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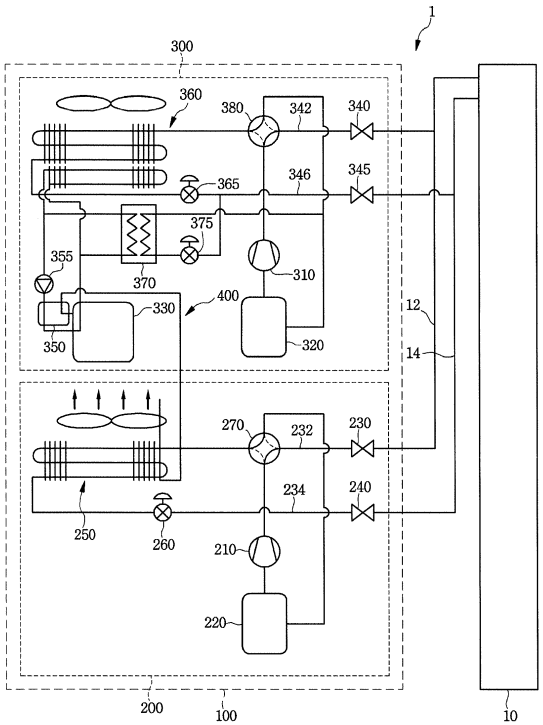
(54) AIR CONDITIONER AND METHOD FOR CONTROLLING AN AIR CONDITIONER

(57) An air conditioner and a method for controlling an air conditioner are provided. The air conditioner may include at least one indoor device; an electric heat pump (EHP) outdoor device connected to the at least one indoor device, and configured to drive a first compressor using electric power; a gas heat pump (GHP) outdoor device connected to the at least one indoor device, and having an engine configured to drive a second compressor using a burned gas; and an exhaust device connected with the engine to discharge an exhaust gas of the engine, and configured to perform heat exchange with an outdoor heat exchanger provided at the EHP outdoor device.

Fig. 1



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Description

BACKGROUND

1. **Field**

[0001] An air conditioner and a method for controlling an air conditioner are disclosed herein.

2. **Background**

[0002] An air conditioner is an apparatus that cools, warms, or purifies indoor air to provide a more comfortable indoor environment for a user. An air conditioner may be classified as an electric heat pump (EHP) type, which uses electric power, or a gas heat pump (GHP) type, which uses a gas fuel, such as liquefied petroleum gas (LPG) and liquefied natural gas (LNG), according to a power source for driving a compressor. In a GHP type, an engine is operated by burning a gas fuel, and thus, a compressor is driven.

[0003] A conventional EHP type air conditioner is disclosed in Korean Patent Application No.10-2003-0077857, which is hereby incorporated by reference. In the conventional EHP type air conditioner, as the compressor may be easily controlled by adjusting a supply current, it is possible to respond to a partial load, and thus, the conventional EHP type air conditioner has high energy efficiency. However, in the EHP type air conditioner, there is a problem in that an outdoor heat exchanger is covered with frost when low temperature warming is performed.

[0004] A conventional GHP type air conditioner is also disclosed in Korean Patent Application No.10-2003-0077857. As the conventional GHP type air conditioner uses waste heat of the engine, it has excellent defrosting performance, but there is a problem in that it has low engine efficiency due to heat loss, for example.

[0005] Therefore, measures capable of providing an air conditioner having further improved performance and efficiency are required.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements, and wherein:

FIG. 1 is a schematic diagram of an air conditioner according to an embodiment;
FIG. 2 is a partial view illustrating components of the air conditioner of FIG. 1; and
FIG. 3 is a schematic diagram illustrating an operation of the air conditioner of FIG. 1.

DETAILED DESCRIPTION

[0007] In the following detailed description of embodiments, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration embodiments which may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the embodiments, and it is understood that other embodiments may be utilized and that logical structural, mechanical, electrical, and chemical changes may be made without departing from the spirit or scope. To avoid detail not necessary to enable those skilled in the art to practice the embodiments, the description may omit certain information known to those skilled in the art. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope is defined only by the appended claims.

