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(54) **ROTARY COMPRESSOR AND REFRIGERATION CYCLE DEVICE**
DREHKOMPRESSOR UND KÜHLKREISVORRICHTUNG
COMPRESSEUR ROTATIF ET DISPOSITIF À CYCLE DE RÉFRIGÉRATION

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Description

FIELD

[0001] Embodiments described herein relate generally to a rotary compressor including an airtight container filled with refrigerating machine oil and refrigeration cycle device.

BACKGROUND

[0002] For example, JP 4325751 B2 discloses a refrigeration cycle device formed by connecting a plurality of rotary compressors in parallel to a refrigerant circuit in which a refrigerant is circulated. In a refrigeration cycle device of this kind, in order to prevent refrigerating machine oil filled into a plurality of rotary compressors from being unevenly distributed between the rotary compressors, an operation of taking out surplus refrigerating machine oil in a rotary compressor from the rotary compressor and supplying the taken-out refrigerating machine oil to a rotary compressor lacking in refrigerating machine oil is carried out.

[0003] An oil equalizing pipe configured to take out surplus refrigerating machine oil from the rotary compressor is connected to an airtight container of the rotary compressor. An opening end part of the oil equalizing pipe positioned outside the airtight container is sealed up by means of a rubber stopper disclosed in JP 2001-132644 A at the time of, for example, shipment of the rotary compressor filled with refrigerating machine oil from the factory. The rubber stopper is pressed into the opening end part of the oil equalizing pipe and is removed from the oil equalizing pipe when cycle piping is joined to the opening end part of the oil equalizing pipe.

[0004] On the other hand, when a rotary compressor including an oil equalizing pipe is singly used, although the opening end part of the oil equalizing pipe is kept in the state where the opening end part is sealed up by means of the rubber stopper, the rubber stopper cannot withstand the pressure of the refrigerant. For this reason, it is necessary to separately prepare a dedicated rotary compressor including no oil equalizing pipe.

[0005] As described above, heretofore, it has been necessary to prepare both a rotary compressor including an oil equalizing pipe and rotary compressor including no oil equalizing pipe according to the specifications of the refrigeration cycle device in which the rotary compressor is used, and thus it cannot be denied that the manufacture and management of the rotary compressor become complicated.

[0006] An object of the present invention is to obtain a rotary compressor in which an opening end part of a connecting pipe connected to the airtight container can firmly be sealed up by means of a sealing stopper, furthermore, the workability at the time when another piece of piping is inserted into the opening end part of the connecting pipe from which the sealing stopper is removed and the inserted piping is brazed to the opening end part is excellent and, the joint strength and sealability between the connecting pipe and the piping can sufficiently be secured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a circuit diagram schematically showing the configuration of a refrigeration cycle device according to a first embodiment.

FIG. 2 is a cross-sectional view of a rotary compressor used in the refrigeration cycle device of the first embodiment.

FIG. 3A is a cross-sectional view showing the part F3 in FIG. 2 in an enlarged form.

FIG. 3B is a cross-sectional view of a sealing stopper used in the first embodiment.

FIG. 3C is a cross-sectional view showing a state where cycle piping is inserted into a second opening end part of an oil equalizing pipe from which the sealing stopper is removed, and the cycle piping is brazed to the second opening end part in the first embodiment.

FIG. 4 is a circuit diagram schematically showing the configuration of the refrigeration cycle device in which one rotary compressor including an oil equalizing pipe is incorporated in the circulation pathway in the first embodiment.

FIG. 5A is a cross-sectional view showing a state where a sealing stopper is brazed to a second opening end part of an oil equalizing pipe in a second embodiment.

FIG. 5B is a cross-sectional view of the sealing stopper used in the second embodiment.

FIG. 6A is a cross-sectional view showing a state where a sealing stopper is brazed to a second opening end part of an oil equalizing pipe in a third embodiment.

FIG. 6B is a cross-sectional view of the sealing stopper used in the third embodiment.

FIG. 7A is a cross-sectional view showing a state where a sealing stopper is brazed to a second opening end part of an oil equalizing pipe in a fourth embodiment.

FIG. 7B is a cross-sectional view of the sealing stopper used in the fourth embodiment.

FIG. 8 is a cross-sectional view showing a state where a second opening end part of an oil equalizing pipe is inserted into a concave part of a sealing stopper in a fifth embodiment.

FIG. 9 is a cross-sectional view showing a state where a second opening end part of an oil equalizing pipe is inserted into a concave part of a sealing stopper in a sixth embodiment.

FIG. 10 is a cross-sectional view showing a state where a second opening end part of an oil equalizing pipe is inserted into a concave part of a sealing stopper in a seventh embodiment.

DETAILED DESCRIPTION

[0008] In general, according to one embodiment, a rotary compressor includes an airtight container accommodating therein a compression mechanism section configured to compress a working fluid, and filled with refrigerating machine oil configured to lubricate the compression mechanism section, a connecting pipe connected to the airtight container and including an opening end part opened to the outside of the airtight container, and a sealing stopper detachably fitted on the opening end part of the connecting pipe and tightly sealing up the opening end part.

[0009] The sealing stopper includes a cylindrical peripheral wall part to be brazed to the connecting pipe in a state where the peripheral wall part surrounds an outer circumferential surface of the opening end part of the connecting pipe, and an end wall part provided in such a manner as to be continuous with the peripheral wall part and opposed to an apical surface of the opening end part.

[First Embodiment]

[0010] Hereinafter, a first embodiment will be described with reference to FIG. 1 through FIG. 4.

[0011] FIG. 1 is a refrigeration cycle circuit diagram of an air conditioner 1 which is, for example, an example of a refrigeration cycle device. The air conditioner 1 of this embodiment is constituted of one outdoor unit 2 and one indoor unit 3. The outdoor unit 2 is provided with two rotary compressors 4a and 4b configured to compress a refrigerant serving as a working fluid.

[0012] The rotary compressors 4a and 4b respectively includes refrigerant discharge pipes 5a and 5b, and the refrigerant discharge pipes 5a and 5b are connected in parallel to one piece of high-pressure piping 6. To the high-pressure piping 6, an oil separator 7, a first port 8a and a second port 8b of a four-way valve 8, an outdoor heat exchanger 9, a liquid tank 10, and a liquid pipe 11 are connected.

[0013] As shown in FIG. 1, the rotary compressors 4a and 4b respectively include refrigerant suction pipes 14a and 14b. The refrigerant suction pipes 14a and 14b are respectively connected to suction cups 15a and 15b. Connecting ports 16a and 16b respectively belonging to the suction cups 15a and 15b are connected to one piece of low-pressure piping 18 respectively through refrigerant piping 17a and refrigerant piping 17b. To the low-pressure piping 18, an accumulator 19, a third port 8c and a fourth port 8d of the four-way valve 8, and a gas pipe 20 are connected.

[0014] The liquid pipe 11 and the gas pipe 20 are routed from the outdoor unit 2 to the indoor unit 3. The liquid pipe 11 is connected to an indoor heat exchanger 23 through an expanding device 22 belonging to the indoor unit 3. Likewise, the gas pipe 20 is also connected to the indoor heat exchanger 23 of the indoor unit 3. Accordingly, the high-pressure the piping 6, the liquid pipe 11, the refrigerant piping 17a and the refrigerant piping 17b, the low-pressure piping 18, and the gas pipe 20 cooperate with each other to constitute a circulation circuit 24 configured to circulate the refrigerant between the outdoor unit 2 and the indoor unit 3.

[0015] As shown in FIG. 1, the outdoor unit 2 is provided with an oil equalizing circuit 25 configured to prevent the refrigerating machine oil with which the rotary compressors 4a and 4b are filled from being unevenly distributed between the rotary compressors 4a and 4b. Describing the oil equalizing circuit 25, oil equalizing pipes 26a and 26b are respectively connected to the rotary compressors 4a and 4b. The oil equalizing pipes 26a and 26b are connected to an upper end of a common oil tank 28 respectively through cycle piping 27a and cycle piping 27b. An oil equalizing guide pipe 29 is connected to the side face of the oil tank 28. The oil equalizing guide pipe 29 is bifurcated halfway, and the bifurcated ends of the oil equalizing guide pipe 29 are respectively connected to the refrigerant piping 17a and refrigerant piping 17b.

[0016] The oil tank 28 is connected to the high-pressure piping 6 through a bypass pipe 30. Furthermore, a first oil return pipe 31a and second oil return pipe 31b are connected in parallel between the oil separator 7 and the oil equalizing guide pipe 29. The first oil return pipe 31a is provided with a normally closed on-off valve 32.

[0017] In the air conditioner 1 having such a refrigeration cycle circuit, when the operation of the air conditioner 1 is started in the cooling mode, the high-temperature/high-pressure gas-phase refrigerant components compressed by the rotary compressors 4a and 4b are respectively guided from the refrigerant discharge pipes 5a and 5b to the oil separator 7 through the high-pressure piping 6.

[0018] The gas-phase refrigerant from which the refrigerating machine oil is separated by the oil separator 7 is guided to the outdoor heat exchanger 9 functioning as a heat radiator (condenser) by way of the four-way valve 8, and is condensed by the heat exchange between the refrigerant and outdoor air. The high-pressure liquid-phase refrigerant condensed by the outdoor heat exchanger 9 is guided to the indoor unit 3 through the liquid tank 10 and the liquid pipe 11. In the indoor unit 3, the high-pressure gas-phase refrigerant is decompressed by the expanding device 22 and is changed into a low-pressure gas-liquid two-phase refrigerant. The gas-liquid two-phase refrigerant is guided to the indoor heat exchanger 23 functioning as a heat absorber (evaporator), and carries out heat exchange between itself and the indoor air during the process of passing through the indoor heat exchanger 23.

[0019] The low-temperature/low-pressure gas-phase refrigerant passing through the indoor heat exchanger 23 is guided to the accumulator 19 through the gas pipe

20 and the four-way valve 8. The gas-phase refrigerant from which the liquid-phase refrigerant has been separated by the accumulator 19 is sucked into the rotary compressors 4a and 4b through the low-pressure piping 18, the refrigerant piping 17a and the refrigerant piping 17b, the suction cups 15a and 15b, and the refrigerant suction pipes 14a and 14b.

[0020] When the air conditioner 1 carries out an operation in the heating mode, the high-temperature/high-pressure gas-phase refrigerant compressed in the rotary compressors 4a and 4b flows in the direction opposite to the direction at the time of the operation in the cooling mode through the four-way valve 8, and the indoor heat exchanger 23 functions as a condenser. The indoor air passing through the indoor heat exchanger 23 is heated by heat exchange between the indoor air and gas-phase refrigerant.

[0021] Next, the operation of the oil equalizing circuit 25 will be described below.

