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(54) FREEZING APPARATUS

(57) A freezing apparatus according to the present disclosure operates while switching the gas cooler used, the freezing apparatus comprising: a refrigerant circuit which is composed of a low-stage compression mechanism, a water-cooled intercooler that cools a refrigerant discharged from the low-stage compression mechanism, a high-stage compression mechanism that suctions and compresses the refrigerant that has passed through the water-cooled intercooler, a water-cooled gas cooler and an air-cooled gas cooler that cool the refrigerant discharged from the high-stage compression mechanism, an expansion mechanism, and an evaporator; and an injection circuit which connects a refrigerant pipe on the upstream side of the expansion mechanism and a suction refrigerant pipe of the high-stage compression mechanism via an injection expansion mechanism.

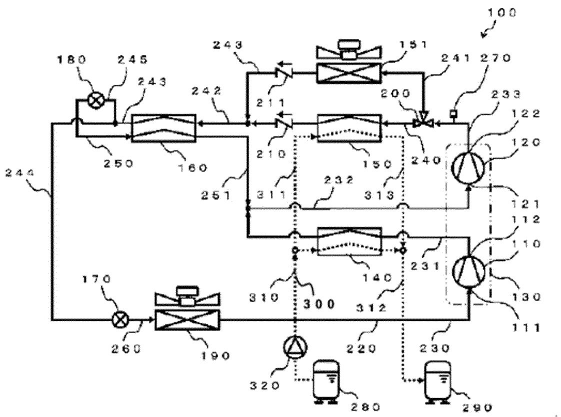

FIG. 1

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Description

Technical Field

[0001] The present disclosure relates to a refrigeration device to be connected to a refrigerating or freezing showcase or the like and relates, in particular, to a refrigeration device in which waste heat of the refrigeration device can be used for hot-water supply and heating.

Background Art

[0002] PTL 1 discloses a condensing unit in which waste heat of a refrigeration device can be used for hot-water supply and heating. The condensing unit includes an intercooler and a gas cooler that are of a water-cooling type and an intercooler and a gas cooler that are of an air-cooling type.

Citation List

Patent Literature

[0003] PTL 1
Japanese Patent Application Laid-Open No. 2020-118354

Summary of Invention

Technical Problem

[0004] The present disclosure provides a refrigeration device in which waste heat of the refrigeration device can be used for hot-water supply and heating while size and cost reductions are addressed.

Solution to Problem

[0005] A refrigeration device in the present disclosure is a refrigeration device that operates while switching a gas cooler to be used, the refrigeration device including: a refrigerant circuit that is constituted by a low-stage compression mechanism, a water-cooling-type intercooler that cools a refrigerant that has been discharged from the low-stage compression mechanism, a high-stage compression mechanism that draws in and compresses a refrigerant that has passed through the water-cooling-type intercooler, a water-cooling-type gas cooler and an air-cooling-type gas cooler that cool the refrigerant that has been discharged from the high-stage compression mechanism, an expansion mechanism, and an evaporator; and an injection circuit in which a refrigerant pipe on an upstream side of the expansion mechanism and an intake refrigerant pipe of the high-stage compression mechanism are connected to each other via an injection-use expansion mechanism.

Advantageous Effects of Invention

[0006] A refrigeration device in the present disclosure uses a water-cooling-type intercooler and a water-cooling-type gas cooler during a water-cooling operation and causes a refrigerant to exchange heat with water to thereby enable usage of waste heat of the refrigeration device for hot-water supply. In addition, it is possible, even when the high-pressure-side pressure is increased with an increase in a water temperature in the summer season and the like, to suppress an abnormal increase in a discharged gas temperature by the water-cooling-type intercooler performing intercooling of the refrigerant that has been discharged from a low-stage compression mechanism. Meanwhile, it is possible to use waste heat of the refrigeration device for heating by using the air-cooling-type gas cooler during an air-cooling operation and causing the refrigerant to exchange heat with air. In addition, since heat is exchanged with indoor air having a low temperature during the air-cooling operation, the high pressure does not easily increase, and it is possible to sufficiently suppress an increase in the discharged gas temperature by performing intercooling by mixing the refrigerant that has been discharged from the low-stage compression mechanism with a refrigerant that is a portion of a high-pressure refrigerant that has branched and that has been decompressed. Thus, the air-cooling-type intercooler can be omitted. Consequently, a refrigerant-passage switching mechanism for switching between the water-cooling-type intercooler and the air-cooling-type intercooler and a connection pipe for the refrigerant-passage switching mechanism are not required, and it is thus possible to address size and cost reductions of the refrigeration device.

Brief Description of Drawings

[0007]

FIG. 1 is a refrigerant circuit diagram of a refrigeration device in Embodiment 1; and
FIG. 2 is a general configuration diagram of the refrigeration device in Embodiment 1 mounted on a closed showcase.

