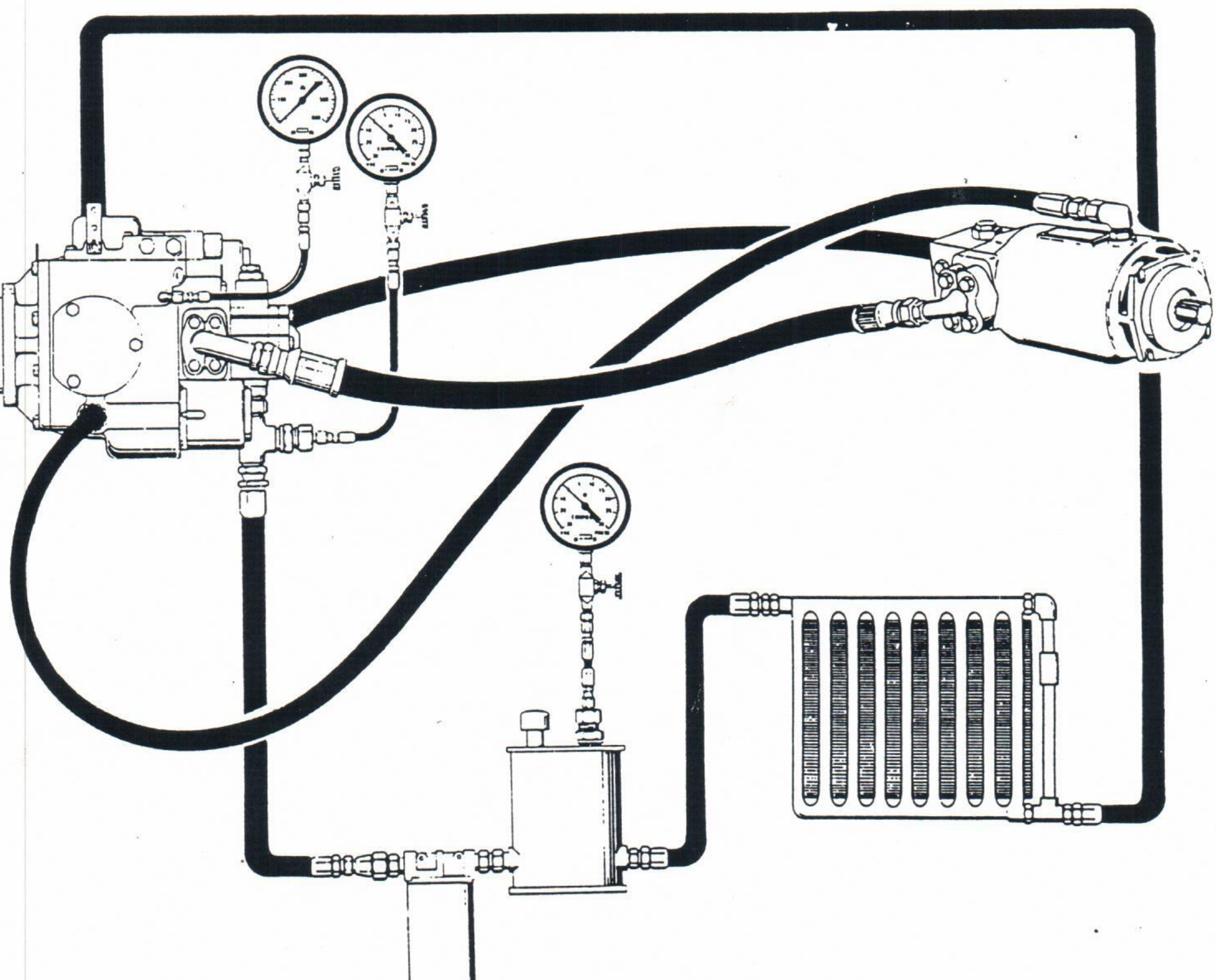
NO. 7-404

Eaton
Hydraulics
Division

ADVANCE MIXER, INC.

Trouble Shooting Information

Eaton Hydrostatic Transmissions Models 33 thru 76



EATON

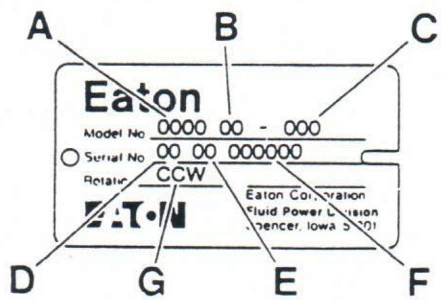
This manual provides the information necessary to understand a typical hydrostatic system. It will help you diagnose minor problems that can occur with Eaton heavy duty hydrostatic transmissions.

Maintaining cleanliness while you work will prevent contamination of the system and insure continuous and satisfactory transmission life.

The following publications are also available for use with Eaton hydrostatic heavy duty transmissions.

Eaton Hydrostatic Heavy Duty Start-up Procedure	No. 2-402
Eaton Hydrostatic Variable Pump Repair Manual	No. 7-603
Eaton Hydrostatic Fixed Motor Repair Manual	No. 7-122
Eaton Hydrostatic Variable Motor Repair Manual	No. 7-121

Identification Tag



B— Identifies Type of Product
00=Transmission
20=Variable Displacement Pump
30=Fixed Displacement Motor
40=Variable Displacement Motor

C— Identifies Specific Unit Configuration

D— Month of Manufacturer

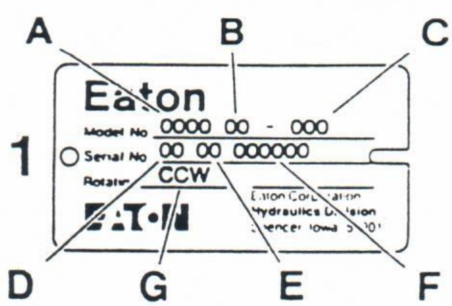
E— Year of Manufacturer

F— Specific Serial Number of Unit

A— Displacement (cu. in. / rev.)
0033=3.3 CIR
0039=3.9 CIR
0046=4.6 CIR
0054=5.4 CIR
0076=7.6 CIR

G— Identifies Direction of Input Shaft (Pumps Only) Rotation. (Observed from Shaft End of Unit)
CW=Clockwise
CCW=Counterclockwise

Series 1



B— Identifies Type of Product
21=Variable Displacement Pump
31=Fixed Displacement Motor
41=Variable Displacement Motor

C— Identifies Specific Unit Configuration

D— Month of Manufacture

E— Year of Manufacture

F— Specific Serial Number of Unit

A— Displacement (cu. in. / rev.)
0033=3.3 CIR
0039=3.9 CIR
0046=4.6 CIR
0054=5.4 CIR
0064=6.4 CIR

