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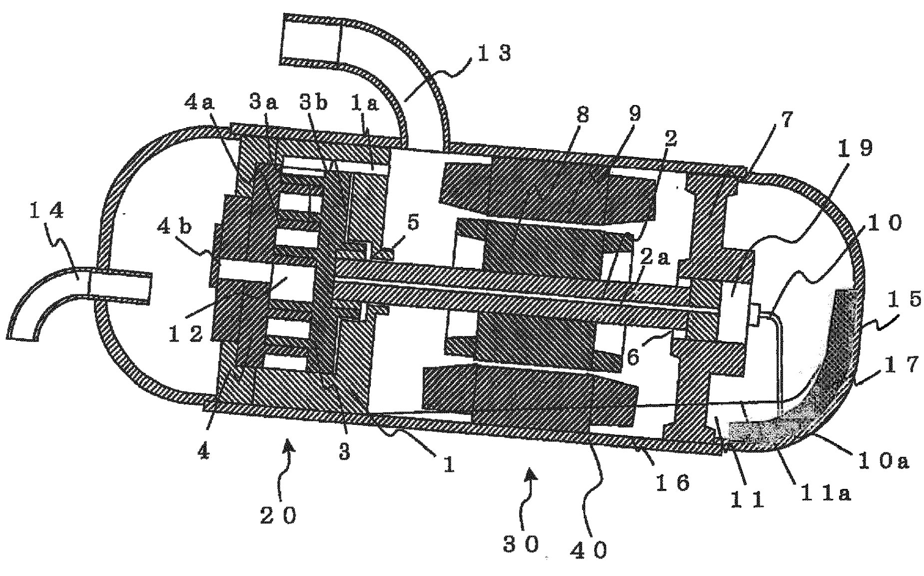
(54) **Compressor**

(57) It is an object to provide a compressor which can supply a relatively large amount of oil while preventing shortage of the oil. The compressor includes a sealed container (40), a rotary shaft (2) supported in the sealed container (40), a compression mechanism (20) that compresses a refrigerant upon rotation of the rotary shaft (2), an oil supply conduit (2a) that is formed inside the rotary shaft (2), and allows the oil supplied to the compression mechanism (20) to flow through it, an oil reservoir (11 provided inside the sealed container (40) in its lower portion, oil retaining means (17) having a part disposed in the oil reservoir (11) and the remaining part disposed in the gas space above the oil reservoir (11), and containing a large number of voids to retain the oil, and an oil supply pipe (10) having its one port connected to the oil supply conduit (2a), and its other port disposed in the oil reservoir (11).

FIG. 1



EP 2 884 106 A1

Description

Technical Field

[0001] The present invention relates to a compressor employed in, for example, refrigerating apparatuses and air-conditioning apparatuses.

Background Art

[0002] Conventional compressors typically include those configured to draw by suction lubricating oil, stored in an oil reservoir provided in the bottom portion of a container, using an oil pump through an oil supply pipe, and supply the lubricating oil to sliding portions through oil supply conduits.

[0003] In such a compressor, for example, when the apparatus on which the compressor is installed is in operation, the surface of the oil in the oil reservoir oscillates due to vibration transmitted from the apparatus or vibration of the compressor itself. Therefore, the suction port of the oil supply pipe is prone to be exposed on the oil surface, which often leads to short supply of the oil.

[0004] Patent Literature 1 discloses a scroll compressor that includes an oil supply means including an oil supply member having its lower end portion dipped in the lubricating oil in the oil reservoir, so as to draw the lubricating oil up by suction by the capillary effect and supply the lubricating oil to the key of the scroll of an Oldham's coupling from the upper end portion of the oil supply member.

[0005] In addition, Patent Literature 2 discloses a horizontal vibration compressor including a flexible and permeable oil suction pipe, having at least a part dipped in an oil reservoir and connected to a low-pressure chamber in the main body of the compressor. The oil suction pipe includes a metal wire for maintaining the shape of this pipe, and has its free end which is fixed to the metal wire and has its opening blocked.

List of Citations

Patent Literature

[0006]

Patent Literature Japanese Unexamined Patent Application Publication JP-A-2009-162 078

Patent Literature 2 Japanese Unexamined Patent Application Publication JP-A-2011-094 569

Summary of Invention

Technical Problem

[0007] To prevent short supply of the oil in the conventional compressors cited above, it is possible to store a relatively large amount of oil in the oil reservoir. In this case, however, the rotor is dipped in the oil reservoir, and hence the oil may splash inside the container and bubbles may be generated owing to foaming resulting from a sharp decrease in pressure in the container incurred, for example, upon activation of the compressor, and, as a result, a larger amount of oil is distributed in the space inside the container. Therefore, the amount of oil contained in the discharged refrigerant is relatively large, which leads to temporary shortage of the oil.

[0008] Further, the compressors according to Patent Literatures 1 and 2 utilize a capillary force instead of pump power, and therefore oil may not be supplied in sufficient amounts.

[0009] The present invention has been made in order to solve the foregoing problems, and has as its object to provide a compressor configured to supply a relatively large amount of oil while preventing shortage of the oil.

Solution to the Problem

[0010] In an aspect, the present invention provides a compressor including a container, a rotary shaft supported in the container, a compression mechanism that compresses a refrigerant upon rotation of the rotary shaft, an oil supply conduit that is formed inside the rotary shaft, and allows oil supplied to the compression mechanism to flow therethrough, an oil reservoir provided inside the container in a lower portion thereof, oil retaining means having a part disposed in the oil reservoir and the other part disposed in a gas space above the oil reservoir, oil retaining means containing a large number of voids to retain the oil, and an oil supply pipe having its one port connected to the oil supply conduit, and its other port disposed in the oil reservoir.

Advantageous Effects of the Invention

[0011] According to the present invention, even though the oil surface falls to a level lower than that of the other port because of a decrease in amount of oil or vibration, the oil can be stably supplied to the compression mechanism through the oil supply pipe. It is, therefore, possible to achieve a compressor which can supply a relatively large amount of oil while preventing shortage of the oil.

Brief Description of the Drawings

[0012]

- FIG. 1 is a cross-sectional view showing an exemplary configuration of a compressor according to Embodiment 1 of the present invention.
- FIG. 2 is a cross-sectional view showing an exemplary configuration of an oil reservoir 11 and surrounding parts of a popular vertical compressor.
- FIG. 3 is a schematic diagram for explaining how to define the direction and angle of tilt of a horizontal compressor.
- FIG. 4 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of a compressor according to Embodiment 2 of the present invention.
- FIG. 5 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of a compressor according to a modification to Embodiment 2 of the present invention.
- FIG. 6 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of a compressor according to Embodiment 3 of the present invention.
- FIG. 7 is a perspective view showing an exemplary configuration of a cover 18 around an oil supply pipe 10 in the compressor according to a modification to Embodiment 3 of the present invention.
- FIG. 8 is a perspective view showing an exemplary configuration of the cover 18 around the oil supply pipe 10 in a compressor according to Embodiment 4 of the present invention.
- FIG. 9 is a perspective view showing an exemplary configuration of the cover 18 around the oil supply pipe 10 in a compressor according to Embodiment 5 of the present invention.
- FIG. 10 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of a compressor according to Embodiment 6 of the present invention.
- FIG. 11 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of a compressor according to Embodiment 7 of the present invention.
- FIG. 12 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11, a subframe 7, and surrounding parts of a compressor according to Embodiment 8 of the present invention.
- FIG. 13 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11, the subframe 7, and surrounding parts of a compressor according to Embodiment 9 of the present invention.
- FIG. 14 is a cross-sectional view showing an exemplary configuration of oil retaining means 17 of a compressor according to Embodiment 10 of the present invention.

