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(54) **WATER-COOLED AIR CONDITIONER**

WASSERGEKÜHLTE KLIMAANLAGE

APPAREIL DE CLIMATISATION À REFROIDISSEMENT À EAU

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Description

Technical Field

[0001] The present invention relates to a water-cooled air conditioner, and more particularly, a water-cooled air conditioner having a refrigerant bypassing unit that can heat a heat exchanger by allowing a portion of high temperature/pressure refrigerant compressed by a compressor to be directed to the second heat exchanger, thereby preventing the second heat exchanger from being damaged.

Background Art

[0002] Generally, an air conditioner is designed to reduce a temperature of an indoor space by (a) sucking warm indoor air, (b) heat-exchanging the warm indoor air with refrigerant, and (c) discharging the heat-exchanged air to the indoor space or to increase the temperature of the indoor space through a reverse cycle. The air conditioner provides a cooling/heating cycle in which the refrigerant circulates through a compressor, a condenser, and expansion valve, and an evaporator in this order.

[0003] Recently, as the quality of the life is improved and in response to the needs of the customers, in addition to the air cooling/heating function, the air conditioner also provides a variety of other functions such as an air cleaning function for discharging purified air into the indoor space after filtering off foreign objects contained in sucked air or a dehumidifying function for discharging dry air into the indoor space after changing humid sucked air into the dry air.

[0004] Meanwhile, the air conditioner is generally divided into an outdoor unit (called a heat discharge unit) installed at an outdoor space and an indoor unit (called a heat absorption unit) installed at an indoor space. The outdoor unit includes a condenser (a second heat exchanger) and a compressor and the indoor unit includes an evaporator (a first heat exchanger).

[0005] The air conditioner is generally classified into a split type air conditioner where the outdoor and indoor units are separately installed and an integral type air conditioner where the outdoor and indoor units are integrally installed. The split type air conditioner has been widely used due to its advantages in terms of an installation space and noise.

[0006] In order to reduce excessive power consumption during the air-conditioning of the indoor air, a water-cooled air conditioner has been actively used and developed. A water-cooled heat exchanger according to the preamble of claim 1 is disclosed in JP H09 105551 A.

[0007] Unlike a condenser (a second heat exchanger) of a conventional air-cooled air conditioner where the refrigerant is cooled by an outdoor air, the refrigerant of the water-cooled air conditioner is cooled by water. That is, the water and the refrigerant are not mixed with each

other but separately pass through a second heat exchanger.

[0008] When the refrigerant and the water separately flow through the water-cooled condenser (second heat exchanger), the heat-exchange between the refrigerant and the water occurs in the water-cooled condenser.

[0009] When the water-cooled air conditioner in cold weather during winter is not operated, the water does not flow through the water-cooled condenser and thus the water may be frozen due to the low temperature of an external side.

[0010] When the water is frozen, no heat exchange is realized even when the air conditioner operates and thus the air conditioning is not realized. This causes the deterioration of the reliability of the product.

[0011] Furthermore, when the water is frozen, this causes the damage of the water-cooled condenser and thus the increase of the maintenance costs.

Disclosure of Invention

Technical Problem

[0012] Accordingly, the present invention is directed to a water-cooled air conditioner that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0013] An object of the present invention is to provide a water-cooled air conditioner having a refrigerant bypassing unit that can heat a heat exchanger by allowing a portion of high temperature/pressure refrigerant compressed by a compressor to be directed to the second heat exchanger, thereby preventing the second heat exchanger from being damaged.

Technical Solution

[0014] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0015] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is provided a water-cooled air conditioner according to claim 1.

Advantageous Effects

[0016] According to the above-defined water-cooled air conditioner, a refrigerant bypassing unit for allowing a portion of high temperature/pressure refrigerant compressed by a compressor to be directed to the second heat exchanger is further provided. Therefore, the freez-

ing of the water passing through the heat exchanger during winter can be prevented and thus the damage of the second heat exchanger can be prevented.

[0017] The refrigerant bypassing unit is designed to synchronize with an outdoor temperature sensor. Therefore, an operation of the refrigerant bypassing unit is automatically controlled depending on a water temperature in the second heat exchanger detected by the outdoor temperature sensor, thereby improving the use convenience of the water-cooled air conditioner. By the above-described advantage, the reliability of the product can be improved.

[0018] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

Brief Description of the Drawings

[0019] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

FIG. 1 is an air view illustrating a state where a water-cooled air conditioner according to an embodiment of the present invention is installed in a building;

FIG. 2 is a view illustrating flows of air and water in a building when an integral type water-cooled air conditioner according to an embodiment of the present invention operates;

FIG. 3 is an air view illustrating a state where a multiple water-cooled air conditioner according to another embodiment of the present invention is installed in a building;

FIG. 4 is a perspective view of an outdoor unit of a water-cooled air conditioner according to an embodiment of the present invention;

FIG. 5 is an exploded perspective view of an internal structure of the outdoor unit of FIG. 4;

FIG. 6 is a schematic view of the outdoor unit according to an embodiment of the present invention; and

FIG. 7 is a view illustrating flow of refrigerant during an air heating operation of a water-cooled air conditioner according to an embodiment of the present invention.

Best Mode for Carrying Out the Invention

[0020] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0021] FIG. 1 shows an air view illustrating a state where a water-cooled air conditioner according to an em-

bodiment of the present invention is installed in a building, and FIG. 2 is a view illustrating flows of air and water in a building when an integral type water-cooled air conditioner according to an embodiment of the present invention operates.

[0022] Referring to FIGs. 1 and 2, a water-cooled air conditioner is installed in an enclosed space 52 formed in a building 50. The enclosed space 52 is completely isolated from an external side of the building 50 and communicates with an indoor space 62 through an air intake 60 formed through a ceiling to suck indoor air.

[0023] A duct 70 is connected to the indoor space 62 to allow air heat-exchanged by the water-cooled air conditioner to be discharged into the indoor space 62. That is, the water-cooled air conditioner includes an indoor unit 100 for sucking the indoor air and discharging the indoor air after heat-exchanging the indoor air and an outdoor unit 200 connected to the indoor unit 100 by a refrigerant pipe (130 of FIG. 3) and allowing the refrigerant introduced through the refrigerant pipe to be heat-exchanged with a water. The duct 70 allows the indoor unit 100 to communicate with the indoor space 62.

[0024] The outdoor unit 200 includes a compressor 210, an accumulator (270 of FIG. 5), a second heat exchanger 290, and an outdoor linear expansion valve (234 of FIG. 6). The indoor unit 100 includes a first heat exchanger 120 and an expansion valve (not shown).

[0025] When the water-cooled air conditioner operates, the indoor air is introduced into the indoor unit 100 through the air intake H formed in the ceiling of the building.

[0026] For this indoor air circulation, an indoor fan 100 for making an indoor air current is installed in the indoor unit 100. In addition, the first heat exchanger 120 is installed to be inclined at a lower side of the indoor fan 110.

[0027] The first heat exchanger 120 is provided to heat-exchange the indoor air using the refrigerant flowing inside the first heat exchanger 120. The first heat exchanger 120 is connected to the second heat exchanger by the refrigerant pipe 130.

[0028] The refrigerant pipe 130 is designed to circulate the refrigerant between the indoor and outdoor units 100 and 200. A common liquid pipe (132 of FIG. 6) along which a liquid-phase refrigerant flows and which is a single pipe and a common gas pipe (134 of FIG. 6) along which a gas-phase refrigerant flows and which is a single pipe are provided between the indoor and outdoor units 100 and 200.

