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(54) REFRIGERATION SYSTEM AND THE CONTROL METHOD THEREOF

(57) A refrigeration system and a control method thereof are provided. The refrigeration system comprises: a refrigeration circuit formed by sequentially connecting a compressor (4), a condenser (1) and an evaporation portion provided with a throttle element (10), wherein the evaporation portion comprises a first-type evaporation branch and a second-type evaporation branch that are connected in parallel, the first-type evaporation branch is used for air conditioning, and the second-type evaporation branch is used for refrigerating or freezing products; and a heat recovery branch having a first end and a second end that are connected into the refrigeration circuit from between the downstream section of the compressor and the upstream section of the condenser, and a heat-recovery heat exchanger (8) disposed thereon, wherein the first-type evaporation branch has a first evaporator (9) and a first fan (7) for driving air to flow through the first evaporator, and the heat-recovery heat exchanger is disposed upstream or downstream the first evaporator in the direction of air flowing through the first evaporator. According to the refrigeration system and the control method thereof in this application, heat recycling is realized by disposing, on a refrigeration circuit, a heat recovery branch having a first end and a second end that are connected into the refrigeration circuit from between the downstream section of a compressor and the upstream section of a condenser, arranging a heat-recovery heat exchanger disposed on the heat recovery branch and a first evaporator at upstream and downstream positions in an air flow direction, and controlling on/off state of a flow path, thereby effectively achieving low temperature preservation of commodities in a refrigerated display cabinet, air conditioning for a commercial environment (such as a convenience store) where the refrigerated display cabinet is located, and energy efficiency improvement for the whole refrigeration system at the same time.

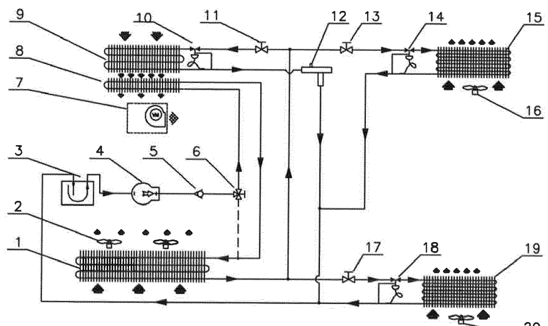

FIG. 3

Description

Technical Field

[0001] The present invention relates to the field of air conditioning and low temperature storage of commodities, and more specifically, to a refrigeration system and a control method thereof.

Background Art

[0002] At present, at least two refrigeration systems need to be provided in a place like a conventional convenience store. One refrigeration system is used for providing refrigerating capacity to a refrigerated display cabinet for exhibition and sales of commodities, and the other refrigeration system is used for providing the application place with the cooling/heating air-conditioning effect according to the change in seasons. Since the outdoor unit of the refrigerated display cabinet is constantly in a heat dissipation state, the heat utilization rate will be undoubtedly improved if the heat dissipated by the outdoor unit can be utilized to provide some heat when the air conditioning system needs to work in a heating mode.

[0003] However, how to couple the two refrigeration systems with independent functions and provide a heat recovery function becomes a technical problem to be solved urgently.

Summary of the Invention

[0004] This application is aimed at providing a refrigeration system and a control method thereof, so as to improve the utilization rate of energy between refrigeration circulation for air conditioning and refrigeration circulation for refrigerating or freezing products.

[0005] According to one aspect of this application, a refrigeration system is provided, including: a refrigeration circuit including a compressor, a condenser and an evaporation portion provided with a throttle element that are sequentially connected to form a circuit, wherein the evaporation portion includes a first-type evaporation branch and a second-type evaporation branch that are connected in parallel, the first-type evaporation branch is used for air conditioning, and the second-type evaporation branch is used for refrigerating or freezing products; and a heat recovery branch having a first end and a second end that are connected into the refrigeration circuit from between the downstream section of the compressor and the upstream section of the condenser, and a heat-recovery heat exchanger disposed thereon, wherein the first-type evaporation branch has a first evaporator and a first fan for driving air to flow through the first evaporator, and the heat-recovery heat exchanger is disposed upstream or downstream of the first evaporator in the direction of air flowing through the first evaporator.

[0006] Optionally, the refrigeration system further includes a flow path switching portion controlled to switch on or switch off the heat recovery branch.

[0007] Optionally, the flow path switching portion includes a three-way valve disposed at the first end or the second end of the heat recovery branch.

[0008] Optionally, the flow path switching portion includes a first switch valve and a second switch valve, wherein the first switch valve is disposed on the heat recovery branch, and the second switch valve is disposed on a refrigeration circuit section between the first end and the second end.

[0009] Optionally, the refrigeration system further includes an evaporation pressure regulator disposed on the first-type evaporation branch and located downstream of the first evaporator.

[0010] Optionally, the refrigeration system further includes a gas-liquid separator disposed on the refrigeration circuit upstream of an air suction port of the compressor.

[0011] Optionally, the evaporation portion has a plurality of throttle elements, and throttle elements of the first-type evaporation branch and the second-type evaporation branch have different throttling degrees.