Description of Embodiments

Embodiment 1

[0013] A compressor according to Embodiment 1 of the present invention will be described hereinafter. FIG. 1 is a cross-sectional view showing an exemplary configuration of the compressor according to Embodiment 1. Embodiment 1 refers to a horizontal scroll compressor as an example. The compressor according to Embodiment 1 constitutes a part of a refrigeration cycle apparatus employed in, for example, an air-conditioning apparatus, a refrigerating apparatus, a refrigerator for refrigerating and keeping items cool, a freezer for freezing and keeping items frozen, an automatic vending machine, and a water heater.

[0014] In FIG. 1 and other drawings, the dimensional ratios or shapes of constituent components may be different from the actual ones.

[0015] As shown in FIG. 1, the compressor according to Embodiment 1 includes a compression mechanism 20 that compresses a refrigerant, an electric motor mechanism 30 that drives the compression mechanism 20, and a sealed container 40 (exemplifying the container in the present invention) accommodating the compression mechanism 20 and the electric motor mechanism 30.

[0016] A suction pipe 13 for introducing a refrigerant with a low pressure from the outside, and a discharge pipe 14 for discharging to the outside the refrigerant as compressed to a high pressure are attached to the sealed container 40. The compression mechanism 20 is disposed so as to divide the space inside the sealed container 40 into a space on the side of the suction pipe 13 (suction space) and a space on the side of the discharge pipe 14 (discharge space). The electric motor mechanism 30 and an oil reservoir 11 (to be described later) are located in the suction space.

[0017] The compression mechanism 20 is covered with a main frame 1 fixed to the sealed container 40. The compression mechanism 20 includes an oscillating scroll 3 attached to a rotary shaft 2 to be rotated by the electric motor mechanism 30, and a fixed scroll 4 fixed to the main frame 1. The oscillating scroll 3 includes a scroll lap 3a formed on its one face, and the fixed scroll 4 includes a scroll lap 4a formed on its one face.

[0018] The oscillating scroll 3 and the fixed scroll 4 are oriented such that the scroll laps 3a and 4a mesh with each other. Accordingly, a plurality of compression chambers 12 partitioned from each other by the scroll lap 3a or 4a are provided between the oscillating scroll 3 and the fixed scroll 4.

[0019] The surface of the oscillating scroll 3 opposite to the surface, with the scroll lap 3a, of the oscillating scroll 3 serves as a thrust surface 3b which abuts against a thrust bearing provided between the thrust surface 3b and the main frame 1. The rotary shaft 2 is rotatably supported by a main bearing 5 attached to the main frame 1, and a sub bearing 6 attached to a subframe 7. The subframe 7 is fixed to the sealed container 40. Note that FIG. 1 does not illustrate the detailed configuration and position of the main bearing 5 and the sub bearing 6.

[0020] A rotor 8 of the electric motor mechanism 30 is attached to a portion of the rotary shaft 2 between the main bearing 5 and the sub bearing 6. A stator 9 of the electric motor mechanism 30 is attached to the sealed container 40, so as to cover the outer periphery of the rotor 8. The rotary shaft 2 includes an oil supply conduit 2a formed in it. An oil reservoir 11 in which the oil is stored is provided between the end portion of the rotary shaft 2 on the side of the subframe 7 and the inner surface of the sealed container 40 (for example, a bottom portion 15 or a side face 16). The oil supply pipe 10 has its one port connected to the end portion of the oil supply conduit 2a on the side of the subframe 7.

[0021] A suction port 10a, that is, the other port of the oil supply pipe 10 is dipped in the oil within the oil reservoir 11 and connected to oil retaining means 17 (to be described later) at a position lower than an oil surface 11a (for example, the suction port 10a is covered with the oil retaining means 17). That is, the oil supply pipe 10 extends from the end portion of the oil supply conduit 2a (the end portion of the rotary shaft 2) to the oil retaining means 17.

[0022] Further, an oil pump 19 is provided at the end portion of the oil supply conduit 2a on the side of the subframe 7. The oil pump 19 serves to draw up the oil in the oil reservoir 11 through the oil supply pipe 10 and supply it to each sliding portion through the oil supply conduit 2a. Note that although the oil pump 19 is provided at the end portion of the oil supply conduit 2a on the side of the subframe 7 in Embodiment 1, the oil pump 19 may be provided on the side of the main frame 1. In addition, various known pumps can be employed as the oil pump 19.

[0023] When power is supplied to the electric motor mechanism 30, a torque is applied to the rotor 8 so as to rotate the rotary shaft 2, and the oscillating scroll 3 oscillates with respect to the fixed scroll 4. With this operation, the refrigerant is compressed in the compression chambers 12. In this process, the low-pressure refrigerant and the oil flow into the sealed container 40 through the suction pipe 13.

[0024] A certain component of the thus introduced oil passes through the sealed container 40 and is stored in the oil reservoir 11, and the remainder of the oil and oil droplets that have splashed from the oil reservoir 11 flow into the compression chamber 12, together with the refrigerant, through a refrigerant suction hole 1a provided in the main frame 1. The high-pressure refrigerant and the oil compressed in the compression chamber 12 are discharged to the outside of the compressor through a discharge hole 4b formed in the fixed scroll 4 and through the discharge pipe 14.

[0025] The oil stored in the oil reservoir 11 is drawn by suction by the oil pump 19 provided in the oil supply conduit 2a from the suction port 10a of the oil supply pipe 10, and supplied to each sliding portion in the compressor (for example, the thrust surface 3b (thrust bearing), the main bearing 5, and the sub bearing 6) through the oil supply conduit 2a. This lubricates the sliding portions in the compressor, and thus prevents them from suffering a seizure. The oil that has lubricated the sliding portions is returned to the oil reservoir 11 through predetermined lubricant paths.

[0026] FIG. 2 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of a popular vertical compressor. In FIG. 2, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor shown in FIG. 1. As shown in FIG. 2, in the vertical compressor the oil reservoir 11 is formed on the bottom portion 15 of the sealed container 40 upon fall (or downflow) of the oil due to gravity. In most types of vertical compressors, further, the oil supply pipe 10 straightly extends vertically downwards from the connection point at the end portion of the oil supply conduit 2a on the side of the subframe 7, and the suction port 10a at the lower end is dipped in the oil within the oil reservoir 11.

[0027] How to define the direction and angle of tilt of the horizontal compressor will be described hereinafter. FIG. 3 is a schematic diagram for explaining how to define the direction and angle of tilt of the horizontal compressor. As shown in FIG. 3, the direction in which the rotary shaft 2 rotates (the direction of rotation about the rotary shaft 2) is defined as the θ-direction, and the angle of tilt with respect to an arbitrary set angle is defined as θ [unit: degrees or °].

[0028] In addition, the direction of tilt (elevation angle direction) of the rotary shaft 2 with respect to a horizontal plane (or a horizontal axis included in the horizontal plane) perpendicular to the gravitational direction (vertical direction) of fall is defined as the α-direction, and the thus measured angle of tilt (angle of elevation) is defined as α [unit: degrees or °]. The angle of tilt α is defined to be 0° when the rotary shaft 2 is set horizontal, positive when the end portion of the rotary shaft 2 on the side of the oscillating scroll 3 is elevated, and negative when the end portion of the rotary shaft 2 on the side of the bottom portion 15 is elevated.

[0029] The horizontal compressor according to Embodiment 1 is typically installed in practice and ready to use such that the main body of the compressor (sealed container 40) is tilted at an angle of tilt θ of 0° to 360° ($0° \leq \theta < 360°$), and at an angle of tilt α of 0° to 90° ($0° \leq \alpha < 90°$).

