Intelligent of Electric Vehicle Heat Pump Air Conditioning Control System

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Abstract. Traditional fuel vehicles consume a lot of fuel and cause serious environmental pollution. At present, when environmental protection is being paid more and more attention, Electric vehicles have received extensive attention from countries all over the world for their advantages in energy safety, environmental protection and long-term development. Electric vehicles have received extensive attention from countries all over the world for their advantages in energy safety, environmental protection and long-term development. With the rapid development of electric vehicles, as the main energy consumer, following the electrical system, the air-conditioning system has become an important factor restricting the power, economy and durability of electric buses. At the same time, compared with the current electric heating PTC method commonly used in electric vehicles, heat pump air conditioners can increase the working range of electric vehicles. Therefore, the application of large-scale energy-saving systems, high-efficiency energy-saving systems, and electric vehicle air-conditioning systems is developed, it is of great significance to the promotion of electric vehicles. This article aims to intelligently study the control system of the electric vehicle air-conditioning heat pump.

Keywords: Electric Car, Intelligent Research, Heat Pump Air Conditioner

1. Introduction

The electric vehicle heat pump softener is an independent heat pump type in the frequency conversion of the automobile air conditioner, and the air system is controlled by the frequency conversion module. The top equipment receives DC400–900V high voltage in the middle of the battery [1]. The control unit provides a DC 510V DC power switch for the frequently rolling compressor, and the remaining electric energy is converted into a 24V power supply to control internal and external operation [2]. When the system runs in the refrigerator: the low-pressure and low-pressure air passing through the compressor is forced into the compressor and hot air by the compressor, and the hot air enters the four-way external switching valve of the compressor and emits natural heat [3]. The cooled high-pressure supercooled liquid refrigerant passes through the two-way liquid storage heater, enters the throttle valve, and adjusts the enthalpy value as a small-capacity low-temperature high-pressure gas-liquid two-phase mixed refrigerant [4]. Then it flows into the indoor heat exchanger through the liquid separator, evaporates and absorbs heat [5]. Cooling is provided by the evaporation of refrigerant, which cools the fresh air and...
return air in the pipe system and delivers it to the interior of the house to cool the passenger compartment [6].

2. Establishment of simulation model of electric vehicle heat pump air-conditioning system

In order to carry out the thermal efficiency analysis and performance prediction research of the electric vehicle heat pump air conditioner, the AMESim software environment is used to build the electric vehicle heat pump air conditioner simulation system [7]. AMESim provides a complete system engineering design platform, which can create complex multi-field system models, and perform simulation calculations and in-depth analysis on this basis [8].

This paper mainly studies the performance of the electric vehicle heat pump air conditioning system when the heating conditions are stable, and has nothing to do with the performance changes when the system is started and closed [9]. The following assumptions were made when establishing the simulation model:

(1) The fluid flow mechanism working in the pipeline is a static flow mechanism;
(2) The flow of working fluid in the pipeline is unidirectional, ignoring its axial heat conduction;
(3) Ignore the heat exchange loss and flow resistance between the flowing water and the outdoor;
(4) When the working fluid passes through the throttling device, it is adiabatic expansion;
(5) The compression process of the fluid working in the compressor is adiabatic compression;
(6) Adiabatic compression is the compression process of the fluid working in the compressor;
(7) The working fluid is in two uniformly mixed states, without relative sliding phenomenon, and the fluid temperature is the same;
(8) Ignore the flow resistance and heat loss caused by the working fluid passing through the four-way reversing valve.

The stability system simulation of the electric motor electric pump system mainly uses the rotary compressor model, the internal and external heat exchanger models, and the throttle model [10]. When establishing the simulation model, according to the thermodynamic process, according to the nature of each element, create the corresponding characteristic equation [11].

\[ n = \frac{1}{50 \mu_d} \cdot \omega_t \cdot e \cdot D \times 10^{-5} \]  \hspace{1cm} (1)

3. Implementation of electric vehicle heat pump air-conditioning system

3.1. Main program module

Based on the hardware structure and simulation design of the fuzzy controller, the software program of the fuzzy controller is designed [12]. The main system is the input software of the controller software, responsible for managing the configuration of the chip application, the integrity of each module, and the execution sequence of each function. The main system includes setting, temperature measurement, confusion control algorithm, subroutine and subroutine compressor control, as shown in Figure 1.
3.2. System heating scheme

As a preventive measure against the effect of the heat of the pump, a heating test was performed in which the internal flow returned to the required air conditions and foot pressure. Maintain the maximum gear position of the fan in the car, and the surface wind speed of the heat exchanger outside the car is 4.5m/s, and record the 40-minute process from the start of the compressor to the stable operation of the system [13]. Exhaust system temperature, average temperature inside the car, air temperature outside the car, return air temperature, front seat temperature (first co-pilot head and feet temperature), changes in the average rear seat temperature, and the specific test and development procedures are shown in Table 1.

