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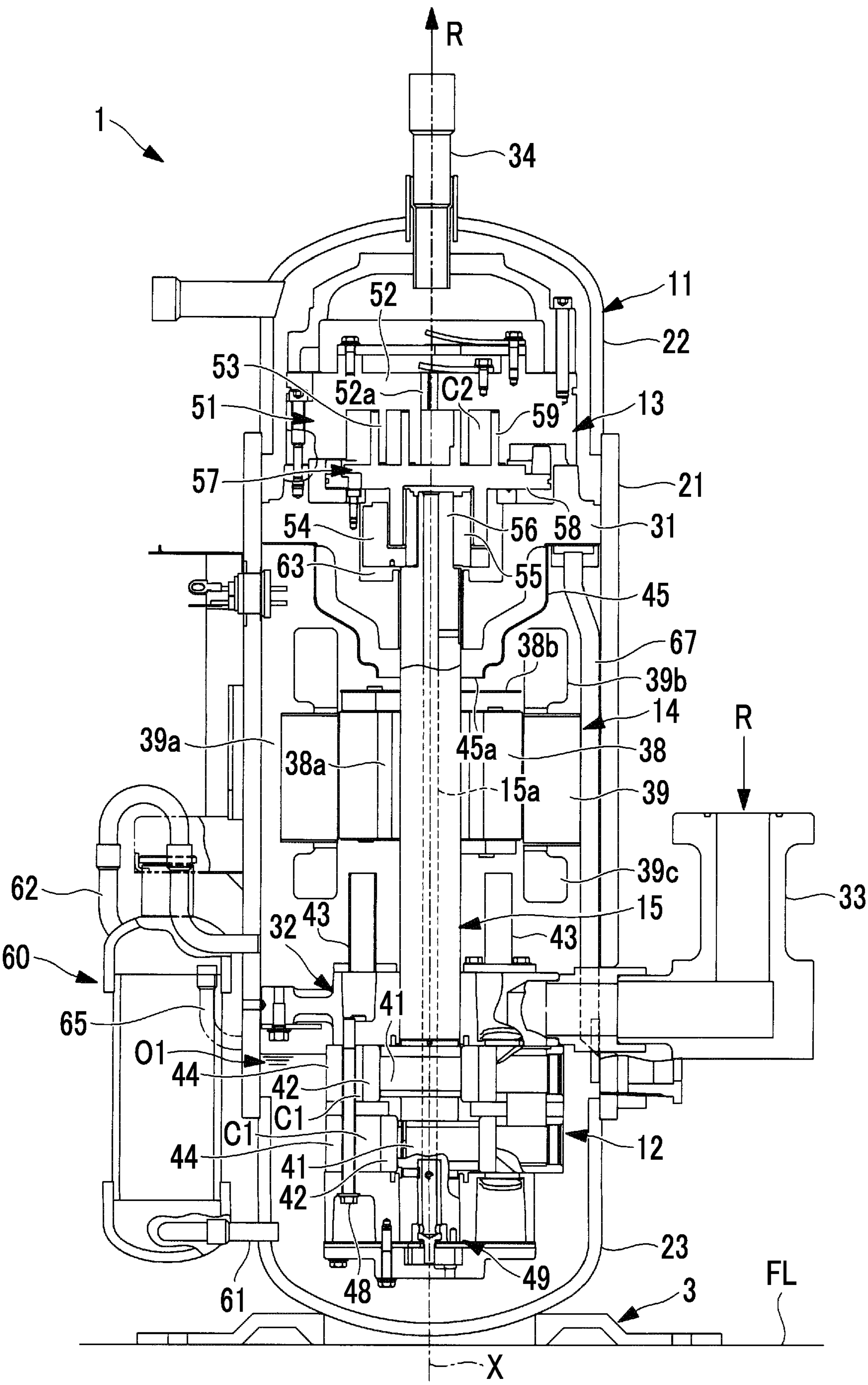
(54) **COMPRESSOR**

(57) Provided is a compressor capable of reducing the vibration of an oil return pipe. A compressor (1) comprises: a housing (11) containing a rotation shaft (15), a scroll compression mechanism (13), and an upper bearing (31), and having an oil reservoir (O1) underneath; and an oil return pipe (67) provided in the housing (11), and having one end fixed to the upper bearing (31) and another end extending toward the oil reservoir (O1) so that the oil held by the upper bearing (31) can return to the oil reservoir (O1). A plurality of the oil return pipes (67) are provided in parallel such that the longitudinal axes thereof are parallel to each other, and the plurality of oil return pipes (67) are bundled together.

FIG. 1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Description

Technical Field

[0001] The present disclosure relates to a compressor, and more specifically, to a compressor including an oil return pipe that returns oil to an oil reservoir in a housing.

Background Art

[0002] A refrigerant discharged from a compressor that compresses the refrigerant inevitably contains oil used for lubrication. Since the discharge oil discharged together with the refrigerant in this way causes a decrease in performance of a heat exchanger, a reduction in discharge oil amount is desired.

[0003] PTL 1 discloses that an oil discharge pipe for returning the oil supplied to a sliding portion of a compression mechanism portion to an oil reservoir in a lower portion of a housing is provided in the housing. In addition, an outer diameter of a central portion of the oil discharge pipe is made larger than that of other portions in order to reduce vibration of the oil discharge pipe.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 2018-100595

Summary of Invention

Technical Problem

[0005] However, in a case of the oil discharge pipe of PTL 1, the vibration is reduced by making the outer diameter of the central portion larger than the other portions. However, the oil discharge pipe has a special shape, which is not preferable in terms of cost.

[0006] The present disclosure has been made in view of such circumstances, and an object thereof is to provide a compressor capable of reducing vibration of an oil return pipe that returns oil to an oil reservoir in a housing with a simpler configuration.

Solution to Problem

[0007] 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 bearing portion that supports the rotary shaft portion; a housing that accommodates the rotary shaft portion, the compression mechanism, and the bearing portion and has an oil reservoir in a lower portion; and an oil return pipe that is provided in the housing and has one end fixed to the bearing portion and the other end extending toward the oil reservoir such that oil held in the bearing portion is returned to the oil reservoir, in which a plurality of the oil return pipes are provided in parallel such that longitudinal axes thereof are parallel to each other, and the oil return pipes are bundled.

Advantageous Effects of Invention

[0008] The vibration of the oil return pipe can be reduced with a simple configuration in which a plurality of oil return pipes are bundled.

Brief Description of Drawings

[0009]

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 cross-sectional view taken along cutting line IV-IV of Fig. 2.
Fig. 5 is an enlarged view of a portion A in Fig. 2.
Fig. 6 is a front view of a lower end of an oil return pipe shown in Fig. 5 as seen from an inside of a housing.
Fig. 7 is a transverse cross-sectional view at the lower end of the oil return pipe shown in Fig. 5.
Fig. 8 is a longitudinal cross-sectional view showing a compressor in an enlarged manner at a height position of the lower end of the oil return pipe.
Fig. 9 is a transverse cross-sectional view of a stabilizing plate as seen from below.
Fig. 10 is a transverse cross-sectional view of the stabilizing plate as seen from above.
Fig. 11 is a longitudinal cross-sectional view showing a main part of a compressor according to a modification example.
Fig. 12 is an enlarged view of a portion B in Fig. 11.
Fig. 13 is a front view of the lower end of the oil return pipe shown in Fig. 12 as seen from the inside of the housing.
Fig. 14 is a transverse cross-sectional view at the lower end of the oil return pipe shown in Fig. 12.

Description of Embodiments

[0010] Hereinafter, an embodiment according to the present disclosure will be described with reference to the drawings.

[0011] 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 (low-stage-side compression mechanism) 12, a scroll compression mechanism (high-stage-side compression mechanism) 13, an electric motor 14, and a rotary shaft (rotary shaft portion) 15, which are provided inside the housing 11.

[0012] 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.

