"D2008 VALVE ON VTL"

LIST OF CONTENTS

OPERATING AND MAINTENANCE INSTRUCTIONS

MIMIK DYNATRACE 360° Tracing System

SECTION I

GENERAL DESCRIPTION OF TRACING SYSTEM:

The MIMIK Dynatrace 360° Tracing System is designed for tracing two-dimensional contours under full control of the tracer valve. When the tracing stylus is guided onto a template the tracer valve will automatically supply oil to two hydraulic drives in accordance with the template contour. These drives control rotation of the horizontal (saddle) and vertical (ram) feed screws so that the cutting tool follows a path identical to the template contour.

The tracer valve is mounted in a fixed position on the cross-rail, and adjustment is provided to facilitate job setups of varying size and shape.

The template is mounted to the vertical ram, and hence moves in unison with the cutting tool. While this requires that the template be reversed relative to the workpiece, the template itself is a true 1:1 duplication of the desired workpiece contour.

Fig. 1 is a schematic drawing of the hydraulic system. Its main components and their functions are described below:

Hydraulic Supply Unit (See figs. 2 & 3)

This consists of an oil reservoir, oil filters, and two hydraulic pumps (one supplies the two hydraulic drives and the other supplies the steering control in the tracer valve). Mounted on the supply unit are an electrical control panel and a vacuum pump to handle drain oil from the tracer valve.

Refer to Section VI for oil and filter specifications

Tracer Valve

The tracer valve controls the amount and direction of oil flow to the hydraulic drives on the x and y axes. This is accomplished by deflection of the stylus, which is guided around the template by the steering control mechanism in the tracer valve.

Fig. 4 shows the location of the various controls on the tracer valve. These controls function as follows:-

a) Feed Rate Control
Allows operator to set desired feed rate for tracing. This is then maintained automatically over any contour, but may be varied manually during the cut, if desired. Note that this control only affects feed rate while tracing, not while steering manually.

The numbered scale above the control knob is not graduated in distance/time values. It merely assists in returning the setting to a previous value.

b) Feed Direction Selector
Axial movement of this control selects feed direction for tracing either clockwise or counter-clockwise around a contour.

c) Automatic Steering Selector
Allows selection of automatic or manual steering by engaging or disengaging the steering control mechanism. Manual steering is effected by grasping the stylus and deflecting it in the direction of desired feed movement.

The tracer can be manually steered whether the steering selector is set to Manual or Automatic. Manual selection is recommended, however, as stylus deflection force is much lighter and the normal oscillating motion of the stylus is absent.

When steering manually, rate of feed is controllable only by the amount of stylus deflection.

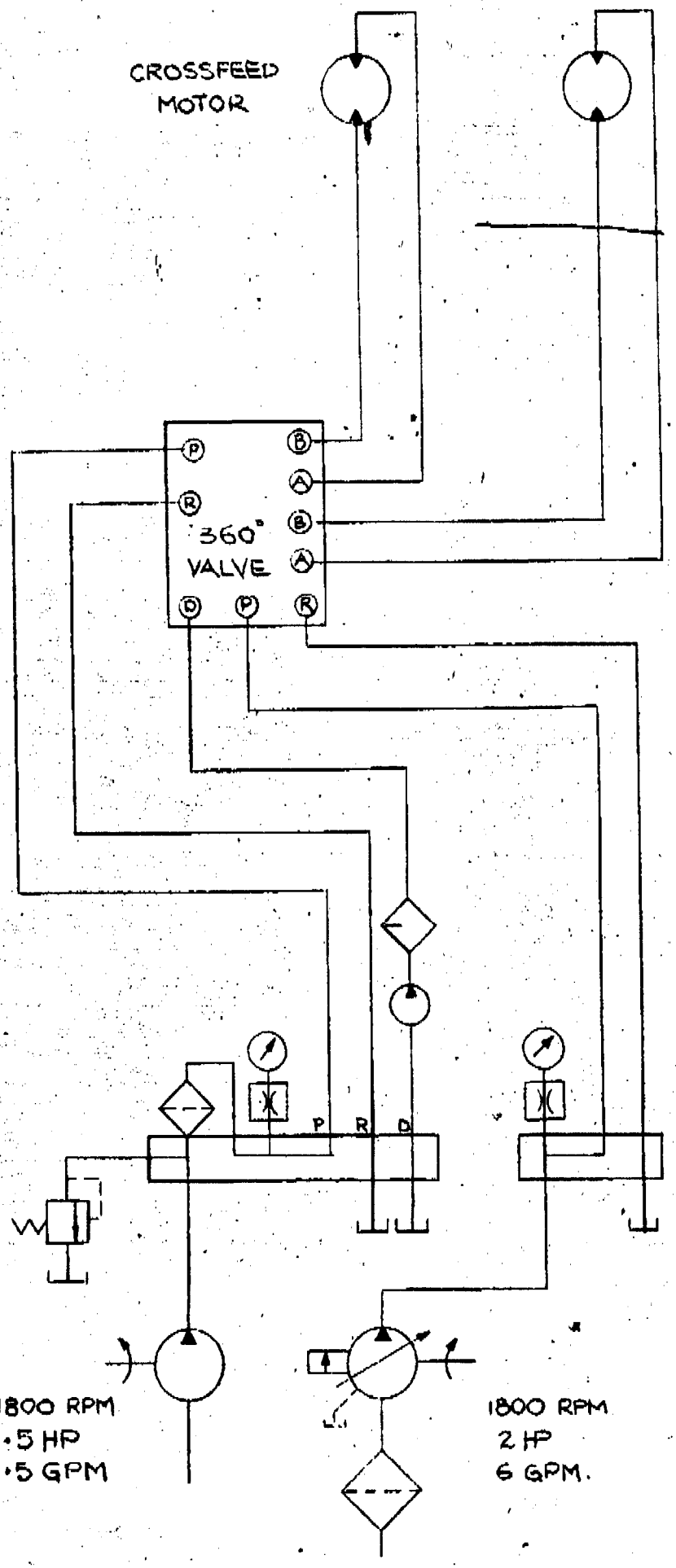
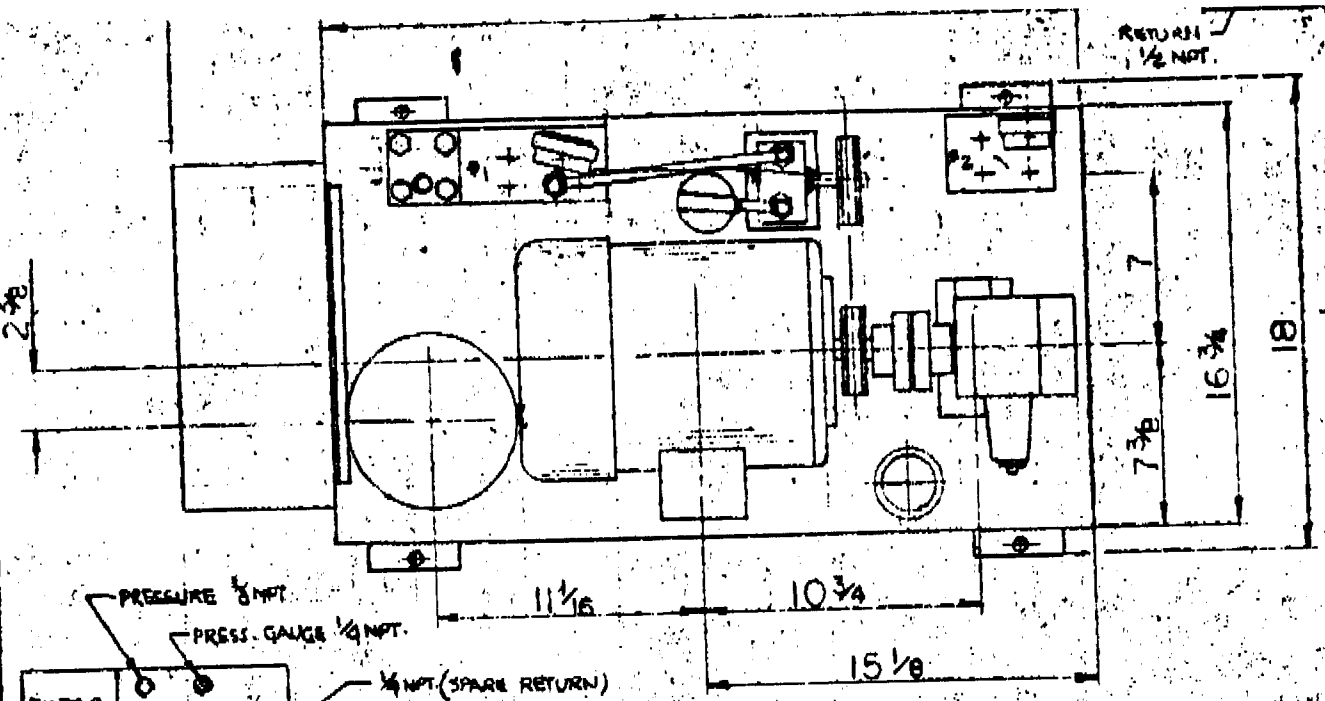
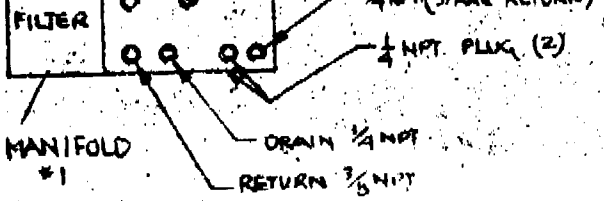
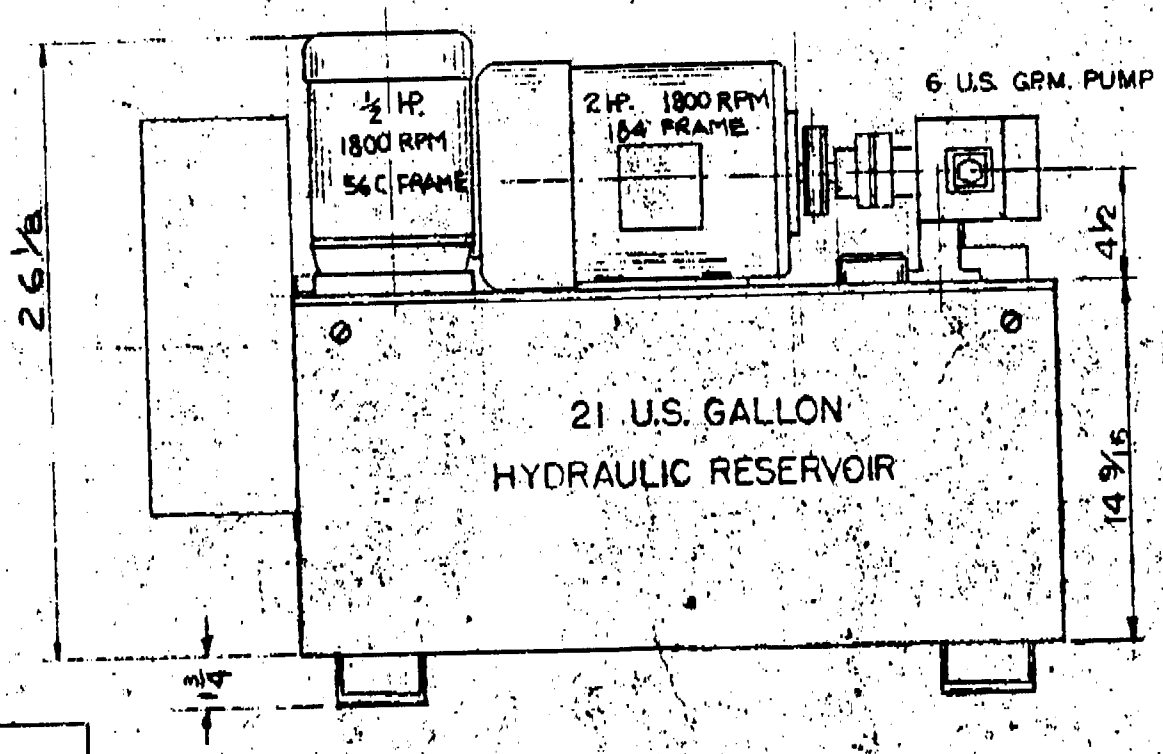

