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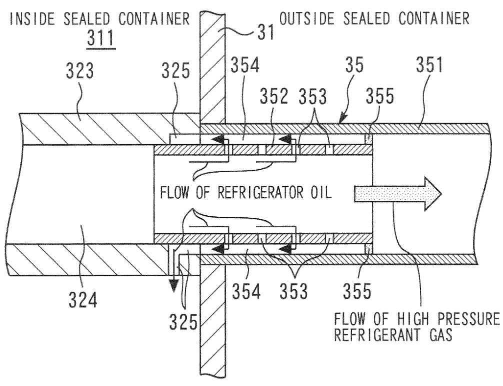
(54) COMPRESSOR, REFRIGERATION CYCLE DEVICE, AND HEAT PUMP HOT-WATER SUPPLY DEVICE

(57) The compressor includes: a first intake passage for guiding a refrigerant to a compressing element without releasing the refrigerant into a sealed container; a first discharge passage for discharging a high pressure refrigerant compressed by the compressing element to an outside of the sealed container; a second intake passage for guiding the high pressure refrigerant having passed through an external heat exchanger into the sealed container; a second discharge passage for discharging the high pressure refrigerant in the sealed container; and an oil return flow path for guiding refrigerator oil from the first discharge passage into the sealed container or the second intake passage. Due to pressure loss of the external heat exchanger, pressure in the sealed container and the second intake passage is lower than pressure in the first discharge passage. Owing to a difference between the pressures, the refrigerator oil moves in the oil return flow path.

FIG. 5



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Description

Technical Field

[0001] The present invention relates to a compressor, a refrigeration cycle device, and a heat pump hot-water supply device.

Background Art

[0002] Patent Literature 1 discloses a hot-water supplying compressor having a compressing element and an electric actuating element in a sealed container. The compressor includes: an intake pipe (first intake passage) for guiding a refrigerant on a low pressure side directly to the compressing element; a discharge pipe (first discharge passage) for discharging a high pressure refrigerant compressed by the compressing element directly to an outside of the sealed container without releasing the high pressure refrigerant into the sealed container; a refrigerant reintroduction pipe (second intake passage) for reintroducing the refrigerant discharged from the discharge pipe and subjected to heat exchange into the sealed container; and a refrigerant redischarge pipe (second discharge passage) for discharging the refrigerant reintroduced into the sealed container and having passed through the electric actuating element to the outside of the sealed container.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Patent Laid-Open No. 2006-132427

Summary of Invention

Technical Problem

[0004] Generally, refrigerator oil is supplied into a compression chamber of a compressing element of a compressor in order to lubricate and seal a slide portion and reduce friction and gap leakage. The refrigerator oil refers to a lubricant for a compressor of a refrigeration cycle device. For the compressor disclosed in Patent Literature 1, a large amount of refrigerator oil together with a compressed high pressure refrigerant gas flows through the first discharge passage to the outside of the compressor. The high pressure refrigerant gas and the refrigerator oil form a gas-liquid two-phase flow, which passes through an external heat exchanger. Thus, heat transfer in the heat exchanger is inhibited by the refrigerator oil, or the refrigerator oil increases pressure loss, thereby reducing performance of a refrigeration cycle. Also, an amount of the refrigerator oil in the compressor is reduced, which may affect reliability.

[0005] The present invention is achieved to solve the above described problems, and has an object to provide a compressor including a first intake passage, a first discharge passage, a second intake passage, and a second discharge passage, and allowing an amount of refrigerator oil flowing out of the first discharge passage together with a refrigerant to be reduced with a simple configuration, and further has an object to provide a refrigeration cycle device and a heat pump hot-water supply device including the compressor.

Solution to Problem

[0006] A compressor of the invention includes: a sealed container; a compressing element provided in the sealed container; a first intake passage for guiding sucked low pressure refrigerant to the compressing element without releasing the low pressure refrigerant to an internal space of the sealed container; a first discharge passage for discharging high pressure refrigerant compressed by the compressing element directly to an outside of the sealed container without releasing the high pressure refrigerant to the internal space of the sealed container; a second intake passage for guiding the high pressure refrigerant having passed through the first discharge passage and an external heat exchanger provided downstream of the first discharge passage to the internal space of the sealed container; a second discharge passage for discharging the high pressure refrigerant in the internal space of the sealed container to the outside of the sealed container; and an oil return flow path for guiding refrigerator oil, the refrigerator oil having flowed out of the compressing element to the first discharge passage, to the internal space of the sealed container or into the second intake passage. Due to pressure loss occurring when the high pressure refrigerant passes through the external heat exchanger, a second high pressure which is a pressure in the internal space of the sealed container and the second intake passage being lower than a first high pressure which is a pressure in the first discharge passage. Owing to a difference between the first high pressure and the second high pressure, the refrigerator oil moves in the oil return flow path.

Advantageous Effects of Invention

[0007] According to the present invention, in a compressor including a first intake passage, a first discharge passage, a second intake passage, and a second discharge passage, an amount of refrigerator oil flowing out of the first discharge passage together with a refrigerant can be reliably reduced with a simple configuration. This can prevent inhibition of heat transfer in a heat exchanger that performs heat exchange of a refrigerant discharged from the first discharge passage and an increase in pressure loss, and also prevent a reduction in refrigerator oil in the compressor.

Brief Description of Drawings

[0008]

[Figure 1] Figure 1 is a configuration diagram of a heat pump hot-water supply device including a compressor according to Embodiment 1 of the present invention.
[Figure 2] Figure 2 is a configuration diagram of a storage type hot-water supply system including the heat pump hot-water supply device in Figure 1.
[Figure 3] Figure 3 is a sectional view of the compressor according to Embodiment 1 of the present invention.
[Figure 4] Figure 4 is a schematic sectional view of a flow state of a refrigerant gas and refrigerator oil.
[Figure 5] Figure 5 is a sectional view of an oil return flow path included in the compressor according to Embodiment 1 of the present invention.
[Figure 6] Figure 6 is a cross sectional view of an inner pipe of a first discharge passage included in a compressor according to Embodiment 2 of the present invention.
[Figure 7] Figure 7 is a sectional view of an oil return flow path included in a compressor according to Embodiment 3 of the present invention.
[Figure 8] Figure 8 is a longitudinal sectional view of around a downstream end of a second intake passage included in a compressor according to Embodiment 4 of the present invention.
[Figure 9] Figure 9 is a cross sectional view of around the downstream end of the second intake passage included in the compressor according to Embodiment 4 of the present invention.
[Figure 10] Figure 10 is a view of around a downstream end of a second intake passage included in a compressor according to Embodiment 5 of the present invention.

Description of Embodiments

[0009] Now, with reference to the drawings, embodiments of the present invention will be described. In the drawings, like components are denoted by like reference numerals and overlapping descriptions will be omitted.

Embodiment 1

[0010] Figure 1 is a configuration diagram of a heat pump hot-water supply device including a compressor according to Embodiment 1 of the present invention. Figure 2 is a configuration diagram of a storage type hot-water supply system including the heat pump hot-water supply device in Figure 1. As shown in Figure 1, the heat pump hot-water supply device 1 of this embodiment includes a refrigerant circuit including a compressor 3, a first water-refrigerant heat exchanger 4 (first heat exchanger), a second water-refrigerant heat exchanger 5 (second heat exchanger), an expansion valve 6 (expansion means), and an evaporator 7, and water channels that cause water to flow through the first water-refrigerant heat exchanger 4 and the second water-refrigerant heat exchanger 5. The evaporator 7 in this embodiment is constituted by an air-refrigerant heat exchanger that performs heat exchange between air and refrigerant. The heat pump hot-water supply device 1 according to this embodiment further includes a fan 8 that blows air to the evaporator 7, and a high and low pressures heat exchanger 9 that performs heat exchange between a high pressure side refrigerant and a low pressure side refrigerant. The compressor 3, the first water-refrigerant heat exchanger 4, the second water-refrigerant heat exchanger 5, the expansion valve 6, the evaporator 7, and the high and low pressures heat exchanger 9 are connected by a pipe through which the refrigerant passes to form a refrigerant circuit. During heating operation, the heat pump hot-water supply device 1 actuates the compressor 3 to operate a refrigeration cycle.

[0011] As shown in Figure 2, the heat pump hot-water supply device 1 according to this embodiment may be combined with a tank unit 2 and used as a storage type hot-water supply system. In the tank unit 2, a hot water storage tank 2a that stores water, and a water pump 2b are provided. The heat pump hot-water supply device 1 and the tank unit 2 are connected via pipes 11 and 12 through which water flows, and electric wires (not shown). One end of the pipe 11 is connected to a water inlet 1a of the heat pump hot-water supply device 1. The other end of the pipe 11 is connected to a lower portion of the hot water storage tank 2a in the tank unit 2. The water pump 2b is provided in a middle of the pipe 11 in the tank unit 2. One end of the pipe 12 is connected to a hot water outlet 1b of the heat pump hot-water supply device 1. The other end of the pipe 12 is connected to an upper portion of the hot water storage tank 2a in the tank unit 2. Instead of the shown configuration, the water pump 2b may be placed in the heat pump hot-water supply device 1.

[0012] As shown in Figure 1, the compressor 3 in the heat pump hot-water supply device 1 includes a sealed container 31, a compressing element 32 and an electric actuating element 33 provided in the sealed container 31, a first intake passage 34, a first discharge passage 35, a second intake passage 36, and a second discharge passage 37. A low pressure refrigerant sucked through the first intake passage 34 flows directly into the compressing element 32 without being released to an internal space 311 of the sealed container 31. The compressing element 32 is driven by the electric actuating element 33, and compresses the low pressure refrigerant into a high pressure refrigerant. The high pressure refrigerant compressed by the compressing element 32 is discharged through the first discharge passage 35 directly to the outside of the sealed container 31 without being released to the internal space 311 of the sealed container 31. The high pressure refrigerant discharged from the first discharge passage 35 flows through a pipe 10 and reaches the first water-refrigerant heat exchanger 4. The high pressure refrigerant having passed through the first water-refrigerant heat exchanger 4 flows through a pipe 17 and reaches the second intake passage 36. The second intake passage 36 guides the high pressure refrigerant to the internal space 311 of the sealed container 31 of the compressor 3. The high pressure refrigerant having flowed to the internal space 311 of the sealed container 31 passes between a rotor and a stator of the electric actuating element 33 to cool the electric actuating element 33, and is then discharged through the second discharge passage 37 to the outside of the sealed container 31. The high pressure refrigerant having been discharged from the second discharge passage 37 passes through a pipe 18 and reaches the second water-refrigerant heat exchanger 5. The high pressure refrigerant having passed through the second water-refrigerant heat exchanger 5 passes through a pipe 19 and reaches the expansion valve 6. The high pressure refrigerant passes through the expansion valve 6 to turn into a low pressure refrigerant. The low pressure refrigerant passes through a pipe 20 and flows into the evaporator 7. The low pressure refrigerant having passed through the evaporator 7 passes through a pipe 21 and reaches the first intake passage 34, and is sucked into the compressor 3. The high and low pressures heat exchanger 9 performs heat exchange between the high pressure refrigerant passing through the pipe 19 and the low pressure refrigerant passing through the pipe 21.