[0022] When the oil levels of the refrigerating machine oil with which the rotary compressors 4a and 4b are filled are higher than the connecting positions of the oil equalizing pipes 26a and 26b at which the pipes 26a and 26b are connected to the rotary compressors 4a and 4b, the amount of the refrigerating machine oil exceeding the connecting positions flows into the oil equalizing pipes 26a and 26b as the surplus amount. The refrigerating machine oil flowing into the oil equalizing pipes 26a and 26b is guided to the oil tank 28 through the cycle piping 27a and cycle piping 27b.

[0023] The high-pressure gas-phase refrigerant distributed from the high-pressure piping 6 to the bypass pipe 30 flows into the oil tank 28, and hence the refrigerating machine oil guided to the oil tank 28 is evenly distributed from the oil equalizing guide pipe 29 to the refrigerant piping 17a and the refrigerant piping 17b by the pressure of the gas-phase refrigerant applied to the oil tank 28. The refrigerating machine oil components distributed to the refrigerant piping 17a and the refrigerant piping 17b are sucked into the rotary compressors 4a and 4b from the suction cups 15a and 15b together with the gas-phase refrigerant circulating through the circulation circuit 24.

[0024] On the other hand, during the operation of the air conditioner 1, there is sometimes a case where unevenness in fill ration occurs in the two rotary compressors 4a and 4b. For example, when the oil level of the refrigerating machine oil in the one rotary compressor 4a is higher than the connecting position of the oil equalizing pipe 26a, and oil level of the refrigerating machine oil in the other rotary compressor 4b is lower than the connecting position of the oil equalizing pipe 26b, the refrigerating machine oil flows into the oil equalizing pipe 26a corresponding to the one rotary compressor 4a, and high-pressure gas-phase refrigerant flows into the oil equalizing pipe 26b corresponding to the other rotary compressor 4b.

[0025] The refrigerating machine oil and gas-phase refrigerant which have respectively flowed into the oil equalizing pipes 26a and 26b join each other inside the oil tank 28 and are evenly distributed from the oil equalizing guide pipe 29 to the refrigerant piping 17a and refrigerant piping 17b in the state where they are mixed with each other. As a result, the refrigerating machine oil moves from the one rotary compressor 4a toward the other rotary compressor 4b.

[0026] In the gas-phase refrigerant discharged from the refrigerant discharge pipes 5a and 5b of the rotary compressors 4a and 4b, the refrigerating machine oil is contained. The refrigerating machine oil contained in the gas-phase refrigerant is guided from the high-pressure piping 6 to the oil separator 7, and is separated from the gas-phase refrigerant inside the oil separator 7. When the oil level of the refrigerating machine oil collected in the oil separator 7 exceeds the connecting position of the second oil return pipe 31b connected to the oil separator 7, the amount of the refrigerating machine oil exceeding the connecting position is returned to the rotary compressors 4a and 4b through the second oil return pipe 31b and the oil equalizing guide pipe 29.

[0027] Furthermore, when the oil levels of the refrigerating machine oil inside the two rotary compressors 4a and 4b become lower than the connecting positions of the oil equalizing pipes 26a and 26b, the on-off valve 32 is opened. Thereby, the refrigerating machine oil accumulated in the oil tank 28 is returned to the rotary compressors 4a and 4b through the first oil return pipe 31a and the oil equalizing guide pipe 29.

[0028] Next, the specific configurations of the rotary compressors 4a and 4b will be described below by describing the one rotary compressor 4a as a representative.

[0029] As shown in FIG. 2 in cross section, the rotary compressor 4a of this embodiment is a vertical two-cylinder rotary compressor and, FIG. 2 shows the form of the rotary compressor 4a immediately after shipment from the factory.

[0030] The rotary compressor 4a is provided with an airtight container 35, an electric motor 36, and a compression mechanism section 37 as principal elements. The airtight container 35 includes a cylindrical peripheral wall 35a, and is made upright in the vertical direction. The refrigerant discharge pipe 5a is attached to the upper end part of the airtight container 35. At the point in time when the rotary compressor 4a is shipped from the factory, the opening end positioned at the upper end of the refrigerant discharge pipe 5a is sealed up by means of a removable rubber stopper 38.

[0031] The electric motor 36 is accommodated in the airtight container 35 at an intermediate part in the height direction of the airtight container 35. The stator 40 of the electric motor 36 is fixed to the inner surface of the peripheral wall 35a of the airtight container 35. The rotor 41 of the electric motor 36 is surrounded by the stator 40.

[0032] The compression mechanism section 37 is accommodated in the airtight container 35 at the bottom part of the airtight container 35 in such a manner as to be positioned beneath the electric motor 36. The compression mechanism section 37 is provided with a first cylinder 42, a second cylinder 43, a partition plate 44, a first bearing 45, a second bearing 46, and a rotating shaft 47 as principal elements.

[0033] The first cylinder 42 and the second cylinder 43 are arranged with a gap held between them in the axial direction of the airtight container 35. The partition plate 44 is interposed between the first cylinder 42 and the second cylinder 43. A top surface of the partition plate 44 is made in contact with an underside of the first cylinder 42 in such a manner as to cover the inner diameter part of the first cylinder 42 from below. An underside of the partition plate 44 is made in contact with a top surface of the second cylinder 43 in such a manner as to cover the inner diameter part of the second cylinder 43 from above.

[0034] The first bearing 45 is arranged on the first cylinder 42 in such a manner as to cover the inner diameter part of the first cylinder 42 from above. The region surrounded by the inner diameter part of the first cylinder 42, the partition plate 44, and the first bearing 45 constitutes a first cylinder chamber 48.

[0035] The second bearing 46 is arranged under the second cylinder 43 in such a manner as to cover the inner diameter part of the second cylinder 43 from below. The region surrounded by the inner diameter part of the second cylinder 43, the partition plate 44, and the second bearing 46 constitutes a second cylinder chamber 49.

[0036] A first muffler cover 50 is attached to the first bearing 45. The first muffler cover 50 defines a first sound-muffling chamber 51 between itself and the first bearing 45. The first sound-muffling chamber 51 is opened to the inside of the airtight container 35 through an exhaust hole (not shown) included in the first muffler cover 50.

[0037] A second muffler cover 52 is attached to the second bearing 46. The second muffler cover 52 defines a second sound-muffling chamber 53 between itself and the second bearing 46. The second sound-muffling chamber 53 is made to communicate with the first sound-muffling chamber 51 through a discharge pathway not shown.

[0038] A fist discharge port 54 is formed in the first bearing 45. The first discharge port 54 is opened to the first cylinder chamber 48 and the first sound-muffling chamber 51 and is opened/closed by a reed valve 55.

[0039] A second discharge port 56 is formed in the second bearing 46. The second discharge port 56 is opened to the second cylinder chamber 49 and the second sound-muffling chamber 53 and is opened/closed by a reed valve 57.

[0040] A ring-shaped supporting member 60 is arranged around the first bearing 45. The supporting member 60 is fixed to the inner surface of the peripheral wall 35a of the airtight container 35 by means of welding or the like, and an outer circumferential part of the first cylinder 42 is fixed to the underside of the supporting member 60 by means of a first fastening bolt 61. Furthermore, the first cylinder 42, the second cylinder 43, the partition plate 44, the first bearing 45, the second bearing 46, the first muffler cover 50, and the second muffler cover 52 are integrally joined together by means of a second fastening bolt 62.

[0041] As shown in FIG. 2, the rotating shaft 47 has a central axis line O1 coaxially positioned with respect to the airtight container 35. The rotating shaft 47 is rotatably supported on the compression mechanism section 37 through the first bearing 45a and the second bearing 46, and is coupled to the rotor 41 of the electric motor 36.

[0042] The rotating shaft 47 is provided with a pair of crank sections 64a and 64b respectively positioned in the first cylinder chamber 48 and the second cylinder chamber 49. Ring-shaped rollers 65a and 65b are respectively fitted on the outer circumferential surfaces of the crank sections 64a and 64b. The rollers 65a and 65b are eccentrically rotated inside the first cylinder chamber 48 and the second cylinder chamber 49. Thereby, the volumetric capacities of the compression region and inlet region of each of the first cylinder chamber 48 and the second cylinder chamber 49 are continuously changed.

[0043] The first cylinder 42 includes an inlet port 66 opened to the inlet region of the first cylinder chamber 48. The inlet port 66 also communicates with the inlet region of the second cylinder chamber 49 through a refrigerant distribution pathway 67 provided in the partition plate 44.

[0044] The suction cup 15a is attached to the side of the airtight container 35. The refrigerant suction pipe 14a protruded from the lower end part of the suction cup 15a penetrates the peripheral wall 35a of the airtight container 35, and is connected to the inlet port 66 of the first cylinder 42. Part of the refrigerant guided from the suction cup 15a to the inlet port 66 is sucked into the first cylinder chamber 48. The remaining refrigerant is sucked into the second cylinder chamber 49 from the inlet port 66 through the refrigerant distribution pathway 67.

[0045] Furthermore, the connecting port 16a is attached to the upper end of the suction cup 15a. At the point in time when the rotary compressor 4a is shipped from the factory, the opening end positioned at the upper end of the connecting port 16a is sealed up by means of a removable rubber stopper 68.

[0046] When the rotating shaft 47 is rotated by the electric motor 36, the rollers 65a and 65b are respectively eccentrically rotated inside the first and second cylinder chambers 48 and 49, and gas-phase refrigerant inside the suction cup 15a is sucked into the inlet regions of the first and second cylinder chambers 48 and 49 through the inlet pipe 14a, the inlet port 66, and the refrigerant distribution pathway 67.

[0047] The gas-phase refrigerant sucked into the first and second cylinder chambers 48 and 49 is compressed in the process in which the inlet region makes a transition to the compression region, and is discharged from the first sound-muffling chamber 51 to the inside of the airtight container 35 through the exhaust hole of the first muffler cover 50. The gas-phase refrigerant discharged to the inside of the airtight container 35 is passed through the electric motor 36 and is thereafter guided from the refrigerant discharge pipe 5a to the circulation circuit 24.

[0048] In this embodiment, the CO_2-based refrigerant which is a kind of natural refrigerant is used as a refrigerant. The CO_2-based refrigerant has pressure higher than the HFC-based refrigerant, and hence the pressure inside the airtight container 35 to which the refrigerant compressed in the first and second cylinder chambers 48 and 49 is discharged reaches 14 Mpa at the maximum in some cases.

[0049] According to this embodiment, the compression mechanism section 37 is lubricated with the refrigerating machine oil filled into the airtight container 35. As shown in FIG. 2, the oil level inside the airtight container 35 varies between the upper limit level H and the lower limit level L.

