Design of Lubrication and Cooling Flushing Mechanism for Hand-held Pneumatic Rock Drill

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Abstract: The advantages and disadvantages of the traditional lubrication and cooling mechanism of Air-leg Rock drill are analyzed. In order to solve the shortcomings of the traditional structure and the fatal disadvantages of gas-water linkage failure and hammer washing, a new lubrication and cooling mechanism of Air-leg Rock drill is designed. It prevents the backfilling of pneumatic rock drill in the normal working process and at the end, improves the life of pneumatic rock drill as a whole, and has been verified in the customer site, and achieved good results.

1 INTRODUCTION

Pneumatic rock drills used in mining, railway and highway construction generally work in open pits, tunnels or mountainous areas (Liu Enguo., 2013). When the pneumatic rock drill works, there is relative movement between the head and the rotating sleeve and between the piston and the rotating nut. It is easy to wear and tear (Chen Bingzhi, 1987). Insufficient lubrication is one of the reasons that often cause the failure of rock drill and parts damage (Class B, Grade, 1979). Because of the change of working condition of rock drill, water pressure also changes, which can't guarantee that water pressure is always lower than air pressure. In the water washing mechanism of conventional pneumatic rock drill, water pressure in water needle can't be adjusted. Reverse irrigation during normal working process and at the end of pneumatic rock drill will destroy the lubrication system of pneumatic rock drill, accelerate wear and tear, reduce the service life of parts, and also reduce the machine torque. Drilling efficiency decreases (Liu Jian, et.al, 2015).

2 CURRENT LUBRICATION MECHANISM

Air leg rock drill needs lubricating oil for three purposes: reducing friction, anti-corrosion and sealing clearance. At present, pneumatic rock drill has three parts that need lubrication (Yang Wansheng, 2008): spline pair, brazing tail pair, head and rotating sleeve matching pair. The lubrication oil supply of pneumatic rock drill depends on the exhaust of the front chamber of the cylinder, and the residual air of compressed air containing atomized oil passes through the friction pair parts mentioned above. There are two ways of drainage (Cai Shumei, 2002):

One is the single drainage mode, and the compressed air residual flow through the spline pair gap, through a narrow way, flows through the brazing tail pair and the head and the rotating sleeve matching pair, leading to the atmosphere. It is simple in structure, but when the rock drill is operated under heavy load, because of less gas flowing through and less atomized oil, it causes poor lubrication and shortens the service life of the rock drill.

The other is double drainage and compressed air surplus through spline pair, which only leads to brazing tail pair. In addition, a drainage air passage is provided to lubricate the matching pair of the head and the rotating sleeve. Its structure is complex and the lubrication condition of the spline pair becomes worse due to the reduction of compressed air surplus flowing through the spline pair, which will also shorten the service life of the rock drill.

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3 CURRENT COOLING AND FLUSHING MECHANISM

In the working process of air leg rock drill, water will supply water needle, through drill rod, to reach the bottom of the hole, water will be used to cool and wash the rock powder at the bottom of the hole to achieve the purpose of dust and powder discharge (Liu Guangwen, Wang Yueyong, Liu Enguo, 2018). Ideally, when the Air-leg Rock drill works, the water pressure of the water needle should be lower than the air pressure. If the water pressure in the water needle is higher than the air pressure, the water flow will enter the air passage and cylinder block, destroying the oil film of the moving parts, thus affecting the normal work of the rock drill. When the water pressure in the water needle is higher than the air pressure, the water will be poured back into the air channel. The water washing mechanism of the existing pneumatic rock drill can not regulate the water pressure in the water needle, and can not guarantee that when the water pressure is higher than the air pressure, the water pressure can be regulated below the air pressure.

Therefore, there is a rigid requirement in the use of air leg rock drill: the working pressure must be lower than the working pressure. Excessive water pressure can easily cause gas-water linkage (water injection valve) failure; in particular, backfilling will occur, which will cause air-water mixing to appear "wash hammer" and destroy lubrication; there will also be some disadvantages such as ice in silence cover. The general water pressure is between 0.2 MPa and 0.3 MPa.

4 NEW DESIGN OF LUBRICATION MECHANISM

In order to solve the above problems (Luo Liangguang, 2008), a new design scheme of lubrication mechanism is proposed.

The lubrication of the new air leg rock drill consists of a control valve, a handle, a cylinder block, a guide sleeve and a head (see Figure 1). The control valve is arranged in the handle body. A strong blow hole is opened on the control valve and a handle hole is arranged on the handle body. In the position of the strong blow hole of the control valve, an annular groove is opened along the radial direction of the control valve. When the pneumatic rock drill enters the compressed air (oil), the compressed air (oil) enters the nose of the pneumatic rock drill through the annular groove of the control valve along the handle channel, cylinder block channel, guide sleeve channel and the nose hole. The width of the annular groove is 2 mm and the depth of the annular groove is 0.5 mm. After compressed air (containing oil) enters the head, it passes through the gap between the head and the rotating sleeve and forms oil film to realize lubrication function. Then it enters the body of the rotating sleeve through the hole of the rotating sleeve, passes through the gap between the rotating nut and the piston and forms oil film to realize lubrication function. At the same time, the gas forms a pressure chamber in the head, and the pressure in the pressure chamber is higher than the water pressure, thus preventing water from drilling. The center hole of the rod is poured back into the pneumatic rock drill.