[0008] FIG. 1 is a schematic diagram of an air conditioner according to an embodiment. FIG. 2 is a partial view illustrating components of the air conditioner of FIG. 1. Referring to Figs. 1 and 2, the air conditioner 1 may include an indoor unit or device 10 and an outdoor unit or device 100. One or a plurality of indoor devices 10 may be provided. The one or more indoor device 10 may be connected with the outdoor device 100, and may cool, warm or purify indoor air.

[0009] The outdoor device 100 may be connected with the one or more indoor device 10 and may perform compressing and expanding, for example, of a refrigerant to allow a sufficient heat exchanging operation of the indoor device 10. A plurality of outdoor devices 100 may be provided. Hereinafter, as an example, an embodiment having one pair of outdoor devices 100 will be described.

[0010] The outdoor device 100 may be a combined type including an electric heat pump (EHP) type using electric power and a gas heat pump (GHP) type using a gas fuel, such as LPG and LNG. The outdoor device 100 may include an EHP outdoor unit or device 200, a GHP outdoor unit or device 300, and an exhaust unit or device 400.

[0011] The EHP outdoor device 200 may be an outdoor device operated using an EHP and may include a first compressor 210, a first accumulator 220, a pair of connection valves 230 and 240, a first outdoor heat exchanger 250, a first outdoor heat exchanger control valve 260, and a first four-way valve 270. The first compressor 210 may compress the refrigerant and may be driven by applying a voltage. That is, when the voltage is applied to the first compressor 210, the first compressor 210 may compress the refrigerant. The first accumulator 220 may supply the refrigerant to the first compressor 210. When the refrigerant flows backwards or is introduced into the first compressor 210 as a liquid, the first compressor 210 may be damaged, and thus, the first accumulator 220 may temporarily store a mixture of oil and refrigerant.

[0012] The pair of connection valves 230 and 240 may include a connection valve 230, which may connect a pipe 232 that connects to the first compressor 210 with a pipe 12 of the indoor device 10, and a connection valve 240, which may connect a pipe 234 that connects to the first outdoor heat exchanger 250 with a pipe 14 of the

indoor device 10. The first outdoor heat exchanger 250 may evaporate or condense the refrigerant according to a cooling operation or a warming operation of the air conditioner 1. When the air conditioner 1 performs the cooling operation, the refrigerant may be condensed, and when the air conditioner 1 performs the warming operation, the refrigerant may be evaporated.

[0013] The first outdoor heat exchanger 250 may be provided with a distributor 252. The distributor 252 may extend in a heightwise or lengthwise direction of the first outdoor heat exchanger 250 and may allow the refrigerant to be evenly introduced into the first outdoor heat exchanger 250 when the refrigerant passes through the first outdoor heat exchanger 250. As the distributor 252 is well known, detailed description thereof has been omitted.

[0014] The first outdoor heat exchanger control valve 260 may control a flow of the refrigerant toward the first outdoor heat exchanger 250. As the first outdoor heat exchanger control valve 260 is well known, detailed description thereof has been omitted.

[0015] The first four-way valve 270 may change or switch a passage of the refrigerant flowing in the EHP outdoor device 200. As the first four-way valve 270 is well known, detailed description thereof has been omitted.

[0016] The GHP outdoor device 300 may be an outdoor device operated using a GHP method and may include a second compressor 310, a second accumulator 320, an engine 330, a pair of connection valves 340 and 345, a cooling water heat exchanger 350, a cooling water pump 355, a second outdoor heat exchanger 360, a second outdoor heat exchanger control valve 365, a plate type heat exchanger 370, a plate type heat exchanger control valve 375, and a second four-way valve 380. The second compressor 310 may compress the refrigerant and may be operated through driving of the engine 330, which will be described hereinafter. When a driving force is transmitted to the second compressor 310 through the engine 330, the second compressor 310 may compress the refrigerant, similar to the first compressor 210.

[0017] The second accumulator 320 may supply the refrigerant to the second compressor 310. When the refrigerant flows backwards or is introduced into the second compressor 310 as a liquid, the second compressor 310 may be damaged, and thus, the second accumulator 320 may temporarily store a mixture of oil and refrigerant, similar to the first accumulator 220.

