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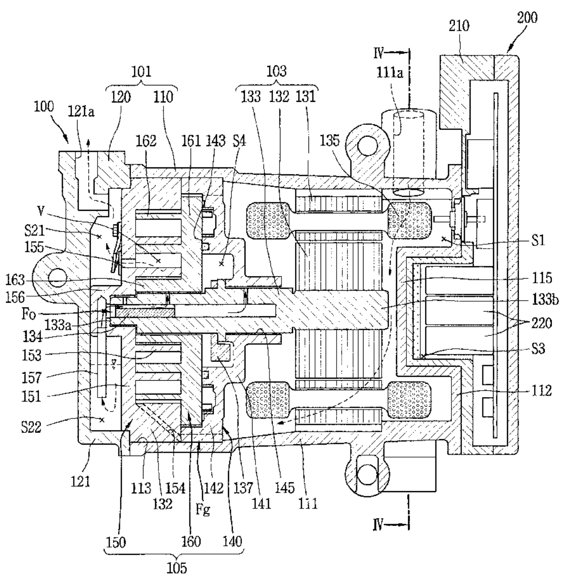
(54) **MOTOR-OPERATED COMPRESSOR**

(57) A motor-operated compressor includes a casing having a sealed internal space, a first scroll fixed in a radial direction in the internal space of the casing, a second scroll engaged with the first scroll to make an orbiting motion to form a pair of two compression chambers with the first scroll, a frame fixed on the opposite side of the first scroll in a radial direction with the second scroll interposed therebetween, a driving motor provided on the opposite side of the second scroll with the frame interposed therebetween, and a rotary shaft having a first end portion coupled to the second scroll in an off-centered manner and a second end portion coupled to the driving motor and transmitting a rotational force from the driving motor to the second scroll, wherein the first end portion of the rotary shaft forms a fixed end supported in the radial direction by members positioned on both sides of the second scroll in an axial direction and the second end portion of the rotary shaft forms a free end coupled to a rotor of the driving motor on the opposite side of the first end portion with respect to the frame.

FIG. 2



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Description

[0001] The present disclosure relates to a compressor, and more particularly, to a motor-operated compressor mainly applied to vehicles including electric vehicles.

[0002] Generally, compressors for compressing a refrigerant in automotive air conditioning systems have been developed in various forms. Recently, motor-operated compressors driven by electricity using motors have been actively developed as automotive parts tend portion to become electronic/electric components.

[0003] Among motor-operated compressors, a scroll compression method suitable for a high compression ratio operation is mainly applied. In the scroll type motor-operated compressor, a motor unit formed as a rotary motor is installed inside a closed casing, a compression unit including a fixed scroll and an orbiting scroll is installed on one side of the motor unit, and the motor unit and the compression unit are connected by a rotary shaft so that a rotational force of the motor unit is transmitted to the compression unit. The rotational force transmitted to the compression unit causes the orbiting scroll to make a rotating movement with respect to the fixed scroll to form a pair of two compression chambers composed of a suction chamber, an intermediate pressure chamber, and a discharge chamber, allowing a refrigerant to be sucked into both compression chamber, compressed, and simultaneously discharged.

[0004] In addition, an inverter type compressor in which an operation speed of a motor is variable, as well as a constant speed motor, has also been developed as a motor-operated compressor. In the inverter-type motor-operated compressor, an inverter is mounted on the outer circumferential surface or one side surface of a casing, and the inverter is electrically connected to a motor provided inside the casing using a terminal penetrating through the casing.

[0005] Meanwhile, the scroll type compressor applied to automotive air conditioning systems is mainly installed as a horizontal type in terms of an engine room structure of a vehicle. Thus, as the motor unit and the compression unit are arranged in a horizontal direction and connected by a rotary shaft, a main frame and a subframe for supporting the rotary shaft are respectively provided on both sides of the motor unit in the horizontal direction.

[0006] However, in the related art motor-operated compressor as described above, since the motor unit is positioned on one side of the compression unit and the main frame and the sub-frame are positioned on both sides of the motor unit in an axial direction, a length of the compressor in the axial direction is increased.

[0007] Also, in the related art motor-operated compressor, in the case of a low pressure type, the inverter is provided on the side where the subframe is provided but a low-temperature refrigerant sucked into an internal space of the casing may not be sufficiently in contact with a surface to which the inventor is combined due to the sub-frame. As a result, the refrigerant may not effectively cool the inverter and the inverter may be overheated to degrade compressor efficiency.

[0008] In addition, in the related art motor-operated compressor, oil is separated from a refrigerant discharged from a compression chamber to a discharge space and supplied to the compression chamber or a bearing surface through an oil supply passage provided in a scroll or frame. However, it is difficult to form the oil supply passage in the scroll or frame and the oil supply passage is lengthened, and thus, when the compressor starts, oil may not be supplied rapidly to cause frictional loss.

[0009] Also, in the related art motor-operated compressor, a rotary shaft is supported by a ball bearing. However, cost and operational noise are increased due to the ball bearing and, as a space between the compression unit and the bearing is increased, an orbiting scroll is increasingly tilted to increase leakage of a refrigerant from the compression chamber.

[0010] Further, in the related art motor-operated compressor, the compression chamber is formed only on one side of the orbiting scroll, a rear surface of the orbiting scroll is supported by a back pressure. Here, a behavior of the orbiting scroll becomes unstable due to a differential pressure generated between the back pressure of a backing space and a gas force in an axial direction in the compression chamber, and thus, a high speed operation is restricted and compression efficiency is degraded due to leakage of a refrigerant.

[0011] Therefore, an aspect of the detailed description is to provide a motor-operated compressor reduced in length in an axial direction as a rotary shaft is supported by one side of a motor unit in the axial direction.

[0012] Another aspect of the detailed description is to provide a motor-operated compressor in which a space between an intake guiding a suction refrigerant to an internal space of a casing and an inverter is narrowed so that the sucked refrigerant effectively cools the suction refrigerant.

[0013] Another aspect of the detailed description is to provide a motor-operated compressor in which an oil supply passage guiding oil to a sliding portion is easily formed and oil may be rapidly supplied.

[0014] Another aspect of the detailed description is to provide a motor-operated compressor in which cost due to a bearing supporting a rotary shaft is reduced, operating noise is reduced, and leakage of a refrigerant in a compression chamber is reduced by reducing a gap between a compression unit and the bearing.

[0015] Another aspect of the detailed description is to provide a motor-operated compressor in which compression chambers are formed on both sides of an orbiting scroll so that a behavior of the orbiting scroll may be stabilized even without a separate backing space.

[0016] The invention defined in the appended independent claim achieves these and other advantages in accordance with the purpose of this specification. According to the disclosure of this specification, there is provided a motor-operated compressor in which a plurality of scrolls are supported inside a casing, a rotary shaft transmitting rotational force of a driving motor is coupled to any one of the plurality of scrolls, and a portion of the casing is recessed toward the driving motor in an axial direction.

[0017] Here, at one end of the rotary shaft, a plurality of bearing portions supported in a radial direction on the opposite of the driving motor with respect to the frame may be spaced apart from each other by a predetermined distance in the axial direction.

[0018] There may be provided a motor-operated compressor include: a casing having a sealed internal space; a first scroll fixed in a radial direction in the internal space of the casing; a second scroll engaged with the first scroll to make an orbiting motion to form a pair of two compression chambers with the first scroll; a frame fixed on the opposite side of the first scroll in a radial direction with the second scroll interposed therebetween; a driving motor provided on the opposite side of the second scroll with the frame interposed therebetween; and a rotary shaft having a first end portion coupled to the second scroll in an off-centered manner and a second end portion coupled to the driving motor and transmitting a rotational force from the driving motor to the second scroll, wherein the first end portion of the rotary shaft forms a fixed end supported in the radial direction by members positioned on both sides of the second scroll in an axial direction and the second end portion of the rotary shaft forms a free end coupled to a rotor of the driving motor on the opposite side of the first end portion with respect to the frame.

[0019] The first end portion of the rotary shaft may be inserted into the first scroll through the frame and the second scroll, and the first end portion of the rotary shaft may be supported by the frame and the first scroll in the radial direction.

[0020] The first end portion of the rotary shaft may be inserted into the casing through the frame, the second scroll, and the first scroll, and the first end portion of the rotary shaft may be supported by the frame and the casing in the radial direction.

[0021] In the driving motor, a stator surrounding the rotor may be coupled to the casing, the stator is wound around with a winding coil, and an end of the second end portion of the rotary shaft may be positioned within an axial range of the winding coil.

[0022] One side surface of the casing may protrude toward the driving motor to form an inverter accommodating portion, and at least a portion of an inverter housing accommodating an inverter device may be inserted into the inverter accommodating portion.

[0023] At least a portion of the inverter accommodating portion may be positioned within an axial range of the winding coil.

[0024] An intake port communicating with a suction tube may be formed in a space in which the driving motor is provided with respect to the frame in the internal space of the casing, and at least a portion of the inverter accommodating portion may be positioned in a range overlapping the intake port in the radial direction.

[0025] The rotary shaft may have an oil supply recess formed to have a predetermined length in the axial direction from an end of the first end portion, and a plurality of oil supply holes may be formed in the oil supply recess and spaced apart from each other in the axial direction to face each bearing portion and each eccentric portion.

[0026] The oil supply recess may have a decompression member for decompressing pressure of oil.

[0027] A first orbiting wrap and a second orbiting wrap may be formed on both axial sides of the second scroll, and a first fixed wrap is formed in the first scroll to be engaged with the first orbiting wrap to form a first compression space and a second fixed wrap is formed in the frame to be engaged with the wrap and the second orbiting wrap to form a second compression space.

[0028] The internal space of the casing may be divided into a first space in which the driving motor is provided and a second space opposite to the first space with respect to the frame, and discharge ports may be respectively formed at the frame and the first scroll such that a refrigerant compressed in each compression chamber is discharged toward the first space and the second space of the casing.

[0029] The frame may have a discharge guide separated from the first space and guiding the refrigerant discharged from the discharge port to the second space.

[0030] A plurality of pin holes may be formed in the second scroll, and a pin member forming an anti-rotation portion of the second scroll may be fixedly coupled to the first scroll and the frame by rotatably penetrating through each of the plurality of pin holes.

[0031] A plurality of protrusions may protrude in a radial direction from an outer circumferential surface of the second scroll, and the pin hole may be formed in each of the plurality of protrusions.

[0032] There may be provided a motor-operated compressor include: a casing having a sealed internal space; a first scroll fixed in a radial direction in the internal space of the casing; a second scroll engaged with the first scroll to make an orbiting motion to form a pair of two compression chambers with the first scroll; a frame fixed on the opposite side of the first scroll in a radial direction with the second scroll interposed therebetween; a driving motor provided on the opposite side of the second scroll with the frame interposed therebetween; and a rotary shaft transmitting a rotational force from the driving motor to the second scroll, wherein the rotary shaft is supported in a radial direction on both sides in an axial direction with the second scroll interposed therebetween.

[0033] A first end portion of the rotary shaft may have an eccentric portion coupled to the second scroll in an off-centered manner, a first bearing portion and a second bearing portion may be formed on both sides of the eccentric portion in the axial direction, the first bearing portion and the second bearing portion may be formed to have the same axial central line, and the eccentric portion may have an axial central line different from those of the first bearing portion and the second bearing portion.

[0034] The first scroll may have a bearing accommodating protrusion protruding toward the casing and accommodating the second bearing portion of the rotary shaft.

[0035] The casing may have a bearing accommodating protrusion protruding toward the first scroll and accommodating the second bearing portion of the rotary shaft.

[0036] At least one of the first bearing portion and the second bearing portion may be supported by a bush bearing.

[0037] In the motor-operated compressor according to the present invention, since the bearing portion supporting the rotary shaft in the radial direction is provided only on one side of the driving motor, an axial length of the compressor as a whole may be reduced as compared with a case where the bearing portions are formed at both ends of the rotary shaft.

[0038] In addition, since only one of both ends of the rotary shaft is supported in the radial direction and the other end portion is formed as a free end in the radial direction, the length of the rotary shaft protruding from the driving motor may be minimized. Accordingly, since the inverter accommodating portion is disposed close to the driving motor, the possibility of contact between the inverter accommodating portion and a sucked refrigerant may be increased to effectively cool the inverter.

[0039] Further, as the oil supply passage is formed in a penetrating manner in the rotary shaft, the length of the oil supply passage for supplying oil to each bearing portion may be reduced, whereby oil is rapidly supplied to each bearing portion when the compressor starts, reducing frictional loss.

[0040] Further, since the rotary shaft is supported in the radial direction using the bush bearing, cost due to the bearing may be lowered, operating noise may be reduced, and a gap between the compression unit and the bearing may be reduced to reduce leakage of a refrigerant in the compression chamber.

