Transmission Clutch Modulation

Transmission Modulator Valve Operational Description

Both directional clutch assemblies are controlled by individual modulator valves. The pressure rise at side “A” of the regulator spool is the same as that applying the clutch piston. Supply flow to the clutch and modulator is limited by a flow limiting orifice. From this limited flow the regulator spool drains flow to the vent port. The regulator spool restricts flow through the vent port to build clutch pressure at a predetermined rate. Once the vent flow is shut off, only minimal flow passes through the flow limiting orifice to make up for normal spool and clutch leakages. Pressure on either side of the orifice is virtually identical and full regulated system pressure is applied at the clutch piston.

When forward direction is selected the oil under pressure enters the port on the “A” side of the regulator spool. This passes through the quick release ball check. The pressure force on the spool area shifts the spool to the right exposing the vent port. The time required to shift the regulator spool over to expose the vent port shows up as a pressure spike at the beginning of the pressure versus time chart.

The movement of the regulator spool is opposed by the regulator and accumulator springs. This provides an initial low pressure head of approximately 20 psi [137,9 Kpa] on the “A” side of the spool. This 20 psi [137,9 Kpa] is represented as a horizontal line on the pressure versus time chart immediately following the spike. Oil flows through the regulator spool orifice due to a pressure imbalance. Pressure at the side “A” is constantly higher than side “B” as a result of the added force of the side “B” spring.

The pressure differential of side “A” to side “B” across the regulator spool orifice gives a controlled flow rate. This controlled flow establishes the time it takes to fill the accumulated cavity.

As the accumulator cavity is filled, the accumulator spool is forced against the accumulator springs. As the springs compress their force increases causing the hydraulic pressure in the accumulator cavity and “B” side of the regulator spool to increase. Pressure on the “A” side of the regulator spool increases with the opposing force on the “B” side.

This causes the rising slope in the clutch pressure versus time chart. The rate of this rise is controlled by the accumulator spring force. Once the accumulator spool is stroked to its limit, pressure on “A” and “B” side of the regulator spool is balanced since no flow passes through the regulator spool orifice. The clutch and modulator pressure rapidly rise to the system regulated clutch supply pressure setting. This is the vertical line on the clutch pressure versus time chart.

The entire modulator sequence of events occurs in less than two seconds. The steady rise of clutch pressure increases the clutch driving torque which results in a smooth clutch application.

When forward direction is selected the reverse clutch and modulator are vented through the control valve to the transmission sump. The reverse accumulator cavity is vented back through the regulator spool orifice and the quick release ball check. To hasten the reset time of the accumulator, immediately preparing the transmission for a directional shift, full system regulated clutch supply pressure from the forward control valve is directed to the spring cavity of the reverse accumulator.

When reverse direction is selected the reverse clutch and modulator function through the same sequence of events as the forward clutch and modulator.

The lock-up modulator system works on the same hydraulic principles.

Troubleshooting Guide - Modulated Transmissions

Introduction

Standard Service manual pressure and flow check procedures must be supplemented with this guide for modulated transmission assemblies. However, relatively simple procedures may be employed to assist in troubleshooting these transmissions. These procedures are written to assist in leakage checks and to enable isolation of problem areas.

Modulated Transmission Design

1. Modulated Transmission Concepts

a. A complete modulation circuit is provided for each clutch being modulated. Included are a differential pressure regulator and a spring loaded accumulator. Such a valve circuit is shown schematically on page 5.

b. All modulator circuits are in hydraulic parallel to clutch supply lines. They do not interrupt the circuit at any time. A flow limiting orifice is designed into each modulation valve assembly. Consequently conventional regulated pressure ports, often noted as clutch pressure ports no longer indicate actual clutch pressure for forward and reverse clutches. (See 2b & 2c below).

c. All current modulated transmission directional clutch pistons employ a fixed bleed orifice. Due to the combination of clutch leakage, piston bleed orifice flow rate, and flow limited orifices, directional clutch pressure will be slightly lower than regulated pressure.

2. Pressure Gauge Ports

a. Refer to Figure 1 for locations of directional clutch pressure check ports.

3. Pre-Test Study

a. Modulated transmission charging pump size should be determined prior to test.

