Arab Academy for Science, Technologyand Maritime Transport

Industrial Hydraulic Systems Assignment #1

Servo Valve Technology

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Introduction

1- Directional Control Valves

Directional control valves have been commonly referred to as switching valves because they simply direct or “switch” fluid passing through the valve from the source of flow to one of a selection of available cylinder ports. The flow control variety of valve generally selects an orifice which only allows a specified volume of flow to pass. The specified volume controls the speed of a cylinder or hydraulic motor. Likewise, the pressure control type is used to select a particular pressure setting.

Changing direction, flow or pressure during machine operation with these valves would require a separate individual valve for each direction, flow or pressure desired.

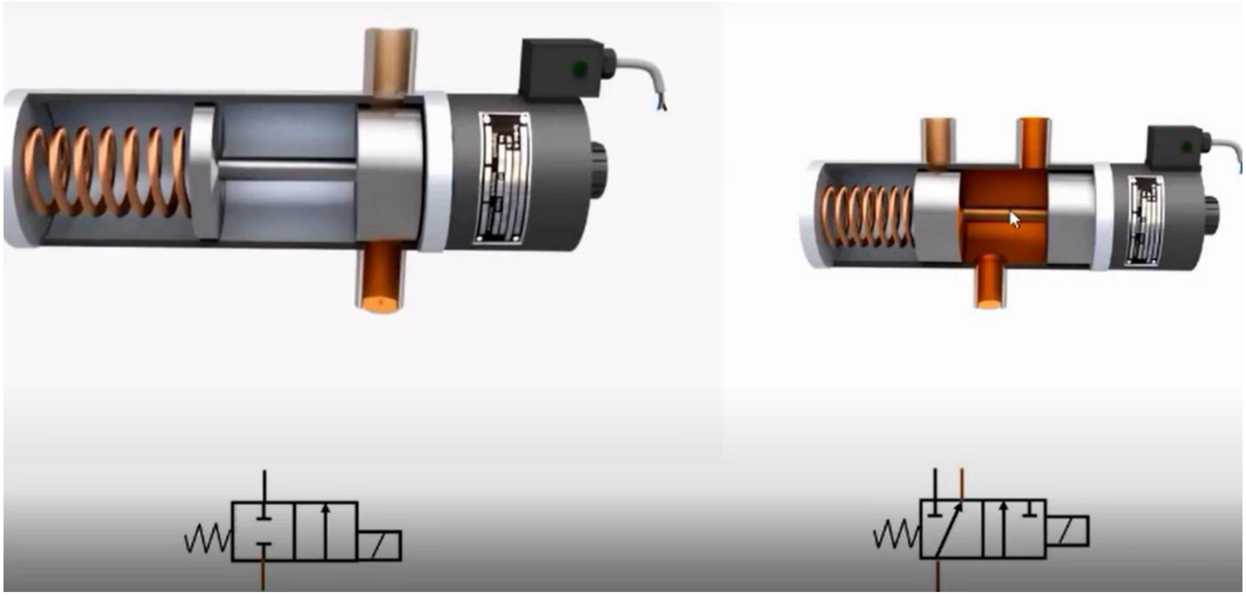

Figure 1 Directional Control Valves

2- Proportional Valves

The technological solution to these more complex circuits has been the development of proportional valves. These revolutionary valves allow infinite positioning of spools, thus providing infinitely adjustable flow volumes. Either stroke-controlled or force-controlled solenoids are used to achieve the infinite positioning of spools.

This variable positioning allows spools to be designed with metering notches to provide flow/speed control as well as directional control functions all in one valve, instead of requiring separate valves for direction and speed. The other major benefit is when the circuit requires more than one speed. The various speeds are achieved by changing the electrical signal level to deliver the flow/speed required. No additional hydraulic components are required. These proportional directional valves are controlled by DC power. The proportional controls, used with their associated electronic controls, also add the desirable features of acceleration and deceleration. This offers a variety of machine cycles, safely operated at greater speeds, yet with controlled start and stop characteristics.