[0041] Further, since the compression chambers are formed on both sides of the orbiting scroll, bearing power with respect to the orbiting scroll in the axial direction may be increased, while a backing space is excluded, the behavior of the orbiting scroll is stabilized to allow for a high-speed operation, and leakage of a refrigerant may be effectively suppressed.

[0042] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate exemplary embodiments and together with the description serve to explain the principles of the invention.

[0043] In the drawings:

FIG. 1 is an exploded perspective view illustrating a compressor module and an inverter module in a motor-operated compressor according to an embodiment of the present invention;

FIG. 2 is an assembled cross-sectional view illustrating an internal structure of the compressor module and the inverter module in the motor-operated compressor of FIG. 1;

FIG. 3 is a cross-sectional view taken along line IV-IV in FIG. 2, illustrating a relationship between an intake port and an inverter accommodating portion, and FIG. 4 is an enlarged cross-sectional view illustrating the periphery of a driving motor;

FIGS. 5 and 6 are views illustrating a rotary shaft, wherein FIG. 5 is a cross-sectional view illustrating a support state of the rotary shaft and FIG. 6 is a cross-sectional view taken along line V-V in FIG. 5;

FIG. 7 is an enlarged cross-sectional view of a compression mechanism unit in the motor-operated compressor of FIG. 2;

FIG. 8 is a plan view illustrating a state in which a fixed wrap and an orbiting wrap are engaged in a compression mechanism unit according to the present embodiment;

FIG. 9 is a cross-sectional view illustrating a motor-operated compressor having a double-sided scroll according to the present invention;

FIG. 10 is an enlarged cross-sectional view illustrating a coupled state of an anti-rotation member in FIG. 9;

FIG. 11 is a cross-sectional view illustrating a second scroll in FIG. 9;

FIG. 12 is a cross-sectional view illustrating a low-pressure scroll compressor to which A double-sided scroll is applied; and

FIG. 13 is a cross-sectional view illustrating another embodiment of a support structure of a rotary shaft in a motor-operated compressor according to the present invention.

[0044] Description will now be given in detail of the exemplary embodiments, with reference to the accompanying drawings. For the sake of brief description with reference to the drawings, the same or equivalent components will be provided with the same reference numbers, and description thereof will not be repeated.

[0045] Hereinafter, a motor-operated compressor according to the present invention will be described in detail with reference to an embodiment illustrated in the accompanying drawings.

[0046] FIG. 1 is an exploded perspective view illustrating a compressor module and an inverter module in a motor-operated compressor according to an embodiment of the present invention, and FIG. 2 is an assembled cross-sectional view illustrating an internal structure of the compressor module and the inverter module in the motor-operated compressor of FIG. 1.

[0047] As illustrated in FIGS. 1 and 2, a low-pressure electric scroll compressor (hereinafter, referred to as a 'motor-operated compressor') 1 according to the present embodiment includes a compressor module 100 for sucking, compressing and discharging a refrigerant, and an inverter module 200 detachably coupled to one side the compressor module 100 to control a rotational speed of a driving motor 103 (to be described later).

[0048] The compressor module 100 is provided with a first sealing terminal 107 and the inverter module 200 is provided with a second sealing terminal 201. The first sealing terminal 107 is exposed to the outside of the compressor module 100 and the second sealing terminal is exposed to the outside of the inverter module 200 so that the first sealing terminal 107 and the second sealing terminal 201 may be detachably attached to each other.

[0049] Meanwhile, the inverter module 200 is provided to be in contact with a portion of the compressor casing 101 that forms a suction space S1. Accordingly, heat generated in an inverter device 220 of the inverter module 200, and the like, may be dissipated quickly by the cold refrigerant sucked into the suction space S1.

[0050] In addition, the inverter module 200 includes an inverter housing 210 having a predetermined internal volume. At least one inverter element 220 for controlling a rotational speed of the driving motor 103, as well as the second sealing terminal 201 described above, is accommodated in the inverter housing 210 as well as the second sealing terminal 201 described above.

[0051] The compressor module 100 includes a driving motor 103 serving as a motor unit and a compression mechanism unit 105 for compressing a refrigerant using a rotational force of the driving motor 103.

[0052] The compressor casing 101 is provided with an intake port 111a to which a suction pipe is connected and an exhaust port 121a to which a discharge pipe is connected. The suction space S1 communicates with the intake port 111a, a discharge space S2 communicates with the discharge port 121a. The driving motor 103 is installed in the suction space S1, and the compressor of the present embodiment is a low pressure compressor.

[0053] The compressor casing 101 includes a main housing 110 in which the driving motor 103 is installed and a rear housing 120 coupled to an open rear end portion of the main housing 110. An internal space of the main housing 110 forms the suction space S1 together with one side of the compression mechanism unit 105 and an internal space of the rear housing 120 forms the discharge space S2 together with the other surface of the compression mechanism unit 105.

[0054] On one side of the discharge space S2, the exhaust port 121a described above may be formed on one side of a rear housing body 121 and an oil separator (not shown) for separating oil from a discharged refrigerant may be installed inside the exhaust port 121a or near the exhaust port 121a. Also, an oil separating portion S21 for separating oil from the refrigerant discharged from the compression chamber may be formed on an upper portion of the discharge space S2, and an oil storage portion S22 storing oil separated from the discharge space S2 may be formed in a lower portion of the discharge space S2. The oil storage portion S22 communicates with the compression mechanism unit 105 through an oil supply passage Fo. An oil supply structure will be described later.

[0055] The main housing 110 has a cylindrical portion 111 formed in a cylindrical shape and a front end portion of the cylindrical portion 111 integrally extends to form a sealing portion 112. A rear end portion of the cylindrical portion 111 has an opening 113 which is open. The inverter module 200 is coupled to an outer surface of the sealing portion 112 and the compression mechanism unit 105 is coupled to the opening 113 to seal the suction space S1.

[0056] In the main housing 110, an inner diameter of a front end portion thereof and an inner diameter of a rear end portion thereof may be equal. Here, in consideration of withdrawing of a mold core when a mold of the main housing 110 is manufactured, the inner diameter of the rear end, an opened side, and an inner diameter of the front end, a closed side, may be formed to be greater.

[0057] In the sealing portion 112 of the main housing 110, an inverter accommodating portion 115 protruding from an inner central portion toward the opening 113 and forming the inverter accommodation space S3 may be formed. The inverter accommodating portion 115 is a space for accommodating an inverter heat dissipation protrusion 211 of the inverter housing 210 and recessed with a height (or depth) in which the inverter accommodating portion 115 overlaps the intake port 111a in a radial direction. Accordingly, a contact area in which the cold refrigerant sucked into the suction space S1 through the intake port 111a and the sealing portion 112 is increased by the inverter accommodating portion 115, increasing a heat dissipation effect for the inverter device. This will be described again when the driving motor and the rotary shaft are described.

[0058] Meanwhile, the driving motor 103 constituting a motor unit is press-fit to be coupled inside the main housing 110. The driving motor 103 includes a stator 131 fixed to the inside the main housing 110 and a rotor 132 positioned inside the stator 131 and rotated according to an interaction with the stator 131.

[0059] The stator 131 is shrinkage-fit to an inner circumferential surface of the main housing 110. An outer circumferential surface of the stator 131 is formed to be D-cut to form a coolant passage between the outer circumferential surface of the stator 131 and am inner circumferential surface of the compressor casing (hereinafter, referred to as a 'casing') 110. Accordingly, the refrigerant sucked through the intake port 111a may be guided to the compression chamber V through a suction flow path 154 of a first scroll 150 (to be described).

[0060] The stator 131 includes a stator core 131a formed by laminating a plurality of thin annular steel plates, and the stator laminate 131a is wound with a coil 135. FIG. 3 is a cross-sectional view taken along line IV-

IV in FIG. 2, illustrating a relationship between an intake port and an inverter accommodating portion, and FIG. 4 is an enlarged cross-sectional view illustrating the periphery of a driving motor.

[0061] As illustrated in FIGS. 3 and 4, the coil 135 is annular when viewed from the rear side, and an axial length L1 of the coil is longer than an axial length L2 of the stator laminate, and thus, a front end portion of the coil 135 facing the sealing portion 112 of the stator 110 protrudes, relative to a front end portion of the stator core 131a. Thus, as described above, the inverter accommodating portion 115 of the main housing 110 may be formed to have a height to overlap the intake port 111a in the radial direction and overlap the coil 135 in the radial direction as described above. Thus, since a rotary shaft 133 to be described later is supported by the compression mechanism unit in the form of a cantilever, the sealing portion 112 of the main housing 110 does not need to have a separate subframe or bearing, and the inverter accommodating portion may protrude to have a height to overlap the coil by utilizing the space from which the subframe or the bearing is excluded.

[0062] In the rotor 132, a rotor laminate 132 is formed by laminating a plurality of thin annular steel plates like the stator 131 and the rotary shaft 133 is press-fit and coupled to an inner circumferential surface of the rotor laminate 132a. A length of the rotor laminate is shorter than a length of the stator laminate or smaller than at least the length of the coil.

[0063] The rotary shaft 133 is coupled to the center of the rotor 132 so that a rear end portion facing the compression mechanism unit 105 is supported by a frame 140 (개 be described) and the fixed scroll 150 in a cantilever form.

[0064] For example, as illustrated in FIGS. 2 and 4, a front end portion (second end) 133b of the rotary shaft 133 may be formed to be shorter than or equal to the front end portion of the rotor 132, and a rear end portion (first end portion) 133a thereof may be rotatably coupled to the fixed scroll 150 through the frame 140 and the orbiting scroll 160.

[0065] The front end portion 133b of the rotary shaft 133 may be longer than a front end portion of the rotor 132. However, since the front end portion of the rotary shaft 133 is formed as a free end not supported by a separate bearing, it is not required to be longer than the rotor 132. Although it is formed to be longer than the rotor 132, it may be formed to be shorter than a front end portion of the coil 135. FIGS. 5 and 6 are views showing a rotary shaft. Specifically, FIG. 5 is a cross-sectional view illustrating a support state of the rotational shaft and FIG. 6 is a cross-sectional view taken along line "V-V" of FIG. 5.

[0066] As illustrated in FIG. 5, since the first end portion 133a of the rotary shaft 133 is axially supported on the frame 140 and the fixed scroll 150 and must transfer a rotational force to the orbiting scroll 160 as described above, a second bearing portion 133c2, an eccentric portion 133c3 and a first bearing portion 133c1 are formed in order from the first end portion 133a toward the second end portion 133b.

[0067] The first bearing portion 133c1 may be formed to correspond to a first bush bearing 171 provided on the frame 140, the second bearing portion 133c2 may be formed to correspond to a second bush bearing 172 provided on the fixed scroll 150, and the eccentric portion 133c3 may be formed to correspond to a third bush bearing 173 provided in the orbiting scroll 160. Accordingly, the first bearing portion 133c1 and the second bearing portion 133c2 are formed on the coaxial center lines CL1 and CL2, and the eccentric portion 133c3 is off-centered with respect to the first bearing portion 133c1 and the second bearing portion 133c2 and formed on a different axial center line CL3.

[0068] Also, the oil supply passage Fo for guiding oil stored in the oil storage portion S22 to each of the bearing portions 133c1 and 133c2 and the eccentric portion 133c3 described above is formed on the rotary shaft 133. The oil supply passage Fo includes an oil supply recess 133e formed by a predetermined depth in a direction from the first end portion 133a of the rotary shaft 133 toward the second end portion 133b and a plurality of oil supply holes 133f1, 133f2, and 133f3 radially penetrating the bearing portions 133c1 and 133c2 and the eccentric portion 133c3. The oil supply holes include a first oil supply hole 133f1 corresponding to the first bearing portion 133c1, a second oil supply hole 133f2 corresponding to the second bearing portion 133c2, a third oil supply hole 133f3 corresponding to the eccentric portion 133c3. The oil supply holes may be formed within an axial range of the bearing portions and the eccentric portion respectively corresponding to the oil supply holes.

[0069] Meanwhile, a decompression portion may be formed in the oil supply recess 133e. That is, an inlet of the oil supply passage Fo communicates with the discharge space (specifically, the oil storage portion) S2 which is a high pressure portion, while an outlet of the oil supply passage Fo communicates with the suction space S1 which is the low pressure portion. Accordingly, oil may excessively flow out from the oil storage portion S22 of the discharge space S2 to the suction space S1 or the refrigerant discharged to the discharge space S2 or oil of the backing space S4 may be leaked to the suction space S1 through the oil supply passage (specifically, between the first bearing portion and the first bush bearing). In consideration of this, as illustrated in FIG. 6, a decompression member 133g such as a decompression bar may be inserted into the oil supply recess 133e to narrow an inner diameter of the oil supply recess 133e, whereby pressure of oil mixed with a refrigerant gas may be lowered to an intermediate pressure, when the oil mixed with a refrigerant gas passes through a decompression section.

