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(54) **HEAT PUMP SYSTEM, COMBO WASHER-DRYER, AND DRYER**

(57) Provided are a heat pump system, a washing-drying integrated machine and a clothes dryer. The heat pump system includes an evaporator (3), a compressor (4), a condenser (2) and a refrigerant regulating subsystem (1); where the evaporator (3), the compressor (4), the condenser (2) and the refrigerant regulating subsystem (1) are sequentially communicated through a pipeline to form a refrigerant circulating loop; and the refrigerant regulating subsystem (1) includes a first branch (11) and a second branch (12) connected in parallel between the evaporator (3) and the condenser (2); the first branch (11) includes a first throttling device (111) having an outlet connected with a pipe inlet of the evaporator (3), and a liquid storing device (114) located between the first throttling device (111) and the condenser (2); and a second throttling device (121) is connected with the second branch (12) in series. When a temperature is high, the liquid storing device (114) enables a space for accommodating refrigerant to increase, and pressure load does not rise rapidly. When the temperature is low, the space for accommodating the refrigerant is reduced, and load of the compressor (4) rises rapidly.

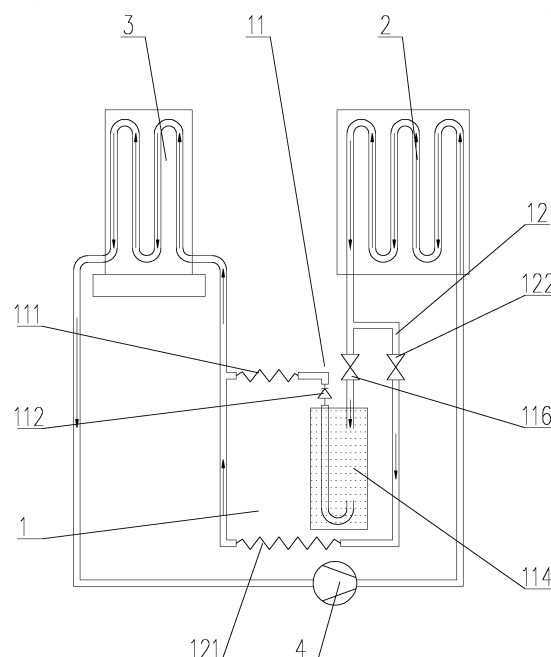


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to the field of heating and dehumidifying of heat pumps, and in particular to a heat pump system, a washing-drying integrated machine and a clothes dryer.

BACKGROUND

[0002] Clothes dryers in the existing art include a direct-drainage type clothes dryer and a condensation type clothes dryer; both the direct-drainage type clothes dryer and the condensation type clothes dryer are prepared in a way that an air inflow passage and an air outflow passage are communicated with a drum in a tank body; a difference between the direct-drainage type clothes dryer and the condensation type clothes dryer is that a heater for heating air flowing into a washing drum is mounted in the air inflow passage of the direct-drainage type clothes dryer; the air inflow passage and the air outflow passage of the condensation type clothes dryer are communicated to form an air duct; not only a heating device for heating the air flowing into the washing drum and a fan for feeding the air heated by the heating device into the drum are mounted in the air duct, but also a condensing device for cooling a high-temperature gas flowing out of the washing drum is mounted; and similarly, drying systems of existing washing-drying integrated machines are same as those of the clothes dryers.

[0003] In the existing art, many direct-drainage type clothes dryers or washing-drying integrated machines adopt a heat pump drying mode in a drying process; heat pump systems in the washing-drying integrated machines or clothes dryers adopting the heat pump drying mode are used for dehumidifying and heating the air flowing through the air duct; the heat pump system includes an evaporator, a compressor, a condenser and a throttling device; the evaporator, the compressor, the condenser and the throttling device are sequentially communicated through a pipeline to form a refrigerant circulating loop; the evaporator of the heat pump system is arranged at an air inlet of the air duct; the evaporator evaporates a liquid refrigerant into a gaseous refrigerant when refrigerant in the heat pump system enters the evaporator; in this process, the evaporator absorbs surrounding heat, as a condensing device in the air duct used for condensing the air flowing through the air duct; the condenser of the heat pump system is located in the air duct between a fan and the evaporator; the condenser changes a high-temperature and high-pressure gaseous refrigerant into a low-temperature and high-pressure gaseous refrigerant when the refrigerant in the heat pump system enters the condenser; and at the moment, the condenser releases heat to the outside, as a heating device in the air duct used for heating the air flowing through the air duct.