[0030] As shown in FIG. 1, in the horizontal compressor, the oil reservoir 11 formed on the inner surface of the sealed container 40 is positioned on the side of the lower, side face 16 due to gravity. For this reason, the oil supply pipe 10 is bent vertically downwards in the horizontal compressor, so as to dip the suction port 10a at the lower end in the oil within the oil reservoir 11.

[0031] Since the oil reservoir 11 is positioned on the side of the side face 16 in the horizontal compressor, the height of the oil surface 11a, which is defined vertically upwards from the suction port 10a, is more likely to be low. On the other hand, when the flow rate of the refrigerant increases or when the refrigerant dissolved in the oil evaporates to form bubbles at the time of activating the compressor, the oil splashes inside the sealed container 40.

[0032] As a result, a large amount of oil enters the refrigerant suction hole 1a and the oil is taken out of the compressor. When the oil is taken out of the compressor, the oil surface 11a often falls below the suction port 10a, and therefore the oil is less likely to be supplied to the sliding portions in sufficient amounts. Even when the amount of oil introduced into the oil reservoir 11 is increased so as to, in turn, increase the amount of oil stored in the oil reservoir 11 and thereby elevate the oil surface 11a, the rotor 8 is dipped in the oil within the oil reservoir 11, and therefore the oil splashes in the sealed container 40 when the rotor 8 is driven and similarly the oil is more likely to be taken out of the compressor.

[0033] Accordingly, most types of horizontal compressors are formed larger in diameter of the sealed container 40 than the vertical compressor, to increase the amount of oil corresponding to the height of the oil surface 11a. However, to increase the diameter of the sealed container 40, the compression mechanism 20 and the electric motor mechanism 30 have to be redesigned in accordance with the structure of the sealed container 40. Therefore, the vertical compressor and the horizontal compressor are manufactured using different processes, and hence cannot be manufactured through the same manufacturing line.

[0034] Referring back to FIG. 1, since the compressor according to Embodiment 1 is the horizontal compressor tilted at angles of tilt θ and α that satisfy $0° \leq \theta < 360°$ and $0° \leq \alpha < 90°$, respectively, the oil reservoir 11 is positioned on the side of the side face 16 of the sealed container 40 due to gravity. The oil supply pipe 10 is bent so as to dip the suction port 10a in the oil within the oil reservoir 11 which is positioned on the side of the side face 16.

[0035] The suction port 10a is located in the vicinity of the lowermost portion in the oil reservoir 11. The oil reservoir 11 in the sealed container 40 includes the oil retaining means 17 configured to retain the oil. The oil retaining means 17 according to Embodiment 1 is attached to extend along the shapes of the bottom portion 15 and the side face 16. A part of the oil retaining means 17 is dipped in the oil within the oil reservoir 11, and its remaining part is disposed in a gas space above the oil reservoir 11.

[0036] In addition, the oil retaining means 17 is attached so as to cover the suction port 10a of the oil supply pipe 10, or disposed so as to enclose the suction port 10a with a gap formed between them. The oil retaining means 17 has an internal structure with a large number of voids, such as a porous (continuous porous), cotton-like, grid, or net-like structure. At least a part of the surface of the oil retaining means 17 (for example, its entire surface) disposed in contact with the oil is formed of a lipophilic material. Accordingly, the oil retaining means 17 is capable of absorbing the oil in the oil reservoir 11 by the capillary effect, and retaining the absorbed oil.

[0037] Since the suction port 10a of the oil supply pipe 10 is connected to the oil retaining means 17 disposed in the oil reservoir 11, the oil is collected around the suction port 10a due to the capillary effect. Therefore, even though the oil surface 11a falls below the suction port 10a, the oil drawn by suction through the suction port 10a can be prevented from decreasing, and hence short supply of the oil to the sliding portions can be prevented.

[0038] The aforementioned configuration eliminates the need to increase the diameter of the container of the horizontal compressor to increase the amount of oil stored (initial amount of oil charged), and allows the vertical compressor to be converted into a horizontal compressor with a simple structural conversion method. More specifically, the diameter of the container of the horizontal compressor can be kept small, and the horizontal compressor and the vertical compressor can be manufactured through the same manufacturing line.

[0039] For example, the vertical compressor can be converted into a horizontal compressor simply by removing the bottom portion 15 of the sealed container 40 or attaching, before mounting the bottom portion 15 in the manufacturing process, the oil supply pipe 10 bent in a different direction (or bending the oil supply pipe 10), attaching the oil retaining means 17 to the bottom portion 15 or the side face 16, and then mounting the bottom portion 15 onto the sealed container 40.

[0040] In addition, since there is no need to increase the amount of oil stored in the horizontal compressor, the oil can be prevented from splashing inside the container because the rotor is dipped in the oil within the oil reservoir. Therefore, degradation in efficiency of the refrigeration cycle due to an increase in amount of oil in the discharged refrigerant can be suppressed.

[0041] When the apparatus on which the compressor is installed is in operation, the oil surface 11a oscillates due to movement or vibration of the compressor. Accordingly, the suction port 10a may be exposed from the oil reservoir 11, or the oil surface 11a may come into contact with the rotor 8 so that the oil splashes inside the sealed container 40 and is discharged together with the refrigerant. However, the compressor according to Embodiment 1 allows the oil retained by the oil retaining means 17 to be drawn by suction through the suction port 10a even in the aforementioned occasions, thereby preventing short supply of the oil to the sliding portions.

[0042] As described above, the compressor according to Embodiment 1 includes the sealed container 40, the rotary shaft 2 supported in the sealed container 40, the compression mechanism 20 that compresses the refrigerant upon rotation of the rotary shaft 2, the oil supply conduit 2a that is formed inside the rotary shaft 2, and allows the oil supplied to the compression mechanism 20 to flow through it, the oil reservoir 11 provided inside the sealed container 40 in its lower portion, the oil retaining means 17 having a part disposed in the oil reservoir 11, and the remaining part disposed in the gas space above the oil reservoir 11, and containing a large number of voids to retain the oil, and the oil supply pipe 10 having its one port connected to the oil supply conduit 2a, and its other port (suction port 10a) disposed in the oil reservoir 11.

[0043] In addition, the sealed container 40 of the compressor according to Embodiment 1 is disposed such that the rotary shaft 2 is tilted with respect to the vertical direction, and the oil supply pipe 10 is bent such that the suction port 10a faces downwards in the gravitational direction and is located in the vicinity of the lowermost portion of the oil reservoir 11.

[0044] The aforementioned configuration allows the oil to be collected in the oil retaining means 17 located around the suction port 10a, thereby preventing a decrease in amount of oil drawn by suction through the suction port 10a, and allowing stable supply of the oil to the sliding portions, even when the oil surface 11a falls below the suction port 10a due, for example, to a decrease in level of the oil surface 11a or vibration.

[0045] Therefore, the amount of oil supplied can be increased while preventing shortage of the oil. This makes it possible to provide a highly reliable and durable compressor that prevents a failure in lubrication due to shortage of lubricating oil and damage to the bearing resulting from shortage of the lubricating oil. In addition, the configuration of Embodiment 1 achieves a wide allowable range of the initial amount of oil charged into the compressor to be extended, thereby facilitating the adjustment of the initial amount of oil charged.

[0046] Further, the foregoing configuration allows the vertical compressor to be converted into a horizontal compressor with a simple structural conversion process that does not require significant redesigning of the manufacturing process, thereby making it possible to manufacture the vertical compressor and the horizontal compressor through the same manufacturing line.

