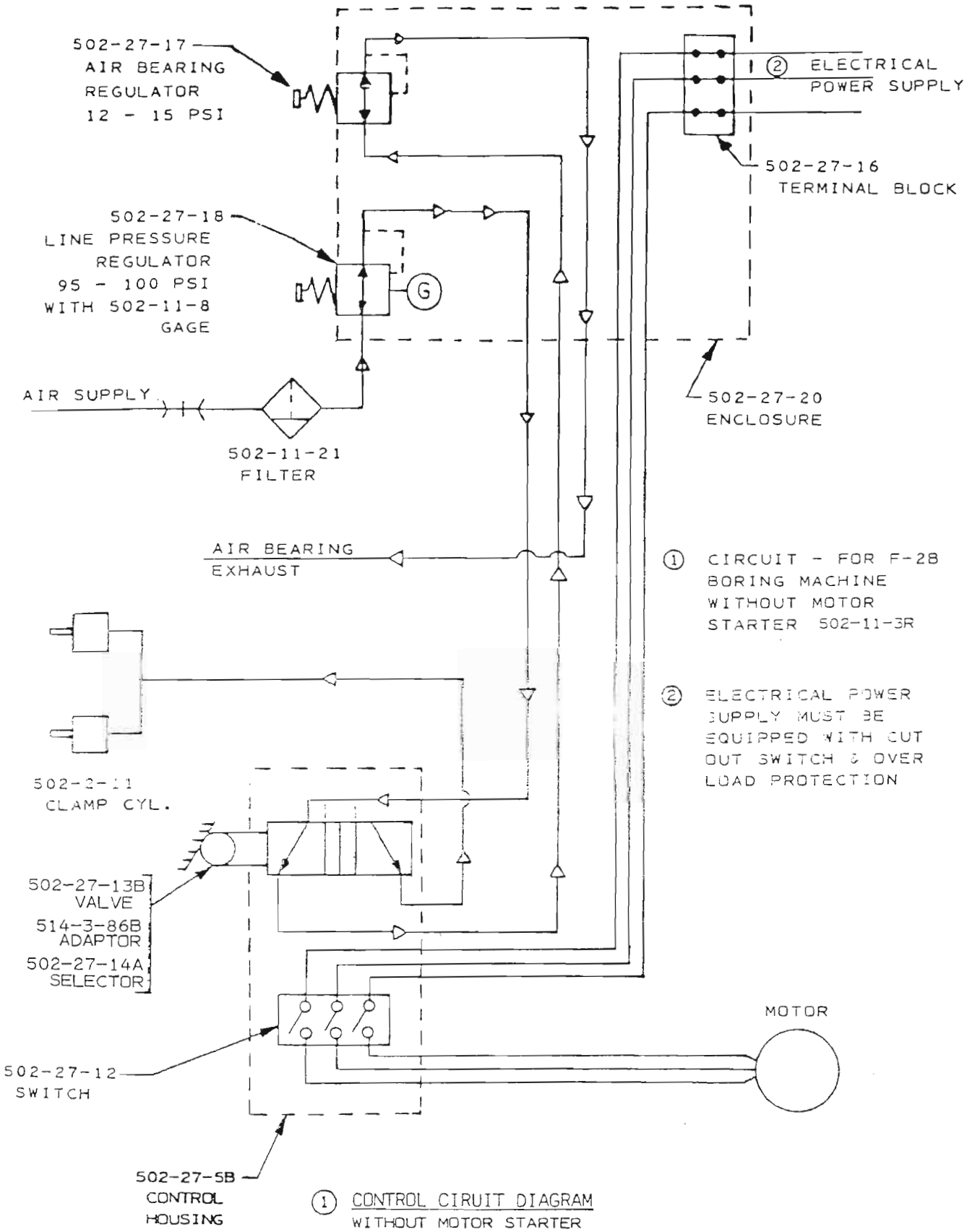
The great majority of these problems are a result of tool bit sharpening. Check to make sure tool bit "B" land is of proper width, with keen sharp faces and that top of bit is free from flaws, with original rake angle and smooth finish. Frequently a minute flaw, not visible to the naked eye, will prevent 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. (502-2-43). The result of this would be to encounter spindle chatter at bottom of bore, particularly on long bores.

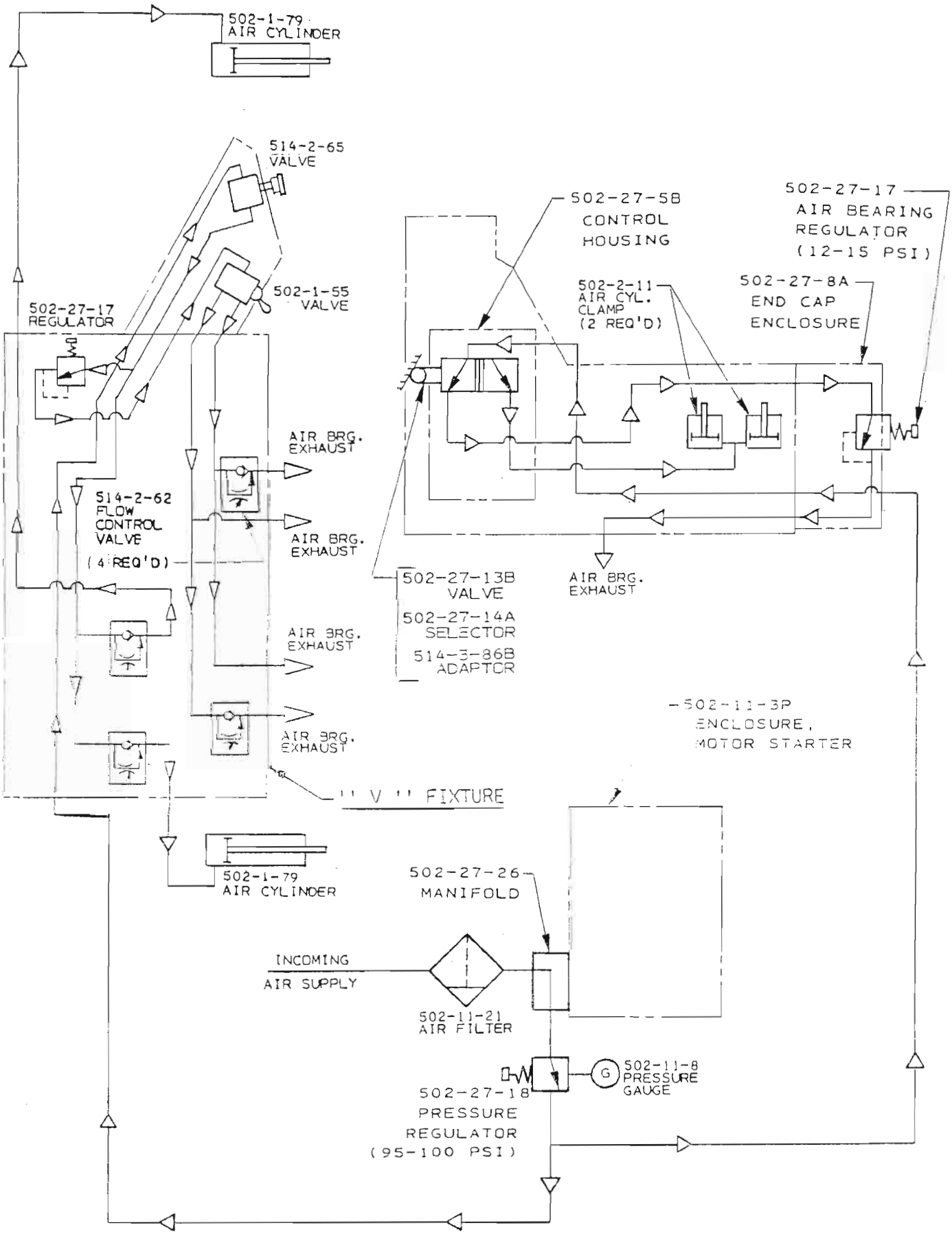
Clean the inside of this assembly extremely cautiously and thoroughly, leaving completely dry. Tolerances on these parts are extremely close and much care should be used.

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.

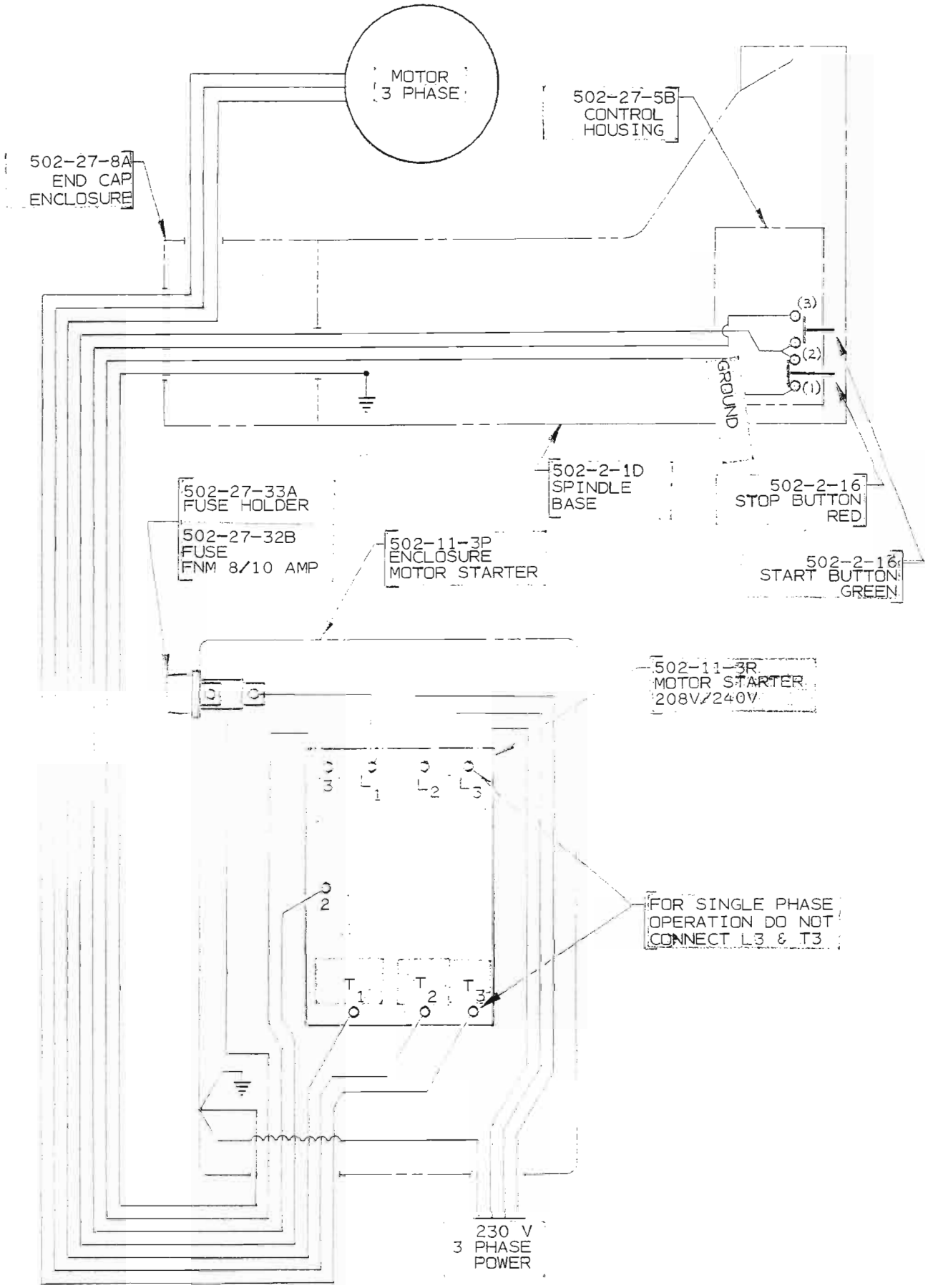
A loose outer spindle bearing will not generally result in taper or inaccurate bores, but can allow spindle to drop slack in feed nut, resulting in a mark in the cylinder.