[0013] The heat pump hot-water supply device 1 further includes a water channel 23 that connects the water inlet 1a and an inlet of the second water-refrigerant heat exchanger 5, a water channel 24 that connects an outlet of the second water-refrigerant heat exchanger 5 and an inlet of the first water-refrigerant heat exchanger 4, and a water channel 26 that connects an outlet of the first water-refrigerant heat exchanger 4 and the hot water outlet 1b. During heating operation, water having flowed in from the water inlet 1a flows through the water channel 23 into the second water-refrigerant heat exchanger 5, and is heated by heat from the refrigerant in the second water-refrigerant heat exchanger 5. Hot water generated by heating in the second water-refrigerant heat exchanger 5 flows through the water channel 24 into the first water-refrigerant heat exchanger 4, and is further heated by heat from the refrigerant in the first water-refrigerant heat exchanger 4. The hot water further increased in temperature by being further heated in the first water-refrigerant heat exchanger 4 passes through the water channel 26 and reaches the hot water outlet 1b, and is fed through the pipe 12 to the tank unit 2.

[0014] An appropriate refrigerant includes refrigerants that can generate a high temperature hot water, for example, refrigerants such as carbon dioxide, R410A, propane, or propylene, but not limited to them.

[0015] The high temperature and high pressure refrigerant gas discharged from the first discharge passage 35 of the compressor 3 releases heat and is reduced in temperature while passing through the first water-refrigerant heat exchanger 4. Due to pressure loss that occurs in the first water-refrigerant heat exchanger 4, the pipes 10, 17, of the like, pressure of the high pressure refrigerant in the second intake passage 36 is slightly lower than pressure of the high pressure refrigerant in the first discharge passage 35. In this embodiment, the high pressure refrigerant reduced in temperature while passing through the first water-refrigerant heat exchanger 4 is sucked from the second intake passage 36 to the internal space 311 of the sealed container 31 to cool the electric actuating element 33, thereby reducing a temperature of the electric actuating element 33 and a surface temperature of the sealed container 31. This can increase motor efficiency of the electric actuating element 33, and reduce heat dissipation loss from a surface of the sealed container 31. The high pressure refrigerant gas guided from the second intake passage 36 to the internal space 311 of the sealed container 31 draws heat from the electric actuating element 33 and is increased in temperature, and then discharged from the second discharge passage 37 in a high pressure state. The high pressure refrigerant discharged from the second discharge passage 37 flows into the second water-refrigerant heat exchanger 5, and releases heat and is reduced in temperature while passing through the second water-refrigerant heat exchanger 5. The high pressure refrigerant reduced in temperature heats the low pressure refrigerant while passing through the high and low pressures heat exchanger 9, and then passes through the expansion valve 6. The high pressure refrigerant passes through the expansion valve 6, and is thus reduced in pressure into a low pressure gas-liquid two-phase state. The low pressure refrigerant having passed through the expansion valve 6 absorbs heat from outside air while passing through the evaporator 7, and is evaporated and gasified. The low pressure refrigerant coming out of the evaporator 7 is heated by the high and low pressures heat exchanger 9, and then sucked from the first intake passage 34 into the compressor 3.

[0016] If the high pressure side refrigerant pressure is critical pressure or more, the high pressure refrigerant in the first water-refrigerant heat exchanger 4 and the second water-refrigerant heat exchanger 5 is reduced in temperature and releases heat still in a supercritical state without gas-liquid phase transition. If the high pressure side refrigerant pressure is the critical pressure or less, the high pressure refrigerant is liquefied and releases heat. In this embodiment, carbon dioxide is preferably used as a refrigerant to bring the high pressure side refrigerant pressure to the critical pressure or more. When the high pressure side refrigerant pressure is the critical pressure or more, the liquefied refrigerant can be reliably prevented from flowing through the second intake passage 36 to the internal space 311 of the sealed container 31. This can reliably prevent the liquefied refrigerant from adhering to the electric actuating element 33, and reduce rotational resistance of the electric actuating element 33. Also, the liquefied refrigerant does not flow through the second intake passage 36 to the internal space 311 of the sealed container 31, thereby preventing the refrigerator oil from being diluted by the refrigerant.

[0017] As shown in Figure 2, a water supply pipe 13 is further connected to a lower portion of the hot water storage tank 2a of the tank unit 2. Water supplied from an external water source such as a water supply flows through the water supply pipe 13 into the hot water storage tank 2a and is stored. The hot water storage tank 2a is always filled with water flowing in from the water supply pipe 13. A hot-water supplying mixing valve 2c is further provided in the tank unit 2. The hot-water supplying mixing valve 2c is connected via a hot water delivery pipe 14 to the upper portion of the hot water storage tank 2a. A water supply branch pipe 15 branching off from the water supply pipe 13 is connected to the hot-water supplying mixing valve 2c. One end of the hot-water supply pipe 16 is further connected to the hot-water supplying mixing valve 2c. The other end of the hot-water supply pipe 16 is connected to a hot-water supply terminal such as a tap, a shower, or a bathtub (not shown).

[0018] During heating operation in which water stored in the hot water storage tank 2a is heated, the water stored in the hot water storage tank 2a is fed by the water pump 2b through the pipe 11 to the heat pump hot-water supply device 1, and heated in the heat pump hot-water supply device 1 to be high temperature hot water. The high temperature hot water generated in the heat pump hot-water supply device 1 returns through the pipe 12 to the tank unit 2, and flows into the hot water storage tank 2a from above. By such heating operation, in the hot water storage tank 2a, the high temperature hot water is stored in an upper side and low temperature water is stored in a lower side.

[0019] When hot water is supplied from the hot-water supply pipe 16 to the hot-water supply terminal, the high temperature hot water in the hot water storage tank 2a is supplied through the hot water delivery pipe 14 to the hot-water supplying mixing valve 2c, and low temperature water is supplied through the water supply branch pipe 15 to the hot-water supplying mixing valve 2c. The high temperature hot water and the low temperature water are mixed by the hot-water supplying mixing valve 2c, and then supplied through the hot-water supply pipe 16 to the hot-water supply terminal. The hot-water supplying mixing valve 2c has a function of adjusting a mixture ratio between the high temperature hot water and the low temperature water so as to reach a hot-water supply temperature set by a user.

[0020] The storage type hot-water supply system includes a control unit 50. The control unit 50 is electrically connected to actuators and sensors (not shown) included in the heat pump hot-water supply device 1 and the tank unit 2, and user interface devices (not shown), and functions as control means for controlling operation of the storage type hot-water supply system. In Figure 2, the control unit 50 is provided in the heat pump hot-water supply device 1, but the control unit 50 may be provided other than in the heat pump hot-water supply device 1. The control unit 50 may be provided in the tank unit 2. The control unit 50 may be provided in the heat pump hot-water supply device 1 and the tank unit 2 in a divided manner so as to be able to mutually communicate.

[0021] During heating operation, the control unit 50 performs control so that a temperature of the hot water supplied from the heat pump hot-water supply device 1 to the tank unit 2 (hereinafter referred to as "hot water delivery temperature") reaches a target hot water delivery temperature. The target hot water delivery temperature is set to, for example, 65°C to 90°C. In this embodiment, the control unit 50 adjusts a rotation speed of the water pump 2b to control the hot water delivery temperature. The control unit 50 detects the hot water delivery temperature using a temperature sensor (not shown) provided in the water channel 26. When the detected hot water delivery temperature is higher than the target hot water delivery temperature, the rotation speed of the water pump 2b is corrected to be higher, and when the hot water delivery temperature is lower than the target hot water delivery temperature, the rotation speed of the water pump 2b is corrected to be lower. As such, the control unit 50 can perform control so that the hot water delivery temperature matches the target hot water delivery temperature. The hot water delivery temperature may be controlled by controlling a temperature of the refrigerant discharged from the first discharge passage 35 of the compressor 3, a rotation speed of the compressor 3, or the like.

[0022] Figure 3 is a sectional view of the compressor according to Embodiment 1 of the present invention. Now, with reference to Figure 3, the compressor 3 according to this embodiment will be further described. As shown in Figure 3, the sealed container 31 of the compressor 3 according to this embodiment has a substantially cylindrical shape. An accumulator 27 is provided adjacent to the sealed container 31 of the compressor 3. The low pressure refrigerant passes through the accumulator 27, and is then sucked from the first intake passage 34 into the compressor 3. The accumulator 27 is not shown in Figure 1 mentioned above.

[0023] The compressing element 32 is placed under the electric actuating element 33 in the sealed container 31. The electric actuating element 33 drives the compressing element 32 via a rotating shaft 331. The compressing element 32 includes a compression chamber 321, a muffler 322, and a frame 323. A low pressure refrigerant gas sucked from the first intake passage 34 flows into the compression chamber 321, and is compressed in the compression chamber 321 into a high pressure refrigerant gas. The high pressure refrigerant gas compressed in the compression chamber 321 is discharged into the muffler 322. The high pressure refrigerant gas discharged into the muffler 322 passes in the frame 323, and is discharged through the first discharge passage 35 to the outside of the sealed container 31. As described above, the high pressure refrigerant gas discharged from the first discharge passage 35 passes through the first water-refrigerant heat exchanger 4, and is sucked from the second intake passage 36 to the internal space 311 of the sealed container 31. The internal space 311 of the sealed container 31 is brought into high pressure atmosphere filled with the high pressure refrigerant gas having flowed in from the second intake passage 36. However, as described above, the pressure in the internal space 311 of the sealed container 31, that is, the pressure in the second intake passage 36 is slightly lower than the pressure in the muffler 322, that is, the pressure in the first discharge passage 35 due to pressure loss that occurs in the first water-refrigerant heat exchanger 4, the pipes 10, 17, or the like.