CROSSFEED MOTOR
LONGITUDINAL FEED MOTOR
P
R
B
A
B
A
360° VALVE
D
P
R
P
R
D
1800 RPM
·5 HP
1·5 GPM
1800 RPM
2 HP
6 GPM.

FIG. 1







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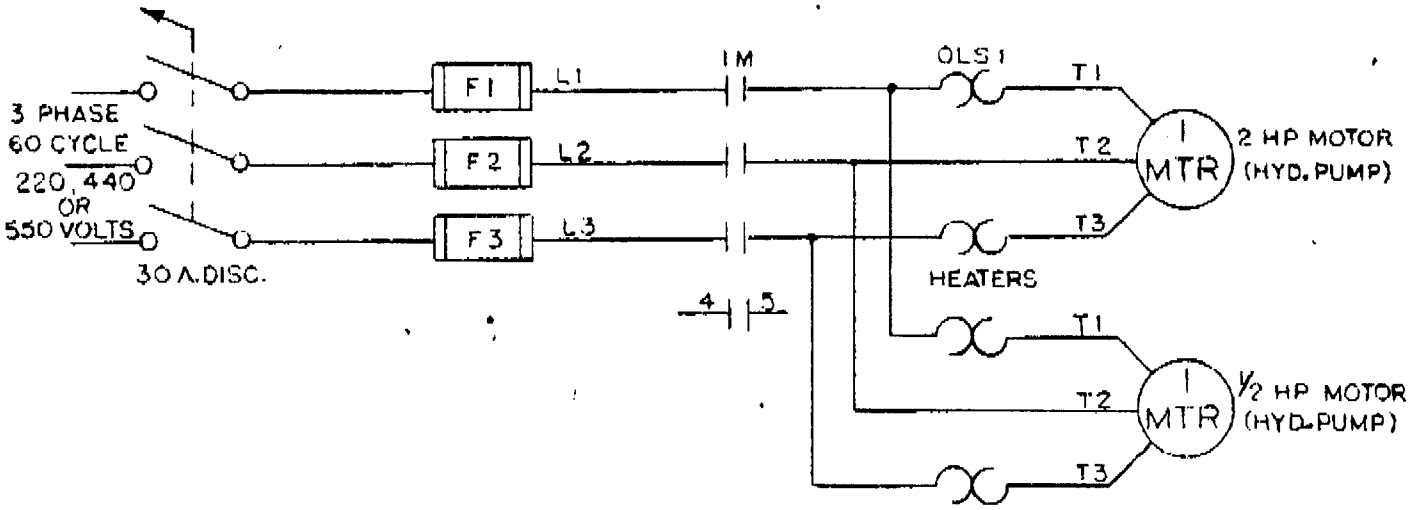

3 PHASE
60 CYCLE
220, 440
OR
550 VOLTS
30 A. DISC.
F1
F2
F3
L1
L2
L3
1M
OLS 1
T1
T2
T3
1 MTR
2 HP MOTOR
(HYD. PUMP)
HEATERS
4
5
T1
T2
T3
1 MTR
½ HP MOTOR
(HYD. PUMP)