[0029] That is, the common liquid pipe 132 connects the second heat exchanger 290 to the first heat exchanger 120 and the common gas pipe 134 connects the compressor 210 to the first heat exchanger 120.

[0030] Although the installing location of the indoor unit 100 may vary depending on a type of the water-cooled air conditioner (integral type or split type), an internal structure thereof is almost identical to that of a conventional indoor unit. Therefore, a detailed description of the indoor unit 100 will be omitted herein.

[0031] The outdoor unit 200 of the outdoor unit 200 is provided under the indoor unit 100. The compressor 210 of the outdoor unit 200 compresses the refrigerant with a high temperature and a high pressure. The second heat exchanger 290 of the outdoor unit 200 allows the refrigerant introduced from the compressor 210 to be heat-exchanged with water directed from a cooling tower 80 installed on, for example, a building top. The second heat exchanger 290 is provided with a waterway 202 communicating with an inside of the cooling tower 80. The waterway 202 includes a water inflow passage 202' for directing the water from the cooling tower 80 to the second heat exchanger 290 and a water outflow passage 202" for directing the water, which is heat-exchanged with the refrigerant while passing through an inside of the second heat exchanger 290, into the cooling tower 80.

[0032] The following will describe a case where a multiple water-cooled air conditioner is applied with reference to FIG. 3. FIG. 3 is an air view illustrating a state where a multiple water-cooled air conditioner according to another embodiment of the present invention is installed in a building.

[0033] As shown in FIG. 3, when the water-cooled air conditioner is provided as a multiple type, the indoor and outdoor units 100 and 200 are separated from each other and connected by a refrigerant pipe 130. That is, the indoor unit 100 is installed on the ceiling of the indoor space 62, and the outdoor unit 200 is installed in the enclosed space 52. The indoor and outdoor units 100 and 200 are connected to each other by the refrigerant pipe 130 so that the refrigerant can circulate and allow the indoor air to be heat-exchanged.

[0034] A first heat exchanger (not shown) by which the indoor air is heat-exchanged with the refrigerant is provided in the indoor unit 100. An indoor fan 110 is further provided to allow the heat-exchanged air to be discharged into the indoor space 62.

[0035] Like the integral type water-cooled air conditioner, the multiple water-cooled air conditioner includes a second heat exchanger for allowing the refrigerant to be heat-exchanged with the water. Since the circulations of the refrigerant and water in the second heat exchanger is identically realized to the integral type water-cooled air conditioner, a detailed description thereof will be omitted herein.

[0036] The following will describe the outdoor unit 200 in more detail with reference to the accompanying drawings.

[0037] FIG. 4 illustrates a perspective view of an outdoor unit of a water-cooled air conditioner according to an embodiment of the present invention, FIG. 5 illustrates an exploded perspective view of an internal structure of the outdoor unit of FIG. 4, and FIG. 6 illustrates a structure of the outdoor unit and flows of refrigerant and water in the cooling operation of the water-cooled air conditioner.

[0038] Referring to FIGs. 4 through 6, the outdoor unit 200 includes a top cover 204 formed in a rectangular parallelepiped and dividing the indoor unit 100 and the

outdoor unit 200 from each other, front and rear panels 205 and 207 that define respectively front and rear outer appearances, side panels 208 that define left and right outer appearances, and a base pan 209 for supporting a plurality of components.

[0039] The top cover 204 is located at a top of the outdoor unit 200 to prevent the air passing through the indoor unit 100 from being introduced into the outdoor unit 200. That is, the top cover 204 is formed in a rectangular plate in which no hole is formed.

[0040] The top cover 204 also functions to support the indoor unit 100 provided thereon. Therefore, the top cover 204 is provided at a bottom edge with a reinforcing beam 204' for reinforcing strength thereof.

[0041] The front panel 205 is erected under a front end of the top cover 204. Service panels 206 are formed at a central left side and a lower left/right side of the front panel 205. The service panels 206 are provided to open an internal side of the outdoor unit 200 when a maintenance service is required due to a malfunctioning of a component installed in the outdoor unit 200. Each of the service panels 206 is provided with slits except for one side.

[0042] Therefore, the service panels 206 pivot with reference to a side where no slit is formed to allow the internal space of the outdoor unit 200 to communicate with an external side, thereby allowing for the maintenance service.

[0043] The side panels 208 contacts rear-left and rear-right ends of the front panel 205. Each of the side panels 208 is provided at an upper portion with a plurality of heat dissipation holes 208' through which the heat generated by the operation of the compressor 210 is dissipated to the external side.

[0044] Although not shown in the drawings, the top cover 204, the front panel 205, the rear panel 207, and the side panel 208 may be provided with connection holes through which the common gas pipe 134 and the common liquid pipe 132 are connected to the indoor unit 100.

[0045] The base pan 209 is provided to contact lower ends of the front, rear, and side panels 205, 207, and 208. The base pan 209 is provided to support a plurality of components. Particularly, the compressor 210 is provided on a top center of the base pan 209.

[0046] The compressor 210 is designed to compress the refrigerant to a high temperature/pressure state. The compressor 210 is provided at left and right sides. That is, the compressor 210 includes a constant speed compressor 212 operated with a constant speed and installed at a relatively right side and an inverter compressor 214 that is a variable speed heat pump installed at a left side of the constant speed compressor 212 and operated with a variable speed.

[0047] A pair of uniform fluid pipes 216 are installed between the constant speed compressor 212 and the inverter compressor 214 to communicate the constant speed compressor 212 and the inverter compressor 214 with each other. Therefore, when one of the compressors

212 and 214 is short of fluid, the fluid of the other is directed to the compressor that is short of the fluid, thereby preventing the compressor 210 from being damaged.

[0048] A scroll compressor where noise is not so intrusive may be used as the compressor 210. Particularly, an inverter scroll compressor whose RPM is controlled depending on a load capacity may be used as the inverter compressor 214.

[0049] Therefore, when a load applied to the compressor 210 is low, the inverter compressor 214 first operates. Then, as the load capacity applied to the compressor 210 gradually increases and thus the inverter compressor 214 is unequal to the increased load capacity, the constant speed compressor 212 operates.

[0050] The compressor 210 is provided at an outlet side with a compressor discharge temperature sensor 217 for detecting a temperature of the refrigerant discharged from the compressor 210 and an oil separator 218. The oil separator 218 filters oil mixed in the refrigerant discharged from the compressor 210 and allows the filtered oil to be returned to the compressor 210.

[0051] That is, the oil used for cooling the frictional heat generated during the operation of the compressor 210 is discharged together with the refrigerant through an outlet of the compressor 210. The oil mixed with the refrigerant is separated by the oil separator 218 and returned to the compressor 210 through an oil recovery pipe 219.

[0052] The oil separator 218 is provided at an outlet with a check valve 232 for preventing the refrigerant from flowing back. That is, when only one of the constant speed compressor 212 and the inverter compressor 214 operates, the check valve 232 prevents the refrigerant from flowing into the other of the compressors.

[0053] The oil separator 218 is designed to communicate with a four-way valve 240 by a pipe. The four-way valve 240 is provided to convert the flow of the refrigerant according to an operation mode (cooling or heating mode) of the air conditioner. The four-way valve 240 includes an inlet port 242, a first outlet port 244, a second outlet port 246, and a third outlet port 248. The ports are connected to an outlet of the compressor 210 (or the oil separator 218), an inlet of the compressor 210 (or an accumulator 270), the second heat exchanger 290, and the indoor unit 100, respectively.