Embodiment 2

[0047] A compressor according to Embodiment 2 of the present invention will be described hereinafter. FIG. 4 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of the compressor according to Embodiment 2. In FIG. 4, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0048] As shown in FIG. 4, in the compressor according to Embodiment 2, the oil retaining means 17 covers the suction port 10a and is provided on almost the entire bottom portion 15 of the sealed container 40. A part of the oil retaining means 17 is dipped in the oil within the oil reservoir 11, and its remaining part is disposed in the gas space above the oil reservoir 11. The oil supply pipe 10 is bent such that the suction port 10a faces vertically downwards, that is, faces the oil reservoir 11. The suction port 10a is located near the lowermost position in the oil reservoir 11.

[0049] The aforementioned configuration allows the oil to be collected in the oil retaining means 17 not only around the oil supply pipe 10 but also over a broad region of the bottom portion 15, thereby increasing the upper limit of the amount of oil stored in the compressor. Further, since the oil retaining means 17 is fitted with the structure of the bottom portion 15, the oil retaining means 17 can be fixed to the sealed container 40 even without an adhesive or the like.

[0050] FIG. 5 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of a compressor according to a modification to Embodiment 2. In this modification, for example, the oil retaining means 17 is formed of a highly lipophilic material. The oil supply pipe 10 is not bent vertically downwards but linearly extends in the axial direction. In the configuration according to this modification, since the oil retaining means 17 is formed of a highly lipophilic material, the oil can be distributed over the entire oil retaining means 17.

[0051] Accordingly, a sufficient amount of oil is collected around the suction port 10a and hence a sufficient amount of oil can be supplied, without the need to bend the oil supply pipe 10 vertically downwards. More specifically, the configuration according to this modification eliminates the need to change the orientation of the oil supply pipe 10 according to the direction and angle of tilt, despite the tilt of the compressor in a given direction at a given angle.

[0052] Therefore, the compressor of the same configuration can be used both as a horizontal compressor tilted at a desired angle of tilt θ of 0° to 360° (0° ≤ θ < 360°) and a desired angle of tilt α of 0° to 90° (0° ≤ α < 90°), and a vertical compressor that is tilted at an angle of tilt α of 90°, in other words, that stands upright.

Embodiment 3

[0053] A compressor according to Embodiment 3 of the present invention will be described hereinafter. FIG. 6 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of the compressor according to Embodiment 3. In FIG. 6, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0054] As shown in FIG. 6, the compressor according to Embodiment 3 includes a cover 18 that covers the oil retaining means 17. The suction port 10a of the oil supply pipe 10 is inserted in the oil retaining means 17 via a through hole (not shown) formed in the cover 18. In other words, the cover 18 is disposed so as to cover the oil retaining means 17 except for the portion in which the oil supply pipe 10 is introduced. The inserted outer peripheral surface of the suction port 10a is fixed, using an adhesive, to the cover 18 without a gap between them.

[0055] The end portion of the cover 18 is fixed to the bottom portion 15 or the side face 16 of the sealed container 40 in close contact with it. The cover 18 includes an opening 18a formed in its portion dipped in the oil within the oil reservoir 11, so as to introduce the oil. The opening 18a may be a through hole formed in the cover 18, or a notch formed in a portion of the cover 18 joined to the bottom portion 15 or the side face 16.

[0056] The cover 18 according to Embodiment 3 tightly seals the oil retaining means 17 between itself and the inner surface of the sealed container 40, except for the through hole through which the suction port 10a is inserted and the opening 18a. For example, a cotton-like or porous member may be employed to form the oil retaining means 17.

[0057] As described above, the compressor according to Embodiment 3 further includes the cover 18 that covers the oil retaining means 17 except for the portion, in which the oil supply pipe 10 is introduced, and is fixed to the oil reservoir 11. The cover 18 includes the opening 18a formed in its portion dipped in the oil within the oil reservoir 11.

[0058] With the aforementioned configuration, the oil retaining means 17 can be covered with the cover 18 and fixed inside the sealed container 40, thereby eliminating the need to provide a means for directly fixing the oil retaining means 17 itself to the sealed container 40, and thus suppressing a positional shift of the oil retaining means 17 resulting from movement or vibration of the compressor.

[0059] In addition, a portion of the cover 18 disposed in contact with the refrigerant gas (for example, a portion above the oil surface 11a) is tightly closed. Accordingly, the internal pressure of the cover 18 (its portion on the side of the oil retaining means 17) drops because of the drawing force of the oil pump 19 provided in the oil supply conduit 2a, and therefore the oil in the oil reservoir 11 can be introduced through the opening 18a. As a result, the amount of refrigerant gas contained in the oil retaining means 17 can be reduced and the amount of oil retained can be increased.

[0060] Further, the oil supply pipe 10 has a small diameter and hence easily flexes. Accordingly, if the suction port 10a is not fixed, vibration is transmitted to the oil supply pipe 10 through the rotary shaft 2 and the subframe 7 upon the operation of the electric motor mechanism 30, so that the oil supply pipe 10 may resonate depending on the rotation frequency, and largely vibrate.

[0061] Therefore, the oil in the oil reservoir 11 and the oil retaining means 17 is stirred up around the oil supply pipe 10 and spreads inside the sealed container 40, and, as a result, a larger amount of oil enters the refrigerant suction hole 1a together with the refrigerant. However, since the distal end of the oil supply pipe 10 (suction port 10a) is fixed to the cover 18 in Embodiment 3, the resonation of the oil supply pipe 10 can be prevented, and therefore the oil can be prevented from being stirred up by the vibration.

[0062] FIG. 7 is a perspective view showing an exemplary configuration of the cover 18 around the oil supply pipe 10 in the compressor according to a modification to Embodiment 3. As shown in FIG. 7, the cover 18 may include a plurality of small openings 18b penetrating through it between its surface on the side of the oil retaining means 17 and its surface, on the side of the gas space, which is opposite to the former.

[0063] With the aforementioned arrangement, the small openings 18b allow, even though the gas dissolved in the oil has evaporated, the gas to be driven out from the inside of the cover 18, thereby maintaining the amount of oil retained by the oil retaining means 17. Since the openings 18b have a small diameter, the drop of the internal pressure of the cover 18 (its portion on the side of the oil retaining means 17) due to the drawing force of the oil pump 19 can be maintained, which allows the oil in the oil reservoir 11 to be introduced through the opening 18a.

Embodiment 4

[0064] A compressor according to Embodiment 4 of the present invention will be described hereinafter. FIG. 8 is a perspective view showing an exemplary configuration of the cover 18 around the oil supply pipe 10 in the compressor according to Embodiment 4. In FIG. 8, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0065] As shown in FIG. 8, the cover 18 includes an opening 18c which is formed around the oil supply pipe 10 and has a diameter larger than the outer diameter of the oil supply pipe 10. In addition, the oil retaining means 17 includes a cylindrical opening 17c which is formed around the oil supply pipe 10 and has a diameter larger than the outer diameter of the oil supply pipe 10. Because of the presence of the openings 17c and 18c, the oil retaining means 17 and the cover 18 covering its upper face are disposed so as to surround the oil supply pipe 10 with a gap between them.

[0066] When the gas dissolved in the oil evaporates, for example, at the time of activating the compressor, the gas collects on the lower face of the cover 18, thereby forming a high-pressure portion. Accordingly, the oil retained by the oil retaining means 17 is pushed out to the low-pressure space (gap) around the oil supply pipe 10. Therefore, the configuration shown in FIG. 8 can raise the level of the oil surface 11 a around the oil supply pipe 10, thereby preventing short supply of the oil resulting from a sudden fall of the oil surface.

