(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 409 948 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.05.2020 Bulletin 2020/20

(21) Application number: **17782527.0**

(22) Date of filing: **14.04.2017**

(51) Int Cl.:
F04C 29/00 *(2006.01)* ***F04C 18/02*** *(2006.01)*
F04C 23/00 *(2006.01)* ***F04C 29/02*** *(2006.01)*
F04C 29/12 *(2006.01)* *F04C 18/356* *(2006.01)*

(86) International application number:
PCT/JP2017/015333

(87) International publication number:
WO 2017/179714 (19.10.2017 Gazette 2017/42)

(54) HERMETIC TWO-STAGE COMPRESSOR

HERMETISCHER ZWEISTUFIGER VERDICHTER

COMPRESSEUR HERMÉTIQUE À DEUX ÉTAGES

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **14.04.2016 JP 2016081000**

(43) Date of publication of application:
05.12.2018 Bulletin 2018/49

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Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field

[0001] The present invention relates to a hermetic two-stage compressor.

[0002] Priority is claimed on Japanese Patent Application No. 2016-081000, filed April 14, 2016.

Background Art

[0003] In the related art, for example, a hermetic two-stage compressor is known, which is used for refrigeration air conditioning and includes a low stage-side compression section and a high stage-side compression section which are sealed in a housing. In addition, an example of the hermetic two-stage compressor is disclosed in PTL 1.

[0004] In the hermetic two-stage compressor of PTL 1, a rotary compressor is disposed as a low stage-side compression section, a scroll compressor is disposed as a high stage-side compression section, a gas supplied into a housing is compressed by the rotary compressor, and thereafter, the gas is further compressed by the scroll compressor to be discharged from the housing. The hermetic two-stage compressor is operated in a state where a lubricating oil of the low stage-side compression section and the high stage-side compression section is held in the housing.

[0005] Here, in the hermetic two-stage compressor disclosed in PTL 1, a bearing bracket is provided in a divided portion of an upper and lower split type housing, and an oil circulation amount (OC%) in a refrigerating cycle is reduced by allowing the gas in a central region where an oil content is small to flow into the scroll compressor while preventing the gas in an outer peripheral region inside the housing containing a lot of oil from flowing into the scroll compressor.

Citation List

Patent Literature

[0006]

[PTL 1] Japanese Unexamined Patent Application Publication No. 2009-180107
[PTL 2] EP 2177768 discloses a multi-stage compressor.
[PTL 3] EP 1371852 discloses a hermetic compressor lubrication system.
[PTL 4] EP 2735742 discloses a fluid machine.

Summary of Invention

Technical Problem

[0007] However, in the bearing bracket of PTL 1, in a case where a member for decreasing the oil circulation amount (OC%) in the refrigerating cycle is provided in the housing by welding, there is a possibility that strain occurs in the housing. Accordingly, it is difficult to accurately manufacture the hermetic two-stage compressor, and it takes time and labor to manufacture. In addition, the bearing bracket of the hermetic two-stage compressor of PTL 1 receives a load from a bearing case, and thus, it is necessary to increase a thickness so as to secure strength. As a result, an internal volume of the housing decreases, which is disadvantageous when oil is separated from the gas.

[0008] Accordingly, the present invention is to provide a hermetic two-stage compressor capable of being easily manufactured and effectively separating oil from a gas.

Solution to Problem

[0009] A first embodiment and a second embodiment of the present invention are defined in appended claims 1 and 6 respectively.

[0010] In the hermetic two-stage compressor, the oil of the oil storage and the gas are compressed in the low stage-side compression section. Accordingly, the oil is contained in the gas which is discharged from the low stage-side compression section. A portion of the gas containing the oil flows out toward the motor, and thereafter, flows to the high stage-side compression section through the gap between the stator and the rotor or a through-hole provided in the rotor. In addition, when the gas passes through the motor, the oil in the gas comes into contact with the rotor or an oil separation plate provided above the rotor, and thus, a content of the oil in the gas decreases. Meanwhile, the gas which has passed through a portion between the stator and the housing does not come into contact with the rotor and flows toward the high stage-side compression section as it is. Accordingly, the gas flows toward the high stage-side compression section in a state where the content of the oil in the gas is high. That is, the amount of the oil in the gas discharged from the low stage-side compression section decreases on the radially inner side of the housing and increases on the radially outer side thereof.

[0011] Here, according to a simple method in which the restricting surface is provided in the bearing casing, the flow of the gas to the suction opening on the radially outer side can be restricted. Therefore, it is possible to prevent the gas having a high content of oil on the radially outer side flows into the suction channel through suction opening as it is, and the gas on the radially inner side having a low content of oil can flow into the suction channel through the suction opening. As a result, it is possible to supply the gas having a low content of oil to the high stage-side compression section, and it is possible to decrease the amount of the oil in the gas which is compressed by the high stage-side compression section and is discharged therefrom. Therefore, it is possible to decrease an oil circulation amount (OC%) in a system in-

cluding the hermetic two-stage compressor.

[0012] In addition, if the gas on the radially outer side comes into contact with the restricting surface, the oil in the gas is attached to the restricting surface, and the gas in which the content of the oil has decreased is guided to the radially inner side by the restricting surface and flows from the suction opening into the suction channel. Accordingly, in a state where the amount of the oil in the gas is decreased by the restricting surface, the gas is supplied from the suction channel to the high stage-side compression section, and thus, it is possible to decrease the amount of the oil in the gas which is compressed by the high stage-side compression section and is discharged therefrom, and it is possible to decrease the oil circulation amount (OC%) in the system.

[0013] Moreover, the hermetic two-stage compressor may further include an inflow restricting plate which is fixed to the bearing casing, is formed in a plate shape, and includes the restricting surface on the one side (first end side) of the axial direction.

