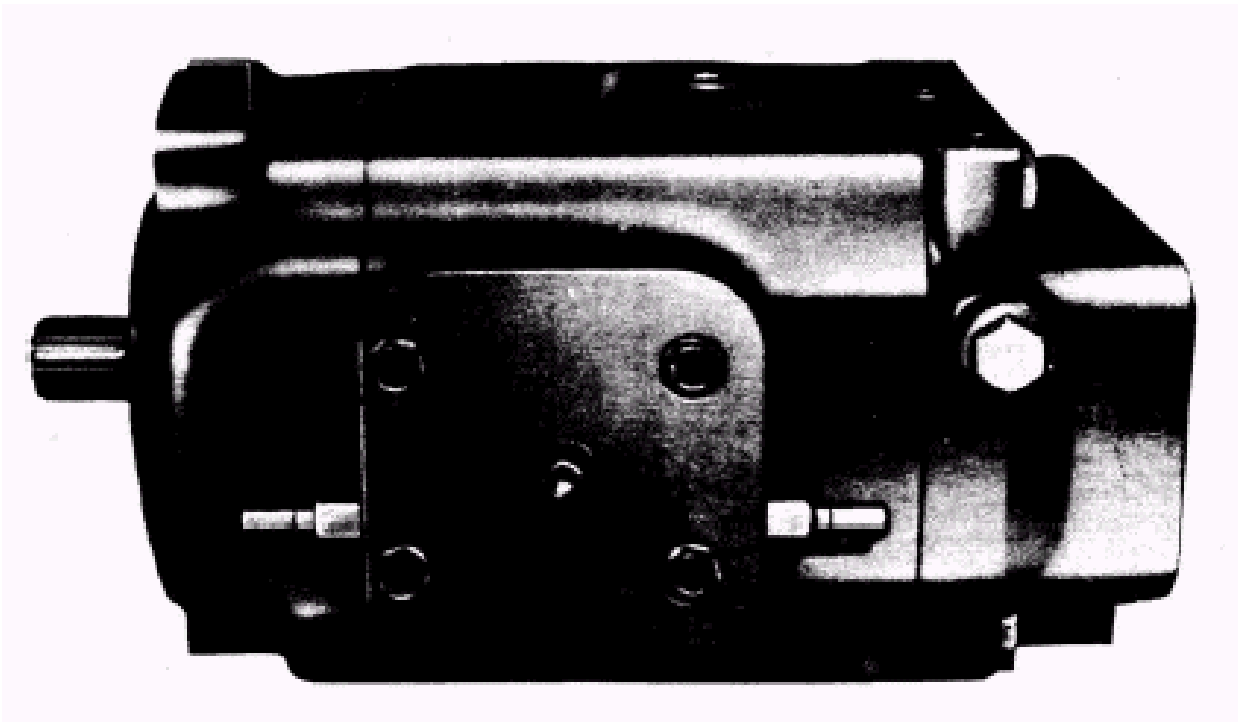


DENISON HYDRAULICS SERVICE LITERATURE

Axial Piston Motor Variable Displacement

Goldcup Series M6H-Model C
Goldcup Series M7H-Model A

INSTALLATION & OVERHAUL INSTRUCTIONS



SVM-M6/M7-G

Revised 4/04

DENISON Hydraulics

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SECTION 1 - INTRODUCTION

General

The Denison Goldcup 6 and 7 axial piston motors feature advanced design concepts which are time proven and provide for smooth controlled power. The instructions contained in this manual cover complete disassembly and reassembly of the unit. Before proceeding with the disassembly or reassembly of any unit, this manual should be studied in order to become familiar with proper order and parts nomenclature.

Description

The use of a rocker cam to control the motor displacement provides a small package size, reduces wear, and speeds control response. The control vane actuator eliminates linkage and backlash inherent in typical stroking cylinder designs.

Standard control for the units is cylinder control with adjustable maximum and minimum displacement stops. Additional optional controls are also available. This unit is bi-directional.

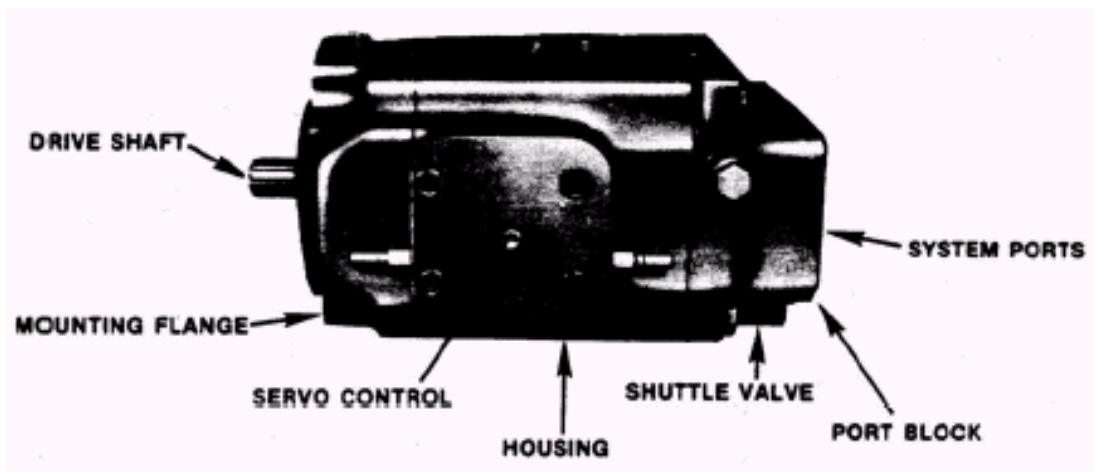


Table 1
TYPICAL CHARACTERISTICS

Specification	Term	Goldcup 6	Goldcup 7
Displacement at max. angle	In.3/rev	6.00	7.25
Pressure Ports A or B max. continuous	PSI	5000	5000
Intermittent (not to exceed 6 sec/min)	PSI	6000	6000
Mounting Standard SAE 2-Bolt fluid connections, Ports A & B		SAE-C	SAE-C
4-Bolt Pad for 6000 PSI Split Flange		SAE-1 1/2"	SAE - 1 1/2"
Speed, max. continuous @ full displacement	RPM	3000	3000
Speed, max. continuous @ 50% displacement	RPM	3600	3600
Flow, Theor. max. @ 100 RPM	GPM	2.6	3.14
Flow, Theor. max. @ 3000 RPM	GPM	77.9	94.2
Torque Theor. max. per 100 PSI	IN#	95.5	115.4
Torque Theor. max. @ 5000 PSI	IN#	4774	5769
Torque Theor. max. @ 6000 PSI	IN#	5729	6923
Power Theor. max. @ 5000 PSI per 100 RPM	HP	7.57	9.15
Power Theor. max. @ 6000 PSI @ 3000 RPM	HP	227	274.3
Efficiency Torque approx.- Stalled	% theor.	81	81
- Running		93	93
Pkg. motor variable displ. 2AO control	Lbs.	155	155

MOUNTING

This motor is designed to operate in any position. The mounting hub and two bolt mounting flange are in full conformance with SAE standard. The motor shaft must be in alignment with the shaft of the driven load and should be checked with a dial indicator. The mounting pad or adaptor into which the fluid motor pilots must be concentric with the motor shaft within 0.010 TIR to prevent bearing failure. This concentricity is particularly important if the fluid is rigidly connected to the driven load without a flexible coupling.

PIPING

Connect inlet and outlet lines to the port block of the motor. It is recommended that the case leakage line be connected to the top of the motor, but it may be connected to the bottom or to the port block between the inlet and outlet ports. The case leakage line must be of sufficient size to prevent back pressure in excess of 75 PSI and returned to the reservoir below the surface of the oil as far from the supply suction as possible. All fluid lines, whether pipe, tubing or hose must be adequate size and strength to assure free flow through the motor. An undersize inlet line will prevent the motor from reaching full speed and torque. An undersize outlet line will create back pressure in the motor from reaching full speed and torque. An undersize outlet line will create back pressure in the motor and cause improper operation. Flexible hose lines are recommended. If rigid piping is used, the workmanship must be accurate to eliminate strain on the motor port block or to the fluid connections. Sharp bends in the lines must be eliminated wherever possible. All system piping must be cleaned with solvent or equivalent before installing motor. Make sure the entire hydraulic system is free of dirt, lint, scale and other foreign material.