Embodiment 5

[0067] A compressor according to Embodiment 5 of the present invention will be described hereinafter. FIG. 9 is a perspective view showing an exemplary configuration of the cover 18 around the oil supply pipe 10 in the compressor according to Embodiment 5. In FIG. 9, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0068] As shown in FIG. 9, the oil retaining means 17 includes the cylindrical opening 17c which is formed around the oil supply pipe 10 and has a diameter larger than the outer diameter of the oil supply pipe 10. Because of the presence of the opening 17c, the oil retaining means 17 is disposed so as to surround the oil supply pipe 10 with a gap between them. The surface of the oil retaining means 17, which surrounds the oil supply pipe 10, is covered with a cylindrical cover 21.

[0069] The cover 21 includes one or a plurality of openings 21a that allow the oil to be introduced from the side of the oil retaining means 17 into the space on the side of the inner circumferential surface of the cover 21. The opening 21a may be a through hole formed in the cover 21, or a notch formed in a portion of the cover 21 joined to the bottom portion 15 or the side face 16.

[0070] With the aforementioned configuration, the cover 21 can interrupt the oil flow when the oil surface 11a in the compressor fluctuates due to acceleration, deceleration, or a sudden change in tilt, to thereby suppress drastic fluctuation of the oil surface 11a in the region between the oil supply pipe 10 and the cover 21.

Embodiment 6

[0071] A compressor according to Embodiment 6 of the present invention will be described hereinafter. FIG. 10 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of the compressor according to Embodiment 6. In FIG. 10, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0072] In Embodiment 6, the oil retaining means 17 is formed of a hard member such as a metal including, for example, a foamed metal plate or a foamed metal block. In other words, the oil retaining means 17 is formed of a member capable of maintaining its shape without the need to be supported by the cover. The oil retaining means 17 is fixed to the bottom portion 15 or the side face 16 of the sealed container 40 using a predetermined fixing tool. The suction port 10a of the oil supply pipe 10 is directly fixed to the oil retaining means 17.

[0073] More specifically, in the compressor according to Embodiment 6, the oil retaining means 17 is fixed to the wall surface (for example, the bottom portion 15 or the side face 16) of the sealed container 40. In addition, the oil retaining means 17 of the compressor according to Embodiment 6 is formed of a metal-based member capable of maintaining its shape, and the suction port 10a of the oil supply pipe 10 is fixed by the oil retaining means 17. According to Embodiment 6, as in Embodiment 3, vibration of the oil supply pipe 10 caused by the rotational operation can be suppressed to prevent oil from splashing inside the sealed container 40.

[0074] In Embodiment 6, the oil supply pipe 10 may have a plurality of bends in the path between its contact end portion on the side of the subframe 7 and the suction port 10a, with the suction port 10a of the oil supply pipe 10 being maintained inside the oil retaining means 17. Such a configuration can shift the natural frequency of the oil supply pipe 10 and tightly fix the oil supply pipe 10 to the oil retaining means 17, thereby more efficiently suppressing vibration of the oil supply pipe 10.

Embodiment 7

[0075] A compressor according to Embodiment 7 of the present invention will be described hereinafter. FIG. 11 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11 and surrounding parts of the compressor according to Embodiment 7. In FIG. 11, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0076] In Embodiment 7, the oil retaining means 17 is connected to the oil supply pipe 10 so as to cover its periphery. The oil retaining means 17 is fixed to the outer peripheral portion of the oil supply pipe 10. In Embodiment 7, most of the oil supply pipe 10 (at least its half) in the axial direction is covered with the oil retaining means 17. At least a part of the oil retaining means 17 is dipped in the oil within the oil reservoir 11.

[0077] The aforementioned configuration allows the oil retaining means 17 and the oil supply pipe 10 to be installed in and removed from the compressor as a unified member, thereby facilitating the manufacturing and the maintenance work of the compressor.

Embodiment 8

[0078] A compressor according to Embodiment 8 of the present invention will be described hereinafter. FIG. 12 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11, the subframe 7, and surrounding parts of a compressor according to Embodiment 8 of the present invention. In FIG. 12, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0079] In Embodiment 8, the oil retaining means 17 is formed on the surface of the subframe 7 on the side of the oil supply pipe 10 (on the side of the bottom portion 15). The oil retaining means 17 covers almost the entire surface of the subframe 7 on the side of the oil supply pipe 10, and is fixed to this surface. At least a part of the oil retaining means 17 is dipped in the oil within the oil reservoir 11.

[0080] The oil retaining means 17 is connected to the oil supply pipe 10 so as to cover the suction port 10a of the oil supply pipe 10 or surround the suction port 10a with a gap between them. Further, openings or gaps that connect the space in the subframe 7 on the side of the oil supply pipe 10 and the space on the side of the electric motor mechanism 30 are covered with the oil retaining means 17 fixed to the surface of the subframe 7 on the side of the oil supply pipe 10.

[0081] More specifically, the compressor according to Embodiment 8 also includes the subframe 7 that supports the end portion of the rotary shaft 2 on the side of the oil supply pipe 10, and the oil retaining means 17 is provided on the surface of the subframe 7 on the side of the oil supply pipe 10.

[0082] With the aforementioned configuration, the oil retaining means 17 can interrupt gas flow between the space on the side of the electric motor mechanism 30 and the space on the side of the oil supply pipe 10 through openings or gaps of the subframe 7, thereby preventing oscillation of the oil surface 11a resulting from strong gas flow.

Embodiment 9

[0083] A compressor according to Embodiment 9 of the present invention will be described hereinafter. FIG. 13 is a cross-sectional view showing an exemplary configuration of the oil reservoir 11, the subframe 7, and surrounding parts of a compressor according to Embodiment 9. In FIG. 13, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0084] In Embodiment 9, oil retaining means 17a covers a region including the bottom portion 15 and a part of the side face 16 in the vicinity of a surface 7a of the subframe 7 on the side of the electric motor mechanism 30 (on the side of the compression mechanism 20), and oil retaining means 17b covers the surface 7a of the subframe 7 on the side of the electric motor mechanism 30.

[0085] The oil retaining means 17b covers an area, surrounding the sub bearing 6, of the surface 7a in noncontact with the portion to be rotated. The oil retaining means 17a provided on the bottom portion 15 and the side face 16 and the oil retaining means 17b provided on the subframe 7 are integrally connected to or in contact with each other.

[0086] More specifically, the compressor according to Embodiment 9 also includes the subframe 7 that supports the end portion of the rotary shaft 2 on the side of the oil supply pipe 10, and the oil retaining means 17a and 17b extend to the portion of the subframe 7 on the side of the compression mechanism 20 along the side face 16 of the sealed container 40, and further cover the surface 7a of the subframe 7 on the side of the compression mechanism 20.

[0087] The aforementioned configuration allows the oil stored in the oil reservoir 11 to be supplied to the sub bearing 6 of the subframe 7 from the outside through the oil retaining means 17a and 17b, thereby improving the lubrication performance for the sliding surface of the sub bearing 6.

[0088] Further, since the oil can be supplied to the sub bearing 6 without passing through the oil supply conduit 2a, the sub bearing 6 can be lubricated even though a compressor without the oil path to supply the oil to the sub bearing 6 through the oil supply conduit 2a. Therefore, the technique adopted in the present invention can be applied to a broader range of products in Embodiment 9 than in other configurations.

Embodiment 10

[0089] A compressor according to Embodiment 10 of the present invention will be described hereinafter. FIG. 14 is a cross-sectional view showing an exemplary configuration of the oil retaining means 17 of a compressor according to Embodiment 10. In FIG. 14, the same reference numerals denote constituent components having the same functions and providing the same effects as those in the compressor according to Embodiment 1, and a description thereof will not be repeated.

