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DELIVERING QUALITY SCIENCE TO THE WORLD

Stroke Analysis Method of Cage Roller

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Abstract: Using the basic analysis method of mechanics, the mechanical analysis of each moving member in the JD-type dispatching winch transmission mechanism is carried out. The analysis results can not only reflect the torque equation of the output and input members, but also obtain the motion pairs of the moving members at different times. Stress situation. The equations of motion and mechanics are linear equations, which are easy to modularize and easy to generate automatically by the computer. It provides some ideas for the innovative design and analysis of the JD-type dispatching winch transmission mechanism.
Keywords: Cage roller, ANSYS, ADAMS, buffer stroke.

1. INTRODUCTION

In recent years, with the increase of mining depth, the lifting container and the lifting speed have been increasing, the composite material tank has been widely used, and the new roller cans are constantly appearing. As an auxiliary device for shaft lifting, the roller cans are required to have good cushioning and vibration damping performance, which can effectively avoid the hard impact of the container and the combined steel can, and ensure the smooth operation of the container during the lifting process.

The buffer stroke is a very important parameter of the roller can ear. It is mainly composed of two parts: 1 the deformation of the polyurethane roller under horizontal thrust and the deformation of the pendulum. Figure 1 shows the structure of a single roller can, and Figure 2 shows the combination of three roller cans.

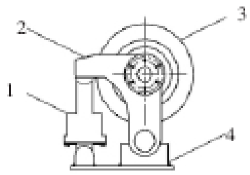

Figure 1 Single roller can ear

Buffer assembly 2. Swing arm assembly 3. Roller assembly 4. Base plate assembly

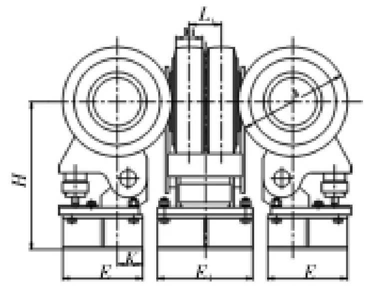

Figure 2 The use of a set of roller cans

2. THE AMOUNT OF DEFORMATION OF THE ROLLER UNDER HORIZONTAL THRUST

(1) Stress analysis

When the lifting container is subjected to a horizontal impact force, the roller can also be subjected to an impact force. The contact stress of the roller can is calculated according to the empirical formula (1). Contact stress is an important factor in the buffer stroke.

$$b_s = \sqrt{\frac{\pi p_s (k_u + k_s) R_s}{L_s}}$$

$$\sigma_s = \sqrt{\frac{p_s}{\pi L_s (k_u + k_s) R_s}}$$

$$k_u = \frac{1-\mu_u^{\ 2}}{\pi E_u} \qquad (1)$$

$$k_s = \frac{1-\mu_s^{\ 2}}{\pi E_u}$$

Where L_s —the actual contact length of the can ear to the can.

It can be seen from the formula (1) that the contact stress is inversely proportional to the square root of the actual can ear radius and the actual contact length, and the thickness of the can ear is increased, which can reduce the contact stress and increase the service life.

(2) Calculation of deformation of polyurethane wheel

ANSYS software is a versatile finite element computer design program that can be used to solve structural, fluid, electrical, electromagnetic, and collision problems. This article will use ANSYS to solve the deformation amount.

It can be seen from Fig. 3 and Fig. 4 that the maximum value of deformation at 10 kN is 0.6 mm, and the maximum value of deformation at 24 kN is 1.5 mm. The maximum deformation of the polyurethane wheel occurs at the position of the horizontal thrust, and the greater the horizontal thrust it receives, the greater the deformation, which is approximately linear. Here, the concept of the deformation stiffness of the polyurethane wheel can be introduced, and the deformation stiffness value (10/0.6 ≈ 24/1.5 ≈ 16.666 kN/mm) varies with the size of the can ear.

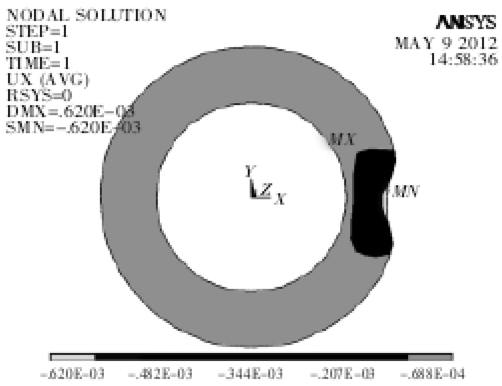

Fig. 3 Deformation of horizontal thrust at 10 kN

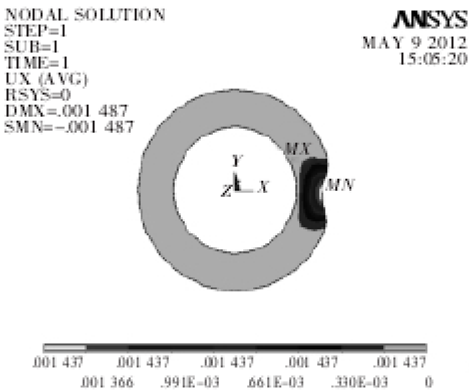

Figure 4 Deformation of horizontal thrust at 24 kN

3. THE AMOUNT OF DEFORMATION OF THE PENDULUM UNDER HORIZONTAL THRUST

The ADAMS software uses an interactive graphical environment and parts library, constraint library, and force library to create a fully parametric mechanical system geometry model. The solver uses the Lagrange equation method in multi-rigid system dynamics theory to establish system dynamics. Equations, static, kinematic, and dynamic analysis of virtual mechanical systems, output displacement, velocity, acceleration, and reaction force curves. This article will use ADAMS to solve the variation of the pendulum under horizontal thrust.