[0014] In this way, the inflow restricting plate is provided in the bearing casing, and thus, it is possible to provide the restricting surface in the bearing casing. Therefore, compared to a case where a member corresponding to the inflow restricting plate is attached to the housing so as to provide the restricting surface, it is possible to very easily provide the restricting surface in the bearing casing. In addition, it is possible to easily provide the restricting surface in the existing bearing casing.

[0015] Moreover, in the hermetic two-stage compressor according to the second embodiment of the invention the restricting surface includes a flat surface which is provided on an end portion on the radially outer side which is an inner surface side of the housing and is perpendicular to the axis to be formed in an annular shape about the axis and an inclined surface which is inclined toward the one side (first end side) in the axial direction from the flat surface toward the radially inner side so as to be formed in a truncated conical shape about the axis.

[0016] In this way, the inclined surface which is formed in a truncated conical shape is provided as the restricting surface, and thus, it is possible to form the opening portion which is formed in an annular shape about the axis so as to extend from the suction opening to the one side (first end side) in the axial direction. Accordingly, the opening portion extending from the suction opening can be formed in an annular shape, and thus, an opening area can be secured, and it is possible to secure a flow rate of the gas flowing from the inside of the housing into the suction channel. In addition, the gas having a high content of oil in the radially outer side region flows to the radially inner side along the flat surface of the restricting surface, and thereafter, collides with the inclined surface, and thus, the oil can be attached to the inclined surface. Accordingly, the gas flows into the suction channel in a state where the content of the oil in the gas further decreases, and thus, it is possible to decrease the amount of the oil in the gas supplied to the high stage-side compression section, and it is possible to decrease the amount of the oil in the gas which is compressed by the high stage-side compression section and is discharged therefrom. Accordingly, it is possible to further decrease the oil circulation amount (OC%) in the system.

[0017] Moreover, in the hermetic two-stage compressor an inner edge portion on the radially inner side of the restricting surface may be disposed at a position on the radially inner side of the stator, and the restricting surface may close a portion of the suction opening so as to secure an intake amount of the gas required in the high stage-side compression section.

[0018] In this way, the inner edge portion of the restricting surface is positioned on the radially inner side from the stator, and thus, the restricting surface extends to the position of the rotor. Accordingly, the gas which comes into contact with the rotor so as to sufficiently decrease the amount of the oil can flow from the suction opening into the suction channel. Therefore, it is possible to further decrease the amount of the oil in the gas which is compressed by the high stage-side compression section and is discharged therefrom, and it is possible to further decrease the oil circulation amount (OC%) in the system. Moreover, at this case, it is possible to secure an intake amount of the gas required in the high stage-side compression section, and it is possible to prevent compression efficiency in the high stage-side compression section from decreasing.

[0019] In addition, the hermetic two-stage compressor may further include a seal member which is provided in a gap between an outer edge portion on the radially outer side of the restricting surface and the inner surface of the housing.

[0020] The gas having a high content of oil which has passed through a portion between the housing and the stator in the radially outer side region in the housing can be prevented from flowing from the portion between the restricting surface and the housing into the high stage-side compression section as it is, by the seal member. Accordingly, it is possible to further decrease the amount of the oil in the gas which is compressed by the high stage-side compression section and is discharged therefrom, and it is possible to further decrease the oil circulation amount (OC%) in the system.

[0021] In addition, the hermetic two-stage compressor may further include an oil return section which is provided at a position of an end portion on the radially outer side in the bearing casing and causes the high stage-side compression section and the one side (first end side) in the axial direction from the bearing casing in the housing to communicate with each other such that oil from the high stage-side compression section can flow through the oil return section.

[0022] The oil return section is provided, and thus, the oil used for lubricating in the high stage-side compression section is returned into the housing through the oil return section. Accordingly, it is possible to further decrease the amount of the oil in the gas which is compressed by the

high stage-side compression section and is discharged therefrom, and it is possible to further decrease the oil circulation amount (OC%) in the system.

[0023] In addition, the oil return section is provided on the end portion on the radially outer side of the bearing casing, and thus, the oil return section is provided at a position separated from the suction opening which is open to the radially inner side. Therefore, the oil which is returned from the oil return section to the housing can be prevented from flowing from the suction opening into the suction channel as it is. Accordingly, it is possible to further decrease the amount of the oil in the gas which is compressed by the high stage-side compression section and is discharged therefrom, and it is possible to further decrease the oil circulation amount (OC%) in the system.

[0024] Moreover, in the hermetic two-stage compressor an accommodation portion which extends in the axial direction and through which a wire of the motor can be inserted may be provided in the bearing casing, and the hermetic two-stage compressor may further include a seal member which is provided in a gap between the restricting surface and the wire of the motor.

[0025] Even when the accommodation portion into which the wire of the motor is inserted is formed in the bearing casing, the gap between the restricting surface and the wire of the motor can be sealed by the seal member. Accordingly, it is possible to prevent the gas containing the oil from being supplied to the high stage-side compression section through the gap as it is.

Advantageous Effects of Invention

[0026] According to the hermetic two-stage compressor, the method of providing the restricting surface in the bearing casing is used, and thus, it is possible to easily manufacture the hermetic two-stage compressor, and it is possible to effectively separate the oil in the gas by the restricting surface.

Brief Description of Drawings

[0027]

Fig. 1 is a longitudinal sectional view showing a hermetic two-stage compressor according to a first embodiment of the present invention.

Fig. 2 shows the hermetic two-stage compressor according to the first embodiment of the present invention and is a longitudinal sectional view at a sectional position from the sectional position of Fig. 1 in a circumferential direction.

Fig. 3 is a view showing a bearing casing and an inflow restricting plate of the hermetic two-stage compressor according to the first embodiment of the present invention and shows a cross section taken along line I-I of Fig. 1.

Fig. 4 is a longitudinal sectional view showing a hermetic two-stage compressor according to a second embodiment of the present invention.

Fig. 5 is a view showing a bearing casing and an inflow restricting plate of the hermetic two-stage compressor according to the second embodiment of the present invention and shows a cross section taken along line IV-IV of Fig. 4.