[0004] However, for a drum type washing-drying inte-

grated machine or clothes dryer adopting the heat pump drying mode in the existing art, since the temperature of water for rinsing clothes is only slightly higher than 0 DEG C in a low-temperature environment such as 0 DEG C environment, the temperature of the air blowing out from a washing/drying drum is close to 0 DEG C at a stage of starting to dry; in this case, a saturation temperature under a refrigerant saturation pressure in the evaporator of the heat pump system is much lower than 0 DEG C, a load of a compressor system is low, and an input power is small; but the heat for drying the air comes from power input of the compressor system, so the rise of the temperature in the washing/drying drum is extremely slow, which is adverse to the efficiency of drying clothes; and when a evaporation temperature is kept below 0 DEG C for a long time in the low-temperature environment, the evaporator is in contact with moist air blown out of the drum, a large number of frost may be condensed on surfaces of fins of the evaporator, an effective area of the evaporator is reduced, and the circulation of the air in a circulating air duct may be blocked, causing that the refrigerant in the compressor system cannot be completely vaporized, and a liquid-state refrigerant enters the compressor along an air suction pipe of the compressor, leading to a failure of the compressor.

[0005] Existing solutions are that (1) an auxiliary heating pipe (wire) is added behind the condenser, and the air heated by the condenser continues to be reheated by the heating pipe (wire), to obtain a higher drying temperature in the low-temperature environment, but an energy consumption level may be increased; (2) a frequency conversion compressor is adopted to operate at a higher operation frequency at a low temperature or when the drying needs to be accelerated, but costs are increased greatly; (3) a high-capacity compressor is adopted, but energy consumption of the high-capacity compressor may be higher at room temperature; and (4) a multi-exhaust-chamber compressor is adopted, but this solution may also increase operation costs.

[0006] In view of the above descriptions, there is an urgent need for a new heat pump system to solve problems that a drying efficiency of clothes is low and the compressor is easy to have a failure in the existing art.

SUMMARY

[0007] In view of this, an objective of the present invention is to provide a heat pump system which can increase a load rise rate of a compressor in a low-temperature environment.

[0008] A further objective of the present invention is to provide a washing-drying integrated machine in which the above heat pump system is arranged to increase the drying efficiency of clothes.

[0009] Another objective of the present invention is to provide a clothes dryer in which the above heat pump system is arranged to increase the drying efficiency of the clothes.

[0010] Embodiments of the present invention adopt the following technical solutions:

[0011] A heat pump system includes an evaporator, a compressor, a condenser and a refrigerant regulating subsystem; where the evaporator, the compressor, the condenser and the refrigerant regulating subsystem are sequentially communicated through a pipeline to form a refrigerant circulating loop; and the refrigerant regulating subsystem includes a first branch and a second branch connected in parallel between the evaporator and the condenser;

the first branch includes a first throttling device having an outlet connected with a pipe inlet of the evaporator, and a liquid storing device located between the first throttling device and the condenser; and

a second throttling device is connected with the second branch in series.

[0012] Preferably, the second branch and the first branch are connected with a pipe outlet of the condenser through a reversing valve.

[0013] Preferably, electromagnetic valves are respectively arranged on the first branch between the condenser and the liquid storing device and the second branch between the second throttling device and the condenser.

[0014] Preferably, the first throttling device is a first capillary tube; the second throttling device is a second capillary tube; and the length of the first capillary tube is smaller than that of the second capillary tube.

[0015] Preferably, the first throttling device and the second throttling device are a same electronic expansion valve; and an opening degree of the electronic expansion valve is adjustable.

[0016] Preferably, both the first throttling device and the second throttling device are electronic expansion valves; and opening degrees of all the electronic expansion valves are adjustable.

[0017] Preferably, check valves are respectively arranged on the first branch between the liquid storing device and the first throttling device and the second branch between the second throttling device and the electromagnetic valve.

[0018] A washing-drying integrated machine includes an outer drum, an air duct and an inner drum arranged in the outer drum; an air inlet and an air outlet of the air duct are respectively connected with a rear part and a front part of the outer drum; the air duct and the outer drum form a closed loop; a fan is arranged in the air duct; the washing-drying integrated machine further includes the heat pump system according to any of the above; the evaporator of the heat pump system is arranged at the air inlet of the air duct, for condensing air flowing through the air duct; and the condenser of the heat pump system is located in the air duct between the fan and the evaporator, for heating air flowing through the air duct.