[0054] Therefore, the refrigerant discharged from the inverter compressor 214 and the constant speed compressor 212 is collected in a location and then directed to the four-way valve 240. The four-way valve 240 is provided at an outlet with a high pressure sensor 240' for detecting the pressure of the refrigerant discharged from the compressor 210.

[0055] Meanwhile, a hot gas pipe is installed bypassing the four-way valve 240 to allow a portion of the refrigerant introduced into the four-way valve 240 to be directly directed to the accumulator 270 that will be described in more detail later.

[0056] The hot gas pipe 250 is provided to directly direct the high pressure refrigerant of an outlet side of the

compressor 210 to the inlet of the hot gas pipe 250 when there is a need to increase the pressure of the low pressure refrigerant introduced into the accumulator 270 during the operation of the air conditioner. A hot gas valve 252 is installed on the hot gas pipe 250 to open and close the hot gas pipe 250.

[0057] An over-cooler 260 is installed on a top-right-rear end of the base pan 209. The over-cooler 260 is provided to further cool the refrigerant that is heat-exchanged in the second heat exchanger 290. The over-cooler 260 is formed at a portion of the outdoor liquid pipe 262 connected to the outlet of the second heat exchanger 290.

[0058] The over-cooler 260 is formed in a dual-pipe structure. That is, the over-cooler 260 includes an inner pipe (not shown) communicating with the outdoor liquid-phase pipe 262 and an outer pipe surrounding the inner pipe.

[0059] A reverse transfer pipe 264 is branched off from the outlet of the over-cooler 260. The reverse transfer pipe 264 allows a portion of the refrigerant flowing along the outdoor liquid-phase pipe 262 to flow back along the outer pipe of the over-cooler 260.

[0060] An over-cooler expansion valve 266 for expansion-cooling the refrigerant is installed on the reverse transfer pipe 264. Therefore, a portion of the refrigerant discharged from the over-cooler 260 and flowing along the outdoor liquid-phase pipe 262 is introduced into the reverse transfer pipe 264 and cooled while passing through the over-cooler expansion valve 266. The cooled refrigerant flows back along the outer tube of the over-cooler 260 and thus the refrigerant flowing along the inner tube is further cooled. Branched refrigerant discharged from the over-cooler is fed again to the accumulator 270 along the over-cooler recovering pipe 267.

[0061] Meanwhile, the over-cooler 260 is provided at an outlet with a liquid pipe temperature sensor 263 for detecting the temperature of the refrigerant discharged from the outdoor unit 200. The over-cooler expansion valve 266 is provided at an outlet with an over-cooler inlet sensor 265 to detect the temperature of the backflow refrigerant inflowing the over-cooler 260. The over-cooler recovering pipe 267 for guiding the branched refrigerant discharged from the over-cooler 260 to the accumulator 270 is provided with an over-cooler outlet sensor 267'.

[0062] The accumulator 270 is installed at a left portion of the base pan 209 (i.e., at a left side of the inverter compressor 214). The accumulator 270 functions to filter off the liquid-phase refrigerant and allow only the gas-phase refrigerant to be introduced into the compressor 210.

[0063] If the liquid-phase refrigerant that is directed from the indoor unit 100 and is not vaporized is directly introduced into the compressor 210, the compressor 210 for compressing the refrigerant to a high temperature and high pressure gas-phase state is overloaded and thus damaged.

[0064] Therefore, since the liquid-phase refrigerant

that is introduced into the accumulator 270 and is not vaporized is relatively heavier than the gas-phase refrigerant, the liquid-phase refrigerant is settled down at a lower portion of the accumulator 270 and only the gas-phase refrigerant is introduced into the compressor 210.

[0065] The accumulator 270 is provided at an inlet with an intake pipe temperature sensor 272 for detecting the temperature of the refrigerant introduced therein and a low pressure sensor 274 for detecting the pressure of the refrigerant.

[0066] Meanwhile, a control box 280 is installed in rear of the front panel 205. The control box 280 is formed in a rectangular parallelepiped and is selectively closed by a control cover 282 pivotally fixed on a top end of the control box 280.

[0067] Control components such as a voltage transformer, a printed circuit board, and a capacitor are provided in the control box 280 and a heat dissipation unit 284 formed with heat dissipation fins are formed on a rear surface of the control box 280.

[0068] The second heat exchanger 290 is provided at a rear side of the control box 280 to allow the refrigerant and the water to be heat-exchanged with each other while passing therethrough. The second heat exchanger 290 is formed in a rectangular parallelepiped.

[0069] A plurality of water flow pipes and refrigerant flow pipes are provided in the second heat exchanger 290 to prevent the refrigerant and the water from being mixed with each other. The water and refrigerant flow pipes are alternately arranged to be adjacent to each other so that the heat-exchange between the refrigerant and water can be effectively realized.

[0070] That is, the refrigerant flow pipes (not shown) are arranged to surround the water pipes (not shown) while the water pipes are arranged to surround the refrigerant flow pipes. Therefore, it will be preferable that the water and refrigerant pipes are designed to be identical in a sectional shape and size with each other.

[0071] For example, the water and refrigerant flow pipes are formed in a regular hexagonal shape so that they can be arranged in a honeycomb shape.

[0072] The second heat exchanger 290 is provided at a front surface with water inflow and outflow pipes 292 and 293 through which the water is introduced into or discharged from the second heat exchanger 290 and refrigerant inflow and outflow pipes 294 and 295 through which the refrigerant is introduced into or discharged from the second heat exchanger 290.

[0073] That is, the water inflow and outflow pipes 292 and 293 are formed on front-right upper and lower portions of the second heat exchanger 290 and extend into the second heat exchanger to guide the introduction and discharge of the water into or from the second heat exchanger 290. The water inflow pipe 292 is positioned under the water outflow pipe 293.

[0074] In addition, the refrigerant inflow and outflow pipes 294 and 295 are formed on front-left upper and lower portions of the second heat exchanger 290 and

extend into the second heat exchanger 290 to guide the introduction and discharge of the refrigerant into or from the second heat exchanger 290. The refrigerant inflow pipe 294 is positioned under the water outflow pipe 295.

[0075] When the water and refrigerant are introduced into the second heat exchanger 290, the water flows from an upper side to a lower side along the water flow pipe disposed in the second heat exchanger 290. The refrigerant introduced into the second heat exchanger 290 flows from the lower side to the upper side along the refrigerant flow pipe.

[0076] As the water and the refrigerant flow in an opposite direction to each other in the second heat exchanger 290, the heat exchange efficiency between the water and the refrigerant may be maximized.

[0077] An outdoor temperature sensor 296 is provided at a side of the second heat exchanger 290, i.e., at a side of the water outflow pipe 293. The outdoor temperature sensor 296 is provided to detect the temperature of the water that is discharged through the water outflow pipe 293 after being heat-exchanged with the refrigerant in the second heat exchanger 290.

[0078] Meanwhile, according to a feature of the present invention, a refrigerant bypassing unit 300 is provided between the second heat exchanger 290 and the compressor 210. The refrigerant bypassing unit 300 is selectively operated when the water-cooled air conditioner is in the heating mode operation. That is, the refrigerant bypassing unit 300 is designed to selectively operate depending on a temperature of water passing through the second heat exchanger 290.

