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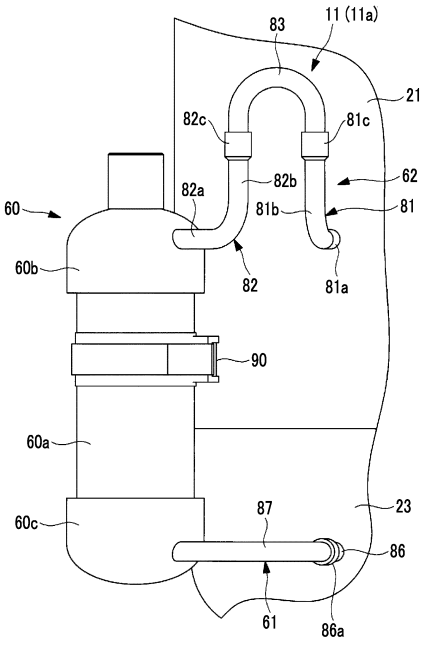
(54) COMPRESSOR

(57) This compressor comprises: an oil level tank (60) that is provided adjacent to a housing (11) and measures the height of the surface of an oil in an oil reservoir; a pressure-equalizing pipe (62) that is connected at one end to an adjacent side surface (11a) of the housing (11) and connects the housing (11) and the oil level tank (60); and a lower pipe (61) that is connected at one end to the adjacent side surface (11a) and connects the housing (11) and the oil level tank (60). The pressure-equalizing pipe (62) has a housing-side pipe (81) that is connected to the housing (11), an oil level tank-side pipe (82) that is connected to the oil level tank (60), and a U-shaped U-pipe (83) that connects the housing-side pipe (81) and the oil level tank-side pipe (82). The U-pipe (83) is inserted into the housing-side pipe (81) and the oil level tank-side pipe (82) from above.

FIG. 4



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Description

Technical Field

[0001] The present disclosure relates to a compressor.

Background Art

[0002] A sealed compressor including a compression mechanism in a housing is known. As the sealed compressor, a compressor is known in which in addition to a compressor body having a housing that forms an outer shell, another device is provided to be adjacent to the compressor body, and the compressor body and the other device are connected to each other by a pipe (for example, PTL 1).

[0003] PTL 1 discloses a compressor including a sealed container that accommodates a compression mechanism, a discharge muffler that is provided to be adjacent to the sealed container, and a discharge pressure connection pipe and an oil return pipe that connect the sealed container and the discharge muffler.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 2008-175066

Summary of Invention

Technical Problem

[0005] Since a pipe used in a compressor (particularly, a compressor using carbon dioxide as a refrigerant) is designed to have a large wall thickness so as to withstand a high pressure, the pipe is difficult to deform. For this reason, in a case where a pipe for connecting a housing of the compressor and another device adjacent to the housing (hereinafter, referred to as an "adjacent device") is provided, the pipe is difficult to absorb a tolerance of each component. Therefore, in such a compressor, there is a possibility that the tolerance of each component cannot be sufficiently absorbed, and the pipe cannot be connected to appropriate positions of the housing and the adjacent device. In particular, in a case where two or more pipes for connecting the housing and the adjacent device are provided, when any one of the pipes is attached, there is a possibility that the other pipe cannot be attached at appropriate positions due to the tolerance of each component.

[0006] In the compressor described in PTL 1, the discharge pressure connection pipe is connected to a surface (hereinafter, referred to as a "non-adjacent-side surface") of an outer peripheral surface of the sealed container that is on a side opposite to a surface adjacent to the discharge muffler (adjacent device). In such a case, since it is necessary to extend the discharge pressure connection pipe to the non-adjacent-side surface, a length of the discharge pressure connection pipe becomes long. For this reason, the tolerance of each component is more likely to be absorbed by the entire discharge pressure connection pipe as compared to a case where the discharge pressure connection pipe is short. Therefore, the discharge pressure connection pipe could be relatively easily connected to the appropriate positions of the sealed container and the discharge muffler.

[0007] Meanwhile, for various reasons, there is a case where a pipe connecting the housing and the adjacent device is connected to a surface (hereinafter, referred to as an "adjacent-side surface") of the outer peripheral surface of the housing that is adjacent to the adjacent device. In such a case, the length of the pipe is short as compared to a case where the pipe is connected to the non-adjacent-side surface. For this reason, it is difficult to absorb the tolerance of each component by the entire pipe, and thus there is a problem in that it is difficult to connect the pipe to appropriate positions of the housing and the adjacent device.

[0008] The present disclosure has been made in view of such circumstances, and an object thereof is to provide a compressor in which a pipe that connects a housing and an oil level tank can be appropriately connected to the housing and the oil level tank.

Solution to Problem

[0009] In order to solve the above problems, a compressor of the present disclosure adopts the following means.

[0010] According to an aspect of the present disclosure, there is provided a compressor including: a rotary shaft portion that is rotationally driven; a compression mechanism that is connected to one end of the rotary shaft portion and compresses a refrigerant; a housing that accommodates the rotary shaft portion and the compression mechanism and has an oil reservoir in a lower portion; an oil level tank that is provided adjacent to the housing and measures an oil level of the oil reservoir; a first connection pipe that has one end connected to an adjacent-side surface, which is a surface on a side adjacent to the oil level tank of the housing, and connects the housing and the oil level tank; and a second connection pipe that has one end connected to the adjacent-side surface and connects the housing and the oil level tank, in which the first connection pipe includes a housing-side pipe connected to the housing, an oil level tank-side pipe connected to the oil level tank, and a U-shaped pipe having a U shape that connects the housing-side pipe and the oil level tank-side pipe, the U-shaped pipe and the housing-side pipe are connected such that one of the U-shaped pipe and the housing-side pipe is inserted into the other thereof from above or below, and the U-shaped pipe and the oil level tank-side pipe are connected such that one of the U-shaped pipe and the oil

level tank-side pipe is inserted into the other thereof from above or below.

Advantageous Effects of Invention

[0011] According to the present disclosure, the pipe connecting the housing and the oil level tank can be appropriately connected to the housing and the oil level tank.

Brief Description of Drawings

[0012]

Fig. 1 is a longitudinal cross-sectional view of a compressor according to an embodiment of the present disclosure.
Fig. 2 is a longitudinal cross-sectional view showing a main part of the compressor of Fig. 1.
Fig. 3 is a cross-sectional view taken along cutting line III-III of Fig. 2.
Fig. 4 is a front view showing a main part (oil level tank) of the compressor of Fig. 1.
Fig. 5 is a plan view showing the main part (oil level tank) of the compressor of Fig. 1.
Fig. 6 is a bottom view showing the main part (oil level tank) of the compressor of Fig. 1.

Description of Embodiments

[0013] Hereinafter, an embodiment according to the present disclosure will be described with reference to the drawings.

[0014] As shown in Fig. 1, a compressor 1 is used for an air conditioner and compresses a refrigerant R, which is, for example, a gas such as carbon dioxide, in two stages. The compressor 1 is fixed to an installation surface FL via leg portions 3. The compressor 1 includes a housing 11 and includes a rotary compression mechanism 12, a scroll compression mechanism 13, an electric motor 14, and a rotary shaft (rotary shaft portion) 15, which are provided inside the housing 11.

[0015] The housing 11 has a main body portion 21 having a cylindrical shape, and an upper cover portion 22 and a lower cover portion 23 that close upper and lower openings of the main body portion 21. The inside of the housing 11 forms a sealed space.

[0016] The rotary shaft 15 is provided to extend vertically along an axis X inside the housing 11. An upper end side of the rotary shaft 15 is rotatably supported by an upper bearing 31. A lower end side of the rotary shaft 15 is rotatably supported by a lower bearing 32.

