ROSEBROOK

TRACERS INC.

ROSEBROOK
CRESCENT GROUND
MODEL 3000
3 DIMENSIONAL TRACER

PATENTED

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION I

GENERAL INFORMATION

HYDRAULIC OIL

The Crescent Ground Tracer will operate on any good grade of Socony Mobil, or exact equivalent, hydraulic oil of from 80 SSU to 300 SSU viscosity. Mobil Type DTE 24 (formerly called DTE light) 150 SSU is the grade most generally used.

OIL TEMPERATURE

The oil temperature should not exceed 140° F. regardless of the grade used. The lower the viscosity of the oil is, the lower the temperature that should be maintained.

Before any attempt is made to adjust the 360° feed rate of the tracer, find what the average running temperature is and set the feed rate of the tracer at that temperature. Example: high 130° F - Low 110° F. Adjust feed rate at 120° F.

If this procedure is followed, less out of rate problems will be encountered throughout the working day.

OIL COOLERS

A fan cooled type of oil cooler should be used when one is required. Run the dump line from the pressure relief valve to the "IN" side of the cooler.

Do not choose a cooler for its volumetric capacity only. The larger a cooler is in relation to the pump GPM, the more effective the results will be.

POWER UNITS

The requirements of a power unit are:

1. Adequate horsepower to handle the volume and pressure required for the machine.

2. A 10 micron filter large enough to handle the full volume of the pump (or pumps, if used with depth control and rapid traverse). This can be either on the intake side or pressure side.

3. A cooler, preferably temperature controlled.

4. A two pump system is required; however, variable volume pumps of certain types used with flow dividers have in some cases proven satisfactory.

5. A vacuum device of some type, which does not aerate the reservoir, such as Gast Mfg. Co. Vacuum Pump Model 0211-V36-G10, to scavenge the seepage oil from the tracer.

PRESSURE SETTING

The Crescent Ground Tracer will operate at any pressure from 150 PSI to 1500 PSI; however, 400 to 600 PSI meets most requirements. The lower pressures are conducive to lower minimum feed rates, but higher pressures compress the entrained air in a system and give better control, particularly when climb cutting.

CYLINDERS

Crescent Ground Tracers have been found to be compatible with any well designed standard type hydraulic cylinder, except the metal piston ring type. For trouble free service, the I. D. of the cylinder and the rod surface should have a 10 micro or better surface. Chevron type rod seals are most desirable. U-cup type rod seals will permit air to suck in to the cylinders. As the oil in the cylinder cools and contracts, a vacuum is created which sucks air into the cylinder, thereby requiring bleeding of the cylinder each time the machine is re-started. Cylinders must be equipped with bleeders on each end. Cylinder sizes should be chosen for compatibility with the size of the machine and the work to be done.

The most effective and efficient method of removing metal when milling is climb cutting. When climb cutting, the cutter biting into the work piece is like a rack and pinion, the cutter being the pinion and the work piece the rack. Here the cutter torque, which is sometimes multiplied many times, tends to pull the work along rather than allowing the cylinder to push. Under these conditions, a cylinder must be large enough to hold the work in check; therefore, a large area cylinder is required.

For slow cutter RPM and slow feed rates on machines having slides weighing 2,000 pounds and over, cylinders of from 7 inches up are recommended. For faster cutting and lighter machines, a minimum of 5 inches is recommended.

In choosing a cylinder for any tracer controlled machine, remember that the cylinder's first function is to minutely control very sudden changes of movement in any direction. The second consideration is to move the load. A small cylinder at high pressure will move the load but cannot control it.

FLUID MOTORS

Fluid motors with anti-back lash ball screws have proven very satisfactory under certain conditions.

If gearing is required between the fluid motor and the screw, be sure there is no lost motion in the gearing as this will show up in bad tolerances and surface finish.

NOTE

Tracers used with fluid motors require a special grind and are not compatible with cylinder equipped machines.

GENERAL TROUBLE

Although the Crescent Ground Tracer is built to very close tolerances, it is really quite rugged. Heavy service will not harm it but abuse can.

Unless the tracer has been abused, most malfunctions are found by service personnel to be from conditions beyond the tracer's control.

Listed below are general difficulties encountered in the approximate order of most frequent occurrences.

A. 360 feed rate not uniform (see 360 Feed Rate Setting, page 24, and 360 Rate Control Lubrication, page 29.

B. Rod or cylinder brackets loose or weak.

C. Tracer mounting brackets loose or weak.

D. Tracer spool bind because of fittings being installed too tightly or lack of proper filter.

E. Gibs too loose on the machine.

F. Gibs too tight on the machine.

G. Ways not properly lubricated.

H. Machine not level.

I. Bad foundation.

J. Blow-by in the cylinders.

K. Improper set up.

L. Cutter and stylus not 1 to 1 ratio.

M. Stylus eccentric or bent.

N. Tracer spindle bent.

O. Oil leakage or blow-by in the system.

P. Worn ways causing fish tail.

Q. Bad machining technique.

R. Inadequate operator training.

S. Improper hydraulic hookup.

T. Cutter spindle runout.

U. Cutter spindle defective.

V. Cutter runout.

W. Contaminated or improper oil.

X. Bad tooling.

TRAINING PROGRAM

A training session of approximately four hours, at the manufacturer's plant, is offered to anyone authorized by the original purchaser of a Crescent Ground Tracer. There is no charge for this training. If, after reading this manual, it is felt that such a session would be in order, contact the manufacturer for further details.

REPAIR PARTS

When ordering repair parts, please state the Serial No. of the tracer, and the part numbers of the parts desired. The parts list drawing identifies each part with an index number which is as low as possible for easy remembering. To order parts, simply add 3,000 to the index number. EXAMPLE: Part index No. 42 would be part No. 3042.

SECTION II

OPERATION

The CRESCENT GROUND 3D TRACER is designed to give you the best control over any condition that may be encountered when duplicating parts from a template or master.

The CRESCENT GROUND FLOW BALANCE of the servo valves provides a feed rate as slow as 1/4 inch per minute to as fast as 100 inches per minute, without the use of needle valves for metering. The cross sectional area of the cylinders or displacement per revolution of fluid motors, however, will determine the maximum and the minimum feed rate of any given machine.

The function of the tracer is to infinitely meter the volume of oil and regulate the pressure balance simultaneously to either side of any one of three coordinated hydraulic actuators, which in turn control the X, Y, and Z (360 - 3D) movements of a machine tool.

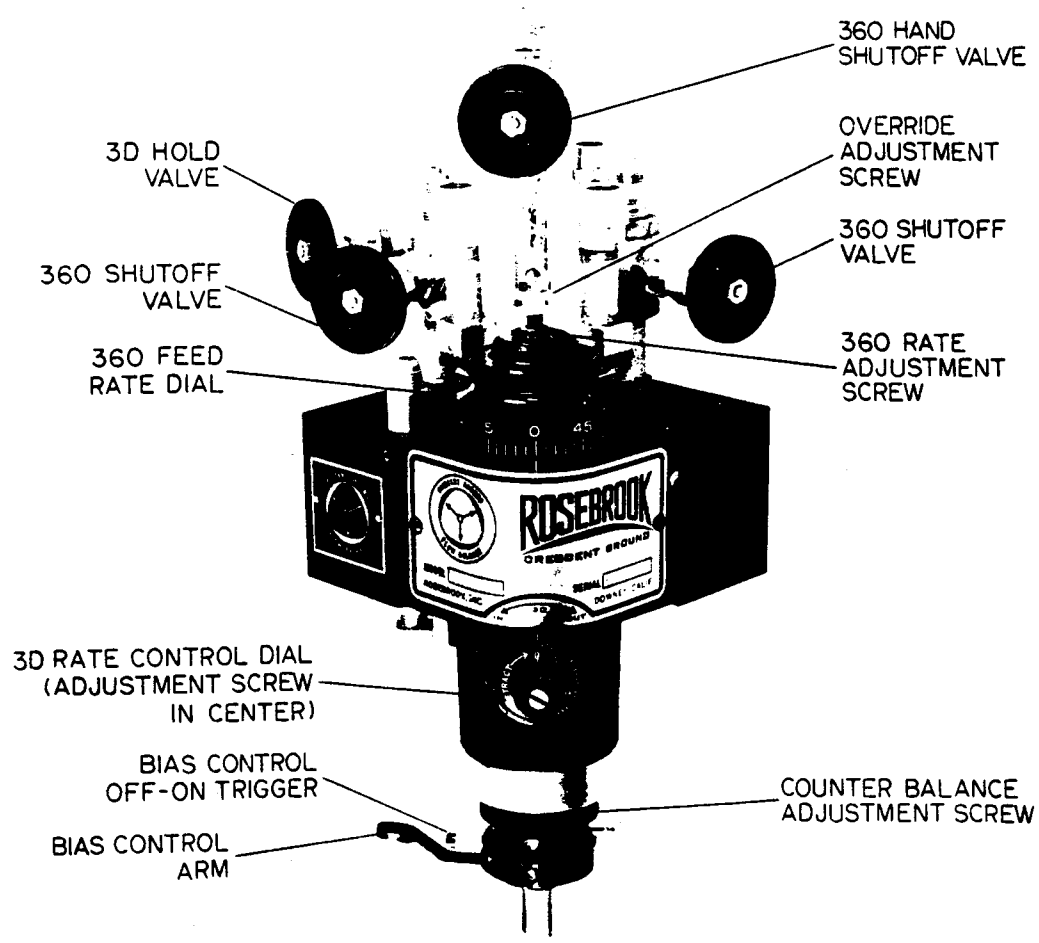


Figure 1. Operating Controls

The pencil type "Joy Stick" stylus spindle, when manually urged toward and along a pattern, induces finite coordinated micrometer controlled movements of the three servo spools.

The horizontal spools (360) are absolutely coordinated in their movements by the yoke assembly, which is in turn controlled by manipulation of the stylus movements.

The yoke assembly permits a completely free 360° movement of the horizontal spools as well as allowing the stylus spindle to be moved vertically for control of the 3D movement.

The 360 rate control on the top of the tracing valve controls longitudinal, transverse, and vertical up or out feed rates. Any pre-selected feed rate setting for 360 or 3D up can be overridden by extra pressure on the stylus for rapid traverse. When the extra pressure is released, the feed rate will automatically return to the pre-selected setting.

A knurled thumb screw in the center of the 360 rate control enables the operator to set the over ride pressure requirement to suit his "feel".

NOTE

This over ride adjustment screw must be screwed full in when using the bias control.

Hand shut off valves can be provided for each servo valve in the 360 section of the tracer. These shut off valves are not intended for metering feed rates. They are to be used to lock out movement of either horizontal slide, to facilitate indicating a fixture alignment, or to stop and hold movement when pick feeding to remove metal in a straight line over a 3D template.

A hand valve can also be provided to shut off pump pressure to the tracer to stop all movement.

BIAS CONTROL

The bias control has a simple trigger actuated mechanism to enable the operator to engage or disengage the bias pressure with the thumb or finger of the guiding hand, thus leaving the other hand free to do another operation simultaneously. It is not recommended that the bias control be used when tracing 3D; however, on some patterns with very low angles it will perform satisfactorily when tracing up.

When the bias control is directed at approximately 45 degrees toward the template, and in the direction of desired travel around the template, it leaves the operator free to do other work until a bias correction is required.

The 3D rate control dial should always be set at between "0" and "5" graduation when tracing 360 only.

The 3D rate control serves two purposes:

1. to control the rate of feed when plunge cutting.

2. to retract and hold the cutter out of the part for reloading, etc.

When the 3D rate control dial is set at "0", the vertical slide should remain practically stationary. As the dial is rotated to the left, the rate of plunge is increased, and as the dial is rotated to the right (no graduations), the speed of retract is increased.

NOTE

Do not try to trace on a flat plane with the 3D dial set at "0"; the cutter may drift up.

To trace a flat plane, set the 3D rate control dial at a pre-selected graduation which corresponds to the desired rate of plunge. After the stylus has touched the floor of the template, rotate the dial to about graduation "5".

If you do not wish to make a full depth cut, close the 3D hold shutoff valve when the desired depth is reached, but leave the dial set at the plunge rate feed setting until full depth is reached, then set at "5" graduation for finishing.

The stylus weight counter balance adjustment, which is located at the lower end of the tracer, just above the bias control, enables the operator to compensate for the weight of a heavy stylus. Rotation to the right increases the lift, and rotation to the left decreases the lift.