[0018] The engine 330 may transmit the driving force to the second compressor 310 and may be operated by burning the gas fuel, such as LPG and LNG. The GHP outdoor device 300 may be operated using the GHP method through a burned gas from the engine 330.

[0019] The pair of connection valves 330 and 340 may include a connection valve 340, which may connect a pipe 342 connected to the second compressor 310 with the pipe 12 of the indoor device 10, and a connection valve 345, which may connect a pipe 346 connected to the second outdoor heat exchanger 360 with the pipe 14 of the indoor device 10.

[0020] The cooling water heat exchanger 350 may cool the engine 330. The cooling water heat exchanger 350 may absorb heat of the engine 330 overheated by the driving of the engine 330 using cooling water.

[0021] The cooling water pump 355 may provide a flowing force to the cooling water and may be connected with the cooling water heat exchanger 350. Therefore, the cooling water pump 355 may supply the cooling water to the cooling water heat exchanger 350.

[0022] The second outdoor heat exchanger 360 may evaporate or condense the refrigerant according to the cooling operation or the warming operation of the air conditioner 1, similar to the first outdoor heat exchanger 250. When the air conditioner 1 performs the cooling operation, the refrigerant may be condensed, and when the air conditioner 1 performs the warming operation, the refrigerant may be evaporated.

[0023] The second outdoor heat exchanger control valve 365 may control a flow of the refrigerant toward the second outdoor heat exchanger 360. As the second outdoor heat exchanger control valve 365 is also well known and similar to the first outdoor heat exchanger control valve 260, detailed description thereof has been omitted.

[0024] The plate type heat exchanger 370 may evaporate or condense the refrigerant according to the cooling operation or the warming operation of the air conditioner 1, similar to the second outdoor heat exchanger 360. The plate type heat exchanger 370 may evaporate or condense the refrigerant together with the second outdoor heat exchanger 360. The plate type heat exchanger control valve 375 may control the flow of the refrigerant toward the plate type heat exchanger 370. As the plate type heat exchanger control valve 375 is well known, detailed description thereof has been omitted.

[0025] The second four-way valve 380 may change or switch a passage of the refrigerant flowing in the GHP outdoor device 300. As the second four-way valve 380 is also well known and similar to the first four-way valve 270, detailed description thereof has been omitted.

[0026] The exhaust device 400 may connect with the engine 330 to discharge an exhaust gas of or from the engine 330 and may be provided to pass through the first outdoor heat exchanger 250 and to heat exchange with the first outdoor heat exchanger 250 provided at the EHP outdoor device 200. The exhaust device 400 may be adjacent to the first outdoor heat exchanger 250 and extend along the first outdoor heat exchanger 250. The exhaust device 400 may include a first exhaust pipe 410, a second exhaust pipe 420, and a third exhaust pipe 430.

[0027] The first exhaust pipe 410 may extend from the engine 330 toward the EHP outdoor device 200. That is, the first exhaust pipe 410 may extend from the engine 330 of the GHP outdoor device 300 to a point or position near the first outdoor heat exchanger 250 of the EHP outdoor device 200. The first exhaust pipe 410 may extend to the point or position near the first outdoor heat

exchanger 250 of the EHP outdoor device 200 via the cooling water heat exchanger 350 of the GHP outdoor device 300.

[0028] The second exhaust pipe 420 may connect with the first exhaust pipe 410 and may be adjacent to the first outdoor heat exchanger 250 of the EHP outdoor device 200. The second exhaust pipe 420 may be adjacent to the distributor 252 and extend along the distributor 252 or may be provided at or on the distributor 252.

[0029] A distributor insertion groove 425, into which the distributor 252 may be inserted, may be formed at or in the second exhaust pipe 420. The distributor insertion groove 425 may be provided at or in an outer surface of the second exhaust pipe 420 and may have a size sufficient such that the distributor 252 may be inserted in a longitudinal direction of the second exhaust pipe 420.

[0030] The second exhaust pipe 420 may have a rectangular parallelepiped shape provided in a heightwise direction of the distributor 252; however, embodiments are not limited thereto. For example, the second exhaust pipe 420 may be provided as near as possible to the outer surface of the distributor 252, or may be provided at the outer surface over a range or area, which may be as wide as possible.

