Research on Travel Control System of Hydrostatic Transmission Chassis

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Abstract. Aiming at the control problem of driving system of hydrostatic transmission chassis, the composition of the control system of hydrostatic transmission chassis is introduced and the control method of dual engine is solved. According to the number of driving axles in driving process, The external characteristic curve of the engine controls the variable hydraulic pump by one parameter, controls the rotational speed of the variable hydraulic motor according to the change of the vehicle speed, and introduces the control flow of the brake system. It provides a reference for the design of driving control system of multi-axis hydrostatic transmission chassis.

1 Introduction

With the development of the national economy, more and more high-rise buildings in the city, and its accompanying construction and fire-fighting machinery and equipment are also toward large-scale development in order to meet the construction and fire safety requirements. For large-scale construction machinery and equipment to develop high load capacity and through the hydrostatic hydraulic chassis, in order to make it get better power and economy, the study of multi-axis hydrostatic drive chassis drive system in the control Some methods can solve the problem of lack of theory in the driving system of multi-axis hydrostatic drive chassis and provide a solution for the speed control of the hydraulically driven chassis at high speed.

Large-scale machinery and equipment need to have a high carrying capacity of the chassis, and to be able to facilitate the operation, to achieve the vehicle's micro-driving and high-speed requirements. Hydrostatic transmission technology has a compact structure, wide speed range, easy to control, you can achieve the vehicle stepless speed regulation and freestyle, in the construction machinery walking system has been a lot of applications. At present, hydrostatic transmission technology is mainly used in low-speed operation of engineering vehicles, in multi-axis drive and high-speed vehicles in the application of research is still blank, speed control problems in driving lack of theoretical support.

2 Composition and working principle

The hydrodynamic drive vehicle has four hydraulic pumps and 14 drive motors, which are driven in a fully driven manner. Hydraulic drive vehicle unilateral driving hydraulic and control system works as shown in Figure 1, including the controller, the engine 1, the variable hydraulic pump 2, the pressure sensor 3, the accelerator pedal 4, the handle 5, cartridge valve 6 , An electromagnetic directional valve 7, a safety relief valve 8, a variable hydraulic motor 9, a speed sensor 10, and a wheel reducer 11.

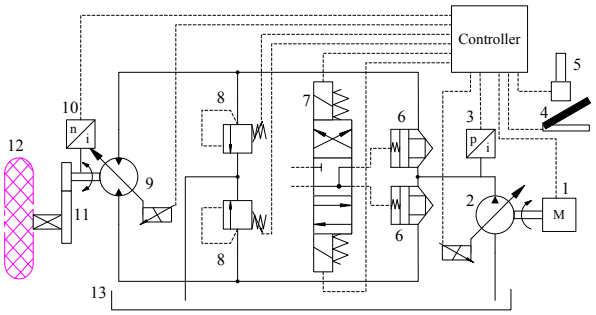

Figure 1. Schematic diagram of single-sided driving hydraulic system

The engine 1 and the variable hydraulic pump 2 are connected. The controller controls the engine 1 to drive the variable hydraulic pump by detecting the signal of the accelerator pedal. The hydraulic system is supplied to the travel system. The hydraulic motor 9 is driven by hydrostatic pressure. The wheel is driven by the wheel reducer. The electromagnetic directional control valve 7 controls the flow of the hydraulic oil to change the steering of the variable hydraulic motor and realize the function of advancing and retreating the vehicle. The hydraulic pump uses constant power control with pressure cut off, adjusts the displacement of the variable hydraulic pump according to the external characteristic curve of the engine. The variable hydraulic motor 9 is controlled by the electric proportional control. The controller detects the gear signal of the gear position and

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the pressure of the hydraulic system. The magnitude of the hydraulic motor coil is controlled to control the displacement of the variable hydraulic motor.

3 Driving principle

Control of the drive section of the multi-axis hydrostatic drive chassis drive includes control of the engine, variable displacement hydraulic pump, variable displacement hydraulic motor and associated solenoid valves. The control schematic shown in Figure 2. By adjusting the accelerator pedal stroke to adjust the engine throttle opening to adjust the engine speed, according to the engine's external characteristics curve to determine the maximum power of the engine at each speed, combined with the hydraulic system to determine the variable displacement hydraulic pump target displacement. Through the gear lever gear signal and hydraulic system pressure variable displacement hydraulic motor displacement, change the variable speed hydraulic motor to change the vehicle speed.