CAUTION

Always be sure that the counter balance adjustment screw NEVER HAS LESS THAN 1/8 INCH space between its lower surface and the top of the bias control body. If this clearance is not present, the tracer spindle cannot be lifted for retracting

Never tighten the thumb screw in the bias control body more than finger tight. If the stylus touches the template when plunging, the bias control will be pushed off of the spindle carrier as the spindle moves up to seek a null position. This will not damage the bias control, which can be reset, and protects the tracer from damage.

Some machines are equipped with both 3D tracers and 180 solenoid activated depth control servo valves. This type of installation has changeover valves incorporated into the hydraulic circuit controlling the vertical slide. This system enables the operator to use the 3D servo valve which is operated by stylus manipulation for tracing up and down over a pattern, or to shift to 180 control for holding depth of cut in various planes on the part being produced.

CAUTION

It must be remembered that the 3D tracer has no control over the vertical slide movement when the hydraulic circuit is directed or shifted to the 180 depth control servo system. In the event the operator energizes the 180 circuit to plunge toward the work, and the end of the 3D tracer stylus contacts an obstruction, the tracer or machine could be badly damaged.

If the tracer is equipped with an electronic safety switch accessory, the tracer spindle will move upward into the body of the tracer and cause the 3D servo spool to move to the extreme limit of its travel. Just before the spool reaches this limit, it trips a switch which opens the electrical circuit leading to the 180 solenoid and causes the 180 servo valve to retract the vertical slide.

After corrections have been made, the operator can press the reset button on the bottom of the switch housing to reactivate the 180 electrical circuit.

This switch can also be manually tripped, by lifting up on the stylus, for a quick retract without reaching for the 180 retract control switch.

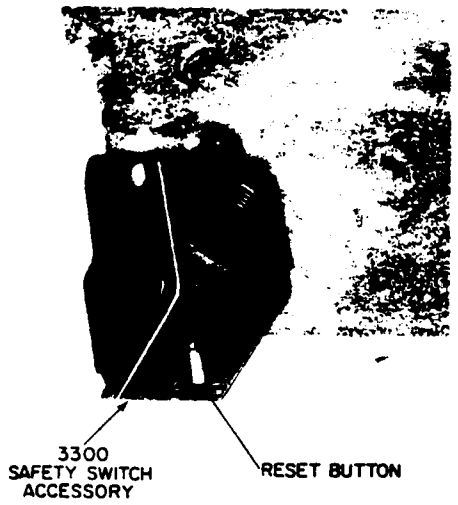


Figure 2. Safety Switch Reset Button

SECTION III

MAINTENANCE

YOUR NEW CRESCENT GROUND TRACER AND HOW TO ADJUST IT

Whether you have received your Crescent Ground tracer on a new machine tool, to replace an obsolete type of tracer, or for use on a machine of your own creation, rest assured that the tracer has been adjusted and thoroughly tested on a prove-out machine at the factory. Unless it has been badly handled in transit to you, only the horizontal feed rates of cross and longitudinal travel may need to be adjusted before putting the tracer into operation.

The type of hydraulic actuator used has an effect on the adjustment to balance the feed rate. A double-end cylinder with equal-size rods or a hydraulic motor requires a perfect spool null setting. A cylinder with a single-end rod requires a slight spool offset to compensate for the cylinder area differential, depending upon the rod size and from which end of the cylinder the rod works.

Assuming no damage, and that you have connected the lines correctly, (see Figure 3, Pressure-Exhaust and Cylinder Ports), the following simple adjustments should get you into operation quickly.

Checkout Procedure Prior to Setting 360 Feed Rate

1. Set 360 and 3D rate control dials at zero graduation.

2. Check stylus spindle movement in a 360° oscillation. The tip of the spindle should not move more than .003 total indicator reading in any straight-line motion.

3. Check the stylus spindle up and down, or vertical, motion. The tip of the spindle should move .003" to .006". Tracer should hold position vertically when 3D dial is set at zero but move up or away from template when spindle is urged upward.

If any of these adjustments is incorrect, refer to the Table of Contents for adjustment of the defective setting. NOTE ALSO THE SEQUENCE OF ADJUSTMENTS, page 12. When adjustments are correct, proceed as follows.

Start the hydraulic power unit (pump) and let it run until the oil temperature is between 110° and 120° F.

The operating oil temperature is important when setting feed rate, because of the coefficient of expansion and contraction of the dissimilar metals used in the manufacture of the tracer.

The average temperature of the oil when the tracer is in use should be approximately 120°; if temperature exceeds 140°, an oil cooler should be installed on the hydraulic power unit.

If the oil temperature varies as much as 30° during a shift, the feed rates will also change to some extent.

Cylinder Bleeding

When the oil is at the proper temperature, bleed all air out of the system, using the following method:

1. Rotate 360 rate control dial full open.

2. Press stylus spindle, in any direction relative to a slide motion, and hold until piston "bottoms out"; repeat in opposite direction. (Do this several times in all directions to bring the tracer and cylinders up to the temperature of the oil.)

Now "bottom out" the piston at the end of any cylinder and set the 360 rate control at about No. "5" graduation. Open the bleeder on that end of the cylinder, press stylus for slide movement in the opposite direction, and hold for about 5 seconds. Return piston to end of cylinder and repeat. Continue this process until no air can be detected at bleeder; then close bleeder.

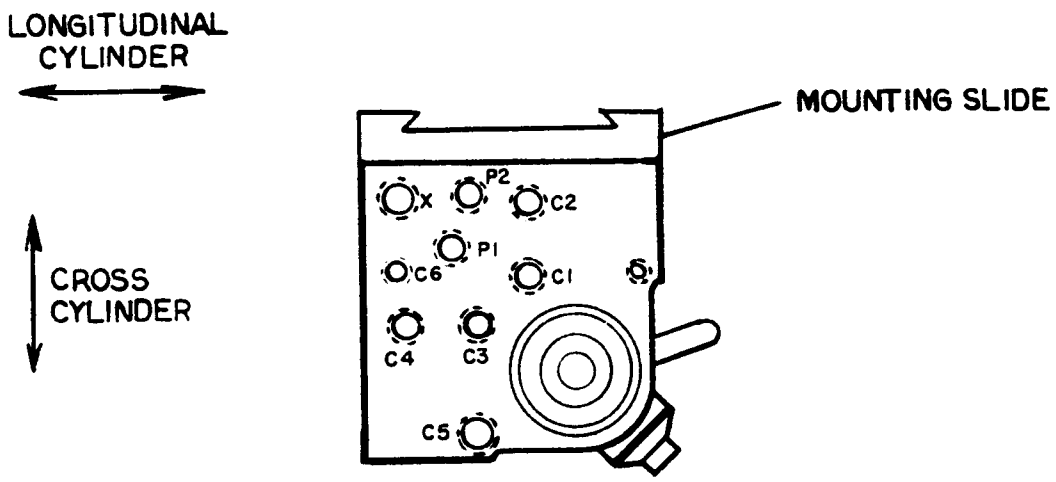
Repeat this operation on each end of all cylinders.

NOTE

If the hydraulic lines are very long and high, a bleeder may have to be installed at the highest point in each line to remove the air.

The object of this method of bleeding is to not only remove the air from the cylinder, but also to remove air that is trapped in lines and hoses which can not return to the power unit due to the fact that oil flow in the system stops when the piston "bottoms out".

Some cylinder rod packings allow air to enter the cylinder as the oil cools and contracts, thus creating a vacuum and sucking the air in around the rod. Cylinders of this type must be bled each time the machine is restarted after cooling off. (See Cylinders, page 2.)



PATTERN OF PRESSURE-EXHAUST AND CYLINDER PORTS

(RIGHT-HAND MOUNTING SHOWN)

LEGEND

(AS SHOWN ABOVE)

X = COMMON EXHAUST

C1 = TO CROSS SLIDE CYLINDER

C2 = TO CROSS SLIDE CYLINDER OPPOSITE END

C3 = TO LONGITUDINAL CYLINDER

C4 = TO LONGITUDINAL CYLINDER OPPOSITE END

C5 = TO VERTICAL CYLINDER

C6 = TO VERTICAL CYLINDER OPPOSITE END

P1 = HORIZONTAL PRESSURE

P2 = VERTICAL PRESSURE

Figure 3. Pressure - Exhaust and Cylinder Ports

SEQUENCE OF ADJUSTMENTS

In the event that it becomes necessary to completely readjust the Crescent Ground 3D tracer because of an accident, abuse, disassembly for inspection, or to replace worn parts, proceed in exactly the following order:

1. Spindle pivot bearing adjustment (see Spindle Reassembly Adjustment, step 5 and notes, page 14).

2. 3D adjustment screw center or mid-position setting, page 17.

3. 360 rate control assembly adjustment to top of spindle (setting for free vertical movement of spindle) (see 360 Rate Control Installation and Adjustment, steps 4 through 13, page 23). (VERY IMPORTANT.)

4. 360 dial zero setting (see 360 Rate Control Installation and Adjustment, steps 4, and 11 through 14, page 23).

5. 360 feed rate setting, page 24.

SPINDLE ADJUSTMENT

Adjustments of the spindle are simple but touchy; proceed with care and complete cleanliness.

Removal and Disassembly

NOTE

These instructions apply to tracers with or without the electronic safety switch (3300) accessory.

1. Remove the two 8-32 Round Head Screws (77, page 30) in the 3D Cover Plate (76), and remove cover plate and Spring (80). This releases pressure on Translator Ball (73). Do not remove 3D Spool (79).

2. Loosen Lock Screw (67) in the bias control assembly and remove bias assembly.

3. Unscrew (left, looking up) Counterbalance Adjustment Screw (52), and remove adjustment screw and Spring (51).

4. Loosen 8-32 Round Head Screw (37), which holds 3D Dial Stop (38), two turns.

5. Hold spindle assembly as 3D Rate Control Dial (40) is unscrewed to the left until spindle assembly drops free for removal.

6. Lock Washer (69) prevents vibration from loosening the spindle assembly. The washer has a tongue protruding into its inner hole which engages the slot in the pivot bearing Adjustment Screw (65). The washer has been staked one direction into the notch on the bottom of spindle Carrier Spool (35), and in the opposite direction into the slot of Lock Nut (61). Carefully, with a square punch, unstake the lock nut side.

CAUTION

Do not clamp spool in vise.

7. Rotate Lock Nut (68) to the left 1/2 turn. Unscrew (left) pivot bearing Adjustment Screw (65) and slide Spindle (58) out of Spool (35) (see figure 5, Locknut Removal and Installation).

Reassembly

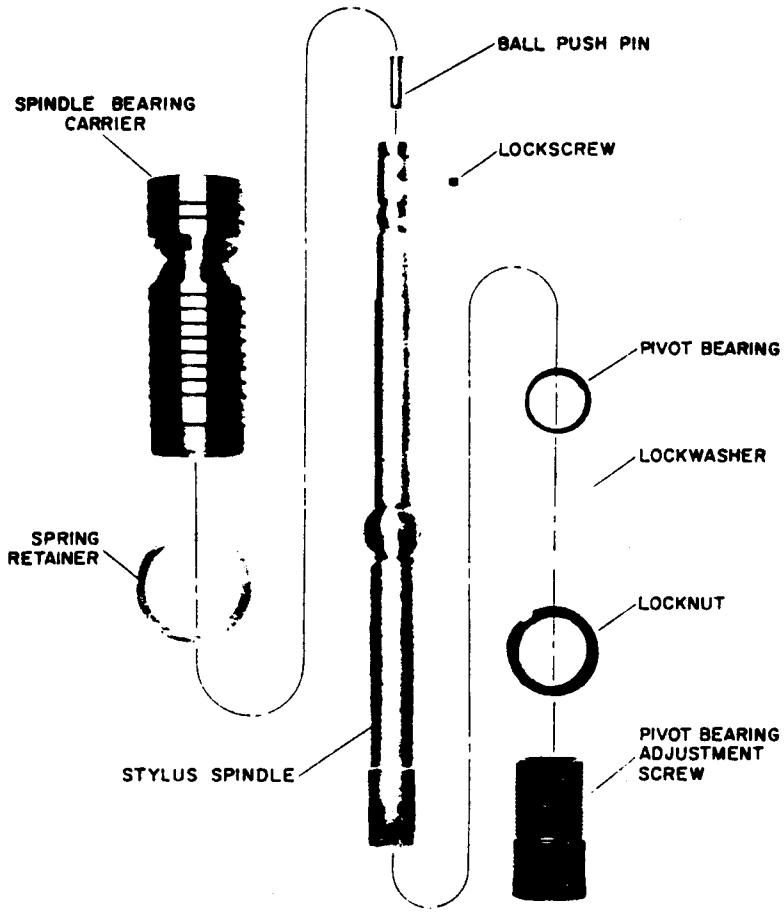


Figure 4. Stylus Spindle Reassembly

Wash all parts in solvent and keep clean during assembly.