[0031] The third exhaust pipe 430 may connect with the second exhaust pipe 420 to discharge the exhaust gas from the engine 330 outside. The third exhaust pipe 430 may include a connection part or portion 432 and an exhaust gas discharging part or portion 434.

[0032] The connection portion 432 may connect with the second exhaust pipe 420. The exhaust gas discharging portion 434 may be formed to be bent from the connection portion 432. The exhaust gas discharging portion 434 may be bent in a direction so as to extend substantially parallel with the first outdoor heat exchanger 250. The exhaust gas discharging portion 434 may be bent upward from the connection portion 432 and extend substantially parallel with the first outdoor heat exchanger 250.

[0033] FIG. 3 is a schematic diagram illustrating an operation of the air conditioner of FIG. 1. Referring to FIG. 3, when the air conditioner 1 performs the warming operation, in the EHP outdoor device 200, a high temperature gas refrigerant may be transferred to the indoor device 10, and a low temperature liquid refrigerant may be introduced from the indoor device 10. The high temperature gas refrigerant may be transferred to the indoor device 10 through the connection valve 230 and the pipe 12 of the indoor device 10, and the low temperature liquid refrigerant may be introduced into the EHP outdoor device 200 through the pipe 14 of the indoor device 10 and the connection valve 240.

[0034] When the air conditioner 1 performs the warming operation, in the GHP outdoor device 300, similar to the EHP outdoor device 200, the high temperature gas refrigerant may be transferred to the indoor device 10, and the low temperature liquid refrigerant may be introduced from the indoor device 10. That is, the air conditioner 1 may be driven in a combined method of the EHP method and the GHP method.

[0035] In the EHP outdoor device 200, the low temperature liquid refrigerant introduced into the EHP outdoor device 200 may be evaporated in the first outdoor heat exchanger 250 via the pipe 234 and may heat exchange with air. Therefore, a temperature of the low temperature liquid refrigerant may be increased.

[0036] When an external environment, in which the EHP outdoor device 200 may be provided, has a low temperature and high humidity, the first outdoor heat exchanger 250 of the EHP outdoor device 200 may be covered with frost due to moisture in the air. When a frosting range, or range at which frost occurs, at the first outdoor heat exchanger 250 is widened, heat exchange with the refrigerant may not be performed properly, and thus, an undesirable defrosting operation may need to be performed. Due to the defrosting operation, the warming operation may not be performed at the indoor device 10 connected with the EHP outdoor device 200.

[0037] However, in the air conditioner 1 according to embodiments disclosed herein, the above-described problem may not occur due to the exhaust device 400. The exhaust gas discharged from the engine 330 may pass through the exhaust device 400. Typically, a temperature of the exhaust gas introduced into the exhaust device 400 may be higher than a temperature of the air in the atmosphere. The temperature of the exhaust gas may be about 60°C to 70°C. The exhaust gas having the temperature of about 60°C to 70°C may be transferred to the first outdoor heat exchanger 250 through the exhaust device 400.

[0038] The exhaust gas may pass through the first exhaust pipe 410 of the exhaust device 400, the second exhaust pipe 420 of the exhaust device 400, and the third exhaust pipe 430 of the exhaust device 400, and may then be discharged outside through the exhaust gas discharging portion 434. Heat exchange between the refrigerant flowing through the distributor 252 and the exhaust gas flowing through the second exhaust pipe 420 may be performed through the second exhaust pipe 420, in which the distributor 252 may be inserted and which may be adjacent to the distributor 252. Therefore, as the temperature of the refrigerant flowing through the distributor 252 is increased, the frosting phenomenon may be considerably reduced, even when the first outdoor heat exchanger 250 is provided at or in a position or environment having low temperature and high humidity.

