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RESEARCH ON LAUNCH VEHICLE SERVO SYSTEM BASED ON ENERGY REGULATING STRATEGY

Abstract

It is well known that servo systems are important parts of launch vehicles. Servo systems are used to receive the control signals of vehicle controllers and to drive gas vanes or displacement of rocket tube so as to control the flight attitude of launch vehicles.

At the present time, valve control electro-hydraulic systems are widely used in the vehicle servo systems. Valve control electro-hydraulic systems have the advantage of high control precision and quick dynamic response. But there is much throttle and overflow energy loss in valve control systems, so their energy efficiency is usually low especially in low speed conditions.

Variable speed hydraulic control system is a new kind of hydraulic system, it can regulate output flow rate of the pump by vary servo motor's speed to control the displacement or velocity of the load. Thus there is little throttle or overflow energy loss in variable speed hydraulic control systems, and their energy efficiency is usually high. But variable speed dydraulic control system has the disadvantage of low dynamic response because of big rotate inertia of the motor and pump, and it can't meet the dynamic request of launch vehicle servo systems.

A new type of variable speed dydraulic control system based on energy regulating strategy is dicussed in detail in this paper. In this system, a fixed displacement hydraulic pump is driven by an servo motor, so the output flow rate of the pump can be modified by changing the speed of the motor. A proportional directional valve is used to acquire higher low-speed control precision and quicker dynamic reponse while the system is decelerating. In order to improve the dynamic response while the system is accelerating, an accumulator controlled by a proportional valve is employed in this system and acts as an 'energy regulation device'. The energy regulation device can absorb redundant flow rate output by the pump while the system is decelerating, and it can output oil while the system is accelerating to compensate the pump's output.

The system structure and control strategy is put forward by the author. The experiment results shown that this system is very suit to apply in launch vehicle servo systems, because it has higher efficiency than valve control system, further more it has quicker dynamic response and higher low-speed control precision than normal variable speed hydraulic control system.