[0079] The refrigerant bypassing unit 300 allows the refrigerant that is compressed to a high temperature/pressure state by the compressor to be directed to the second heat exchanger 290, thereby preventing the water in the second heat exchanger 290 from freezing.

[0080] To this end, the refrigerant bypassing unit 300 includes a refrigerant bypassing pipe 320 having a first end communicating with a lower portion of the second heat exchanger 290 and a second end communicating with the outlet of the compressor 210 and a bypassing blocking valve 340 for selectively blocking the refrigerant bypassing pipe 320.

[0081] The refrigerant bypassing pipe 320 is provided to guide the refrigerant discharged from the compressor 210 into the second heat exchanger 290. Therefore, opposite ends of the refrigerant bypassing pipe 320 are respectively connected to a refrigerant outflow portion of the inverter compressor 214 and a refrigerant inflow portion of the second heat exchanger 290. That is, the opposite ends of the refrigerant bypassing pipe 320 communicate with the refrigerant outflow pipe 295 and the hot gas pipe 250, respectively.

[0082] Therefore, when the water-cooled air conditioner is in the heat mode operation, a portion of the refrigerant discharged from the inverter compressor 214 is directed to the indoor unit 100 through the four-way valve 240 and the rest of the refrigerant is introduced into the

second heat-exchanger 290 along the refrigerant bypassing pipe 320 connected to the hot gas pipe 250 via the refrigerant outflow pipe 295.

[0083] A right end (in FIG. 6) of the refrigerant bypassing pipe 320 is located at a right side of the hot gas valve 252 so that the refrigerant discharged from the inverter compressor 214 can be introduced into the refrigerant bypassing pipe 320 regardless of the opening/closing of the hot gas valve 252.

[0084] The bypassing blocking valve 340 is provided at a right portion of the refrigerant bypassing pipe 320. The bypassing blocking valve 340 is designed to operate depending on the temperature detected by the outdoor temperature sensor 296.

[0085] That is, when the temperature of the water outflow pipe 293 (when it is regarded that the temperature of the water outflow pipe 293 is same as that of the water in the water outflow pipe 293) is lowered to 0°C, the outdoor temperature sensor 296 generates a signal and transmits the same to the printed circuit board. Then, the printed circuit board opens the bypassing blocking valve 340.

[0086] Therefore, even when the water-cooled air conditioner is not used for many days and an outside temperature is lowered to be equal to or lower than 0°C, the damage of the second heat exchanger 290 due to the freezing of the water can be prevented.

[0087] A heat exchanger support 298 is provided under the second heat exchanger 290. The heat exchanger support 298 supports the second heat exchanger 290 such that the second heat exchanger 290 is spaced apart from the base pan 209.

[0088] That is, the top surface of the heat exchanger support 298 is slightly larger than the bottom surface of the second heat exchanger 290. A rear half of the heat exchanger support 298 is formed to extend and be inclined toward a lower-rear side from the top rear end. The lower end of the heat exchanger support 298 is fixedly coupled to the base pan 209.

[0089] The following will describe an operation of the above-described water-cooled air conditioner with reference to FIGs. 1 through 7. FIG. 7 is a view illustrating flow of refrigerant during an air heating operation of the water-cooled air conditioner according to an embodiment of the present invention, in which a refrigerant flow by the refrigerant bypassing unit is illustrated.

[0090] The following will describe the refrigerant flow in the outdoor unit in the cooling mode operation of the air conditioner.

[0091] As shown in FIG. 6, the outdoor electronic valve 234 is closed and the refrigerant discharged from the second heat exchanger 290 flows toward the outdoor unit. In addition, the bypassing blocking valve 340 is closed to prevent the refrigerant from being introduced into the refrigerant bypassing pipe 320.

[0092] Describing the refrigerant flow in the outdoor unit 200 with reference to FIG. 6, the gas-phase refrigerant is introduced from the outdoor unit 100 into the four-

way valve 240 through the third outlet port 248 and is directed to the accumulator 270 through the second outlet port 246 of the four-way valve 240. The gas-phase refrigerant coming out of the accumulator 270 goes into the compressor 210.

[0093] The refrigerant is compressed in the compressor 210 and discharged to pass through the oil separator 218. The oil contained in the refrigerant is separated and recovered into the compressor 210 through the oil recovery pipe 219.

[0094] That is, as the refrigerant is compressed in the compressor 210, it is mixed with the oil. At this point, since the oil is in a liquid-phase, it can be separated from the refrigerant by the oil separator 218 that is a gas/liquid separator.

[0095] Then, the refrigerant discharged from the oil separator 218 is introduced into the four-way valve 240 through the inlet port 242 and is then directed to the second heat exchanger 290 through the first outlet port 244 of the four-way valve 240.

[0096] The discharged refrigerant is introduced into the second heat exchanger 290 through the refrigerant inflow pipe 294 and heat-exchanged with the water introduced from the cooling tower 80 into the second heat exchanger 290 through the water inflow pipe 292, thereby being converted into the liquid-phase refrigerant. Then, this liquid-phase refrigerant is directed to the over-cooler 260 to be further cooled.

[0097] At this same time, the water is warmed during the heat exchange with the refrigerant in the second heat exchanger 290 is discharged out of the second heat exchanger 290 through the water outflow pipe 293 and is then introduced into the cooling tower 80 through the water outflow passage 202".

[0098] The water introduced into the cooling tower 80 is introduced again into the second heater exchanger 290 through the water inflow passage 202'. This process is continuously repeated.

[0099] Meanwhile, the refrigerant passing through the over-cooler 260 further passes through a drier where the moisture contained in the refrigerant is removed and is then introduced into the indoor unit 100. Then, the refrigerant is reduced in pressure by the expansion valve (not shown) and heat-exchanged in the first heat exchanger 120. At this point, the first heat exchanger 120 functions as an evaporator, the refrigerant is changed into a low-pressure gas-phase through the heat exchange.

[0100] The refrigerant heat-exchanged while passing through the first heat exchanger 120 flows along the common gas-phase pipe 134 and is then introduced into the accumulator 270 via the four-way valve 240.

[0101] The accumulator 270 filters off the liquid-phase refrigerant so that only the gas-phase refrigerant can be fed to the compressor 210. By the above-described series of processes, one cooling cycle is completed.

[0102] The following will describe a heat mode operation of the water-cooled air conditioner.

[0103] As shown in FIG. 7, in the heating mode oper-

ation, the outdoor electronic valve 234 and the bypassing blocking valve 340 is opened allow the refrigerant to flow through the refrigerant bypassing pipe 320.

[0104] Describing the refrigerant flow in the outdoor unit 200 in more detail with reference to FIG. 7, the refrigerant is introduced from the outdoor unit 100 into the outdoor unit 200 along the common liquid-phase pipe 132.

[0105] The refrigerant introduced into the outdoor unit 200 is directed into the second heat exchanger 290 through the refrigerant outflow pipe 295. The refrigerant introduced into the second heat exchanger 290 is heat-exchanged with the water and discharged from the second heat exchanger 290 through the refrigerant inflow pipe 294.

[0106] Meanwhile, the water passing through the second heat exchanger 290 circulates the cooling tower 80. That is, the water introduced from the cooling tower 80 into the second heat exchanger 290 through the water inflow pipe 292 is cooled by heat-exchanging with the refrigerant in the second heat exchanger 290 and discharged out of the second heater exchanger 290. Then, the water is returned to the cooling tower 80 through the water outflow passage 202".

