



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
29.06.2011 Bulletin 2011/26

(51) Int Cl.:
F24F 1/00 (2011.01) F25B 1/00 (2006.01)
F25B 13/00 (2006.01)

(21) Application number: **09814265.6**

(86) International application number:
PCT/JP2009/004567

(22) Date of filing: **14.09.2009**

(87) International publication number:
WO 2010/032420 (25.03.2010 Gazette 2010/12)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

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(30) Priority: **17.09.2008 JP 2008238724**

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(54) **OUTDOOR UNIT OF AIR CONDITIONER**

(57) An outdoor unit of an air conditioner is provided in which the refrigerant heating apparatus can be stably mounted and ease of assembly can be improved. The outdoor unit (2) of an air conditioner is provided with a compressor (21), an accumulator (25) for separating gas and liquid refrigerant, and a refrigerant heating apparatus (30). The accumulator (25) is connected to the intake side of the compressor (21). The refrigerant heating apparatus (30) is connected to the intake side of the accumulator (25) and heats the refrigerant. The refrigerant heating apparatus (30) is arranged above the accumulator (25).

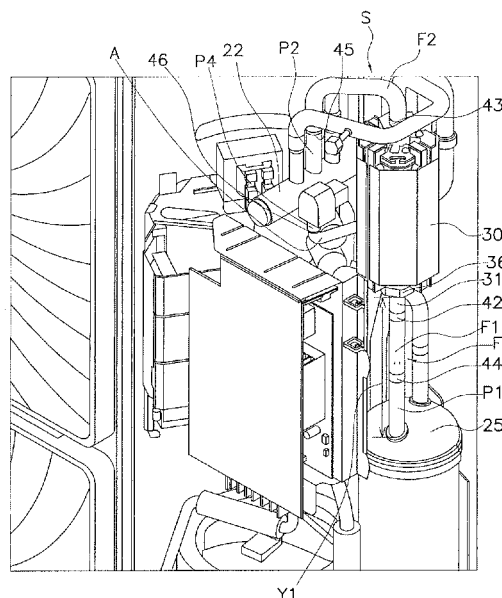


Fig. 8

Description

TECHNICAL FIELD

5 [0001] The present invention relates to an outdoor unit of an air conditioner.

BACKGROUND ART

10 [0002] A variety of refrigerant heating apparatuses have been used in the past for heating a refrigerant in a refrigerant circuit, but an induction heating heater (hereinafter referred to as IH heater) is convenient in that the refrigerant can be rapidly heated using induction heating.

[0003] An IH heater for heating refrigerant produces heat by induction by exciting a tube through which refrigerant flows or a magnetic body inside or outside a tube using an induction heating coil, and is thereby capable of heating refrigerant in a tube. Such an IH heater is described in Patent Literature 1 (Japanese Laid-open Patent Application No. 2001-174054).

15 [0004] The IH heater described in Patent Document 1 is mounted, e.g., near an expansion valve in order to be used as refrigerant heating means or as an air-warming auxiliary heater during defrosting operation.

SUMMARY OF THE INVENTION

20 <Problems the Invention is to Solve>

[0005] The IH heater or other refrigerant heating apparatus is a relatively heavy component, and there are therefore problems in that the work for installing the IH heater inside the outdoor unit is difficult during the assembly of the outdoor unit and it is difficult to improve mounting stability.

25 [0006] An object of the present invention is to provide an outdoor unit of an air conditioner in which the refrigerant heating apparatus can be mounted in a stable manner, and assembly can be carried out with greater ease.

30 <Means for Solving the Problems>

[0007] The outdoor unit of an air conditioner according to a first aspect comprises a refrigerant container and a refrigerant heating apparatus. The refrigerant container is a container capable of accumulating refrigerant that flows through a refrigerant circuit. The refrigerant heating apparatus heats the refrigerant flowing through the refrigerant circuit. The refrigerant heating apparatus is arranged above the refrigerant container.

35 [0008] According to the aspect described above, the refrigerant heating apparatus can be stably mounted and the outdoor unit can be assembled with greater ease because the refrigerant heating apparatus for heating the refrigerant that flows through the refrigerant circuit is arranged above the refrigerant container.

[0009] An outdoor unit of an air conditioner according to a second aspect is the outdoor unit according to the first aspect, and further comprises a compressor. The compressor compresses the refrigerant that flows through the refrigerant circuit. The refrigerant container is an accumulator for separating gas and liquid refrigerant, the accumulator being connected to an intake side of the compressor. The refrigerant heating apparatus is connected to an intake side of the accumulator.

40 [0010] According to the aspect described above, the refrigerant heating apparatus is connected to the intake side of the accumulator and is arranged above the accumulator. Therefore, the refrigerant heating apparatus can be stably mounted above the accumulator, and the outdoor unit can be assembled with greater ease.

[0011] An outdoor unit of an air conditioner according to a third aspect is the outdoor unit according to the second aspect, wherein the distance between the refrigerant heating apparatus and the accumulator is a distance that allows brazing of a tube that connects between the refrigerant heating apparatus and the accumulator.

45 [0012] According to the aspect described above, brazing can be readily and reliably carried out, and the outdoor unit can be assembled with greater ease because the distance between the refrigerant heating apparatus and the accumulator is a distance that allows brazing of the tube that connects between the refrigerant heating apparatus and the accumulator.

[0013] An outdoor unit of an air conditioner according to a fourth aspect is the outdoor unit according to the second aspect, and further comprises an accumulator tube and switching means. The accumulator tube is a tube for connecting the refrigerant heating apparatus to the accumulator. The switching means switches the flow of refrigerant inside the refrigerant circuit. The refrigerant heating apparatus, the accumulator tube, and the switching means constitute an integrated assembly. The integrated assembly is brazed to the accumulator.

50 [0014] According to the aspect described above, the integrated assembly can be readily and reliably installed in an outdoor unit and the outdoor unit can be assembled with considerably greater ease because the refrigerant heating

apparatus, the accumulator tube, and the switching means constitute an integrated assembly, and the integrated assembly is brazed to the accumulator.

[0015] An outdoor unit of an air conditioner according to a fifth aspect is the outdoor unit according to the second aspect, wherein one end of the integrated assembly is brazed to the accumulator and another end of the integrated assembly is brazed to another tube constituting the refrigerant circuit, whereby the integrated assembly is secured inside the outdoor unit.

[0016] According to the aspect described above, the integrated assembly is secured to a tube constituting the refrigerant circuit merely by brazing in two locations, and has a support structure in which no support is provided by other tubes, fixed objects, and/or the like. For this reason, the refrigerant heating apparatus is arranged above the accumulator and can thereby be stably arranged because the weight of the refrigerant heating apparatus is positioned on the accumulator.

[0017] An outdoor unit of an air conditioner according to a sixth aspect is the outdoor unit according to the first aspect, and further comprises an outdoor heat exchanger for exchanging heat between outdoor air and the refrigerant flowing through the refrigerant circuit. The refrigerant container is a receiver for separating gas and liquid refrigerant and is connected between the outdoor heat exchanger and an indoor heat exchanger that is connected to the refrigerant circuit.

[0018] According to the aspect described above, the refrigerant heating apparatus can be stably mounted above the receiver and the outdoor unit can be assembled with greater ease because the refrigerant container is a receiver for separating gas and liquid refrigerant and is connected between the outdoor heat exchanger and an indoor heat exchanger connected to the refrigerant circuit, and the refrigerant heating apparatus is arranged above the receiver.

<Effects of Invention>

[0019] According to the first aspect of the invention, the refrigerant heating apparatus can be stably mounted and the outdoor unit can be assembled with considerably greater ease.

[0020] According to the second aspect of the invention, the refrigerant heating apparatus can be stably mounted above the accumulator, and the outdoor unit can be assembled with considerably greater ease.

[0021] According to the third aspect of the invention, brazing can be readily and reliably carried out, and the outdoor unit can be assembled with greater ease.

[0022] According to the fourth aspect of the invention, the integrated assembly can be readily and reliably installed in an outdoor unit and the outdoor unit can be assembled with considerably greater ease.

[0023] According to the fifth aspect of the invention, the refrigerant heating apparatus is arranged above the accumulator and can thereby be stably arranged because the weight of the refrigerant heating apparatus is positioned on the accumulator.

[0024] According to the sixth aspect of the invention, the refrigerant heating apparatus can be stably mounted above the receiver and the outdoor unit can be assembled with considerably greater ease.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a circuit diagram of an air conditioner in which the IH heater assembly according to the first embodiment of the present invention has been mounted.