[0017] The electric motor 14 is disposed at a center of the rotary shaft 15 in a longitudinal direction and on an outer peripheral side of the rotary shaft 15, and rotates the rotary shaft 15 around the axis X. The electric motor 14 includes a rotor 38 fixed to an outer peripheral surface of the rotary shaft 15, and a stator 39 that faces the rotor 38 in a radial direction with a gap from an outer peripheral surface of the rotor 38 and that is fixed to an inner wall of the main body portion 21 of the housing 11 by shrink fitting or the like.

[0018] The rotor 38 is provided with rotor passages 38a provided at a predetermined interval in a circumferential direction. Each rotor passage 38a penetrates the rotor 38 in a vertical direction (axis X direction). The refrigerant discharged from a rotary compression mechanism 12 flows upward through the rotor passages 38a. An oil separation plate 38b is fixed to an upper portion of the rotor 38. The oil separation plate 38b has a circular plate shape and is disposed to extend in a horizontal direction. The oil separation plate 38b rotates around the axis X together with the rotor 38.

[0019] A plurality of stator passages 39a are formed in an outer periphery of the stator 39 at a predetermined angular interval in a circumferential direction (specifically, it will be described later with reference to Fig. 3).

[0020] As shown in Fig. 1, an upper coil end 39b in which a winding is folded back is located at an upper portion of the stator 39, and a lower coil end 39c in which a winding is folded back is located at a lower portion of the stator 39. The electric motor 14 is connected to a power source via an inverter (not shown) and rotates the rotary shaft 15 with a variable frequency.

[0021] The rotary compression mechanism 12 is provided on the lower end (other end) side of the rotary shaft 15 inside the housing 11. The rotary compression mechanism 12 is a two-cylinder mechanism in the present embodiment, and includes an eccentric shaft portion 41 provided in the rotary shaft 15, a rotor 42 fixed to the eccentric shaft portion 41 and rotating in a compression chamber C1 eccentrically with respect to the axis X as the rotary shaft 15 rotates, and a cylinder 44 in which the compression chamber C1 is formed.

[0022] The refrigerant R is supplied to the compression chamber C1 formed in the cylinder 44 from a suction pipe 33. The refrigerant compressed in the compression chamber C1 is discharged from a guide pipe 43 to a region below the electric motor 14 in the housing 11 via the lower bearing 32 (specifically, a discharge space formed inside the lower bearing 32).

[0023] The cylinder 44 is fixed to the lower bearing 32 from below by a bolt 48. An oil pump 49 fixed by the bolt 48 together with the cylinder 44 is provided below the cylinder 44. The oil is sucked from an oil reservoir O1 in a lower portion of the housing 11 by the oil pump 49, and is guided to the upper bearing 31 side through an oil supply hole 15a penetrating the rotary shaft 15 along the axis X.

[0024] A scroll compression mechanism 13 is disposed above the electric motor 14 inside the housing 11. The scroll compression mechanism 13 includes a fixed scroll 51 fixed to the upper bearing 31, and an orbiting scroll 57 disposed below the fixed scroll 51 to face the fixed scroll 51.

[0025] The fixed scroll 51 has an end plate 52 fixed to

an upper surface of the upper bearing 31 and a fixed wrap 53 protruding downward from the end plate 52. A discharge hole 52a vertically penetrating the end plate 52 is formed in a central portion (vicinity of the axis X) of the end plate 52.

[0026] The orbiting scroll 57 is disposed to be interposed between the upper bearing 31 and the fixed scroll 51. The orbiting scroll 57 has an end plate 58 connected to an upper end side of the rotary shaft 15 and an orbiting wrap 59 protruding upward from the end plate 58.

[0027] The end plate 58 is fixed to the eccentric shaft portion 56 provided at the upper end of the rotary shaft 15 via a bush 55, and rotates eccentrically with respect to the axis X as the rotary shaft 15 rotates.

[0028] The orbiting wrap 59 forms a compression chamber C2 for compressing the refrigerant R between the orbiting wrap 59 and the fixed wrap 53 by meshing with the fixed wrap 53.

[0029] A balance weight chamber 63 is formed between a recessed portion on a central side of the upper bearing 31 and a lower side of the orbiting scroll 57. In the balance weight chamber 63, a balance weight 54 rotates together with the rotary shaft 15.

[0030] The refrigerant R compressed by the rotary compression mechanism 12 and discharged into the housing 11 is sucked into the compression chamber C2 from an outer peripheral side of the scroll compression mechanism 13 and is compressed toward a center side. The compressed refrigerant R is discharged from a discharge pipe 34 to the outside of the housing 11 via the discharge hole 52a of the fixed scroll 51.

[0031] A cover 45 is provided below the upper bearing 31 so as to cover the upper bearing 31. The cover 45 is formed by sheet metal processing, and has a substantially conical shape that is expanded in diameter from the lower side to the upper side. An upper end of the cover 45 on an outer peripheral side is fixed to the upper bearing 31 by a bolt 45b (refer to Fig. 2).

[0032] A suction opening 45a is provided at a lower end of the cover 45. That is, the suction opening 45a faces downward and is an annular region formed between the cover 45 and the rotary shaft 15. A space below the housing 11 and a space on the upper bearing 31 side are partitioned by the cover 45, and only the refrigerant sucked from the suction opening 45a is guided to the scroll compression mechanism 13.

[0033] An oil level tank 60 is provided outside and below the housing 11. The oil level tank 60 is a hollow container and communicates with the inside of the housing 11 via a lower pipe 61 and an upper pressure equalization pipe (first connection pipe) 62. The oil level tank 60 measures an oil level of the oil reservoir O1 by guiding the oil from the oil reservoir O1 in the housing 11 via the lower pipe (second connection pipe) 61.

[0034] A downstream end of an oil separator oil return pipe 65 is connected to a lower side portion of the housing 11. An upstream end of the oil separator oil return pipe 65 is connected to an oil separator (not shown). The oil separated by the oil separator from the refrigerant discharged from the compressor 1 is returned to the oil reservoir O1 in the housing 11 via the oil separator oil return pipe 65. A height position where the downstream end of the oil separator oil return pipe 65 is connected to the housing 11 is below the lower bearing 32.

[0035] An oil return pipe 67 that is in contact with an inner wall of the housing 11 and extends in a vertical direction is provided in the housing 11. As shown in Fig. 2, an upper end (one end) of the oil return pipe 67 is fixed to the upper bearing 31 via a boss 68, and a lower end (other end) is provided to be located in the oil reservoir O1 in the lower portion of the housing 11. The lower end of the oil return pipe 67 is fixed to the inner wall of the housing 11 via a rod-shaped member 70.

[0036] The oil return pipe 67 is provided to penetrate a space formed between the stator 39 and the housing 11. Specifically, as shown in Fig. 3, cutouts are provided in the outer periphery of the stator 39 in a circumferential direction at a predetermined angular interval so that the plurality of stator passages 39a are formed with the inner wall of the housing 11. The refrigerant or the oil flows through the stator passages 39a. Two oil return pipes 67 are inserted through one or a plurality of the stator passages 39a.

[0037] As can be seen from Fig. 3, the rotor passages 38a are provided at a predetermined interval in the circumferential direction. The refrigerant discharged from a rotary compression mechanism 12 flows upward through the rotor passages 38a.

[0038] In addition, as shown in Fig. 2, a stabilizing plate 75 is fixed to a lower surface of the lower bearing 32 (refer to Fig. 1). The stabilizing plate 75 is fixed to the lower bearing 32 (specifically, a leg portion protruding in a radial direction of the lower bearing 32) by a bolt. The stabilizing plate 75 is a circular plate in which an opening is formed at the center. The stabilizing plate 75 covers an upper side of an oil surface of the oil reservoir O1 to stabilize the oil surface.

[0039] Next, the oil level tank 60, and the pressure equalization pipe 62 and the lower pipe 61 that connect the housing 11 and the oil level tank 60 will be described with reference to Figs. 4 to 6.