Description of Embodiments

(Underlying Knowledge and the like Forming Basis of the Present Disclosure)

[0008] At the time when the present disclosure was conceived by the inventor, waste heat of refrigeration devices has been desired to be used for hot-water supply and heating in stores such as convenience stores and supermarkets. With the intercooler and the gas cooler that are of the water-cooling type and the intercooler and the gas cooler that are of the air-cooling type, the condensing unit in PTL 1 enables usage of waste heat for hot-water supply and heating by being switched between a water-cooling operation and an air-cooling operation. However, when intercooling is to be performed as in the condensing unit in PTL 1 by the water-cooling-type intercooler and the air-cooling-type intercooler, a refrigerant-passage switching mechanism for switching between the water-cooling-type intercooler and the air-cooling-type intercooler and a connection pipe for the refrigerant-passage switching mechanism are required in addition to a refrigerant-passage switching mechanism for switching between the water-cooling-type gas cooler and the air-cooling-type gas cooler. The inventor has found a problem that this makes arrangement of pipes complicated and increases the size and costs of the refrigeration device, and the inventor has made a theme of the present disclosure to solve the problem.

[0009] Thus, the present disclosure provides a refrigeration device in which waste heat of the refrigeration device can be used for hot-water supply and heating while size and cost reductions are addressed.

[0010] Hereinafter, an embodiment will be described in detail with reference to the drawings. However, detailed description more than necessary may be omitted. For example, detailed description of already well-known matters or duplicated description of substantially identical configurations may be omitted.

[0011] Note that the accompanying drawings and the following description are provided for a person skilled in the art to sufficiently understand the present disclosure and are not intended to limit the theme disclosed in the claims.

(Embodiment 1)

[0012] Hereinafter, Embodiment 1 will be described with FIG. 1 and FIG. 2.

[1-1. Configuration]

[0013] In FIG. 1, refrigeration device 100 includes compressor 130 including low-stage compression mechanism 110 and high-stage compression mechanism 120; water-cooling-type intercooler 140 that cools a refrigerant that has been discharged from low-stage compression mechanism 110; water-cooling-type gas cooler 150 and air-cooling-type gas cooler 151 that cool the refrigerant that has been discharged from high-stage compression mechanism 120; subcooling heat exchanger 160 that further cools the refrigerant that has flowed out from water-cooling-type gas cooler 150 or air-cooling-type gas cooler 151; expansion mechanism 170 and injection-use expansion mechanism 180 that decompress the refrigerant that has flowed out from subcooling heat exchanger 160; and evaporator 190 that absorbs heat from a heat source, such as air.

[0014] Low-stage compression mechanism 110 has low-stage intake port 111 and low-stage discharge port 112. High-stage compression mechanism 120 has high-stage intake port 121 and high-stage discharge port 122.

[0015] Refrigeration device 100 is switchable between a water-cooling operation and an air-cooling operation and includes refrigerant-passage switching mechanism 200 that switches to cause the refrigerant that has been discharged from high-stage compression mechanism 120 to flow into water-cooling-type gas cooler 150 or to flow into air-cooling-type gas cooler 151; first backflow preventing mechanism 210 that prevents the refrigerant that has flowed out from water-cooling-type gas cooler 150 from flowing backward to air-cooling-type gas cooler 151; and second backflow preventing mechanism 211 that prevents the refrigerant that has flowed out from air-cooling-type gas cooler 151 from flowing backward to water-cooling-type gas cooler 150.

[0016] In the present embodiment, a three-way electromagnetic valve is used in refrigerant-passage switching mechanism 200. In addition, a check valve is used in each of first backflow preventing mechanism 210 and second backflow preventing mechanism 211.

[0017] These devices that constitute refrigeration device 100 are connected to each other by refrigerant pipe 220 through which the refrigerant flows.

[0018] Refrigerant pipe 220 is constituted by low-stage intake pipe 230 that connects evaporator 190 to low-stage intake port 111; low-stage discharge pipe 231 that connects low-stage discharge port 112 to water-cooling-type intercooler 140; high-stage intake pipe 232 that connects water-cooling-type intercooler 140 to high-stage intake port 121; high-stage discharge pipe 233 that connects high-stage discharge port 122 to an inlet of refrigerant-passage switching mechanism 200; first high-pressure pipe 240 that connects one of outlets of refrigerant-passage switching mechanism 200 to water-cooling-type gas cooler 150; second high-pressure pipe 241 that connects another one of the outlets of refrigerant-passage switching mechanism 200 to air-cooling-type gas cooler 151; third high-pressure pipe 242 that connects water-cooling-type gas cooler 150 to subcooling heat exchanger 160 via first backflow preventing mechanism 210; fourth high-pressure pipe 243 that extends from air-cooling-type gas cooler 151 and joins/connects with third high-pressure pipe 242 via second backflow preventing mechanism 211; fifth high-pressure pipe 244 that connects subcooling heat exchanger 160 to expansion mechanism 170; sixth high-pressure pipe 245 that branches from fifth high-pressure pipe 244 and connects with injection-use expansion mechanism 180; first intermediate-pressure pipe 250 that connects injection-use expansion mechanism 180 to subcooling heat exchanger 160; second intermediate-pressure pipe 251 that extends from subcooling heat exchanger 160 and joins/connects with high-stage intake pipe 232; and evaporator inlet pipe 260 that connects expansion mechanism 170 to evaporator 190.

[0019] High-stage discharge pipe 233 is provided with discharged gas temperature sensor 270 that detects a temperature of the refrigerant that has been discharged from high-stage compression mechanism 120.