FIG. 2 is an enlarged perspective view of a machine compartment portion of the outdoor unit of FIG. 1.

FIG. 3 is a front view the IH heater assembly of FIG. 1.

FIG. 4 is a cross-sectional view the IH heater assembly of FIG. 1.

FIG. 5 is a schematic cross-sectional view showing the insertion step in the method for manufacturing the IH heater assembly of FIG. 1.

FIG. 6 is a schematic cross-sectional view showing the tube expansion step in the method for manufacturing the IH heater assembly of FIG. 1.

FIG. 7 is a schematic cross-sectional view showing the bobbin mounting step in the method for manufacturing the IH heater assembly of FIG. 1.

FIG. 8 is an enlarged perspective view of the arrangement of the IH heater assembly of FIG. 1.

FIG. 9 is a schematic cross-sectional view showing the brazing of the IH heater assembly of FIG. 1.

FIG. 10 is a circuit diagram of a heat pump apparatus in which the IH heater assembly according to the second embodiment of the present invention is mounted.

DESCRIPTION OF EMBODIMENTS

[0026] Next, embodiments of the outdoor unit of an air conditioner of the present invention will be described with

reference to the drawings.

<First embodiment>

5 <Basic configuration>

[0027] In an air conditioner 1 that includes the refrigerant heating apparatus 30 (hereinafter referred to as IH heater assembly 30) shown in FIG. 1, there is provided a refrigerant circuit 11 that connects an outdoor unit 2 and an indoor unit 4 by way of a liquid refrigerant communication tube 6 and a gas refrigerant communication tube 7, as shown in FIG. 1. The refrigerant tubes of the refrigerant circuit 11 are ordinarily made of copper.

[0028] The refrigerant circuit 11 is provided with a compressor 21, a four-way switching valve 22, an outdoor heat exchanger 23, an expansion valve 24 composed of an electronic expansion valve that can be adjustably metered, an IH heater assembly 30, an accumulator 25, and the like in an outdoor unit 2, as shown in FIGS. 1 and 2. Also, the refrigerant circuit 11 is provided with an indoor heat exchanger 26, or the like, as shown in FIG. 1, inside the indoor unit 4. The four-way switching valve 22 is shown in FIG. 1 to be in a switched and connected state for air-warming operation.

[0029] The accumulator 25 of the first embodiment corresponds to the refrigerant container of the present invention.

[0030] Here, the refrigerant that flows through the refrigerant circuit 11 is not particularly limited in the present invention, and may be, e.g., HFC (R410A or the like), carbon dioxide refrigerant, or the like.

[0031] The refrigerant circuit 11 has a discharge tube A, an indoor-side gas tube B, an indoor-side liquid tube C, an outdoor-side liquid tube D, and outdoor-side gas tube E, an accumulator tube F, and an intake tube G, as shown in FIG. 1.

[0032] The accumulator tube F has a straight tube portion F1, and a U-shaped tube portion F2, as shown in FIG. 8.

[0033] The connective states of the refrigerant tubes are described below in the sequence of the flow channel in which the refrigerant discharged from the compressor 21 flows out and then again taken into the compressor 21.

[0034] The discharge tube A connects the discharge side of the compressor 21 and the four-way switching valve 22.

[0035] The indoor-side gas tube B connects the four-way switching valve 22 and the gas side of the indoor heat exchanger 26.

[0036] The indoor-side liquid tube C connects the liquid side of the indoor heat exchanger 26 and the expansion valve 24. Here, the indoor-side liquid tube C includes a liquid refrigerant communication tube 6 for communicating between the outdoor unit 2 and the indoor unit 4.

[0037] The outdoor-side liquid tube D connects the expansion valve 24 and the liquid side of the outdoor heat exchanger 23.

[0038] The outdoor-side gas tube E connects the gas side of the outdoor heat exchanger 23 and the four-way switching valve 22.

[0039] The accumulator tube F connects the four-way switching valve 22 and the accumulator 25.

[0040] The intake tube G connects the accumulator 25 and the intake side of the compressor 21.

[0041] The refrigerant circuit 11 is configured in the manner described above and is capable of carrying out air-warming operation when refrigerant circulates and flows in the direction described above. Air-cooling operation is also possible by switching the connection state of the four-way switching valve 22.

[0042] The IH heater assembly 30 is arranged above the accumulator 25, as shown in FIGS. 2 and 5. Specifically, the later-described IH heater assembly 30 is connected by brazing at an intermediate point in the accumulator tube F (between the straight tube portion F1 and the U-shaped tube portion F2).

<Configuration of the IH heater assembly 30>

[0043] The IH heater assembly 30 is an IH heater composed of a double tube, as shown in FIGS. 3 and 4, and is provided with an inner tube 31, an outer tube 32, an induction heating coil 33, a bobbin 34, a pair of lids 35, a pair of nuts 36, a plurality of ferrite blocks 37, a ferrite holders 38, and a sheet metal cover 39.

[0044] The inner tube 31 is made of copper, which is the same material as refrigerant tubes 5, and refrigerant flows through the interior thereof.

[0045] The outer tube 32 is made of stainless steel, which is a magnetic body, and is wrapped around the periphery of the inner tube 31. Specifically, the inner tube 31 is expanded, whereby the external peripheral surface of the inner tube 31 and the internal peripheral surface of the outer tube are directly attached. The thickness of the outer tube 32 is 1 to 1.2 mm so that effective induction heating can be obtained by the skin effect (a phenomenon in which the current density increases on the surface of the conductor and decreases with increasing distance from the surface when a high-frequency current flows through the conductor).

[0046] The material of the outer tube 32 is not limited to stainless steel, it also being possible to use iron, copper, aluminum, chromium, nickel, or another conductor; or an alloy or the like that includes at least two or more types of metals selected from the above group of metals. Examples of the stainless steel include at least one type of ferrite or

martensite, or a combination thereof.

[0047] The induction heating coil 33 is wrapped around the periphery of the outer tube 32 and inductively heats the outer tube 32. The induction heating coil 33 is arranged so as to be wrapped around the periphery of the outer tube 32 in a state wrapped around the outer tube 32 and the bobbin 34 as a separate member.

[0048] The bobbin 34 is a cylindrical member open at both ends, and the induction heating coil 33 is wrapped around lateral peripheral surface thereof.

[0049] The pair of lids 35 has an aperture 35a in the center and is fitted onto the external periphery of the outer tube 32. The pair of lids 35 are secured from the top and bottom sides by later-described C-shaped ferrite holders 38 in a state mounted on the bobbin 34.

[0050] The pair of nuts 36 thread onto externally treaded portions 32a formed on the external periphery near the two ends of the outer tube 32, and thereby secure the preassembled bobbin 34, lids 35, ferrite holders 38, and nuts 36 of the IH heater assembly 30 to the outer periphery of the outer tube 32.

[0051] The plurality of ferrite blocks 37 are mounted in alignment with the C-shaped ferrite holders 38 in order to reduce leakage flux to the exterior of the sheet metal cover 39 of the IH heater assembly 30. The ferrite holders 38 are mounted from four directions of the bobbin 34 over the exterior of the induction heating coil 33.

[0052] The sheet metal cover 39 is a cover composed of a thin sheet of metal, and threadably held to the exterior of the ferrite holders 38. The sheet metal cover 39 is cylindrical or polygonal in order to wrap around the cylindrical bobbin 34, and has a single integrated shape, or a shape divided into two or more shapes.

[0053] The inner tube 31 and the accumulator tube F are thereby readily joined together (manufacture is facilitated) because the inner tube 31 is made of the same type of copper as the other refrigerant tubes including accumulator tube F. Also, efficient induction heating is made possible by the outer tube 32 composed of stainless steel, or another a magnetic body.

[0054] The strength of the entire IH heater assembly 30 is improved because a structure is adopted in which the outer tube 32 having a certain degree of thickness is made to support the bobbin 34 on which the induction heating coil 33 is wrapped.

[0055] As described above, the IH heater assembly 30 is disposed at an intermediate point in the accumulator tube F portion connecting the four-way switching valve 22 and the accumulator 25, whereby the intake gas refrigerant traveling from the four-way switching valve 22 toward the accumulator 25 can be warmed and air-warming ability can be improved by the IH heater assembly 30 which receives a high-frequency AC current from a high-frequency power source 60 via a power line 71, as shown in FIG. 1.

[0056] There are cases in which the compressor 21 has not sufficiently warmed up when air-warming operation is started, but in this configuration, the IH heater assembly 30 produces heat and the gas refrigerant traveling from the four-way switching valve 22 toward the accumulator 25 can be heated to thereby offset insufficient capacity during startup.