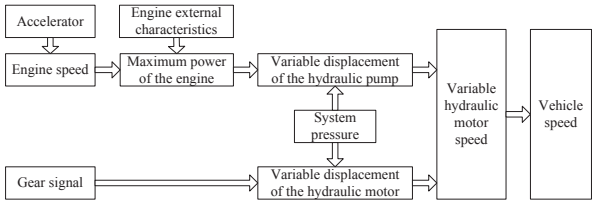

Figure 2. Schematic diagram of the operation of the hydrostatic transmission vehicle

3.1 Power control system

Power control system is mainly on the engine control, the engine has two engines, when traveling need to use two engines; in the operation of the load when the need to use an engine, priority use of the main engine, if there is a fault available from Engine; two engines can be a separate start-up, downtime; two engines share a single accelerator pedal while driving. As shown below. The engine speed is directly controlled by the accelerator pedal in the cab. Both the master and slave engines are equipped with KSM, and the bodywork can separately control the engine speed regulation.

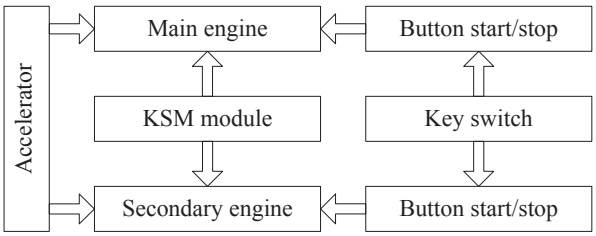

Figure 3. Power control system schematic

3.2 Hydraulic pump control

The hydraulic pump is directly connected to the engine, the input speed, torque and engine output speed, torque and power of the hydraulic pump are equal. The displacement of the hydraulic pump for a single parameter control, according to the engine changes set the pump displacement, pump displacement and the engine speed n .

$$q_b = f(n) \tag{1}$$

Where q_b is the displacement of the hydraulic pump; n is the speed of the engine.

The relationship is determined by the following figure:

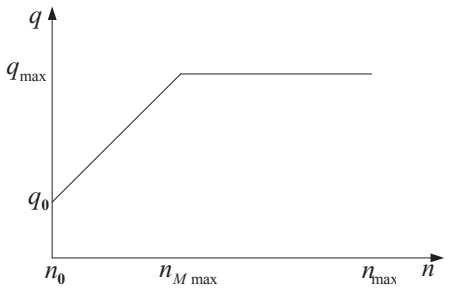

Figure 4. Relationship between the displacement of pump and engine speed

Where q_0 is the minimum displacement of the hydraulic pump, $q_{\max}$ is the maximum displacement of the hydraulic pump, n_0 is the engine idling, $n_{M\max}$ is the maximum torque speed of the engine, $n_{\max}$ is the maximum engine speed.

Hydraulic pump control strategy shown in Figure 5.

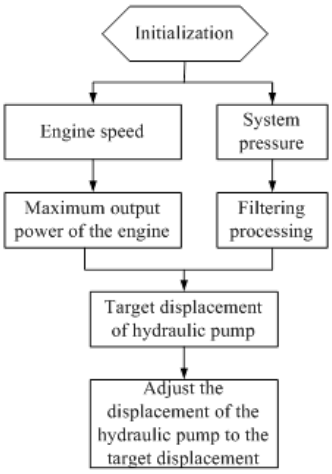

Figure 5. Hydraulic pump control strategy

3.3 Hydraulic motor control

Hydraulic motor displacement According to gear, speed and system pressure to calculate the displacement of the motor at any time, the speed and force into a hyperbola similar to the current vehicle speed calculated according to the target displacement is:

$$q_m = \frac{q_{\min} \cdot v_{\max}}{v} \tag{2}$$

Where q_m is the displacement of the hydraulic motor; v is the speed of the vehicle; $v_{\max}$ is the

maximum speed per file ; $q_{\min}$ is the minimum displacement corresponding to each gear of the motor.
First, the motor displacement opening to the maximum, and then according to the highest speed of each file to determine the motor displacement, the motor displacement from the maximum transfer to the maximum speed corresponding to the displacement, and then automatically adjust the motor displacement according to the system pressure.