[0040] As shown in Fig. 4, the oil level tank 60 is disposed to be adjacent to the housing 11. The oil level tank 60 includes a main body portion 60a having a cylindrical shape, and an upper cover portion 60b and a lower cover portion 60c that close upper and lower openings of the main body portion 60a. The inside of the oil level tank 60 forms a sealed space. The oil level tank 60 measures an oil level of the oil reservoir O1 by, for example, a capacitive sensor (not shown) provided in the oil level tank 60. A method for measuring the oil level of the oil level tank 60 is not limited thereto. The oil level may be measured by other methods.

[0041] The oil level tank 60 is fixed to the housing 11 by a bracket 90. The bracket 90 fixes the main body portion 60a of the oil level tank 60 to the main body portion

21 of the housing 11.

[0042] As shown in Fig. 4, the lower pipe 61 connects the lower cover portion 23 of the housing 11 and the lower cover portion 60c of the oil level tank 60. In addition, as shown in Fig. 6, the lower pipe 61 has one end that is connected to an adjacent-side surface 11a, which is a surface on a side adjacent to the oil level tank 60, of the housing 11, and the other end that is connected to an outer peripheral surface of the oil level tank 60. The other end of the lower pipe 61 may be connected to an adjacent-side surface, which is a surface on a side adjacent to the housing 11, of the outer peripheral surface of the oil level tank 60. The lower pipe 61 is formed of, for example, a metallic material (for example, copper). The material of the lower pipe 61 is not limited thereto.

[0043] In addition, the lower pipe 61 has a housing-side lower pipe 86 connected to the housing 11 and an oil level tank-side lower pipe 87 connected to the oil level tank 60. The housing-side lower pipe 86 extends linearly. In addition, the housing-side lower pipe 86 is provided with a lower expanded pipe portion 86a having a larger inner diameter than other portions at a tip portion (an end portion on the oil level tank-side lower pipe 87 side). The oil level tank-side lower pipe 87 is inserted into the lower expanded pipe portion 86a. The oil level tank-side lower pipe 87 is curved in a top view. An angle (smaller angle) at which the oil level tank-side lower pipe 87 is curved is the same as an angle $\Theta 1$ at which the pressure equalization pipe 62, which will be described later, is curved. A tip (an end portion on the housing-side lower pipe 86 side) of the oil level tank-side lower pipe 87 is formed to have an outer diameter smaller than an inner diameter of the lower expanded pipe portion 86a, and is inserted into the lower expanded pipe portion 86a. The housing-side lower pipe 86 and the oil level tank-side lower pipe 87 are fixed by brazing a portion inserted into the lower expanded pipe portion 86a.

[0044] As shown in Figs. 4 and 5, the pressure equalization pipe 62 equalizes a pressure inside the housing 11 and a pressure inside the oil level tank 60 by causing the inside of the housing 11 and the inside of the oil level tank 60 to communicate with each other. As shown in Fig. 4, the pressure equalization pipe 62 connects the main body portion 21 of the housing 11 and the upper cover portion 60b of the oil level tank 60. As shown in Fig. 1, the pressure equalization pipe 62 is connected to the housing 11 at a portion below a center of the housing 11 in the longitudinal direction (axis X direction) and above the oil reservoir O1. Specifically, the pressure equalization pipe 62 is connected between the electric motor 14 and the lower bearing 32. In addition, as shown in Fig. 5, one end of the pressure equalization pipe 62 is connected to the adjacent-side surface 11a, which is a surface on a side adjacent to the oil level tank 60, of the housing 11, and the other end is connected to the outer peripheral surface of the oil level tank 60. The other end of the pressure equalization pipe 62 may be connected to an adjacent-side surface, which is a surface on a side adjacent to the housing 11, of the outer peripheral surface of the oil level tank 60. The pressure equalization pipe 62 is formed of, for example, a metallic material (for example, copper). The material of the pressure equalization pipe 62 is not limited thereto.

[0045] The adjacent-side surface 11a of the housing 11 is an outer peripheral surface of the housing 11 that is located within a range forming an angle of 90 degrees with respect to a center line L, which is a line connecting a center point of the housing 11 (a point through which the axis X passes) and a center point of the oil level tank 60, in a cross section of the compressor 1. That is, the adjacent-side surface 11a is the outer peripheral surface of the housing 11 that is located within a range of 180 degrees in a circumferential direction centered on an intersection P between the center line L and the housing 11. Further, the adjacent-side surface of the oil level tank 60 is an outer peripheral surface of the oil level tank 60 that is located within a range forming an angle of 90 degrees with respect to the center line L.

[0046] The housing-side pipe 81 may be connected to any portion of the adjacent-side surface 11a, but in the present embodiment, the housing-side pipe 81 is connected to the adjacent-side surface 11a within a range of an angle of 45 degrees with respect to the center line L.

[0047] In addition, as shown in Figs. 4 and 5, the pressure equalization pipe 62 includes the housing-side pipe 81 connected to the housing 11, the oil level tank-side pipe 82 connected to the oil level tank 60, and a U-shaped pipe 83 having a U shape connecting the housing-side pipe 81 and the oil level tank-side pipe 82 to each other.

[0048] As shown in Figs. 4 and 5, the housing-side pipe 81 integrally includes a housing-side horizontal pipe 81a that extends substantially horizontally from the housing 11 and a housing-side vertical pipe 81b that is bent substantially perpendicularly from a tip of the housing-side horizontal pipe 81a to extend upward. A housing-side expanded pipe portion 81c having a larger inner diameter than other portions is provided at a tip of the housing-side pipe 81 (a tip of the housing-side vertical pipe 81b). An inner diameter of the housing-side expanded pipe portion 81c is larger than an outer diameter of the U-shaped pipe 83 which will be described later. The housing-side expanded pipe portion 81c is open upward.

[0049] As shown in Figs. 4 and 5, the oil level tank-side pipe 82 integrally includes an oil level tank-side horizontal pipe 82a that extends substantially horizontally from the oil level tank 60, and an oil level tank-side vertical pipe 82b that is bent substantially perpendicularly from a tip of the oil level tank-side horizontal pipe 82a to extend upward. An oil level tank-side expanded pipe portion 82c having a larger inner diameter than other portions is provided at a tip of the oil level tank-side pipe 82 (a tip of the oil level tank-side vertical pipe 82b) . An inner diameter of the oil level tank-side expanded pipe portion 82c is larger than the outer diameter of the U-shaped pipe 83 which will be described later. The oil level tank-side expanded pipe portion 82c is open upward.

[0050] As shown in Fig. 5, the housing-side horizontal pipe 81a and the oil level tank-side horizontal pipe 82a are disposed such that extension lines of central axes thereof form an angle Θ1 in a top view. In the present embodiment, the angle Θ1 is an acute angle. More specifically, in the present embodiment, the angle Θ1 is set to be approximately 50 degrees. The numerical value of the angle Θ1 is an example, and is not limited to this numerical value. In addition, as shown in Fig. 4, the housing-side vertical pipe 81b and the oil level tank-side vertical pipe 82b are disposed to be substantially parallel to each other.

[0051] As shown in Fig. 4, the U-shaped pipe 83 is curved to be folded back by 180 degrees in a front view. That is, the U-shaped pipe 83 causes a fluid flowing inside the U-shaped pipe 83 to flow upward and then to flow downward by turning back by 180 degrees. One end of the U-shaped pipe 83 is inserted into the housing-side expanded pipe portion 81c of the housing-side pipe 81 from above. The other end of the U-shaped pipe 83 is inserted into the oil level tank-side expanded pipe portion 82c of the oil level tank-side pipe 82 from above. The outer diameter of the U-shaped pipe 83 is formed to be smaller than the inner diameters of the housing-side expanded pipe portion 81c and the oil level tank-side expanded pipe portion 82c.

[0052] The U-shaped pipe 83 and the housing-side pipe 81 are fixed by brazing a portion inserted into the housing-side expanded pipe portion 81c. The U-shaped pipe 83 and the oil level tank-side pipe 82 are fixed by brazing a portion inserted into the oil level tank-side expanded pipe portion 82c.

