Design and Research of Multi Rope Friction Hoisting System

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Abstract

The mine hoist system is an important part of the mine transport equipment. Multi rope friction hoist system is widely used in modern mining industry. Foundation design of machine working principle of multi rope friction hoist on the detailed analysis, analysis of each institution arrangement and selection of multi rope friction hoist. A machine shop or fabricating shop will use an integral-package hoist, while a Steel Mill or NASA would use a built-up unit to meet durability, performance, and repairability requirements. NASA has also seen a change in the use of package hoists. The NASA Astronaut training pool, for example, utilizes cranes with packaged hoists.

Keywords

The mine hoist system;Multi rope friction hoist; The selection and calculation; The selection and calculation.

1. Introduction

Mine hoist is one of the main mine equipment, used for lifting personnel and materials, used to contact the underground and ground transportation tools. In China, the hoisting equipment whose drum diameter is more than 2m is called hoist (except explosion-proof hydraulic winch), and the hoist whose drum diameter is less than 2m is commonly called winch.

The working characteristic of mine hoist is to run reciprocating at a higher speed within a certain distance. In order to ensure high efficiency, safety and reliability, mine hoist should have good control equipment and perfect protection device. Once mechanical and electrical faults occur in the mine hoist, it will seriously affect the production of the mine, and even cause personal casualties.

Mine hoist and air pressure, ventilation and drainage equipment constitute the four major mine fixed equipment, is a complex mechanical and electrical group. So reasonable selection of mine hoisting equipment is of great significance.

Nowadays, the main structure forms of our country's production are single-rope winding single-barrel and double-barrel mine hoist, friction multi-rope landing and tower multi-rope friction hoist, drag mode selection needs to be designed, in addition to the underground mine hoist with hydraulic transmission. The main types of mine hoists commonly used in China are single rope winding and multi rope friction. Compared with the developed countries in the world, the mines in our country have smaller shaft type, higher mine lifting height, more coal mines, less metal and non-metal mines in other mines, and less proportion of inclined shaft lifting. Therefore, in the 1980s, multi-rope friction mine hoist began to use more, because multi-rope friction is more suitable for this mine.

2. Advantages of Multi Rope Friction Hoist

The lifting container is jointly suspended by several lifting wire ropes, and the probability of all wire ropes being pulled out at the same time is very small. Therefore, the safety and reliability

of the lifting container is high, and it is no longer necessary to install a rope breaking device on the lifting container.

The multi-rope friction hoist is composed of several hoisting wire ropes to bear the load together, so each wire rope only bears 1/n of the load at the end of the rope (n - the root of the hoisting wire rope), so that the smaller diameter wire rope can be used and the diameter of the main wheel can be reduced accordingly.

With the decrease of the main wheel diameter, the multi-rope friction hoist can adopt high-speed motor at the same lifting speed. Therefore, the multi-rope hoist has many advantages - small size, small transmission torque, small motor power, light weight, low price, low construction investment, low power consumption in operation, low cost, etc.

The multi-rope friction hoist is installed on the shaft tower, which simplifies the layout of the hoisting system and the wellhead floor, reduces the area occupied, and improves the force condition of the shaft tower. The shaft tower has no oblique pulling force. Because it does not need to be set up as a supporting leg to counteract the oblique pulling force, the steel is saved and the reinforced concrete is used in the construction of the shaft tower. Building materials create favorable conditions.

The number of hoisting ropes is even, so the same number of left-twisted and right-twisted ropes can be used. In this way, the torsional force produced by the hoisting rope in operation can be cancelled each other, thus reducing the lateral tension of the hoisting vessel to the tank passage caused by the torsional force of the wire rope, and reducing the influence of friction resistance in operation. The unidirectional wear between the tank and the tank can be reduced, and the service life of the cage and the tank ears can be prolonged.

The multi-rope friction hoist installed on the shaft tower can reduce the bending times of the hoisting wire rope, especially for the multi-rope friction hoist without guide wheels, so the service life of the hoisting wire rope can be prolonged. At the same time, because the hoisting wire rope only operates in the wellbore and does not contact with the outside, it is almost unaffected by climate change.