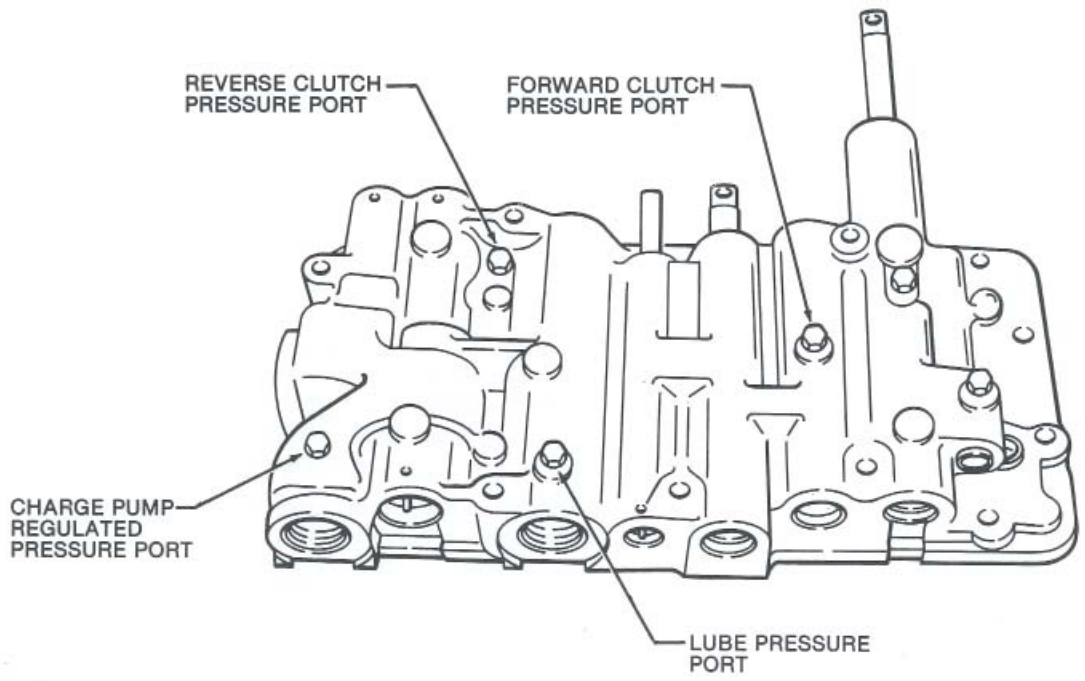

Figure 1 8000 Series Transmission Check Ports

Transmission Leakage Studies

1. Clutch Pressure Study

a. Locate gauge ports for regulated, forward clutch, and reverse clutch pressures. A 400 PSI [2758,0 Kpa] gauge is recommended for use at these ports.

b. Warm system up to operating temperature (180 to 200° F [82,2 - 93,3° C] at converter outlet). Always use parking brake when making pressure checks.

c. At idle (assumed to be 650-800 RPM) measure and record directional clutch pressures in forward and reverse (use 3rd or 4th range). At idle, with the direction control in neutral, measure and record system regulated clutch pressure, in all ranges, 1, 2, 3, 4.

d. The system regulated clutch pressure for the 8000 series transmission should be between 180-200 PSI [1241.1 - 1516.8 Kpa].

e. The maximum difference between clutch pressures is 5 PSI [34.4 Kpa].

f. Due to the combination of clutch leakage, piston bleed orifice flow rate, and flow limiting orifices, directional (fwd. and rev.) clutch pressure can be as much as 30 psi [206.8 Kpa] lower than the system regulated clutch pressure.

g. Use Table 1 to evaluate sample data. Note that data indicates 2nd clutch repair is required.

Clutch	System Regulated Clutch Pressure				Mod. Clutch Pressure	
Dir.-Range	PSI	Kpa	Fwd. PSI	Kpa	Rev. PSI	Kpa
Fwd.- 4th	195	[1344.5]	180	[1241.1]	0	
Rev.- 4th	195	[1344.5]	0		165	[1137.6]
Neut. - 1	195	[1344.5]	0		0	
Neut. - 2	175	[1206.6]	0		0	
Neut. - 3	195	[1344.5]	0		0	
Neut. - 4	195	[1344.5]	0		0	

Table 1 Clutch Pressure Study at Idle Example

Techniques for Problem Isolation

1. Transmission Malfunctions

a. Low Clutch Pressure

Assume an operation malfunction that results in lack of propulsion due to little or no pressure in forward or reverse clutches.