[0020] Refrigeration device 100 also includes a controller (not illustrated) that controls units integrally.

[0021] The controller (not illustrated) performs discharged gas temperature control on the basis of a detection value obtained by discharged gas temperature sensor 270.

[0022] In refrigeration device 100 in the present embodiment, carbon dioxide, with which the refrigerant pressure on the high-pressure side becomes higher than or equal to a critical pressure (supercritical), is used as the refrigerant. The carbon dioxide refrigerant is a non-flammable and non-toxic natural refrigerant that has a less environmental load.

[0023] Refrigeration device 100 also includes water supply tank 280 and hot-water storage tank 290. These devices, water-cooling-type intercooler 140, and water-cooling-type gas cooler 150 are connected to each other by water pipe 300 through which water flows.

[0024] Water pipe 300 is constituted by first water pipe 310 that connects water supply tank 280 to water-cooling-type intercooler 140; second water pipe 311 that branches from first water pipe 310 and connects with water-cooling-type gas cooler 150; third water pipe 312 that connects water-cooling-type intercooler 140 to hot-water storage tank 290; and fourth water pipe 313 that extends from water-cooling-type gas cooler 150 and joins/connects with third water pipe 312.

[0025] First water pipe 310 includes water-conveyance pump 320.

[0026] In the present embodiment, water-cooling-type intercooler 140 and water-cooling-type gas cooler 150 are connected in parallel by first water pipe 310 and second water pipe 311.

[0027] Next, FIG. 2 is a general configuration diagram of refrigeration device 100 in the present embodiment mounted on a closed showcase.

[0028] In FIG. 2, showcase 330 is a closed showcase that includes openable-closable door 340 at the front side of the closed showcase.

[0029] Showcase 330 includes case body 350 made of a heat insulating material and whose front side is open, case body 350 having a substantially U-shaped cross-section and covering the upper side, the back side, and the lower side; duct 360 that causes a space below case body 350 to be in communication with an upper portion; deck pan 370; and display chamber 380.

[0030] Evaporator 190 and expansion mechanism 170 are accommodated in deck pan 370.

[0031] A plurality of shelf plates 390 for displaying commodities are set with a predetermined interval therebetween in the up-down direction in the inside of display chamber 380.

[0032] In addition, opening portion 400 is provided at the front side of the space below case body 350.

[0033] In the present embodiment, air-cooling-type gas cooler 151 is disposed at the upper side of case body 350.

[1-2. Actions]

[0034] Actions and operations of refrigeration device 100 that is configured as described above will be described below.

[0035] Refrigeration device 100 in the present embodiment is switchable between the water-cooling operation and the air-cooling operation.

[0036] Actions of the refrigerant during the water-cooling operation, in which the water-cooling-type gas cooler is used, will be first described.

[0037] First, compressor 130 is actuated to thereby cause the refrigerant that has returned from evaporator 190 to be drawn into low-stage compression mechanism 110 via low-stage intake port 111.

[0038] The refrigerant that has been drawn into low-stage compression mechanism 110 is compressed to an intermediate pressure and is discharged through low-stage discharge port 112.

[0039] The refrigerant that has been discharged through low-stage discharge port 112 flows into water-cooling-type intercooler 140 via low-stage discharge pipe 231.

[0040] The refrigerant that has flowed into water-cooling-type intercooler 140 is cooled by exchanging heat with water and is drawn into high-stage compression mechanism 120 via high-stage intake pipe 232 and high-stage intake port 121 sequentially.

[0041] The refrigerant that has been drawn into high-stage compression mechanism 120 is compressed to the high-pressure-side pressure and is discharged through high-stage discharge port 122.

[0042] The refrigerant that has been discharged through high-stage discharge port 122 flows into refrigerant-passage switching mechanism 200 via high-stage discharge pipe 233.

[0043] During the water-cooling operation, refrigerant-passage switching mechanism 200 is actuated such that the outlet on the side of first high-pressure pipe 240 is an opened state and the outlet on the side of second high-pressure pipe 241 is in a closed state.

[0044] Therefore, the refrigerant that has flowed into refrigerant-passage switching mechanism 200 flows into water-cooling-type gas cooler 150 via first high-pressure pipe 240.

[0045] The refrigerant that has flowed into water-cooling-type gas cooler 150 is cooled by exchanging heat with water and then flows into subcooling heat exchanger 160 via third high-pressure pipe 242 and the first backflow preventing mechanism.

[0046] The refrigerant that has flowed into subcooling heat exchanger 160 is further cooled by exchanging heat with a refrigerant that has passed through the injection-use expansion mechanism 180, which is described later. The cooled refrigerant splits into a refrigerant that flows into expansion mechanism 170 via fifth high-pressure pipe 244 and a refrigerant that flows into injection-use expansion mechanism 180 via fifth high-pressure pipe

244 and sixth high-pressure pipe 245.

[0047] The refrigerant that has flowed into expansion mechanism 170 is decompressed to a predetermined low-pressure-side pressure and then is sent to evaporator 190 via evaporator inlet pipe 260.

[0048] The refrigerant that has been sent to evaporator 190 in the present embodiment is heated by exchanging heat with the air in showcase 330 and is drawn again into low-stage compression mechanism 110.

