Universe Scientific Publishing

DOI:10.18686/ahe.v7i17.9066

Research on Energy-saving Technology of Electro-hydraulic Control System of Electromechanical Coupling Transmission for Plug-in Hybrid Electric Vehicle

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Abstract: Along with the development of society, the increasing maturity of science and technology, our country ushered in the new era: the new energy era, which creates a favorable environment for the development of the national new energy automobile industry. By the state to give new energy vehicles policy incentives and support, expand the development scale of new energy vehicles, new energy vehicles have become a major vehicle enterprises and research institutions to discuss the hot spot. At the present stage, the development of pure motor trams is very slow due to the inadequacy of various basic supporting facilities such as low-level battery technology and charging piles. Plug-in hybrid electric vehicle (Plug-in hybrid electric vehicle) is an effective technical measure for the transition from traditional fuel vehicle to electric vehicle. The power coupling of driving motor and engine can ensure the power performance of the whole vehicle, minimize the economic cost and solve the problems related to the driving range of electric vehicle. Taking plug-in hybrid electric vehicle as an example, this paper analyzes the energy-saving technology and measures of the electro-hydraulic control system of the electromechanical coupling transmission of plug-in hybrid electric vehicle.

Keywords: Plug-in hybrid electric vehicle; Electromechanical coupling transmission; Electro-hydraulic control system; Energy-saving technology

Fund Project:

"Research on Characteristics and Energy-saving Technology of Electro-hydraulic Control System of Electromechanical Coupling Transmission for Plug-in Hybrid Electric Vehicle", Hunan Provincial Education Department (21C1218)

Introduction: At present, most domestic and foreign researches on energy-saving technology of electromechanical coupling transmission and electro-hydraulic control system of plug-in hybrid electric vehicle focus on macro research, strengthening the matching and optimization of configuration technology and system of several coupling transmission, as well as the improvement and optimization of vehicle power performance and fuel economy. The other part is mainly to improve the drivability of plug-in hybrid electric vehicles for the purpose of clutch control optimization research. In the research, the author mainly researches the plug-in hybrid electric vehicle technology, and strives to provide suggestions for the R&D and design personnel of the electro-hydraulic control system of the electromechanical coupling transmission of the plug-in hybrid electric vehicle through the research of various energy-saving technologies. Through the application of skills and technologies, the operation effect of the system is enhanced, and the energy consumption and economic cost expenditure are controlled.

1. Hydraulic system control loop technology

The electro-hydraulic control system of the electromechanical coupling transmission of the plug-in hybrid electric vehicle can apply the control loop technology of the hydraulic system to adjust the main pressure, promote the hydraulic system to maintain a good running state, control the energy loss, and provide high-quality service for the driver.

1.1 The design of oil supply pressure regulation and flow control loop

We all know that the composition of oil supply pressure regulation and flow control loop mainly includes proportional solenoid valve and fixed value reducing valve as well as the main pressure regulating valve and safety valve, oil pump equipment. The output flow of the oil pump equipment passes through the main pressure regulating valve and is controlled by the first arrival pressure regulated by the proportional battery valve to obtain the main pressure required by the system. When the pressure of the system reaches a certain limit value, the safety valve starts to relieve pressure in order to improve the safety of the system [1]. The electromagnetic valve is used to achieve good oil supply, during which the oil pressure of the system will flow to the customized pressure reducing valve for decompression, input a fixed pressure for the proportional battery valve, combined with the battery valve performance and parameters of the design, to ensure accuracy, in addition, the pressure is also very stable. If the pressure supplied by the battery valve is very high, the application performance of the battery valve will be affected, in addition to avoid unnecessary efficiency loss. The above points should be fully considered in the design of oil supply pressure regulation and flow control loop [2].

1.2 Torque converter and lubricating oil cooling control loop

For the locking control measures of the torque converter equipment, it is suggested to gradually increase the transformer lock stop chamber to the clutch is completely locked to achieve rigid connection of the transmission and transmission input shaft; Another method is to switch the locking and unlocking chamber pressure of the torque converter to the maximum pressure, and then unlock the pressure of the sealing chamber, so as to achieve the clutch of the torque converter and the clutch of the two devices. The locking control oil circuit of torque converter equipment can be designed by referring to the locking and unlocking and lubrication cooling circuit design scheme of the latest HCU torque converter of Audi A6 or Aisin 6AT [3].