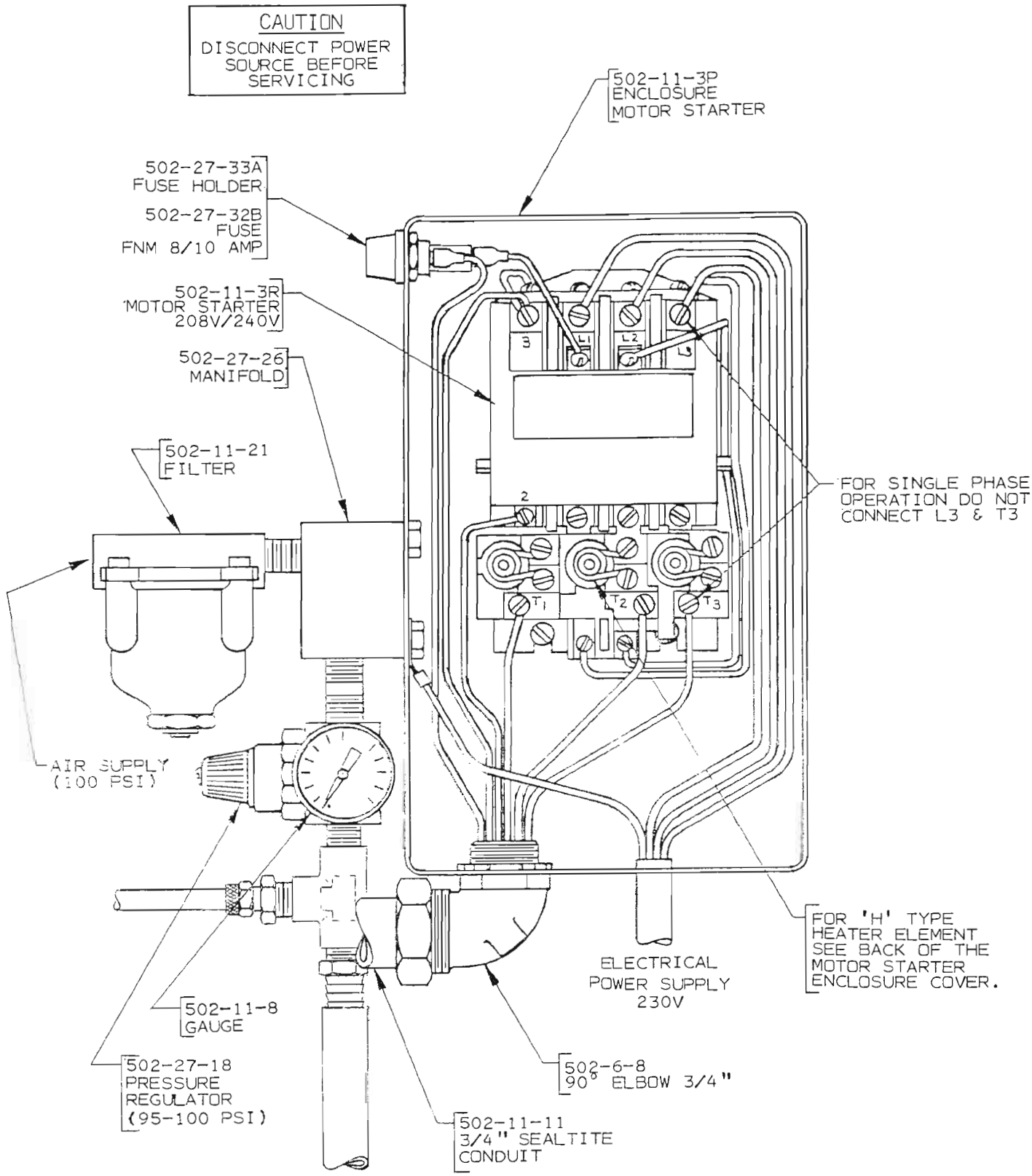
① CONTROL CIRUIT DIAGRAM
WITHOUT MOTOR STARTER



F-2B PNEUMATIC CONTROL
CIRCUIT DIAGRAM

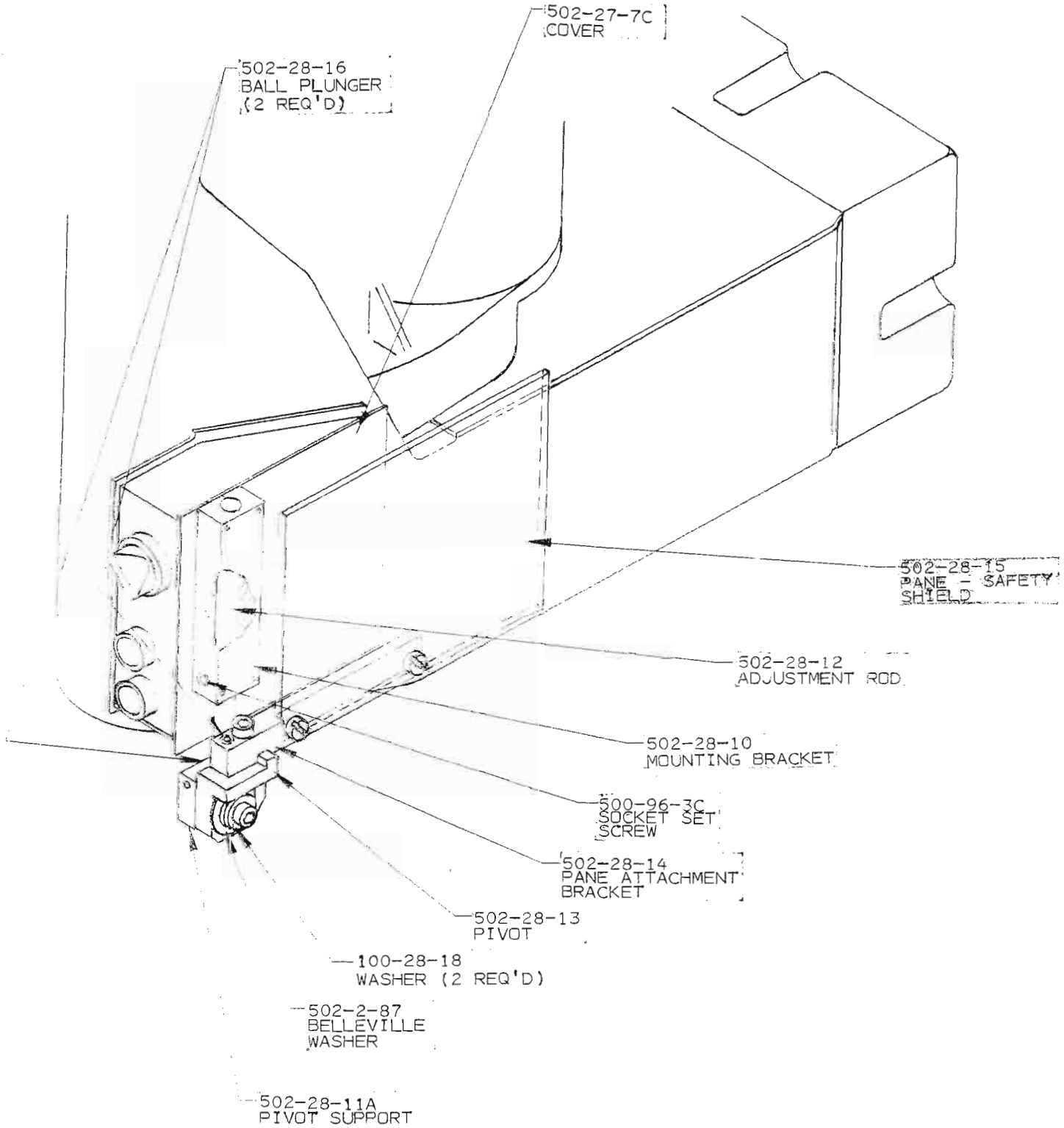


F-2B
WIRING DIAGRAM



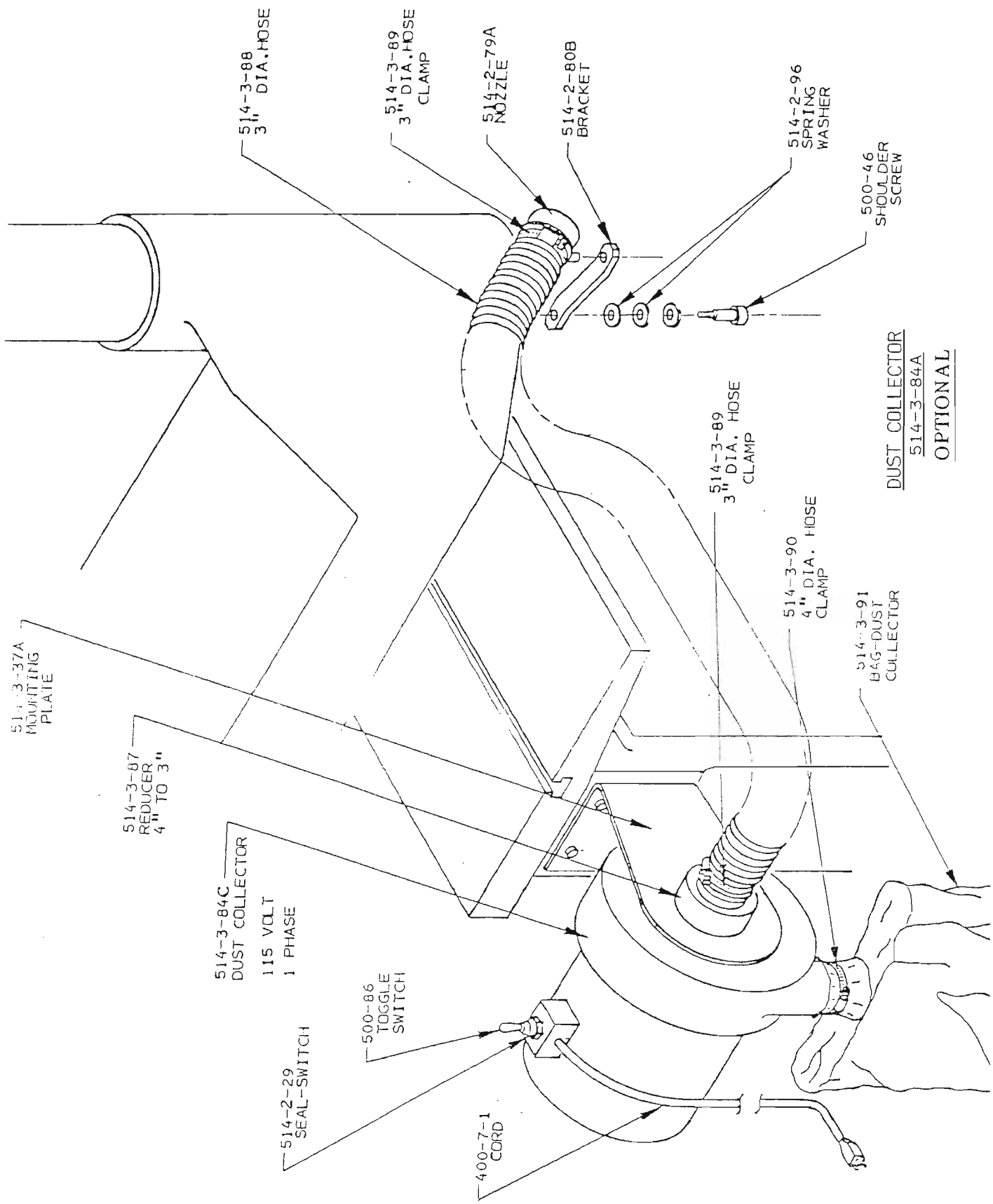
POWER SUPPLY PANEL

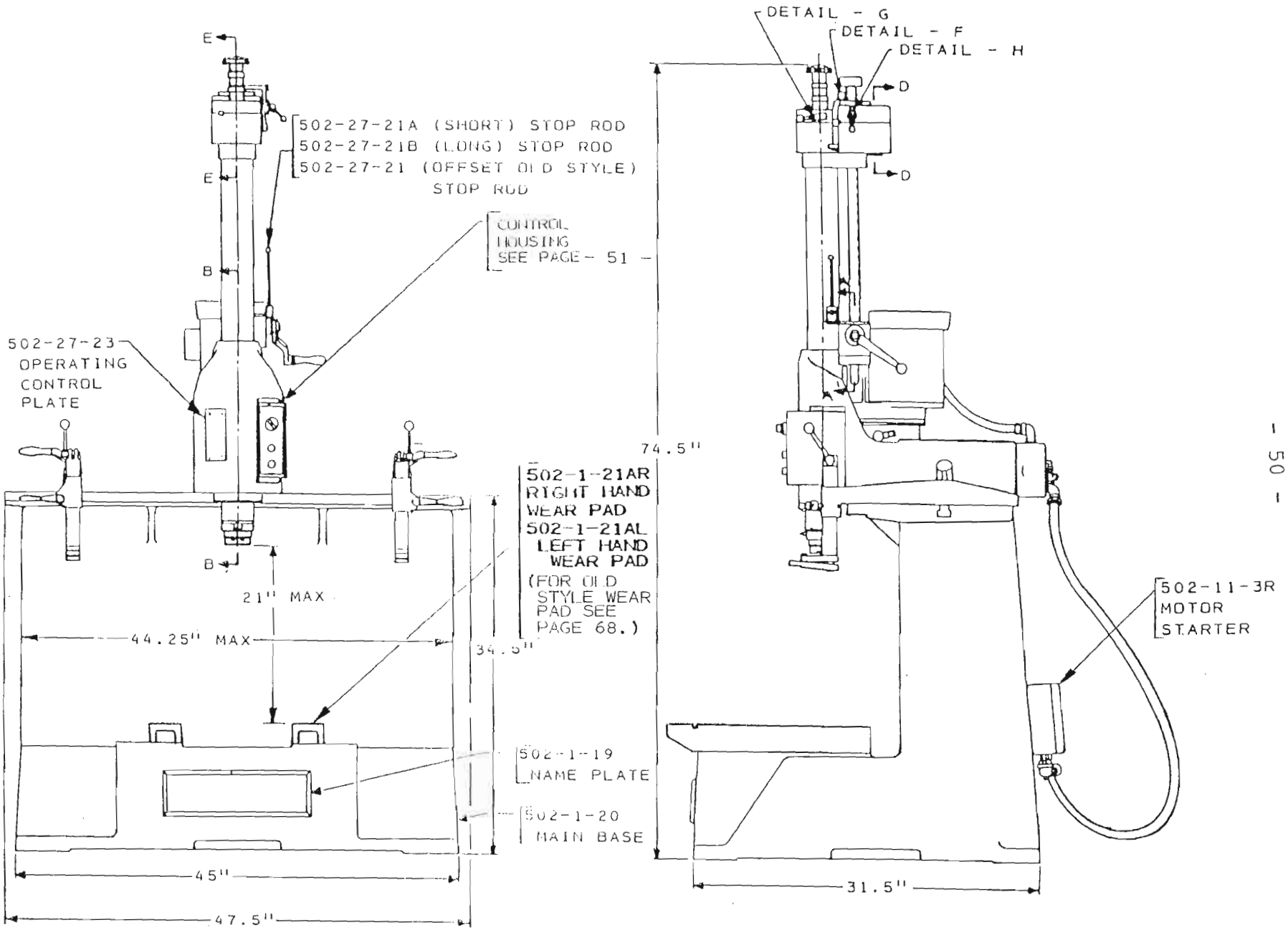
F-2B

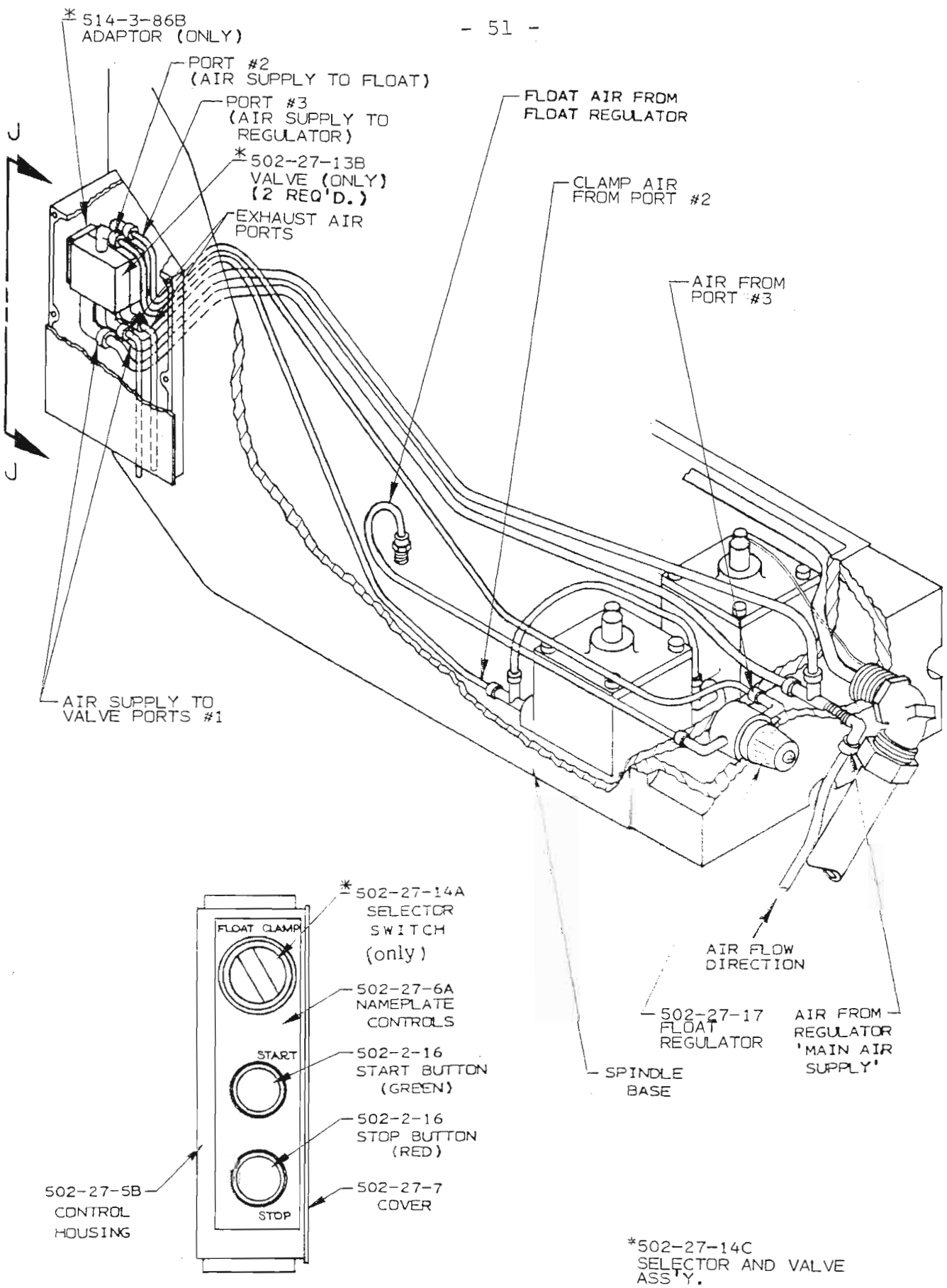


OPTIONAL — SAFETY SHIELD

F-2B ONLY


514-3-88
3" DIA. HOSE
514-3-89
3" DIA. HOSE
CLAMP
514-2-79A
NOZZLE
514-2-80B
BRACKET
514-2-96
SPRING
WASHER
500-46
SHOULDER
SCREW
514-3-89
3" DIA. HOSE
CLAMP
514-3-90
4" DIA. HOSE
CLAMP
514-3-91
BAG-DUST
COLLECTOR
514-3-37A
MOUNTING
PLATE
514-3-87
REDUCER
4" TO 3"
514-3-84C
DUST COLLECTOR
115 VOLT
1 PHASE
500-86
TOGGLE
SWITCH
514-2-29
SEAL-SWITCH
400-7-1
CORD
DUST COLLECTOR
514-3-84A
OPTIONAL

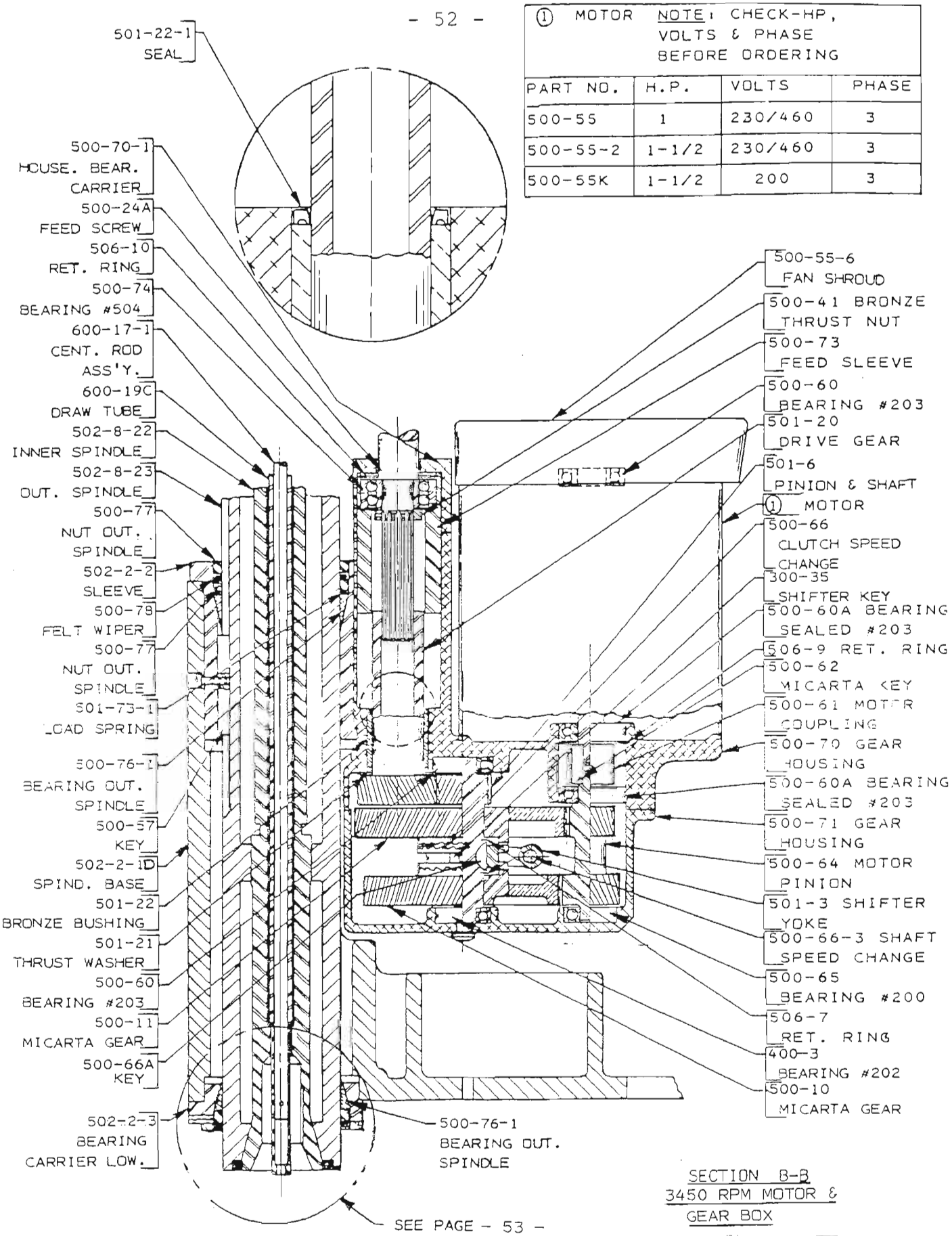

DETAIL - G
DETAIL - F
DETAIL - H
E
E
B
B
D
D
502-27-21A (SHORT) STOP ROD
502-27-21B (LONG) STOP ROD
502-27-21 (OFFSET OLD STYLE) STOP ROD
CONTROL HOUSING SEE PAGE - 51 -
502-27-23 OPERATING CONTROL PLATE
74.5"
502-1-21AR RIGHT HAND WEAR PAD
502-1-21AL LEFT HAND WEAR PAD
(FOR OLD STYLE WEAR PAD SEE PAGE 68.)
21" MAX
44.25" MAX
34.5"
502-1-19 NAME PLATE
502-1-20 MAIN BASE
45"
47.5"
31.5"
502-11-3R MOTOR STARTER



VIEW J - J

*502-27-14C
SELECTOR AND VALVE
ASS'Y.
INCLUDES PARTS
502-27-13B, 502-27-14A
& 514-3-86B.