[0049] Meanwhile, the refrigerant that has flowed into injection-use expansion mechanism 180 is decompressed to an intermediate pressure and then flows into subcooling heat exchanger 160 via first intermediate-pressure pipe 250.

[0050] The refrigerant that has flowed into subcooling heat exchanger 160 is heated by exchanging heat with a refrigerant that has passed through water-cooling-type gas cooler 150 described above. The heated refrigerant joins with a refrigerant in high-stage intake pipe 233 via second intermediate-pressure pipe 251 and is drawn into high-stage compression mechanism 120.

[0051] Then, these actions of the refrigerant are repeated while compressor 130 is actuated.

[0052] Next, actions of water during the water-cooling operation will be described.

[0053] Water-conveyance pump 320 is actuated to thereby cause water to be supplied from water supply tank 280, to flow into water-cooling-type intercooler 140 via first water pipe 310, to branch from first pipe 310, and to flow into water-cooling-type gas cooler 150 via the second water pipe.

[0054] The water that has flowed into water-cooling-type intercooler 140 is heated by exchanging heat with the refrigerant and then flows into hot-water storage tank 290 via third water pipe 312.

[0055] The water that has flowed into water-cooling-type gas cooler 150 is heated by exchanging heat with the refrigerant, then joins with water in third water pipe 312 via fourth water pipe 313, and flows into hot-water storage tank 290.

[0056] Then, these actions of the water are repeated while the water-conveyance pump 320 is actuated.

[0057] Next, actions of the refrigerant during the air-cooling operation, in which air-cooling-type gas cooler is used, will be described.

[0058] First, compressor 130 is actuated to thereby cause the refrigerant that has returned from evaporator 190 to be drawn into low-stage compression mechanism 110 via low-stage intake port 111.

[0059] The refrigerant that has been drawn into low-stage compression mechanism 110 is compressed to an intermediate pressure and is discharged through low-stage discharge port 112.

[0060] The refrigerant that has been discharged through low-stage discharge port 112 flows into water-cooling-type intercooler 140 via low-stage discharge pipe 231.

[0061] During the air-cooling operation, water is not supplied to water-cooling-type intercooler 140. Therefore, the refrigerant that has flowed into water-cooling-type intercooler 140 is drawn, without exchanging heat with water, into high-stage compression mechanism 120 via high-stage intake pipe 232 and high-stage intake port 121 sequentially.

[0062] The refrigerant that has been drawn into high-stage compression mechanism 120 is compressed to the high-pressure-side pressure and is discharged through high-stage discharge port 122.

[0063] The refrigerant that has been discharged through high-stage discharge port 122 flows into refrigerant-passage switching mechanism 200 via high-stage discharge pipe 233.

[0064] During the air-cooling operation, refrigerant-passage switching mechanism 200 is actuated such that the outlet on the side of first high-pressure pipe 240 is in a closed state and the outlet on the side of second high-pressure pipe 241 is in an opened state.

[0065] Therefore, the refrigerant that has flowed into refrigerant-passage switching mechanism 200 flows into air-cooling-type gas cooler 151 via second high-pressure pipe 241.

[0066] The refrigerant that has flowed into air-cooling-type gas cooler 151 is cooled by exchanging heat with air and then flows into subcooling heat exchanger 160 via fourth high-pressure pipe 243, the second backflow preventing mechanism, and third high-pressure pipe 242.

[0067] The refrigerant that has flowed into subcooling heat exchanger 160 is further cooled by exchanging heat with a refrigerant that has passed through the injection-use expansion mechanism 180, which is described later. The cooled refrigerant splits into a refrigerant that flows into expansion mechanism 170 via fifth high-pressure pipe 244 and a refrigerant that branches from fifth high-pressure pipe 244 and that flows into injection-use expansion mechanism 180 via the sixth high-pressure pipe.

[0068] The refrigerant that has flowed into expansion mechanism 170 is decompressed to a predetermined low-pressure-side pressure and then is sent to evaporator 190 via evaporator inlet pipe 260.

[0069] The refrigerant that has been sent to evaporator 190 in the present embodiment is heated by exchanging heat with the air in showcase 330 and is drawn again into low-stage compression mechanism 110.

[0070] Meanwhile, the refrigerant that has flowed into injection-use expansion mechanism 180 is decompressed to an intermediate pressure and then flows into subcooling heat exchanger 160 via first intermediate-pressure pipe 250.

[0071] The refrigerant that has flowed into subcooling heat exchanger 160 is heated by exchanging heat with a refrigerant that has passed through air-cooling-type gas cooler 150 described above. The heated refrigerant joins with a refrigerant in high-stage intake pipe 233 via second intermediate-pressure pipe 251 and is drawn into high-stage compression mechanism 120.

[0072] Then, these actions of the refrigerant are repeated while compressor 130 is actuated.

[0073] Next, actions of air during the air-cooling operation will be described.

[0074] In the present embodiment, air-cooling gas cooler 151 is actuated to thereby cause air to be taken in through opening portion 400 and flow into air-cooling-type gas cooler 151 via duct 360.