[0057] In the case that the four-way switching valve 22 is switched to an air-cooling operation and a defrost operation is to be carried out for removing frost deposited on the outdoor heat exchanger 23, the gas refrigerant warmed by passing through the IH heater assembly 30 can be further compressed by the compressor 21, and the temperature of the hot gas discharged from the compressor 21 can be increased. The time required by the defrost operation for thawing frost can thereby be shortened. It is therefore possible to restore air-warming operation as soon as possible and to increase the comfort of the user, even when a defrost operation must be carried out in a timely manner during an air-warming operation.

<Method for manufacturing an IH heater assembly 30>

[0058] In the case that the IH heater assembly 30 of the first embodiment is to be manufactured, first, an inner tube 31 made of copper constituting a portion of the refrigerant tubes of the refrigerant circuit 11 is inserted into a stainless steel outer tube 32 constituting a magnetic body (insertion step), as shown in FIG. 5.

[0059] An expansion billet 41 having a slightly greater outside diameter than the inside diameter of the inner tube 31 is press-fitted into the inner tube, whereby the inner tube 31 is expanded in the direction in which the outside diameter expands and is fitted inside the outer tube 32 (tube expansion step), as shown in FIG. 6.

[0060] The preassembled bobbin 34, lids 35, ferrite holders 38, and nuts 36 of the IH heater assembly 30 are thereafter inserted over the outer periphery of the outer tube 32 with the nuts 36 in a loosened state, as shown in FIG. 7. The nuts 36 are then tightened onto the outer tube 32 to thereby press a C-shaped ring 43 in the inside diameter direction, whereby the bobbin 34 and other main constituent elements are mounted (bobbin-mounting step). Manufacture of the IH heater assembly 30 is thereby completed.

<Structure for mounting the IH heater assembly 30>

[0061] The IH heater assembly 30 is connected to the intake side of the upper end of the accumulator 25 via the

accumulator tube F and is thereby arranged above the accumulator 25, as shown in FIG. 8. The IH heater assembly 30 can, thereby, be stably mounted and assembly facilitated.

[0062] The IH heater assembly 30 is mounted in the refrigerant circuit 11 by having the upper and lower ends of the inner tube 31 of the IH heater assembly 30 brazed using a filler metal in brazing locations 42, 43 in an intermediate point in the accumulator tube F among the copper refrigerant tubes A to G of the refrigerant circuit 11, as shown in FIGS. 8 and 9. The inner tube 31 and accumulator tube F are thereby readily joined together (manufacture is facilitated) because materials of the same type are brazed together, and efficient induction heating is also made possible.

[0063] Specifically, with the structure for mounting the IH heater assembly 30 of the first embodiment, the lower end of the inner tube 31 of the IH heater assembly 30 is brazed to the straight tube portion F1 of the accumulator tube F in the brazing location 42, as shown in FIG. 8; and the upper end of the inner tube 31 is brazed to one end of the U-shaped tube portion F2 of the accumulator tube F in the brazing location 43. The lower end of the straight tube portion F1 is brazed to the straight tube-shaped intake tube P1 of the accumulator 25 in the brazing location 44. The other end of the U-shaped tube portion F2 is brazed to the connection tube P2 of the four-way switching valve 22 at the brazing location 45.

[0064] Therefore, the intake tube P1 of the accumulator 25, the straight tube portion F1 of the accumulator tube F, and the IH heater assembly 30 are coaxially arranged in the vertical direction above the accumulator 25 using the space provided above the accumulator 25, as shown in FIG. 8. This arrangement makes it possible to position the center of gravity of the heavy IH heater assembly 30 above the intake tube P1 and the straight tube portion F1 of the accumulator tube F, and makes it possible to stably mount the IH heater assembly 30. Accordingly, the assembly of the outdoor unit 2 is considerably facilitated.

[0065] In the assembly process of the outdoor unit 2, it is possible to pre-configure an assembly S in which the IH heater assembly 30, the accumulator tube F (i.e., the straight tube portion F1 and U-shaped tube portion F2), and the four-way switching valve 22 are brazed together, as shown in FIG. 8. In this case, the straight tube portion F1 of the integrated assembly S is brazed to the intake tube P1 of the accumulator 25, whereby the integrated assembly S can be readily and reliably installed in the outdoor unit 2 and assembly is considerably improved.

[0066] The integrated assembly S is secured inside the outdoor unit 2 by brazing one end of the integrated assembly (i.e., the lower end of the straight tube portion F1 of the assembly S) to the intake tube P1 of the accumulator 25 in the brazing location 44, and by brazing the other end (i.e., the connection tube P4 or the extended tube thereof of the four-way switching valve 22) to the discharge tube A, which is the other tube constituting the refrigerant circuit 11 in the brazing location 46, for example. Accordingly, the IH heater assembly 30, which is a heavy object, can be stably arranged above the accumulator by resting the weight of the IH heater assembly 30 on the accumulator 25.

[0067] Also, the brazing location 44 can be brazed because the distance Y1 between the IH heater assembly 30 and the accumulator 25 (i.e., the distance from the lowermost end of the nut 36 on the lower side of the IH heater assembly 30 to the base of the intake tube P1 of the accumulator 25) is a sufficient distance to allow the tubes connecting the IH heater assembly 30 and the accumulator 25 to be brazed (i.e., see the brazing location 44).

<Characteristic of the first embodiment>

(1)

[0068] In the outdoor unit 2 of an air conditioner of the first embodiment, the IH heater assembly 30 is connected to the intake side at the upper end of the accumulator 25 via the accumulator tube F and is thereby arranged above the accumulator 25. The IH heater assembly 30 can thereby be stably arranged above the accumulator 25 and the assembly of the outdoor unit 2 can be facilitated.

[0069] The IH heater assembly 30 can be arranged at a distance above the compressor and the heavy, high-capacity accumulator, and such an arrangement is advantageous in terms of the layout of the outdoor unit.

(2)

[0070] In the outdoor unit 2 of an air conditioner of the first embodiment, the distance Y1 between the IH heater assembly 30 and the accumulator 25 is kept at a distance that allows the tubes connecting the IH heater assembly 30 and the accumulator 25 to be brazed together. Therefore, brazing at the brazing location 44 can be readily and reliably carried out. The outdoor unit 2 can thereby be assembled with greater ease.

(3)

[0071] In the outdoor unit 2 of an air conditioner of the first embodiment, the IH heater assembly 30, the accumulator tube F (i.e., the straight tube portion F1 and U-shaped tube portion F2), and the four-way switching valve 22 are brazed together to form an integrated assembly S, and the integrated assembly S is brazed to the accumulator 25. The assembly

S can thereby be readily and reliably installed in the outdoor unit 2, and the outdoor unit 2 can be assembled with considerably greater ease.

(4)

[0072] In the outdoor unit 2 of an air conditioner of the first embodiment, the integrated assembly S is secured inside the outdoor unit 2 by having one end brazed to the intake tube P1 of the accumulator 25 at the brazing location 44 and the other end brazed to the discharge tube A, which is another tube constituting the refrigerant circuit 11, at the brazing location 46, or the like.

[0073] Here, the integrated assembly S is secured to the tubes (intake tube P1, discharge tube A, and the like) constituting the refrigerant circuit 11 merely by brazing in two locations, and has a support structure that does not involve support by other tubes, fixed objects, or the like. Accordingly, the IH heater assembly 30, which is a heavy object, can be stably arranged above the accumulator by resting the weight of the IH heater assembly 30 on the accumulator 25.

<Second embodiment>

[0074] An example in which the IH heater assembly 30 is arranged above the accumulator 25 was described in the first embodiment above, but the present invention is not limited thereby, and it is also possible to apply the present invention to the case of a refrigerant container other than an accumulator.

[0075] In other words, in a refrigerant circuit provided with an outdoor heat exchanger 108 for carrying out heat exchange between outdoor air and refrigerant flowing through the refrigerant circuit, as shown in FIG. 10 in the second embodiment described below, a heater 105 as a refrigerant heating apparatus is arranged above a gas-liquid separation receiver 106 as a refrigerant container other than an accumulator for carrying out gas-liquid separation of the refrigerant that has passed through the outdoor heat exchanger 108, and is connected between the outdoor heat exchanger 108 and an indoor heat exchanger 103 outside of the outdoor unit connected to the refrigerant circuit. Accordingly, the heater 105 is stably mounted above the gas-liquid separation receiver 106.