[0107] The water introduced in the cooling tower 80 increases in a temperature by heat-exchanging with the air and introduced again into the second heat exchanger 290 through the water inflow passage 202'. The process is repeated.

[0108] Meanwhile, the refrigerant discharged from the second heat exchanger 290 is introduced into the accumulator 270 via the first and second outlet ports 244 and 246 of the four-way valve 240.

[0109] The accumulator 270 filters off the liquid-phase refrigerant so that only the gas-phase refrigerant can be fed to the compressor 210.

[0110] A portion of the refrigerant discharged from the inverter compressor 214, which is not introduced into the refrigerant bypassing pipe 320, and the refrigerant discharged from the constant speed compressor 212 are introduced into the indoor unit 100 through the common gas-phase pipe 134 via the inlet portion 242 of the four-way valve 240 and the third outlet portion 248 through the four-way valve 240.

[0111] The refrigerant introduced into the indoor unit 100 is condensed while passing through the first heat exchanger 120, after which it is introduced into the outdoor unit 200 along the common liquid-phase pipe 132. The refrigerant introduced into the outdoor unit 200 is introduced again into the second heat exchanger 290. By the above-described series of processes, one heating cycle is completed.

[0112] The air conditioner is generally operated with the heating mode during winter. At this point, the outdoor temperature sensor 296 keeps operating to detect the water temperature of the water outflow pipe 293. When the water temperature detected by the outdoor temperature sensor 296 is equal to or less than 0°C, the water

in the second heat exchanger 290 may be frozen. Therefore, the temperature of the refrigerant introduced into the second heat exchanger 290 is controlled using the refrigerant bypassing unit 300.

[0113] That is, when the temperature of the water discharged through the second heat exchanger 290 is equal to or less than 0°C, this is detected by the outdoor temperature sensor 296 and signalized. This signal is transmitted to the printed circuit board so that the printed circuit board can open the refrigerant bypassing pipe 320 by applying the electric power to the bypassing blocking valve 340.

[0114] Therefore, a portion of the high temperature/pressure refrigerant compressed by and discharged from the inverter compressor 214 is introduced into the second heat exchanger 290 through the refrigerant bypassing pipe 320.

[0115] In more detail, a temperature of the refrigerant discharged from the indoor unit 100 and passing through the outdoor electronic valve 234 is relatively low. Therefore, this low temperature refrigerant is mixed with the high temperature refrigerant introduced through the refrigerant bypassing pipe 320 and the mixed refrigerant is then introduced into the second heat exchanger 290.

[0116] Accordingly, a temperature of the refrigerant passing through the second heat exchanger becomes higher compared with a case where no refrigerant bypassing unit 300 is used. As a result, a temperature of the water that is heat-exchanged with the refrigerant while passing through the second heat exchanger 290 becomes relatively higher and thus the freezing of the water can be prevented.

[0117] During the operation of the refrigerant bypassing unit 300, when the water temperature detected by the outdoor temperature sensor 296 becomes greater than 0°C, the bypassing blocking valve 340 is closed to block the refrigerant bypassing pipe 320, thereby stopping the operation of the refrigerant bypassing unit 300.

[0118] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims.

[0119] For instance, the reference temperature (0°C) with reference of which the operation of the refrigerant bypassing unit 300 is determined may vary if required.

[0120] That is, the referent temperature may be 1°C or 3°C. In addition, the outdoor temperature sensor 296 may be designed to detect a temperature of outdoor air instead of detecting the temperature of the water.

Industrial Applicability

[0121] According to the above-defined water-cooled air conditioner, a refrigerant bypassing unit for allowing a portion of high temperature/pressure refrigerant compressed by a compressor to be directed to the second

heat exchanger is further provided. Therefore, the freezing of the water passing through the heat exchanger during winter can be prevented and thus the damage of the second heat exchanger can be prevented.

[0122] The refrigerant bypassing unit is designed to synchronize with an outdoor temperature sensor. Therefore, an operation of the refrigerant bypassing unit is automatically controlled depending on a water temperature in the second heat exchanger detected by the outdoor temperature sensor, thereby improving the use convenience of the water-cooled air conditioner. By the above-described advantage, the reliability of the product can be improved.

[0123] Therefore, water-cooled air conditioner according to the present invention allows for a high industrial applicability.

Claims

1. A water-cooled air conditioner, the water-cooled air conditioner comprising:

a first heat exchanger (120) indoor air is heat-exchanged with refrigerant;
a compressor (210) for compressing the refrigerant;

an accumulator (270) that is installed at a side of the compressor to filter off liquid-phase refrigerant so that only gas-phase refrigerant can be introduced into the compressor; and

a plate-shaped second heat exchanger (290) the refrigerant is heat-exchanged with the water, **characterized in that** the water-cooled air conditioner further comprises a refrigerant bypassing unit (300) selectively operates to allow a portion of the refrigerant compressed in the compressor to be directly returned to the second heat exchanger,

the refrigerant bypassing unit (300) comprising:

a hot gas pipe (250) that is disposed between the compressor (210) and the accumulator (270) to allow the high pressure refrigerant discharged from the compressor (210) to be returned to the accumulator (270); and

a refrigerant bypassing pipe (320) for guiding a refrigerant flow direction, the refrigerant bypassing pipe (320) has first end connected to a side of the hot gas pipe (250) and second end connected to a refrigerant inlet of the second heat exchanger (290),

wherein when the refrigerant bypassing unit (300) operates, a portion of the refrigerant discharged from the compressor (210) is directed to the first heat exchanger (120), and the rest of

the refrigerant is introduced into the second heat exchanger (290) along the hot gas pipe (250) and the refrigerant bypassing pipe, and wherein the refrigerant bypassing unit (300) selectively operates depending on a temperature of the water passing through the plate-shaped second heat exchanger when the air conditioner operates in a heat mode, wherein the refrigerant bypassing unit comprises a bypassing blocking valve (340) for selectively blocking the refrigerant bypassing pipe.

2. The water-cooled air conditioner according to claim 1, wherein an outdoor temperature sensor for detecting a temperature of the water passing through the second heat exchanger is provided at a side of the second heat exchanger.
3. The water-cooled air conditioner according to claim 2, wherein the bypassing blocking valve opens the refrigerant bypassing valve when the temperature detected by the outdoor temperature sensor is equal to or less than a reference temperature.
4. The water-cooled air conditioner according to claim 3, wherein the reference temperature is 0 °C.
5. The water-cooled air conditioner according to claim 1, wherein the compressor is an inverter compressor whose RPM is controlled in accordance with a load capacity.