Table 1. Heating test plan of the whole vehicle heat pump air-conditioning system

| Test conditions | Ambient temperature outside the car (°C) | Relative humidity outside the car (%) | Test mode | Compressor speed (r/min) | Surface wind speed of heat exchanger outside the vehicle (m/s) | Air volume of fan in car (m³/h) |
|-----------------|----------------------------------------|--------------------------------------|-----------|----------------------------|-------------------------------------------------------------|-------------------------------|
| Heating         | -5                                     | 45                                   | Inner loop blowing face, blowing foot mode | 3000–6000       | 4.5                          | 370                           |
|                 | -15                                    | 45                                   | Internal circulation foot blowing mode    | 3000–6000       | 4.5                          | 450                           |

In the vehicle system test, the system performance, the compatibility of the vehicle system, and the safety and comfort of the indoor temperature are first investigated [14]. Put the whole vehicle into a
standard enthalpy laboratory, set up air pumps under different working conditions, use pressure sensors, thermocouples and data acquisition equipment to collect the important pressure and temperature data of the system and the temperature data in the vehicle, and then collect the data for processing [15]. When calculating the cooling capacity, there is no air volume measuring box in the bench test, and the cooling capacity cannot be read directly. The total cooling capacity needs to be calculated through intelligent thermal energy calculation and cooling capacity heat latent capacity. The intelligent cooling capacity needs to be calculated by measuring and calculating the inlet and outlet temperature of the dry bulb that has changed the heat in the car, while the latent cooling temperature is calculated by the water in the heat exchanger in the car and weighing. The processing of other data is the same as the bench test.

3.3. **Intelligent analysis of the principle of electric vehicle heat pump air conditioning**

According to the characteristics of electric buses that focus on energy-saving functions, the system power is used as the deficit control point; Secondly, select compressor frequency, evaporator fan frequency, and condenser fan frequency as optimized control variables to match the performance analysis results of the air conditioning system; Based on the basic functions of air-conditioning operation, the requirements for cooling and heating loads of passenger cars during operation are regarded as limiting functions. Based on the established simulation system model, hybrid automation automation algorithms are used to enable the electric vehicle control system.

With the increasing capacity of today's environment and environmental safety, clean electric vehicles as the main product of the front-wheel drive industry are growing rapidly. Like fuel vehicles, electric vehicles also need to create a comfortable driving and driving environment. Therefore, when developing electric vehicles, it is necessary to develop and support air conditioning systems. When the air-conditioning system of an electric car is running, the energy required comes from the car battery, which is the most energy-consuming subsystem in the electric car. The air-conditioning system of electric vehicles will increase the mileage of electric vehicles, which is of great significance to the promotion of electric vehicle applications.

4. **Electric vehicle heat pump air conditioning system circulation**

Through the comparison and analysis of four solutions for power-free electric vehicle air-conditioning systems, thermo-electric air-conditioning systems, electric compressor refrigeration and PTC electric heating hybrid air-conditioning systems, heat pump air-conditioning systems and air-conditioning systems, A new type of air-conditioning system for pure electric vehicles is proposed to adapt to the development of society.

Compared with the wind generator of the electric vehicle engine, the electric vehicle stabilization system studied in this paper has the following characteristics: (1) Electric closed scroll compressor is adopted, and its speed can be continuously adjusted. In the cooling system of the oil truck, the compressor is driven by the machine, and the start and stop of the compressor are detected by the change of the electronic clutch. (2) This electric vehicle heat pump air conditioning system is a vapor compression air conditioning system with cooling/heating functions. The four-way reversing valve can switch the cooling/heating mode of the system. The four-way shut-off valve is powerful and the system is in heating mode; the four-way moving button saves power, and the system is in cooling mode. However, traditional automobile air conditioners can only be used for cooling, and the heat source for heating in winter is the waste heat of the engine. (3) Using the outdoor heat exchange fan and the indoor fan DC power supply to change the driving voltage, the speed of the fan can be adjusted, thereby adjusting the wind speed of the heat exchanger and the indoor air volume in advance.

5. **Conclusion**

Whether emerging electric vehicles can occupy the market depends largely on whether they are equipped with efficient air-conditioning systems. Therefore, improving the efficiency of the air conditioning system through the best technology of various components and developing energy-saving variable-frequency wind generators with good variable load characteristics are essential for the promotion and
application of electric vehicles.

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