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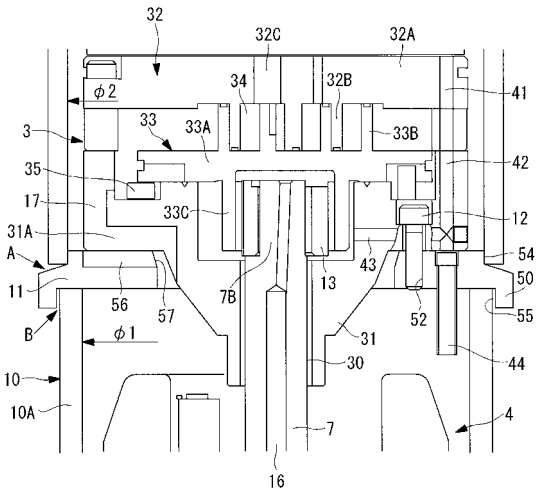
(54) SEALED-TYPE SCROLL COMPRESSOR

(57) An object thereof is, when employing a structure in which a sealed housing is divided, to provide a hermetic scroll compressor that can improve the assembly precision, the manufacturability, and the ease of assembly and that can easily realize housings having different diameters according to the necessity. A sealed housing (10) includes a center housing (10A) in which an electric motor (4) is securely mounted, a ring-like bearing bracket (11) provided at the upper end of the center housing (10A), and an upper housing (10C) provided on the bearing bracket (11) and accommodating a scroll compressor (3) therein. First and second welded portions (54, 55) to which the ends of the center housing (10A) and upper housing (10C) are fitted and to which the housings are welded from the outer circumference side are provided on the outer circumferential portion of the bearing bracket (11), and a bearing case (31) to which the scroll compressor (3) is incorporated is securely mounted on the top surface thereof with bolts (12).

FIG. 2



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Description

Technical Field

[0001] The present invention relates to hermetic scroll compressors in which a sealed housing accommodates a scroll compressor and an electric motor for driving the scroll compressor.

Background Art

[0002] Conventionally, in hermetic scroll compressors, various structures for securely mounting a scroll compressor in a sealed housing have been proposed. Representative examples include a structure in which a bearing case, which is typically provided in scroll compressors, is directly plug-welded or caulked to the sealed housing, and the scroll compressor is mounted thereto, and a structure in which a bearing bracket is welded in the sealed housing, and the bearing case is bolted thereto to mount the scroll compressor thereto.

[0003] A hermetic scroll compressor in which a bearing case is bolted to a bearing bracket to incorporate a scroll compressor therein has a feature that it is not affected by distortion caused by plug welding or caulking, thus making centering easy, though it requires installation of the bearing bracket. A hermetic scroll compressor in which a bearing bracket is directly bonded to the inner circumferential surface of a sealed housing by welding or the like, as shown in Patent Citation 1, and a hermetic scroll compressor in which a sealed housing is divided into upper and lower housings by a bearing bracket disposed therebetween, and the divided upper and lower housings are bonded to the bearing bracket, as shown in Patent Citation 2, have been proposed as examples of the hermetic scroll compressors having the above configuration.

[0004] Patent Citation 1:
Japanese Unexamined Patent Application, Publication No. Hei 5-99168 (see FIG. 1)
Patent Citation 2:
Japanese Unexamined Patent Application, Publication No. 2000-97173 (see FIG. 1)

Disclosure of Invention

[0005] In the hermetic scroll compressor shown in Patent Citation 1, the bearing bracket is bonded to the inner circumferential surface of the sealed housing by welding or the like. In such a configuration, however, the working efficiency is low because the bearing bracket is welded to the inner circumference. In addition, there is a problem in that it is difficult to perform weld bead treatment or finishing of a bearing surface of the bearing bracket where the bearing case is mounted. Thus, there is a problem in that the manufacturability and the assembly precision decrease.
Furthermore, in the hermetic scroll compressor shown in Patent Citation 2, the housings divided into the upper and lower housings are bonded to the bearing bracket. However, Patent Citation 2 does not specifically teach or suggest a bracket structure or a welding structure for easily and efficiently welding the divided housings to the bearing bracket, taking into consideration the working efficiency and the manufacturability, or a configuration utilizing the features achieved by the divided housings. Thus, there are still many problems.

[0006] The present invention has been made in view of the above-described circumstances, and an object thereof is, when a structure in which a sealed housing is divided by disposing a bearing bracket is employed, to provide a hermetic scroll compressor that can improve the assembly precision, the manufacturability, and the ease of assembly and that can easily realize housings having different diameters according to the necessity.

[0007] To solve the above-described problems, the hermetic scroll compressor of the present invention employs the following solutions.
A hermetic scroll compressor of the present invention is a hermetic scroll compressor in which an electric motor is mounted at a lower part in a sealed housing and a scroll compressor driven by the electric motor is mounted at an upper part in the sealed housing. The sealed housing includes a cylindrical center housing that is sealed by a lower housing at the lower end and accommodates the electric motor securely mounted therein, a ring-like bearing bracket provided at the upper end of the center housing, and an upper housing that is provided on the bearing bracket, seals the upper part of the center housing, and accommodates the scroll compressor. The bearing bracket has first and second welded portions provided at an outer circumferential portion thereof, to which ends of the center and upper housings are fitted and to which the housings are welded from the outer circumference side, and a bearing case in which the scroll compressor is incorporated is securely mounted on the top surface of the bearing bracket with bolts.

[0008] In the present invention, because the bearing bracket divides the sealed housing into the center housing accommodating the electric motor and the upper housing accommodating the scroll compressor, finishing of the top surface of the bearing bracket where the bearing case, in which the scroll compressor is incorporated, is securely mounted can be easily performed. That is, it is possible for finishing to be performed after the bearing bracket is welded to the center housing and while the top surface of the bearing bracket is exposed. Thus, it is possible to simplify finishing, such as machining the top surface, and to eliminate the thermal deformation caused by welding. Accordingly, it is possible to increase the assembly precision of the scroll compressor securely mounted on the top surface of the bearing bracket and to improve the manufacturability and ease of assembly thereof. Furthermore, because the ends of the center and upper housings are fitted to the first and second welded portions of the bearing bracket and the housings are

welded from the outer circumference side, it is possible to simplify the welding operation and to eliminate or simplify the weld bead treatment, thereby improving the manufacturability. Furthermore, because it is possible to make the center and upper housings welded to the first and second welded portions through the bearing bracket have different diameters, the diameters of the center and upper housings can be easily differentiated according to the capacity (size) or the like of the electric motor and scroll compressor to be accommodated therein.

[0009] The above-described hermetic scroll compressor of the present invention may be configured such that the bearing bracket has the first welded portion to which the end of the upper housing is fitted from the outside and the second welded portion to which the end of the center housing is fitted from the inside.

[0010] With this configuration, because the upper housing fitted to the first welded portion from the outside can be welded from the outer circumference side to the outer circumferential surface of the bearing bracket to which the center housing is fitted from the inside and is welded to the second welded portion from the outer circumference side, the top surface of the bearing bracket can be finished while the center and upper housings are fitted to the first and second welded portions of the bearing bracket from the outside and the inside, respectively, and are welded from outer circumference side, and while the bearing bracket is welded to the center housing. Accordingly, it is possible to simplify the welding operations and the finishing of the top surface and to eliminate or simplify the weld bead treatment, thereby improving the manufacturability.

[0011] Any one of the above-described hermetic scroll compressors of the present invention may be configured such that the bearing bracket is provided with bolt holes for fixing the bearing case, the bolt holes being processed after the bearing bracket is welded to the center housing.

[0012] With this configuration, because the bolt holes for fixing the bearing case, which are provided in the bearing bracket, are processed after the bearing bracket is welded to the center housing, misalignment of the bolt holes due to thermal deformation during welding or axial misalignment between the bearing bracket and the center housing can be prevented. Accordingly, the ease of assembly and assembly precision of the scroll compressor can be improved.

[0013] Any one of the above-described hermetic scroll compressors of the present invention may be configured such that the top surface of the bearing bracket is provided with at least one gas-channel groove extending radially from the inner circumferential surface toward the outer circumference.