The lack of acceptable directional clutch pressure may be due to clutch leakage or due to modulator malfunction. To isolate proceed as follows.

i. Install .375 dia. x 1.125 [9.525 x 28.565 mm] pin inside modulator regulator spool. This blocks valve shut. See Figure 2.

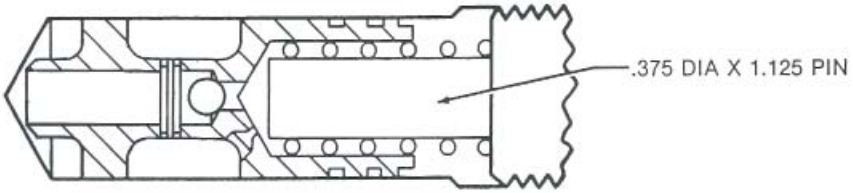

Figure 2 Blocking Pin

ii. If pressure at clutch increases to acceptable level, assume clutch is good. Assume modulator malfunction.

iii. If pressure remains low, assume clutch is leaking.

ALWAYS REMOVE PIN AFTER TEST. DO NOT ATTEMPT TO ELIMINATE MODULATION BY BLOCKING REGULATOR SHUT. CLUTCHES OF DIFFERENT DESIGN ARE REQUIRED TO ELIMINATE MODULATION SAFELY

b. Harsh Shift or Excessively Delayed Shift

If modulation is ineffective, problem could be associated with modulator or with clutch. If problem is in modulator, a regulator or accumulator spool may be bound up. Accumulator spring breakage is also possible. To study, observe action of a directional clutch pressure gauge. On a modulated clutch you should note a distinct pause in application of pressure. If clutch pressure remains at a low level with the engine at idle and doesn't rise, repair of the modulator valve or clutch pack is indicated.

2. Modulation Valve Service

a. The modulation valve assemblies can be cleaned. The regulator spool orifice (approximately .030 [0.76mm] diameter) and spool ball check should be checked for dirt. Spools should all be free to move in their respective bores.