[0024] In the description below, pressure in the muffler 322 and the first discharge passage 35 is referred to as first high pressure, and pressure in the internal space 311 of the sealed container 31 and the second intake passage 36 is referred to as second high pressure. A difference between the first high pressure and the second high pressure corresponds to pressure loss that occurs when the high pressure refrigerant passes through the first water-refrigerant heat exchanger 4 or the like.

[0025] The first intake passage 34, the first discharge passage 35, and the second intake passage 36 protrude from side surfaces of the sealed container 31. The second intake passage 36 is placed above the first discharge passage 35. An outlet of the second intake passage 36 opens into a space below the electric actuating element 33 in the internal space 311 of the sealed container 31. Specifically, the outlet of the second intake passage 36 is lower than the electric actuating element 33. An oil reservoir 312 that stores refrigerator oil (not shown) is located in a lower portion of the internal space 311 of the sealed container 31. An oil surface of the refrigerator oil in the oil reservoir 312 in the sealed container 31 is lower than an opening of the outlet of the second intake passage 36. An inlet of the second discharge passage 37 opens into a space above the electric actuating element 33 in the internal space 311 of the sealed container 31. As such, the outlet of the second intake passage 36 and the inlet of the second discharge passage 37 are located on opposite sides with the electric actuating element 33 therebetween.

[0026] The high pressure refrigerant gas having flowed from the second intake passage 36 into the space below the electric actuating element 33 in the internal space 311 of the sealed container 31 passes through a gap between the rotor and the stator of the electric actuating element 33, or the like, and moves to the space above the electric actuating element 33 in the internal space 311. Then, the high pressure refrigerant gas is discharged through the second discharge passage 37 to the outside of the sealed container 31. As described above, the refrigerant discharged from the second discharge passage 37 passes through the second water-refrigerant heat exchanger 5, the expansion valve 6, the evaporator 7, or the like, and then returns to the first intake passage 34 of the compressor 3.

[0027] In order to lubricate and seal a slide portion of the compressing element 32 to reduce friction and gap leakage, the refrigerator oil is supplied from the oil reservoir 312 into the compression chamber 321. The refrigerator oil supplied into the compression chamber 321 and the compressed high pressure refrigerant gas pass together through the muffler 322 and the frame 323, and flow into the first discharge passage 35. The high pressure refrigerant gas and the refrigerator oil form a gas-liquid two-phase flow.

[0028] Figure 4 is a schematic sectional view of a flow state of the refrigerant gas and the refrigerator oil. As shown in Figure 4, the flow state of the refrigerant gas and the refrigerator oil is referred to as an annular flow or an annular dispersed flow. Specifically, the refrigerator oil as a liquid phase flows as an annular liquid film along a pipe wall, and the refrigerant gas as a gas phase flows through a center of the pipe. Such a state is referred to as an annular flow. A part of the refrigerator oil may be spattered in the refrigerant gas in the center of the pipe to form mist. Such a state is referred to as an annular dispersed flow.

[0029] If a large amount of refrigerator oil having flowed out of the compressing element 32 to the first discharge passage 35 together with the high pressure refrigerant gas flows into the first water-refrigerant heat exchanger 4, heat transfer in the first water-refrigerant heat exchanger 4 is inhibited by the refrigerator oil, or pressure loss increases, which may reduce performance of the heat pump hot-water supply device 1. Also, a reduction in the amount of the refrigerator oil in the sealed container 31 may affect reliability. Thus, in order to prevent the refrigerator oil from flowing into the first water-refrigerant heat exchanger 4, the compressor 3 according to Embodiment 1 includes an oil return flow path for guiding the refrigerator oil to the internal space 311 of the sealed container 31, the refrigerator oil having flowed out of the compressing element 32 to the first discharge passage 35. Now, with reference to Figure 5, the oil return flow path included in the compressor 3 according to this embodiment will be described.

[0030] Figure 5 is a sectional view of the oil return flow path included in the compressor 3 according to Embodiment 1 of the present invention. As shown in Figure 5, the first discharge passage 35 includes an outer pipe 351, and an inner pipe 352 placed inside the outer pipe 351. An upstream end of the outer pipe 351 airtightly fits in a hole portion provided in a wall of the sealed container 31. An upstream end surface of the outer pipe 351 abuts against a frame 323 of the compressing element 32. The inner pipe 352 protrudes from an upstream end surface of the outer pipe 351, and is inserted into a passage 324 formed in the frame 323. An upstream end of the inner pipe 352 airtightly fits in the passage 324. A plurality of holes 353 through which the refrigerator oil can pass are formed in a pipe wall of the inner pipe 352. The holes 353 open in an inner peripheral surface of the inner pipe 352 of the first discharge passage 35. A gap is formed between an inner peripheral surface of the outer pipe 351 and an outer peripheral surface of the inner pipe 352. This gap constitutes a first oil return passage 354 through which the refrigerator oil can pass. A sealing member 355 seals between an outer peripheral surface of the downstream end of the inner pipe 352 and the inner peripheral surface of the outer pipe 351. A second oil return passage 325 through which the refrigerator oil can pass is formed in the frame 323. The second oil return passage 325 is constituted by an annular recess communicating with the first oil return passage 354, and a through passage penetrating from the recess to a lower surface of the frame 323. As such, the holes 353 communicate with the internal space 311 of the sealed container 31 via the first oil return passage 354 and the second oil return passage 325.

[0031] The refrigerator oil supplied into the compression chamber 321 of the compressing element 32 flows, together with the compressed high pressure refrigerant gas, through the muffler 322 and the passage 324 in the frame 323 into the inner pipe 352 of the first discharge passage 35. The high pressure refrigerant gas and the refrigerator oil form an annular flow in the inner pipe 352. Specifically, most of the refrigerator oil in the inner pipe 352 flows as an annular liquid film along the inner peripheral surface of the inner pipe 352. As such, the refrigerator oil as a liquid film on the inner peripheral surface of the inner pipe 352 is sucked into the holes 353 opening in the inner peripheral surface of the inner pipe 352, passes through the first oil return passage 354 and the second oil return passage 325, and flows out of an outlet of the second oil return passage 325 to the internal space 311 of the sealed container 31 as shown by thin arrows in Figure 5. Since the refrigerator oil has a higher density than the refrigerant gas, the refrigerator oil having flowed out of the outlet of the second oil return passage 325 falls by gravity, and returns to the oil reservoir 312 in the lower portion of the internal space 311 of the sealed container 31. In contrast, the refrigerant gas passes through the inner pipe 352 and reaches the outer pipe 351, and is fed toward the first water-refrigerant heat exchanger 4.

[0032] As such, the oil return flow path in Embodiment 1 is constituted by the first oil return passage 354 provided on an outer peripheral side of the inner pipe 352 of the first discharge passage 35, and the second oil return passage 325 that provides communication between the first oil return passage 354 and the internal space 311 of the sealed container 31, the second oil return passage 325 being inside the sealed container 31.

[0033] According to Embodiment 1, the oil return flow path as described above is provided in the compressor 3, thereby allowing the refrigerator oil having flowed out to the first discharge passage 35 to be guided to the internal space 311 of the sealed container 31. Thus, the amount of the refrigerator oil flowing from the first discharge passage 35 to the first water-refrigerant heat exchanger 4 can be reliably reduced. This can reliably prevent an increase in pressure loss and inhibition of heat transfer in the first water-refrigerant heat exchanger 4 caused by the refrigerator oil. This can improve performance of the heat pump hot-water supply device 1. Also, a reduction in the amount of the refrigerator oil in the sealed container 31 can be prevented to increase reliability of the compressor 3. Further, there is no need to provide an oil separator in a middle of a pipe connecting the compressor 3 and the first water-refrigerant heat exchanger 4, which allows a simple and compact device configuration.

[0034] In particular, in Embodiment 1, the first oil return passage 354 and the second oil return passage 325 can be integrally provided in or near the first discharge passage 35. Thus, with an extremely simple and compact configuration, the above described advantage can be achieved. This can reduce manufacturing cost, weight, and space.

[0035] As described above, the second high pressure in the internal space 311 of the sealed container 31 is lower than the first high pressure in the first discharge passage 35. Thus, a force caused by the difference between the first high pressure and the second high pressure automatically moves the refrigerator oil in the first oil return passage 354 and the second oil return passage 325. Thus, the refrigerator oil in the first discharge passage 35 can be efficiently and reliably returned to the internal space 311 of the sealed container 31. The difference between the first high pressure and the second high pressure corresponds to the pressure loss that occurs in the first water-refrigerant heat exchanger 4 or the like, and is thus a moderate pressure difference rather than an excessive pressure difference. Thus, a force applied on the refrigerator oil in the first oil return passage 354 and the second oil return passage 325 by the difference between the first high pressure and the second high pressure moves the refrigerator oil at a moderate speed. Also, even without an on-off valve, a pressure reducing valve, a capillary tube, or the like being provided in a middle of the oil return flow path, the high pressure refrigerant gas in the first discharge passage 35 can be reliably prevented from leaking through the oil return flow path to the internal space 311 of the sealed container 31. Thus, there is no need to provide an on-off valve, a pressure reducing valve, a capillary tube, or the like in the middle of the oil return flow path, which can simplify the configuration.

[0036] In Embodiment 1, the refrigerator oil is sucked into the first oil return passage 354 from the plurality of holes 353 opening in the inner peripheral surface of the inner pipe 352 of the first discharge passage 35. Thus, the refrigerator oil that forms the annular liquid film along the inner peripheral surface of the inner pipe 352 can be efficiently introduced into the first oil return passage 354.

[0037] In Embodiment 1, the amount of the refrigerator oil flowing out of the compressing element 32 to the first discharge passage 35 may be previously estimated, and the size and number of the holes 353 are set according to the amount, thereby allowing the amount of the refrigerator oil flowing from the holes 353 to the first oil return passage 354 to be appropriately controlled.

