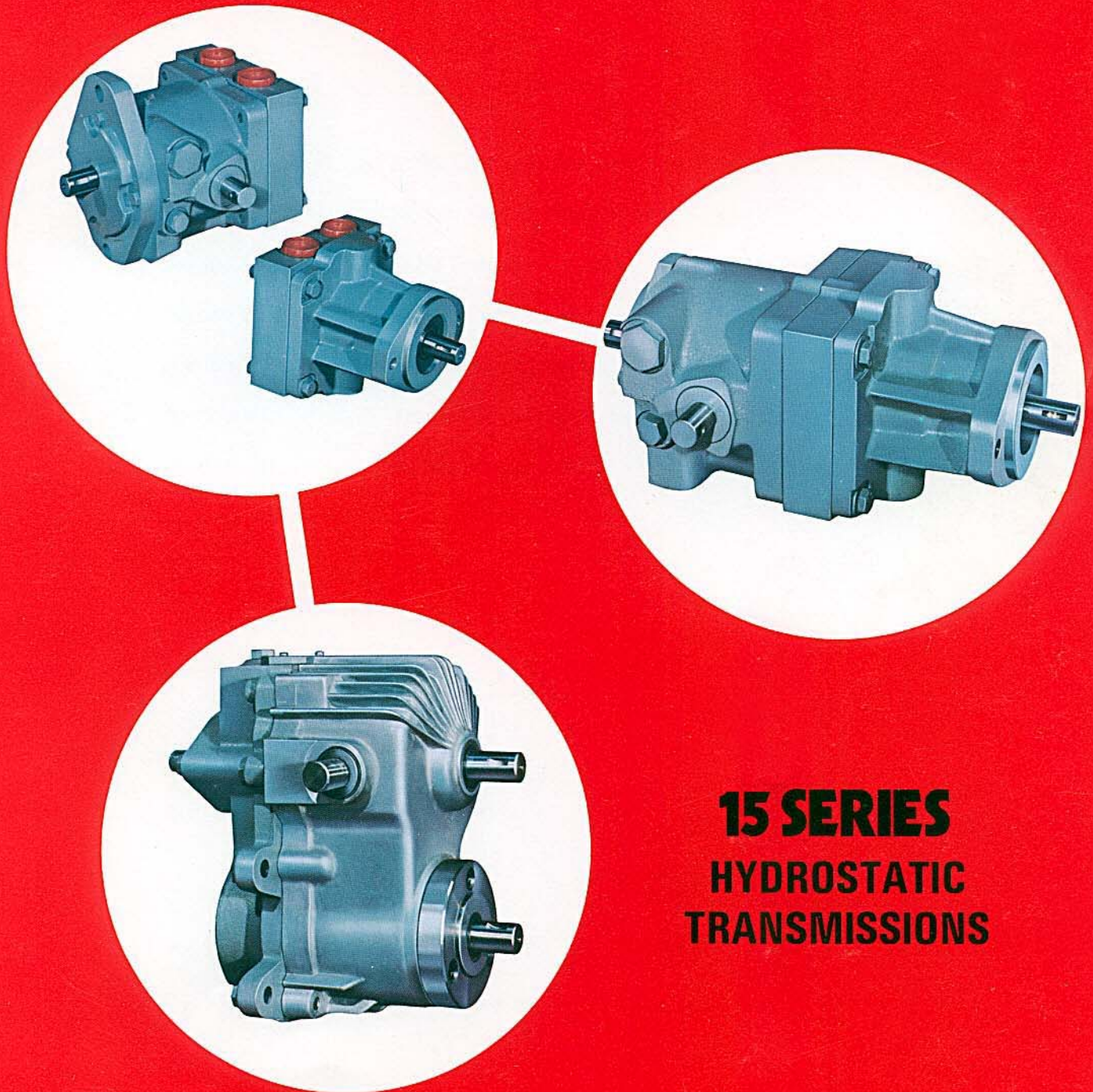


# SUNDSTRAND SERVICE MANUAL



## 15 SERIES HYDROSTATIC TRANSMISSIONS

**Sundstrand Hydro-Transmission**

AMES, IOWA 50010  
division of Sundstrand Corporation



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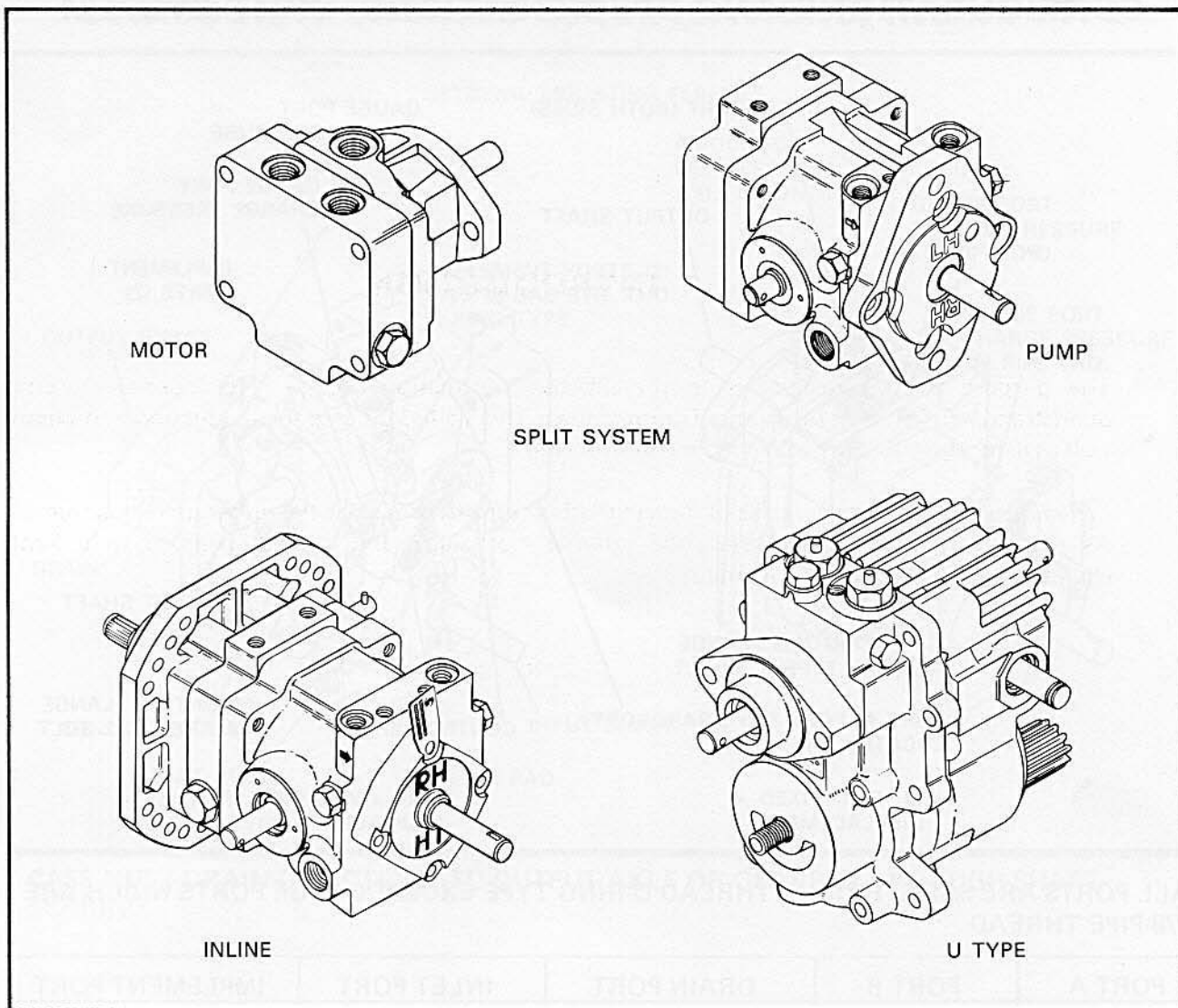
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## INTRODUCTION

The purpose of this manual is to present the information necessary for normal servicing of the Sundstrand 15 Series Hydrostatic Transmissions. This includes component function and description as well as general trouble shooting and repair procedures.

*Cleanliness* is the primary means of insuring satisfactory transmission life either on new or repaired units. As with any precision equipment, the internal mechanism and related items must be kept free of chemical and particulate contaminants.

## SECTION I: SERIES CONFIGURATIONS AND SPECIFICATIONS



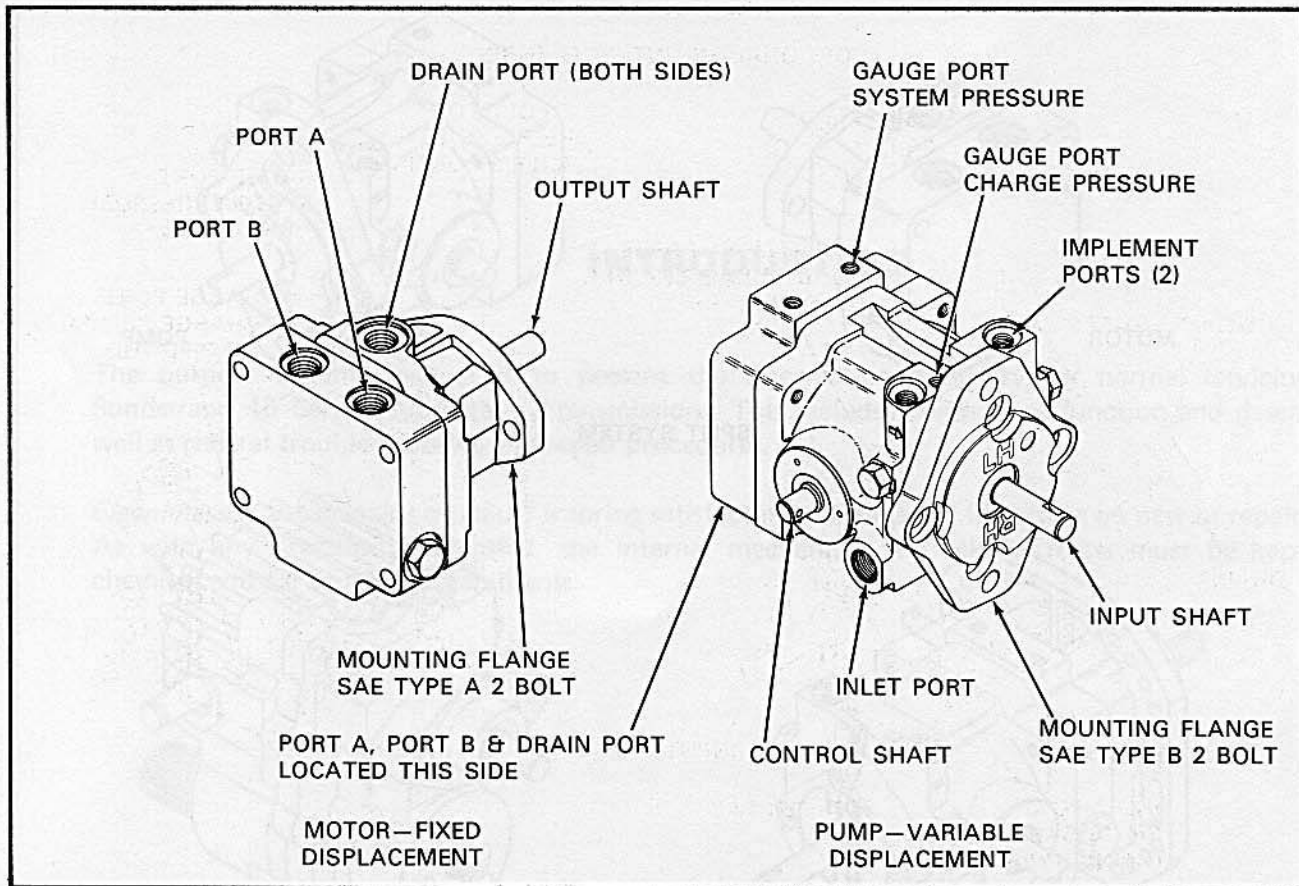
### SPECIFICATIONS

PUMP DISPLACEMENT:	0-.913 in <sup>3</sup> /rev
PUMP INPUT SPEED:	Up to 4000 RPM
MOTOR DISPLACEMENT:	.913 in <sup>3</sup> /rev
MOTOR OUTPUT SPEED:	0-4000 RPM
MAX. OPERATING PRESSURE:	3000 PSI
CHARGE PUMP DISP:	.19, .30 or .33 in <sup>3</sup> /rev
CHARGE RELIEF SETTING:	70-150 PSI
MAX. INLET VACUUM:	5 in. hg.
MAX. CASE PRESSURE:	15 PSI
IMPLEMENT RELIEF SETTING:	550-700 PSI or 700-800 PSI
FILTRATION:	25 Micron (nominal)