[0075] The air that has flowed into air-cooling-type intercooler 151 is heated by exchanging heat with the refrigerant and then is blown out in the front side direction of showcase 330.

[0076] Last, the discharged gas temperature control will be described.

[0077] In the present embodiment, the controller (not illustrated) controls injection-use expansion mechanism 180 on the basis of a detection value obtained by discharged gas temperature sensor 270 such that the discharged gas temperature of high-stage compression mechanism 120 is a predetermined value.

[0078] When the discharged gas temperature is higher than the predetermined value, the controller (not illustrated) controls injection-use expansion mechanism 180 such that the amount of the refrigerant that flows via injection-use expansion mechanism 180 is increased.

[0079] When the discharged gas temperature is lower than the predetermined value, the controller (not illustrated) controls injection-use expansion mechanism 180 such that the amount of the refrigerant that flows via injection-use expansion mechanism 180 is decreased.

[1-3. Effects and the like]

[0080] As described above, refrigeration device 100 in the present embodiment is a refrigeration device in which the refrigerant circuit is constituted by low-stage compression mechanism 110, water-cooling-type intercooler 140 that cools, with water, the refrigerant that has been discharged from low-stage compression mechanism 110, high-stage compression mechanism 120 that draws in the refrigerant that has passed through water-cooling-type intercooler 140, water-cooling-type gas cooler 150 and air-cooling-type gas cooler 151 that cool the refrigerant that has been discharged from high-stage compression mechanism 120, expansion mechanism 170, and evaporator 190. The refrigeration device operates while switching a gas cooler to be used and includes an injection circuit in which the high-pressure side of the refrigerant circuit and an intermediate-pressure region are connected to each other via injection-use expansion mechanism 180.

[0081] Consequently, it is possible to use waste heat of refrigeration device 100 for hot-water supply by using water-cooling-type intercooler 140 and water-cooling-type gas cooler 150 during the water-cooling operation and causing the refrigerant to exchange heat with water. In addition, it is possible, even when the high-pressure-side pressure is increased with an increase in a water temperature in the summer season and the like, to suppress an abnormal increase in the discharged gas temperature by the water-cooling-type intercooler 140 performing intercooling of the refrigerant that has been discharged from low-stage compression mechanism 110.

[0082] Meanwhile, it is possible to use waste heat of refrigeration device 100 for heating by using air-cooling-type gas cooler 151 during the air-cooling operation and causing the refrigerant to exchange heat with air. In addition, since heat is exchanged with indoor air having a low temperature during the air-cooling operation, the high pressure does not easily increase, and it is possible to sufficiently suppress an increase in the discharged gas temperature by performing intercooling by mixing the refrigerant that has been discharged from low-stage compression mechanism 110 with a refrigerant that is a portion of a high-pressure refrigerant that has branched and that has been decompressed. Thus, the air-cooling-type intercooler can be omitted. Consequently, a refrigerant-passage switching mechanism for switching between the water-cooling-type intercooler and the air-cooling-type intercooler and a connection pipe for the refrigerant-passage switching mechanism are not required, and it is thus possible to address size and cost reductions of refrigeration device 100.

[0083] In addition, as in the present embodiment, discharged gas temperature sensor 270 that detects a temperature of the refrigerant that has been discharged from high-stage compression mechanism 120 may be included and may control injection-use expansion mechanism 180 on the basis of the temperature of the refrigerant that has been discharged from high-stage compression mechanism 120.

[0084] Consequently, it is possible to maintain the temperature of the refrigerant that has been discharged from high-stage compression mechanism 120 to be a predetermined value. It is thus possible to prevent the overheating operation of compressor 130 caused by an abnormal increase in the discharged gas temperature.

[0085] In addition, as in the present embodiment, subcooling heat exchanger 160 that causes the refrigerant that has passed through water-cooling-type gas cooler 150 or air-cooling-type gas cooler 151 to exchange heat with the refrigerant that has passed through injection-use expansion mechanism 180 may be included.

[0086] Consequently, the refrigerant that has been cooled in water-cooling-type gas cooler 150 or air-cooling-type gas cooler 151 is further cooled and flows into expansion valve 170. It is thus possible to increase the freezing effect and to increase the refrigerating capacity of refrigeration device 100.

[0087] In addition, as in the present embodiment, refrigeration device 100 that cools showcase 330 may include opening portion 400 at the front side of a portion below showcase 330 and may cool the refrigerant by causing the air that has been taken in through opening portion 400 to flow into air-cooling-type gas cooler 151.

[0088] Consequently, it is possible to cause cold air that is generated due to leakage of cool air of showcase 330 to flow into air-cooling-type gas cooler 151. A temperature difference between the refrigerant and the air is thus increased and increases a heat flux to thereby improve heat dissipation capacity per unit area. It is thus possible to address size and cost reductions of air-cooling-type gas cooler 151. It is also possible to suppress stagnation of cool air, that is, a cold isle due to leakage of cool air.

[0089] In addition, as in the present embodiment, carbon dioxide may be used as the refrigerant in refrigeration device 100.

[0090] Consequently, a temperature glide increases in the process of heat dissipation on the high-pressure side, and it is thus possible to improve efficiency in a heat exchange through a counter flow. Therefore, it is possible to more efficiently generate waste heat having a high temperature and possible to use the waste heat for hot-water supply and heating.

