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Safety Catcher Performance Optimization of braking Based on ADAMS

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Abstract: Utilizing the application of UG/Solid Modeling in the structural design of the product, it forms a good matching of the whole mechanism and the damping structure of the system, which reduces the impact of the inertial force on the brake wire rope under the emergency braking state; the design and application of the working spring, the analysis of the cylinder The application of the spring in the detection hydraulic cylinder and its fatigue life; the application of the butterfly spring in the driving hydraulic cylinder and its fatigue life analysis; the working principle of the anti-dropping brake system and the impact during the braking process are analyzed. With security protection.

Keywords: Safety catcher , ADAMS, Performance Optimization of braking.

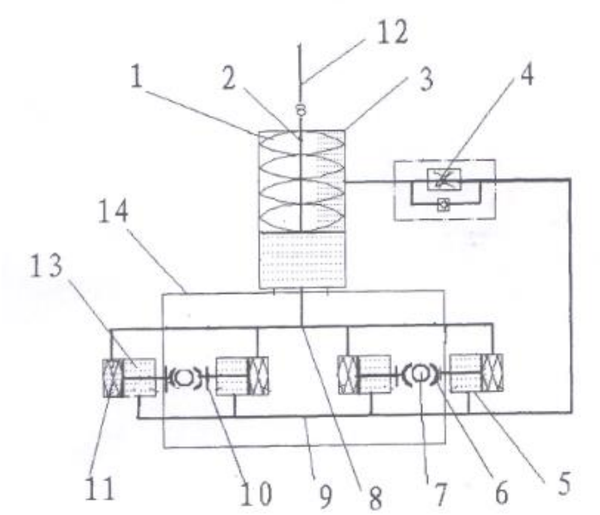
1. INTRODUCTION

The single rope winding lifting cage of the mine is the only equipment for lifting personnel and material equipment. In order to meet the safety of mine production, there are strict regulations for safe production: single rope lifting cages for lifting personnel or lifting personnel and materials (including buckets with passengers) , A reliable safety catcher must be installed. When the lifting wire rope or the connecting device breaks, the cage can be stably supported on the tank road or the brake rope in the wellbore to prevent the cage from falling into the bottom of the well, causing a major accident (commonly known as the tank).

The current safety catcher has a wooden tank mechanical structure and a steel rope canister mechanical structure. Different manufacturers have different designs and models for the safety catcher. The commonly used domestic BF series, BS series and GF series safety catcher, the series of safety catcher are all mechanical transmission mechanism.

The BF series brake rope safety catcher is a standard safety catcher widely used in China. The safety catcher is used in conjunction with the brake wire on both sides of the lifting cage, and the braking process is completed by the pure mechanical brake structure lever transmission principle. Since the brake shoe adopts a mechanical plane (wedge shape) structure, the wire rope table has a sludge. When the cow is broken, the friction between the plane brake shoe and the wire rope is low, and the falling cage cannot be blocked. At the same time, due to the mechanical structure, the anti-drop device is rusted by the influence of the water from the wellbore, resulting in the failure of the action transmission when the rope is broken, and cannot meet the requirements of the relevant safety regulations on the transmission time. Therefore, designing a safe and reliable normally closed hydraulic fall arrester will have important practical significance for improving mine safety and production conditions and improving the safety of mine single rope lifting system.

2. SAFETY CATCHER STRUCTURE PRINCIPLE



1-return spring 2-piston rod 3-start hydraulic cylinder 4-regulating valve 5-execution hydraulic cylinder 6-curved brake shoe 7-brake wire rope 8-outlet pipe 9- return pipe 10-adjustment bolt 11- return spring 12-lift wire rope 13-execution piston rod 14-lift cage