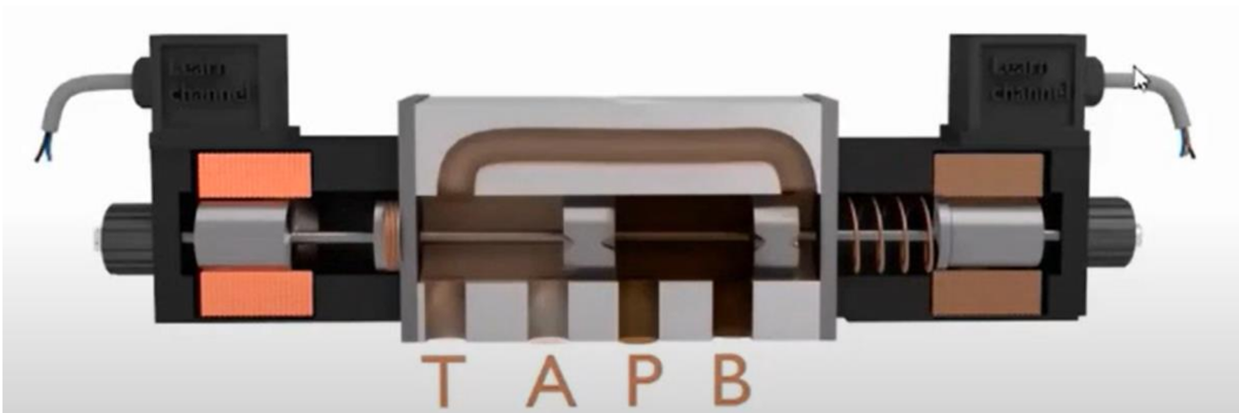

Figure 2 Proportional Valve

3- Servo Valves

The third type of hydraulic directional control technology is the servo valve**.** Servo valves are not a new technology as servo valves were first used in the 1940s. Servo valves operate with very high accuracy, very high repeatability, very low hysteresis, and very high frequency response. Servo valves are used in conjunction with more sophisticated electronics and closed loop systems. As a result, servo valves are always much more expensive.