[0070] The rotary shaft 133 may be pushed toward the suction space S1 by a pressure difference between the discharge space S2 and the suction space S1. Accordingly, when the rotary shaft 133 is supported by a ball bearing, the rotary shaft 133 is axially supported by the ball bearing, while when the rotary shaft 133 is supported by a bush bearing, a thrust bearing supporting the rotary shaft 133 in the axial direction must be separately provided.

[0071] In this embodiment, as illustrated in FIGS. 2 and 5, an axial bearing protrusion portion 136 may be formed on the rotary shaft 133 and may be axially supported on an axial bearing surface portion 146 of the frame 140 (to be described later). The axial bearing protrusion portion 136 of the rotary shaft 133 may extend portion from an outer circumferential surface of the rotary shaft 133 to have an annular flange shape, and the axial bearing surface portion 146 of the frame 140 may extend portion to protrude from an end portion of an axial hole 145 of the frame 140 forming the backing space S4 by a predetermined height in an axial direction. Although not shown, a balance weight 137 coupled to the rotary shaft may axially be in contact with the axial bearing surface portion 146 of the frame 140 to form a thrust bearing.

[0072] Meanwhile, in the scroll compressor according to the present embodiment, the orbiting scroll coupled to the rotary shaft is supported by the frame and is pivotally moved relative to the fixed scroll, thereby forming the compression mechanism unit. FIG. 7 is an enlarged cross-sectional view of the compression mechanism unit in the motor-operated compressor of FIG. 2.

[0073] As illustrated in FIGS. 2 and 7, the compression mechanism unit 105 includes the frame 140, the fixed scroll (hereinafter, referred to as a 'first scroll') 150 supported by the frame 140, a frame 140, and the orbiting scroll (hereinafter, referred to as a 'second scroll') 160 provided between the frame 140 and the first scroll 150 to perform an orbiting motion.

[0074] The frame 140 is coupled to a front opening 113 of the main housing 110, the first scroll 150 is fixedly supported on a rear surface of the frame 140, and the second scroll 160 is supported on a rear surface of the frame 140 in an orbiting manner to make an orbiting motion between the first scroll 150 and the frame 140. The second scroll 160 is eccentrically coupled to the rotary shaft 133 coupled to the rotor 132 of the driving motor 103 and makes an orbiting motion relative to the first scroll 150, forming a pair of two compression chambers V including a suction chamber, an intermediate pressure chamber, and a discharge chamber, together with the first scroll 150.

[0075] The frame 140 includes a disk plate portion 141 having a disk shape and a frame side wall portion 141 protruding from a rear surface of the disk plate portion 141. A side wall portion 152 of the first scroll 150 (to be described) is coupled to the frame side wall portion 142.

[0076] A frame thrust surface 143 is formed on an inner side of the frame side wall portion 142 and allowing the second scroll 160 to be mounted and supported thereon in the axial direction. The backing space S4 is formed at the center of the frame thrust surface 143 and filled with a partial amount of the refrigerant discharged from the compression chamber V together with oil to support a rear surface of the second scroll 160. Thus, pressure in the backing space S4 forms an intermediate pressure between a pressure in the suction space S1 and a final pressure in the compression chamber V (i.e., a discharge pressure).

[0077] A frame shaft hole 145 through which the rotary shaft 133 passes is formed in the middle of the backing space S4 and a first bearing 171 is provided on an inner circumferential surface of the frame shaft hole 145.

[0078] The first bearing 171 may be configured as a bush bearing as illustrated in FIG. 5 but may be configured as a ball bearing in some cases. However, since the bush bearing is less expensive than the ball bearing, it is advantageous not only in terms of cost but also is easy to assemble and reduces weight and noise.

[0079] The backing space S4 may be sealed by a first sealing member 181 provided on a thrust surface between the frame 140 and the second scroll 160 and a second sealing member 181 installed between an inner circumferential surface of the frame 140 and an outer circumferential surface of the rotary shaft 133 may be sealed by the two sealing members 182.

[0080] The first sealing member 181 may have an annular shape having a quadrangular cross-sectional shape or a V cross-sectional shape and may be inserted into a first sealing recess (not shown) provided on the thrust surface 143 of the frame 140. In this case, the first sealing member 181 may be pushed up by a force due to pressure of the backing space S4 to seal a gap between the first sealing member 181 and the second scroll 160.

[0081] The second sealing member 182 may have an annular shape having a U-shaped cross-sectional shape and may be inserted into an annular second sealing recess (not shown) provided around the frame shaft hole 145. In this case, the second sealing member 182 is separated by a force due to pressure of the backing space S4 and brought into close contact with the outer circumferential surface of the rotary shaft 133 to seal the backing space S4. However, the second sealing member 182 may be omitted in some cases. In case where the second sealing member is omitted, the backing space S4 may communicate with the suction space S1 through a fine passage formed on the inner circumferential surface of the first bearing 171 to restrain pressure of the backing space S4 from being stagnated, thus allowing oil to be smoothly introduced to each bearing hole.

[0082] Meanwhile, the first scroll 150 may be fixedly coupled to the frame 140 or may be press-fit to the casing 110 so as to be fixed.

[0083] In the first scroll 150, the fixed scroll disk plate portion (hereinafter, referred to as a 'first disk plate portion') 151 has a substantially disk shape, and the fixed scroll side wall portion (hereinafter, referred to as a 'first side wall portion') 152 coupled to the side wall portion

142 of the frame 140 is formed on the edge of the first disk plate portion 151. A fixed wrap (hereinafter, referred to as a 'first wrap') 153 engaged with an orbiting wrap (hereinafter, referred to as a 'second wrap') 162 (to be described hereinafter) to form the compression chamber V is formed on a front side of the first disk plate portion 151. The first wrap 153 will be described later with the second wrap 162.

[0084] A suction flow path 154 is formed on one side of the first side wall portion 152 so that the suction space S1 and a suction chamber (not shown) communicate with each other, and a discharge port 155 is formed at a central portion of the first disk plate portion 151. The discharge port 155 communicates with the discharge chamber so that the compressed refrigerant is discharged to the discharge space S2 through the discharge port 155. Only one discharge port 155 may be formed to communicate with both the first compression chamber V1 and the second compression chamber V2 which will be described later or a first discharge port 155a and a second discharge port 155b may be formed to independently communicate with the first compression chamber V1 and a second compression chamber V2.

[0085] A bearing accommodating portion 156 may be formed on a rear surface of the first disk plate portion 151 and protrude toward an inner wall surface of the rear housing 120. The bearing accommodating portion 156 may be in close contact with the inner wall surface of the rear housing 120 or may be spaced apart from the inner wall surface of the rear housing 120 by a predetermined distance. However, if the second bearing portion 133c2 of the rotary shaft 133 can be stably supported only by the thickness of the first disk plate portion 151, the bearing accommodating portion may not be formed.

[0086] However, in case where the bearing accommodating portion 156 is formed, an oil supply pipe 157 protruding from the lowest point of the bearing accommodating portion toward a lower surface of the discharge space S2 may be connected to the bearing accommodating portion 156. Accordingly, an internal space 156a of the bearing accommodating portion 156 is connected to the oil storage portion S22 of the discharge space S2 so that the oil stored in the oil storage portion S22 may be introduced to the bearing accommodating portion 156 by a pressure difference.

[0087] A second bearing hole 158 is formed at the center of the bearing accommodating portion 156 at the center of the first disk plate portion 151 such that the second bearing portion 133c2 of the rotary shaft 133 is rotatably inserted thereinto and supported in a radial direction, and a second bearing 172 is inserted and coupled to the second bearing hole 158. The second bearing 172 may be a bush bearing as illustrated in FIG. 5 or may be a ball bearing like the first bearing 171 in some cases.

[0088] Meanwhile, the second scroll 160 is disposed between the frame 140 and the first scroll 150 and is rotatably coupled to the rotary shaft 133 in an eccentric manner.

[0089] In the second scroll portion 160, an orbiting scroll disk plate portion (hereinafter, referred to as a 'second disk plate portion') 161 is formed to have a substantially disk shape, and a second wrap 162 is formed on a rear side of the second disk plate portion 161 and engaged with the first wrap 153 to form a compression chamber.

[0090] The second wrap 162 may be formed in an involute shape together with the first wrap 153 but may be formed in various other shapes. FIG. 8 is a plan view illustrating a state in which the fixed wrap and the orbiting wrap are engaged in the compression mechanism unit according to the present embodiment.

[0091] As illustrated in FIGS. 2 and 8, the second wrap 162 has a shape in which a plurality of circular arcs having different diameters and starting points are connected, and the outermost curve may have a substantially elliptical shape having a longer axis and a shorter axis. The first wrap 153 may also be formed in the same manner.

[0092] A rotary shaft coupling portion 163 may be formed in a penetrating manner at a central portion of the second disk plate portion 161 in an axial direction. The rotary shaft coupling portion 163 may form an inner end portion of the second wrap 162 and allow the eccentric portion 133c3 of the rotary shaft 133 (to be described) to be rotatably inserted and coupled thereto. An outer circumferential portion of the rotary shaft coupling portion 163 is connected to the second wrap 162 to form the compression chamber V together with the first wrap 153 during a compression process.

[0093] The rotary shaft coupling portion 163 is formed at a height that overlaps the second wrap 162 on the same plane so that the eccentric portion 133c2 of the rotary shaft 133 may be disposed at a height that overlaps the second wrap 162 on the same plane. Accordingly, a repulsive force and a compressive force of the refrigerant are applied to the same plane with respect to the second disk plate portion so as to be canceled out, whereby tilting of the second scroll 160 due to the action of the compressive force and the repulsive force may be prevented.

[0094] In the rotary shaft coupling portion 163, a concave portion 163a to be engaged with the protrusion 153a of the first wrap 153 (to be described) is formed on an outer circumferential portion opposing the inner end portion of the first wrap 153, and an increased portion 163b is formed on one side of the portion 163a along a formation direction of the compression chamber V. A thickness of the increased portion 163b may increase from an inner circumferential portion of the rotary shaft coupling portion 163 to an outer circumferential portion thereof on an upstream side. Accordingly, a compression path of the first compression chamber V1 immediately before discharging may be lengthened, resultantly increasing a compression ratio of the first compression chamber V1 to be close to a compression ratio of the second compression chamber V2. The first compression chamber V1 is a compression chamber formed between an inner side surface of the first wrap 153 and an outer side surface of the second wrap. The first compression chamber V1 differentiated from the second compression chamber V2 will be described later.

[0095] A circular arc compression surface 163c having a circular arc shape is formed on the other side of the concave portion 163a. A diameter of the circular arc compression surface 163c is determined by a thickness of an inner end portion of the first wrap 153 (i.e., a thickness of a discharge end) and an orbiting radius of the first wrap 153. When the thickness of the inner end portion of the first wrap 153 is increased, the diameter of the circular arc compression surface 163c may be increased. As a result, a thickness of the second wrap around the circular arc compression surface 163c may also be increased to ensure durability, and a compression path may be lengthened as much, thereby increasing the compression ratio of the second compression chamber V2.

[0096] A protrusion 153a protruding to the outer circumferential portion of the rotary shaft coupling portion 163 is formed in the vicinity of the inner end portion (suction end portion or starting end) of the first wrap 153 corresponding to the rotary shaft coupling portion 163, and a contact portion 153b may protrude from the protrusion and may be engaged with the concave portion 163a. That is, the inner end portion of the first wrap 153 may be formed to have a larger thickness than other portions. Accordingly, a wrap strength at the inner end, which is subjected to the greatest compressive force, among the first laps 153, may be improved to enhance durability.

[0097] The compression chamber V may be formed between the first disk plate portion 151 and the first wrap 153 and between the second wrap 162 and the second disk plate portion 161, in which a suction chamber, an intermediate pressure chamber, and a discharge chamber may be continuously formed according to a progress direction of the wrap.

[0098] As illustrated in FIG. 8, the compression chamber V may include the first compression chamber V1 formed between the inner surface of the first wrap 153 and the outer surface of the second wrap 162 and the second compression chamber V2 formed between the outer surface of the first wrap 153 and the inner surface of the second wrap 162. That is, the first compression chamber V1 includes a compression chamber formed between two contact points P11 and P12 formed as the inner surface of the first wrap 153 and the outer surface of the second wrap 162 are in contact with each other, and the second compression chamber V2 includes a compression chamber formed between two contact points P21 and P22 formed as the outer surface of the first wrap 153 and the inner surface of the second wrap 162 are in contact with each other.

