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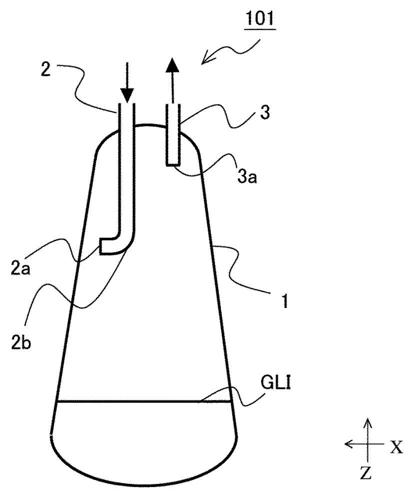
(54) REFRIGERANT STORAGE CONTAINER, AND REFRIGERATION CYCLE DEVICE PROVIDED WITH SAID REFRIGERANT STORAGE CONTAINER

(57) A refrigerant reservoir container includes: a container body reserving refrigerant; an inflow pipe inserted into an upper space of the container body, the inflow pipe having an inlet through which the refrigerant flows into the container body; and an outflow pipe inserted into the upper space of the container body, the outflow pipe having an outlet through which the refrigerant flows out from the container body, wherein a cross-sectional area of an inner space of the container body where the outlet of the outflow pipe is located is larger towards a bottom of the container body and away from the outlet.

FIG. 2



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Description

Technical Field

[0001] The present disclosure relates to a refrigerant reservoir container reserving refrigerant therein, and also relates to a refrigeration cycle device including the refrigerant reservoir container.

Background Art

[0002] In a refrigeration cycle device, when a compressor suctions liquid refrigerant, refrigerating machine oil in a shell of the compressor is diluted with the liquid refrigerant, which causes seizure of sliding parts of the compressor. In view of that, a configuration of a refrigeration cycle device is proposed, in which a refrigerant reservoir container is provided upstream of a suction port through which a compressor suctions refrigerant. The refrigerant reservoir container is configured to separate two-phase gas-liquid refrigerant into gas refrigerant and liquid refrigerant and reserve the liquid refrigerant in the container. For example, Patent Literature 1 discloses a gas-liquid separator located in a refrigeration cycle to separate refrigerant into liquid refrigerant and gas refrigerant. The gas-liquid separator has a function of the refrigerant reservoir container, and includes a gas-phase refrigerant outflow pipe provided in an upper portion of the container to allow the gas refrigerant to flow out from the gas-liquid separator, a liquid-phase refrigerant outflow pipe provided in a lower portion of the container to allow the liquid refrigerant to flow out from the gas-liquid separator, a first plate configured to partition a refrigerant inflow chamber from a liquid-phase refrigerant accumulation chamber, and a second plate configured to partition the refrigerant inflow chamber from a gas-phase refrigerant collection chamber.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2015-172469

Summary of Invention

Technical Problem

[0004] In the gas-liquid separator described in Patent Literature 1, since the first plate partitions the refrigerant inflow chamber from the liquid-phase refrigerant accumulation chamber, the accumulating liquid refrigerant is restrained from rolling up and entering the refrigerant inflow chamber. In addition, since the second plate partitions the refrigerant inflow chamber from the gas-phase refrigerant collection chamber, refrigerant having flowed into the refrigerant inflow chamber and having become liquid droplets is restrained from entering the gas-phase refrigerant collection chamber. As a result, in the gas-liquid separator in Patent Literature 1, the accumulating liquid refrigerant is restrained from entering the refrigerant outflow pipe through which gas refrigerant flows out.

[0005] However, as disclosed in Patent Literature 1, the plates are used to simply partition a region into which refrigerant flows, a region in which liquid refrigerant is reserved, and a region in which gas refrigerant is reserved, from each other. This cannot always suppress roll-up of the accumulating liquid refrigerant, or restrain scattering liquid droplets from entering the refrigerant outflow pipe. For example, when liquid refrigerant is reserved up to the upper portion of the container, the reserved liquid refrigerant may ripple and scatter, and the scattering liquid droplets may reach the refrigerant outflow pipe and flow into the compressor along with gas refrigerant. As the area of gas-liquid interface increases, ripples of the liquid refrigerant spread more widely over the gas-liquid interface in the refrigerant reservoir container. In addition, the volume of scattering liquid droplets increases in proportion to the area of gas-liquid interface. For this reason, even when the volume of liquid refrigerant reserved is below the maximum reservoir volume, the liquid refrigerant that ripples over the gas-liquid interface and thus scatters may still reach the refrigerant outflow pipe and may flow out along with the gas refrigerant from the refrigerant reservoir container.

[0006] The present disclosure has been made in view of the above problems, and it is an object of the present disclosure to provide a refrigerant reservoir container that restrains liquid refrigerant from flowing out along with gas refrigerant from the refrigerant reservoir container, and a refrigeration cycle device including the refrigerant reservoir container.

Solution to Problem

[0007] A refrigerant reservoir container according to one embodiment of the present disclosure includes: a container body reserving refrigerant; an inflow pipe inserted into an upper space of the container body, the inflow pipe having an inlet through which the refrigerant flows into the container body; and an outflow pipe inserted into the upper space of the container body, the outflow pipe having an outlet through which the refrigerant flows out from the container body, wherein a cross-sectional area of an inner space of the container body where the outlet of the outflow pipe is located is larger towards a bottom of the container body and away from the outlet.

[0008] A refrigeration cycle device according to another embodiment of the present disclosure includes: the refrigerant reservoir container described above; and a compressor connected to the refrigerant reservoir container through the outflow pipe. Advantageous Effects of Invention

[0009] According to one embodiment of the present disclosure, in the container body of a gas-liquid reservoir container, the cross-sectional area of the inner space where the outlet of the outflow pipe is located, through which refrigerant flows out from the gas-liquid reservoir container, increases towards the bottom of the container body. The outflow pipe is inserted into the upper space of the container body, and thus the cross-sectional area of the inner space near the outlet is smaller than the cross-sectional area of the inner space near the bottom of the container body. With this configuration, even when liquid refrigerant is reserved up to the vicinity of the outlet, ripples of the liquid refrigerant are generated still on a small area of gas-liquid interface. This can reduce the volume of scattering liquid droplets. Therefore, the liquid droplets scattering from the gas-liquid interface are restrained from reaching the refrigerant outflow pipe and flowing along with gas refrigerant into the compressor.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram of a refrigeration cycle device including a refrigerant reservoir container according to Embodiment 1.

[Fig. 2] Fig. 2 is a front view of the refrigerant reservoir container according to Embodiment 1.

[Fig. 3] Fig. 3 is a plan view of the refrigerant reservoir container according to Embodiment 1.

[Fig. 4] Fig. 4 illustrates a relationship between a height and a cross-sectional area of a container body of the refrigerant reservoir container according to Embodiment 1.

[Fig. 5] Fig. 5 illustrates a relationship between the height and an inner volume of the container body of the refrigerant reservoir container according to Embodiment 1.

[Fig. 6] Fig. 6 is a front view of a refrigerant reservoir container according to Embodiment 2.

[Fig. 7] Fig. 7 is a sectional view illustrating an A-A cross section of Fig. 6.