[0038] A compressor for compressing a refrigerant generally includes a low pressure shell type compressor in which an internal space of a sealed container is filled with a low pressure refrigerant gas before compression, and a high pressure shell type compressor in which an internal space of a sealed container is filled with a high pressure refrigerant gas after compression. "Shell" corresponds to a sealed container. As described above, the compressor 3 according to Embodiment 1 is one of high pressure shell type compressors because the internal space 311 of the sealed container 31 is filled with the high pressure refrigerant gas. In a conventional compressor including one refrigerant intake passage and one refrigerant discharge passage among high pressure shell type compressors, if an oil separator is provided on a discharge passage side of the compressor, it is difficult to directly return refrigerator oil separated by the oil separator to an internal space of a sealed container. This is because in the conventional high pressure shell type compressor, refrigerant pressure on a discharge passage side is equal to pressure in an internal space of a sealed container (shell), and thus refrigerator oil separated by an oil separator cannot be fed to the internal space of the sealed container by a pressure difference. Thus, when the oil separator is provided on the discharge passage side of the conventional high pressure shell type compressor, the refrigerator oil separated by the oil separator has to be returned to an intake passage side of the compressor having low pressure. Thus, there is a need for an oil return pipe connecting the oil separator provided on the discharge passage side and the intake passage side of the compressor. In contrast, in the compressor 3 according to Embodiment 1, as described above, the refrigerator oil can be directly returned from the first discharge passage 35 to the internal space 311 of the sealed container 31 using the difference between the first high pressure and the second high pressure. This can extremely simplify a structure.

[0039] In the meantime, for a low pressure shell type compressor having a configuration in which an oil separator is provided on a discharge passage side and an oil return pipe connecting the oil separator and a sealed container is provided, refrigerator oil can be fed from the oil separator to an internal space of the sealed container by a pressure difference. However, with this configuration, pressure in the oil separator is equal to pressure of a high pressure refrigerant gas, and pressure in the internal space of the sealed container is equal to pressure of a low pressure refrigerant gas, and thus there is too large a difference between the pressure in the oil separator and the pressure in the internal space of the sealed container. Thus, the high pressure refrigerant gas may flow through the oil return pipe to the internal space of the sealed container. Thus, when the oil separator is provided on the discharge passage side of the low pressure shell type compressor, there is a need to provide an on-off valve, a pressure reducing valve, a capillary tube, or the like in a middle of the oil return pipe in order to prevent the high pressure refrigerant gas from leaking from the oil separator through the oil return pipe to the internal space of the sealed container. Providing an on-off valve, a pressure reducing valve, a capillary tube, or the like in a middle of the oil return pipe complicates a structure. In contrast, in the compressor 3 according to Embodiment 1, as described above, there is no need to provide an on-off valve, a pressure reducing valve, a capillary tube, or the like in the middle of the oil return flow path, which can extremely simplify the structure.

[0040] The embodiment in which the compressor according to the present invention is used to configure the heat pump hot-water supply device has been described above, however, not limited to the heat pump hot-water supply device, the present invention may be similarly applied to various vapor compression refrigeration cycle devices such as an air conditioning device or a cooling device.

Embodiment 2

[0041] Next, with reference to Figure 6, Embodiment 2 of the present invention will be described. Differences from Embodiment 1 described above will be mainly described, and like or corresponding parts are denoted by like reference numerals and descriptions thereof will be omitted. Figure 6 is a cross sectional view of an inner pipe 352 of a first discharge passage 35 included in a compressor 3 according to Embodiment 2 of the present invention. As shown in Figure 6, in Embodiment 2, longitudinal grooves 356 are formed in an inner wall of the inner pipe 352 of the first discharge passage 35. In this embodiment, many grooves 356 are formed in parallel over the entire inner periphery of the inner pipe 352. Embodiment 2 is similar to Embodiment 1 other than the grooves 356 being formed in the inner wall of the inner pipe 352.

[0042] In Embodiment 2, the grooves 356 are formed in the inner wall of the inner pipe 352, and thus refrigerator oil is more reliably captured in the inner wall of the inner pipe 352 by action of surface tension. Thus, the refrigerator oil can more efficiently flow into holes 353 formed in the inner pipe 352. Thus, in the first discharge passage 35, the refrigerator oil can be more reliably separated from a high pressure refrigerant gas, and returned to an internal space 311 of a sealed container 31.

[0043] In an example in Figure 6, the groove 356 has a substantially V-shaped section. The groove 356 may have a rectangular or semicircular section. The groove 356 may not be completely parallel to an axial direction of the inner pipe 352, but the groove 356 may be twisted with respect to the axial direction of the inner pipe 352.

Embodiment 3

[0044] Next, with reference to Figure 7, Embodiment 3 of the present invention will be described. Differences from Embodiment 1 described above will be mainly described, and like or corresponding parts are denoted by like reference numerals and descriptions thereof will be omitted. Figure 7 is a sectional view of an oil return flow path included in a compressor 3 according to Embodiment 3 of the present invention. Embodiment 3 is similar to Embodiment 1 other than a different configuration of the oil return flow path. Now, with reference to Figure 7, the oil return flow path included in the compressor 3 according to Embodiment 3 will be described.

[0045] As shown in Figure 7, a first discharge passage 35 includes an outer pipe 351, and an inner pipe 352 placed outside the outer pipe 351. An upstream end of the outer pipe 351 airtightly fits in a hole portion provided in a wall of a sealed container 31. An upstream end surface of the outer pipe 351 abuts against a frame 323 of a compressing element 32. The inner pipe 352 protrudes from an upstream end surface of the outer pipe 351, and is inserted into a passage 324 formed in the frame 323. An upstream end of the inner pipe 352 airtightly fits in the passage 324. A plurality of holes 353 through which the refrigerator oil can pass are formed in a side wall of the inner pipe 352. The holes 353 open in an inner peripheral surface of the inner pipe 352 of the first discharge passage 35. A gap is formed between an inner peripheral surface of the outer pipe 351 and an outer peripheral surface of the inner pipe 352. This gap forms a first oil return passage 354 through which the refrigerator oil can pass. A sealing member 355 seals between an outer peripheral surface of the downstream end of the inner pipe 352 and the inner peripheral surface of the outer pipe 351. The first oil return passage 354 communicates with a second intake passage 36 via a second oil return passage 357. In the shown configuration, a hole formed in a pipe wall of the outer pipe 351 outside the first oil return passage 354 and a hole formed in a pipe wall of the second intake passage 36 are connected by a pipe, and the pipe constitutes the second oil return passage 357. As such, the holes 353 communicate with the second intake passage 36 via the first oil return passage 354 and the second oil return passage 357.

[0046] The refrigerator oil supplied into the compression chamber 321 of the compressing element 32 flows, together with the compressed high pressure refrigerant gas, through a muffler 322 and the passage 324 in the frame 323 into the inner pipe 352 of the first discharge passage 35 to form an annular flow. The refrigerator oil as a liquid film on the inner peripheral surface of the inner pipe 352 is sucked into the holes 353 opening in the inner peripheral surface of the inner pipe 352, passes through the first oil return passage 354 and the second oil return passage 357, and reaches inside the second intake passage 36 as shown by thin arrows in Figure 7. The refrigerator oil further flows out of an outlet of the second intake passage 36 to an internal space 311 of the sealed container 31, falls by gravity, and returns to an oil reservoir 312 in a lower portion of the internal space 311 of the sealed container 31. In contrast, a high pressure refrigerant gas in the inner pipe 352 passes through the inner pipe 352 and reaches the outer pipe 351, and is fed to the first water-refrigerant heat exchanger 4.

[0047] As such, the oil return flow path in Embodiment 3 is constituted by the first oil return passage 354 provided on an outer peripheral side of the inner pipe 352 of the first discharge passage 35 and the second oil return passage 357 that provides communication between the first oil return passage 354 and the second intake passage 36, the second oil return passage 357 being outside the sealed container 31.

[0048] In the compressor 3 according to Embodiment 3, the oil return flow path as described above is provided in the compressor 3, thereby allowing the refrigerator oil having flowed out to the first discharge passage 35 to be guided to the second intake passage 36, and allowing the refrigerator oil to return from the second intake passage 36 to the internal space 311 of the sealed container 31. Thus, the amount of the refrigerator oil flowing from the first discharge passage 35 to a first water-refrigerant heat exchanger 4 can be reliably reduced. This can reliably prevent an increase in pressure loss and inhibition of heat transfer in the first water-refrigerant heat exchanger 4 caused by the refrigerator oil. This can improve performance of the heat pump hot-water supply device 1. Also, a reduction in the amount of the refrigerator oil in the sealed container 31 can be prevented to increase reliability of the compressor 3. Further, there is no need to provide an oil separator in a middle of a pipe connecting the compressor 3 and the first water-refrigerant heat exchanger 4, which allows a simple and compact device configuration.

[0049] Also, according to Embodiment 3, the first oil return passage 354 and the second oil return passage 357 may be placed near the first discharge passage 35 and the second intake passage 36 of the compressor 3 with a simple structure. This can reduce manufacturing cost, weight, and space.

[0050] Also, in Embodiment 3, as in Embodiment 1, a moderate force caused by a difference between first high pressure and second high pressure automatically moves the refrigerator oil in the first oil return passage 354 and the second oil return passage 357 at a moderate speed. This provides similar advantage as of Embodiment 1. In Embodiment 3, as in Embodiment 2, grooves 356 may be formed in an inner wall of the inner pipe 352.

Embodiment 4

[0051] Next, with reference to Figures 8 and 9, Embodiment 4 of the present invention will be described. Differences from the embodiments described above will be mainly described, and like or corresponding parts are denoted by like reference numerals and descriptions thereof will be omitted. Figure 8 is a longitudinal sectional view of around a downstream end of a second intake passage 36 included in a compressor 3 according to Embodiment 4 of the present invention. Figure 9 is a cross sectional view of around the downstream end of the second intake passage 36 included in the compressor 3 according to Embodiment 4 of the present invention.

[0052] In Embodiment 3 described above, the refrigerator oil in the first discharge passage 35 is guided into the second intake passage 36 to flow from an outlet of the second intake passage 36 into a sealed container 31. When the refrigerator oil flows out of the outlet of the second intake passage 36, the refrigerator oil may be raised by a flow of a high pressure refrigerant gas spouting from the outlet of the second intake passage 36. A part of the raised refrigerator oil is atomized and mixed in the high pressure refrigerant gas. Thus, the refrigerator oil mixed in the high pressure refrigerant gas may flow out of the second discharge passage 37, and is circulated to a refrigerant circuit such as a second water-refrigerant heat exchanger 5. Thus, heat transfer in the second water-refrigerant heat exchanger 5 may be inhibited by the refrigerator oil, or pressure loss may increase, which may reduce performance of the heat pump hot-water supply device 1.

