Standardized Application and Management of a New Type of Equipment Support Resources

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Abstract. As a new type of equipment support resource, metal rubber plays an irreplaceable role in buffer damping. This paper mainly introduces the research status of metal rubber materials, and discusses the preparation process, theoretical research and performance characteristics of metal rubber. The preparation standard and management system of metal rubber products are put forward. The proposed system not only reduces the cost of equipment support resource management and production, but also has certain reference for the design, improvement and practical application of metal rubber products.

1. Introduction
Metal rubber is an elastic porous material with large damping, which has good molding ability and environmental adaptability, and has been widely used. In the military field, metal rubber is used in weapon systems such as drone photoelectric platforms, torpedoes, aerospace engines, and submarine pipelines [1]. In the civil field, metal rubber is applied to Galileo satellite laser corner reflectors, meridian engineering sounding rockets, transformers and other equipment. In addition, metal rubber is also used in the fields of sealing [2], medicine, etc.

Figure. 1 Metal rubber cells.
The inside of the metal rubber is a spatial network structure in which metal spiral coils cross each other and are hooked. When the metal rubber is subjected to dynamic load and impact, friction, extrusion and deformation occur between the spiral coils inside, and the mechanical energy generated by the vibration of the system is generated. It is converted into internal energy dissipation, which plays a role in buffering vibration reduction. Metal rubber components are shown in Figure 1.

Metal rubber is a kind of homogeneous elastic porous material. Although it is called metal rubber, it is not a composite material consisting of metal and rubber in the conventional sense. Instead, it coils the metal wire into a spiral shape by choosing a suitable quality of metal wire. After stretching, the pitch is equal to the diameter of the spiral. Then it is knitted, pressed and properly warped. A material formed by heat treatment [3]. It has not only the metal properties of the selected wire, but also the elastic properties similar to rubber. It is also a porous material. Metal rubber material, which integrates elasticity and porosity, cannot be replaced by other materials. It has the characteristics of large damping, absorbing impact energy, high and low temperature resistance and not easy to aging. It has attracted more and more attention in the fields of aerospace and national defense [4,5].

2. Preparation Technology of Metal Rubber

The size, shape, porosity, damping properties and strength properties of the metal rubber are largely related to the preparation process of the blank. The preparation process of metal rubber blank plays a key role in the performance and structure of metal rubber, and is the basis of metal rubber research.

In the early stage of metal rubber research, metal rubber was mostly prepared by hand paving due to limitations of preparation conditions. The Russian National Samara University of Aeronautics and Astronautics has carried out a lot of in-depth research in the field of hand-laid blanks. For the different application environments of metal rubber, many manufacturing processes with application value have been designed. For example, in order to expand the application range of damping properties and tensile strength of metal rubber, a process for preparing blanks by winding spiral coils and filament bundles is designed; in order to improve the strength of the metal rubber shock absorber, it is designed to wrap the core wires. The preparation process of covering and stacking spiral coils. In order to improve the degree of bite of the metal spiral coil and improve the uniformity of the material, Wang Fengming designed three spiral-wound metal-rubber blanks for the tying, ring-crossing and cross-hooking. Wang Ruirui carried out the two-dimensional blank laying of the metal spiral coil according to the "well" shape, and then wound the two-dimensional blank into a three-dimensional blank. The preparation process improved the smoothness of the hand-knit and reduced the weaving difficulty. Firstly, a two-dimensional blank is woven into a two-dimensional blank, and then a two-dimensional blank is wound into a three-dimensional blank. Dong Xiuping uses the blank preparation process as a background to establish a numerical model of cylindrical metal rubber based on the assumption of two-dimensional uniformity. Theoretical support for the design and preparation of metal-like rubber products. In order to make the metal rubber density more uniform and the performance more stable, Yang Kunpeng divides the metal spiral coil for preparing the blank into two parts according to the ratio of 2:1, and stacks the spiral volume with the specific gravity of 2 into a strip shape, and carries it along the mandrel. Winding, forming a preliminary blank, and then winding a metal spiral having a specific gravity of 1 on the bobbin, so that the blank is tighter, and the surface of the metal rubber produced has no burrs, which overcomes the disadvantages of uneven density and easy delamination of the metal rubber.