[0014] With this configuration, because the gas channel that introduces intake gas from the center housing side into the scroll compressor is formed of the gas-channel groove provided on the top surface of the bearing bracket so as to extend radially from the inner circumferential surface toward the outer circumference, the intake gas can be introduced from a position closer to the center of the housing. Accordingly, it becomes possible to introduce more gas from the central area where the amount of gas component is large, while avoiding introducing gas from the outer circumferential area of the housing where the oil content tends to be high. Thus, the oil circulation rate (OCR) to the refrigeration cycle side can be reduced.

[0015] The above-described hermetic scroll compressor of the present invention may be configured such that the inner circumferential surface of the bearing bracket is provided with a tapered surface widening upward, at least at the entirety or part of the position where the gas-channel groove is provided.

[0016] With this configuration, because the inner circumferential surface of the bearing bracket is provided with the tapered surface widening upward, at the entirety or part of the position where the gas-channel groove is provided, it is possible to increase the gas channel area and to smoothly guide the intake gas to the radially extending gas-channel groove along the tapered surface. Accordingly, pressure loss of the intake gas in the gas channel can be reduced as much as possible.

[0017] Any one of the above-described hermetic scroll compressors of the present invention may be configured such that the bearing bracket is provided with a slit extending radially from the inner circumferential surface toward the outer circumference, and the slit, by being sealed by the bearing case at the inner circumference side, forms on the outer circumference side a wiring channel for a motor lead wire connected to the electric motor.

[0018] With this configuration, because the bearing bracket is provided with the radially extending slit, and the inner circumference side thereof is closed by the bearing case to form the wiring channel for the motor lead wire on the outer circumference side, it is possible to easily form the wiring channel having a minimum channel area and capable of preventing bypassing of the intake gas, without providing a through-hole. Accordingly, wiring and leading out of the motor lead wire to be connected to the electric motor can be simplified.

[0019] Any one of the above-described hermetic scroll compressors of the present invention may be configured such that the first and second welded portions have diameters different from each other, and the center and upper housings having different diameters are welded to the first and second welded portions.

[0020] With this configuration, because the first and second welded portions of the bearing bracket have diameters different from each other, the center and upper housings having different diameters can be welded thereto. Thus, it becomes possible to make the diameters of the center housing accommodating the electric motor and the upper housing accommodating the scroll compressor different, enabling an electric motor capable of achieving necessary output power or a scroll compressor capable of achieving necessary capacity to be arbitrarily selected, without being limited by the diameters of the housings. Accordingly, it is possible to increase the de-

sign flexibility and expand the extent of use of common components, when selecting the motor capacity or the compressor capacity.

[0021] The above-described hermetic scroll compressor of the present invention may be configured such that the bearing bracket is formed in a shape protruding toward the housing having a smaller diameter among the center and upper housings.

[0022] With this configuration, because the bearing bracket is formed in a shape protruding toward the housing having a smaller diameter, even when the diameters of the center and upper housings are significantly different, it is possible to reduce stress concentration on the bearing bracket and to easily ensure the pressure-resisting strength of the sealed housing. Accordingly, while the present invention can reduce the capacity of the compressor by using high-pressure, high-density refrigerant, it can be effectively applied to a hermetic scroll compressor that requires a high-output electric motor.

[0023] According to the present invention, because finishing can be performed after the bearing bracket is welded to the center housing and while the top surface of the bearing bracket is exposed, it is possible to simplify finishing, such as machining the top surface, and to eliminate the thermal deformation caused by welding. Thus, it is possible to increase the assembly precision of the scroll compressor securely mounted on the top surface of the bearing bracket and to improve the manufacturability and ease of assembly thereof. Furthermore, because the ends of the center and upper housings are fitted to the first and second welded portions of the bearing bracket, and the housings are welded from the outer circumference side, it is possible to simplify the welding operation and to eliminate or simplify the weld bead treatment, thereby improving the manufacturability. Furthermore, because it is possible to make the center and upper housings welded to the first and second welded portions through the bearing bracket have different diameters, the diameters of the center and upper housings can be easily differentiated according to the capacity (size) or the like of the electric motor and scroll compressor to be accommodated therein.

Brief Description of Drawings

[0024]

[FIG. 1] FIG. 1 is a longitudinal sectional view of a two-stage compressor that employs a hermetic scroll compressor according to a first embodiment of the present invention.

[FIG. 2] FIG. 2 is an enlarged longitudinal sectional view of the vicinity of a bearing bracket of the hermetic scroll compressor shown in FIG. 1.

[FIG. 3A] FIG. 3A is a lateral sectional view of the vicinity of the bearing bracket of the hermetic scroll compressor shown in FIG. 2.

[FIG. 3B] FIG. 3B is a view equivalent to the longitudinal cross section of a gas-channel groove portion in the vicinity of the bearing bracket of the hermetic scroll compressor shown in FIG. 2.

[FIG. 4A] FIG. 4A is a longitudinal sectional view of a center housing and the bearing bracket of the hermetic scroll compressor shown in FIG. 2.

[FIG. 4B] FIG. 4B is a right side view of the center housing and the bearing bracket of the hermetic scroll compressor shown in FIG. 2.

[FIG. 5] FIG. 5 is a view equivalent to the cross section taken along line a-a in FIG. 2.

[FIG. 6] FIG. 6 is a view equivalent to the cross section taken along line b-b in FIG. 2.

[FIG. 7] FIG. 7 is a longitudinal sectional view of a two-stage compressor that employs a hermetic scroll compressor according to a second embodiment of the present invention.

[FIG. 8] FIG. 8 is a longitudinal sectional view of a two-stage compressor that employs a hermetic scroll compressor according to a third embodiment of the present invention.

Explanation of Reference:

[0025]

1: two-stage compressor
3: scroll compressor
4: electric motor
10: sealed housing
10A: center housing
10B: lower housing
10C: upper housing
11, 11A: bearing bracket
12: bolt
50B: flange portion (protruding shape)
51: top surface of bearing bracket
52: bolt hole
54: first welded portion
55: second welded portion
56: gas-channel groove
57: tapered surface
58: slit
59: wiring channel
Φ1, Φ3, Φ5: inside diameter of center housing
Φ2, Φ4, Φ6: inside diameter of upper housing

Best Mode for Carrying Out the Invention

[0026] Embodiments of the present invention will be described below with reference to the drawings.

.First Embodiment

[0027] A first embodiment of the present invention will be described below using FIGS. 1 to 6.

[0028] FIG. 1 shows a longitudinal sectional view of a two-stage compressor 1 for refrigeration air-conditioning

that uses a hermetic scroll compressor according to the first embodiment of the present invention. Note that, in this embodiment, for convenience' sake, although a hermetic scroll compressor 3 according to the first embodiment of the present invention will be described taking as an example the two-stage compressor 1, configured by using a rotary compressor 2 on a low-stage side and a scroll compressor 3 on a high-stage side, the present invention is of course applicable to a single-stage hermetic scroll compressor or a multi-stage hermetic scroll compressor in which scroll compressors are used on both the low-stage side and the high-stage side.

[0029] The two-stage compressor 1 using the hermetic scroll compressor 3 includes a sealed housing 10. The sealed housing 10 consists of a cylindrical center housing 10A, a ring-like bearing bracket 11 provided on the center housing 10A and welded thereto over the entire circumference, a lower housing 10B that seals the bottom of the center housing 10A, and an upper housing 10C that seals the top of the center housing 10A and is provided on the bearing bracket 11 and welded thereto over the entire circumference.

[0030] An electric motor 4 consisting of a stator 5 and a rotor 6 is securely mounted at substantially the central part in the center housing 10A. A rotary shaft (crank shaft) 7 is integrally connected to the rotor 6. The rotary compressor 2 on the low-stage side is mounted below the electric motor 4. The rotary compressor 2 on the low-stage side is configured to include a cylinder body 21 that has a cylinder chamber 20 and is securely mounted in the center housing 10A; an upper bearing 22 and a lower bearing 23 that are securely mounted above and below the cylinder body 21 to seal the top and bottom of the cylinder chamber 20; a rotor 24 that is fitted to a crank portion 7A of the rotary shaft 7 and rotates on the inner circumferential surface of the cylinder chamber 20; and a blade and a blade holding spring (not shown) that divide the inside of the cylinder chamber 20 into an intake side and a discharge side.