[0012] Optionally, the evaporation portion has a plurality of switch valves that are each used for controlling on/off state of the first-type evaporation branch and/or on/off state of the second-type evaporation branch.

[0013] Optionally, the refrigeration system further includes a one-way valve disposed on the refrigeration circuit between an exhaust port of the compressor and the first end of the heat recovery branch.

[0014] According to another aspect of this application, a control method of a refrigeration system for the aforementioned refrigeration system is further provided. The control method includes: in a first mode S100, switching off the heat recovery branch, so that a refrigerant sequentially flows through the compressor, the condenser, and the first-type evaporation branch and the second-type evaporation branch that are connected in parallel; in a second mode S200, switching on the heat recovery branch, so that the refrigerant sequentially flows through the compressor, the heat recovery branch, the condenser, and the second-type evaporation branch; in a third mode S300, switching on the heat recovery branch, so that the refrigerant sequentially flows through the compressor, the heat recovery branch, the condenser, and the first-type evaporation branch and the second-type evaporation branch that are connected in parallel; and in a fourth mode S400, switching off the heat recovery branch, so that the refrigerant sequentially flows through the compressor, the condenser, and the second-type evaporation branch.

[0015] Optionally, the first mode S100 is performed when an outlet air temperature of the first evaporator is not less than a first pre-set temperature; and/or the second mode S200 is performed when the outlet air temperature of the first evaporator is less than a second pre-set temperature.

[0016] Optionally, the third mode S300 is performed when the outlet air temperature of the first evaporator is not greater than a third pre-set temperature while performing the first mode S100; and/or the first mode S100 is maintained when the outlet air temperature of the first evaporator is greater than the third pre-set temperature.

[0017] Optionally, the first mode S100 is performed when the outlet air temperature of the first evaporator is not less than the third pre-set temperature while performing the third mode S300; and/or the third mode S300 is maintained when the outlet air temperature of the first evaporator is less than the third pre-set temperature.

[0018] Optionally, the first fan is kept on and the heat recovery branch is switched off when the outlet air temperature of the first evaporator is not less than a fourth pre-set temperature while performing the second mode S200; and/or the second mode S200 is maintained when the outlet air temperature of the first evaporator is less than the fourth pre-set temperature.

[0019] Optionally, the first pre-set temperature is 23°C to 26°C.

[0020] Optionally, the second pre-set temperature is 8°C to 10°C.

[0021] Optionally, the third pre-set temperature is 13°C to 16°C.

[0022] Optionally, the fourth pre-set temperature is 16°C to 23°C.

[0023] According to the refrigeration system and the control method thereof in this application, heat recycling is realized by disposing, on a refrigeration circuit, a heat recovery branch having a first end and a second end that are connected into the refrigeration circuit from between the downstream section of a compressor and the upstream section of a condenser, arranging a heat-recovery heat exchanger disposed on the heat recovery branch and a first evaporator at upstream and downstream positions in an air flow direction, and controlling on/off state of a flow path, thereby effectively achieving low temperature preservation of commodities in a refrigerated display cabinet, air conditioning for a commercial environment (such as a convenience store) where the refrigerated display cabinet is located, and energy efficiency improvement for the whole refrigeration system at the same time.

Brief Description of the Drawings

[0024]

FIG. 1 is a schematic diagram of a system flow direction of a refrigeration system in a first mode.

FIG. 2 is a schematic diagram of a system flow direction of a refrigeration system in a second mode.

FIG. 3 is a schematic diagram of a system flow direction of a refrigeration system in a third mode.

FIG. 4 is a schematic diagram of a system flow direction of a refrigeration system in a fourth mode.

Detailed description

[0025] As shown in FIG. 1 to FIG. 3, according to an embodiment of this application, a refrigeration system is provided, which includes a refrigeration circuit for providing a refrigerating capacity. The refrigeration circuit is formed by sequentially connecting a compressor 4, a condenser 1 and an evaporation portion provided with a throttle element. The evaporation portion includes a first-type evaporation branch and a second-type evaporation branch that are connected in parallel. The first-type evaporation branch here mainly refers to a type of evaporation branch for air conditioning, and it is feasible to arrange a plurality of such evaporation branches or arrange a plurality of evaporators on such an evaporation branch according to an actual refrigerating capacity demand or a refrigeration area demand. The second-type evaporation branch here mainly refers to a type of evaporation branch for refrigerating or freezing products. Similarly, it is feasible to arrange a plurality of such evaporation branches or arrange a plurality of evaporators on such an evaporation branch according to an actual refrigerating capacity demand or a refrigeration area demand. In addition, the refrigeration system further includes a heat recovery branch. The heat recovery branch has a first end and a second end that are connected into the refrigeration circuit from between the downstream section of the compressor 4 and the upstream section of the condenser 1, and a heat-recovery heat exchanger 8 is disposed on the heat recovery branch. Because the refrigeration circuit used for refrigerating or freezing products needs to stay in a refrigerating state constantly, heat thereof can be recovered and used for air conditioning. Therefore, the heat-recovery heat exchanger 8 needs to be disposed at a heat exchange part passing through the first-type evaporation branch. For example, since the first-type evaporation branch has a first evaporator 9 and a first fan for driving air to flow through the first evaporator 9, the heat-recovery heat exchanger 8 may be disposed downstream or upstream of the first evaporator 9. Hence, the heat-recovery heat exchanger 8 and the first evaporator 9 can share an air outlet 7 of the first evaporator. In this case, when air conditioning is needed to provide heat, the heat recovery branch can be switched on while the first-type evaporation branch is switched off, and then the air outlet 7 will blow hot air. Or when air conditioning is needed for refrigeration while ambient temperature and humidity need to be controlled, the heat recovery branch can be switched on while the first-type evaporation branch is switched on; therefore, the air outlet 7 can blow cold air generally, with the temperature and humidity thereof changing in a certain degree. Through the foregoing arrangement, heat recovery of the whole system is taken into account while refrigeration of commodities and air conditioning are realized, thus improving the comprehensive energy efficiency ratio.