Fig. 6 is a view showing a bearing casing and an inflow restricting plate of a hermetic two-stage compressor according to a modification example of the embodiment of the present invention.

Description of Embodiments

[First Embodiment]

[0028] Hereinafter, a hermetic two-stage compressor 1 (hereinafter, referred to as a two-stage compressor 1) according to a first embodiment of the present invention will be described.

[0029] As shown in Figs. 1 and 2, for example, the two-stage compressor 1 compresses a refrigerant R which is a gas such as carbon dioxide. The two-stage compressor 1 includes a housing 11, a rotary compressor (low stage-side compression section) 12, a scroll compressor (high stage-side compression section) 13, an electric motor 14, a rotary shaft 15, and a bearing device 30 which are provided inside the housing 11, and an inflow restricting plate 61 which is fixed to the bearing device 30.

[0030] The housing 11 includes a main body portion 21 which is formed in a cylindrical shape, and an upper cover portion 22 and a lower cover portion 23 which close an upper opening and a lower opening of the main body portion 21. In addition, a space inside the housing 11 is sealed.

[0031] The rotary shaft 15 is disposed to extend vertically inside the housing 11.

[0032] The electric motor 14 is disposed on an outer peripheral side of the rotary shaft 15 and rotates the rotary shaft 15 around an axis X. That is, the electric motor 14 includes a rotor 38 which is fixed to an outer peripheral surface of the rotary shaft 15, and a stator 39 which radially faces the rotor 38 with a gap between the stator 39 and the outer peripheral surface of the rotor 38 and is fixed to an inner surface of the main body portion 21 of the housing 11.

[0033] The electric motor 14 is connected to a power source (not shown) via a wire 14a and rotates the rotary shaft 15 by power from the power source. A portion of the stator 39 in a circumferential direction is fixed to the inner surface of the housing 11, and in portions other than the portion fixed to the inner surface of the housing 11, the inner surface of the housing 11 and the stator 39 are disposed with a gap S in a radial direction.

[0034] The rotary compressor 12 is disposed at a position adjacent to the lower cover portion 23 at a lower portion which is one in a direction of the axis X of the electric motor 14 inside the housing 11. The rotary com-

pressor 12 includes an eccentric shaft portion 41 which is provided on the rotary shaft 15, a piston rotor 42 which is fixed to the eccentric shaft portion 41 and is eccentrically rotated about the axis X according to a rotation of the rotary shaft 15, and a cylinder 44 which includes a compression chamber C1 accommodating the piston rotor 42 is formed inside the cylinder 44.

[0035] A suction hole 44a through which the refrigerant R can flow into the cylinder 44 is formed in the cylinder 44. A suction pipe 33 which is provided to penetrate the main body portion 21 of the housing 11 is connected to the suction hole 44a and the refrigerant R is supplied through the suction pipe 33 from the outside of the housing 11. In addition, a discharge hole (not shown) is formed in the cylinder 44, and the refrigerant R compressed by the rotary compressor 12 is discharged from the discharge hole to a region in the housing 11 in which the electric motor 14 is provided.

[0036] In addition, oil A is stored in the bottom portion of the housing 11 and an oil storage O1 is provided in the bottom portion. When the oil A is initially sealed, a liquid surface of the oil storage O1 is positioned above the rotary compressor 12. Accordingly, the rotary compressor 12 is driven in the oil storage O1.

[0037] The scroll compressor 13 is disposed above the electric motor 14 inside the housing 11. The scroll compressor 13 includes a fixed scroll 51 which is fixed to an upper bearing 31 and an orbiting scroll 57 which is disposed to face the fixed scroll 51 below the fixed scroll 51.

[0038] The fixed scroll 51 includes an end plate 52 which is fixed to an upper surface of the upper bearing 31 and a fixed lap 53 which protrudes downward from the end plate 52. A discharge hole 52a which vertically penetrates the end plate 52 is formed at a center portion (in the vicinity of the axis X) of the end plate 52.

[0039] The orbiting scroll 57 includes an end plate 58 which is disposed to be interposed between the bearing device 30 (upper bearing 31 described below) and the end plate 52 of the fixed scroll 51 in the direction of the axis X and is fixed to the rotary shaft 15, and an orbiting lap 59 which protrudes upward from the end plate 58.

[0040] The end plate 58 is fixed to an eccentric shaft portion 56 provided on an upper end of the rotary shaft 15 and is eccentrically rotated about the axis X according to the rotation of the rotary shaft 15.

[0041] The orbiting lap 59 meshes with the fixed lap 53, and thus, a compression chamber C2 in which the refrigerant R is compressed is formed between the orbiting lap 59 and the fixed lap 53.

[0042] Here, a suction hole (not shown) is formed in the fixed scroll 51, and the refrigerant R which is compressed by the rotary compressor 12 and is discharged into the housing 11 can be sucked into the compression chamber C2 via the bearing device 30 through the suction hole. The refrigerant R compressed in the compression chamber C2 is discharged to the outside of the housing 11 from a discharge pipe 34 through the discharge hole 52a of the fixed scroll 51, and the discharge pipe 34 is open to a space surrounded by the fixed scroll 51 fixed to the upper portion of the fixed scroll 51 in the housing 11 and the discharge cover 50 and is provided to penetrate the housing 11 so as to extend the outside of the housing 11.

[0043] The bearing device 30 includes the upper bearing 31 which is provided on the upper portion of the housing 11 inside the housing 11, and lower bearings 32A and 32B which are provided on the lower portion of the housing 11 inside the housing 11.

[0044] The lower bearings 32A and 32B rotatably support the rotary shaft 15 with respect to the housing 11 at the lower portion of the housing 11. Specifically, the rotary compressor 12 is vertically disposed in the direction of the axis X between the lower bearings 32A and 32B, and the lower bearings 32A and 32B are fixed to the cylinder 44 by a bolt 48.