Figure 1. Schematic diagram of the normal closed hydraulic safety catcher

As shown in the figure, the normally closed liquid safety catcher braking system includes a hydraulic cylinder actuating mechanism connected between the lifting cage 14 and the lift wire rope 12, and is respectively fixed on the frame on both sides of the lifting cage I4 and is braked along Two normally closed hydraulic actuators in which the wire rope 7 runs. The hydraulic cylinder actuating mechanism is configured to include a vertically disposed hydraulic cylinder 3 having a piston rod 2 disposed therein, and a return spring l for actuating the rodless chamber and the rod chamber of the hydraulic cylinder 3 Full of hydraulic oil, the end of the piston rod 2 is connected to the hoisting rope 12 through a wedge-shaped loop connecting mechanism, and the cylinder of the hydraulic cylinder 3 is connected to the lifting cage 14; the two normally closed hydraulic actuators have the same structure, each normally closed The liquid helium actuator comprises two execution hydraulic cylinders 5 arranged transversely on the same axis. The cylinders of the two hydraulic cylinders 5 are fixed on the side frame of the lifting cage, and the piston rod of the hydraulic cylinder 5 is provided with an execution piston rod. 13 and the return spring 11, the rodless chamber of the hydraulic cylinder 5 and the rod chamber are filled with hydraulic oil, the two piston actuator rods 13 are mounted with the curved brake shoe 6, and the two curved brake shoes 6 The curved surface is relatively ambiguous.

Surrounded by the brake wire rope 7; the rod cavity of the actuating hydraulic cylinder 3 is connected to the rod cavity of each of the execution hydraulic cylinders 5 through the regulating valve 4 and the oil return pipe 9, and the rodless cavity of the hydraulic cylinder 3 is actuated through the oil discharge pipe. The rodless chamber connection of the hydraulic cylinder 5 is performed to constitute a hydraulic circuit.

In order to meet the requirements of different lifting loads on the braking action time, a brake lash adjuster is arranged on the curved brake shoe 6, and a regulating valve 4 is connected in series on the oil pipe 9 for adjusting the effective action of the hydraulic cylinder 3 Work volume and action time.

3. OPTIMIZED DESIGN OF SAFETY CATCHER'S BRAKING PERFORMANCE

3.1 Parametric design of the stiffness of the butterfly spring

The combined stiffness of the butterfly spring is 14729 N/mm, and the butterfly spring is composed of several overlapping combinations. The butterfly spring of this subject is composed of 8 superimposed combinations, and the stiffness design value is 1841 N/ Mm. Therefore, in the process of parameterizing the butterfly spring, six, seven, eight, nine, and ten superimposed combinations can be considered, and the stiffnesses are 2455 N/mm, 2104 N/mm, 1841 N/mm, 1637 N/mm, and 1473 N/mm, respectively.

Butterfly spring stiffness is associated with design variables

Once the design variables for the stiffness of the butterfly spring are established, the design variables need to be associated with the butterfly springs in the virtual prototype. Right click on the position of the anti-dropper virtual prototype disc spring, select SPRING2/Modify, then right click on the disc spring stiffness item, select Parameterize/ReferenceDesign Variable, and select DV_K in the pop-up dialog box. The result is shown in Figure 5.2.

Parametric analysis of the safety catcher's stiffness on the butterfly spring

By simulating the stiffness parameters of five different disc springs and combining the curves of different parameters into one graph through the ADAMS post processor, the influence of the change of the disc spring stiffness on the braking performance of the fall arrester can be clearly reflected. Figure 2 and 3 are the influence curves of the stiffness of the butterfly spring on the braking distance and the influence of the stiffness of the butterfly spring on the braking speed. As can be seen from Figure 2, the smaller the disc spring stiffness, the greater the braking distance.

As can be seen from Figure 3, the smaller the disc spring stiffness, the slower the braking speed changes, and the longer the speed brake is zero.

