

Current Situation and Development Prospect of Automobile Manufacturing Technology

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Abstract: In recent years, with the development and progress of science and technology, the manufacturing technology of automobiles has gradually developed from the previous manual production and assembly to the current direction of intelligence and automation. This paper first discusses the development history of automobile engine and reducer, studies the structure of automobile engine and reducer currently used, analyzes their advantages and disadvantages, and proposes improved methods for the existing shortcomings. The rapid development of automobile manufacturing technology has inevitably caused a lot of pollution to the environment. Therefore, many R&D institutions at home and abroad are developing energy-saving new energy vehicles, making an outlook for the future development of automobiles.

1. Introduction

With the rapid development of science and technology, the automobile manufacturing industry has experienced a development track from mechanization to automation and even intelligent manufacturing[1]. The automobile manufacturing industry is a heavy industrial enterprise. With the advent of the “automobile era”, the mass production of automobiles has brought enormous pressure to the environment, such as a large amount of oil consumption causing great pollution to the environment. Under the request of the world advocating an environment-based economy, developed countries in Europe and the United States have formulated very strict standards for automobile fuel consumption for sustainable development. China also formulated relevant plans in 2012, and further planned to reach 4L and 3.2L fuel consumption per 100 kilometers from 2025 to five years later[2]. At the same time, China also released plans for energy saving and utilization of new energy vehicles in the automobile manufacturing industry, which makes an outlook on the development direction of future automobiles.

2. Development Status of Automobile Manufacturing Technology

In the development process of automobile manufacturing technology, the engine and reducer of the automobile have always been the key research and development objects in the development process. Next, these two structures will be discussed.

2.1 Motor Manufacturing and Development

The motor is the heart of the car and is a device that converts electrical energy into mechanical energy. The principle of the motor is to use the energized coil of the stator winding to generate a rotating magnetic field, and then the rotating magnetic field acts on the rotor to form electromagnetic torque, which drives the rotor to rotate.

Electric motors of electric vehicles are roughly classified into “DC motors” and “AC motors”. A DC motor literally means a motor that uses direct current (DC), while an AC motor is a motor that uses alternating current (AC). DC motors generally use brushes, which have a large starting torque and are easier to control than AC motors. However, its speed and power performance are limited due to the loss, pollution and noise generated by the rotation of the brushes, so it cannot be used well as a power source for electric vehicles. Therefore, the main motor used in electric vehicles is

an AC motor, as shown in Figure 1:

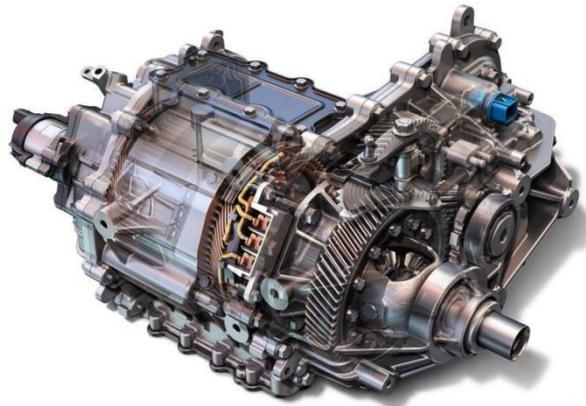


Fig.1 Schematic Diagram of an Ac Motor

AC motors are motors that use alternating current, and are classified into two types: asynchronous motors and synchronous motors. Among them, synchronous motors are the most widely used in automobiles. Synchronous motors are widely used as power sources for automobiles due to their excellent power consumption efficiency, low noise, high output density, and favorable constant-speed rotation due to their structure.

For drive motors, China has experienced a long period of development. Self-developed and produced permanent magnet synchronous motors, AC asynchronous motors have completed the technical support for the industrialization of vehicles. However, the industrial chain of my country's drive motors still needs greater development.

Some major components such as high-speed gears have insufficient investment in research and development, and core components such as iron cores and permanent magnets have low utilization rates. The technology and process technology of driving motors need to be improved, and the international competitiveness needs to be strengthened.

With the advancement of science and technology, China is also developing new structures and high-performance motors. In terms of the processing and production technology of high-performance, new-structure motors, such as rectangular conductors, segmented conductors, and segments of stator and rotor cores, China has developed rapidly, but only a small number of electric motor manufacturers in China are developing components, while other manufacturers in the world have mass-produced and entered the market.

Regarding the main technologies in the motor, such as cooling technology, plastic sealing and oil cooling technology of winding ends, our products are still in the preliminary stage. The production technology of high-end testing, key production equipment and inspection equipment is still relatively backward, mainly relying on imports, and in the process of large-scale industrialization, the automated production line has a lot of shortcomings, and there is still a lot of room for improvement.

Regarding the controller of the electric motor, the electric vehicle market in my country is in the initial stage of development. There are some markets for self-developed products, and most of the new energy vehicles of independent brands are still equipped with domestic controllers. Compared with manufacturers in the same industry in the world, my country's level of development and industrialization of power electronic controllers is still relatively low, and the industrial chain such as proprietary circuits, chips and film capacitors has obvious shortcomings, and the competitiveness of the basic core needs to be improved urgently.