[0019] A clothes dryer includes a tank body, an air duct and a drying drum mounted in the tank body; an air inlet and an air outlet of the air duct are respectively connected with a rear part and a front part of the drying drum to form

a closed loop together with the drying drum; a fan is arranged in the air duct; the clothes dryer further includes the heat pump system according to any of the above; the evaporator of the heat pump system is arranged at the air inlet of the air duct, for condensing air flowing through the air duct; and the condenser of the heat pump system is located in the air duct between the fan and the evaporator, for heating air flowing through the air duct.

[0020] Preferably, an auxiliary electric heating device is arranged in the air duct between the fan and the air outlet of the air duct.

[0021] The technical solutions proposed by embodiments of the present invention have beneficial technical effects that

(1) the refrigerant regulating subsystem of the heat pump system includes the first branch and the second branch connected between the evaporator and the condenser in parallel; the first branch includes the first throttling device having the outlet connected with the pipe inlet of the evaporator, and the liquid storing device located between the first throttling device and the condenser; the second throttling device is connected with the second branch in series; a flow direction of the refrigerant is the compressor, the condenser, the first branch (the liquid storing device and the first throttling device), the evaporator and the compressor when an environment temperature is high; the flow direction of the refrigerant is the compressor, the condenser, the second branch (the second throttling device), the evaporator and the compressor when an environment temperature is low; therefore, when the temperature is high, the liquid storing device enables a space for accommodating the refrigerant to increase, and pressure load does not increase rapidly; while at a low temperature, the refrigerant enters the evaporator only through the second throttling device from the condenser, since the space for accommodating the refrigerant is reduced, a compressor load may rise rapidly, thereby increasing a load rise rate of the compressor in the low-temperature environment.

(2) the length of the first capillary tube is smaller than that of the second capillary tube, i.e., the length of the second capillary tube is longer, and the capillary tube is set to be longer at the low temperature in order to match a superheat degree of the evaporator in this environment, avoid incomplete evaporation since a pressure rises rapidly and excessive refrigerant enters the evaporator, and avoid a problem of a failure of the compressor since a liquid-state refrigerant enters the compressor along an air suction pipe of the compressor.

BRIEF DESCRIPTION OF DRAWINGS

[0022] In order to more clearly illustrate the technical

solutions in embodiments of the present invention, drawings which are required to be used in the description of embodiments of the present invention are briefly described hereinafter. It is apparent that the drawings described below are only some embodiments of the present invention; and for those ordinary skilled in the art, other drawings can also be obtained in accordance with contents and these drawings of embodiments of the present invention without paying creative efforts.

Fig. 1 is a schematic structural diagram illustrating a heat pump system provided by device embodiments according to the present invention; and

Fig. 2 is a schematic structural diagram illustrating a clothes dryer provided by device embodiments according to the present invention.

[0023] In the figures:

1: Refrigerant regulating subsystem; 2: Condenser; 3: Evaporator; 4: Compressor; 5: Air duct; 6: Tank body; 7: Drying drum;

11: First branch; 12: Second branch;

111: First throttling device; 112: First check valve; 114: Liquid storing device; 116: First electromagnetic valve;

121: Second throttling device; 122: Second electromagnetic valve;

51: Air inlet; 52: Air outlet; 53: Auxiliary electric heating device; 54: Fan; 55: Filter.

DETAILED DESCRIPTION

[0024] In order to make solved technical problems, adopted technical solutions and achieved technical effects of the present invention clearer, the technical solutions of embodiments of the present invention are further described in detail in combination with the drawings below. Apparently, the described embodiments are merely some embodiments of the present invention, rather than all embodiments. All other embodiments obtained by those skilled in the art without paying creative efforts fall within a protection scope of the present invention, based on embodiments of the present invention.

[0025] The solution solves a problem of a compressor load at a low temperature in existing art from a new perspective. Fig. 1 is a schematic structural diagram illustrating a heat pump system provided by device embodiments according to the present invention. As shown in Fig. 1, the heat pump system includes an evaporator 3, a compressor 4, a condenser 2 and a refrigerant regulating subsystem 1; and the evaporator 3, the compressor 4, the condenser 2 and the refrigerant regulating subsystem

1 are sequentially communicated through a pipeline to form a refrigerant circulating loop, where the refrigerant regulating subsystem 1 includes a first branch 11 and a second branch 12 connected in parallel between the evaporator 3 and the condenser 2.