① MOTOR NOTE: CHECK-HP, VOLTS & PHASE BEFORE ORDERING			
PART NO.	H.P.	VOLTS	PHASE
500-55	1	230/460	3
500-55-2	1-1/2	230/460	3
500-55K	1-1/2	200	3

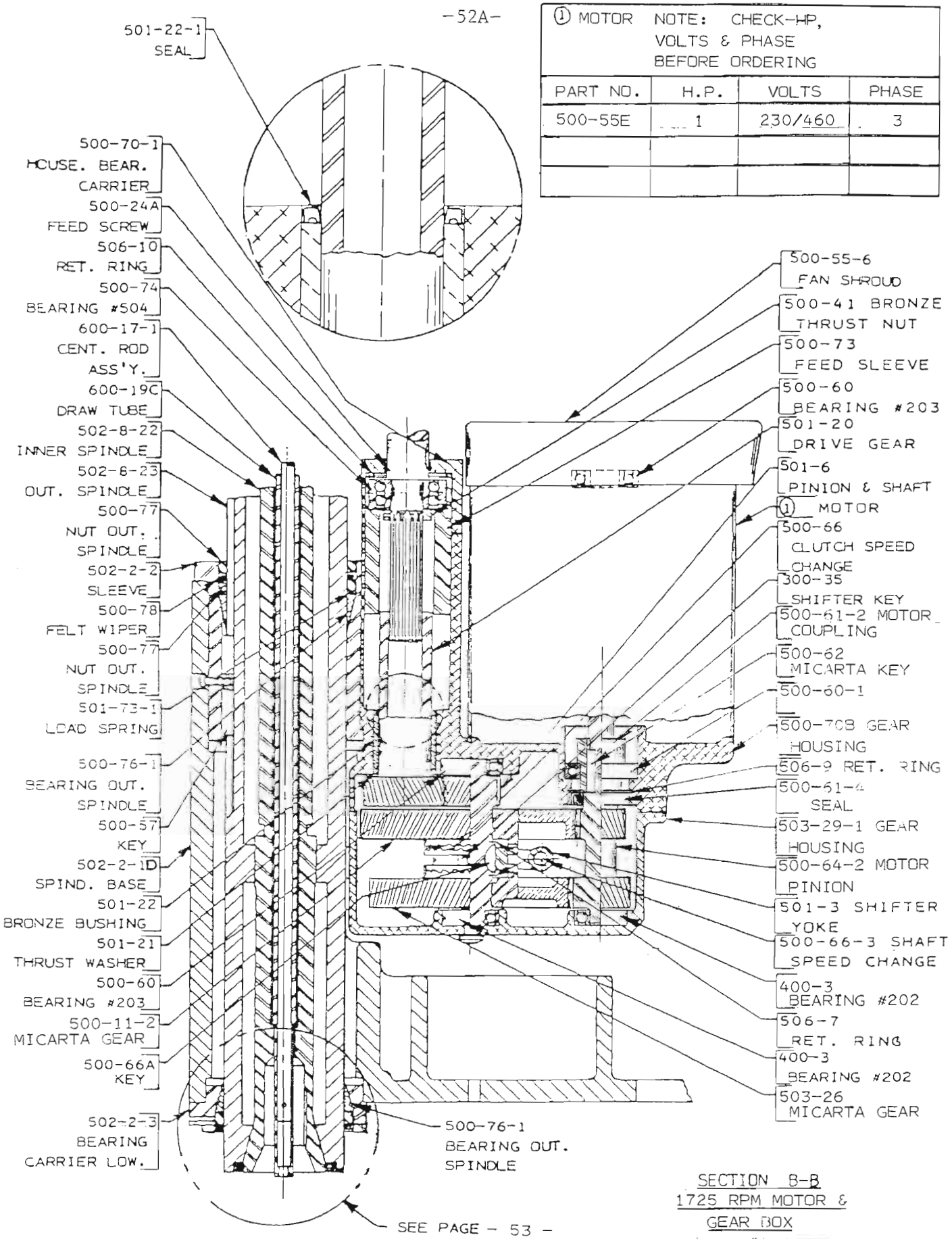


SEE PAGE - 53 -

SECTION B-B
3450 RPM MOTOR & GEAR BOX

VERIFY WITH MOTOR NAMEPLATE.

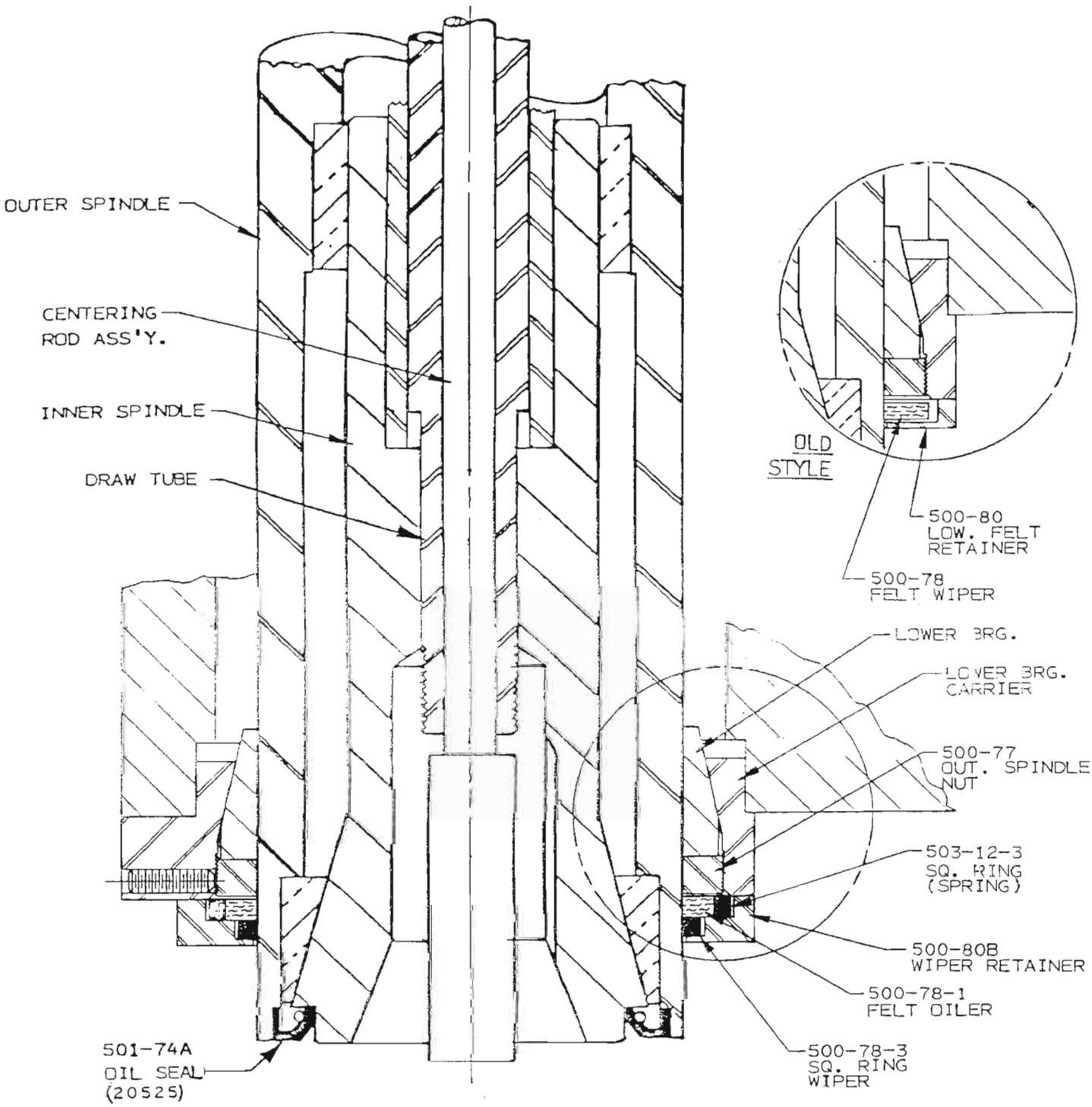
① MOTOR NOTE: CHECK-HP, VOLTS & PHASE BEFORE ORDERING			
PART NO.	H.P.	VOLTS	PHASE
500-55E	1	230/460	3

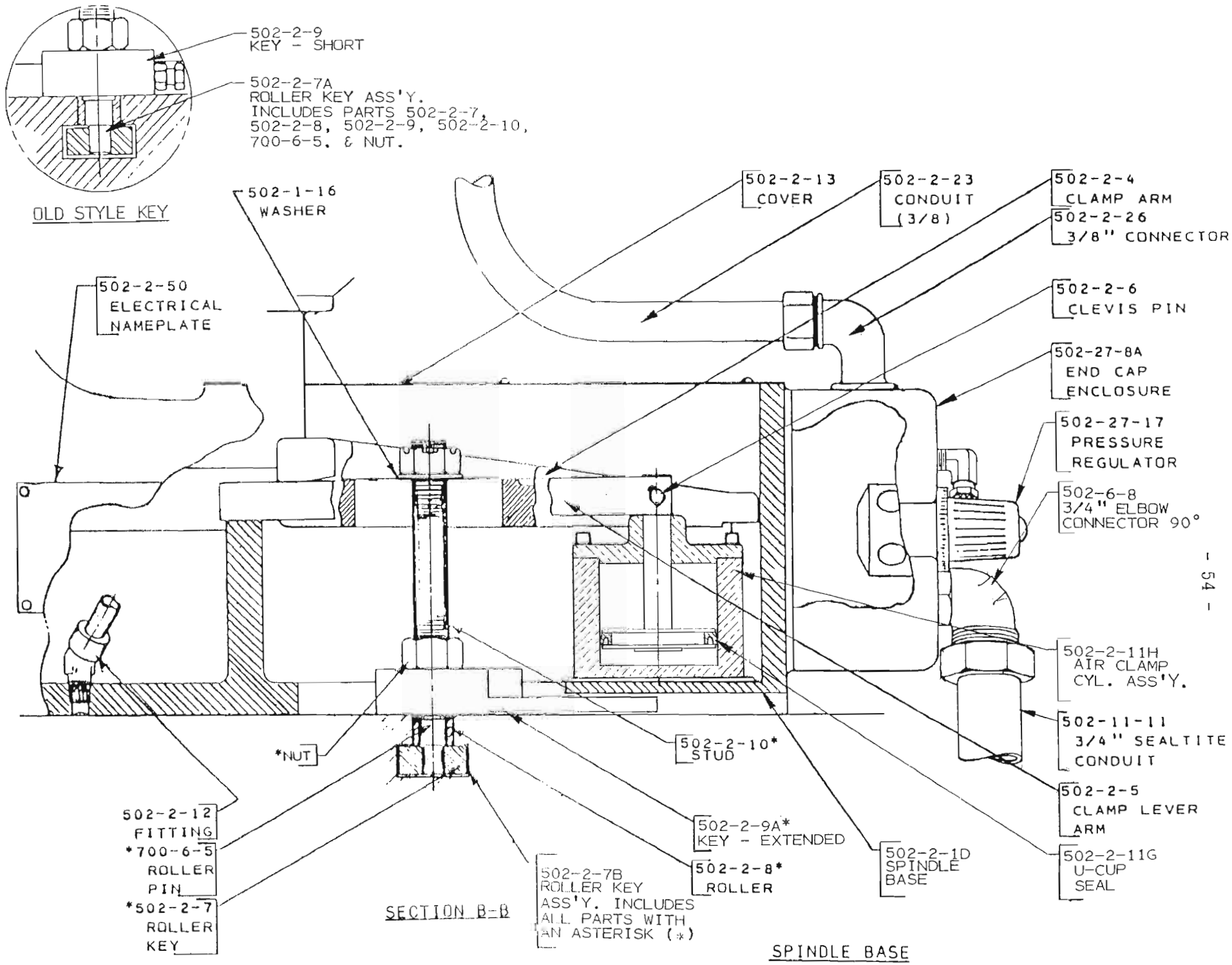


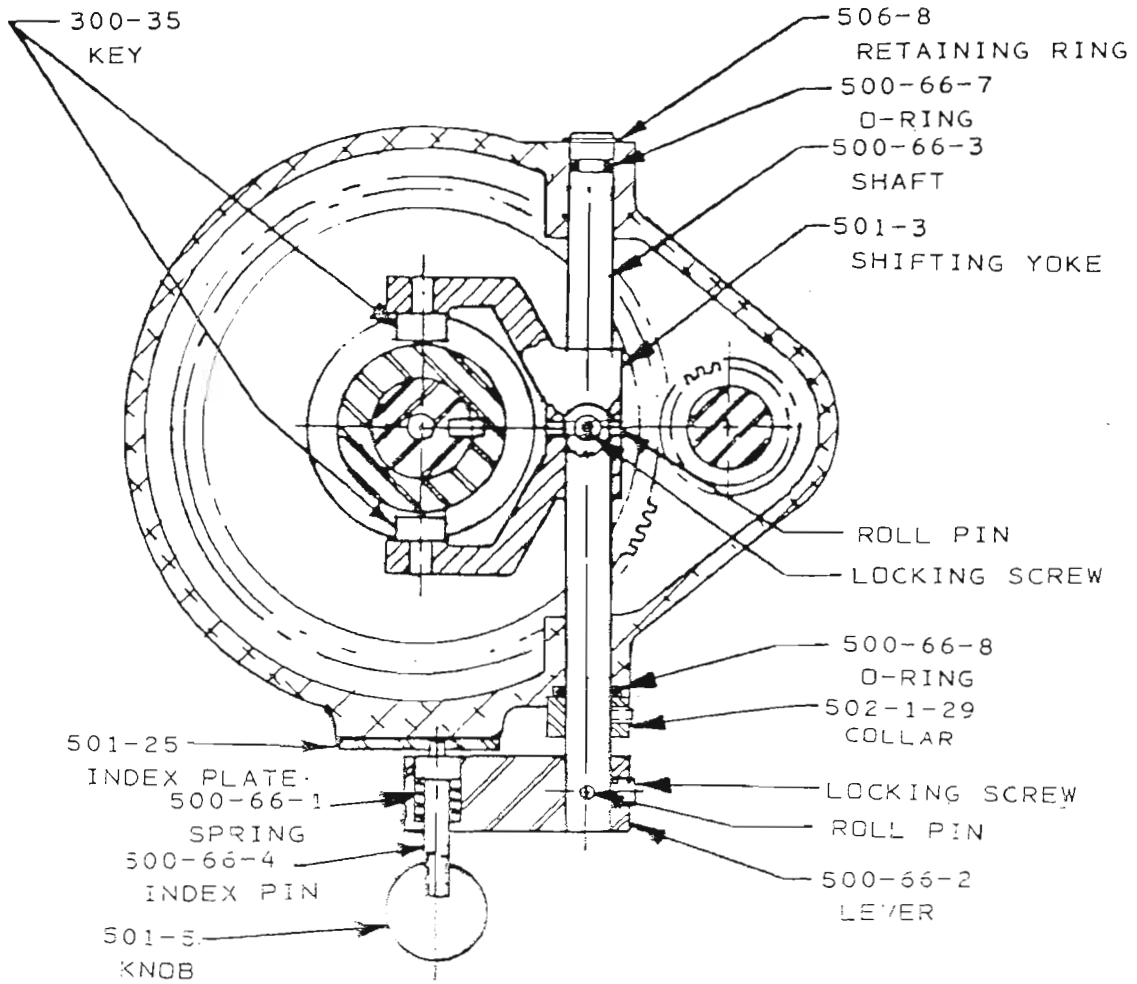
SEE PAGE - 53 -

SECTION B-B
1725 RPM MOTOR & GEAR BOX

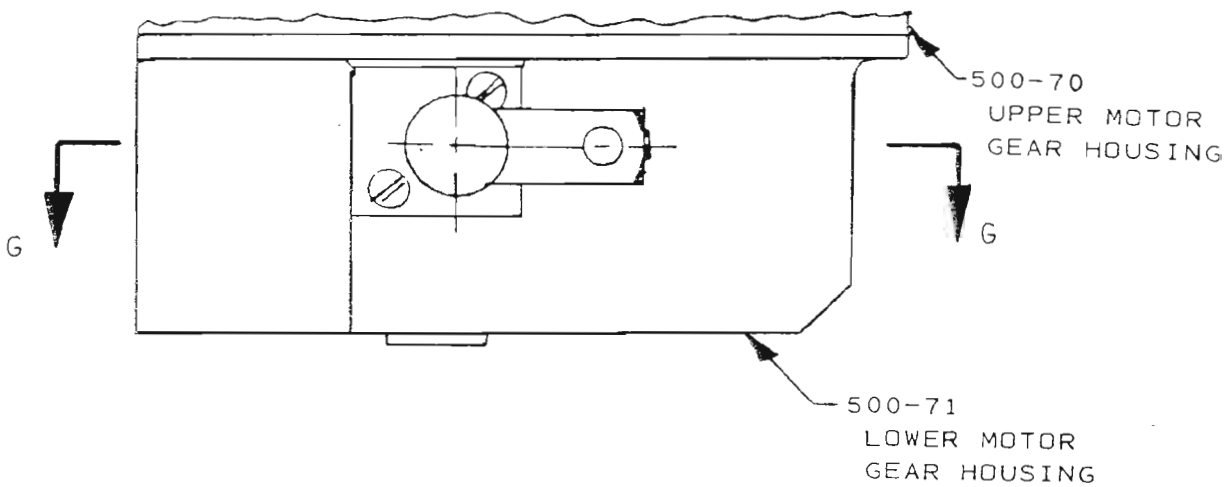
VERIFY WITH MOTOR NAMEPLATE.