[Fig. 8] Fig. 8 is a front view of a refrigerant reservoir container according to Embodiment 3.

[Fig. 9] Fig. 9 is a sectional view illustrating a B-B cross section of Fig. 8.

[Fig. 10] Fig. 10 is a sectional view illustrating a C-C cross section of Fig. 8.

Description of Embodiments

[0011] Hereinafter, a refrigerant reservoir container according to the present embodiment and a refrigeration cycle device including the refrigerant reservoir container will be described with reference to the drawings. The present disclosure is not limited to the embodiments described below, and can be variously modified without departing from the gist of the present disclosure. In addition, the present disclosure includes all combinations of configurations that can be combined among the configurations shown in the embodiments described below. The configurations of the refrigerant reservoir container and the refrigeration cycle device are illustrated in the drawings merely as examples. The refrigerant reservoir container and the refrigeration cycle device illustrated in the drawings are not intended to limit the configurations of the present disclosure. In the descriptions below, terms that represent directions (for example, "up," "down," "right," "left," "front," and "rear") are appropriately used for the sake of easy understanding. However, these terms are used merely for description purposes, and are not intended to limit the present disclosure.

[0012] In the drawings, the same reference signs denote the same or equivalent components, which are common throughout the entire specification. Note that the relative relationship of sizes of the constituent components, the shapes of the constituent components, and the like in the drawings may differ from those of actual ones. In the drawings, the X-direction shows a left-right direction of the refrigerant reservoir container, and is illustrated with the arrow pointing to the leftward direction from the rightward side. The Y-direction shows a front-rear direction of the refrigerant reservoir container, and is illustrated with the arrow pointing to the rearward direction from the forward side. The Z-direction shows an up-down direction of the refrigerant reservoir container, and is illustrated with the arrow pointing to the upward direction from the downward side.

Embodiment 1

Refrigeration cycle device 100

[0013] With reference to Fig. 1, a refrigeration cycle device 100 including a refrigerant reservoir container 101 according to Embodiment 1 is described below. Fig. 1 is a refrigerant circuit diagram of the refrigeration cycle device 100 including the refrigerant reservoir container 101 according to Embodiment 1. As illustrated in Fig. 1, the refrigeration cycle device 100 according to Embodiment 1 includes a compressor 10, a flow switching device 11, an outdoor heat exchanger 12, an expansion mechanism 13, an indoor heat exchanger 14, and the refrigerant reservoir container 101. The compressor 10, the flow switching device 11, the outdoor heat exchanger 12, the expansion mechanism 13, the indoor heat exchanger 14, and the refrigerant reservoir container 101 are connected by a refrigerant pipe 15. With this connection, a refrigerant circuit 200 is formed in which refrigerant circulates through the refrigerant pipe 15.

[0014] In the refrigeration cycle device 100, the refrigerant reservoir container 101 is connected to the compressor 10 through an outflow pipe 3 that is a portion of the refrigerant pipe 15. The compressor 10 suctions refrigerant, compresses the suctioned refrigerant into a high-temperature high-pressure state, and discharges the compressed refrigerant. The compressor 10 is, for example, an inverter compressor. Refrigerant discharged from the compressor 10 flows into the outdoor heat exchanger 12 or the indoor heat exchanger 14 via the flow switching device 11.

[0015] The flow switching device 11 has a function of switching between refrigerant flow passages. The flow switching device 11 switches operation between cooling and heating. In the cooling operation, refrigerant discharged from the compressor 10 flows through the outdoor heat exchanger 12, the expansion mechanism 13, the indoor heat exchanger 14, and the refrigerant reservoir container 101 in this order, and flows back to the compressor 10. In contrast, in the heating operation, refrigerant discharged from the compressor 10 flows through the indoor heat exchanger 14, the expansion mechanism 13, the outdoor heat exchanger 12, and the refrigerant reservoir container 101 in this order, and flows back to the compressor 10. That is, during the cooling operation in a room, the outdoor heat exchanger 12 serves as a condenser, while the indoor heat exchanger 14 serves as an evaporator. During the heating operation in a room, the indoor heat exchanger 14 serves as a condenser, while the outdoor heat exchanger 12 serves as an evaporator. The flow switching device 11 is, for example, a four-way valve. The flow switching device 11 may be made up of a combination of two-way valves or three-way valves.

[0016] The expansion mechanism 13 is a pressure-reducing device configured to reduce the pressure of refrigerant flowing in the refrigerant circuit 200 to expand the refrigerant. The expansion mechanism 13 is constituted by, for example, an electronic expansion valve whose opening degree is variably controlled.

[0017] In the refrigeration cycle device 100, it is optimal that superheated gas is suctioned into the compressor 10 as refrigerant. However, the state of refrigerant to be suctioned into the compressor 10 depends on a refrigerant distribution in the refrigerant circuit 200. Thus, refrigerant containing liquid refrigerant may sometimes be suctioned into the compressor 10. When the liquid refrigerant is suctioned into the compressor 10, refrigerating machine oil in a shell of the compressor 10 is diluted with the liquid refrigerant. This may cause seizure of sliding parts of the compressor 10. In view of that, in the refrigeration cycle device 100, the refrigerant reservoir container 101 is installed upstream of the compressor 10 in the refrigerant flow direction. Two-phase gas-liquid refrigerant flowing out from the evaporator and passing through the flow switching device 11 flows into the refrigerant reservoir container 101 from an inflow pipe 2 that is a portion of the refrigerant pipe 15. The two-phase gas-liquid refrigerant flowing into the refrigerant reservoir container 101 is separated into gas refrigerant and liquid refrigerant. The liquid refrigerant accumulates in the refrigerant reservoir container 101. The gas refrigerant passes through the outflow pipe 3, flows out from the refrigerant reservoir container 101, and is suctioned into the compressor 10. Therefore, in the refrigeration cycle device 100 according to the present embodiment, liquid refrigerant is separated from the two-phase gas-liquid refrigerant and reserved in the refrigerant reservoir container 101, so that the liquid refrigerant can be restrained from being suctioned into the compressor 10.

[0018] Note that the refrigeration cycle device 100 is not limited to being an air-conditioning apparatus capable of switching operation between cooling and heating as described above. The refrigerant reservoir container 101 may be applied to a refrigeration cycle device such as a dehumidifier or a refrigerator-freezer.

Refrigerant reservoir container 101

[0019] The refrigerant reservoir container 101 according to the present embodiment is described below with reference to Figs. 2 and 3. Fig. 2 is a front view of the refrigerant reservoir container 101 according to Embodiment 1. The arrows in Fig. 2 conceptually illustrate a refrigerant flow. Fig. 3 is a plan view of the refrigerant reservoir container 101 according to Embodiment 1.

[0020] As illustrated in Fig. 2, the refrigerant reservoir container 101 includes a container body 1, the inflow pipe 2, and the outflow pipe 3. The container body 1 has a substantially truncated conical shape with its inner space having a cross-sectional area that gradually increases from the upper end towards the bottom. Refrigerant accumulates in the inner space of the container body 1. The inflow pipe 2 and the outflow pipe 3 are inserted into the upper space of the container body 1. As illustrated in Fig. 2, the inflow pipe 2 and the outflow pipe 3 may be inserted from the upper end portion of the container body 1. Although not illustrated, the inflow pipe 2 and the outflow pipe 3 may be inserted from a lateral surface of the container body 1 such that the inflow pipe 2 and the outflow pipe 3 are located in the upper space of the container body 1.