[0053] In view of the above, the compressor 3 according to Embodiment 4 further includes oil separation means for separating the high pressure refrigerant gas and the refrigerator oil flowing from the second intake passage 36 in addition to the configuration in Embodiment 3. Now, a configuration of the oil separation means in Embodiment 4 will be described.

[0054] As shown in Figure 8, the compressor 3 according to Embodiment 4 includes an inner pipe 38 inside the second intake passage 36. The high pressure refrigerant gas can pass through an inside of the inner pipe 38. Specifically, the inner pipe 38 has a channel cross-sectional area through which a high pressure refrigerant gas can smoothly pass. Refrigerator oil introduced from the first discharge passage 35 into the second intake passage 36 can pass between an inner wall of the second intake passage 36 and an outer wall of the inner pipe 38. Specifically, a gap to form a channel cross-sectional area through which the refrigerator oil can smoothly pass is formed between the inner wall of the second intake passage 36 and the outer wall of the inner pipe 38.

[0055] A downstream end of the inner pipe 38 protrudes from a downstream end of the second intake passage 36. Specifically, the downstream end of the inner pipe 38 is located in a position protruding inward of the sealed container 31 as compared to the position of the downstream end of the second intake passage 36. In Embodiment 4, such an inner pipe 38 is provided as oil separation means. The refrigerator oil flows out of the downstream end of the second intake passage 36, and falls downward into an oil reservoir 312 in a lower portion of an internal space 311 of the sealed container 31. The high pressure refrigerant gas spouts from the downstream end of the inner pipe 38 to the internal space 311 of the sealed container 31. Thus, the refrigerator oil having flowed out of the downstream end of the second intake passage 36 does not collide with a flow of the high pressure refrigerant gas spouting from the downstream end of the inner pipe 38, thereby reliably preventing the refrigerator oil from being raised and spattered by the flow of the high pressure refrigerant gas. As such, in Embodiment 4, the refrigerator oil having flowed out of the downstream end of the second intake passage 36 can reliably fall into the oil reservoir 312 in the lower portion of the internal space 311 of the sealed container 31 and be separated. Thus, mixture of the high pressure refrigerant gas and the refrigerator oil flowing from the second intake passage 36 to the internal space 311 of the sealed container 31 can be reliably prevented to reliably separate the high pressure refrigerant gas and the refrigerator oil. Thus, the amount of the refrigerator oil mixed in the refrigerant and flowing out of the second discharge passage 37 can be reduced. This can reduce a circulation rate of the refrigerator oil to the second water-refrigerant heat exchanger 5, the expansion valve 6, the evaporator 7, or the like, and reliably prevent an increase in pressure loss and inhibition of heat transfer in the second water-refrigerant heat exchanger 5 caused by the refrigerator oil. This can further improve performance of the heat pump hot-water supply device 1. Also, a reduction in the amount of the refrigerator oil in the sealed container 31 can be more reliably prevented to further increase reliability of the compressor 3.

[0056] Also in Embodiment 4, as shown in Figure 9, longitudinal grooves 364 are formed in an inner wall of the second intake passage 36 so that the refrigerator oil can pass through the grooves 364. In Embodiment 4, many grooves 364 are formed in parallel over the entire inner periphery of the second intake passage 36. In the shown configuration, the groove 364 has a substantially V-shaped section, but the groove 364 may have a rectangular or semicircular section. The groove 364 may not be completely parallel to an axial direction of the second intake passage 36, but the groove 364 may be twisted with respect to the axial direction of the second intake passage 36. In Embodiment 4, the grooves 364 are formed in the inner wall of the second intake passage 36, and thus the refrigerator oil flowing in the second intake passage 36 is reliably captured in the grooves 364 by surface tension. Thus, the refrigerator oil can be reliably prevented from being spattered and atomized in the high pressure refrigerant gas in a center of the second intake passage 36 to more reliably guide the refrigerator oil to a gap between the inner wall of the second intake passage 36 and an outer wall of the inner pipe 38. Thus, mixture of the high pressure refrigerant gas and the refrigerator oil flowing from the second intake passage 36 to the internal space 311 of the sealed container 31 can be more reliably prevented to more reliably separate the high pressure refrigerant gas and the refrigerator oil. In Embodiment 4, no grooves 364 may be provided in the inner wall of the second intake passage 36. Specifically, the inner wall of the second intake passage 36 may be smooth. In Embodiment 4, a space through which the refrigerator oil can pass will suffice, the space being provided between the inner wall of the second intake passage 36 and the outer wall of the inner pipe 38.

Embodiment 5

[0057] Next, with reference to Figure 10, Embodiment 5 of the present invention will be described. Differences from Embodiments 3 and 4 described above will be mainly described, and like or corresponding parts are denoted by like reference numerals and descriptions thereof will be omitted. Figure 10 is a view of around a downstream end of a second intake passage 36 included in a compressor 3 according to Embodiment 5 of the present invention.

[0058] For the same reason as in Embodiment 4, the compressor 3 according to Embodiment 5 further includes oil separation means for separating a high pressure refrigerant gas and refrigerator oil flowing from the second intake passage 36 in addition to the configuration in Embodiment 3. Now, a configuration of the oil separation means in Embodiment 5 will be described.

[0059] As shown in Figure 10, in the compressor 3 according to Embodiment 5, a tubular mesh member 39 is connected to a downstream end of the second intake passage 36 in the sealed container 31. The mesh member 39 is made of, for example, a metal material, and has substantially the same diameter as the second intake passage 36. In Embodiment 5, such a mesh member 39 is provided as the oil separation means. A central axis of the mesh member 39 is substantially horizontal. Refrigerator oil having flowed out of the downstream end of the second intake passage 36 is captured by the mesh member 39, collected along a peripheral surface of the mesh member 39 in a lower portion of the mesh member 39, and falls into an oil reservoir 312 in a lower portion of an internal space 311 of the sealed container 31. An end surface of the mesh member 39 has an opening. A high pressure refrigerant gas spouts through the opening in the end surface of the mesh member 39 rather than meshes (pores) of the mesh member 39 to the internal space 311 of the sealed container 31. With such a configuration, in Embodiment 5, the refrigerator oil having flowed out of the downstream end of the second intake passage 36 can be reliably prevented from being raised and spattered by the flow of the high pressure refrigerant gas. Thus, mixture of the high pressure refrigerant gas and the refrigerator oil flowing from the second intake passage 36 to the internal space 311 of the sealed container 31 can be reliably prevented to reliably separate the high pressure refrigerant gas and the refrigerator oil. This can provide similar advantage as of Embodiment 4.

[0060] In Embodiment 5, grooves 364 as in Embodiment 4 are desirably formed in an inner wall of the second intake passage 36. Thus, the refrigerator oil flowing in the second intake passage 36 is reliably captured in the grooves 364 by surface tension. Thus, the refrigerator oil can be reliably prevented from being spattered and atomized in the high pressure refrigerant gas in a center of the second intake passage 36 to more reliably guide the refrigerator oil as a liquid film to the mesh member 39. This can more reliably prevent mixture of the high pressure refrigerant gas and the refrigerator oil flowing from the second intake passage 36 into the sealed container 31 to more reliably separate both.

Reference Signs List

[0061]

1	heat pump hot-water supply device
1a	water inlet
1b	hot water outlet
2	tank unit
2a	hot water storage tank
2b	water pump
2c	hot-water supplying mixing valve
3	compressor
4	first water-refrigerant heat exchanger
5	second water-refrigerant heat exchanger
6	expansion valve
7	evaporator
8	fan
9	high and low pressures heat exchanger

10, 11, 12	pipe
13	water supply pipe
14	hot water delivery pipe
15	water supply branch pipe
16	hot-water supply pipe
17, 18, 19, 20, 21	pipe
23, 24, 26	water channel
27	accumulator
31	sealed container
32	compressing element
33	electric actuating element
34	first intake passage
35	first discharge passage
36	second intake passage
37	second discharge passage
38	inner pipe
39	mesh member
50	control unit
311	internal space
312	oil reservoir
321	compression chamber
322	muffler
323	frame
324	passage
325	second oil return passage
331	rotating shaft
351	outer pipe
352	inner pipe
353	hole
354	first oil return passage
355	sealing member
356	groove
357	second oil return passage
364	groove

Claims

1. A compressor comprising:

a sealed container;
a compressing element provided in the sealed container;
a first intake passage for guiding sucked low pressure refrigerant to the compressing element without releasing the low pressure refrigerant to an internal space of the sealed container;
a first discharge passage for discharging high pressure refrigerant compressed by the compressing element directly to an outside of the sealed container without releasing the high pressure refrigerant to the internal space of the sealed container;
a second intake passage for guiding the high pressure refrigerant having passed through the first discharge passage and an external heat exchanger provided downstream of the first discharge passage to the internal space of the sealed container;
a second discharge passage for discharging the high pressure refrigerant in the internal space of the sealed container to the outside of the sealed container; and
an oil return flow path for guiding refrigerator oil, the refrigerator oil having flowed out of the compressing element to the first discharge passage, to the internal space of the sealed container or into the second intake passage, due to pressure loss occurring when the high pressure refrigerant passes through the external heat exchanger, a second high pressure which is a pressure in the internal space of the sealed container and the second intake passage being lower than a first high pressure which is a pressure in the first discharge passage,
owing to a difference between the first high pressure and the second high pressure, the refrigerator oil moving

in the oil return flow path.

2. The compressor according to claim 1, further comprising a plurality of holes opening in an inner peripheral surface of the first discharge passage, the refrigerator oil in the first discharge passage being sucked into the plurality of holes.

3. The compressor according to claim 1 or 2, wherein the oil return flow path includes a first oil return passage provided on an outer peripheral side of the first discharge passage, and a second oil return passage that provides communication between the first oil return passage and the internal space of the sealed container, the second oil return passage being inside the sealed container.

4. The compressor according to claim 1 or 2, wherein the oil return flow path includes a first oil return passage provided on an outer peripheral side of the first discharge passage, and a second oil return passage that provides communication between the first oil return passage and the second intake passage, the second oil return passage being outside the sealed container.

5. The compressor according to any one of claims 1 to 4, wherein a longitudinal groove is formed in an inner wall of the first discharge passage.

6. The compressor according to any one of claims 1 to 5, further comprising oil separation means for separating the high pressure refrigerant and the refrigerator oil flowing from the second intake passage to the internal space of the sealed container.