[0013] The rotary shaft 15 is provided to extend vertically along an axis X inside the housing 11. An upper end (one end) side of the rotary shaft 15 is rotatably supported by an upper bearing 31. A lower end (other end) side of the rotary shaft 15 is rotatably supported by a lower bearing 32.

[0014] 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.

[0015] 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.

[0016] 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).

[0017] 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.

[0018] 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.

[0019] 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 rotary discharge pipe 43 to a region below the electric motor 14 in the housing 11 via the lower bearing 32.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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. 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.

[0029] 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 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 61.

[0030] 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.

[0031] 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, and a lower end (other end) is provided to be located in the oil reservoir O1 in the lower portion of the housing 11.

[0032] 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. The oil return pipe 67 is inserted through one or a plurality of the stator passages 39a. In an example shown in Fig. 3, the oil return pipe 67 is inserted through one of the stator passages 39a.

[0033] 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.

[0034] As can be seen from Fig. 3, two oil return pipes 67 are provided in parallel. That is, the two oil return pipes 67 are provided in parallel such that longitudinal axes thereof are parallel to each other. Each of the oil return pipes 67 is made of, for example, a copper pipe, and has the same outer diameter and the same inner diameter in the length direction. The number of the oil return pipes 67 provided in parallel is determined by an amount of the oil to be returned, and can be three or more.

[0035] As shown in Fig. 2, an upper end of the oil return pipe 67 is attached to communicate with an oil return hole 31a formed in the upper bearing 31. The oil return hole 31a extends in a horizontal direction and is formed such that an inner periphery-side end portion thereof is open to the balance weight chamber 63 that accommodates the balance weight 54.

[0036] Fig. 4 is a cross-sectional view taken along cutting line IV-IV of Fig. 2, in which a fixing portion between the oil return pipe 67 and the upper bearing 31 is shown. The upper end of each of the two oil return pipes 67 is fixed to a common boss 68. The boss 68 is made of metal, into which the upper end of each oil return pipe 67 is inserted and fixed by brazing or the like. The upper end of each oil return pipe 67 communicates with a communication hole 68a formed in the boss 68. The communication hole 68a is open toward an upper surface of the boss 68. The boss 68 is fixed to a lower surface of the upper bearing 31 by a plurality of bolts 69. The communication hole 68a formed in the boss 68 is open to a vertical hole 31b connected to the oil return hole 31a of the upper bearing 31 so that the oil return pipe 67 and the balance weight chamber 63 communicate with each other.

[0037] Fig. 5 is an enlarged view of a portion A of Fig. 2, in which a lower end of the oil return pipe 67 is shown. 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. The rod-shaped member 70 is made of steel and is a solid round bar. A length of the rod-shaped member 70 overlaps a predetermined dimension (for example, several mm to several tens of mm) of a tip of the oil return pipe 67 and protrudes downward from the tip of the oil return pipe 67 in a range of a predetermined dimension (for example, several mm to several tens of mm).

[0038] As shown in Figs. 6 and 7, the rod-shaped member 70 is fixed to each of side surfaces of lower ends of the rod-shaped members 70 on both sides adjacent to each other. The fixing between the rod-shaped member 70 and the oil return pipe 67 is performed by, for example, brazing. An outer diameter of the rod-shaped member 70 may be any size as long as the rod-shaped member 70 can be inserted between the oil return pipes 67 and can be fixed to each of the oil return pipes 67, and is preferably smaller than the outer diameter of the oil return pipe 67. A cross-sectional shape of the rod-shaped member 70 may be circular as shown in Fig. 7, or may be a polygon.

[0039] The rod-shaped member 70 is fixed to the inner wall of the housing 11. Specifically, the lower end (tip) of the rod-shaped member 70 is fixed by welding. For example, before the lower cover portion 23 (refer to Fig. 1) of the housing 11 is attached, the lower end of the rod-shaped member 70 is welded by accessing from below the main body portion 21. The lower end of the rod-shaped member 70 is fixed to the inner wall of the housing 11, so that the oil return pipe 67 is in a state of being close to the inner wall of the housing 11 over substantially the entire oil return pipe 67 (for example, 1/2 or more of a longitudinal dimension from the lower end of the oil return pipe 67) . For example, as shown in Fig. 1, the oil return pipe 67 is subjected to bending between a fixing position of the upper end of the oil return pipe 67 and a height position of the upper coil end 39b of the electric motor 14, and the oil return pipe 67 is brought close to the inner wall of the housing 11 from the height position of the upper coil end 39b over the entire lower side. Accordingly, the movement of the oil return pipe 67 is restricted, and the generation of vibration of the oil return pipe 67 can be suppressed. It is preferable that the oil return pipe 67 is brought into contact with the inner wall of the housing 11. However, a slight gap (for example, 0.1 mm to several mm) may be formed as long as the movement of the oil return pipe 67 during vibration can be restricted.

[0040] As shown in Fig. 5, the lower end of the rod-shaped member 70 has a tapered shape cut at one surface inclined with respect to the longitudinal axis of the oil return pipe 67. Then, a tip 67a of the oil return pipe 67 having a tapered shape is located on an inner wall side of the housing 11. Accordingly, when the oil return pipe 67 is inserted along the inner wall of the housing 11 during fabrication, the sharpened tip 67a is advanced along the inner wall, so that the oil return pipe 67 can be smoothly inserted while avoiding interference with other members (for example, the stator 39 or the like) in the housing.

[0041] As shown in Fig. 8, a stabilizing plate (oil surface upper plate) 75 is fixed to a lower surface of the lower bearing 32. 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 76. As shown in Figs. 9 and 10, the stabilizing plate 75 is a circular plate in which an opening is formed at the center. The stabilizing plate 75 can cover an upper side of an oil surface of the oil reservoir O1 (refer to Figs. 1 and 2). However, a height position of the stabilizing plate 75 may be lower than a refrigerant discharge position of the rotary compression mechanism 12. In addition, a fixing position of the stabilizing plate 75 is not limited to the lower bearing 32, and may be fixed to another fixing position (for example, the housing 11). The stabilizing plate 75 can stabilize the oil surface of the oil reservoir O1, and can prevent the oil from separating from the oil reservoir O1 as much as possible due to the flow of the refrigerant discharged from the rotary compression mechanism 12.

[0042] In Fig. 9, one set of two oil return pipes 67 are provided at each of three locations in the circumferential direction. However, this is an example, and one set of the oil return pipes 67 may be provided at one location as in Fig. 10 or Fig. 3.

[0043] As shown in Fig. 8, the lower end of the oil return pipe 67 is located below the stabilizing plate 75. By partitioning an opening of the lower end of the oil return pipe 67 from a discharge side of the rotary compression mechanism 12 in this way, even when the oil returned from the oil return pipe 67 splashes on the oil surface of the oil reservoir O1, the oil can be prevented from being rolled up in association with the flow of the discharged refrigerant of the rotary compression mechanism 12.

[0044] The lower end of the oil return pipe 67 is provided below a position where the downstream end of the oil separator oil return pipe 65 is open into the housing 11. In this way, the oil separator oil return pipe 65 is opened below the stabilizing plate 75. Accordingly, even when the oil returned from the oil separator oil return pipe 65 flows in as indicated by a black arrow (refer to Fig. 8), and the oil splashes on the oil surface of the oil reservoir O1 to disturb the oil surface, the oil can be prevented from being rolled up in association with the flow of the discharged refrigerant of the rotary compression mechanism 12.

[0045] The compressor 1 having the above-described configuration operates as follows.

[0046] 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 rotary discharge pipe 43 into the housing 11.

[0047] 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.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] According to the present embodiment, the following operations and effects are achieved.