Patentansprüche

1. Wassergekühlte Klimaanlage, wobei die wassergekühlte Klimaanlage aufweist:

einen ersten Wärmetauscher (120), bei dem ein Wärmeaustausch von Innenraumlufte mit einem Kältemittel stattfindet;

einen Kompressor (210) zum Komprimieren des Kältemittels;

einen Speicher (270), der an einer Seite des Kompressors angeordnet ist, um Kältemittel in der Flüssigphase auszufiltern, sodass nur Kältemittel in der Gasphase in den Kompressor eingespeist werden kann;

und einen plattenförmigen zweiten Wärmetauscher (290), bei dem ein Wärmeaustausch zwischen dem Kältemittel und Wasser stattfindet;

dadurch gekennzeichnet, dass die wassergekühlte Klimaanlage ferner eine Kältemittelumkehrungseinheit (300) umfasst, die selektiv so betrieben wird, dass ein Teil des in dem Kompressor komprimierten Kältemittels direkt zu dem zweiten Wärmetauscher zurückgeführt werden kann, wobei die Kältemittelumkehrungs-

einheit (300) aufweist:

eine Heißgasleitung (250), die zwischen dem Kompressor (210) und dem Speicher (270) angeordnet ist, sodass aus dem Kompressor (210) abgegebenes Hochdruck-Kältemittel zu dem Speicher (270) zurückgeführt werden kann; und
eine Kältemittelumgehungsleitung (320) zum Lenken der Flussrichtung des Kältemittels, wobei die Kältemittelumgehungsleitung (320) ein erstes Ende, das mit einer Seite der Heißgasleitung (250) verbunden ist, und ein zweites Ende aufweist, das mit einem Kältemittelleinlass des zweiten Wärmetauschers (290) verbunden ist,

wobei, wenn die Kältemittelumgehungsseinheit (300) in Betrieb ist, ein Teil des von dem Kompressor (210) abgeleiteten Kältemittels zu dem ersten Wärmetauscher (120) geleitet wird, und das restliche Kältemittel entlang der Heißgasleitung (250) und der Kältemittelumgehungsleitung (320) in den zweiten Wärmetauscher (290) eingespeist wird, wobei die Kältemittelumgehungsseinheit (300) in Abhängigkeit der Temperatur des durch den plattenförmigen zweiten Wärmetauscher geführten Wassers selektiv in Betrieb ist, wenn die Klimaanlage in einem Wärmemodus arbeitet,
wobei die Kältemittelumgehungsseinheit ein Umgehungsabsperrventil (340) aufweist, um die Kältemittelumgehungsleitung selektiv abzusperren.

2. Wassergekühlte Klimaanlage nach Anspruch 1, wobei ein Außentemperatursensor zum Erfassen der Temperatur des durch den zweiten Wärmetauscher geführten Wassers an einer Seite des zweiten Wärmetauschers angeordnet ist.
3. Wassergekühlte Klimaanlage nach Anspruch 2, wobei das Umgehungsabsperrventil das Kältemittelumgehungsventil öffnet, wenn die von dem Außentemperatursensor erfasste Temperatur kleiner oder gleich einer Referenztemperatur ist.
4. Wassergekühlte Klimaanlage nach Anspruch 3, wobei die Referenztemperatur 0 °C beträgt.
5. Wassergekühlte Klimaanlage nach Anspruch 1, wobei der Kompressor ein Inverterverdichter ist, dessen UpM gemäß einer Belastungskapazität gesteuert werden.

Revendications

1. Climatiseur refroidi à l'eau, le climatiseur refroidi à l'eau comprenant :

un premier échangeur de chaleur (120), de l'air intérieur subit un échange de chaleur avec un fluide frigorigène ;
un compresseur (210) pour comprimer le fluide frigorigène ;
un accumulateur (270) qui est installé d'un côté du compresseur pour filtrer le fluide frigorigène en phase liquide de sorte que seul le fluide frigorigène en phase gazeuse puisse être introduit dans le compresseur ; et
un deuxième échangeur de chaleur en forme de plaque (290), le fluide frigorigène subit un échange de chaleur avec l'eau,
caractérisé en ce que le climatiseur refroidi à l'eau comprend en outre une unité de dérivation de fluide frigorigène (300) fonctionnant de manière sélective pour permettre à une partie du fluide frigorigène comprimé dans le compresseur d'être directement renvoyée dans le deuxième échangeur de chaleur,
l'unité de dérivation de fluide frigorigène (300) comprenant :

un tuyau de gaz chaud (250) qui est disposé entre le compresseur (210) et l'accumulateur (270) pour permettre au fluide frigorigène haute pression déchargé du compresseur (210) d'être renvoyé dans l'accumulateur (270) ; et
un tuyau de dérivation de fluide frigorigène (320) pour guider un sens d'écoulement de fluide frigorigène, le tuyau de dérivation de fluide frigorigène (320) a une première extrémité reliée à un côté du tuyau de gaz chaud (250) et une deuxième extrémité reliée à une entrée de fluide frigorigène du deuxième échangeur de chaleur (290),

dans lequel, lorsque l'unité de dérivation de fluide frigorigène (300) fonctionne, une partie du fluide frigorigène déchargé du compresseur (210) est dirigée vers le premier échangeur de chaleur (120), et le reste du fluide frigorigène est introduit dans le deuxième échangeur de chaleur (290) le long du tuyau de gaz chaud (250) et du tuyau de dérivation de fluide frigorigène, et dans lequel l'unité de dérivation de fluide frigorigène (300) fonctionne de manière sélective en fonction d'une température de l'eau traversant le deuxième échangeur de chaleur en forme de plaque lorsque le climatiseur fonctionne en mode chauffage,
dans lequel l'unité de dérivation de fluide frigo-

rigène comprend une soupape de blocage de dérivation (340) pour bloquer de manière sélective le tuyau de dérivation de fluide frigorigène.

2. Climatiseur refroidi à l'eau selon la revendication 1, dans lequel un capteur de température extérieure pour détecter une température de l'eau traversant le deuxième échangeur de chaleur est prévu d'un côté du deuxième échangeur de chaleur. 5
3. Climatiseur refroidi à l'eau selon la revendication 2, dans lequel la soupape de blocage de dérivation ouvre la soupape de dérivation de fluide frigorigène lorsque la température détectée par le capteur de température extérieure est inférieure ou égale à une température de référence. 10 15
4. Climatiseur refroidi à l'eau selon la revendication 3, dans lequel la température de référence est de 0°C. 20
5. Climatiseur refroidi à l'eau selon la revendication 1, dans lequel le compresseur est un compresseur inverseur dont le régime est commandé en fonction d'une capacité de charge. 25