[0076] The configuration of a heat pump apparatus provided with an outdoor unit according to the second embodiment of the present invention is described below.

[0077] FIG. 10 shows the heat pump apparatus according to the second embodiment of the present invention, and shows the open/closed state of the valves and the flow of refrigerant during defrost operation (in the diagram, "close" shows the closed state of the open/close valves during defrost operation, and the other valves shown in an open state.). The refrigerant circuit of the heat pump apparatus is configured as a refrigerant circuit in which a compressor 101, a four-way switching valve 102, the indoor heat exchanger 103, a first electronic expansion valve 104, the gas-liquid separation receiver 106, a second electronic expansion valve 107, the outdoor heat exchanger 108, and an accumulator 109 are connected in sequence by a refrigerant tube 110 to form a closed circuit, as shown in the diagram. A gas outlet 106a of the gas-liquid separation receiver 106 is connected to an injection port 101a of the compressor 101 by the injection circuit 111.

[0078] Excluding the indoor heat exchanger 103 of the refrigerant circuit of FIG. 10, an outdoor unit 100 is composed of the compressor 101, four-way switching valve 102, first electronic expansion valve 104, gas-liquid separation receiver 106, second electronic expansion valve 107, outdoor heat exchanger 108, accumulator 109.

[0079] In other words, the first electronic expansion valve 104 is disposed between the indoor heat exchanger 103 and the gas-liquid separation receiver 106, and the second electronic expansion valve 107 is disposed between the gas-liquid separation receiver 106 and the outdoor heat exchanger 108.

[0080] The degree of opening of the first electronic expansion valve 104 is set so that highpressure refrigerant is decompressed to a predetermined intermediate pressure during air-warming operation, and the second electronic expansion valve 107 is set so that intermediate-pressure refrigerant is decompressed to a predetermined low pressure.

[0081] The four-way switching valve 102 is configured so as to be selectively set to air-warming operation or air-cooling operation by switching the connection of the four ports.

[0082] In the present embodiment 2, a first connection tube 112, which is a different channel than the injection circuit 111, is branched and connected to the refrigerant circuit between the first electronic expansion valve 104 and the gas-liquid separation receiver 106, and is designed to feed refrigerant to the compressor 101 via the accumulator 109. A first open/close valve 113 that is opened only during defrost operation for defrosting the outdoor heat exchanger 108 is provided to the first connection tube 112, and a second open/close valve 115 that is similarly closed only during defrost operation is provided to the injection circuit 111.

[0083] Reference numeral 105 is a heater provided to the refrigerant circuit between a branching part 112a to the first connection tube 112 and the gas-liquid separation receiver 106, and is designed to heat the refrigerant that departs the outdoor heat exchanger 108 and returns to the compressor 101 during defrost operation.

[0084] The heater 105 is arranged above the gas-liquid separation receiver 106 and is connected to inlet/outlet 106b

of the gas-liquid separation receiver 106 not to the gas outlet 106a.

[0085] An electromagnetic-induction heating-type IH heater assembly having the same configuration as that in the first embodiment described above is used as the heater 105.

[0086] Next, the operation for circulating the refrigerant in the heat pump apparatus configured in the manner described above will be described. First the first and second electronic expansion valves 104, 107 are opened to a predetermined degree of opening during air-warming operation, the second open/close valve 115 of the injection circuit 111 is opened, and the open/close valve 113 of the first connection tube 112 is closed. The four-way switching valve 102 allows refrigerant to flow from the compressor 101 to the indoor heat exchanger 103, and can furthermore be switched to a state in which refrigerant is allowed to flow from the outdoor heat exchanger 108 to the compressor 101 (see the route indicated by the broken arrows in FIG. 10).

[0087] In this manner, the refrigerant is fed from the compressor 101 to the gas-liquid separation receiver 106 via the indoor heat exchanger 103 and the first electronic expansion valve 104. The refrigerant in the gas-liquid separation receiver 106 is separated into liquid refrigerant and gas refrigerant, and the gas refrigerant is fed to the compressor 101 via the injection circuit 111. Conversely, the liquid refrigerant is fed to the compressor 101 via the second electronic expansion valve 107, the outdoor heat exchanger 108, the accumulator 109. In this manner, the refrigerant is circulated in the refrigerant circuit and air-warming operation is carried out.

[0088] Among the first and second electronic expansion valves 104, 107, the first electronic expansion valve 104, which is an expansion valve positioned between the indoor heat exchanger 103 side and the branching part 112a to the first connection tube 112, is closed during defrost operation for defrosting the refrigerant tubes of the outdoor heat exchanger 108. The second open/close valve 115 of the injection circuit 111 is closed, and the first open/close valve 113 is opened. The four-way switching valve 102 is switched to a state that allows refrigerant to flow from the compressor 101 to the outdoor heat exchanger 108, and the heater 105 is energized to heat the refrigerant (see the route indicated by the solid arrows in FIG. 10).

[0089] In this manner, the refrigerant is fed from the compressor 101 via the outdoor heat exchanger 108, the second electronic expansion valve 107, and the gas-liquid separation receiver 106 to the location where the heater 105 is disposed. Here, the refrigerant is evaporated by the heat of the heater 105, or is provided with an elevated temperature and fed to the compressor 101. The high-temperature refrigerant is sent to the outdoor heat exchanger 108 and defrosting is carried out in a short period of time.

[0090] At this time, the first electronic expansion valve 104 is closed so as to prevent refrigerant from flowing to the indoor heat exchanger 103. Therefore, the temperature of the refrigerant inside the indoor heat exchanger 103 is prevented from being reduced.

[0091] At this point, high-temperature refrigerant is fed from the compressor 101 to the outdoor heat exchanger 108 in order for the heater 105 to supplement the amount of heat required for defrosting in the outdoor heat exchanger 108, and defrosting can be carried out with good efficiency in a short period of time.

[0092] The first electronic expansion valve 104 is closed in the defrosting operation, whereby the temperature can be prevented from being reduced on the indoor side because refrigerant that is cooler than during air-warming operation is not allowed to flow to the indoor heat exchanger 103. It is possible to improve startup performance when operation is restored from defrost operation to air-warming operation.

[0093] The refrigerant can be rapidly heated and the control characteristics of the heater can be enhanced by using an electromagnetic-induction heating-type heater 105.

[0094] In accordance with the configuration described above, it is possible to provide a heat pump apparatus having an injection circuit that can defrost in a short period of time because the refrigerant, is heated by the heater 105 and the temperature of the refrigerant is increased.

<Characteristics of the second embodiment>

[0095] In the outdoor unit 100 of the second embodiment, the refrigerant container is a gas-liquid separation receiver 106 for separating gas and liquid refrigerant, and is connected between the outdoor heat exchanger 108 and the indoor heat exchanger 103, which is disposed outside of the outdoor unit 100 and is connected to the refrigerant circuit; and the refrigerant heating apparatus is arranged above the gas-liquid separation receiver 106. Therefore, the heater 105 for heating refrigerant can be stably mounted above the gas-liquid separation receiver 106 and the outdoor unit 100 can be assembled with greater ease.

INDUSTRIAL APPLICABILITY

[0096] The present invention can be variously applied in the field of outdoor units for an air conditioner provided with an IH heater or various other refrigerant heating apparatuses.

REFERENCE SIGNS LIST

[0097]

5	1	Air conditioner
	2	Outdoor unit
	4	Indoor unit
	6	Liquid refrigerant communication tube
	7	Gas refrigerant communication tube
10	11	Refrigerant circuit
	21	Compressor
	22	Four-way switching valve
	23	Outdoor heat exchanger
	24	Expansion valve
15	25	Accumulator (refrigerant container)
	26	Indoor heat exchanger
	30	IH heater assembly (refrigerant heating apparatus)
	31	Inner tube
	32	Outer tube
20	33	Induction heating coil
	34	Bobbin
	35	Lid
	36	Nut
	37	Ferrite block
25	38	Ferrite holder
	39	Sheet metal cover
	41	Tube expansion billet
	42, 43, 44, 45, 46	Brazed portions
	105	Heater (Refrigerant heating apparatus)
30	106	Gas-liquid separation receiver (Refrigerant container)
	A	Discharge tube
	B	Indoor-side gas tube
	C	Indoor-side liquid tube
	D	Outdoor-side liquid tube
35	E	Outdoor-side gas tube
	F	Accumulation tube (F1: Straight tube portion; F2: U-shaped tube portion)
	G	Intake tube
	S	Integrated assembly

40 CITATION LIST

PATENT LITERATURE

45 [0098] <Patent Literature 1> Japanese Laid-open Patent Application 2001-174054

Claims

- 50 1. An outdoor unit (2, 100) of an air conditioner, comprising:
- a refrigerant container (25, 106) capable of accumulating refrigerant that flows through a refrigerant circuit; and
a refrigerant heating apparatus (30, 105) for heating the refrigerant flowing through the refrigerant circuit, wherein
the refrigerant heating apparatus (30, 105) is arranged above the refrigerant container (25, 106).
- 55 2. An outdoor unit (2) of an air conditioner (*1), further comprising a compressor (21) for compressing the refrigerant that flows through the refrigerant circuit, wherein
the refrigerant container is an accumulator (25) for separating gas and liquid refrigerant, the accumulator being connected to an intake side of the compressor (21); and

the refrigerant heating apparatus (30) is connected to an intake side of the accumulator (25).