CAUTION: Do not use galvanized pipe. Galvanized coating can flake off with continued use.

SERVICE INFORMATION

These hydraulic products are designed to give long dependable service when properly applied and their systems properly maintained. These general instructions apply to typical systems. Specific instructions for particular equipment can be developed from them.

START UP PROCEDURE FOR NEW INSTALLATION

1. Read and understand the instruction manual. Identify components and their function.
2. Visually inspect components and lines for possible damage.
3. Check reservoir for cleanliness and drain and clean as required.
4. Check fluid level and fill as required with filtered fluid at least as clean as that recommended. Fill motor case as necessary.
5. Check alignment of drive.
6. Check oil cooler and activate it, if included in circuit. Check fluid temperature.
7. Reduce pressure settings of relief valve. Make sure accurate pressure readings can be made at appropriate places.
8. If solenoids in system, check for actuation.
9. Start pump drive. Make sure pump and motor fill properly.
10. Bleed system of air. Recheck fluid level.
11. Cycle unloaded machine at low pressure and observe actuation (at low speed if possible).
12. Increase pressure settings gradually steps. Check for leaks in all lines, especially in pump and motor inlet lines.
13. Make correct pressure adjustments.
14. Gradually increase speed. Be alert for trouble as indicated by changes in sounds, system shocks and air in fluid.
15. Equipment is operational.

FLUID

It is recommended that a hydraulic fluid be used as specified in Denison Bulletin 1107.

MAINTENANCE

This motor is self lubricating and preventive maintenance is limited to keeping the system fluid clean by changing filters frequently. Fluid cleanliness level per NAS 1638, Class 8 above 15 micron or Class 9 under 15 micron must be maintained. This usually can be accomplished by effective use of 10 micron filters. Do not allow dirt to accumulate on the motor especially around the shaft seal. Keep all fittings and screws tight. Do not operate the motor at pressures and speeds in excess of the recommended limit. If the motor does not operate properly, check the Trouble Shooting Chart before attempting to overhaul the unit. Overhaul is relatively simple and may be accomplished by referring to the procedures in Section III.

TROUBLESHOOTING

Component problems and circuit problems are often interrelated. An improper circuit may operate with apparent success but will cause failure of a particular component within it. The component failure is the effect, not the cause of the problem.

This general guide is offered to help in locating and eliminating the cause of problems by studying their effects.

Effect of Trouble	Possible Cause	Fault which needs remedy
Noisy pump	Air in fluid	Leak at suction line of pump Leak at shaft seal of pump Low fluid level in reservoir Turbulent fluid Return lines above fluid level in reservoir Gas leak from accumulator Excessive pressure drop in the inlet line from a pressurized reservoir Suction line strainer acting as air trap
	Cavitation in Motor rotating group	Fluid too cold Fluid too viscous Fluid too heavy Shaft speed too high Suction line too small Suction line collapsed Suction strainer too small Suction strainer dirty Operating altitude too high Boost or replenishment pressure too low Replenishment flow too small for dynamic conditions
	Misaligned shaft	Faulty installation Distortion in mounting Axial interference Faulty coupling Excessive overhung loads
	Mechanical fault in pump/motor	Piston and shoe looseness or failure Bearing failure Incorrect port plate selection Eroded or worn parts in the displacement control
Erosion on barrel ports and port plate	Air in fluid	See above
	Cavitation	See above
High wear in motor	Excessive loads	Reduce pressure settings Reduce speeds
	Contaminant particles in fluid	Improper filter maintenance Filters too coarse Introduction of dirty fluid to system reservoir openings Reservoir breather Improper line replacement
	Improper fluid	Fluid too thin or thick for operating temperature range Breakdown of fluid with time/temperature/shearing effects Incorrect additives in new fluid Destruction of additive effectiveness with chemical aging

TROUBLESHOOTING

(continued)

Effect of Trouble	Possible Cause	Fault which needs remedy
High wear in motor (continued)	Improper repair	Incorrect parts Incorrect procedures, dimensions, finishes
	Unwanted water In fluid	Condensation Faulty breather/strainer Heat exchanger leakage Faulty clean-up practice Water in make-up fluid
Pressure shocks	Cogging load	Mechanical considerations
	Worn relief valve	Needed repairs
	Worn compensator	Needed repairs
	Show response in check valves	Replace or relocate
	Servo pressure to low to maintain firm control	Increase pressure and check pressure drop through servo filter
	Excessive de-Compression energy rates	Improve decompression control
	Excessive line capacitance (line volume, line stretch, accumulator effects)	Reduce line size or lengths Eliminate hose Bleed air
Heating of fluid	Barrel blow-off	Re-check pump hold-down, rotating group, drain pressure
	Excessive motor leakage	Recheck case drain flow and repair as required Fluid too thin Improper assembly, port timing
	Relief Valve	Set too low (compared to load or to compensator) Instability caused by back pressure, worn parts
	Compensator	Set too high (compared to relief) Worn parts
	Pump too large for fluid needs	Select smaller pump displacement
	Heat exchanger	Water turned off or too little flow Water too hot Fan clogged or restricted Efficiency reduced by mud or scale deposits Intermittent hydraulic fluid flow
	Reservoir	Too little fluid Entrained air in fluid Improper baffles Insulating air blanket that prevents heat rejection Heat pick-up from adjacent equipment

The instructions contained in this section cover a complete teardown of the subject motor. Disassemble only as far as necessary to replace or repair any worn parts.

DISASSEMBLY

Position motor unit so the shuttle valve assembly is on the bottom. A bench or similar suitable surface capable of supporting unit should be used. Disassembly area should be clean.

CONTROLS

(See Figure 9)

1. Remove the four screws (14) from the side (16) and remove the input shear seal assembly.
2. Remove the four screws (14) from the side cover (15) and remove the counter balance shear seal assembly.
3. Remove the two screws (12) and spacers (11). Remove the servo stem (9) and plate (10).

BARREL HOLD-DOWN

(See Figure 8)

1. Remove snap ring (8), end cover (6) and O-ring (7).
2. Remove cotter pin (5), hold-down nut (4), thrust washers (1), bearing (2) and seal ring (3).

PORT BLOCK

(See Figure 7)

1. Remove four screws (5) that secure the port block (1) to the housing (9).
2. Remove port block (1) and gasket (8). Remove port plate (7) and port plate pins (6).

CAUTION: When removing port block, the port plate can cling to the face plate because of oil film. Make sure it does not fall and become damaged.

BARREL AND HOLD-DOWN SHAFT

Remove the barrel assembly by grasping the hold-down shaft and lifting the complete assembly out of the housing.

DRIVE SHAFT REMOVAL

(See Figure 9)

1. Remove the four screws (8) and gaskets (7).
2. Remove seal retainer (6), and gasket (5). See view of item 4.
3. Carefully remove the carbon ring and the remainder of the shaft seal from the shaft. Do not scratch seal area of the shaft.
4. Remove snap ring (3) and the shaft and bearing assembly (1). Remove spacer or ring (2).

HOUSING REMOVAL

(See Figure 6)

After shaft assembly has been removed, position the unit on end with the mounting flange turned down.

1. Push the ends of the small tube lines (5) away from the housing (4).
2. Lift the housing from the mounting flange, remove the gasket (3), and dowel pins (7) from the mounting flange.
3. Do not remove the roll pins and the bearing from the housing unless the bearing is damaged and must be replaced.