[0053] The compressor 1 having the above-described configuration operates as follows.

[0054] The refrigerant evaporated in an evaporator (not shown) is sucked into the compressor 1 from the suction pipe 33 and is compressed by the rotary compression mechanism 12. The refrigerant compressed by the rotary compression mechanism 12 is discharged from the guide pipe 43 into the housing 11.

[0055] The refrigerant discharged into the housing 11 is sucked from the suction opening 45a of the cover 45, and is guided to the scroll compression mechanism 13 through a flow path in the cover 45 to be compressed. The refrigerant compressed by the scroll compression mechanism 13 is discharged from the discharge pipe 34 to an external gas cooler or condenser through the discharge hole 52a of the fixed scroll 51.

[0056] The oil is separated from the refrigerant discharged from the discharge pipe 34 by an oil separator (not shown). The separated oil is returned to the housing 11 through the oil separator oil return pipe 65, and is stored in the oil reservoir O1.

[0057] The oil stored in the oil reservoir O1 is sucked up by the oil pump 49, and is guided to the scroll compression mechanism 13 side through the oil supply hole 15a formed in the rotary shaft 15. The oil guided to the scroll compression mechanism 13 side is returned to the oil reservoir O1 on the lower side after lubricating a sliding portion such as a bearing portion of the upper bearing 31 and the bush 55. The oil after lubrication, which is guided to the balance weight chamber 63, is guided to the oil return pipe 67 through the oil return hole 31a and the vertical hole 31b (refer to Fig. 2) formed in the upper bearing 31.

[0058] The oil guided to the oil return pipe 67 is discharged from the lower end through a flow path inside the oil return pipe 67, and is returned to the oil reservoir O1.

[0059] According to the present disclosures, the following operations and effects are achieved.

[0060] In the present embodiment, any of the pressure equalization pipe 62 and the lower pipe 61 is connected to the adjacent-side surface 11a of the housing 11. Therefore, lengths of the pressure equalization pipe 62 and the lower pipe 61 are short as compared to a case where the pressure equalization pipe 62 and the lower pipe 61 are connected to a surface on a side opposite to the adjacent-side surface 11a of the housing 11. Therefore, the compressor 1 can be reduced in size.

[0061] In the present embodiment, the U-shaped pipe 83 and the housing-side pipe 81 are connected such that one of them is inserted into the other from above or below, and the U-shaped pipe 83 and the oil level tank-side pipe 82 are connected such that one of them is inserted into the other from above or below. Specifically, the U-shaped pipe 83 is inserted into the housing-side pipe 81 and the oil level tank-side pipe 82 from above. Accordingly, a tolerance (deviation from the time of design) in a vertical direction of each component can be absorbed by adjusting a length of the U-shaped pipe 83 to be inserted.

[0062] In addition, in insertion portions between the housing-side pipe 81, the oil level tank-side pipe 82, and the U-shaped pipe 83, a gap is generated between an outer peripheral surface of one of the pipes (inserting side pipe, which is the U-shaped pipe 83 in the present embodiment) and an inner peripheral surface of the other of the pipes (inserted side pipes, which are the housing-side pipe 81 and the oil level tank-side pipe 82 in the present embodiment). The gap can absorb a tolerance in a horizontal direction of each component. In addition, since the insertion portions are provided at two locations (a connection portion between the housing-side pipe 81 and the U-shaped pipe 83 and a connection portion between the oil level tank-side pipe 82 and the U-shaped pipe 83), the tolerance in the horizontal direction can be absorbed more as compared to a case where the insertion portion is provided at one location.

[0063] In this way, the tolerance in the vertical direction and the tolerance in the horizontal direction can be absorbed by the pressure equalization pipe 62. Therefore, both the pressure equalization pipe 62 and the lower pipe 61 can be appropriately connected to the housing 11 and the oil level tank 60.

[0064] In addition, in the present embodiment, the U-shaped pipe 83 is inserted into the housing-side pipe 81

and the oil level tank-side pipe 82 from above. Accordingly, it is possible to easily perform processing (for example, brazing) for connecting the housing-side pipe 81, the oil level tank-side pipe 82, and the U-shaped pipe 83.

[0065] In addition, in the present embodiment, the housing-side expanded pipe portion 81c is provided at an end portion of the housing-side pipe 81. In addition, the oil level tank-side expanded pipe portion 82c is provided at an end portion of the oil level tank-side pipe 82. Accordingly, the U-shaped pipe 83 can be easily inserted into the housing-side pipe 81 and the oil level tank-side pipe 82.

[0066] In addition, a gap between an inner peripheral surface of the housing-side pipe 81 and an outer peripheral surface of the U-shaped pipe 83 is increased. Therefore, the tolerance in the horizontal direction can be more absorbed.

[0067] In addition, in the present embodiment, the U-shaped pipe 83 is disposed to be curved in a front view. That is, the pressure equalization pipe 62 is curved in a front view. In addition, the pressure equalization pipe 62 is also curved in a top view. In this way, the pressure equalization pipe 62 is curved in a plurality of directions (vertical direction and horizontal direction). That is, the pressure equalization pipe 62 is three-dimensionally curved. Accordingly, even in a case where the housing 11 vibrates in various directions due to the compression of the refrigerant, the vibration can be absorbed by the pressure equalization pipe 62. Therefore, it is possible to suppress damage to the pressure equalization pipe 62 and the like caused by vibration.

[0068] In the present embodiment, one curved portion is provided in each of the housing-side pipe 81, the oil level tank-side pipe 82, and the U-shaped pipe 83. Accordingly, for example, when each pipe is manufactured, the pipe can be manufactured only by performing bending once with respect to a straight pipe. Therefore, each pipe can be easily manufactured.

[0069] In addition, since a shape of each pipe is relatively simple, assembly work can be facilitated.

[0070] The present disclosure is not limited to each of the embodiments described above, and can be appropriately modified within a scope which does not depart from the gist of the present disclosure.

[0071] For example, in the above embodiment, an example has been described in which the U-shaped pipe 83 is inserted into the housing-side pipe 81 and the oil level tank-side pipe 82 from above. However, the present disclosure is not limited thereto. For example, the housing-side pipe 81 and the oil level tank-side pipe 82 may be inserted into the U-shaped pipe 83 from below by providing expanded pipe portions at both end portions of the U-shaped pipe 83 without providing the expanded pipe portions in the housing-side pipe 81 and the oil level tank-side pipe 82.

[0072] The compressor described in the embodiment described above is understood as follows, for example.

[0073] A compressor according to an aspect of the present disclosure includes: a rotary shaft portion (15) that is rotationally driven; a compression mechanism (12, 13) that is connected to one end of the rotary shaft portion and compresses a refrigerant; a housing (11) that accommodates the rotary shaft portion and the compression mechanism and has an oil reservoir (O1) in a lower portion; an oil level tank (60) that is provided adjacent to the housing and measures an oil level of the oil reservoir; a first connection pipe (62) that has one end connected to an adjacent-side surface (11a), which is a surface on a side adjacent to the oil level tank of the housing, and connects the housing and the oil level tank; and a second connection pipe (61) that has one end connected to the adjacent-side surface and connects the housing and the oil level tank, in which the first connection pipe includes a housing-side pipe (81) connected to the housing, an oil level tank-side pipe (82) connected to the oil level tank, and a U-shaped pipe (83) having a U shape that connects the housing-side pipe and the oil level tank-side pipe, the U-shaped pipe and the housing-side pipe are connected such that one of the U-shaped pipe and the housing-side pipe is inserted into the other thereof from above or below, and the U-shaped pipe and the oil level tank-side pipe are connected such that one of the U-shaped pipe and the oil level tank-side pipe is inserted into the other thereof from above or below.