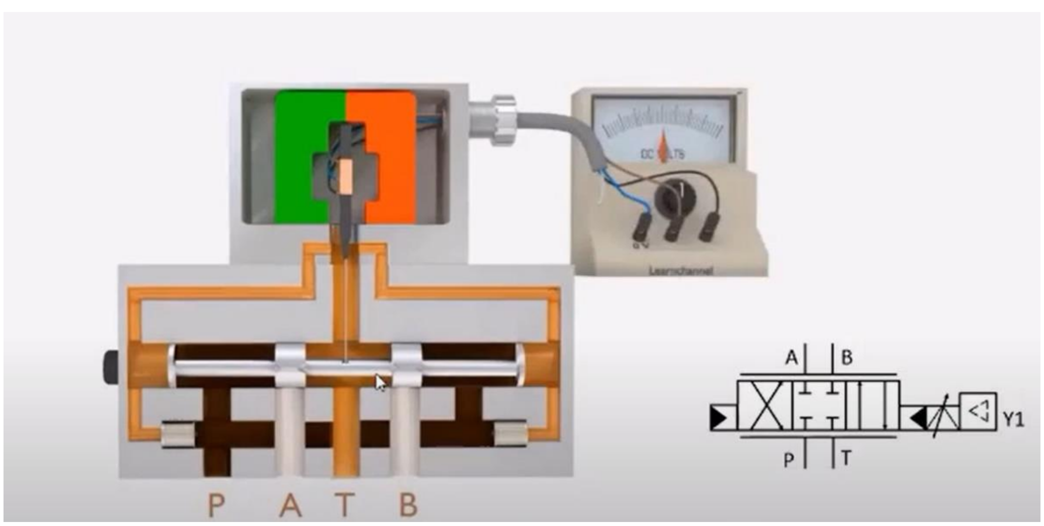

Figure 3 Servo Valve

Servo Valve Working Principle

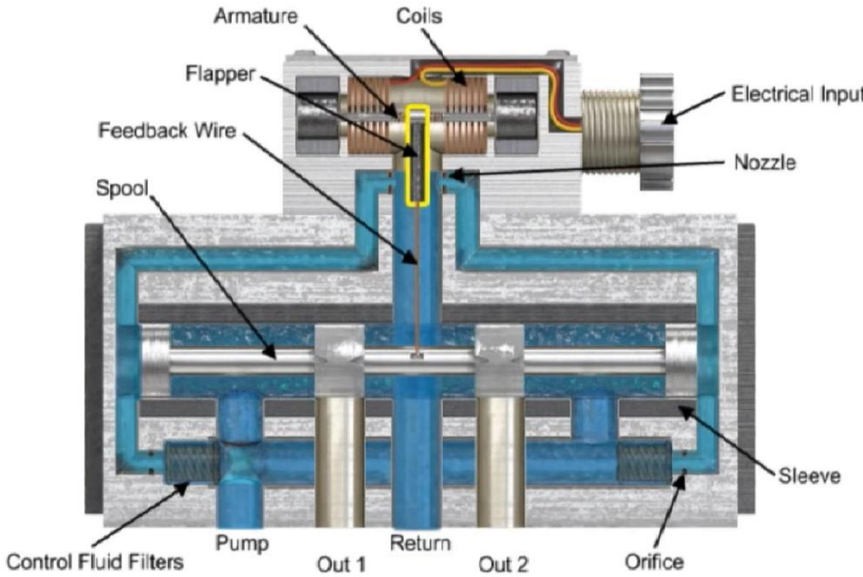

Figure 4

The torque motor armature moves in response to the electrical flux created by the current flowing through the coils of the force motor. A flapper is connected to the armature by a thin-walled flexure sleeve. The flapper is positioned between two opposing nozzles. Fluid at system pressure flows through these nozzles. Branching off from the inlet passage of each of the nozzles is a connection to each end of the main spool. When no input current is applied to the torque motor, the flapper remains centered between the two nozzles, and pressure between each of the nozzles and the flapper remains balanced, and the pressures at the ends of the spool remain balanced. Also connected to the flapper is a thin length of stainless-steel wire, termed a feedback spring. The free end of the feedback spring rests in a groove in the main spool. In this way, the spool position is mechanically fed back into the flapper nozzle assembly.

In figure 5, a current has been applied to the force motor, rotating the armature counterclockwise. This moves the right side of the flapper closer to the right nozzle, creating higher pressure in the right passage and lower pressure in the left passage. The higher pressure in the right passage acts on the right end of the spool applying force to displace the spool to the left. At the same time, lower pressure is acting on the left side of the spool, creating a force imbalance, facilitating the spool's movement to the left.

