Lesson 2: Hydrostatic System Controls

Introduction

The hydrostatic system controls described in this lesson will show how the maximum pressures are limited, the hydraulic motor and pump components are cooled and flushed, the make up fluid is added for the system leakage and how the simple mechanical control can be used to control the direction of motor rotation. The information in this lesson will allow students to understand the hydrostatic system controls used on a large variety of machines.

Objectives

Upon completion of this lesson, the student will be able to:

1. Identify the following components in a hydrostatic drive system:
   A. Crossover relief valve
   B. Flushing shuttle valve
   C. Flushing relief valve
   D. Charge pump
   E. Charge system filter
   F. Makeup valve
   G. Charge relief valve
   H. Pump control valve
   I. Drive Pump
   J. Motor

2. State the purpose of each component and how it functions.

3. Trace the oil flow through the various components in each direction of operation.

Fig. 3.2.1 Closed Loop, Bi-directional, Variable Pump and Fixed Motor Hydrostatic System

Closed Loop System

A closed loop, bi-directional variable pump and fixed motor hydrostatic system (Fig. 3.2.1) will be used to describe the function of the control components found in many modern hydrostatic systems. The components will be added one at a time to better describe the function of each control component.

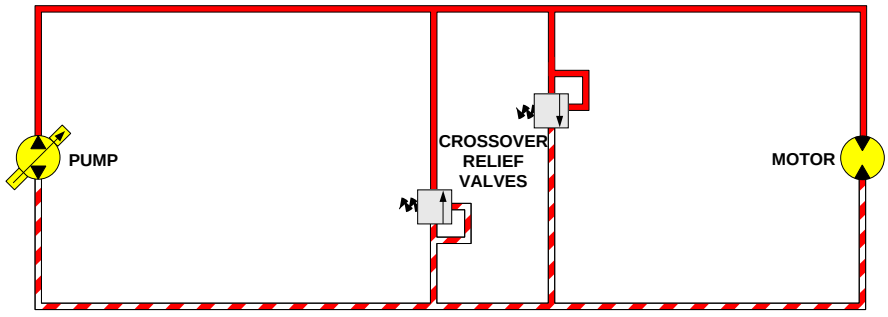

Fig. 3.2.2 Crossover Relief Valves

Crossover Relief Valves

When the system relief valve pressure is exceeded, the crossover relief valves located between the pump and motor direct the high pressure supply oil to the low pressure suction side of the pump. Two relief valves are required for the closed loop, bi-directional hydrostatic systems as shown in Fig. 3.2.2.

However, closed loop, mono-directional hydrostatic systems and all open loop hydrostatic systems require only one crossover relief valve. The flow through the relief valve is directed to the low pressure suction side of the pump in the closed loop, mono-directional hydrostatic systems and to the tank in open loop hydrostatic systems.

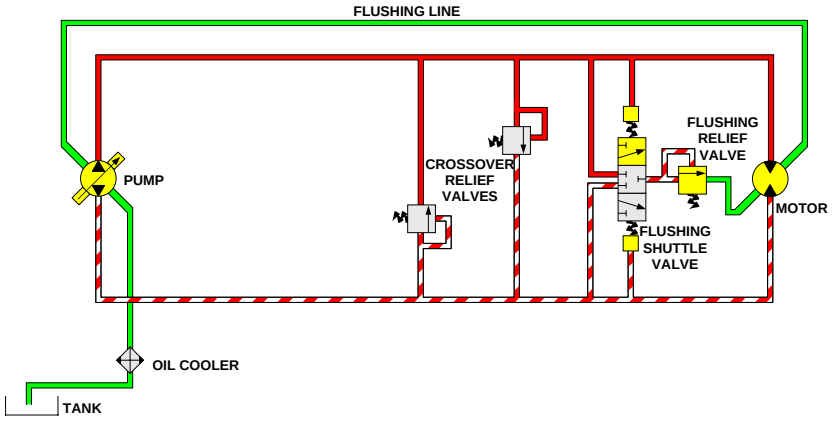

Fig. 3.2.3 Crossover Relief Valves and Flushing System

Flushing System

The flushing system consists of two valves, a shuttle valve and a relief valve (Fig. 3.2.3). When the pump is upstroked, the high pressure on the pump output side of the closed loop shifts the shuttle valve. The oil from the low pressure side of the closed loop flows through the shuttle valve to the flushing relief valve. The flushing relief valve maintains a preset back pressure in the low pressure side of the closed loop system. The oil that is relieved through the relief valve flows into the motor case. When the oil passes through the motor case, it cools the rotating parts and purges the wear particles from the motor case. The motor case drain oil flows to the pump case and cools and purges the pump. The pump case drain oil flows through an oil cooler to the tank .