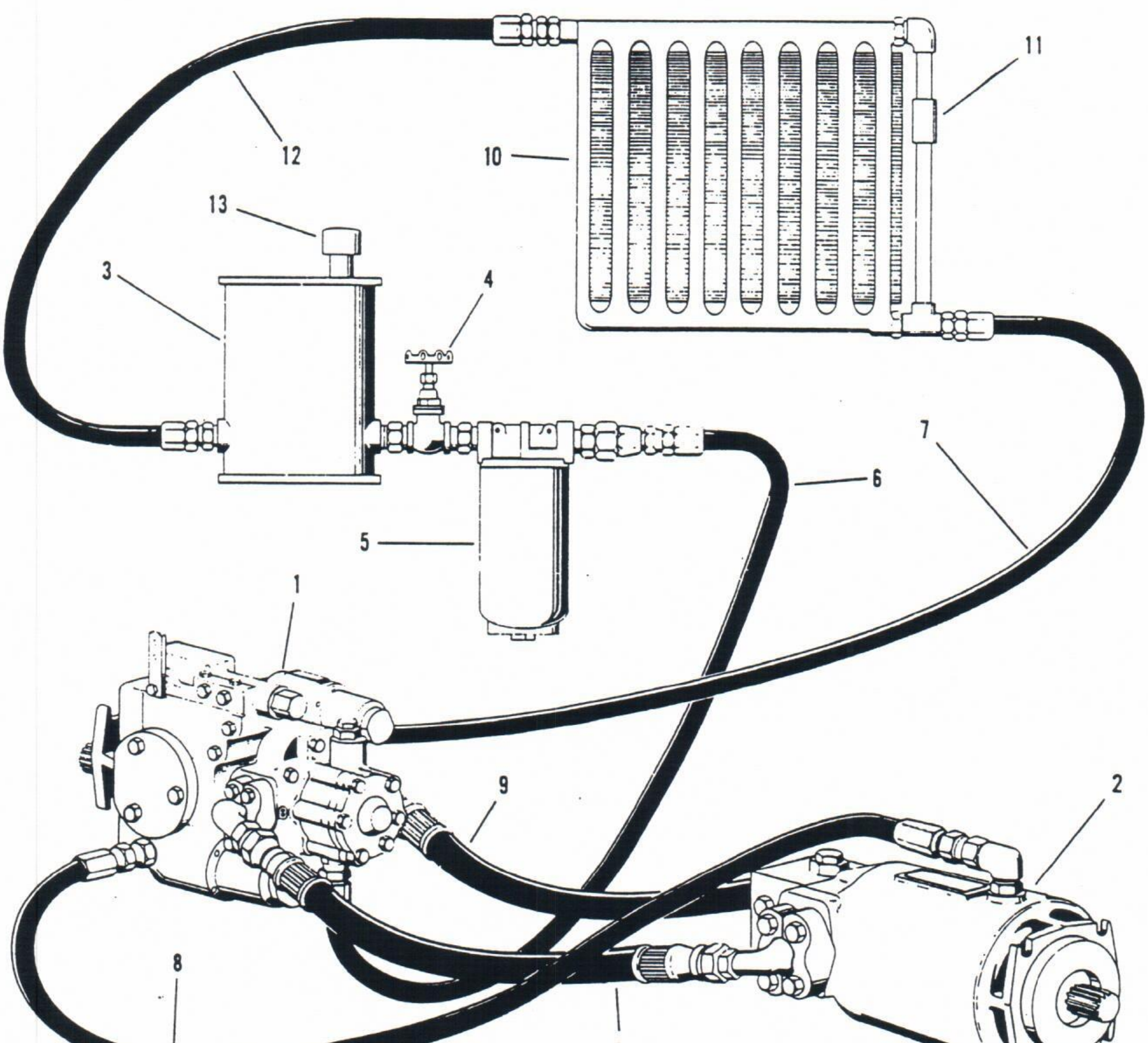
G— Identifies Direction of Input Shaft (Pumps Only) Rotation. (Observed from Shaft End of Unit)
CW=Clockwise
CCW=Counterclockwise

The above diagram shows how to identify your specific model.

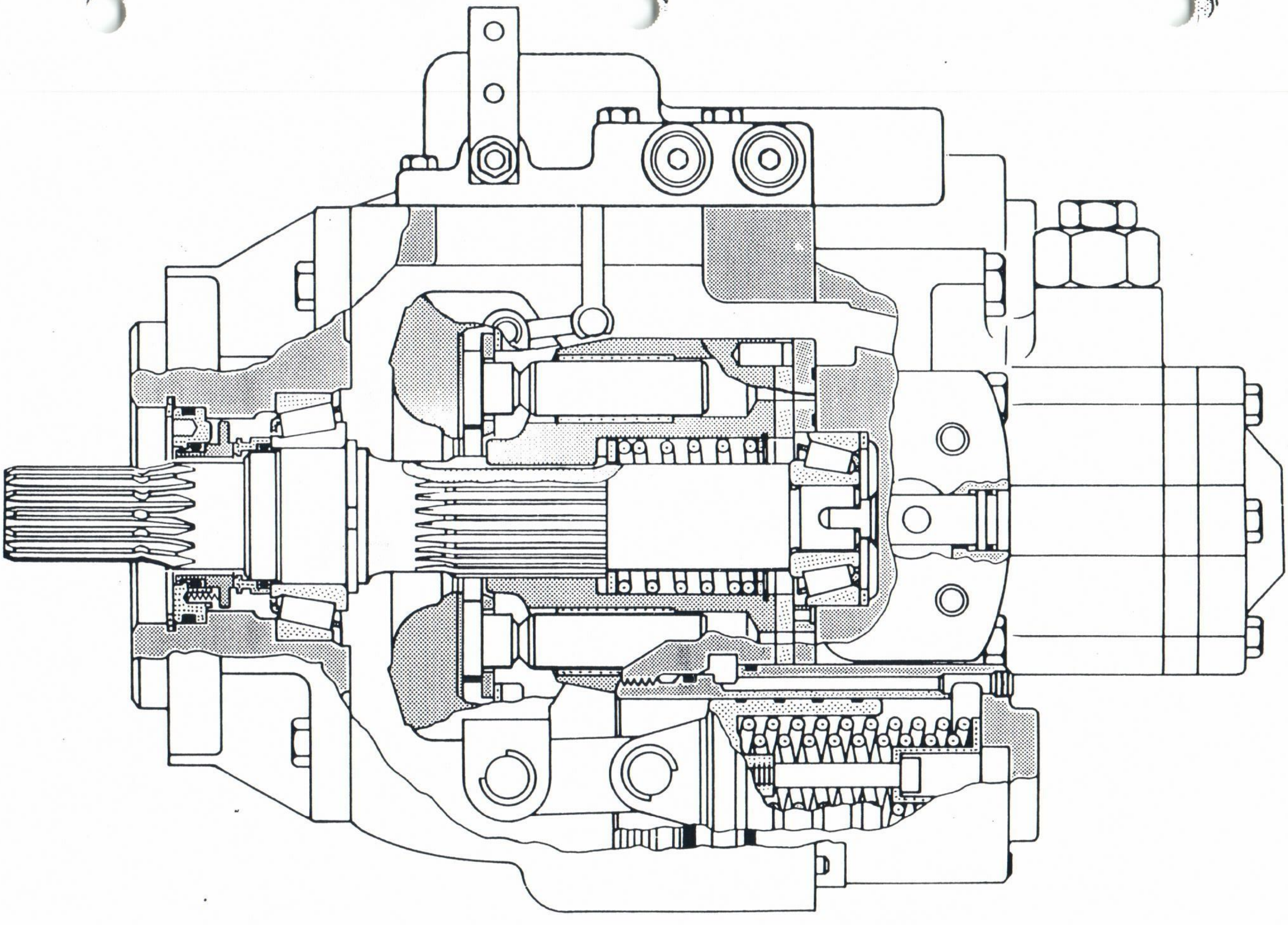
Please refer to the complete model number when ordering repair parts.