ROCKER CAM AND CONTROL STROKING ASSEMBLY

(See Figure 4)

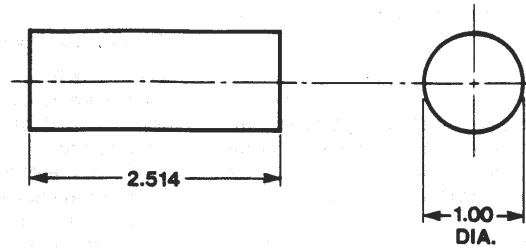
1. Remove the complete assembly from the mounting flange and position on a clean flat surface with the two tubes (2) in a horizontal position and located at the top. Mark the cam (24) and cradle (20) as indicated in Figure 3. These marks will determine positioning of parts during reassembly.

Caution: Do not bend these lines.

(See Figure 3)

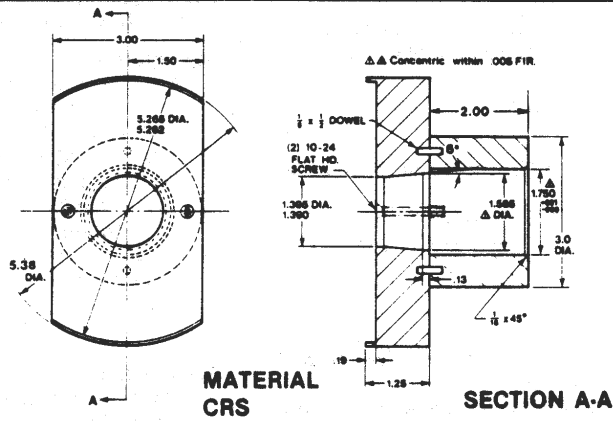
1. Position the assembly in an upright position on the flat surface on the cradle (20). Remove the retaining ring (1) and thrust washer (2).
2. Remove the piston and shoe assembly (4) and the creep plate (5) from the cam (24). Carefully remove the screws (6a) and (6) that secure the servo input parts (7, 8 and) to the cam (24).
3. Remove the four 7/16" screws (10) and eight 1/4" screws (11) and (12) from the control covers (15R) and (15L).
4. Remove the four dowel pins (16) and remove the two chambers (17). Remove the two special seats (18) and the four steel balls (19).
5. Remove the two vane seal cartridge assemblies (23), vane springs (21) and the four hold-down vanes (22) from the rocker cam (24).
6. Remove the rocker cam (24) from the cradle (20).

T-1

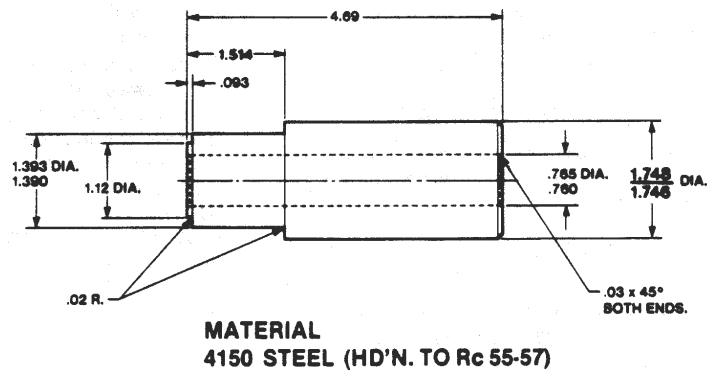


MATERIAL
CRS 1" DIA. x 2-5/8"

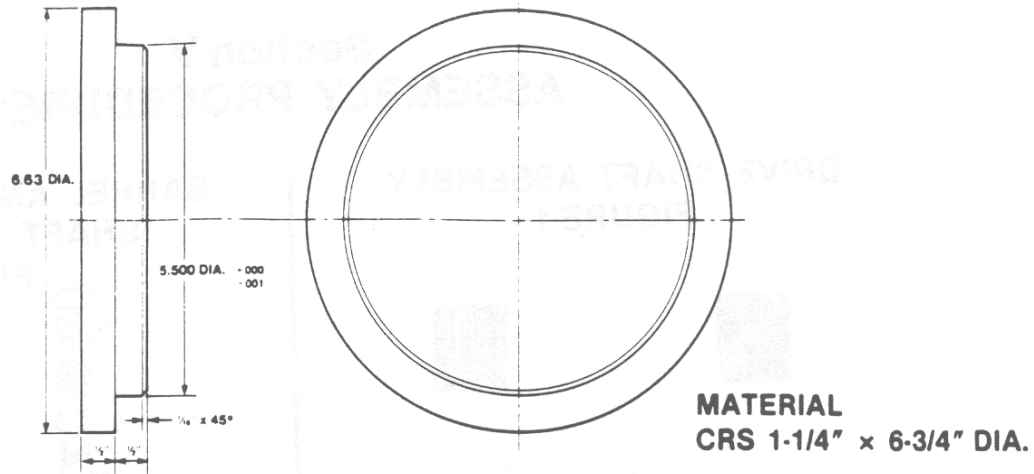
T-2



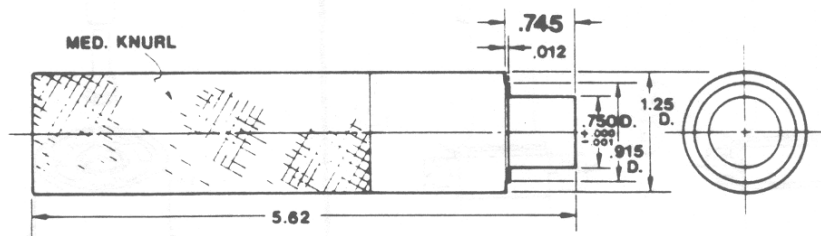
T-3



T-4



T-5



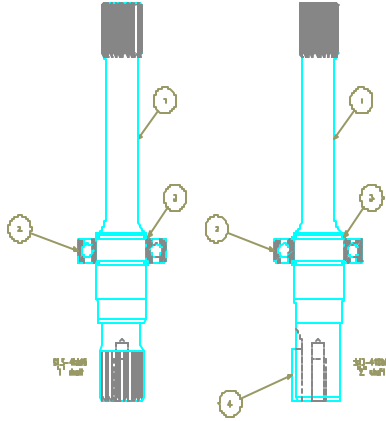
MATERIAL
OHTS 5-5/8 x 1-1/4 DIA.
Hardened Tip RC 58-62

REWORK LIMITS OF WEAR PARTS

6 and 7.25 In.3	Original Dimension	Max. Rework from Original Dimension	Min. Dimension After Rework
Port plate face	.315/.305"	.010"	.295"
Cylinder barrel face	4.480"	.010"	4.470"
Shoe retainer face	.314/.312"	.005"	.307"
Piston shoe face (pocket)	.019/.014"	.011/.006"	.281"
Creep plate face	.293/.291"	.010"	.281"
Face plate		None	Replace

DRIVESHAFT ASSEMBLY

Figure 1



1. Pass one retaining ring (3) over the internal end of drive shaft (1) and install in the groove near the shaft seal surface.

DO NOT PASS THE RING OVER THE SEAL SURFACE.

2. Slide the bearing (2) over the same end of the shaft and seat against the ring.

Support only the inner race of the bearing and press on the coupling end of the shaft.

DO NOT USE EXCESSIVE FORCE AND DISTORT OR DAMAGE THE RETAINING PIN.