[0031] This rotary compressor 2 is configured to take in a low-pressure refrigerant gas (working gas) into the cylinder chamber 20 through an intake tube 25, compress the refrigerant gas to an intermediate pressure via rotation of the rotor 24, discharge the gas into discharge chambers 26 and 27 formed thereabove and therebelow using an upper bearing 22 and a lower bearing 23, merge the gas in the discharge chamber 26, and discharge the gas into the center housing 10A. This intermediate-pressure refrigerant gas circulates through a gas channel hole 6A or the like provided in the rotor 6 of the electric motor 4, is guided to a space above the electric motor 4, and is then taken into the scroll compressor 3 on the high-stage side to be subjected to two-stage compression.

[0032] The scroll compressor 3 on the high-stage side is provided in the upper housing 10C. The scroll compressor 3 includes a bearing case 31 (also referred to as a frame member or a support member) that has a bearing 30 for supporting the rotary shaft (crank shaft) 7 and is securely mounted on a top surface 51 of the bearing bracket 11 (see FIGS. 4A and 4B) with bolts 12, and a fixed scroll member 32 and an orbiting scroll member 33 that respectively have spiral-shaped wraps 32B and 33B provided upright on end plates 32A and 33A and that form a pair of compression chambers 34 by being mounted onto the bearing case 31 in such a manner that the spiral-shaped wraps 32B and 33B are meshed with each other.

[0033] Furthermore, the scroll compressor 3 is configured to include an orbit boss portion 33C that connects the orbiting scroll member 33 and an eccentric pin 7B of the rotary shaft 7 through a drive bush 13 to allow the orbiting scroll member 33 to orbitally revolve; a self-rotation preventing mechanism 35 that is provided between the orbiting scroll member 33 and the bearing case 31 to allow the orbiting scroll member 33 to orbitally revolve while preventing self rotation thereof; a discharge reed valve 36 provided on the back surface side of the fixed scroll member 32 to open and close a discharge port 32C; a discharge cover 38 securely mounted on the back surface side of the fixed scroll member 32 so as to surround the discharge reed valve 36 and form an oil-separation chamber 37; an outlet tube 39 connected to the central portion of the discharge cover 38, through which the compressed high-pressure gas is discharged outside; and an oil-separation mechanism 40 that is mounted in the oil-separation chamber 37 and separates oil from compressed gas by centrifugation.

[0034] The scroll compressor 3 is configured to take intermediate-pressure refrigerant gas compressed by the rotary compressor 2 on the low-stage side and discharged into the sealed housing 10 into the compression chambers 34, compress the intermediate-pressure refrigerant gas to a higher pressure state through a compression operation performed by orbital revolution of the orbiting scroll member 33, and then discharge the gas into the oil-separation chamber 37 in the discharge cover 38 through the discharge reed valve 36. This high-temperature, high-pressure refrigerant gas is sent to the outside of the two-stage compressor 1, i.e., toward the refrigeration cycle side, through the outlet tube 39, after oil in the gas is separated by the oil-separation mechanism 40 in the oil-separation chamber 37.

[0035] Furthermore, a known displacement-type oil-supply pump 14 is incorporated between the bottom end of the rotary shaft (crank shaft) 7 and the lower bearing 23 of the rotary compressor 2 on the low-stage side. This displacement-type oil-supply pump 14 is configured to pump up lubricant oil 15 filled in the bottom of the sealed housing 10 and forcibly supply the lubricant oil 15 to portions requiring lubrication, such as bearing portions of the rotary compressor 2 and scroll compressor 3, through an oil-supply hole 16 provided in the rotary shaft 7.

[0036] The oil supplied by the oil-supply pump 14 and lubricating the scroll compressor 3 and the oil separated by the oil-separation mechanism 40 pass through oil drop holes 41, 42, and 43 provided in the fixed scroll member

32 and bearing case 31 and flow from an oil discharge pipe 44 connected to the bearing bracket 11 to the bottom of the sealed housing 10. Note that a pressure-reduction mechanism (not shown) is disposed in the oil drop hole 41 from the oil-separation mechanism 40.

[0037] The configuration of the vicinity of the bearing bracket 11 that divides the sealed housing 10 into upper and lower housings will be described in detail below.

As has been described above, the sealed housing 10 is configured to include the cylindrical center housing 10A accommodating the electric motor 4 and the upper housing 10C accommodating the scroll compressor 3 and sealing the top of the center housing 10A, the housings being welded into a single part with the bearing bracket 11 therebetween.

[0038] As shown in FIGS. 2 to 6, the bearing bracket 11 is a ring-like bracket made of a flat plate and has a flange portion 50 that extends downward at a right angle at the bottom of the outer circumference thereof. The top surface 51 of the bearing bracket 11 serves as a bearing surface where the bearing case 31 of the scroll compressor 3 is securely mounted with the bolts 12, and a plurality of (in this embodiment, six) bolt holes 52 with which the bolts 12 are engaged are bored therein at equal intervals. Furthermore, a pipe hole 53 to which the above-described oil discharge pipe 44 is connected is provided in the top surface 51 of the bearing bracket 11.

[0039] At the outer circumferential portion of the bearing bracket 11, a first welded portion 54 to which the lower end of the upper housing 10C is fitted from the outside is formed on the outer circumference of the upper half portion, and a second welded portion 55 to which the upper end of the center housing 10A is fitted from the inside is formed on the inner circumference of the flange portion 50. The structure is configured such that the ends of the upper housing 10C and center housing 10A are fitted to the first welded portion 54 and the second welded portion 55, respectively, and, in another step, they are welded from the outer circumference side, as indicated by arrows A and B shown in FIG. 2.

[0040] Furthermore, a plurality of gas-channel grooves 56 having a certain depth (see FIG. 3B) and extending radially from the inner circumferential surface toward the outer circumference are provided in the top surface 51 of the bearing bracket 11. These gas-channel grooves 56 guide the gas taken in from the inner circumference side of the bearing bracket 11 toward the outer circumference and, as shown in FIG. 5, constitute intake gas channels 17 that are continuous from the inside of the center housing 10A to the compression chambers 34 of the scroll compressor 3, by being combined with corresponding gas-channel grooves 31A provided in the bottom surface and outer circumferential surface of the bearing case 31 securely mounted on the bearing bracket 11.

[0041] Furthermore, the upper half portion of the inner circumferential surface of the bearing bracket 11 is a tapered surface 57 widening upward. Although this tapered surface 57 can be provided over the entire circumference of the inner circumferential surface (this embodiment), it does not necessarily need to be provided over the entire circumference, and it may be provided at least at a position corresponding to the gas-channel grooves 56. Also with respect to the height direction (thickness direction), not only the upper half portion, but also the entire area in the thickness direction between the top and bottom surfaces may be tapered.

[0042] Furthermore, the bearing bracket 11 has a slit 58 provided radially from the inner circumferential surface toward the outer circumference and penetrating from the top to bottom, at one location on the circumference. As shown in FIG. 6, this slit 58 is configured to be closed at the inner circumference side by the bearing case 31 securely mounted on the bearing bracket 11 and to allow the upper side and lower side of the bearing bracket 11 to communicate with each other at part of the outer circumference side to form a wiring channel 59 through which a motor lead wire 19 (U-V-W wire) for supplying electricity to the electric motor 4 through a glass-sealed terminal 18 (see FIG. 1) passes.

[0043] Furthermore, in the above-described center housing 10A, upper housing 10C, and bearing bracket 11, finishing of the top surface 51 of the bearing bracket 11 (flat-surface machining of the bearing surface) and processing of the bolt holes 52 and pipe hole 53 are performed after one end of the center housing 10A is fitted to the second welded portion 55 of the bearing bracket 11 and is welded over the entire circumference thereof, so that distortion due to thermal deformation during welding, misalignment of the centers of the holes, and the like are prevented. The bearing case 31 is mounted on the thus-finished top surface 51 of the bearing bracket 11, and then, the components of the scroll compressor 3 are mounted thereto. Then, the upper housing 10C is fitted to the first welded portion 54 of the bearing bracket 11 and is welded over the entire circumference thereof.