[0026] The first branch 11 includes a first throttling device 111 having an outlet connected with a pipe inlet of the evaporator 3, and a liquid storing device 114 for storing refrigerant; and the liquid storing device 114 is located between the first throttling device 111 and the condenser 2.

[0027] A second throttling device 121 is connected with the second branch 12 in series.

[0028] In the present embodiment, as a preferred solution, the second branch 12 and the first branch 11 are connected with the pipe outlet of the condenser 2 through a reversing valve. The reversing valve is connected with a controller; the reversing valve controls a flow direction of refrigerant flowing out of the condenser 2 according to a received signal sent by the controller and controls the refrigerant to flow through the first branch 11 or the second branch 12; and therefore, the purpose of adopting the reversing valve is to control refrigerant to switch between two flow directions.

[0029] Definitely, the present invention is not limited to the above solution; as another preferred solution, a first electromagnetic valve 116 can also be arranged on the first branch 11 between the condenser 2 and the liquid storing device 114, and a second electromagnetic valve 122 is arranged on the second branch 12 between the second throttling device 121 and the pipe outlet of the condenser 2; both the first electromagnetic valve 116 and the second electromagnetic valve 122 are connected with the controller; the controller controls the flow direction of the refrigerant flowing out of the condenser 2 by controlling opening or closing of the first electromagnetic valve 116 or the second electromagnetic valve 122, and controls the refrigerant to flow through the first branch 11 or the second branch 12; and therefore, the purpose of adopting the electromagnetic valves is also to control refrigerant to switch between two flow directions.

[0030] An operation process of the heat pump system is described below:

[0031] When an environment temperature is high, the flow direction of the refrigerant is that high-temperature and high-pressure gaseous refrigerant flowing out of the compressor 4 flows through the condenser 2 and is changed into a liquid condensing agent after being condensed by the condenser 2; in this process, the condenser 2 releases heat to the outside; the liquid condensing agent enters the liquid storing device 114 through the reversing valve; the liquid storing device 114 temporarily stores the refrigerant; then the refrigerant enters the evaporator 3 from the liquid storing device 114 through the first throttling device 111; the evaporator 3 evaporates the liquid refrigerant into gaseous refrigerant; in this process, the evaporator 3 absorbs the surrounding heat; and the gaseous refrigerant enters the compressor 4

along the pipeline.

[0032] When the environment temperature is low, the flow direction of the refrigerant is that high-temperature and high-pressure gaseous refrigerant flowing out of the compressor 4 flows through the condenser 2 and is changed into the liquid condensing agent after being condensed by the condenser 2; in this process, the condenser 2 releases heat to the outside; the liquid condensing agent enters the second branch 12 through the reversing valve, enters the second throttling device 121 along the second branch 12, and then flows to the evaporator 3; the evaporator 3 evaporates the liquid refrigerant into gaseous refrigerant; in the process, the evaporator 3 absorbs the surrounding heat; and the gaseous refrigerant enters the compressor 4 along the pipeline.

[0033] Therefore, when the temperature is high, pressure load would not rise rapidly since the refrigerant is accommodated in a space of the liquid storing device 114; while at a low temperature, the compressor 4 is started, the reversing valve is first closed to return the refrigerant in the liquid storing device 114 to a refrigeration system under an effect of the compressor 4; then the reversing valve is communicated with the second branch 12, so that the refrigerant is subjected to circulation of the drying process; and the load of the compressor 4 would rise rapidly since the space for accommodating the refrigerant is reduced.

[0034] In the present embodiment, as a preferred solution, the first throttling device 111 is a first capillary tube, and the second throttling device 121 is a second capillary tube.

[0035] In the present embodiment, as a preferred solution, the length of the first capillary tube is smaller than that of the second capillary tube, and the second capillary tube is set to be longer in order to match a superheat degree of the evaporator 3 in a low-temperature state, thereby avoiding incomplete evaporation since a pressure rises rapidly and excessive refrigerant enters the evaporator 3.

[0036] Definitely, selection of the first throttling device 111 and the second throttling device 121 is not limited to this; electronic expansion valves may be used respectively as the first throttling device 111 and the second throttling device 121; the electronic expansion valves on the two branches are respectively connected with the controller; the electronic expansion valves regulate respective opening degrees according to command signals sent by the controller; and the opening degree of the electronic expansion valve on the first branch 11 during normal operation is greater than that of the electronic expansion valve on the second branch 12 during normal operation.