[0052] The oil that has lubricated the upper bearing 31 is returned to the oil reservoir O1 in the lower portion of the housing 11 by the oil return pipe 67. Since the upper end of the oil return pipe 67 is a fixed end fixed to the upper bearing 31, there is a possibility that the vibration of the compressor 1 is transmitted and repeated stress is generated. In the present embodiment, the overall rigidity of the oil return pipes 67 is increased by bundling a plurality of oil return pipes 67 provided in parallel such that the longitudinal axes thereof are parallel to each other via the rod-shaped member 70. Accordingly, the vibration of the oil return pipe 67 can be suppressed. In addition, since a strength of the upper end of the oil return pipe 67 fixed to the upper bearing 31 can be increased by increasing a cross-sectional secondary moment with the plurality of oil return pipes 67, fatigue breakage at the upper end of the oil return pipe 67 can be suppressed.

[0053] The lower end of the oil return pipe 67 is fixed to the inner wall of the housing 11 by using the rod-shaped member 70. Accordingly, two points of the upper end and the lower end of the oil return pipe 67 are fixed, so that the vibration of the oil return pipe 67 can be further suppressed.

[0054] Both oil return pipes 67 are bundled by fixing the rod-shaped member 70 to each of the side surfaces of the lower ends of the oil return pipes 67 adjacent to each other. Then, the rod-shaped member 70 is fixed to the inner wall of the housing 11. Accordingly, the oil return pipes 67 adjacent to each other can be easily fixed to the inner wall of the housing 11 after being bundled.

[0055] In the above-described embodiment, the rod-shaped member 70 is used when the lower ends of the oil return pipes 67 are bundled and fixed, but the configuration can be modified as follows.

[0056] As shown in Figs. 11 to 14, the lower ends of the oil return pipes 67 are bundled and fixed by using a fixing bracket 78. The fixing bracket 78 can be formed by bending a flat plate. Specifically, as shown in Fig. 14, the flat plate is bent so as to form a space with the inner wall of the housing 11. Then, leg portions 78a on both sides of the fixing bracket 78 are fixed to the housing 11 by welding or the like. The lower end of the oil return pipe 67 is inserted into the space formed by the fixing bracket 78. The displacement of each of the oil return pipes 67 is constrained in the space formed by the fixing bracket 78. Accordingly, the lower ends of the oil return pipes 67 can be easily bundled and positioned.

[0057] The compressor described in the embodiments described above is understood as follows, for example.

[0058] A compressor according to an aspect of the present disclosure includes: a rotary shaft portion (15) that is rotationally driven; a compression mechanism (13) that is connected to one end of the rotary shaft portion and compresses a refrigerant; a bearing portion (31) that supports the rotary shaft portion; a housing (11) that accommodates the rotary shaft portion, the compression mechanism, and the bearing portion and has an oil reservoir (O1) in a lower portion; and an oil return pipe (67) that is provided in the housing and has one end fixed to the bearing portion and the other end extending toward the oil reservoir such that oil held in the bearing portion is returned to the oil reservoir, in which a plurality of the oil return pipes are provided in parallel such that longitudinal axes thereof are parallel to each other, and the oil return pipes are bundled.

[0059] The oil that has lubricated the bearing portion is temporarily held in the bearing portion and is returned to the oil reservoir in the lower portion of the housing by the oil return pipe. Since one end of the oil return pipe is a fixed end fixed to the bearing portion, the vibration of the compressor is transmitted and repeated stress is generated.

[0060] The overall rigidity of the oil return pipes can be increased by bundling the plurality of oil return pipes provided in parallel such that the longitudinal axes thereof are parallel to each other. Accordingly, the vibration of the oil return pipe can be suppressed. In addition, since a strength of one end of the oil return pipe fixed to the bearing portion can be increased by increasing a cross-sectional secondary moment with the plurality of oil return pipes, fatigue breakage at the one end of the oil return pipe can be suppressed.

[0061] For example, a scroll compression mechanism is used as the compression mechanism.

[0062] In the compressor according to the aspect of the present disclosure, the other end of the oil return pipe is fixed to an inner wall of the housing.

[0063] The other end of the oil return pipe is fixed to the inner wall of the housing. Accordingly, two points of the one end and the other end of the oil return pipe are fixed, so that the vibration of the oil return pipe can be further suppressed.

[0064] The compressor according to the aspect of the present disclosure further includes a rod-shaped member (70) that is provided between the other ends of the oil return pipes adjacent to each other and is fixed to each of side surfaces of the other ends adjacent to each other, in which the rod-shaped member is fixed to the inner wall of the housing.

[0065] Both oil return pipes are bundled by fixing the rod-shaped member to each of the side surfaces of the other ends of the oil return pipes adjacent to each other. Then, the rod-shaped member is fixed to the inner wall of the housing. Accordingly, the oil return pipes adjacent to each other can be easily fixed to the inner wall of the housing after being bundled.

[0066] The fixing of the rod-shaped member and the oil return pipe and/or the fixing of the rod-shaped member and the inner wall of the housing can be performed by, for example, brazing or welding.

[0067] The compressor according to the aspect of the present disclosure further includes a fixing bracket (78) that is fixed to the inner wall of the housing and forms a space with the inner wall, in which the other ends of the plurality of oil return pipes are bundled in a state of being inserted into the space.

[0068] The fixing bracket is fixed to the inner wall of the housing, and a space is formed between the inner wall and the fixing bracket. Then, the other ends of the plurality of oil return pipes are inserted into the space to bundle the oil return pipes. As a result, the other ends of the oil return pipes can be easily bundled.

[0069] In the compressor according to the aspect of the present disclosure, the oil return pipe is installed in a state of being close to the inner wall of the housing over 1/2 or more of a length in a longitudinal direction from the other end.

[0070] The oil return pipe is disposed in a state of being close to the inner wall of the housing over 1/2 or more of a length in the longitudinal direction from the other end of the oil return pipe. Accordingly, the movement of the oil return pipe is restricted, and the generation of vibration of the oil return pipe can be suppressed.

[0071] The close means that the oil return pipe and the inner wall of the housing may be in contact with each other or may be separated by a gap of, for example, about 0.1 mm to several mm.

[0072] In the compressor according to the aspect of the present disclosure, the oil return pipe has the same diameter in the longitudinal direction thereof.

[0073] Since the oil return pipe can be fabricated using the pipe having the same diameter, it is possible to reduce the cost.

[0074] In the compressor according to an aspect of the present disclosure, the other end of the oil return pipe has a tapered shape cut at one surface inclined with respect to a longitudinal axis of the oil return pipe, and a tip (67a) of the tapered shape is located on an inner wall side of the housing.

[0075] The other end of the oil return pipe has a tapered shape cut at one surface inclined with respect to the longitudinal axis, and the tip thereof is located on the inner wall side of the housing. Accordingly, when the oil return pipe is inserted along the inner wall of the housing, the sharpened tip is advanced along the inner wall, so that the oil return pipe can be smoothly inserted while avoiding interference with other members in the housing.

[0076] The compressor according to the aspect of the present disclosure is the compressor according to any one of Claims 1 to 7 further including: another compression mechanism (12) that is connected to the other end of the rotary shaft portion and compresses a refrigerant; and an oil surface upper plate (75) that is provided below a refrigerant discharge position of the other compression mechanism and above an oil surface formed in the oil reservoir to cover the oil surface.

[0077] The oil surface upper plate that covers the oil surface is provided below a refrigerant discharge position of another compression mechanism connected to the other end of the rotary shaft portion. Further, the oil surface upper plate is provided above the oil surface formed in the oil reservoir. In this manner, it is possible to prevent the oil from being separated from the oil reservoir as much as possible due to the flow of the refrigerant discharged from the other compression mechanism.

[0078] As another compression mechanism, for example, a rotary compression mechanism is used.

[0079] In the compressor according to the aspect of the present disclosure, the other end of the oil return pipe is open below the oil surface upper plate.

[0080] Since the other end of the oil return pipe is open below the oil surface upper plate, even when the oil returned from the oil return pipe splashes on the oil surface, the oil can be prevented from flowing in association with the flow of the discharged refrigerant of the other compression mechanism by the oil surface upper plate.

[0081] The compressor according to the aspect of the present disclosure further includes an oil separator oil return pipe (65) that returns oil from an oil separator that stores the oil separated from the refrigerant discharged from the compressor, in which the oil separator oil return pipe is open below the oil surface upper plate.