(Other Embodiments)

[0091] As an example of the technology disclosed in the present application, Embodiment 1 has been described as above. However, the technology disclosed in the present disclosure is not limited thereto and can be also applied to the embodiment in which modification, replacement, addition, omission, or the like has been performed. In addition, the components described in Embodiment 1 above can be combined together to form a new embodiment.

[0092] Thus, hereinafter, other embodiments will be presented as examples.

[0093] In Embodiment 1, an example in which the closed showcase is used as showcase 330 has been described. The refrigeration device is, however, not limited thereto and may be mounted on, for example, an open showcase or a walk-in showcase.

[0094] In addition, while air-cooling-type gas cooler 151 is disposed at the upper side of case body 350, air-cooling-type gas cooler 151 may be disposed at any location and may be disposed, for example, at a ceiling or below showcase 330. Note that devices, other than air-cooling-type gas cooler 151, constituting refrigeration device 100 may be disposed at any locations and are disposed, for example, at the upper side of case body 350 or at deck pan 360.

[0095] In addition, while water-cooling-type intercooler 140 and water-cooling-type gas cooler 150 are connected in parallel by water pipe 300, water-cooling-type intercooler 140 and water-cooling-type gas cooler 150 may be connected in any manner and may be connected, for example, in series in order of water-cooling-type intercooler 140 and water-cooling-type gas cooler 150.

[0096] In addition, while water supply tank 280 is included to supply water to water-cooling-type intercooler 140 and water-cooling-type gas cooler 150, the refrigeration device may be connected directly to a water supply without including water supply tank 280.

[0097] In addition, while one compressor that includes the two-stage compression mechanism including low-stage compression mechanism 110 and high-stage compression mechanism 120 is used as compressor 180, the same function can be obtained even when two compressors are used as a low-stage-side compressor and a high-stage-side compressor.

[0098] In addition, while the three-way electromagnetic valve has been described as one example of refrigerant-passage switching mechanism 200, as long as refrigerant-passage switching mechanism 200 is a unit that switches to cause the refrigerant that has been discharged from high-stage compression mechanism 120 to flow into water-cooling-type gas cooler 150 or to flow into air-cooling-type gas cooler 151, for example, an electromagnetic valve may be provided on the inlet side of each of water-cooling-type gas cooler 150 and air-cooling-type gas cooler 151, and the switching may be performed by bringing one of the electromagnetic valves into a closed state. Therefore, refrigerant-passage switching mechanism 200 is not limited to the three-way electromagnetic valve.

[0099] In addition, while carbon dioxide has been described as one example of the refrigerant to be used, the refrigerant to be used may be any medium for moving heat in a refrigeration cycle. Therefore, the refrigerant to be used is not limited to carbon dioxide.

[0100] Note that the embodiments described above are presented as examples of the technology in the present disclosure, and thus, various modification, replacement, addition, omission, and the like can be performed in the embodiments within the scope of the claims or a scope equivalent to the claims.

[0101] The disclosure of the specification, drawings, and abstract included in Japanese Patent Application No. 2022-004033, filed on January 14, 2022, is incorporated herein by reference in its entirety.

Industrial Applicability

[0102] The present disclosure is applicable to a device that effectively uses waste heat of a refrigeration device. Specifically, the present disclosure is applicable to a hot-water supplying device, a floor heating device, a warm-water room heater, an air conditioning device, and the like that use waste heat of a refrigeration device.

Reference Signs List

[0103]

100 Refrigeration device
110 Low-stage compression mechanism
111 Low-stage intake port
112 Low-stage discharge port
120 High-stage compression mechanism
121 High-stage intake port

122 High-stage discharge port
130 Compressor
140 Water-cooling-type intercooler
150 Water-cooling-type gas cooler
151 Air-cooling-type gas cooler
160 Subcooling heat exchanger
170 Expansion mechanism
180 Injection-use expansion mechanism
190 Evaporator
200 Refrigerant-passage switching mechanism
210 First backflow preventing mechanism
211 Second backflow preventing mechanism
220 Refrigerant pipe
230 Low-stage intake pipe
231 Low-stage discharge pipe
232 High-stage intake pipe
233 High-stage discharge pipe
240 First high-pressure pipe
241 Second high-pressure pipe
242 Third high-pressure pipe
243 Fourth high-pressure pipe
244 Fifth high-pressure pipe
245 Sixth high-pressure pipe
250 First intermediate-pressure pipe
251 Second intermediate-pressure pipe
260 Evaporator inlet pipe
270 Discharged gas temperature sensor
280 Water supply tank
290 Hot-water storage tank
300 Water pipe
310 First water pipe
311 Second water pipe
312 Third water pipe
313 Fourth water pipe
320 Water conveyance pump
330 Showcase
340 Door
350 Case body
360 Duct
370 Deck pan
380 Display chamber
390 Shelf plate
400 Opening portion

Claims

1. A refrigeration device that operates while switching a gas cooler to be used, the refrigeration device comprising:

a refrigerant circuit that is constituted by a low-stage compression mechanism, a water-cooling-type intercooler that cools a refrigerant that has been discharged from the low-stage compression mechanism, a high-stage compression mechanism that draws in and compresses a refrigerant that has passed through the water-cooling-type intercooler, a water-cooling-type gas cooler and an air-cooling-type gas cooler that cool the refrigerant that has been discharged from the high-stage compression mechanism, an expansion mechanism, and an evaporator; and

an injection circuit in which a refrigerant pipe on an upstream side of the expansion mechanism and an intake refrigerant pipe of the high-stage compression mechanism are connected to each other via an injection-use expansion mechanism.