The hoisting wire rope of multi-rope friction hoist is not winded on the main wheel, and there is no requirement for the width of the main wheel. Therefore, the width of the main wheel is smaller than that of the single-rope hoist, and the winding position is fixed, so it has nothing to do with the depth of the well. It makes the multi-rope hoist better adapt to the actual needs of deep mine and mine with large load, which is also the greatest advantage of multi-rope hoist.

In summary, the width of the main wheel is small, and the span of the shaft is small, which improves the load performance of the spindle.

3. Main Structure and Function of Multi Rope Friction Hoist

The multi-rope friction hoist is mainly composed of spindle device, brake device, reducer, depth indicator, and groove device and guide wheel.

3.1. Spindle Device

The main shaft of multi rope friction hoist is composed of main guide wheel, main shaft and two bearings. The main guide wheel and brake disc can be welded by 16Mn steel plate. For the hoist above JKMD-2.8/4, the main wheel also has a supporting ring to increase the rigidity of the main wheel. Because of the different capacity (maximum static tension difference) of various hoists, the number of pairs of disc brakes used in hoists is also different, so a main wheel has a brake disc welded, there are also two brake discs welded. The main shaft is forged from 45 steel and its ultimate strength is 4.2-5.6 Mpa. It is connected with the reducer by rigid coupling. The main shaft and the cast steel hub are connected by hot pressing. The main bearing adopts rolling

bearing, which has the advantages of higher efficiency, smaller width, simple maintenance and long service life compared with sliding bearing.

Friction pad is one of the important parts of multi-rope friction hoist. It bears all the load on the wire rope of the hoist and must have enough friction coefficient to prevent sliding during the hoisting process. Therefore, the material of the friction liner is good or bad.

It has a significant and direct impact on the performance, application scope and safety of the friction hoist. At present, thermoplastic and polyvinyl chloride (PVC) gaskets are mostly used in China. The gaskets are pushed in by trapezoidal groove fixation method, i.e. by circumferential thrust, thus increasing the strength of the main wheel and prolonging its service life.

3.2. Reducer

The multi rope friction hoist adopts planetary gear reducer. Because planetary gears use several planetary gears to transmit loads at the same time so that power splitting can reasonably use internal meshing, they have a series of notable advantages, such as compact structure, small size, light weight, large transmission ratio range, high transmission efficiency, concentric input and output, power splitting and variable speed. As a result, it meets the above requirements and has been widely used in light industry, aviation, ship, power, metallurgy, mining, crane transportation, and other equipment as deceleration, speed increase and speed change transmission. However, due to the complex structure of planetary gear transmission, the design, manufacture and maintenance of the planetary gear drive are required. Especially the high-speed planetary gear transmission requires higher dynamic characteristics of load sharing mechanism, vibration characteristics of system, structure of parts and manufacturing accuracy.

3.3. Digital Depth Indicator

In order to prevent the deviation caused by the slip elongation and creep of the steel wire rope from harmful effect on the system, a zero adjusting mechanism is usually used to eliminate the error between the actual stopping position of the lifting container and the predetermined zero position of the depth indicator pointer caused by the above reasons after each operation of the lifting container. Depth indicator. When the hoisting wire rope does not slip elongation and creep, then zero adjusting motor does not run, so the screw connected with it, the turbine does not turn. At this point, the main shaft and gear of the hoist make the bevel gear of the differential gear train rotate, and then drive the bevel gear to rotate through the shaft and gear. When the screw rotates, the pointer of the depth indicator moves up or down, indicating the position of the lifting container in the wellbore. A pointer is called a thick needle. In order to accurately reflect the position of the container before stopping, a fine needle is driven by several stages of gear transmission, and a geomagnetic induction disconnector controlled by an electromagnetic clutch is installed 10 meters ahead of the unloading position of the lifting container in the shaft. When the container passes through the magnetic induction breaker in the wellbore, the electromagnetic clutch is closed to connect the gear and shaft. So when the container is lifted to 10m at the unloading location, the needle starts to rotate. There is a scale on the precision needle dial, and each column represents an elevation of 1 m, so that the position of the container before stopping can be accurately reflected.