[0037] The same electronic expansion valve may also be used as the first throttling device 111 and the second throttling device 121; the electronic expansion valve is connected with the controller; the electronic expansion valve regulates the opening degree according to the command signal sent by the controller; when the system uses

different branches, opening degrees of the electronic expansion valve are also different; normally, the opening degree of the electronic expansion valve when the first branch 11 is operated normally is greater than that of the electronic expansion valve when the second branch 12 is operated normally.

[0038] In the present embodiment, as a preferred solution, a first check valve 112 is arranged on the first branch 11 between the liquid storing device 114 and the first throttling device 111; and the first check valve 112 plays a role of preventing the refrigerant from flowing back into the liquid storing device 114 during operation in a low-temperature mode.

[0039] In the present embodiment, if a distance from the second electromagnetic valve 122 on the second branch 12 to the second capillary tube is large, a second check valve may also be arranged on the second branch 113 between the second throttling device 121 and the second electromagnetic valve 122, to avoid accumulating the refrigerant or lubricating oil in the pipeline in a state of high environment temperature.

[0040] In the present embodiment, as a preferred solution, the liquid storing device 114 is a liquid storing tank, but certainly is not limited hereto; and the liquid storing device may also be selected.

[0041] The present invention also provides a clothes dryer, as shown in Fig. 2; the clothes dryer includes a tank body 6, an air duct 5 and a drying drum 7 mounted in the tank body 6; an air inlet 51 and an air outlet 52 of the air duct 5 are respectively connected with a rear part and a front part of the drying drum 7; the air duct 5 and the drying drum 7 form a closed loop; a fan 54 is arranged in the air duct 5; the clothes dryer further includes the above heat pump system; the evaporator 3 of the heat pump system is arranged at the air inlet 51 of the air duct 5, as a condensing device in the air duct 5, for condensing air flowing through the air duct 5; and the condenser 2 of the heat pump system is located in the air duct 5 between the fan 54 and the evaporator 3, as a heating device in the air duct 5, for heating the air flowing through the air duct 5.

[0042] In the present embodiment, as a preferred solution, an auxiliary electric heating device 53 is arranged in the air duct 5 between the fan 54 and the air outlet 52 of the air duct 5, for further heating the air flowing through the air duct 5.

[0043] In the present embodiment, as a preferred solution, a filter 55 is arranged at the air inlet 51 of the air duct 5; and the filter 55 can filter the air entering the air duct 5 from the drying drum 7, and prevent dander and other debris in the air from entering the air duct 5, so as to guarantee sanitation and hygiene in the air duct 5.

[0044] The drying process of the clothes dryer is that the fan 54 drives the air to flow in the air duct 5 and the drying drum 7 in a circulation manner, while the condenser 2 of the heat pump system heats the air flowing there-through; hot air enters the drying drum 7, to evaporate out and take away water vapor in clothes; then the air

containing the water vapor passes through the evaporator 3 of the heat pump system; the evaporator 3 absorbs the surrounding heat to cool the surrounding air so that the water vapor in the hot air is condensed into liquid water and is drained out of a machine along with tap water; dry air from which the water vapor is removed is reheated by the condenser 2 of the heat pump system and re-enters the drying drum 7 to dry the clothes; and this process is continuously circulated until the clothes are dried.

[0045] The present application further provides a washing-drying integrated machine; the washing-drying integrated machine includes an outer drum, an air duct and an inner drum arranged in the outer drum; an air inlet and an air outlet of the air duct are respectively connected with a rear part and a front part of the outer drum; the air duct and the outer drum form a closed loop; and a fan is arranged in the air duct. The washing-drying integrated machine further includes the heat pump system according to any of the above; the evaporator 3 of the heat pump system is arranged at the air inlet of the air duct, as a condensing device in the air duct, for condensing the air flowing through the air duct; and the condenser 2 of the heat pump system is located in the air duct between the fan 54 and the evaporator 3, as a heating device in the air duct, for heating the air flowing through the air duct.

[0046] In the present embodiment, as a preferred solution, an auxiliary electric heating device is arranged in the air duct between the fan and the air outlet of the air duct, for further heating the air flowing through the air duct.

[0047] The drying process of the washing-drying integrated machine is similar to the drying process of the clothes dryer, and is not repeatedly described here.