Typical Hydrostatic System

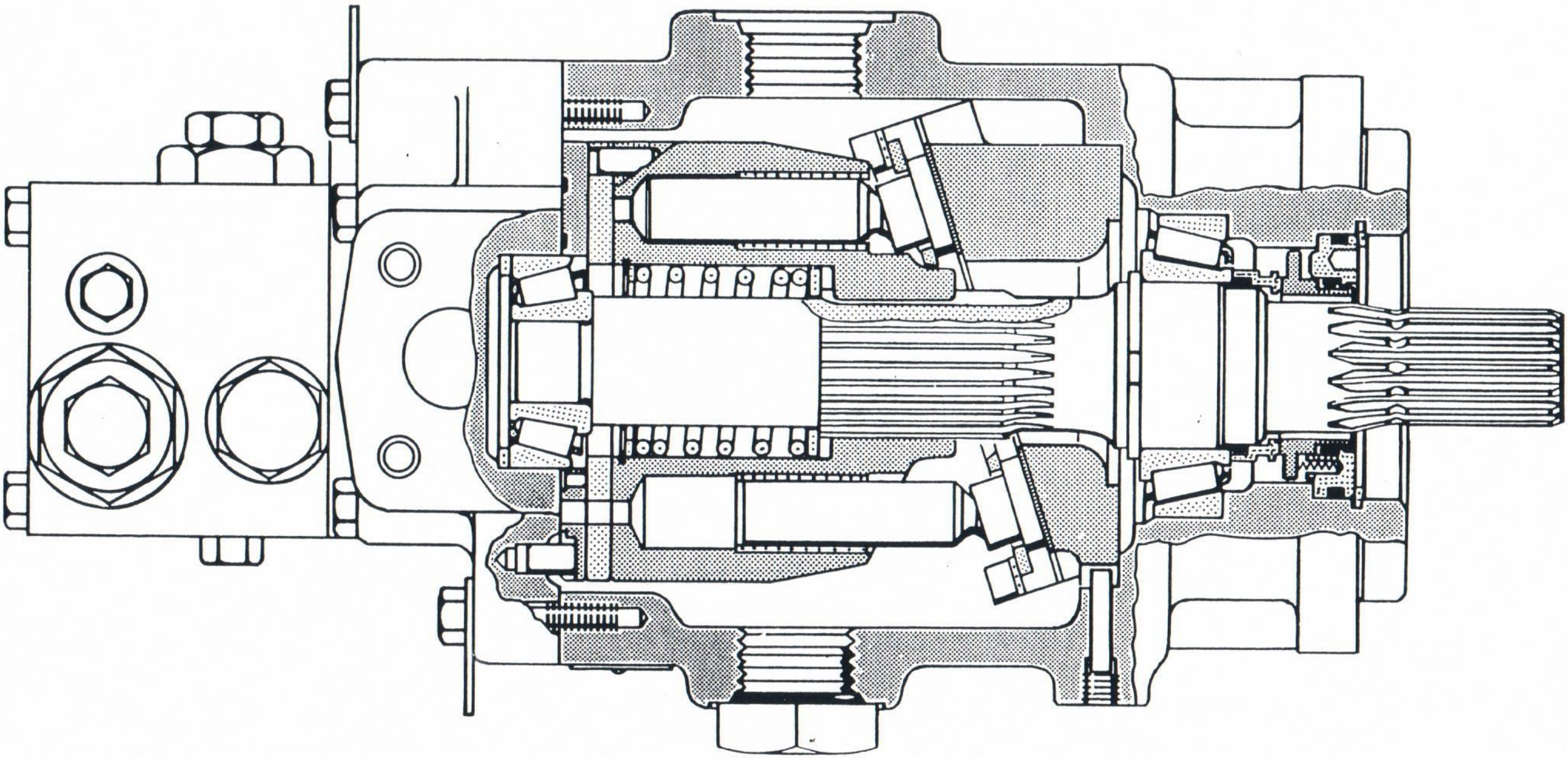
Variable Pump-Fixed Motor



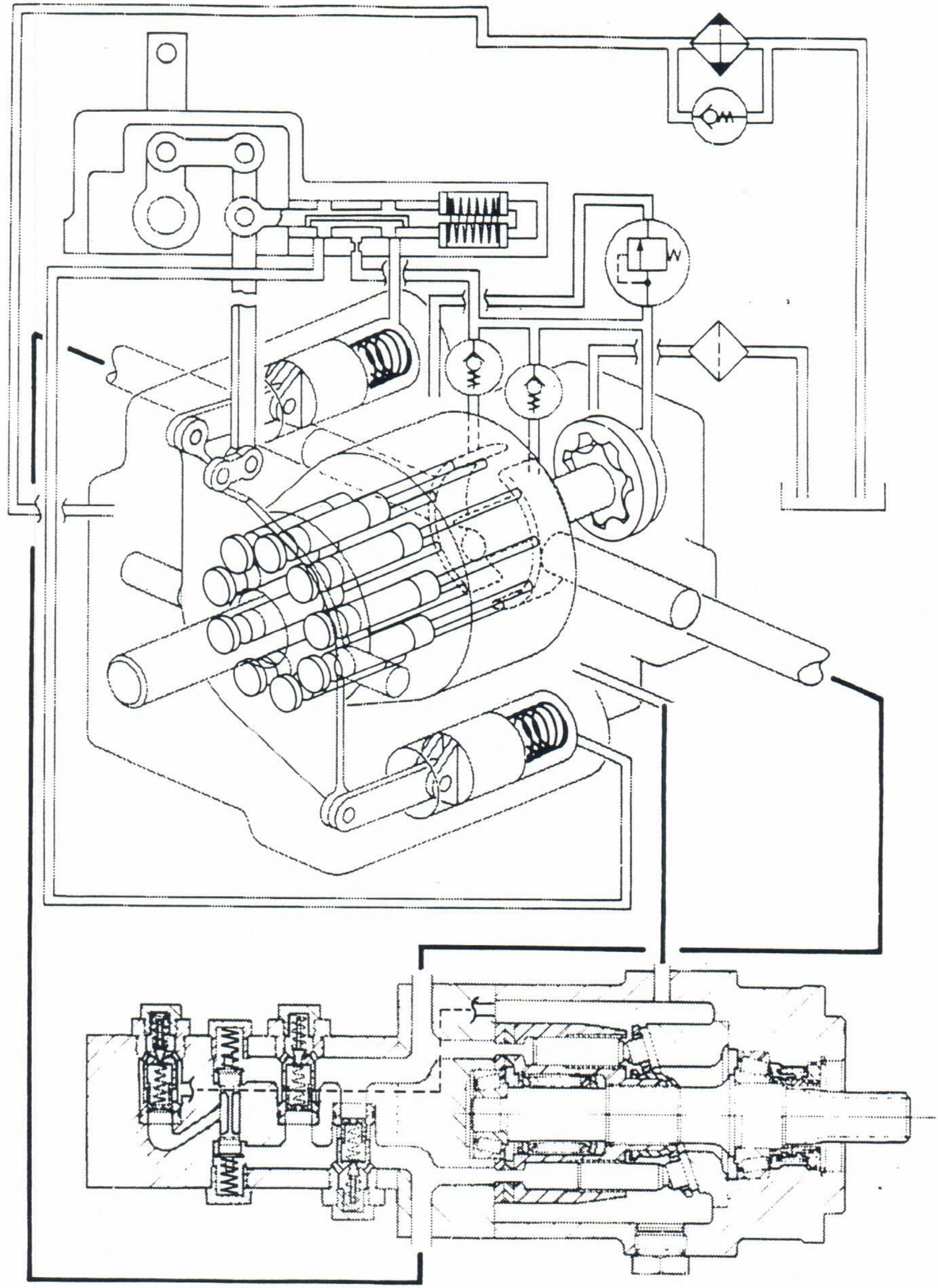
1 Variable Displacement Pump
2 Fixed Displacement Motor
3 Transmission Reservoir
4 Shut-off Valve
5 Filter
6 Inlet Line
7 Pump Case Drain Line
8 Motor Case Drain Line
9 High Pressure Lines
10 Heat Exchanger
11 Heat Exchanger By-Pass Valve
12 Reservoir Return Line
13 Reservoir Fill Cap and Breather



Hydrostatic Pumps Series 1 -Variable, Models 33 thru 64



Hydrostatic Motors Series 1 – Fixed, Models 33 thru 64



Variable Displacement Pump and Fixed Motor Assembly.

How It Works

The Eaton Heavy Duty Hydrostatic Transmission offers infinite control of speed and provides forward-reverse shuttle with single lever control. A typical Eaton transmission consists of a variable displacement axial piston pump and a fixed (or variable) displacement axial piston motor.

Pumps and motors are usually contained in separate housings for flexibility in vehicle design and installation. All closed circuit valves are included in either the pump or motor assembies. A reservoir, filter, lines and heat exchanger complete the circuit.

The displacement of the variable pump is varied and controlled by a servo system. A servo control system requires minimum operator effort at the control handle to vary transmission output speed. The pump flow can be varied from zero to maximum, providing infinitely variable output speed from the motor.

To operate the transmission in the forward direction, one of the control servos is opened to control fluid. This tilts the pump swashplate. As the pump pistons reciprocate, flow is directed to the motor through one of the high pressure lines. The motor receives the flow and its pistons reciprocate, causing the motor shaft to rotate.

In neutral the pump swashplate is centered. Because the pump pistons do not reciprocate, there is no flow from the pump to the motor. Consequently, there is no transmission output.

In reverse the opposite pump servo receives control fluid, tilting the pump swashplate to the other side of neutral. Flow from the pump to the motor is reversed, causing the motor to rotate in the opposite direction.

Variable Displacement Pump—Fixed Displacement Motor (PV-MF) Flow Explanation

Neutral

The hydrostatic transmission is in neutral when no output flow is generated by the variable displacement pump even though the shaft, internal components and charge pump are rotating. With no flow available to the motor, there is no transmission output.

Because the variable displacement pump is being driven, the following functions must be maintained.

Hydraulic fluid continues to flow from the reservoir, through the filter, to the charge pump inlet.

The input shaft drives the charge pump. Charge pump displacement and driven speed dictate the flow rate. The charge pump continues to perform these functions:

- Provides flow to keep the circuit primed and make up internal leakages.
- Provides flow, under pressure, to maintain back pressure on pump and motor pistons.
- Provides flow, under pressure, for hydraulic control.
- Provides cooled, cleansed fluid for temperature control and flushing.