OUTER SPINDLE
CENTERING ROD ASS'Y.
INNER SPINDLE
DRAW TUBE
501-74A OIL SEAL (20525)
OLD STYLE
500-80 LOW. FELT RETAINER
500-78 FELT WIPER
LOWER BRG.
LOWER BRG. CARRIER
500-77 OUT. SPINDLE NUT
503-12-3 SQ. RING (SPRING)
500-80B WIPER RETAINER
500-78-1 FELT OILER
500-78-3 SQ. RING WIPER

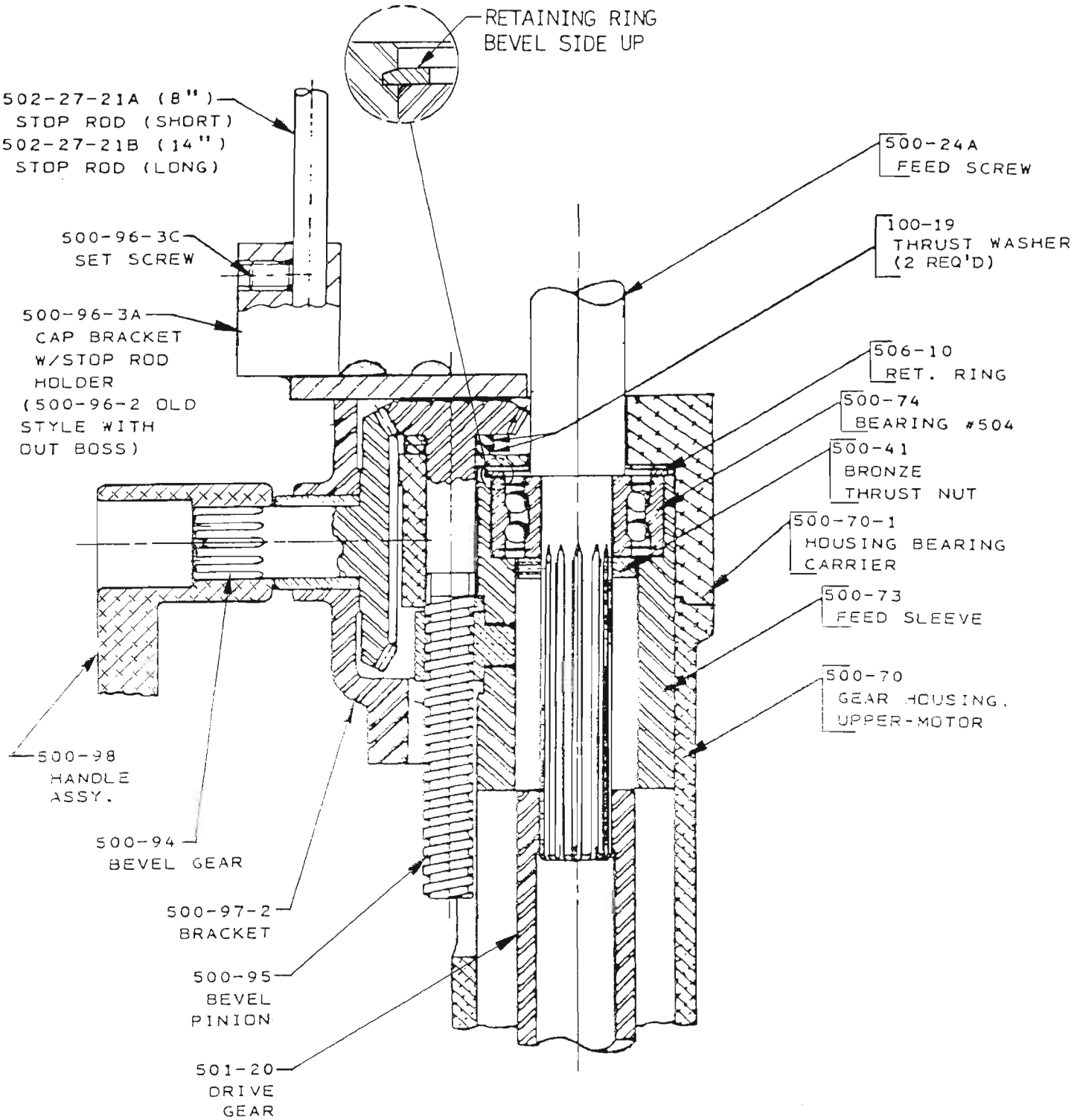

502-2-9
KEY - SHORT
502-2-7A
ROLLER KEY ASS'Y.
INCLUDES PARTS 502-2-7,
502-2-8, 502-2-9, 502-2-10,
700-6-5, & NUT.
OLD STYLE KEY
502-1-16
WASHER
502-2-13
COVER
502-2-23
CONDUIT
(3/8)
502-2-4
CLAMP ARM
502-2-26
3/8" CONNECTOR
502-2-50
ELECTRICAL
NAMEPLATE
502-2-6
CLEVIS PIN
502-27-8A
END CAP
ENCLOSURE
502-27-17
PRESSURE
REGULATOR
502-6-8
3/4" ELBOW
CONNECTOR 90°
502-2-11H
AIR CLAMP
CYL. ASS'Y.
502-11-11
3/4" SEALTITE
CONDUIT
502-2-5
CLAMP LEVER
ARM
502-2-11G
U-CUP
SEAL
*NUT
502-2-10*
STUD
502-2-12
FITTING
*700-6-5
ROLLER
PIN
*502-2-7
ROLLER
KEY
502-2-9A*
KEY - EXTENDED
502-2-8*
ROLLER
502-2-1D
SPINDLE
BASE
502-2-7B
ROLLER KEY
ASS'Y. INCLUDES
ALL PARTS WITH
AN ASTERISK (*)
SECTION B-B
SPINDLE BASE