Relief valve pressures are set at 3600 RPM pump speeds

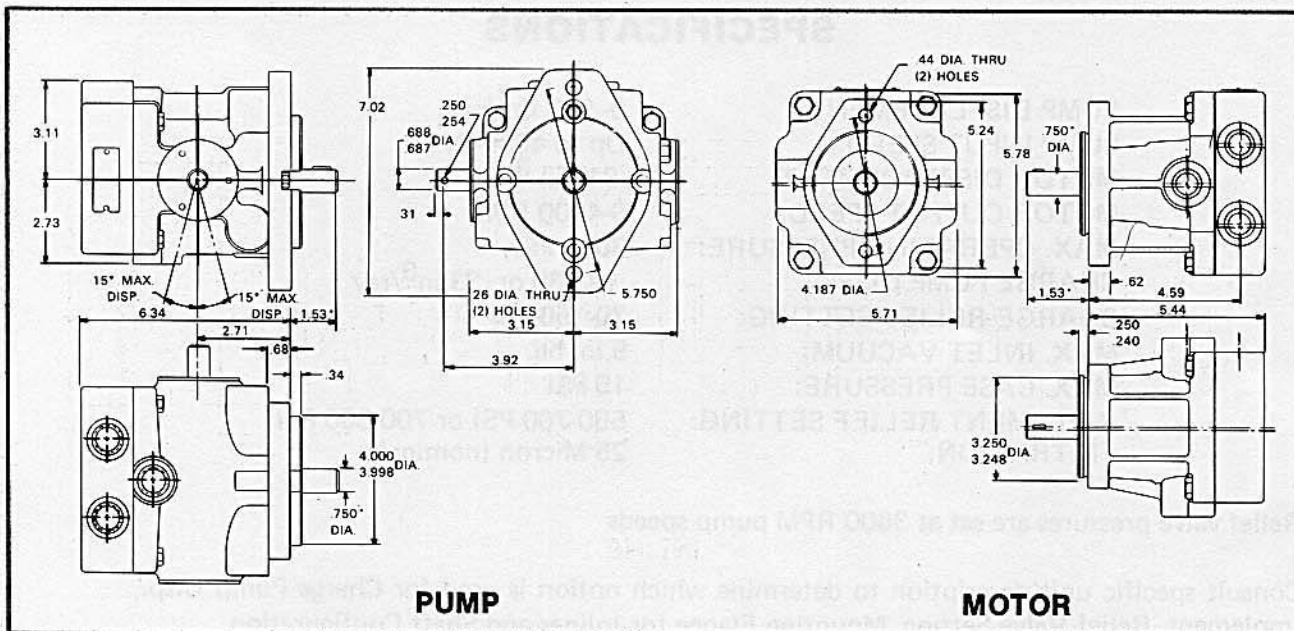
Consult specific unit description to determine which option is used for Charge Pump Disp., Implement Relief Valve Setting, Mounting Flange for Inlines and Shaft Configuration.

# SECTION I: CONFIGURATIONS AND SPECIFICATIONS, SPLIT SYSTEM

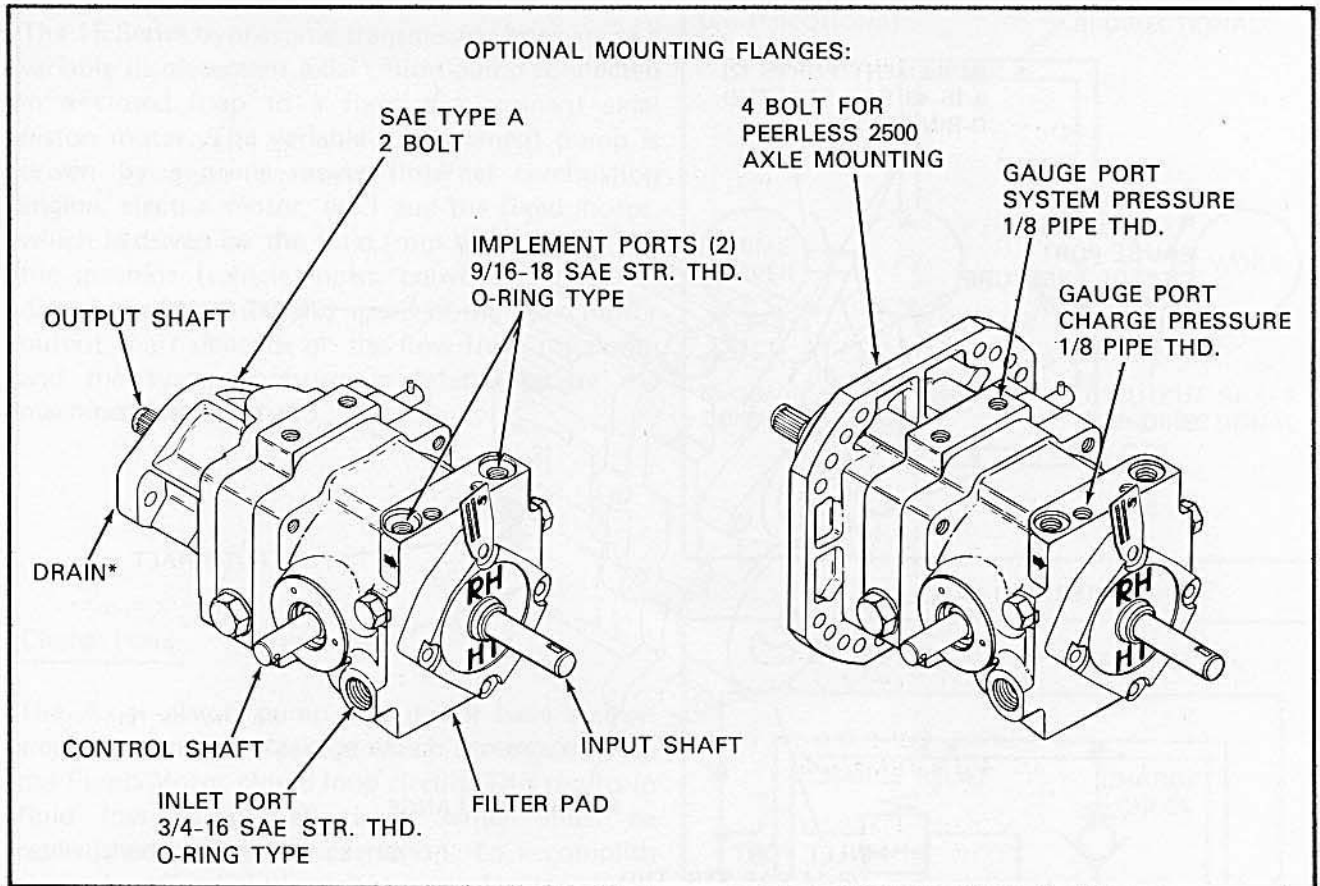


ALL PORTS ARE SAE STRAIGHT THREAD O-RING TYPE EXCEPT GAUGE PORTS WHICH ARE 1/8 PIPE THREAD

PORT A	PORT B	DRAIN PORT	INLET PORT	IMPLEMENT PORT
3/4-16	3/4-16	3/4-16	3/4-16	9/16-18

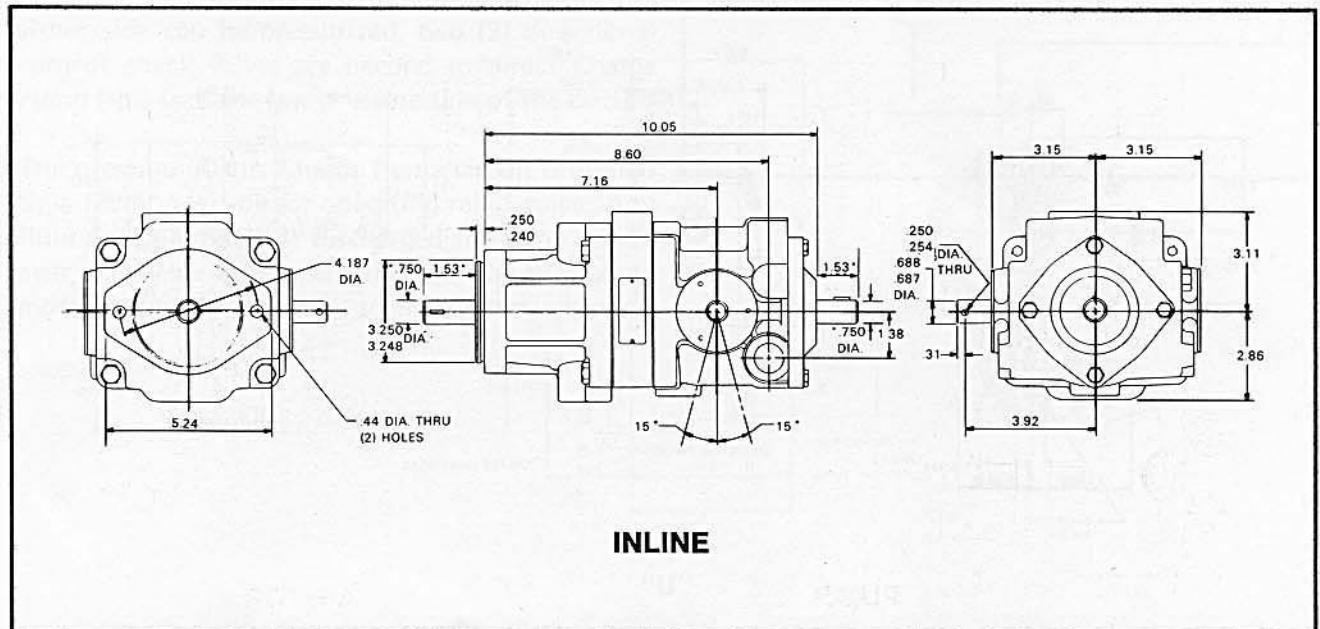


# SECTION I: CONFIGURATIONS AND SPECIFICATIONS, INLINE TYPE

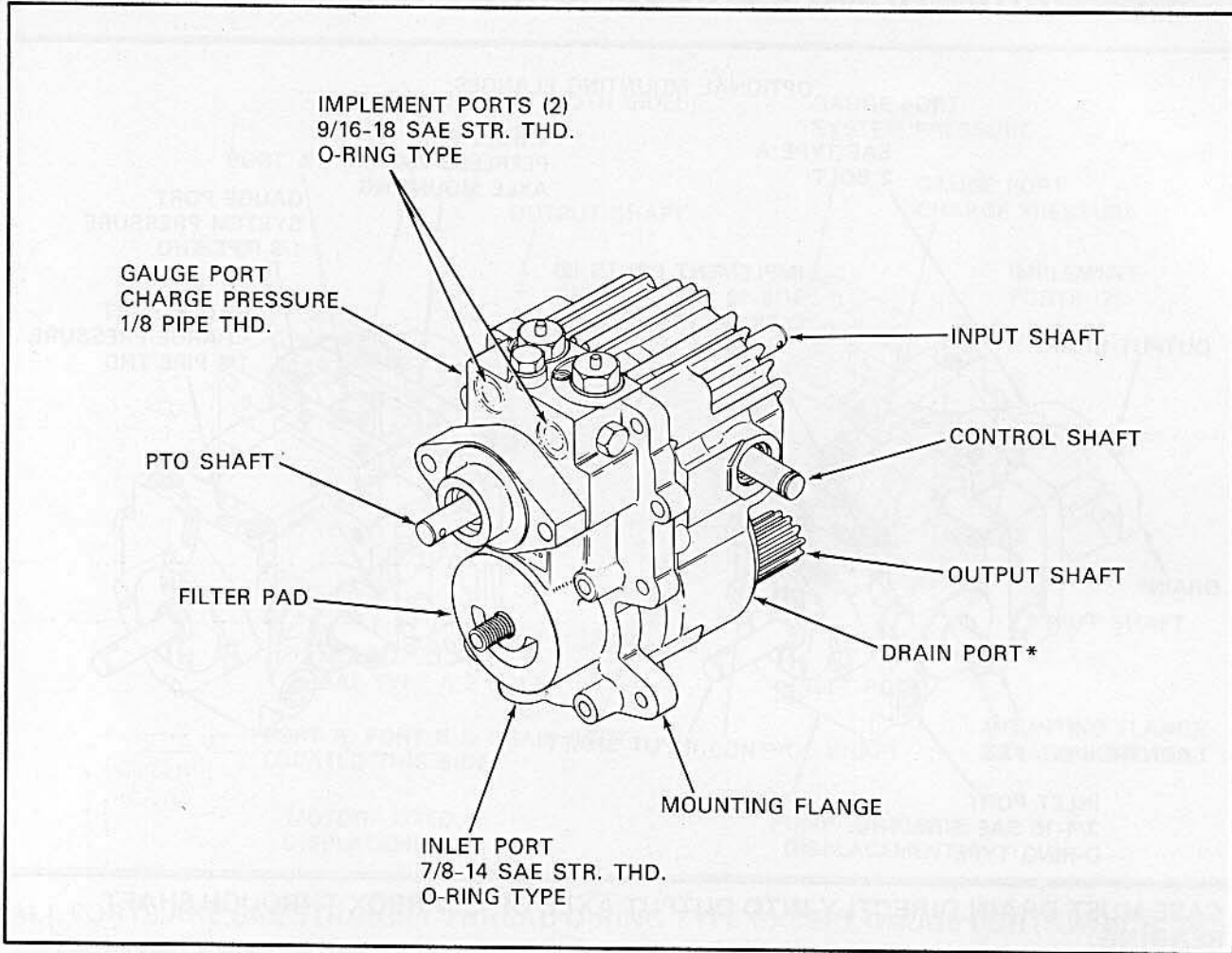


\* CASE MUST DRAIN DIRECTLY INTO OUTPUT AXLE OR GEARBOX THROUGH SHAFT BEARING.