[0021] Refrigerant in a two-phase gas-liquid state passes through the inflow pipe 2, and flows into the container body 1 from an inlet 2a of the inflow pipe 2. Liquid refrigerant flowing into the container body 1 from the inlet 2a drops to the bottom of the container body 1 due to gravity and accumulates in the container body 1. As the volume of liquid refrigerant that accumulates in the container body 1 increases, the level of a gas-liquid interface GLI rises. In other words, as the volume of liquid refrigerant that accumulates in the container body 1 increases, the gas-liquid interface GLI moves towards the upper portion of the container body 1. Accordingly, as the volume of accumulating liquid refrigerant increases, the gas-liquid interface GLI becomes closer to the inflow pipe 2 and the outflow pipe 3 in distance.

[0022] Gas refrigerant entering the container body 1 from the inlet 2a flows into the outflow pipe 3 from an outlet 3a. The gas refrigerant flowing into the outflow pipe 3 passes through the outflow pipe 3, flows out from the container body 1, and is suctioned into the compressor 10.

[0023] As illustrated in Figs. 2 and 3, an end portion of the inflow pipe 2 is located in the container body 1 and has a bent portion 2b that is bent in the X-direction. The inlet 2a is provided at the bent portion 2b to be opposite to the lateral surface of the container body 1. The inlet 2a is provided to be opposite to the lateral surface of the container body 1, so that the distance between the inlet 2a and the outlet 3a can be increased. Therefore, this can reduce the likelihood that liquid refrigerant flows into the outlet 3a from the inlet 2a. Also. The velocity of liquid refrigerant flowing through the inflow pipe 2 is reduced by the bent portion 2b. Consequently, the liquid refrigerant flowing out from the inlet 2a reduces its momentum, so that when the liquid refrigerant drops to the gas-liquid interface GLI, ripples over the gas-liquid interface GLI can be suppressed. Note that it is desirable for the inlet 2a to be provided at a location where the inlet 2a does not overlap the outflow pipe 3 in the up-down direction of the container body 1.

Container body 1

[0024] Next, the container body 1 is described with reference to Figs. 4 and 5. Fig. 4 illustrates a relationship between a height and a cross-sectional area of the container body 1 of the refrigerant reservoir container 101 according to Embodiment 1. Fig. 5 illustrates a relationship between the height and an inner volume of the container body 1 of the refrigerant reservoir container 101 according to Embodiment 1. As described above, the container body 1 has a substantially truncated conical shape with its inner space having a cross-sectional area that gradually increases from the upper end towards the bottom. Figs. 4 and 5 illustrate a virtual container body VC with a cylindrical shape by the dotted line in the container body 1 for the purpose of comparison with the container body 1 with a substantially truncated conical shape.

[0025] Fig. 4 illustrates, on the right side of the drawing, a cross-sectional area relationship diagram showing the relationship between the height of the container body and the cross-sectional area of the container body. Fig. 4 illustrates, on the left side of the drawing, the container body 1 of the refrigerant reservoir container 101 and the virtual container body VC. In the container body 1, a first height position HPt1 and a second height position Hpt2 are illustrated, each of which shows a height position. In the cross-sectional area relationship diagram, the height corresponding to the first height position HPt1 is illustrated as a first reference line L1, while the height corresponding to the second height position Hpt2 is illustrated as a second reference line.

[0026] In the cross-sectional area relationship diagram, the vertical axis represents the height of the container body 1 and the virtual container body VC, while the horizontal axis represents the cross-sectional area of the container body 1 and the virtual container body VC. On the vertical axis, the height increases towards the upper side of the drawing, while on the horizontal axis, the cross-sectional area increases towards the right side of the drawing. In the cross-sectional area relationship diagram, the relationship between the height and the cross-sectional area of the container body 1 is illustrated by the solid line, while the relationship between the height and the cross-sectional area of the virtual container body VC is illustrated by the thick dotted line. The container body 1 has a substantially truncated conical shape with its cross-sectional area increasing towards the bottom, and thus the cross-sectional area of the container body 1 decreases towards the upper portion. In contrast, the virtual container body VC has a cylindrical shape, and thus the cross-sectional area of the virtual container body VC is constant regardless of its height.

[0027] As illustrated in Fig. 4, at the first height position HPt1, the cross-sectional area of the container body 1 is equal to the cross-sectional area of the virtual container body VC. Accordingly, in the cross-sectional area relationship diagram, the point showing the cross-sectional area of the container body 1 at the first height position HPt1 coincides, at a first point XPt1, with the point showing the cross-sectional area of the virtual container body VC at the first height position HPt1. In the cross-sectional area relationship diagram, the point showing the cross-sectional area of the container body 1 at the second height position HPt2 is illustrated as a third point XPt3. Further, in the cross-sectional area relationship diagram, the point showing the cross-sectional area of the virtual container body VC at the second height position HPt2 is illustrated as a second point XPt2. At the second height position HPt2, the cross-sectional area of the container body 1 is larger than the cross-sectional area of the virtual container body VC. Accordingly, the third point XPt3 is located on the right side relative to the second point XPt2.

[0028] Fig. 5 illustrates, on the right side of the drawing, an inner volume relationship diagram showing the relationship between the height of the container body and the inner volume of the container body. Similar to Fig. 4, Fig. 5 illustrates, on the left side of the drawing, the container body 1 and the virtual container body VC along with the first height position HPt1 and the second height position Hpt2. Fig. 5 also illustrates a third height position HPt3 showing the upper end portion of the container body 1 and the virtual container body VC. In the inner volume relationship diagram, the height corresponding to the third height position HPt3 is illustrated as a third reference line L3.

[0029] In the inner volume relationship diagram in Fig. 5, the vertical axis represents the height of the container body 1 and the virtual container body VC, while the horizontal axis represents the inner volume of the container body 1 and the virtual container body VC. On the vertical axis, the height increases towards the upper side of the drawing, while on the horizontal axis, the inner volume increases towards the right side of the drawing. In the inner volume relationship diagram, the relationship between the height and the inner volume of the container body 1 is illustrated by the solid line, while the relationship between the height and the inner volume of the virtual container body VC is illustrated by the thick dotted line. Since the container body 1 has a substantially truncated conical shape with its cross-sectional area increasing towards the bottom, the inner volume of the container body 1 increases at a greater rate closer to the bottom. In contrast, since the virtual container body VC has a cylindrical shape, the inner volume of the virtual container body VC increases at a constant rate regardless of its height.

[0030] As illustrated in Fig. 5, between the first height position HPt1 and the third height position HPt3, the container body 1 has the same shape as the shape of the virtual container body VC, and thus their shapes overlap each other. In other words, the inner volume of the container body 1 increases between the first height position HPt1 and the third height position HPt3 at the same rate as the increase in the inner volume of the virtual container body VC between the first height position HPt1 and the third height position HPt3. Accordingly, between the first reference line L1 and the third reference line L3 in the inner volume relationship diagram, the difference in inner volume between the container body 1 and the virtual container body VC remains unchanged. In the inner volume relationship diagram, the point showing the inner volume of the container body 1 at the second height position HPt2 is illustrated as a fifth point XPt5. Further, in the cross-sectional area relationship diagram, the point showing the inner volume of the virtual container body VC at the second height position HPt2 is illustrated as a fourth point XPt4. At the second height position HPt2, the inner volume of the container body 1 is larger than the inner volume of the virtual container body VC. Accordingly, the fifth point XPt5 is located on the right side relative to the fourth point XPt4.