[0045] The upper bearing 31 includes a bearing 31a which rotatably supports the rotary shaft 15 around the axis X of the rotary shaft 15 with respect to the housing 11 and a bearing casing 31b which supports the bearing 31a on the housing 11 integrally with the bearing 31a.

[0046] As shown in Figs. 1 to 3, a plurality of suction channels FC are provided in the bearing casing 31b, and the suction channels FC extend to be parallel to the axis X over the entire region of the bearing casing 31b in the direction of the axis X with intervals to each other in the circumferential direction. In the present embodiment, each of the suction channels FC is a recessed groove having a rectangular cross section which is recessed from the outer peripheral surface of the bearing casing 31b toward the radially inner side.

[0047] In addition, a suction opening FCa is provided in the bearing casing 31b, and the suction opening FCa extends from a lower end of the suction channel FC toward the radially inner side so as to be continued to the lower side which is one side (first end side) of the axis X and is open in a fan shape downward when the bearing casing 31b is viewed.

[0048] In addition, a recessed portion (accommodation portion) 31c is provided in the bearing casing 31b, and the recessed portion 31c is recessed over the entire region in the direction of the axis X from the outer peripheral surface toward the radially inner side at a position at which the recessed portion does not interfere with the suction opening FCa. The wire 14a of the electric motor 14 is disposed inside the recessed portion. A seal member 65 is provided in a gap among the recessed portion 31c, the wire 14a, and the inner surface of the housing 11. For example, as the seal member 65, a seal material such as a resin can be used.

[0049] In addition, a bearing channel 31d (refer to Fig. 2) is formed in the bearing casing 31b, and the bearing channel 31d radially penetrates the bearing casing 31b and is open to the inside of the housing 11 at a position in the direction of the axis X at which the orbiting scroll 57 is fixed to the eccentric shaft portion 56.

[0050] In addition, an oil return pipe (oil return section)

72 is provided in the bearing casing 31b, and, at a position at which the oil return pipe 72 does not interfere with the suction opening FCa and the recessed portion 31c and a position of an end portion on the radially outer side, the oil return pipe 72 communicates with the bearing channel 31d, penetrates the bearing casing 31b toward the electric motor 14 to extend along the inner surface of the housing 11, and protrudes downward from the bearing casing 31b.

[0051] As shown in Fig. 3, the inflow restricting plate 61 is fixed to the bearing casing 31b by bolts 60 from below. The inflow restricting plate 61 is formed in an annular shape about the axis X. The inflow restricting plate 61 includes a plurality of notches 63, which are cut out from the end portion on the radially inner side toward the radially inner side, at positions corresponding to the suction openings FCa. A lower surface of the inflow restricting plate 61 becomes a restricting surface 62, and a bottom portion of each notch 63 forms an inner edge portion 62a of the restricting surface 62. The inner edge portion 62a has a curved shape formed along the circumferential direction. The inner edge portion 62a is positioned at a radially intermediate position of the suction opening FCa, and as a result, only the radially inner position of the suction opening FCa is open toward the electric motor 14 by the inflow restricting plate 61. Accordingly, a flow of the refrigerant R to the suction opening FCa on the radially outer side is restricted by the restricting surface 62.

[0052] In addition, a notch 61a is provided in the inflow restricting plate 61, and the notch 61a is recessed from the outer edge portion 62b toward the radially inner side at a position corresponding to the position of the wire 14a so as not to interfere with the wire 14a.

[0053] As shown in Fig. 1, when viewed from a cross section including the axis X, the restricting surface 62 is provided to protrude from the inner surface of the housing 11 toward the radially inner side.

[0054] In addition, in the present embodiment, a seal member 66 is provided in a gap between the inner surface of the housing 11 and an outer edge portion 62b (an end edge on the radially outer side along the inner surface of the housing 11) of the restricting surface 62. As the seal member 66, a seal member formed of a resin, an O ring, or the like can be used.

[0055] In the two-stage compressor 1 of the above-described present embodiment, the oil A of the oil storage O1 and the refrigerant R are compressed by the rotary compressor 12. Accordingly, the oil A is included in the refrigerant R discharged from the rotary compressor 12. A portion of the refrigerant R including the oil A flows out toward the electric motor 14, and thereafter, flows toward the scroll compressor 13 through the gap between the stator 39 and the rotor 38 or the through-hole 37 provided in the rotor 38. In addition, when the refrigerant R passes through the electric motor 14, the oil A in the refrigerant R comes into contact with the rotor 38 or an oil separation plate 38a which is provided on the rotor 38 and extends in the radial direction, and thus, a content of the oil A in the refrigerant R decreases.

[0056] Meanwhile, the refrigerant R which has passed through the gap S between the stator 39 and the housing 11 does not come into contact with the rotor 38 and flows toward the scroll compressor 13 as it is. Accordingly, the refrigerant R flows toward the scroll compressor 13 in a state where the content of the oil A in the refrigerant R is high. That is, the amount of the oil A in the refrigerant R discharged from the rotary compressor 12 decreases on the radially inner side of the housing 11 and increases on the radially outer side thereof.

[0057] Here, in the present embodiment, the inflow restricting plate 61 having the restricting surface 62 is provided in the bearing casing 31b, and thus, the flow of the refrigerant R to the suction opening FCa on the radially outer side can be restricted. Accordingly, it is possible to prevent the refrigerant R having a high content of oil A on the radially outer side flows into the suction channel FC through the suction opening FCa as it is. In addition, the refrigerant R on the radially inner side having a low content of oil A can flow into the suction channel FC through the suction opening FCa.

[0058] As a result, it is possible to supply the refrigerant R having a low content of oil A to the scroll compressor 13, and it is possible to decrease the amount of the oil A in the refrigerant R which is compressed by the scroll compressor 13 and is discharged therefrom. It is possible to decrease an oil circulation amount (OC%) in a system including the two-stage compressor 1.