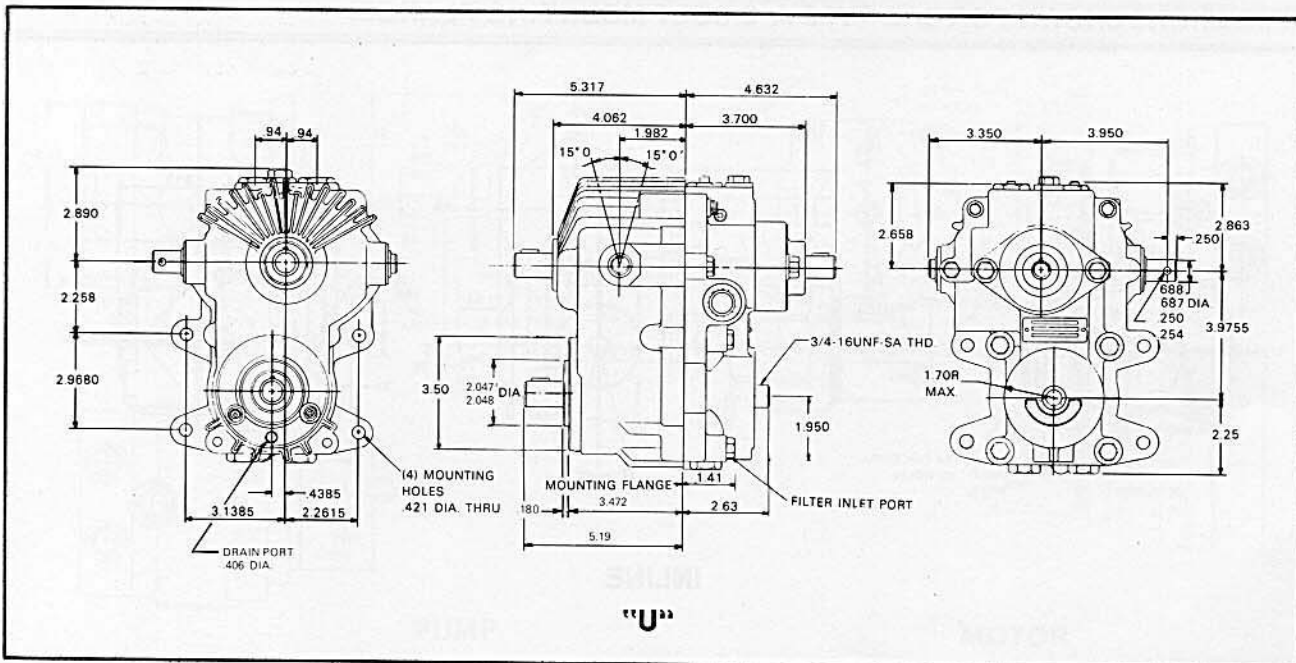
DIMENSIONS SHOWN FOR SAE TYPE A 2 BOLT MOUNTING FLANGE.



# SECTION I: CONFIGURATIONS AND SPECIFICATIONS, U TYPE



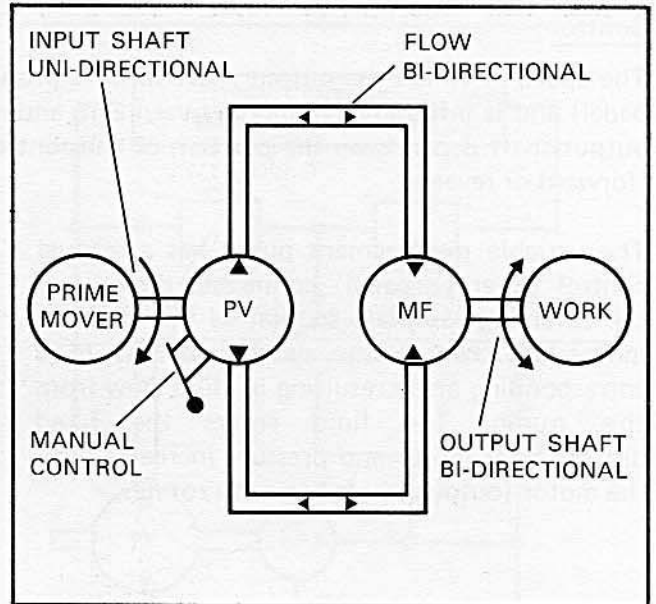
\* CASE MUST DRAIN DIRECTLY INTO OUTPUT AXLE OR GEARBOX THROUGH .406 DIA. PORT.



## SECTION II: SYSTEM CIRCUIT DESCRIPTION

### Pump/Motor

The 15 Series hydrostatic transmission consists of a variable displacement axial piston pump connected in a closed loop to a fixed displacement axial piston motor. The variable displacement pump is driven by a prime mover (internal combustion engine, electric motor, etc.) and the fixed motor, which is driven by the fluid from the pump, drives the machine (vehicle, hoist, conveyor, etc). The direction of rotation and speed of the fixed motor output shaft depends on the flow from the pump and the system pressure is determined by the machine load.

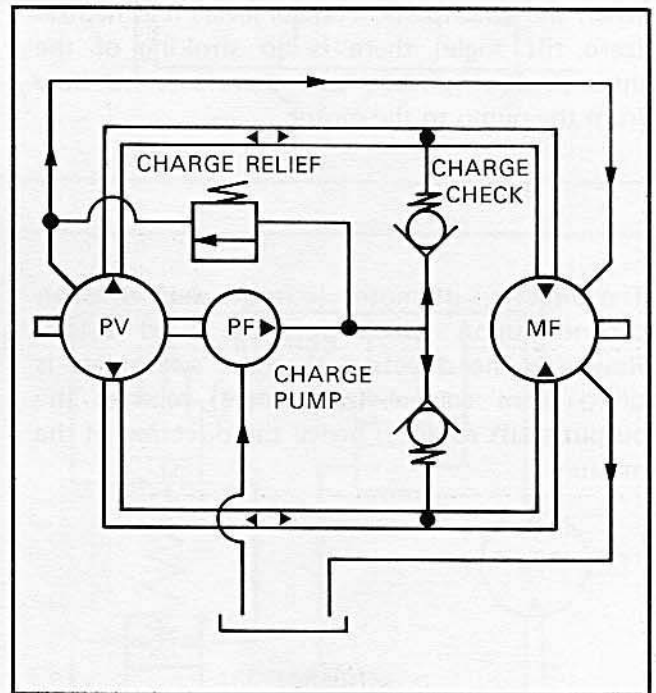


### Charge Pump

The Axial piston pump and motor have a small amount of internal leakage which is removed from the Pump/Motor closed loop circuit. This results in fluid loss from that circuit which must be replenished to prevent cavitation. To accomplish this task, a fixed displacement pump (gerotor type) is used. It is driven directly by the prime mover through the variable displacement pump shaft. This Charge Pump provides a predetermined amount of fluid that is used by the Pump/Motor circuit as required to replenish leakage losses.

Since the Pump/Motor circuit is a closed loop, and either side can be pressurized, two (2) directional control check valves are needed to direct Charge Pump flow into the low pressure side of the circuit.

The pressure in this Charge Pump circuit is limited by a factory set, direct operating relief valve. Any fluid not being used is discharged from the circuit over this valve and passes through the pump and motor housings and back to the system reservoir.





## SECTION II: SYSTEM CIRCUIT DESCRIPTION

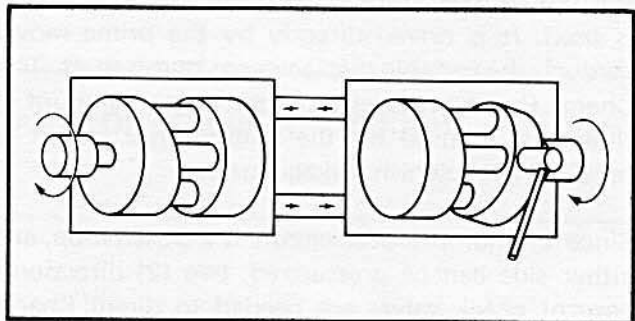
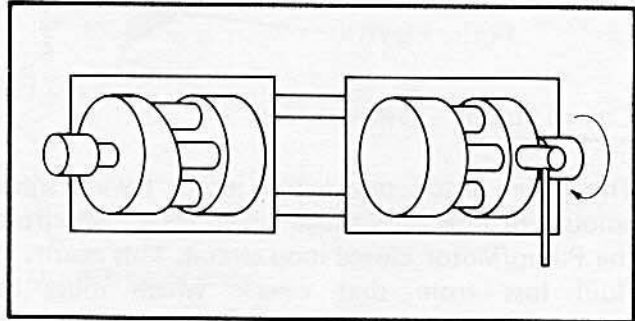
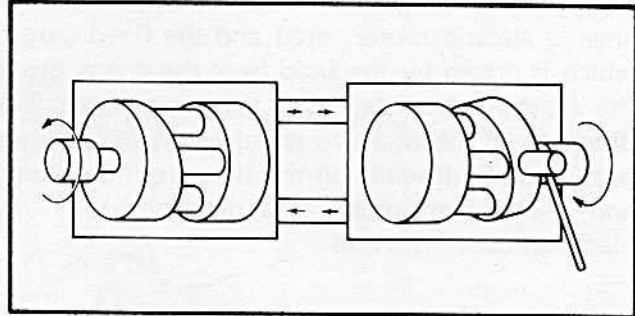
### Control

The speed at which the output shaft turns is proportional to the position of the control lever (or pedal) and is infinitely variable between zero and maximum speed. The direction of rotation of the output shaft depends on the position of the control lever (pedal) in relation to the neutral position (forward or reverse).

The variable displacement pump has a manual control (lever or pedal) connected directly to the tiltable swashplate so that as the operator moves the control, the swashplate tilts to a corresponding angle resulting in fluid flow from the pump. The fluid enters the fixed displacement motor and pressure increases until the motor (output) shaft begins to rotate.

When the swashplate (control lever) is at neutral (zero tilt angle) there is no stroking of the internal axial pistons and therefore, no flow from the pump to the motor.

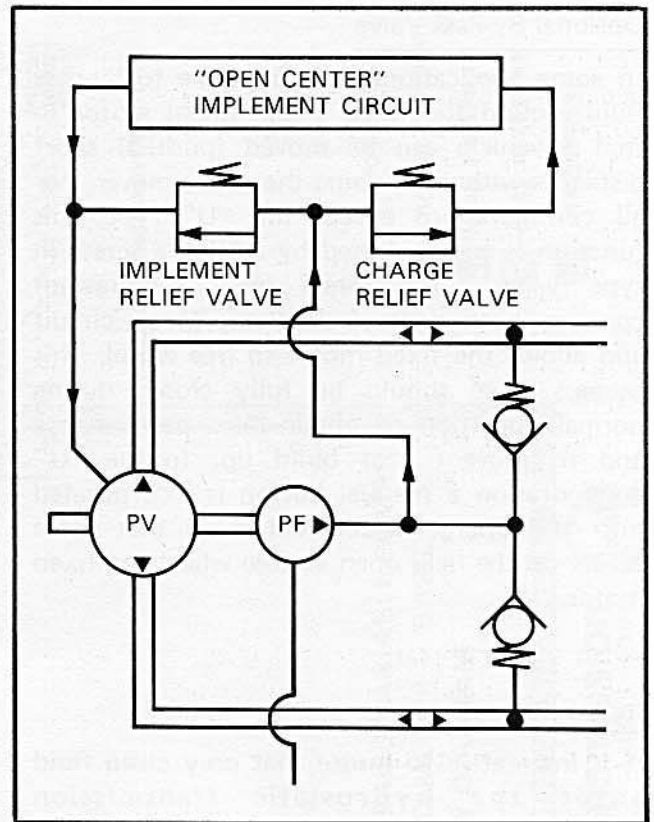
The direction of motor (output) shaft rotation depends upon which port the fluid enters. Reversing the direction that the swashplate is tilted from neutral (zero angle) reverses the output shaft rotation hence the direction of the machine.