Fluid from the charge pump is directed through the two check valves in the pump end cover. From this point, fluid proceeds to both sides of the hydrostatic circuit, filling or priming the lines and valves between the pump and motor.

When the circuit is primed, charge pump flow dumps across the charge pump relief valve to the pump housing. After cooling and flushing the pump, the fluid returns to the reservoir through the heat exchanger. The charge pump relief valve maintains a minimum charge pressure level.

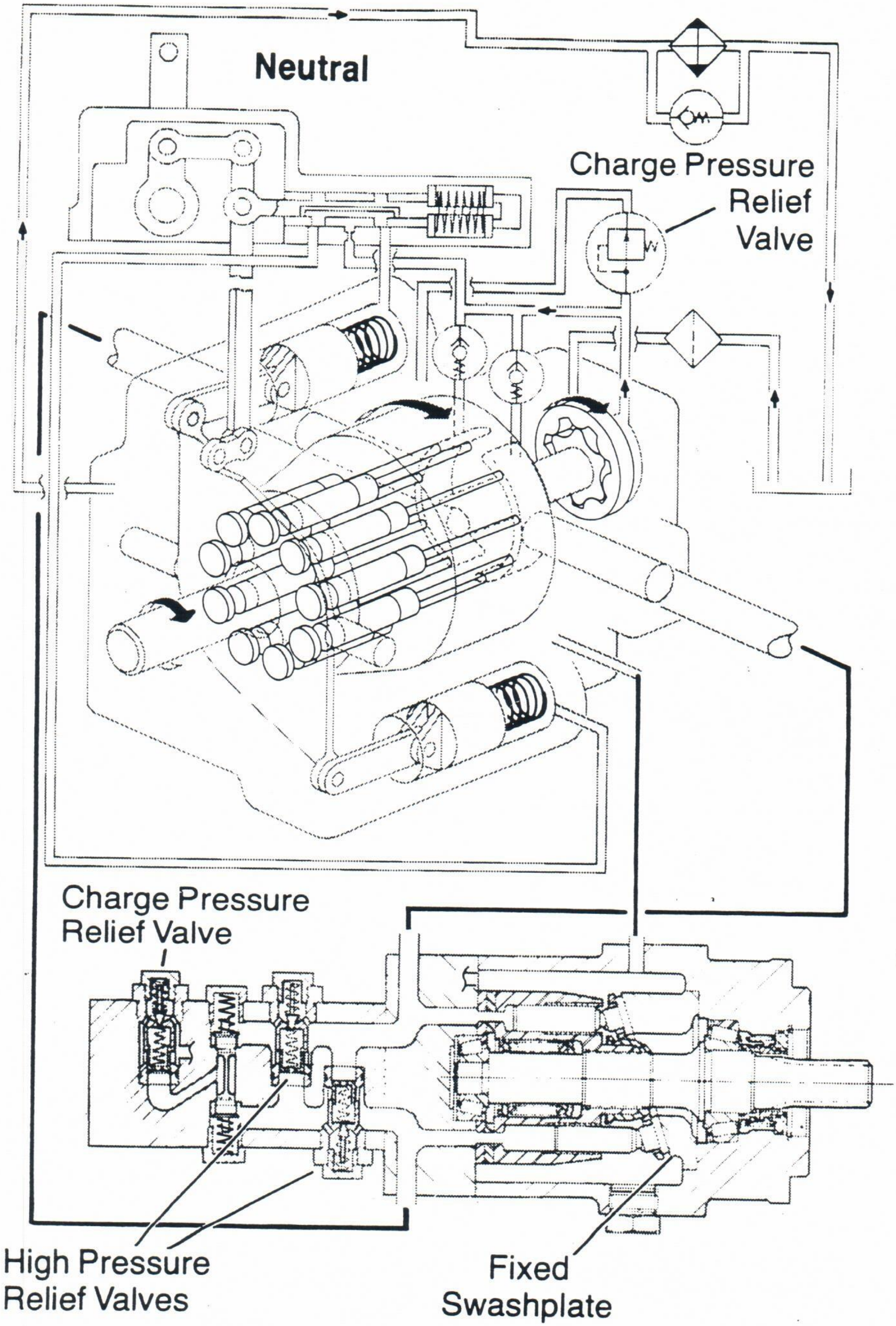
Centering springs hold the variable displacement pump in a neutral position. The springs are located between the servo control sleeves and servo pistons, which are connected to the variable swashplate. The swashplate must be kept in a neutral position to prevent the pump pistons from reciprocating.

Forward

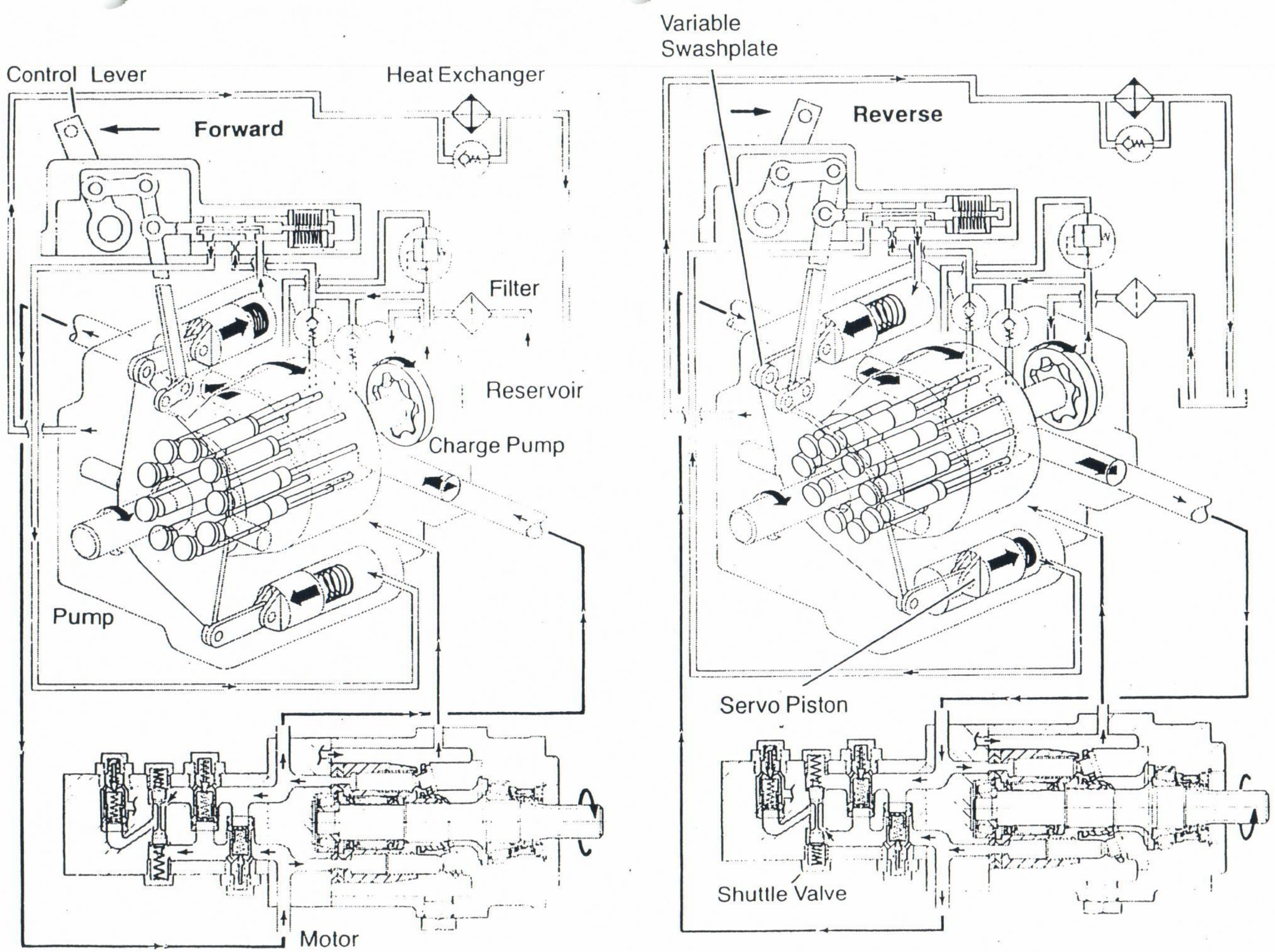
The Eaton PV-MF closed circuit hydrostatic transmission is in forward position when system flows and pressures permit the motor output shaft to rotate.