[0039] Thus, in the embodiments disclosed herein, when the air conditioner 1 performs the warming operation, the frosting phenomenon of the first outdoor heat exchanger 250 may be prevented. Additionally, the undesirable defrosting operation may be prevented, even though the first outdoor heat exchanger 250 of the EHP outdoor device 200 may be exposed to an environment having low temperature and high humidity. Therefore, in the warming operation of the air conditioner 1, the air conditioner 1 according to the embodiments disclosed

herein may improve performance and efficiency of the outdoor device 100.

[0040] An air conditioner according to embodiments disclosed herein capable of further improving performance and efficiency may be provided.

[0041] Embodiments disclosed herein provide an air conditioner including at least one indoor unit or device; an electric heat pump (EHP) outdoor unit or device connected with the at least one indoor unit, and configured to drive a first compressor using electric power; a gas heat pump (GHP) outdoor unit or device connected with the at least one indoor unit, and having an engine configured to drive a second compressor using a burned gas; and an exhaust unit or device connected with the engine to discharge an exhaust gas of the engine, and configured to perform heat exchange with an outdoor heat exchanger provided at the EHP outdoor unit. The exhaust unit may be disposed or provided adjacent to the outdoor heat exchanger along the outdoor heat exchanger. The exhaust unit may include a first exhaust pipe formed to extend from the engine toward the EHP outdoor unit; a second exhaust pipe connected with the first exhaust pipe and disposed adjacent to the outdoor heat exchanger; and a third exhaust pipe connected with the second exhaust pipe and configured to discharge the exhaust gas.

[0042] The outdoor heat exchanger may have a distributor, which may be disposed or provided or extend in a heightwise or lengthwise direction of the outdoor heat exchanger. The second exhaust pipe may be disposed or provided adjacent to the distributor along the distributor. A distributor insertion groove, in which the distributor may be inserted, may be formed at the second exhaust pipe.

[0043] The GHP outdoor unit may include a cooling water heat exchanger configured to perform the heat exchange with a refrigerant introduced from the at least one indoor unit. The first exhaust pipe may pass through the cooling water heat exchanger at the engine. The second exhaust pipe may have a rectangular parallelepiped shape. The third exhaust pipe may include a connection part or portion connected with the second exhaust pipe, and an exhaust gas discharging part or portion formed to be bent from the connection part. The exhaust gas discharging part may be disposed or extend in parallel with the outdoor heat exchanger.

[0044] Even though all the elements of the embodiments are coupled into one or operated in the combined state, the embodiments are not limited to such. That is, all the elements may be selectively combined with each other without departing the scope. Further, when it is described that one comprises (or comprises or has) some elements, it should be understood that it may comprise (or include or have) only those elements, or it may comprise (or include or have) other elements as well as those elements if there is no specific limitation. Unless otherwise specifically defined herein, all terms comprising technical or scientific terms are to be given meanings understood by those skilled in the art. Like terms defined in dictionaries, generally used terms needs to be construed as meaning used in technical contexts and are not construed as ideal or excessively formal meanings unless otherwise clearly defined herein.

[0045] Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

[0046] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. An air conditioner, comprising:

   at least one indoor device;
   an electric heat pump (EHP) outdoor device connected to the at least one indoor device, and including a first compressor using electric power and an outdoor heat exchanger;
   a gas heat pump (GHP) outdoor device connected to the at least one indoor device, and having an engine configured to drive a second compressor using a burned gas; and
   an exhaust device connected to the engine to discharge an exhaust gas of the engine, and configured to perform heat exchange with the outdoor heat exchanger.

2. The air conditioner according to claim 1, wherein the exhaust device is provided adjacent to and extends along the outdoor heat exchanger.

3. The air conditioner according to claim 2, wherein the exhaust device includes:

   a first exhaust pipe that extends from the engine

toward the EHP outdoor device;
a second exhaust pipe connected to the first exhaust pipe and provided adjacent to the outdoor heat exchanger; and
a third exhaust pipe connected to the second exhaust pipe and configured to discharge the exhaust gas.

4. The air conditioner according to claim 3, wherein the outdoor heat exchanger has a distributor that extends in a lengthwise direction of the outdoor heat exchanger.

5. The air conditioner according to claim 4, wherein the second exhaust pipe is provided adjacent to and extends along the distributor.

6. The air conditioner according to claim 4, wherein the second exhaust pipe includes a distributor insertion groove into which the distributor is inserted.