[0048] It should be noted that the above is only preferred embodiments and applied technical principles of the present invention. Those skilled in the art should understand that the present invention is not limited to specific embodiments described here. For those skilled in the art, the present invention may be subjected to various apparent changes, re-adjustments and substitutions without departing from a protection scope of the present invention. Thus, although the present invention is described in detail with reference to the above embodiments, the present invention is not limited to the above embodiments, and may also include many other equivalent embodiments without departing from the conception of the present invention. However, the scope of the present invention is determined by the scope of appended claims.

Claims

1. A heat pump system, comprising an evaporator, a compressor, a condenser and a refrigerant regulating subsystem, wherein the evaporator, the compressor, the condenser and the refrigerant regulating

subsystem are sequentially communicated through a pipeline to form a refrigerant circulating loop; and the refrigerant regulating subsystem comprises a first branch and a second branch connected in parallel between the evaporator and the condenser; the first branch comprises a first throttling device having an outlet connected with a pipe inlet of the evaporator, and a liquid storing device located between the first throttling device and the condenser; and a second throttling device is connected with the second branch in series.

2. The heat pump system according to claim 1, wherein the second branch and the first branch are connected with a pipe outlet of the condenser through a reversing valve.

3. The heat pump system according to claim 1, wherein electromagnetic valves are respectively arranged on the first branch between the condenser and the liquid storing device and the second branch between the second throttling device and the condenser.

4. The heat pump system according to claim 1, wherein the first throttling device is a first capillary tube; the second throttling device is a second capillary tube; and the length of the first capillary tube is smaller than that of the second capillary tube.

5. The heat pump system according to claim 1, wherein the first throttling device and the second throttling device are a same electronic expansion valve; and an opening degree of the electronic expansion valve is adjustable.

6. The heat pump system according to claim 1, wherein both the first throttling device and the second throttling device are electronic expansion valves; and opening degrees of all the electronic expansion valves are adjustable.

7. The heat pump system according to claim 3, wherein check valves are respectively arranged on the first branch between the liquid storing device and the first throttling device and the second branch between the second throttling device and the electromagnetic valve.

8. A washing-drying integrated machine, comprising an outer drum, an air duct and an inner drum arranged in the outer drum, wherein an air inlet and an air outlet of the air duct are respectively connected with a rear part and a front part of the outer drum; the air duct and the outer drum form a closed loop; a fan is arranged in the air duct, wherein the washing-drying integrated machine further comprises the heat pump system according to any of claims 1-7; the evapora-

tor of the heat pump system is arranged at the air inlet of the air duct, for condensing air flowing through the air duct; and the condenser of the heat pump system is located in the air duct between the fan and the evaporator, for heating air flowing through the air duct. 5

9. A clothes dryer, comprising a tank body, an air duct and a drying drum mounted in the tank body, wherein an air inlet and an air outlet of the air duct are respectively connected with a rear part and a front part of the drying drum to form a closed loop together with the drying drum; a fan is arranged in the air duct, wherein the clothes dryer further comprises the heat pump system according to any of claims 1-7; the evaporator of the heat pump system is arranged at the air inlet of the air duct, for condensing air flowing through the air duct; and the condenser of the heat pump system is located in the air duct between the fan and the evaporator, for heating air flowing through the air duct. 10 15 20
10. The clothes dryer according to claim 9, wherein an auxiliary electric heating device is arranged in the air duct between the fan and the air outlet of the air duct. 25