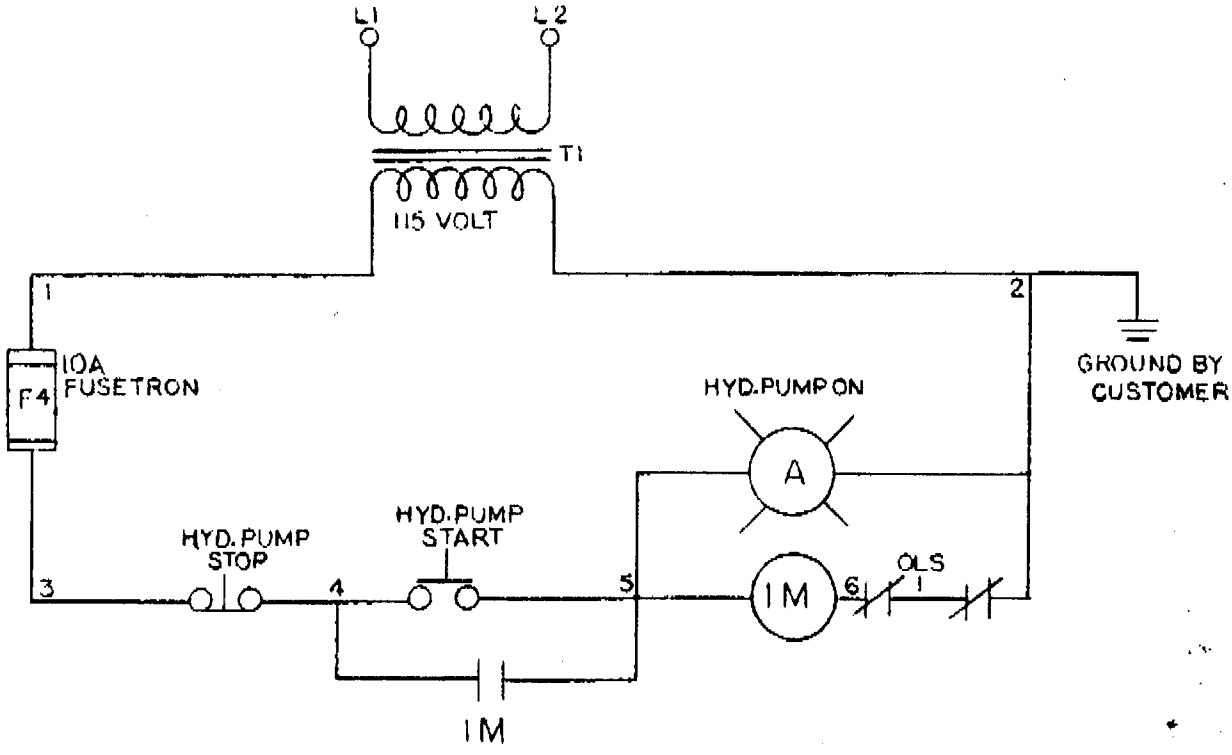
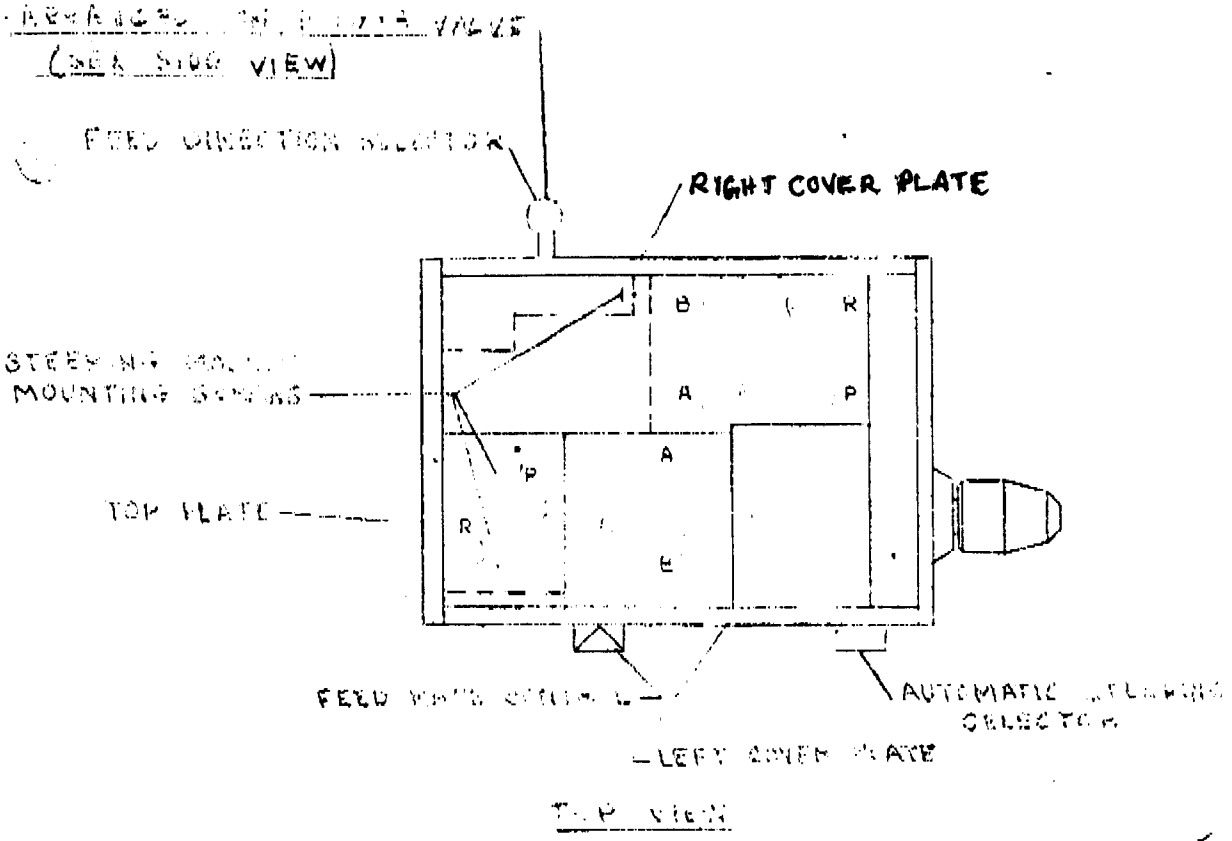
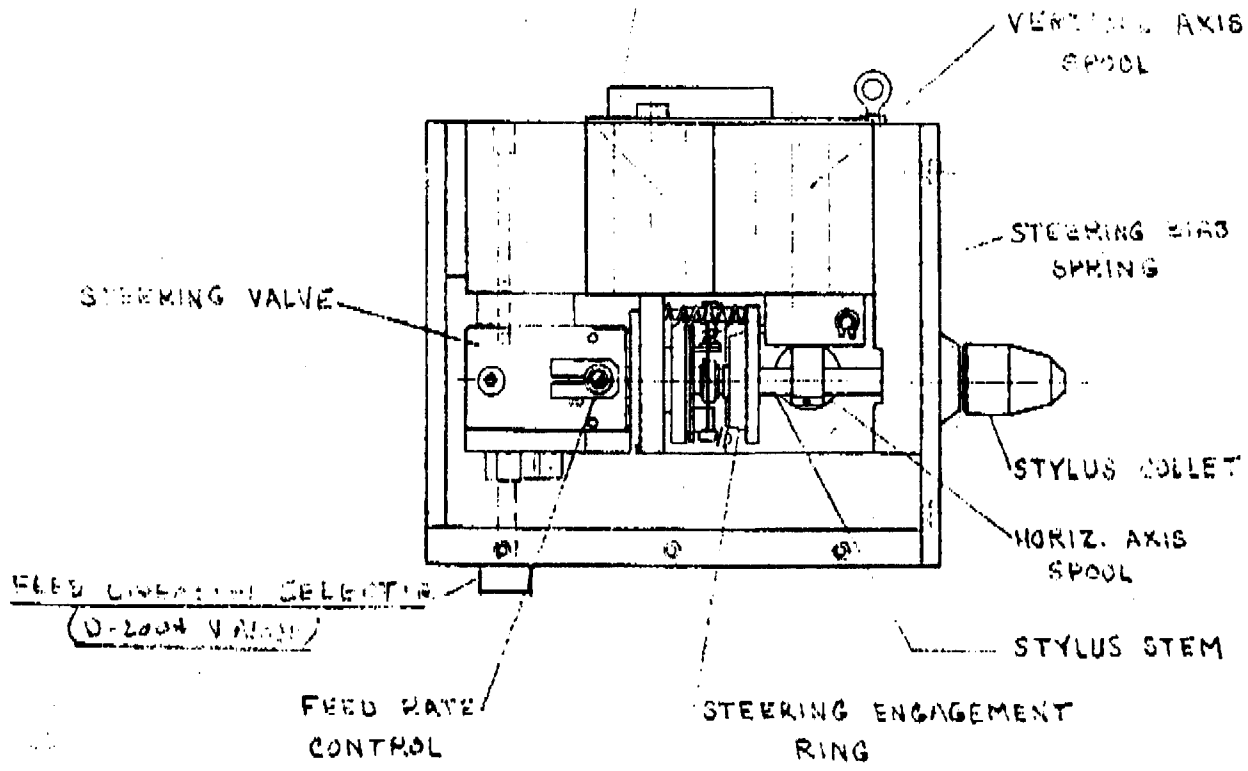

L1
L2
T1
115 VOLT
1
2
F4
10A
FUSETRON
GROUND BY
CUSTOMER
HYD. PUMP ON
A
HYD. PUMP
STOP
HYD. PUMP
START
3
4
5
1M
6
OLS
1
1M

FIG. 3



TOP VIEW



D-202A AUTOMATIC TRACER VALVE (HORIZONTAL MOUNTING)