SECTION G-G

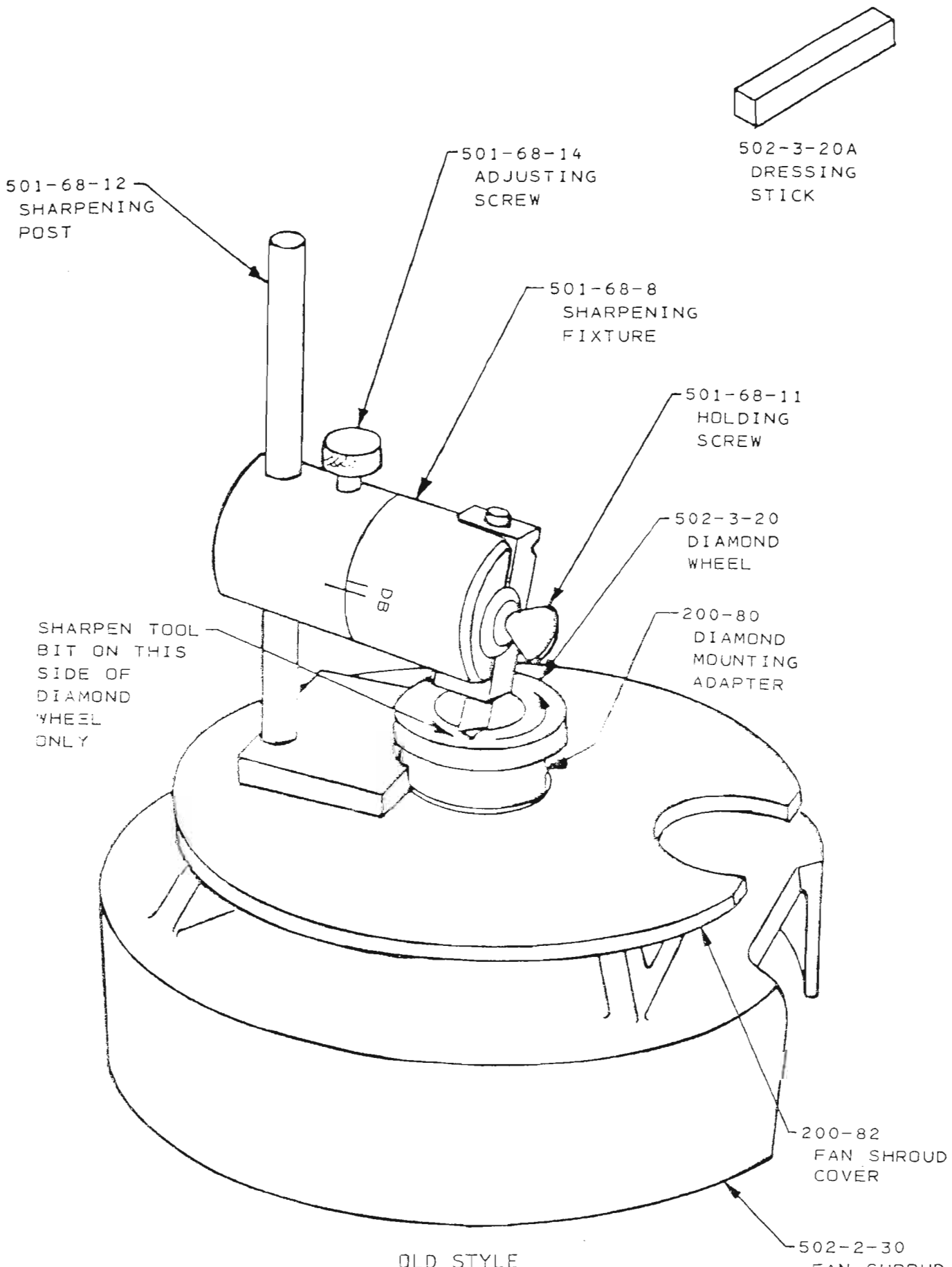


SPEED CONTROL
LOWER MOTOR HOUSING

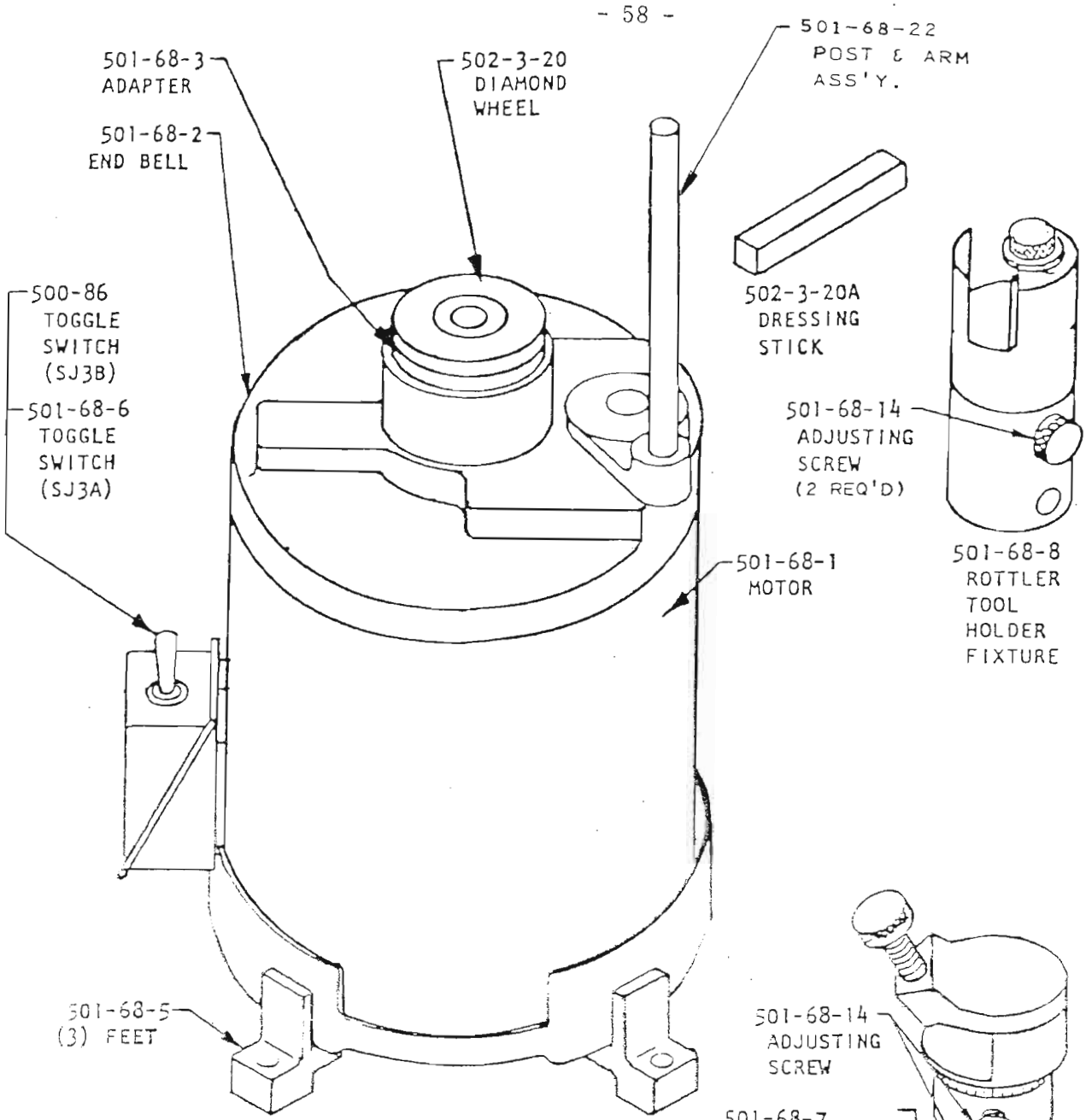


SECTION A - A

HAND FEED

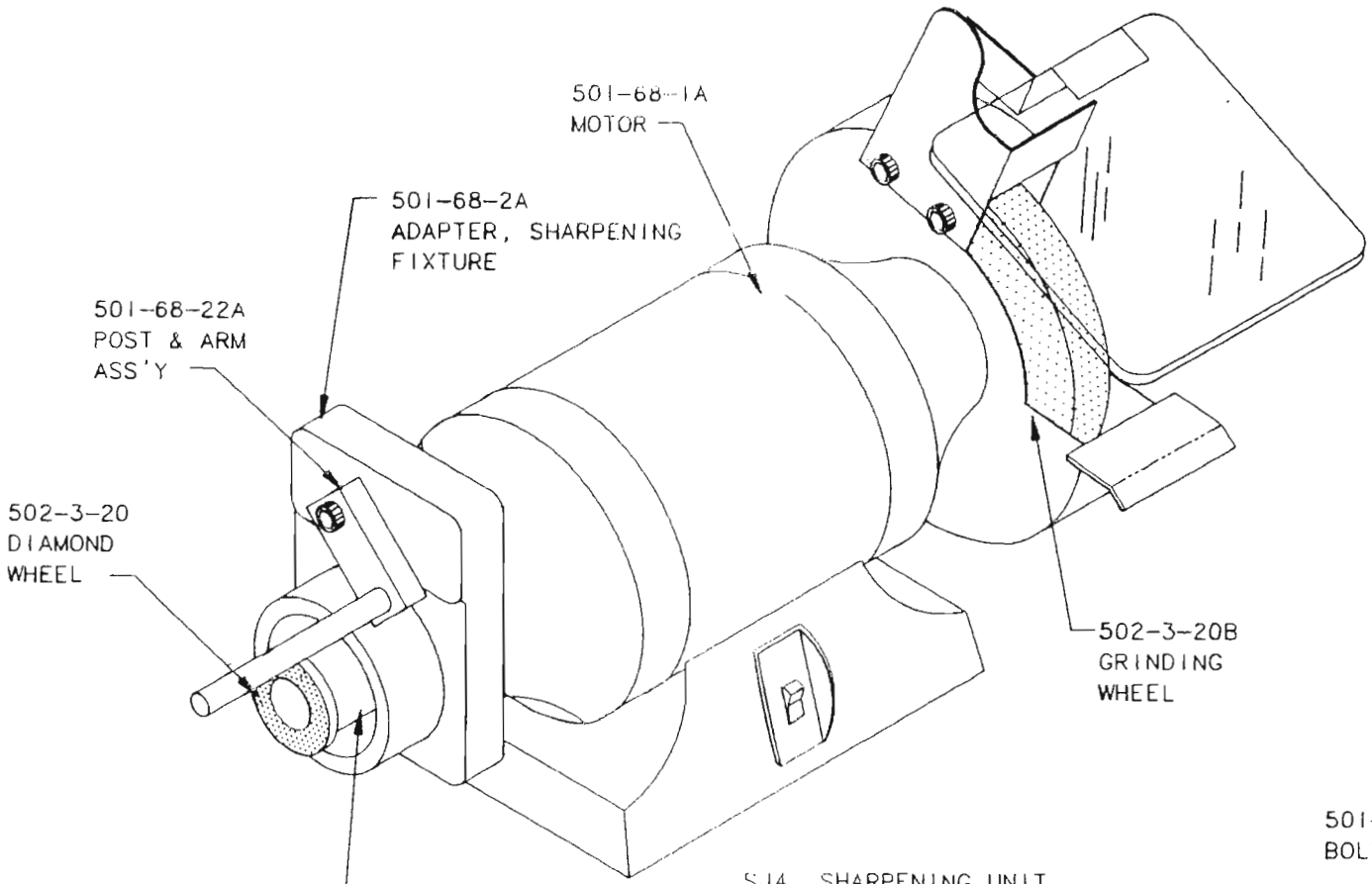


OLD STYLE
FAN SHROUD &
TOOL BIT SHARPENING
ON BORING BAR MOTOR



SJ3	MOTORIZED SHARPENING UNIT 501-66 (WITHOUT TOOL FIXTURE)
SJ3B 501-66A	MOTORIZED SHARPENING UNIT 501-66 WITH ROTTLER TOOL HOLDER FIXTURE 501-68-8
SJ3A 501-67	MOTORIZED SHARPENING UNIT 501-66 WITH ALL ANGLE TOOL HOLDER FIXTURE 501-68-7 AND REVERSING SWITCH 501-68-6 (OPTIONAL)

SJ3 SHARPENING UNIT

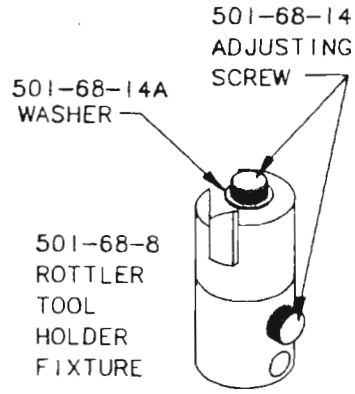


502-3-20A
DRESSING
STICK

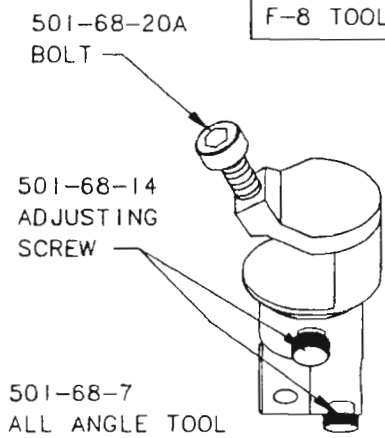
SJ4 SHARPENING UNIT
501-66E (WITHOUT
TOOL FIXTURE)