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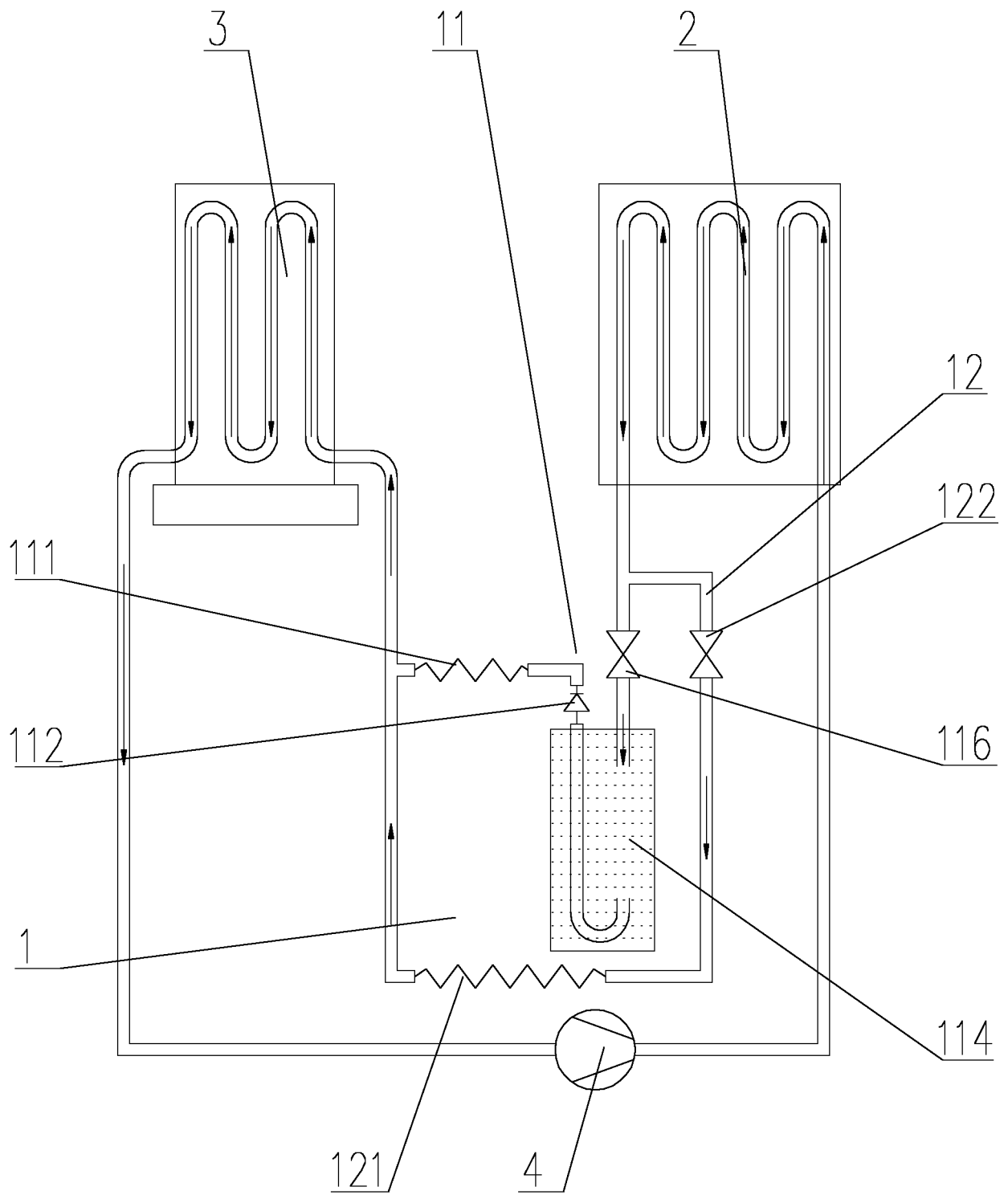