[0059] In addition, if the refrigerant R on the radially outer side comes into contact with the restricting surface 62, the oil A in the refrigerant R is attached to the restricting surface 62, and the refrigerant R in which the content of the oil A has decreased is guided to the radially inner side by the restricting surface 62 and flows from suction opening FCa into suction channel FC. Accordingly, in a state where the amount of the oil A in the refrigerant R is decreased by the restricting surface 62, the refrigerant R is supplied from the suction channel FC to the scroll compressor 13. In this way, it is possible to decrease the amount of the oil A in the refrigerant R which is compressed by the scroll compressor 13 and is discharged from the discharge pipe 34 to the outside of the housing 11, and it is possible to decrease the oil circulation amount (OC%) in the system.

[0060] In addition, the inflow restricting plate 61 is provided in the bearing casing 31b, and thus, the restricting surface 62 can be provided in the bearing casing 31b. Accordingly, compared to a case where a member corresponding to the inflow restricting plate 61 is attached to the housing 11, a welding work or the like with respect to the housing 11 is not required, and it is possible to very easily provide the restricting surface 62 in the bearing casing 31b. Accordingly, it is possible to effectively separate the oil A in the refrigerant R from the refrigerant R while easily manufacturing the two-stage compressor 1 having the restricting surface 62.

[0061] In addition, the oil return pipe 72 is provided, and thus, the oil which is used to lubricate the high stage-side compression section is returned into the housing 11 through the oil return pipe 72. Accordingly, it is possible to further decrease the amount of the oil A in the refrigerant R which is compressed by the scroll compressor 13 and is discharged therefrom. In addition, the oil return pipe 72 is provided on the end portion on the radially outer side of the bearing casing 31b, and thus, the oil return pipe 72 is provided at a position separated from the opening portion on the radially inner side in the suction opening FCa on the radially inner side. Therefore, the oil A which is returned from the oil return pipe 72 to the housing 11 can be prevented from flowing from the suction opening FCa into the suction channel FC as it is. Accordingly, it is possible to further decrease the amount of the oil A in the refrigerant R which is compressed by the scroll compressor 13 and is discharged therefrom.

[0062] In addition, the refrigerant R having a high content of oil A which has passed through the gap S between the housing 11 and the stator 39 in the region on the radially outer side inside the housing 11 can be prevented from flowing from the portion between the restricting surface 62 and the inner surface of the housing 11 into the scroll compressor 13 as it is by the seal member 66. Therefore, it is possible to further decrease the amount of the oil A in the refrigerant R which is compressed by the scroll compressor 13 and is discharged therefrom.

[0063] In addition, even when the recessed portion 31c into which the wire 14a of the electric motor 14 is inserted is formed in the bearing casing 31b, it is possible to seal the gap among the recessed portion 31c, the wire 14a, and the inner surface of the housing 11 by the seal member 65. Accordingly, it is possible to prevent the refrigerant R including the oil A from being supplied to the scroll compressor 13 through the gap as it is.

[Second Embodiment]

[0064] Next, a two-stage compressor 80 according to a second embodiment of the present invention will be described with reference to Figs. 4 and 5. In Fig. 4, for convenience of descriptions, the wire 14a of the electric motor 14 and the oil return pipe 72 are not shown.

[0065] The same reference numerals are assigned to the components similar to those of the second embodiment, and detail descriptions.

[0066] In the two-stage compressor 80 of the present embodiment, an inflow restricting plate 81 having a restricting surface 82 is different from the inflow restricting plate 61 of the first embodiment.

[0067] The inflow restricting plate 81 includes an annular portion 83 which is disposed on the radially outer side along the inner surface of the housing 11 and is formed in an annular shape about the axis X, and a conical portion 84 which is continuous to the radially inner side of the annular portion 83 so as to be provided integrally with the annular portion 83.

[0068] A lower surface of the annular portion 83 is a flat surface 86 which is formed in an annular shape about the axis X. In addition, an outer surface of the conical portion 84 is an inclined surface 87 which is formed in a truncated conical shape about the axis X. The inclined surface 87 is inclined downward from the flat surface 86 toward the radially inner side.

[0069] In this way, the restricting surface 82 of the present embodiment includes the flat surface 86 and the inclined surface 87. An inner edge portion 87a which is an end edge on the radially inner side of the inclined surface 87 is positioned on the radially inner side from the stator 39 and on the radially outer side from the bearing casing 31b and the rotary shaft 15.

[0070] In addition, in the present embodiment, the inner edge portion 87a of the inflow restricting plate 81 is disposed at a position at which an intake amount of the refrigerant R required in the scroll compressor 13 can be secured, that is, an opening area of the suction opening FCa can be secured.

[0071] In the two-stage compressor 80 of the above-described present embodiment, the restricting surface 82 has the inclined surface 87, and thus, it is possible to form an opening portion OP which is formed in an annular shape about the axis X so as to extend downward in the direction of the axis X from the suction opening FCa. Accordingly, compared to the first embodiment, the area of the suction opening FCa which is open toward the electric motor 14 can increase. Therefore, it is possible to secure a flow rate of the refrigerant R flowing from the inside of the housing 11 into the suction channel FC.

[0072] In addition, the refrigerant R having a high content of the oil A in the radially outer side region in the housing 11 flows to the radially inner side along the flat surface 86, and thereafter, collides with the inclined surface 87, and thus, the oil A can be attached to the inclined surface 87. Accordingly, the refrigerant R can flow into the suction channel FC in a state where the content of the oil A in the refrigerant R further decreases so as to be supplied to the scroll compressor 13. As a result, it is possible to further decrease the amount of the oil A in the refrigerant R which is compressed by the scroll compressor 13 and is discharged to the outside of the housing 11 and it is possible to further decrease the oil circulation amount (OC%) in the system including the two-stage compressor 80.

[0073] In addition, in the present embodiment, the inner edge portion 87a on the radially inner side of the inclined surface 87 is positioned on the radially inner side from the stator 39, and thus, the restricting surface 82 extends to the position of the rotor 38. Accordingly, the refrigerant R flowing through the radially inner side in the housing 11 and the oil A in the refrigerant R come into contact with the rotor 38, and the refrigerant R in which the amount of the oil A is sufficiently decreased by the rotor 38 can flow from the suction opening FCa into the suction channel FC.