2. The refrigeration device according to claim 1, further comprising:

a discharged gas temperature sensor that detects a temperature of the refrigerant that has been discharged from the high-stage compression mechanism, wherein

the injection-use expansion mechanism is controlled based on the temperature of the refrigerant that has been discharged from the high-stage compression mechanism.

3. The refrigeration device according to claim 1, further comprising:
a subcooling heat exchanger that causes the refrigerant that has passed through the water-cooling-type gas cooler or the air-cooling-type gas cooler to exchange heat with the refrigerant that has passed through the injection-use expansion mechanism.

4. The refrigeration device according to claim 1, wherein

the refrigeration device is a refrigeration device that cools a showcase,

the refrigeration device includes an opening portion at a front side of a portion below the showcase, and

air that is taken in through the opening portion is caused to flow into the air-cooling-type gas cooler to thereby cool the refrigerant.

5. The refrigeration device according to claim 1, wherein
carbon dioxide is used as the refrigerant.

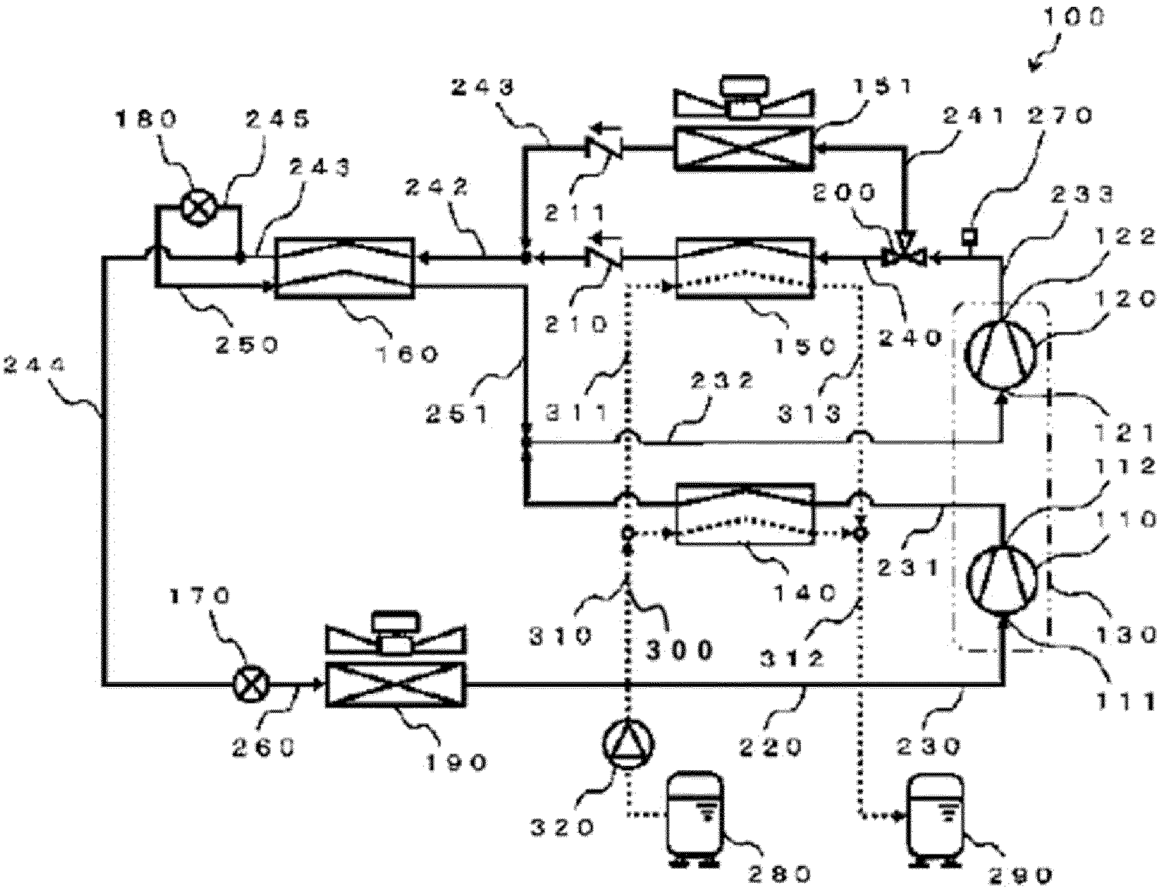
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FIG. 1

