

Modulated switching control of ON/OFF poppet valves for proportional flow control

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ABSTRACT :

Hydraulic actuators are invariably used when high power-to-weight ratios are required and when high torques or forces are required. When there is a need to be able to control the speed of a hydraulic actuator, proportional valves or servo valves are used. In comparison with the poppet valves, proportional valves and servo valves are at a disadvantage in terms of cost and complexity. As servo and proportional valves have closer valve clearances, an additional disadvantage is the need for clean hydraulic fluid. In an industrial environment, this requirement is difficult and expensive to maintain. The poppet valves is designed for an that its operating state is either fully open or fully closed. This causes 'shock' waves when the valves are first open and when it closes. This is undesirable as it imposes stress to the system and induces structural vibration to the surrounding system. Various switching schemes have been applied in an effort to minimize these efforts.

Our disclosure describes a novel switching of the poppet valve solenoid that provides for a proportional flow control of hydraulic actuators. The resulting system possesses the contaminant immunity associated with the use of poppet valves with little increase in complexity of the poppet control circuit. We achieve the proportional control by high frequency excitation of the valve poppet at varying duty cycle. This effectively floats the poppet and adjusts the flow rate. The results have been tested in the laboratory both experimentally and on Matlab simulations.

This technology should be extremely relevant to sectors of industry that adopt hydraulic fluid power actuators and who desires flow control without the disadvantages of servo and/or proportional valves. We are developing a compact manipulator for underwater ROVs using this technology.



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