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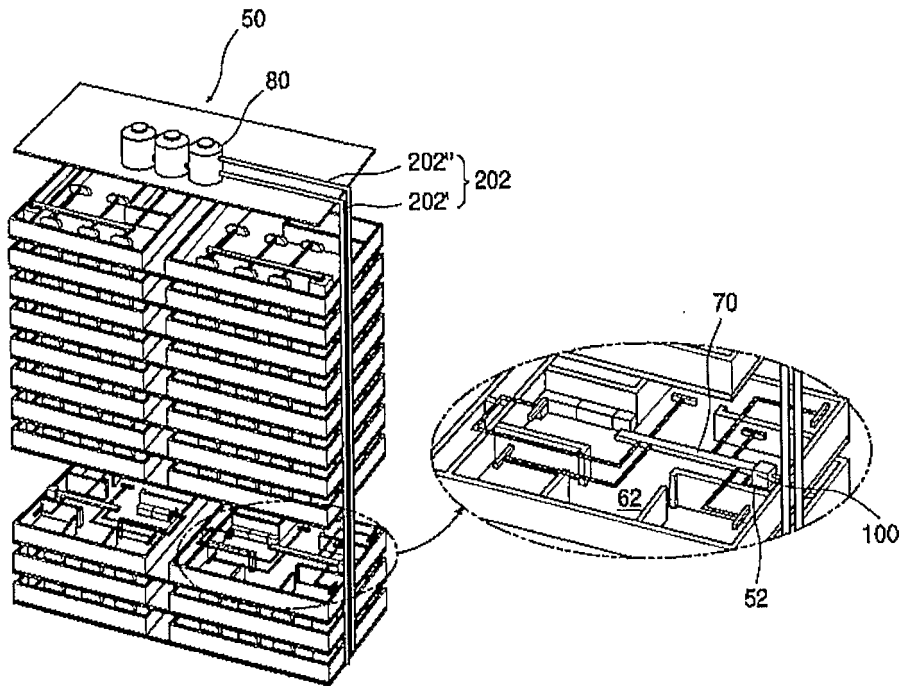
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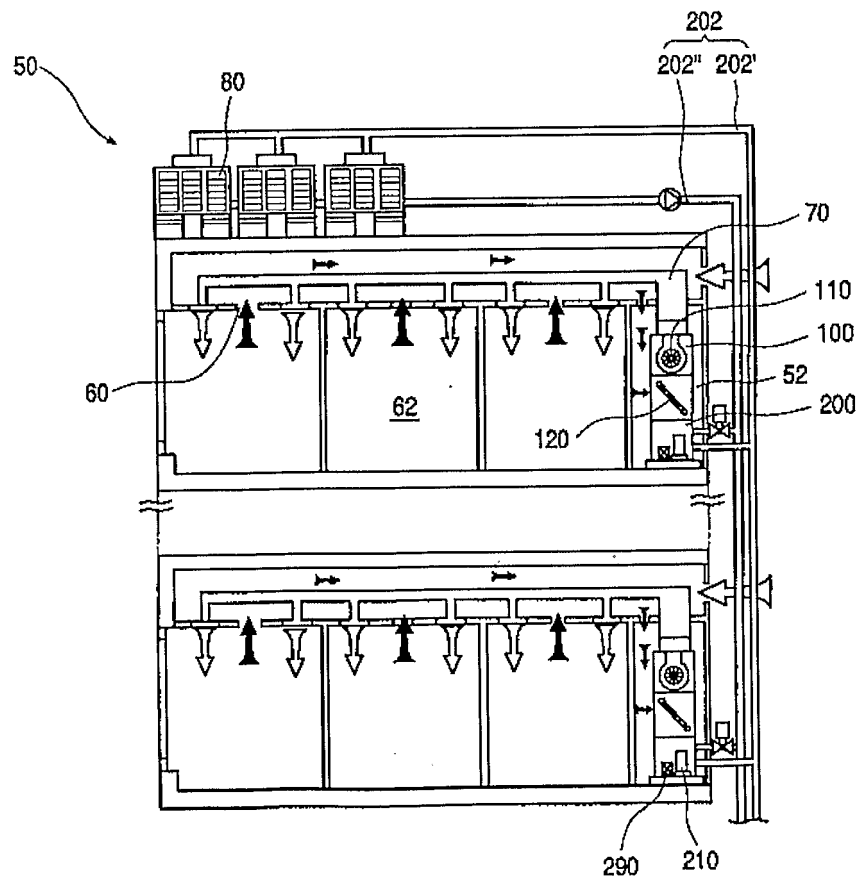
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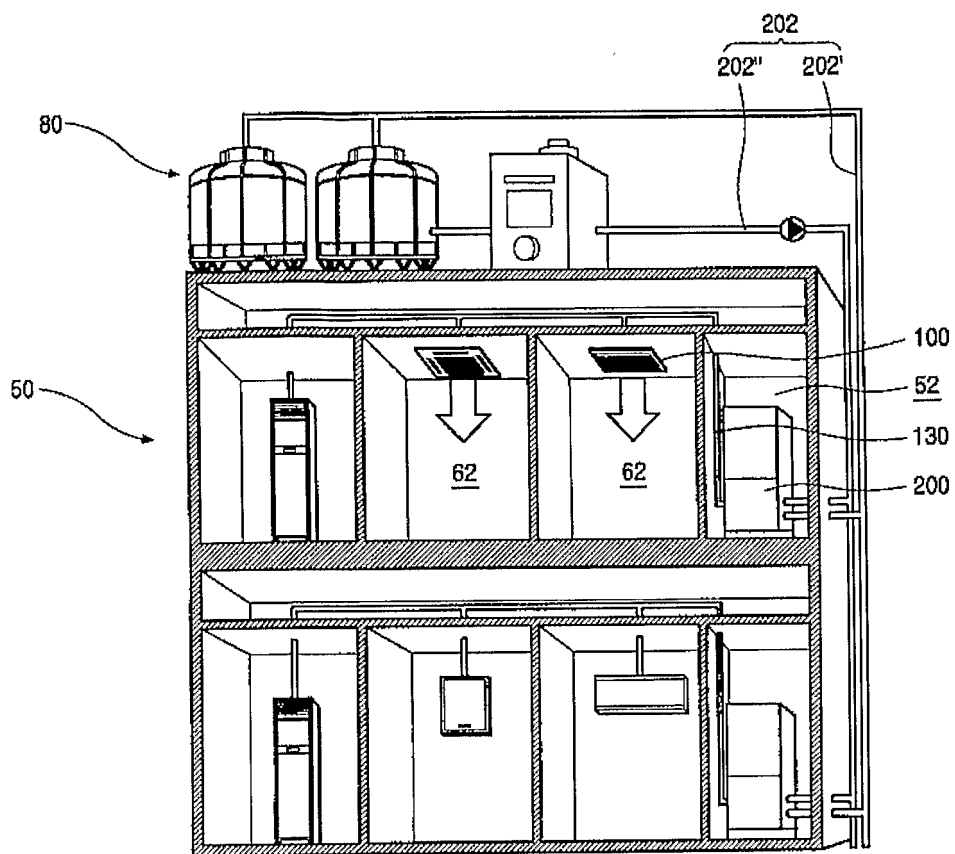
【Fig.1】