7. The compressor according to claim 6, comprising, as the oil separation means, an inner pipe provided inside the second intake passage,
wherein a downstream end of the inner pipe protrudes from a downstream end of the second intake passage,
the high pressure refrigerant is able to pass through an inside of the inner pipe, and
the refrigerator oil is able to pass between an inner wall of the second intake passage and an outer wall of the inner pipe.

8. The compressor according to claim 6, comprising, as the oil separation means, a tubular mesh member connected to a downstream end of the second intake passage.

9. The compressor according to any one of claims 1 to 8, wherein pressure on a high pressure side of the refrigerant exceeds critical pressure.

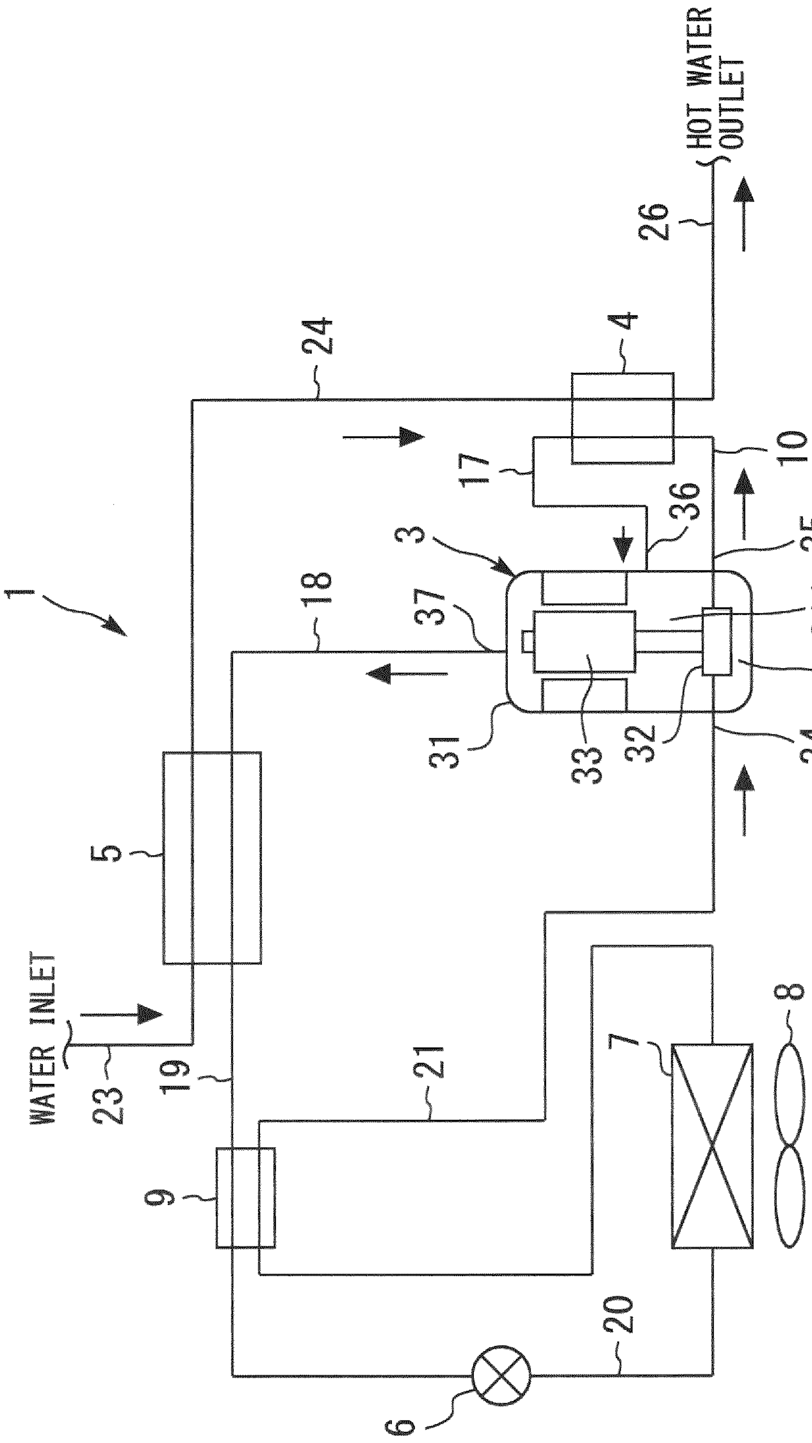
10. A refrigeration cycle device comprising:

the compressor according to any one of claims 1 to 9;
a first heat exchanger, as the external heat exchanger, for making the high pressure refrigerant discharged from the first discharge passage of the compressor release heat; and
a second heat exchanger for making the high pressure refrigerant discharged from the second discharge passage of the compressor release heat.

11. A heat pump hot-water supply device comprising:

the compressor according to any one of claims 1 to 9;
a first water-refrigerant heat exchanger, as the external heat exchanger, for performing heat exchange between the high pressure refrigerant discharged from the first discharge passage of the compressor and water; and
a second water-refrigerant heat exchanger for performing heat exchange between the high pressure refrigerant discharged from the second discharge passage of the compressor and water.

FIG. 1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32
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34
35
36
37
311
312
WATER INLET
HOT WATER
OUTLET

