Application of Modern Machinery Design Method in Mine Machinery Design

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Abstract: In the context of the rapid development of science and technology, people's demand for energy is also increasing. Moreover, mineral resources are an important type of energy indispensable in the development of the national economy. However, as the mining volume of mineral resources continues to increase, the difficulty of mining mineral resources is also increasing. Therefore, we must improve traditional mining machinery and equipment and increase the production capacity of mining machinery and equipment. Only in this way can we improve mining efficiency. In this process, we can use modern mechanical design methods to ensure that the design of mining machinery is compatible with the actual mining of minerals. At the same time, this can also improve the design level of mining machinery and equipment, and ensure mining benefits.

1. Introduction

If modern mechanical design methods based on traditional mechanical design methods are upgraded from pure mechanical design to a systematic, logical and rational level, it will play an important role in improving the level of mining machinery design. In particular, the development and application of digital technology and intelligent technology provide the possibility for further innovation and development of mining machinery design. The application of unmanned operating systems and intelligent systems in the current mining machinery design can enhance the mining capacity of mining machinery. This is also the future development trend of mining machinery and equipment design work.

2. Overview of Modern Mechanical Design Methods

2.1 Modern Mechanical Design Method Content

In traditional mechanical design methods, designers are mainly based on their own work experience and related design data, using direct and analogy methods to complete the design of mining machinery and equipment. In the design process, traditional design methods pay more attention to the staff's own experience and the degree of intelligent activity designed. The modern mechanical design method is based on the traditional mechanical design method,
and it has become a logical and systematic modern scientific method by improving the empirical method and analogy method. When applying modern machinery design methods to carry out mining machinery design work, it is mainly based on the functional requirements of the product and the actual market competition to complete the mining machinery design work. In the design process, designers must give full play to innovative design thinking and put forward corresponding planning concepts. In addition, workers also need to make scientific decisions on the design plan according to the specific application requirements of mining machinery and equipment to ensure that the mining machinery design plan can guide actual production, so as to ensure the production capacity of mining machinery and equipment.

With the continuous improvement of the social and economic level, modern mechanical design methods are constantly improving and developing, designers can apply computer network technology in actual design work. This not only improves the efficiency of design work, but also promotes the enrichment of design techniques. In addition, promoting the effective integration of control technology, computer technology, communication technology, and information technology can further enrich the connotation of modern mechanical design and broaden the scope of modern mechanical design. Besides, this also helps designers to obtain more design inspiration according to the actual production requirements of mining machinery. In the application of modern mechanical design methods, we need to give full play to its dynamic, intelligent, systematic and scientific advantages to ensure that it can meet the production needs of enterprises and market needs, so as to improve the production performance of mining machinery and equipment [1].

2.2 Application Advantages of Modern Mechanical Design Methods

At this stage, the complexity and difficulty of mining work are relatively large. In the process of mining, we need to pay attention to the use of mining machinery, so as to ensure the efficiency and quality of mining, and ensure the safety of mining. In order to ensure the reliability and stability of mining machinery and equipment, we need to fully discuss modern mechanical design methods, so as to improve the design level of mining machinery and equipment, and improve its production efficiency and safety. The design effect of mining machinery and equipment will have a direct impact on the safety of mining. In the innovative design of mining machinery and equipment, the application of advanced science and technology in the design of mining machinery has a positive effect on improving the reliability and safety of mining machinery and equipment. At present, modern mechanical design concepts are developing in the direction of intelligent, green and ecological. Therefore, the combined application of a variety of advanced theoretical knowledge can improve the intelligence and automation of mining machinery and equipment. This is important to improve the production capacity and mining efficiency of mining machinery and equipment.