[0099] Here, in the first compression chamber (V1) immediately before discharging, when a greater angle, among angles formed between two lines connecting the center of the eccentric portion, i.e., the center O of the rotary shaft coupling portion, and the two contact points P11 and P12, is α, α is greater than 360° (α<360°) at least before starting discharging and a distance ℓ between normal vectors at the two contact points P11 and P12 has a value greater than 0. Thus, since the first compression chamber immediately before discharging has a smaller volume compared with a case where the first compression chamber has the fixed wrap and the orbiting wrap having an involute curve, both the compression ratio of the first compression chamber V1 and the compression ratio of the second compression chamber V2 may be improved.

[0100] Meanwhile, an anti-rotation mechanism for preventing rotation of the second scroll 160 is installed between the frame 140 and the second scroll 160. The anti-rotation mechanism may be an Oldham ring or pin-ring structure. The present embodiment will be described focusing on an example in which the pin-ring structure is applied.

[0101] An anti-rotation portion 190 according to the present embodiment may include an anti-rotation recess 191 formed on any one of a rear surface of the frame 140 and a front surface of the disk plate portion 161 of the second scroll 160, and a member facing the anti-rotation recess 191 may be configured as an anti-rotation pin 192 rotatably inserted into the anti-rotation recess. In FIGS. 2 and 7, examples in which the anti-rotation recess 191 is formed on the frame 140 and the anti-rotation pin 192 is coupled to the second scroll are illustrated.

[0102] The anti-rotation recesses 191 may be formed at regular intervals along a circumferential direction on an outer side of the backing space S4 on the thrust surface 143 of the frame 140. An inner diameter of the anti-rotation recess 191 is larger than the anti-rotation pin 192 so that the anti-rotation pin 192 may make an orbiting motion.

[0103] The anti-rotation recess 191 may be formed directly on the thrust surface 143 of the frame 140. Alternatively, after an annular recess (not shown) is formed on the thrust surface 143 of the frame, a plurality of anti-rotation recesses 191 may be formed at regular intervals inside the annular recess.

[0104] The anti-rotation pins 192 and the anti-rotation recesses 191 are formed to correspond to each other so that the anti-rotation pins 192 may be inserted into the plurality of anti-rotation recesses 191, respectively. Accordingly, the plurality of anti-rotation pins 192 are inserted into the anti-rotation recesses 191, respectively, to guide an orbiting motion of the second scroll 160, while limiting rotation (spinning) of the second scroll 160.

[0105] Since the outer circumferential surface of the anti-rotation pin 192 continuously makes sliding contact with the inner circumferential surface of the anti-rotation recess 191, the anti-rotation recess 191 and the anti-rotation pin 192 are preferably formed of a wear resistant material such as spring steel. However, since the second scroll 160 and the frame 140 in which the anti-rotation recess 191 and the anti-rotation pin 192 are formed are formed of a light-weight and soft material such as aluminum in consideration of a weight of the compressor, the anti-rotation recess 191 and the anti-rotation pin 192 may be susceptible to wear.

[0106] Thus, the anti-rotation pin 192 is formed of a material having high wear resistance and high rigidity such as spring steel and fixedly coupled to the second scroll 160, and an oiling ring formed of a material which is the same as or similar to that of the anti-rotation pin 192 may be inserted into the anti-rotation recess 191 to form an anti-rotation mechanism having a pin-ring structure.

[0107] Here, the oiling ring may be formed apiece or a plurality of oiling rings may be bound to an annular plate so as to be integrally formed. This is the same for the anti-rotation ring. That is, a plurality of anti-rotation rings may also be formed integrally with one annular plate and collectively coupled to the second scroll.

[0108] Reference numerals 159a and 159b denote bypass holes.

[0109] The scroll compressor according to this embodiment operates as follows.

[0110] That is, when power is applied to the driving motor 103, the rotary shaft 133 rotates together with the rotor 132 to transmit a rotational force to the second scroll 160.

[0111] Then, the second scroll (160) makes an orbiting motion by the anti-rotation mechanism and continuously moves toward the center, reducing the volume of the compression chamber (V).

[0112] Then, 2, the refrigerant flows into the suction space S1 through the intake port 111a as indicated by the arrows in FIG. 2, and the refrigerant introduced into the suction space S1 passes through a flow path formed on the outer circumferential surface of the stator 131 and the inner circumferential surface of the main housing 110 or an air gap between the stator 131 and the rotor 132 and is sucked to the compression chamber V through the suction flow path 154.

[0113] Here, a portion of the refrigerant sucked into the suction space S1 through the intake port 111a first comes into contact with the sealing portion 112, which is a front side of the main housing 110, before passing through the driving motor 103. Accordingly, the sealing portion 112 is heat-exchanged with the sucked cold refrigerant so as to be cooled to dissipate heat the inverter module attached to the outer surface of the main housing 110.

[0114] In particular, when the inverter accommodating portion 115 provided in the sealing portion 112 protrudes in a direction toward the driving motor 130 as in the present embodiment, the cold refrigerant sucked into the suction space S1 may be easily in contact with the inverter accommodating portion 115 as described above to increase a heat dissipation effect with respect to the sealing portion 112, and accordingly, since the temperature of the inverter housing 210 is lowered, the inverter device 220 accommodated in the inverter housing 210 may be rapidly heat-dissipated.

[0115] The refrigerant sucked into the compression chamber V through the suction space S1 is compressed by the first scroll 150 and the second scroll 160 and discharged to the discharge space S2 through the discharge port 155. Oil of the refrigerant discharged to the discharge space S2 is separated in the discharge space S2 so that the refrigerant is discharged to a refrigerating cycle through the exhaust port 121a while the oil is accumulated in the oil storage portion S22.

[0116] The oil collected in the oil storage portion S22 flows to the oil supply recess 133e of the rotary shaft 133 through the oil supply pipe 157 according to a pressure difference between the discharge space S2 and the suction space S1, and while the oil moves in a direction from the first end portion 133a to the second end portion 133b of the rotary shaft 133 along the oil supply recess 133e, the oil is supplied to the second oil supply hole 133f2, the third oil supply hole 133f3, and the first oil supply hole 133f1. Here, since the decompression member 133g is inserted into the oil supply recess 133e, pressure of oil moving in the oil supply recess 133e may be lowered to an intermediate pressure.

[0117] The oil supplied to the second oil supply hole 133f2 and the third oil supply hole 133f3 moves to the compression chamber V and the backing space S4 according to a pressure difference to lubricate the second bearing 172 and the third bearing 173, and the oil supplied to the first oil supply hole 133f1 moves to an outer circumferential surface of the first bearing portion 133c1 according to a pressure difference to lubricate the first bearing 171.

[0118] Here, when the backing space S4 communicates with the suction space S1, the discharge space S2, the backing space S4, and the suction space S1 communicate with each other by the oil supply recess 133e and the oil supply holes 133f1, 133f2, and 133f3 of the rotary shaft 133, and thus, oil may not be stagnant.

[0119] The backing space S4 and the suction space S1 communicate with each other so that the oil may move between the discharge space S2, the backing space S4, and the suction space S1 according to a pressure difference to lubricate each bearing surface, rather than being stagnant in the oil storage portion S22, the oil supply passage Fo, and the backing space S4.

[0120] In this manner, since the bearing portion supporting the rotary shaft in the radial direction is provided only on one side of the driving motor with respect to the driving motor, the axial length of the compressor as a whole may be reduced.

[0121] Further, since the rotary shaft does not protrude from the driving motor or the protruded length of the rotary shaft is reduced, the inverter accommodating portion may be disposed close to the driving motor, whereby a possibility of contact between the refrigerant sucked into the suction space of the casing and the inverter accommodating portion may be increased, and thus, the inverter may be cooled effectively.

[0122] Further, since the oil supply passage is formed through in a penetrating manner in the rotary shaft, the length of the oil supply passage may be reduced, and thus, oil may be supplied quickly when the compressor is started, reducing frictional loss.

[0123] Further, since the rotary shaft is supported in the radial direction using the bush bearing, cost due to the bearing may be lowered, operating noise is reduced, and a space between the compression unit and the bearing is reduced, thereby reducing leakage of the refrigerant from the compression chamber.

[0124] Further, as the rotary shaft is coupled by penetrating through the orbiting scroll, a differential pressure between a back pressure of the backing space and an axial gas force in the compression chamber is reduced, and thus, a behavior of the orbiting scroll is stabilized to allow for a high speed operation and leakage of a refrigerant may be suppressed.

[0125] Meanwhile, in the above-described embodiment, the orbiting wrap of the orbiting scroll is formed only on one side of the disk plate portion of the orbiting scroll, but in some cases, the above-described structure may also be applied to a double-sided scroll scheme in which the orbiting scroll of the orbiting scroll is formed on each of the front and rear surfaces of the disk plate portion of the orbiting scroll. FIG. 9 is a cross-sectional view of a motor-operated compressor including a double-sided scroll according to the present invention.

[0126] As illustrated, the second scroll 1160, which is an orbiting scroll, may include first and second orbiting wraps 1162a and 1162b formed on both axial sides of the disk plate portion 1161, and a first fixed wrap 1153 may be formed on the first scroll 1150 corresponding to a first orbiting wrap 1162a and a second fixed wrap 1147 may be formed on the frame 1140 corresponding to the second orbiting wrap 1162b. Accordingly, the first orbiting wrap 1162a may be engaged with the first fixed wrap 1155 and the second orbiting wrap 1162b is engaged with the second fixed wrap 1147 to form a first compression space Vc1 and a second compression space Vc2, respectively. Since the first compression space Vc1 and the second compression space Vc2 form a first compression chamber and a second compression chamber, respectively, resulting in that the double-sided scroll type motor-operated compressor may have four compression chambers.

[0127] In this case, an intake port 1111a is formed to penetrate through a side wall portion of the main housing 110 and the frame 1140 constituting the compressor casing and a side wall portion of the first scroll 1150. The intake port 1111a is formed to communicate with both the compression spaces Vc1 and Vc2 in a space between the frame 1140 and the first scroll 1150. Accordingly, an outlet end portion of the intake port 1111a may be formed to face the first compression space Vc1 and the second compression space Vc2 corresponding to the disk plate portion of the second scroll 1160.

[0128] A first discharge port 1155 is formed in a first disk plate portion 1151 of the first scroll 1150 and a second discharge port 1148 is formed in a frame disk plate portion 1141 of the frame 1140. The refrigerant compressed in the first compression space Vc1 is discharged to an internal space of the rear housing 1120 through the first discharge port 1155, and the refrigerant compressed in the second compression space Vc2 is discharged to the internal space of the main housing 1110 through the second discharge port 1148. The refrigerant discharged to the internal space of the main housing passes through the side wall portion of the frame 1140 and the side wall portion of the first scroll 1150 to move to the internal space of the rear housing 1120 and then is discharged to the outside of the compressor through an exhaust port 1121a. Accordingly, the scroll compressor of this embodiment forms a high-pressure scroll compressor in which the entire internal space of the casing 1101 forms a kind of discharge space.

[0129] Also, in the case of the double-sided scroll compressor described above, a first end portion 1133a of the rotary shaft 1133 sequentially passes through the frame 1140, the second scroll 1160 and the first scroll 1150 and is supported by the frame 1140 and the first scroll 1150 in a radial direction, and a second end portion 1133b of the rotary shaft 1133 is coupled to a rotor 1132 to form a free end, which is the same as the above-described embodiment. Accordingly, an inverter accommodating portion 1115 protrudes toward the driving motor in the sealing portion 1112 on the front side of the main housing 1110, which is the same as the above-described embodiment. Although not repeatedly described, a basic structure including the bearing and an operational effect thereof are the same as those of the above-described embodiment.

[0130] However, in this embodiment, since the compression spaces are formed on both sides of the orbiting scroll, it is not necessary to form a separate backing space, and thus, the configuration of the compression mechanism unit may be simplified. As a result, an axial bearing power with respect to the orbiting scroll is uniform, so that the behavior of the orbiting scroll becomes more stable to allow for a high-speed operation and leakage of the refrigerant may be effectively suppressed.

[0131] In this embodiment, since the first orbiting wrap 1162a and the second orbiting wrap 1162b are formed on both sides of the second scroll 1160, it is difficult for an anti-rotation member 1190 to be positioned within a range of the orbiting wrap. Thus, in this embodiment, the anti-rotation member may be formed outside the range of the orbiting wrap. FIG. 10 is an enlarged cross-sectional view illustrating a coupled state of the anti-rotation member in FIG. 9.