FIG. 2

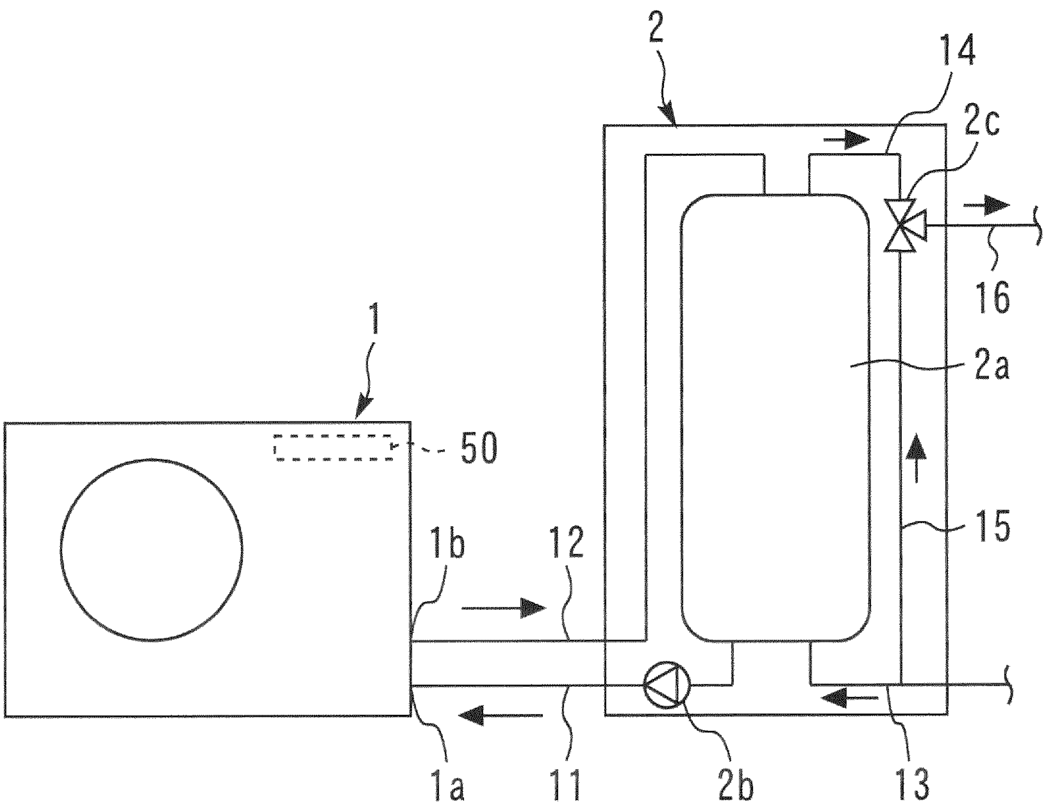


FIG. 3

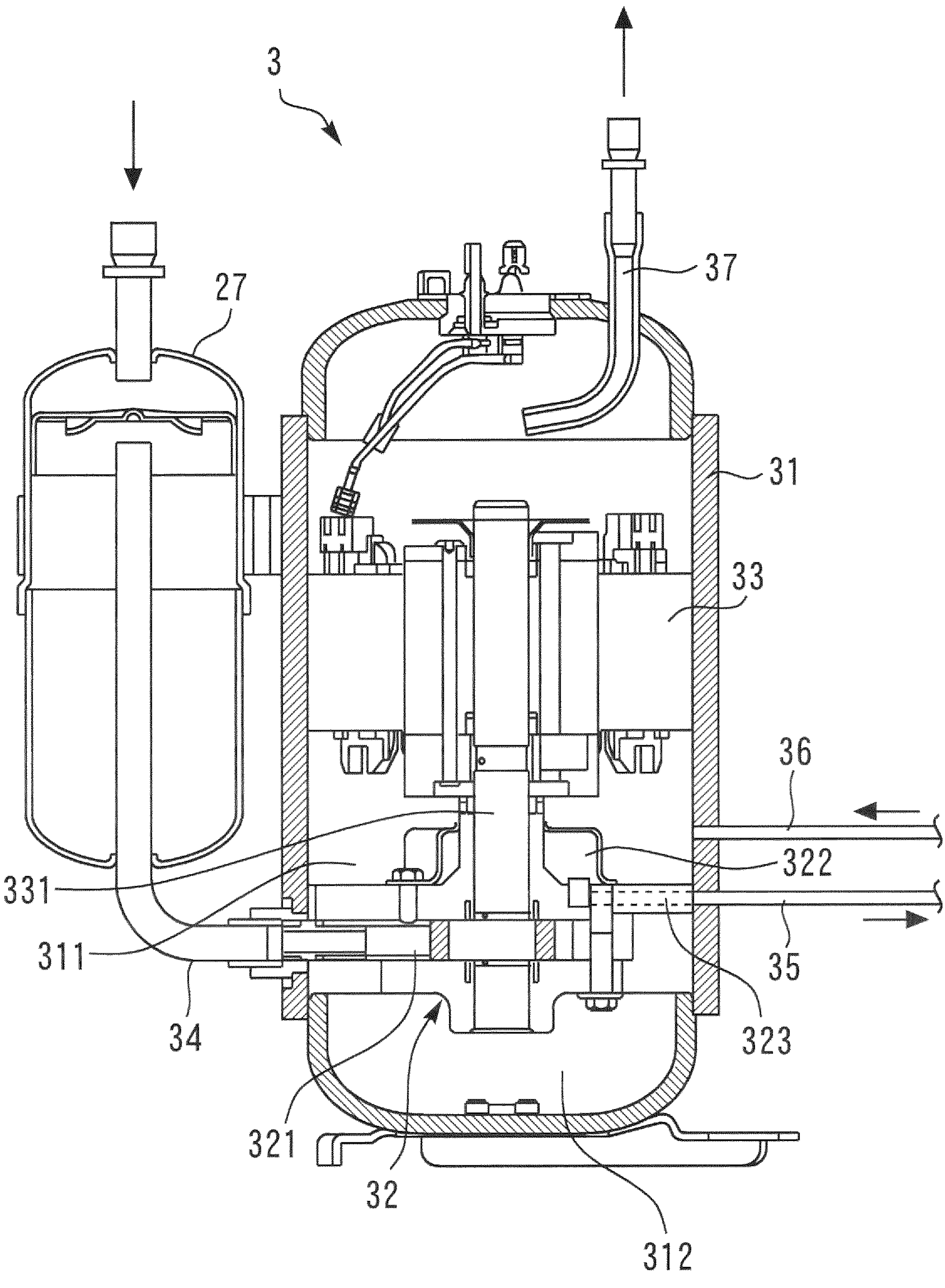
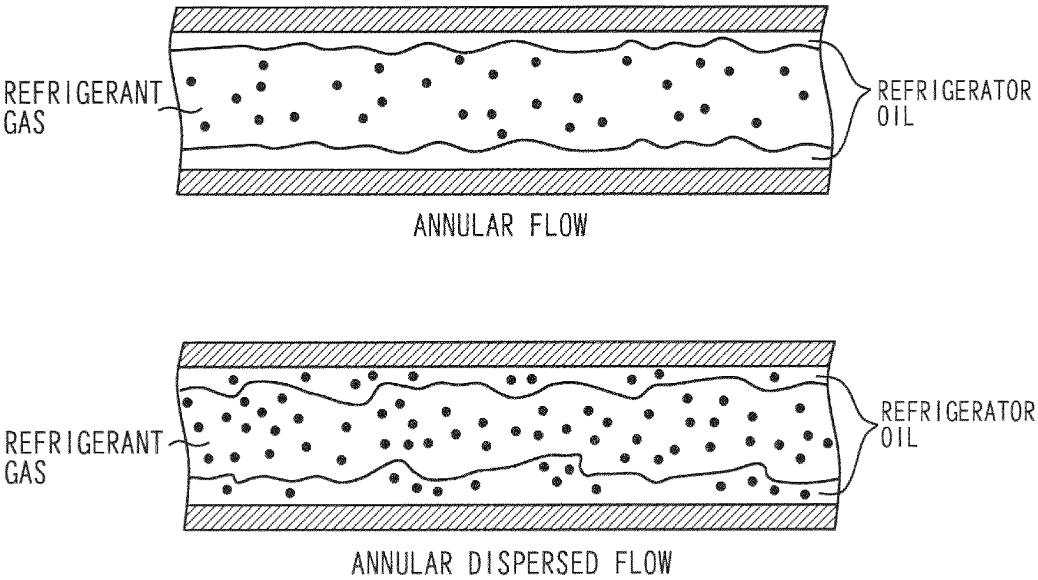


FIG. 4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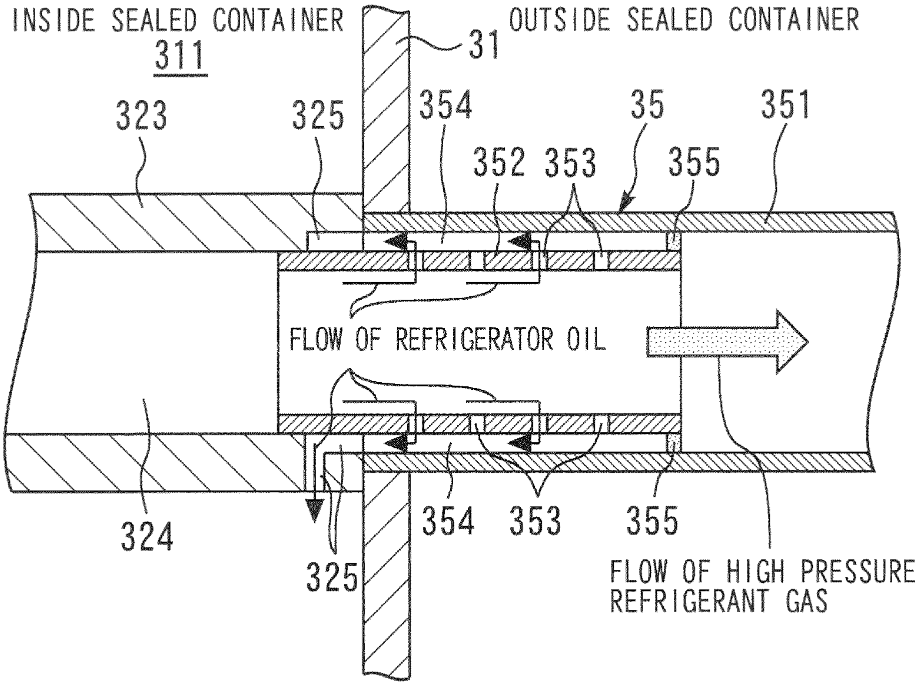
REFRIGERATOR OIL
ANNULAR FLOW
REFRIGERANT GAS
REFRIGERATOR OIL
ANNULAR DISPERSED FLOW

FIG. 5


INSIDE SEALED CONTAINER
311
OUTSIDE SEALED CONTAINER
31
323
325
354
35
351
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FLOW OF REFRIGERATOR OIL
324
354
353
355
325
FLOW OF HIGH PRESSURE REFRIGERANT GAS

FIG. 6

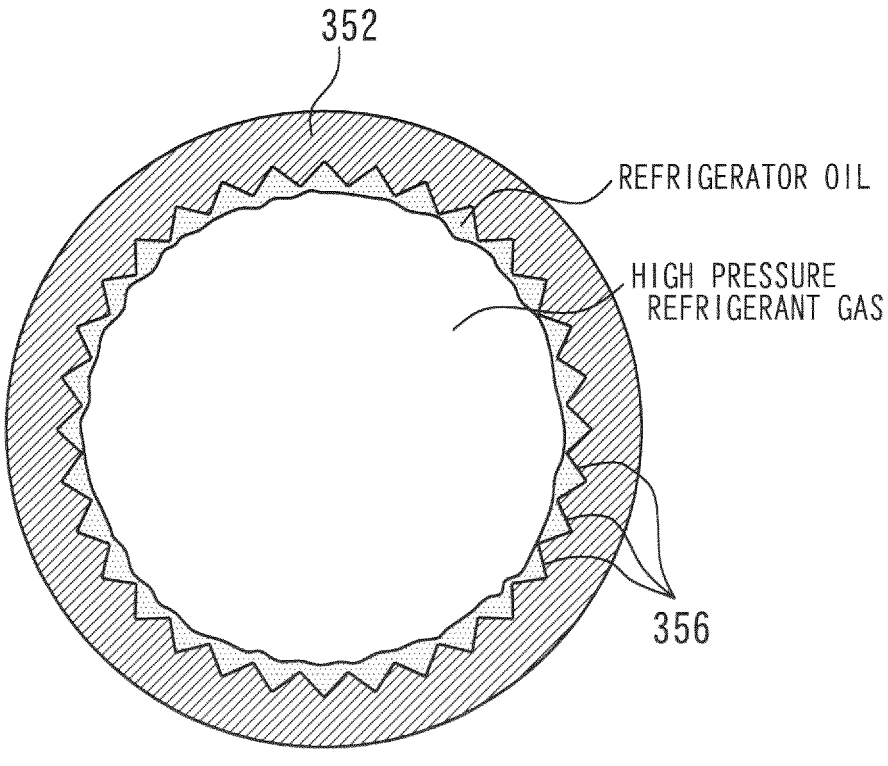
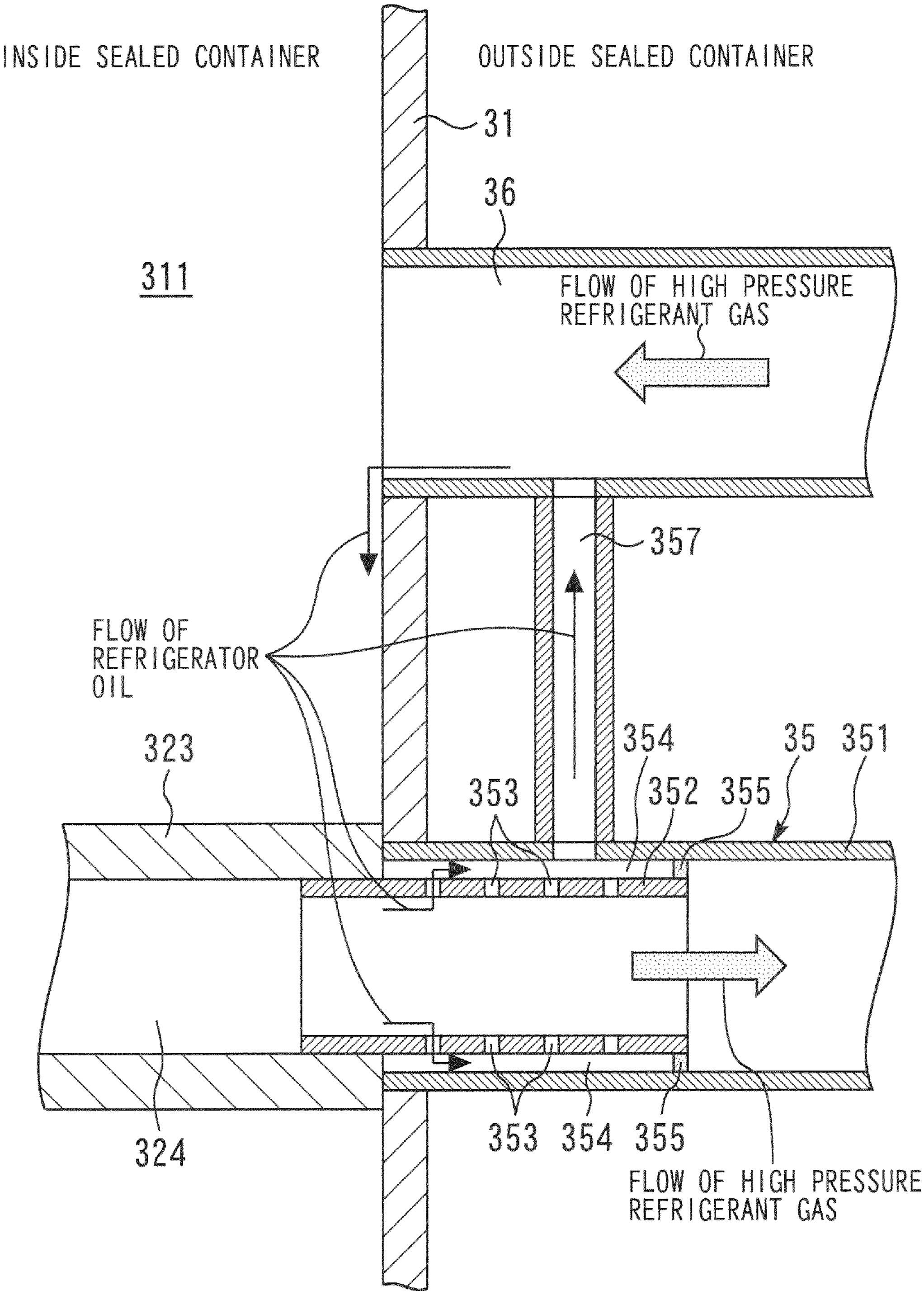