1. Lay Lock Washer (69) on flat surface and lightly hammer out the stake marks.

2. Thread Lock Nut (68) onto Adjustment Screw (65). (If lock washer is placed upside down from the original assembly, the old stake marks will not effect a new lock position.)

3. Slide the Pivot Bearing (47), with spherical side toward ball, onto the stylus end of the Spindle (58). Next slide pivot bearing Adjustment Screw (65) onto the spindle after the pivot bearing.

4. Place Spring Retainer Washer (48) over small end of Spool (35). Insert spindle as assembled, small end first, into threaded end of spool, and thread pivot bearing Adjustment Screw (65) in until the pivot bearing is seated.

NOTE

The next step requires a little patience to obtain the correct adjustment for a free but not sloppy fit.

5. Hold the Spool (35) in your hand and with the other hand tighten the Adjustment Screw (65) until a very slight bind is felt when the spindle is oscillated in all directions. Hold Spool (35) in hand and tighten Lock Nut (38) by striking spanner wrench with hammer (see figure 5, Locknut Removal and Installation). Remember, no vise.

NOTE

As the lock nut is tightened, it tends to pull the inner end of the adjustment screw away from the pivot bearing a few tenths of a thousandth (.0000), thus creating a free but close fit to the ball on the spindle. The oscillating feel must be absolutely free of bind but with no lost movement in ball adjustment either in and out or sideways. If necessary, repeat the adjustment using more or less bind on the first adjustment, as stated in step 5, until adjustment is correct.

NOTE

STRIKE SPANNER WRENCH
SHARPLY WITH HAMMER
IF NECESSARY FOR DISASSEMBLY,
AND AS STANDARD PRACTICE
FOR REASSEMBLY

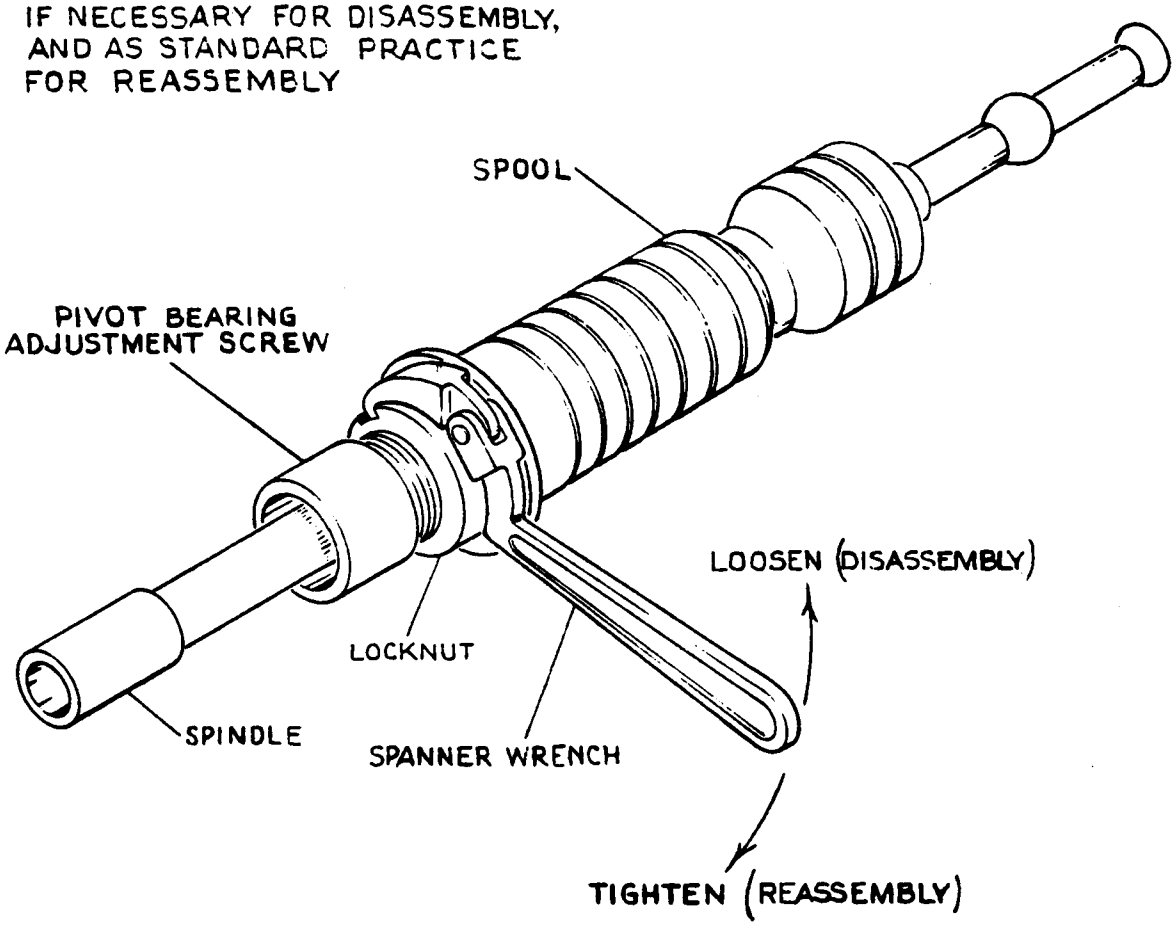


Figure 5. Locknut Removal and Installation

NOTE

If the adjustment is too tight, the operator will feel a stiffness in operating the tracer and will find it difficult to hold to the template. If adjustment is too loose, it will affect tolerance and finishes on the parts produced.

6. When the adjustment is correct, place the assembly on clean rags on the bench with pivot bearing adjustment screw towards you and rotate the spool until the stake notch in the spool is up.

With a punch, stake the lock washer into the left side of the notch in the spool (see figure 6, Lockwasher Staking).

Next, rotate the spool until the slot in the lock ring is up and stake the lock washer into the right side of the slot.

NOTE

SLOTS IN SPOOL AND LOCKNUT NEED NOT BE IN RELATIONSHIP SHOWN

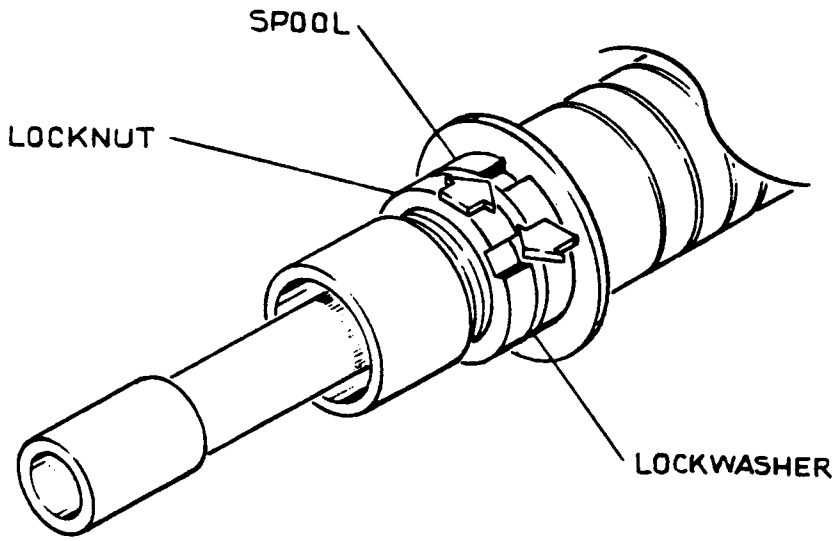


Figure 6. Lockwasher Staking

7. Insert the spindle assembly carefully and clean into the tracer, guiding the spindle through the hole in the yoke assembly and into the Centering Ring (26) of the 360 rate control assembly.

NOTE

Be sure Translator Ball (73) is in the hole in the side of the Translator Sleeve (46).

8. Replace Rate Control Dial (40) and tighten 8-32 screw in Dial Stop (38).

9. Replace Counterbalance Spring (51) and Counterbalance Adjustment Screw (52).

10. Replace bias control assembly and tighten Lock Screw (67). (Use fingers only.)

3D ADJUSTMENT SCREW CENTER OR MID-POSITION SETTING

1. Loosen 8-32 Round Head Screw (37) two turns to let 3D Rate Control Dial (40) pass the Dial Stop (38) clip.

2. Loosen 10-32 Set Screw (41) in 3D Rate Control Dial (40) and remove the dial.

3. Screw the 3D Rate Control Adjustment Screw (42) in (right) as far as it will go (with your fingers only).

4. Replace Dial (40) on Rate Control Screw (42). Set at zero and press dial in as far as possible, overriding the Spring (45) in Friction Pin (44), and then lock Set Screw (41).

5. Turn Dial (40) to the left one full turn to zero and retighten Screw (37) on Dial Stop (38).

6. Turn on hydraulic pump and check vertical null position (3D) by rotating Dial (40) right and left approximately five graduations each way. If null is noted within these limits, reset the dial to match zero and the index mark on the face of the 3D Rate Control Body (43).

NOTE

FACE OF DIAL AND FACE OF RATE CONTROL BODY SHOULD BE HELD FLUSH WITH EACH OTHER AS SET SCREW (41) IS LOCKED.

If conditions of step 6 are not satisfactory, proceed as follows:

7. Turn off hydraulic pump.

8. Remove the two 8-32 Round Head Screws (77) which hold 3D Cover Plate (76), and remove cover plate and Spring (80).

9. Slide Spool (79) out of the tracer.

10. Loosen 3D Lock Nut (75) one turn (left). Do not clamp spool in vise or use pliers on spool.

11. Clean spool thoroughly in solvent and carefully replace in tracer.

12. Turn on hydraulic pump.

13. Place an Allen wrench into the spool to engage the socket in 3D Centering Stud (74).

14. Set 3D Adjustment Dial (40) at zero.

15. Hold Spool (79) in with your fingers to prevent rotation as you turn the Allen wrench in first one direction and then the other until the 3D null position is found.

16. Turn off hydraulic pump and carefully remove Spool (79). Do not disturb the position of the Allen wrench.

17. Holding the spool and Allen wrench in one hand, carefully retighten Lock Nut (75).

18. Clean spool in solvent and carefully replace in the tracer.

19. Replace Spring (80), Cover Plate (76), and Screws (77).

20. Turn on hydraulic pump and recheck zero setting on 3D Dial (40). If null position is found to be off a few graduations, no more than ± 5, reset zero on the dial.

NOTE

If setting is off more than ± 5 graduations, steps 13 through 17 were performed incorrectly and will have to be repeated.

3D SPOOL NULL POSITION ADJUSTMENT

The 3D Spool (79) null adjustment is set and locked at the factory and should not change or need adjusting.

In the event it becomes necessary, the adjustment must be started from the 3D rate control assembly on the front face of the tracer.

See 3D Adjustment Screw Center or Mid-Position Setting, steps 8 through 20, page 18.

3D DIAL ZERO SETTING

See 3D Adjustment Screw Center or Mid-Position Setting, steps 1 through 6, page 17.

360 RATE CONTROL DISASSEMBLY

1. Remove cover plate (name plate) from face of tracer.
2. Remove Override Adjustment Screw (22).
3. Loosen 10-32 Set Screw (19) in 360 Rate Control Dial (20) and remove dial.
4. Loosen 1/4-20 Set Screw (29) on both the right and left face of tracer body 1/8 turn.
5. Insert 1/8" pins or spanner wrench into the convenient holes (four are provided) in top of Rate Control Housing (30); rotate assembly to left (counter clockwise, looking down on tracer) and remove 360 rate control assembly.
6. Remove 360 Rate Adjustment Screw (21) (turn to left).

7. Turn 360 Rate Control Adjustment Screw (21) upside down; Spring (23) and Pin (24) will fall out.

8. Loosen 1/4-20 Set Screw (16) to release Half-Nut Pin (17) in Housing (30).

9. Unscrew Ball Cage (18), by turning to the left, from Housing (30).

10. Turn Housing (30) upside down; Ball (25) and Centering Ring (26) will fall out.

360 RATE CONTROL REASSEMBLY

NOTE

Thoroughly clean all parts with solvent before reassembly and keep clean during reassembly.

1. Hold 360 Rate Housing (30) in your hand with inner bore face up, at approximately a 45° angle, with Half-Nut Pin (17) on lower side.