[0132] As illustrated in FIG. 10, a plurality of pin fixing recesses 1191a and 1191b are formed at predetermined intervals on a frame side wall portion 1142 of the frame 1140 and a first side wall portion 1152 of the first scroll 1150, and a plurality of pin holes 1192 are formed to correspond to the pin fixing recesses 1191a and 1191b in the second scroll 1160, respectively. An oiling ring 1192a may be inserted into the pin hole 1192.

[0133] One end portion of a pin member 1193 is first inserted into one of the pin fixing recesses 1191a and 1191b of the frame side wall portion 1142 or the first side wall portion 1152, and the other end portion thereof is later inserted into the other pin fixing recess through a pin hole 1192, whereby both ends of the pin member 1193 are fixedly coupled. A diameter of the pin member 1193 is formed smaller than an inner diameter of the pin hole 1192. Accordingly, in a state in which the pin member 1193 is insertedly fixed to the both side wall portions 1142 and 1152, the pin member 1193 is rotatably inserted into the pin hole 1192 of the second scroll 1160, and in this state, the second scroll 1160 is restrained from rotating and induced to make an orbiting motion.

[0134] Here, since the pin hole 1192 is formed at the edge of the second disk plate portion 1161, an outer diameter of the second disk plate portion 1161 may increase and the second scroll 1160 may become heavy. Then, a load of the driving motor may increase to degrade efficiency of the compressor. FIG. 11 is a cross-sectional view for explaining the second scroll in FIG. 9.

[0135] As illustrated in FIG. 11, a plurality of radial protrusions 1165 are formed on a rim surface of the second disk plate portion 1161 at regular intervals along the circumferential direction, and the pin holes 1192 described above are formed in the radial protrusions 1165, respectively. Accordingly, the diameter of the second scroll may increase while the weight of the second scroll may not increase significantly.

[0136] Although not shown, an anti-rotation pin may be fixed to the second scroll, and an anti-rotation recess serving as a pin hole may be formed in the frame and the first scroll.

[0137] In the above-described double-sided scroll compressor, when rotation of the second scroll is suppressed using the pin and the ring, the pin member may serve as a reference pin for setting assembly positions of the frame and the first scroll, and thus, a separate reference pin and a reference recess may be excluded.

[0138] Meanwhile, although the high-pressure type compressor in which the double-sided scroll is applied has been described in the above embodiment, the double-sided scroll may also be applied to a low-pressure type compressor. FIG. 12 is a cross-sectional view illustrating a low-pressure scroll compressor to which a double-sided scroll is applied.

[0139] As illustrated in FIG. 12, a discharge guide 1149 is provided in the frame 1140 (in the case of the double-sided scroll compressor according to the present embodiment, the frame and the first scroll are not clearly distinguished from each other, but a member adjacent to the driving motor will be defined as the frame, for the purposes of description) to divide the internal space into the suction space S1 and the discharge space S2 in order to move a refrigerant discharged from the second compression space Vc2 to the discharge space S2, the opposite side, thereby forming the low pressure type compressor in the double-sided scroll compressor.

[0140] In this case, a refrigerant passage Fc allowing the suction space S1 and the discharge space S2 to communicate with each other is formed in the frame 1140 and the first scroll 1150, and the discharge guide 1149 seals a gap between the second discharge port 1148 and the refrigerant passage Fc. Then, the refrigerant discharged through the second discharge port 1148 moves to the discharge space S2 through the discharge guide 1149 and the refrigerant passage Fc and moves together with the refrigerant, which is discharged from the first compression space Vc1 to the discharge space S2, to the exhaust port 1121a.

[0141] Also, in the case of the low-pressure scroll compressor to which the double-sided scroll is applied as described above, the basic structure and operational effects are the same as those of the high-pressure scroll compressor described above.

[0142] In the above-described embodiments, the third bearing portion of the rotary shaft is rotatably coupled to the first scroll and is supported in the radial direction. However, the third bearing portion of the rotary shaft may be rotatably inserted into the bearing accommodating portion provided in the rear housing and may be supported in the radial direction. FIG. 13 is a cross-sectional view illustrating another embodiment of a supporting structure of a rotary shaft in a motor-operated compressor according to the present invention.

[0143] As illustrated in FIG. 13, a bearing protrusion 1122 is formed on an inner circumferential surface of the rear housing 1120 in a direction toward the first scroll 1150, and a bearing recess 1122a is formed at the center of the bearing protrusion 1122 such that a first end portion 1133a of the rotary shaft 1122 penetrating through the frame 1140, the second scroll 1160, and the first scroll 1150 is rotatably coupled thereto.

[0144] A second bearing 1172 formed of a bush bearing may be inserted and coupled to an inner circumferential surface of the bearing recess 1122a to radially support a second bearing portion 1133c2 of the rotary shaft 1133.

[0145] A sealing member 1123 is provided between an end portion surface of the bearing recess 1122a and a rear surface of the first scroll 1150 to prevent an introduction of the refrigerant in the discharge space S2 to an internal space of the compression chamber V or the bearing recess 1122a.

[0146] The basic structure and the operational effect of the motor-operated compressor according to the present embodiment as described above are the same as those of the above-described embodiment. However, in this embodiment, since the second bearing 1172 supporting the second bearing portion 1133c2 of the rotary shaft 1133 is installed in the casing 1110 instead of the first scroll 1150, the first scroll 1150, which is to be processed to be relatively precise, may be easily processed, and although the rotational shaft 1133 rotates at a high speed, the first scroll 1150 is restrained from being thermally deformed by friction with the rotary shaft 1133, increasing reliability of the compressor.

[0147] Although shown, also, in the case of the present embodiment, the double-sided scroll may be applied as the second scroll. In this case as well, the basic configuration described above may be applied in the same manner.

[0148] The foregoing embodiments and advantages are merely exemplary and are not to be considered as limiting the present disclosure. The present teachings may be readily applied to other types of apparatuses. This description is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. The features, structures, methods, and other characteristics of the exemplary embodiments described herein may be combined in various ways to obtain additional and/or alternative exemplary embodiments.

Claims

1. A motor-operated compressor comprising:

    a casing (101, 1101) having a sealed internal space;
    a first scroll (150, 1150) fixed in a radial direction in the internal space of the casing;
    a second scroll (160, 1160) engaged with the first scroll (150, 1150) and configured to make an orbiting motion to form a pair of two compression chambers with the first scroll (150, 1150);
    a frame (140, 1140) fixed on a side of the first scroll (150, 1150) with the second scroll (160, 1160) interposed therebetween;
    a driving motor (103) comprising a rotor (132) and disposed apart from the frame (140) with the frame (140) interposed between the second scroll (160) and the driving motor (103); and
    a rotary shaft (133, 1133) having a first end portion (133a, 1133a) coupled to the second scroll (160, 160) in an off-centered manner and a second end portion (133b, 1133b) coupled to the driving motor (103) and configured to transmit a rotational force from the driving motor (103) to the second scroll (160),
    wherein the first end portion (133a, 1133a) of the rotary shaft (133, 1133) forms an support end portion supported in the radial direction by members positioned on both sides of the second scroll (160, 1160) in an axial direction, and the second end portion (133b, 1133b) of the rotary shaft (133, 1133) forms a free end portion coupled to the rotor (132) of the driving motor (103).

2. The motor-operated compressor of claim 1, wherein the first end portion (133a) of the rotary shaft (133) is disposed to be inserted into the first scroll (150) through the frame (140) and the second scroll (160), and the first end portion (133a) of the rotary shaft (133) is supported by the frame (140) and the first scroll (150) in the radial direction.

3. The motor-operated compressor of claim 1, wherein the first end portion (1133a) of the rotary shaft (1133) is disposed to be inserted into the casing (1120) through the frame (1140), the second scroll (1160), and the first scroll (1150), and the first end portion (1133a) of the rotary shaft (1133) is supported by the frame (1140) and the casing (1120) in the radial direction.

4. The motor-operated compressor of any one of claims 1 to 3, wherein
    the driving motor (103) comprises a stator (131) surrounding the rotor (132) and coupled to the casing, the stator being wound around with a winding coil, and
    an end of the second end portion (133b, 1133b) of the rotary shaft (133, 1133)is positioned within an axial location range of the winding coil.

5. The motor-operated compressor of claim 4, wherein one side surface of the casing (101, 1101) protrudes toward the driving motor (103) to form an inverter accommodating portion (115), and at least a portion of an inverter housing (210) accommodating an inverter device (220) is disposed to be inserted into the inverter accommodating portion (115).

6. The motor-operated compressor of claim 5, wherein at least a portion of the inverter accommodating portion (115) is positioned within an axial location range of the winding coil.

7. The motor-operated compressor of claim 5, wherein an intake port (111a, 1111a) communicating with a suction tube is disposed adjacent to the driving motor (103) provided in the internal space of the casing (101, 1101), and at least a portion of the inverter accommodating portion (115) is positioned to at least partly overlap with the intake port (111a, 1111a) in the radial direction.

8. The motor-operated compressor of any one of claims 1 to 7, wherein
    the rotary shaft (133, 1133) has an oil supply recess (133e) formed to have a predetermined length in the axial direction from an end of the first end portion (133a, 1133a), and
    the rotary shaft (133, 1133) further includes a plurality of oil supply holes (133f1, 133f2, 133f3) formed in the oil supply recess (133e) and spaced apart from each other in the axial direction to supply oil in the radial direction from the oil supply recess (133e).

9. The motor-operated compressor of claim 8, wherein the oil supply recess (133e) has a decompression

member (133g) for reducing pressure of oil.

10. The motor-operated compressor of any one of claims 1 to 9, further comprising:
a first orbiting wrap (1162a) and a second orbiting wrap (1162b) formed on both axial sides of the second scroll (1160), a first fixed wrap (1153) formed in the first scroll (1150) to be engaged with the first orbiting wrap (1162a) to form a first compression space, and a second fixed wrap (1147) formed in the frame (140) to be engaged with the second orbiting wrap (1162b) to form a second compression space.

11. The motor-operated compressor of claim 10, wherein
the internal space of the casing (1101) is divided into a first space in which the driving motor (103) is provided and a second space opposite to the first space with respect to the frame (1140), and
the compressor further comprises discharge ports (1155, 1148) respectively formed at the frame (1140) and the first scroll (1150) such that a refrigerant compressed in each compression chamber is discharged toward the first space and the second space of the casing (1101).

12. The motor-operated compressor of claim 11, wherein
the frame (1140) has a discharge guide (1149) guiding the refrigerant discharged from the discharge port (1148) to the second space.

13. The motor-operated compressor of claim 10, further comprising:
a plurality of pin holes (1192) formed in the second scroll (1160), and a pin member (1193) forming an anti-rotation portion of the second scroll (1160) and fixedly coupled to the first scroll (1150) and the frame (1140) by rotatably penetrating through each of the plurality of pin holes (1192).

14. The motor-operated compressor of claim 13, further comprising:
a plurality of protrusions (1165) formed to protrude in a radial direction from an outer circumferential surface of the second scroll (1160), wherein the pin holes (1192) are formed in each of the plurality of protrusions (1165).