7. The air conditioner according to any of claims 3 to 6, wherein the GHP outdoor device includes a cooling water heat exchanger configured to perform heat exchange with refrigerant introduced from the at least one indoor device.

8. The air conditioner according to claim 7, wherein the first exhaust pipe passes through the cooling water heat exchanger.

9. The air conditioner according to any of claims 3 to 8, wherein the second exhaust pipe has a rectangular parallelepiped shape.

10. The air conditioner according to any of claims 3 to 9, wherein the third exhaust pipe includes:

a connection portion connected to the second exhaust pipe; and
an exhaust gas discharging portion bent from the connection portion.

11. The air conditioner according to claim 10, wherein the exhaust gas discharging portion extends parallel with the outdoor heat exchanger.

12. A method for controlling an air conditioner including at least one indoor device; an electric heat pump (EHP) outdoor device connected to the at least one indoor device, and including a first compressor using electric power and an outdoor heat exchanger; a gas heat pump (GHP) outdoor device connected to the at least one indoor device, and having an engine configured to drive a second compressor using a burned gas; and an exhaust device connected to the engine to discharge an exhaust gas of the engine, the method comprising:

driving the GHP outdoor device and the EHP outdoor device to perform a warming operation; and
during the warming operation performing heat exchange with the outdoor heat exchanger using the exhaust device.

13. The method according to claim 12, wherein the exhaust device is provided adjacent to and extends along the outdoor heat exchanger.

14. The method according to claim 12 or 13, wherein the exhaust device includes:

a first exhaust pipe that extends from the engine toward the EHP outdoor device;
a second exhaust pipe connected to the first exhaust pipe and provided adjacent to the outdoor heat exchanger; and
a third exhaust pipe connected to the second exhaust pipe and configured to discharge the exhaust gas.

15. The method according to any of claims 12 to 14, wherein the outdoor heat exchanger has a distributor that extends in a lengthwise direction of the outdoor heat exchanger.

Fig. 1

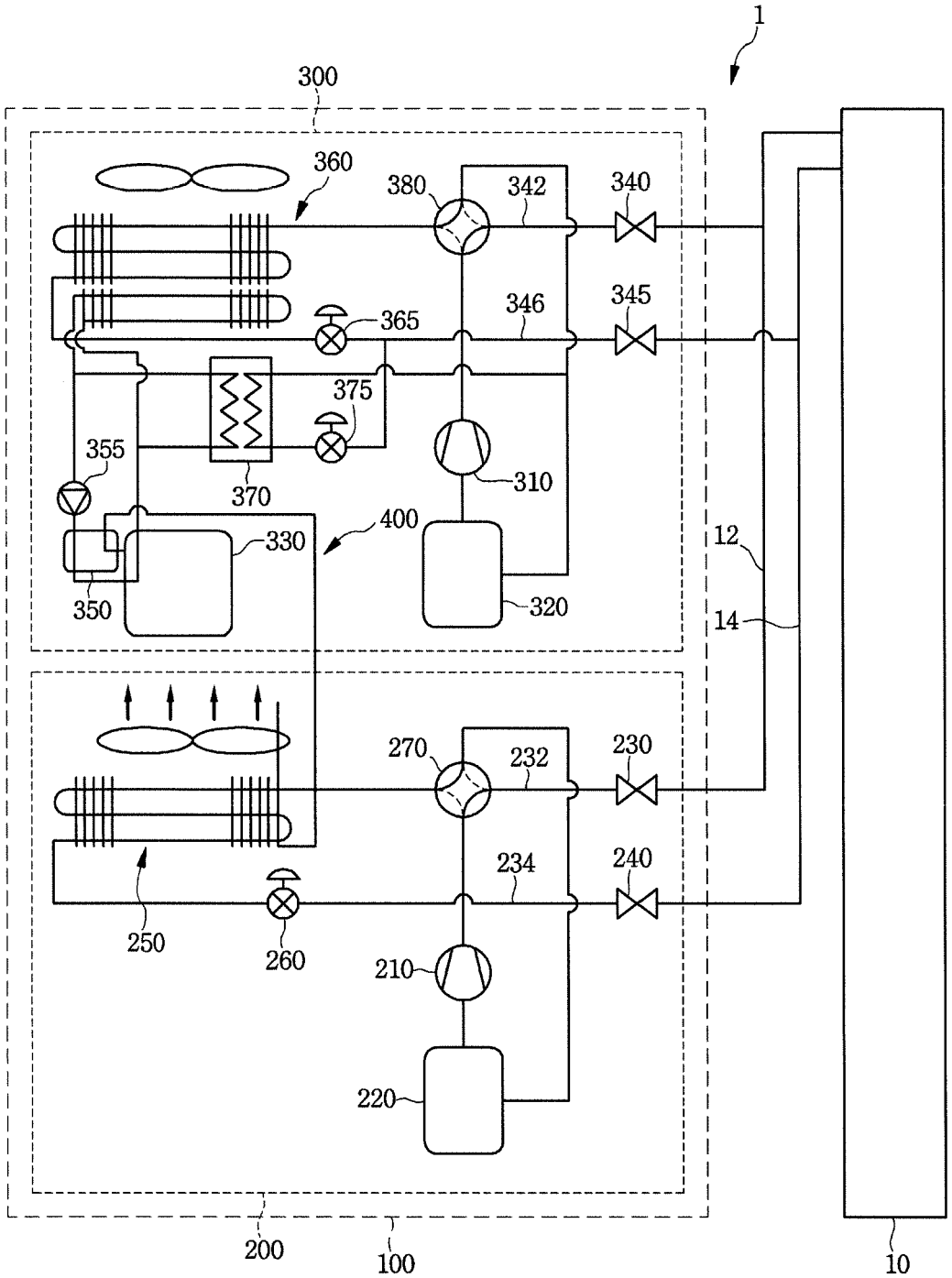
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Fig. 2