2. The new generation of PHEV hybrid technology

2.1 Application status of the new generation of PHEV hybrid power technology

Plug-in hybrid electric vehicles, pure electric vehicles and fuel cells are the main points of our new energy vehicles in the next decades, the technical development and technical level of the new energy vehicles have a greater influence on the energy saving and emission reduction. In recent years, various automobile enterprises have increased the research of PHEV hybrid technology and planned the overall business pattern of PHEV hybrid technology. For example, Volkswagen, Toyota, Honda and auto makers such as Mechanism, BYD and Changan are participating. In 2019, relevant departments issued a development plan for the new energy automobile industry, naming the need for the development of new energy vehicles in China to carry out research and development in a three-vertical and three-horizontal layout, accelerate technological innovation in the new energy automobile industry, and develop related technologies. In the three-vertical and three-horizontal R&D layout, plug-in hybrid electric vehicles are the main components. In the development of plug-in hybrid electric vehicles, attention should be paid to the research and development of power batteries and management systems, and more efforts should be made in the research and development of driving motors, power electronics, networking and intelligent technologies. PHEV hybrid technology solves the energy-saving and emission reduction problems of our new energy automobile industry. At present, our country still exists a very unbalanced energy structure, in the energy structure of the largest proportion of coal energy, relatively small oil and natural gas, relatively small renewable energy. This means that at present our country energy saving emission reduction work is very urgent and arduous. The application of PHEV hybrid technology in the electro-hydraulic control system of the electromechanical coupling transmission of the production hybrid electric vehicle can extend the cross-city driving range, effectively control the energy consumption, and reduce the fuel consumption. In addition, the application of PHEV hybrid technology is also a good solution to pure electric range anxiety. Generally, domestic PHEV models have a pure electric mileage of more than 50 kilometers, which can meet the basic commuting requirements. Taking Toyota RAV4PHEV of Japan as an example, the comprehensive driving mileage of the car reaches 1,280 kilometers when full of fuel, which can meet the basic requirements of daily driving through points and long-distance hybrid driving [4].

2.2 Application advantages of the new generation of PHEV hybrid technology

Based on the advantages of PHEV hybrid technology, we can try to apply PHEV hybrid technology to the electromechanical coupling transmission control system of plug-in hybrid electric vehicle, and analyze the powertrain architecture during the process. Nowadays, the configuration of PHEVs in the world appears the phenomenon of a hundred flowers blooming, among which the single motor parallel and power shunt and double motor series or parallel three mainstream technologies.

At present, the new generation of PHEV hybrid technology mainly includes the following types, and the development of technical advantages and disadvantages are described as follows:

Power shunt depth petrol-electric hybrid technology. The technology is widely used in Toyota vehicles. It adopts the star-row structure frame and realizes the power-coupled dual-motor shunt technology. The single and double planetary alignment technique is

used. In domestic automobile, the engine operating condition is adjusted to the area with high thermal efficiency and small area mainly by means of the star alignment structure frame and star alignment technology. Based on this, it is suggested to apply Atkinson cycle engine equipment that can be used exclusively for hybrid electric vehicles [5].

Single motor double clutch technology. This technology takes single-motor dual-clutch configuration as the core technology, among which P2 hybrid structure and P2.5 power structure are the most representative. This technology is easy to control and easy to apply. The P2 motor is usually installed behind the engine and in front of the transmission, which ensures that the transmission is fully used by the motor. The motor itself must be too large to turn, therefore, it must also be high-speed rotation, which not only controls the cost of the least, but also reduces the volume of the engine equipment, to ensure the efficiency of fuel. At present, the domestic technology is not very mature in our country. Most of it adopts some well-known international brands. Small domestic and unknown independent brands cannot highly integrate the P2 module. In addition, it is difficult to integrate a P2 module into the horizontal engine of self-branded compact cars. Therefore, these issues and practical constraints should be fully considered when applying the new generation of PHEV hybrid technology [6].

Conclusion:

This paper focuses on the application of hydraulic system control loop technology and loop design, a new generation of PHEV hybrid technology research, as a new skill technology is more worthy of application and promotion. In addition, in the future, further research should be conducted on the construction of electromechanical coupling transmission simulation model and the manufacture of physical prototype of electro-hydraulic control system of electromechanical coupling transmission of plug-in hybrid electric vehicle. Only in this way can suitable simulation software be selected to build the overall simulation model of electromechanical coupling transmission of plug-in hybrid electric vehicle. To solve the problem of system modeling difficulty during the application of energy-saving technology of electro-hydraulic control system of electromechanical coupling transmission of plug-in hybrid electric vehicle.

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