2. Place Centering Ring (26), with cone up, and Precision Ball (25) in cone of Centering Ring (26).

3. Align threads on half-nut pin to coincide with the threads on the outside of the 360 Rate Control Ball Cage (18).

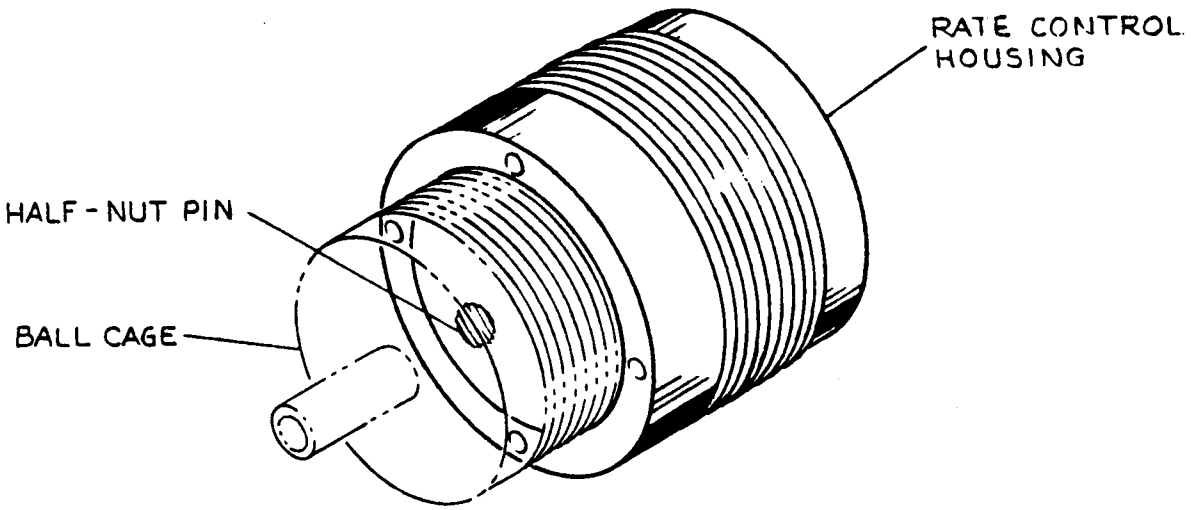


Figure 7. Half-Nut Pin Thread Alignment

20. Turn on hydraulic pump and recheck zero setting on 3D Dial (40). If null position is found to be off a few graduations, no more than ± 5, reset zero on the dial.

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8. Loosen 1/4-20 Set Screw (16) to release Half-Nut Pin (17) in Housing (30).

9. Unscrew Ball Cage (18), by turning to the left, from Housing (30).

10. Turn Housing (30) upside down; Ball (25) and Centering Ring (26) will fall out.

360 RATE CONTROL REASSEMBLY

NOTE

Thoroughly clean all parts with solvent before reassembly and keep clean during reassembly.

1. Hold 360 Rate Housing (30) in your hand with inner bore face up, at approximately a 45° angle, with Half-Nut Pin (17) on lower side.

2. Place Centering Ring (26), with cone up, and Precision Ball (25) in cone of Centering Ring (26).

3. Align threads on half-nut pin to coincide with the threads on the outside of the 360 Rate Control Ball Cage (18).

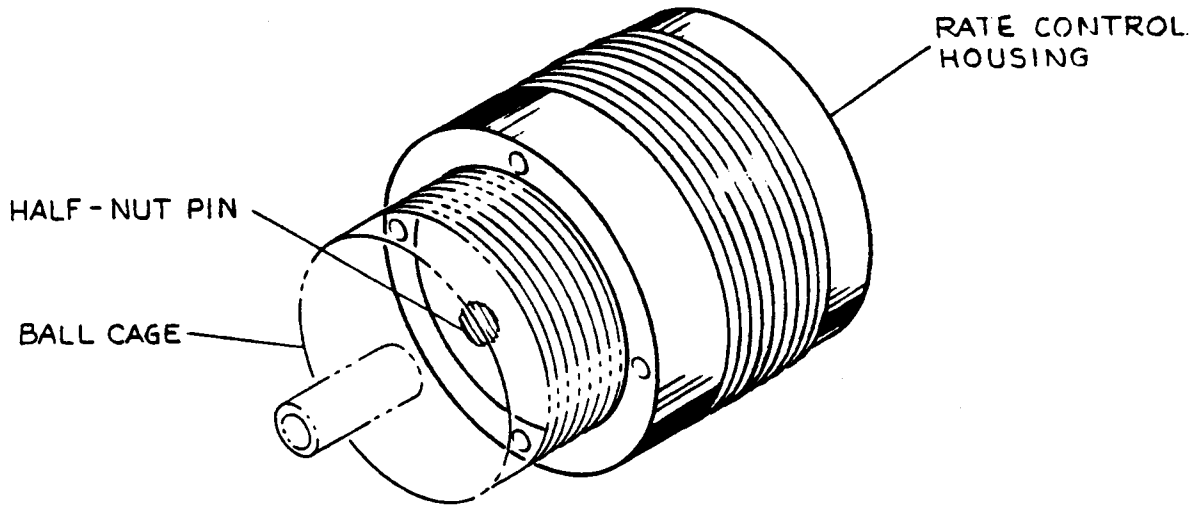


Figure 7. Half-Nut Pin Thread Alignment

4. Carefully insert 360 Rate Control Ball Cage (18) into bore of 360 Rate Control Housing (30) and engage Half-Nut Pin (17) (see figure 7, Half-Nut Pin Thread Alignment).

5. Screw 360 Rate Control Ball Cage (18) into 360 Rate Control Housing (30) until it touches Centering Ring (26); then unscrew ball cage 1/2 turn.

6. Lightly tighten Set Screw (16) as 360 Rate Control Ball Cage (19) is rotated back and forth to set the threads of Half-Nut Pin (17) firmly into the threads of 360 Rate Control Ball Cage (18).

7. With Set Screw (16) snug (not tight) against ball cage half-nut pin, screw in (right) 360 Rate Control Ball Cage (18) until Centering Ring (26) cannot be moved from side to side when a .002 feeler is inserted between the inner flange of 360 Rate Control Housing (30) and bottom (lower) surface of Centering Ring (26) (see figure 8, Center Ring Setting).

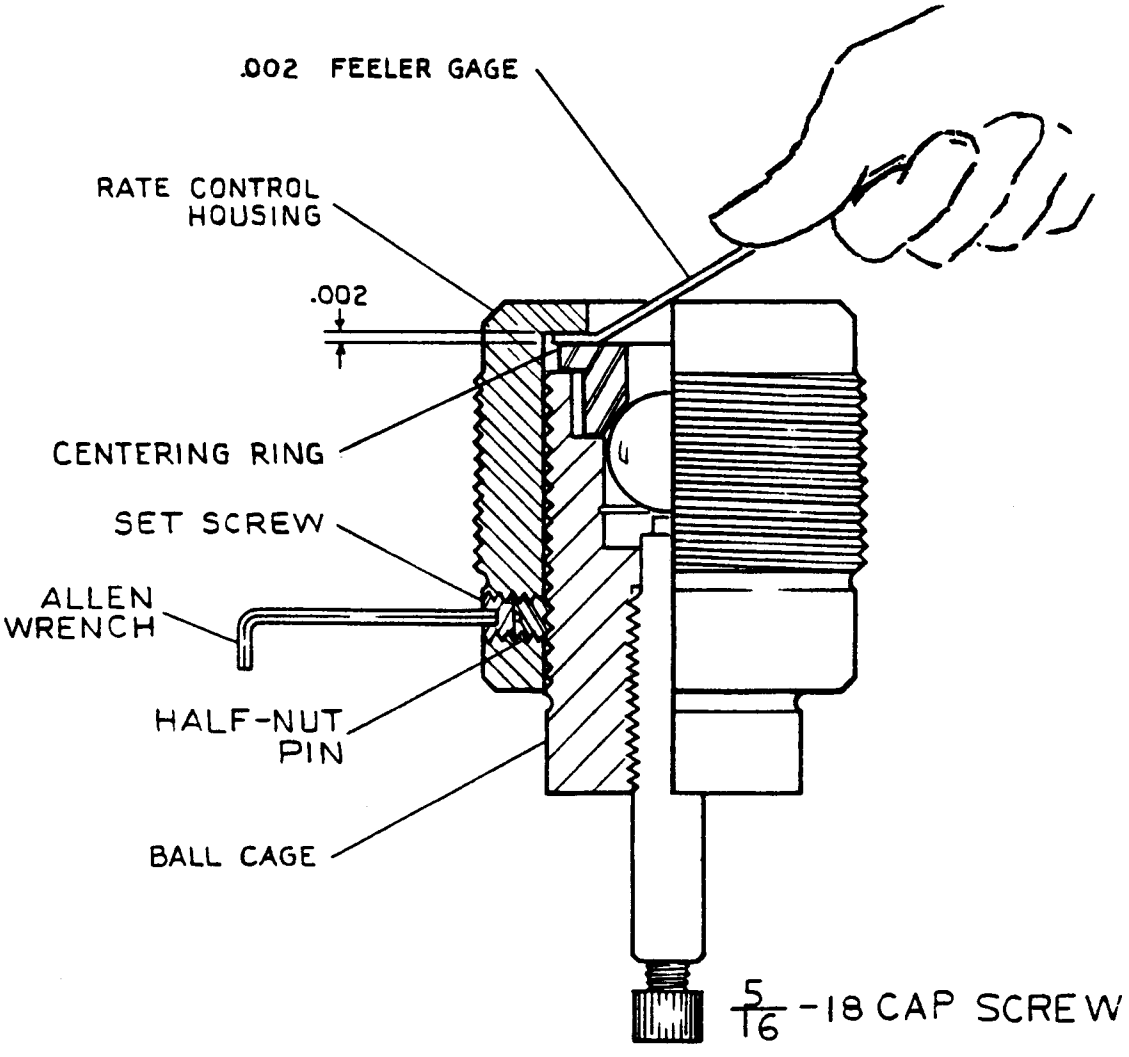


Figure 8. Center Ring Setting

8. Remove feeler and tighten Set Screw (16) firmly. Centering Ring (26) should slide freely sideways 360° without stick or bind.

9. Insert Override Pin (24), head up, and Override Spring (23) into threaded hole of 360 Rate Adjustment Screw (21). Substitute a 5/16-18 x 1" socket head screw or set screw for the Override Adjustment Screw (22) at this time; screw into rate adjustment screw finger tight (no wrench, please) until the override spring has a medium amount of tension on the override pin.

10. Screw 360 Rate Adjustment Screw (21) (right) into 360 Rate Control Ball Cage (18) snugly. Centering Ring (26) should not be movable at this time. However, as rate adjustment screw is unscrewed (left), oscillating movement of centering ring should increase. If oscillation does not increase or if movement is sticky, the assembly is incorrect. Recheck.

11. Lubricate the complete 360 rate control assembly with clean oil. Mobil Type DTE Light or Medium.

360 RATE CONTROL INSTALLATION AND ADJUSTMENT

1. Align Half-Nut Pin (28) on right inside surface of the hole in the top of Valve Body (1) to match threads on 360 Rate Control Housing (30).

2. Carefully insert rate control assembly into top of hole and rotate it to the right as it is inserted to pick up half-nut thread.

3. When the lower end of assembly protrudes about 1/4" into body cavity, lightly tighten 1/4" Set Screw (29) as the assembly is rotated to right and left to seat the half-nut pin.

8. Remove feeler and tighten Set Screw (16) firmly. Centering Ring (26) should slide freely sideways 360° without stick or bind.

9. Insert Override Pin (24), head up, and Override Spring (23) into threaded hole of 360 Rate Adjustment Screw (21). Substitute a 5/16-18 x 1" socket head screw or set screw for the Override Adjustment Screw (22) at this time; screw into rate adjustment screw finger tight (no wrench, please) until the override spring has a medium amount of tension on the override pin.

10. Screw 360 Rate Adjustment Screw (21) (right) into 360 Rate Control Ball Cage (18) snugly. Centering Ring (26) should not be movable at this time. However, as rate adjustment screw is unscrewed (left), oscillating movement of centering ring should increase. If oscillation does not increase or if movement is sticky, the assembly is incorrect. Recheck.

11. Lubricate the complete 360 rate control assembly with clean oil. Mobil Type DTE Light or Medium.

360 RATE CONTROL INSTALLATION AND ADJUSTMENT

1. Align Half-Nut Pin (28) on right inside surface of the hole in the top of Valve Body (1) to match threads on 360 Rate Control Housing (30).