FIG. 1

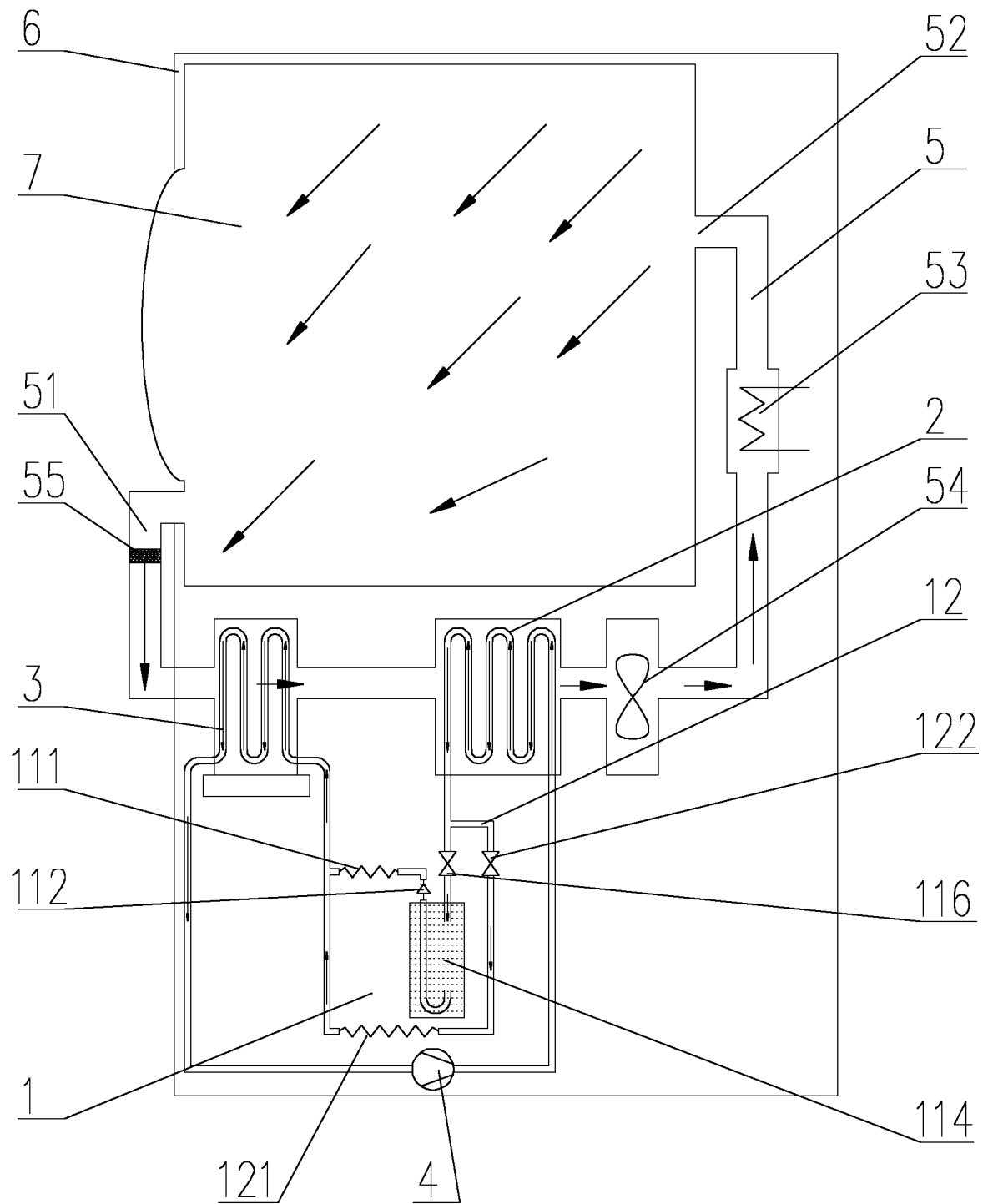


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/091311

A. CLASSIFICATION OF SUBJECT MATTER

F25B 1/00 (2006.01) i; D06F 25/00 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25B 1; F25B 41; F25B 30; D06F 25; F26B 11; CPC: F25B 2341/0661

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, CNTXT, CNKI: Haier laundry, liquid storage, accumulat+, receiver, parallel, branch, throttl+, expan+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 1645016 A (GUANGDONG KELON ELECTRICAL HOLDINGS CO., LTD.), 27 July 2005 (27.07.2005), description, page 3, embodiment 1, and figure 1	1-10
Y	CN 1050764 A (MOSCOW TECHNOLOGICAL INSTITUTE et al.), 17 April 1991 (17.04.1991), description, page 5, paragraph 5, and figure 1	1-10
Y	CN 102330316 A (HAIER GROUP CORP. et al.), 25 January 2012 (25.01.2012), description, paragraphs [0041]-[0047], and figures 1-4	8
Y	CN 102677438 A (HAIER GROUP CORP. et al.), 19 September 2012 (19.09.2012), description, paragraph [0002], and figure 1	9, 10
A	US 3264837 A (WESTINGHOUSE ELECTRIC CORP.), 09 August 1966 (09.08.1966), the whole document	1-10
A	JP H04203757 A (HITACHI LTD. et al.), 24 July 1992 (24.07.1992), the whole document	1-10

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search

15 May 2015 (15.05.2015)

Date of mailing of the international search report

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ZHANG, Lihong

Telephone No.: (86-10) 62085509

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2014/091311

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 1645016 A	27 July 2005	CN 1301391 C	21 February 2007
CN 1050764 A	17 April 1991	DE 3930319 A1	14 March 1991
		FI 894150 A	05 March 1991
		FR 2652150 A1	22 March 1991
CN 102330316 A	25 January 2012	None	
CN 102677438 A	19 September 2012	None	
US 3264837 A	09 August 1966	None	
JP H04203757 A	24 July 1992	None	

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