[0074] In addition, the inner edge portion 87a of the

inflow restricting plate 81 is disposed at the position at which the intake amount of the refrigerant R required in the scroll compressor 13 can be secured, and thus, it is possible to prevent compression efficiency in the scroll compressor 13 from decreasing.

[0075] Hereinbefore, the embodiments of the present invention are described in detail with reference to the drawings. However, the respective configurations and combinations thereof in the respective embodiments are merely examples, and additions, omissions, substations, and other modifications of configurations are possible within the scope which does not depart from the present invention. In addition, the present invention is not limited to the embodiments and are limited by only claims.

[0076] For example, the bearing casing 31b and each of the inflow restricting plates 61 and 81 may be integrated with each other. That is, each of the restricting surfaces 62 and 82 may be directly provided in the bearing casing 31b.

[0077] In addition, similarly to the second embodiment, in the first embodiment, the inner edge portion 62a of the restricting surface 62 may be disposed on the radially inner side from the stator 39. In addition, in this case, the position of the inner edge portion 62a may be determined such that the intake amount of the refrigerant R required in the scroll compressor 13 can be secured.

[0078] In addition, in the bearing casing 31b, instead of the recessed portion 31c, a through-hole penetrating the bearing casing 31b in the direction of the axis X may be formed such that the wire 14a is inserted into the through-hole so as to be disposed.

[0079] In addition, as shown in Fig. 6, an annular recessed portion 90 which is recessed upward and is formed in an annular shape about the axis X may be provided in the restricting surface 62A. According to the annular recessed portion, the refrigerant R on the radially outer side comes into contact with the restricting surface 62A, and thus, the oil A attached to the restricting surface 62A flows toward the radially inner side, and it is possible to prevent the oil A from being sucked into the suction opening FCa. The annular recessed portion 90 can be provided in any one of the restricting surface 62 of the first embodiment and the restricting surface 82 of the second embodiment.

[0080] In addition, in the housing 11, the rotary compressor 12 is provided as the low stage-side compressor and the scroll compressor 13 is provided as the high stage-side compressor. However, the present invention is not limited to this. For example, the scroll compressor 13 may be provided as the low stage-side compressor and the rotary compressor 12 may be used as the high stage-side compressor. In addition, the scroll compressor 13 may be provided on both the low stage side and the high stage side, or the rotary compressor 12 may be provided on both the low stage side and the high stage side. In addition, a compressor other than the scroll compressor 13 and the rotary compressor 12 may be provided.

[0081] Moreover, the restricting surfaces 62 and 82 may be provided in a two-stage compressor which is used in a horizontal position so that the axis of the rotary shaft extends in a horizontal direction.

Industrial Applicability

[0082] According to the hermetic two-stage compressor, the hermetic two-stage compressor can be easily manufactured, and the oil in the gas can be effectively separated. Reference Signs List

[0083]

1, 80: hermetic two-stage compressor
11: housing
12: rotary compressor (low stage-side compression section)
13: scroll compressor (high stage-side compression section)
14: electric motor
14a: wire
15: rotary shaft
21: main body portion
22: upper cover portion
23: lower cover portion
30: bearing device
31: upper bearing
31a: bearing
31b: bearing casing
31c: recessed portion (accommodation portion)
31d: bearing channel
32A, 32B: lower bearing
33: suction pipe
34: discharge pipe
37: through-hole
38: rotor
38a: oil separation plate
39: stator
41: eccentric shaft portion
42: piston rotor
44: cylinder
44a: suction hole
48: bolt
50: discharge cover
51: fixed scroll
52: end plate
52a: discharge hole
53: fixed lap
56: eccentric shaft portion
57: orbiting scroll
58: end plate
59: orbiting lap
60: bolt
61: inflow restricting plate
61a: notch
62, 62A: restricting surface
62a: inner edge portion
62b: outer edge portion

63: notch
65: seal member
66: seal member
72: oil return pipe (oil return section)
81: inflow restricting plate
82: restricting surface
83: annular portion
84: conical portion
86: flat surface
87: inclined surface
87a: inner edge portion
90: annular recessed portion
C1: compression chamber
C2: compression chamber
O1: oil storage
R: refrigerant
X: axis
A: oil
S: gap
FC: suction channel
FCa: suction opening
OP: opening portion

Claims

1. A hermetic two-stage compressor (1, 80) comprising:

a housing (11) which includes an oil storage (O1) inside the housing (11);
a rotary shaft (15) which is disposed in the housing (11) ;
a motor (14) which is disposed in the housing (11) so as to rotate the rotary shaft (15) and includes a stator (39) which is provided on a radially outer side and a rotor (39) which is provided on a radially inner side;
a low stage-side compression section (12) which is disposed on one side in an axial direction of the rotary shaft (15) with respect to the motor (14) in the housing (11) and is connected to the rotary shaft (15) so as to compress a gas;
a bearing device (30) which is disposed on the other side in the axial direction with respect to the motor (14) in the housing (11) and includes a bearing (31a) which supports the rotary shaft (15) and a bearing casing (31b) which supports the bearing (31a) to the housing (11); and
a high stage-side compression section (13) which is disposed furhter on the other side in the axial direction with respect to the bearing device (30) and further compresses the gas discharged from the low stage-side compression section (12),

characterised in that the bearing casing (31b) includes

a plurality of suction channels (FC) which are provided to suck the gas into the high stage-side compression section (13) and each of the plurality of the suction channels (FC) include a suction opening (FCa) which is open to the one side in the axial direction, and
a restricting surface (62) which is disposed between the suction opening (FCa) and the motor (14) and is provided toward the radially inner side from an inner surface of the housing (11) so as to restrict a flow of the gas to the suction opening (FCa) on the radially outer side, wherein

the plurality of suction channels (FC) extend to be parallel to the axis (X) over the entire region of the bearing casing (31b) in the direction of the axis (X) with intervals to each other in the circumferential direction (X), and
wherein the restricting surface (62) includes a plurality of notches (63) which are cut out from an end portion on the radially inner side toward the radially inner side at a position corresponding to the suction opening (FCa) and only a position on the radially inner side of the suction opening (FCa) is open toward the motor (14) .