3. Install the other retaining ring (3) in the other retaining ring groove. Be sure that both rings are fully seated.

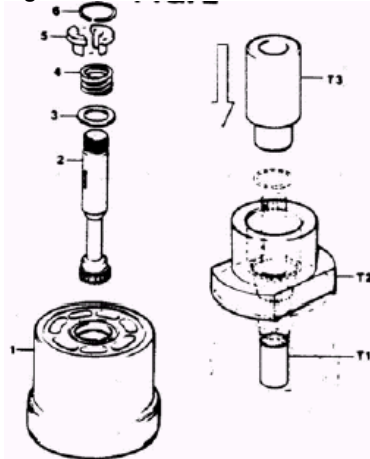
PARTS LIST FOR FIGURE 1

S13-41805 #1 Drive Shaft Assembly (Splined)
S13-41806 #2 Drive Shaft Assembly (W/Key-way)

ITEM	QUANTITY		PART NUMBER	DESCRIPTION
	#1	#2		
1	2	--	033-70567	#1 (Splined) Drive Shaft
	--	1	033-70579	#2 (W/ 5/16 KW) Drive Shaft
2	1	1	230-82140	Shaft bearing MRC-107KS
3	2	2	033-70817	Retaining Ring
4	--	1	035-71348	Square Key 5/16 x 1 1/4

BARREL AND HOLD-DOWN SHAFT ASSEMBLY

Figure 2



1. Position the barrel (1) in a press with the large end turned down and insert tool figure T-1 in the splined shaft hole in the barrel.
2. Place thrust washer (3) and spring (4) over shaft (2) in the same sequence as shown.
3. Insert shaft (2) in barrel (1) and rest on tool figure T-1. Position the two spring retainers (5) around the shaft (2) and inside of spring (4).
4. Carefully place tool figure T-2, with the large end of the tapered hole up, over the shaft (2) and against the barrel (1) face. Insert ring (6) around the shaft (2) and in the tool.
5. Position the ring with the gap within 5/8" of the notch in the barrel for easy removal.
6. Place tool figure T-3 over the shaft (2) with the small end against ring (6). Press on the end of the assembly tool and seat the ring (6) in the groove in the barrel (1).
7. Remove the assembly tools. Check to be sure that the ring is properly seated. Check barrel face to be certain it is not marred.

PARTS LIST FOR FIGURE 2

ITEM	QUANTITY		PART NUMBER	DESCRIPTION
	#1	#2		
1	1	--	S13-43657	Barrel & Sleeve Assy. M6 Only
	--	1	S13-47511	Barrel & Sleeve Assy. M7 Only
2	1	1	033-70583	Hold-down Shaft
3	1	1	350-10069	Thrust Washer TRA -1220
4	1	1	033-70493	Barrel Hold-down Spring
5	2	2	033-70483	Spring Retainer
6	1	1	033-70494	Retaining Ring

ROCKER CAM ASSEMBLY See Figure 3

Position the rocker cam (24) on the cradle (20). Note the marks made previously on the cradle and cam to indicate top. (See marks in Figure 3.) Marks will be used for assembly reference.

VANE SEAL CARTRIDGES

1. Install O-ring (23c) around spacer (23d) and insert in the seal vane (23b).
2. Install check valve (23e) inside of spacer (23d) and assemble between the two backup plates (23a) with the notched V's exposed.
3. Install assembled cartridge in slot in cam as indicated in Figure 3. Repeat steps 1, 2, and 3 on other side of cam.
4. Install the four hold-down vanes (22) and springs (21) in the slots on each side of the control vanes (23).

CONTROL CHAMBER

1. Position both control chambers (17) on a clean flat surface with seal grooves turned up. Drop the four steel balls (19) in the four counter-bored holes at each end of the seal grooves.
2. Lubricate seals (18) and insert in seal grooves in control chamber (17).
3. The tapered side of the seals must be pushed into the grooves and the ends must cover the steel balls.
4. Install the control chamber (17) with seal (18) and steel balls (19) assembled over the control vane (23). The seal must be against the cam. Rotate the chamber until it passes over the control vane assembly, then rotate in the opposite direction until the 1/4" dowel pins (16) can be pushed through the chamber (17) and into the cradle (20). Install chamber in the same manner on the other side of the cam.

NOTE: Two sets of chamber covers are available. The set marked CW must be installed in the right hand rotation pump and the set marked CCW must be used in the left hand rotation pump. (Rotation is determined facing the shaft end of pump.) The covers must be installed with the tubing holes and the tapped holes at the top of the unit.

5. Install chamber covers (15r) and (15l) on the control chambers (17) over the dowel pins (16). **The tapped holes must be at the top.** Refer to the "T" marked on the rocker cam (24) and cradle (20).
6. Install four 1/4 – 20 screws, two (11) and two (12), in each side and torque to 10 ft. lbs.
7. Install two 7/16-14 screws (10) in each side and torque to 45 ft. lbs.
8. Install O-ring 914) and plug (13) in each cover.
9. Install tubes (25) in reamed holes in each cover. These tubes must be a tight fit. If tubes are loose, the ends can be expanded with a tapered punch.
10. Tap the tubes in place with a plastic mallet.

SERVO ASSEMBLY

1. Install two orifice screws (8) in the servo stem (7).
2. Install servo plate with the screws through the servo stem. The orifice screw end of the servo stem must be against the servo plate.
3. Position the stem and plate on the rocker cam input side (at 9 o'clock on "B" model or 3 o'clock on "A" models) with the screws positioned over the 10-24 tapped holes. Hold the assembly against the cam and alternately turn the screws 1/2 turn each until the stem and plate are firmly attached to the cam. Torque the screws (6) to 40 in. lbs. Install set-screws (6a) over the screws (6) and torque to 5 ft. lbs.

CAUTION: The screws must not protrude from the servo plate.

