ME 4232: Fluid Power Control Lab

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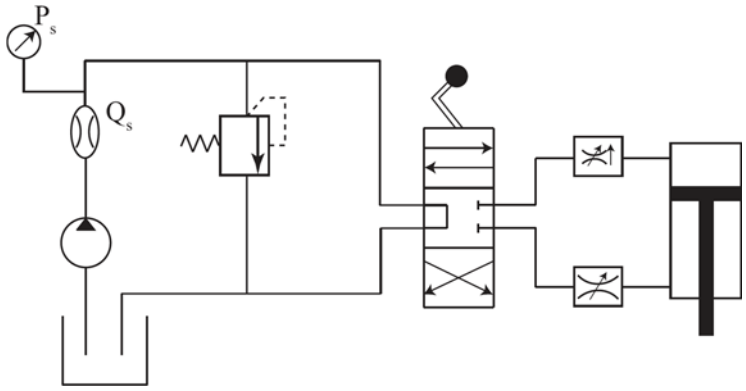
Lab 6: Meter in / Meter out circuit

Objective

We saw in Labs 3 and 4 that needle valves and PCFCs are used to control flow rate. Because of the direct relationship between flow rate and velocity of a piston in a cylinder, these flow control valves are used to control the speed of an actuator. Such circuits are called meter-in / meter out circuits. In this lab, you will demonstrate the superior performance of a pressure compensated control valve over a needle valve for speed control.

Pre-lab – Due as a hardcopy at the beginning of lab

Review the operation of a pressure compensated flow control valves especially about what causes them to deviate from the ideal behavior. Also, study meter-in and meter-out circuits [Ch. 11 in Eaton Manual]. In a one-paragraph summary, explain what happens in both the meter-in and meter-out circuits when the load on the actuator is acting in the direction of motion (over-running) and against the direction of motion (opposing).



Procedure

1. Set the relief valve cracking pressure at a sufficiently high level (e.g. 450psi).
2. Measure the speed of piston extension when valve the needle valve is 1) fully open, and 2) partially closed.
3. Decrease the relief valve setting and observe the velocity of extension. In this circuit the **needle valve is used to mimic a load on the actuator (Force on the actuator ←→ pressure inside the actuator) and thus it is out of the designer's control**
4. Reset the relief valve setting to the previous high cracking pressure (e.g. 400psi). Replace the PCFC with a needle valve with a setting such that when the load needle valve is fully open, the piston speed is similar to the case when with the pressure compensated flow control valve.
5. Measure the piston extension speed when the load needle valve is 1) fully open and 2) partially closed.
6. Design and implement a meter-out circuit that uses the PCFC to control the flow and a needle valve to simulate a load on the hydraulic cylinder. Compare this control method with the meter-in circuit.
7. Due to the difficulty in applying over-running loads with the current setup, we will not perform any experiments for that condition. However, be sure to discuss among yourselves and with the T.A. about the relative benefits of both circuits (meter-in/meter-out)

Report

Your report should include the following

- Brief description of the experiment
- Comment about which control valve is better at speed regulation.
- Describe the conditions that need to be satisfied in order for the metering circuit to function as expected.
- Discuss the relative merits of meter-in and meter-out circuits for various applications.