[0050] The oil equalizing pipe 26a constituting the oil equalizing circuit 25 is an example of a connecting pipe and is constituted of, for example, a round pipe made of a copper alloy having a circular cross-sectional shape. As shown in FIG. 2, the oil equalizing pipe 26a has a first opening end part 70 supported on the peripheral wall 35a of the airtight container 35 and a second opening end part 71 positioned on the opposite side of the first opening end part 70. The first opening end part 70 is opened to the inside of the airtight container 35 at a position between the upper limit level H and the lower limit level L of the refrigerating machine oil.

[0051] The oil equalizing pipe 26a is protruded sideward from the airtight container 35 and is bent almost perpendicularly in such a manner that the second opening end part 71 is located at a position above the upper limit level H of the refrigerating machine oil.

[0052] As shown in FIG. 3A, the second opening end part 71 of the oil equalizing pipe 26a is expanded wider in the radial direction than the first opening end part 70, and the inner diameter D1 of the second opening end part 71 is greater than the inner diameter D2 of the main part of the oil equalizing pipe 26a. The second opening end part 71 is formed into a cylindrical shape the inner diameter D1 and the outer diameter D3 of which are kept constant.

[0053] The apical surface 71a of the oil equalizing pipe 26a defining the opening end of the second opening end part 71 is finished to a flat surface perpendicular to the axial direction of the second opening end part 71. Furthermore, the wall thickness T1 of the oil equalizing pipe 26a is kept approximately constant throughout the entire length of the oil equalizing pipe 26a from the first opening end part 70 to the second opening end part 71.

[0054] At the point in time when the rotary compressor 4a is shipped from the factory, the second opening end part 71 of the oil equalizing pipe 26a is sealed up by a removable sealing stopper 72. It is desirable that the sealing stopper 72 be formed of, for example, a copper-based metallic material identical to that for the oil equalizing pipe 26a such as a copper alloy or brass.

[0055] As shown in FIG. 3A and FIG. 3B, the sealing stopper 72 has a peripheral wall part 73 and an end wall part 74. The peripheral wall part 73 is formed into a cylindrical shape continuously surrounding the outer circumferential surface of the second opening end part 71 in the circumferential direction. The end wall part 74 is continuous with one end of the peripheral wall part 73, and is opposed to the apical surface 71a which is the opening end of the second opening end part 71 from the direction in which the second opening end part 71 is opened. Accordingly, the peripheral wall part 73 and the end wall part 74 define a concave part 75 into which the second opening end part 71 is to be detachably fitted.

[0056] According to this embodiment, the inner surface of the end wall part 74 serving as the bottom part of the concave part 75 is finished to a flat abutting surface 76. Accordingly, in the state where the second opening end part 71 of the oil equalizing pipe 26a is fitted into the concave part 75 of the sealing stopper 72, the apical surface 71a of the oil equalizing pipe 26a abuts against the abutting surface 76 of the end wall part 74 continuously in the circumferential direction.

[0057] In other words, the apical surface 71a of the oil equalizing pipe 26a and the abutting surface 76 of the end wall part 74 maintain a sLate of surface contact continuously in the circumferential direction, and a gap is eliminated from the part between the apical surface 71a and the abutting surface 76.

[0058] Furthermore, the wall thickness T2 of the end wall part 74 of the sealing stopper 72 is greater than the wall thickness T1 of the oil equalizing pipe 26a, and the wall thickness T3 of the peripheral wall part 73 is greater than the wall thickness T1 of the oil equalizing pipe 26a. In addition, the depth dimension d of the concave part 75 in the axial direction of the second opening end part 71 is greater than the inner diameter D1 of the second opening end part 71 of the oil equalizing pipe 26a.

[0059] The sealing stopper 72 configured in this way is fitted on the second opening end part 71 of the oil equalizing pipe 26a from outside in the form of, for example, loose fitting, and is detachably joined to the oil equalizing pipe 26a at the peripheral wall part 73 thereof by brazing.

[0060] More specifically, as shown in FIG. 3A, a joint part 78 is formed by brazing on the outer circumferential surface of the second opening end part 71 at an end part of the peripheral wall part 73 on the opposite side of the end wall part 74. The joint part 78 can be obtained by solidification of the molten brazing material. At the time of brazing, the molten brazing material continuously spreads in the circumferential direction in such a manner as to be astride the end part of the peripheral wall part 73 and the outer circumferential surface of the second opening end part 71 and, at the same time, permeates through the clearance C between the inner circumferential surface of the peripheral wall part 73 and the outer circumferential surface of the opening end part 71 by the capillary phenomenon. Thereafter, the brazing material solidifies, whereby the sealing stopper 72 is firmly joined to the second opening end part 71 in the state where the sealing stopper 72 seals up the second opening end part 71.

[0061] When the two rotary compressors 4a and 4b are to be incorporated into the oil equalizing circuit 25, the joint part 78 formed astride the sealing stopper 72 and the oil equalizing pipes 26a, 26b is heated, and brazing material is melted, whereby the sealing stopper 72 is removed from the oil equalizing pipe 26a, 26b. After this, as shown in FIG. 3C, the apical end part of the cycle piping 27a, 27b is inserted into the inner side of the second opening end part 71 of the oil equalizing pipe 26a, 26b, and is joined to the second opening end part 71 by brazing.

[0062] In this embodiment, the joint part 79 is formed between the apical surface 71a of the second opening end part 71 of the oil equalizing pipe 26a, 26b and the outer circumferential surface of the apical end part of the cycle piping 27a, 27b by brazing. At the time of brazing, the molten brazing material continuously spreads in the circumferential direction in such a manner as to be astride the apical surface 71a of the oil equalizing pipe 26a, 26b and the outer circumferential surface of the apical end part of the cycle piping 27a, 27b and, at the same time, permeates through the clearance between the inner circumferential surface of the second opening end part 71 and the outer circumferential surface of the apical end part of the cycle piping 27a, 27b by the capillary phenomenon. After this, the brazing material solidifies, whereby the cycle piping 27a, 27b is firmly fixed to the second opening end part 71 of the oil equalizing pipe 26a, 26b.

[0063] On the other hand, FIG. 4 discloses the state where only one rotary compressor 4a is incorporated into the circulation circuit 24. When a CO_2-based refrigerant is compressed by using the one rotary compressor 4a, the oil equalizing circuit 25 becomes unnecessary. Accordingly, the second opening end part 71 of the oil equalizing pipe 26a is kept in the state where the second opening end part 71 is sealed up by the sealing stopper 72, and the sealing stopper 72 receives the pressure inside the airtight container 35 through the oil equalizing pipe 26a.

[0064] According to the first embodiment, the sealing stopper 72 configured to tightly seal up the second opening end part 71 of the oil equalizing pipe 26a is fitted on the second opening end part 71 in the state where the sealing stopper 72 covers the second opening end part 71 from outside. The sealing stopper 72 fitted on the second opening end part 71 is joined to the outer circumferential surface of the second opening end part 71 by brazing at the end part of the peripheral wall part 73 thereof on the opposite side of the end wall part 74.

[0065] Accordingly, it is possible for the sealing stopper 72 to firmly seal up the second opening end part 71 in such a manner as to overcome the pressure inside the airtight container 35 acting on the second opening end part 71 of the oil equalizing pipe 26a, and sufficiently secure the airtightness of the airtight container 35 even in a rotary compressor 4a handling a high-pressure refrigerant such as the CO_2-based refrigerant.

[0066] From the above description, it is possible to apply the rotary compressors 4a and 4b including the oil equalizing pipes 26a and 26b to each of the case where a plurality of rotary compressors 4a and 4b are connected in parallel to the circulation circuit 24 to be used and case where one rotary compressor 4a or 4b is singly used, whereby the versatility is improved. Accordingly, unlike the conventional case, it is not necessary to prepare both a rotary compressor including an oil equalizing pipe and rotary compressor including no oil equalizing pipe, whereby Lhe manufacture and management of the rotary compressor is facilitated.

[0067] Moreover, according to the first embodiment, when the brazing material of the joint part 78 is melted, and the sealing stopper 72 is removed from the second opening end part 71, the molten existing brazing material is only kept in the state where the molten brazing material adheres to a position on the outer circumferential surface of the second opening end part 71 separate from the apical surface 71a of the second opening end part 71.

[0068] In other words, when the cycle piping 27a is inserted into the inner side of the second opening end part 71 from which the sealing stopper 72 has been removed, and is brazed to the second opening end part 71, the existing brazing material which has formerly joined the sealing stopper 72 to the second opening end part 71 never adheres to the apical surface 71a of the second opening end part 71, the apical surface 71a being a surface with which another new brazing material is to be brought into contact.

[0069] As a result, when the cycle piping 27a is brazed to the second opening end part 71 of the oil equalizing pipe 26a, the troublesome and burdensome work of removing the existing brazing material is made unnecessary, and the workability at the time of brazing is improved. Accordingly, it is possible to sufficiently secure the joint strength and sealability of the joint part 78 between the oil equalizing pipe 26a and the cycle piping 27a, this being appropriate for the rotary compressor 4a handling a high-pressure refrigerant such as the CO_2-based refrigerant.

[0070] According to this embodiment, the sealing stopper 72 is formed of a copper-based metallic material identical to that for the oil equalizing pipe 26a such as a copper ally or brass. For this reason, the thermal expansion coefficients of the sealing stopper 72 and oil equalizing pipe 26a become equal to each other, whereby it is possible to easily carry out the brazing work.

[0071] In addition, even when the sealing stopper 72 and the oil equalizing pipe 26a cause thermal expansion due to the heat of the brazing or the sealing stopper 72 and the oil equalizing pipe 26a cause thermal shrinkage after brazing, it is possible to avoid the clearance C between the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72 and the outer circumferential surface of the second opening end part 71 of the oil equalizing pipe 26a from excessively becoming large.

[0072] Accordingly, when the sealing stopper 72 is brazed to the second opening end part 71 of the oil equalizing pipe 26a, it is possible to prevent the molten brazing material permeating through the clearance C between the outer circumferential surface of the second opening end part 71 and the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72 from reaching the apical surface 71a of the second opening end part 71.

[0073] In addition, in the state where the second opening end part 71 of the oil equalizing pipe 26a is fitted into the concave part 75 of the sealing stopper 72, the apical surface 71a of the oil equalizing pipe 26a and the abutting surface 76 of the sealing stopper 72 maintain a state of surface contact continuously in the circumferential direction, and a gap is eliminated from the part between the apical surface 71a and the abutting surface 76.

[0074] Accordingly, the apical surface 71a of the oil equalizing pipe 26a is sealed up by the abutting surface 76 of the sealing stopper 72 and, even if by any chance, the molten brazing material reaches a position in the vicinity of the apical surface 71a of the oil equalizing pipe 26a through the clearance C between the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72 and the outer circumferential surface of the second opening end part 71 of the oil equalizing pipe 26a, the molten brazing material never adheres to the apical surface 71a of the oil equalizing pipe 26a. Moreover, when the joint part 78 is heated, and the sealing stopper 72 is removed from the oil equalizing pipe 26a, it is possible to prevent the molten brazing material from flowing into the inner side of the second opening end part 71 of the oil equalizing pipe 26a.