[0026] Many details of the refrigeration system are further changed here, such as specific implementation forms of various functional components or a connection relationship between components, which will be illustrated exemplarily below.

[0027] For example, the heat-recovery heat exchanger 8 is disposed downstream the first evaporator 9 in the direction of air flowing through the first evaporator 9, that is, the heat-recovery heat exchanger 8 is disposed closer to the air outlet of the first evaporator.

[0028] For another example, in order to realize switching of the refrigeration system between a main circuit and the heat recovery circuit, the refrigeration system should further include a flow path switching portion that can be controlled to switch on or switch off the heat recovery branch. As an example, the flow path switching portion includes a three-way valve 6. The three-way valve 6 is disposed at the first end or the second end of the heat recovery branch. Then the heat recovery branch can be switched on or off by opening or closing the three-way valve 6. Although not shown in the figure, as another example, the flow path switching portion may include a first switch valve and a second switch valve. The first switch valve is disposed on the heat recovery branch to control on/off state of the heat recovery branch. The second switch valve is disposed on a refrigeration circuit section between the first end and the second end to control on/off state of the refrigeration circuit section.

[0029] In addition, the refrigeration system may further include an evaporation pressure regulator 12 disposed on the first-type evaporation branch and located downstream of the first evaporator 9. Because air conditioning and refrigeration of commodities have different requirements on the operating evaporation temperature needed by the evaporator, the evaporation pressure regulator 12 disposed here can desirably adjust the temperature of the evaporator on the first-type evaporation branch for air conditioning.

[0030] Besides, the refrigeration system further includes a gas-liquid separator 3 disposed on the refrigeration circuit upstream of an air suction port of the compressor 4 to perform gas-liquid separation on a refrigerant flowing into the compressor, thus preventing the liquid refrigerant from entering the compressor to cause liquid hammering. Optionally, a one-way valve 5 can further be disposed on the refrigeration circuit between an exhaust port of the compressor 4 and the first end of the heat recovery branch to avoid refrigerant backflow.

[0031] In addition, the evaporation portion has a plurality of throttle elements, for example, a first thermostatic expansion valve 10 and second thermostatic expansion valves 14 and 18. Throttle elements of the first-type evaporation branch and the second-type evaporation branch have different throttling degrees to meet requirements corresponding to different refrigeration capabilities in different application situations. Moreover, a plurality of switch valves can further be disposed on the evaporation portion. For example, a first solenoid valve 11 and second solenoid valves 13 and 17 are each used for controlling on/off state of the first-type evaporation branch and/or on/off state of the second-type evaporation branch, so as to implement on/off control over each circuit as required.

[0032] In addition, to better manage and control the refrigeration system in the foregoing embodiment so that the system can realize heat recovery while meeting actual refrigeration and ventilation requirements, a control method of the refrigeration system is further provided correspondingly. The control method includes: a first mode S100, in which the heat recovery branch is switched off so that a refrigerant sequentially flows through the compressor 4, the condenser 1, and the first evaporation branch and the second evaporation branch that are connected in parallel, where functions of air-conditioning refrigeration and commodity refrigeration can be realized at the same time in this mode; a second mode S200, in which the heat recovery branch is switched on so that the refrigerant sequentially flows through the compressor 4, the heat recovery branch, the condenser 1, and the second evaporation branch, where functions of air-conditioning heating and commodity refrigeration can be realized at the same time in this mode; a third mode S300, in which the heat recovery branch is switched on so that the refrigerant sequentially flows through the compressor 4, the heat recovery branch, the condenser 1, and the first evaporation branch and the second evaporation branch that are connected in parallel, where functions of air conditioning and commodity refrigeration can be realized at the same time in this mode; and a fourth mode S400, in which the heat recovery branch is switched off so that the refrigerant sequentially flows through the compressor, the condenser, and the second evaporation branch, where the function of commodity refrigeration can be realized alone in this mode.