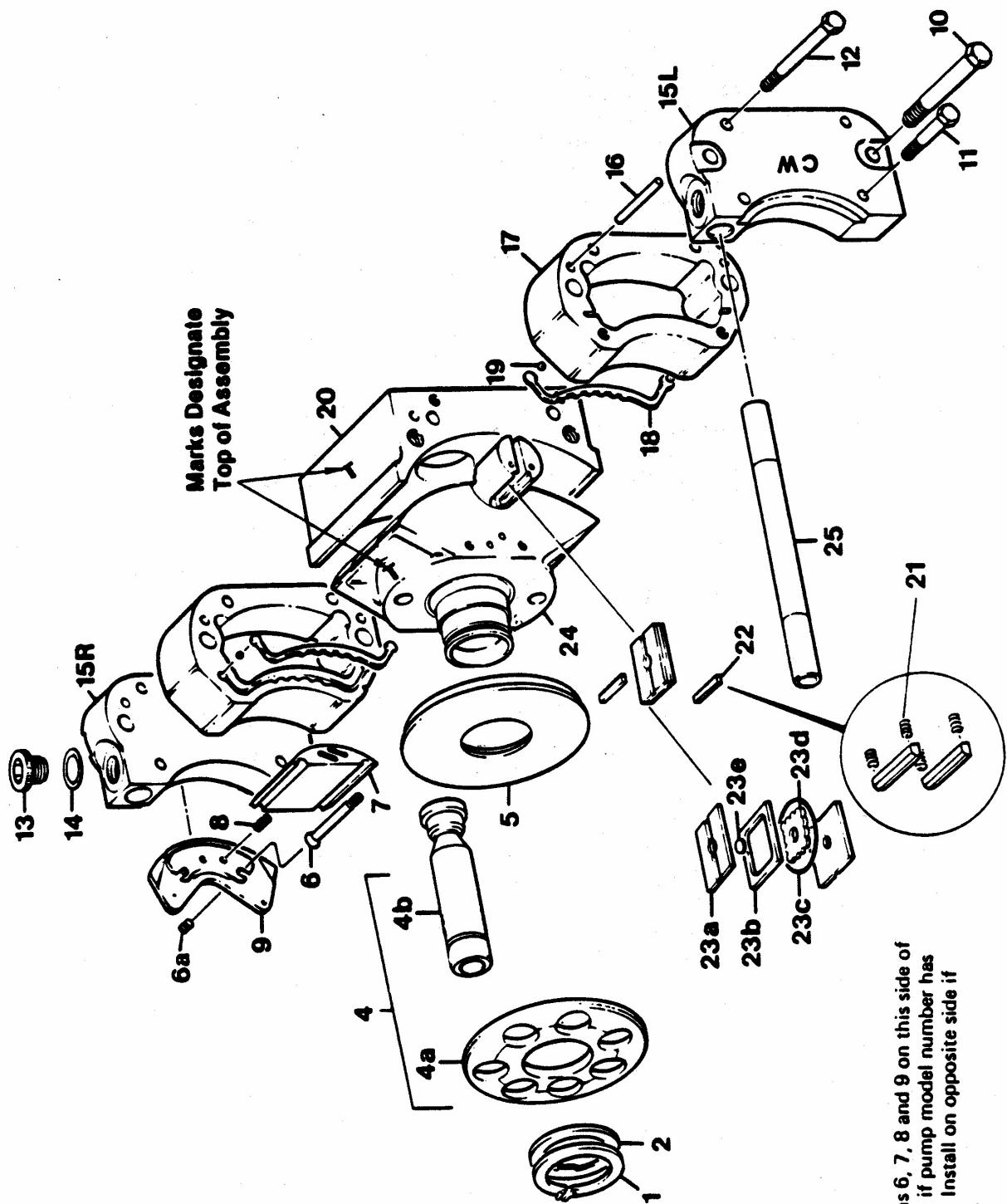
PISTON AND SHOE ASSEMBLY

1. Install creep plate (5) over center post on rocker cam. Small O.D. of plate must face the cam.
2. Install the seven piston and shoes (4b) in the shoe retainer (4a). Position the assembly (4). Position the assembly (4) over the center post and against the creep plate.
3. Install thrust washer (2) over center post.
4. Five different retaining rings (1) are available for the hold-down assembly. Install the thickest ring (1) with the dot up, that will fit in the groove on the center post and allow a clearance of .002 to .004 between the shoe and creep plate. Grasp one piston and lift tightly against shoe retainer to measure this clearance.
5. The piston and shoe assembly (4) should be free to rotate by hand. (5 ft. lbs. or less). See Figure 4.

PARTS LIST FOR FIGURE 3

NO.	QTY.	PART NUMBER	DESCRIPTION
1	1		Retaining ring – USE ONE ONLY
		033-72175	.086 w/white dot
		033-72176	.084 w/blue dot
		033-70484	.083 thick w/yellow dot
		033-70488	.081 thick w/green dot
		033-70490	.079 thick w/red dot
2	1	033-72249	Thrust washer
3	--	-----	NOT USED
4	--	See below	Piston & shoe assy. w/retainer
5	1	033-71261	Creep plate
6	2	353-25041	Screw
6a	2	312-09032	Setscrew
7	1	033-71312	Servo stem
8	2	033-70819	Orifice screw
9	1	033-53874	Servo plate
10	4	306-40183	Hex hd. screws 7/16-14 x 2 1/2
11	4	306-40188	Hex hd. screws 1/4-20 x 1 1/4
12	4	306-40187	Hex hd. screws 1/4-20 x 2 1/4
13	2	488-35001	Hex socket plug SAE-4
14	2	691-00904	O-ring 90-6290-4
15R	1	033-70572	Right side chamber cover CW Rot.
15L	1	033-70571	Left side chamber cover CW Rot.
16	4	324-21624	Dowel pin 1/4 x 1 1/2
17	2	033-70570	Chamber
18	2	606-25036	Seal
19	4	201-06001	Steel Ball 3/16 H & G
20	1	033-53951	Rocker Cradle
21	8	033-72233	Vane hold-down spring
22	4	033-72232	Hold-down vane
23			NOT USED
23a	4	033-70802	Seal back-up plate
23b	2	033-70501	Vane seal
23c	2	691-00120	O-ring 90-914-20
23d	2	033-70519	Spacer
23e	2	033-70803	Check valve
24	1	S23-12104	Rocker cam and plug assembly
25	2	033-70524	Pressure tube

NO.	QTY.	M6	M7	DESCRIPTION
4	1	S13-43655	S13-42308	Piston & shoe assy. w/retainer
4a	1	033-54290	033-54290	Shoe retainer
4b	7	S13-45680	S13-46040	Piston & shoe assy. only



Install items 6, 7, 8 and 9 on this side of rocker cam if pump model number has "B" suffix. Install on opposite side if "A" suffix.

BARREL, ROCKER CAM AND FLANGE ASSEMBLY

See Figure 4

1. Install tube line assemblies (3) and (4) in the holes provided in cradle.
2. Install two dowel pins (6) in the cradle mounting surface of the flange and two dowel pins (6) in the outer edge of the flange.
3. Install rocker cam and cradle assembly over the two dowel pins (6) in the mounting flange. Be certain that cradle is seated over the pins and against the flange with the tube lines (3) and (4) in the grooves in the flange.
4. Install two or more 1/4-20 x 1 1/4 screws through the seal retainer area into the cradle. Be certain the cradle is fully seated in flange. These screws are required to hold the rocker cam assembly in and will be removed later.
5. Tilt the rocker cam to either extreme position in the cradle and position the barrel assembly with auxiliary shaft (1) directly over the pistons. Start with the upper-most piston and guide them one at a time into the barrel. Return the rocker cam to a level position in the cradle.

NOTE: Tube assemblies (3 & 4) must be a snug fit into holes in cradle. Expand end of tubes with a pointed tool to assure fit.

PARTS LIST FOR FIGURE 4

NO.	QTY.	PART NO.	DESCRIPTION
1	1	See Fig. 2	Barrel and Hold-down Shaft Assy.
2	2	033-70524	Pressure Tube
3	1	S13-42402	Tubing Assy. (right side)
4	1	S13-42403	Tubing Assy. (left side)
5	1	See Fig. 3	Rocker Cam and Stroking Assembly
6	4	324-22412	Dowel Pin 3/8 x 3/4
7	1	033-70604	Mounting Flange

FIG. 5 s15-42335 HOUSING ASSEMBLY

NO.	QTY.	PART NO.	DESCRIPTION
1	1	033-71284	Housing
2	1	033-70580	Bearing
3	4	324-21608	Dowel Pin
4	2	325-16280	Roll Pin
5	1	691-00912	O-ring 90-6290-12
6	1	488-35014	Hollow Hex Plug SAE-12

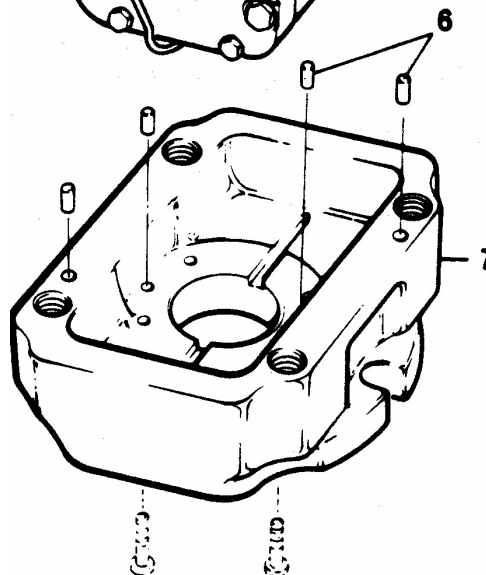
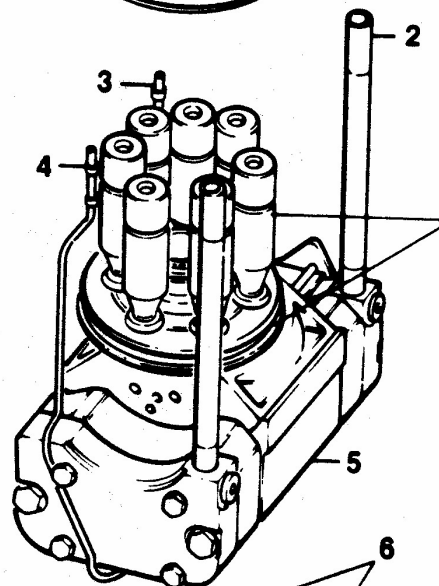
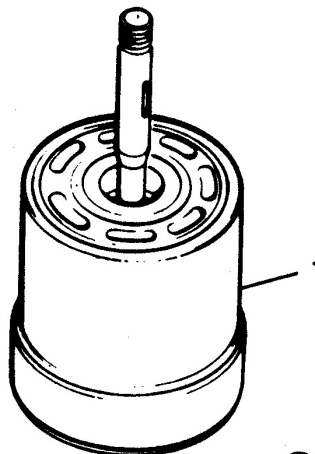


