

Hydraulic Control Systems

Many mechanical systems are controlled by hydraulic lines containing hydraulic oil whose purpose is to communicate a desired control signal from an operator (usually human) to the component whose activation is desired. These systems are commonly seen in the braking and steering systems of motor vehicles but are also extensively used in large machines such as cranes, earth-moving equipment and aircraft. Indeed a modern passenger plane is said to be equipped with more than 7 miles of hydraulic control line. These hydraulic systems can consist of a positive displacement pump to supply high pressure oil, a control valve activated by a human or some sensor to control the oil pressure in a hydraulic line and an actuator at the other end of the line that performs the desired mechanical action. Figure 1 is a typical schematic of a hydraulic control system. One of the advantages of hydraulic control systems is the ability to handle very large loads or accommodate tremendous forces. One important limit to the response time in hydraulic control systems is the occurrence of cavitation (called column separation) in the hydraulic oil. This is particularly a problem in fighter aircraft.

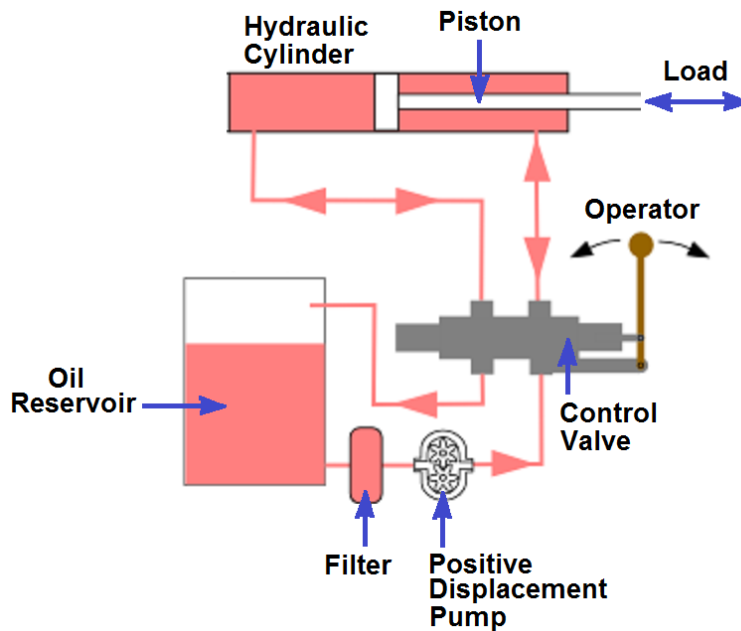


Figure 1: Typical hydraulic system.

Figure 2 is a simple example of a hydraulic control valve. The valve setting is adjusted by controlling the pressure in the supply of hydraulic fluid while the normally adjustable spring loading is used to control the mean setting of the valve. The hydraulic control system in a complicated machine like an airplane can contain hundreds (if not thousands) of such valves.

There also exist pneumatic control systems such as air brakes that use air rather than oil to communicate the control. These are similar to the hydraulic valves in many ways though they tend to be simpler and limited to much smaller loads and slower in response times. An example of a pneumatic control valve is included in Figure 3.

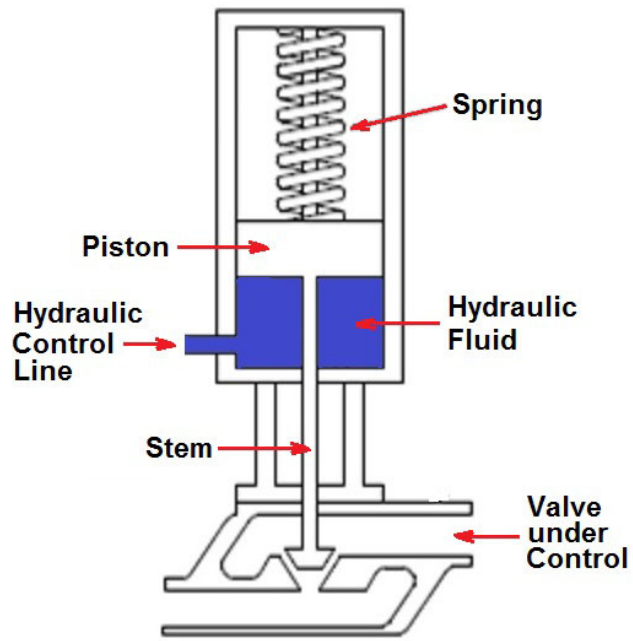


Figure 2: Hydraulically actuated hydraulic valve.

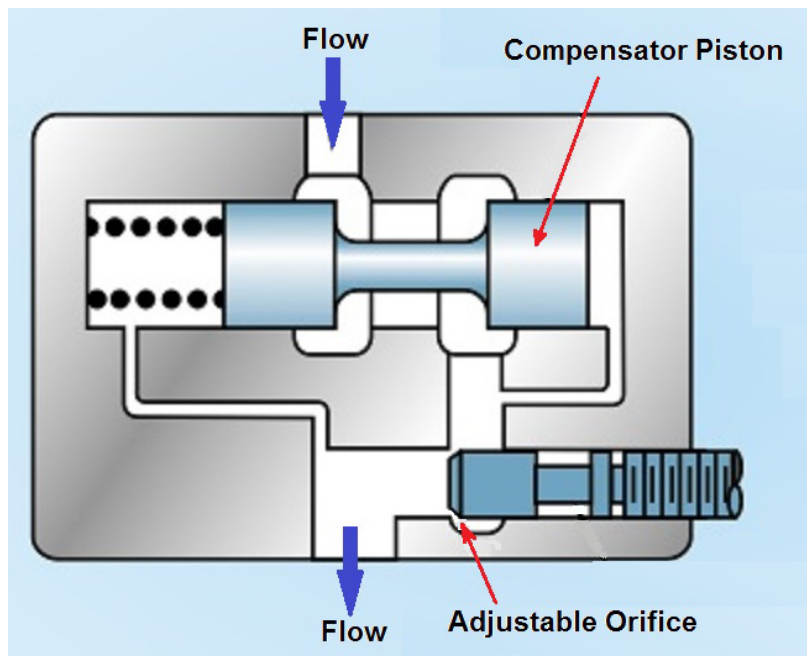


Figure 3: Typical pneumatic valve.