FIG 4

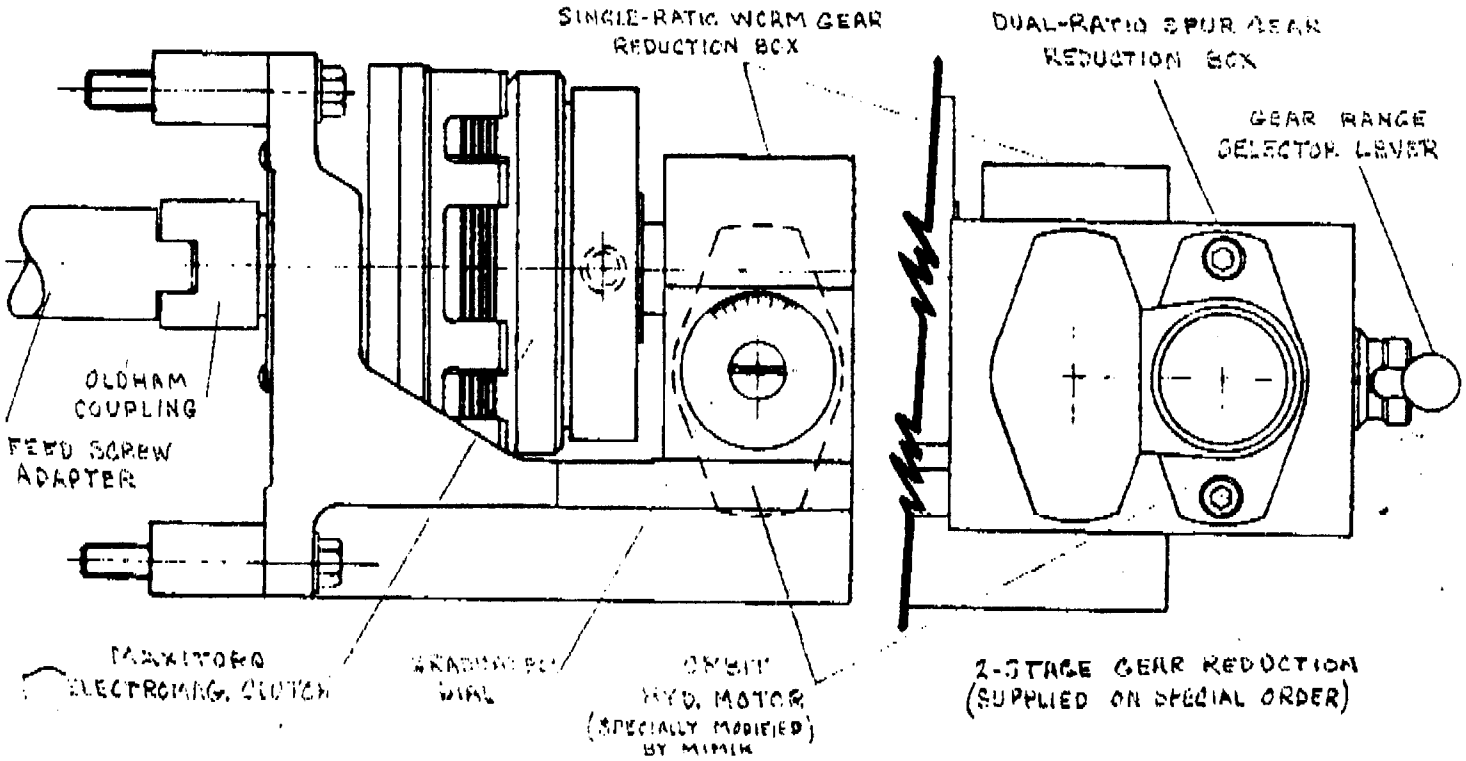
Hydraulic Motor Drives

Each drive assembly, as shown in Fig. 5, consists of a hydraulic motor controlled directly by the tracer valve, a worm gear reduction box, and an electric clutch to allow disengagement from the machine's feed screws. The clutch output shaft is connected to the feed screw by an Oldham coupling, which ensures positive drive without backlash, and compensates for slight misalignment.

Rotation of the hydraulic motor in either direction is transferred through the worm gear box and thence through the electric clutch to the feed screw. The final drive of the worm gear box is equipped with a graduated dial to indicate rotation.

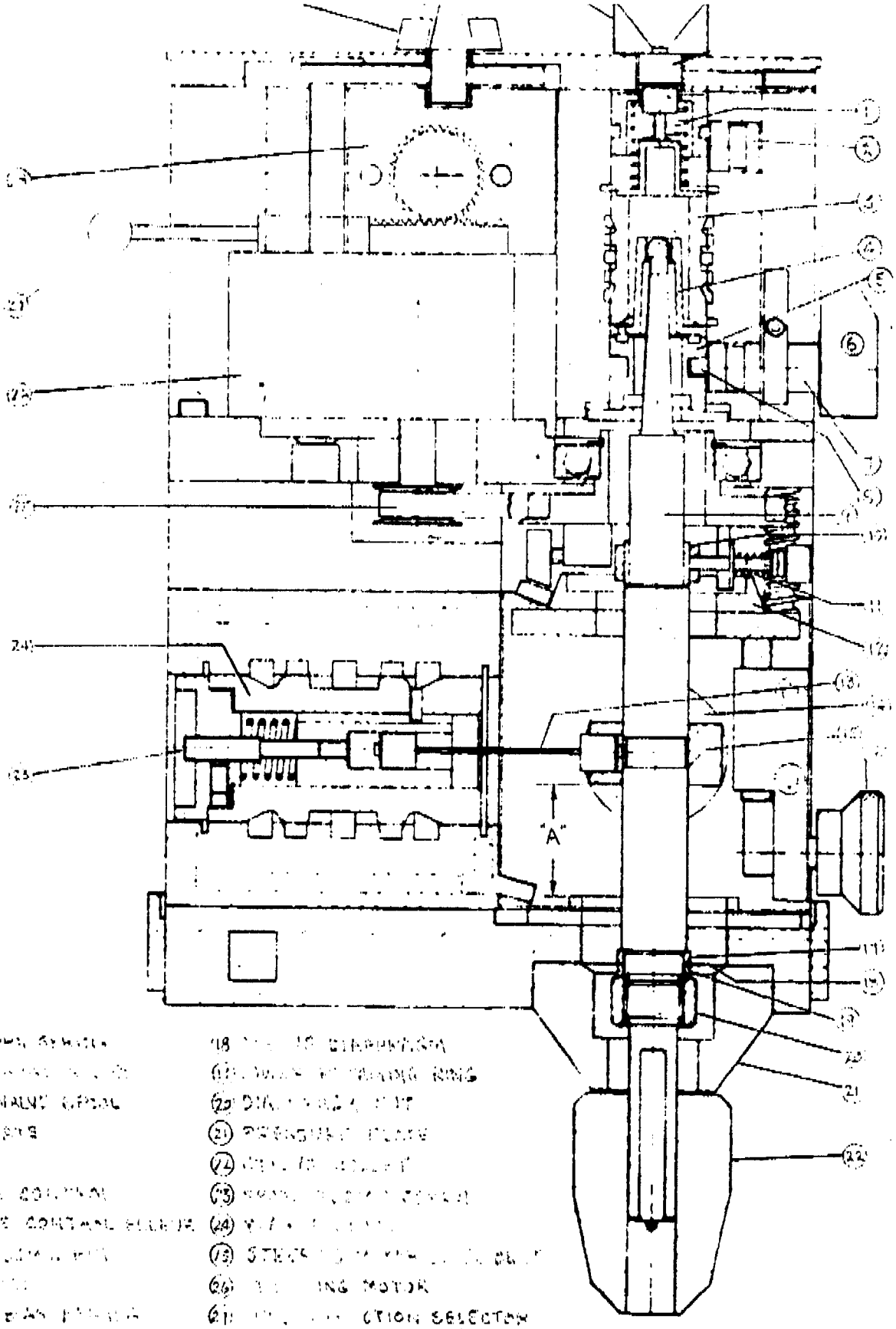
The electric clutch is controllable through a pendant-mounted push-button switch, and is interconnected to the machine's rapid traverse control so that engagement of rapid traverse automatically disengages the clutch.

NOTE: A 2-speed spur gear box can be added as illustrated below to increase feed rate range where necessary on large machines or for materials having high or low machineability ratings.