3. The outdoor unit (2) of an air conditioner according to claim 2, wherein
the distance between the refrigerant heating apparatus (30) and the accumulator (25) is a distance that allows
brazing of a tube that connects the refrigerant heating apparatus (30) and the accumulator (25).

4. The outdoor unit (2) of an air conditioner according to claim 2, further comprising:

an accumulator tube (F), which is a tube for connecting the refrigerant heating apparatus (30) to the accumulator
(25); and
switching means (22) for switching the flow of refrigerant inside the refrigerant circuit, wherein
the refrigerant heating apparatus (30), the accumulator tube (F), and the switching means (22) constitute an
integrated assembly; and
the integrated assembly is brazed to the accumulator (25).

5. The outdoor unit (2) of an air conditioner according to claim 2, wherein
one end of the integrated assembly is brazed to the accumulator (25) and another end of the integrated assembly
is brazed to another tube constituting the refrigerant circuit, whereby the integrated assembly is secured inside the
outdoor unit (2).

6. The outdoor unit (100) of an air conditioner according to claim 1, further comprising:

an outdoor heat exchanger (108) for exchanging heat between outdoor air and the refrigerant flowing through
the refrigerant circuit, wherein
the refrigerant container is a receiver (106) for separating gas and liquid refrigerant,
the receiver being connected between the outdoor heat exchanger (108) and an indoor heat exchanger con-
nected to the refrigerant circuit.