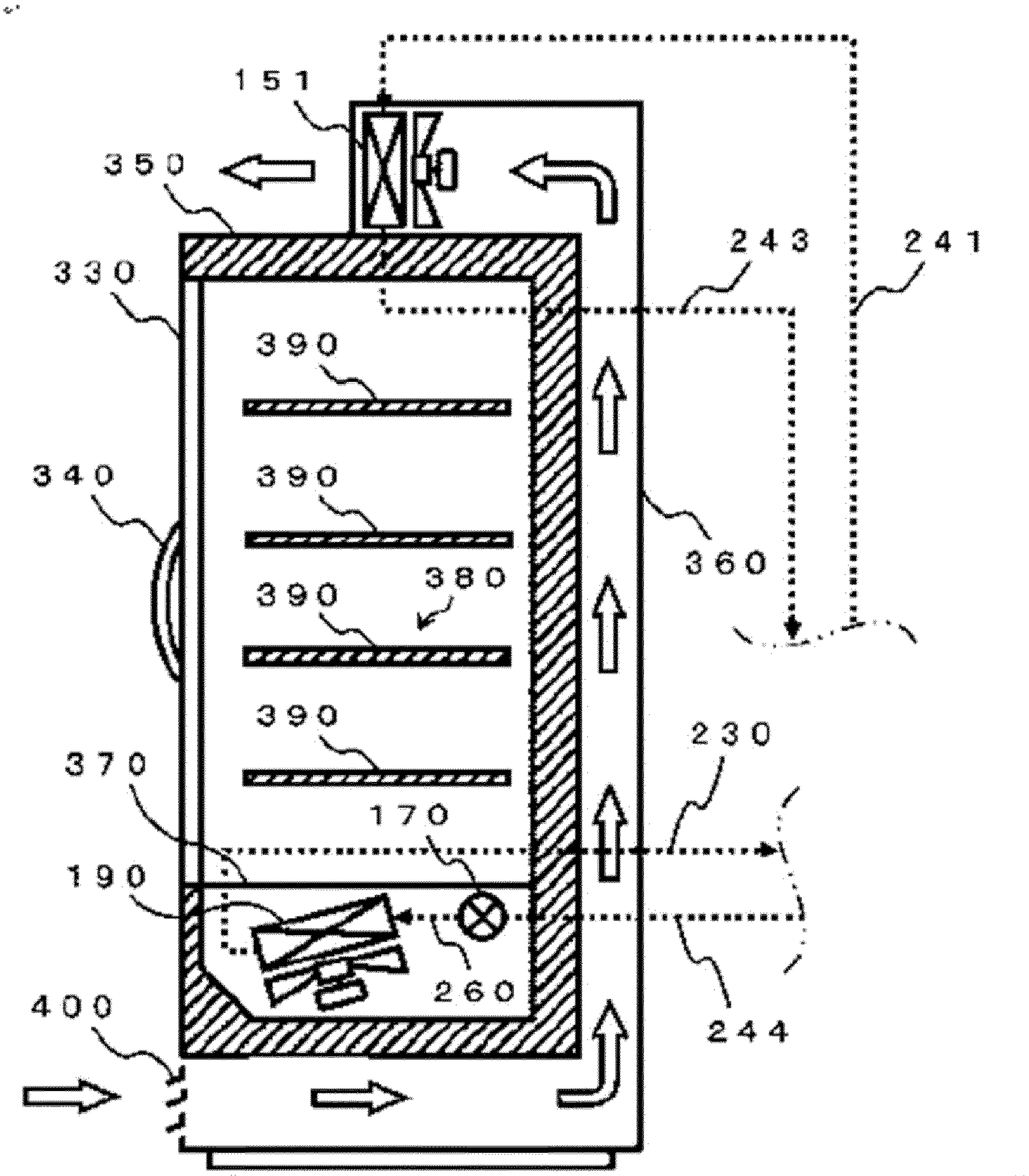
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FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/043693

A. CLASSIFICATION OF SUBJECT MATTER

F25B 6/02(2006.01)i; ***F25B 29/00***(2006.01)i; ***F25D 19/00***(2006.01)i; ***F25B 1/00***(2006.01)i; ***F25B 1/10***(2006.01)i
FI: F25B1/10 E; F25B6/02 H; F25B1/00 396D; F25B1/00 304H; F25B29/00 351; F25B1/00 331E; F25D19/00 550C; F25D19/00 552D

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)

F25B6/02; F25B29/00; F25D19/00; F25B1/00; F25B1/10

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2021-134954 A (PANASONIC IP MANAGEMENT CORP.) 13 September 2021 (2021-09-13) paragraphs [0011]-[0046]	1-5
Y	JP 2020-118354 A (PANASONIC IP MANAGEMENT CORP.) 06 August 2020 (2020-08-06) paragraphs [0002]-[0070]	1-5
Y	WO 2016/084175 A1 (MITSUBISHI ELECTRIC CORP.) 02 June 2016 (2016-06-02) paragraphs [0017]-[0022]	1-5
Y	WO 2017/203608 A1 (MITSUBISHI ELECTRIC CORP.) 30 November 2017 (2017-11-30) paragraphs [0042]-[0080]	2
Y	JP 2020-94760 A (DAIKIN IND., LTD.) 18 June 2020 (2020-06-18) paragraphs [0081]-[0106]	3

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"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
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 December 2022	**10 January 2023**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/043693

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JP 2020-118354 A	06 August 2020	(Family: none)	
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- JP 2022004033 A **[0101]**