2. Carefully insert rate control assembly into top of hole and rotate it to the right as it is inserted to pick up half-nut thread.

3. When the lower end of assembly protrudes about 1/4" into body cavity, lightly tighten 1/4" Set Screw (29) as the assembly is rotated to right and left to seat the half-nut pin.

CAUTION

Be sure Half-Nut Pin (28) is properly seated.

4. If not previously done, substitute a 5/16-18 x 1" socket head screw or set screw for the Override Adjustment Screw (22). (Refer to step 9, 360 Rate Control Reassembly.)

5. Rotate 360 Rate Adjustment Screw (21) to the right (in) until it makes contact with Ball (25) and continue 1/2 turn more.

6. Set 3D rate control dial at zero. (VERY IMPORTANT.)

7. Insert spanner wrench or 1/8" pins into the holes in top of 360 Rate Control Housing (30) and use a screwdriver for leverage, or a spanner wrench.

8. Lift or urge stylus Spindle (58) up until the top of the spindle makes contact with the Ball (25) and note the approximate distance spindle moves.

9. The Rate Control Housing (30) has a 20-pitch thread on the outer surface so that one turn to the right would move the assembly .050 closer to the top of the spindle. Continue to rotate the assembly until the spindle has only .003 to .006 free end-play movement. Lock Set Screw (29) right and recheck end-play. Repeat corrective adjustment if necessary.

10. Unscrew 360 Rate Adjustment Screw (21) two or three turns; then retighten until Override Pin (24) lightly contacts Precision Ball (25).

11. Carefully place 360 Rate Dial (20) on 360 Rate Adjustment Screw (21), aligning graduation No. "2" with index mark on body, and press dial down to override tension of Friction Pin (15) until bottom face of dial is 1/32" from top surface of tracer body. Tighten Set Screw (19) firmly.

12. Turn dial to No. "20"" then turn back to zero. If a sudden bind is felt when returning to zero, the 360 rate adjustment screw is rotated too far to the right in the dial (looking down on dial). Loosen Set Screw (19) and turn 360 Rate Adjustment Screw (21) to the left. Repeat steps 10 and 11 until adjustment is correct.

13. If top of Spindle (58) can be moved more than .003" total, back and forth in any direction with 360 Rate Control Dial (20) set at zero, step 5 was not performed correctly, or 360 Rate Adjustment

Screw (21) was not rotated far enough to the right to allow Override Pin (24) to make firm contact with the Ball (25). Repeat steps 10 and 11 until adjustment is correct.

14. Remove 5/16-18 x 1" socket head screw or set screw previously installed in 360 Rate Adjustment Screw (21) and replace with Override Adjustment Screw (22).

360 FEED RATE SETTING

If the seals on a piston have "blow-by", if gibs are too tight, if ways need lubrication, or if air is present in the hydraulic system, a precise adjustment is impossible. These faults must be corrected to obtain proper feed rate adjustment.

The Valve Spool (3) has a 5/16-24 right-hand thread formed on the shank, which is inserted into the Connecting Block (6). The bore in the connecting block is straight (no threads) but a close fit to the O.D. of the threads on the shank of the spool. Half-Nut Pin (8) has a mating female thread, formed on its end at 90° to its axis, which engages the threads on the shank of the spool. See figure 9, 360 Feed Rate Setting.

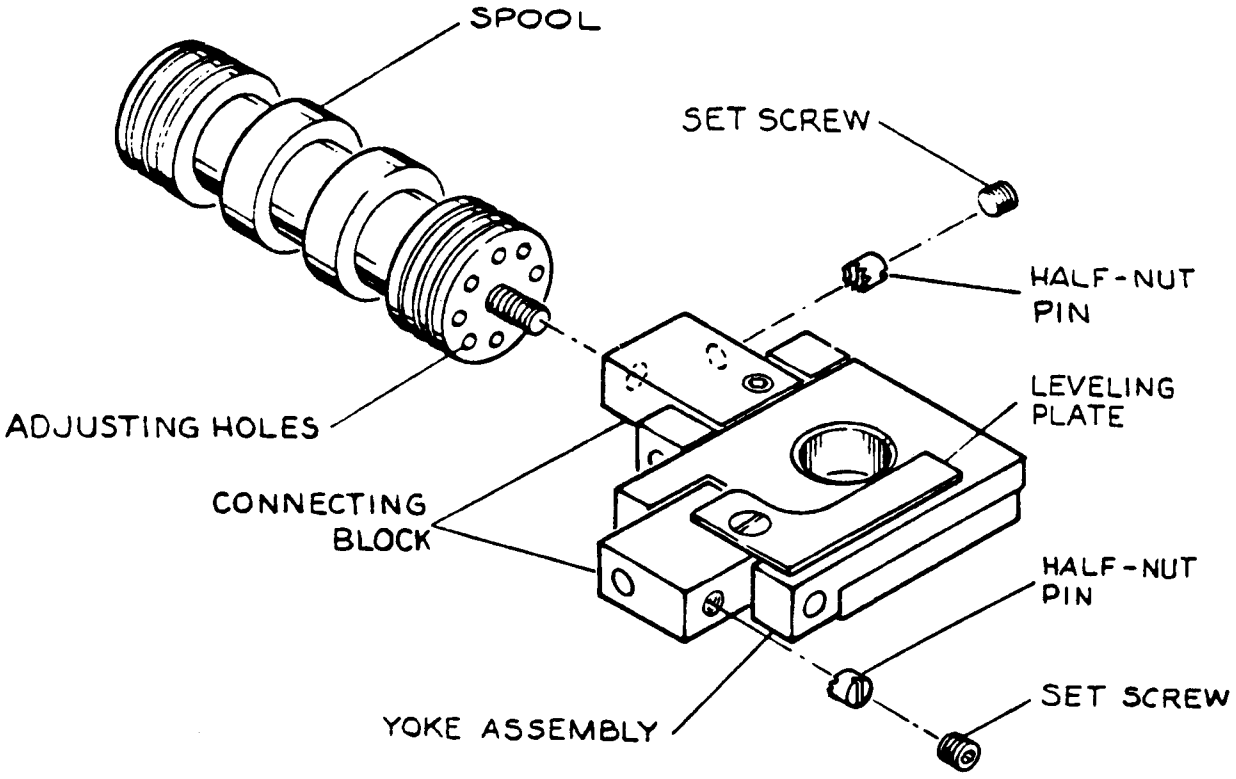


Figure 9. 360 Feed Rate Setting

The half-nut pin serves two purposes:

a. to act as a female thread in the Connecting Block (6) for adjusting null position when Valve Spool (3) is rotated.

b. to lock the position of adjustment when Set Screw (7) is firmly set.

CAUTION

Be sure half-nut pin is properly aligned to engage the threads of the valve spool shank.

1. Start the hydraulic power unit (pump).

2. Close 3D hold valve and set 3D rate control dial between zero and No. "5" graduation.

3. Set 360 rate control dial at No. "3" or "5" graduation.

4. Lightly but firmly deflect the stylus spindle to the right and then to the left for about 5 seconds each way, observing the rate of movements. Repeat the same operation to you and from you (front to back, and back to front). If a difference in rate is noted, remove cover plate (name plate) from tracer.

5. Shut off the hold valve which controls the motion parallel to the slide which is the nearest to being in balance.

6. Loosen the 10-32 Set Screw (7) in the Connecting Block (6) connected to the valve Spool (3) which is parallel to the direction of the desired motion to be corrected, and retighten Set Screw (7) snugly (thumb and finger).

7. Move spindle back and forth with light but firm finger pressure several times to determine which direction is faster, and at the same time observe whether the Spool (3) is being "pulled out" or "pushed in" to the Valve Sleeve (2).

8. If the spool is being "pulled out" when the faster rate is noted, it indicates the spool is past null too far. To correct this condition, rotate the spool to the right (clockwise facing spool) with the tip of a screw driver inserted into one of the holes which are spaced around the front face of the spool. (If necessary, tap the screw driver handle with your knuckle or a light hammer to rotate the spool.) The amount the spool must be rotated depends on the "out of rate" difference. If the difference is slight, a rotation of 1^{o} could change the faster feed rate from one direction to the opposite.

If the difference is great, a rotation of several hole spacings may be required. Firmly tighten set screw when adjustment is correct.

9. Perform the same operation on the other 360 spool.

NOTE

A long travel indicator conveniently placed to register slide movement in both directions is recommended for the final adjustment (see figure 10, Slide Movement Timing). Since this is the most critical adjustment in the tracer, we suggest you take ample time to be sure it is correct.

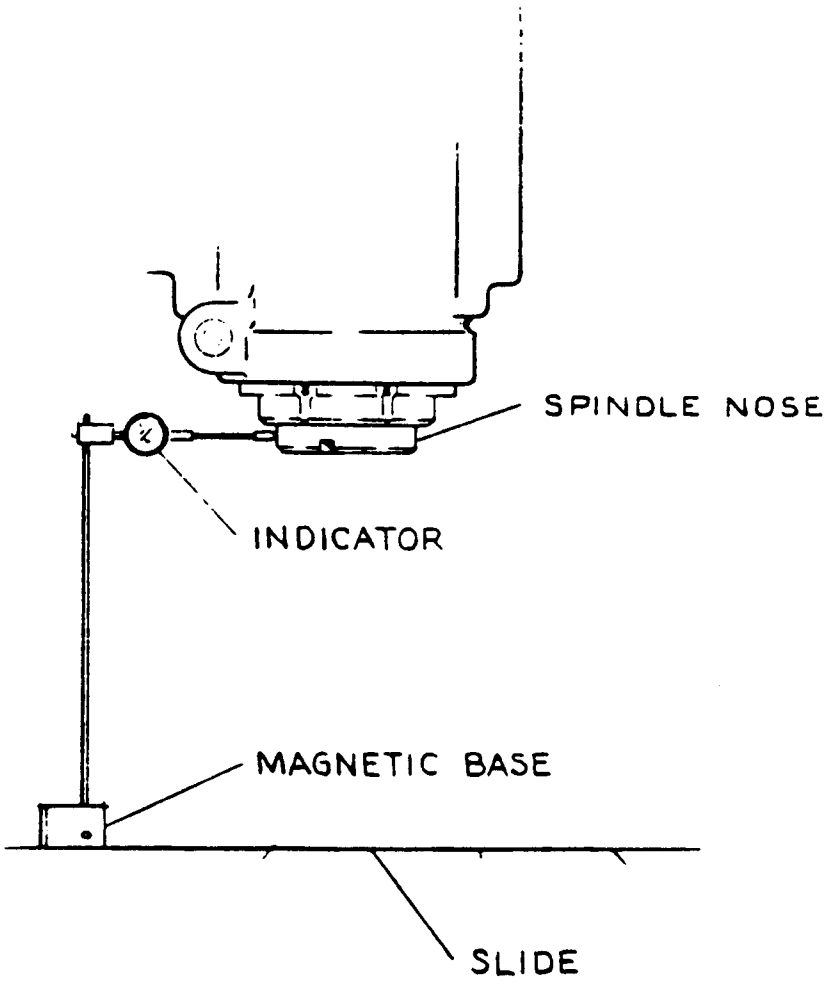


Figure 10. Slide Movement Timing (Example)

BIAS CONTROL - DISASSEMBLY

1. Loosen Lock Screw (67) to remove the assembly.

2. Unscrew two 6-32 Round Head Screws (57) and remove Control Arm (53).

3. Unscrew two 6-32 Round Head Screws (63) and remove the two flat Springs (61).

4. Rotate Control Ring (66) until Control Pins (62) are visible and use needle-nose pliers or tweezers to remove control pins.

5. Lift Bias Control Body (56) out of Bias Control Ring (66).

BIAS CONTROL - REASSEMBLY

Reverse the procedure of disassembly - steps 5 through 1. Be sure that Lock Screw (67) is positioned 180° from Trigger Sleeve (55) when Control Arm (53) is reattached.

STYLUS COUNTER BALANCE SPRING INTERCHANGE

Two interchangeable springs of different values are furnished with each tracer. (The light-weight spring is cadmium plated; the heavy spring is black.) These springs are provided with adjustable means (Adjusting Screw (52)) to enable the operator to counter balance styli of various weights.

To change springs, proceed as follows:

1. Loosen Lock Screw (67) in Bias Control Body (56) and remove bias control from the extended end of Adjustment Screw (65).

2. Unscrew (left) counter balance Adjustment Screw (52) until it is free of lower projection of Tracer Body (1). The Spring (51) will come out with the Adjustment Screw (52).

3. Change springs and reassemble. Be sure Spring Retainer Washer (48) is on the extension of Spool (35) before spring is installed.