In the preparation of metal rubber articles having a conventional size and a simple configuration, a spiral wound winding technique is generally employed to prepare a metal rubber blank. In order to improve the efficiency of metal rubber blank preparation, Li Mingsen selected the stepping motor controlled by single-chip microcomputer as the power device, and developed the dynamic spiral coil laying platform to realize the automatic laying of metal rubber blank. Based on the automatic spiral coil laying platform, the advantages and disadvantages of two different winding methods of fine needle positioning and pressure line positioning are studied. Chen Hui and Zhu Yuquan are based on
the fine needle positioning winding principle of metal rubber blanks. The characteristics of the winding motion and the fine needle positioning and winding method were studied, and a new winding device was designed to realize the control of the winding motion and the display and adjustment of the process parameters. In order to obtain metal rubber products with special properties and complex configuration, Huang Kai conducted in-depth research on the automatic laying equipment and process flow of metal rubber blanks, and proposed a strategy for judging the feasible path of blank laying, based on background grid technology. The genetic algorithm is used to establish the positioning pin design and laying path planning design method, which improves the uniformity and compactness of the metal rubber blank, and provides a theoretical basis for the blank laying.

Figure 2: Metal wire spiral coil CNC automatic fixed pitch stretching device.

In order to prepare low-rigidity, low-density metal rubber components, Li Tuo designed a woven-grooved metal rubber preparation process. The process uses a circular weft knitting machine to form a wire into a net, and then press the wire mesh to finally form a rolled metal rubber blank. He Weiming and Ye Wenbo used the planar weaving technique to make the warp-knitted wire into a spiral coil, and then weaved the spiral coil into a metal mesh through a hook-and-knit process. Finally, the metal mesh was wound into a metal rubber blank, which was repeated by a hooking weaving process. The regularity of the unit is good, which improves the stability of the performance of the metal rubber.

Some researchers have proposed a number of metal rubber blank preparation processes with research value from the preparation materials and preparation methods of metal rubber, which enrich the diversity of metal rubber products. Mao Chenxi and Huang Rui used metal alloy wire instead of stainless-steel wire to prepare metal rubber. This type of metal rubber not only has good damping effect, but also has shape recovery. Zhao Cheng used a 65Mn steel wire with a large modulus of elasticity to prepare a large-diameter metal spiral coil. The metal rubber was prepared by a weaving process. The prepared metal rubber has high rigidity and good damping performance, and can adapt to large load conditions. Based on the principle of resistance welding, Chen Ya designed a high-energy pulse discharge system that can operate stably. Through this system, the discharge sintering of metal rubber can be completed.

The later treatment of metal rubber depends on the working environment and the special performance required. It mainly includes heat treatment, cleaning, strengthening and coating protective film, etc. Heat treatment is tempering and aging hardening treatment to eliminate the internal stress during forming and stabilize the structure and size of metal rubber products. Cleaning is to prevent metal chips and dirt from being produced during pressing. Impurities will affect the ultimate performance of metal rubber components. Components without special requirements can be cleaned by detergent. Components such as elastic dampers should be cleaned by ultrasonic wave [6,7]. The
protective film is mainly applied to the setting of metal rubber products with corrosion resistance requirements.

3. Study on Performance Characteristics and Application of Metal Rubber Material

3.1. Properties of Metal Rubber

The properties of metal rubber can be divided into material properties, physical properties, mechanical properties and chemical properties. This paper mainly studies physical and mechanical properties. Physical properties include heat capacity, thermal expansion, thermal conductivity, conductivity, electrical structure, magnetic structure, sound absorption and permeability; mechanical properties include strength, stiffness, friction technical performance and dissipation performance. The main advantages of metal rubber materials are as follows: 1) They have high carrying capacity, strong environmental adaptability, and are not easy to deteriorate and age under high temperature, large temperature difference, vacuum, radiation and corrosion environment, and have a very long time to use and store. 2) The non-linear damping characteristics of metal rubber make it more suitable for vibration reduction under complex loads than ordinary rubber, and it has a good effect on shock reduction. 3) The porous structure of metal rubber makes it the best substitute for ordinary rubber products and other porous materials in sealing, filtering and throttling. 4) Structural and performance indicators can be designed, such as stiffness, porosity and capillarity. Metal rubber products with different structural sizes and properties can be prepared by changing different process parameters and methods. 5) It is widely used in aerospace, weapons and equipment, petrochemical and other fields. It has the distinctive characteristics of dual-use of military and civil.

