CLAIMS

The Listing of Claims:

1. A thermal management system, wherein the thermal management system comprises at least a heating circuit, a refrigerant circuit, a battery circuit, a first three-way valve, and a water-cooled condenser, and the refrigerant circuit comprises an electric compressor, wherein

the heating circuit is coupled to the refrigerant circuit via the water-cooled condenser, and the water-cooled condenser is configured to transfer heat of a high-temperature refrigerant discharged from the electric compressor in the refrigerant circuit to the heating circuit; and

the first three-way valve has a first port connected to the heating circuit, a second port connected to a heater unit in a passenger compartment, and a third port connected to the battery circuit, and is configured to adjust a connection relationship among the heating circuit, the heater unit, and the battery circuit.

2. The system according to claim 1, wherein the thermal management system further comprises an electric drive cooling circuit, a waste heat recovery unit, and a second three-way valve, and the electric drive cooling circuit comprises at least a low-temperature radiator, a motor controller, a rear electric drive, and a water-cooled intercooler, wherein

the second three-way valve has a fourth port coupled to the refrigerant circuit via the waste heat recovery unit, a fifth port disposed on a pipeline which coolant flows after absorbing waste heat from the motor controller, the rear electric drive, and the water-cooled intercooler, and a sixth port disposed at an inlet of the low-temperature radiator in the electric drive cooling circuit, and is configured to adjust a flow direction of coolant carrying electric drive waste heat, and the waste heat recovery unit is configured to utilize recovered electric drive waste heat to increase a temperature of a refrigerant.

3. The system according to claim 2, wherein the thermal management system further comprises a first refrigerant shut-off valve and a second refrigerant shut-off valve, and the refrigerant circuit further comprises a condenser and an electronic expansion valve, wherein

the first refrigerant shut-off valve is disposed on a pipeline interconnecting the electric compressor and the waste heat recovery unit, and is configured to control the refrigerant discharged from the electric compressor to flow through the electronic expansion valve and the condenser before entering a passenger compartment evaporator or the battery circuit; and

the second refrigerant shut-off valve is disposed on a pipeline interconnecting the electric

compressor and the water-cooled condenser, and is configured to control the high-temperature refrigerant discharged from the electric compressor to enter the water-cooled condenser.

4. The system according to claim 1, wherein the battery circuit comprises at least a battery cooler and a battery, wherein

the first port of the first three-way valve is connected to an outlet of the water-cooled condenser, the second port thereof is connected to the heater unit in the passenger compartment, and the third port thereof is connected to the battery cooler in the battery circuit; and

the battery cooler is connected to the battery, and is configured to receive coolant flowing out of the battery, perform heat exchange, and return the heat-exchanged coolant to the battery.

5. The system according to claim 1, wherein the thermal management system further comprises an engine circuit and a four-way valve, wherein

the four-way valve has a seventh port and an eighth port connected to the engine circuit and a ninth port and a tenth port connected to the heating circuit, and is configured to adjust a connection relationship between the engine circuit and the heating circuit.

6. The system according to claim 5, wherein the engine circuit comprises at least an engine and an electronic main water pump, wherein

the seventh port of the four-way valve is connected to an inlet of the engine, the eighth port thereof is coupled to an outlet of the engine via the electronic main water pump, the ninth port thereof is connected to the heater unit in the passenger compartment, and the tenth port thereof is connected to an inlet of the water-cooled condenser.

7. The system according to claim 3, wherein the thermal management system further comprises a first refrigerant expansion valve and a second refrigerant expansion valve, and the battery circuit comprises at least a battery cooler and a battery, wherein

the first refrigerant expansion valve is disposed on a pipeline interconnecting the condenser and the passenger compartment evaporator, and is configured to control the refrigerant discharged from the condenser to enter the passenger compartment evaporator; and

the second refrigerant expansion valve is disposed on a pipeline interconnecting the battery cooler and the condenser, and is configured to control the refrigerant discharged from the condenser to enter the battery cooler, and the battery cooler is connected to the battery, and is configured to receive coolant

flowing out of the battery, perform heat exchange, and return the heat-exchanged coolant to the battery.

8. The system according to claim 1 or 4, wherein the first three-way valve is a three-way proportional valve.

9. A thermal management method, applied by the thermal management system of any one of claims 1 to 8, wherein the method comprises:

obtaining a current driving mode of a vehicle, an operating status of a battery, and a temperature of a passenger compartment;

determining a battery temperature requirement based on the operating status of the battery, and determining a current thermal management requirement based on the current driving mode of the vehicle, a relationship between a current battery temperature and the battery temperature requirement, and a relationship between the temperature of the passenger compartment and a temperature requirement of a user for the passenger compartment; and

controlling port communication states of a first three-way valve, a second three-way valve, and a four-way valve based on the current thermal management requirement to change an operating state of the thermal management system, to meet the current thermal management requirement.