The control lever determines transmission output. As the lever is rotated, the control valve moves from its centered position. This allows charge pump flow, or control pressure, to proceed to one of the servo pistons.

(Continued on Page 16)



Neutral
Charge Pressure
Relief
Valve
Charge Pressure
Relief Valve
High Pressure
Relief Valves
Fixed
Swashplate


Control Lever
Forward
Heat Exchanger
Filter
Reservoir
Charge Pump
Pump
Motor
Variable
Swashplate
Reverse
Servo Piston
Shuttle Valve

The pressurized servo piston pushes against the swashplate and overcomes the centering spring force in the opposing servo piston. This causes the swashplate to rotate out of neutral position. Fluid in the opposing servo piston is exhausted through the control valve to the pump housing.

The extent to which the control lever is moved determines the position of the variable swashplate. Moving the control lever to its extreme position gives maximum pump displacement. As the swashplate responds to a shift in the control lever, follow-up links move the control valve to a closed position. This blocks the fluid between the valve and servo piston, holding the swashplate in its desired location.

The speed of swashplate movement can be varied by changing the flow rate to the servo pistons. The flow rate is adjusted by changing the diameter of the control orifice.

As the variable swashplate moves from neutral, the pistons in the pump cylinder barrel reciprocate, generating a high pressure flow. The flow rate is determined by stroke length and frequency. The high pressure flow closes the check valve in the high pressure side of the pump.

Pump flow enters the end cover of the fixed displacement motor and is directed to the back of the pistons in the cylinder barrel. When subjected to the pump flow, the pistons extend from the cylinder barrel. As the pistons slide down the incline of the fixed swashplate, the motor cylinder barrel turns. The barrel, in turn, rotates the output shaft. The high pressure flow overcomes the load or resistance on the motor output shaft.

Flow ratios between pump and motor displacements determine motor output shaft speeds. The motor, with its fixed swashplate, is always at maximum torque potential.

Flow leaves the motor cylinder block as the pistons slide up the incline of the fixed swashplate. This flow returns through the low pressure line to the low pressure side of the pump to repeat the cycle.

High circuit pressure is limited by high pressure relief valves in the composite valve block attached to the motor end cover. If system pressure exceeds the valve setting, flow passes from the high pressure side of the circuit, through the valve, to the low pressure line returning to the pump. This reduces motor output speed, signaling that the system is overloaded.

Charge or low pressure provides a minimum back pressure in the circuit. Charge pressure is maintained by the charge pressure relief valve in the valve block. Access to this valve is gained when high pressure fluid overcomes the spring force and moves the shuttle valve to one side. The flow across this charge relief valve helps cool the motor and pump cases before returning to the reservoir. The amount of this flow is determined by main pump demand, charge pump flow through the check valve and low pressure oil returning from the motor. Excess motor fluid that does not return to the main pump flows across the motor charge relief valve.

All circuit fluid comes from the reservoir and is filtered before entering the charge pump. All fluid removed from the circuit returns to the reservoir.

Reverse

The following changes occur when the system is in reverse.

- The control lever is moved to the other side of neutral, causing the control valve to shift in the opposite direction. Control flow and pressure are directed to the other servo piston. The swashplate then tilts in the opposite direction, reversing the pump flow that is under high pressure.
- High pressure flow enters the opposite side of the motor cylinder barrel, causing the motor to rotate in the opposite direction.
- The other high pressure relief valve limits system pressure.
- High pressure shifts the shuttle valve to the other end of its cavity, permitting access to the low pressure relief valve for motor cooling.
- Flow returns to the pump in the opposite line, which is now low pressure.
- Charge pump flow enters the circuit through the other check valve which is now on the low pressure side.

Pressure Readings

The pressures given in this manual are gauge pressures or delta pressures. A pressure gauge reads zero when connected to atmospheric pressure. Any reading above or below this zero point is referred to as gauge pressure (PSI). Delta pressure is the difference of two gauge pressures in a hydraulic circuit. For example:

	Charge Pressure of 240 PSI
minus	Case Pressure of 20 PSI

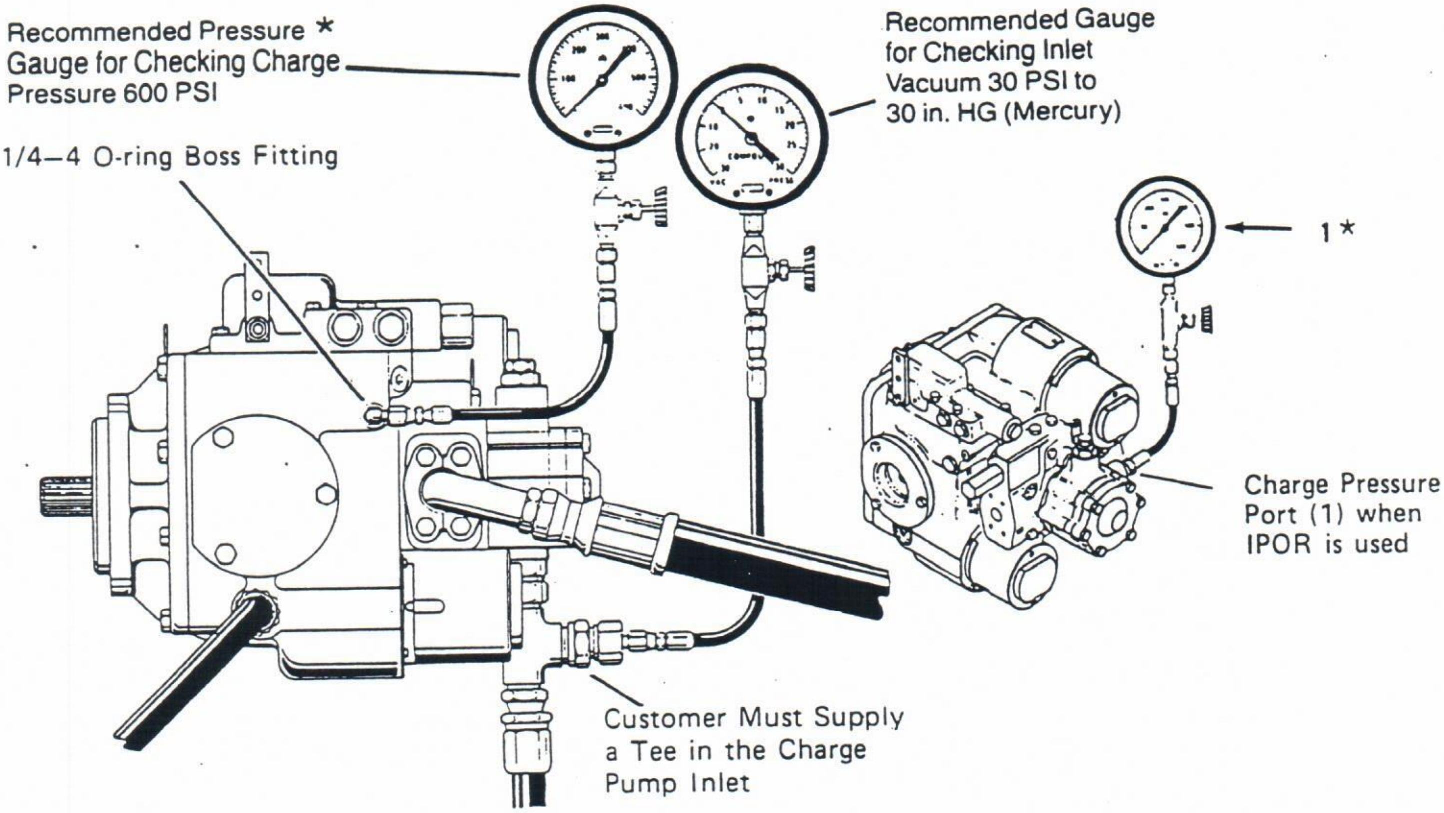
equals Differential Pressure of 220 △ PSI