[0090] In Embodiment 10, the porosity of the oil retaining means 17 has a stepwise or continuous spatial variation, and takes smaller values in areas farther from its upper portion and closer to its lower portion. For example, the oil retaining means 17 may include a first layer 17d, a second layer 17e, and a third layer 17f stacked in this order from the upper side to the lower side. The porosity of the second layer 17e is lower than that of the first layer 17d, and the porosity of the third layer 17f is still lower than that of the second layer 17e.

[0091] The oil retaining means 17 is disposed such that at least the third layer 17f is dipped in the oil within the oil reservoir 11. The suction port 10a of the oil supply pipe 10 is connected, for example, to the third layer 17f.

[0092] With the aforementioned configuration, since oil tends to concentrate in a region where the porosity is relatively low because of surface tension, the downward migration of the oil retained in the upper portion of the oil retaining means 17 can be speeded up when the oil surface 11a suddenly drops. Therefore, the oil can be quickly supplied to the oil reservoir 11 from the upper portion of the oil retaining means 17 when the oil surface 11a suddenly drops, which more reliably prevents shortage of the oil.

Other Embodiments

[0093] The present invention may be modified in various forms without limitations to Embodiments.

[0094] For example, although the foregoing description assumes the horizontal compressor tilted at an angle of tilt α in the range of $0° \leq \alpha < 90°$, the present invention is also applicable to a vertical compressor ($\alpha = 90°$).

[0095] Although the foregoing description assumes the scroll compressor, the present invention is also applicable to compressors other than the scroll compressor.

[0096] Further, although the foregoing description assumes the fully sealed compressor, the present invention is also applicable to a semi-sealed compressor or an open compressor.

[0097] In addition, Embodiments and the modifications thereof may be adopted in desired combinations.

List of Reference Signs

[0098]

1 = main frame
1a = refrigerant suction hole
2 = rotary shaft
2a = oil supply conduit
3 = oscillating scroll
3a = scroll lap
4a = scroll lap
3b = thrust surface
4 = fixed scroll
4b = discharge hole
5 = main bearing
6 = sub bearing
7 = subframe
7a = surface
8 = rotor
9 = stator
10 = oil supply pipe
10a = suction port

11 = oil reservoir
11a = oil surface
12 = compression chamber
13 = suction pipe
14 = discharge pipe
15 = bottom portion
16 = side face
17 = oil retaining means
17a = oil retaining means
17b = oil retaining means
17c = opening
17d = first layer
17e = second layer
17f = third layer
18 = cover
18a = opening
18b = opening
18c = opening
19 = oil pump
20 = compression mechanism
21 = cover
21a = opening
30 = electric motor mechanism
40 = sealed container

Claims

1. A compressor comprising:

- a container (40);
- a rotary shaft (2) supported in the container (40);
- a compression mechanism (20) that is adapted to compress a refrigerant upon rotation of the rotary shaft (2);
- an oil supply conduit (2a) that is formed inside the rotary shaft (2), and is adapted to allow oil supplied to the compression mechanism (20) to flow therethrough;
- an oil reservoir (11) provided inside the container (40) in a lower portion thereof;
- oil retaining means (17) having a part disposed in the oil reservoir (11) and another part disposed in a gas space above the oil reservoir (11), the oil retaining means (17) containing a large number of voids to retain the oil; and
- an oil supply pipe (10) having one port thereof connected to the oil supply conduit (2a), and another port (10a) thereof disposed in the oil reservoir (11).

2. The compressor according to claim 1,
wherein the container (40) is tilted such that the rotary shaft (2) is tilted with respect to a vertical direction, and the oil supply pipe (10) is bent such that the other port (10a) thereof faces downwards in a gravitational direction and located in vicinity of a lowermost portion of the oil reservoir (11).

3. The compressor according to claim 1 or 2,
further comprising a cover (18) that covers the oil retaining means (17) except for a portion, in which the oil supply pipe (10) is introduced, and is fixed to the oil reservoir (11),
the cover (18) having a portion thereof dipped in the oil within the oil reservoir (11), the portion including an opening (18a) that is adapted to receive the oil.

4. The compressor according to claim 3,
wherein the cover (18) is formed with a plurality of openings (18b) penetrating therethrough between a surface of the cover (18) on a side of the oil retaining means (17) and another surface of the cover (18) on a side of the gas space.

5. The compressor according to claim 3 or 4, wherein the cover (18) is formed with another opening (18c) located around the oil supply pipe (10).

6. The compressor according to claim 1 or 2,
wherein the oil retaining means (17) is fixed to a wall surface of the container (40).

7. The compressor according to claim 6,
wherein the oil retaining means (17) is formed of a metal-based member capable of maintaining a shape of the oil retaining means (17), and the other port (10a) of the oil supply pipe (10) is fixed by the oil retaining means (17).

8. The compressor according to claim 7,
wherein the oil supply pipe (10) has a plurality of bends in a path between the one port thereof and the other port (10a) thereof.

9. The compressor according to any one of claims 1 to 8,
wherein the oil retaining means (17) is fixed to an outer peripheral portion of the oil supply pipe (10).

10. The compressor according to any one of claims 1 to 9,
further comprising a frame (7) that supports an end portion of the rotary shaft (2) on a side of the oil supply pipe (10),
wherein the oil retaining means (17) is provided on a surface of the frame (7) on a side of the oil supply pipe (10).

11. The compressor according to any one of claims 1 to 9,
further comprising a frame (7) that supports an end portion of the rotary shaft (2) on a side of the oil supply pipe (10),
wherein the oil retaining means (17) extends to a surface of the frame (7) on a side of the compression mechanism (20) along a side face of the container (40), and is further formed on the surface of the frame (7) on the side of the compression mechanism (20).

12. The compressor according to any one of claims 1 to 11,
wherein a porosity of the oil retaining means (17, 17d, 17e, 17f) has a stepwise spatial variation, and takes smaller values in areas farther from an upper portion thereof and closer to a lower portion thereof.

