Structure Design of Hydraulic Cylinder Support Based on Finite Element Analysis

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Abstract: Mill AGC servo hydraulic cylinder are widely used in industrial production. Rolling mill AGC servo hydraulic cylinder plays a very important role in AGC servo hydraulic system. Failure of AGC servo hydraulic cylinder of rolling mill will affect the rolling precision of plate, and also produce quality defects. During plate production, the use of rolling mill AGC servo hydraulic cylinder is beneficial to improve the quality of plate and improve the economic benefit of steel production enterprises. During plate production, rolling mill AGC servo system can control the rolling thickness, which is very important to the accuracy of plate. But in the rolling mill AGC servo hydraulic cylinder working process, will be affected by its own operation failure. As a result, the current failure analysis of AGC servo hydraulic cylinder of rolling mill can improve the quality of plate production.

1. Selection of Hydraulic Cylinder Main Part Structure and Processing Technology Analysis

1.1. Determination of Dimensions and Diameters of Hydraulic Cylinders

The determination of the size and diameter of hydraulic cylinder block is very important to the selection of hydraulic system of construction machinery, such as the structure, strength and volume of its parts. As one of the important components of hydraulic cylinder block which directly affects these stability, the size selection process needs to be emphasized in practice. Because the purpose of this paper is to study the practical application of hydraulic cylinder in hydraulic system of construction machinery in depth, so this paper selects the hydraulic cylinder block with an inner diameter of 70 mm to study. Since the inner diameter is 70 mm, the calculation accuracy of the cylinder block size is seven, which means that the roughness of the inner hole cylinder block surface should be less than 0.3 um, and the tolerance of the inner hole coaxiality should be 0.04 mm, so that the oil leakage can be avoided. In order to better ensure the safety and reliability of hydraulic cylinder block, we must pay more attention to the setting of hydraulic cylinder block and the structural parameters at the same time, and can not ignore any detail.

Figure 1 Hydraulic cylinder

1.2. Selection of Wall Thickness of Hydraulic Cylinder Block

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The wall thickness of the hydraulic cylinder block directly affects the normal operation and performance of the whole hydraulic cylinder. Generally, hydraulic cylinders in the design of the body wall can be divided into thin and thick two categories. Among them, the ratio of cylinder block wall thickness to hydraulic cylinder block inner diameter thickness is less than 0.1 called thin wall hydraulic cylinder block, and the ratio of cylinder block wall thickness to hydraulic cylinder block inner diameter thickness is more than 0.1 called thick wall hydraulic cylinder block. In the accurate calculation of cylinder block size, it is also necessary to strictly consider some key factors, such as safety factor, tensile ability and strength of cylinder block material.

1.3. Selection of Piston Rod Length for Hydraulic Cylinder and Guide

The piston rod length of the hydraulic cylinder and guide device is also an important factor which directly affects the operation of the whole hydraulic system of construction machinery. the piston rod structure needs to be able to rotate and round-trip within the hydraulic cylinder and the guide device. during this rotation, if the piston rod length and stroke of its guide device are too long, the area and length of the piston rod needed for the internal rotation of the hydraulic cylinder and the guide cylinder block will be enlarged. If the length of its guiding device is too short, it will directly reduce the length and stroke of the piston rod. Therefore, whether the length of the guiding device is too long or too short, it will directly affect the strength and effect of its dynamic guidance, and lose the guiding role. If we want to ensure good operation effect of hydraulic cylinder and guide device, we must strictly select hydraulic cylinder and guide device, and strictly control the length of piston rod of guide device.

2. Effect of Hydraulic Cylinder and Piston Rod Structure on Dynamic Guiding Strength

The hydraulic cylinder structure has different kinds of power, and the position and environment of the power demand are different. As an important component of its transmission of hydraulic system power, hydraulic cylinder in the operation of construction machinery hydraulic system, the strength of the power and piston rod stiffness meet the standard requirements are the basic conditions. This paper mainly studies a kind of large hydraulic cylinder, which is widely used in hydraulic system of large construction machinery. Because its guiding cylinder structure needs to be able to withstand large guiding pressure, and its cylinder block structure is also subjected to great tensile force, it needs strict technical requirements on whether its cylinder block structure is stable and whether it can be used safely enough. Therefore, it is necessary to strictly control the processing design and process of all hydraulic cylinder related parts to ensure that the strength and mechanical stiffness of their parts can meet the standards.

Figure 2 Hydraulic cylinders

3. Determination of Processes Hydraulic Cylinder Design and Processing

3.1. Determination of Machining Design Schemes for Various Large Hydraulic Cylinders

In the production and processing of various large hydraulic cylinders, seamless steel pipe is most commonly used, but it also has some defects and drawbacks, such as in the process of use, the straightness and the cylinder of the internal air inlet can not be fully guaranteed. Therefore, the precision seamless steel pipe is more suitable for processing blank.

3.2. Design and Implementation of Working Process for Hydraulic Cylinder Structure Design of Grinding Wheel Machine

In order to ensure that the grinding end of the inner hole is neat and convenient for subsequent work, first of all, the grinder should be used when the grinding end of the inner hole is neat. Secondly, in the grinding turbine honing inner hole, the support force assisted by the grinder can be used, which can greatly enhance the stability and accuracy of hydraulic cylinder processing. Thus, honing the inner hole can greatly enhance the roughness and smoothness of the inner hole, and can be based on this technology and standards to undertake the next process of hydraulic cylinder processing design work.