GEAR-REDUCED HYDRAULIC MOTOR DRIVE ASSEMBLY

FIG. 5

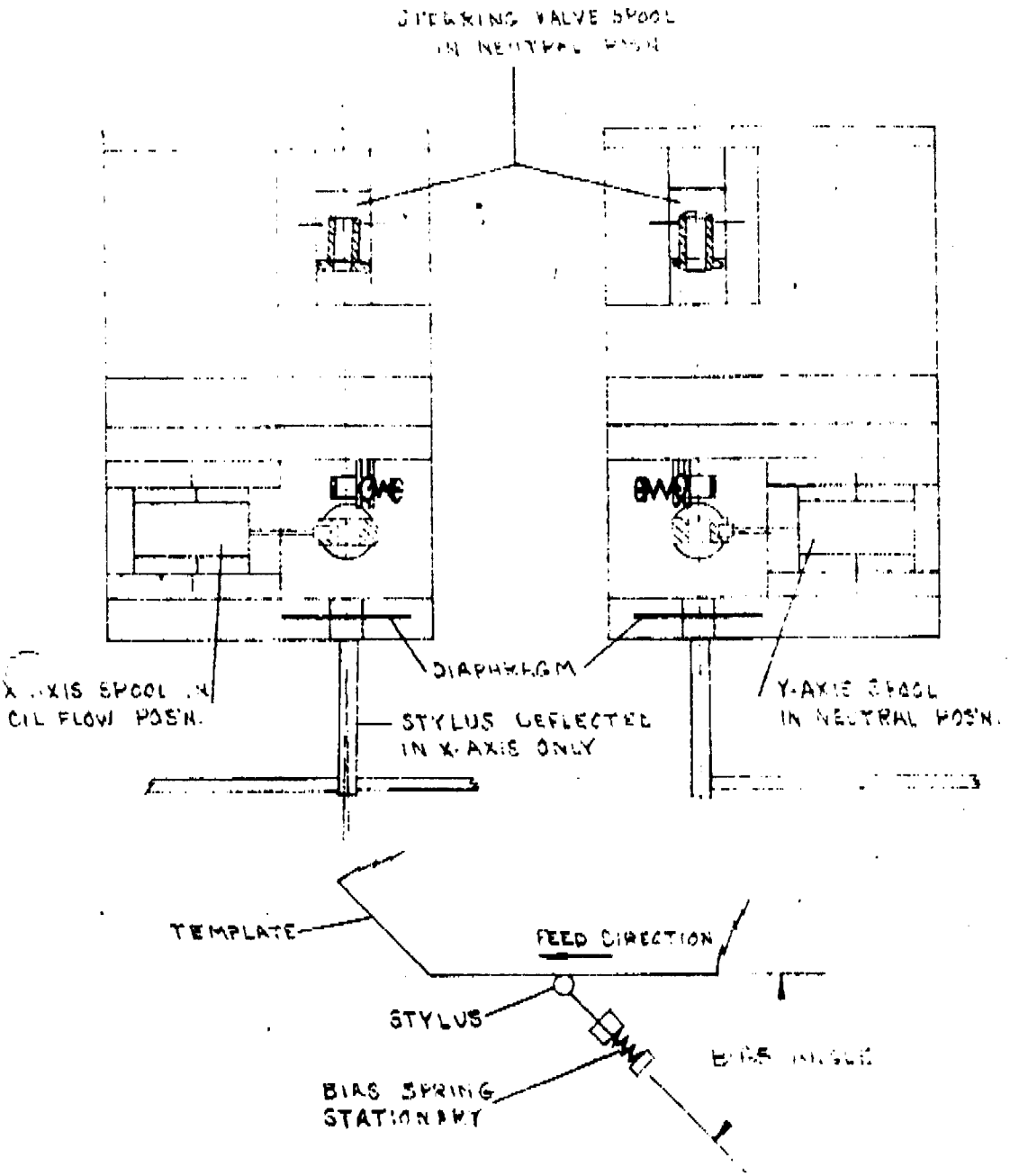


(1) [illegible]
(2) [illegible]
(3) STEERING VALVE SPOOL
(4) [illegible]
(5) RETAINER
(6) FEED RATE CONTROL
(7) FEED RATE CONTROL ADJUSTING
(8) [illegible]
(9) [illegible]
(10) [illegible]
(11) STEERING DIRS [illegible]
(12) STEERING ORIENTATION [illegible]
(13) [illegible]
(14) [illegible]
(15) [illegible]
(16) [illegible]
(17) UPPER [illegible]
(18) [illegible]
(19) [illegible]
(20) [illegible]
(21) [illegible]
(22) [illegible]
(23) [illegible]
(24) [illegible]
(25) [illegible]
(26) [illegible]
(27) [illegible]
(28) [illegible]
(29) [illegible]
(30) [illegible]

*D-2008 = VALVE ONLY

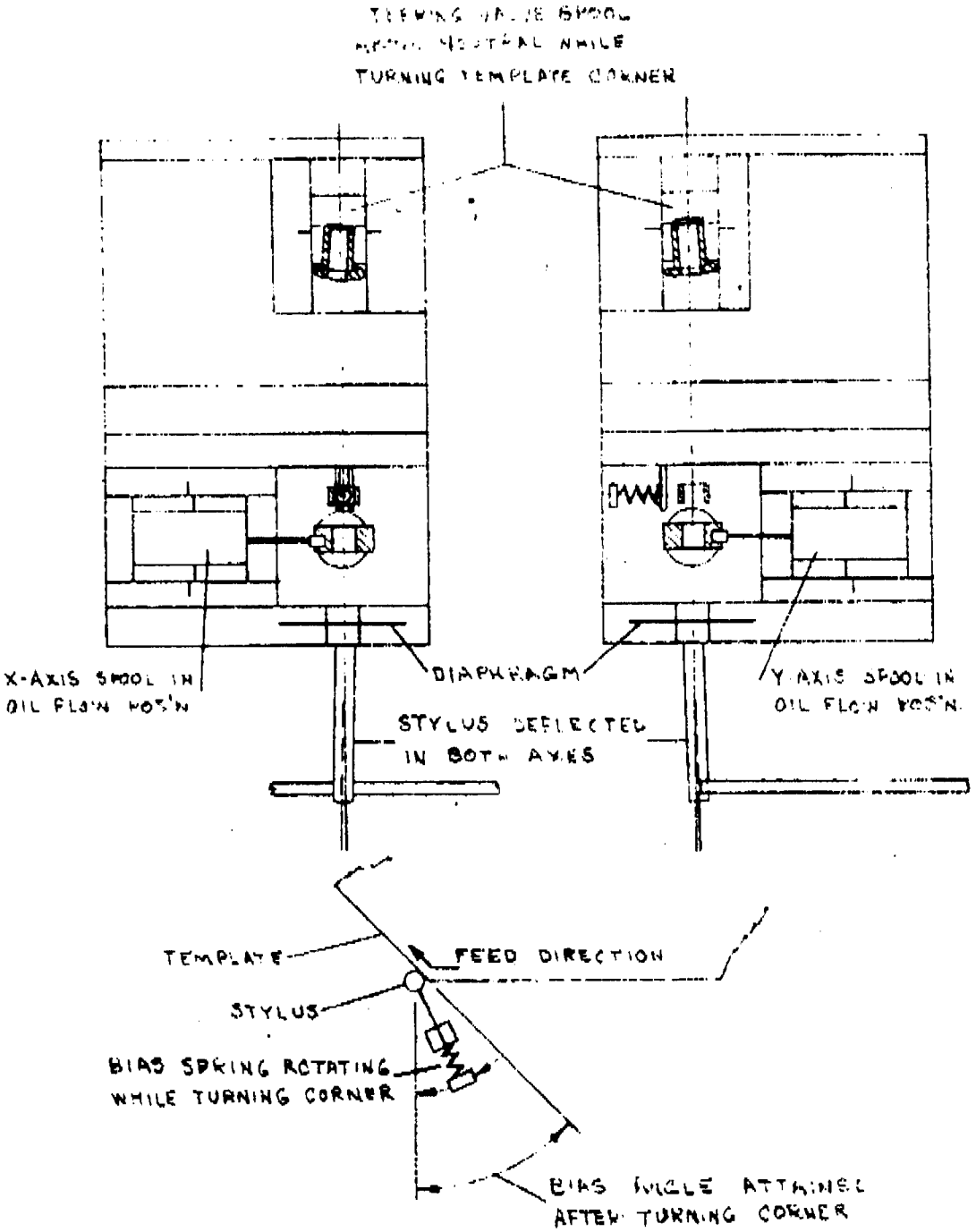
D-2008 AUTOMATIC 360°
TRACER VALVE
(VERTICAL MOUNTING)

FIG. 6



AUTOMATIC STEERING - TEMPLATE PARALLEL TO ONE MACHINE AXIS

FIG. 1



AUTOMATIC STEERING - TEMPLATE AT ANGLE TO MACHINE AXES

FIG. 7A

SECTION II

Tracer Valve Operating Theory

Note: Explanatory drawings (Figs. 6, 7 and 7A) show a vertically mounted D-2008 valve. The horizontally mounted D-2024 valve operates in the same manner, with the vertical axis spool being equivalent to the y axis spool noted on these drawings.

The MIMIK Automatic 360° tracer valve consists basically of the two 4-way hydraulic servo valves arranged at 90° to one another, each controlling the rate and direction of oil flow to one of the machine's two hydraulic drives. Actuation of the spools in these two valves results from deflection of the stylus which is held in a steel diaphragm to allow universal pivotting.

In this respect the valve is similar to a manually operated pencil-trace valve, where the operator pushes the stylus in whatever direction he wishes the stylus and cutter to move relative to template and workpiece.

In the Automatic 360° valve, however, the operator is replaced by a third servo valve which controls rate and direction of oil flow to a hydraulic steering motor. Changes in the template contour are sensed by the stylus, and cause the steering motor to move a bias spring around the stylus stem. This bias, or push, applied to the stylus is equivalent to an operator's manual push, but is much more uniform and is completely automatic.

Figs. 7 and 7A further illustrate the action of the system at a change in contour on the template.

(12)

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In Fig. 7 the stylus is against a template edge parallel to the x machine axis. The bias angle is proportional to the rate of feed, and has been established by the feed rate control setting. The steering spool is in neutral, so no oil is being ported to the steering motor, and the bias spring is therefore stationary. The spring is exerting a pull on the stylus which deflects it in the x axis only, deflection in the y axis being prevented by the template. This x-axis deflection positions the x spool to produce machine movement parallel to the template edge.

On reaching the outside corner shown in Fig. 7A, the bias spring deflects the stylus in the y, as well as the x, axis, producing a corresponding movement along both machine axes. The slight change in deflection resulting from the contour change moves the steering spool upward. Oil is thus ported to the steering motor and the bias spring rotates about the stylus until reaching the pre-set bias angle. Reduced stylus deflection due to resistance of the template edge then returns the steering spool to neutral.

On reaching an inside corner (not illustrated) stylus deflection is decreased by the newly-presented template edge. The steering spool is moved downward, and the bias spring thus rotates in the opposite direction until reaching the pre-set bias angle. X and y spools are simultaneously positioned to produce machine movement parallel to the template edge.

On curved template contours, the above actions are continuous, the steering valve always seeking to maintain a constant bias angle and thus a constant feed rate.