FIG. 1

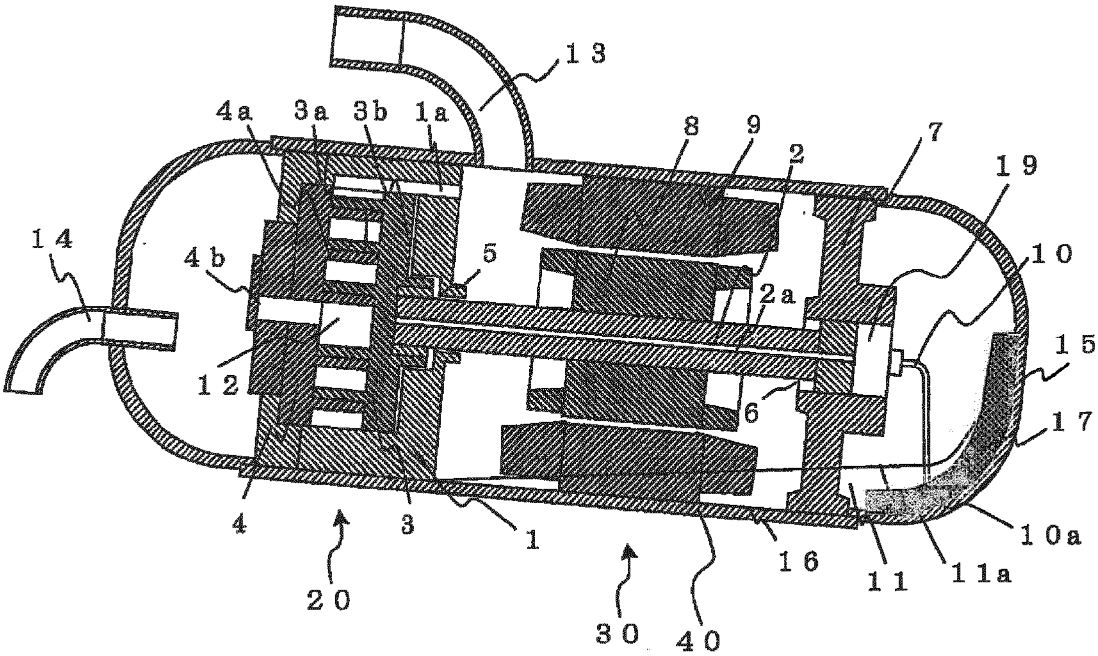
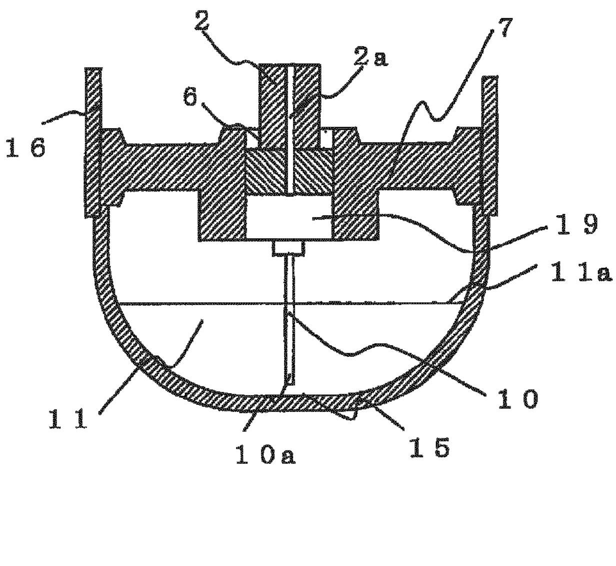

13
4a
3a
3b
1a
8
9
2
7
19
14
4b
5
2a
10
12
6
15
17
4
3
1
16
11
11a
10a
20
30
40

FIG. 2


2
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6
16
19
11a
10
11
10a
15

FIG. 3

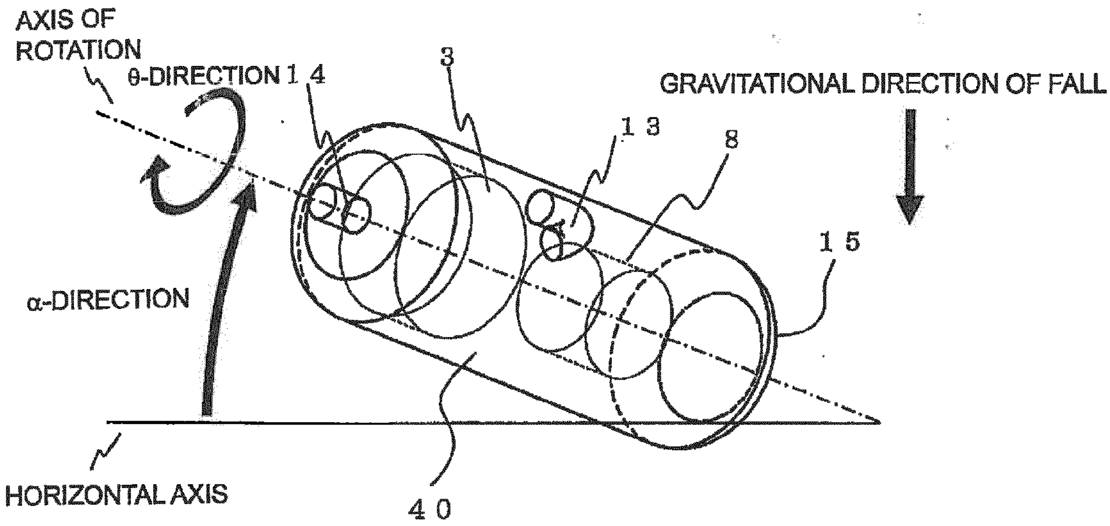
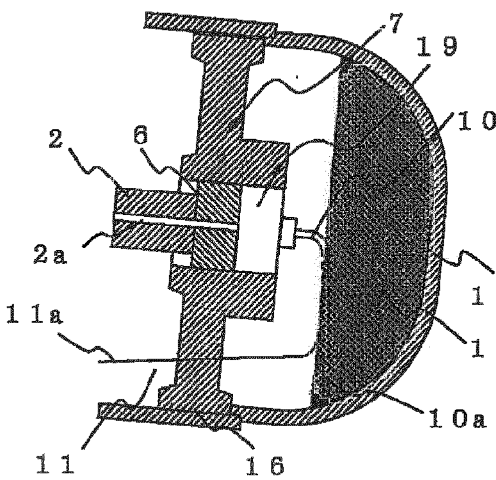