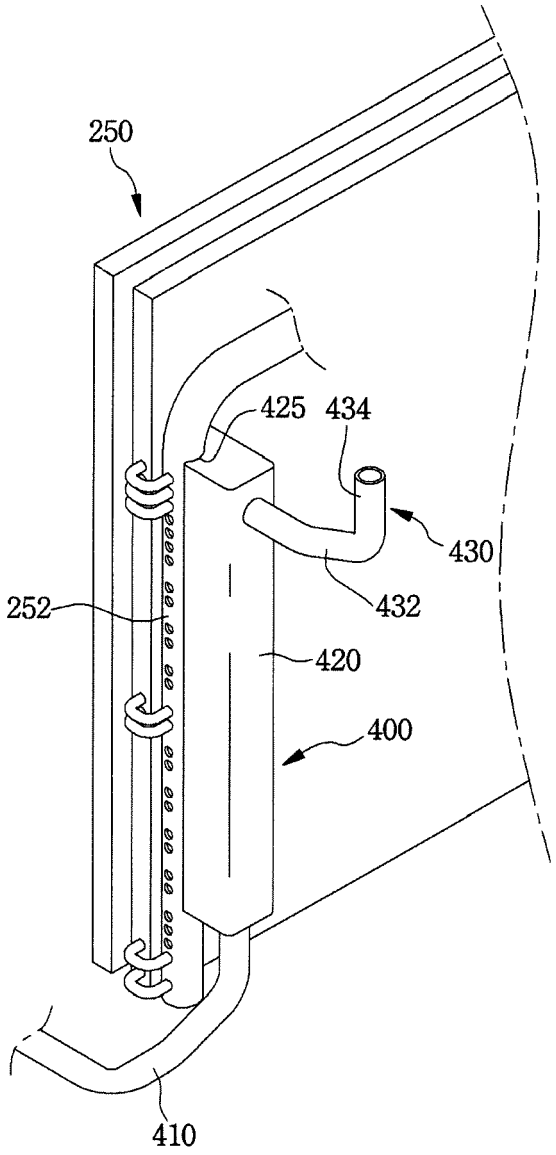
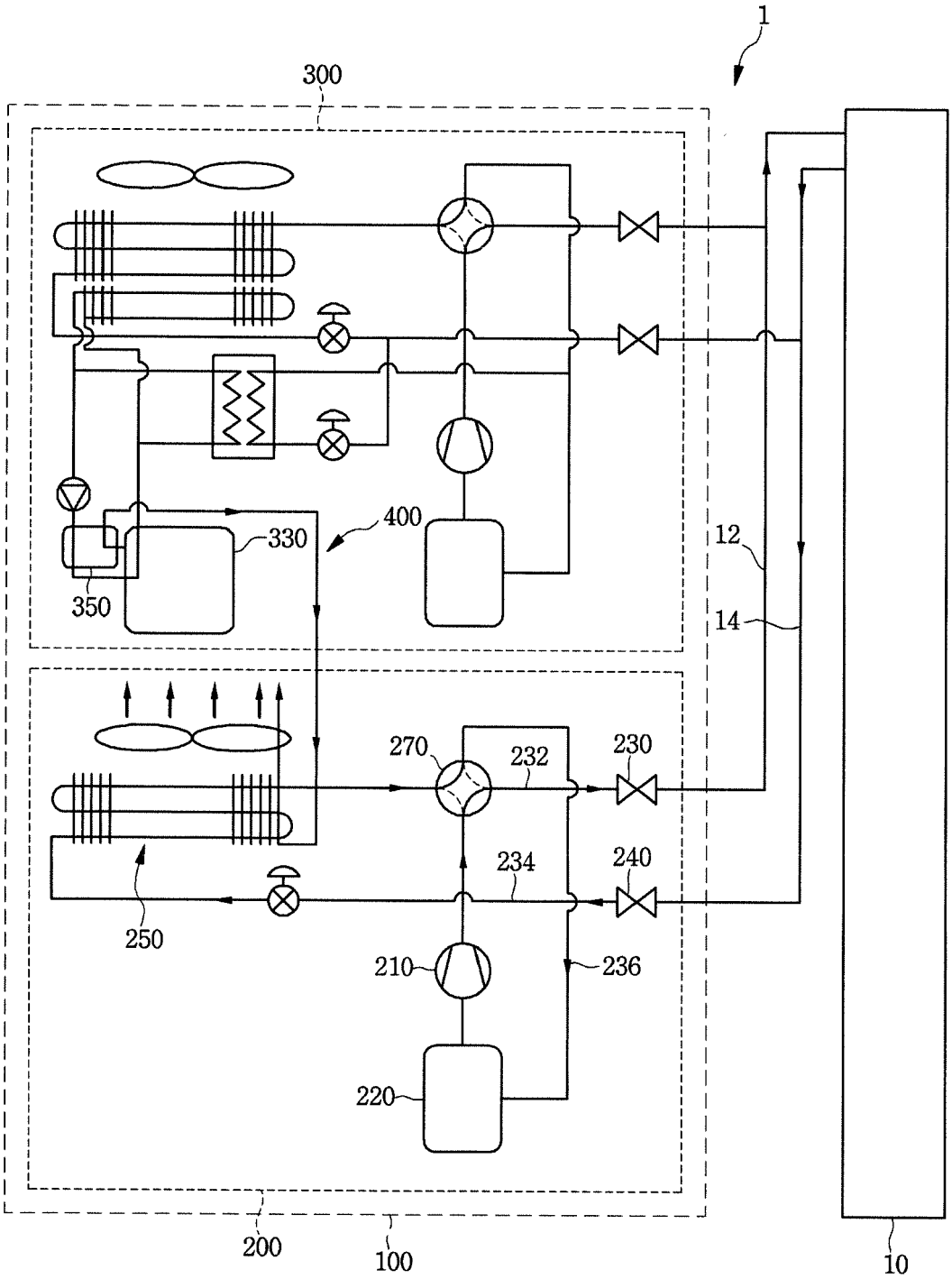


Fig. 3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EUROPEAN SEARCH REPORT

Application Number
EP 16 15 0788

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TECHNICAL FIELDS SEARCHED (IPC)

F25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 May 2016	Amous, Moez

CATEGORY OF CITED DOCUMENTS

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06-05-2016

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REFERENCES CITED IN THE DESCRIPTION

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