[0075] As a result, when the sealing stopper 72 is removed from the second opening end part 71 of the oil equalizing pipe 26a, and thereafter the cycle piping 27a is inserted into the second opening end part 71, it is possible to prevent the cycle piping 27a from being caught by the existing brazing material and prevent insertion of the cycle piping 27a from being disturbed. Accordingly, the workability at the time when the cycle piping 27a is brazed to the second opening end part 71 of the oil equalizing pipe 26a is improved.

[0076] On the other hand, when one rotary compressor 4a is used singly, the end wall part 74 of the sealing stopper 72 sealing up the second opening end part 71 of the oil equalizing pipe 26a directly receives the pressure of the gas-phase refrigerant discharged to the inside of the airtight container 35. In this embodiment, the wall thickness T2 of the end wall part 74 is greater than the wall thickness T1 of the oil equalizing pipe 26a, and hence it is possible to maintain the pressure resistance fatigue strength of the sealing stopper 72 at a level higher than or equal to that of the oil equalizing pipe 26a. Furthermore, the depth dimension d of the concave part 75 of the sealing stopper 72 is greater than the inner diameter D1 of the second opening end part 71 of the oil equalizing pipe 26a, and hence it is possible to secure a sufficient length of fit of the sealing stopper 72 with respect to the second opening end part 71.

[0077] Accordingly, in combination with the advantage that the pressure resistance fatigue strength of the sealing stopper 72 can be secured, even in the case of the rotary compressor 4a handling, particularly, the high-pressure refrigerant such as the CO_2-based refrigerant, it is possible to firmly seal up the second opening end part 71 of the oil equalizing pipe 26a.

[Second Embodiment]

[0078] FIG. 5A and FIG. 5B disclose a second embodiment. The second embodiment differs from the first embodiment in part of the configuration of the sealing stopper 72. As shown in FIG. 5A and FIG. 5B, the inner surface of the end wall part 74 of the sealing stopper 72 includes a recess part 100 opened at the center of the abutting surface 76. The recess part 100 has a shape cylindrically recessed in the direction away from the second opening end part 71. The inner diameter D4 of the recess part 100 is smaller than the inner diameter D1 of the second opening end part 71, and a step part 101 having a step-like shape is formed at the boundary between the recess part 100 and the abutting surface 76.

[0079] Furthermore, in this embodiment, the wall thickness T4 of the end wall part 74 at the position corresponding to the recess part 100 is greater than the wall thickness T1 of the oil equalizing pipe 26a so that the end wall part 74 can withstand the pressure inside the airtight container 35.

[0080] According to the second embodiment, in the state where the second opening end part 71 of the oil equalizing pipe 26a is fitted into the concave part 75 of the sealing stopper 72, the apical surface 71a of the oil equalizing pipe 26a and the abutting surface 76 of the sealing stopper 72 maintain a state of surface contact continuously in the circumferential direction. Accordingly, even if by any chance, the molten brazing material reaches a position in the vicinity of the apical surface 71a of the oil equalizing pipe 26a through the clearance C between the outer circumferential surface of the second opening end part 71 and the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72, the molten brazing material can be prevented from adhering to the apical surface 71a of the oil equalizing pipe 26a.

[0081] In addition, when the joint part 78 is heated, and the sealing stopper 72 is removed from the oil equalizing pipe 26a, it is possible to prevent the molten brazing material from flowing into the inner side of the second opening end part 71 of the oil equalizing pipe 26a.

[0082] Furthermore, the recess part 100 serves the function of eliminating the superfluous thickness/weight from the end wall part 74, i.e., carrying out a kind of thickness/weight reduction, and the weight of the sealing stopper 72 can be reduced correspondingly.

[Third Embodiment]

[0083] FIG. 6A and FIG. 6B disclose a third embodiment. The third embodiment differs from the first embodiment in part of the configuration of the sealing stopper 72. As shown in FIG. 6A and FIG. 6B, an inner surface 110 of the end wall part 74 of the sealing stopper 72 has a conical shape inclined in such a manner that the greater the distance from the beginning of the inner surface 110 in the direction toward the center of the inner surface 110, the farther the inner surface 110 becomes away from the apical surface 71a of the second opening end part 71, and thus the end wall part 74 and the second opening end part 71 define a space 111 having a tapering-off shape between them. Accordingly, the inner circumferential part of the inner surface 110 of the end wall part 74 is separate from the apical surface 71a of the second opening end part 71 without being in contact with the apical surface 71a.

[0084] Moreover, in this embodiment, the minimum wall thickness T5 of the end wall part 74 at the position corresponding to the space 111 is greater than the wall thickness T1 of the oil equalizing pipe 26a so that the end wall part 74 can withstand the pressure inside the airtight container 35.

[0085] According to the third embodiment, when the sealing stopper 72 is brazed to the second opening end part 71 of the oil equalizing pipe 26a, even if the surplus molten brazing material reaches the apical surface 71a of the oil equalizing pipe 26a through the clearance C between the outer circumferential surface of the second opening end part 71 and the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72, the molten brazing material flows along the inner surface 110 of the end wall part 74 and then flows into the space 111 between the end wall part 74 and the second opening end part 71.

[0086] Accordingly, it becomes difficult for the molten brazing material configured to join the sealing stopper 72 to the oil equalizing pipe 26a to adhere to the apical surface 71a of the oil equalizing pipe 26a. Besides, when the joint part 78 is reheated, and the sealing stopper 72 is removed from the oil equalizing pipe 26a, the molten brazing material can be prevented from flowing into the inner side of the second opening end part 71 of the oil equalizing pipe 26a.

[Fourth Embodiment]

[0087] FIG. 7A and FIG. 7B disclose a fourth embodiment. The fourth embodiment differs from the first embodiment in part of the configuration of the sealing stopper 72. As shown in FIG. 7A and FIG. 7B, a single groove 120 is formed in the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72. The groove 120 is continuous in the circumferential direction of the peripheral wall part 73 and is opened to the concave part 75 at an intermediate part of the concave part 75 of the sealing stopper 72 in the depth direction.

[0088] When the sealing stopper 72 is brazed to the second opening end part 71 of the oil equalizing pipe 26a, the opening end of the groove 120 is opposed to the outer circumferential surface of the second opening end part 71.

[0089] Accordingly, the groove 120 and the outer circumferential surface of the second opening end part 71 define a ring-shaped inflow chamber 121 between them. The inflow chamber 121 communicates with the clearance C between the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72 and the outer circumferential surface of the second opening end part 71 of the oil equalizing pipe 26a, and is separate from the apical surface 71a of the second opening end part 71.

[0090] According to the fourth embodiment, when the sealing stopper 72 is brazed to the second opening end part 71 of the oil equalizing pipe 26a, the surplus molten brazing material flowing into the clearance C between the outer circumferential surface of the second opening end part 71 and the inner circumferential surface of the peripheral wall part 73 of the sealing stopper 72 flows into the inflow chamber 121 from the clearance C.

[0091] Accordingly, it is possible to avoid the molten brazing material configured to join the sealing stopper 72 to the oil equalizing pipe 26a from reaching the apical surface 71a of the oil equalizing pipe 26a. Therefore, as in the case of the first embodiment, when the cycle piping 27a is brazed to the second opening end part 71 of the oil equalizing pipe 26a, the troublesome and burdensome work of removing the existing brazing material is made unnecessary and, at the same time, the work of brazing the cycle piping 27a to the oil equalizing pipe 26a can easily be carried out.

[0092] In the fourth embodiment, the number of the grooves 120 is not limited to one, and a plurality of grooves 120 may be arranged at intervals in the depth direction of the concave part 75 of the sealing stopper 72.

[Fifth Embodiment]

[0093] FIG. 8 discloses a fifth embodiment. The fifth embodiment differs from the first embodiment in the configuration of the concave part 75 of the sealing stopper 72. As shown in FIG. 8, the concave part 75 surrounded by the peripheral wall part 73 of the sealing stopper 72 is provided with a cylinder part 130 and a taper part 131.

[0094] The cylinder part 130 is positioned on the opening end side of the concave part 75. The cylinder part 130 has an inner diameter D5 slightly greater than the outer diameter D3 of the second opening end part 71 so that a clearance C through which a molten brazing material permeates can be secured between the cylinder part 130 and the outer circumferential surface of the second opening end part 71 of the oil equalizing pipe 26a.

[0095] The taper part 131 is positioned on the end wall part 74 side closer to the bottom part of the concave part 75. The taper part 131 is coaxially continuous with the end of the cylinder part 130, and the inner diameter D6 of the taper part 131 is formed in such a manner that the inner diameter D6 is continuously reduced as the distance from the cylinder part 130 becomes greater in the direction away from the cylinder part 130. At the end of the taper part 131, the inner diameter D6 of the taper part 131 is set to a diameter equal to or less than the inner diameter D1 of the second opening end part 71. Accordingly, the inner circumferential surface 131a of the taper part 131 is inwardly inclined in the radial direction of the sealing stopper 72 as the distance from the cylinder part 130 becomes greater in the direction away from the cylinder part 130.

[0096] According to the fifth embodiment, when the second opening end part 71 of the oil equalizing pipe 26a is to be tightly sealed up by means of the sealing stopper 72, the second opening end part 71 is inserted into the cylinder part 130 of the concave part 75. The inner diameter D6 of the taper part 131 continuous with the cylinder part 130 is continuously reduced as the distance from the cylinder part 130 becomes greater in the direction away from the cylinder part 130, and hence at the point in time when the second opening end part 71 is made to pass through the cylinder part 130 and enter the taper part 131, the outer circumferential edge of the apical surface 71a of the second opening end part 71 continuously abuts against the inner circumferential surface 131a of the taper part 131 in the circumferential direction.

[0097] Thereby, the apical surface 71a of the oil equalizing pipe 26a is sealed up by the inner circumferential surface 131a of the taper part 131 and, even if by any chance, the molten brazing material reaches a position in the vicinity of the apical surface 71a of the oil equalizing pipe 26a through the clearance C between the sealing stopper 72 and second opening end part 71, the molten brazing material can be avoided from adhering to the apical surface 71a of the oil equalizing pipe 26a. Besides, when the solidified brazing material is melted and the sealing stopper 72 is removed from the oil equalizing pipe 26a, it is possible to prevent the molten brazing material from flowing into the inner side of the second opening end part 71 of the oil equalizing pipe 26a.