AXIS OF
ROTATION
θ-DIRECTION
14
3
GRAVITATIONAL DIRECTION OF FALL
13
8
15
α-DIRECTION
HORIZONTAL AXIS
40

FIG. 4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10a
11
16

FIG. 5

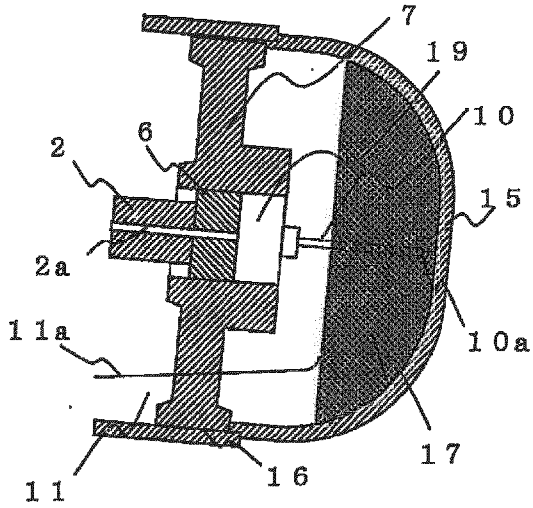


FIG. 6

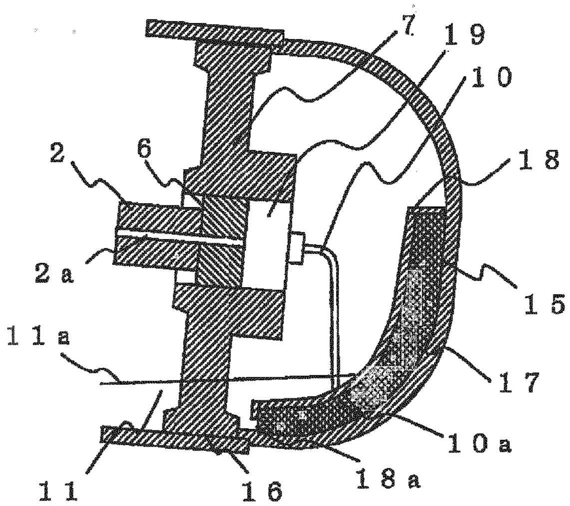


FIG. 7

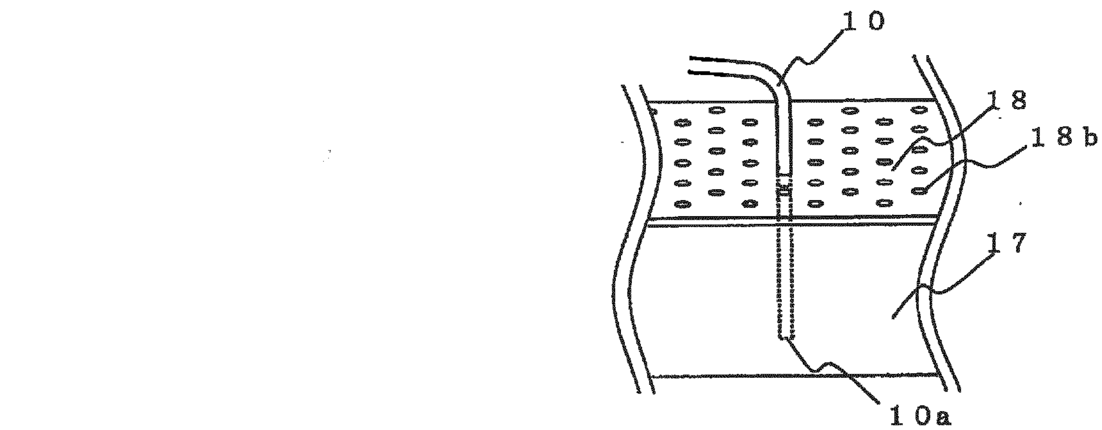


FIG. 8

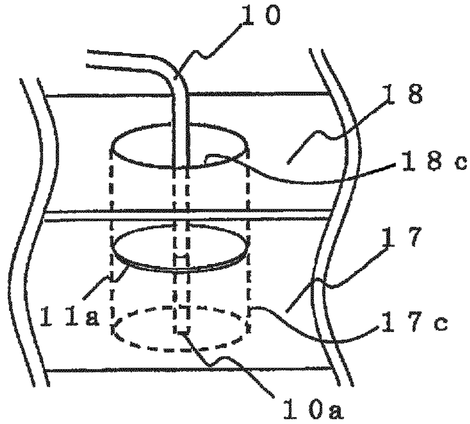


FIG. 9

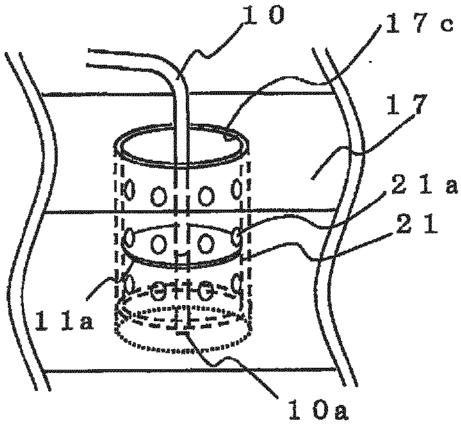


FIG. 10

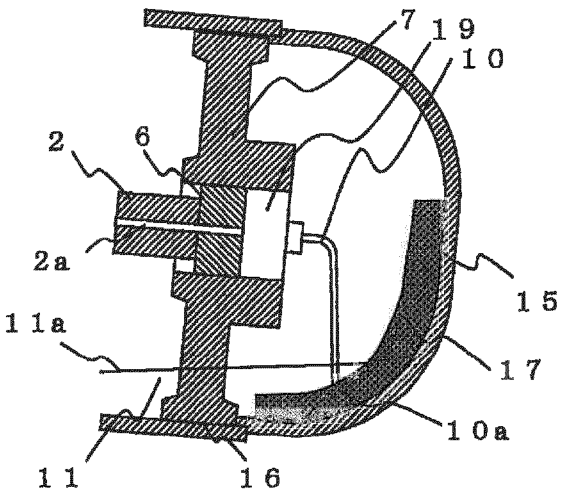


FIG. 11

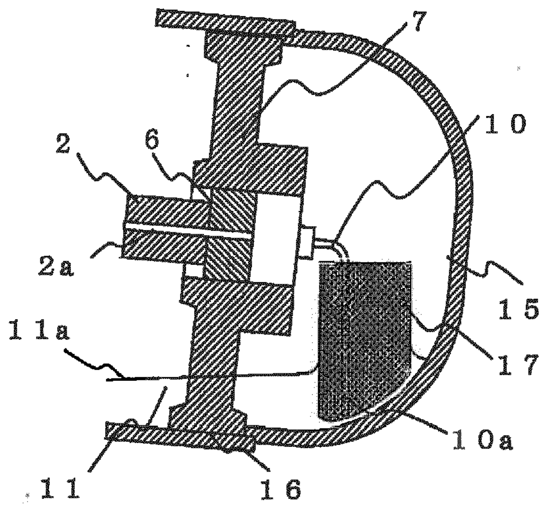
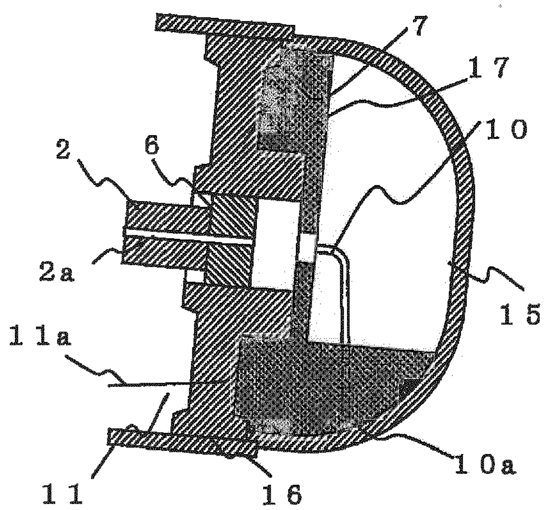


FIG. 12



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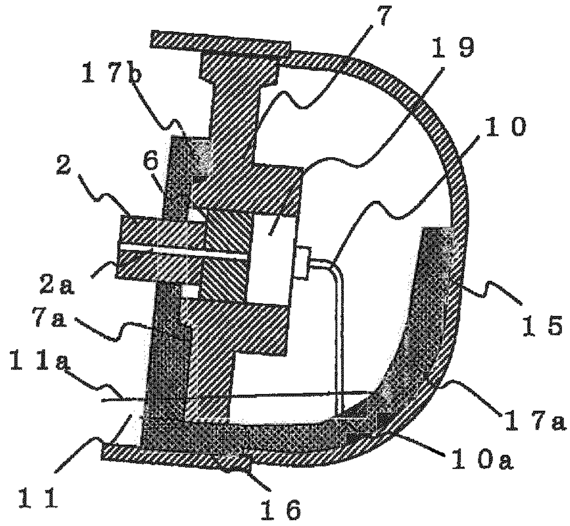
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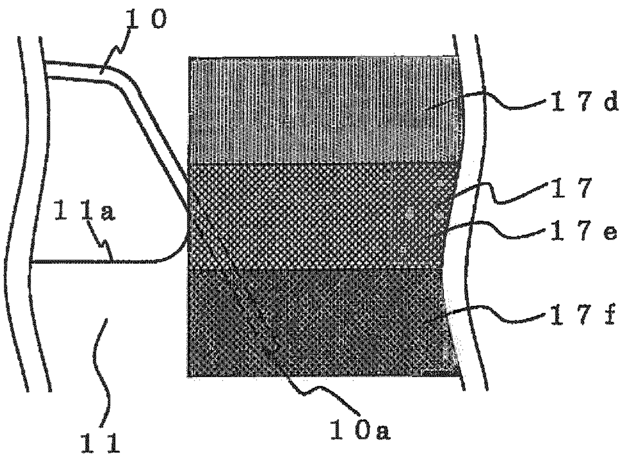
6
2a
15
7a
11a
17a
10a
11
16

F I G. 1 4


10
17d
17
11a
17e
17f
11
10a

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 6423

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	22 April 2015	Fistas, Nikolaos

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