3.2. Application of Metal Rubber

Metal rubber materials are mainly used in vibration isolation and elastic damping structures, accounting for about 35% of all its applications. Metal rubber vibration isolators made of metal rubber materials not only have inherent characteristics of metal, but also have elastic and damping characteristics similar to rubber vibration isolators, which make them widely used in aerospace, weapons and equipment, petrochemical and other fields. Metal rubber vibration isolator solves the problem of vibration isolation in extremely harsh environment with good vibration isolation performance. Even in the application of conventional environment, because of its long storage period, it has practical significance to enhance the maintenance of equipment and improve the reliability of equipment.

In aerospace and rocket engines, in order to ensure the full combustion of liquid hydrogen, liquid oxygen and aviation kerosene, improve thermal efficiency and prolong the service life of combustion system, it is necessary to filter fuel and combustion-supporting gases adequately. The porous metal rubber can be used to produce excellent filtration and throttling components, and its anti-clogging ability and throttling pore pressure are connected. Continuously adjustable properties are incomparable with other porous materials. In addition, metal rubber can also be used to make pressure relief valves and regulators for rocket engines and pneumatic and hydraulic systems. Russia has successfully applied metal rubber filters equipped with magnetization devices to the filtration of drinking water, and developed a variety of metal rubber filters with adjustable filtering accuracy.

4. Standardized production and management of metal rubber products

4.1. Standardized management model

It can be seen from the introduction before this paper that metal rubber materials have a very wide range of application value and superior performance than traditional materials in many aspects. However, due to the short development time of metal rubber in China, there are still many problems to be solved, the most important one is the lack of systematic basic research, only relying on experience and trial-and-error [8,9].
The design and processing are inefficient and cost-effective. Therefore, it is urgent to establish unified national standards for performance and testing, carry out standardization and industrialization research of metal rubber products, establish stable process routes and testing means, and formulate relevant standards and product quality evaluation system for metal rubber products will also be the direction of future development of metal rubber technology.

Standardization is an important means of modern industrial management and engineering technology implementation. The main goal of standardization is to achieve a wide range of systematic and social benefits through standardization research of common technologies. Nowadays, new technologies emerge in endlessly, which are closely combined with advanced technologies. Advanced standardization is a new requirement of engineering practice for standardization work [10].

4.2. Composition of standardized management

Standardization is an important means of modern industrial management and engineering technology implementation. Through the standardization research of common technology, it is the main goal of standardization to obtain a wide range of system benefits and social benefits. At present, new technologies are emerging one after another, closely integrated with cutting-edge technologies, and achieving standardization ahead of time is a new demand for standardization work in engineering practice. Standardization is the development of standards for product types, dimensions, material properties, inspection methods, design methods, and drafting standards, primarily for design, manufacturing, and repair. Serialization refers to the formation of a series of products based on different performance parameters to meet the needs of different environments or loads. Generalization refers to the same product, which can be used in different situations as long as it has the same requirements.

Metal rubber products can follow this method in product standardization, mainly divided into classification standards and technical support standards. Classification criteria are defined according to the workplace. Users can choose corresponding types of metal rubber products according to actual needs. Technical support criteria refer to a series of supporting standards to ensure correct product design, consistent manufacturing process and stable production quality. As metal rubber materials are mainly used in vibration reduction, vibration isolation, sound absorption, noise reduction and throttling filtration, the standardization of metal rubber products should be carried out mainly in these areas. In these areas, metal rubber products are made as a new material to replace the original products, so the standardization work can start from referring to the standard of the original products, and then increase some specific technical indicators of metal rubber, such as wire material, diameter and porosity.

5. Conclusion

According to the above elaboration and analysis, with the further development of the basic theory of metal rubber, the diversification of product development and the development of standardization, many excellent properties of metal rubber will be discovered and utilized, and its application scale and field will be greatly expanded, which will not only promote the development of aerospace industry in China, but also in ship, metallurgy, petroleum and chemical industries. Industry, textile and other areas of national economy can also be widely used. In a word, the establishment of standardization system for the preparation and management of metal rubber plays an irreplaceable role in the management of equipment support resources.
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