Deep well multi rope friction hoist adopts DPV-96 digital depth indicator.

This type of digital depth indicator is a special electromechanical component of mine hoist. It has a standard level parallel interface circuit and a standard RS232C serial interface circuit. It can be conveniently used with PLC or industrial control computer and other control devices with corresponding interfaces.

The working principle of the digital depth indicator is shown in Figure 1-1. Depth indicator is set on the driver's desk, and there are two kinds of depth indicator, coarse indication and digital

precision instruction. The coarse indicator consists of 61 light-emitting diodes, which correspond to the entire wellbore depth, so its resolution varies with the lifting distance. For example, the lifting height of the lifting system is 430, and each light-emitting diode corresponds to about 7m. When the container is running, the light-emitting diode is illuminated to indicate the location of the container in the wellbore. The digital precision instruction is composed of 6 digit digital display, which is used to show the location and positive and negative sign of the container. The digital depth indicator has the function of four quadrant digital precise indication, that is, the well head stop point is +, the stop point above is +, indicating the overwind distance; the stop point below is-,The depth indicator has a resolution of 0.01 and a maximum indication height.

The position of the lifting container can be displayed on the operation platform and on the upper computer. On the operating table, one is that the PLC control system directly drives the light column depth indicator on the operating table through an analog output, which acts as a thick needle indication to visually indicate the position of the container in the wellbore; the other is that the PLC control system drives a digital depth indicator through a digital output port for digital indication. By accumulating and counting the two pulses from the shaft encoder, the trip and speed of the hoist can be detected, and the difference between the calculated values of the pulses can be read in the same time interval (0.2 seconds), thus the speed can be obtained. The number of counted pulses is multiplied by the actual distance represented by each pulse, and the stroke can be obtained.

Through software programming, the PLC control system compares the counting value with the preset value, so as to set various position points, such as deceleration point, fine needle input point, speed limit point, each level stop point, etc. During the operation of the hoist, the PLC control system sends out different position signals and completes corresponding operation control according to the hoisting process.

Due to the data protection measures taken in the PLC control system, the depth indicator value will not appear because of power failure and the actual value does not conform, that is, the so-called out of step phenomenon. In order to prevent the error of depth indication caused by wire rope sliding and creeping, PLC system automatically corrects the depth value to ensure the accuracy of indication.

4. Conclusion

The first Blair hoist equipment appeared in 1958. Since then, we can see the continuous development of this double rope and double drum hoist. Now, they are used to reach a depth of 3150 meters [the Man 7 material in the Moab well is lifted, a single lifting weight is 13500 kg, a speed of 19.2 M 7 seconds per second, and two 7400 kW AC motors are used]. The Blair do rope system can be used either in wells or in mining. The depth range is from 715 meters to 3150 meters, and the maximum surge load reaches 20 tons. Single lift system is the first choice in South Africa deep well.

The graduation design lasted nearly three months, under the guidance of the teacher, I completed the overall mechanism design of multi-rope friction hoist, mainly on the main body of mine hoist design and selection calculation and hoist accessories selection of two parts. The working principle of multi-rope friction hoist is analyzed in detail, and the arrangement and type selection of each mechanism of multi-rope friction hoist are analyzed.

In the process of designing and calculating the main body of the hoist, the main shaft device, reducer and brake are designed and calculated. According to the mine parameters, the hoist container, wire rope, hoisting system, displacement quality, hoisting speed diagram, etc. are calculated and analyzed and selected. And give an illustration.

For the auxiliary equipment of the hoist, the tank passage, depth indicator, guide wheel, micro-drive device, etc. are selected.

The multi-rope friction mine hoist has the characteristics of compact structure, good rigidity, high efficiency, easy installation and movement, stable starting, flexible operation, reliable braking, low noise and so on. It is mainly applicable to large and medium sized mines, and it is also suitable for small mines if slightly changed.

Due to my lack of experience and technology, there may be many shortcomings in the design, I hope the teacher can give guidance and correction.

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