[0044] Furthermore, the gas-channel grooves 56 and the slit 58 provided in the bearing bracket 11 do not penetrate through to the extreme outer circumferential surface of the bearing bracket 11, so that no portion penetrates through to the outer circumferential surface. Thus, a configuration that can ensure strength against deformation during welding or the like as much as possible is achieved.

Note that, in this embodiment, as shown in FIG. 2, the inside diameter $\Phi 2$ of the upper housing 10C accommodating the scroll compressor 3 is slightly larger than the inside diameter $\Phi 1$ of the center housing 10A accommodating the electric motor 4 ($\Phi 1 < \Phi 2$), and the diameters of the first welded portion 54 and the second welded portion 55 of the bearing bracket 11 have the same relationship. This shows that the divided center housing 10A and the upper housing 10C do not necessarily have to have the same diameters, but they may of course have the same diameters.

[0045] With the above-described configuration, this embodiment provides the following advantages.

Low-temperature, low-pressure refrigerant gas taken into the cylinder chamber 20 of the rotary compressor 2 on the low-stage side through the intake tube 25 is compressed by the rotation of the rotor 24 to an intermediate pressure and is then discharged into the discharge chambers 26 and 27. This intermediate-pressure refrigerant gas is merged in the discharge chamber 26 and is then discharged into the space below the electric motor 4, from where it circulates through the gas channel hole 6A and the like provided in the rotor 6 of the electric motor 4 and flows to the space above the electric motor 4.

[0046] The intermediate-pressure refrigerant gas flowing to the space above the electric motor 4 passes through the intake gas channels 17 formed of the gas-channel grooves 31A and 56 provided in the outer surface of the bearing case 31 and in the top surface 51 of the bearing bracket 11 so as to extend radially from the central region of the center housing 10A, and is taken into the compression chambers 34 formed between the fixed scroll member 32 and the orbiting scroll member 33. This intermediate-pressure refrigerant gas is subjected to two-stage compression to a high-temperature, high-pressure state through a compression operation performed by orbital revolution of the orbiting scroll member 33 and is then discharged from the discharge port 32C into the discharge cover 38 through the discharge reed valve 36.

[0047] In the above-described two-stage compression process, part of the lubricant oil 15 supplied by the oil-supply pump 14 and used for lubricating the rotary compressor 2 is entrained in the refrigerant gas and is discharged into the center housing 10A together with the intermediate-pressure refrigerant gas. Furthermore, part of the lubricant oil 15 supplied to the scroll compressor 3 through the oil-supply hole 16 to lubricate the scroll compressor 3 and flowing down through the oil drop holes 43 and 42 and the oil discharge pipe 44 to the bottom in the sealed housing 10 is entrained in this intermediate-pressure refrigerant gas. Thus, the intermediate-pressure refrigerant gas in which the lubricant oil 15 is entrained is taken into the scroll compressor 3 to be compressed while containing oil. Then, it is turned into a high-temperature, high-pressure gas and is discharged from the discharge port 32C together with the oil.

[0048] This high-temperature, high-pressure compressed gas containing oil is discharged to the refrigeration cycle side from the outlet tube 39 connected to the central portion of the discharge cover 38, after the oil is separated by centrifugation in the centrifugal oil-separation mechanism 40 provided in the oil-separation chamber 37 in the discharge cover 38. Accordingly, the oil circulation rate (OCR) of the lubricant oil 15 circulated to the refrigeration cycle side is reduced, improving the system efficiency and solving the problem of lubricant oil shortage in the compressor 1. The oil separated in the oil-separation chamber 37 is reduced to a low pressure by the pressure-reduction mechanism in the oil drop hole 41 and is allowed to flow through the oil drop hole 42 and the oil discharge pipe 44 to the bottom of the sealed housing 10.

[0049] In the above-described scroll compressor 3, the sealed housing 10 is configured to be divided, above and below the bearing bracket 11 to which the bearing case 31 is securely mounted, into the upper housing accommodating the scroll compressor 3 and the center housing 10A accommodating the electric motor 4. Thus, finishing, such as machining and processing of the bolt holes 52 and pipe hole 53, can be performed after the bearing bracket 11 is welded to the center housing 10A and while the top surface 51 of the bearing bracket 11 is exposed. Thus, it is possible to simplify finishing of the top surface 51 of the bearing bracket 11 and to eliminate distortion due to thermal deformation caused by welding, misalignment between the centers of the bolt holes 52, and the like. Accordingly, it is possible to increase the assembly precision of the scroll compressor 3 securely mounted on the bearing bracket 11 and to improve the manufacturability and ease of assembly thereof.

[0050] Furthermore, because the first welded portion 54 and the second welded portion 55 are provided on the outer circumference of the bearing bracket 11, so that the ends of the upper housing 10C and center housing 10A can be fitted to the first and second welded portions 54 and 55 from the outside and the inside, respectively, and so that the housings 10A and 10C can be welded thereto from the outer circumference side, it is possible to facilitate positioning during welding, as well as the welding operation itself, and to eliminate or simplify the weld bead treatment, thereby improving the manufacturability.

[0051] Furthermore, it is possible to make the center housing 10A and upper housing 10C welded to the first welded portion 54 and the second welded portion 55 through the bearing bracket 11 have different diameters. That is, because the center housing 10A and the upper housing 10C do not necessarily need to have the same diameters, the diameters of the center housing 10A and the upper housing 10C can be appropriately differentiated according to the capacity (size) or the like of the electric motor 4 and scroll compressor 3 to be accommodated therein.

[0052] Furthermore, because the intake gas channels 17 are formed of the plurality of gas-channel grooves 56 provided in the top surface 51 of the bearing bracket 11 so as to extend radially from the inner circumferential surface toward the outer circumference and the gas-channel grooves 31A provided in the outer surface of the bearing case 31 so as to correspond to the gas-channel grooves 56, the intake gas channels 17 having a sufficient channel area can be formed from the central region of the sealed housing 10 toward the outer circumference. Thus, the intake gas in the center housing 10A can be introduced from a position closer to the center of the housing. Accordingly, it becomes possible to introduce more gas from the central area where the amount of gas component is large, while avoiding introducing gas from

the outer circumferential area of the housing where the oil content tends to be high. Thus, the oil circulation rate (OCR) to the refrigeration cycle side can be reduced.

[0053] Furthermore, in addition to the above-described configuration, because the tapered surface 57 widening upward is provided on the inner circumferential surface of the bearing bracket 11, at least at the entirety or part of the position where the gas-channel grooves 56 are provided, the gas channel area can be further increased and the intake gas can be smoothly guided to the radially extending gas-channel grooves 56, i.e., the intake gas channels 17, along the tapered surface 57. Accordingly, pressure loss of the intake gas in the intake gas channels 17 can be reduced as much as possible, thereby increasing the intake efficiency.

[0054] Furthermore, the inner circumference side of the radially extending slit 58 provided in the bearing bracket 11 is closed by the bearing case 31 to form the wiring channel 59 through which the motor lead wire 19 passes on the outer circumference side thereof. Thus, the wiring channel 59 having a minimum channel area and capable of minimizing bypassing of the intake gas can be easily formed without providing a through-hole. Accordingly, there is no need to allow the motor lead wire 19 to pass through a small through-hole, simplifying wiring and leading out of the motor lead wire 19 to be connected to the electric motor 4.

[0055] Furthermore, although the gas-channel grooves 56, the slit 58, etc., are processed in the bearing bracket 11, they do not penetrate through to the extreme outer circumferential surface of the bearing bracket 11, so that no portion penetrates through to the outer circumferential surface. Thus, strength against deformation during welding or the like can be ensured as much as possible. Accordingly, deformation during welding is reduced as much as possible, whereby high assembly precision can be maintained.

Second Embodiment

[0056] Next, a second embodiment of the present invention will be described using FIG. 7.