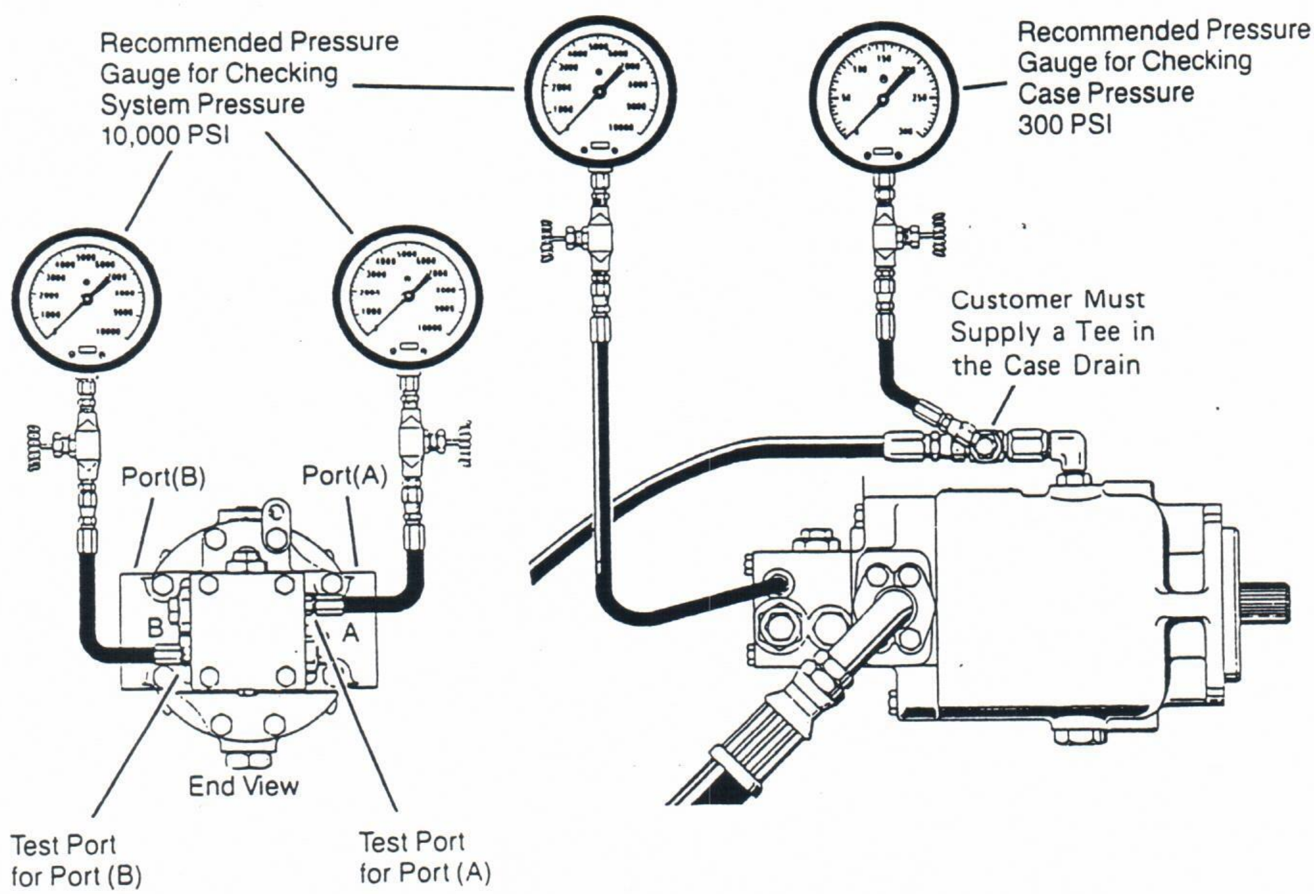
Hydrostatic circuits typically include high pressure, low or charge pressure, case pressure and inlet pressure. These pressures will vary per application and operating conditions.

Nominal Operating Pressures
(At Normal Operating Temperature)

Inlet Vacuum	Should not exceed 10 in.Hg (inches mercury) for an extended period of time	
Case Pressure	Should not exceed 40 PSI for an extended period of time	
Charge Pressure*	Neutral	220 PSI
	Forward or Reverse	160 PSI

*Charge pressure relief valves are factory preset to their nominal setting with a 2 GPM flow rate. The original valve pressure setting will increase approximately 6.5 PSI per 1 GPM additional flow over the valve. The charge pressures given above are typical. Higher charge pressures may be set at the factory for your particular application.


Recommended Pressure *
Gauge for Checking Charge
Pressure 600 PSI
1/4—4 O-ring Boss Fitting
Recommended Gauge
for Checking Inlet
Vacuum 30 PSI to
30 in. HG (Mercury)
1*
Charge Pressure
Port (1) when
IPOR is used
Customer Must Supply
a Tee in the Charge
Pump Inlet


Recommended Pressure
Gauge for Checking
System Pressure
10,000 PSI
Recommended Pressure
Gauge for Checking
Case Pressure
300 PSI
Customer Must
Supply a Tee in
the Case Drain
Port(B)
Port(A)
B
A
End View
Test Port
for Port (B)
Test Port
for Port (A)
1/4—4 O-ring Boss Fitting

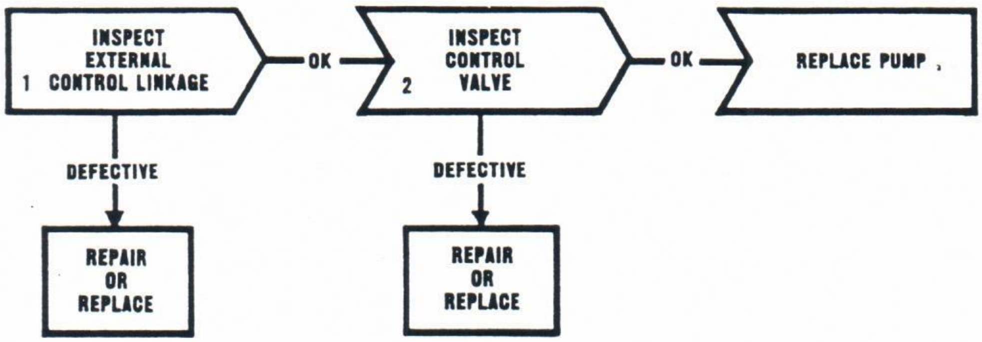
Fault-Logic

This fault-logic troubleshooting section is designed as a diagnostic aid in locating transmission problems by the user.

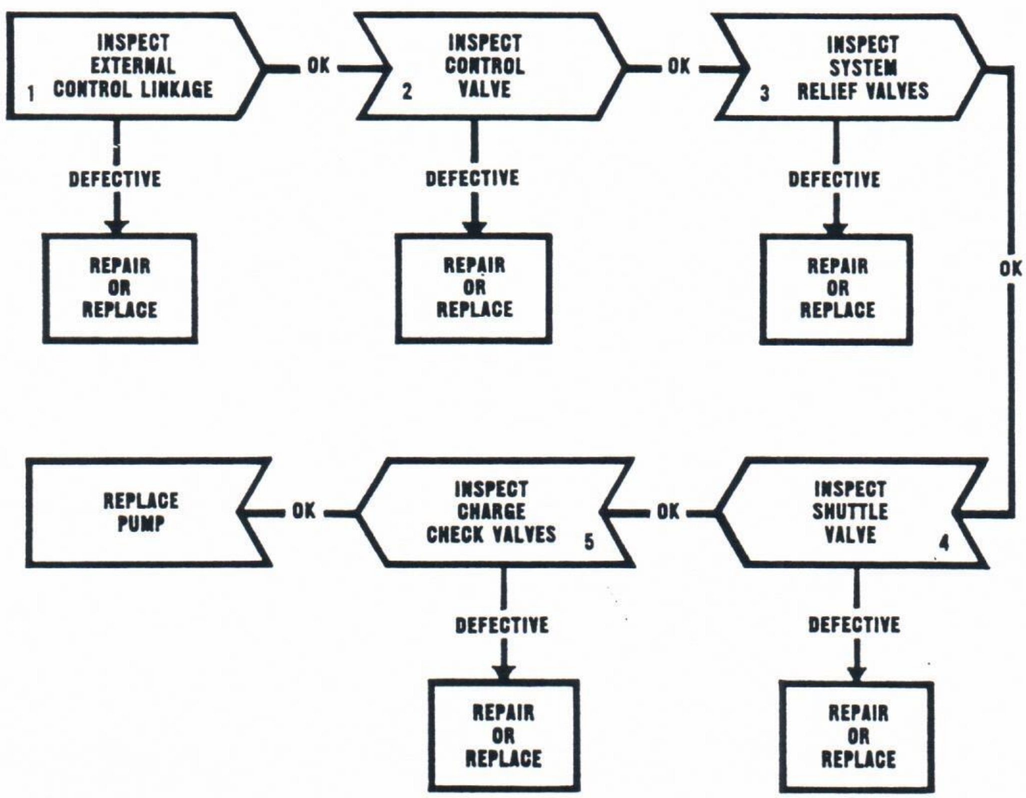
Match the transmission symptoms with the problem statements and follow the action steps shown in the box diagrams. This will give the user expedient aids in correcting minor problems eliminating unnecessary machine down time.