2. The hermetic two-stage compressor (1) according to claim 1, further comprising:
an inflow restricting plate (61) which is fixed to the bearing casing (31b), is formed in a plate shape, and includes the restricting surface (62) on the one side of the axial direction.

3. A hermetic two-stage compressor (80) according to any one of claims 1 or 2,
wherein an inner edge portion (87a) on the radially inner side of the restricting surface (82) is disposed at a position on the radially inner side of the stator (39), and
wherein the restricting surface (82) closes a portion of the suction opening (FCa) so as to secure an intake amount of the gas required in the high stage-side compression section (13).

4. The hermetic two-stage compressor (1, 80) according to any one of claims 1 to 3, further comprising:
a seal member (66) which is provided in a gap between an outer edge portion (62b) on the radially outer side of the restricting surface and the inner surface of the housing (11).

5. The hermetic two-stage compressor (1, 80) according to any one of claims 1 to 4, further comprising:
an oil return section (72) which is provided at a position of an end portion on the radially outer side in the bearing casing (31b), and causes the high stage-

side compression section (13) and the one side in the axial direction from the bearing casing (31b) in the housing (11) to communicate with each other such that oil from the high stage-side compression section (13) can flow through the oil return section (72).

6. A hermetic two-stage compressor (80) comprising:

a housing (11) which includes an oil storage (O1) inside the housing (11);
a rotary shaft (15) which is disposed in the housing (11) ;
a motor (14) which is disposed in the housing (11) so as to rotate the rotary shaft (15) and includes a stator (39) which is provided on a radially outer side and a rotor (39) which is provided on a radially inner side;
a low stage-side compression section (12) which is disposed on one side in an axial direction of the rotary shaft (15) with respect to the motor (14) in the housing (11) and is connected to the rotary shaft (15) so as to compress a gas;
a bearing device (30) which is disposed on the other side in the axial direction with respect to the motor (14) in the housing (11) and includes a bearing (31a) which supports the rotary shaft (15) and a bearing casing (31b) which supports the bearing (31a) to the housing (11); and
a high stage-side compression section (13) which is disposed further on the other side in the axial direction with respect to the bearing device (30) and further compresses the gas discharged from the low stage-side compression section (12),

characterised in that the bearing casing (31b) includes
a plurality of suction channels (FC) which are provided to suck the gas into the high stage-side compression section (13) and each of the plurality of suction channels (FC) include a suction opening (FCa) which is open to the one side in the axial direction, and
a restricting surface (82) which is disposed between the suction opening (FCa) and the motor (14) and is provided toward the radially inner side from an inner surface of the housing (11) so as to restrict a flow of the gas to the suction opening (FCa) on the radially outer side,
wherein the plurality of suction channels (FC) extend to be parallel to the axis (X) over the entire region of the bearing casing (31b) in the direction of the axis (X) with intervals to each other in the circumferential direction (X), and

wherein the restricting surface (82) includes

a flat surface (86) which is provided on an end portion on the radially outer side which is an inner surface side of the housing and is perpendicular to the axis to be formed in an annular shape about the axis, and
an inclined surface (87) which is inclined toward the one side in the axial direction from the flat surface (86) toward the radially inner side so as to be formed in a truncated conical shape about the axis.

Patentansprüche

1. Hermetischer zweistufiger Kompressor (1, 80) umfassend:

ein Gehäuse (11), welches einen Ölspeicher (O1) innerhalb des Gehäuses (11) umfasst;
eine Drehwelle (15), die in dem Gehäuse (11) angeordnet ist;
einen Motor (14), der derart in dem Gehäuse (11) angeordnet ist, dass er die Drehwelle (15) dreht, und einen Stator (39) umfasst, welcher auf einer radial äußeren Seite vorgesehen ist, und einen Rotor (39) umfasst, welcher auf einer radial inneren Seite vorgesehen ist;
einen niederdruckstufenseitigen Kompressionsabschnitt (12), welcher auf einer Seite in einer axialen Richtung der Drehwelle (15) in Bezug auf den Motor (14) in dem Gehäuse (11) angeordnet und mit der Drehwelle (15) verbunden ist, um ein Gas zu komprimieren;
eine Lagervorrichtung (30), welche auf der anderen Seite in der axialen Richtung in Bezug auf den Motor (14) in dem Gehäuse (11) angeordnet ist und ein Lager (31a), welches die Drehwelle (15) abstützt, und ein Lagergehäuse (31b) umfasst, welches das Lager (31a) am Gehäuse (11) abstützt; und
einen hochdruckstufenseitigen Kompressionsabschnitt (13), welcher weiter auf der anderen Seite in der axialen Richtung in Bezug auf die Lagervorrichtung (30) angeordnet ist und das aus dem niederdruckstufenseitigen Kompressionsabschnitt (12) entladene Gas weiter komprimiert,
dadurch gekennzeichnet, dass
das Lagergehäuse (31b) umfasst:

eine Vielzahl von Saugkanälen (FC), welche dafür vorgesehen sind, das Gas in den hochdruckstufenseitigen Kompressionsabschnitt (13) zu saugen, wobei jeder der Vielzahl von Saugkanälen (FC) eine Ansaugöffnung (FCa) aufweist, welche zu der einen

Seite in der axialen Richtung offen ist, und eine Begrenzungsfläche (62), welche zwischen der Ansaugöffnung (FCa) und dem Motor (14) angeordnet und von einer Innenfläche des Gehäuses (11) in Richtung der radial inneren Seite vorgesehen ist, um eine Strömung des Gases zu der Ansaugöffnung (FCa) auf der radial äußeren Seite zu begrenzen,
wobei sich die Vielzahl von Saugkanälen (FC) parallel zur Achse (X) über den gesamten Bereich des Lagergehäuses (31b) in der Richtung der Achse (X) mit Abständen zueinander in der Umfangsrichtung (X) erstreckt, und
wobei die Begrenzungsfläche (62) eine Vielzahl von Kerben (63) umfasst, welche von einem Endabschnitt auf der radial inneren Seite in Richtung der radial inneren Seite an einer Position ausgeschnitten sind, die der Ansaugöffnung (FCa) entspricht, und nur eine Position auf der radial inneren Seite der Ansaugöffnung (FCa) in Richtung des Motors (14) offen ist.