YOKE ASSEMBLY

The mechanism which coordinates and translates the movements induced by the stylus Spindle (58) to the 360 servo valves in the tracer is called a yoke.

Because of the very close tolerances required in this precision assembly, it is manufactured to selective fits.

We do not recommend disassembly in the field.

The mechanism is simple but we strongly recommend its return to the factory for repair.

In the event of damage or wear, an exchange service is offered and charges are based on time and material required.

The assembly is quite rugged for its functional requirements, so you may expect many years of service from it, barring accidents.

LUBRICATION OF TRACER

See Figure 11, 360 Rate Control Lubrication, page 29.

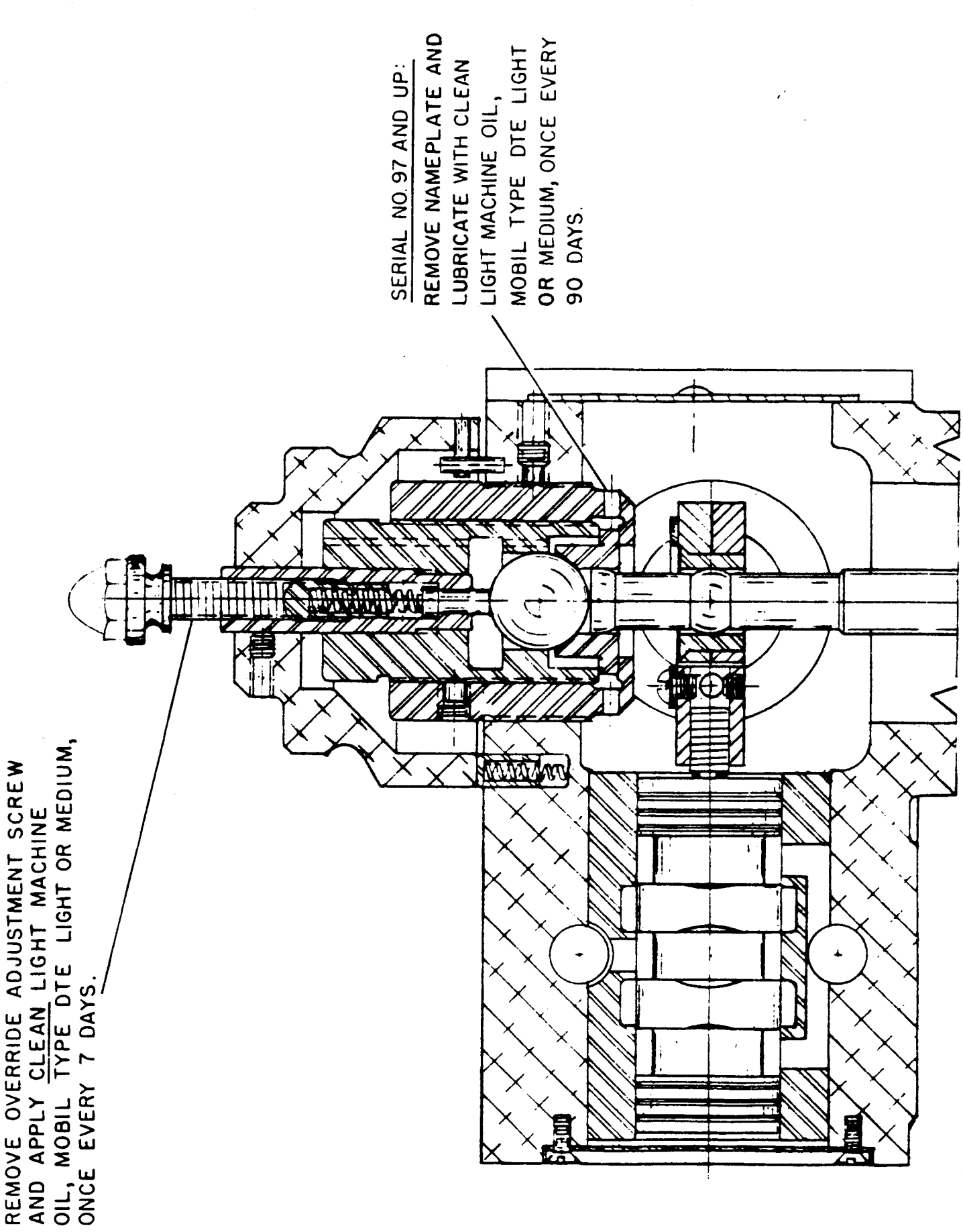
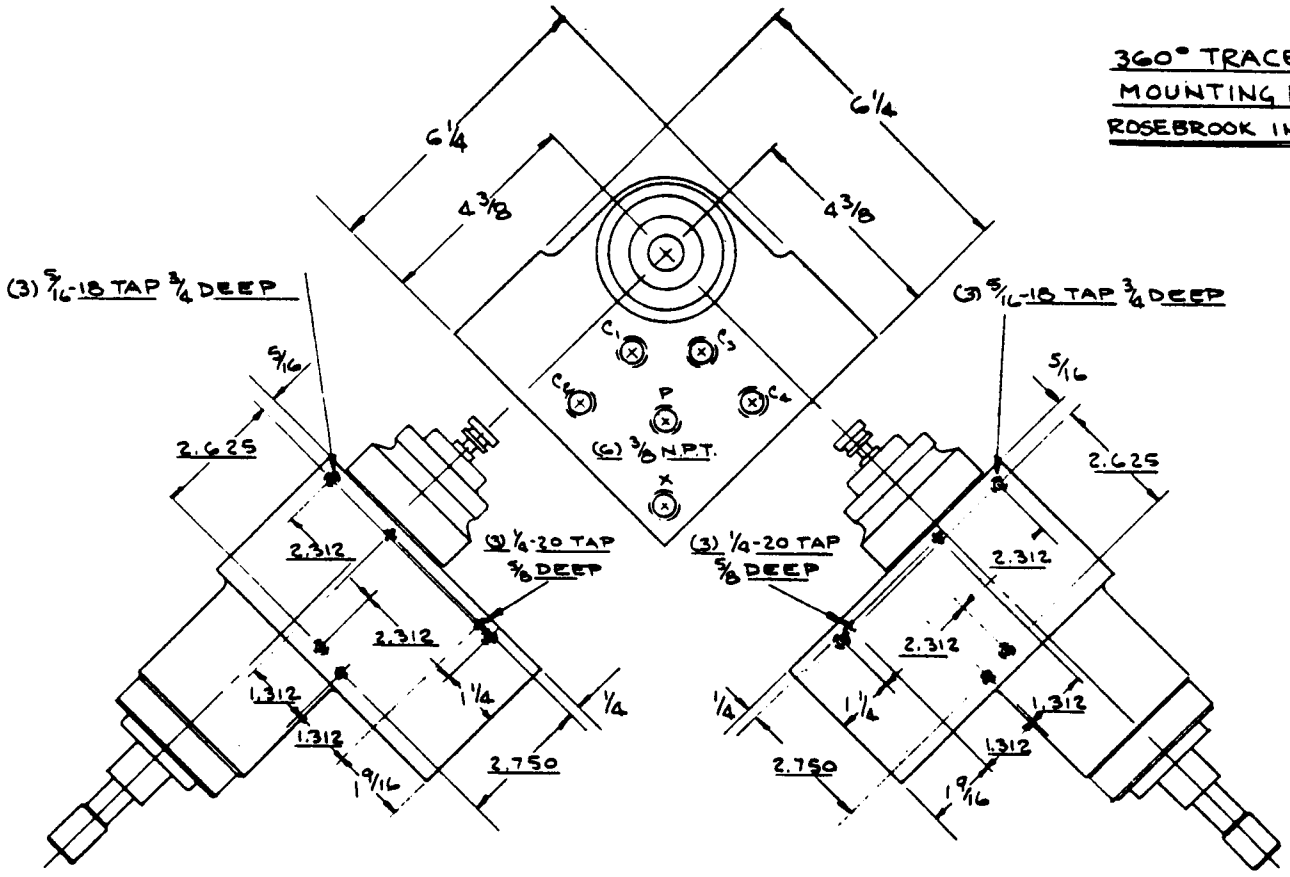


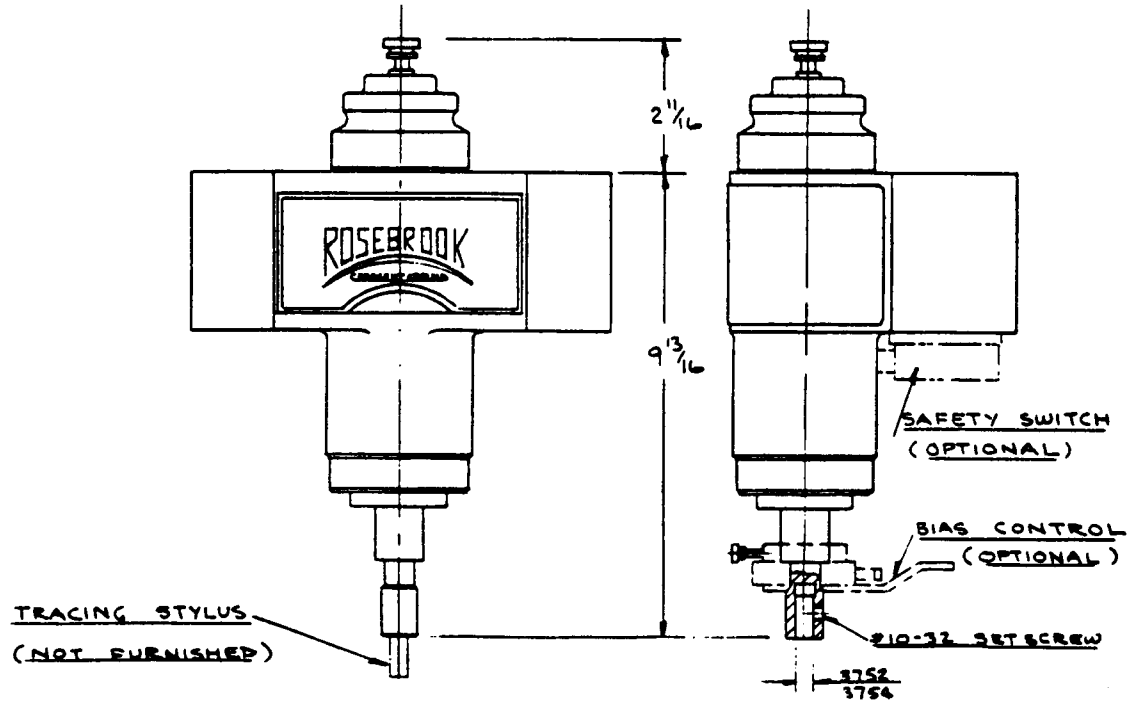
Figure 11. 360 Rate Control Lubrication

360° TRACER SER. 2000
MOUNTING DIMENSIONS
ROSEBROOK INC. DOWNEY, CAL.