Therefore, for the improvement of the controller, I think it is possible to use devices with better control performance, such as the third-generation wide-bandgap power semiconductor. The third-generation wide-bandgap power semiconductor controller is the main development direction of the next-generation motor controller in the world. It has the advantages of high frequency, low loss, high temperature resistance and small size. Compared with international power devices, the research and development of Chinese wide-bandgap semiconductor-related products, such as

high-reliability chips, power modules and controllers, is still in the preliminary stage.

In addition, for the situation that the manufacturing cost of electric vehicles and battery prices rise together, there are the following methods to reduce costs and improve performance, such as developing new battery structures, improving energy storage efficiency, and breaking technical barriers are the main methods to improve the cost performance of new energy vehicles in the future.

2.2 Manufacture and Development of Reducer

The reducer is an independent component composed of gear drive, worm drive, and gear-worm drive enclosed in a rigid housing[3]. It is often used as a reduction drive between the prime mover and the working machine. It plays the role of matching speed and transmission torque, which is widely used in modern automobiles, as show in fig.2.

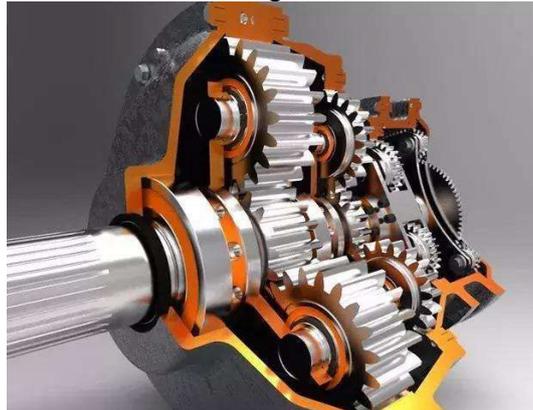


Fig.2 Schematic Diagram of the Reducer

As a main structure of the car, the reducer can change the torque and speed in the drive axle, increase the torque from the transmission or universal transmission, reduce the speed and change the direction of torque transmission.

Regarding automobile transmissions, the manufacturing level of reducers for domestic automobiles has approached the production level of international automobiles, and some reducer products have been equipped with mass-produced self-owned brand new energy vehicles. However, the independent research and development technology, especially the development technology of automatic transmission and electromechanical coupling system is very poor, there is still a gap between the main production technology and the world level.

Gear precision machining, grinding machine tools, test equipment and factory test benches are still imported, and the production level of precision low-noise gears, clutches and operating mechanisms and assembly controllers is still far from the world level.

For the shortcomings of the current reducer, the improvement method of the domestic reducer can focus on the research of new structure and the use of more precise gears, so as to reduce the friction loss generated when the gears are coupled and rotated.

3. Prospects for the Development of Future Automobiles

With the introduction of the national dual-carbon policy of “carbon peaking and carbon neutrality”, China's supportive policies for new energy vehicles are also increasing. Looking back at the changes in the past ten years, from coal to natural gas, and to the rapidly developing new energy, the country has paid more and more attention to environmental protection and emission reduction, energy saving and carbon reduction[4].

In the past 20 years, new energy has laid the foundation step by step, and it is a strategic energy for the country's market expansion and deployment for many years. Since 2018, the technology of China's new energy vehicle industry has been changing with each passing day. By 2020, China has also invested hundreds of millions of yuan in subsidies for the development of new energy vehicles[5]. Under the above conditions of new energy development, the development of automobiles in the future will show the following trends:

First, the scale of the new energy vehicle market is expanding. China's new energy vehicle market is developing faster and faster, and will move from being limited to domestic sales to the international market. The “dual cycle” proposed by China has further accelerated the development of China's electric vehicle globalization. The sales volume of new energy vehicles in the domestic market will also increase steadily.

Second, the production technology is becoming more and more mature. One of the core parts of new energy vehicles - battery research and development, China's technology is becoming more and more mature, and it has become the world's third largest lithium battery producer after Japan and South Korea. China's lithium batteries are constantly improving in terms of battery life, cycle, safety, and production technology.

Third. Strong support for new energy vehicles. The central and local governments have begun to introduce “all-round, multi-level” support measures for the new energy vehicle industry, which mainly include two parts, one is tax relief and R&D support for new energy vehicle companies. The second is the consumption preferences, supporting infrastructure construction, purchase subsidies and other aspects of new energy vehicle consumers. The investment of a large amount of financial subsidies has led to a surge in the sales of new energy vehicles.

Fourth. “Double carbon” boosts the development of the industry. Decarbonization under the carbon peak and carbon neutral strategy has become the first driving force for the development of global hydrogen energy. China proposes that carbon dioxide emissions will peak before 2030, and strive to achieve carbon neutrality first in the future. Driven by the policy, the prospect of my country's new energy industry is still promising in the future.

In the future, the scale of the new energy vehicle market will gradually expand, and the production technology will become more and more mature. Moreover, the focus of R&D institutions will be mainly on energy storage, improving charging efficiency, and the layout of charging piles across the country, which are very important for the development of new energy vehicles.

4. Conclusion

This paper firstly introduces the development status of automobile manufacturing technology, including the development, structure, principle and function of automobile engine and reducer, analyzes the advantages and disadvantages of the most commonly used asynchronous motors and reducers, and proposes improvement ideas for the shortcomings. Finally, the future development of new energy vehicles is prospected, and the development direction of new energy vehicles is pointed out, which has a great significance to the development of new energy vehicles.

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