This embodiment differs from the above-described first embodiment in the inside diameter Φ3 of the center housing 10A and the inside diameter Φ4 of the upper housing 10C. Because the other structures are the same as those in the first embodiment, descriptions thereof will be omitted.

In this embodiment, the inside diameter Φ4 of the upper housing 10C accommodating the scroll compressor 3 is slightly smaller than the inside diameter Φ3 of the center housing 10A accommodating the electric motor 4 (Φ3 > Φ4), and the diameters of the first welded portion 54 and the second welded portion 55 provided on the bearing bracket 11 have the same relationship.

[0057] In this manner, the relationship between the inside diameter Φ3 of the center housing 10A accommodating the electric motor 4 and the inside diameter Φ4 of the upper housing 10C accommodating the scroll compressor 3 can be made Φ3 > Φ4 to make the inside diameter Φ3 of the center housing 10A larger, in contrast to the first embodiment. This makes it easy to implement variations, such as producing hermetic scroll compressors 3 having different performances by combining scroll compressors 3 having the same capacities with electric motors 4 having different specifications or output capacities (sizes). In this case, the use of common components in the scroll compressors 3 can be achieved. The other configurations are the same as those in the first embodiment.

Third Embodiment

[0058] Next, a third embodiment of the present invention will be described using FIG. 8.

[0059] This embodiment differs from the above-described first and second embodiments in that the ratio of the difference in diameter between an inside diameter Φ5 of the center housing 10A and an inside diameter Φ6 of the upper housing 10C is further increased. Because other configurations are the same as those in the first and second embodiments, descriptions thereof will be omitted.

In this embodiment, the inside diameter Φ5 of the center housing 10A accommodating the electric motor 4 is much larger than the inside diameter Φ6 of the upper housing 10C accommodating the scroll compressor 3 (Φ5 >> Φ6).

[0060] Corresponding to the above-described inside diameters Φ5 and Φ6, the diameters of the first welded portion 54 and the second welded portion 55 provided on the bearing bracket 11A have the same relationship.

In this embodiment, to ensure the pressure-resisting strength of the sealed housing 10, the flange portion 50B of the bearing bracket 11A extending in the radial direction corresponding to the size of the inside diameter Φ5 of the center housing 10A is formed in a shape smoothly protruding toward the upper housing 10C having a smaller diameter.

[0061] As has been described above, in the case where the inside diameter Φ5 of the center housing 10A and the inside diameter Φ6 of the upper housing 10C are significantly different (also in the case where the upper housing 10C has a larger diameter, in contrast to this embodiment), by forming the bearing bracket 11A in a shape protruding toward the housing having a smaller diameter, it is possible to reduce stress concentration on the bearing bracket 11A and to easily ensure the pressure-resisting strength of the sealed housing 10. Accordingly, while the invention can reduce the capacity of the compressor by using high-pressure, high-density refrigerant, it can be effectively applied to a hermetic scroll compressor that requires a high-output electric motor.

[0062] Note that, the present invention is not limited to the invention according to the above-described embodiments but may be appropriately modified within a scope not departing from the spirit thereof. For example, al-

though the hermetic scroll compressors 3 according to the above-described embodiments are applicable to refrigeration cycle compressors that use any type of refrigerant (working gas), including R410A refrigerant and CO2 refrigerant, the hermetic scroll compressor 3 according to the third embodiment is particularly suited for use with CO2 refrigerant, which is a high-pressure refrigerant. That is, because the CO2 refrigerant has a high pressure and a high density, it can reduce the capacity of the scroll compressor 3. However, because it requires a high-capacity (high-output) electric motor 4, there is a case where the diameter of the housing accommodating the electric motor 4 has to be increased relative to the diameter of the housing accommodating the scroll compressor 3. The present invention can be effectively applied to such cases.

[0063] Also in the case where a constant-speed electric motor 4 is used, the diameter of the housing accommodating the electric motor 4 increases. Thus, similarly to the above case, the present invention is effective. Furthermore, there is a case where the diameter of the housing accommodating the scroll compressor 3 has to be increased relative to the diameter of the housing accommodating the electric motor. In such a case, the bearing bracket 11 may be formed in a shape smoothly protruding toward the housing accommodating the electric motor. Furthermore, with respect to the first and second welded portions 54 and 55 provided on the bearing bracket 11, they may be configured such that the end of the upper housing 10C is fitted to the first welded portion 54 from the inside, and the center housing 10A is fitted to the second welded portion 55 from the outside. This configuration is also encompassed by the present invention.

Claims

1. A hermetic scroll compressor in which an electric motor is mounted at a lower part in a sealed housing and a scroll compressor driven by the electric motor is mounted at an upper part in the sealed housing,
   wherein the sealed housing includes a cylindrical center housing that is sealed by a lower housing at the lower end and accommodates the electric motor securely mounted therein, a ring-like bearing bracket provided at the upper end of the center housing, and an upper housing that is provided on the bearing bracket, seals the upper part of the center housing, and accommodates the scroll compressor therein, and
   wherein the bearing bracket has first and second welded portions provided at an outer circumferential portion thereof, to which ends of the center and upper housings are fitted and to which the housings are welded from the outer circumference side, and a bearing case in which the scroll compressor is incorporated is securely mounted on the top surface of the bearing bracket with bolts.

2. The hermetic scroll compressor according to claim 1, wherein the bearing bracket has the first welded portion to which the end of the upper housing is fitted from the outside and has the second welded portion to which the end of the center housing is fitted from the inside.

3. The hermetic scroll compressor according to claim 1 or 2,
   wherein the bearing bracket is provided with bolt holes for fixing the bearing case, the bolt holes being processed after the bearing bracket is welded to the center housing.

4. The hermetic scroll compressor according to any one of claims 1 to 3,
   wherein the top surface of the bearing bracket is provided with at least one gas-channel groove extending radially from the inner circumferential surface toward the outer circumference.

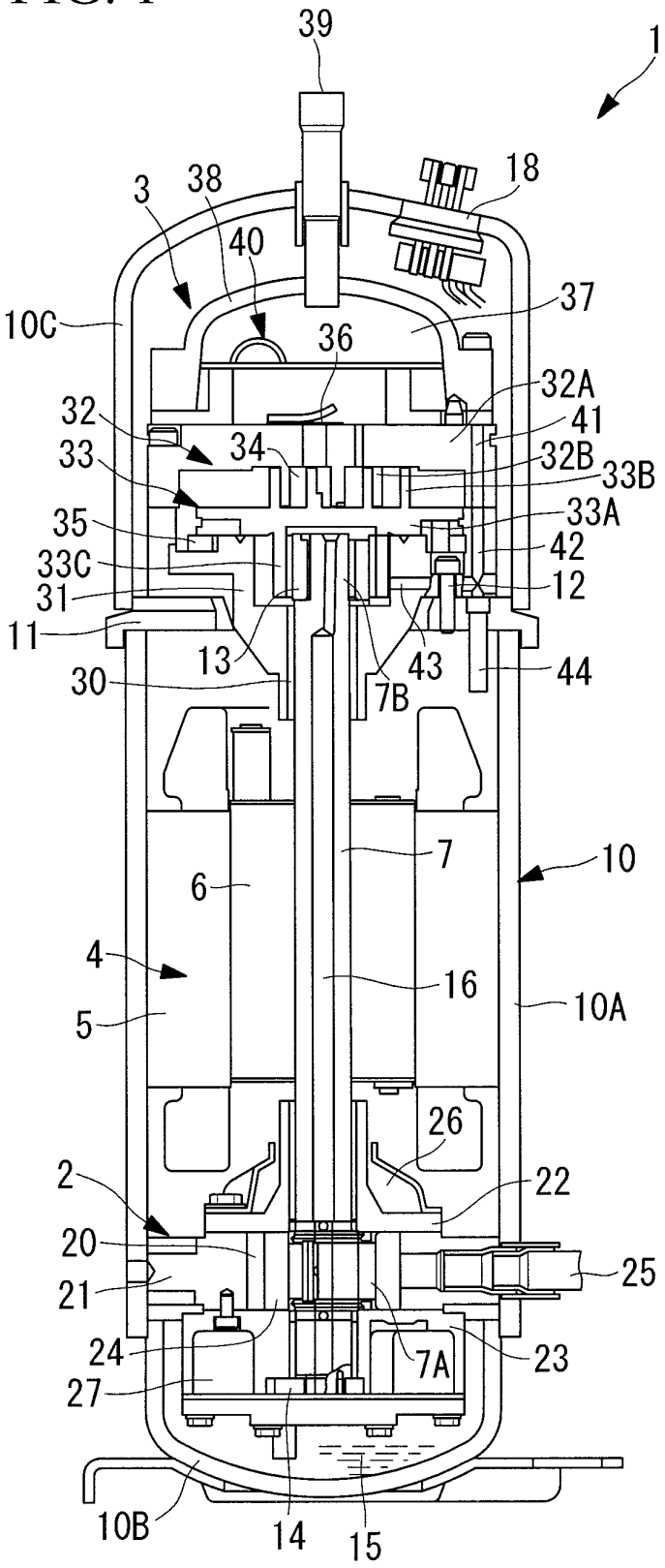
5. The hermetic scroll compressor according to claim 4, wherein the inner circumferential surface of the bearing bracket is provided with a tapered surface widening upward, at least at the entirety or part of the position where the gas-channel groove is provided.