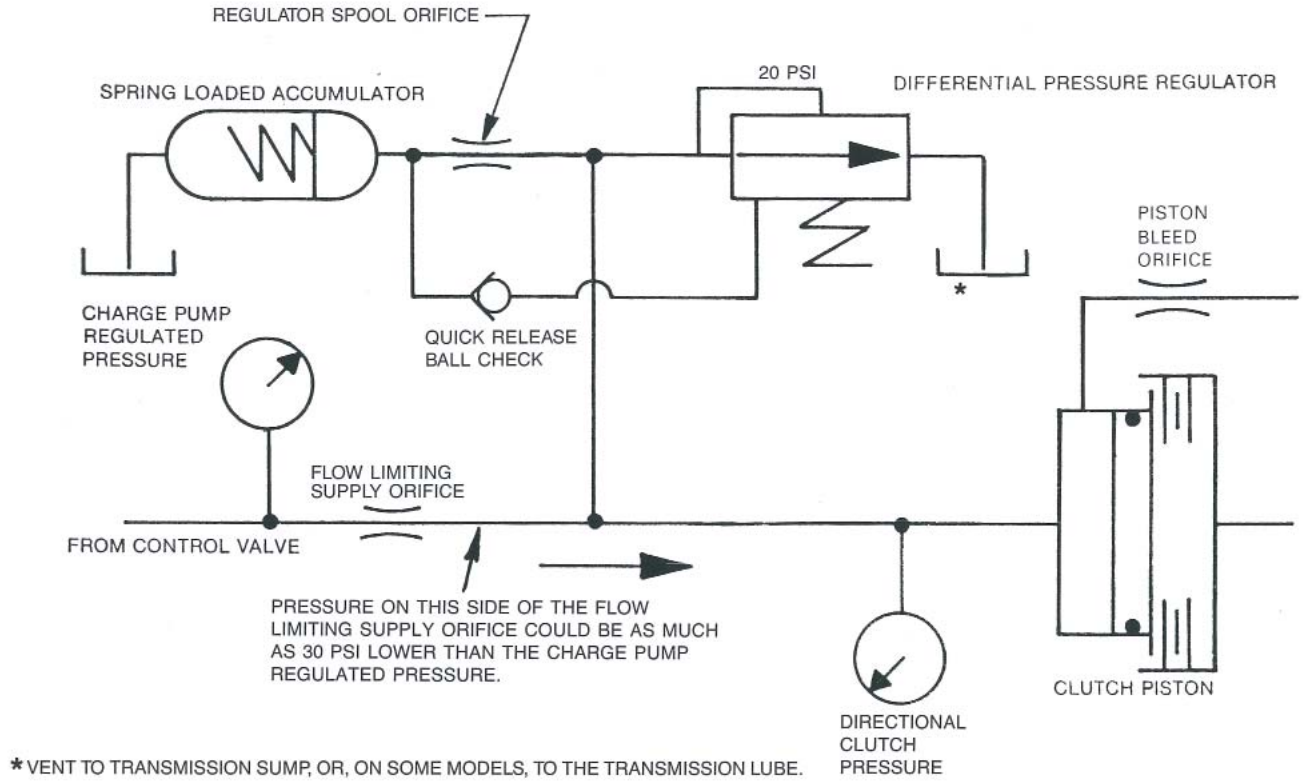

Figure 3 Modulation Valve Schematic

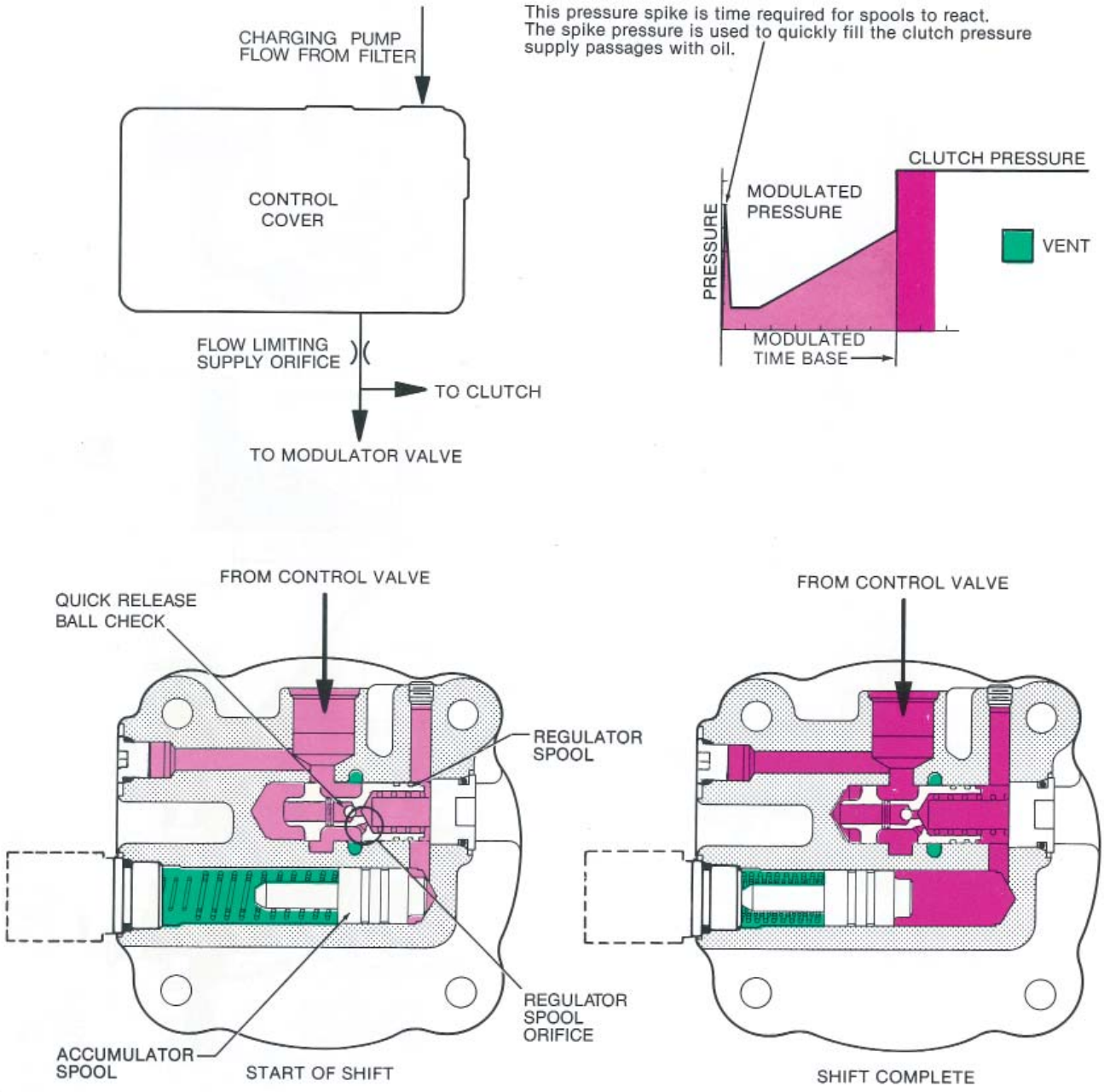