FIG. 1

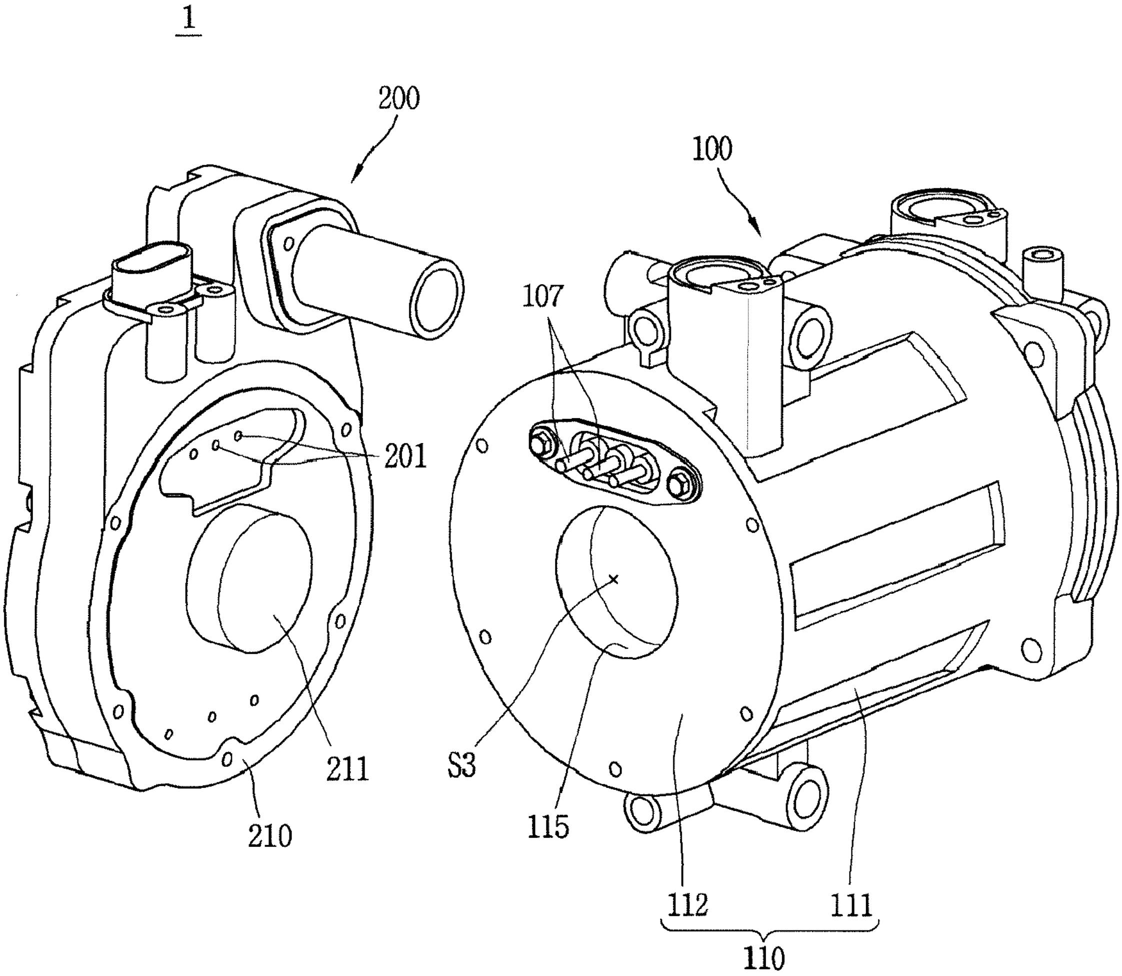


FIG. 2

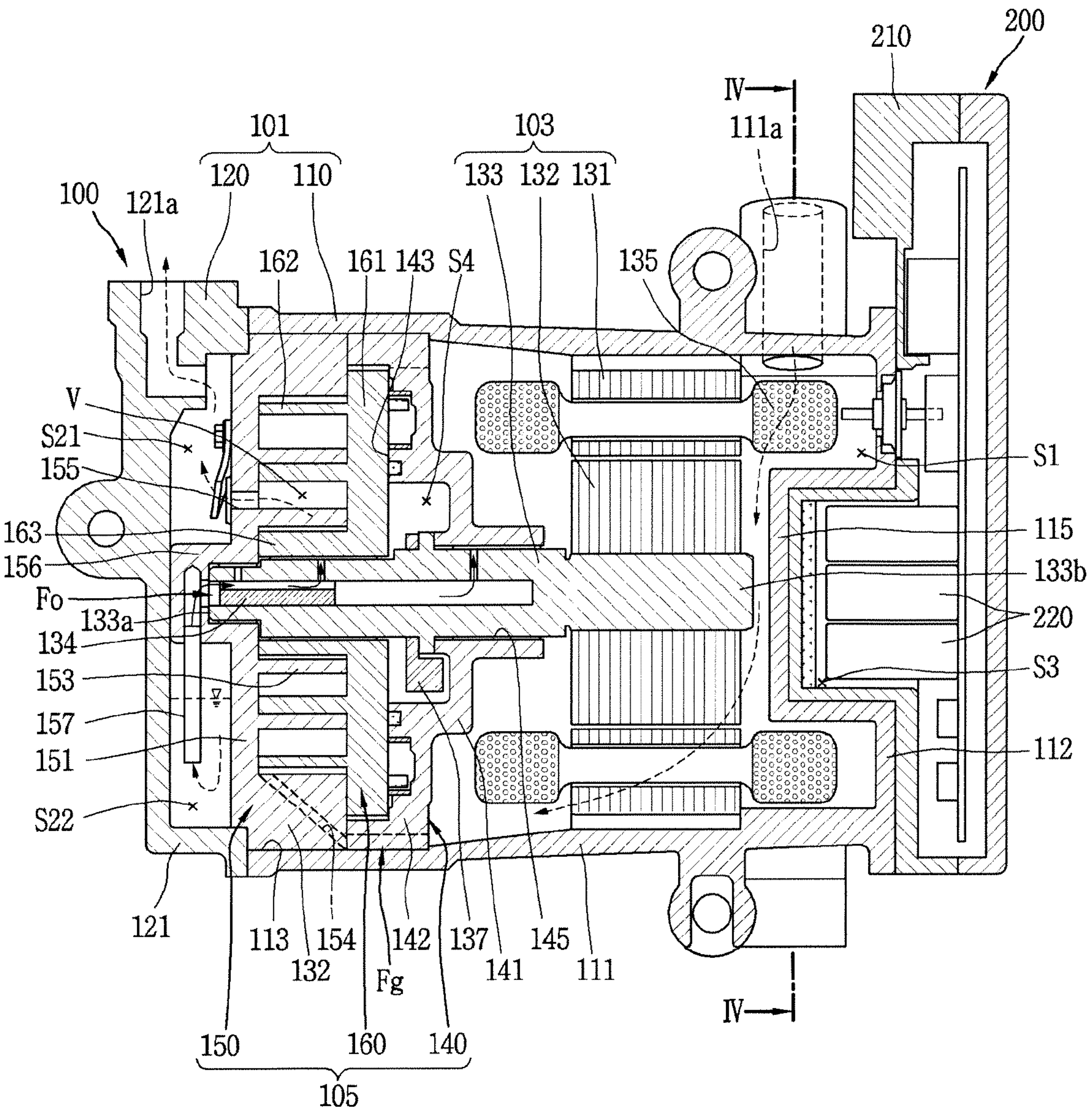

200
210
IV
111a
101
103
120
110
133
132
131
100
121a
162
161
143
S4
135
V
S21
155
S1
163
115
156
133b
Fo
220
133a
134
S3
153
157
112
151
S22
121
113
132
154
142
137
141
145
111
Fg
IV
150
160
140
105