10. The method according to claim 9, wherein the step of determining a battery temperature requirement based on the operating status of the battery, and determining a current thermal management requirement based on the current driving mode of the vehicle, a relationship between a current battery temperature and the battery temperature requirement, and a relationship between the temperature of the passenger compartment and a temperature requirement of a user for the passenger compartment comprises:

if the current battery temperature is within a battery temperature requirement range but a current temperature of the passenger compartment is higher than the temperature requirement of the user for the passenger compartment, determining that the current thermal management requirement is a first thermal management requirement of cooling the passenger compartment by a refrigerant circuit, or

if a current operating status of the battery is a charging state, or the current battery temperature is above the battery temperature requirement range, and the current temperature of the passenger compartment is higher than the temperature requirement of the user for the passenger compartment, determining that the current thermal management requirement is a second thermal management requirement of cooling the passenger compartment and the battery by the refrigerant circuit, or

if the current driving mode of the vehicle is an engine operating mode, and the current battery temperature is within the battery temperature requirement range, but the current temperature of the passenger compartment is lower than the temperature requirement of the user for the passenger compartment, determining that the current thermal management requirement is a third thermal management requirement of heating the passenger compartment by an engine circuit, or

if the current driving mode of the vehicle is the engine operating mode, the current battery temperature is below the battery temperature requirement range, and the current temperature of the passenger compartment is lower than the temperature requirement of the user for the passenger compartment, determining that the current thermal management requirement is a fourth thermal management requirement of heating the passenger compartment and the battery by the engine circuit, or

if the current driving mode of the vehicle is pure electric mode, and the current battery temperature is within the battery temperature requirement range, but the current temperature of the passenger compartment is lower than the temperature requirement of the user for the passenger compartment, determining that the current thermal management requirement is a fifth thermal management requirement of heating the passenger compartment by the refrigerant circuit, or

if the current driving mode of the vehicle is pure electric mode, the current battery temperature is below the battery temperature requirement range, and the current temperature of the passenger compartment is lower than the temperature requirement of the user for the passenger compartment, determining that the current thermal management requirement is a sixth thermal management requirement of heating the passenger compartment and the battery by the refrigerant circuit.

11. The method according to claim 10, wherein the step of controlling port communication states of a first three-way valve, a second three-way valve, and a four-way valve based on the current thermal management requirement comprises:

if the current thermal management requirement is the first thermal management requirement or the second thermal management requirement, controlling a fifth port and a sixth port of the second three-way valve to be mutually connected, controlling the first three-way valve to be closed, and controlling the four-way valve to be closed;

if the current thermal management requirement is the third thermal management requirement, controlling the fifth port and the sixth port of the second three-way valve to be mutually connected, controlling a first port and a second port of the first three-way valve to be mutually connected, controlling a seventh port and a ninth port of the four-way valve to be mutually connected, and

controlling an eighth port and a tenth port of the four-way valve to be mutually connected;

if the current thermal management requirement is the fourth thermal management requirement, controlling the fifth port and the sixth port of the second three-way valve to be mutually connected, controlling all the first port, the second port, and a third port of the first three-way valve to be mutually connected, controlling the seventh port and the ninth port of the four-way valve to be mutually connected, and controlling the eighth port and the tenth port of the four-way valve to be mutually connected;

if the current thermal management requirement is the fifth thermal management requirement, controlling a fourth port and the fifth port of the second three-way valve to be mutually connected, controlling the first port and the second port of the first three-way valve to be mutually connected, controlling the seventh port and the eighth port of the four-way valve to be mutually connected, and controlling the ninth port and the tenth port of the four-way valve to be mutually connected; and

if the current thermal management requirement is the sixth thermal management requirement, controlling the fourth port and the fifth port of the second three-way valve to be mutually connected, controlling all the first port, the second port, and the third port of the first three-way valve to be mutually connected, controlling the seventh port and the eighth port of the four-way valve to be mutually connected, and controlling the ninth port and the tenth port of the four-way valve to be mutually connected.

12. The method according to claim 10, wherein the method further comprises:

if the current thermal management requirement is the first thermal management requirement or the second thermal management requirement, controlling a first refrigerant shut-off valve to be opened and a second refrigerant shut-off valve to be closed;

if the current thermal management requirement is the third thermal management requirement or the fourth thermal management requirement, controlling both the first refrigerant shut-off valve and the second refrigerant shut-off valve to be closed; and

if the current thermal management requirement is the fifth thermal management requirement or the sixth thermal management requirement, controlling the first refrigerant shut-off valve to be closed and the second refrigerant shut-off valve to be opened.

13. The method according to claim 10 or 12, wherein the method further comprises:

if the current thermal management requirement is the first thermal management requirement, controlling a first refrigerant expansion valve to be opened and a second refrigerant expansion valve

to be closed;

if the current thermal management requirement is the second thermal management requirement, controlling both the first refrigerant expansion valve and the second refrigerant expansion valve to be opened; and

if the current thermal management requirement is the third thermal management requirement, the fourth thermal management requirement, the fifth thermal management requirement, or the sixth thermal management requirement, controlling both the first refrigerant expansion valve and the second refrigerant expansion valve to be closed.

14. A computer device, comprising:

a memory and a processor, wherein the memory and the processor are communicatively connected to each other, the memory has computer instructions stored therein, and the processor is configured to execute the computer instructions to perform thermal management method of any one of claims 9 to 13.

15. A vehicle, wherein the vehicle comprises a controller and the thermal management system of any one of claims 1 to 8, and the controller is configured to perform the thermal management method of any one of claims 9 to 13.

16. A computer-readable storage medium, wherein the computer-readable storage medium has computer instructions stored therein, and the computer instructions are configured to enable a computer to perform the thermal management method of any one of claims 9 to 13.