6. The hermetic scroll compressor according to any one of claims 1 to 5,
   wherein the bearing bracket is provided with a slit extending radially from the inner circumferential surface toward the outer circumference, and the slit, by being sealed by the bearing case at the inner circumference side, forms on the outer circumference side a wiring channel for a motor lead wire connected to the electric motor.

7. The hermetic scroll compressor according to any one of claims 1 to 6,
   wherein the first and second welded portions have diameters different from each other, and the center and upper housings having different diameters are welded to the first and second welded portions.

8. The hermetic scroll compressor according to claim 7, wherein the bearing bracket is formed in a shape protruding toward the housing having a smaller diameter among the center and upper housings.

FIG. 1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10B
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FIG. 2

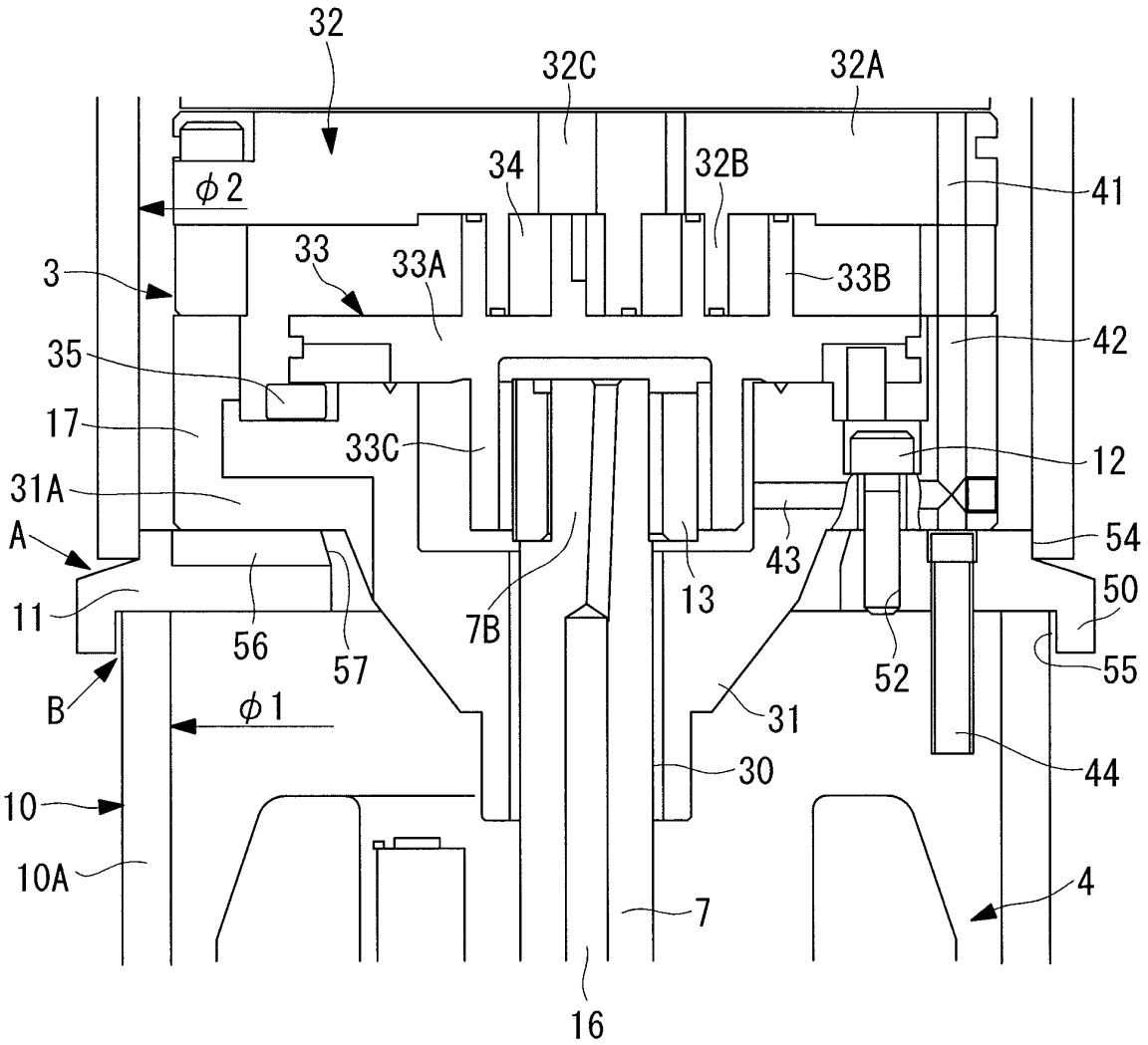
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FIG. 3A