## SECTION II: SYSTEM CIRCUIT DESCRIPTION

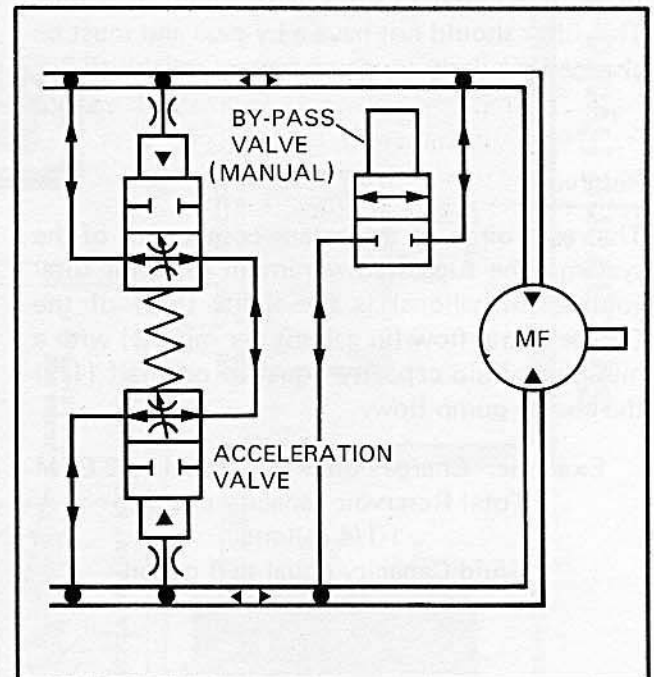
### Optional Implement Relief Valve

In many applications it is desirable to operate auxiliary equipment or implements with the excess Charge Pump supply. In these cases a second relief valve is added to the transmission circuit which allows intermittent operation of the Charge Pump at higher pressure (up to 800 PSI). The Implement Circuit must be of the "Open Center" type so that when not in operation the excess Charge Pump flow spills across the Charge Relief Valve, which is set at normal Charge pressure, through the Implement Circuit and into the pump housing. When the Implement Circuit is being operated the charge pressure can build up to the higher setting of the Implement Relief Valve.



### Optional Acceleration Valves (Not available on "U" Configurations)

One of the characteristics of a closed loop system is its instantaneous response to control input signals. This characteristic may not be desirable in some applications. Acceleration control valves can be added to give a desirable machine response rate. These valves consist of spring loaded spools that by-pass some of the pump flow around the fixed motor so maximum flow does not reach the motor instantly even though a maximum command has been given (control stroked rapidly). These valves close at a predetermined rate as system pressure increases giving a safe response rate.



## SECTION II: SYSTEM CIRCUIT DESCRIPTION

### Optional By-Pass Valve

In some applications it is desirable to by-pass fluid around the fixed displacement motor so that a vehicle can be moved (pushed) short distances without running the prime mover. For all configurations except the "U" type, this function is accomplished by adding a screw in type valve which when open (unscrewed) connects both sides of the Pump/Motor circuit and allows the fixed motor to free wheel. This by-pass valve should be fully closed during normal operation to obtain max. performance and to prevent heat build up. In the "U" configuration a manual button is incorporated into the Charge Check Valves so that these valves can be held open to free wheel the fixed motor.

### Inlet Filter

It is imperative to insure that only clean fluid enter the hydrostatic transmission circuit; therefore, a 25 micron (nominal rating) filter is required in the Charge Pump inlet line. This filter should not have a by-pass and must be changed regularly to insure system reliability.

### Reservoir

The reservoir is an important component of the system. The suggested minimum reservoir total volume (in gallons) is five-eighths (5/8) of the Charge Pump flow (in gallons per minute) with a minimum fluid capacity equal to one-half (1/2) the charge pump flow.

Example: Charge Pump flow equal to 2 GPM  
Total Reservoir capacity equal to  
1-1/4 gallons  
Fluid Capacity equal to 1 gallon

The Charge Pump inlet port in the reservoir must be above the bottom of the reservoir and must always be covered with fluid.

The return port should be located as far from the inlet port as possible to provide maximum dwell time of the fluid in the reservoir. The returning fluid must always discharge below the fluid level.

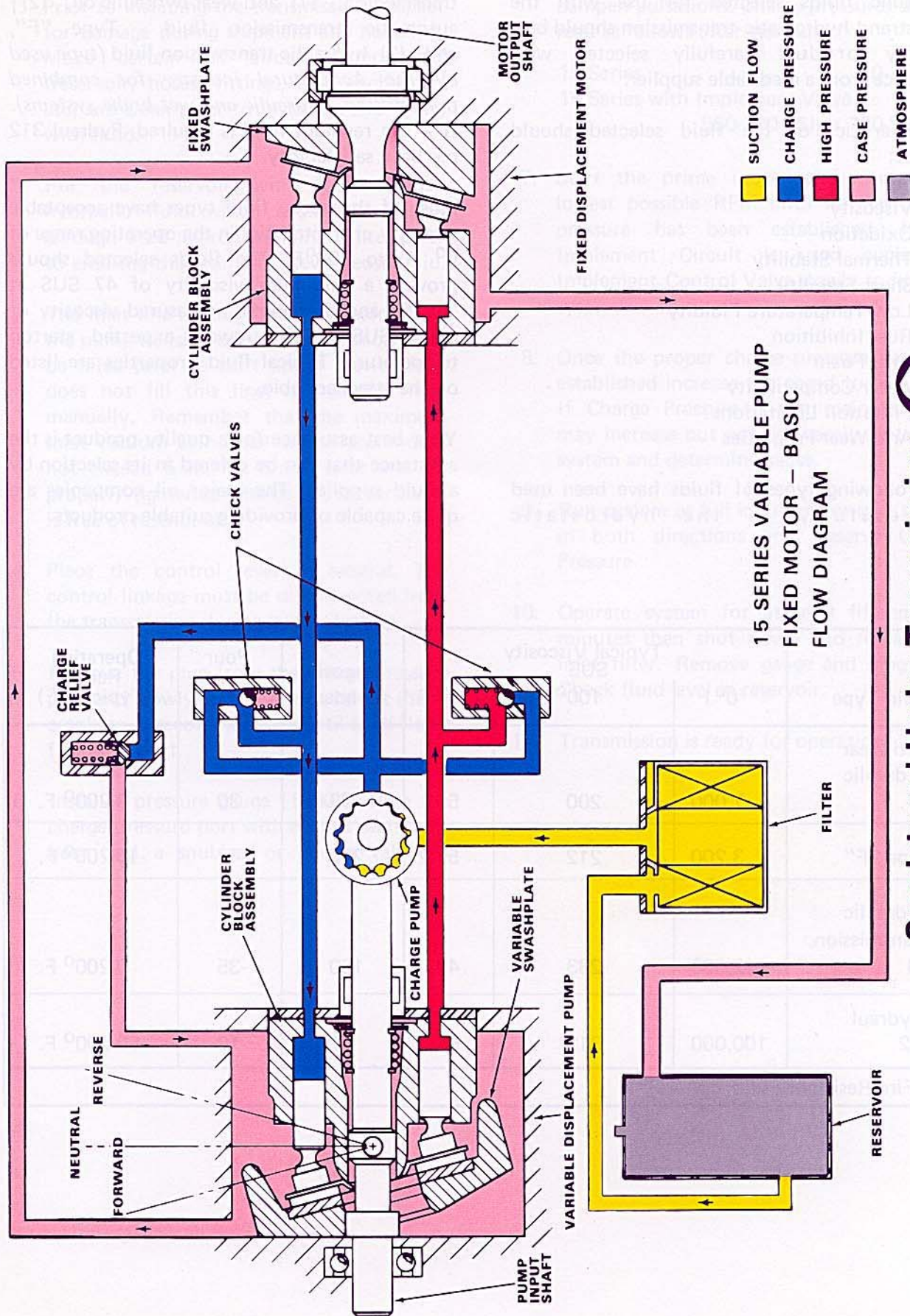
If an open or air breathing reservoir is used, the air breather must be of sufficient capacity to prevent excessive contamination from airborne particles.

### Heat Exchanger

The hydrostatic transmission should not exceed 200°F as a continuous operating temperature. To maintain this maximum temperature may require the addition of a Heat Exchanger in the line returning fluid to the reservoir. The optimum Heat Exchanger should be capable of dissipating at least 25% of the maximum input horsepower to the transmission.

Example: Maximum Input Horsepower at  
8 HP  
Heat Exchanger Capacity at 2 HP

# SECTION II: SYSTEM CIRCUIT DESCRIPTION



**Sundstrand Hydro-Transmission**  
 AMES, IOWA 50010  
 division of Sundstrand Corporation

**SUNSTRAND**<sup>®</sup>

## SECTION III: FLUID RECOMMENDATIONS

Hydraulic fluids selected for use with the Sundstrand hydrostatic transmission should be a quality product carefully selected with assistance from a creditable supplier.

Characteristics of the fluid selected should include:

- Viscosity
- Oxidation
- Thermal Stability
- Shear Stability
- Low Temperature Fluidity
- Rust Inhibition
- Anti Foam
- Water Compatibility
- Filtration Limitations
- Anti-Wear Properties

The following types of fluids have been used successfully in the hydrostatic

transmission: (1) anti-wear hydraulic oil, (2) automatic transmission fluid - Type "F", and (3) hydraulic transmission fluid (*type used by the Agricultural industry for combined transmission, hydraulic and wet brake systems*). If a fire resistant fluid is required, Pydraul 312 has been satisfactory.

Most of the above fluid types have acceptable viscosity characteristics in the operating range of 0° F. to 200°F. The fluids selected should provide a minimum viscosity of 47 SUS at 210°F. and a maximum measured viscosity of 6000 SUS at the lowest expected startup temperature. Typical fluid properties are listed on the attached table.

Your best assurance for a quality product is the assistance that can be offered in its selection by a fluid supplier. The major oil companies are quite capable of providing suitable products.

Fluid Type	Typical Viscosity SUS			Viscosity Index	Pour Point °F	Operating Range (Typical °F)
	0° F	100° F	210° F			
Anti-Wear Hydraulic Oil	7,000	200	50	130	-30	0-200° F.
Type "F"	3,200	212	57.2	208	-40	-15-200° F.
Hydraulic Transmission Oil	12,000	233	49	100	-35	0-200° F.
*Pydraul 312	100,000	312	51	77	-10	50-200° F.
* Fire Resistant Fluid						

## SECTION IV: START UP PROCEDURE

1. Prior to installing the transmission, inspect for damage during shipment and handling. Make certain all circuit components (reservoir, hoses, fittings, heat exchanger, etc) are clean prior to installing and filling with fluid.
2. Fill the reservoir with recommended hydraulic fluid which should be passed through a 25 micron (nominal) filter prior to entering the reservoir. Never reuse fluid.
3. The inlet line leading from the reservoir to the pump housing on the transmission must be filled prior to start up. If gravity feed does not fill this line, it must be filled manually. Remember that the maximum inlet vacuum at normal conditions should not exceed 5 in. hg. Check inlet line for properly tightened fittings and be certain it is free of restrictions.
4. Place the control lever in neutral. The control linkage must be disconnected from the transmission during initial start up.
5. Remove the plug from the charge pressure port and slowly turn the input shaft (hand cranking is recommended) until fluid flows from this port.
6. Install a pressure gauge (1000 PSI) in the charge pressure port with a short section of hose and a snubber or needle valve to dampen pulsations. Charge pressures should read as follows after start up:

15 Series	70-150 PSI
15 Series with Implement Valve	550-700 PSI or 700-800 PSI
7. Start the prime mover and run at the lowest possible RPM until normal charge pressure has been established. If an Implement Circuit is used cycle the Implement Control Valve slowly to fill that system.
8. Once the proper charge pressure has been established increase the speed to full RPM. If Charge Pressure is not maintained (it may increase but not decrease), shut down system and determine cause.
9. Run system at full input and output speeds in both directions and observe Charge Pressure.
10. Operate system for at least fifteen (15) minutes then shut down and replace the inlet filter. Remove gauge and plug port. Check fluid level in reservoir.
11. Transmission is ready for operation.

## SECTION V: SYSTEM MAINTENANCE

The hydrostatic transmission and related system components, no matter how perfectly matched to the machine, will not give satisfactory service without proper and regular system maintenance of the following major areas.

### Fluid

The hydraulic fluid should be changed at least every 2000 hours of operation when a sealed reservoir is used.

An open (air breathing) reservoir should have the hydraulic fluid changed at least every 500 hours.

If the fluid becomes contaminated with any foreign material (dirt, water, solvent, grease, etc) or has been subjected to abnormal operating conditions, the fluid should be changed more frequently.

Use only the fluid recommended for the equipment.

### Filters

The charge pump inlet filter must be changed at least every 500 hours when a sealed reservoir is used.

When an open (air breathing) reservoir is used, the filter must be replaced at least every 100 hours.

The air breather on an open reservoir must be replaced or cleaned every 500 hours.