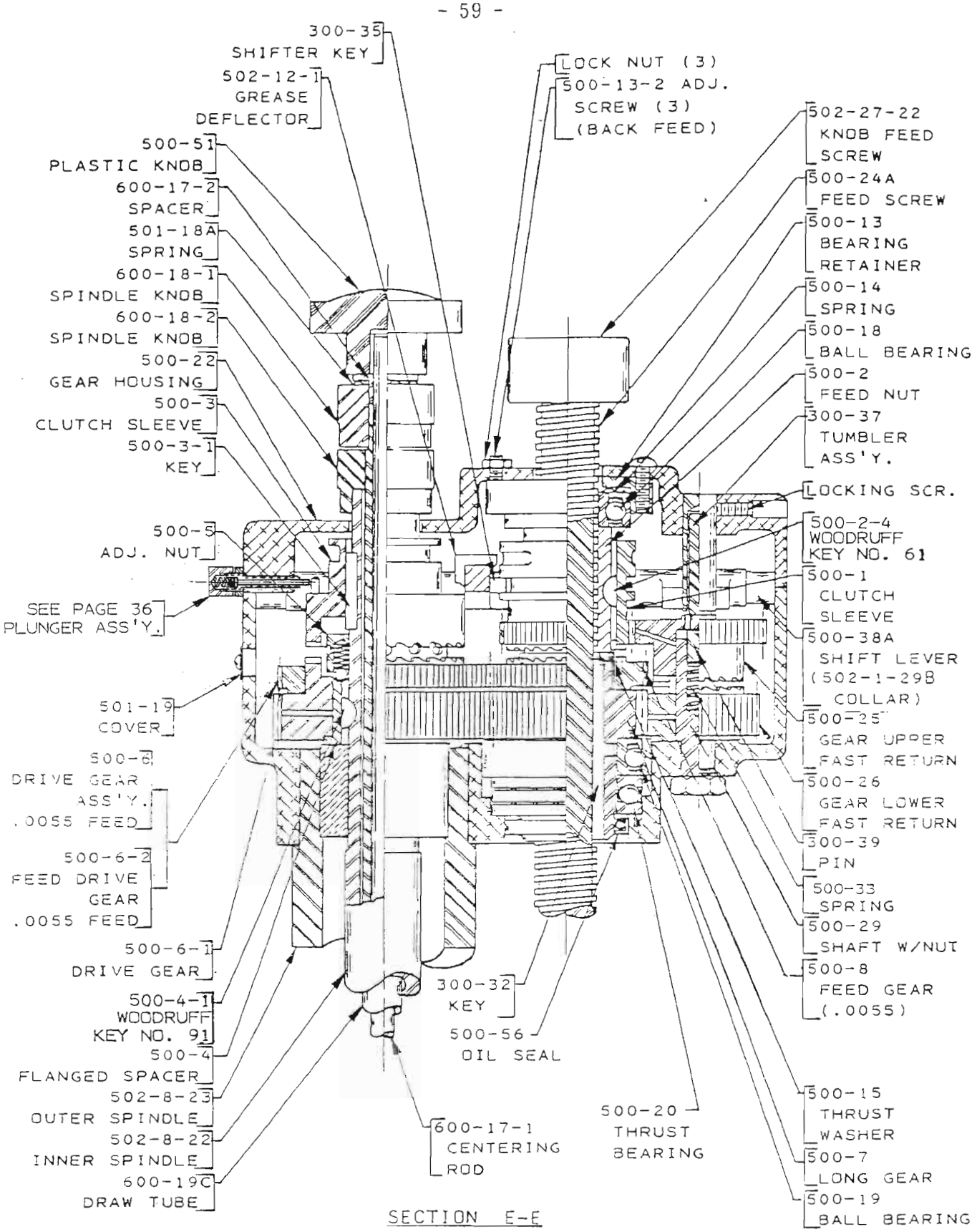
SJ4B SHARPENING UNIT
501-66B WITH ROTTLER
TOOL HOLDER FIXTURE
501-68-8

SJ4A SHARPENING UNIT
501-66D WITH ALL ANGLE
TOOL HOLDER FIXTURE
501-68-7



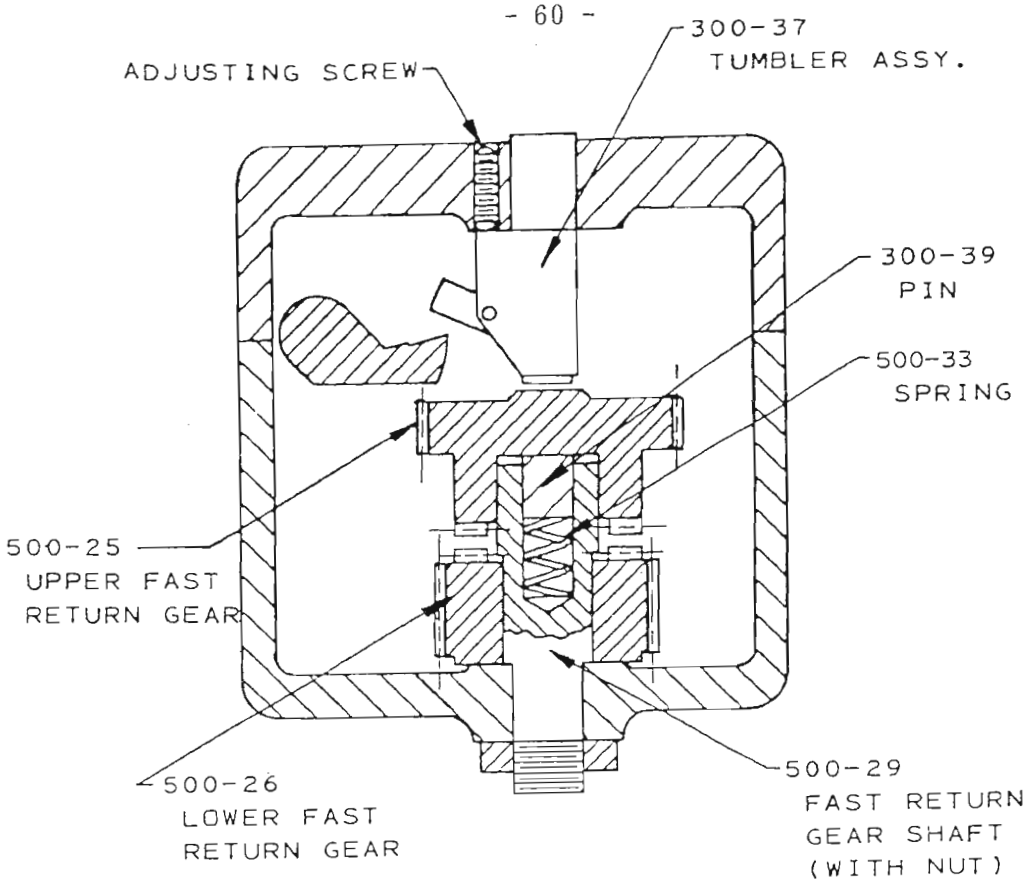
5418A
OPT. ROTTLER
TOOL HOLDER
FIXTURE FOR
F-8 TOOLING



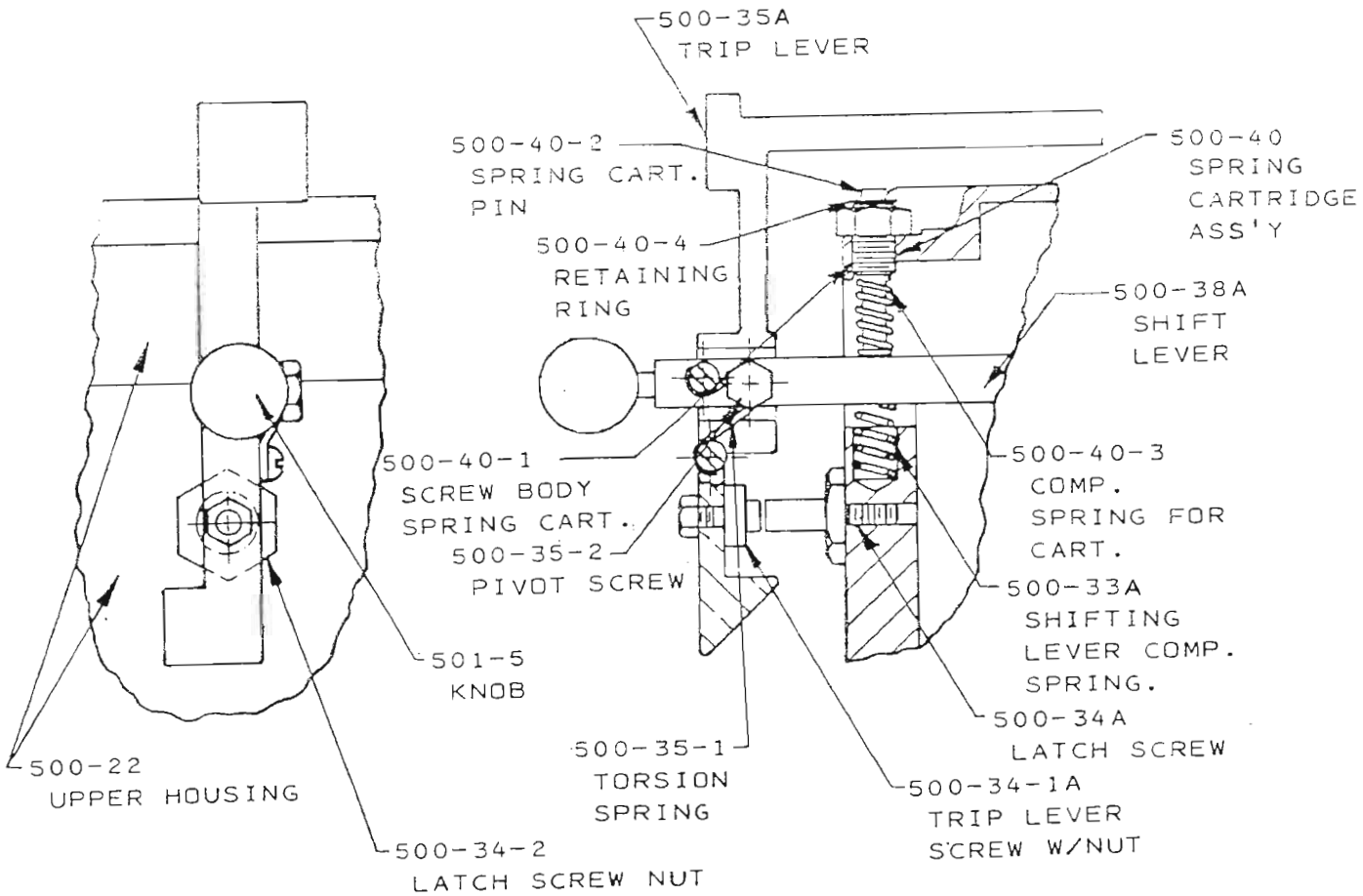


SECTION E-E

UPPER HOUSING

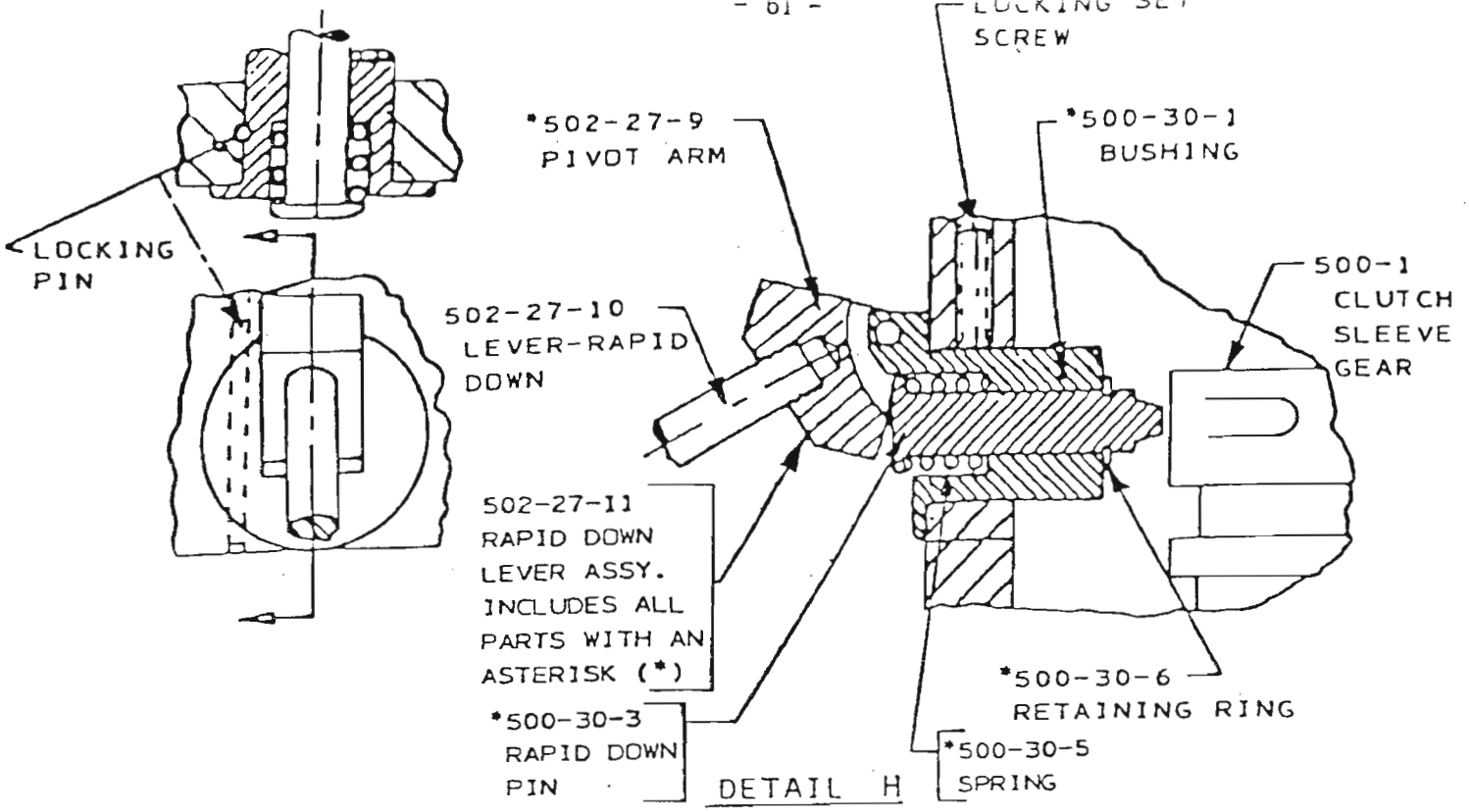


SECTION D - D



DETAIL F

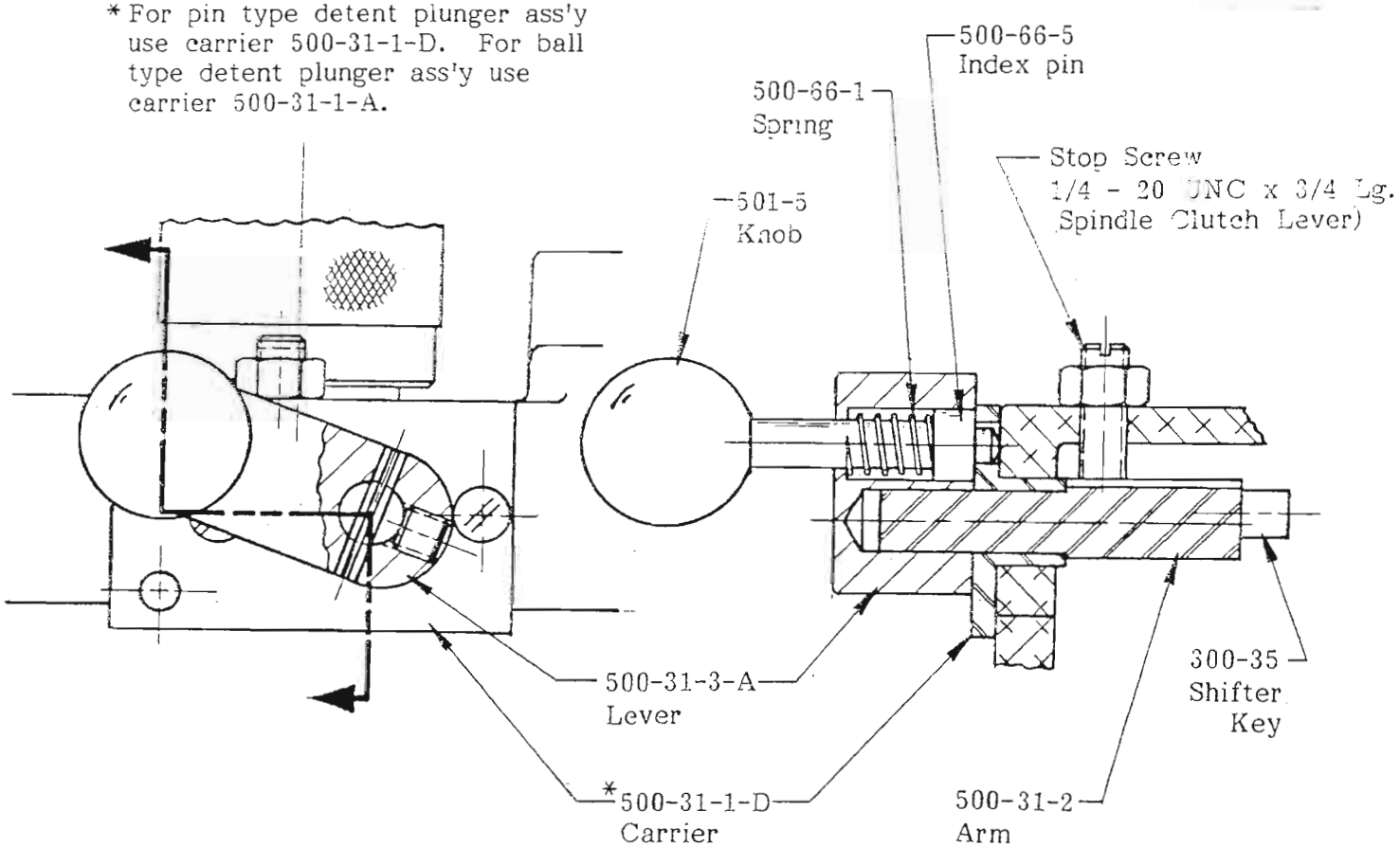
(FEED LEVER)



FAST DOWN LEVER

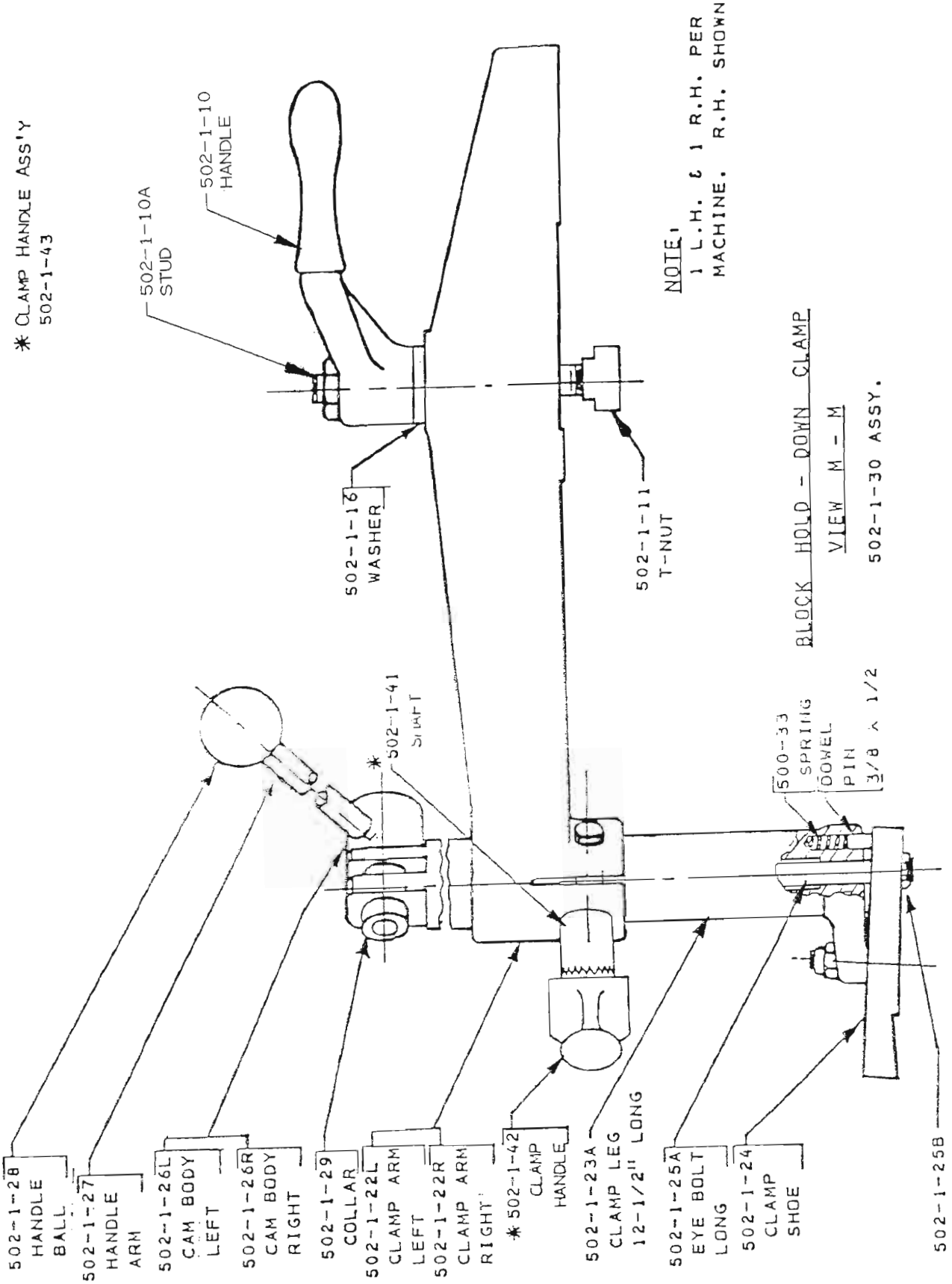
---

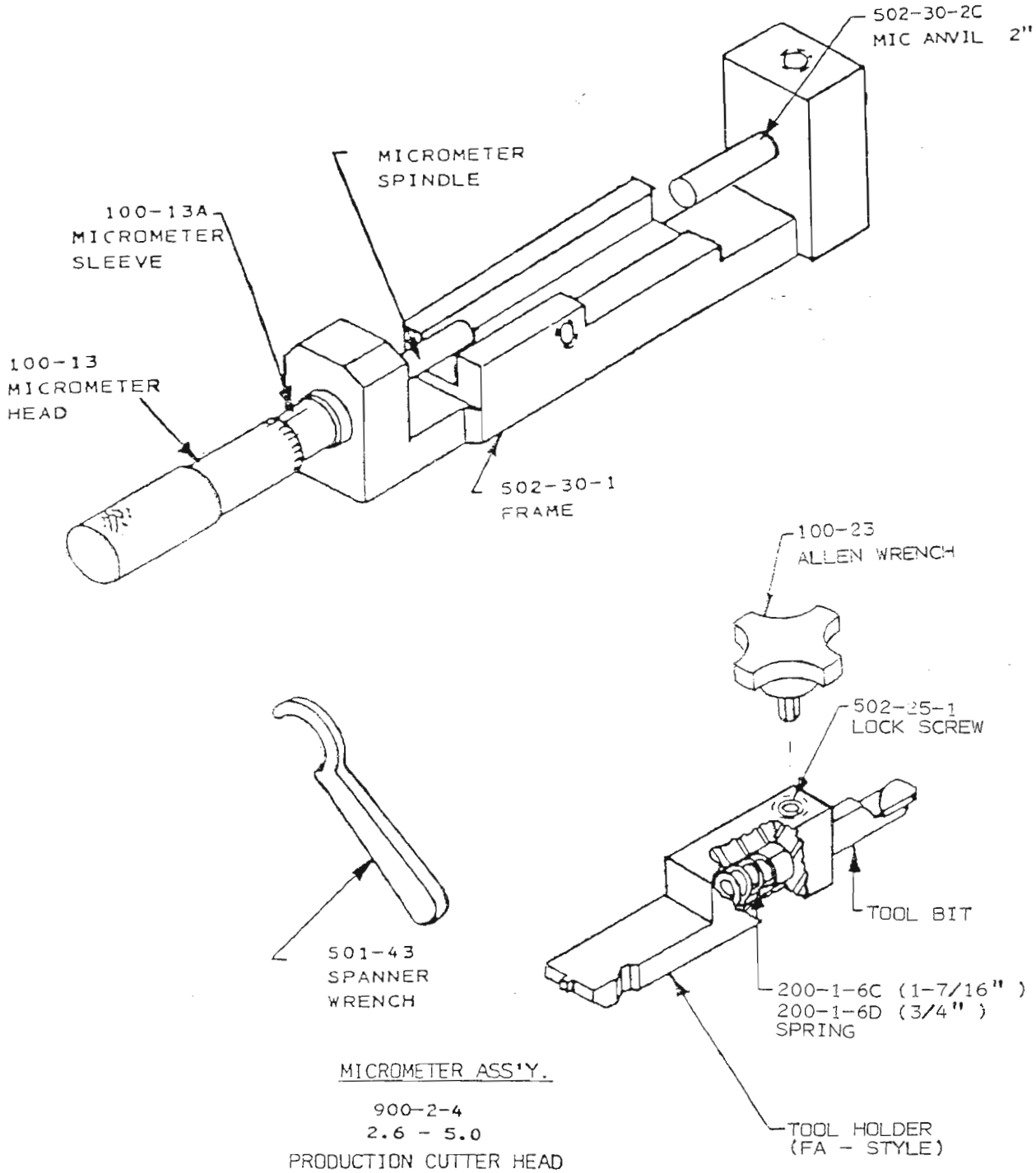
* For pin type detent plunger ass'y use carrier 500-31-1-D. For ball type detent plunger ass'y use carrier 500-31-1-A.