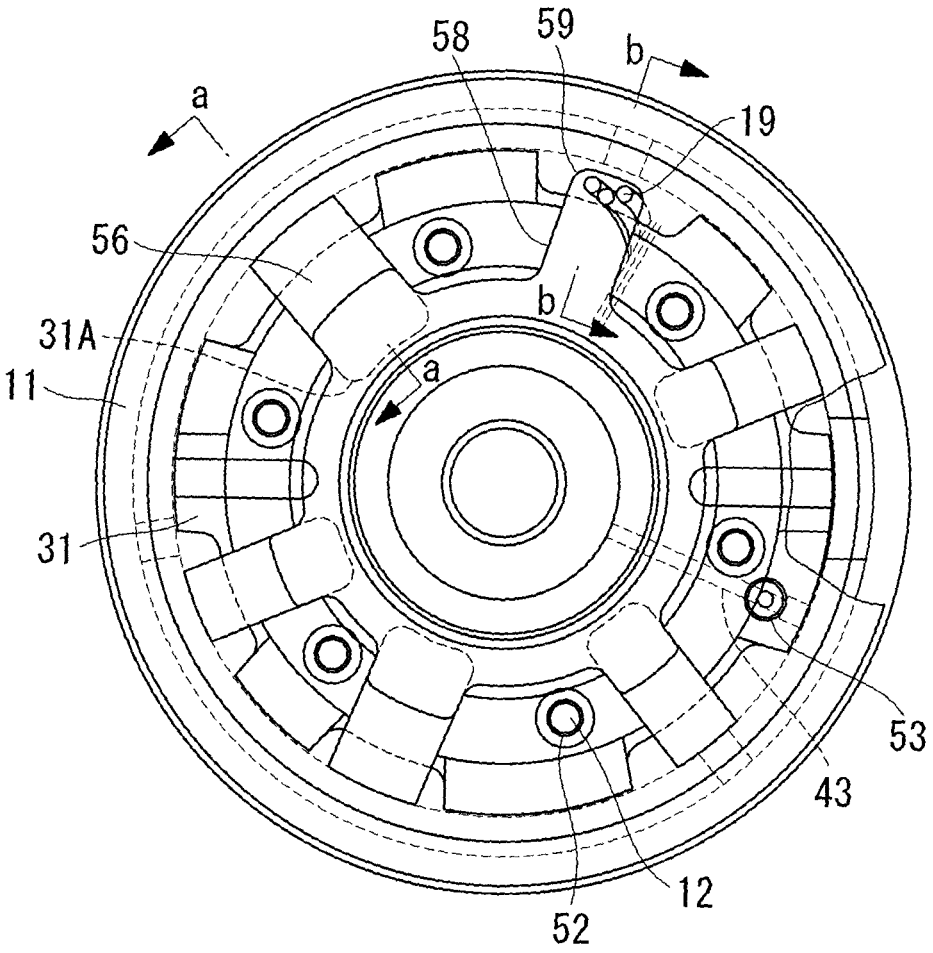


FIG. 3B

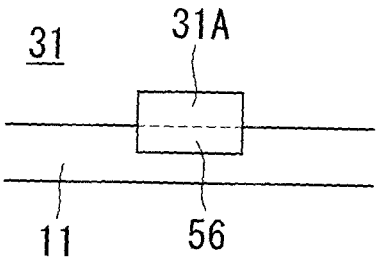


FIG. 4A

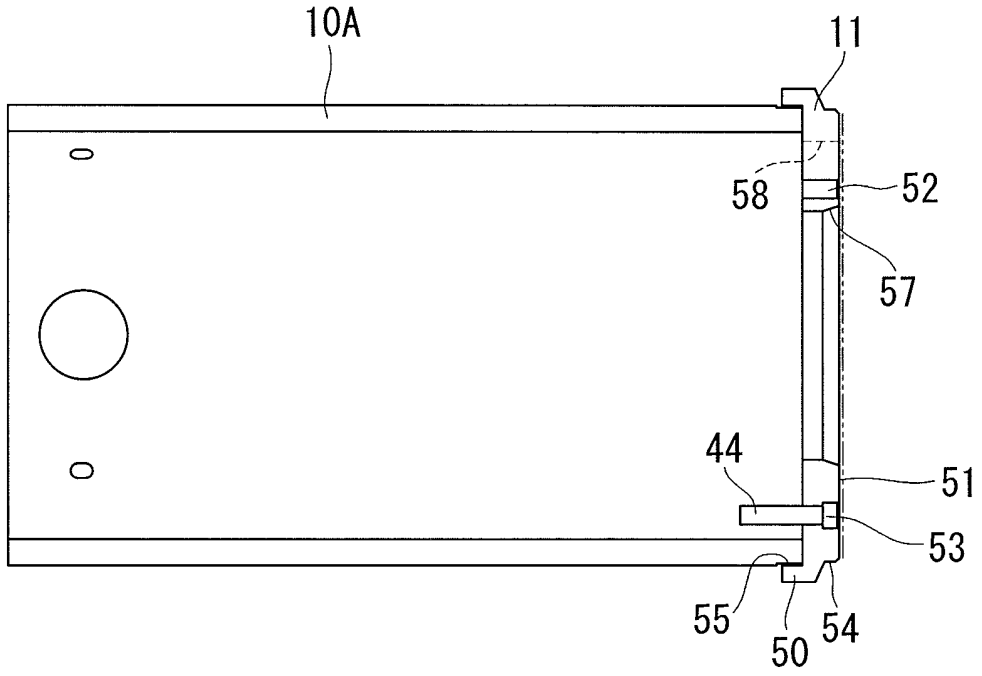


FIG. 4B

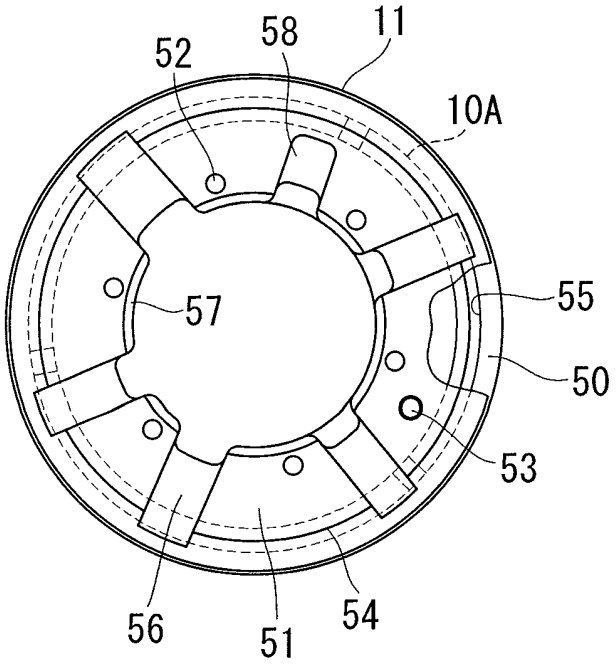


FIG. 5

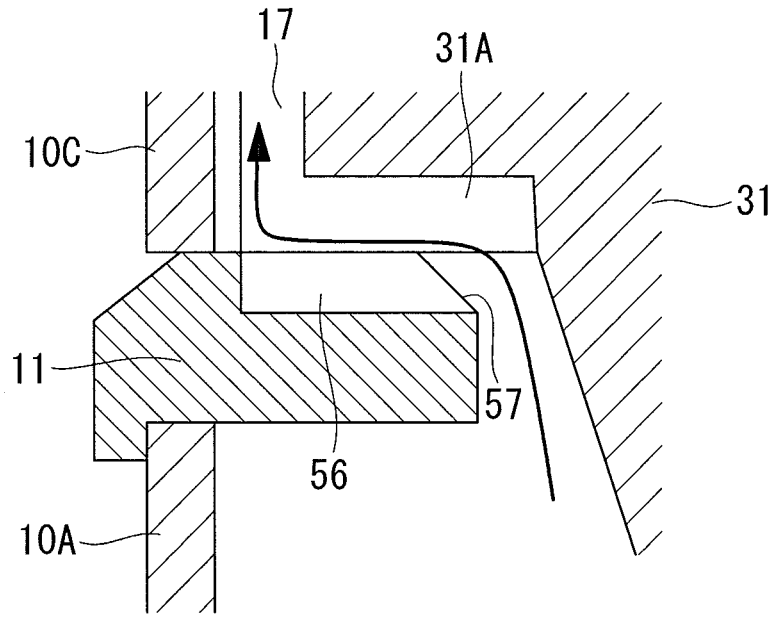


FIG. 6

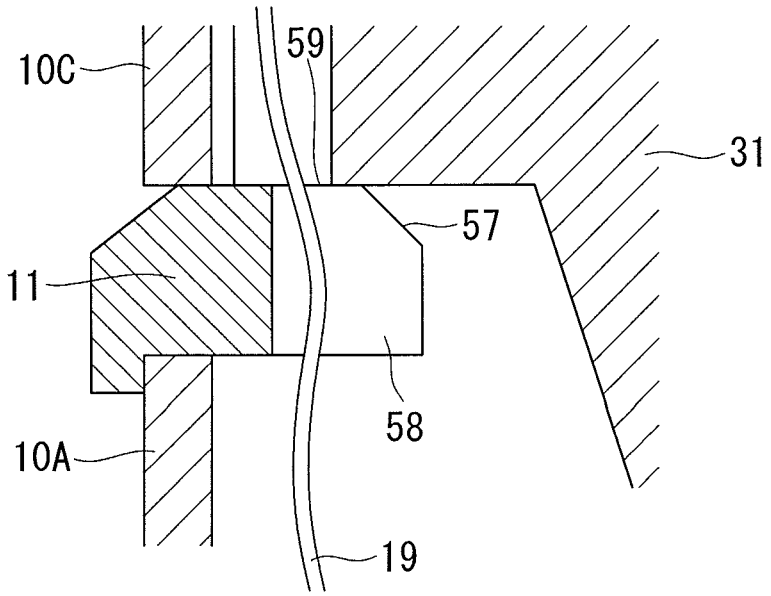


FIG. 7

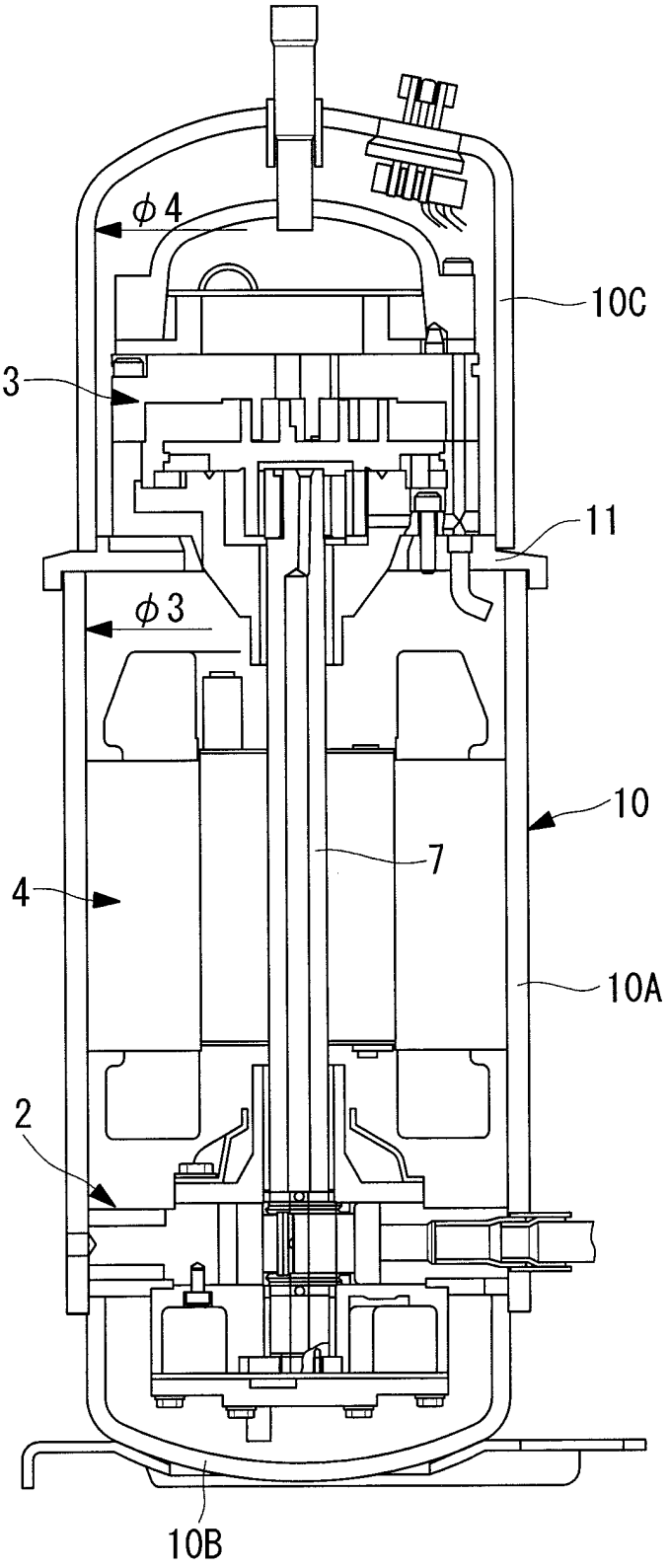
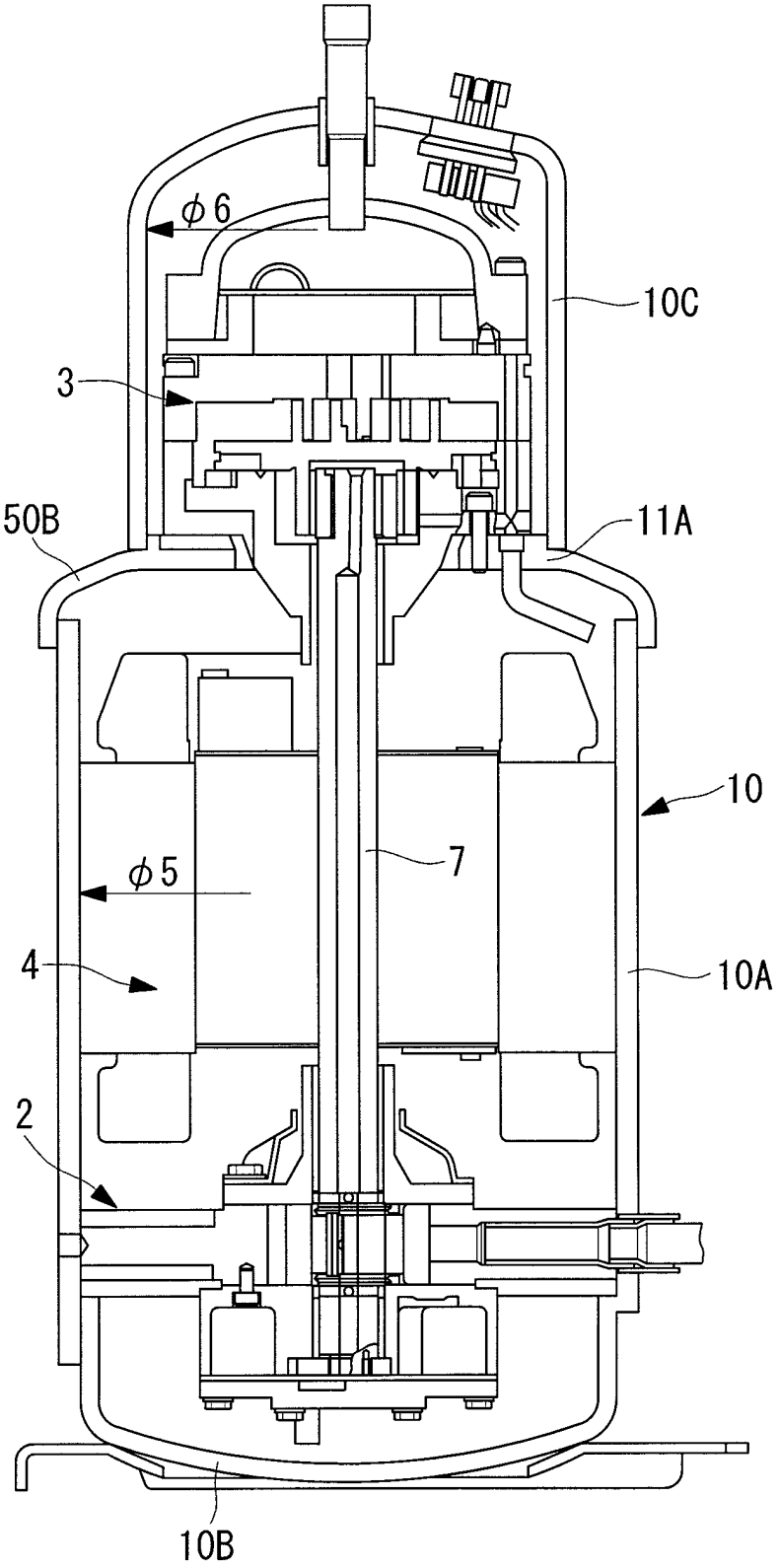


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/050861

A. CLASSIFICATION OF SUBJECT MATTER
F04C18/02(2006.01)i, *F04C23/02*(2006.01)i, *F04C29/00*(2006.01)i

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)
F04C18/02, F04C23/02, F04C29/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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 A	JP 2000-97173 A (Daikin Industries, Ltd.), 04 April, 2000 (04.04.00), Par. No. [0013]; Figs. 1, 9 (Family: none)	1-3,7 4-6,8
Y	JP 2001-263273 A (Fujitsu General Ltd.), 26 September, 2001 (26.09.01), Par. Nos. [0018], [0021]; Figs. 1 to 3 (Family: none)	1-3,7
Y	JP 2000-213472 A (Matsushita Electric Industrial Co., Ltd.), 02 August, 2000 (02.08.00), Full text; all drawings (Family: none)	7

☒ 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
09 April, 2009 (09.04.09)	21 April, 2009 (21.04.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/050861

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-118364 A (Matsushita Electric Industrial Co., Ltd.), 11 May, 2006 (11.05.06), Full text; all drawings (Family: none)	7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP HEI599168 B **[0004]**
- JP 2000097173 A **[0004]**