Design and Simulation Study of the Anti-Skid Braking System for Mine Electric Locomotive

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Abstract
The motor vehicle as the research object, designed a new scheme of the brake, hydraulic disc brake used in motor vehicle design, anti-skid brake system for the control, PID control and non-motor vehicle braking system for modeling and Simulation of the logic threshold value in MATLAB/Simulink. The simulation results show that the motor vehicle braking effect of motor vehicle use of anti-slip brake system was better than that of non-slip system; using PID braking system control algorithm is better than using logic threshold control braking system.

Keywords: Motor vehicle, disc brake, PID control, MATLAB/Simulink.

I. INTRODUCTION

Motor vehicle plays a very important role in coal transportation, because the existing motor vehicle braking system is relatively backward, the braking distance is too long, and easy to lock, seriously affect the transportation efficiency and motor vehicle safety. To solve this problem, this paper designs a new scheme of the brake, hydraulic disc brake braking system used in motor vehicles, and the addition of the anti lock braking system, it not only shortens the response time of the braking system, but also improve the utilization rate of adhesion coefficient between wheel and rail.

II. DESIGN OF BRAKE ACTUTING MECHANISM FOR ELETRIC LOCOMOTIVE

A new type of braking scheme is designed. The hydraulic disc brake is applied to the electric locomotive. In order to refit the existing electric locomotive, the brake disc is installed at one end of each reducer's middle speed shaft. In order to reduce the adverse effects of braking torque on each part of the gear box during braking, two sets of brake caliper assemblies are arranged on the brake disc and symmetrically arranged. The installation details of the brake are shown in figure 1.

Figure 1: The Installation Details of the Brake

III. ANTI LOCK BRAKING SYSTEM PRINCIPLE AND DESIGN

Anti Lock Braking System Principle

The motion state of anti lock function of the system is analyzed and the locomotive wheel, through the booster, the wheel cylinder pressure and decompression operation, to adjust the braking torque of the brake, the wheel slip rate has been near optimal value fluctuations, in order to obtain the highest braking torque. As shown in Figure 2, said the working principle of anti lock braking system, brake in the initial state, pressure regulation unit components are not electricity, normally open solenoid valve 4, normally closed solenoid valve 5 and the motor 12 is reset, at this time, as with conventional brake oil pressure, brake master cylinder 2 often open the high-speed switch electromagnetic valve 4 into 6 wheel brake cylinder, wheel cylinder piston pushes the friction pads pressure in the brake disc 7, then the implementation of locomotive brake.
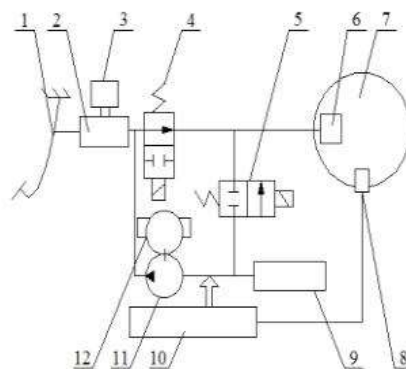

Figure 2: Anti-Lock Braking System Schematic

In the braking process, to obtain real-time state information using wheel motion controller 10 wheel speed sensor 8, and compared with the reference speed, when a wheel slip rate exceeds the set value, the need to implement decompression operation on the wheel. When the creep rate of the wheel set is reduced to the set range, the pressure maintaining operation is carried out on the wheel set. When the creep rate of the wheel set decreases below the set range, it is necessary to perform pressurization operation on the wheel cylinder. Anti lock braking system is through the booster - wheel cylinder pressure - relief, this cycle of action, to adjust the braking torque of the brake disc, to ensure that the wheel set creep rate at the best value near the fluctuation, provide larger braking force and motor vehicle.

IV.CONCLUSION

In order to improve the efficiency and safety of the coal mine, it is necessary to improve the braking system and skid control system of the mine electric locomotive. This paper designed a new scheme of the brake, hydraulic disc brake used in motor vehicle design, anti-skid braking system. The braking system modeling simulation using MATLAB/Simulink antiskid braking control, motor vehicle logic threshold control and PID control of the

simulation results demonstrate the feasibility of mine electric locomotive used PID control of anti-skid braking system and effective, provide ideas for the study of anti-skid braking system of mine electric locomotive.

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