[0098] In addition, the sealing stopper 72 is provided with the taper part 131, and hence even when a variation in the outer diameter D3 of the second opening end part 71 occurs to a certain extent, the outer circumferential edge of the apical surface 71a of the oil equalizing pipe 26a continuously abuts against the inner circumferential surface 131a of the taper part 131 of the sealing stopper 72 in the circumferential direction. Accordingly, it is possible to prevent the molten brazing material from flowing toward the apical surface 71a of the oil equalizing pipe 26a.

[Sixth Embodiment]

[0099] FIG. 9 discloses a sixth embodiment. The sixth embodiment differs from the fifth embodiment in the configuration of the concave part 75 of the sealing stopper 72. As shown in FIG. 9, the concave part 75 is formed into a tapered shape configured in such a manner that the inner diameter D7 of the concave part 75 is continuously reduced as the distance from the opening end of concave part 75 becomes grater in the direction away from the opening end of the concave part 75 toward the end wall part 74 which is the bottom part of the concave part 75. At the end wall part 74, the inner diameter D7 of the concave part 75 is less than the outer diameter D3 of the second opening end part 71. Accordingly, the inner circumferential surface 75a of the concave part 75 is inwardly inclined in the radial direction of the sealing stopper 72 as the distance from the opening end of the concave part 75 becomes greater in the direction away from the opening end of the concave part 75 toward the end thereof.

[0100] In the sixth embodiment, when the second opening end part 71 of the oil equalizing pipe 26a is inserted into the concave part 75 of the sealing stopper 72, the outer circumferential edge of the apical surface 71a of the second opening end part 71 continuously abuts against the inner circumferential surface 75a of the concave part 75 in the circumferential direction.

[0101] Accordingly, the apical surface 71a of the oil equalizing pipe 26a is sealed up by the inner circumferential surface 75a of the concave part 75, and an advantage identical to the fifth embodiment can be obtained.

[Seventh Embodiment]

[0102] FIG. 10 discloses a seventh embodiment. In the seventh embodiment, a part of the concave part 75 on the opening end side thereof is formed into a tapered shape, and a cylinder part 140 having a constant inner diameter D8 is provided on the end wall part 74 side so as to be continuous with the tapered part, the end wall part 74 being the bottom part of the concave part 75. Configurations of the sealing stopper 72 other than the above are identical to the sixth embodiment.

[0103] In the seventh embodiment having the configuration described above too, when the second opening end part 71 of the oil equalizing pipe 26a is inserted into the concave part 75 of the sealing stopper 72, the outer circumferential edge of the apical surface 71a of the second opening end part 71 continuously abuts against the inner circumferential surface 75a of the concave part 75 in the circumferential direction.

[0104] Accordingly, the apical surface 71a of the oil equalizing pipe 26a is sealed up by the inner circumferential surface 75a of the concave part 75, and an advantage identical to the fifth embodiment can be obtained.

[0105] In the embodiments of the present invention, the sealing stopper 72 is not limited to being brazed to the second opening end part 71 of the oil equalizing pipe 26a, and the sealing stopper 72 may also be brazed to an opening end part of a connecting pipe connected to the airtight container 35 such as the refrigerant discharge pipe 5a, 5b or the connecting port 16a, 16b of the suction cup 15a, 15b.

[0106] In addition, the rotary compressor is not limited to the vertical type rotary compressor the airtight container of which is made upright, and the aforementioned embodiments can also be applied to a horizontal rotary compressor an airtight container of which is horizontally arranged.

[0107] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the invention which is defined by the appended claims.

Claims

1. A rotary compressor comprising:

an airtight container (35) accommodating therein a compression mechanism section (37) configured to compress a working fluid, and filled with refrigerating machine oil configured to lubricate the compression mechanism section (37); and
a connecting pipe (26a, 26b) connected to the airtight container (35) and including an opening end part (71) opened to the outside of the airtight container (35), **characterized in that**
the rotary compressor further comprises
a sealing stopper (72) detachably fitted on the opening end part (71) of the connecting pipe (26a, 26b) and tightly sealing up the opening end part (71), and
the sealing stopper (72) includes a cylindrical peripheral wall part (73) to be brazed to the connecting pipe (26a, 26b) in a state where the peripheral wall part (73) surrounds an outer circumferential surface of the opening end part (71) of the connecting pipe (26a, 26b), and an end wall part (74) provided in such a manner as to be continuous with the peripheral wall part (73) and opposed to an apical surface (71a) of the opening end part (71).

2. The rotary compressor of Claim 1,
characterized in that
a wall thickness of at least the end wall part (74) of the sealing stopper (72) is greater than a wall thickness of the connecting pipe (26a, 26b).

3. The rotary compressor of Claim 1 or 2,
characterized in that
the peripheral wall part (73) and the end wall part (74) define a concave part (75) into which the opening end part (71) of the connecting pipe (26a, 26b) is to be fitted.

4. The rotary compressor of Claim 3,
characterized in that
a depth dimension of the concave part (75) in an axial direction of the connecting pipe (26a, 26b) is greater than an inner diameter of the connecting pipe (26a, 26b).

5. The rotary compressor of any one of Claims 1 to 4,
characterized in that
the connecting pipe (26a, 26b) is formed of a copper alloy and the sealing stopper (72) is formed of a copper-based metallic material.

6. The rotary compressor of Claim 3 or 4,
characterized in that
the sealing stopper (72) includes a flat abutting surface (76) at the bottom part of the concave part (75), and the apical surface (71a) of the connecting pipe (26a, 26b) abuts against the abutting surface (76) .

7. The rotary compressor of Claim 6,
characterized in that
the sealing stopper (72) includes a recess part (100) opened at a central part of the bottom part of the concave part (75), the recess part (100) possesses a shape recessed in a direction away from the opening end part (71) of the connecting pipe (26a, 26b) and, at the same time, a step part (101) is formed at a boundary between the recess part (100) and the abutting surface (76).

8. The rotary compressor of Claim 3 or 4,
characterized in that
a bottom part of the concave part (75) of the sealing stopper (72) possesses a shape inclined in such a manner that the greater the distance from the beginning of the inclined shape in a direction toward a center of the inclined shape, the farther the inclined shape becomes away from the opening end part (71).

9. The rotary compressor of any one of Claims 1 to 4,
characterized in that
the peripheral wall part (73) of the sealing stopper (72) includes an inner circumferential surface surrounding the outer circumferential surface of the opening end part (71), and at least one groove (120) in the circumferential direction of the peripheral wall part (73) is formed in the inner circumferential surface.

10. The rotary compressor of Claim 3 or 4,
characterized in that
an inner circumferential surface (75a, 131a) of the

concave part (75) of the sealing stopper (72) is inwardly inclined in the radial direction of the sealing stopper (72) as the distance from the opening end side of the concave part (75) becomes greater toward the bottom part side thereof, and an outer circumferential edge of the apical surface (71a) of the opening end part (71) continuously abuts against the inner circumferential surface (75a, 131a) of the concave part (75) in the circumferential direction.

11. A refrigeration cycle device **characterized by** comprising:

a circulation circuit (24) in which a working fluid is circulated, and a heat radiator (9), an expanding device (22), and a heat absorber (23) are connected in series; and
at least one rotary compressor (4a, 4b) according to any one of Claims 1 to 10 and connected to the circulation circuit (24) between the heat radiator (9) and the heat absorber (23).

Patentansprüche

1. Rotationskompressor, aufweisend:

einen luftdichten Behälter (35), in dem ein Kompressionsmechanismusabschnitt (37) untergebracht ist, der so konfiguriert ist, dass er ein Arbeitsfluid komprimiert, und der mit Kältemaschinenöl gefüllt ist, das so konfiguriert ist, dass es den Kompressionsmechanismusabschnitt (37) schmiert; und
ein Verbindungsrohr (26a, 26b), das mit dem luftdichten Behälter (35) verbunden ist und ein Öffnungsendteil (71) enthält, das zur Außenseite des luftdichten Behälters (35) geöffnet ist,
dadurch gekennzeichnet, dass
der Rotationskompressor ferner aufweist:

einen Dichtungsstopfen (72), der abnehmbar auf dem Öffnungsendteil (71) des Verbindungsrohrs (26a, 26b) angebracht ist und das Öffnungsendteil (71) dicht verschließt, und
der Dichtungsstopfen (72) einen zylindrischen Umfangswandteil (73) aufweist, der an das Verbindungsrohr (26a, 26b) in einem Zustand zu löten ist, in dem der Umfangswandteil (73) eine äußere Umfangsfläche des Öffnungsendteils (71) des Verbindungsrohrs (26a, 26b) umgibt, und einen Endwandteil (74), der so vorgesehen ist, dass er mit dem Umfangswandteil (73) zusammenhängend ist und einer Scheitelfläche (71a) des Öffnungsendteils (71) gegenüberliegt.

2. Rotationskompressor nach Anspruch 1, **dadurch gekennzeichnet, dass** eine Wandstärke zumindest des stirnseitigen Wandteils (74) des Dichtungsstopfens (72) größer ist als eine Wandstärke des Verbindungsrohrs (26a, 26b).

3. Rotationskompressor nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**
der Umfangswandteil (73) und der Endwandteil (74) einen konkaven Teil (75) definieren, in den der Öffnungsendteil (71) des Verbindungsrohrs (26a, 26b) einzupassen ist.

4. Rotationskompressor nach Anspruch 3, **dadurch gekennzeichnet, dass**
ein Tiefenmaß des konkaven Teils (75) in einer axialen Richtung des Verbindungsrohrs (26a, 26b) größer ist als ein Innendurchmesser des Verbindungsrohrs (26a, 26b).

5. Rotationskompressor nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass**
das Verbindungsrohr (26a, 26b) aus einer Kupferlegierung gebildet ist, und der Dichtungsstopfen (72) aus einem metallischen Werkstoff auf Kupferbasis gebildet ist.

6. Rotationskompressor nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass**
der Dichtungsstopfen (72) eine flache Anlagefläche (76) am unteren Teil des konkaven Teils (75) aufweist, und die Scheitelfläche (71a) des Verbindungsrohrs (26a, 26b) an der Anlagefläche (76) anliegt.

7. Rotationskompressor nach Anspruch 6, **dadurch gekennzeichnet, dass**
der Dichtungsstopfen (72) einen Aussparungsteil (100) aufweist, der an einem zentralen Teil des Bodenteils des konkaven Teils (75) geöffnet ist, wobei der Aussparungsteil (100) eine Form besitzt, die in einer Richtung weg von dem Öffnungsendteil (71) des Verbindungsrohrs (26a, 26b) ausgespart ist, und gleichzeitig ein Stufenteil (101) an einer Grenze zwischen dem Aussparungsteil (100) und der Anlagefläche (76) ausgebildet ist.