Figure 4 8000 Series Transmission Modulation

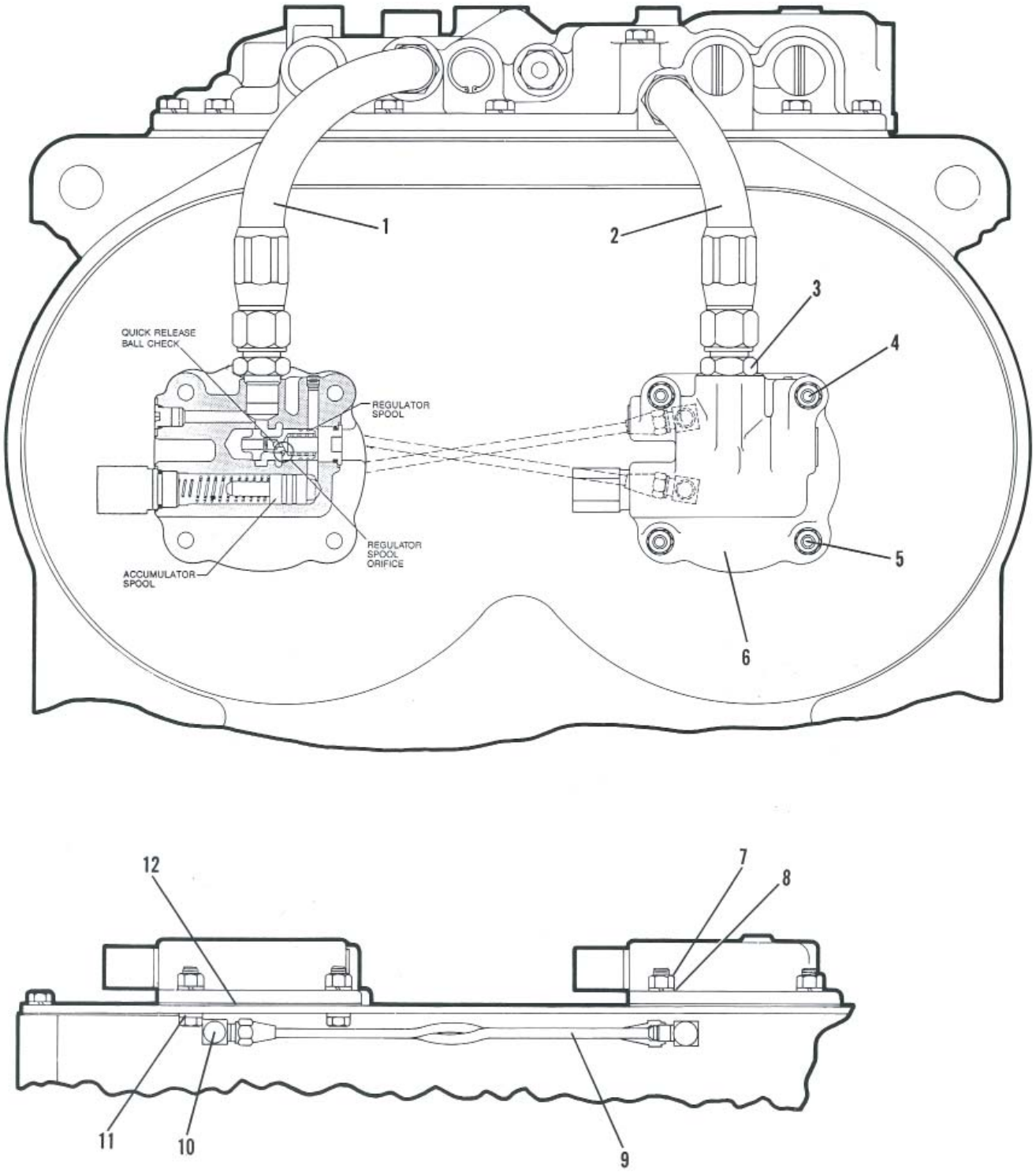

Figure 5 8000 Series Transmission Modulator Valve Locations