Processing Technology and Tooling Design of Control Console of Coal Mine Tunnel Drilling Rig

Gao Baizhan¹,a

¹Xi’an Research Institute of China Coal Technology and Engineering Group, Xi’an, shaanxi, China
aemail: gaobaizhan@ctegxian.com

Abstract: Based on the problems existing in the production and processing of the coal mine tunnel drill control console, the processing technology of the drill control console is analyzed, and a set of processing tooling of the coal mine tunnel drill control console is designed. The tool has the advantages of simple structure and convenient use, which can effectively solve the processing precision problem of rig control platform. It is of great significance to improve the processing and production efficiency of the rig control console and to standardize the production of the rig control console.

1. Introduction
The console is the core control module of the coal mine tunnel drilling rig, which is used to control the work of the main machine (execution module) of the coal mine tunnel drilling rig to realize drilling operations[1]. The console is mainly assembled by the console frame and various control valve blocks, pressure gauges, hoses, shields, etc[2]. The assembly efficiency of the console directly affects the production efficiency of the drilling rig. The console frame is the core component of the console's processing and production. Various valve blocks and shields are installed on the console frame through bolt connections, so the processing accuracy of the console frame is relatively high. In actual production, there are often situations in which the console guard and console frame holes are misaligned and cannot be installed. For this reason, this article focuses on the key to the processing of the ZDY6000LD (F) drilling rig console produced by Xi’an Research Institute of China Coal Technology and Engineering Group A set of tooling is designed for the process, which is convenient to improve the processing accuracy of the console frame, enhance the interchangeability of the console assembly and production, and improve the production efficiency of the rig console.

2. Analysis of the processing and assembly process of the console
The control panel is the control module of the drilling rig. The rotation, feeding, lifting and pulling of the power head of the drilling rig and the linkage of the chuck and clamp are all realized by the combination of valves on the control panel[3][4]. The valves and guards on the control panel are all realized. It is connected to the console frame by screw holes. In order to ensure interchangeability and assemblability, the processing accuracy of the console frame is relatively high. Figure 1 shows a schematic diagram of the console structure.
2.1. Control table processing and assembly process
The production of the rig console mainly includes 9 processes in two major steps, processing and assembling. The specific processing processes are shown in Table 1.

| Process | Process name | Process content |
|---------|--------------|-----------------|
| 1       | Cutting      | Leave the margin according to the size of the drawing, and cut the material. |
| 2       | Bending forming | Bending the finished components according to the requirements of the drawings. |
| 3       | Group welding | Prepare each single piece and group welding according to the drawing size. |
| 4       | Bore hole    | Drill holes according to the requirements of the drawings to ensure the spacing. |
| 5       | Tapping      | Tapping operation. |
| 6       | Polished     | Remove burrs, splashes, and polish smoothly. |
| 7       | Spray paint  | Sanding, putty, spray paint. |
| 8       | Assembly     | Assemble valve blocks, joints, hoses, pressure gauges and guards, etc. |
| 9       | Debugging    | Connect the oil circuit and debug the operation of the console. |

2.2. Problems in key production processes

2.2.1. Group welding process
The console frame uses manual arc welding to weld seamless steel pipes and angle steels, panels, side plates, and pull plates. Due to the long auxiliary time, the welding internal stress is serious, the welding accuracy is low, and the frame is easy to deform after welding, and the interchangeability is poor. During the assembly process, the hole position deviation is often too large to be assembled. Figure 2 (a) shows the valve block installation hole position error.
2.2.2. Drilling process
Various valve blocks and shields on the console are connected with the console frame through various through holes and threaded holes. After the console frame is assembled, the drilling and tapping are carried out according to the drilling size marked on the drawing. Due to the large number of holes on the console and the length of the dimensional chain, the cumulative error is serious. The accuracy of drilling through the dimensional chain positioning is low. During the assembly process, there are often holes on the console frame and the console panel and shield. The inconsistency of the position results in the inability to assemble, and repair work must be carried out, which affects the assembly efficiency of the rig console. Figure 2 (b) shows the installation hole position error of the console panel.

![Valve block installation hole position error](image1)
![Installation hole position error of console panel](image2)

Figure 2 The error of the hole position of the console frame

3. Tooling design
Based on the analysis of the processing technology of the control console, in order to solve the problem of the large error of the assembling point of the control console frame and the valve block, the panel and the shield, and improve the processing accuracy of the control console, this paper designed a set of processing tooling for the control console of the tunnel drill. The processing tooling can meet the drilling and positioning needs of ZDY6000LD (F) type coal mine tunnel drill control platform frame, improve the processing precision of control platform, and improve the assembly efficiency of control platform.

The console processing tooling consists of three parts, namely the console front shield positioning tool (shown in Figure 3), the console panel positioning tool (shown in Figure 4) and the console side shield positioning tool (shown in Figure 5). The specific working principle is: After the assembly welding of the console frame is completed, the natural stress is released first. After the deformation of the console frame is completed, the tooling is drilled and positioned at the corresponding position of the console, and finally the console frame and the tooling are fixed. The upper drilling machine completes the drilling process.
4. Application effect and popularization of console tooling

The console tooling designed in this paper was tested on the ZDY6000LD (F) drilling rig console produced by China Coal Science and Industry Group Xi’an Research Institute. Before using this tooling, during the drilling rig production process, due to the large error of the installation hole position, 40% of this type of console needs to be repaired on site, and the average repair time is 1.8 hours, which seriously affects production efficiency; after using the console tooling to process the console, only 3% of the console needs to be repaired at the assembly site, which greatly improves the drilling rig console assembly efficiency.

The console tooling structure designed in this paper is simple, easy to use, stable and reliable, and can effectively solve various installation hole positioning problems in the processing of the drilling rig console frame. It has reproducibility and good promotion. It has been researched by China Coal Science and Industry Group in Xi’an. The ZDY series of drilling rig consoles of the Institute have been widely used in the processing and production. The frames and guards in the consoles of the same model of drilling rigs can basically be interchanged, which effectively improves the overall assembly efficiency of drilling rig production.

5. Conclusions

In order to solve the actual problems encountered in the production of tunnel drilling rig consoles, this paper designs a set of simple structure, accurate positioning, stable and reliable console tooling, which realizes the standardization of the tunnel drilling rig console processing and effectively improves the processing accuracy of the console. The interchangeability of the console frame and various shields has
been enhanced, the production efficiency of the drilling rig console has been improved, and good economic benefits have been achieved in actual production. At the same time, it also provides a reference method for the assembly and processing of console parts in other industries.

References
[1] Gao Y. (2018) Design of Welding Tooling for Frame of Control Platform for Coal Mine Gas Drainage Used Drilling Rig. Coal Mine Machinery, 39(6):81-82.
[2] Wang p. (2018) Welding Technology of Hydraulic Drill Rig Tubing and Fixture Design. Coal Mine Machinery, 39(2):67-68.
[3] LV M. (2019) Design of Assembly Tooling for Rubber-sleeve Type Hydraulic Chuck of Tunnel Drilling Rig. Coal Technology, 38(11):145-146.
[4] Wang p. (2019) Assembly Process and Craft Equipment Design of Radial Piston Chuck of Hydraulic Drilling Rig. Coal Mine Machinery, 40(12):103-105.
[5] Tian L.Y. (2017) Research on Assembly Technology of Power Head for Full Hydraulic Drill in Coal Mine and Design of Assembly Tooling. Coal Mine Machinery, 38(12):69-71.