FOR RIGHT HAND MOUNT

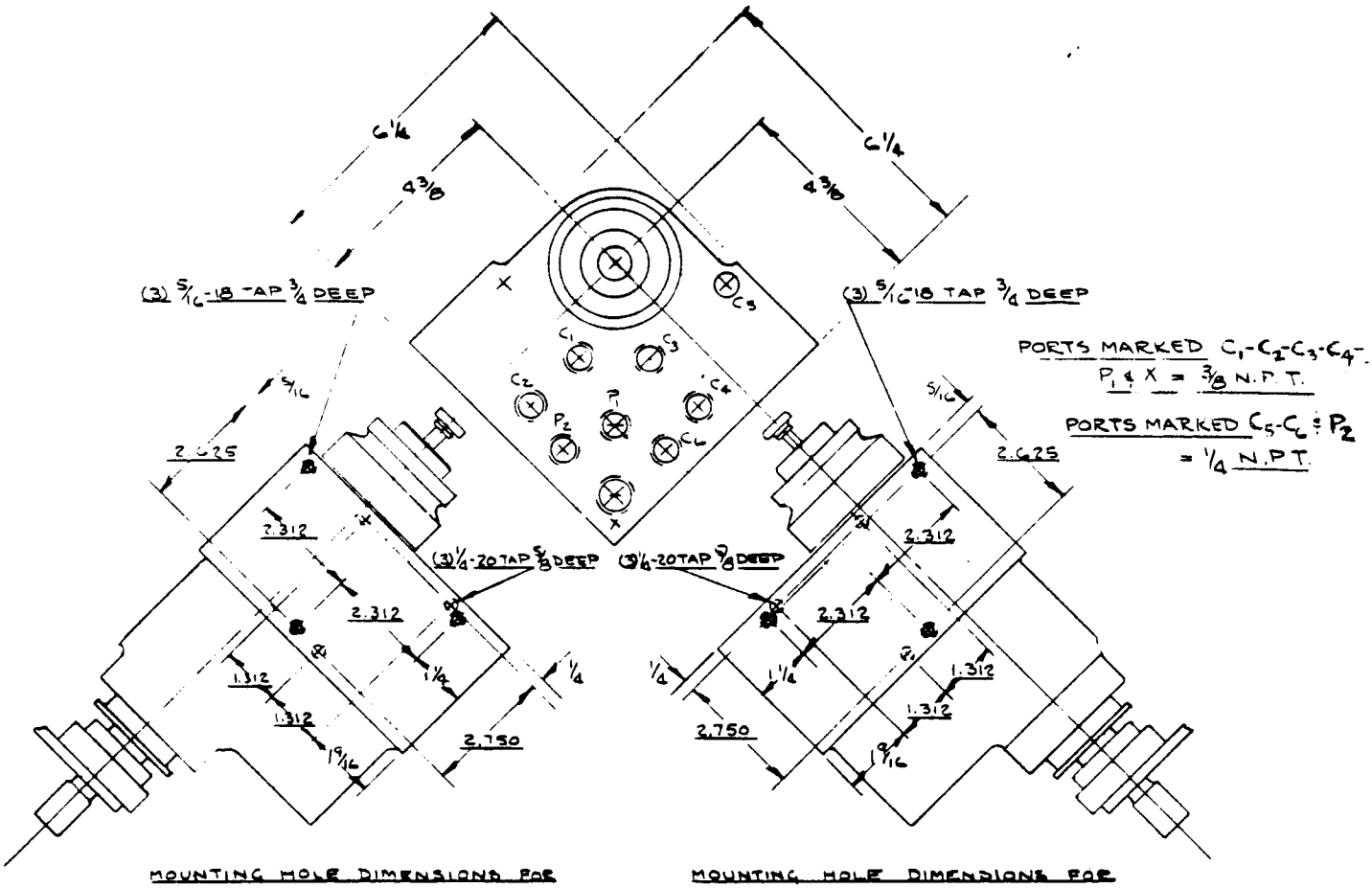
FOR LEFT HAND MOUNT



MOUNTING DIMENSIONS

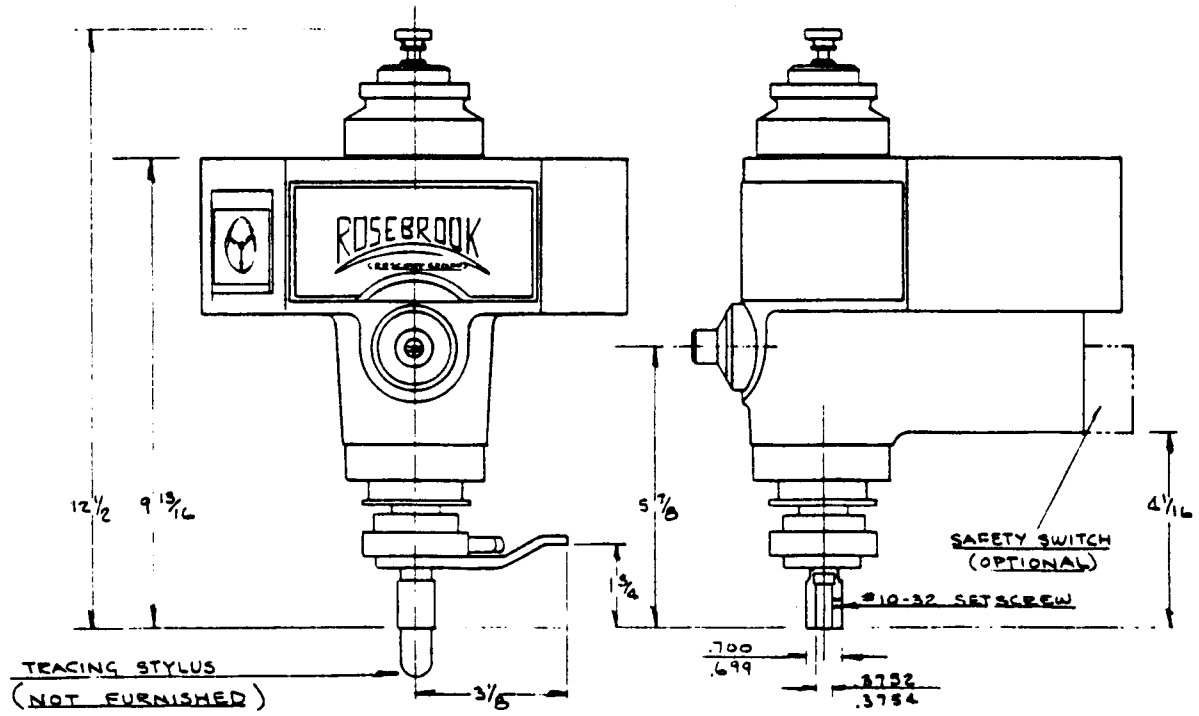
360° TRACER SER. 2000

ROSEBROOK, INC. DOWNEY, CALIFORNIA



MOUNTING HOLE DIMENSIONS FOR RIGHT HAND MOUNT

MOUNTING HOLE DIMENSIONS FOR LEFT HAND MOUNT



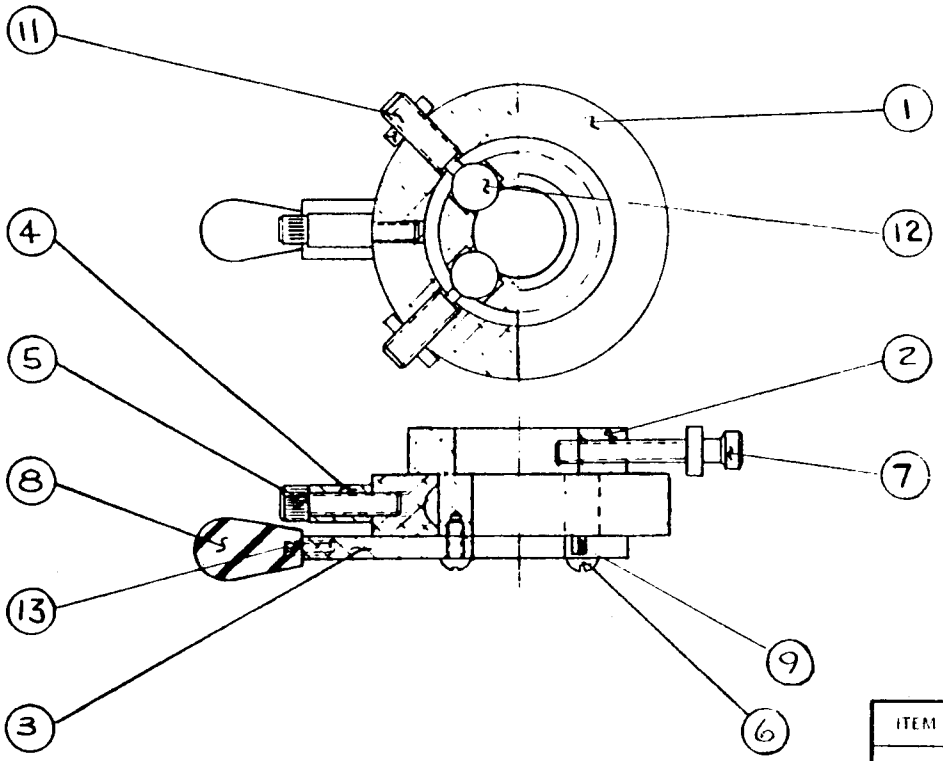
3-D TRACER SER. 3000

MOUNTING DIMENSION DATA & HYDRAULIC PORT IDENTIFICATIONS

SCHNEEBECK CORPORATION COLORADO SPRINGS, COLORADO

6005

A	REVISED & REDRAWN	EE	11-7-74
B	ADDED DET. 15	EH	4/4/75
C	DELETED DET. 15	EH	9-4-75



1.	Bias Control Ring	3066
2.	Bias Control Body	6099
3.	Bias Control Arm	6090
4.	Trigger Sleeve	3055
5.	Soc. Hd. Screw (Nylock)	90196-12
6.	Round Hd. Screw (nylock)	90201-6
7.	Thumb Screw	90012-12
8.	Knob, Plastic	90022-1
9.	Roll Pin	90005-6
10.	Spring Plunger	90203
11.	Steel Ball	90004-6
12.	Soc. Hd. Set Screw (Nylock)	90204-8

MICROFILMED
DATE 1-[illegible]

ITEM	QTY	PART NO	DESCRIPTION

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UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES
BREAK SHARP EDGES .015 MAX
MACHINED SURFACE .125
FINISH TO BE [illegible]
MACH. FILLET RADII .02 MAX
MACHINED DIAMETERS TO BE CONCENTRIC WITHIN .005 F.I.M.
SQUARENESS AND PARALLELISM OF MACHINED SURFACES .001 PER INCH TO A MAX OF .015 PER FOOT
ALL RADII AND CHAMFERS AS NOTED AS SHOWN

TOLERANCES

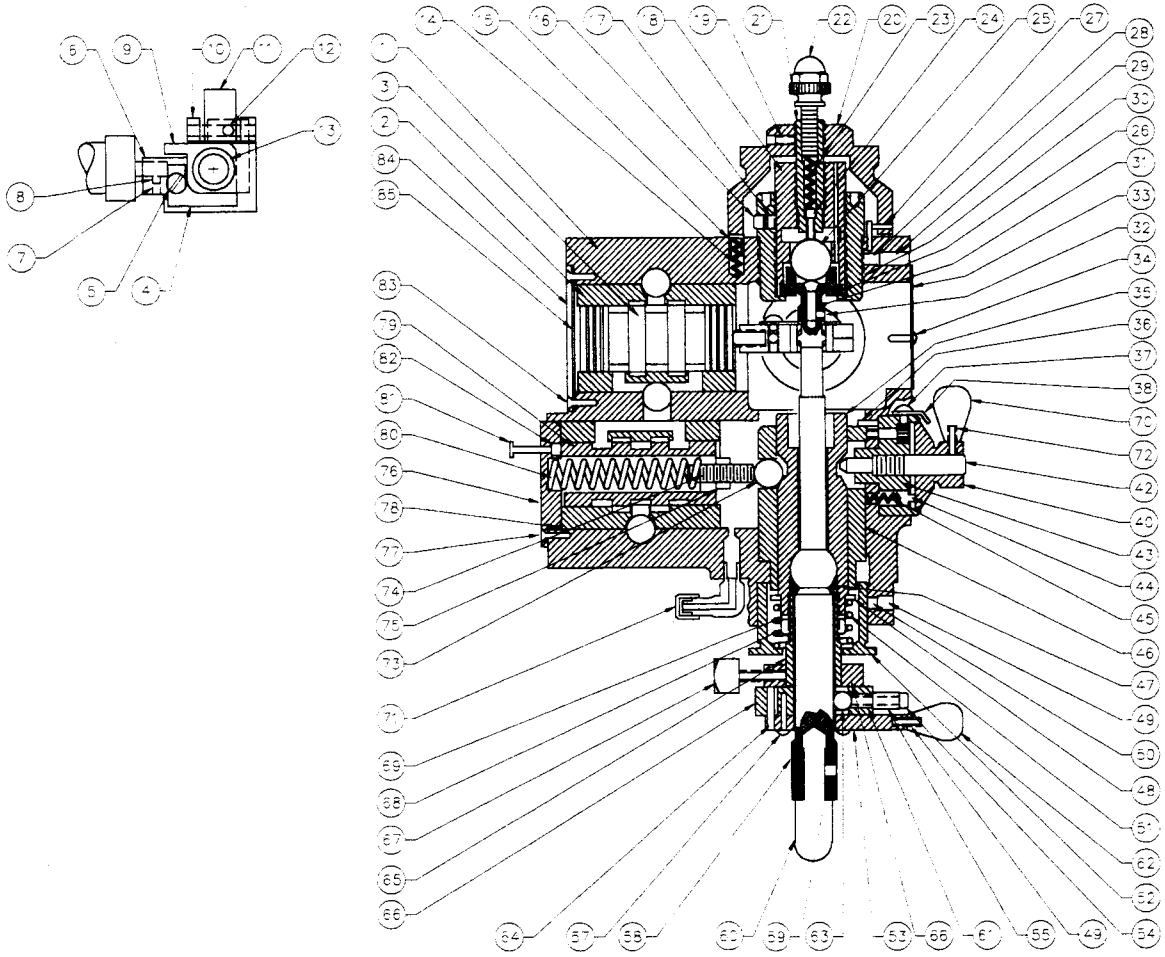
XXX	.005
XX	.015
X	[illegible]
ANGULAR	[illegible]

ROSEBROOK
SCHNEEBECK
Corporation

TITLE
BIAS, CONTROL
ASSY.