FIG. 7


INSIDE SEALED CONTAINER
OUTSIDE SEALED CONTAINER
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36
311
FLOW OF HIGH PRESSURE REFRIGERANT GAS
357
FLOW OF REFRIGERATOR OIL
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352
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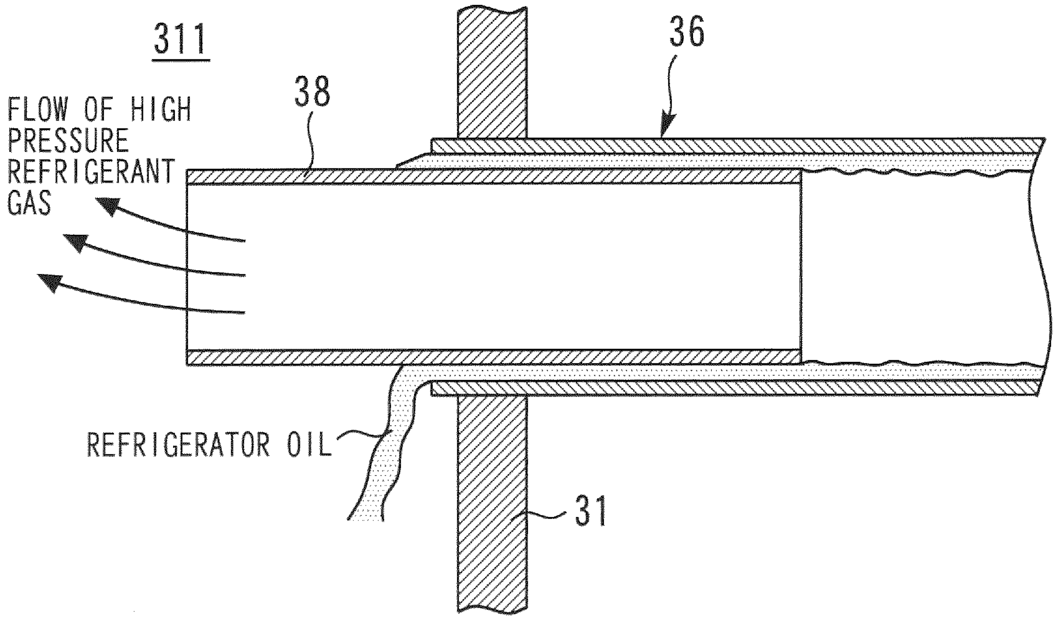
354
355
FLOW OF HIGH PRESSURE REFRIGERANT GAS

FIG. 8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38
36
REFRIGERATOR OIL
31

FIG. 9

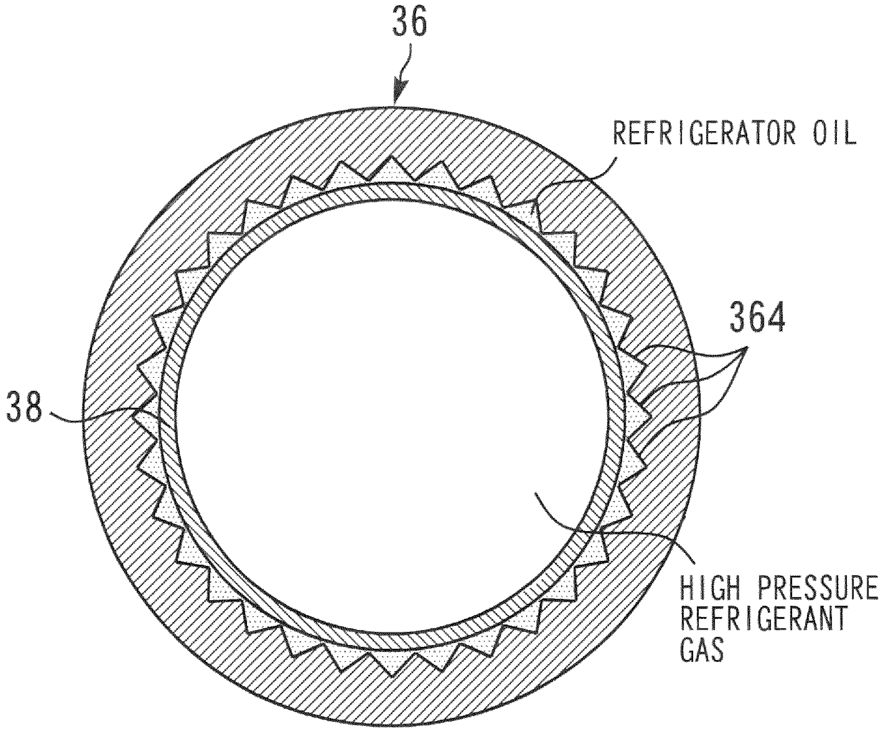
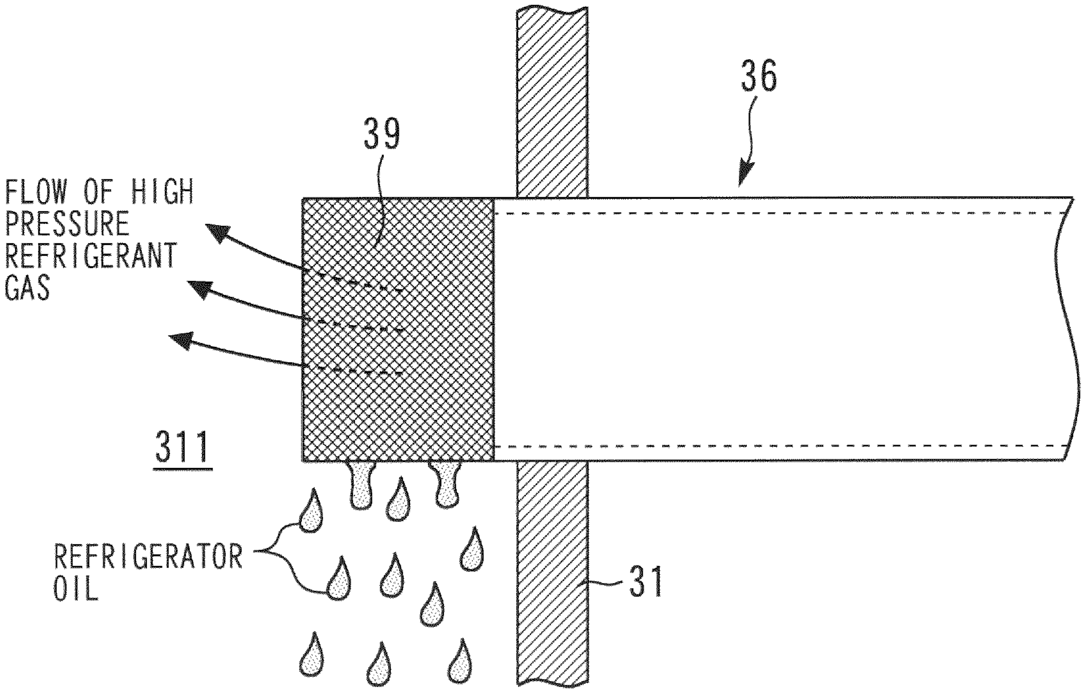

36
REFRIGERATOR OIL
364
38
HIGH PRESSURE REFRIGERANT GAS

FIG. 10


36
39
FLOW OF HIGH PRESSURE REFRIGERANT GAS
311
REFRIGERATOR OIL
31

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/073336

A. CLASSIFICATION OF SUBJECT MATTER
F25B43/02(2006.01)i, *F25B1/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25B43/02, F25B1/00, F04B39/06, F04B39/12, F04C29/04, F04C29/12

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	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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.
A	JP 2006-132427 A (Mitsubishi Electric Corp.), 25 May 2006 (25.05.2006), entire text; all drawings (Family: none)	1-11
A	JP 2009-109102 A (Nippon Soken, Inc.), 21 May 2009 (21.05.2009), entire text; all drawings & US 2009/0071188 A1 & DE 102008047447 A1	1-11
A	JP 2003-13858 A (Mitsubishi Heavy Industries, Ltd.), 15 January 2003 (15.01.2003), entire text; all drawings (Family: none)	1-11

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

* Special categories of cited documents:
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"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
11 September, 2013 (11.09.13)	24 September, 2013 (24.09.13)

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International application No.
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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 10-148422 A (Sanyo Electric Co., Ltd.), 02 June 1998 (02.06.1998), entire text; all drawings (Family: none)	1-11
A	JP 2006-322701 A (LG Electronics Inc.), 30 November 2006 (30.11.2006), entire text; all drawings & EP 1724537 A1 & KR 10-0619785 B1 & CN 1865818 A	1-11
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 24367/1990(Laid-open No. 114585/1991) (Sanyo Electric Co., Ltd.), 25 November 1991 (25.11.1991), entire text; all drawings (Family: none)	1-11
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 68452/1991(Laid-open No. 17459/1993) (Mitsubishi Heavy Industries, Ltd.), 05 March 1993 (05.03.1993), entire text; all drawings (Family: none)	1-11
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