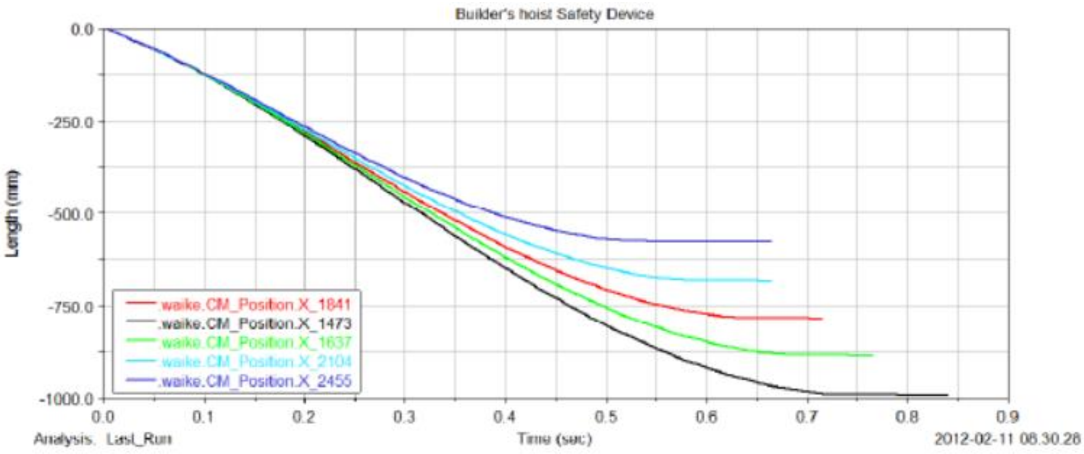


Figure 2. Effect of the stiffness of the butterfly spring on the braking distance

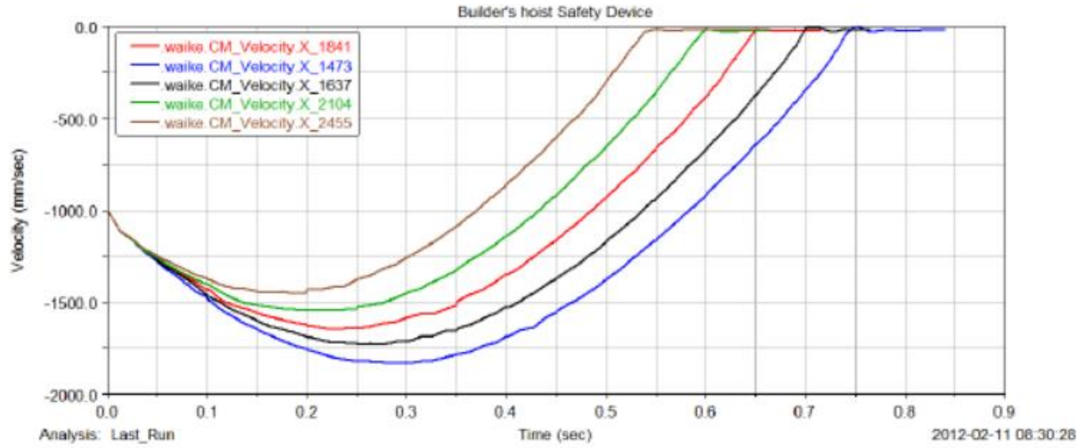


Figure 3. Effect of the stiffness of the butterfly spring on the braking speed

3.2 Parametric design of pretension of butterfly spring

The pre-tightening force of the disc spring is 2000N, and the variation of the design variable is limited to -1000 to +1000N. The association method of the design variables is the same as the correlation method of the disc spring stiffness design variables above, and will not be described here. By simulating the parameters of the pre-tightening parameters of five different disc springs and combining the curves of different parameters into a graph by the ADAMS post-processor, the influence of the change of the disc spring stiffness on the braking performance of the anti-dropper can be clearly reflected. Figure 4 and 5 are the influence curves of the pre-tightening force of the butterfly spring on the braking distance and the influence of the pre-tightening force of the butterfly spring on the braking speed.

As can be seen from Figure 4, the smaller the disc spring preload, the greater the braking distance. As can be seen from Figure 5, the smaller the disc spring preload, the longer the speed brake is zero.