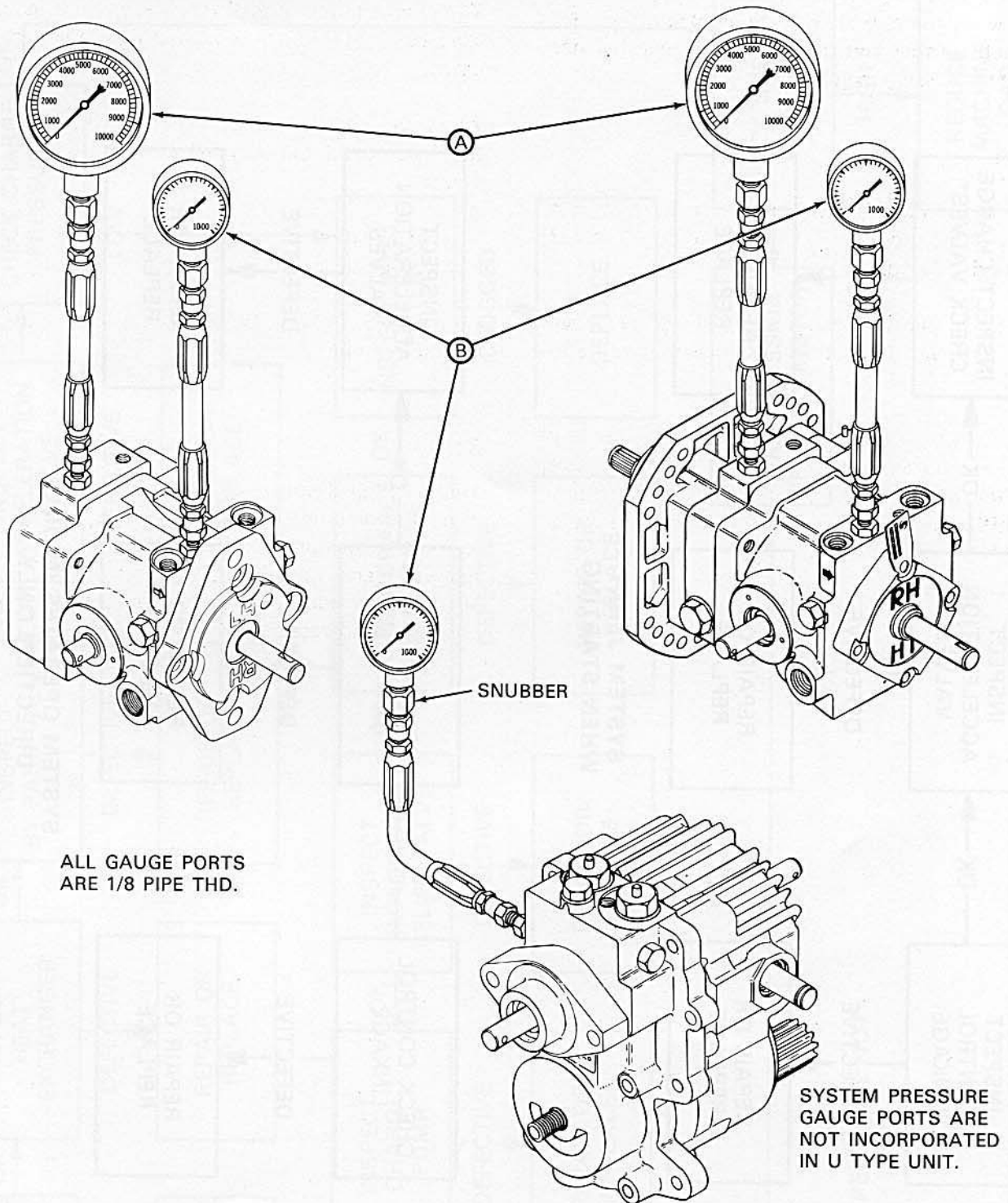
Filters should always be replaced when changing hydraulic fluid.

### Reservoir

The reservoir should be checked daily for proper level, the presence of water (noted by a cloudy to milky appearance or free water in bottom of reservoir) and rancid odor (indicates excessive heat). When adding fluid to the reservoir, use only the fluid recommended for the equipment.

## SECTION VI: TROUBLE SHOOTING PROCEDURES

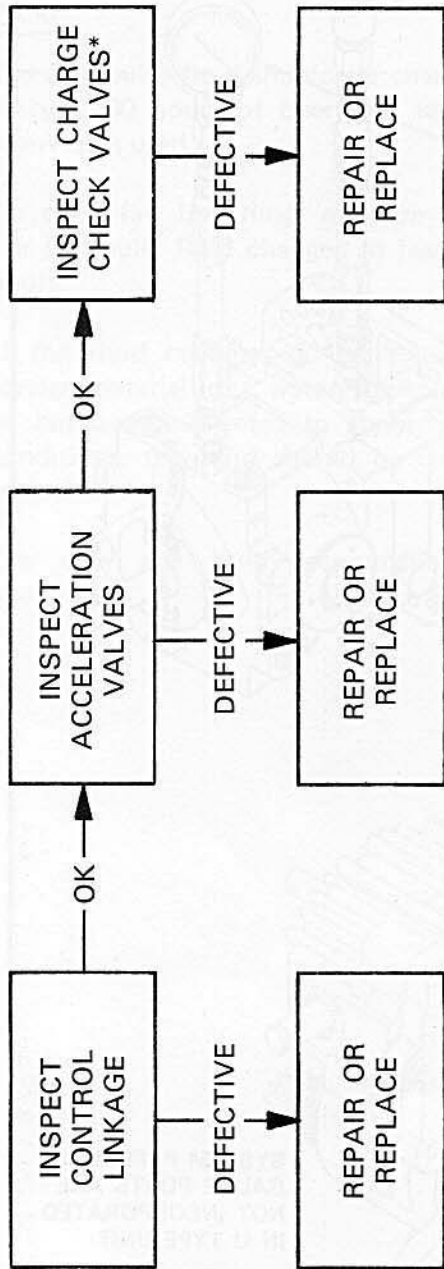
### TYPICAL GAUGE INSTRUCTION



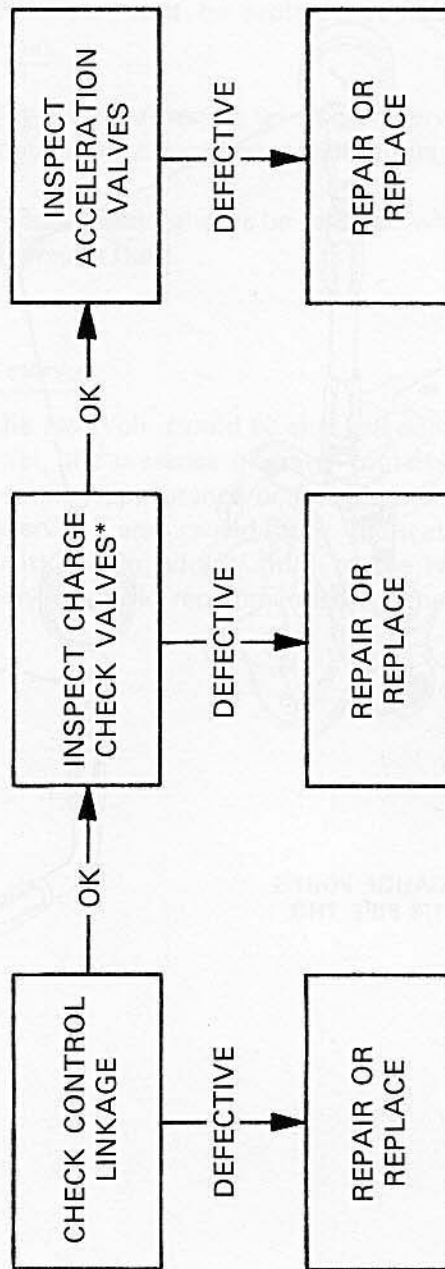
- (A) SYSTEM PRESSURE GAUGE WITH 0 TO 5000 PSI RANGE
- (B) CHARGE PRESSURE GAUGE WITH 0 TO 1000 PSI RANGE  
SNUBBERS ARE RECOMMENDED TO PROTECT GAUGES AND FREQUENT GAUGE CALIBRATION IS NECESSARY TO INSURE ACCURACY.  
INPUT SPEED SHOULD BE AT OR NEAR MAX. RPM WHEN TAKING GAUGE READINGS.