[0031] As described above, the container body 1 has a substantially truncated conical shape. Thus, the inner volume of the container body 1 is larger than that of the virtual container body VC with a cylindrical shape, provided that the container body 1 and the virtual container body VC with a cylindrical shape both have the same height and the same shape of the upper end portion. Accordingly, the container body 1 can reserve a greater volume of liquid refrigerant than the volume of liquid refrigerant that can be reserved in the virtual container body VC. In addition, since the container body 1 has a substantially truncated conical shape, the volume of liquid refrigerant per unit height is larger closer to the bottom. Consequently, a longer time is spent for the gas-liquid interface GLI to become close to the outlet 3a in distance, compared to the virtual container body VC. In other words, in the container body 1, liquid refrigerant can be kept reserved for a longer time with an adequate distance kept between the outlet 3a and the gas-liquid interface GLI. In the container body 1, ripples may be generated on the gas-liquid interface GLI due to an inertial force of the two-phase gas-liquid refrigerant flowing into the container body 1. When ripples are generated on the gas-liquid interface GLI, the liquid refrigerant scatters as liquid droplets in the container body 1. In a case where the outlet 3a and the gas-liquid interface GLI are adequately distanced from each other, even when the liquid droplets scatter from the gas-liquid interface GLI, the liquid droplets are still less likely to reach the outlet 3a. Accordingly, the liquid refrigerant can be restrained from flowing out from the container body 1.

[0032] As the area of the gas-liquid interface GLI increases, ripples spread more widely over the gas-liquid interface GLI. Further, the volume of scattering liquid droplets increases in proportion to the area of the gas-liquid interface GLI. In the container body 1, when the gas-liquid interface GLI becomes close to the outlet 3a in distance, the cross-sectional area on the gas-liquid interface GLI is smaller compared to the cross-sectional area at the bottom of the container body 1. Accordingly, the volume of scattering liquid droplets can be reduced, so that the liquid droplets are less likely to reach the outlet 3a. With this configuration, the container body 1 can reserve a relatively large volume of liquid refrigerant at a location away from the outlet 3a, and can reduce the likelihood that the liquid droplets reach the outlet 3a when the gas-liquid interface GLI becomes close to the outlet 3a in distance.

[0033] As described above, the refrigerant reservoir container 101 according to the present embodiment includes the container body 1 reserving refrigerant, the inflow pipe 2 inserted into the upper space of the container body 1 and having the inlet 2a through which the refrigerant flows into the container body 1, and the outflow pipe 3 inserted into the upper space of the container body 1 and having the outlet 3a through which the refrigerant flows out from the container body 1. The cross-sectional area of the inner space of the container body 1 where the outlet 3a of the outflow pipe 3 is located is larger towards the bottom of the container body 1 and away from the outlet 3a.

[0034] In this configuration, the cross-sectional area of the inner space of the container body 1 is smaller closer to the outlet 3a. That is, even when liquid refrigerant accumulates in the container body 1, and the gas-liquid interface GLI becomes close to the outlet 3a in distance, the volume of liquid droplets that scatter due to ripples of the liquid refrigerant over the gas-liquid interface GLI is still reduced. Accordingly, the liquid refrigerant can be restrained from flowing out from the container body 1.

[0035] In the configuration of the refrigerant reservoir container 101 according to the present embodiment, the inflow pipe 2 and the outflow pipe 3 are inserted from the upper end portion of the container body 1, and the inlet 2a of the inflow pipe 2 is located on the lower side relative to the outlet 3a of the outflow pipe 3. With this configuration, the inlet 2a is located on the lower side relative to the outlet 3a, so that the liquid refrigerant that drops from the inlet 2a is less likely to flow into the outlet 3a. In addition, since the outlet 3a is located on the upper side relative to the inlet 2a, even when liquid refrigerant flowing into the container body 1 from the inlet 2a ripples over the gas-liquid interface GLI and thus liquid droplets scatter, the scattering liquid droplets are still less likely to flow into the outlet 3a.

[0036] In the configuration of the refrigeration cycle device 100 according to the present embodiment, the refrigeration cycle device 100 includes the refrigerant reservoir container 101 described above, and the compressor 10 connected to the refrigerant reservoir container 101 through the outflow pipe 3. With this configuration, liquid refrigerant can be restrained from being suctioned into the compressor 10 from the refrigerant reservoir container 101 through the outflow pipe 3. Therefore, this configuration can reduce the likelihood that refrigerating machine oil in the compressor 10 is diluted with the liquid refrigerant, which causes seizure of sliding parts of the compressor 10.

Embodiment 2

[0037] A container body 1A and an inflow pipe 2A of a refrigerant reservoir container 101A according to the present embodiment are different in configuration from the container body 1 and the inflow pipe 2 in Embodiment 1, respectively. The refrigerant reservoir container 101A in the present embodiment is described below, mainly focusing on the differences from the refrigerant reservoir container 101 in Embodiment 1. Note that in the refrigeration cycle device 100 in Embodiment 1, the refrigerant reservoir container 101 according to Embodiment 1 can be replaced with the refrigerant reservoir container 101A according to the present embodiment. The configuration of the refrigeration cycle device 100, other than the refrigerant reservoir container, is the same as that in Embodiment 1, and therefore descriptions of the configuration are omitted. The same constituent elements as those in Embodiment 1 are denoted by the same reference signs, and descriptions thereof are appropriately omitted.

Container body 1A

[0038] With reference to Figs. 6 and 7, the container body 1A is described below. Fig. 6 is a front view of the refrigerant reservoir container 101A according to Embodiment 2. The solid-line arrows in Fig. 6 conceptually illustrate a refrigerant flow. Fig. 7 is a sectional view illustrating the A-A cross section of Fig. 6. As illustrated in Fig. 6, the container body 1A of the refrigerant reservoir container 101A according to the present embodiment has a cylindrical shape. In the container body 1A, a shielding plate 4 is provided. The inflow pipe 2A and the outflow pipe 3 are inserted into the upper space of the container body 1A. As illustrated in Fig. 6, the inflow pipe 2A and the outflow pipe 3 may be inserted from the upper end portion of the container body 1A.

Shielding plate 4

[0039] The shielding plate 4 partitions the interior of the container body 1A into a first region SP1 where the outlet 3a of the outflow pipe 3 is located, and a second region SP2 where the inlet 2a of the inflow pipe 2A is located. As illustrated in Fig. 6, the shielding plate 4 is provided such that the cross-sectional area of the inner space of the container body 1A where the outlet 3a is located is larger towards the bottom of the container body 1A and away from the outlet 3a. In other words, in the present embodiment, while the container body 1A has a cylindrical shape, the inner space where the outlet 3a is located is formed as the first region SP1 with a truncated conical shape by providing the shielding plate 4 in the container body 1A.