[0074] In the above configuration, any of the first connection pipe and the second connection pipe is connected to the adjacent-side surface of the housing. Therefore, lengths of the first connection pipe and the second connection pipe are short as compared to a case where the first connection pipe and the second connection pipe are connected to a surface on a side opposite to the adjacent-side surface of the housing. Therefore, the compressor can be reduced in size.

[0075] In the present embodiment, the U-shaped pipe and the housing-side pipe are connected such that one of them is inserted into the other from above or below, and the U-shaped pipe and the oil level tank-side pipe are connected such that one of them is inserted into the other from above or below. Accordingly, a tolerance in a vertical direction of each component can be absorbed by adjusting a length of a portion into which the pipe is inserted.

[0076] In addition, in insertion portions between the housing-side pipe, the oil level tank-side pipe, and the U-shaped pipe, a gap is generated between an outer peripheral surface of one of the pipes (inserting side pipe) and an inner peripheral surface of the other of the pipes (inserted side pipes). The gap can absorb a tolerance in a horizontal direction of each component. In addition, since the insertion portions are provided at two locations (a connection portion between the housing-side pipe and the U-shaped pipe and a connection portion between the oil level tank-side pipe and the U-shaped pipe), the tolerance in the horizontal direction can be absorbed more as compared to a case where the insertion portion is provided at one location.

[0077] In this way, the tolerance in the vertical direction and the tolerance in the horizontal direction can be absorbed by the first connection pipe. Therefore, both the first connection pipe and the second connection pipe can be appropriately connected to the housing and the oil level tank.

[0078] In addition, in the compressor according to the aspect of the present disclosure, one end of the U-shaped pipe is inserted into the housing-side pipe from above, and the other end of the U-shaped pipe is inserted into the oil level tank-side pipe from above.

[0079] In the above configuration, the U-shaped pipe is inserted into the housing-side pipe and the oil level tank-side pipe from above. Accordingly, it is possible to easily perform processing (for example, brazing) for connecting the housing-side pipe, the oil level tank-side pipe, and the U-shaped pipe.

[0080] In addition, in the compressor according to the aspect of the present disclosure, an expanded pipe portion (81c) having a larger inner diameter than other portions is provided at an end portion of the housing-side pipe on a side where the U-shaped pipe is inserted.

[0081] In the above configuration, the expanded pipe portion is provided at the end portion of the housing-side pipe. Accordingly, the U-shaped pipe can be easily inserted into the housing-side pipe.

[0082] In addition, a gap between an inner peripheral surface of the housing-side pipe and an outer peripheral surface of the U-shaped pipe is increased. Therefore, the tolerance in the horizontal direction can be more absorbed.

[0083] In addition, in the compressor according to the aspect of the present disclosure, the U-shaped pipe is disposed to be curved in a front view, and the first connection pipe is curved in a top view such that an angle formed by the housing-side pipe and the oil level tank-side pipe is an acute angle.

[0084] In the above configuration, the U-shaped pipe is disposed to be curved in a front view. That is, the first connection pipe is curved in a front view. In addition, the first connection pipe is also curved in a top view. In this way, since the first connection pipe is curved in a plurality of directions, even in a case where the housing vibrates in various directions due to the compression of the refrigerant, the vibration can be absorbed by the first connection pipe. Therefore, it is possible to suppress damage to the first connection pipe and the like caused by vibration.

[0085] In addition, in the compressor according to the aspect of the present disclosure, the housing-side pipe, the oil level tank-side pipe, and the U-shaped pipe each have one curved portion.

[0086] In the above configuration, the housing-side pipe, the oil level tank-side pipe, and the U-shaped pipe each have one curved portion. Accordingly, when each pipe is manufactured, the pipe can be manufactured only by performing bending once with respect to a straight pipe. Therefore, each pipe can be easily manufactured.

[0087] In addition, since a shape of each pipe is relatively simple, assembly work can be facilitated.

Reference Signs List

[0088]

1: compressor
3: leg portion
11: housing
12: rotary compression mechanism
13: scroll compression mechanism
14: electric motor
15: rotary shaft (rotary shaft portion)
15a: oil supply hole
21: main body portion
22: upper cover portion
23: lower cover portion
31: upper bearing
31a: oil return hole
31b: vertical hole
32: lower bearing
33: suction pipe
34: discharge pipe
38: rotor
38a: rotor passage
38b: oil separation plate
39: stator
39a: stator passage
39b: upper coil end
39c: lower coil end
41: eccentric shaft portion
42: rotor
43: guide pipe
44: cylinder
45: cover
45a: suction opening
48: bolt
49: oil pump
51: fixed scroll
52: end plate
52a: discharge hole
53: fixed wrap
54: balance weight
55: bush
56: eccentric shaft portion
57: orbiting scroll
58: end plate
59: orbiting wrap
60: oil level tank
60a: main body portion
60b: upper cover portion
60c: lower cover portion
61: lower pipe (second connection pipe)
62: pressure equalization pipe (first connection pipe)
63: balance weight chamber
65: oil separator oil return pipe
67: oil return pipe

68: boss
70: rod-shaped member
75: stabilizing plate
81: housing-side pipe
81a: housing-side horizontal pipe
81b: housing-side vertical pipe
81c: housing-side expanded pipe portion
82: oil level tank-side pipe
82a: oil level tank-side horizontal pipe
82b: oil level tank-side vertical pipe
82c: oil level tank-side expanded pipe portion
83: U-shaped pipe
86: housing-side lower pipe
86a: lower expanded pipe portion
87: oil level tank-side lower pipe
90: bracket
C1: compression chamber
C2: compression chamber
FL: installation surface
O1: oil reservoir
X: axis

Claims

1. A compressor comprising:

a rotary shaft portion that is rotationally driven;
a compression mechanism that is connected to one end of the rotary shaft portion and compresses a refrigerant;
a housing that accommodates the rotary shaft portion and the compression mechanism and has an oil reservoir in a lower portion;
an oil level tank that is provided adjacent to the housing and measures an oil level of the oil reservoir;
a first connection pipe that has one end connected to an adjacent-side surface, which is a surface on a side adjacent to the oil level tank of the housing, and connects the housing and the oil level tank; and
a second connection pipe that has one end connected to the adjacent-side surface and connects the housing and the oil level tank,
wherein the first connection pipe includes a housing-side pipe connected to the housing, an oil level tank-side pipe connected to the oil level tank, and a U-shaped pipe having a U shape that connects the housing-side pipe and the oil level tank-side pipe,
the U-shaped pipe and the housing-side pipe are connected such that one of the U-shaped pipe and the housing-side pipe is inserted into the other thereof from above or below, and
the U-shaped pipe and the oil level tank-side pipe are connected such that one of the U-shaped pipe and the oil level tank-side pipe is inserted into the other thereof from above or below.

2. The compressor according to Claim 1,
wherein one end of the U-shaped pipe is inserted into the housing-side pipe from above, and the other end of the U-shaped pipe is inserted into the oil level tank-side pipe from above.