# SECTION VI: TROUBLE SHOOTING PROCEDURES



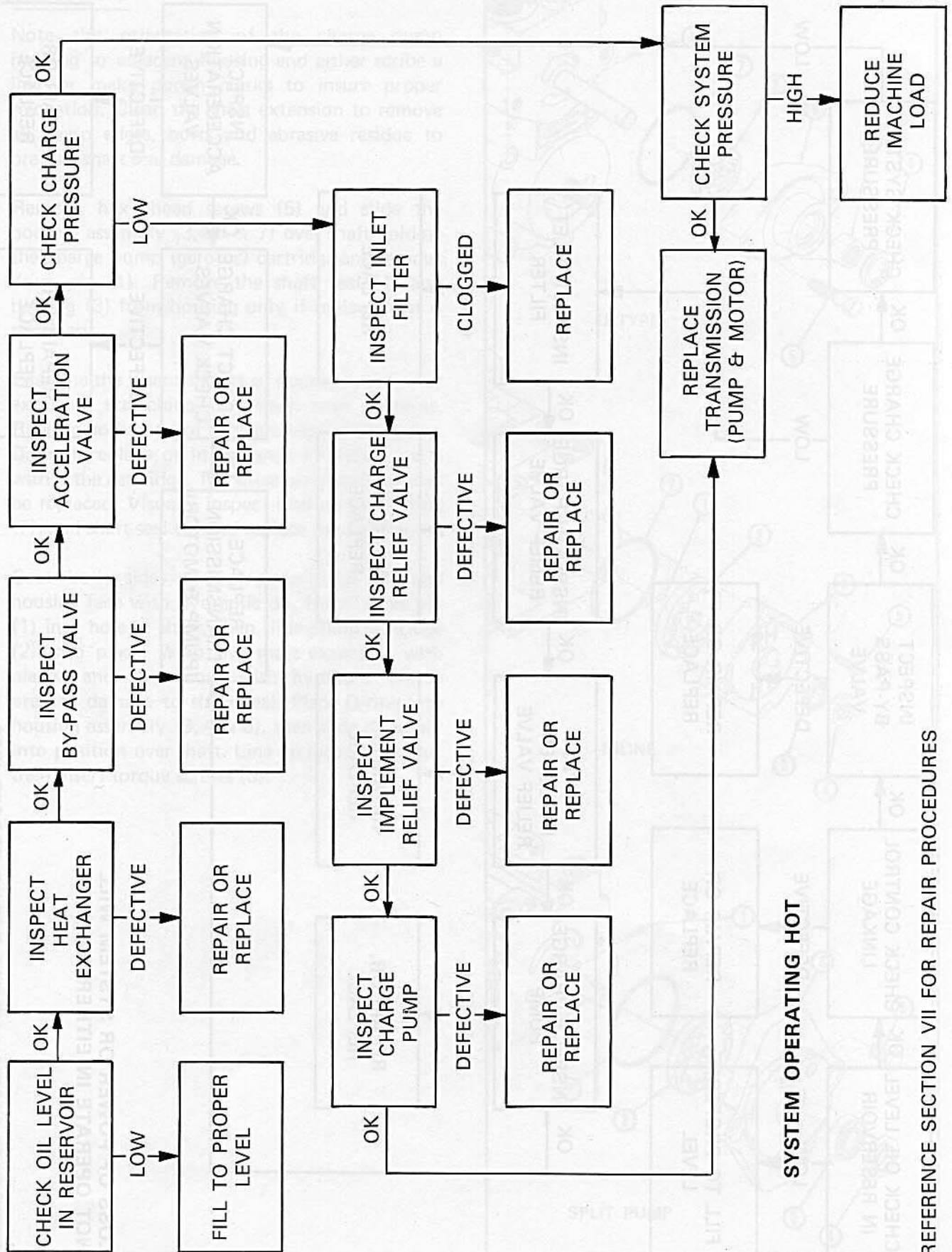
SYSTEM JERKY  
WHEN STARTING



SYSTEM OPERATES IN ONE  
DIRECTION ONLY

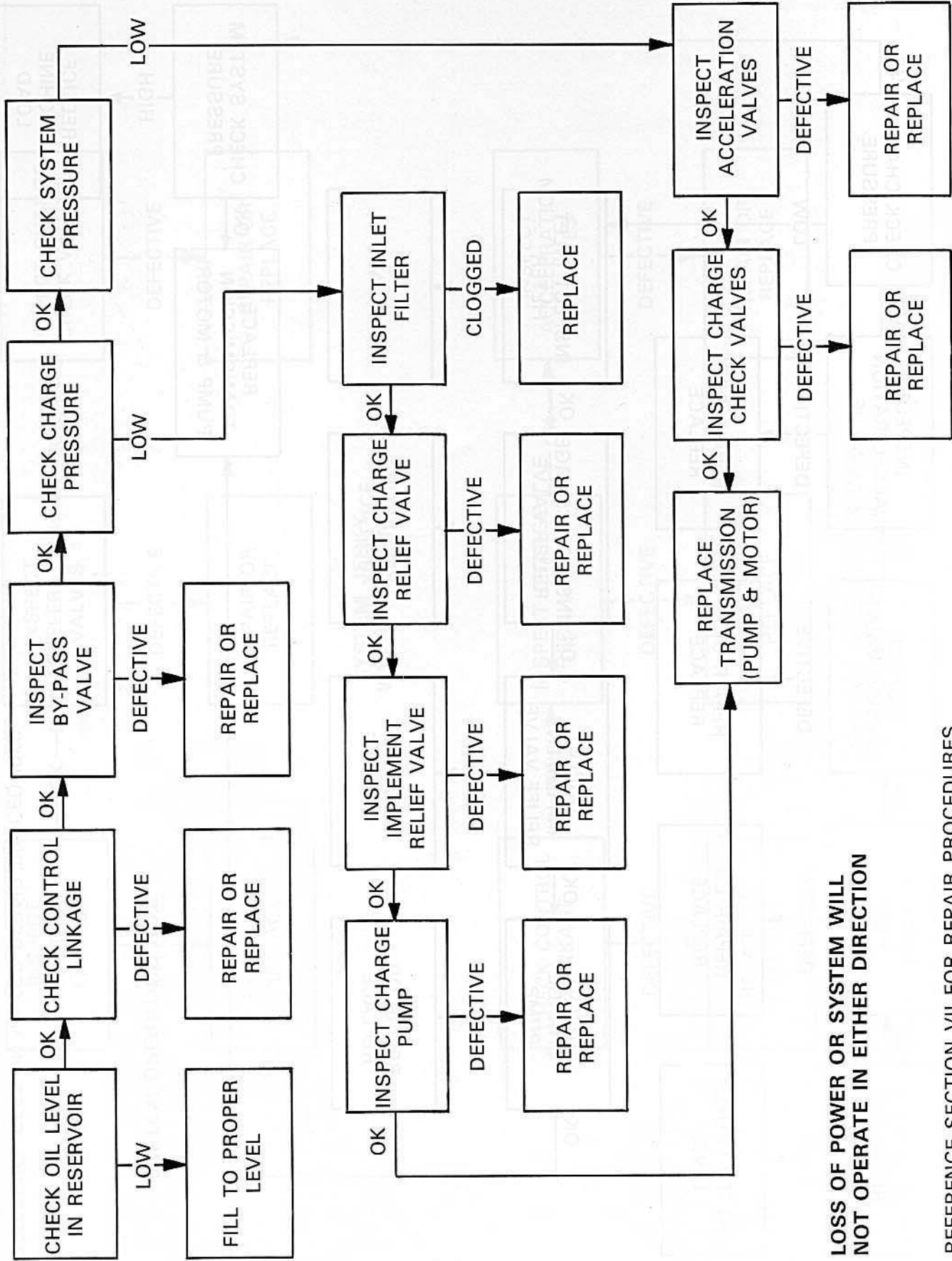
\*APPLIES TO "U" TYPE ONLY  
REFERENCE SECTION VII FOR REPAIR PROCEDURES

# SECTION VI: TROUBLE SHOOTING PROCEDURES



REFERENCE SECTION VII FOR REPAIR PROCEDURES

# SECTION VI: TROUBLE SHOOTING PROCEDURES



**LOSS OF POWER OR SYSTEM WILL NOT OPERATE IN EITHER DIRECTION**

REFERENCE SECTION VII FOR REPAIR PROCEDURES

## SECTION VII: REPAIR PROCEDURES, 15 SERIES, ALL TYPES

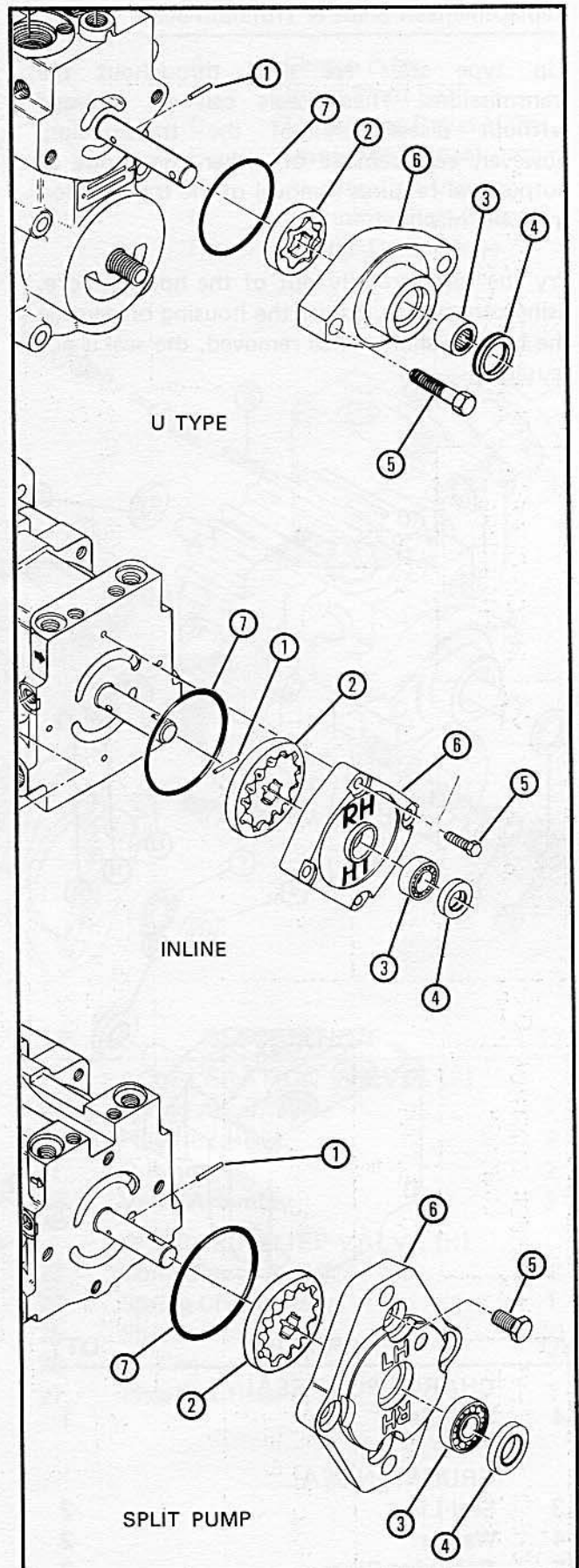
### Charge Pump

Note the orientation of the charge pump housing to adjacent housing and either scribe a line or make punch marks to insure proper relocation. Clean the shaft extension to remove all sharp edges, burrs and abrasive residue to prevent shaft seal damage.

Remove hex. head screws (5) and slide the housing assembly (3,4,6 & 7) over shaft holding the charge pump (gerotor) cartridge and remove drive pin (1). Remove the shaft seal (4) and bearing (3) from housing only if replacement is necessary.

Examine the wear surfaces of pump cartridge for excessive scratching or heavy wear patterns. Replace both parts of this cartridge, if necessary. Do not replace or interchange individual parts within the cartridge. The drive pin should always be replaced. Visually inspect bearing (3), O-ring (7), and shaft seal (4) and replace as required.

Coat both sides of pump cartridge (2) and housing face with hydraulic oil. Install drive pin (1) into hole in shaft, then slide pump cartridge (2) into place. Wrap the shaft extension with plastic and then coat with hydraulic oil to prevent damage to shaft seal. Place O-ring into housing assembly (3, 4 & 6), then slide assembly into position over shaft. Line up location marks, then insert torque screws (5).



## SECTION VII: REPAIR PROCEDURES, 15 SERIES, ALL TYPES

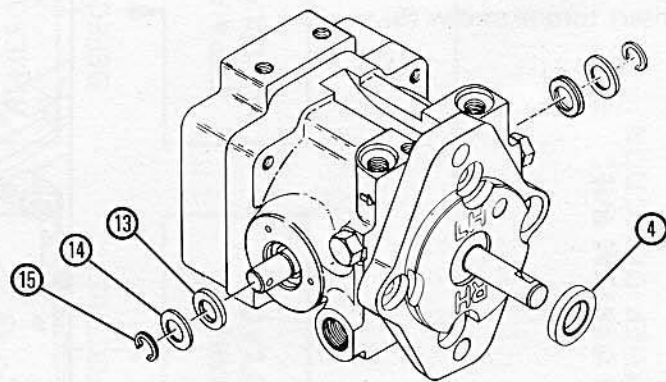
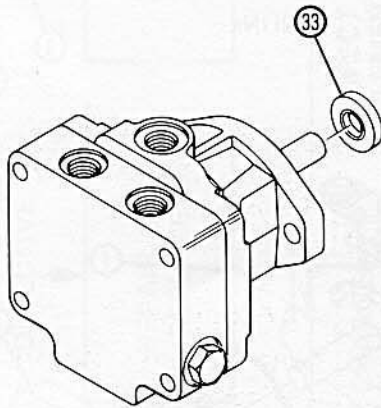
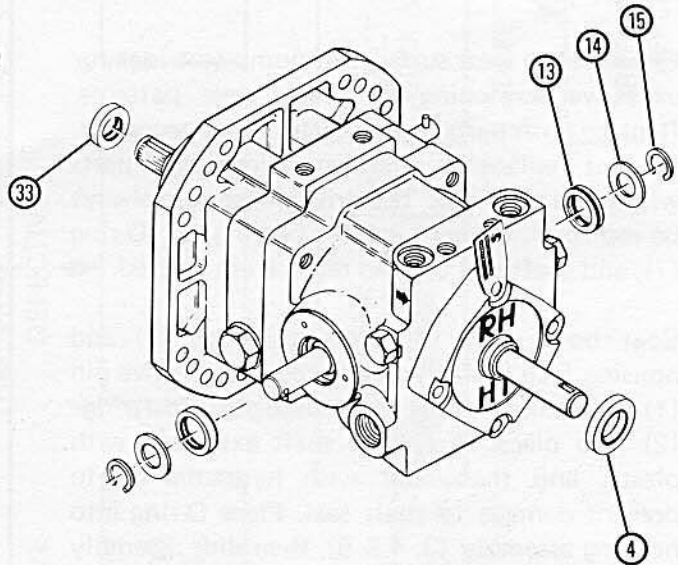
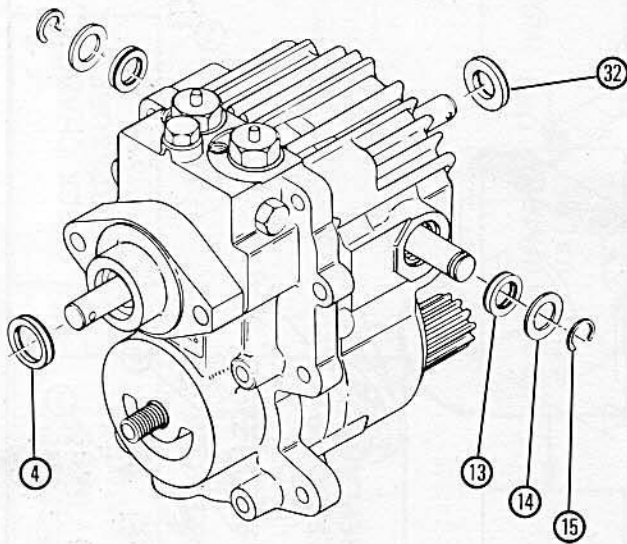
### Replacement of Shaft & Trunnion Seals

Lip type seals are used throughout the transmissions. These seals can be replaced without disassembly of the transmission; however, replacement of either the input or output seal requires removal of the transmission from the machine.

Pry the seal carefully out of the housing bore, using care not to distort the housing or damage the bore or shaft. Once removed, the seal is not reusable.

Prior to installing the new seal, polish the shaft extension, wrap it in thin plastic and lubricate with hydraulic oil to insure that the seal is not damaged during assembly. Slide the seal over the shaft and press it into the housing bore.