[0040] The inner space of the container body 1A is partitioned into the first region SP1 surrounded by the shielding plate 4, the second region SP2 formed between the lateral surface of the container body 1A and the shielding plate 4, and a third region SP3 formed between a lower end portion of the shielding plate 4 and the bottom of the container body 1A. The first region SP1 and the second region SP2 both connect to the third region SP3. Accordingly, the first region SP1, the second region SP2, and the third region SP3 communicate with each other. The outlet 3a is located in the first region SP1, while the inlet 2a is located in the second region SP2.

[0041] Two-phase gas-liquid refrigerant flows into the second region SP2 from the inlet 2a. Gas refrigerant passes through the third region SP3 and flows into the first region SP1. Gas refrigerant flowing into the first region SP1 enters the outflow pipe 3 from the outlet 3a and flows out from the container body 1A. Liquid refrigerant passes through the second region SP2 and accumulates in the third region SP3. As the volume of accumulating liquid refrigerant increases, the level of the gas-liquid interface GLI rises. When the volume of accumulating liquid refrigerant exceeds the volume of the third region SP3, the excessive volume of liquid refrigerant accumulates in the first region SP1 and the second region SP2. Consequently, the gas-liquid interface GLI is located in the first region SP1 and the second region SP2. The second region SP2 and the third region SP3 serve as a passage through which refrigerant flowing from the inlet 2a reaches the first region SP1 and the outlet 3a.

[0042] In Fig. 6, the shielding plate 4 is connected to the upper end portion of the container body 1A. However, the shielding plate 4 may be connected to a lateral surface of the container body 1A. For example, the shielding plate 4 may be connected to an inner lateral surface of the container body 1A through a hook attached to the inner lateral surface of the container body 1A.

[0043] The shielding plate 4 may be provided with a through hole through which the outflow pipe 3 passes. When the inflow pipe 2A is inserted from the lateral surface of the container body 1A, the outflow pipe 3 passes through the through hole and reaches the first region SP1. Accordingly, it is possible to locate the outlet 3a in the first region SP1. In this case, the inflow pipe 2A may be inserted into the second region SP2 from the upper end portion of the container body 1A, or may be inserted into the second region SP2 from the lateral surface of the container body 1A.

Inflow pipe 2A

[0044] As illustrated in Fig. 7, in the configuration of the present embodiment, the shielding plate 4 separates the inflow pipe 2A from the outflow pipe 3. With this configuration, liquid refrigerant is prevented from directly flowing into the outlet 3a from the inlet 2a. Liquid droplets are generated on the gas-liquid interface GLI in the second region SP2 due to ripples of the liquid refrigerant flowing out from the inlet 2a and dropping to the gas-liquid interface GLI. Thus, there is no likelihood that the liquid droplets reach the outlet 3a located in the first region SP1 partitioned off by the shielding plate 4. For this reason, in the present embodiment, it is allowable that the inlet 2a and the outlet 3a are not greatly distanced from each other, or the flow rate of refrigerant flowing into the container body 1A is not decreased. Therefore, as illustrated in Figs. 6 and 7, it is allowable that the inflow pipe 2A does not have the bent portion 2b.

[0045] The refrigerant reservoir container 101A according to the present embodiment includes the shielding plate 4 provided in the container body 1A. The shielding plate 4 partitions the interior of the container body 1A into the first region SP1 that is an inner space where the outlet 3a of the outflow pipe 3 is located, and the second region SP2 where the inlet 2a of the inflow pipe 2A is located. The third region SP3 is formed between the lower end portion of the shielding plate 4 and the bottom of the container body 1A. The first region SP1 and the second region SP2 connect to the third region SP3.

[0046] In this configuration, the inlet 2a is separated from the outlet 3a by the shielding plate 4. Accordingly, it is possible to restrain liquid refrigerant flowing out from the inlet 2a from flowing into the outlet 3a. The container body 1A has a cylindrical shape, and thus can reserve an increased volume of liquid refrigerant compared to a container body with a truncated conical shape, provided that the container body with the truncated conical shape and the container body 1A both have the same height and the same cross-sectional area of the bottom. Further, the shielding plate 4 is provided in the container body 1A with a cylindrical shape. Thus, even when the gas-liquid interface GLI becomes close to the outlet 3a in distance, the cross-sectional area on the gas-liquid interface GLI near the outlet 3a is still smaller than the cross-sectional area of the bottom of the container body 1A. Therefore, even when the gas-liquid interface GLI becomes close to the outlet 3a in distance, ripples are generated still in a small area over the gas-liquid interface GLI. This can reduce the volume of scattering liquid droplets.

[0047] In the refrigerant reservoir container 101A according to the present embodiment, the shielding plate 4 has a hollow truncated conical shape widening from the upper end portion of the container body 1A towards the bottom, and being open on a top base and a bottom base. The first region SP1 is an inner space surrounded by the shielding plate 4, while the second region SP2 is a space between the lateral surface of the container body 1A and the shielding plate 4. This configuration can be obtained by solely connecting the shielding plate 4 with a hollow truncated conical shape to the container body 1A with a cylindrical shape, and thus does not complicate the manufacturing process of the refrigerant reservoir container 101A.

Embodiment 3

[0048] A shielding plate 4A of a refrigerant reservoir container 101B according to the present embodiment is different in configuration from the shielding plate 4 in Embodiment 2. The shielding plate 4A in the present embodiment is described below, mainly focusing on the differences from the shielding plate 4 in Embodiment 2. Note that in the refrigeration cycle device 100 in Embodiment 1, the refrigerant reservoir container 101 according to Embodiment 1 can be replaced with the refrigerant reservoir container 101B according to the present embodiment. The configuration of the refrigeration cycle device 100, other than the refrigerant reservoir container, is the same as that in Embodiment 1, and therefore descriptions of the configuration are omitted. The same constituent elements as those in Embodiments 1 and 2 are denoted by the same reference signs, and descriptions thereof are appropriately omitted.

Shielding plate 4A

[0049] With reference to Figs. 8 to 10, the shielding plate 4A is described below. Fig. 8 is a front view of the refrigerant reservoir container 101B according to Embodiment 3. The solid-line arrows in Fig. 8 conceptually illustrate a refrigerant flow. Fig. 9 is a sectional view illustrating the B-B cross section of Fig. 8. Fig. 10 is a sectional view illustrating the C-C cross section of Fig. 8. As illustrated in Figs. 8 and 10, the shielding plate 4A has a plurality of through holes 6. Each of the through holes 6 has, for example, a round shape. Each of the through holes 6 may have an elliptical shape. All of the plurality of through holes 6 do not necessarily have the same shape or the same size. Note that in the container body 1A in the present embodiment, the B-B cross section illustrated in Fig. 8, in which the through holes 6 are not provided, is identical to the A-A cross section of the container body 1A illustrated in Fig. 6 in Embodiment 2. Therefore, Figs. 7 and 9 illustrate the identical cross-sectional view.