[0033] It should be noted that the foregoing operating modes can be switched manually or switched under automatic control. In an actual application, excessively dry or humid air will cause physical discomfort. Besides, the humidity of air also has a double-sided influence on preservation of refrigerated commodities. For example, if the air is too humid, bacteria easily grow in the commodities (especially foods); if the air is too dry, foods are easily dehydrated. Therefore, an operator can selectively switch the mode according to the foregoing influence to meet the actual application situation. In addition, when the form of automatic control is adopted, corresponding switching conditions need to be provided. Switching conditions of the operating modes will be illustrated exemplarily below.

[0034] First, when an outlet air temperature of the first evaporator 9 is not less than a first pre-set temperature, e.g., 27°C, it indicates that an ambient temperature in an application scenario is too high at this time, and the first mode S100 should be performed; or when the outlet air temperature of the first evaporator 9 is less than a second pre-set temperature, e.g., 7°C, it indicates that the ambient temperature in the application scenario is too low at this time, and the second mode S200 should be performed.

[0035] After that, if it is already in the first mode S100, when the outlet air temperature of the first evaporator 9 is not greater than a third pre-set temperature, e.g., 11°C, it indicates that an air refrigerating temperature is too low at this time, and the third mode S300 should be performed, thereby achieving a reheating and dehumidification effect; or when the outlet air temperature of the first evaporator 9 is greater than the third pre-set temperature, it indicates that the air refrigerating temperature is appropriate at this time, and the first mode S100 can be maintained.

[0036] After that, if it is already in the third mode S300, when the outlet air temperature of the first evaporator 9 is not less than the third pre-set temperature, e.g., 18°C, it indicates that the air refrigerating temperature has been adjusted to the appropriate range at this time, and the first mode S100 can be performed again; or when the outlet air temperature of the first evaporator 9 is less than the third pre-set temperature, it indicates that the air refrigerating temperature is still low at this time, and the third mode S300 can be maintained.

[0037] In addition, if it is already in the second mode S200, when the outlet air temperature of the first evaporator 9 is not less than a fourth pre-set temperature, it indicates that an air heating temperature is already in an appropriate range at this time, and the first fan can be kept on and the heat recovery branch can be switched off; or when the outlet air temperature of the first evaporator 9 is less than the fourth pre-set temperature, it indicates that the air heating temperature is still low at this time, and the second mode S200 can be maintained.

[0038] The following will describe operating processes of the refrigeration system in different modes respectively as well as technical effects on a product application environment (such as a convenience store) with reference to FIG. 1 to FIG. 4. In the figures, a solid line represents that the flow path is in an on-state, and a dashed line represents that the flow path is in an off-state. The bold solid arrow at the heat exchanger represents the flow direction of air, and the thin solid arrow on the pipeline of the refrigeration system represents the flow direction of the refrigerant.

[0039] Referring to FIG. 1, when the first mode S100 is run, the heat recovery branch is switched off, while the first-type evaporation branch and the second-type evaporation branch are switched on. In this case, the high-pressure high-temperature refrigerant flows out from the exhaust port of the compressor 4, and flows into the condenser 1 through the one-way valve 5 and the closed three-way valve 6 to dissipate heat to the air flow that is driven by the fan 2 to flow through the condenser 1. The high-pressure medium-temperature refrigerant that flows out thereafter is divided into two parts that continue to move on. One part of the refrigerant flows into the first-type evaporation branch and becomes low in pressure and low in temperature after being throttled by the switched-on first solenoid valve 11 and first thermostatic expansion valve 10, and then enters the first evaporator 9 to absorb heat. In this case, the temperature of the air flow that is driven by the fan to flow through the first evaporator 9 can be reduced, and the air flow is blown into the convenience store through the air outlet 7 to provide a shopping environment with comfortable temperature and humidity for consumers and shop assistants. The low-pressure medium-temperature refrigerant that flows out after absorbing heat will flow back to the air suction port of the compressor 4 through the gas-liquid separator 3, thus completing circulation of this part. Besides, the other part of the refrigerant will flow into the second-type evaporation branch. For example, in this embodiment, there are two second-type branches. The refrigerant becomes low in pressure and low in temperature after being throttled by the switched-on second solenoid valves 13 and 17 as well as second thermostatic expansion valves 14 and 18, and then enters the second evaporators 15 and 19 to absorb heat. In this case, the temperature of the air flow that is driven by the fans 16 and 20 to flow through the second evaporators 15 and 19 can be reduced, and is blown to exhibited commodities stored in the refrigerated display cabinet, thus providing a preservation environment with suitable temperature and humidity for the commodities. The low-pressure medium-temperature refrigerant that flows out after absorbing heat will flow back to the air suction port of the compressor 4 through the gas-liquid separator 3, thus completing circulation of this part. Hence, one round of circulation of the first mode is completed.