3. Basic Design Concept of Modern Mechanical Design Method

3.1 Adhere to the People-oriented Principle

When using modern mechanical design methods to carry out mining machinery design work, we need to adhere to the people-oriented design concept. Because no matter what kind of mechanical design, it must be easy to operate. Therefore, to implement the people-oriented concept, more emphasis is placed on the special role of people in the mechanical operation process. In adhering to the people-oriented design concept, we need to proceed from the following aspects. First, we need to strictly control the noise generated by mining machinery.
If the noise of the machine is relatively loud, it may cause serious injury to the operator. If the operator is in a noisy environment for a long time, the physical function of the staff will be greatly affected. Once the staff's physical function is injured, the staff will experience symptoms such as vomiting or dizziness. At the same time, we must ensure the performance of mining machinery to provide operators with a safe operating environment. Second, we must improve the automation level of mining machinery as much as possible. In order to be able to reflect the effect of humanized design on the basis of ensuring the convenient operation of mining machinery, we must design as much as possible to reflect the humanized operation of the console. For example, when setting the position of the console, we must consider the best viewing angle of the human eye as much as possible to complete the design of the console position. This will help relieve the operator's visual fatigue during the operation and improve the safety during the entire operation [2].

3.2 Adhere to the Principle of Comprehensive Design
The main characteristics of modern mining machinery are high efficiency, safety and intelligence. This means that when using modern mechanical design methods to complete the design of mining machinery, we must comprehensively consider all factors that affect the performance of mining machinery and equipment, so as to improve the comprehensive design level of mining machinery. This requires the designer to complete the comprehensive design work in combination with the basic parameters and physiological indicators of the human body in the design process. In the comprehensive application of these data and indicators, we must also consider the authenticity and comprehensiveness of the data. Only in this way can the completeness of the design plan be improved, the mining machinery and equipment can meet the requirements of modern mining, and the mining efficiency can be improved.

4. Main Points of Application of Modern Mechanical Design Methods in Mining Machinery Design

4.1 Optimal Design Plan
Designers need to search for reasonable design parameters according to the use of mining machinery to ensure that they can improve the technical and economic indicators of mining machinery under the premise of meeting various design requirements and achieve the purpose of optimized design. The development software used by general mining machinery is mainly 3D development engine, VC++, 3DS MAX, etc. VC++ is a software platform developed by Microsoft; the main function of 3DS MAX is to complete the 3D model and animation production process; the main function of the 3D development engine is to complete the development of virtual reality software, which can realize the basic functions of mining machinery software. Therefore, when optimizing the design, we need to use advanced development software to simulate and master the composition of mining machinery and equipment and the parameters of each part. In this way, scientific methods can be used to establish a complete and effective mathematical model and find the best solution to the problem. In the actual design, through the effective application of the optimized design method, the mining performance of mining machinery and equipment can be maximized, and the manufacturing cost and operation and maintenance cost of mining machinery and equipment can be saved. This can ensure the safe and stable operation of mining machinery and equipment in the mining process, and improve the production capacity of the machinery.
4.2 Intelligent Design
In the process of rapid development of computer technology, full application of computer technology is an important measure to improve the design level of mining machinery and equipment. The effective application of computer technology can further enhance the intelligent level of modern mechanical design. Meanwhile, it can also guarantee the overall working performance of the mechanical equipment. When developing intelligent design, we must comprehensively consider sensors, execution systems, and controllers. We must use modern mechanical design methods as a prerequisite to build an intelligent mechanical equipment system. Only in this way can it be ensured that mining machinery and equipment can autonomously complete functions such as data collection and problem finding, so as to save manpower and improve the production performance of mining machinery and equipment. Simultaneously, in the process of developing intelligent design, we must try our best to improve the adaptability of mining machinery and equipment to various mining environments. This helps ensure that mining machinery and equipment can successfully complete mining tasks in various harsh mining environments, thereby improving mining efficiency and ensuring mining quality. At present, the technology used in mining machinery design is mainly virtual technology, CAD technology, etc. Full application of these technologies can greatly improve the intelligent level of mining machinery and equipment [3].