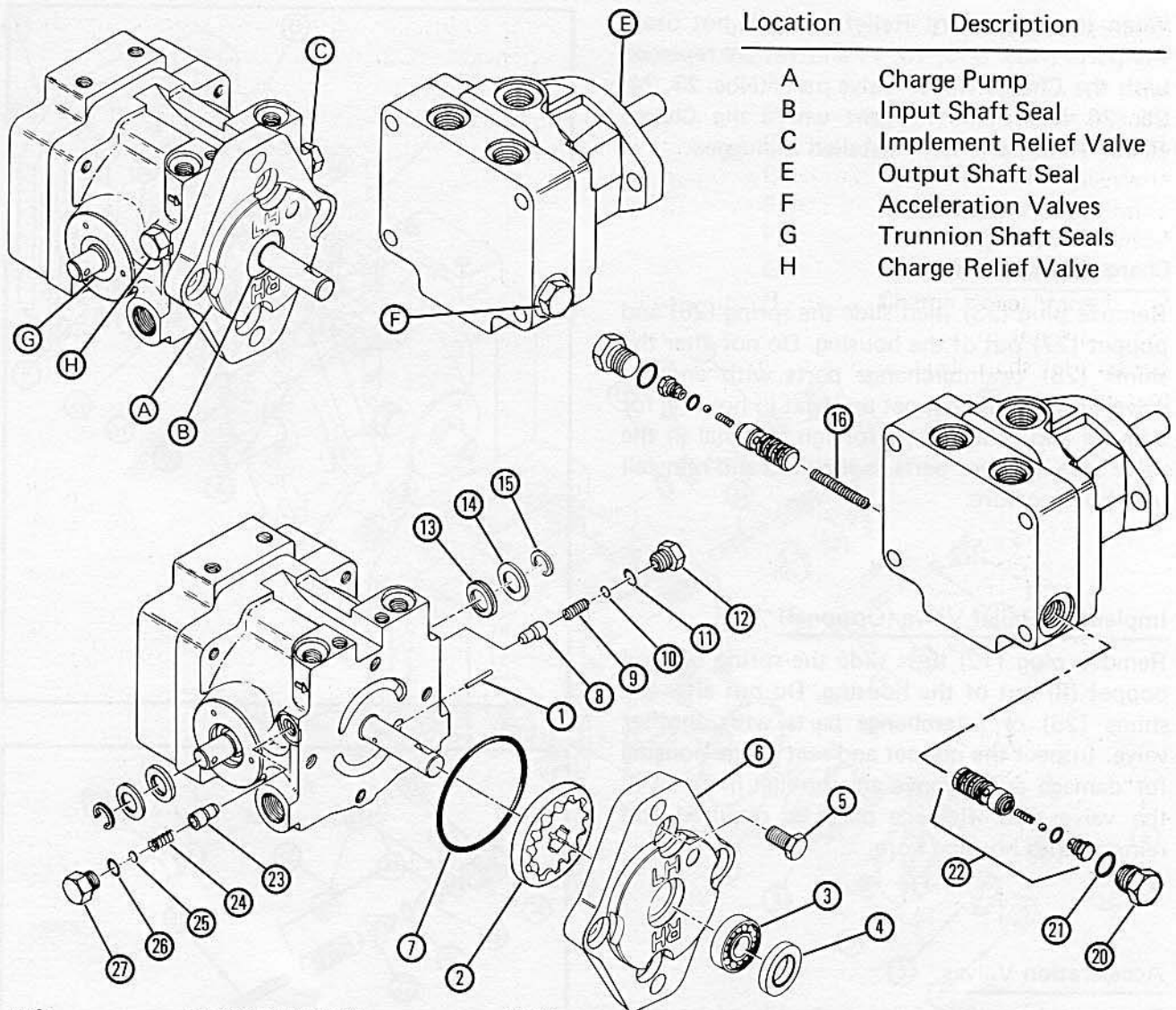
In the case of trunnion shaft seals it is necessary that the retaining rings (15) and washers (14) be removed before removing the seals. The washer should be replaced if it is noticeably bent or distorted.



NO	DESCRIPTION	QTY
4	CHARGE PUMP SEAL Seal-Lip	1
13	TRUNNION SEAL Seal-Lip	2
14	Washer	2
15	Retaining Ring	2

NO	DESCRIPTION	QTY
32	INPUT SHAFT SEAL Seal-Lip	1
33	OUTPUT SHAFT SEAL Seal-Lip	1

# SECTION VII: REPAIR PROCEDURES, 15 SERIES, SPLIT TYPE



Location	Description
A	Charge Pump
B	Input Shaft Seal
C	Implement Relief Valve
E	Output Shaft Seal
F	Acceleration Valves
G	Trunnion Shaft Seals
H	Charge Relief Valve

NO	DESCRIPTION	QTY
	<b>CHARGE PUMP (A)</b>	
1	Pin-Drive	1
2	Charge Pump (Gerotor)	1
3	Bearing	1
4	Seal-Lip	1
5	Screw-Hex. Head	4
6	Housing—Chg. Pump	1
7	O-Ring	1
	<b>IMPLEMENT RELIEF VALVE (C)</b>	
8	Cone-Implement Relief	1
9	Spring-Implement Relief	1
10	Shim	A/R
11	O-Ring	1
12	Plug-Hex.Head	1
	<b>TRUNNION SHAFT SEALS (G)</b>	
13	Seal-Lip	2
14	Washer	2
15	Retaining Ring	2

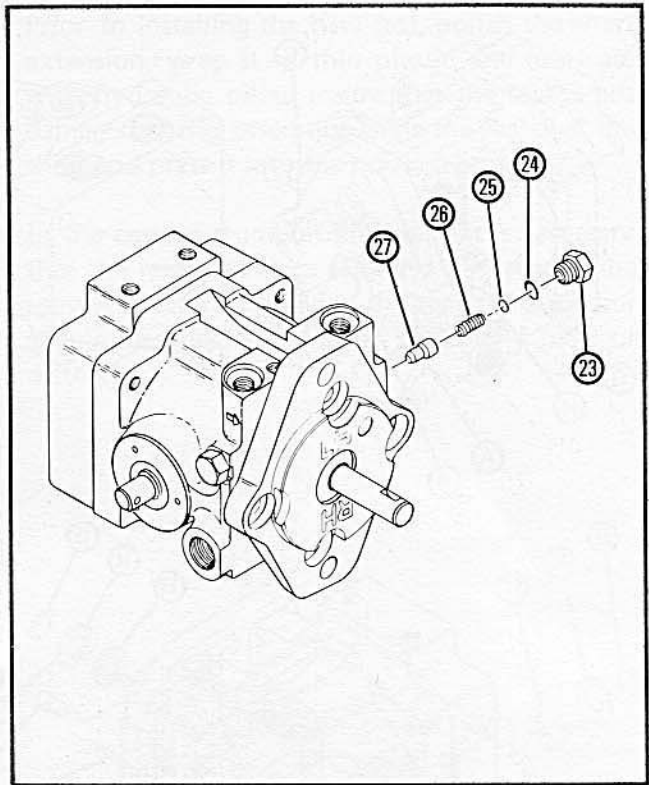
NO	DESCRIPTION	QTY
	<b>ACCELERATION VALVES (F)</b>	
16	Spring-Accel. Valve	1
20	Plug-Hex.Head	2
21	O-Ring	2
22	Valve Assembly	2
	<b>CHARGE RELIEF VALVE (H)</b>	
23	Cone-Charge Relief	1
24	Spring-Charge Relief	1
25	Shim	A/R
26	O-Ring	1
27	Plug-Hex.Head	1

## SECTION VII: REPAIR PROCEDURES, 15 SERIES, SPLIT TYPE

When the Implement Relief Valve is not used, the parts (Nos. 8, 9, 10, 11 and 12) are replaced with the Charge Relief Valve parts (Nos. 23, 24, 25, 26 and 27). The port where the Charge Relief Valve parts were installed is plugged.

### Charge Relief Valve

Remove plug (23) then slide the spring (26) and poppet (27) out of the housing. Do not alter the shims (25) or interchange parts with another valve. Inspect the poppet and seat in housing for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing bore.

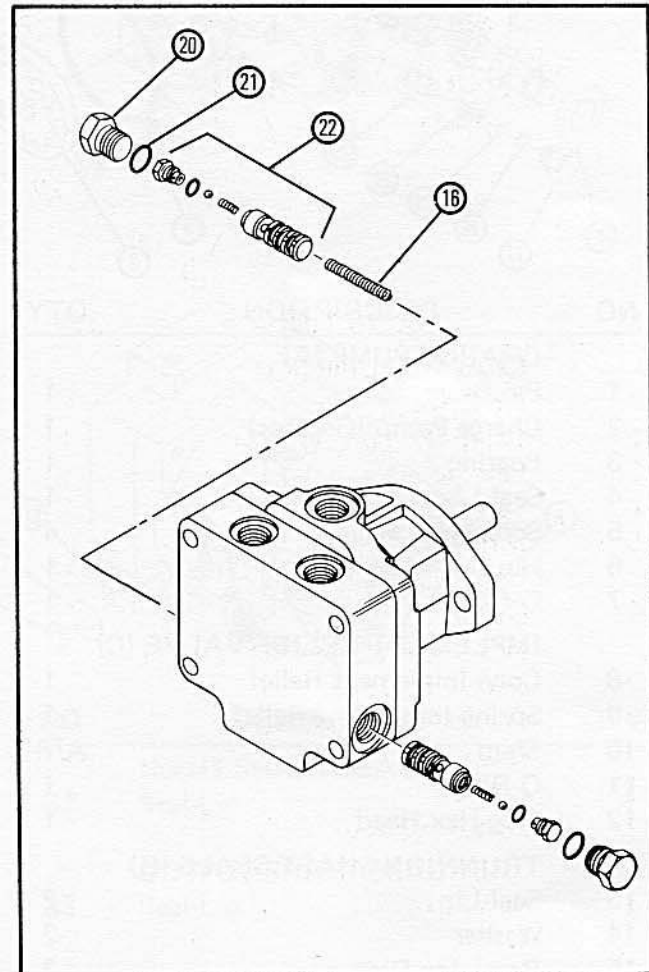


### Implement Relief Valve (Optional)

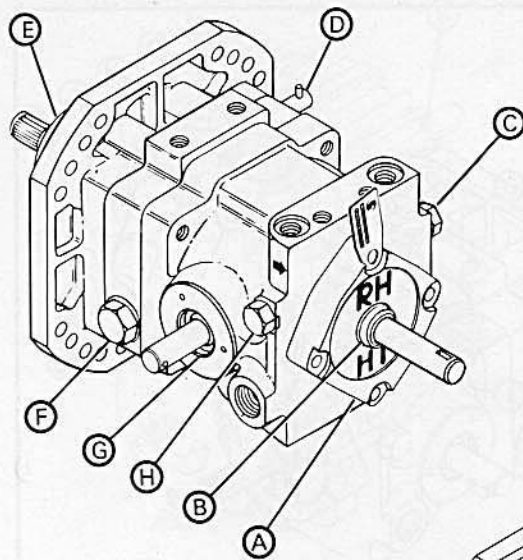
Remove plug (12) then slide the spring (9) and poppet (8) out of the housing. Do not alter the shims (25) or interchange parts with another valve. Inspect the poppet and seat in the housing for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing bore.

### Acceleration Valves

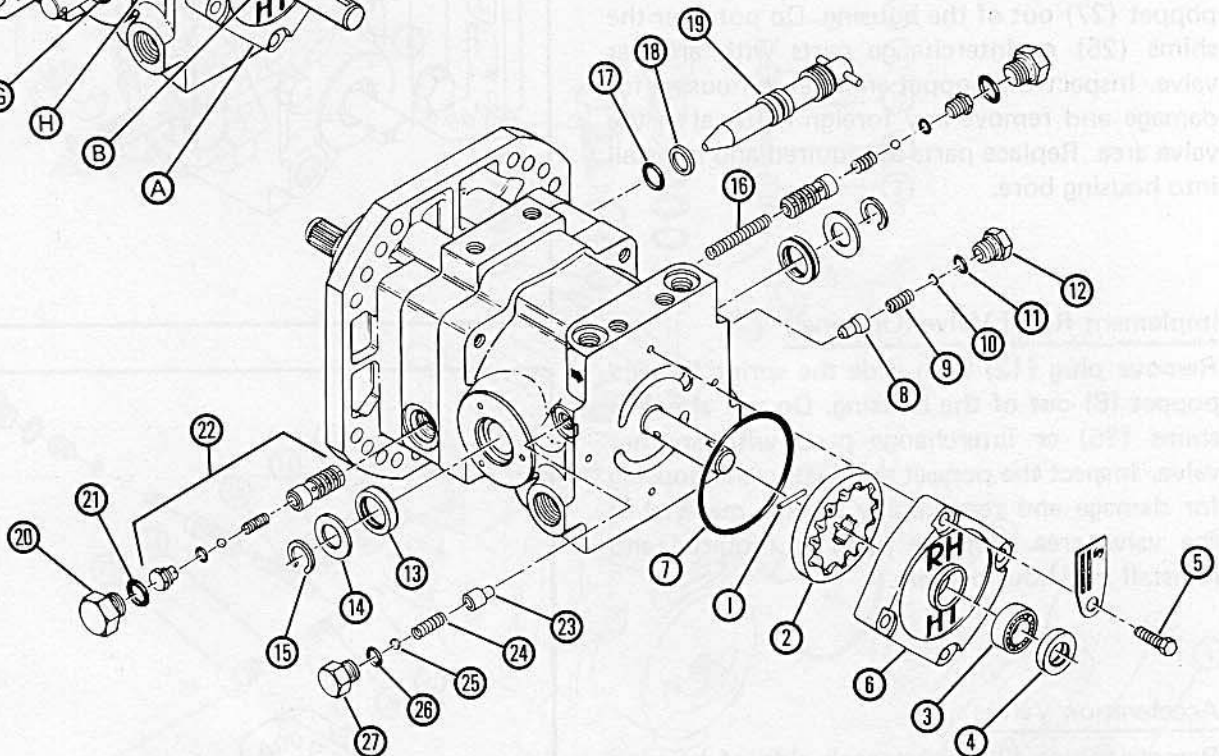
Remove plugs (20) from each side of housing and slide out one valve assembly (22) and spring (16) from one side and the other valve assembly (22) from the other side. Inspect the valves and bores for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing.