[0040] Referring to FIG. 2, when the second mode S200 is run, the heat recovery branch is switched on, the first-type evaporation branch is switched off, and the second-type evaporation branch is switched on. In this case, the high-pressure high-temperature refrigerant flows out from the exhaust port of the compressor 4 and flows into the heat-recovery heat exchanger 8 through the one-way valve 5 and the opened three-way valve 6. In this case, the temperature of the air flow that is driven by the fan to flow through the heat-recovery heat exchanger 8 can be increased and is blown in to the convenience store through the air outlet 7 to provide a shopping environment with comfortable temperature and humidity for consumers and shop assistants. After that, the refrigerant flows into the condenser 1, to dissipate heat to the air flow that is driven by the fan 2 to flow through the condenser 1. The high-pressure medium-temperature refrigerant that flows out thereafter will flow into the second-type evaporation branch. For example, in this embodiment, there are two second-type branches. The refrigerant becomes low in pressure and low in temperature after being throttled by the switched-on second solenoid valves 13 and 17 as well as second thermostatic expansion valves 14 and 18, and then enters the second evaporators 15 and 19 to absorb heat. In this case, the temperature of the air flow that is driven by the fans 16 and 20 to flow through the second evaporators 15 and 19 can be reduced, and is blown to exhibited commodities stored in the refrigerated display cabinet, thus providing a preservation environment with suitable temperature and humidity for the commodities. The low-pressure medium-temperature refrigerant that flows out after absorbing heat will flow back to the air suction port of the compressor 4 through the gas-liquid separator 3, thus completing one round of circulation of the second mode.

[0041] Referring to FIG. 3, when the third mode S300 is run, the heat recovery branch, the first-type evaporation branch, and the second-type evaporation branch are switched on. In this case, the high-pressure high-temperature refrigerant flows out from the exhaust port of the compressor 4, and flows into the heat-recovery heat exchanger 8 through the one-way valve 5 and the opened three-way valve 6, to provide a temperature and humidity regulation space for the air flow that is subsequently driven by the fan to pass through the first evaporator 9 and the heat-recovery heat exchanger 8 sequentially. After that, the refrigerant flows into the condenser 1 to dissipate heat to the air flow that is driven by the fan 2 to flow through the condenser 1. The high-pressure medium-temperature refrigerant that flows out thereafter is divided into two parts that continue to move on. One part of the refrigerant flows into the first-type evaporation branch and becomes low in pressure and low in temperature after being throttled by the switched-on first solenoid valve 11 and first thermostatic expansion valve 10, and then enters the first evaporator 9 to absorb heat. In this case, the temperature of the air flow that is driven by the fan to flow through the first evaporator 9 can be reduced. The air flow continues to flow through the heat-recovery heat exchanger 8 so that the temperature is increased by some degrees to make the outlet air more comfortable. Then, the air flow is blown into the convenience store through the air outlet 7 to provide a shopping environment with comfortable temperature and humidity for consumers and shop assistants. The low-pressure medium-temperature refrigerant that flows out after absorbing heat will flow back to the air suction port of the compressor 4 through the gas-liquid separator 3, thus completing circulation of this part. Besides, the other part of the refrigerant will flow into the second-type evaporation branch. For example, in this embodiment, there are two second-type branches. The refrigerant becomes low in pressure and low in temperature after being throttled by the switched on second solenoid valves 13 and 17 as well as second thermostatic expansion valves 14 and 18, and then enters the second evaporators 15 and 19 to absorb heat. In this case, the temperature of the air flow that is driven by the fans 16 and 20 to flow through the second evaporators 15 and 19 can be reduced, and is blown to exhibited commodities stored in the refrigerated display cabinet, thus providing a preservation environment with suitable temperature and humidity for the commodities. The low-pressure medium-temperature refrigerant that flows out after absorbing heat will flow back to the air suction port of the compressor 4 through the gas-liquid separator 3, thus completing circulation of this part. Hence, one round of circulation of the third mode is completed.

[0042] Referring to FIG. 4, when the fourth mode S400 is run, the heat recovery branch is switched off, the first-type evaporation branch is switched off, and the second-type evaporation branch is switched on. In this case, the high-pressure high-temperature refrigerant flows out from the exhaust port of the compressor 4, and flows into the condenser 1 through the one-way valve 5 and the opened three-way valve 6, to dissipate heat to the air flow that is driven by the fan 2 to flow through the condenser 1. The high-pressure medium-temperature refrigerant that flows out thereafter will flow into the second-type evaporation branch. For example, in this embodiment, there are two second-type branches. The refrigerant becomes low in pressure and low in temperature after being throttled by the switched-on second solenoid valves 13 and 17 as well as second thermostatic expansion valves 14 and 18, and then enters the second evaporators 15 and 19 to absorb heat. In this case, the temperature of the air flow that is driven by the fans 16 and 20 to flow through the second evaporators 15 and 19 can be reduced, and is blown to exhibited commodities stored in the refrigerated display cabinet, thus providing a preservation environment with suitable temperature and humidity for the commodities. The low-pressure medium-temperature refrigerant that flows out after absorbing heat will flow back to the air suction port of the compressor 4 through the gas-liquid separator 3, thus completing one round of circulation of the fourth mode.

[0043] Although the foregoing embodiment shows that the heat-recovery heat exchanger 8 is disposed downstream of the first evaporator 9 in the direction of air flowing through the first evaporator 9, those of ordinary skill in the art should understand that the heat-recovery heat exchanger 8 can also be disposed upstream the first evaporator 9 in the direction of air flowing through the first evaporator 9.