8. Rotationskompressor nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass**
ein Bodenteil des konkaven Teils (75) des Dichtungsstopfens (72) eine Form aufweist, die derart geneigt ist, dass die geneigte Form umso weiter von dem Öffnungsendteil (71) entfernt ist, je größer der Abstand vom Beginn der geneigten Form in einer Richtung zu einer Mitte der geneigten Form ist.

9. Rotationskompressor nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass**
der Umfangswandteil (73) des Dichtungsstopfens

(72) eine innere Umfangsfläche aufweist, die die äußere Umfangsfläche des Öffnungsendteils (71) umgibt, und in der inneren Umfangsfläche mindestens eine Nut (120) in Umfangsrichtung des Umfangswandteils (73) ausgebildet ist.

10. Rotationskompressor nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass**
eine innere Umfangsfläche (75a, 131a) des konkaven Teils (75) des Dichtungsstopfens (72) in der radialen Richtung des Dichtungsstopfens (72) nach innen geneigt ist, während der Abstand von der Öffnungsendseite des konkaven Teils (75) in Richtung dessen Bodenteilseite größer wird, und eine äußere Umfangskante der Scheitelfläche (71a) des Öffnungsendteils (71) kontinuierlich gegen die innere Umfangsfläche (75a, 131a) des konkaven Teils (75) in der Umfangsrichtung anstößt.

11. Kühlkreislaufvorrichtung, **dadurch gekennzeichnet, dass** sie aufweist:

einen Zirkulationskreislauf (24), in dem ein Arbeitsfluid zirkuliert, und ein Wärmestrahler (9), eine Expansionsvorrichtung (22) und ein Wärmeabsorber (23) in Reihe geschaltet sind; und
mindestens einen Rotationskompressor (4a, 4b) nach einem der Ansprüche 1 bis 10, der mit dem Zirkulationskreislauf (24) zwischen dem Wärmestrahler (9) und dem Wärmeabsorber (23) verbunden ist.

Revendications

1. Compresseur rotatif comprenant :

un récipient étanche à l'air (35) logeant dans celui-ci une section de mécanisme de compression (37) configurée pour comprimer un fluide de travail, et chargée d'huile de machine réfrigérante configurée pour lubrifier la section de mécanisme de compression (37) ; et
un tuyau de connexion (26a, 26b) connecté au récipient étanche à l'air (35) et incluant une partie d'extrémité d'ouverture (71) ouverte vers l'extérieur du récipient étanche à l'air (35), **caractérisé en ce que**
le compresseur rotatif comprend de plus
un bouchon d'étanchéité (72) fixé de manière détachable sur la partie d'extrémité d'ouverture (71) du tuyau de connexion (26a, 26b), et scellant de manière étanche la partie d'extrémité d'ouverture (71), et
le bouchon d'étanchéité (72) inclut une partie de paroi périphérique cylindrique (73) à braser au tuyau de connexion (26a, 26b) dans un état où la partie de paroi périphérique (73) entoure une surface circonférentielle externe de la partie d'extrémité d'ouverture (71) du tuyau de connexion (26a, 26b), et une partie de paroi d'extrémité (74) fournie de telle manière à être continue avec la partie de paroi périphérique (73) et opposée à une surface apicale (71a) de la partie d'extrémité d'ouverture (71).

2. Compresseur rotatif selon la revendication 1, **caractérisé en ce que**
une épaisseur de paroi d'au moins la partie de paroi d'extrémité (74) du bouchon d'étanchéité (72) est supérieure à une épaisseur de paroi du tuyau de connexion (26a, 26b).

3. Compresseur rotatif selon la revendication 1 ou 2, **caractérisé en ce que**
la partie de paroi périphérique (73) et la partie de paroi d'extrémité (74) définissent une partie concave (75) dans laquelle la partie d'extrémité d'ouverture (71) du tuyau de connexion (26a, 26b) doit être fixée.

4. Compresseur rotatif selon la revendication 3, **caractérisé en ce que**
une dimension de profondeur de la partie concave (75) dans une direction axiale du tuyau de connexion (26a, 26b) est supérieure à un diamètre interne du tuyau de connexion (26a, 26b).

5. Compresseur rotatif selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que**
le tuyau de connexion (26a, 26b) est formé d'un alliage de cuivre et le bouchon d'étanchéité (72) est formé d'un matériau métallique à base de cuivre.

6. Compresseur rotatif selon la revendication 3 ou 4, **caractérisé en ce que**
le bouchon d'étanchéité (72) inclut une surface de butée plane (76) sur la partie de fond de la partie concave (75), et la surface apicale (71a) du tuyau de connexion (26a, 26b) bute contre la surface de butée (76).

7. Compresseur rotatif selon la revendication 6, **caractérisé en ce que**
le bouchon d'étanchéité (72) inclut une partie de creux (100) ouverte dans une partie centrale de la partie de fond de la partie de concave (75), la surface de creux (100) possède une forme creusée dans une direction s'éloignant de la partie d'extrémité d'ouverture (71) du tuyau de connexion (26a, 26b) et, en même temps, une partie d'échelon (101) est formée à une limite entre la partie de creux (100) et la surface de butée (76).

8. Compresseur rotatif selon la revendication 3 ou 4, **caractérisé en ce que**
une partie de fond de la partie concave (75) du bou-

chon d’étanchéité (72) possède une forme inclinée de telle manière que plus la distance à partir du début de la forme inclinée dans une direction vers un centre de la forme inclinée est grande, plus la forme inclinée s’éloigne de la partie d’extrémité d’ouverture (71).

9. Compresseur rotatif selon l’une quelconque des revendications 1 à 4, **caractérisé en ce que** la partie de paroi périphérique (73) du bouchon d’étanchéité (72) inclut une surface circonférentielle interne entourant la surface circonférentielle externe de la partie d’extrémité d’ouverture (71), et au moins une rainure (120) dans la direction circonférentielle de la partie de paroi périphérique (73) est formée dans la surface circonférentielle interne.

10. Compresseur rotatif selon la revendication 3 ou 4, **caractérisé en ce que** une surface circonférentielle interne (75a, 131a) de la partie concave (75) du bouchon d’étanchéité (72) est inclinée vers l’intérieur dans la direction radiale du bouchon d’étanchéité (72) lorsque la distance à partir du côté d’extrémité d’ouverture de la partie concave (75) augmente vers le côté de partie de fond de celui-ci, et un bord circonférentiel externe de la surface apicale (71a) de la partie d’extrémité d’ouverture (71) bute en continue contre la surface circonférentielle interne (75a, 131a) de la partie concave (75) dans la direction circonférentielle.

11. Dispositif de cycle de réfrigération **caractérisé en ce qu’**il comprend :

un circuit de circulation (24) dans lequel un fluide de travail circule, et un radiateur thermique (9), un dispositif d’expansion (22), et un absorbeur de chaleur (23) sont connectés en série ; et
au moins un compresseur rotatif (4a, 4b) selon l’une quelconque des revendications 1 à 10 et connecté au circuit de circulation (24) entre le radiateur thermique (9) et l’absorbeur de chaleur (23).

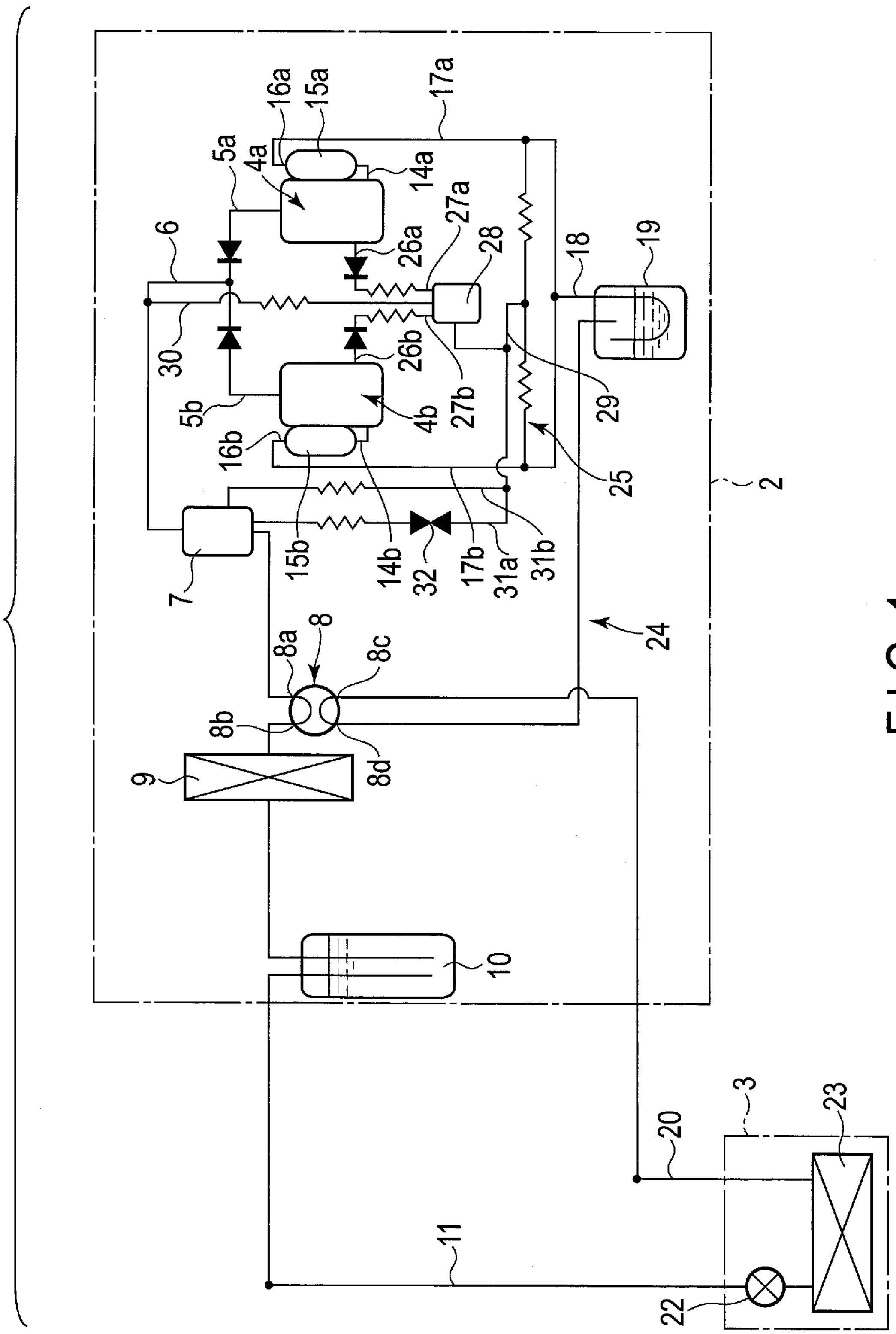
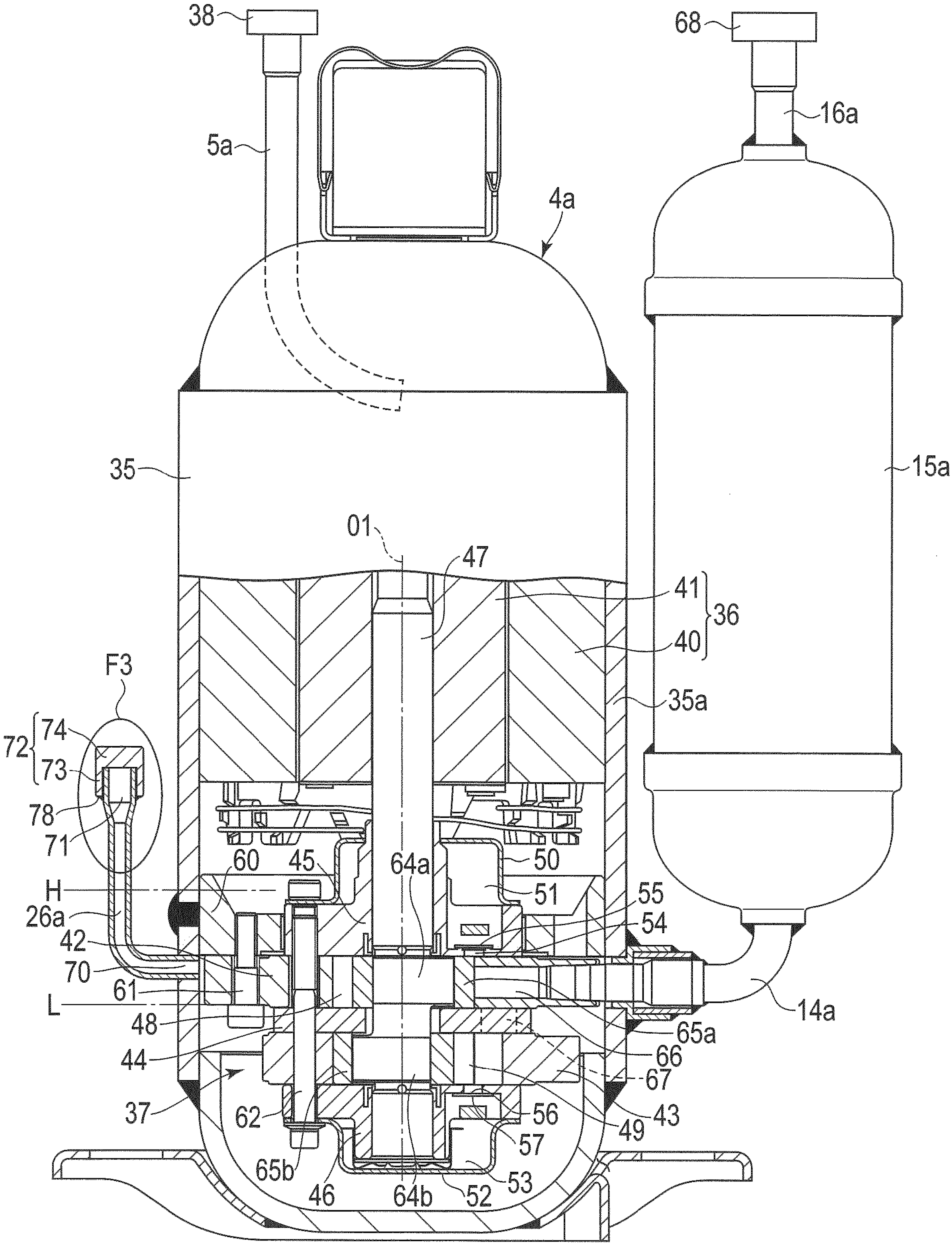