FIGURE 4

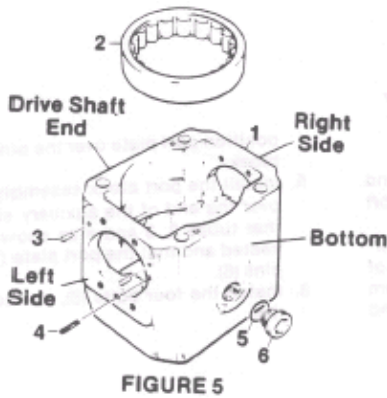


FIGURE 5

HOUSING ASSEMBLY*See Figure 5*

1. Position housing (1) on a clean flat surface with the large open end up.
2. Install bearing (2) in the housing bore. Insert pressing plug tool (figure T-4) in the bearing. With a smooth and steady force, press the bearing into the housing bore until seated. **DO NOT HAMMER OR BEAT INTO PLACE.**
3. Turn housing (1) on side and install roll pin (4) in the 1/4" through hole in the control cover pad. The pin must be 3/8" below the pad surface.

NOTE: The pin end must not interfere with the internal bearing cage.

4. Install two dowel pins (3) in the blind holes in the same pad.
5. Repeat operation 3 on the opposite side of the housing.
6. Install O-ring (5) on plug (6) and install the hollow hex plug in bottom of housing (1). Roll pins (4) are in bottom half of housing.

HOUSING INSTALLATION*See Figure 6*

1. Install the three face plate pins (1) in the holes provided in the holes provided in the barrel face.
2. Apply heavy grease to the face of the barrel and install the face plate (2) over the pins (1) in the barrel.

CAUTION: Make certain the plate is properly seated on the barrel and pins.

3. Install gasket (3) over the two dowel pins (item 7, fig. 4) in the mounting flange.
4. Install the housing assembly (4) over the barrel and auxiliary shaft assembly and carefully guide the pressure tubes and tube lines (items 3, 4 and 5, fig. 4) through the housing assembly (4, fig. 6).

PARTS LIST FOR FIGURE 6

NO.	QTY.	PART NO.	DESCRIPTION
1	3	033-49825	Face Plate Pins
2	1	033-71530	Barrel Face Plate 6 in.3 only
	1	033-72532	Barrel Face Plate 7.25 in.3 only
3	1	033-70576	Housing Gasket
4	1	See Fig. 4	Housing Assembly

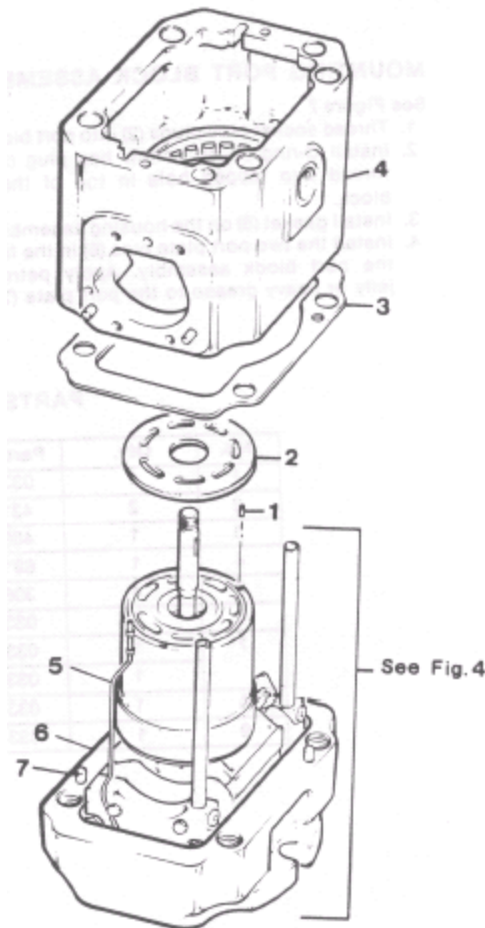


FIGURE 6

**MOUNTING PORT BLOCK
ASSEMBLY**
See Figure 7

1. Thread socket pipe plugs (2) into port block.
2. Install O-ring (4) on hollow hex plug (3) and thread the tapped hole in tope of the port block.
3. Install gasket (8) on the housing assembly (9).
4. Install the two port plate pins (6) in the face of the port block assembly. Apply petroleum jelly or heavy grease to the port plate (7) and position port plate over the pins (6) on the port block.
5. Install the port block assembly and port plate over the end of the auxiliary shaft. Be certain that tubes 2, 3 and 4 as shown on Fig. 4 are seated and that the port plate (7) is still on the pins (6).
6. Install the four bolts (5), and torque to 150 ft. lbs.

PARTS LIST FOR FIGURE 7

NO.	QTY.	PART NO.	DESCRIPTION
1	1	033-71297	Port block
2	2	431-90404	1/4" Soc. Pipe Plugs
3	1	488-35041	Hollow hex plug SAE-6
4	1	691-00906	O-ring 90-6290-6
5	4	306-40182	Hex head cap screw 5/8-11 x 9
6	2	033-49825	Port plate pins
7	1	033-71531	Port plate M6 only
	1	033-71267	Port plate M7 only
8	1	033-70577	Housing gasket
9	1	033-71284	Housing