FIG. 3

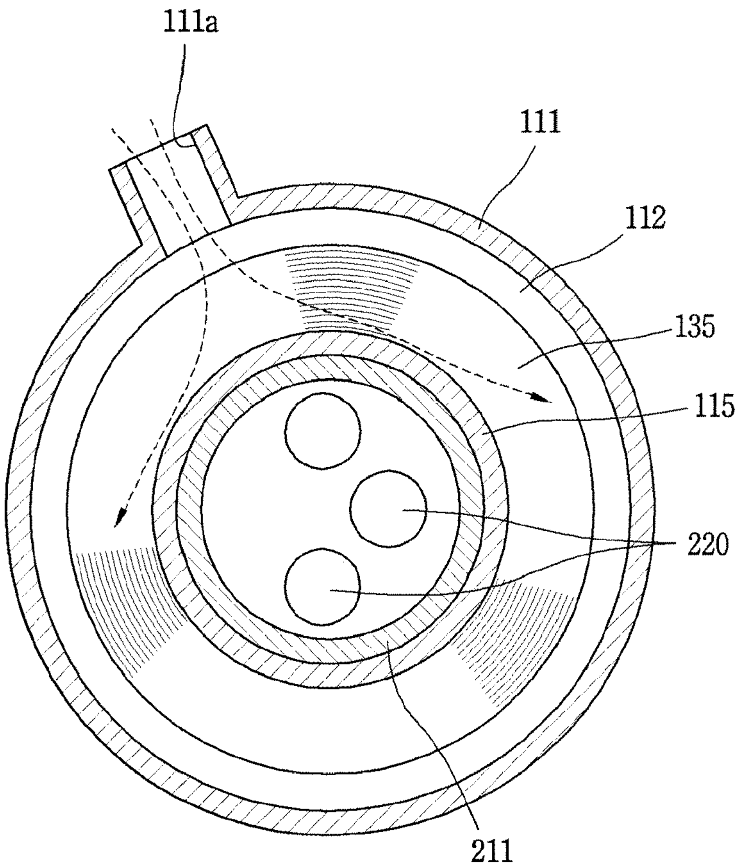


FIG. 4

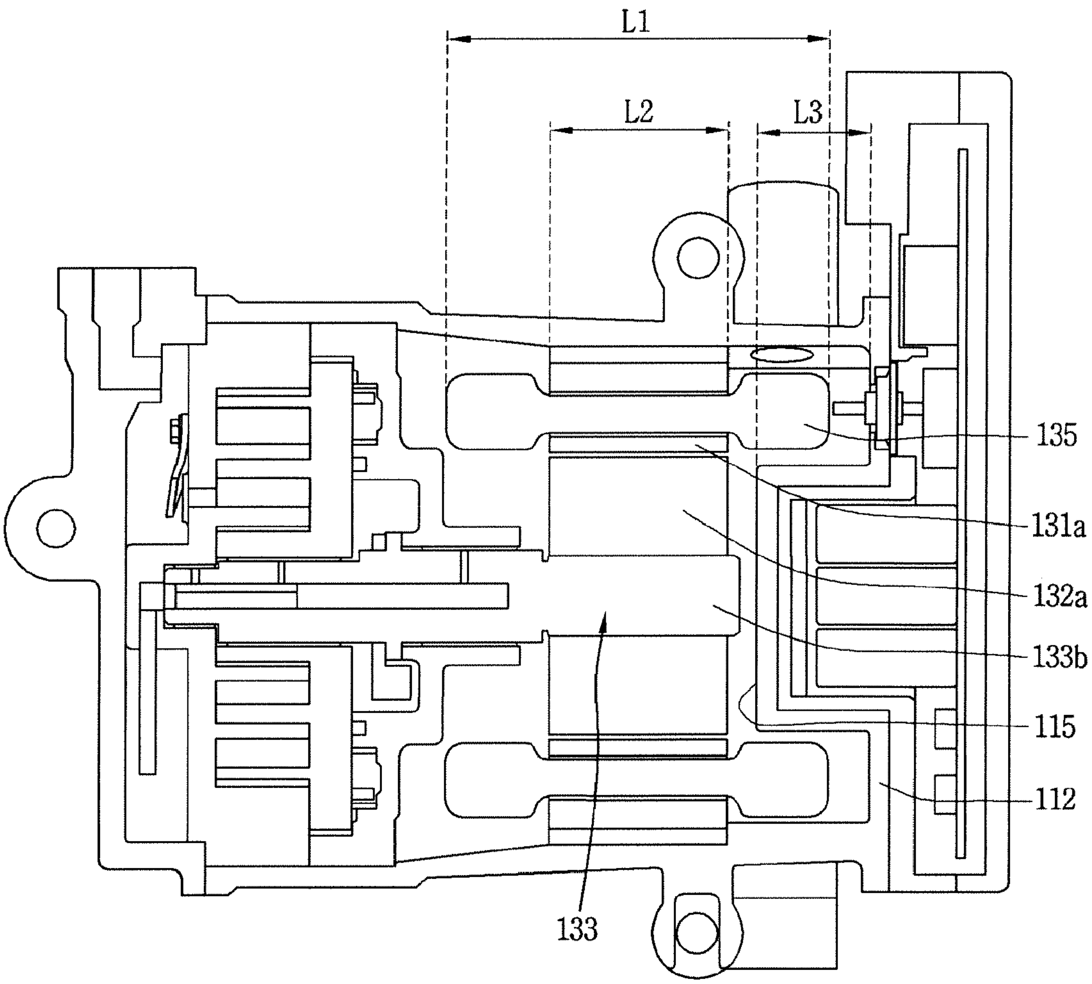


FIG. 5

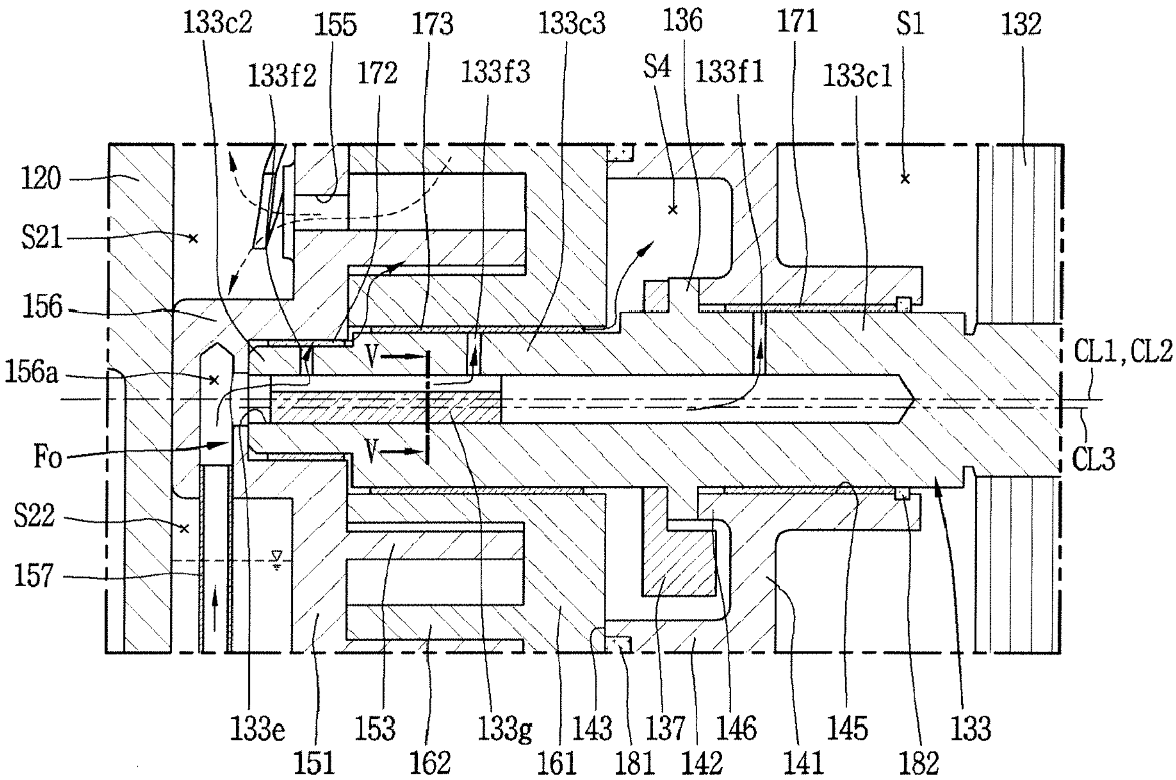

133c2
155
173
133c3
136
171
S1
132
133f2
172
133f3
S4
133f1
133c1
120
S21
156
156a
Fo
S22
157
CL1,CL2
CL3
V
V
133e
151
153
162
133g
161
143
181
137
142
146
141
145
182
133

FIG. 6

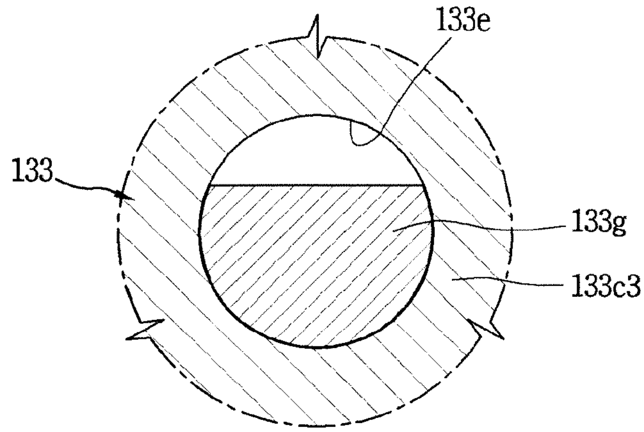

133e
133
133g
133c3

FIG. 7

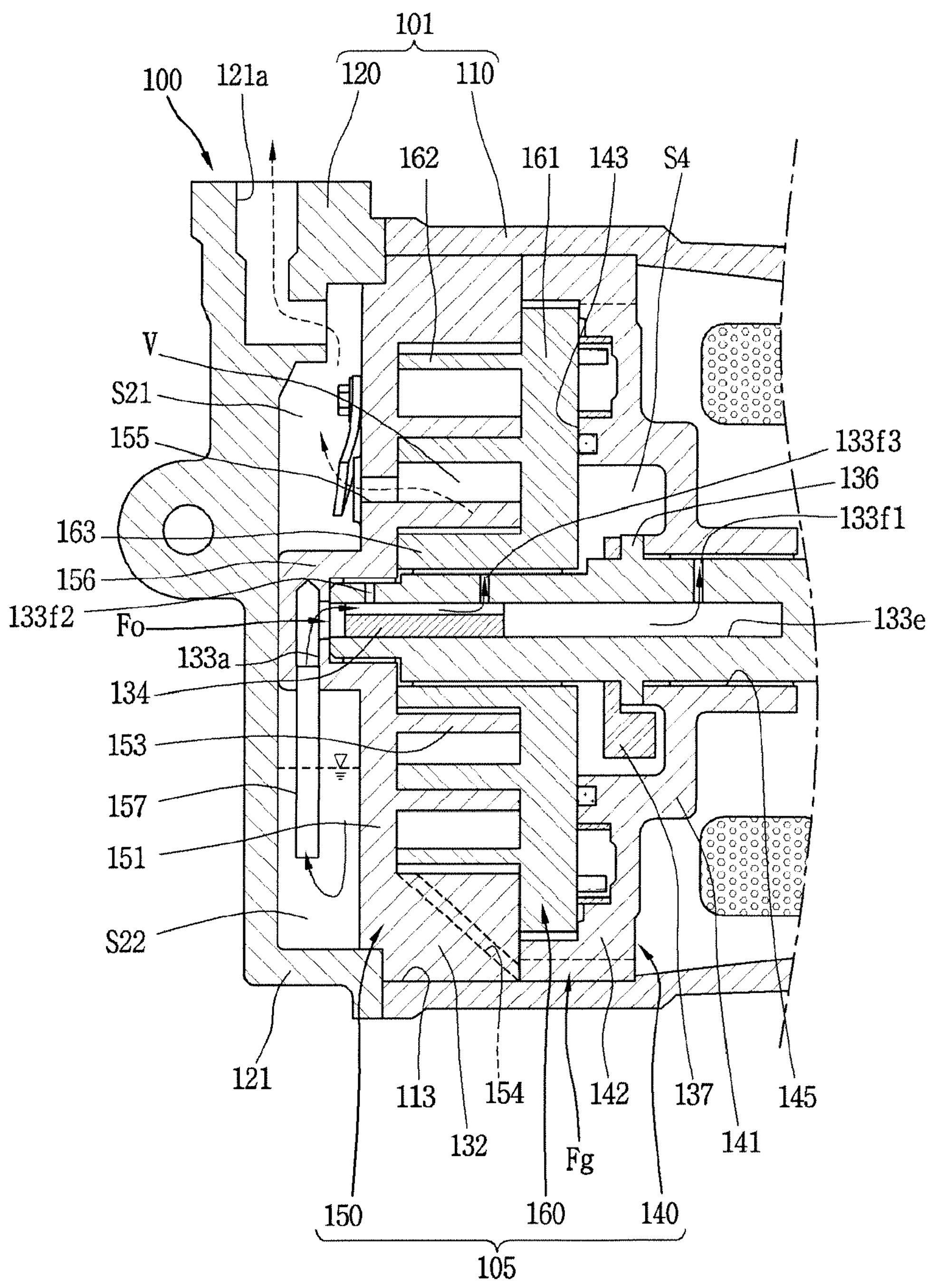

101
100
121a
120
110
162
161
143
S4
V
S21
155
133f3
136
133f1
163
156
133f2
Fo
133e
133a
134
153
157
151
S22
121
113
132
154
142
137
145
141
Fg
150
160
140
105

FIG. 8

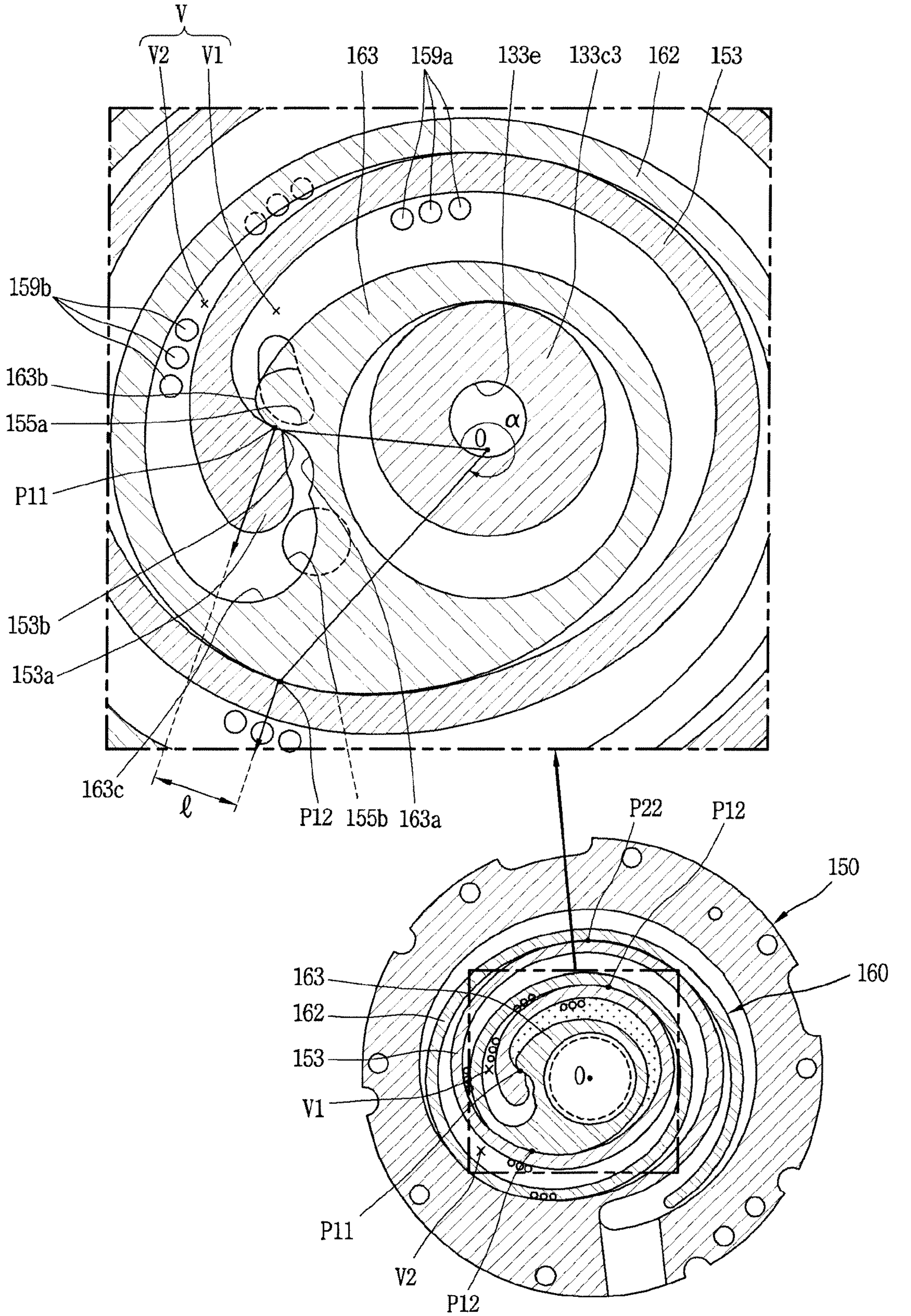

V
V2
V1
163
159a
133e
133c3
162
153
159b
163b
155a
P11
153b
153a
163c
ℓ
P12
155b
163a
α
0
P22
P12
150
160
163
162
153
V1
0
P11
V2
P12