1
2
3
4a
4b
5a
5b
6
7
8
8a
8b
8c
8d
9
10
11
14a
14b
15a
15b
16a
16b
17a
17b
18
19
20
22
23
24
25
26a
26b
27a
27b
28
29
30
31a
31b
32

FIG. 1


38
68
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5a
4a
15a
35
01
47
41
36
40
35a
F3
72
74
73
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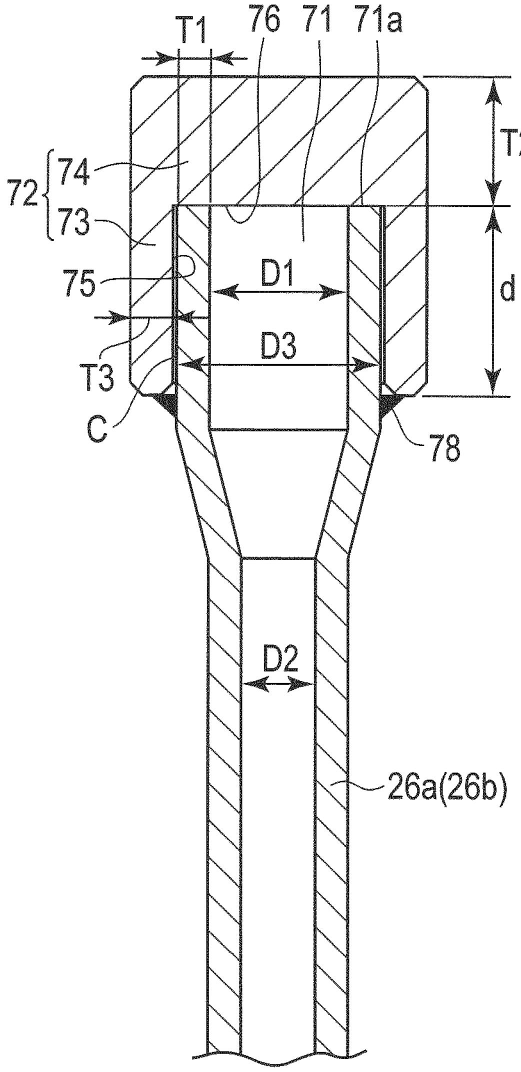
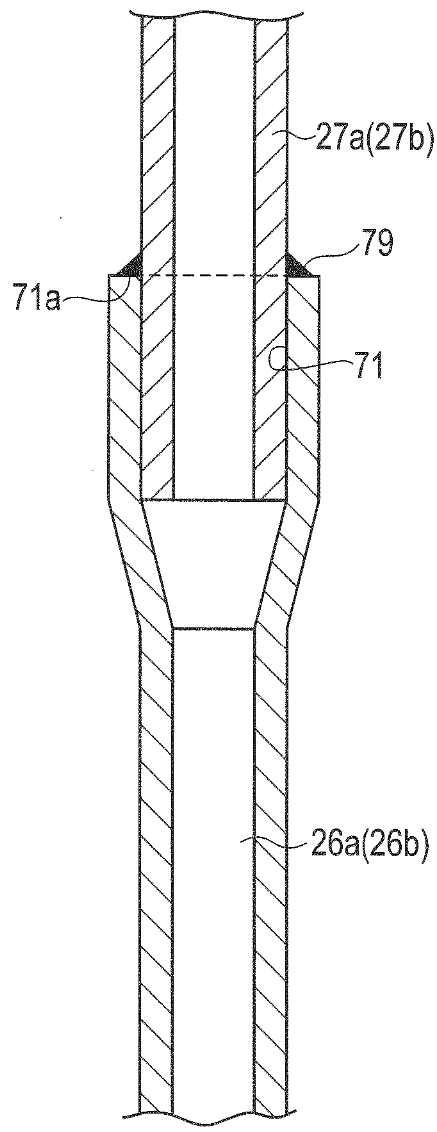
71
60
45
64a
50
51
55
54
H
26a
42
70
61
L
48
44
37
62
65b
46
64b
52
53
57
56
49
43
67
66
65a
14a