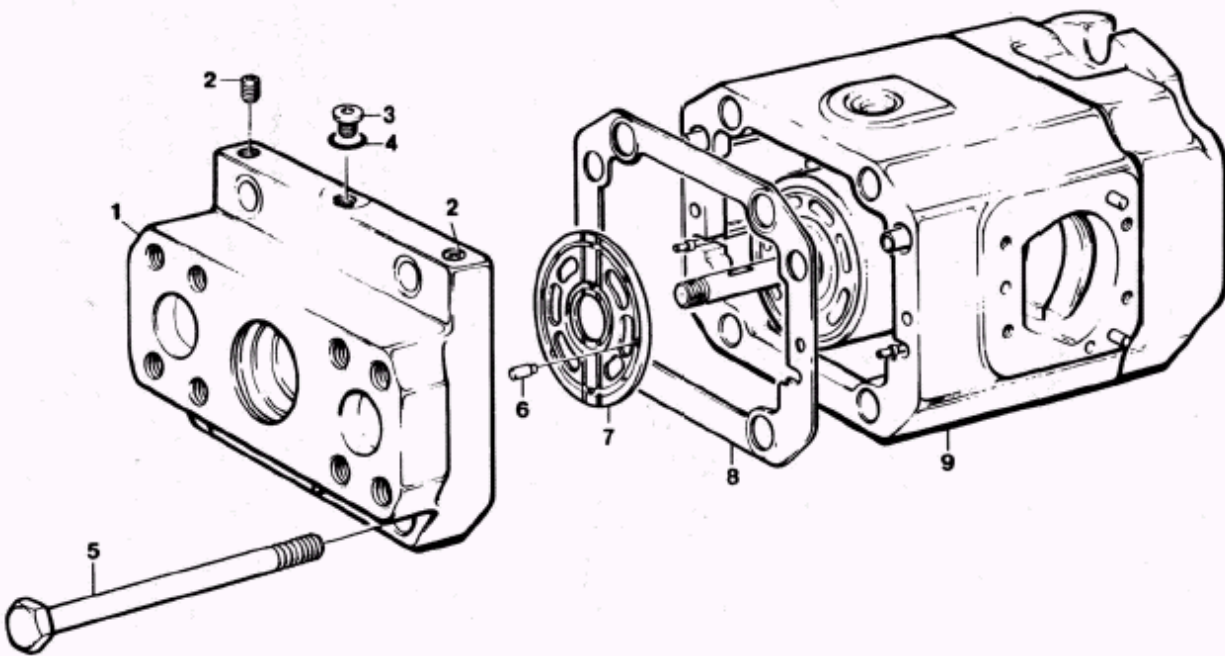


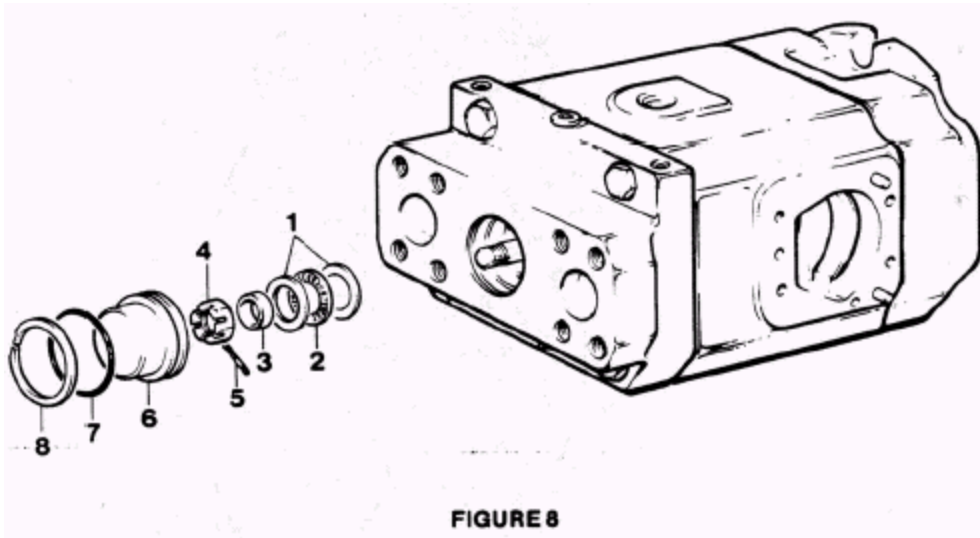
FIGURE 7

BARREL HOLD-DOWN
Figure 8

1. Install seal ring (3) on hold-down shaft. Position bearing (2) between the two thrust washers (1) and install around the seal ring.
2. Install hold-down nut (4) on the shaft and tighten no more than 10 ft. lbs. max. Back off the nut until **second slot** is aligned with cotter pin hole in the shaft. Install cotter pin (5) through nut and shaft and bend one tang over the end of the shaft.
3. Place O-ring (7) on end cover (6) and lubricate. Install end cover over hold-down nut (4).
4. Depress cover and install snap ring (8). Make certain that snap ring is properly seated in groove.

PARTS LIST FOR FIGURE 8

NO.	QTY.	PART NO.	DESCRIPTION
1	2	350-10065	Thrust Washer
2	1	230-82131	Bearing NTA-1625
3	1	033-70510	Seal Ring
4	1	033-53922	Hold-down nut
5	1	322-03324	Cotter pin 3/32 x 1
6	1	033-70537	End cover
7	1	671-00138	O-ring
8	1	356-65095	Internal Snap Ring


FIGURE 8

**SHAFT AND SEAL
INSTALLATION**
See Figure 9

1. Stand the motor in an upright position with the port block inlet and outlet pads turned down.
2. Remove the two 1/4-20 x 1 1/4" screws that were temporarily used to hold the cradle in the mounting flange. Install the shaft and bearing assembly (1) in the mounting flange and cradle. Be certain that there are no burrs or sharp edges on shaft seal area of the shaft.
3. For a rigid shaft application use the shim (2) that results in least clearance around the shaft bearing. Do not use a shim with a floating shaft.
4. Install the snap ring (3) in the mounting flange to retain the shaft assembly. Make sure that the ring is fully seated in the groove. Use the ring that results in the tightest fit.

SEAL ASSEMBLY

The seal assembly (4) is available as a complete unit only.

CAUTION: Before installing the seal assembly, examine all the parts. The lapped seal seat and the carbon ring have a precision finish that must be handled with care. Be certain that both parts are free of scratches, marks and cracks.

1. Install the spring retainer (e) over the shaft and against the retaining ring on the shaft assembly. Place the spring (d) against the retainer (e). Apply oil to the inner surface of the rubber friction ring (f) and position the shell containing the rubber friction ring (f) and carbon ring (c) over the shaft with the carbon ring exposed. Apply heavy grease to the square section rubber seal (a) and install on the cast iron seat (b).
2. Install the seat and seal in the seal retainer (6) with the lapped side of the seat in position to contact the carbon ring. Place the seal retainer assembly and gasket (5) over the shaft with the lapped surface against the carbon face.
3. Install the four gaskets (7) on the four screws (8) and insert in the seal retainer (6). Depress the seal retainer only far enough to start the four screws and tighten evenly. Torque to 10 ft. lbs.

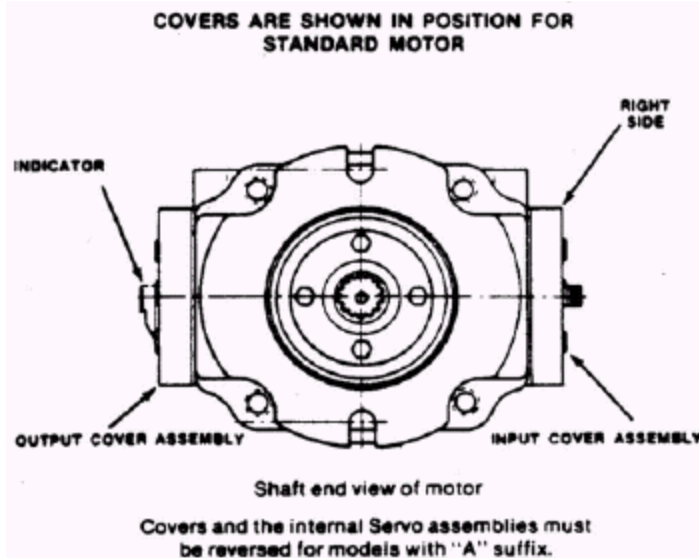
**COUNTER-BALANCE SERVO
STEM ASSEMBLY**

1. Install the two spacers (11) on the two screws (12) and insert through the balance plate (10) and the servo stem (9).
2. Insert these parts through the opening in the side of the housing assembly and position the screws over the two 10-24 tapped holes in the rocker cam.
3. Hold these parts against the cam and alternately tighten screws (12) to hold the assembly firmly in place. Torque screws to (5) ft. lbs.

CONTROL COVER ASSEMBLIES
Figure 9

1. Lubricate O-rings (21 & 22) and install in counter-bore and groove in covers.
2. Position the cover assemblies (15 & 16) over the two dowel pins on the housing pads and secure with seals (13) and screws (14). Torque to 45 ft. lbs.

The input cover assembly must be installed on the right hand side of the motor with a "B" suffix. Install the output cover assembly on the right hand side on models with the "A" suffix.



PARTS LIST FOR FIGURE 9

NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	S13-41805	No. 1 Splined Shaft Assy. (See Fig. 1)
	1	S13-41806	No. 2 Keyed Shaft Assy. (See Fig. 1)
2	1	033-53948	Shim
	1	033-53949	Shim
3	1	033-53901	Retaining Ring
	1	033-53902	Retaining Ring
	1	033-53903	Retaining Ring
4	1	623-00006	Shaft Seal
5	1	033-70549	Seal Retainer Gasket
6	1	033-70516	Seal Retainer
7	4	631-45003	Nylite Gasket
8	4	306-40144	Screw
9	1	033-71312	Servo Stem
10	1	033-70546	Balance Plate
11	2	033-71247	Spacer
12	2	358-10300	10-24 x 2 3/4 Soc. HD. Cap Screw
13	8	631-45007	Nylite Washer
14	8	353-25018	3/8-16 x 1 1/4 Hex Washer Head Screw
15	1	S13-42064	Output Balance Control Assembly
16	1	S13-42068	Input Servo Control Assembly
17	3	691-10016	Tetraseal
18	1	S23-00181	Cover Plate (not shown-optional to item 20)
19	3	306-40106	Hex Head Cap Screw
20	Optional – See Fig. 10		
21	1	671-00017	O-Ring*
22	1	671-00048	O-Ring 4-3/4 x 4-7/8*

*Some controls use gasket #033-53575 in lieu of O-rings.