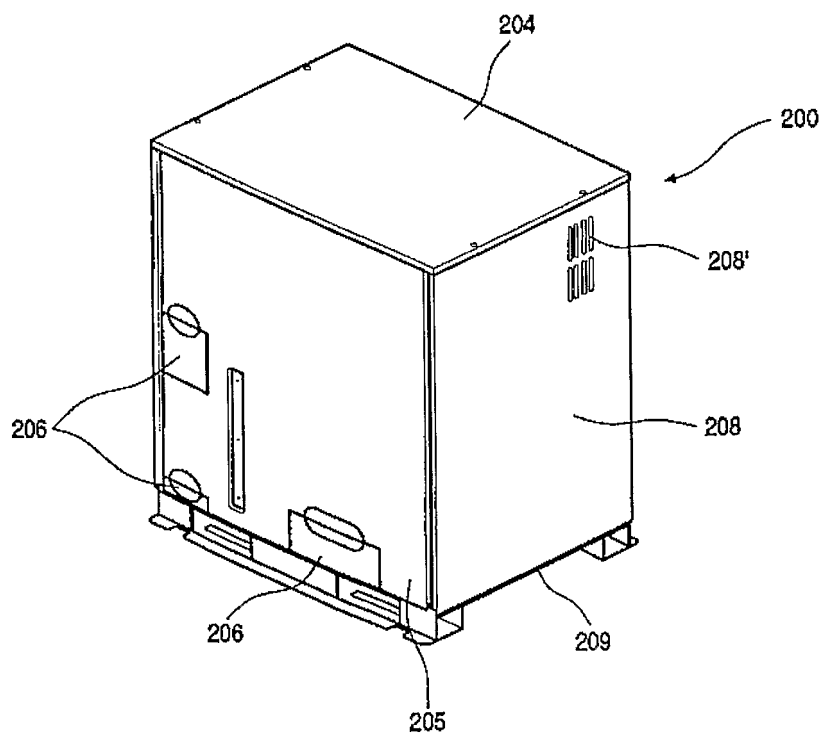
【Fig.2】



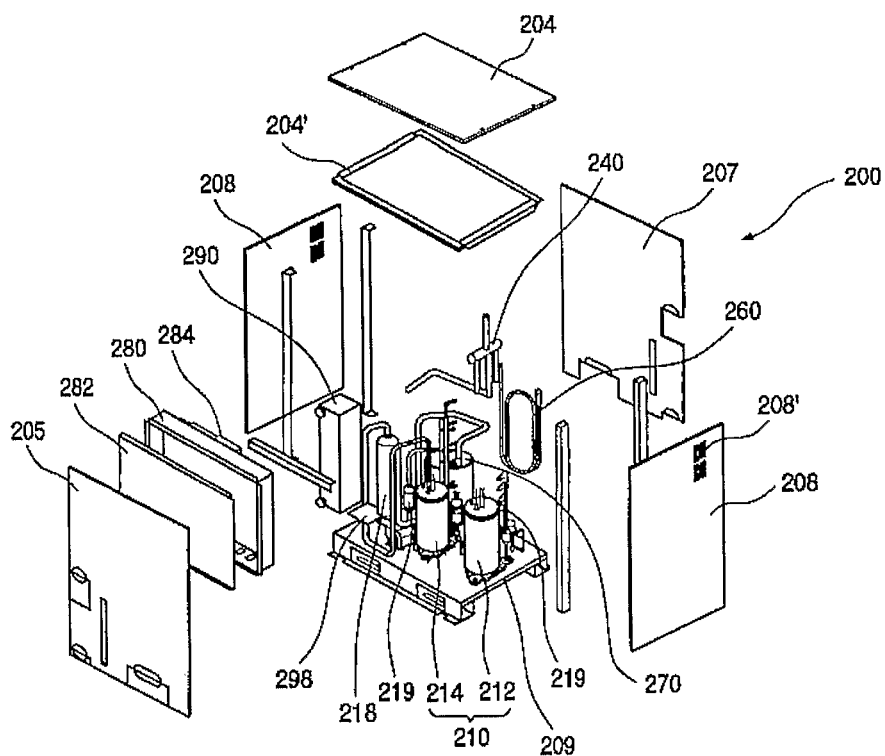
【Fig.3】



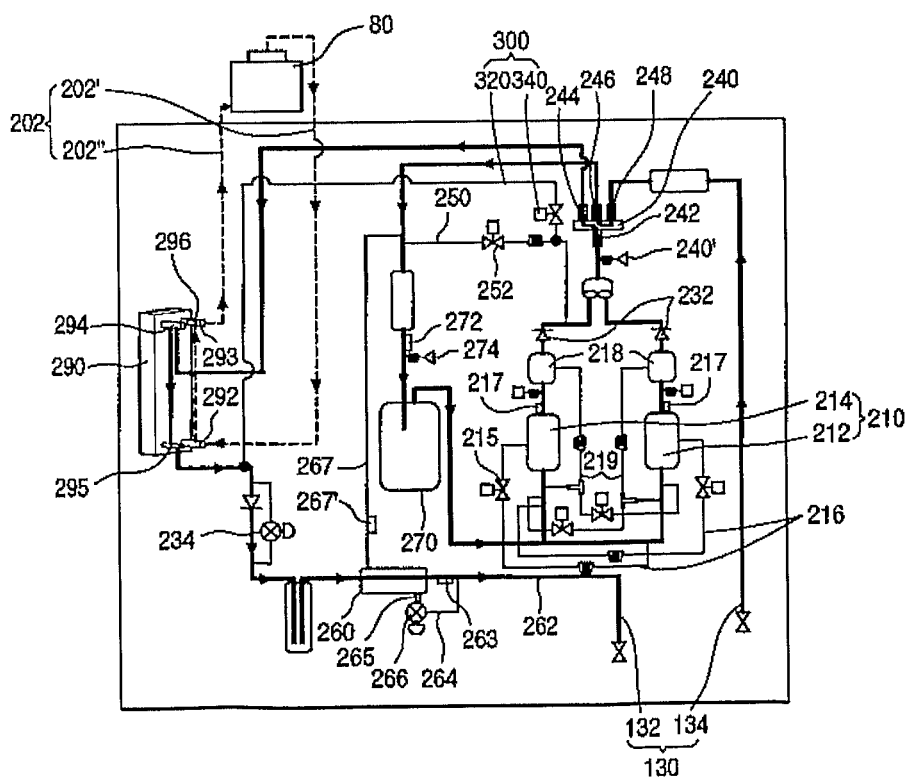
【Fig.4】



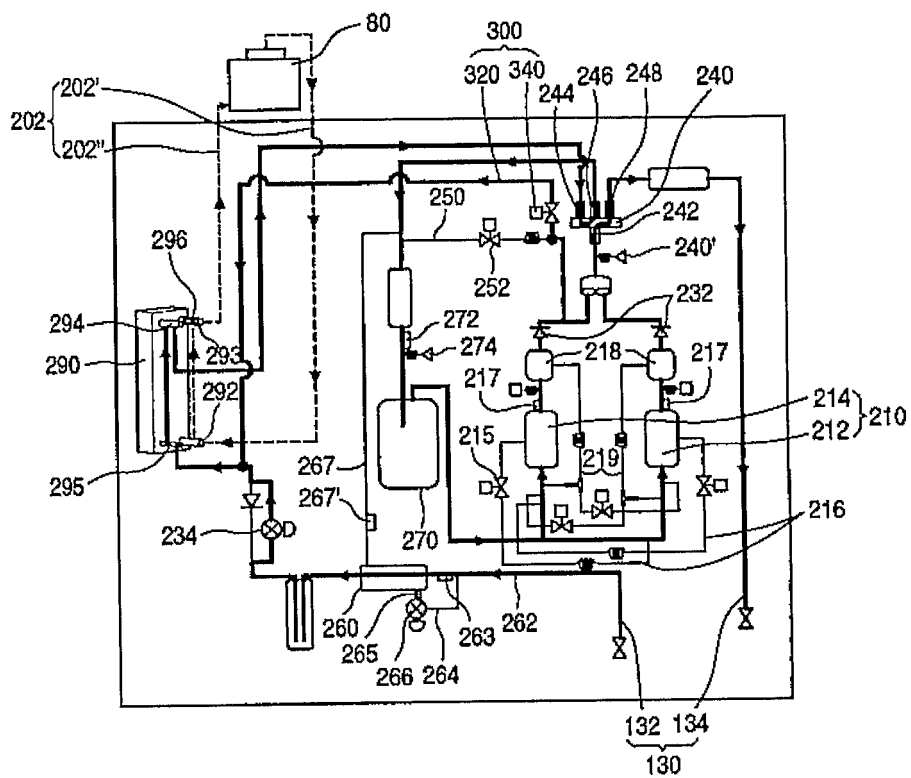
【Fig.5】



【Fig.6】



【Fig.7】



REFERENCES CITED IN THE DESCRIPTION

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