

RESEARCH ARTICLE

Development Status and Patent Analysis of Hybrid Power Technology

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Abstract: Hybrid electric vehicles have the characteristics of both traditional internal combustion engine vehicles and new electric vehicles. This paper introduces the classification of hybrid electric vehicles and the structure and characteristics of the mainstream hybrid system, and analyzes the development status of domestic and foreign automobile enterprises from the perspective of patent application.

Keywords: Hybrid; Patent; New energy

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1. Introduction

In recent years, with the rapid development of the automobile industry, energy, environment and traffic safety issues have attracted more and more attention. National regulations on automobile emission and fuel consumption limit requirements are more and more strict, traditional internal combustion engine can not meet the requirements of emissions and fuel consumption. At present, pure electric vehicles are limited by price, endurance, charging conditions and other aspects, and cannot be developed and applied on a large scale. Hybrid cars, on the other hand, use a combination of a traditional internal combustion engine and an electric motor to drive the car. Hybrid electric vehicles have the characteristics of both traditional internal combustion engine vehicles and new electric vehicles, and have many advantages such as fast power response, low fuel consumption, low emissions, no need for additional charging devices, long driving range and so on. Therefore, in recent years, hybrid electric vehicles have become the focus of active research and development of major automobile manufacturers in the current price segment.

2. Classification of Hybrid Electric Vehicles

At present, there are mainly three working forms of hybrid electric vehicles: series, parallel and hybrid.

2.1 Series Structure

The motor directly drives the wheel, the engine does

not directly participate in the drive, only responsible for the output of mechanical energy. The serial drive system consists of an engine, a motor, a controller, a transmission system and a battery pack. The mechanical energy generated by the engine is directly transmitted to the generator, which converts the mechanical energy into electrical energy. The motor drives the vehicle through the electric energy generated by the battery or directly by the electric energy generated by the generator. The serial structure of the engine is only directly connected with the generator, the engine and the car transmission system without mechanical connection, can control the engine in the lowest fuel consumption area, with high thermal efficiency of the engine, the advantages of obvious oil saving effect.

2.2 Parallel Connection Structure

The engine and motor are two independent power system, the car can be provided by the engine or motor separately in the process of driving power, can also be powered by the two systems, vehicle on a hill, speed when the load is the largest, at this moment need both work together, engine as usual, the battery output power to the motor, This works with the engine to output torque to the gearbox to meet the required load. Compared with the tandem type, the parallel type structure requires the coupling of the engine and the road load, and the coordination with the battery requires quite complex technology, so the system control is relatively difficult.

2.3 Hybrid Structure

Hybrid structure, which integrates the series structure and parallel structure, can realize single series or single parallel structure, and can also realize the joint operation of series and parallel. When the car runs at low speed, the car runs in series; The car runs in parallel when traveling at high speed. When the engine is driven alone, the operation mode is the same as that of the traditional automobile, so that the engine is in the economic speed region, so as to give better play to the advantages of the motor driving mode and the engine driving mode, and achieve the purpose of reducing energy consumption.

3. Comparative Analysis of Mainstream Hybrid Power System

Toyota's second-generation hybrid power system THS-iv adopts the structure of generator and engine coaxial arrangement through single row of planetary rows. The generator is fixedly connected with the sun wheel, and the engine is fixedly connected with the planetary frame. The power of the planetary system is output through the gear ring. The driving motor is arranged in parallel with the planetary row mechanism. The power output by the planetary platoon and the drive motor is combined by the output shaft and finally transmitted to the wheels by the differential. Motor drive system can work alone in the car is in working condition of idle speed and low speed running, the engine stop working, the motor to drive the car, only in motor drive system to provide the driving force of the insufficient or losing electricity, the battery pack engine powering cars to back up and running, and recharge the battery pack, reduce the fuel consumption, improve the fuel economy, At the same time reduce harmful gas emissions.

Honda I-MMD system is mainly composed of Atkinson cycle engine, drive motor, generator, E-CVT and lithium battery pack components. The engine and drive motor have only one gear each, and the engine gear and drive motor gear parallel layout. The driving motor can drive the wheel directly through the deceleration mechanism; Engine output crankshaft and generator through the reduction gear parallel, through the clutch and reduction mechanism coupling, and then drive the wheel. Although Honda's I-MMD hybrid system is not as advanced as Toyota's in terms of technology, it has its own advantages in terms of practicality and ease of popularization, such as simple structure, small footprint and low manufacturing cost.

BYD DM hybrid power system has two motors at the front and rear, in which the front motor drives the front wheel in parallel with the engine through the gearbox,

and the rear motor directly drives the rear wheel, and the power output of the front and rear shafts is shared. By using the rear motor to drive the rear wheel alone, the power of the engine can be transferred to the rear axle without passing the drive shaft, that is, full four-wheel drive is realized, and more space is freed to accommodate the larger capacity of the battery pack. The higher battery degree improves the range of the pure electric drive mode. And the engine and the front and rear double motor can be in the climbing, rapid acceleration and other high load state of external output, dynamic response is fast, and long range.

4. Analysis of Hybrid Electric Vehicle Patent Application

In order to have a deeper understanding of the research status of major automobile manufacturers in hybrid electric vehicles, the search results of patent applications of hybrid electric technology are screened and counted by applicants, and the patent application rankings of hybrid electric technology can be obtained, as shown in Figure 4.

Since the Toyota Prius came out in 1997, Toyota has successively launched four generations of THS gas-electric hybrid systems, all of which adopt hybrid structure. Toyota has applied for more than 13,000 patents worldwide, forming a huge and tight patent protection network. Hyundai Motor of South Korea, Honda Technology Research and Development of Japan, Ford Motor of the United States and Nissan Motor of Japan have also invested a lot of research energy and applied for thousands of patents. Among the major domestic automakers, BYD, Chery, SAIC and Changan have followed suit and started to catch up with the international r&d pace in the field of hybrid power.

5. Conclusions

Since the "13th Five-Year plan", China's new energy vehicles began to develop rapidly, the state and local have introduced many favorable policies for the new energy vehicle industry. For example, "Notice on financial Support Policies for the Promotion and Application of New energy Vehicles in 2016-2020" and "Interim Measures for the Management of Lithium ion Battery Industry Standard Announcement", etc., the introduction of these policies ensures and promotes the development of new energy vehicles to a certain extent. Hybrid electric vehicle effectively solves the problems of high energy consumption and high emissions of traditional vehicles, and is the development direction of the automobile industry for a relatively period of time in the future. However, in the development process of current hybrid electric vehicles, there are still

problems such as poor endurance and low engine combustion efficiency, which seriously affect the development of hybrid electric vehicles. Therefore, it is necessary to accelerate the research and development of key technologies of hybrid electric vehicles and promote the development of the new energy vehicle industry.

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