[0044] The examples above mainly illustrate the refrigeration system and the control method thereof in the present invention. Although only some implementations of the present invention are described, those of ordinary skill in the art should understand that the present invention can be implemented in many other forms without departing from the subject and scope of the present invention. Therefore, the examples and implementations shown are regarded as illustrative rather than limitative, and the present invention can cover various modifications and replacements without departing from the scope of the present invention as defined in the appended claim.

Claims

1. A refrigeration system, comprising:

a refrigeration circuit comprising a compressor (4), a condenser (1) and an evaporation portion provided with a throttle element that are sequentially connected to form a circuit, wherein the evaporation portion comprises a first-type evaporation branch and a second-type evaporation branch that are connected in parallel, the first-type evaporation branch is used for air conditioning, and the second-type evaporation branch is used for refrigerating or freezing products; and

a heat recovery branch having a first end and a second end that are connected into the refrigeration circuit from between the downstream section of the compressor and the upstream section of the condenser, and a heat-recovery heat exchanger (8) disposed thereon,

wherein the first-type evaporation branch has a first evaporator (9) and a first fan for driving air to flow through the first evaporator, and the heat-recovery heat exchanger is disposed upstream or downstream of the first evaporator in the direction of air flowing through the first evaporator.

2. The refrigeration system according to Claim 1, **characterised by** further comprising a flow path switching portion controlled to switch on or switch off the heat recovery branch.

3. The refrigeration system according to Claims 1 or 2, **characterised in that** the flow path switching portion comprises a three-way valve (6) disposed at the first end or the second end of the heat recovery branch.

4. The refrigeration system according to any of Claims 1 to 3, **characterised in that** the flow path switching portion comprises a first switch valve and a second switch valve, wherein the first switch valve is disposed on the heat recovery branch, and the second switch valve is disposed on a refrigeration circuit section between the first end and the second end.

5. The refrigeration system according to any of Claims 1 to 4, **characterised by** further comprising an evaporation pressure regulator (12) disposed on the first-type evaporation branch and located downstream of the first evaporator.

6. The refrigeration system according to any preceding claim, **characterised by** further comprising a gas-liquid separator (3) disposed on the refrigeration circuit upstream of an air suction port of the compressor.

7. The refrigeration system according to any preceding claim, **characterised in that** the evaporation portion has a plurality of throttle elements (10), and throttle elements of the first-type evaporation branch and the second-type evaporation branch have different throttling degrees.

8. The refrigeration system according to any preceding claim, **characterised in that** the evaporation portion has a plurality of switch valves (11) that are each used for controlling on/off state of the first-type evaporation branch and/or on/off state of the second-type evaporation branch.

9. The refrigeration system according to any preceding claim, **characterised by** further comprising a one-way valve (5) disposed on the refrigeration circuit between an exhaust port of the compressor and the first end of the heat recovery branch.

10. A control method of a refrigeration system for the refrigeration system according to any of Claims 1 to 9, comprising:

in a first mode S100, switching off the heat recovery branch, so that a refrigerant sequentially flows through the compressor, the condenser, and the first-type evaporation branch and the second-type evaporation branch that are connected in parallel;

in a second mode S200, switching on the heat recovery branch, so that the refrigerant sequentially flows through the compressor, the heat recovery branch, the condenser, and the second-type evaporation branch;

in a third mode S300, switching on the heat recovery branch, so that the refrigerant sequentially flows through the compressor, the heat recovery branch, the condenser, and the first-type evaporation branch and the second-type evaporation branch that are connected in parallel; and

in a fourth mode S400, switching off the heat recovery branch, so that the refrigerant sequentially flows through the compressor, the condenser, and the second-type evaporation branch.

11. The control method according to Claim 10, **characterised in that** the first mode S100 is performed when an outlet air temperature of the first evaporator is not less than a first pre-set temperature; and/or the second mode S200 is performed when the outlet air temperature of the first evaporator is less than a second pre-set temperature; and/or the third mode S300 is performed when the outlet air temperature of the first evaporator is not greater than a third pre-set temperature while performing the first mode S100; and/or the first mode S100 is maintained when the outlet air temperature of the first evaporator is greater than the third pre-set temperature.

12. The control method according to any of Claims 10 or 11, **characterised in that** the first mode S100 is performed when the outlet air temperature of the first evaporator is not less than the third pre-set temperature while performing the third mode S300; and/or the third mode S300 is maintained when the outlet air temperature of the first evaporator is less than the third pre-set temperature.

13. The control method according to any of Claims 10 or 11, **characterised in that** the first fan is kept on and the heat recovery branch is switched off when the outlet air temperature of the first evaporator is not less than a fourth pre-set temperature while performing the second mode S200; and/or the second mode S200 is maintained when the outlet air temperature of the first evaporator is less than the fourth pre-set temperature.

14. The control method according to any of Claims 10 to 12, **characterised in that** the first pre-set temperature is 23°C to 26°C, the second pre-set temperature is 8°C to 10°C, and/or
the third pre-set temperature is 13°C to 16°C.