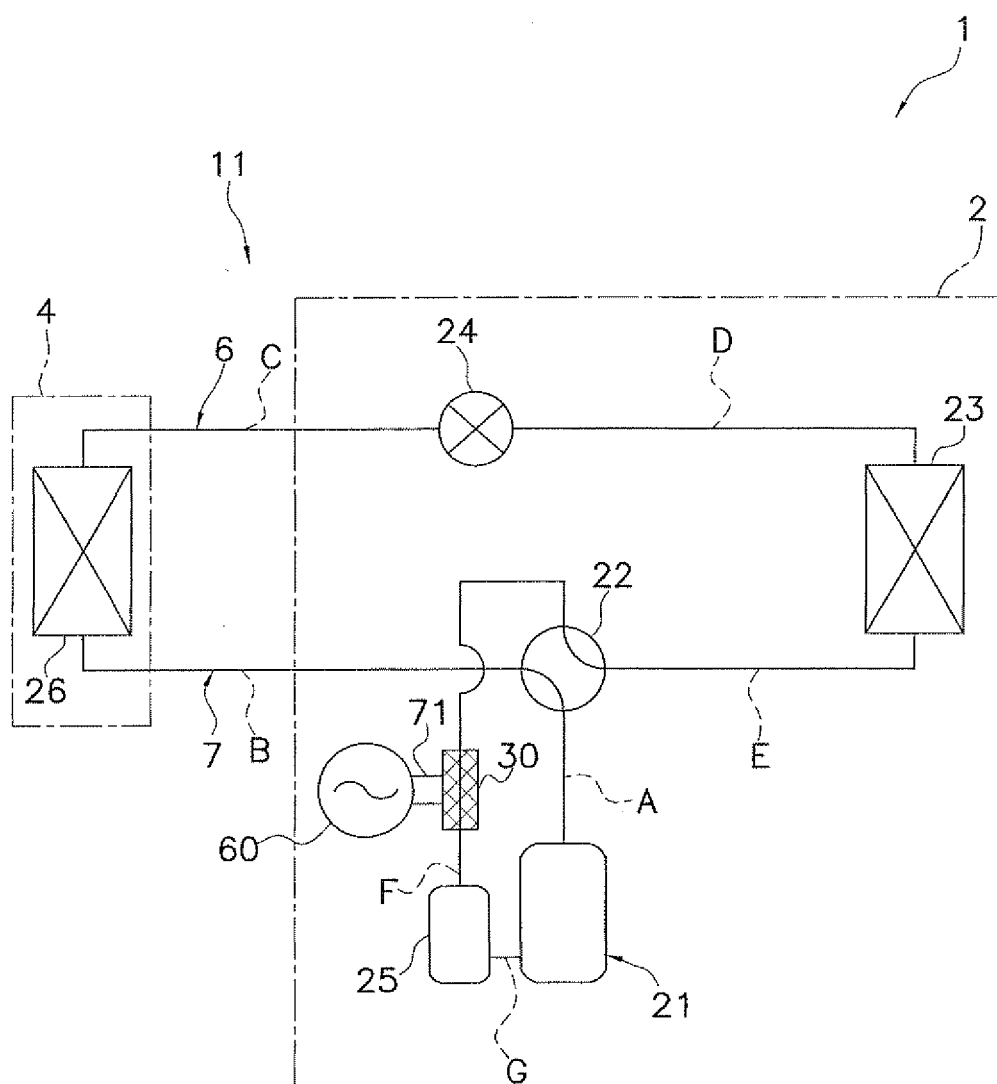


Fig. 1

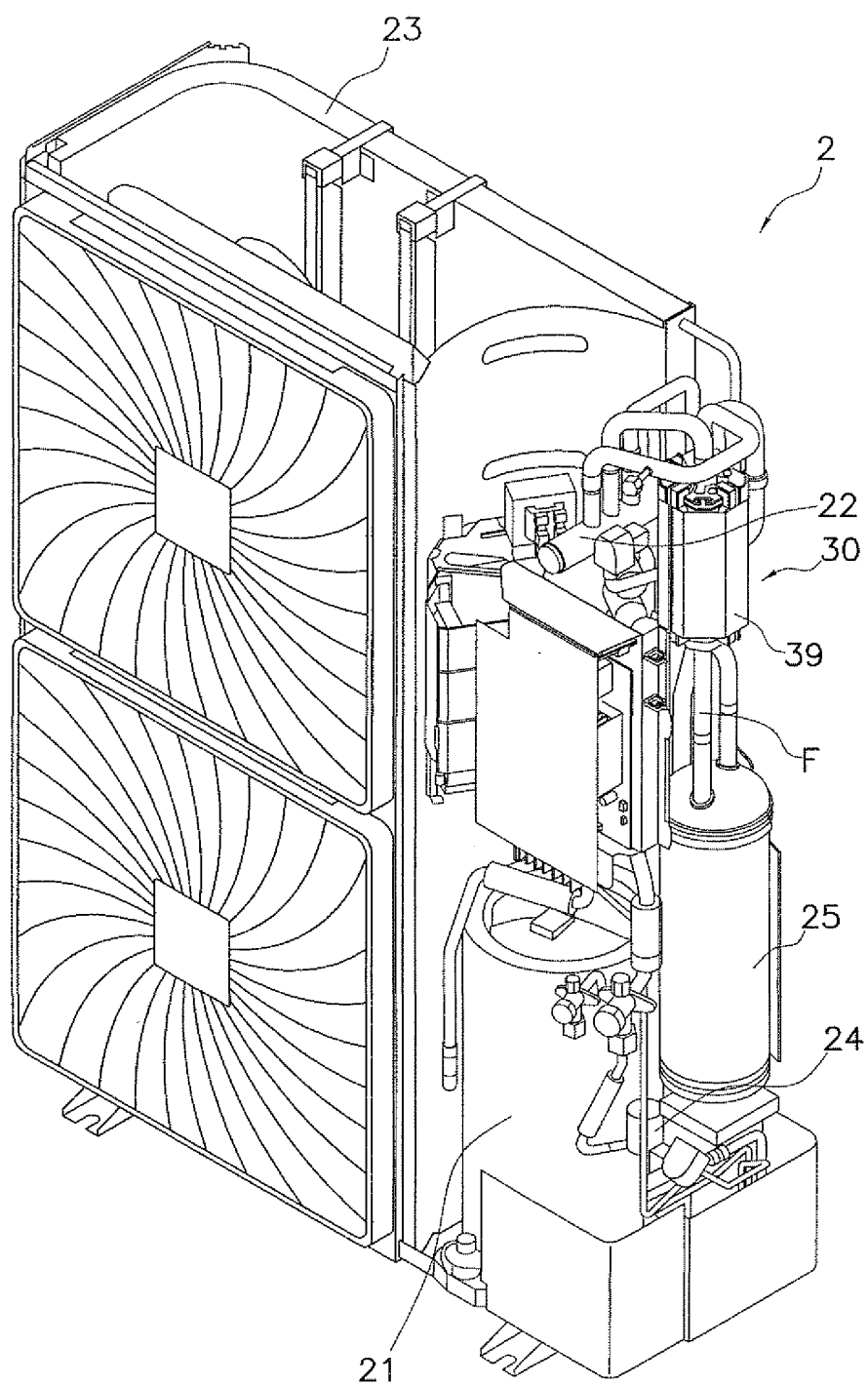


Fig. 2

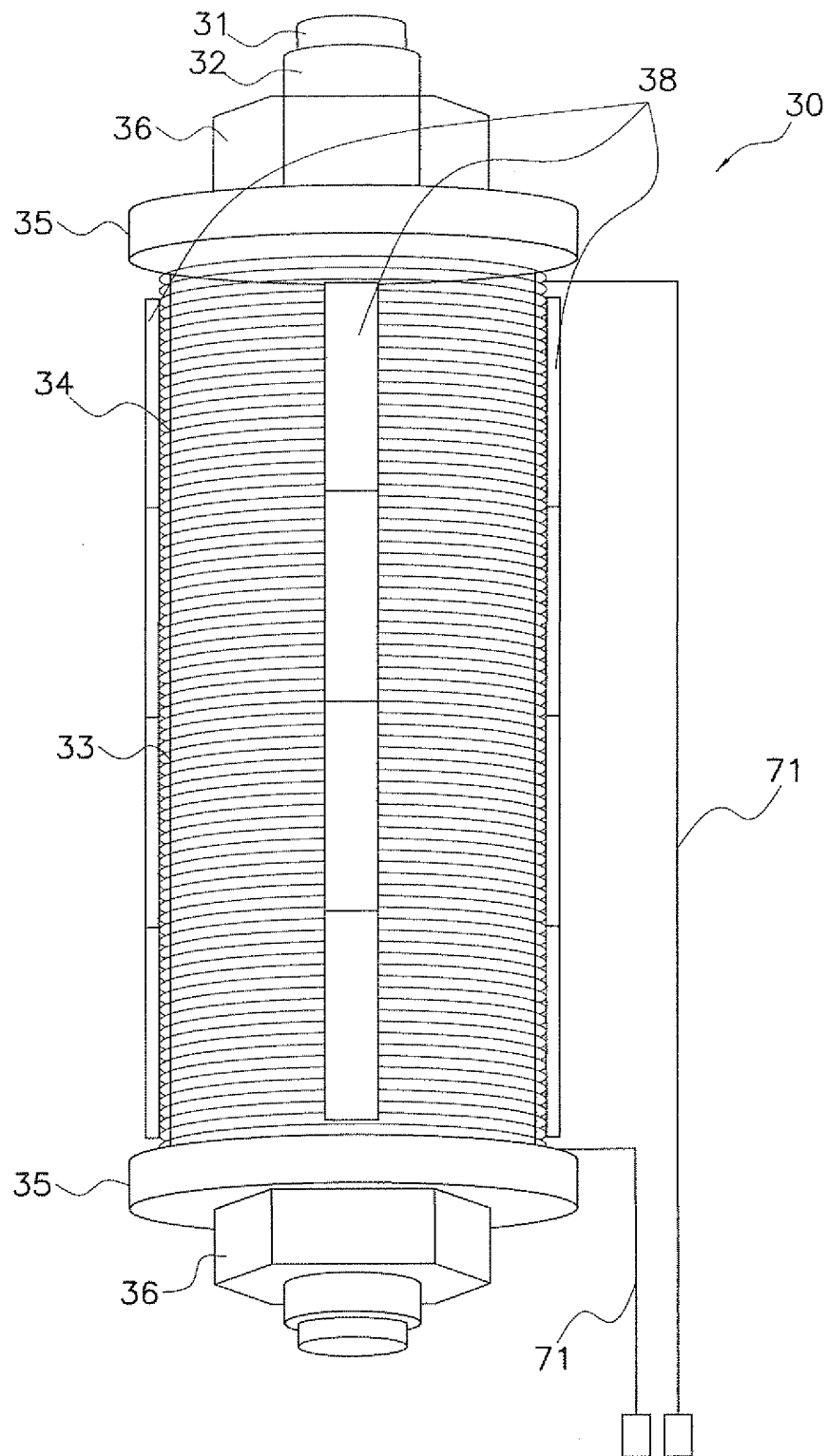


Fig. 3

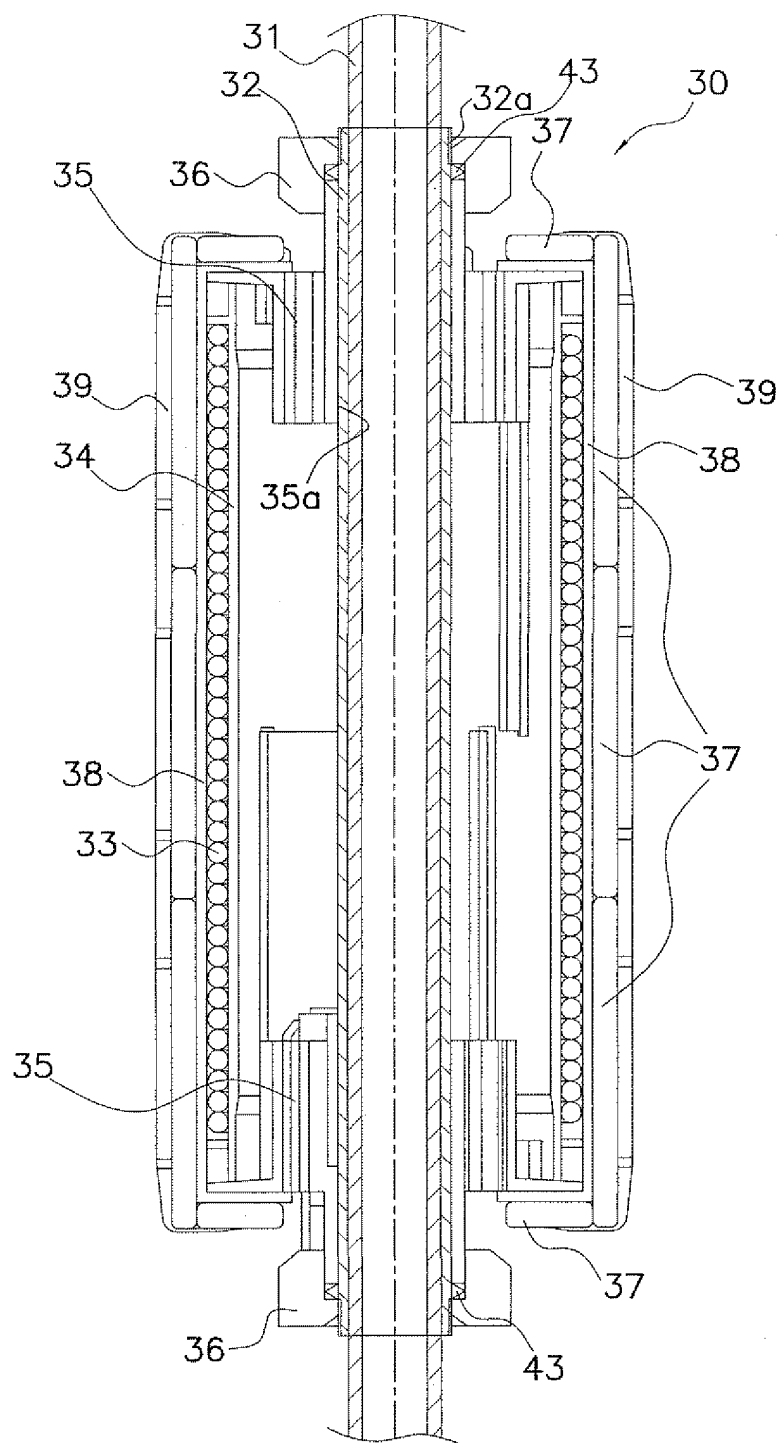


Fig. 4

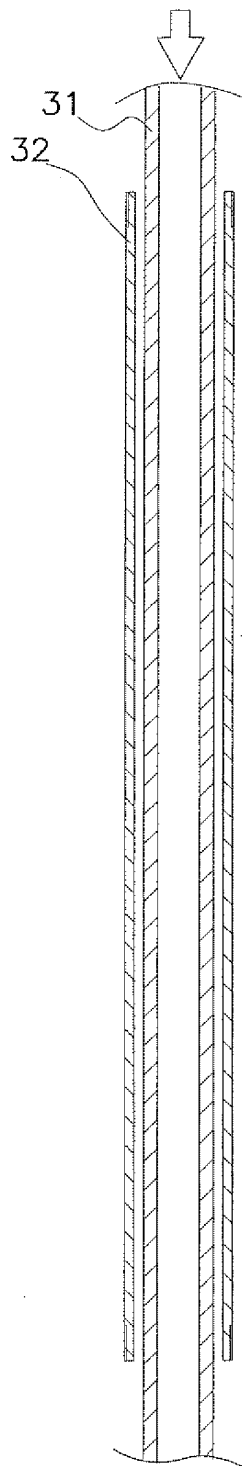


Fig. 5

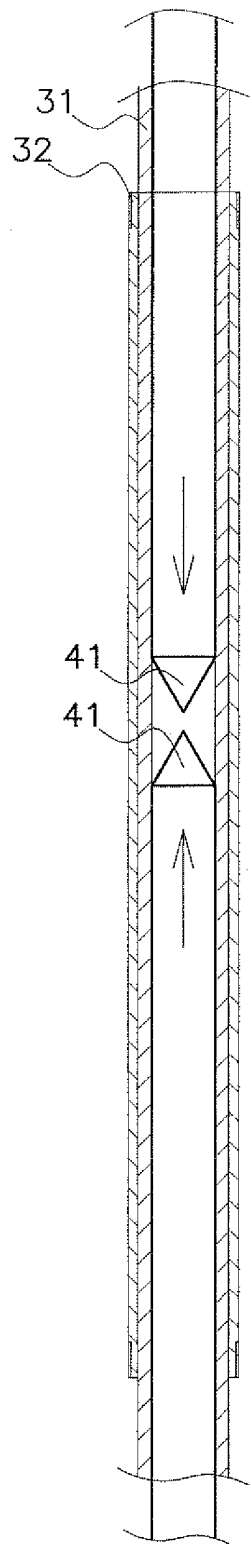


Fig. 6

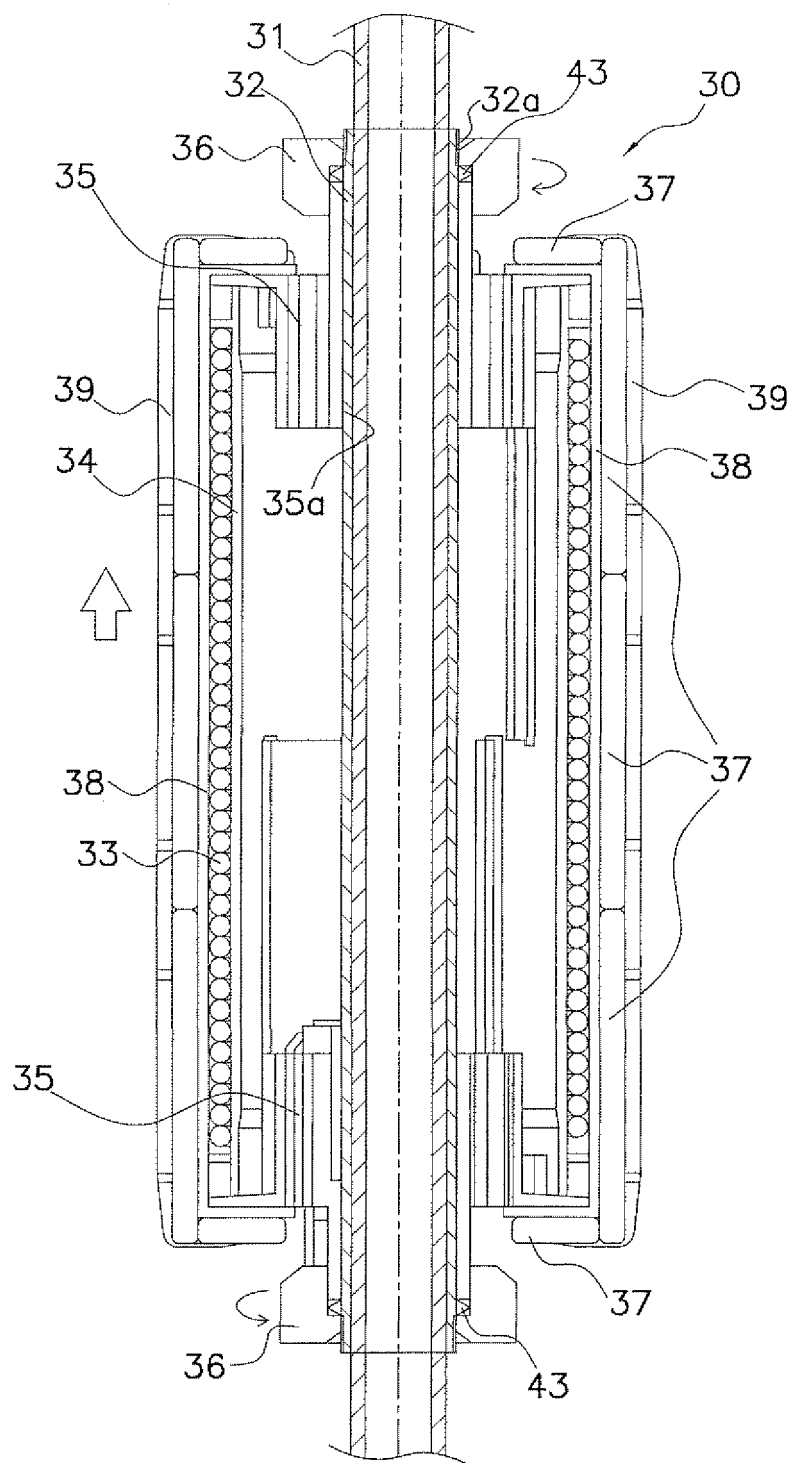


Fig. 7

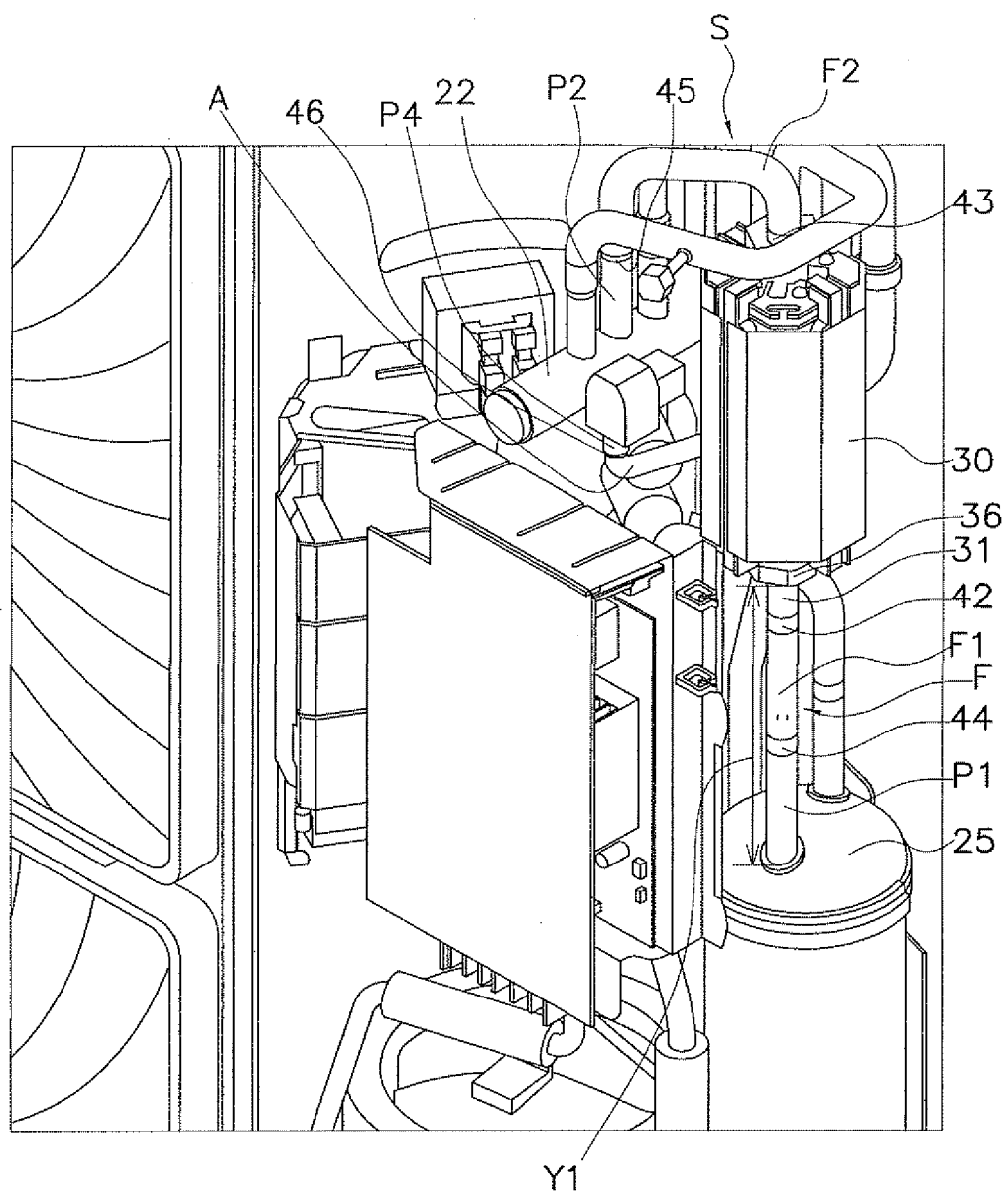


Fig. 8

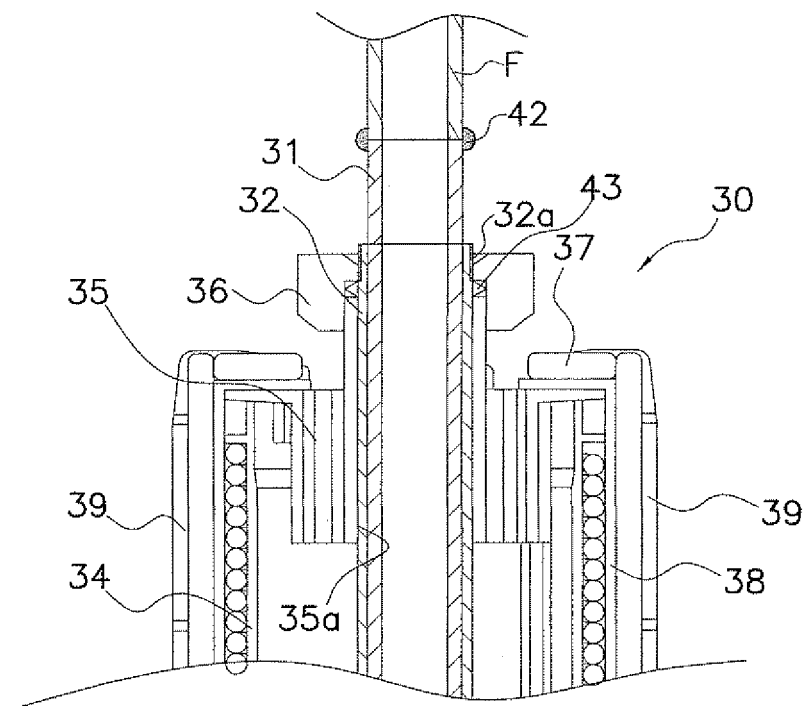


Fig. 9

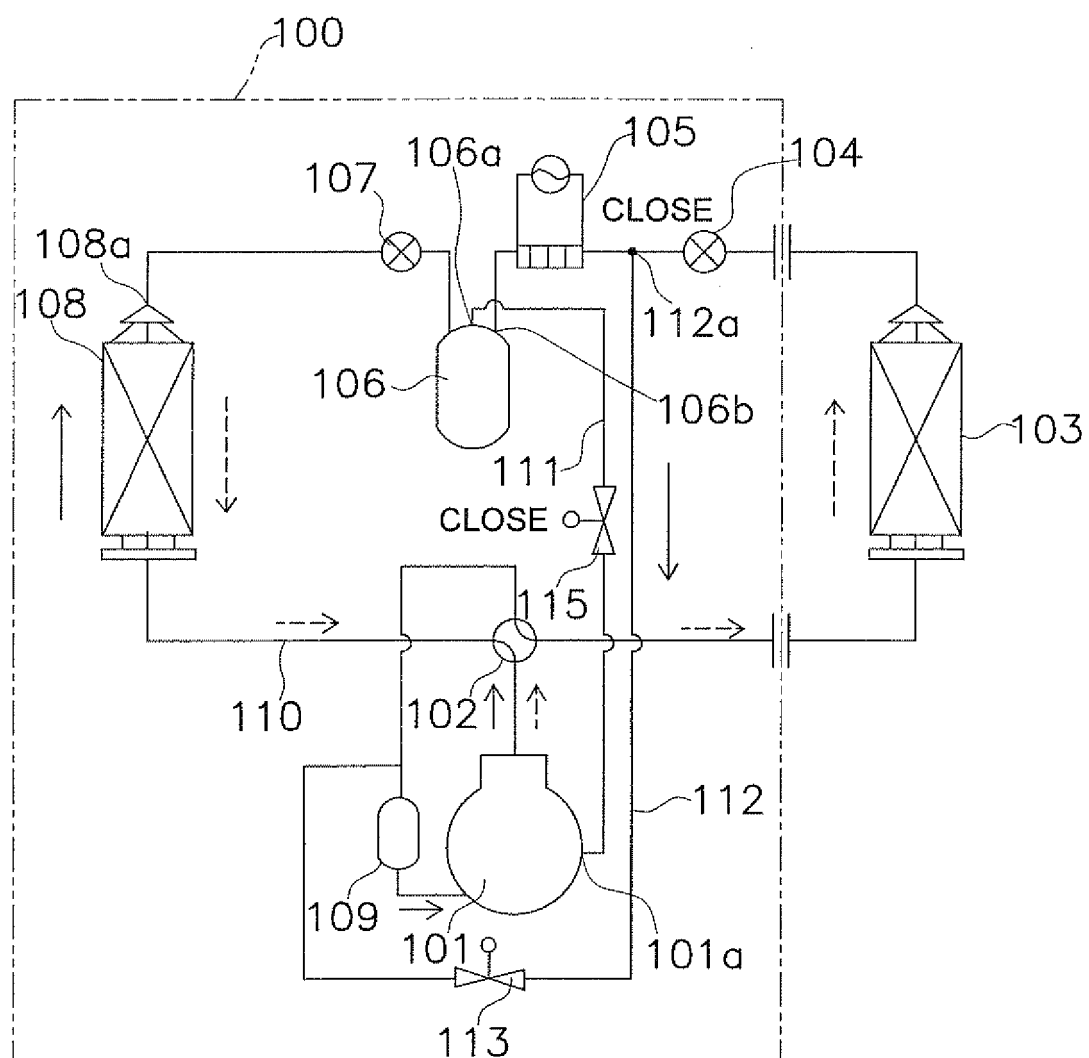


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/004567

A. CLASSIFICATION OF SUBJECT MATTER <i>F24F1/00(2006.01) i, F25B1/00(2006.01) i, F25B13/00(2006.01) i</i> According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) <i>F24F1/00, F25B1/00, F25B13/00</i> Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009 Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009 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 2002-106997 A (Denso Corp.), 10 April 2002 (10.04.2002), fig. 1, 7 (Family: none)	1-6
Y	JP 7-208772 A (Sanyo Electric Co., Ltd.), 11 August 1995 (11.08.1995), fig. 3 (Family: none)	1-6
A	JP 10-281683 A (Toshiba Corp.), 23 October 1998 (23.10.1998), fig. 1 (Family: none)	1-6
☒ 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 08 December, 2009 (08.12.09)		Date of mailing of the international search report 22 December, 2009 (22.12.09)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/004567

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3-134424 A (Sanyo Electric Co., Ltd.), 07 June 1991 (07.06.1991), fig. 3 (Family: none)	1-6
A	JP 2007-240123 A (Matsushita Electric Industrial Co., Ltd.), 20 September 2007 (20.09.2007), fig. 1 (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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