4.3 Reliability Design
Reliability is also an important design principle that must be adhered to in mining machinery and equipment. When designing the reliability of mechanical equipment, our main consideration is that the equipment needs to be able to complete the specified functions within the specified conditions and time. From this aspect, the reliability design effect of mechanical equipment will have a direct impact on the operating efficiency and production efficiency of mechanical equipment. When carrying out the reliability design work, we need to ensure that the mining machinery and equipment can operate safely and stably, and use this as a basis for mining operations to ensure that the mining needs of the mine can be met. In the actual operation of mining machinery and equipment, we need to pay attention to the effective use of reliability design methods. Furthermore, designers need to comprehensively consider potential safety accidents and abnormal failures that may exist, and complete the improvement and innovation of mechanical equipment with the core of avoiding potential safety accidents and abnormal failures. This can improve the reliability and stability of mining machinery and equipment during operation. Once a dangerous situation is encountered, we can take effective measures in time to minimize the adverse effects of dangerous factors and abnormal faults on mechanical equipment. Under normal circumstances, in the reliability design of mining machinery and equipment, we will effectively combine it with optimized design technology, and we need to test it after the equipment design work is completed. Afterwards, we can repeatedly optimize the constraint conditions according to the operating parameters of the mechanical equipment during the test, so as to ensure that the mining machinery and equipment can fully function in the actual mining process [4].

4.4 Virtualization Design
In the context of the rapid development of information technology, virtual design technology, which effectively merges industrialization and information technology, is one of the relatively
widely used technologies in modern mechanical design. When designing mining machinery and equipment, designers need to fully consider the application effects of machinery and equipment in different environments. Designers should maximize the flexibility of mechanical equipment to ensure that the mechanical equipment can meet the mining requirements under different mining conditions. When virtualized design of mining machinery and equipment, we need to input the actual application data of the machinery to the system to accurately grasp the mining situation of the mining machinery and equipment in the virtual environment. This is conducive to timely discovering the problems and deficiencies that exist in the operation of mining machinery, and to propose targeted measures to solve the problems. Using virtual design methods to optimize and improve the design scheme of mining machinery can improve the production capacity of mining machinery in the actual mining environment.

4.5 Ecological Design
Under the premise of the continuous improvement of my country's ecological civilization construction level, in order to effectively improve the current ecological environment, we need to pay attention to the green design of mining machinery and equipment. In the development of modern mechanical design theory, green design has become an important development trend. Nowadays, machinery and equipment need diesel to provide power during use. However, diesel will produce a lot of harmful gases to pollute the surrounding environment and air quality, which will hinder the smooth development of mine environmental protection. Therefore, designers need to use the concepts of green, ecological and sustainable development as guidance to complete the green and ecological design of mining machinery. In addition, we also need to promote the development and improvement of related theories. For example, in the maintenance and maintenance of mechanical equipment, non-damaged, good-performance mechanical parts can be reused. Otherwise, we must also effectively deal with the noise caused by mechanical equipment, minimize the adverse effects of noise on the surrounding environment, and improve the ecological benefits of mining machinery and equipment [5].

5. Conclusion
All in all, the application of modern mechanical design methods in the design process of mining machinery is of positive significance for improving the level of mining machinery design, and it can promote the further development of the mining engineering industry to a certain extent. At present, in the design process of mining machinery, first of all, designers need to actively master advanced design technology and the design concept of modern mining machinery. Secondly, designers should promote the improvement and update of mining machinery design theory and methods according to the development needs of the times and the requirements of mining. Only in this way can the design of mining machinery be promoted in the direction of precision, humanization, intelligence and ecology. Thirdly, mining machinery design staff need to continuously learn new professional knowledge, improve their overall quality, and improve their sense of social responsibility and historical mission. Only in this way can we promote the innovative development of mining machinery and equipment based on new science and technology, and promote the stable development of my country's mining industry.

References:
[1] Tong Chuan, Wang Donglin. Application of modern mechanical design methods in mining machinery design[J]. Urban Construction Theory Research (Electronic Edition), 2017, 000(019): P.118-118.
[2] You Nianhua. Discussion on the application of modern mechanical design methods in mining machinery design[J]. China Equipment Engineering, 2020, 000(006):154-155.
[3] Bu Fangang. The application of modern mechanical design methods in mining machinery design[J]. China New Technology & New Products, 2016, No.317(007):53-54.
[4] Zhao Yongen. Research on the application of modern mechanical design methods in mining machinery design[J]. Digital Design (Part 2), 2018(5).

[5] Ren Wanjie. On the application of modern mechanical design methods in mining machinery design[J]. Commodities and Quality, 2017, 000(003):174.