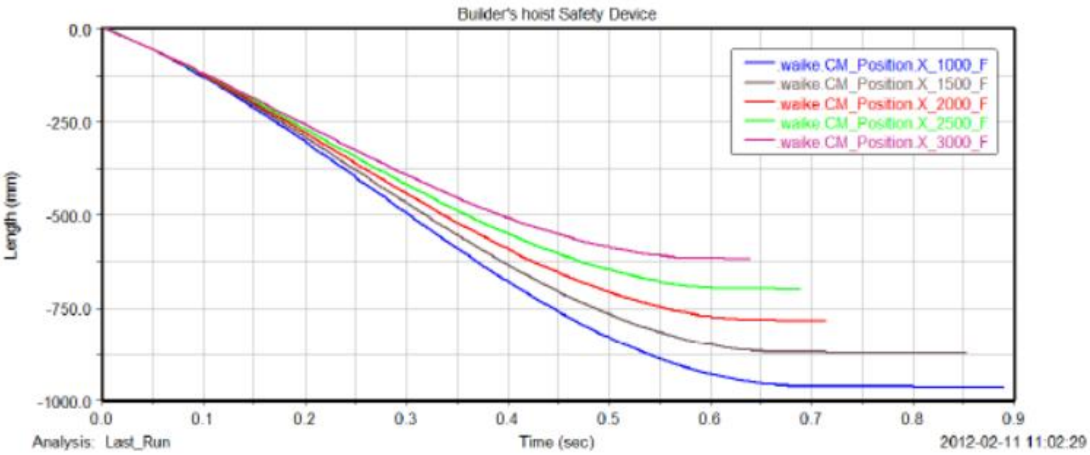


Figure 4. Effect of pre-tightening force of butterfly spring on braking distance

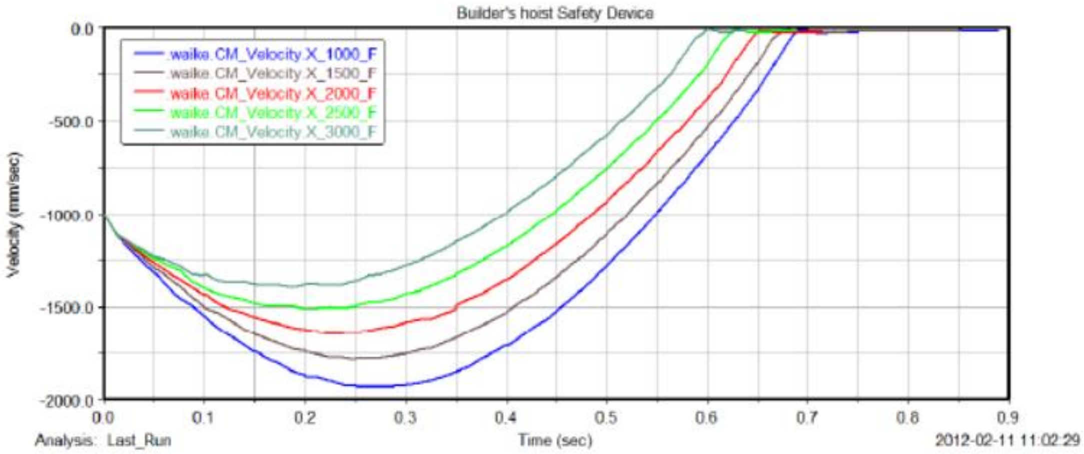


Figure 5. Effect of the preload of the butterfly spring on the braking speed

4. SUMMARY

(1).Utilizing the application of UG/Solid Modeling in the structural design of the product, a good matching of the whole mechanism and a damping structure of the system are formed, and the impact of the inertial force on the brake wire rope under the emergency braking state is reduced.

(2)The design and application of the working spring, the application of the cylindrical spring in the starting detection hydraulic cylinder and its fatigue life; the application of the butterfly spring in the driving hydraulic cylinder and its fatigue life analysis.

(3)Analyze the working principle of the safety catcher brake system and the impact and safety protection during the braking process.

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