[0050] As illustrated in Fig. 8, the plurality of through holes 6 are provided at the same height position in the up-down direction of the container body 1A. As illustrated in Fig. 10, the plurality of through holes 6 are provided in the circumferential direction of the shielding plate 4A. Note that while Fig. 10 illustrates two through holes 6, it is sufficient that one or more through holes 6 are provided. In the up-down direction of the container body 1A, another through hole 6 may be provided at a different height position in addition to the plurality of through holes

6 provided at the same height position.

[0051] In the container body 1A, the volume of accumulating liquid refrigerant that exceeds the volume of the third region SP3 accumulates in the first region SP1 and the second region SP2. When the liquid refrigerant accumulates in the first region SP1, the second region SP2, and the third region SP3, the pressure in the second region SP2 is higher than the pressure in the first region SP1. This causes pulsation of the refrigerant between the first region SP1 and the second region SP2. However, since the shielding plate 4 is provided with the through holes 6 in the present embodiment, gas refrigerant flows into the first region SP1 from the second region SP2 through the through holes 6. This suppresses an increase in the pressure in the second region SP2. Therefore, pulsation of the refrigerant between the first region SP1 and the second region SP2 is suppressed.

[0052] In the refrigerant reservoir container 101B according to the present embodiment, the shielding plate 4A has the through holes 6, and the first region SP1 and the second region SP2 communicate with each other through the through holes 6. With this configuration, gas refrigerant flowing into the second region SP2 passes through the through holes 6 and enters the first region SP1. This reduces variations in the pressure in the container body 1A, and as a consequence, suppresses pulsation of the refrigerant.

[0053] In the refrigerant reservoir container 101B according to the present embodiment, the shielding plate 4A has the plurality of through holes 6. At least two or more of the plurality of through holes 6 are provided at the same height position in the up-down direction of the container body 1A. With this configuration, gas refrigerant flows more efficiently from the second region SP2 to the first region SP1, compared to a configuration in which the through holes 6 are arranged in a line in the up-down direction of the container body 1A.

[0054] While Embodiments 1 to 3 have been described above, the refrigerant reservoir containers 101, 101A, and 101B, and the refrigeration cycle device 100 are not limited to Embodiments 1 to 3 described above. Various modifications and applications can be made without departing from the summary of the present disclosure. For example, the refrigerant reservoir container may employ a configuration in which the container body 1 in Embodiment 1 is provided with the shielding plate 4 in Embodiment 2. For another example, the refrigerant reservoir container may employ a configuration in which the container body 1A in Embodiment 2 is provided with the inflow pipe 2 in Embodiment 1. Embodiments 1 to 3 can be combined with each other within the range not impairing the functions or structures of each of Embodiments 1 to 3.

Reference Signs List

[0055] 1: container body, 1A: container body, 2: inflow pipe, 2A: inflow pipe, 2a: inlet, : 2b: bent portion, 3: outflow pipe, 3a: outlet, 4: shielding plate, 4A: shielding plate, 6: through hole, 10: compressor, 11: flow switching device, 12: outdoor heat exchanger, 13: expansion mechanism, 14: indoor heat exchanger, 15: refrigerant pipe, 100: refrigeration cycle device, 101: refrigerant reservoir container, 101A: refrigerant reservoir container, 101B: refrigerant reservoir container, 200: refrigerant circuit, GLI: gas-liquid interface, VC: virtual container body, HPt1: first height position, HPt2: second height position, HPt3: third height position, L1: first reference line, L2: second reference line, L3: third reference line, XPt1: first point, XPt2: second point, XPt3: third point, XPt4: fourth point, XPt5: fifth point, SP1: first region, SP2: second region, SP3: third region

Claims

1. A refrigerant reservoir container, comprising:

a container body reserving refrigerant;
an inflow pipe inserted into an upper space of the container body, the inflow pipe having an inlet through which the refrigerant flows into the container body; and
an outflow pipe inserted into the upper space of the container body, the outflow pipe having an outlet through which the refrigerant flows out from the container body,
wherein a cross-sectional area of an inner space of the container body where the outlet of the outflow pipe is located is larger towards a bottom of the container body and away from the outlet.

2. The refrigerant reservoir container of claim 1,

wherein the inflow pipe and the outflow pipe are inserted from an upper end portion of the container body, and
the inlet of the inflow pipe is located on a lower side relative to the outlet of the outflow pipe.

3. The refrigerant reservoir container of claim 1 or 2, comprising a shielding plate provided in the container body,

wherein the shielding plate partitions an interior of the container body into a first region being the inner space where the outlet of the outflow pipe is located, and a second region where the inlet of the inflow pipe is located,
a third region is formed between a lower end portion of the shielding plate and the bottom of the container body, and
the first region and the second region connect to the third region.

4. The refrigerant reservoir container of claim 3,

wherein the shielding plate has a hollow truncated conical shape widening from an upper end portion of the container body towards the bottom, and being open on a top base and a bottom base,
the first region is an inner space surrounded by the shielding plate, and
the second region is a space between a lateral surface of the container body and the shielding plate.

5. The refrigerant reservoir container of claim 3 or 4,

wherein the shielding plate has a through hole, and
the first region and the second region communicate with each other through the through hole.

6. The refrigerant reservoir container of claim 5,

wherein the shielding plate has a plurality of the through holes, and
at least two or more of the plurality of the through holes are provided at a same height position in an up-down direction of the container body.

7. A refrigeration cycle device comprising:

the refrigerant reservoir container of any one of claims 1 to 6; and
a compressor connected to the refrigerant reservoir container through the outflow pipe.