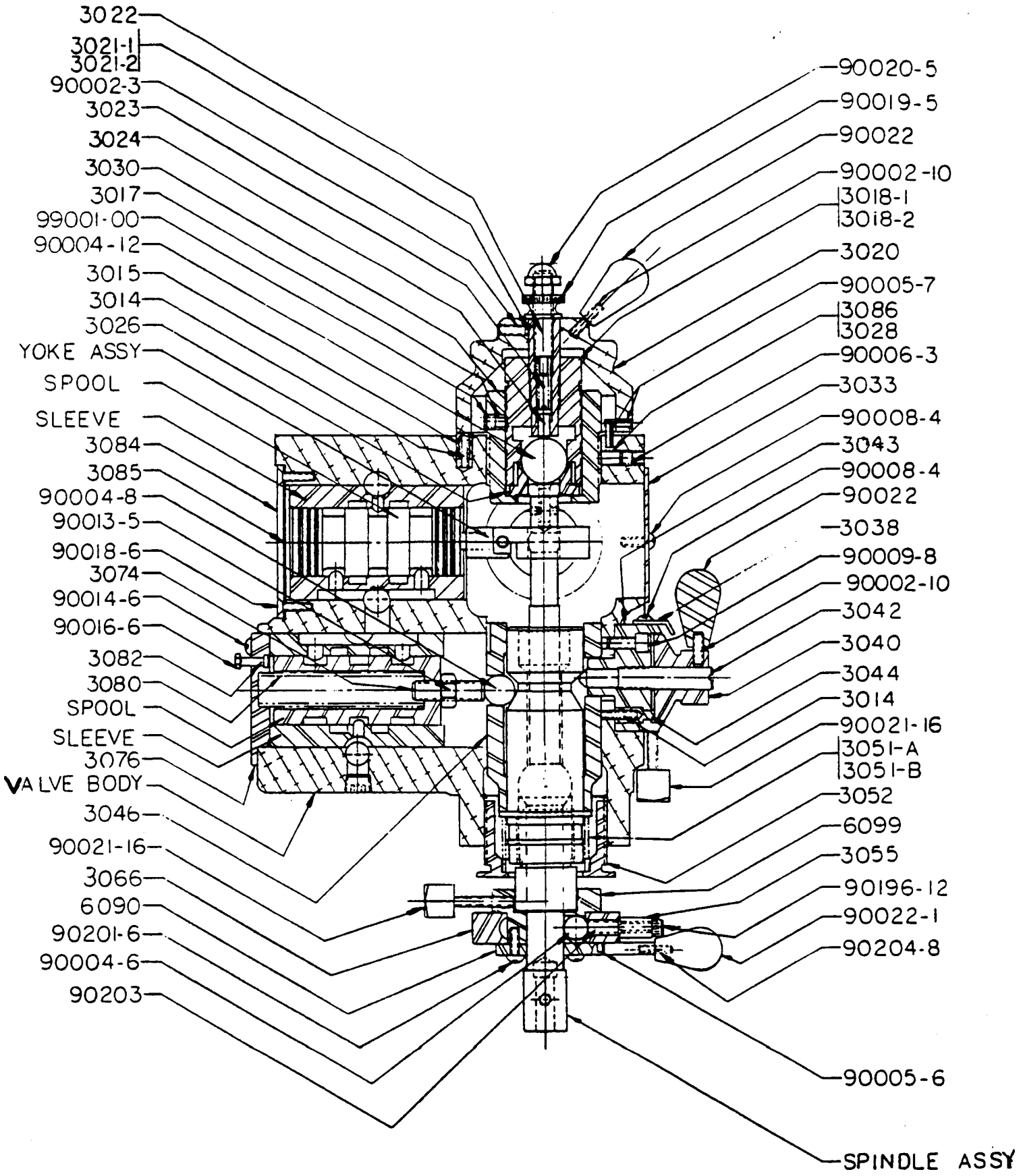
DRAWN BY E. EWING
CHECKED BY
APPROVED BY
SCALE FULL
DRAWING SIZE B
REV C
DRAWING NO 6005
SHEET 1 OF 1

TT 122



CRESCENT GROUND 3-D TRACER
3000 SERIES
PATENTED

ITEM	PART NUMBER	DESCRIPTION	QTY
1	3001	BODY, VALVE	1
2	3002-1	SLEEVE, VALVE	3
3	3003	SPOOL, VALVE	2
4	90001	PIN	2
5	90003-2	SCREW, RND HD	2
6	3006	CONNECTING BLOCK	2
7	90204-3	SCREW, SET	2
8	3008	HALFNUT PIN	2
9	3009	YOKE, SPOOL COORDINATOR (UPPER)	1
10	3010	YOKE, SPOOL COORDINATOR (LOWER)	1
11	3011	LEVELLING BAR	2
12	90204-3	SCREW, SET	2
13	3013	BUSHING, YOKE	1
14	3014	SPRING	1
15	3015	FRICTION PIN	1
16	90006-3	SCREW, SET	1
17	3017	HALFNUT PIN	1
18	3018	BALL CAGE, 360 RATE CONTROL	1
19	90002-4	SCREW, SET	1
20	3020	DIAL, 360 RATE CONTROL	1
21	3021	ADJ SCREW, 360 RATE	1
22	3022	ADJ SCREW, OVER RIDE	1
23	3023	SPRING, OVER RIDE	1
24	3024	PIN, OVER RIDE	1
25	90004-12	BALL	1
26	3026	CENTERING RING	1
27	90005-7	PIN, ROLL	2
28	3028	HALFNUT PIN	1
29	90006-4	SCREW, SET	2
30	3030	HOUSING, 360 RATE CONTROL	1
31	3031	PIN, BALL PUSH	1
32	90172-3	SCREW, SET	1
33	3033	PLATE, COVER	1
34	90008-4	SCREW, RND HD	2
35	3035	SPOOL, SPINDLE CARRIER	1
36		PIN	1
37	90008-4	SCREW, RND HD	1
38	3038	DIAL STOP, 3D RATE CONTROL	1
39	90009-8	SCREW	2
40	3040	DIAL, 3D RATE CONTROL	1
41	90204-3	SCREW, SET	1
42	3042	ADJ SCREW, 3D RATE CONTOL	1
43	3043	BODY, 3D RATE CONTROL	1
44	3044	FRICTION PIN	1
45	3045	SPRING	1
46	3046	TRANSLATOR SLEEVE, 3D	1
47	3047	PIVOT BEARING	1
48	3048	WASHER, SPRING RETAINER	1
49		SCREW, SET	1
50	3050	LOCKING PLUG	1
51	3051A OR B	SPRING, STYLUS CNTRBALANCE	1
52	3052	ADJ. SCREW, COUNTERBALANCE	1
53	3053	CONTROL ARM, BIAS CONTROL	1
54	90009-12	SCREW	1
55	3055	TRIGGER SLEEVE, BIAS CONT	1
56	6099	BODY, BIAS CONTROL	1
57	90140-6	SCREW	2
58	3058	SPINDLE	1
59	90204-3	SCREW, SET	1
60		STYLUS (NOT FURNISHED)	1
61	90203	SPRING PLUNGER	2
62	90021-16	SCREW, LOCK	1
63	3063	RNG, BIAS CONT	1
64	3064	ADJ. SCREW, PIVOT BRG	1
65	90004-8	BALL, TRANSLATOR	1
66	90002-8	SET SCREW	1
67	90185-4	FITTING	1
68	90022	KNOB	1
69	3069	LOCKWASHER	1
70	3068	LOCKNUT	1
71	90013-5	LOCKNUT, 3D	1
72	3076	PLATE, COVER, 3D	1
73	90014-6	SCREW, RND HD	2
74	90015	GASKET, TEFLON	1
75	3079	SPOOL, 3D	1
76	3080	SPRING, 3D SPOOL	1
77	90016-6	BUTTON	1
78	3082	PIN, ANTI-STICK	1
79	90018-6	SCREW, FL HD	4
80	3084	PLATE, COVER	2
81	3085	GASKET	2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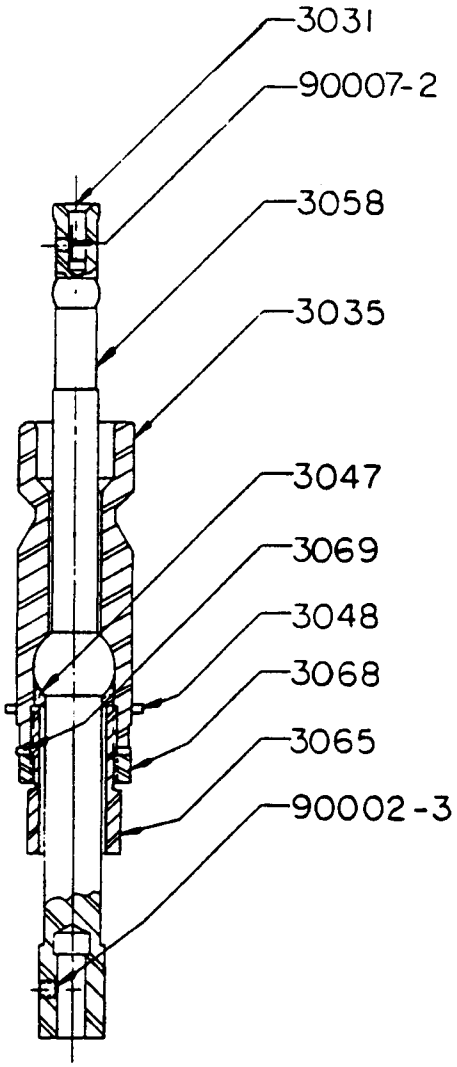
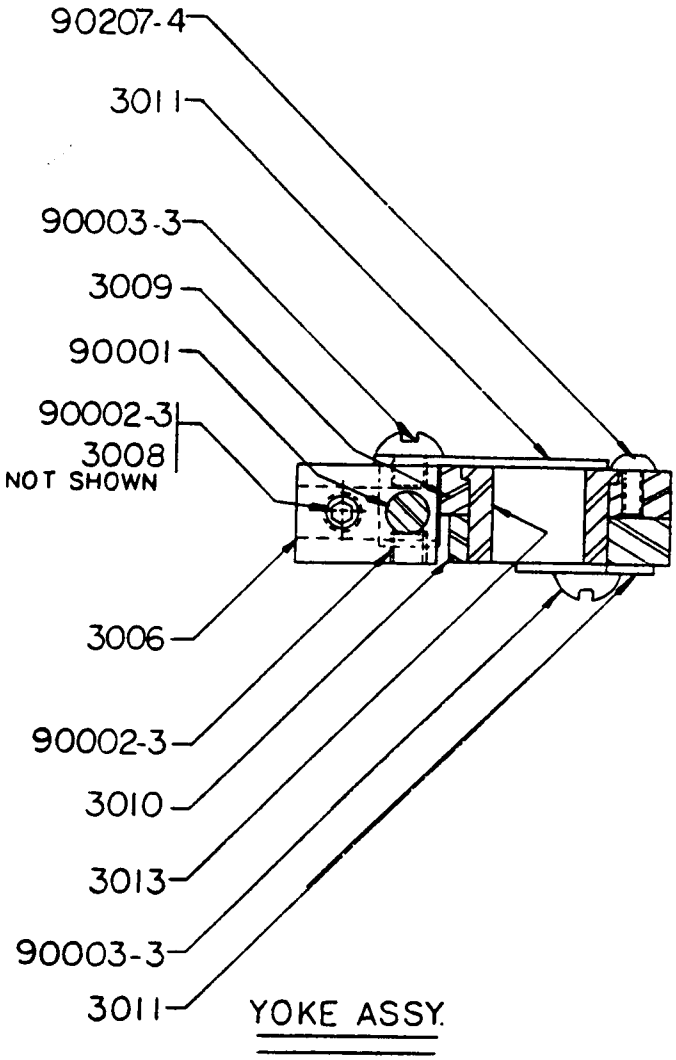
SPINDLE ASSY



SPINDLE ASSY.



YOKE ASSY.