15. The control method according to any of Claims 10 or 13, **characterised in that** the fourth pre-set temperature is 16°C to 23°C.

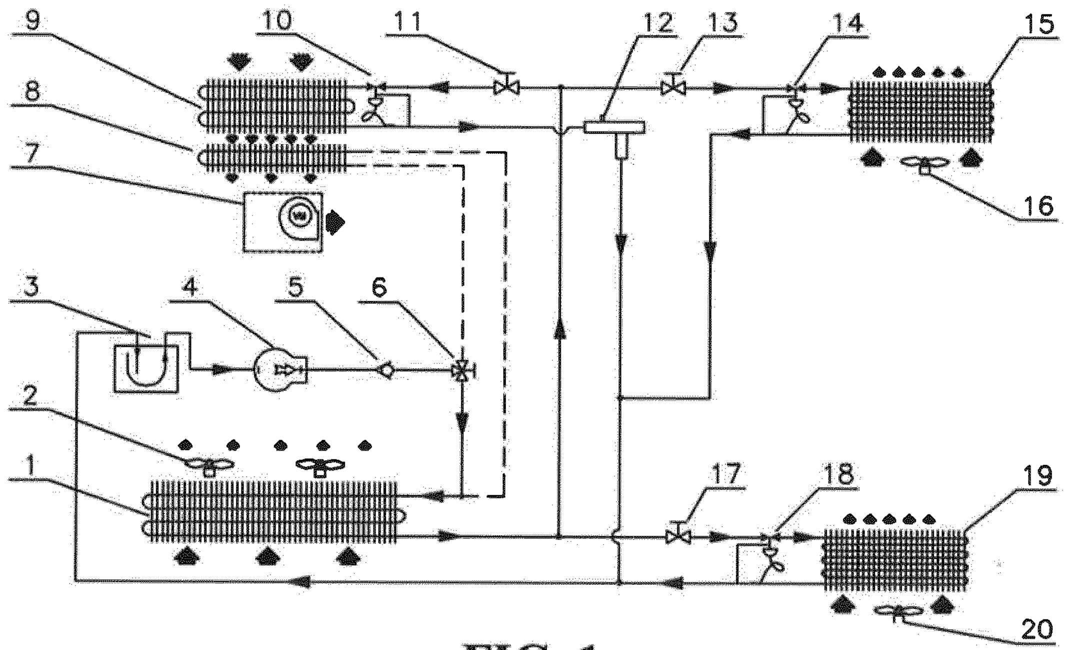
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FIG. 1

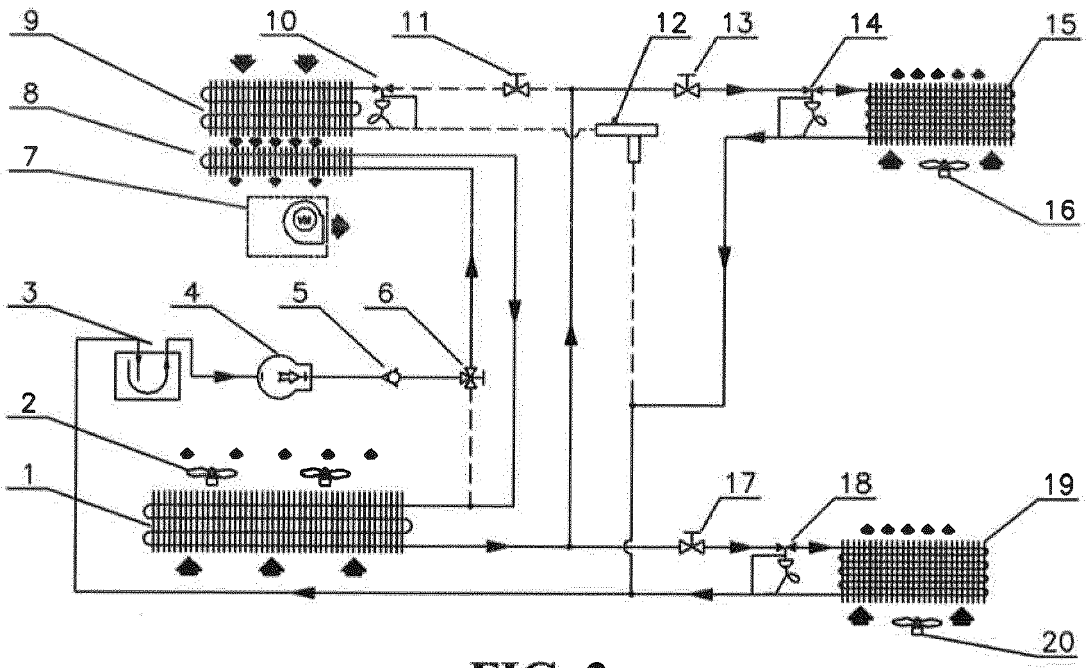
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FIG. 2