When the stylus is not against a template edge, it maintains a slightly deflected position which lowers the steering spool below neutral and produces a continuous rotation of the bias spring. X and y spools are thus being continuously repositioned, and the machine members oscillate in a circular pattern. A gradual creep in one direction will occur if the x and y spools are not balanced to suit the machine. (See Section V - 2).

SECTION III

HOW TO OPERATE THE TRACER SYSTEM

Operation of the MIMIK Automatic 360° tracer system is extremely simple and requires a minimum of operator training.

This section outlines the procedure necessary to start up the unit, adjust the feed rate, etc.

The procedure for setting up the unit to cut parts is outlined in Section IV.

1. Before starting the pumps, check the oil level gage on the oil reservoir to make sure the oil level is approximately half way up the glass.

2. Check the oiler bottle for the vacuum pump to make sure it contains approximately 1" of oil.

3. To start the pumps, turn the disconnect switch on the electrical control cabinet to 'ON' then press the start button. Check pressure gages and set pumps to give dead-head (no flow) readings as follows:

   Steering circuit - 200 psi (feed along straight portion of template)

   Feed circuit - 250 psi (Select manual steering and hold in fixed position on template).

   Check vacuum pump oiler bottle for adequate oil level with some froth on top. This indicates that vacuum pump is receiving lubrication.

4. Clear the system of any accumulated air by running the ram and saddle back and forth a few times. To do this, turn the automatic steering selector to 'Manual', switch on one axis feed clutch, and deflect the stylus manually. Repeat on the other axis. (Note that electrical panel contains individual switches for each clutch, while remote switch controls both clutches). It is not necessary to run either member to the full end of its stroke.

5. The template may be rough-positioned by means of the machine's rapid traverse controls, which should be interconnected to automatically disengage the tracer drive clutches when engaged. Care must be taken to avoid running the template against the tracing stylus when in rapid traverse.

6. There are two ways to start the stylus feeding automatically along the template. In both cases the feed direction selector knob should first be set to the desired direction, feed rate should be set at mid-range, and the automatic steering selector should be set to 'Automatic'.

   a) With both drive clutches engaged, steer the stylus manually onto the template in the desired direction of feed. This will establish the steering bias spring at approximately the correct angle, so that when the stylus is released, automatic feed will continue.

   b) With both drive clutches disengaged, move the machine ram or saddle manually to advance template toward stylus. The stylus will be oscillating while the template is approaching it. Carefully bring the template against the stylus until stylus oscillation ceases. Do not advance template past this point. Engage drive clutch controlling same axis as template has been moved in to check that template stays against stylus. (If stylus begins to oscillate, repeat previous step.) When both clutches are engaged, stylus should feed along template automatically.

7. Feed direction can be reversed while feeding along the template, but the stylus should be steered manually during the direction change to ensure that it does not oscillate off the template.

8. Set the feed rate to the desired value by turning the feed rate control knob. It may also be necessary or desirable to shift the spur gear boxes into either the high or low ratio, depending upon the feed rate desired.

When taking heavy cuts at low feed rates, the gear boxes should be shifted to the low speed position, and the feed rate adjusted to suit, rather than using the high speed ratio and trimming down the feed rate, as this provides more power for cutting.

9. To stop the tracer at any desired point on the template, disengage one or both clutches, or turn the automatic feed selector to 'Manual'. (The stylus may then require manual assistance to start following the template when re-set to 'Automatic'.)

10. There are two methods of removing the stylus from the template:

    a) Steer the stylus manually until clear of the template. Oscillation can be stopped by disengaging both clutches or by setting the automatic steering selector to 'Manual'.

    b) Engage rapid traverse on machine, taking care that template does not strike stylus and tool does not strike workpiece.

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SECTION IV

HOW TO SET UP FOR CUTTING

1. Start hydraulic system and leave running during setup to bring oil to proper temperature. Disengage tracer drive clutches and set automatic feed selector to 'Manual'.

2. Insert a stylus of proper diameter and shape in the stylus collet of the tracer valve.

   Where the workpiece contour allows a conventional single-point tool, the stylus contact edge should have the same included angle and nose radius as the tool. Depth of cut adjustments are then taken by adjusting the valve position in either or both axes.

   Where the contour involves opposing slopes, either a button or a fishtail-type tool must be used, and the stylus must be either round or fishtail in section. In either case the finish-cut stylus should have the same radius as the tool tip.

   Since a valve position adjustment would increase depth of cut on one workpiece slope and decrease it on an opposing slope, cut adjustments must be taken by changing the radius of the stylus. Identical tool and stylus radii are used for the finish cut, while for rough cuts the stylus radius is increased by the amount of workpiece stock to be left on.

   Two types of round stylus are shown in figures 8 and 9. A stepped stylus with several diameters is also convenient for roughing, or interchangeable sleeves can be used when the stylus section is not circular. The breakable type stylus will prevent damage if the template is accidentally run into the stylus under rapid traverse.

3. Select proper cutting tool and clamp in toolholder. (Note that tool and stylus contact edges are 180° apart).

4. Using manual machine controls, advance the cutting tool within 1/8" of a reference point on the workpiece.

(18)

5. Install template so it bears approximately the same relation to the stylus as the workpiece does to the tool.

   Note: The tracer valve is mounted stationary and the template moves with the machine ram. With this arrangement the templates are made as for any conventional tracing system. However, before installing the template it must be turned end for end and top for bottom relative to the workpiece.

6. Check and adjust template for parallelism as follows:

   a) Manually move ram up and/or saddle sideways to clear stylus and tool.

   b) Mount dial indicator on tracer valve or convenient fixed surface and set pointer against straight section of template.

   c) Feed ram (or saddle) manually and check for parallelism.

   d) Pivot template to proper alignment, lock in position, and recheck with indicator.

   Return ram and/or saddle to original position so tool is 1/8" from workpiece. Adjust valve if necessary to maintain same relationship.

7. Pick up reference points on face and diameter of workpiece as follows:

   a) Reference point on face:

   - Adjust valve upward until stylus almost touches horizontal edge of template.

   - Engage vertical drive clutch and steer stylus manually onto template or move template against stylus with machine handwheel. (See para. 6(b) of Section III).

   - Adjust valve downward. Template and tool will feed downward since vertical tracer feed is engaged. Continue until tool is .005" from reference face of workpiece.

- Use manual machine feed to position tool to approximate horizontal location for next reference point.

b) Reference point on diameter:

- Disengage vertical drive clutch and adjust valve horizontally until stylus almost touches vertical edge of template.

- Bring template against stylus as in (a) above.

- Adjust valve horizontally until tool is .005" from reference diameter of workpiece.

- Position template so stylus is near starting point, using either machine feed or manual valve steering.

- Tool and stylus are now in proper relationship and ready for cutting.

8. Adjust valve position or stylus diameter for desired depth of cut.

9. Start machine spindle, set feed direction selector on valve to desired position, engage drive clutches, and manually steer stylus onto run-on portion of template with auto steering selector set to 'Automatic'.

10. At end of cut ram and saddle can be repositioned for next cut by using machine's rapid traverse controls, by manually steering the stylus, or by feeding under tracer control along an enclosed template, with tracer feed rate advanced during the non-cutting portion.

11. All finish cuts should be taken in the same direction, although rough cuts may be taken in alternate directions if tool geometry permits.

12. Between cuts the valve position or stylus diameter must be adjusted for depth of cut, and returned to original setting for the next workpiece.