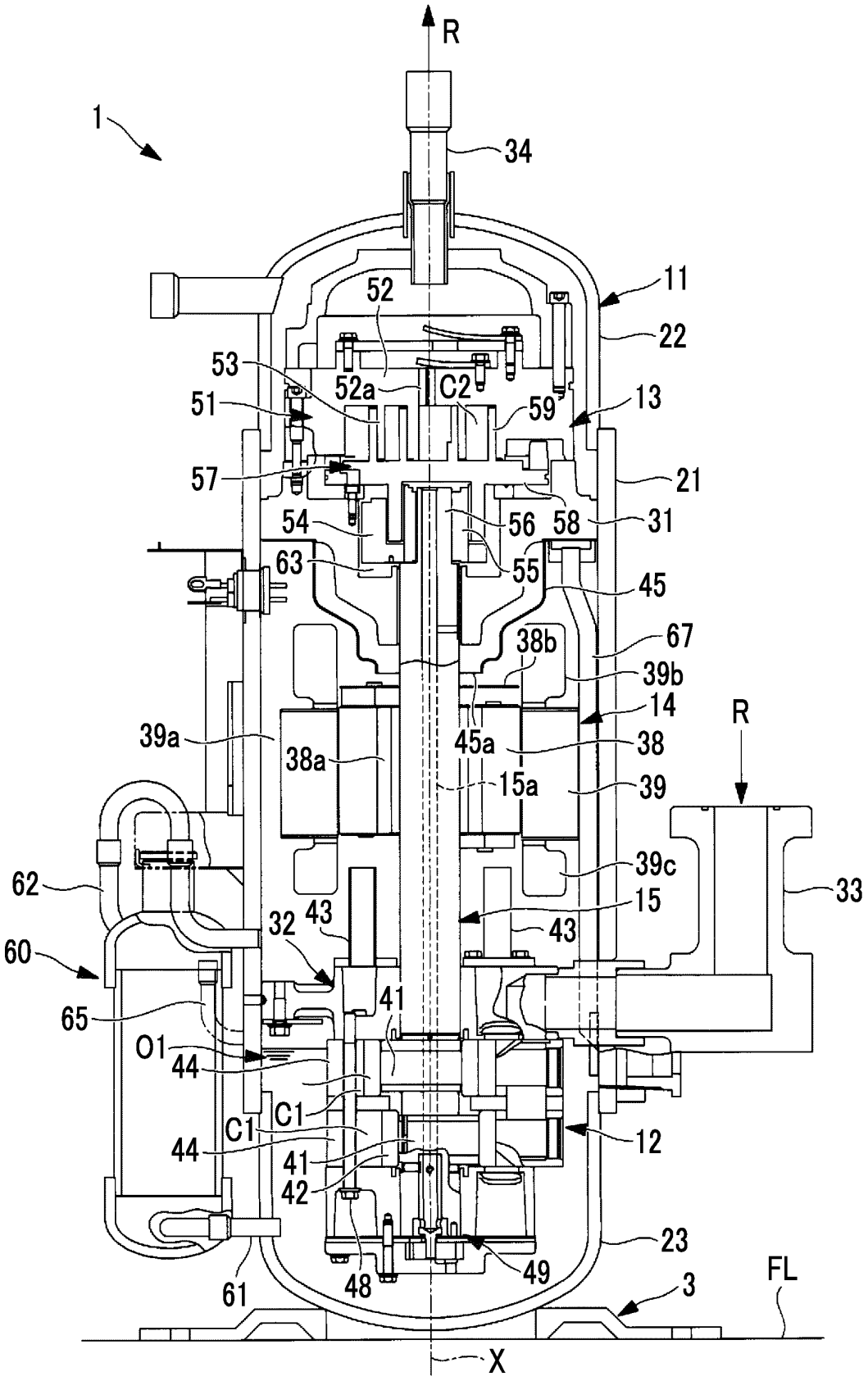
3. The compressor according to Claim 2,
wherein an expanded pipe portion having a larger inner diameter than other portions is provided at an end portion of the housing-side pipe on a side where the U-shaped pipe is inserted.

4. The compressor according to any one of Claims 1 to 3,

wherein the U-shaped pipe is disposed to be curved in a front view, and
the first connection pipe is curved in a top view such that an angle formed by the housing-side pipe and the oil level tank-side pipe is an acute angle.

5. The compressor according to any one of Claims 1 to 4,
wherein the housing-side pipe, the oil level tank-side pipe, and the U-shaped pipe each have one curved portion.

FIG. 1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11
52
22
53
52a
C2
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13
57
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54
56
58
31
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67
38b
39b
14
R
39a
38a
45a
38
15a
39
39c
62
33
32
43
15
43
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C1
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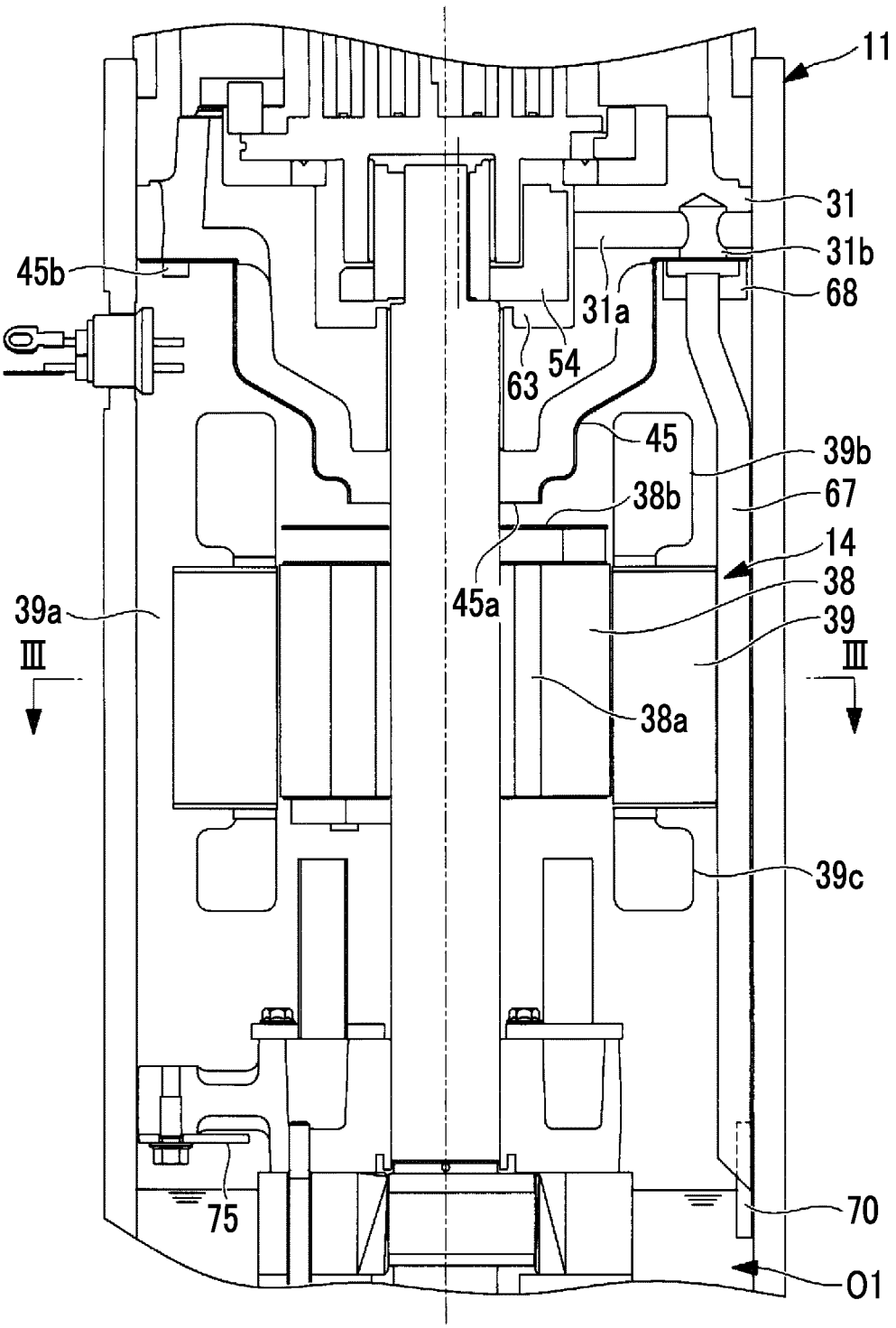
3
FL
X

FIG. 2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31b
68
45b
31a
63
54
45
39b
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67
14
45a
38
39a
39
III
III
38a
39c
75
70
O1