Figure 3 Hydraulic cylinders

4. Mill AGC Servo Hydraulic Cylinder Structure

mill AGC servo fluid system is relatively complex, which is generally divided into seven parts, including hydraulic cylinder power device, electro-hydraulic servo, servo hydraulic cylinder, hydraulic valve, sensor and other accessories. during the working process of rolling mill AGC servo hydraulic cylinder, the output flow rate of voltage servo valve can be controlled, and the piston rod of rolling mill AGC servo hydraulic cylinder can be moved up and down, so that the roll seam can be adjusted reasonably. AGC rolling mill servo hydraulic cylinder is also composed of end cover, cylinder, piston rod and front end cover. during the design process of rolling mill AGC servo hydraulic cylinder, the cylinder and the front end rod, piston and piston rod are all sealed by the sealing device, and a dust-proof ring is set in the interface position. this design is designed to prevent the hydraulic oil from leaking out AGC the rolling mill during the work of the servo hydraulic cylinder. Besides, AGC servo hydraulic cylinder structure design, the mill is equipped with buffer device, otherwise, the piston back to the end of the hydraulic cylinder when the impact is too large.

5. The Fault of Rolling Mill AGC Servo Hydraulic Cylinder

5.1. Rolling Mill AGC Servo Hydraulic Cylinder Position Control Failure

During the working process of rolling mill AGC servo hydraulic cylinder, the position sensor of rolling mill AGC servo hydraulic cylinder is easy to fail. The normal operation of the servo hydraulic system is operated by two hydraulic cylinders together, while the two control systems use

the same set of control instructions to control the upper and lower motion of the two hydraulic cylinders. And if the sensor on the two hydraulic cylinder position appears the specified value deviation, it will cause the whole rolling mill AGC servo hydraulic system to malfunction, and the system instruction failure will also cause the hydraulic cylinder movement disorder.

5.2. Basic Failure AGC Servo Hydraulic Cylinder for Rolling Mill

rolling mill AGC servo hydraulic cylinder in normal operation, there will be many kinds of faults, such as operation and quality, among them, mainly hydraulic cylinder crack problem, rolling mill AGC servo hydraulic cylinder in work hydraulic cylinder is easy to pull injury, pull injury will lead to hydraulic cylinder cracks, cracks seriously form cracks, resulting in serious problems of hydraulic cylinder leakage.

6. Troubleshooting AGC Servo Hydraulic Cylinder in Mill

6.1. Fault Analysis AGC Servo Hydraulic Cylinder Position Control in Rolling Mill

The position control fault can also be said to be the hydraulic cylinder position sensor fault in the rolling mill hydraulic AGC system, which is caused by the abnormal measurement value of the hydraulic cylinder position sensor parameter .[1]. As a result, to solve the sensor fault is to analyze the sensor of two AGC hydraulic cylinder reasonably, find out that the sensor fault is caused by that sensor, and adjust the measurement value of the pressure sensor on both sides or replace the sensor directly.

6.2. Fault Analysis and Related Strategies AGC Servo Hydraulic Cylinder in Rolling Mill

During the working of the AGC servo hydraulic cylinder, it is common for the hydraulic cylinder to appear cracks, and it is very serious if it causes the leakage of the hydraulic cylinder. For the AGC servo hydraulic cylinder crack fault to do specific analysis to solve the crack fault.

In order to analyze the causes of hydraulic cylinder cracks, Analysis of AGC servo hydraulic cylinder, The hydraulic cylinder can be rolled 40 pieces per hour on average, An average of 5-7 rolls per piece of steel, Between 110 and 130 mm thick, the speed [2] between 3.9-5.9 m/s. And the AGC servo hydraulic cylinder working time up to 22.5 hours per day. When the mill bites steel, The hydraulic pressure in the cylinder increases, And the pressure at the hydraulic cylinder is also increased, thus enhancing the impact ability of hydraulic cylinder movement. And when the hydraulic cylinder is throwing steel, The pressure of the hydraulic cylinder and the hydraulic cylinder oil port will suddenly decrease, will also have a strong impact on the hydraulic cylinder. During the hydraulic cylinder, Pressure changes occur repeatedly in the cylinder and oil mouth, Hydraulic cylinder block and cylinder bottom are constantly impacted by pressure, So that the position of the hydraulic cylinder and the area of the area near the cracks. During the design of AGC servo hydraulic cylinder, To prevent cracks in the cylinder, The pressure bearing capacity of hydraulic cylinder should be reasonably designed, Design pressure of the hydraulic cylinder is 28 MPa, And the test pressure MPa,30 But through the actual hydraulic cylinder test, There will still be cracks.

Through the analysis of the AGC servo hydraulic cylinder crack fault, it can be known that the crack fault is caused by the continuous pressure impact in the cylinder, so the quality of the hydraulic cylinder can be improved by the improved AGC servo hydraulic cylinder pressure resistance ability to prevent the [3] of the crack fault. For one hand, improving the pressure bearing capacity of hydraulic cylinder can be achieved by improving the size specification of AGC servo hydraulic cylinder. The size of the experimental hydraulic cylinder is improved, and the thickness of the cylinder bottom is increased by 5 mm. mm, the outer circle position of the cylinder bottom is thickened by 10 After the improvement of the hydraulic cylinder, the simulation experiment is carried out, and compared with the original AGC servo hydraulic cylinder experimental data, the table 1(as shown in table 1) shows that after the improvement of the hydraulic cylinder, the first stress, the third main stress and the equal effect force of the hydraulic cylinder oil mouth position

are reduced, which proves that the improved hydraulic cylinder has stronger pressure resistance, can effectively reduce the occurrence of crack fault, and also enhance the service life of the hydraulic cylinder.

7. Summary

Conclusion: This paper describes AGC servo hydraulic cylinder position control fault and crack fault, and detailed analysis of the fault generation, according to the specific experiments put forward the corresponding solutions, improve the AGC servo hydraulic cylinder working efficiency and service life. I hope this paper can help to improve the working efficiency of AGC servo hydraulic cylinder.

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