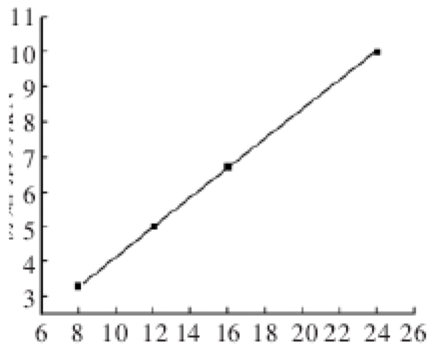

Figure 5 Relationship between horizontal force and initial tension (single row wheel)

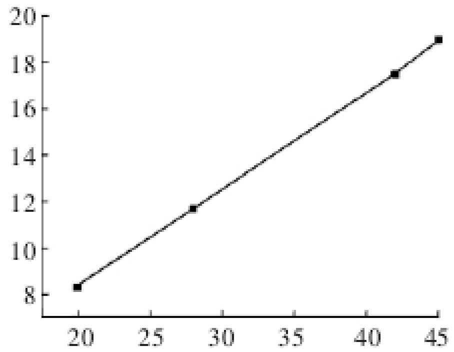

Figure 6 Relationship between horizontal force and initial tension (double row wheel)

Figure 7 shows the roller can ear model established in ADAMS. The model has the following parts: 13 rotating pairs; 21 moving pairs; 31 horizontal thrusts (the direction does not change direction with the deformation of the cans); 41 Spring restraint (analog buffer). The accuracy of this model calculation depends critically on the selection of the spring rate value in the damping device. In this paper, the horizontal thrust applied in the can ear model is shown in Figure 8. This value is kept constant when the thrust reaches 24 kN. The cushioning device in this example consists of a butterfly spring with a spring stiffness of 960 N/mm. When the cushioning device is combined by a plurality of cushioning elements, the selection of the spring stiffness is determined by combining various factors.

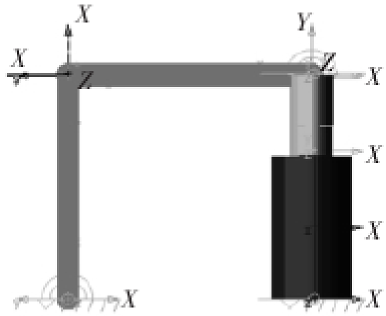

Figure 7 can ear model

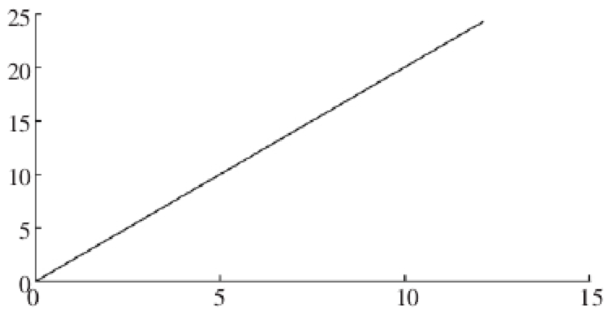

Figure 8 Applied horizontal thrust

After establishing the model in ADAMS and applying constraints, it can be solved. In this paper, we mainly focus on the relationship between horizontal thrust and swing stroke. Figure 9 shows the relationship between horizontal thrust and swing travel obtained by ADAMS. It can be seen that the swinging stroke and the horizontal thrust are linear, and the greater the horizontal thrust, the larger the stroke of the swing.

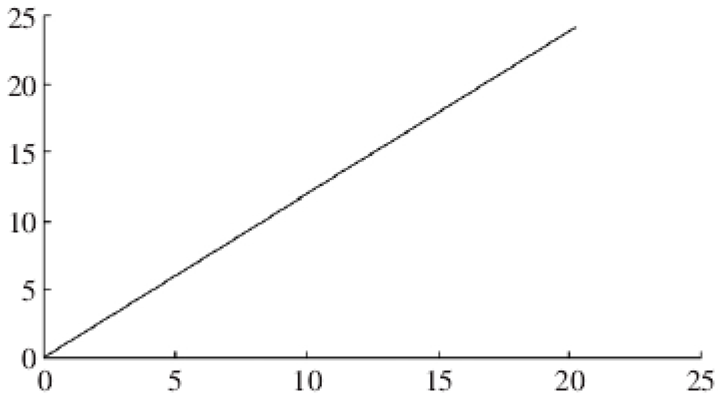

Figure 9 Relationship between horizontal thrust and swing travel

4. TANK EAR BUFFER STROKE TEST VERIFICATION

In order to verify the correctness of the above buffer stroke and analytical method, the cans of the above models were tested. The test is carried out on a dedicated test bench. The buffer stroke is controlled by the piston of the hydraulic cylinder. The horizontal thrust of the can is read by the force measuring device. The test results are shown in Table 1.

Table 1 Test and analytical data

	Horizontal thrust / kN	Buffer stroke / mm
Theoretical analytical method	10	8.6
	24	20.5
Experiment method	10	8.4
	24	19.2

5. CONCLUSION

In this paper, ANSYS and ADAMS are used to theoretically analyze and calculate the buffer stroke of the tank ear, and the rationality of this analytical result is verified by experiments. The results of comprehensive theoretical analysis and experiments show that this analytical method is reasonable and can be widely applied to the calculation of the buffer stroke and horizontal thrust of the tank ear, greatly simplifying the design and installation process.

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