[0082] Since the oil separator oil return pipe is open below the oil surface upper plate, even when the oil returned from the oil separator oil return pipe splashes on the oil surface, the oil can be isolated from the flow of the discharged refrigerant of the other compression mechanism by the oil surface upper plate.

Reference Signs List

[0083]

- 1: compressor
- 3: leg portion
- 11: housing
- 12: rotary compression mechanism (low-stage-side compression mechanism)
- 13: scroll compression mechanism (high-stage-side 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 (bearing portion)
- 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: rotary discharge 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
61: lower pipe
62: pressure equalization pipe
63: balance weight chamber
65: oil separator oil return pipe
67: oil return pipe
67a: tip
68: boss
68a: communication hole
69: bolt
70: rod-shaped member
75: stabilizing plate (oil surface upper plate)
76: bolt
78: fixing bracket
78a: leg portion
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 bearing portion that supports the rotary shaft portion;
   a housing that accommodates the rotary shaft portion, the compression mechanism, and the bearing portion and has an oil reservoir in a lower portion; and
   an oil return pipe that is provided in the housing and has one end fixed to the bearing portion and the other end extending toward the oil reservoir such that oil held in the bearing portion is returned to the oil reservoir,
   wherein a plurality of the oil return pipes are provided in parallel such that longitudinal axes thereof are parallel to each other, and the oil return pipes are bundled.

2. The compressor according to Claim 1, wherein the other end of the oil return pipe is fixed to an inner wall of the housing.

3. The compressor according to Claim 2, further comprising a rod-shaped member that is provided between the other ends of the oil return pipes adjacent to each other and is fixed to each of side surfaces of the other ends adjacent to each other,
   wherein the rod-shaped member is fixed to the inner wall of the housing.

4. The compressor according to Claim 2, further comprising a fixing bracket that is fixed to the inner wall of the housing and forms a space with the inner wall, wherein the other ends of the plurality of oil return pipes are bundled in a state of being inserted into the space.

5. The compressor according to any one of Claims 1 to 4,
   wherein the oil return pipe is installed in a state of being close to the inner wall of the housing over 1/2 or more of a length in a longitudinal direction from the other end.

6. The compressor according to any one of Claims 1 to 5, wherein the oil return pipe has the same diameter in a longitudinal direction thereof.

7. The compressor according to any one of Claims 1 to 6, wherein the other end of the oil return pipe has a tapered shape cut at one surface inclined with respect to a longitudinal axis of the oil return pipe, and a tip of the tapered shape is located on an inner wall side of the housing.

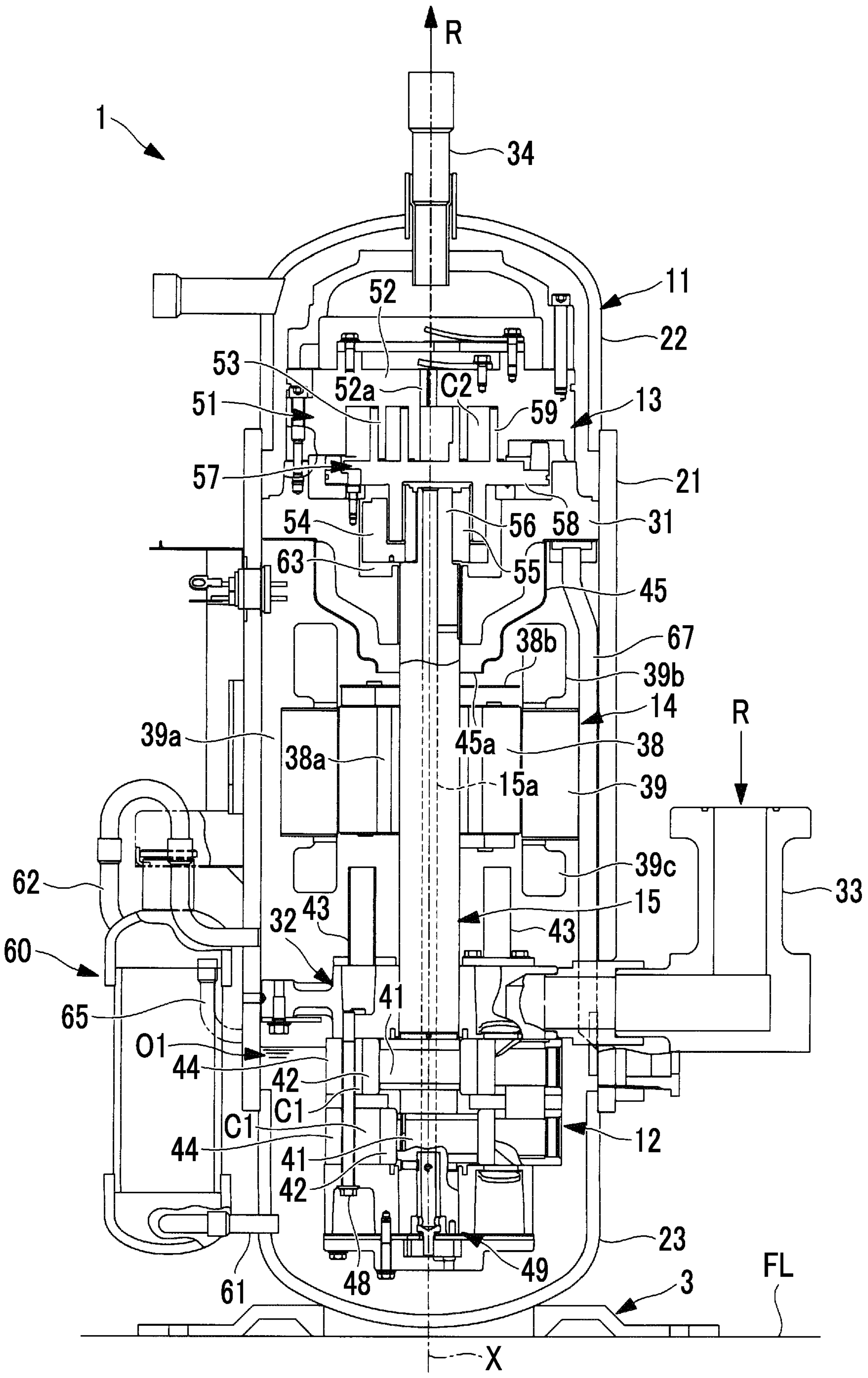
8. The compressor according to any one of Claims 1 to 7, further comprising:

   another compression mechanism that is connected to the other end of the rotary shaft portion and compresses a refrigerant; and
   an oil surface upper plate that is provided below a refrigerant discharge position of the other compression mechanism and above an oil surface formed in the oil reservoir to cover the oil surface.

9. The compressor according to Claim 8,
   wherein the other end of the oil return pipe is open below the oil surface upper plate.