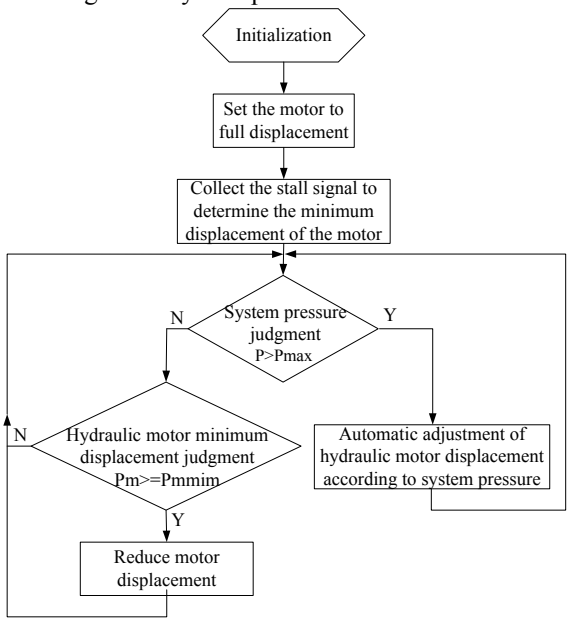

Figure 6. Control strategy for hydraulic motors

3.4 Division of travel vehicles

Multi-axis hydrostatic transmission vehicles in the transmission system without gearbox, the gear design is based on the number of drive axles to determine the number. When the vehicle is moving forward, the number of axles is changed from 7 to 3, and the number of axles is divided into five gears according to the number of drive axles. Can be manual and automatic gear switch, when the need to drive the number of less when the corresponding turn off the displacement of the hydraulic motor, let it in a zero displacement state, to improve the speed of other drive hydraulic motor3.

4 Hydraulic pump control strategy

Braking system can be divided into three brake: brake brake, parking brake and emergency brake. Brake brake: mining brake pedal, the valve is closed, brake relief valve and motor displacement by the brake pedal travel, slope determined. Parking Brake: On flat road or on the slope, the detection speed is zero and the parking brake is started. This button does not really work. Emergency brake: press the stop button, the engine flameout, the pump displacement minimum, maximum motor displacement, the valve closed, the pressure relief valve has been the largest, parking brake start. Control flow chart is as follows:

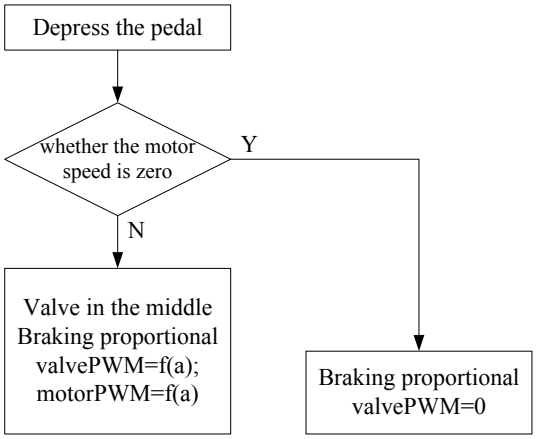

Figure 7. Brake control flow chart

5 Conclusion

Based on the composition and working principle of hydrostatic transmission chassis, this paper introduces the control methods of hydraulic pump, hydraulic motor and brake system.
(1)According to the engine's external characteristics of the variable displacement of the hydraulic pump control, the engine fuel consumption is the best;
(2)According to the driving conditions of the vehicle to control the displacement of the variable hydraulic motor, the torque required at the time of starting is large, and the variable hydraulic control of the variable hydraulic motor is used to maximize the displacement of the hydraulic motor. Constant power control, regulation of hydraulic motor displacement;
(3) Depending on the number of axle of the gear we have been divided.

Acknowledgement

The article was supported by Special research project of Shaanxi Provincial Department of Education (Grant No. 14JK1134),Shaanxi Province Natural Science Basic Research Project(Grant No. 2017JM5087).

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