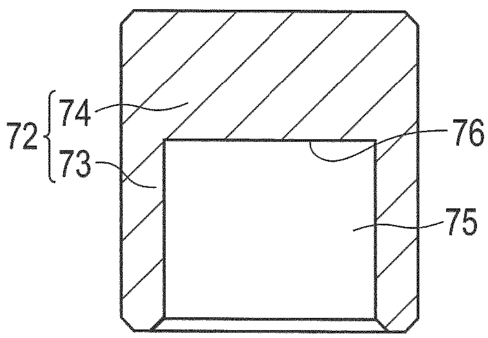
F I G. 2



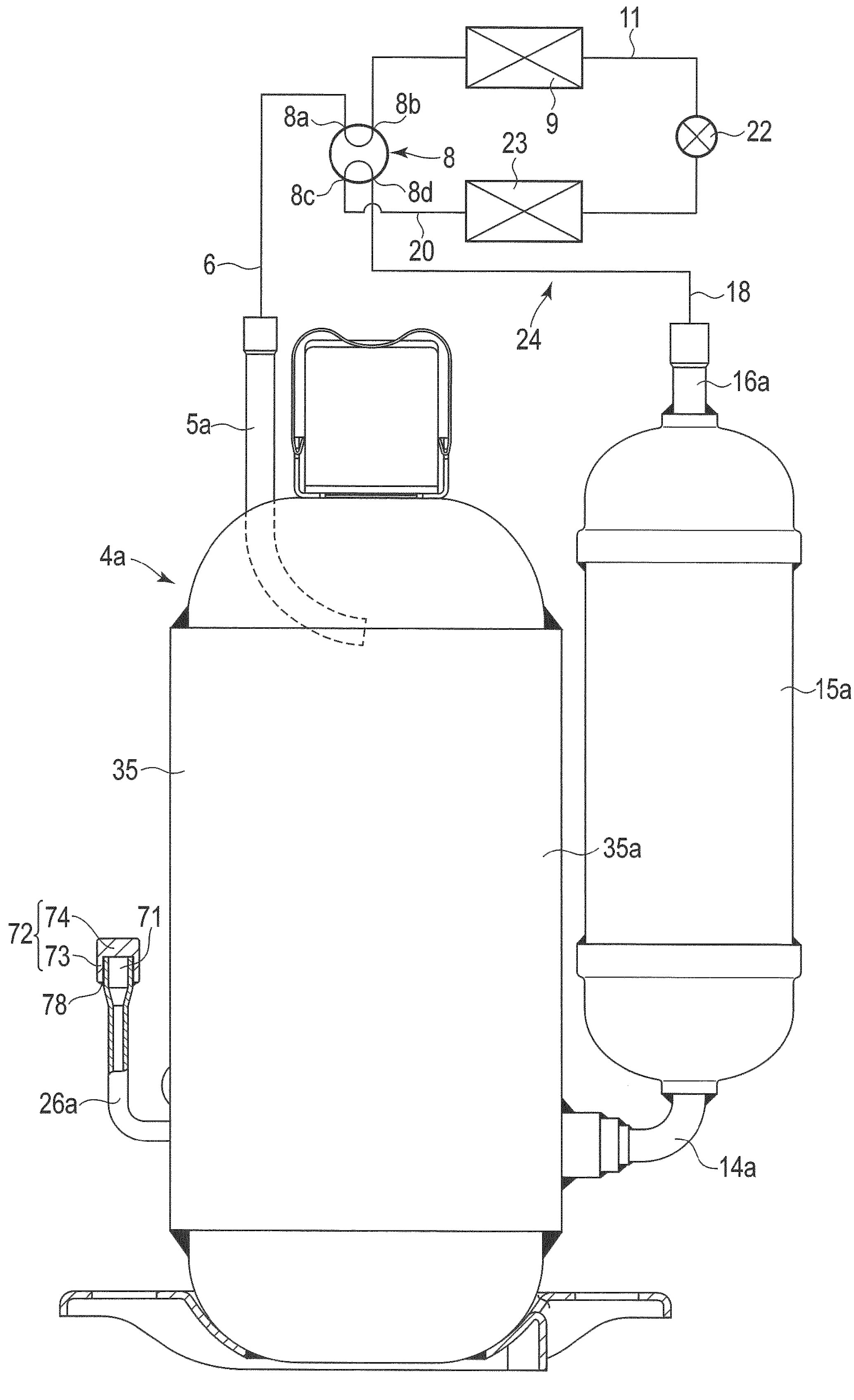
F I G. 3A



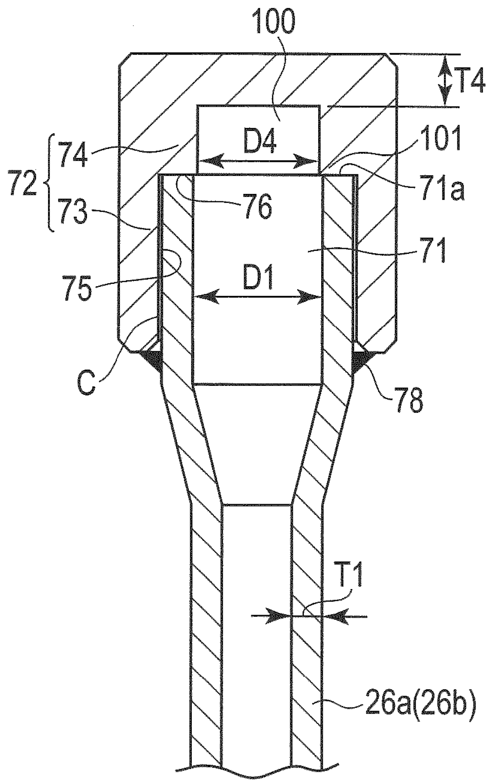
F I G. 3C



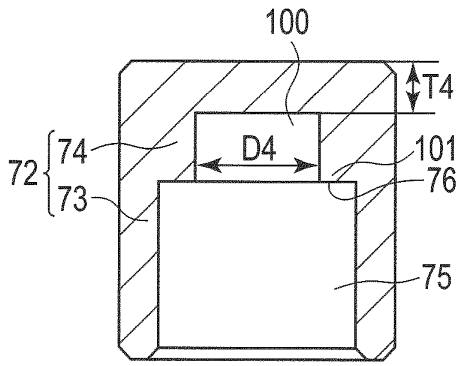
F I G. 3B


11
8a
8b
9
22
8
23
8c
8d
20
6
18
24
16a
5a
4a
15a
35
35a
72
74
71
73
78
26a
14a

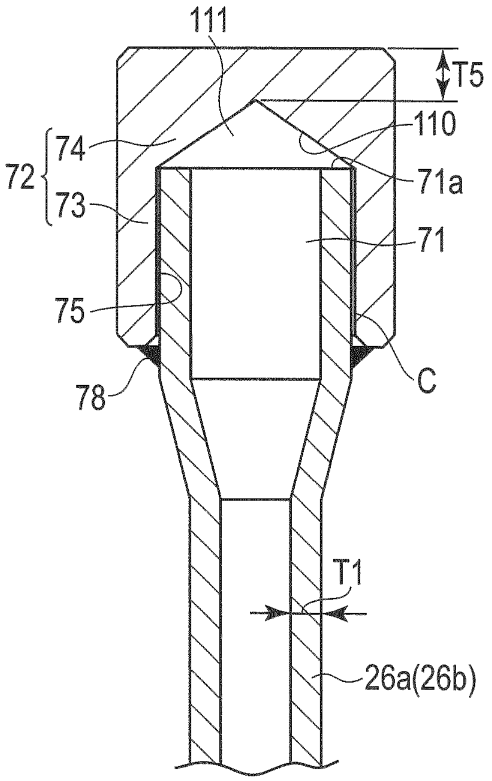
F I G. 4



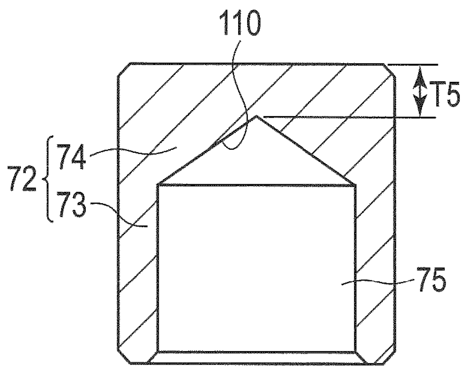
F I G. 5A



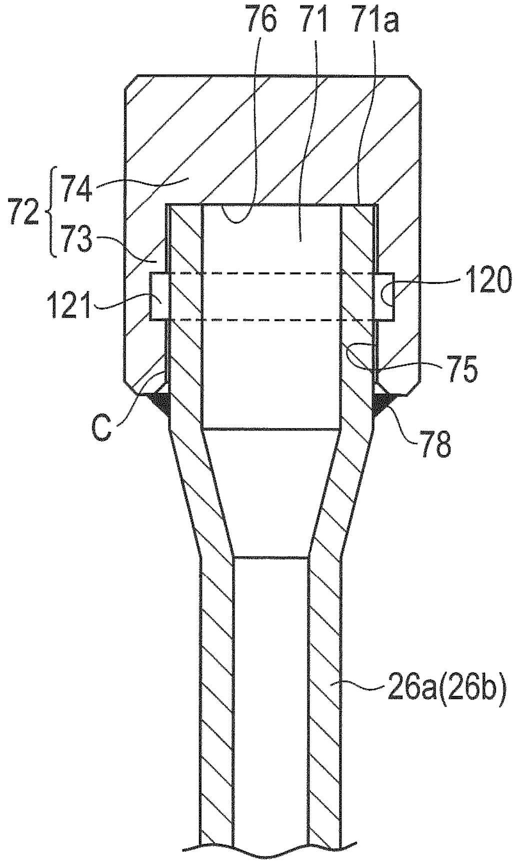
F I G. 5B



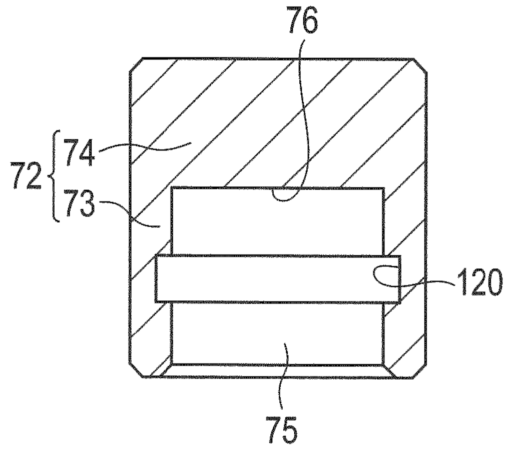
F I G. 6A



F I G. 6B



F I G. 7A



F I G. 7B

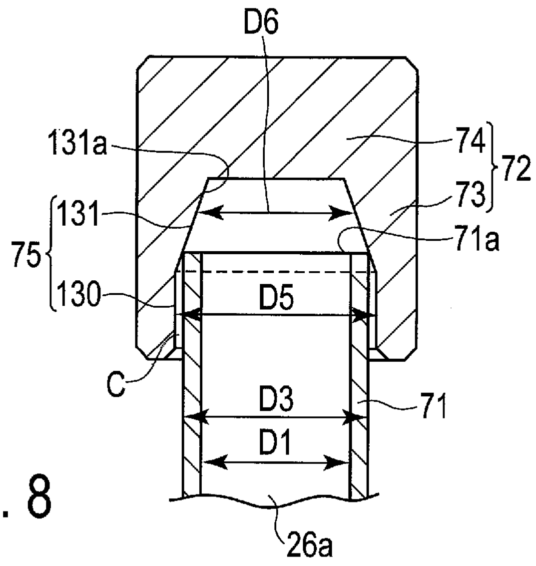


FIG. 8

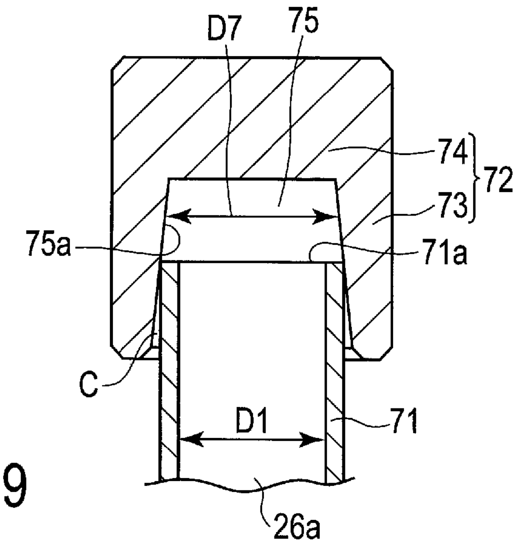


FIG. 9

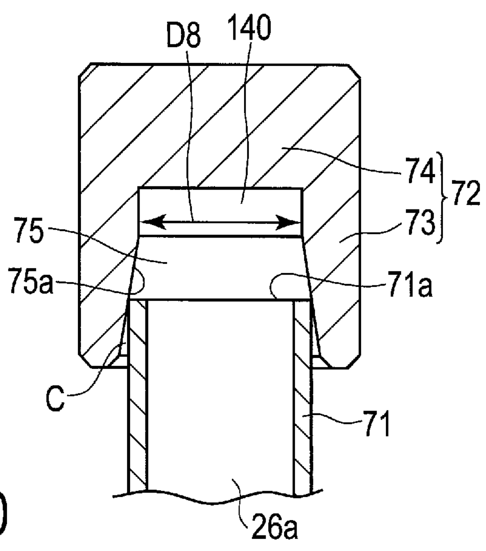


FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4325751 B **[0002]**
- JP 2001132644 A **[0003]**