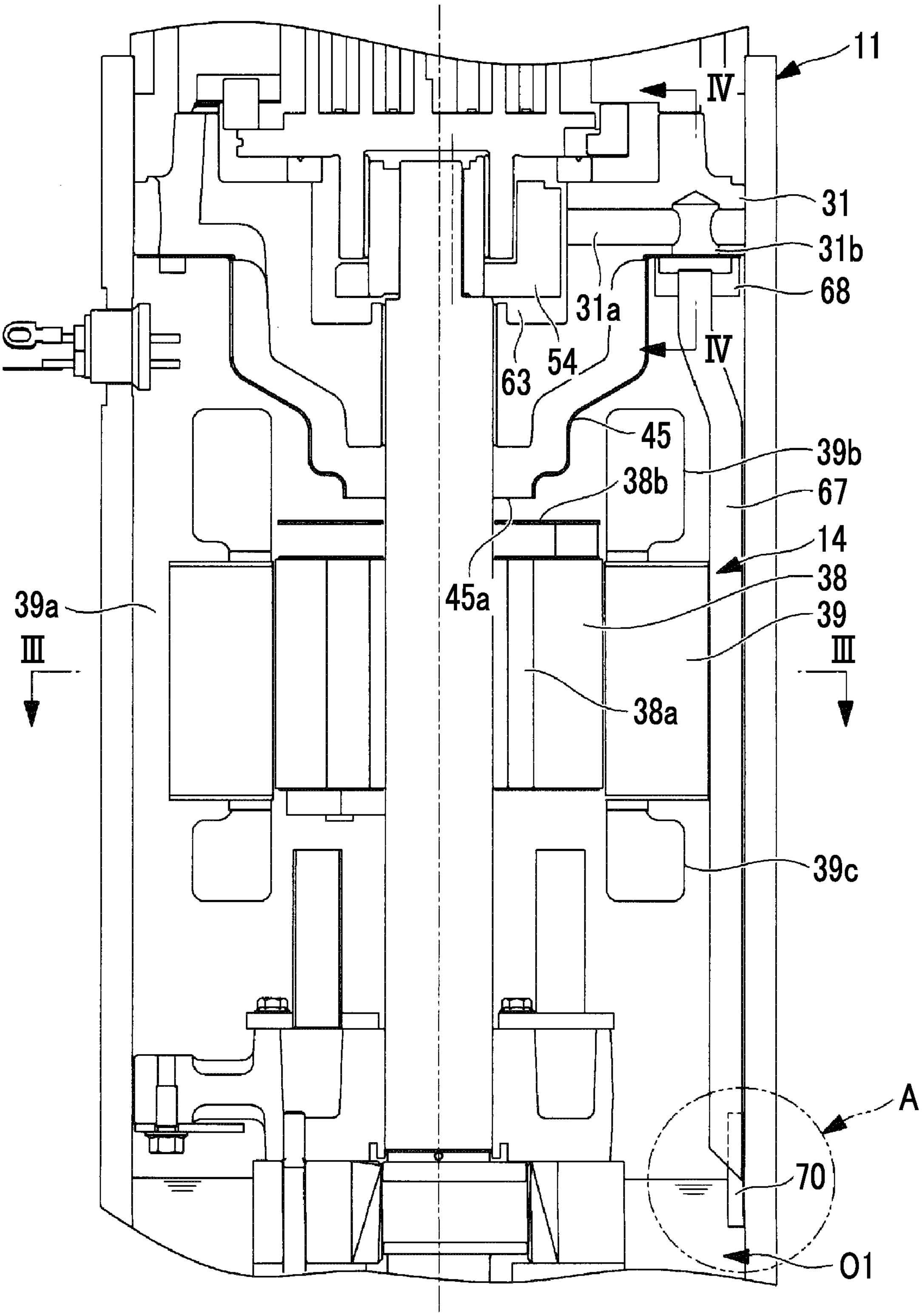
10. The compressor according to Claim 8 or 9, further comprising an oil separator oil return pipe that returns oil from an oil separator that stores the oil separated from the refrigerant discharged from the compressor,
    wherein the oil separator oil return pipe is open below the oil surface upper plate.

FIG. 1



R
1
34
52
11
22
53
52a
C2
13
51
59
57
21
54
56
58
31
63
55
45
67
38b
39b
14
39a
45a
38
38a
15a
39
R
39c
62
33
15
43
32
43
60
41
65
O1
44
42
C1
C1
12
44
41
42
23
48
49
61
3
FL
X