FIG. 3

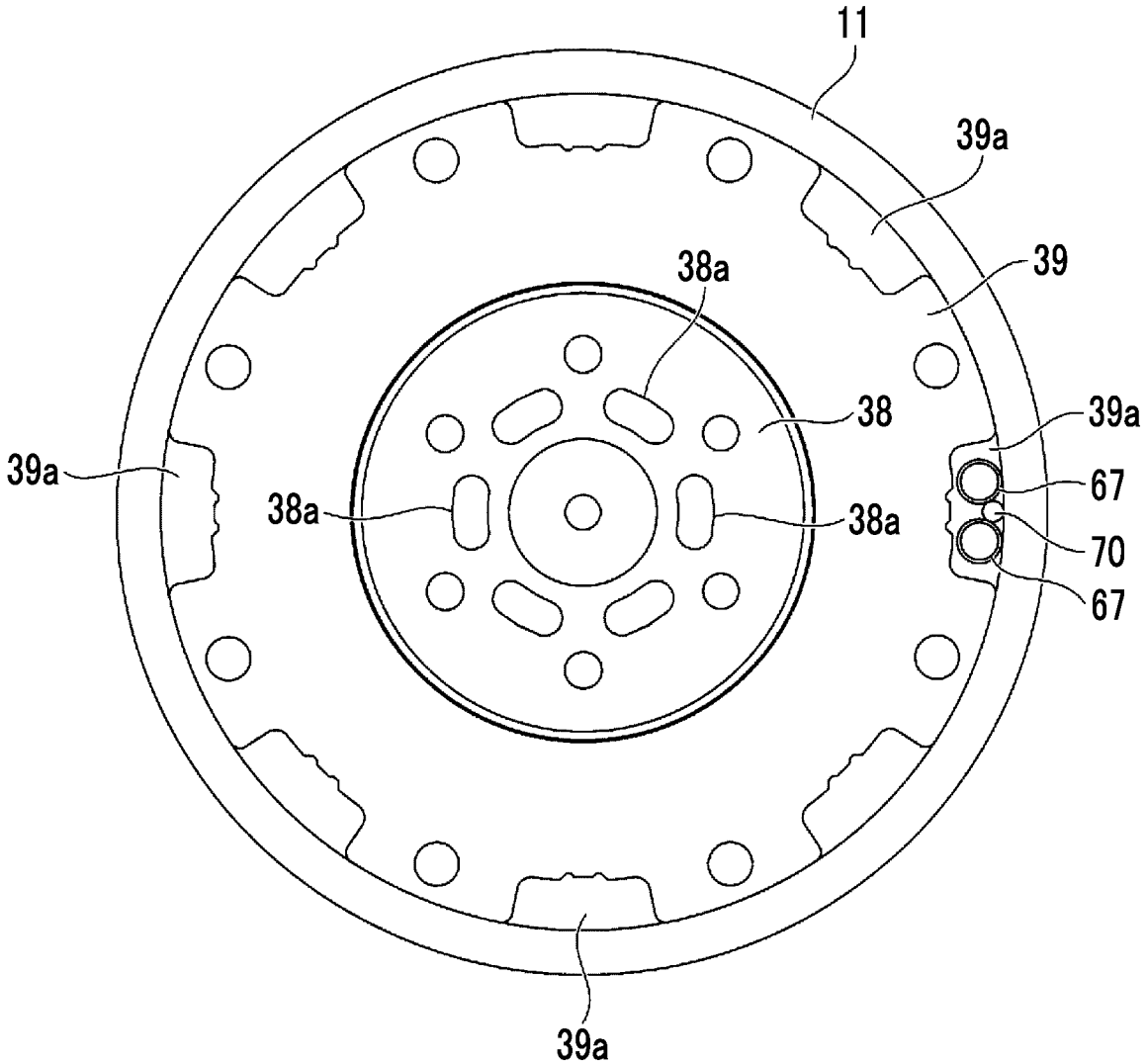


FIG. 4

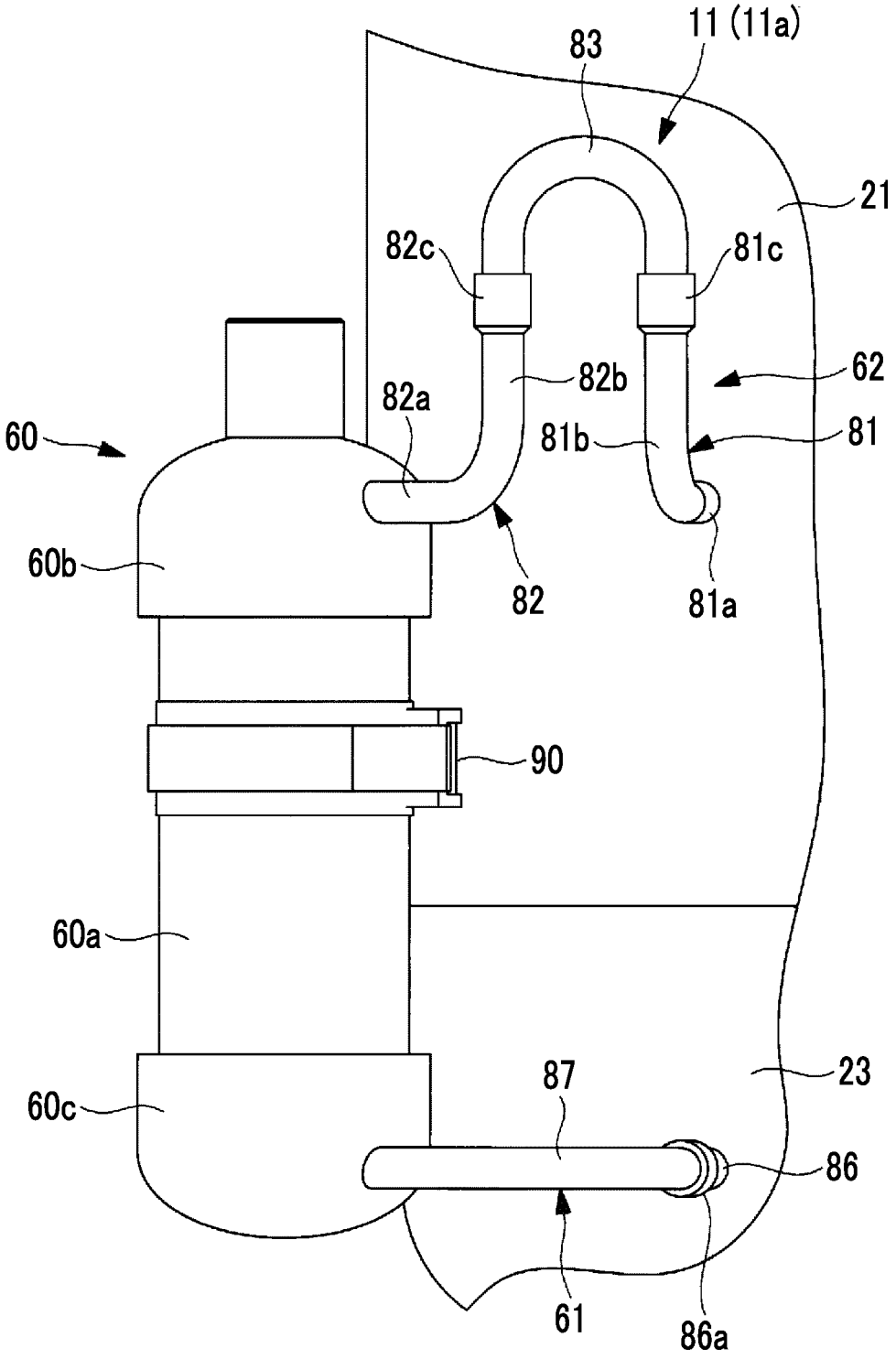

11 (11a)
83
21
82c
81c
62
82b
82a
81b
81
60
60b
82
81a
90
60a
23
87
60c
86
61
86a