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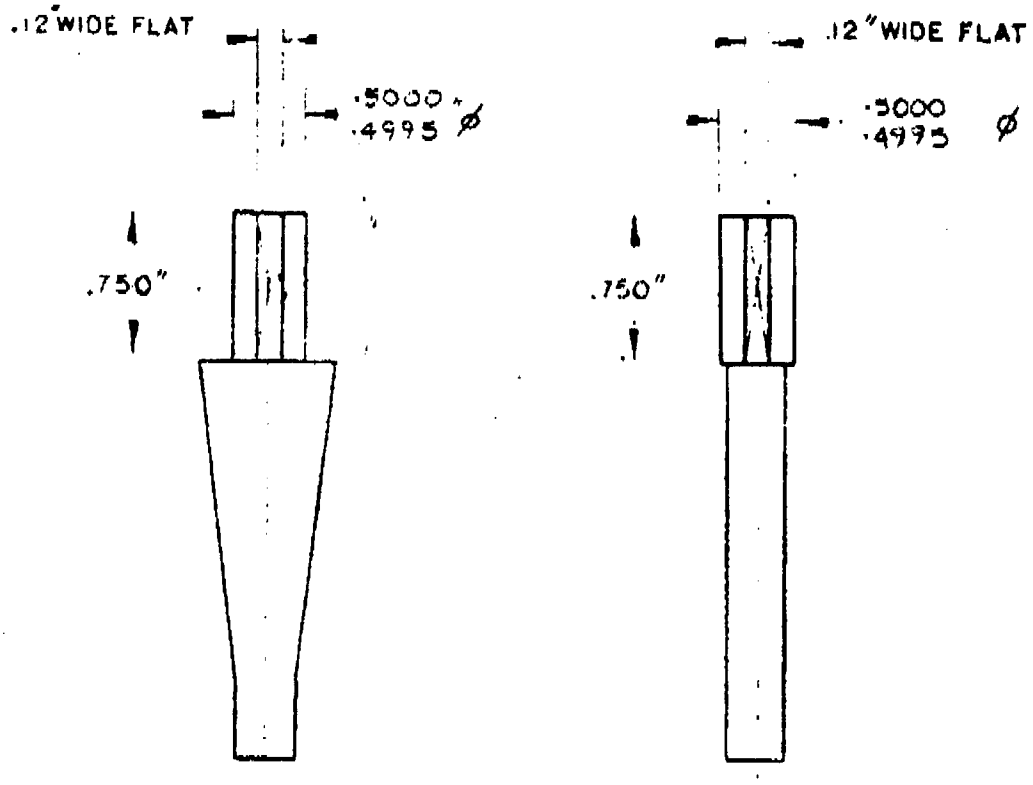
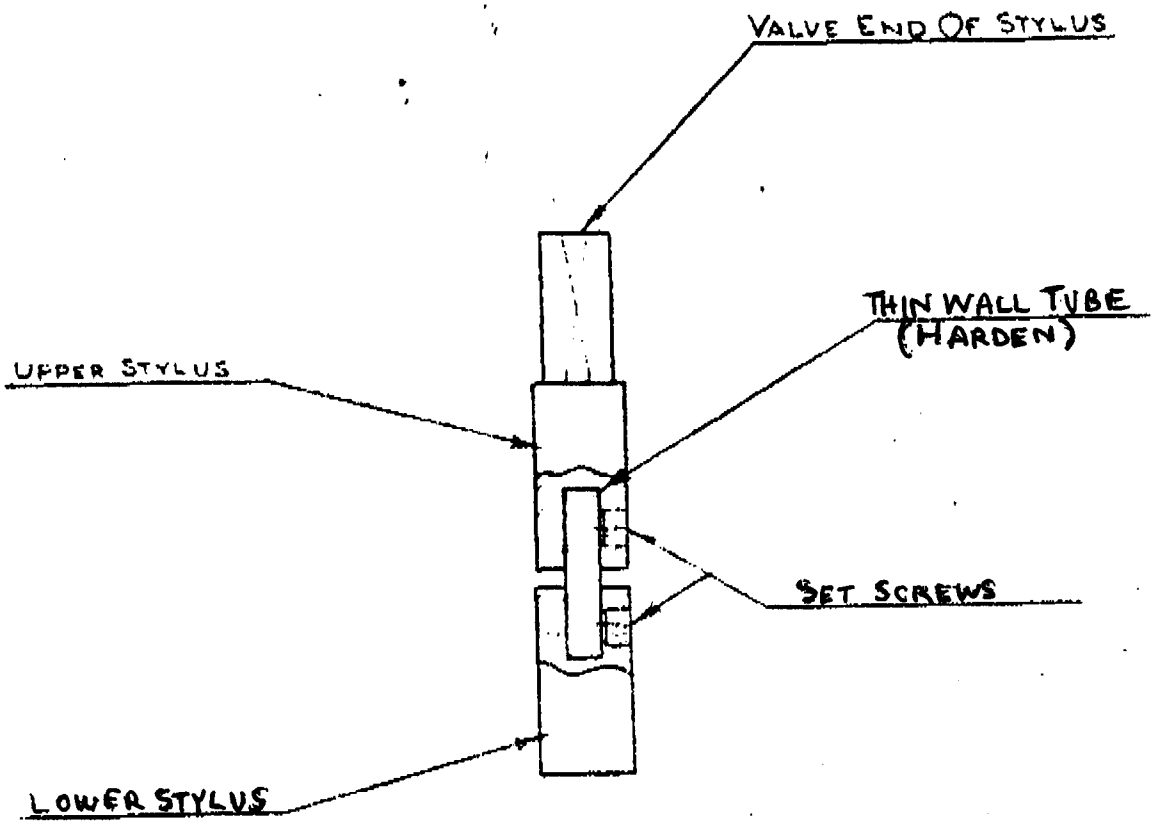


ROUGHING STYLUS

FINISHING STYLUS

END OF STYLUS PROTRUDING FROM VALVE COLLET MUST DUPLICATE CUTTER SHAPE.
ROUGHING STYLUS TO BE LARGER IN DIAMETER THAN CUTTER (REFER TO INSTRUCTION)
NORMAL STYLUS-CUTTER RELATIONSHIP FOR FINISH CUTS IS 1 TO 1.
FOR EXTREME ACCURACY STYLUS MUST BE ESTABLISHED BY TRIAL.

FIG. 8



NOTE

TUBE IS HARDENED TO PERMIT BREAKING BUT NO BENDING

FIG. 9

SECTION V

TRACER VALVE SERVICE PROCEDURES

The following instructions cover service procedures which can be done without factory training. Removal of valve spools or servicing of valve components not covered below should only be done by factory-trained personnel. (Factory training for customer personnel is available on request.)

1. Removal of side cover plates (Refer to Fig. 4)

   Required for stylus diaphragm change, steering motor drive belt change, and for complete axis spool balancing procedure.

   a) Remove feed control knob or remote control mechanism (Do not attempt to remove feed control itself).

   b) Remove automatic steering selector knob.

   c) Remove feed direction selector knob and shaft.

   d) Remove mounting screws at front, sides, and rear of valve, and remove side covers.

2. Balancing of Axis Spools (Refer to Fig. 6)

   The complete procedure is always followed on initial installation, but is not normally required thereafter. It involves first adjusting the steering valve spool to ensure proper neutralization and full-range feed rate control, followed by the actual balancing of the axis spools to

   Due to normal variations in both machine tool and tracer system, the axis spools may require occasional balancing. This is particularly true where very slow feeds are required. The complete

procedure should only be used when valve covers have been removed for other servicing or when the steering valve is obviously out of adjustment.

a) Partial Procedure (Axis spools only)

- Turn hydraulic supply on, disengage drive clutches, and set automatic steering selector to 'Manual'.

- Use allen key to rotate steering valve stylus pressure adjustment (located 2.25" to rear of and in line with feed rate control.) Set to maximum by rotating until indent on end of adjustment shaft is at 12 o'clock. (All "clock" settings apply to normal horizontal valve mounting).

- Check graduated dials on drive unit gear boxes for rotation. If both dials are stationary, axis spools are balanced. If either or both dials are rotating, spools are out of balance.

- To re-balance, insert allen key into the spool adjusting screw of one axis spool (horizontal spool is accessible through access hole in side cover). Turn screw until gearbox dial rotation stops.

- Repeat on other axis spool, then repeat again on first spool.

- Re-set stylus pressure adjustment to 5 o'clock. This setting is 30° above minimum, and should provide enough spring force to prevent spool hang-up without upsetting the force balance between bias spring and spool return spring. (Bias spring tension has been factory set and should not be changed).

- If extremely close balance is required, set up a square template, adjust feed rate control to a low setting, and time movement along template under

automatic feed in both directions along each axis. Adjust axis spools as above, but with stylus pressure at normal 5 o'clock setting, to establish equal feed rates.

b) Complete Procedure

- Remove left side cover plate.

- Turn hydraulic supply on, disengage drive clutches, and set automatic steering selector to 'Manual'.

- Set stylus pressure to maximum (See para. 2 of a) above).

- The bias spring should be rotating about the stylus stem. If it is not, the feed direction selector is in a neutral position midway between extreme positions - pull fully out or push fully in. Note direction of bias spring rotation.

- Deflect stylus by hand. Bias spring should immediately reverse rotation. If it does not, release stylus and adjust the steering spool as follows: (If rotation does reverse, check and adjust for correct rotational speed as noted below).

  Insert slot-head screwdriver into end of feed rate control sleeve to engage tapered adjustment pin. Turn counter-clockwise until bias spring rotation stops and begins to rotate in opposite direction. Set rotational speed at 1 to 4 rpm.

  Steering spool should now be in correct adjustment, and bias spring should reverse rotation when stylus is deflected. ' Failure to reverse indicates feed rate control sleeve is radially out of position. To correct, rotate feed rate control sleeve by means of split clamp lever until control knob locking screw

indent near end of sleeve is just past 3 o'clock position. Without moving sleeve, loosen clamp lever screw, rotate lever to 9 o'clock, and tighten screw. Check again for bias spring reversal and correct rotational speed.

Balance axis spools as per Partial Procedure noted above.

3. Stylus Diaphragm Replacement (Refer to Fig. 6)

Required if diaphragm becomes damaged due to stylus being struck by template or other object. Damage is indicated if stylus action becomes uneven, spongy, abnormally loose or tight, or if stylus has excessive axial play.