FIG. 1

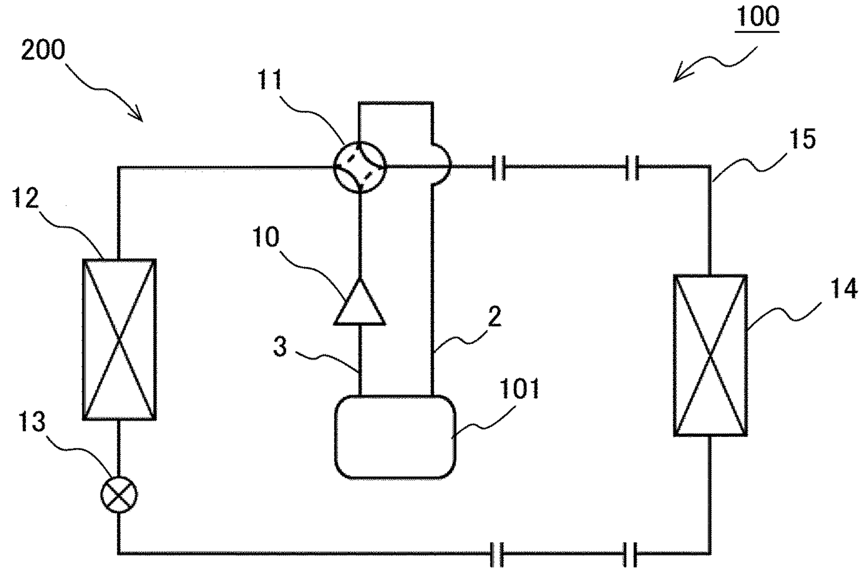


FIG. 2

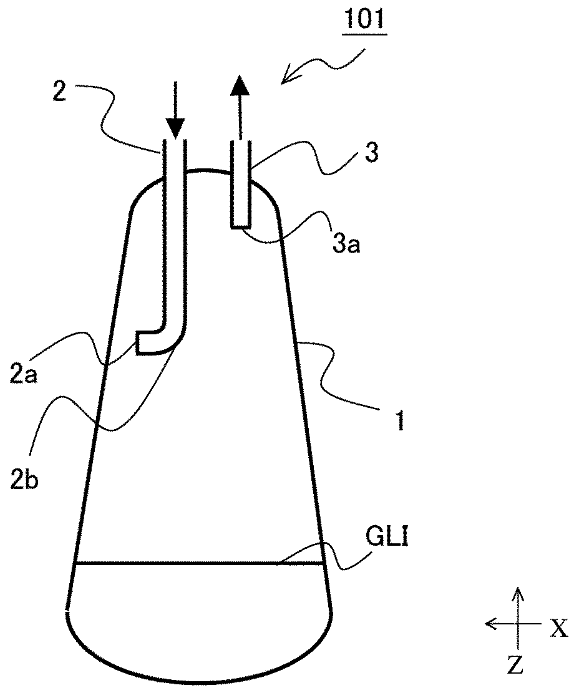


FIG. 3

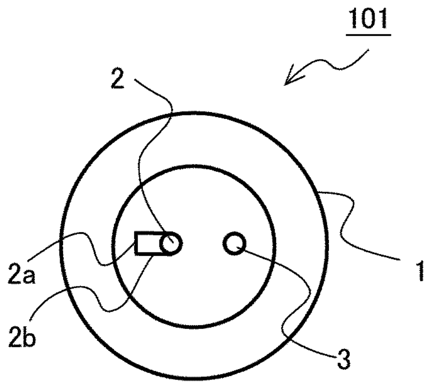

101
2
2a
2b
1
3

FIG. 4

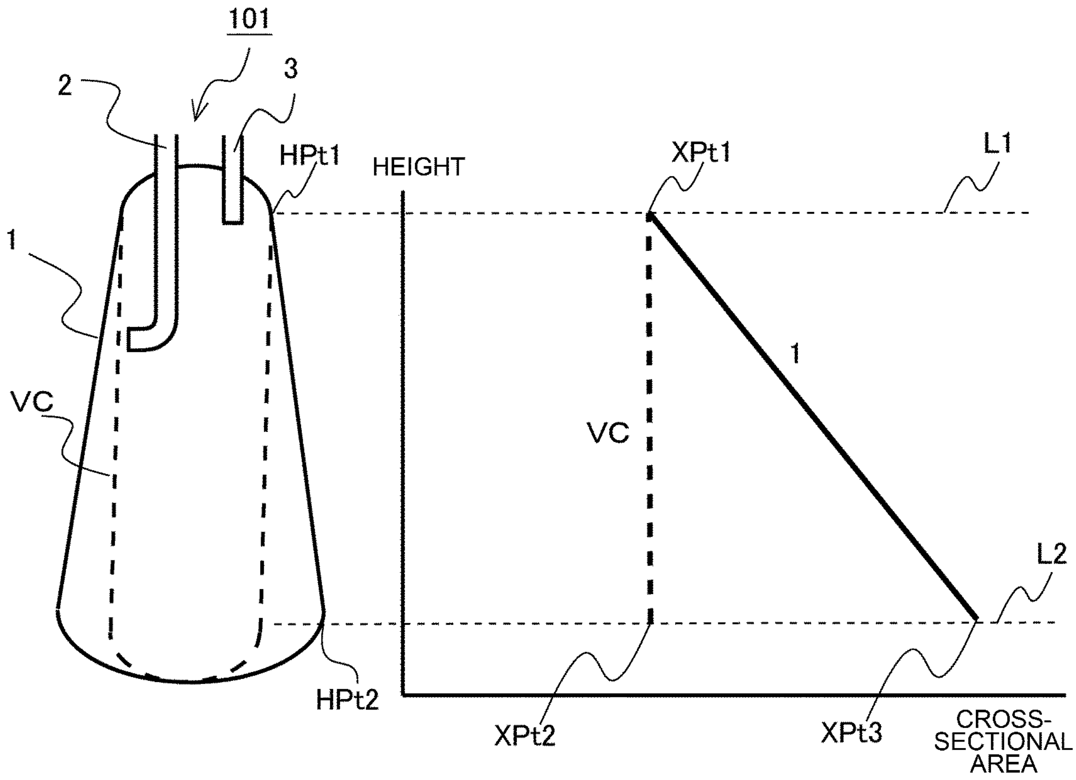

101
2
3
HPt1
1
VC
HPt2
HEIGHT
XPt1
L1
1
VC
L2
XPt2
XPt3
CROSS-
SECTIONAL
AREA

FIG. 5

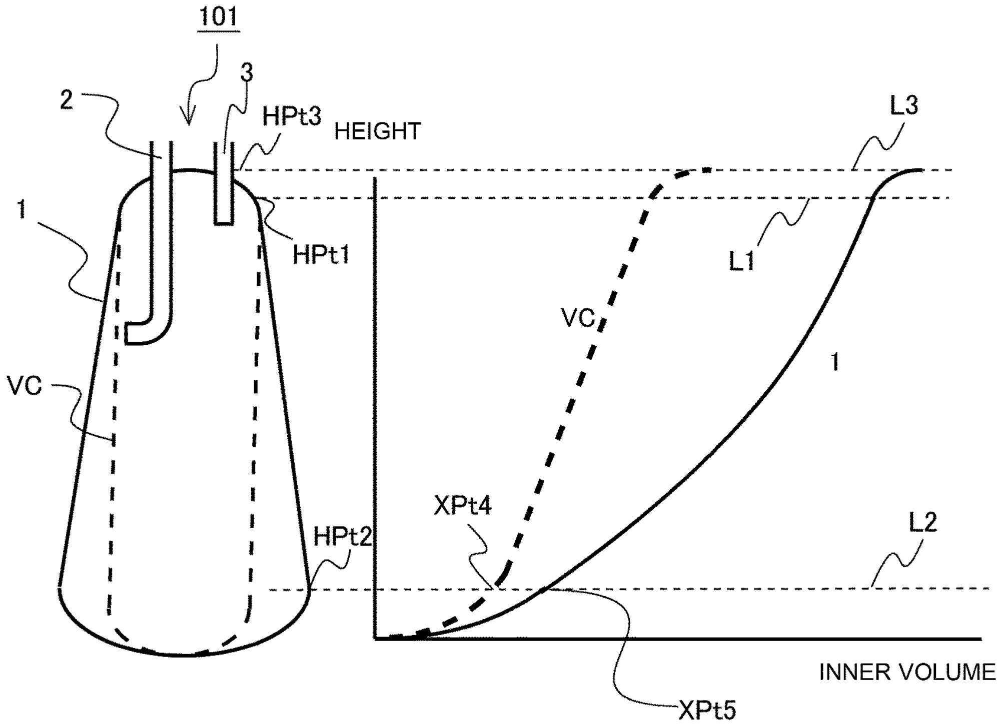

101
2
3
HPt3
HEIGHT
L3
1
HPt1
L1
VC
VC
1
XPt4
HPt2
L2
INNER VOLUME
XPt5

FIG. 6

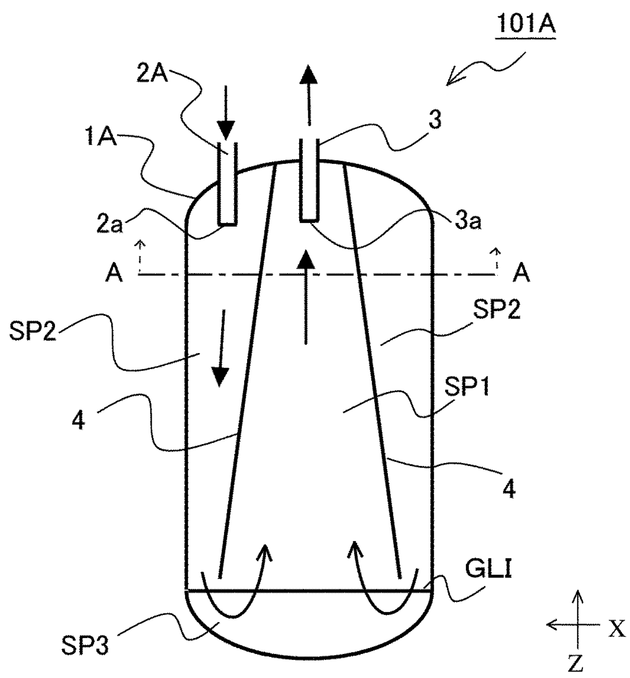

101A
2A
3
1A
2a
3a
A
A
SP2
SP2
SP1
4
4
GLI
SP3
X
Z

FIG. 7

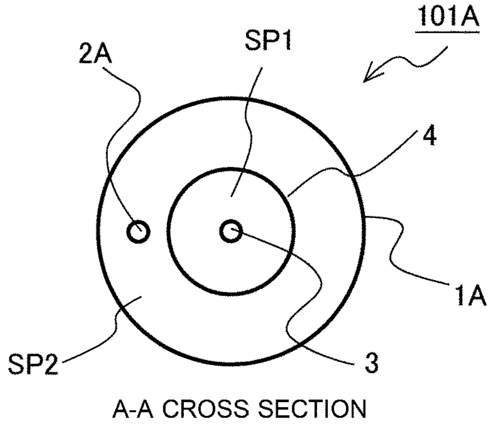
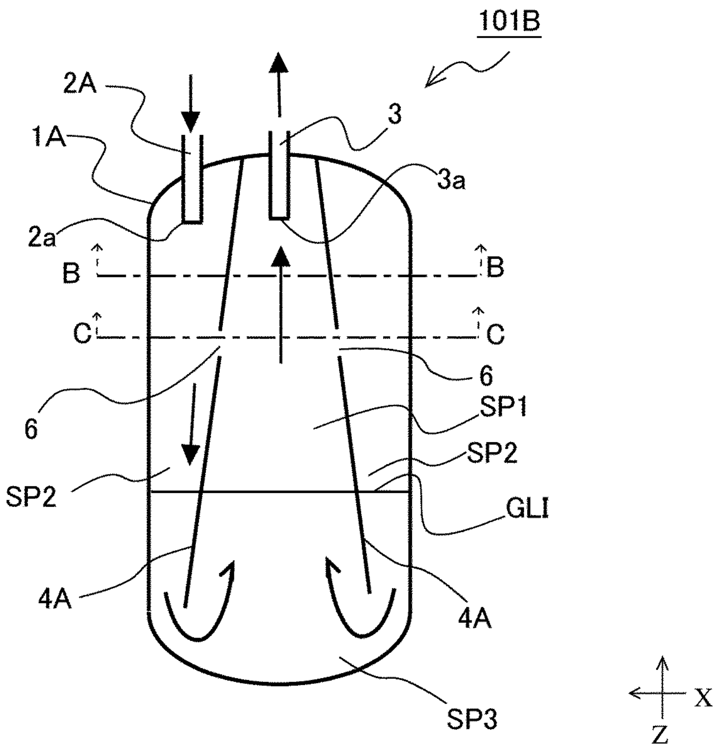

101A
2A
SP1
4
1A
3
SP2
A-A CROSS SECTION

FIG. 8


101B
2A
1A
3
3a
2a
B
B
C
C
6
6
SP1
SP2
SP2
GLI
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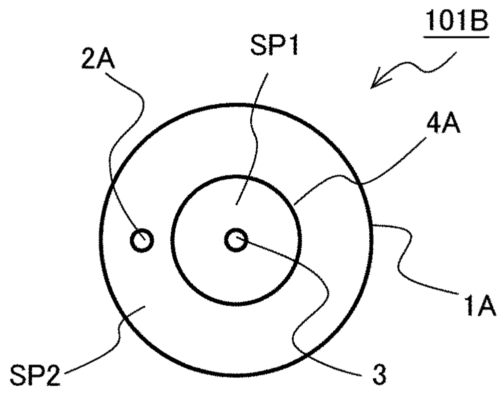
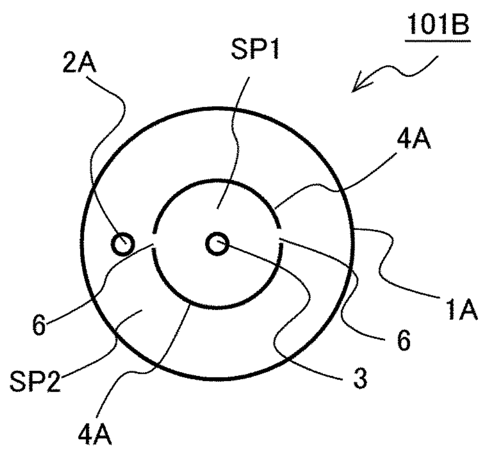
SP3
X
Z

FIG. 9



B-B CROSS SECTION

FIG. 10



C-C CROSS SECTION

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2021/027919

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F25B43/00(2006.01)i
FI: F25B43/00D

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)
Int.Cl. F25B43/00

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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.
X Y	JP 2003-222445 A (DENSO CORP.) 08 August 2003 (2003-08-08), paragraphs [0021]-[0031], fig. 1, 2	1, 7 2
X Y	JP 60-162172 A (MITSUBISHI ELECTRIC CORP.) 23 August 1985 (1985-08-23), page 3, upper left column, line 9 to page 4, lower left column, line 12, fig. 3, 4	1, 3-4, 7 2, 5-6
Y	JP 10-62037 A (MITSUBISHI ELECTRIC CORP.) 06 March 1998 (1998-03-06), fig. 1, 3	2
Y	JP 2008-249242 A (SHOWA DENKO KK) 16 October 2008 (2008-10-16), fig. 1-5	5-6
Y	JP 2008-151374 A (SANDEN CORPORATION) 03 July 2008 (2008-07-03), fig. 4	5-6

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

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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
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"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
24 August 2021	31 August 2021

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

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/027919

JP 2003-222445 A	08 August 2003	(Family: none)
JP 60-162172 A	23 August 1985	(Family: none)
JP 10-62037 A	06 March 1998	(Family: none)
JP 2008-249242 A	16 October 2008	(Family: none)
JP 2008-151374 A	03 July 2008	(Family: none)

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015172469 A **[0003]**