# SECTION VII: REPAIR PROCEDURES, 15 SERIES, INLINE TYPE



Location	Description
A	Charge Pump
B	Input Shaft Seal
C	Implement Relief Valve
D	By-pass Valve
E	Output Shaft Seal
F	Acceleration Valves
G	Trunnion Shaft Seals
H	Charge Relief Valve



NO	DESCRIPTION	QTY	NO	DESCRIPTION	QTY
	CHARGE PUMP (A)			ACCELERATION VALVES (F)	
1	Pin-Drive	1	16	Spring-Accel. Valve	1
2	Charge Pump (Gerotor)	1	20	Plug-Hex.Head	2
3	Bearing	1	21	O-Ring	2
4	Seal-Lip	1	22	Valve Assembly	2
5	Screw-Hex.Head	4		BY-PASS VALVE (D)	
6	Housing-Chg.Pump	1	17	O-Ring	1
7	O-Ring	1	18	Back Up Ring	1
	IMPLEMENT RELIEF VALVE (C)		19	By-Pass Valve	1
8	Cone-Implement Relief	1		CHARGE RELIEF VALVE (H)	
9	Spring-Implement Relief	1	23	Cone-Charge Relief	1
10	Shim	A/R	24	Spring-Charge Relief	1
11	O-Ring	1	25	Shim	A/R
12	Plug-Hex.Head	1	26	O-Ring	1
	TRUNNION SHAFT SEALS(G)		27	Plug-Hex.Head	1
13	Seal-Lip	2			
14	Washer	2			
15	Retaining Ring	2			

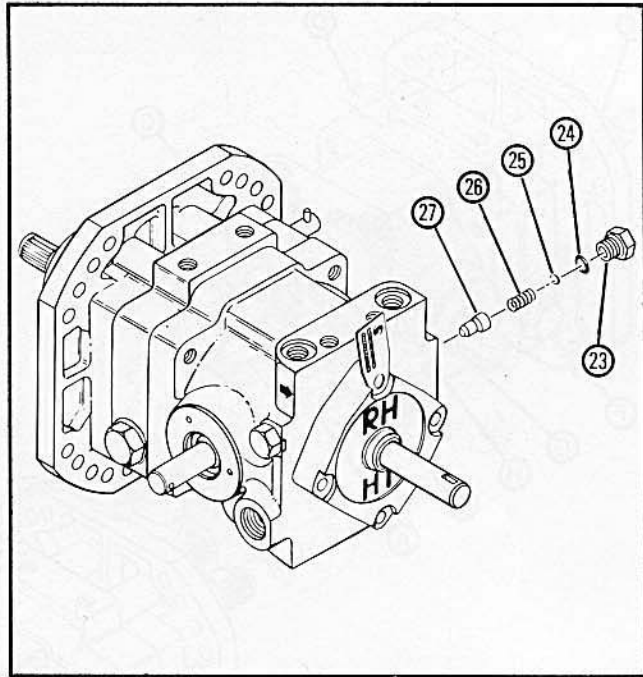


## SECTION VII: REPAIR PROCEDURES, 15 SERIES, INLINE TYPE

When the Implement Relief Valve is not used, the parts (Nos. 8, 9, 10, 11 and 12) are replaced with the Charge Relief Valve parts (Nos. 23, 24, 25, 26 and 27). The port where the Charge Relief Valve parts were installed is plugged.

### Charge Relief Valve

Remove plug (23) then slide the spring (26) and poppet (27) out of the housing. Do not alter the shims (25) or interchange parts with another valve. Inspect the poppet and seat in housing for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing bore.

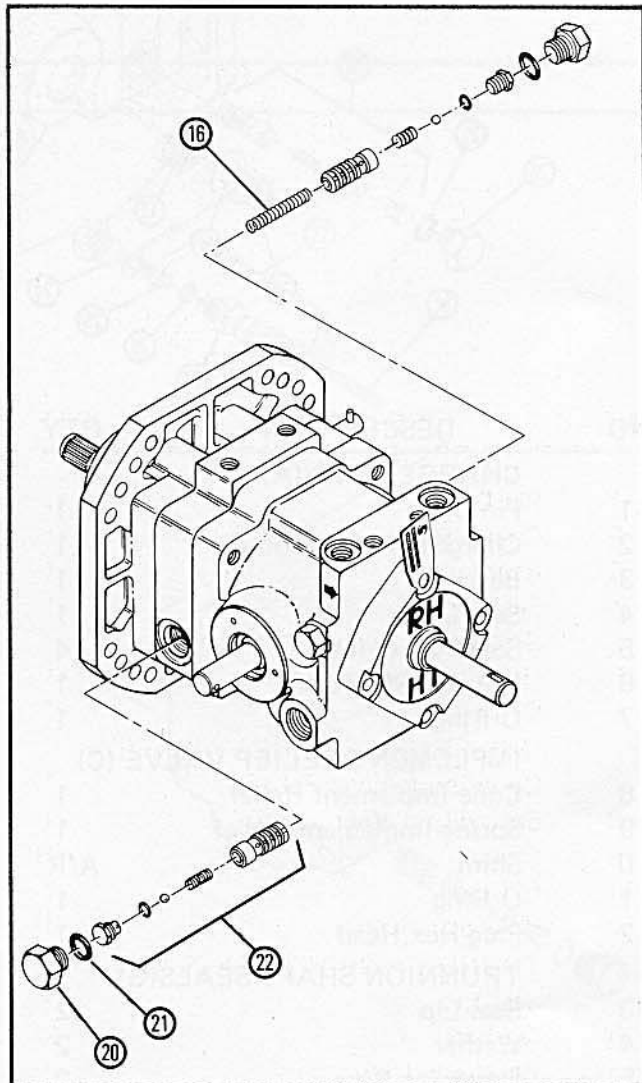


### Implement Relief Valve (Optional)

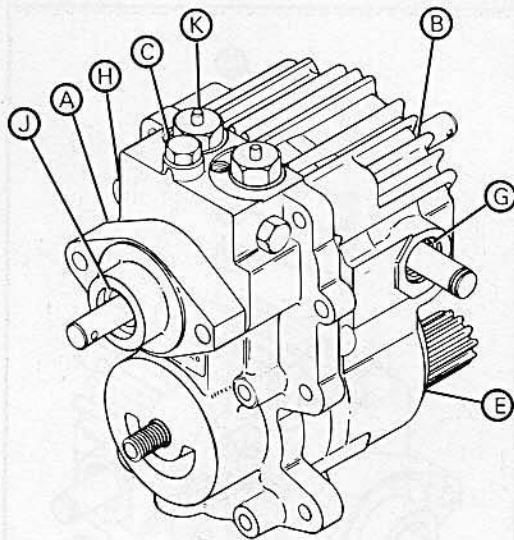
Remove plug (12) then slide the spring (9) and poppet (8) out of the housing. Do not alter the shims (25) or interchange parts with another valve. Inspect the poppet and seat in the housing for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing bore.

### Acceleration Valves

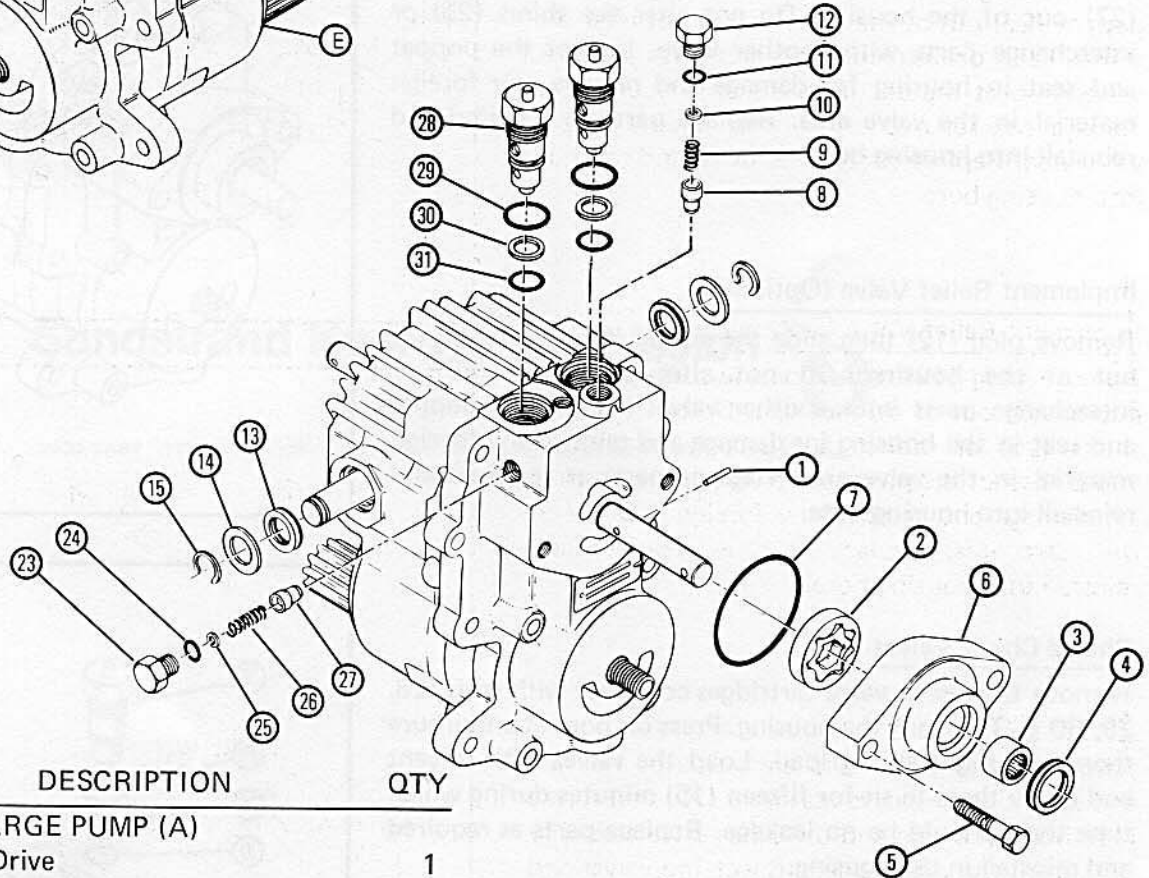
Remove plugs (20) from each side of housing and slide out one valve assembly (22) and spring (16) from one side and the other valve assembly (22) from the other side. Inspect the valves and bores for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing.



# SECTION VII: REPAIR PROCEDURES, 15 SERIES, U TYPE



Location	Description
A	Charge Pump
B	Input Shaft Seal
C	Implement Relief Valve
E	Output Shaft Seal
G	Trunnion Shaft Seals
H	Charge Relief Valve
J	Charge Pump Shaft Seal
K	Charge Check Valves



NO	DESCRIPTION	QTY
	CHARGE PUMP (A)	
1	Pin-Drive	1
2	Charge Pump (Gerotor)	1
3	Bearing	1
4	Seal-Lip	1
5	Screw-Hex. Head	2
6	Housing-Charge Pump	1
7	O-Ring	1
	IMPLEMENT RELIEF VALVE (C)	
8	Cone-Implement Relief	1
9	Spring-Implement Relief	1
10	Shims	A/R
11	O-Ring	1
12	Plug-Hex. Head	1
	TRUNNION SHAFT SEALS (G)	
13	Seal-Lip	2
14	Washer	2
15	Retaining Ring	2

NO	DESCRIPTION	QTY
	CHARGE RELIEF VALVE (H)	
23	Plug-Hex. Head	1
24	O-Ring	1
25	Shims	A/R
26	Spring-Charge Relief	1
27	Cone-Charge Relief	1
	CHARGE CHECK VALVES (K)	
28	Valve Assembly	2
29	O-Ring	2
30	Back up Ring	2
31	O-Ring	2

## SECTION VII: REPAIR PROCEDURES, 15 SERIES, U TYPE

When the Implement Relief Valve is not used, the parts (Nos. 8, 9, 10, 11 and 12) are replaced with the Charge Relief Valve parts (Nos. 23, 24, 25, 26 & 27). The port where the Charge Relief Valve parts were installed is plugged.

### Charge Relief Valve

Remove plug (23) then slide the spring (26) and poppet (27) out of the housing. Do not alter the shims (25) or interchange parts with another valve. Inspect the poppet and seat in housing for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing bore.

### Implement Relief Valve (Optional)

Remove plug (12) then slide the spring (9) and poppet (8) out of the housing. Do not alter the shims (25) or interchange parts with another valve. Inspect the poppet and seat in the housing for damage and remove any foreign material in the valve area. Replace parts as required and reinstall into housing bore.

### Charge Check Valves

Remove the check valve cartridges complete with seals (28, 29, 30 & 31) from the housing. Press on poppet and insure there is a slight spring load. Load the valves with solvent and allow them to sit for fifteen (15) minutes during which time there should be no leakage. Replace parts as required and reinstall in the housing.

This diagram shows an exploded view of the Charge Relief Valve assembly. The components are labeled with circled numbers: 23 (plug), 24 (nut), 25 (shim), 26 (spring), and 27 (poppet). The assembly is shown being installed into a port on the top of a hydraulic pump housing. The housing has several other ports and a cooling finned section on the right side.

This diagram shows an exploded view of the Charge Check Valve assembly. The components are labeled with circled numbers: 28 (cartridge), 29 (seal), 30 (seal), and 31 (seal). The assembly is shown being installed into a port on the top of a hydraulic pump housing, similar to the one in the previous diagram.

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