Study on the design of internal flash cleaning device in long diameter drill pipe used in coal mine

LAN Fei
CCTEG Xi’an Research Institute, Xi’an 710077, China
529329544@qq.com

Abstract: This paper takes the long diameter geological drill pipe used in coal mine as the research object. The internal flash cleaning technology which remains in the drill pipe hole after the internal flash turning is studied. A hand-held pneumatic internal flash cleaning device was designed to replace the original manual way of removing iron filings. It greatly reduces the labor intensity of workers, improves the working environment, and shortens the cleaning time of flash inside a single drill pipe. This device greatly improves the work efficiency and makes it safer and more reliable to use.

1. Lead it
Drilling pipe is an important equipment for underground gas extraction in coal mine[1-5]. Gas extraction by drilling hole is also an important way and method of gas treatment in underground coal mine. With the mature application and popularization of the screen technology in drill pipe, the demand for long diameter drill pipe is increasing day by day. The drill pipe is made of friction welding between the joint of the drill pipe and the pipe body[6]. An inner flash and an outer flash are formed in the welding area, for the long diameter drill pipe with required through hole in the drill pipe, it is necessary to use the CNC lathe to carry out turning with internal flash, and a thick circular iron ring will be formed in the drill pipe hole. In the past, simple iron hooks made by hand were used for cleaning. As the iron ring is thick and not easy to deform, it needs workers to hit it hard for many times before it can be pulled out. The labor intensity of the workers is high, the working efficiency is very low, which affects the normal connection of the next working procedure, and there are safety risks. For this reason, this paper will carry out the research on the inner internal flash cleaning technology, design a handheld pneumatic drill pipe internal flash cleaning device, in order to solve the above problems.

2. Preliminary study
At present, the drill pipe used in underground coal mine is basically made of the threaded joint and the friction welding of the middle pipe body, and then the heat treatment and the turning of the internal and external internal flash are carried out. For long diameter drill pipe, after friction welding, circular flash over about 7mm high will be formed in the friction area between the joint and the pipe body, as shown in Fig. 1.
Fig. 1 Schematic diagram of friction welding of drill pipe

Generally, a CNC lathe is used for turning the inside flash, first turning one end, and then turning the other end. After the turning is completed, thick round iron rings are left in the inner holes at both ends of the drill pipe, as shown in Fig. 2.

The rings are to be removed from the inner holes at both ends of the male and female joints. Because the outside diameter of the iron ring is larger than the inside diameter of the joint through hole, it is difficult to take out the iron ring. In the past, the iron ring was physically deformed by manual beating and pulling.

When the iron ring is taken out of the hole, it actually moves in a straight line. In this paper, a circular motion is designed to produce linear motion force, and the iron ring is removed from the joint hole. There are many ways that circular motion can be transformed into straight motion. Through comparative study, this paper will use the screw nut mechanism to realize this process. The design of the corresponding supporting tooling, at the same time with the help of pneumatic equipment automatic drive, easy and efficient to realize the cleaning of the internal flash in the drill pipe.

3. structural design

Screw nut mechanism is divided into sliding friction mechanism and rolling friction mechanism. Sliding screw friction mechanism has simple structure, convenient processing and low manufacturing cost, but the friction resistance moment is large and the transmission efficiency is extremely low (30%-40%). Although the structure of ball screw nut mechanism is complex and the manufacturing cost is high, the friction resistance moment is small, the transmission efficiency is high (92%-98%), the precision is high, the system rigidity is good, the movement has the reversibility, the service life is long. Therefore, this paper considers the ball screw nut mechanism. The structural design is shown in Fig. 3.
It mainly includes six parts:

Pneumatic wrench: According to the field use requirements, equipped with pneumatic wrench and connected to the external air source, according to repeated tests, determine the maximum torque of the pneumatic wrench 1200Nm, 4600rpm;

(2) Coupling: A special coupling is designed and manufactured, with the two ends of which are of square structure. One end is connected with the pneumatic wrench and the other end is connected with the ball screw to realize power transmission.

(3) Ball screw pair: The ball screw pair is used to transform the rotary motion into the linear motion. The front end iron chip hook is driven by the linear motion of the lead screw to hook out the internal flash (iron ring).

(4) Shell: The two ends are fixed on the ball screw nut, which is convenient to operate by hand. At the same time, the observation groove is cut on the surface, which is convenient to observe the working condition of the screw. At the same time, the weight of the tool is reduced and the labor intensity of the workers is reduced.

(5) Anti-collision pad: The nylon pad with shock absorbing function is used to protect the end thread of the drill pipe joint, so as to avoid the damage to the end thread in the process of use.

(6) Iron chip hook: The removable iron chip hook is made, which is connected with the screw body by thread. It is easy to remove and replace.

4. Application
Take 73-40 drill pipe as an example to test. The comparison results show that the inner internal flash cleaning device can clean about 40 drill pipes per hour, while the original cleaning device can only clean about 20 drill pipes per hour, and the working efficiency is doubled. The application effect is very good, has been put into production use. According to the calculation of 8-hour working system, the number of single shift cleaning drill pipe is shown in Tab.1.

| designation | Output per shift (8-hour work schedule) |
|-------------|----------------------------------------|
| The newly developed internal flash cleaning device | 320 |
| The old way | 160 |

5. conclusion
The device developed in this paper can reduce the hidden danger of internal flash cleaning and make workers' operation safer. Increased safety benefits reduced work noise and improved worker working conditions. Pneumatic device is used to convert the rotary movement into linear movement, which reduces the labor intensity of workers. The substantial improvement of work efficiency greatly meets the production demand of the next process, reduces the waiting time in the production process, saves the time cost, reduces the labor cost, improves the production efficiency and creates economic benefits.
Reference

[1] LI Jin-peng, WANG Ling-he. Equipment and application of ultra-long distance large-aperture directional drilling rig [J]. Coal mine machinery, 2011, 32 (10): 244-247.

[2] SHI Zhi-jun, YAO Ning-ping, YE Gen-fei. Construction technology and equipment for underground gas extraction and drilling in coal mine [J]. Coal science and technology, 2009, 37 (7): 1-4.

[3] CHENG Yuan-ping, FU Jian-hua, YU Qi-xiang. Development of coal gas extraction technology in China [J]. Journal of mining and safety engineering, 2009, 26 (6): 127-139.

[4] ZHU Guang-hui, HAN Jian-guang, HAN Zhen. Discussion on gas prevention and gas drainage technology [J]. Coal, 2009, 18 (1): 49-50.

[5] XU Cui-hua. Gas extraction adopts the automatic technology of friction welding of drill pipe [J]. Coal science and technology, 2013, 41 (7): 114-117.

[6] LAN fei. Research on the design of robot handling track in friction welding of geological drill pipe for mining [J]. Coal mine machinery, 2008, 39 (10): 1-2