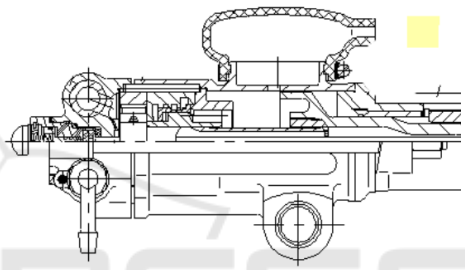

Figure 1. New lubrication mechanism diagram.

5 NEW DESIGN OF COOLING AND FLUSHING MECHANISM

The cooling and flushing mechanism of the air leg rock drill (see figure 2) includes a water valve body and a pressure regulating device that allows the valve body to move to a fixed position to control the opening and closing of water flow in the water needle.

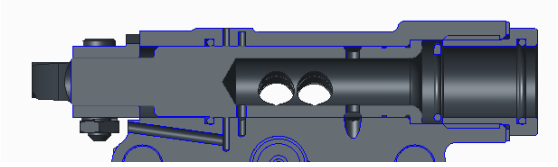

Figure 2. Drawing of New Cooling and Flushing Mechanism.

The valve body contains a passage for opening the valve at preset pressure and allowing water flow to pass through; together with the valve, it can prevent the water pressure in the needle from

exceeding the preset pressure, and the valve can open freely without pressure resistance.

The water valve contains a passage that allows the water pressure in the water needle to enter the other end of the valve. When the water pressure in the water needle exceeds the preset pressure, the water valve moves towards the closing direction, controls the water flow into the water needle, and adjusts the water pressure in the water needle.

A spring is placed at the other end of the valve, which can drive the valve to move in the direction of closure; the valve contains a passage that allows water from the needle to enter the other end of the valve, so that the valve closes before the pressure exceeds the preset pressure to prevent the pressure from exceeding the preset pressure. When the rock drill stops working, the spring can push the water valve to the closed state and stop the water supply.

6 APPLICATION OF NEW INSTITUTIONS AND CONCLUDING REMARKS

The new lubrication mechanism of pneumatic rock drill improves the structure of control valve, optimizes the strong blow and lubrication channel of handle, cylinder block, guide sleeve and head, thus effectively improves the lubrication effect of pneumatic rock drill.

The new cooling and flushing mechanism of Air-leg Rock drill can ensure that the water pressure in the water needle is lower than the air pressure in the working process of rock drill, prevent water from backfilling into the body, destroy the oil film of parts and components, and lead to corrosion or abrasion of parts and components.

After the successful development of the above two new mechanisms, they took the lead in the application of S82 gas-leg rock drill. The first prototype was tested in a metal mine (see Figure 3) in Sichuan Province in 2017. The water pressure of the mine is 0.2 MPa higher than that of the wind pressure. The performance of the gas-leg rock drill fully meets the design requirements, helping customers to achieve rapid rock drilling, smooth operation, shorter working hours, lower costs and maximize the interests of customers. It is fully recognized by customers.

Figure 3. Field tests.

REFERENCES

Cai Shumei. Lubrication mechanism for the head system of a pneumatic rock drill [P]: China, 02243160.8. 2002-07-10.

Class B, Grade 75, Department of Foreign Languages, Lanzhou University. Lubrication Theory and Practice of Rock Drillers [J]. Pneumatic Tools for Rock Drilling Machinery, 1979 (03), 27-34.

Liu Enguo. A Brief Analysis of the Development Trend of Pneumatic Rock Drilling Machinery [J]. Pneumatic Tools for Rock Drilling Machinery, Phase 4, 2013: 14-16.

Liu Guangwen, Wang Yueyong, Liu Enguo. Research on water washing mechanism of pneumatic rock drill [J]. Pneumatic tools for rock drilling machinery, No. 3, 2018: 37-39.

Liu Jian, Wang Yueyong. Lubrication and cooling mechanism of a pneumatic rock drill [P]: China, 201520300855.6. 2015-05-12.

Luo Liangguang. Conception and Practice of New Generation Energy-saving and Environmental-friendly Rock Driller [J]. Pneumatic Tools for Rock Drilling Machinery, 2008 (1), 4.

Translated by Chen Bingzhi. Durability of rock drilling machinery and determination of accuracy of matching parts [J]. Pneumatic tools for rock drilling machinery, 1987 (2), 47.

Yang Wansheng. Factors affecting the life of pneumatic rock drills [J]. Pneumatic tools for rock drilling machinery, Phase 2, 2008: 18-21.