FIG. 2



11
IV
31
31b
68
31a
54
63
IV
45
39b
38b
67
14
38
45a
39a
39
III
III
38a
39c
A
70
O1

FIG. 3

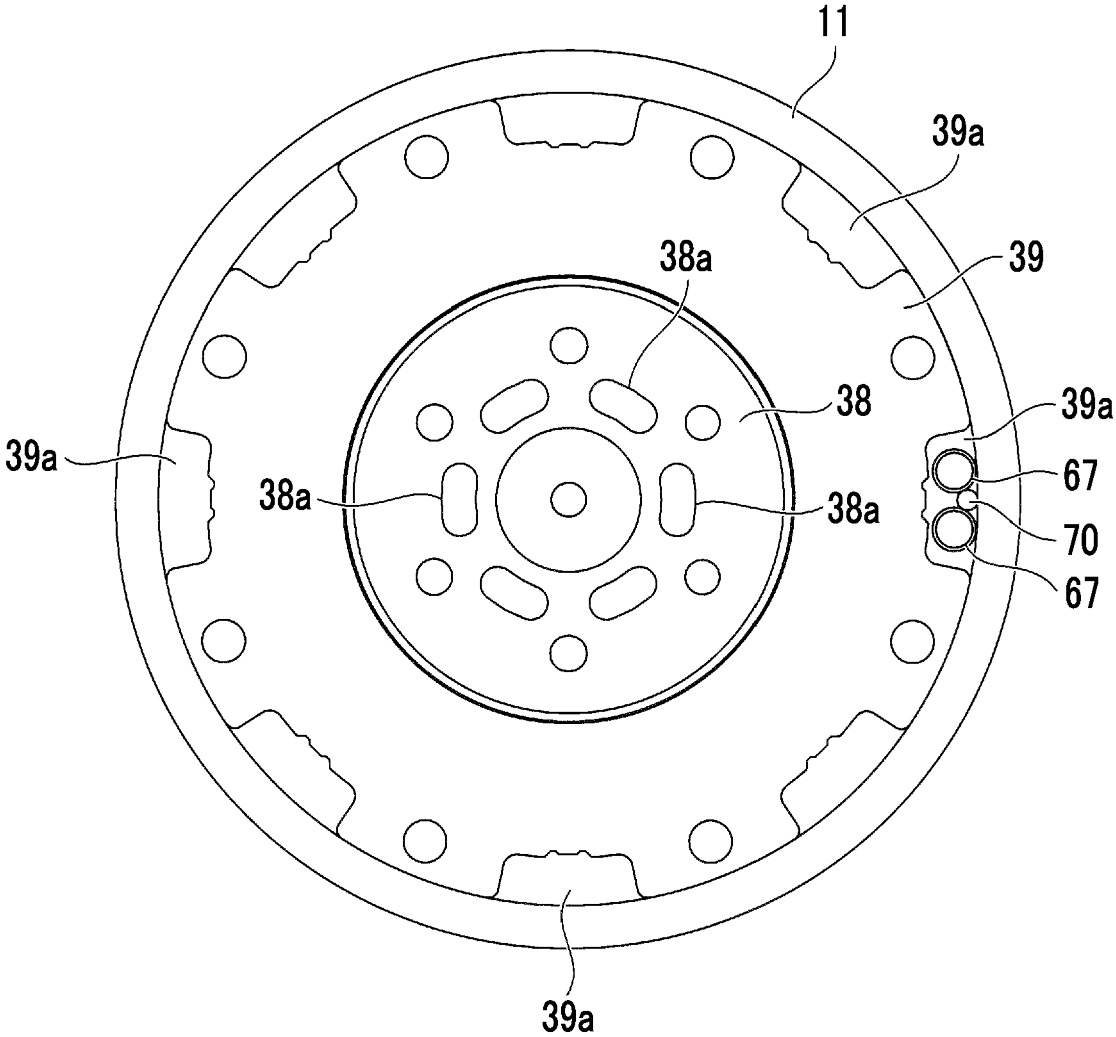


FIG. 4

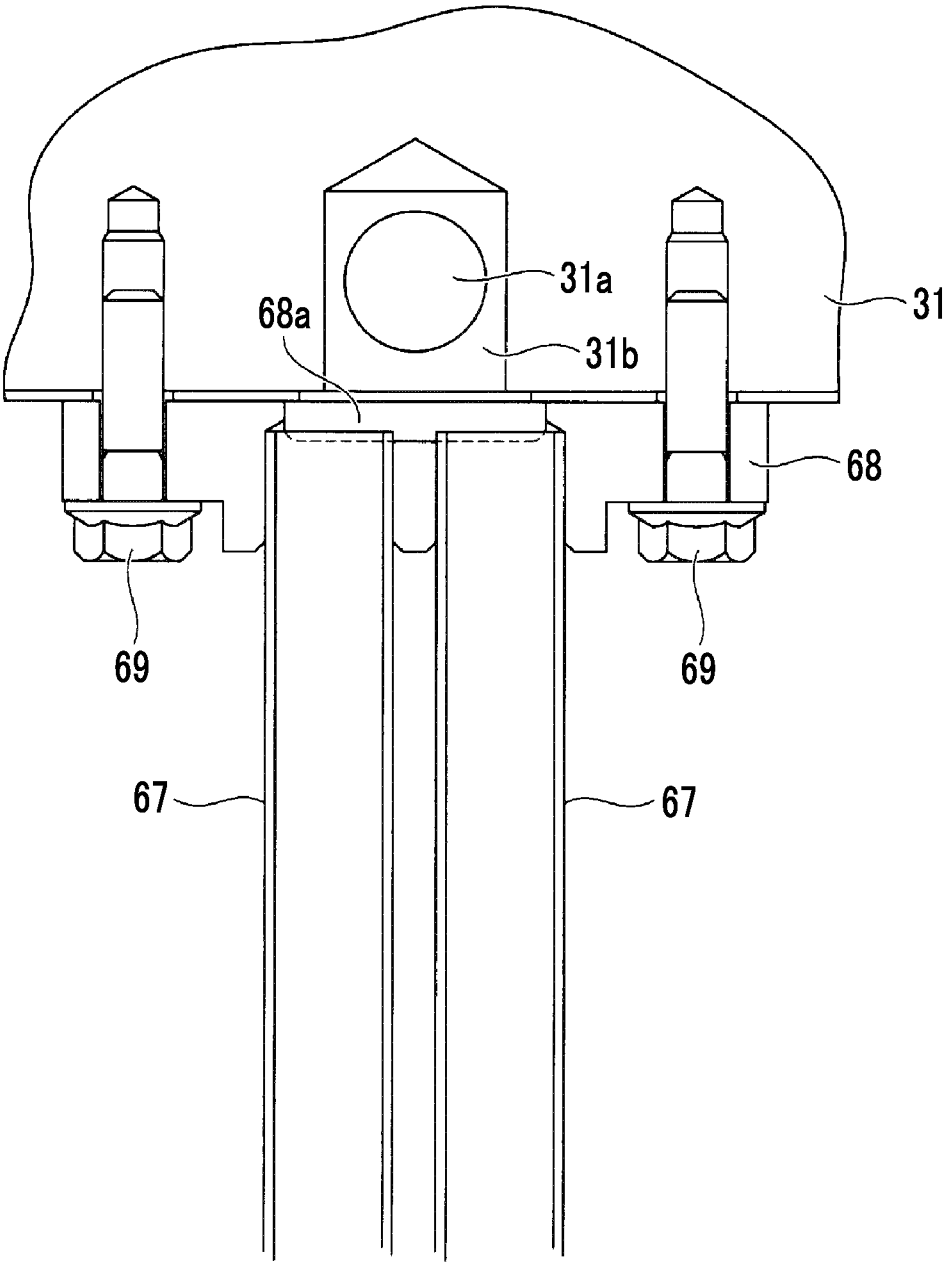


FIG. 5

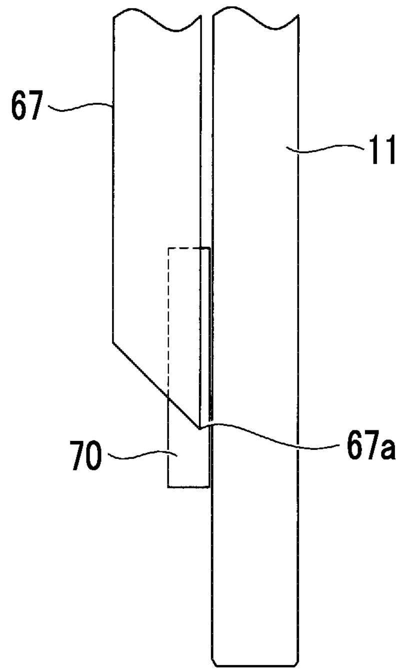


FIG. 6

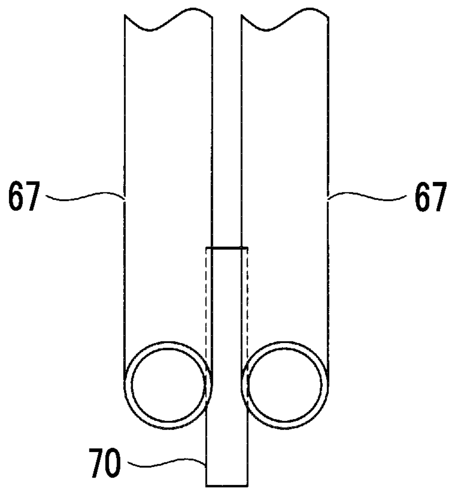


FIG. 7

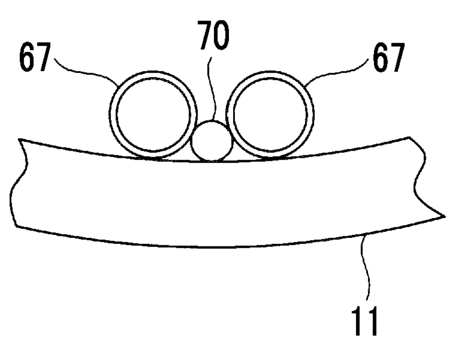


FIG. 8

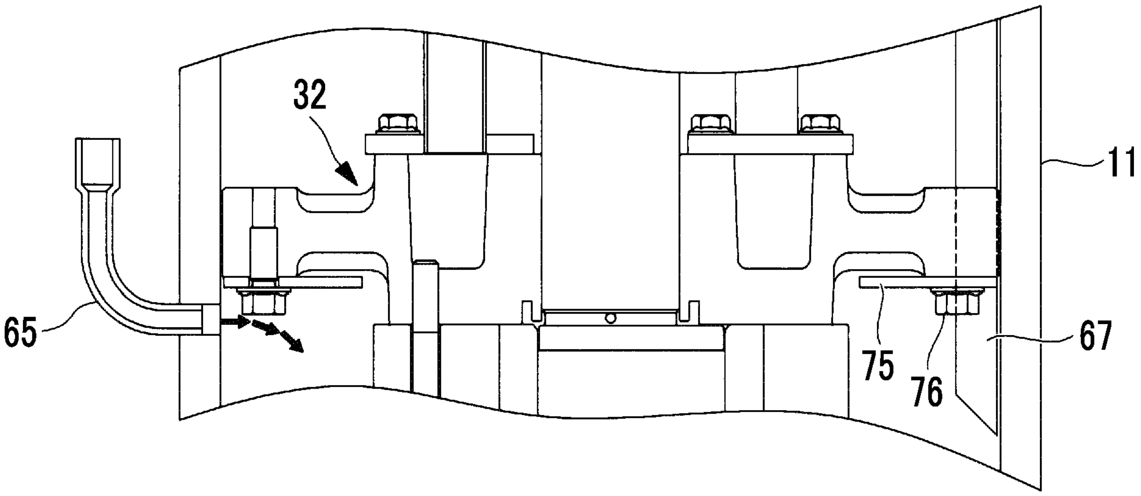


FIG. 9

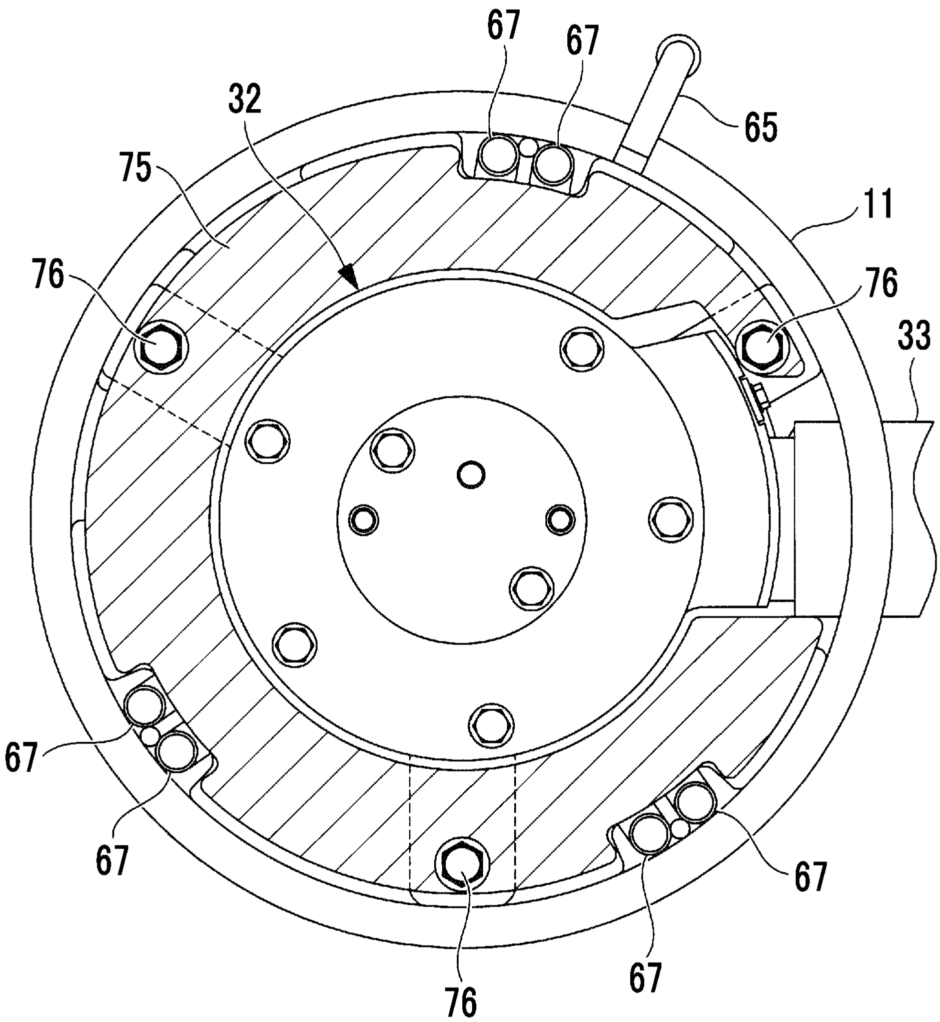


FIG. 10

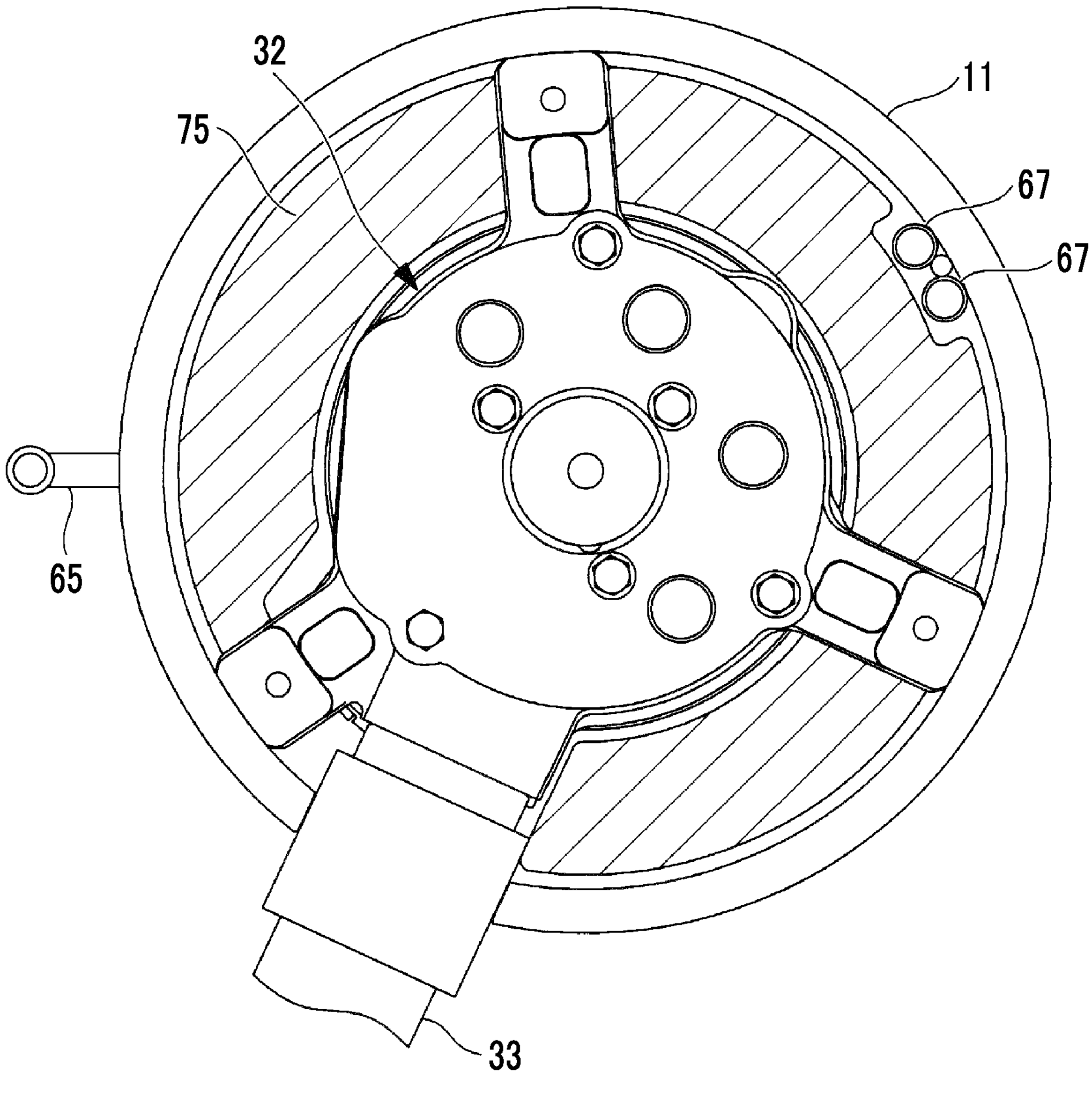


FIG. 11

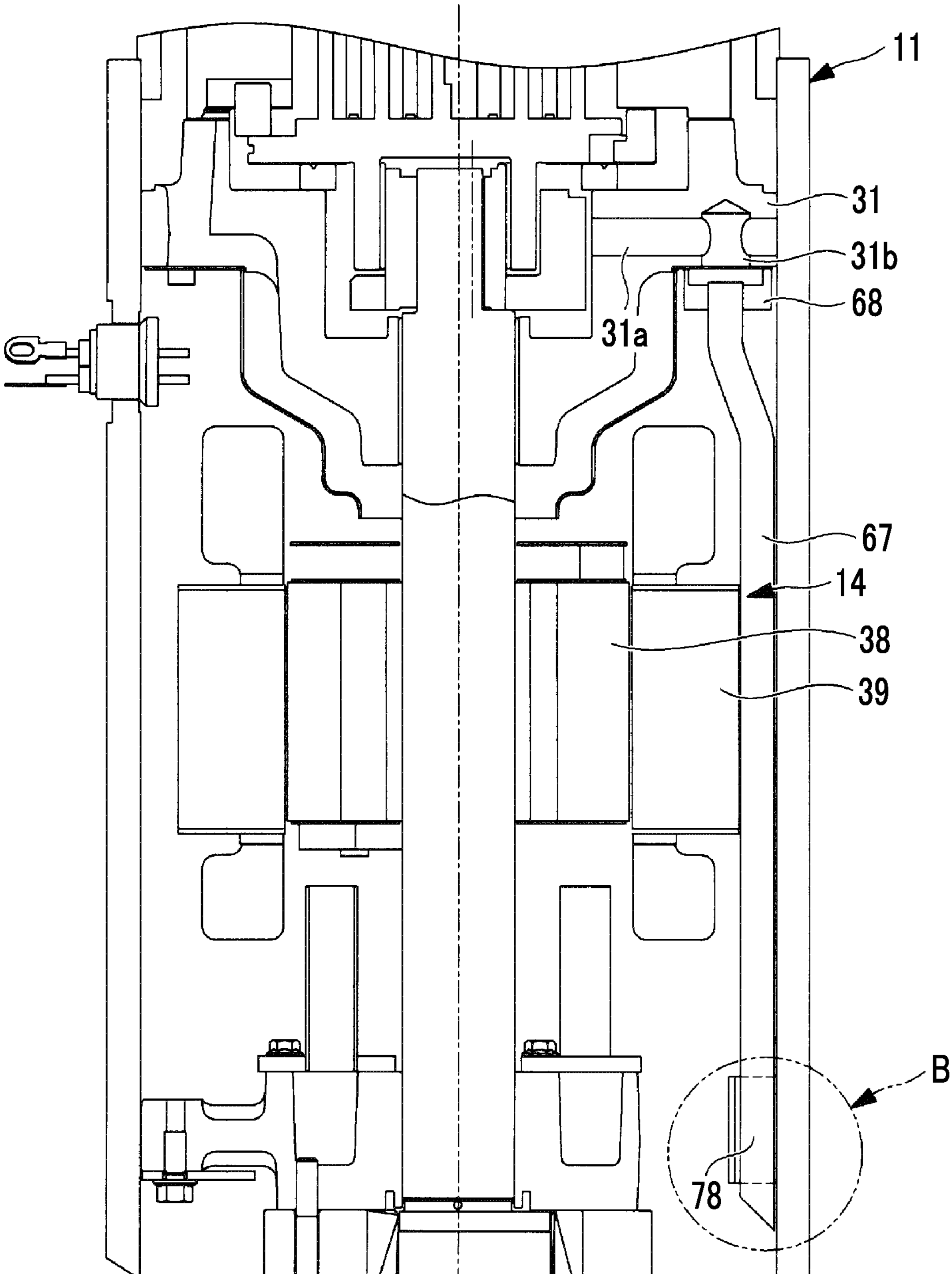


FIG. 12

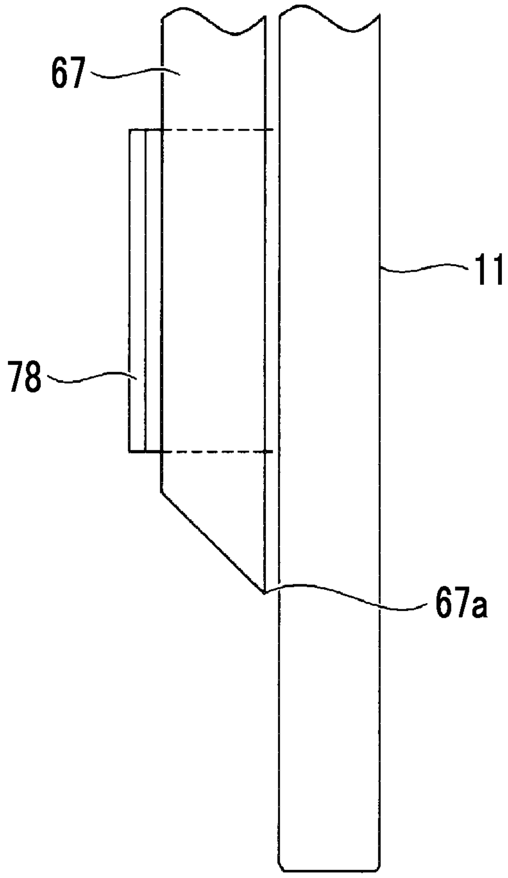