Detail G

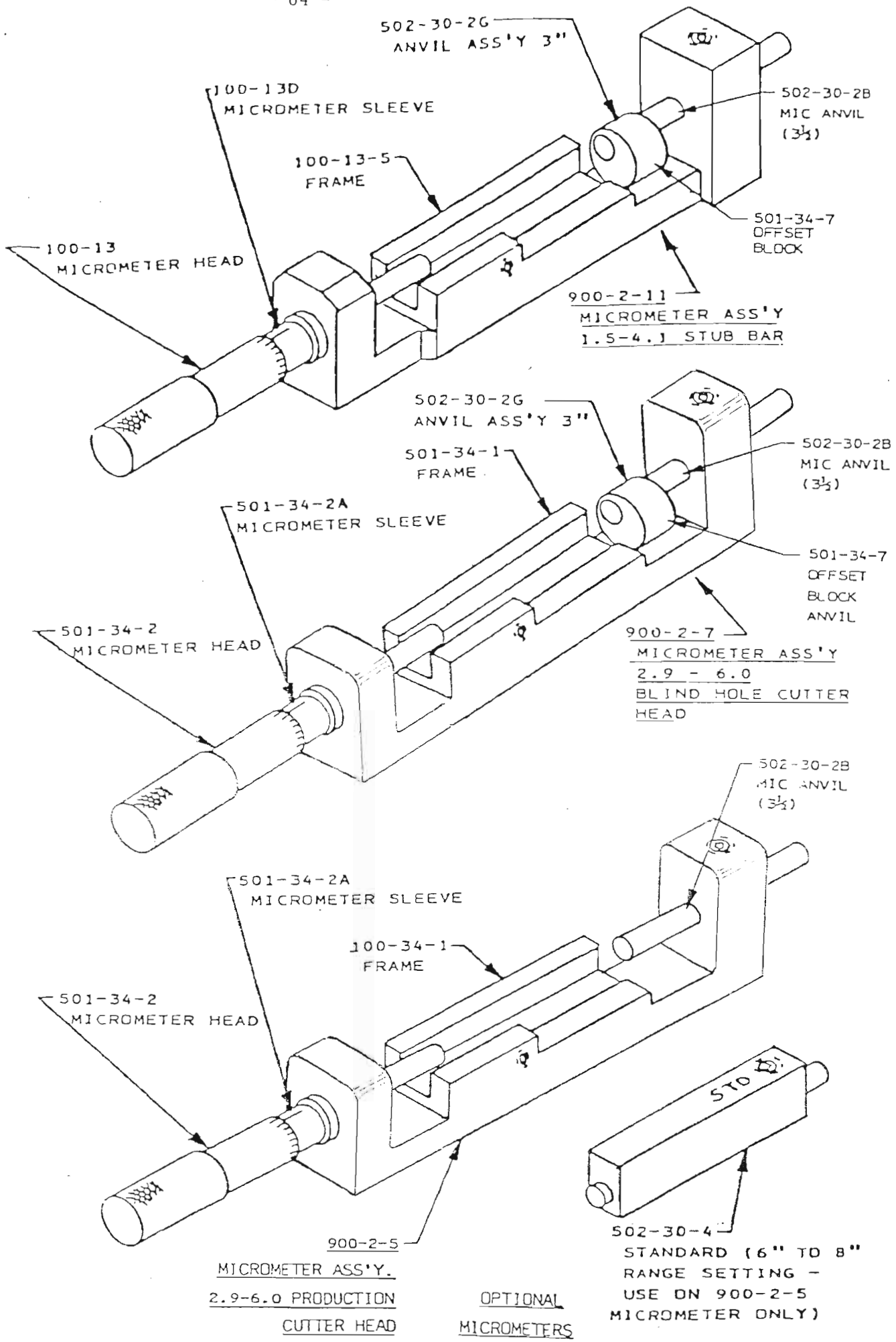
SPINDLE CLUTCH CONTROL
500-31-C

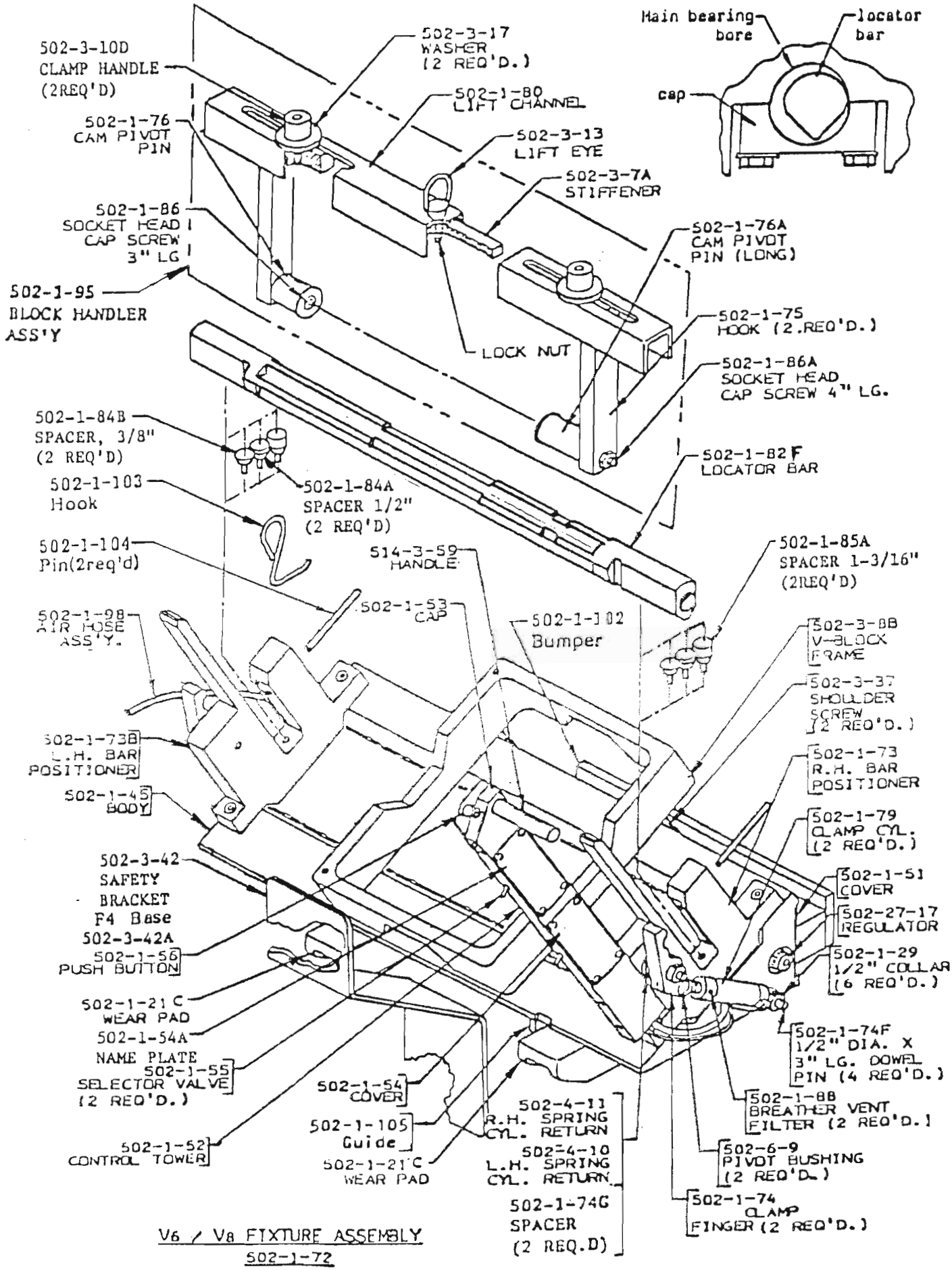

* CLAMP HANDLE ASS'Y
502-1-43
502-1-10A
STUD
502-1-10
HANDLE
502-1-16
WASHER
502-1-11
T-NUT
NOTE:
1 L.H. & 1 R.H. PER
MACHINE. R.H. SHOWN
BLOCK HOLD - DOWN CLAMP
VIEW M - M
502-1-30 ASSY.
* 502-1-41
SHAFT
500-33
SPRING
DOWEL
PIN
3/8 x 1/2
502-1-28
HANDLE
BALL
502-1-27
HANDLE
ARM
502-1-26L
CAM BODY
LEFT
502-1-26R
CAM BODY
RIGHT
502-1-29
COLLAR
502-1-22L
CLAMP ARM
LEFT
502-1-22R
CLAMP ARM
RIGHT
* 502-1-42
CLAMP
HANDLE
502-1-23A
CLAMP LEG
12-1/2" LONG
502-1-25A
EYE BOLT
LONG
502-1-24
CLAMP
SHOE
502-1-25B
LOCK NUT



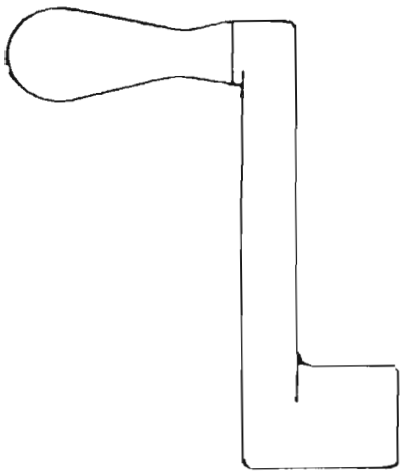
MICROMETER ASS'Y.

900-2-4
2.6 - 5.0
PRODUCTION CUTTER HEAD


502-30-2G
ANVIL ASS'Y 3"
100-13D
MICROMETER SLEEVE
502-30-2B
MIC ANVIL
(3½)
100-13-5
FRAME
501-34-7
OFFSET
BLOCK
100-13
MICROMETER HEAD
900-2-11
MICROMETER ASS'Y
1.5-4.1 STUB BAR
502-30-2G
ANVIL ASS'Y 3"
501-34-1
FRAME
502-30-2B
MIC ANVIL
(3½)
501-34-2A
MICROMETER SLEEVE
501-34-7
OFFSET
BLOCK
ANVIL
501-34-2
MICROMETER HEAD
900-2-7
MICROMETER ASS'Y
2.9 - 6.0
BLIND HOLE CUTTER
HEAD
502-30-2B
MIC ANVIL
(3½)
501-34-2A
MICROMETER SLEEVE
100-34-1
FRAME
501-34-2
MICROMETER HEAD
STD
900-2-5
MICROMETER ASS'Y.
2.9-6.0 PRODUCTION
CUTTER HEAD
502-30-4
STANDARD (6" TO 8"
RANGE SETTING -
USE ON 900-2-5
MICROMETER ONLY)
OPTIONAL
MICROMETERS



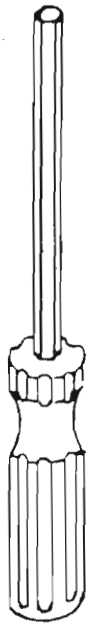
V6 / V8 FIXTURE ASSEMBLY
502-1-72



500-98
HAND FEED
HANDLE ASS'Y

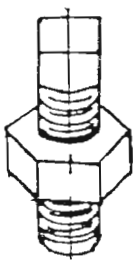
502-12-2
SPANNER
WRENCH
(2 REQUIRED)

100-24
TOOL
PULLER



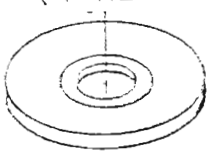
501-72
7/32" HEX
DRIVER

501-72A
7/32" HEX
RIVER

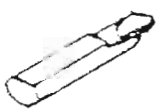


502-1-12A
JACKING
SCREW &
LOCK NUT
(4 REQUIRED)

500-41
LOCK NUT
FEED SCREW

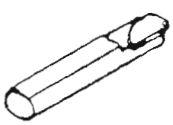


502-1-12
LEVELING
PAD
(4 REQUIRED)

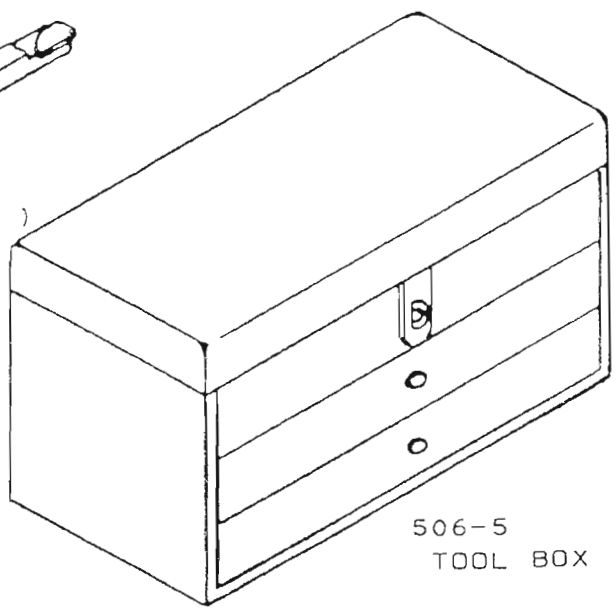


501-31-1
TOOL BIT
R 8 (1")

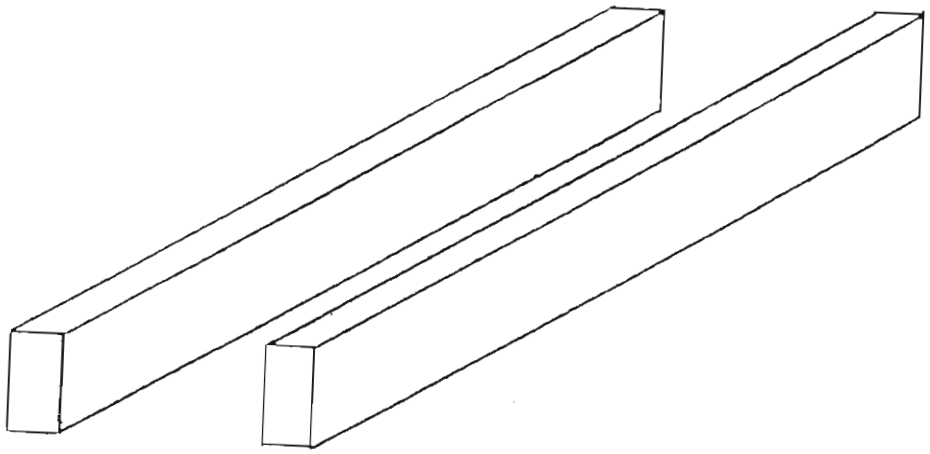
500-62
KEY MICARTA



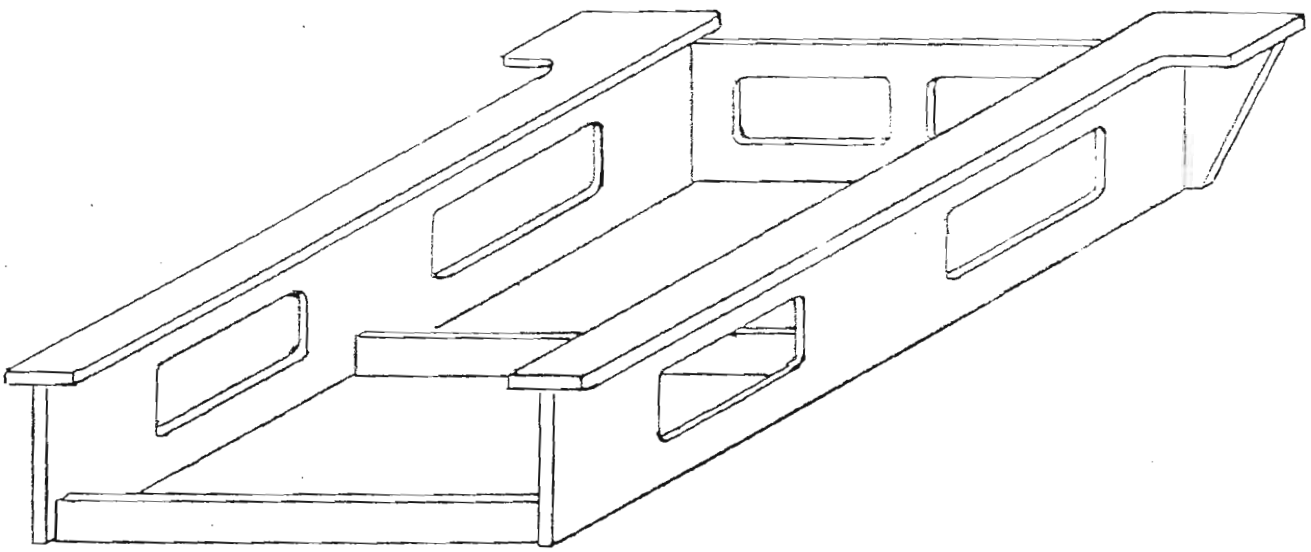
501-31-2
TOOL BIT
R 8 (1-3/8")