Following the fault-logic diagrams are diagram action comments of the action steps shown in the diagrams. Where applicable the comment number of the statement appears in the action block of the diagrams.

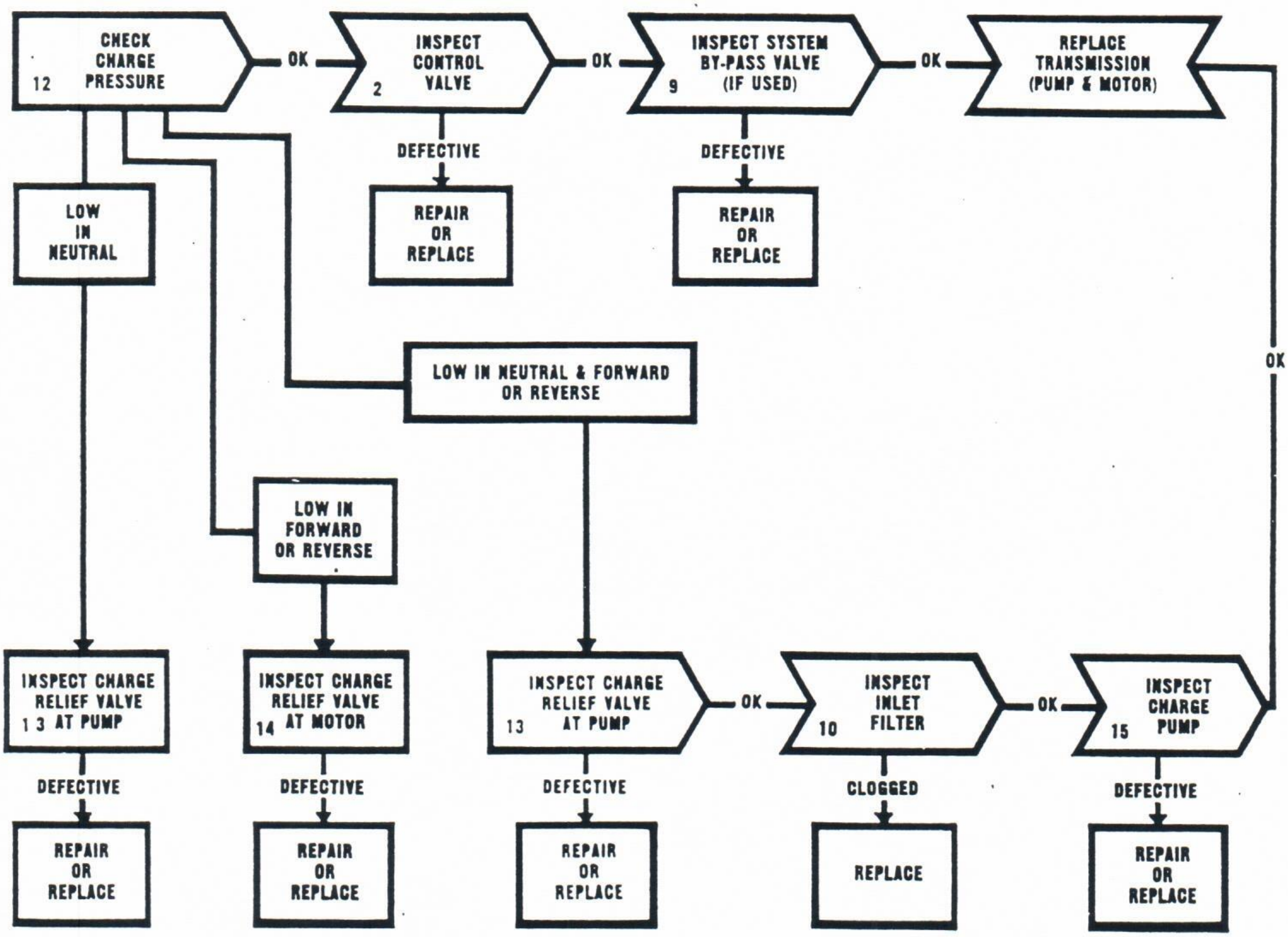
Neutral Difficult or Impossible to Find



Transmission Operates in One Direction Only



System Response Sluggish



System Operating Hot

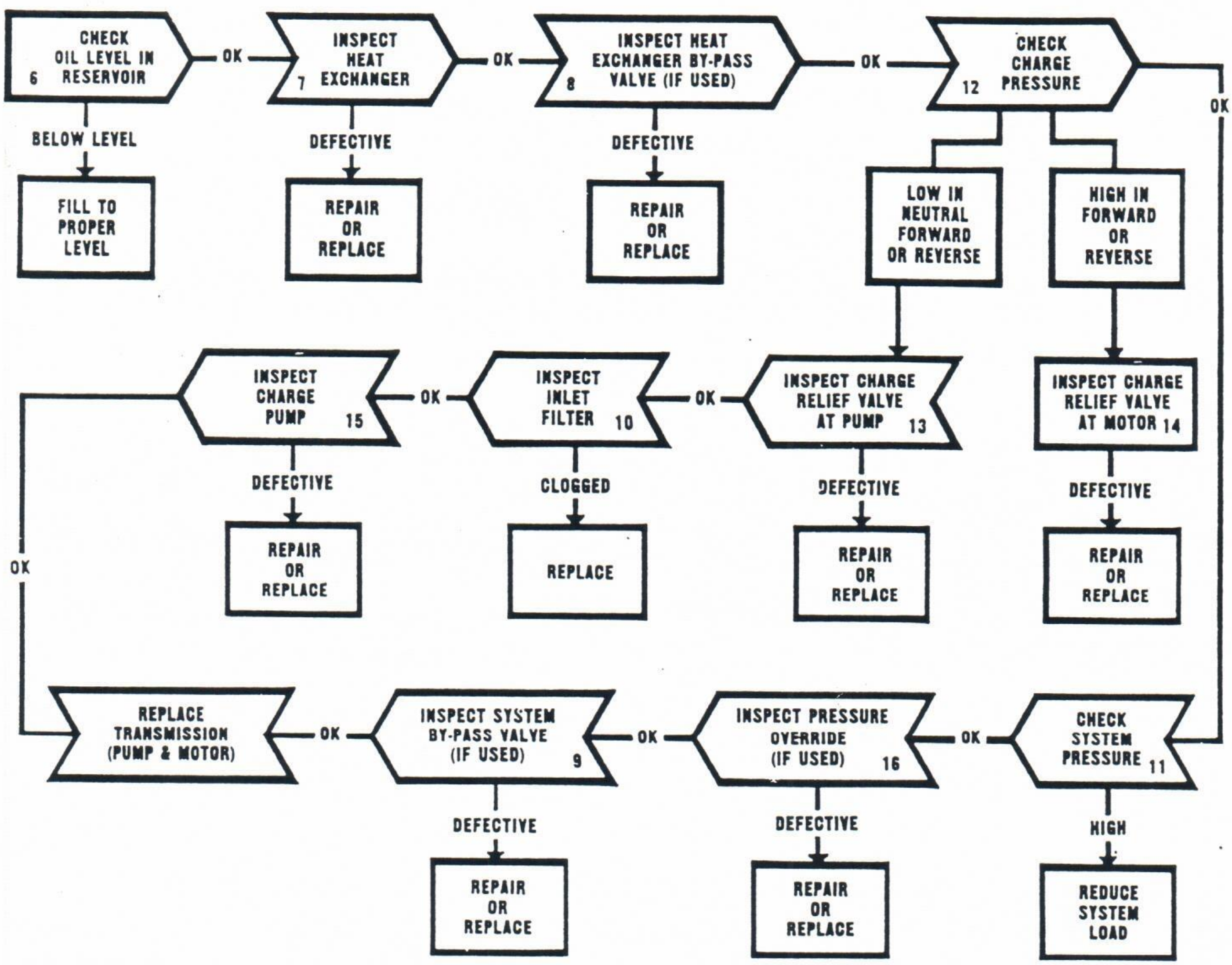


Diagram Action Step Comments

1 **Inspect External Control Linkage for:**
a misadjusted or disconnected
b binding, bent or broken