FIG. 13

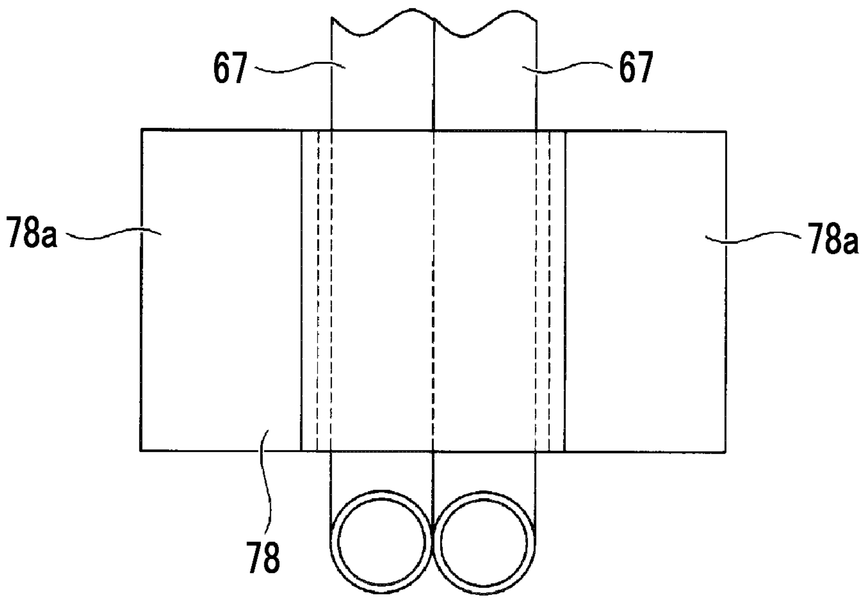
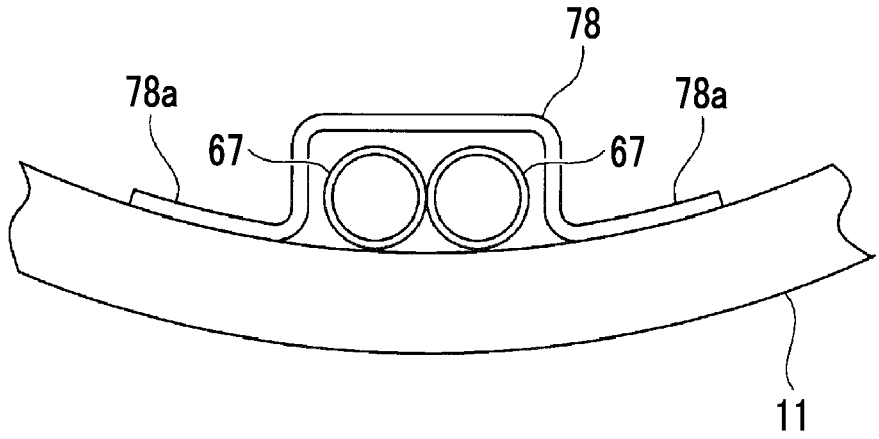


FIG. 14



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/040827

A. CLASSIFICATION OF SUBJECT MATTER

F04C 29/02(2006.01)i; ***F04B 39/02***(2006.01)i
FI: F04B39/02 Y; F04B39/02 X; F04C29/02 361A

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; 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.
A	WO 2020/157792 A1 (MITSUBISHI ELECTRIC CORP.) 06 August 2020 (2020-08-06) entire text, all drawings	1-10
A	JP 2019-39414 A (MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS LTD.) 14 March 2019 (2019-03-14) entire text, all drawings	1-10

☐ 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 December 2022	**10 January 2023**

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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/040827

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2020/157792 A1	06 August 2020	US 2022/0010797 A1 entire text, all drawings GB 2594196 A CN 113396283 A	
JP 2019-39414 A	14 March 2019	EP 3613986 A1 entire text, all drawings CN 110520623 A WO 2019/044419 A1	

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 2018100595 A **[0004]**