FIG. 9

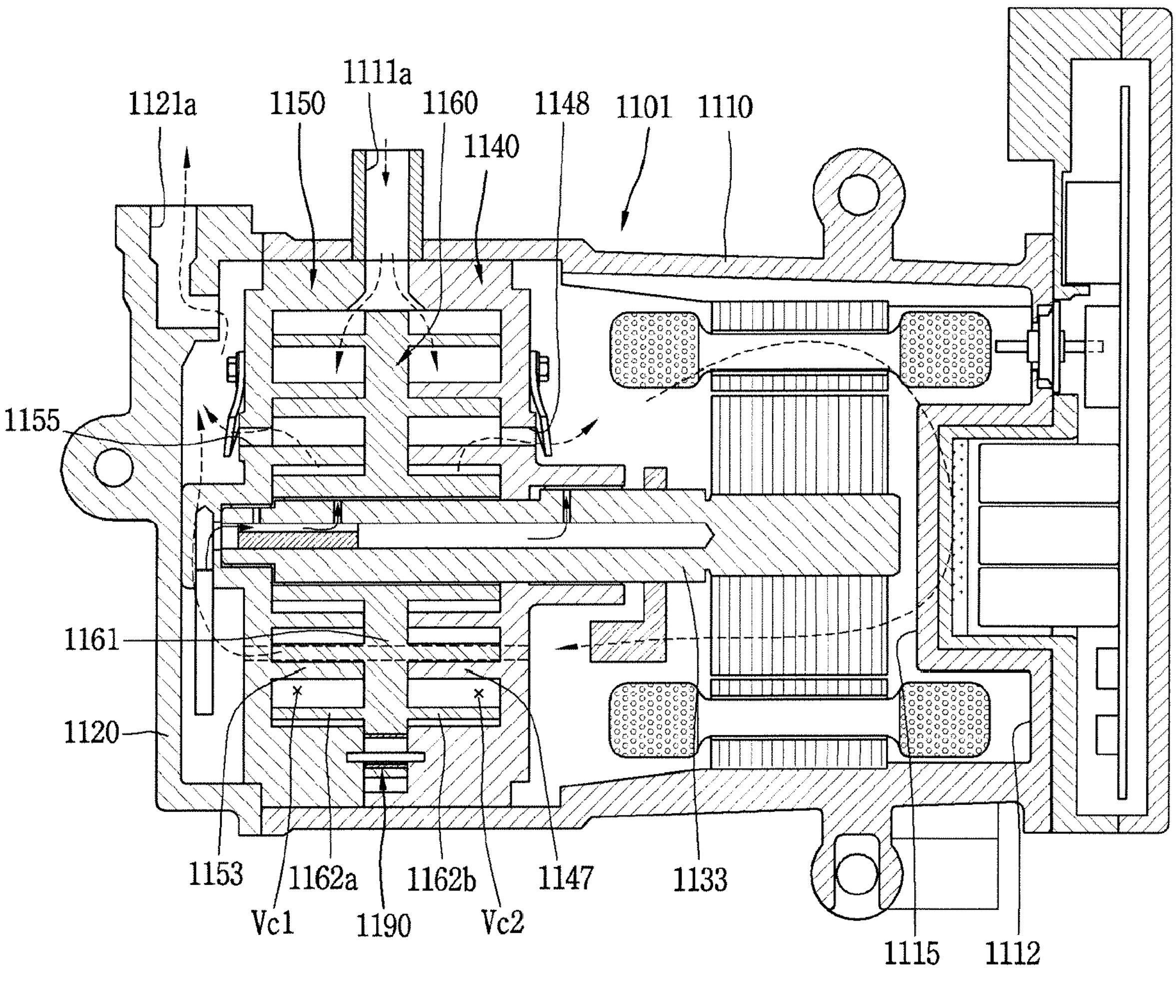

1111a
1121a
1150
1160
1148
1101
1110
1140
1155
1161
1120
1153
1162a
1162b
1147
1133
Vc1
1190
Vc2
1115
1112

FIG. 10

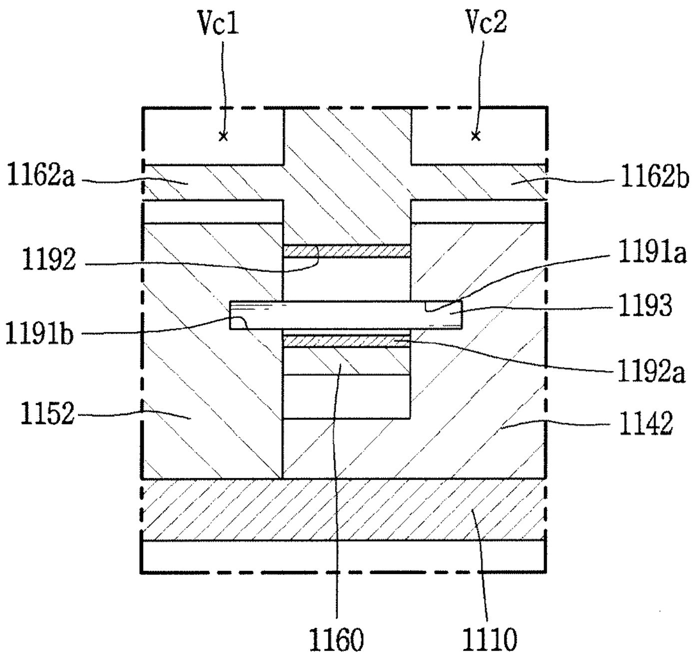

Vc1
Vc2
1162a
1162b
1192
1191a
1193
1191b
1192a
1152
1142
1160
1110

FIG. 11

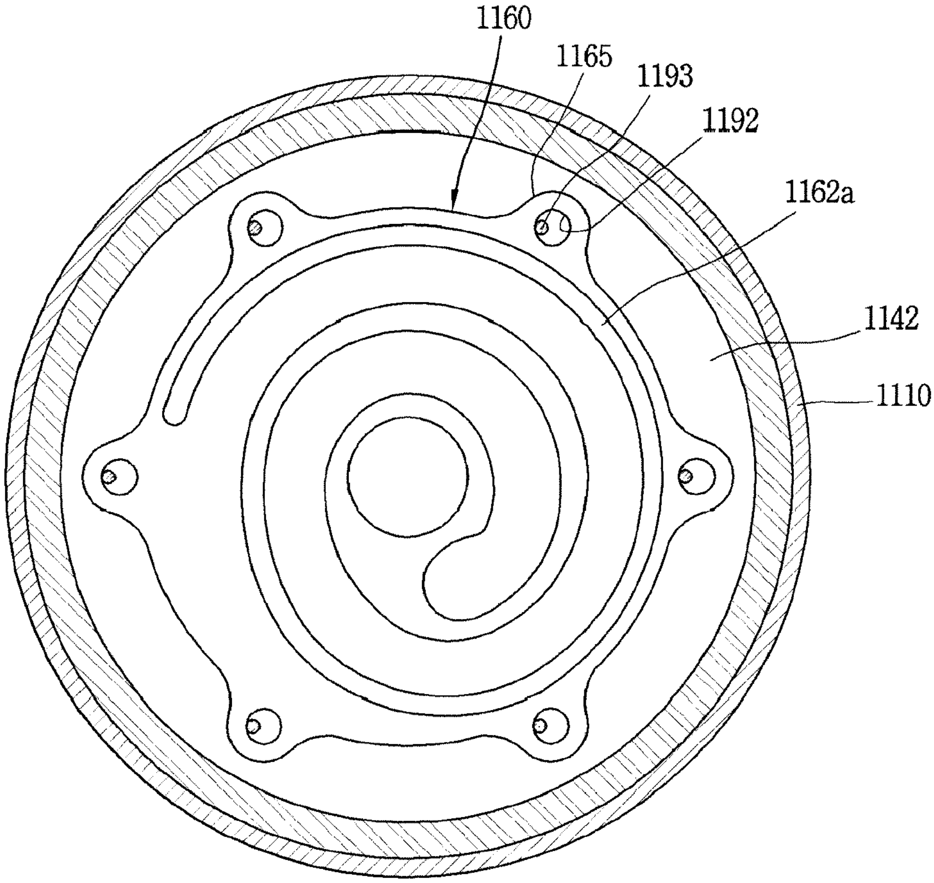


FIG. 12

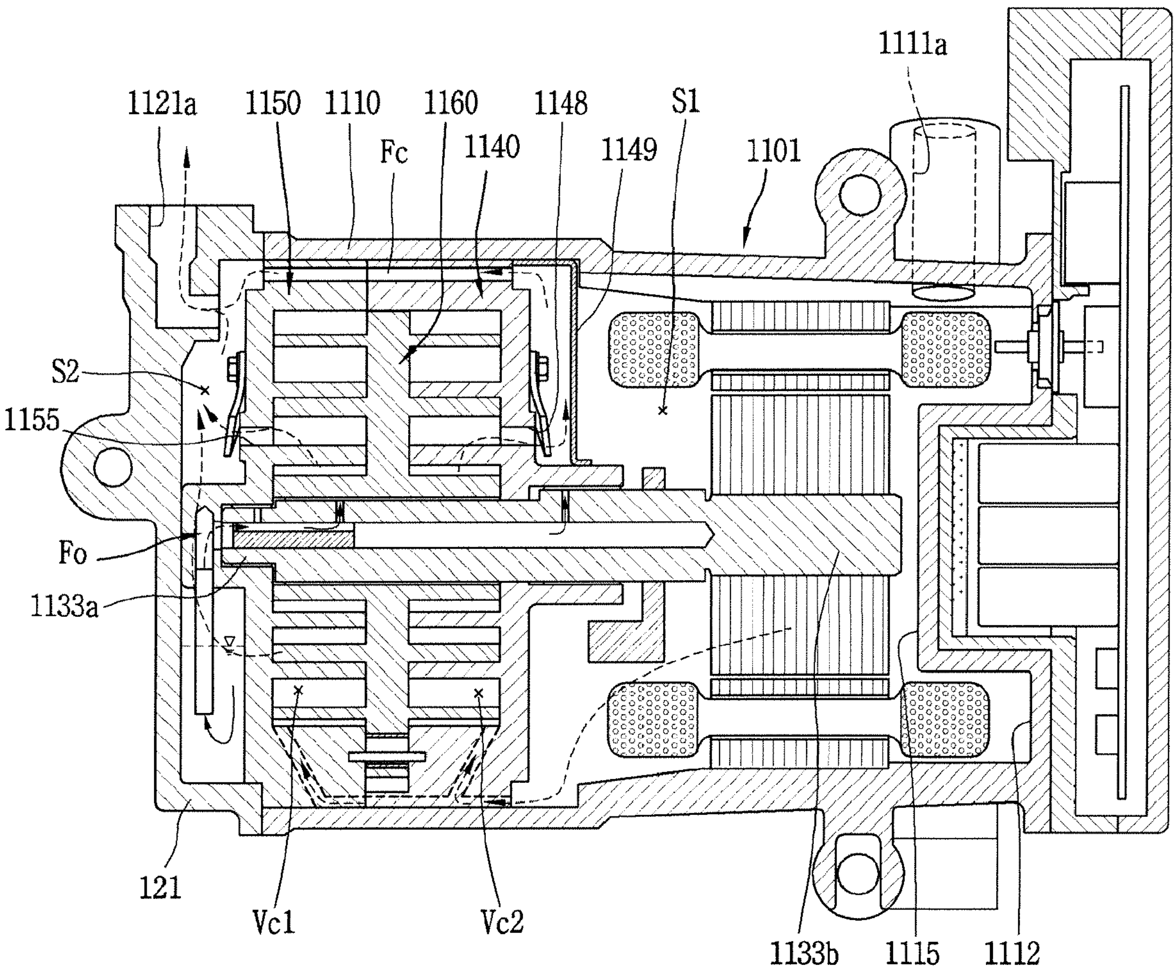
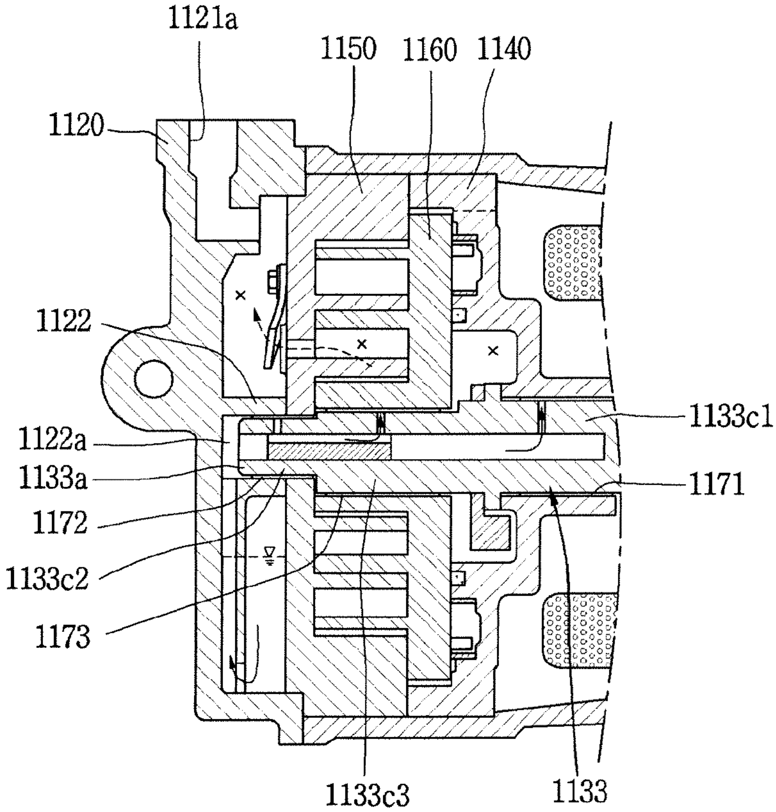

1111a
1121a
1150
1110
1160
1148
S1
Fc
1140
1149
1101
S2
1155
Fo
1133a
121
Vc1
Vc2
1133b
1115
1112

FIG. 13


1121a
1150
1160
1140
1120
1122
1133c1
1122a
1133a
1171
1172
1133c2
1173
1133c3
1133