2 **Inspect Control Valve for:**
a plugged control orifice
b damaged mounting gasket
c misadjusted, damaged or broken neutral return spring
d broken control connector pin
e broken or missing control linkage pins
f galled or stuck control spool

3 **Inspect System Relief Valves* for:**
a improper pressure relief setting
b damaged or missing O-Ring and backing ring
c plugged orifice
d piston galled or stuck
e poppet valve held off seat

4 **Inspect Shuttle Valve for:**
a bent or broken return centering spring
b galled or stuck shuttle spool
c bent or broken shuttle spool

5 **Inspect Charge Check Valves for:**
a damaged or missing O-Ring and/or backing ring
b damaged check ball seat
c stuck check ball

6 **Check Oil Level in Reservoir:**
a consult owner/operators manual for the proper type fluid and level

7 **Inspect Heat Exchanger for:**
a obstructed air flow (air cooled)
b obstructed water flow (water cooled)
c improper plumbing (inlet to outlet)
d obstructed fluid flow

8 **Inspect Heat Exchanger By-Pass Valve for:**
a improper pressure adjustment
b stuck or broken valve

9 **Inspect Rotary By-Pass Valve for:**
a galled or stuck valve spool

10 **Inspect Inlet Filter for:**
a plugged or clogged filter element
b obstructed inlet or outlet
c open inlet to charge pump

11 **Check System Pressure*:**
a consult page 18 in this manual for location of system pressure gauge installation
b consult owner/operators manual for maximum system relief valve settings

12 **Check Charge Pressure*:**
a consult page 18 in this manual for location of charge pressure gauge installation
b consult owner/operators manual for maximum charge relief valve setting

13 **Inspect Charge Relief Valve* at Pump for:**
a improper charge relief pressure setting
b plugged orifice
c piston galled or stuck open/closed
d damaged or missing O-Ring
e poppet valve held off seat

14 **Inspect Charge Relief Valve* at Motor for:**
a improper charge relief pressure setting
b plugged orifice
c piston galled or stuck open/closed
d damaged or missing O-Ring
e poppet valve held off seat

15 **Inspect Charge Pump for:**
a broken drive tang
b damage or missing O-Ring
c broken drive key
d excessive gerotor clearance
e galled or broken gerotor set

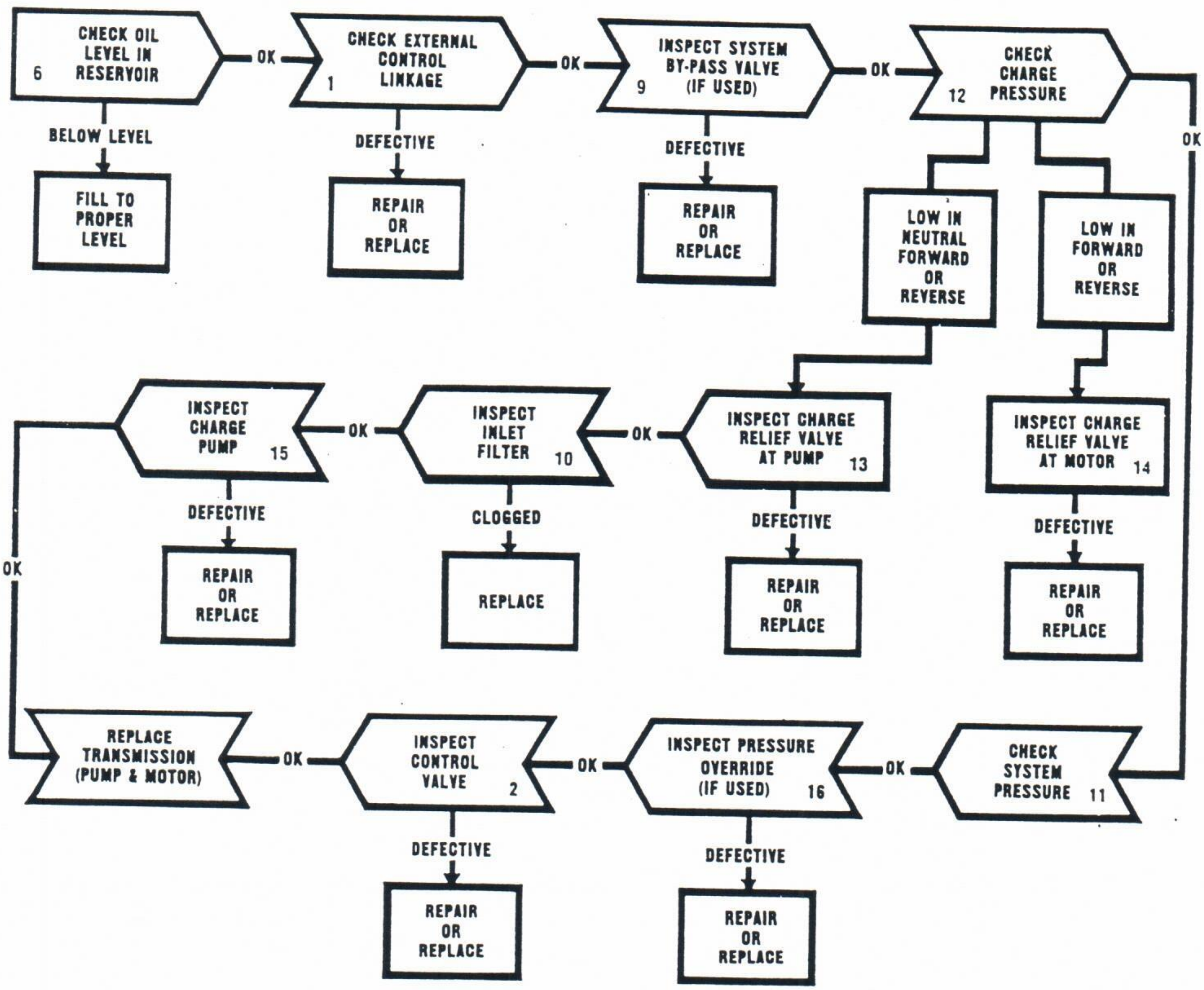
16 **Inspect Pressure Override Valve for:**
a misadjustment of maximum pressure setting
b stuck or missing ball check
c stuck needle roller sensing pin
d stuck or broken control spool
e obstructed sensing line

***System/Charge Relief Valve Maximum Pressure Setting Identifications**

The system/charge pressure relief valves are factory preset. The pressure code is stamped on the hex plug located on the end of the valve cartridge. To determine the pressure setting, add a zero to the right of the stamped number.

Charge Pressure Examples	System Pressure Examples
016 = 160 Δ PSI Setting	400 = 4000 Δ PSI Setting
022 = 220 Δ PSI Setting	500 = 5000 Δ PSI Setting

System Will Not Operate in Either Direction



Hydrostatic Fluid Recommendations

A reputable supplier can help you make the best selection of hydraulic fluid for use in Eaton hydrostatic products.

For satisfactory operation, the following recommendations apply:

1. The filter system used in the hydraulic circuit should be capable of cleaning and maintaining the hydraulic fluid to meet ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5 µm and a maximum of 80 particles per milliliter greater than 15 µm.
2. At normal operating temperatures, optimum viscosity ranges are from 80-180 SUS (16-39 cSt). Viscosity should never fall below 60 SUS (10 cSt) and, at the lowest expected start-up temperature, should not exceed 10,000 SUS (2158 cSt).
3. The fluid should be chemically stable, incorporating rust and oxidation inhibitors.

   Specific types of fluid meeting these requirements are:

   - Premium hydraulic oil
   - Engine crankcase oil–SAE 10w, SAE 20w-20, SAE 30
   - Automatic transmission oil
   - Hydraulic transmission oil
   - Synthetic fire resistant fluid–

     Quintolubric 822-220, -300 or -450
     Quaker Chemical Co.
     Conshohocken, PA 19428

     Cosmolubric HF-122, -130, -144 or -1530
     E.F. Houghton & Co.
     Valley Forge, PA

     Milisafe Code 1274 (280 Series) 280-150, -300 or -500
     Future Trend Industries
     Cottage Grove, MN 55016

Note: If the natural color of the fluid has become black or milky, it is possible that an overheating or water contaminant problem exists.

For accurate level readings, take readings when the fluid is cold.