- Turn off hydraulic supply, set automatic steering selector to 'Manual', and remove both side cover plates from valve (See para. 1 above).
- Set steering valve stylus pressure to maximum. (See para. 2 of 2 a) above).
- Remove stylus collet.
- Measure dimension 'A' (see Fig. 6) and note for future reference.
- Loosen set screw in 45° angular face of anchor block so it clears recess in stylus stem.
- Remove pressure plate (held by 3 countersunk screws).
- Carefully pull stylus stem out of valve with one hand, using a rotating motion and holding the steering bias bushing and anchor block with the other hand. Make sure spool actuating rods do not distort.
- Grip stylus stem carefully in vise jaws.

- Unscrew diaphragm nut and remove diaphragm along with upper and lower retaining rings.

- Clean retaining rings and new diaphragm and remove any burrs.

- Install upper retaining ring, diaphragm, and lower retaining ring, making sure all three are properly seated on stylus stem. Rotate diaphragm so relation of mounting holes to flat on stylus stem will ensure convenient access to stylus collet set screws. Install diaphragm nut and tighten securely but not excessively.

- Carefully install stylus stem in valve, using a rotating motion and holding the steering bias bushing and anchor block to guide the stem through them without binding. If installed correctly, diaphragm will bear snugly against seating face.

- Rotate stylus stem so diaphragm mounting holes align, and install pressure plate. Insert mounting screws loosely, check for proper seating and alignment of mounting holes, and tighten screws gradually until secure.

- Align anchor block radially so spool actuating rods are straight, position block axially on stylus stem to maintain dimension 'A' within ±.005", and tighten set screw.

- Carry out complete axis spool balancing procedure (See para. 2 of 2 a) above).

- Install both side cover plates and all control knobs.

4. <u>Steering Motor Drive Belt Replacement</u> (Refer to Figs. 4 and 6)

Required if belt broken or damaged. Breakage indicated by refusal of stylus to oscillate when not

bearing against template if set for automatic steering. Damage (e.g. torn or stretched belt) indicated by irregular stylus oscillation or erratic tracing performance.

Note - Both conditions are extremely rare, and should be suspected only after checking all other possible causes.

Belt replacement requires removal of the complete steering module from the tracer valve, but inspection of the belt only involves removal of the left side cover plate.

- Turn off hydraulic supply and remove both side cover plates from valve (see para. 1 above).

- Remove top plate from rear of valve.

- Set steering valve stylus pressure to maximum (see para.2 of 2 (a) above).

- The steering module is held on place by two socket cap screws accessible from the rear of the valve and two more on the top face. (see Fig. 4). Remove all four screws.

- Carefully remove steering module from rear of valve, guiding steering bias bushing by hand so it slides freely over valve stem.

- Remove tension spring from belt idler pulley arm. Remove damaged belt and install new belt on small pulley first, then on large pulley. Make sure belt teeth are properly engaged on pulleys. Replace tension spring to apply correct idler tension.

- Carefully install steering module, guiding steering bias bushing to prevent cocking on stylus stem. Depress bias spring if necessary, but do not change spring tension setting.

- Make sure module registers properly with locating dowels and that o-rings between steering valve and manifold are properly seated.

- Install four mounting screws finger-tight, then tighten top and rear screws alternately to prevent distortion.

- Carry out complete axis spool balancing procedure (see 2 (b) above).

- Install top plate, both side cover plates, and all control knobs.

SECTION VI

GENERAL MAINTENANCE

Apart from the normal operating adjustments, reliable tracer performance depends largely on maintaining absolutely clean hydraulic oil and uniform machine slide movement.

1. Dirt entering the hydraulic system can affect valve or hydraulic motor performance and can cause damage to critical components. This can be avoided by adopting the following rules:

   - Cap or plug all hose fittings and couplings immediately if disconnected, and examine for dirt before re-connecting.

   - Flush new hoses thoroughly before installing.

   - Replace hydraulic oil every 1,000 hours of operation, cleaning out oil reservoir with varsol. Replace filter elements at the same time.

     - Use Sunoco Sunvis 747 or equivalent. (This is a detergent-dispersant type of hydraulic oil of 200 SSU viscosity, containing rust, oxidation, and wear inhibitors.)

     - Power circuit filter - Kralinator L-932A.

     - Steering circuit filter - Bendix 035016.

2. Smooth machine slide movement requiring uniform screw torque over the full operating range must be maintained at all times. Adequate way lubrication plays an important part in this requirement. In addition, backlash in both drive trains must be kept to a minimum to avoid inaccuracies and change-over marks.

Frequent and regular checks are recommended to ensure proper gib adjustment, adequate lubrication, and minimum backlash.

3. Both tracer valve and template mounting brackets must be rigidly held in place. Adjustment slides should be locked after adjustment to eliminate play and vibration.

4. Lubricate Oldham couplings at output end of drive units regularly.

5. Maintain refrigeration thermostat setting at 95/100°. (Refrigerated systems only).

6. Avoid running machine slides to ends of travel under tracer control, as this places an undue strain on gears and keys.

SECTION VII

TROUBLE-SHOOTING CHART

If trouble persists after trying the remedies noted, call MIMIK TRACERS for service assistance.

TROUBLE	CAUSES	REMEDIES
A. Vibration	1. Loose gibs on machine ways.	1. Adjust gibs.
	2. Excessive play in feed screw nuts.	2. Adjust nuts or replace if not adjustable. Replace feed screws if worn.
	3. Lack of rigidity in tracer valve or template mounting components.	3. Stiffen mounting brackets, tighten mounting screws, snug or lock adjustment slide gib screws.
	4. Pump pressure too high.	4. Check for faulty pressure gage. Reduce pressure in 25 psi steps and check operation after each change. (Applies to both pumps).
	5. Pump pulsation due to wear or improper adjustment.	5. Re-adjust to manufacturer's instructions.
	6. Air in hydraulic circuit.	6. Clear system by feeding both axes several times. (see Section III, para.4).
	7. Stylus loose in collet.	7. Tighten.

TROUBLE	CAUSES	REMEDIES
B. Poor finish	1. Vibration	1. See above.
	2. Uneven machine movement due to a) dirt or lack of lubrication in machine ways;	2. a) Clean and lubricate machine ways;
	b) gibs improperly adjusted on machine ways;	b) Re-adjust gibs;
	c) machine ways worn;	c) Re-scrape and align;
	d) nut tight on unworn portion of feed screw;	d) Replace screw and nut;
	e) improper machining practice.	e) Sharpen tools, grind correct cutting angles, use correct speeds and feeds.
	3. Excessive backlash in feed screws.	3. Reduce backlash.
	4. Air in hydraulic circuit.	4. See A -6 above.
	5. Play or looseness in machine table.	5. Repair.
C. Uneven tracer feed rates	1. Change in machine way gib settings, operation on unworn portion of machine ways, change in ram counterbalance.	1. Balance axis spools, using partial procedure (see Section V, para. 2-a) (First, correct machine fault.)

TROUBLE	CAUSES	REMEDIES
D. Uneven Stylus action or axial play in stylus	1. Damaged stylus diaphragm.	1. Replace diaphragm (see Section V, para. 3)
E. Stylus sticking or jammed	1. Same as 'D' above. 2. Foreign material in valve preventing spool movement.	1. Same as 'D' above. 2. Call MIMIK TRACERS. Do not dismantle valve spools.
F. Stylus will not follow or remain on template	1. Excessive or inadequate feed rate setting. 2. Excessive pump pressure. 3. Steering valve out of adjustment 4. Foreign material in steering circuit.	1. Adjust feed rate. 2. Reduce in 25 psi steps. 3. Balance axis spools, using complete procedure, (see Sec. V, para. 2b). 4. Call MIMIK TRACERS. Do not dismantle steering components.
G. Erratic performance	1. Same as 'D' or 'F' above. 2. Damaged steering motor drive belt.	1. Same as 'D' or 'F' above. 2. Check belt and replace if necessary (see Sec. V, para. 4).
H. Stylus fails to oscillate when not against template	1. Automatic steering selector in 'Manual'. 2. Feed direction selector in neutral position.	1. Set to 'Automatic'. 2. Pull or push to 'Feed' position.

TROUBLE	CAUSES	REMEDIES
H (continued)	3. Feed rate control set too low.	3. Increase setting.
	4. Broken steering motor drive belt.	4. Replace belt (see Sec. V, para. 4).
I. Tracer drive units not operating	1. Spur gear box lever not engaged.	1. Engage lever.
	2. Clutches not engaged.	2. Check for blown fuse.
	3. Broken gear or drive key.	3. Call MIMIK TRACERS.
J. Excessive leakage -		
a) Tracer valve	1. Faulty vacuum pump or incorrect adjustment	1. Check for adequate suction. Adjust relief valve setting.
b) Shaft end of hydraulic motor	1. Damaged o-ring seal.	1. Call MIMIK TRACERS.
c) Gerotor end of hydraulic motor.	1. Gerotor studs loose.	1. Tighten.
	2. Seepage through metal to metal joints.	2. Remove gerotor and paint thin strip of lacquer around periphery of each joint. Reassemble and allow time to harden.
K. Inaccurate template reproduction	1. General machine or tracer faults.	1. See above.
	2. Machine and tracer operating properly.	2. Modify template or stylus to compensate.