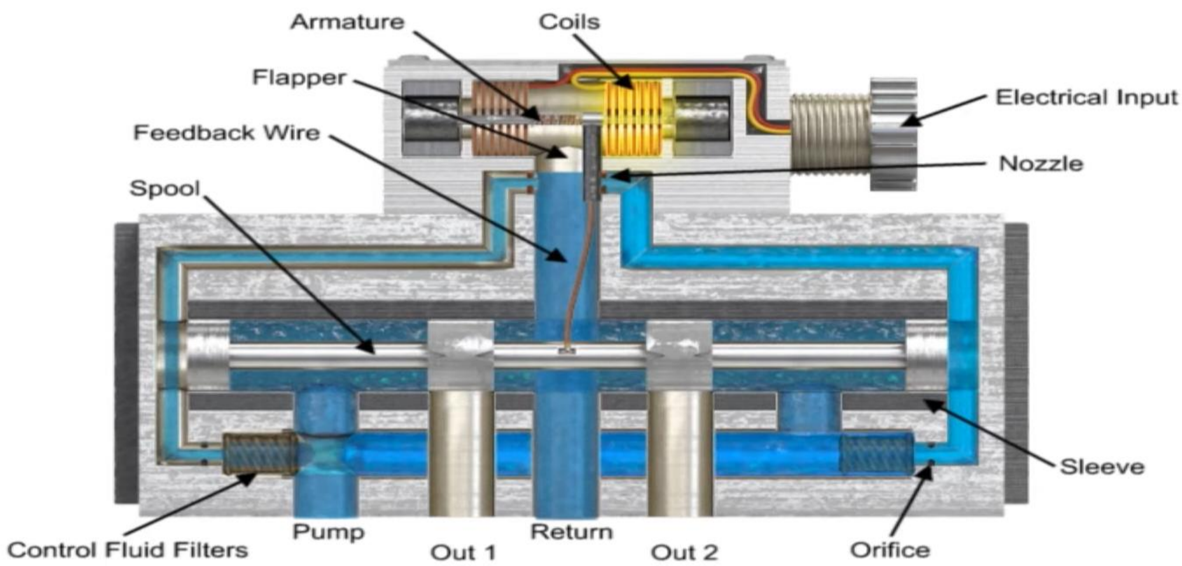

Figure 5

In figure 6, as the spool moves to the left, the small jewel on the end of the feedback spring pulls the feedback spring to the left, thereby inputting a feedback force on the flapper, counteracting the force generated by the torque motor, re-centering the flapper between the nozzles. Once the flapper is centered between the nozzles, pressure between each of the nozzles becomes equalized, and so does the pressure act on the ends of the spool. Once the pressure at the ends of the spool equalizes, the spool stops moving, yet the spool remains displaced, controlling flow to and from the working ports.

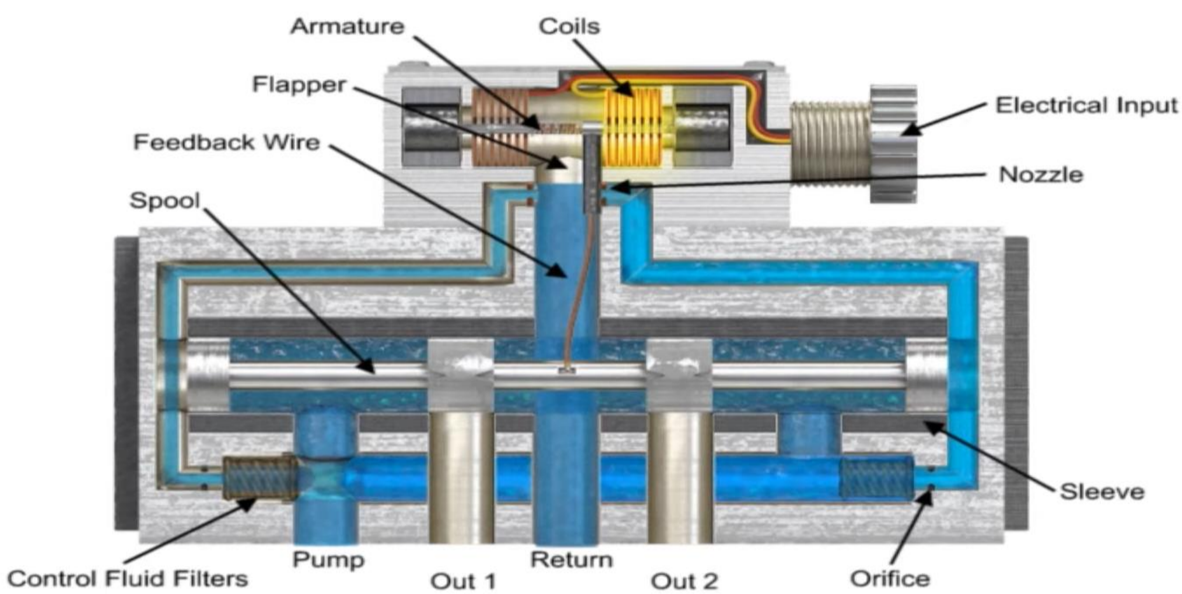

Figure 6