FIG. 5

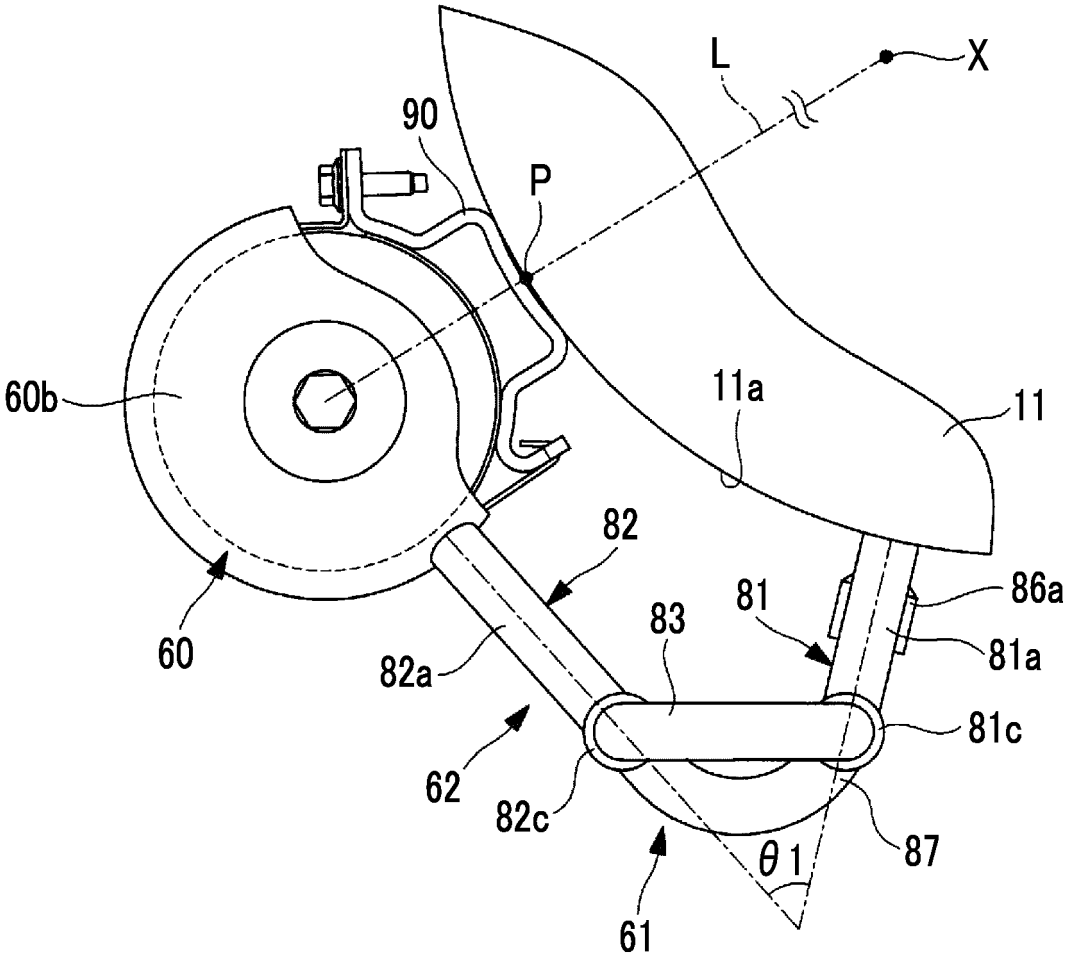
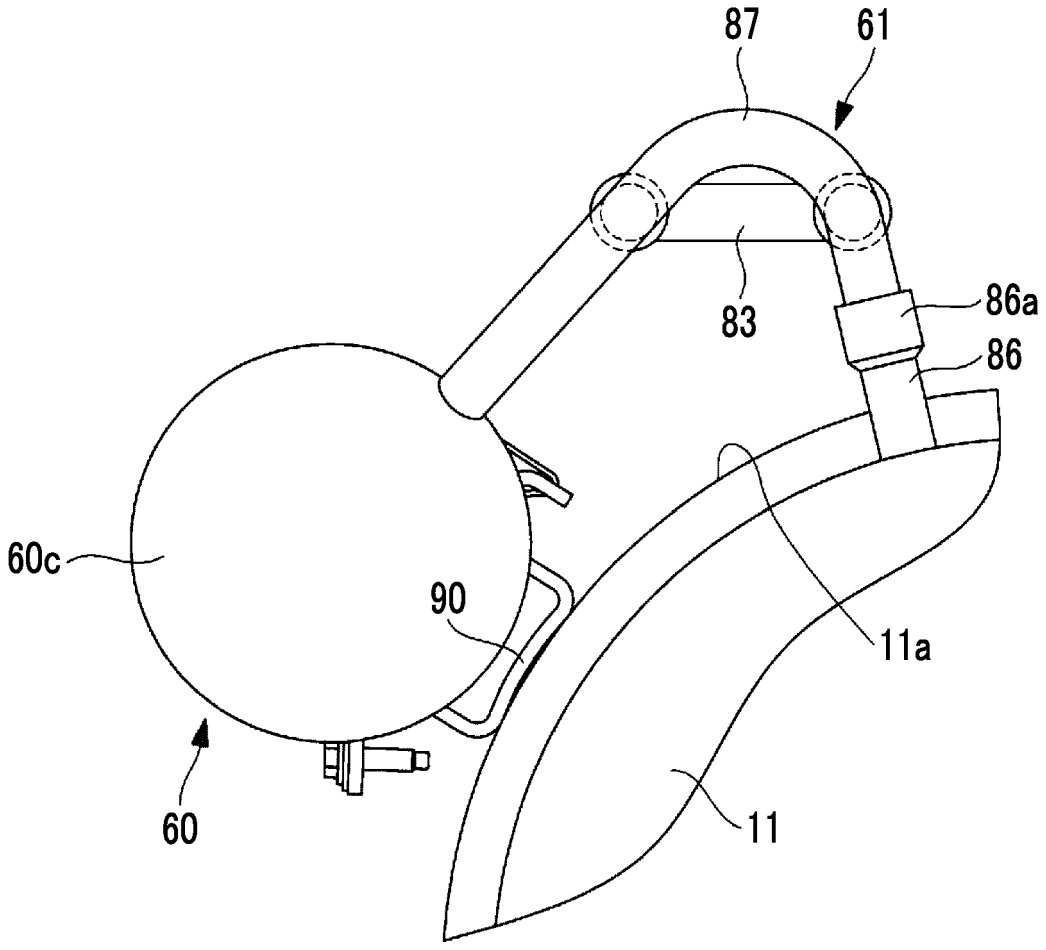


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/040112

A. CLASSIFICATION OF SUBJECT MATTER

F04B 39/02(2006.01)i; ***F04B 39/00***(2006.01)i; ***F04C 28/28***(2006.01)i; ***F04C 29/02***(2006.01)i
FI: F04B39/02 A; F04C29/02 B; F04C28/28 A; F04B39/00 C

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)

F04B39/02; F04B39/00; F04C28/28; F04C29/02

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 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2019-124409 A (MITSUBISHI HEAVY IND THERMAL SYSTEMS LTD) 25 July 2019 (2019-07-25) paragraphs [0018]-[0022], [0041]-[0060], fig. 1-3	1-5
Y	JP 06-249555 A (SANYO ELECTRIC CO LTD) 06 September 1994 (1994-09-06) paragraphs [0014]-[0024], fig. 2-3	1-5
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 129827/1990 (Laid-open No. 086125/1992) (DAIKIN IND LTD) 27 Jul 1992 (1992-07-27), specification, p. 8, line 19 to p. 9, line 7, fig. 5	1-5
A	JP 2020-051347 A (MITSUBISHI HEAVY IND THERMAL SYSTEMS LTD) 02 April 2020 (2020-04-02) fig. 1	1

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 November 2022	**06 December 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/040112

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2019-124409 A	25 July 2019	(Family: none)	
JP 06-249555 A	06 September 1994	(Family: none)	
JP 04-086125 U1	27 July 1992	(Family: none)	
JP 2020-051347 A	02 April 2020	(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 2008175066 A **[0004]**