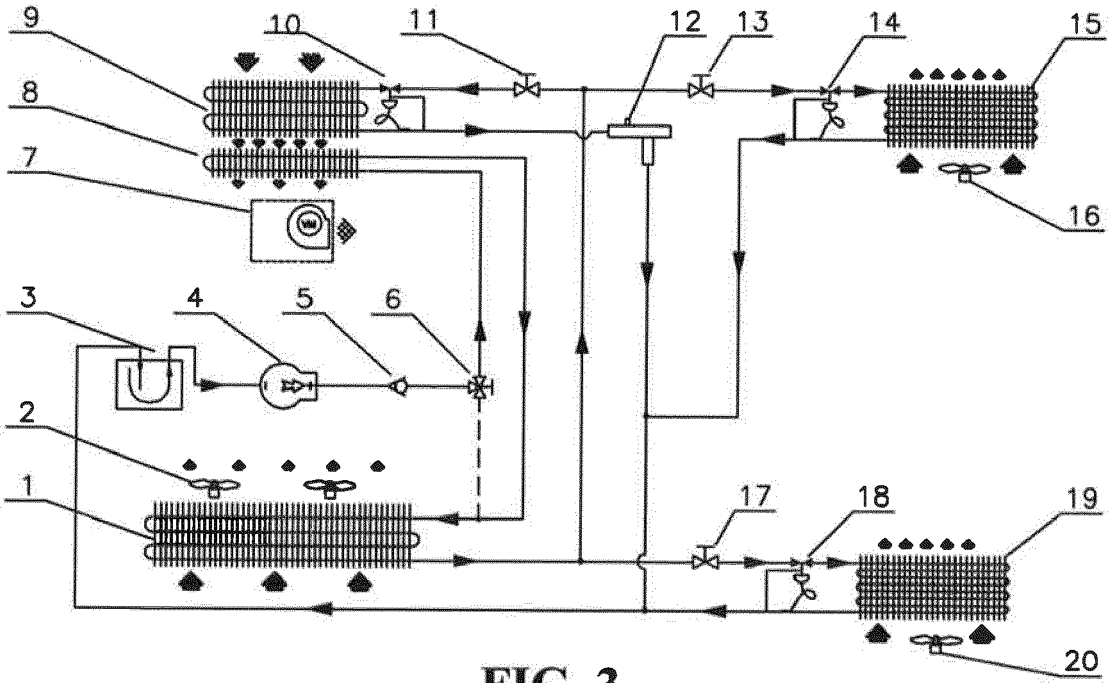

FIG. 3

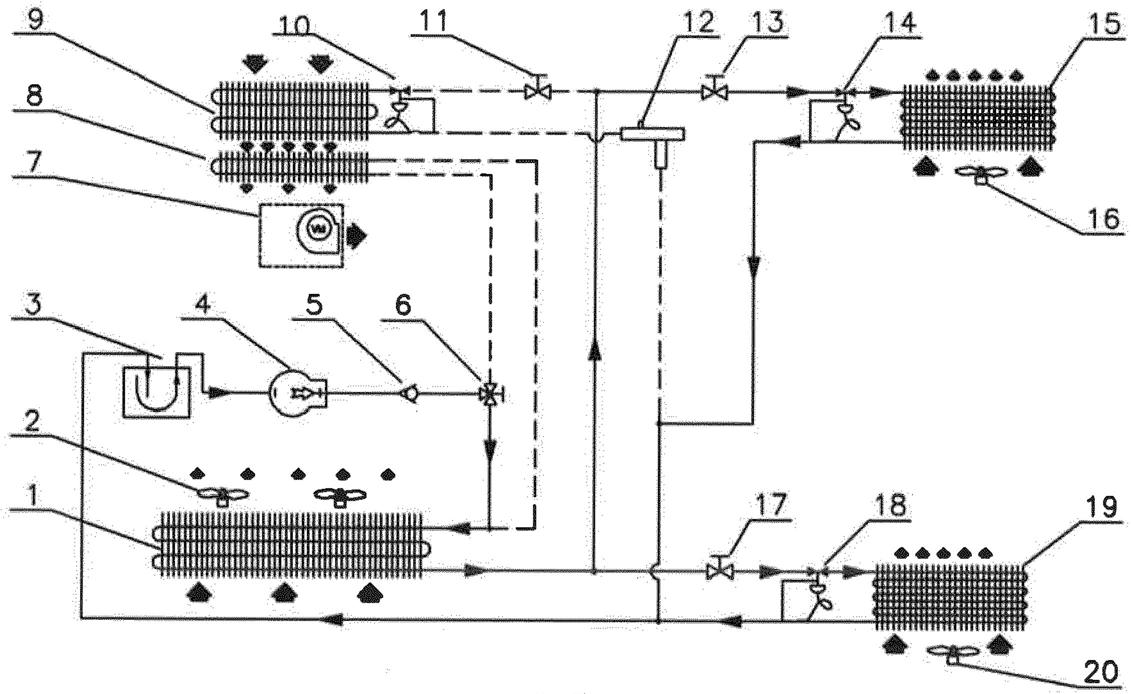

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 0958

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			F25B

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 April 2019	Weisser, Meinrad

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