On some systems, the motor case drain oil is returned directly to the tank. The pump must then use its own case drain oil or get oil from some other source for cooling and flushing.

The case drain oil circuit from the pump or motor to the tank may also be different in some systems. The case drain oil may flow through a cooler, through a cooler and a filter or through a filter only before returning to the tank.

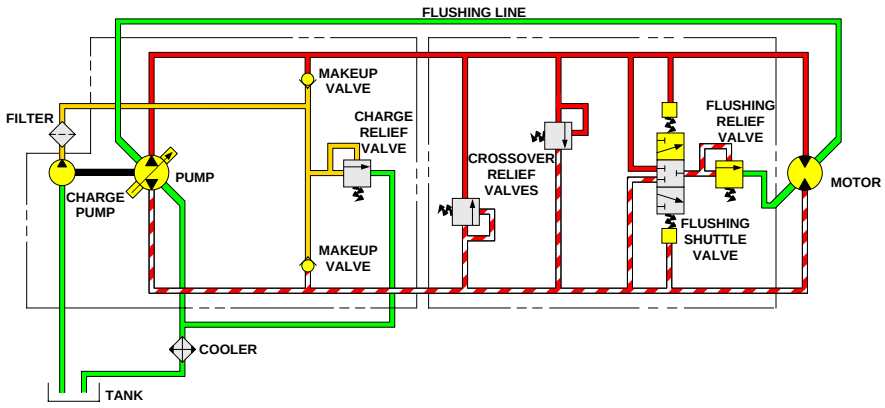

Fig. 3.2.4 Crossover Relief Valves, Flushing System and Charging System

Charging System

The charging system consists of a fixed displacement charge pump, a filter, two makeup valves and a charge relief valve. The charging system provides makeup oil to the low pressure side of the closed loop. This makeup oil replaces the oil that is lost from leakage in the pump and motor and from drainage through the flushing system. However the oil from the motor outlet through the low pressure side of the closed loop is the primary source of oil to the pump inlet. Thus, the hydrostatic system is still classified as a closed loop system.

The charge pump oil flows through the filter to the makeup valves and the charge relief valve. The high pressure on the pump output side closes the high side makeup valve.

The charging system relief valve is set to relieve at a higher pressure than the flushing relief valve. This allows the charging system pressure to be higher than the pressure in the low pressure side of the closed loop. The makeup valve between the charging system and the low pressure side is opened by the higher pressure charging system oil. The charging system oil flows through the makeup valve into the low pressure side to make up for the oil lost through pump and motor leakage and the flushing process. When the pressure on the low pressure side is near or equal to the maximum charge relief valve setting, the charging system oil flows through the charge relief valve to the tank.

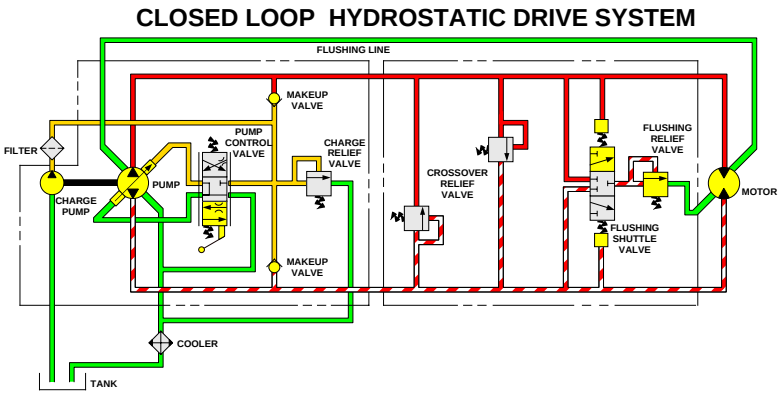

Fig. 3.2.5 Crossover Relief Valves, Flushing System, Charging System and Pump Control Valve

Pump Control Valve

The pump control valve illustrated in Fig. 3.2.5 consists of a simple mechanical valve spool. When the valve spool is moved in one direction, the charging system oil is directed to the pump stroking piston to upstroke the pump toward the upper side of the closed loop system. When the valve spool is moved in the opposite direction, the charging system oil is directed to upstroke the pump toward the lower side of the closed loop system. When the valve spool is in the centered position, the charge system oil is blocked from entering the pump stroking piston and both ends of the pump stroking piston are connected to a return to the hydraulic tank. The pump is returned to the zero angle position (neutral) by mechanical springs. In most closed loop hydrostatic drive systems, the mechanical control valve is replaced by hydraulic and/or electronically controlled valves. The description of how these valves function will be covered in the remaining lessons of Unit 3.

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