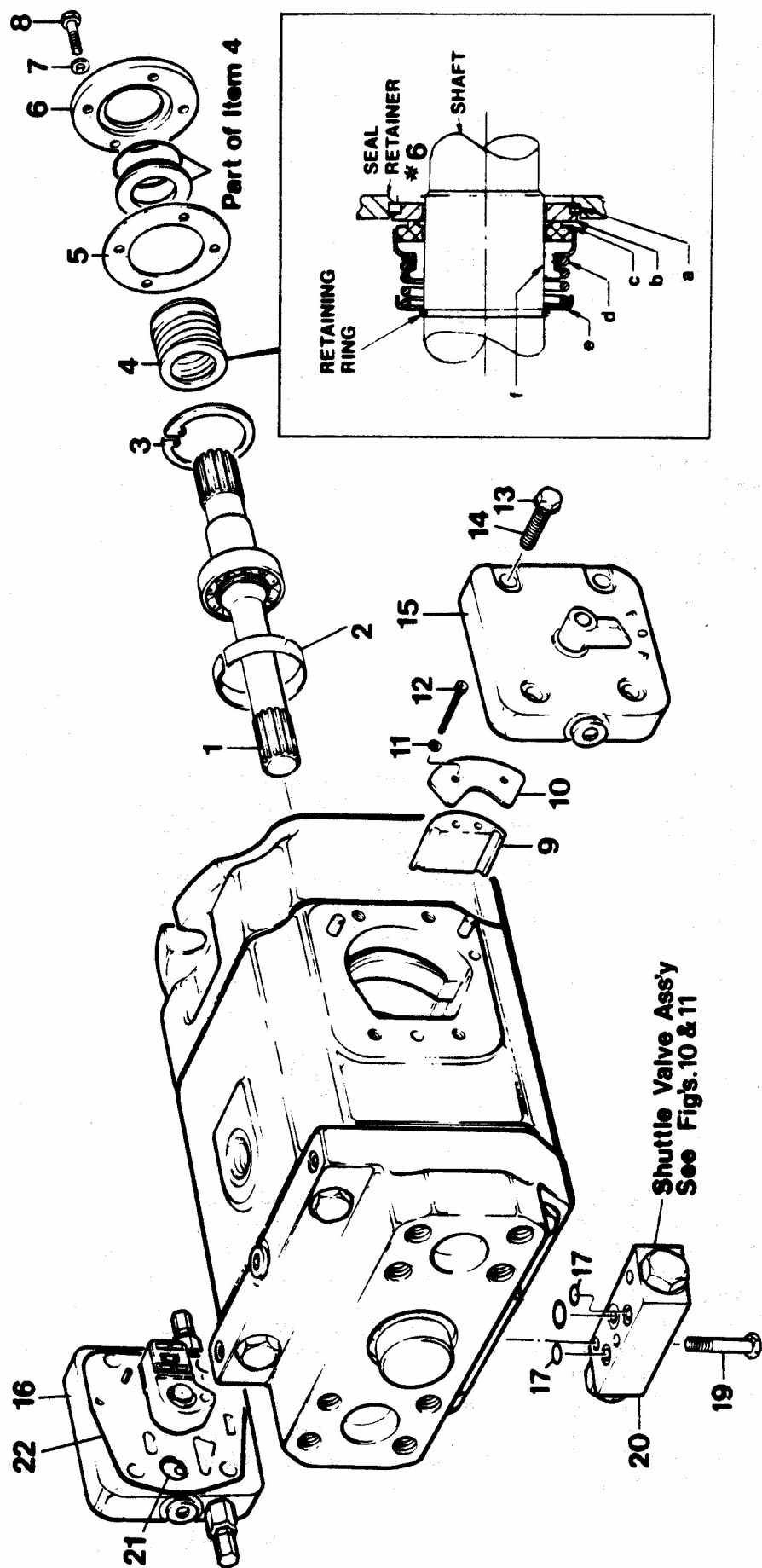


FIGURE 9

SHUTTLE VALVE ASSEMBLY
Internal Drain

1. Place valve assembly (20) in a horizontal position with the O-ring groove up.
2. Press seat (11) in the .500" diameter bore until it is flush with the body surface.
3. Install spool (5) in body bore.
4. Install spring centering washer (4) over each end of spool.
5. Install springs (3) over ends of spool and into sockets of centering washers.
6. Lubricate O-rings (2) and install over plugs (1). Install the plugs over springs and into body.
7. Install spool (10) in bore against seat (11).
8. Install spring (9) in spool (10).
9. Lubricate O-ring (8) and install in groove of plug (7) on internally drained shuttle.
10. Install plug (7) over spring (9) and tighten.
11. Install seal (17) in counter-bore in the center of shuttle valve assembly. Hold in place with a coating of grease. Install two seals in remaining counter-bores.
12. Install shuttle valve assembly on port block pad and secure with screws (19). Torque screws to 20 ft. lbs.

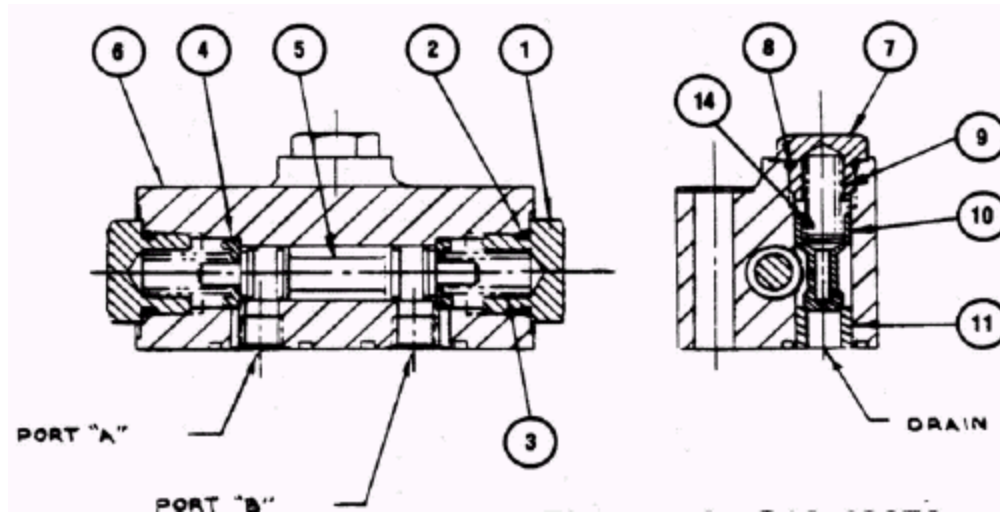


FIGURE 10
ASSEMBLY, SHUTTLE VALVE

NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	488-35002	Plug
2	2	691-00908	O-ring
3	2	033-70515	Spring
4	2	033-70495	Washer, Spring Centered
5	1	033-70529	Spool
6	1	033-53117	Body
7	1	033-72129	Plug
8	1	691-00906	O-ring
9	1	033-71923	Spring, Relief Valve
10	1	033-71925	Spool, Relief Valve
11	1	033-53154	Seat
12	Not shown		
13	Not shown		
14	2	345-20004	Shim Washer
Reference – Orifice P/N 033-53523 for Shuttle S13-48776			

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