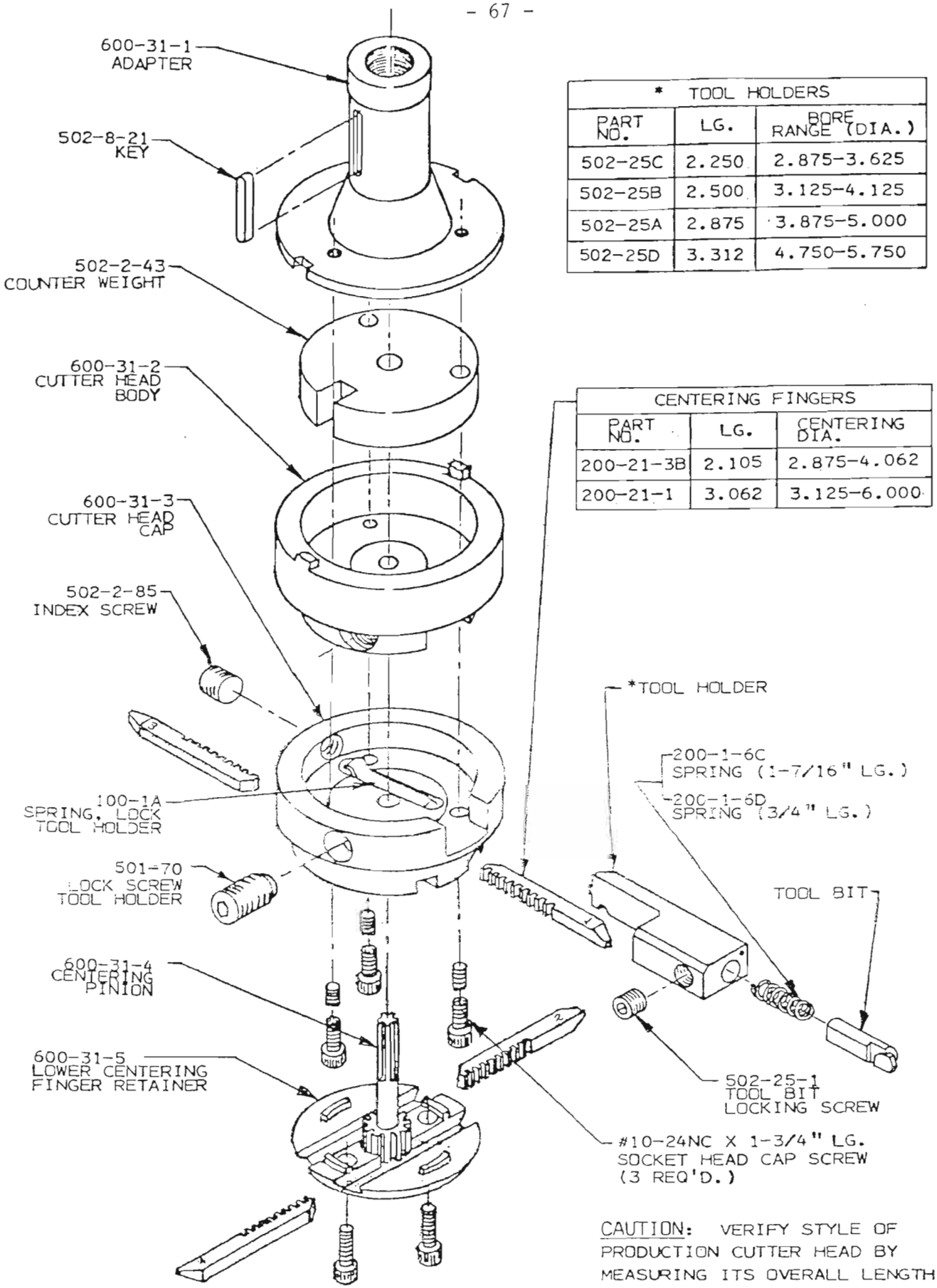
506-5
TOOL BOX



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



502-1-14B
5" PARALLEL
FIXTURE



* 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

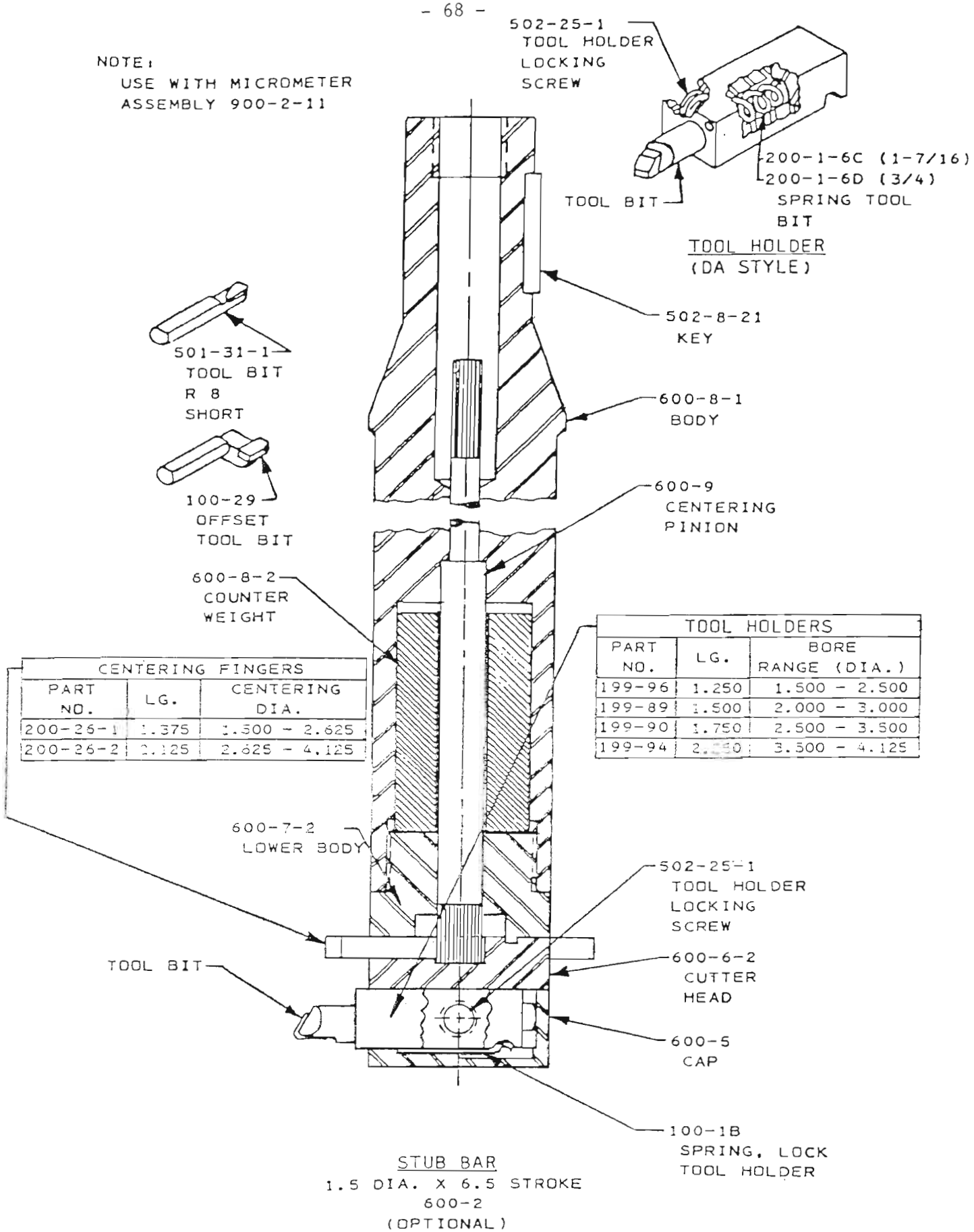
CENTERING FINGERS		
PART NO.	LG.	CENTERING DIA.
200-21-3B	2.105	2.875-4.062
200-21-1	3.062	3.125-6.000

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

2.875 PRODUCTION CUTTER HEAD #2 ASS'Y.

600-8-4-E

NOTE:
USE WITH MICROMETER
ASSEMBLY 900-2-11

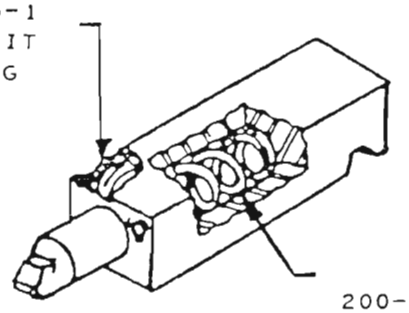


CENTERING FINGERS		
PART NO.	LG.	CENTERING DIA.
200-26-1	1.375	1.500 - 2.625
200-26-2	2.125	2.625 - 4.125

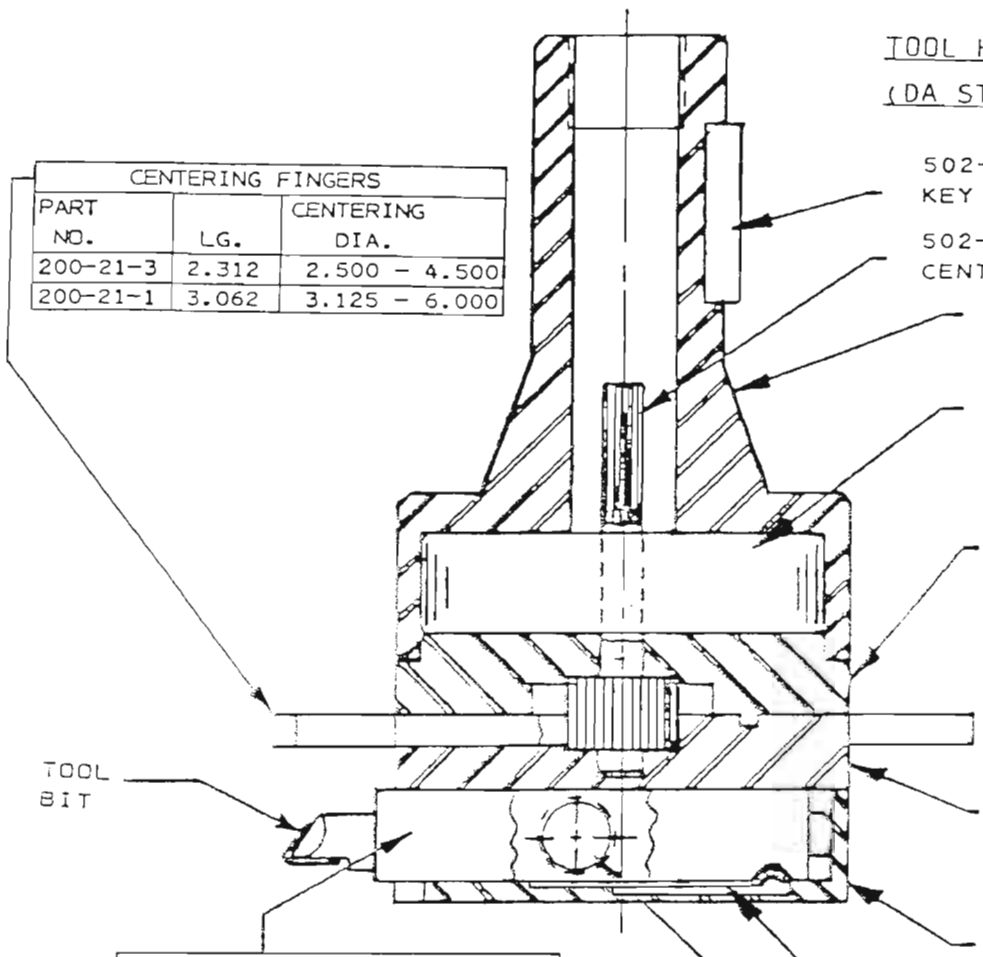
TOOL HOLDERS		
PART NO.	LG.	BORE RANGE (DIA.)
199-96	1.250	1.500 - 2.500
199-89	1.500	2.000 - 3.000
199-90	1.750	2.500 - 3.500
199-94	2.250	3.500 - 4.125

STUB BAR
1.5 DIA. X 6.5 STROKE
600-2
(OPTIONAL)

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



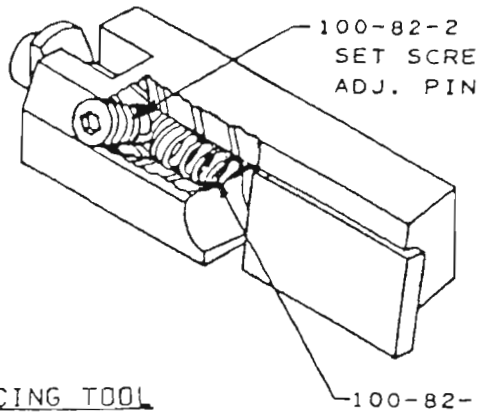
TOOL HOLDER
(DA STYLE)



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

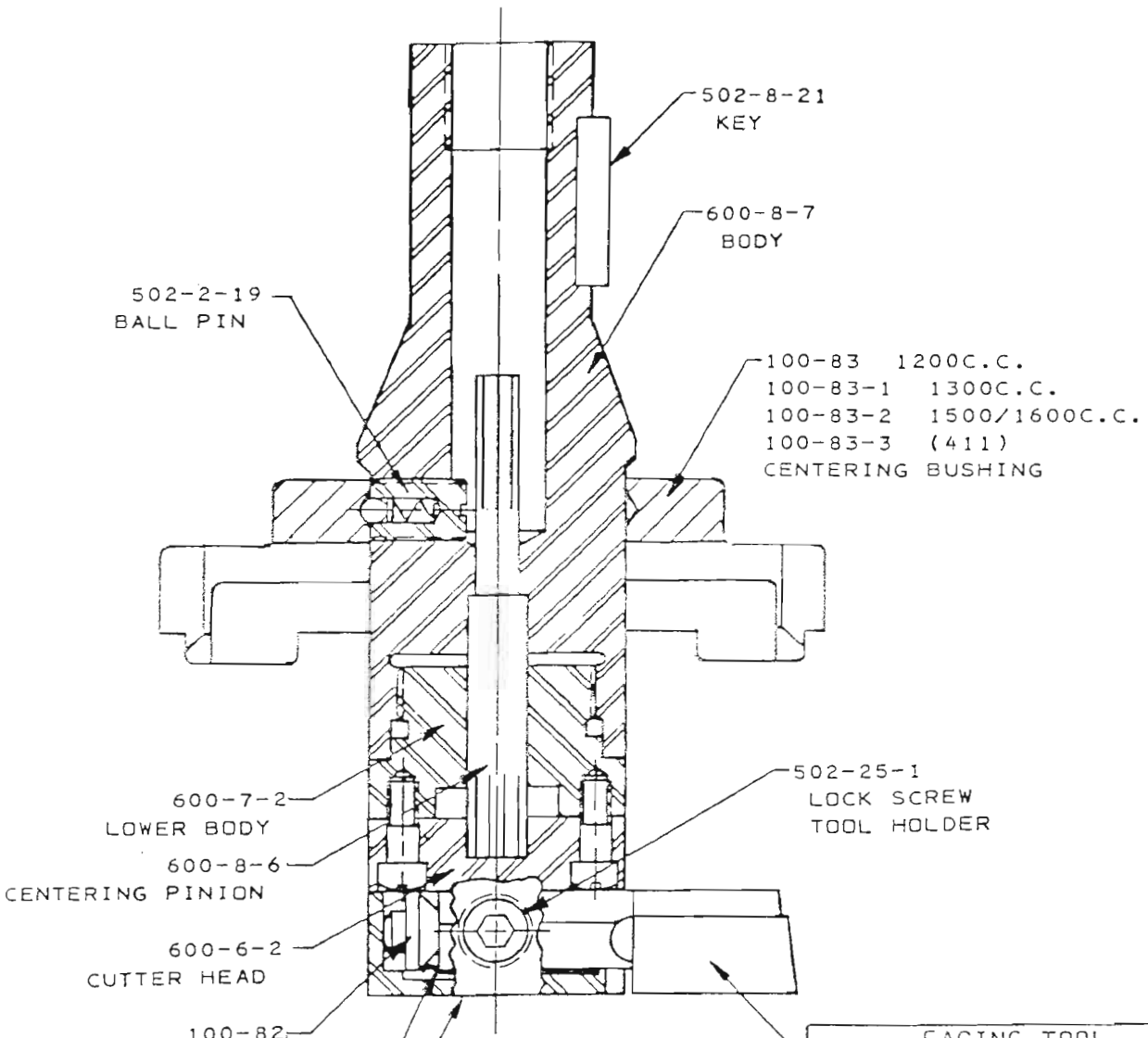
TOOL HOLDERS		
PART NO.	LG.	BORE RANGE (DIA.)
199-94	2.250	2.500 - 3.375
200-1	2.500	2.875 - 3.875
200-2	3.000	3.875 - 4.875
200-3	3.562	4.875 - 5.750

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



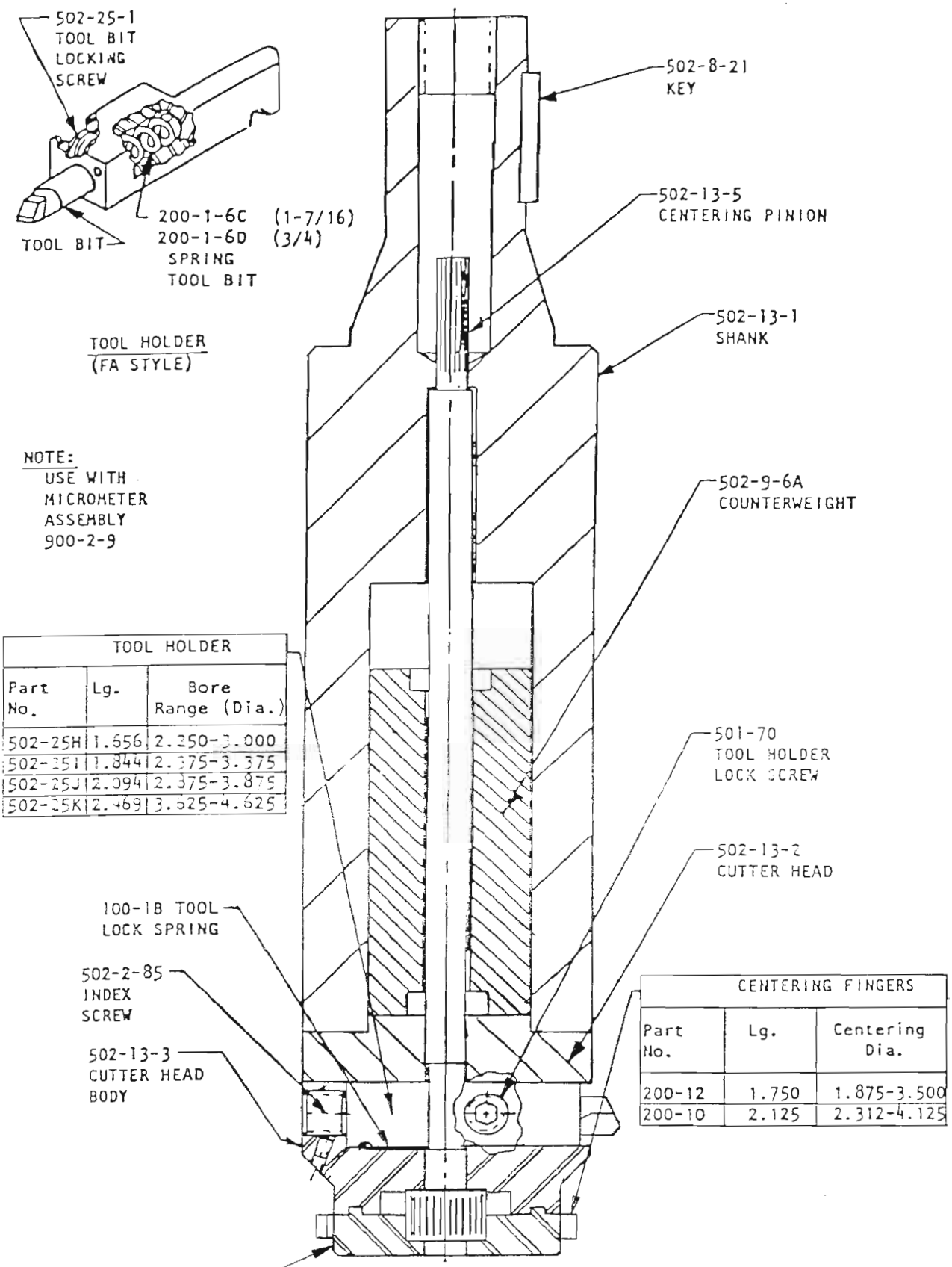
FACING TOOL
(VW HEAD)
ASS'Y.

NOTE:
USE WITH MICROMETER
ASSEMBLY 900-2-11



STUB BAR
1.5 TO 4.1 DIA. X 3" STROKE
600-8-8A
(OPTIONAL)

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	2.375-3.875
502-25K	2.469	3.625-4.625

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

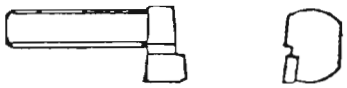
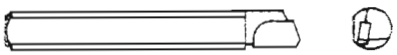
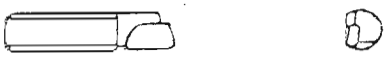
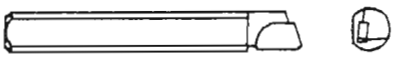
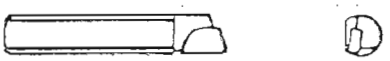
PRODUCTION STUB BAR ASSY.

502-13

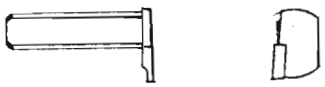
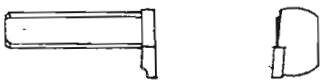
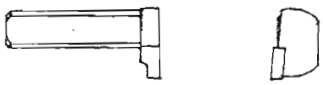
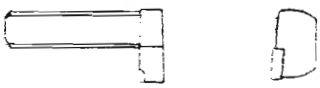
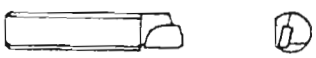
2.23 to 4.1 DIA. X 6 LG.

(OPTIONAL)

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

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)