2. Hermetischer zweistufiger Kompressor (1) nach Anspruch 1, der weiter umfasst:
eine Zuflussbegrenzungsplatte (61), welche an dem Lagergehäuse (31b) befestigt ist, in Plattenform ausgebildet ist und die Begrenzungsfläche (62) auf der einen Seite der axialen Richtung umfasst.

3. Hermetischer zweistufiger Kompressor (80) nach einem der Ansprüche 1 oder 2,
wobei ein innerer Randabschnitt (87a) auf der radial inneren Seite der Begrenzungsfläche (82) an einer Position an der radial inneren Seite des Stators (39) angeordnet ist, und
wobei die Begrenzungsfläche (82) einen Teil der Ansaugöffnung (FCa) verschließt, um eine in dem hochdruckstufenseitigen Kompressionsabschnitt (13) erforderliche Eintrittsmenge des Gases sicherzustellen.

4. Hermetischer zweistufiger Kompressor (1, 80) nach einem der Ansprüche 1 bis 3, der weiter umfasst:
ein Dichtungselement (66), welches in einem Spalt zwischen einem äußeren Randabschnitt (62b) auf der radial äußeren Seite der Begrenzungsfläche und der Innenfläche des Gehäuses (11) vorgesehen ist.

5. Hermetischer zweistufiger Kompressor (1, 80) nach einem der Ansprüche 1 bis 4, der weiter umfasst:
einen Ölrücklaufabschnitt (72), welcher an einer Position eines Endabschnitts auf der radial äußeren Seite in dem Lagergehäuse (31b) vorgesehen ist und bewirkt, dass der hochdruckstufenseitige Kompressionsabschnitt (13) und die eine Seite in der axialen Richtung von dem Lagergehäuse (31b) in das Gehäuse (11) derart miteinander kommunizieren, dass das Öl aus dem hochdruckstufenseitigen Kompressionsabschnitt (13) durch den Ölrücklaufabschnitt (72) fließen kann.

6. Hermetischer zweistufiger Kompressor (80) umfassend:

ein Gehäuse (11), welches einen Ölspeicher (O1) innerhalb des Gehäuses (11) umfasst;
eine Drehwelle (15), die in dem Gehäuse (11) angeordnet ist;
einen Motor (14), der derart in dem Gehäuse (11) angeordnet ist, dass er die Drehwelle (15) dreht, und einen Stator (39) umfasst, welcher auf einer radial äußeren Seite vorgesehen ist, und einen Rotor (39) umfasst, welcher auf einer radial inneren Seite vorgesehen ist;
einen niederdruckstufenseitigen Kompressionsabschnitt (12), welcher auf einer Seite in einer axialen Richtung der Drehwelle (15) in Bezug auf den Motor (14) in dem Gehäuse (11) angeordnet und mit der Drehwelle (15) verbunden ist, um ein Gas zu komprimieren;
eine Lagervorrichtung (30), welche auf der anderen Seite in der axialen Richtung in Bezug auf den Motor (14) in dem Gehäuse (11) angeordnet ist und ein Lager (31a), welches die Drehwelle (15) abstützt, und ein Lagergehäuse (31b) umfasst, welches das Lager (31a) am Gehäuse (11) abstützt; und
einen hochdruckstufenseitigen Kompressionsabschnitt (13), welcher weiter auf der anderen Seite in der axialen Richtung in Bezug auf die Lagervorrichtung (30) angeordnet ist und das aus dem niederdruckstufenseitigen Kompressionsabschnitt (12) entladene Gas weiter komprimiert,
dadurch gekennzeichnet, dass
das Lagergehäuse (31b) umfasst:

eine Vielzahl von Saugkanälen (FC), welche dafür vorgesehen sind, das Gas in den hochdruckstufenseitigen Kompressionsabschnitt (13) zu saugen, wobei jeder der Vielzahl von Saugkanälen (FC) eine Ansaugöffnung (FCa) aufweist, welche zu der einen Seite in der axialen Richtung offen ist, und eine Begrenzungsfläche (82), welche zwischen der Ansaugöffnung (FCa) und dem Motor (14) angeordnet und von einer Innenfläche des Gehäuses (11) in Richtung der radial inneren Seite vorgesehen ist, um eine Strömung des Gases zu der Ansaugöffnung (FCa) auf der radial äußeren Seite zu begrenzen,
wobei sich die Vielzahl von Saugkanälen

(FC) parallel zur Achse (X) über den gesamten Bereich des Lagergehäuses (31b) in der Richtung der Achse (X) mit Abständen zueinander in der Umfangsrichtung (X) erstreckt, und
wobei die Begrenzungsfläche (82) umfasst:

eine flache Oberfläche (86), welche an einem Endabschnitt auf der radial äußeren Seite vorgesehen ist, welche eine Innenflächenseite des Gehäuses ist und senkrecht zu der Achse steht, die in einer Ringform um die Achse gebildet wird, und
eine geneigte Fläche (87), welche zu der einen Seite in der axialen Richtung von der flachen Oberfläche (86) in Richtung der radial inneren Seite geneigt ist, um in einer Kegelstumpfform um die Achse ausgebildet zu sein.

Revendications

1. Compresseur hermétique à deux étages (1, 80) comprenant :

un boîtier (11) qui comprend un stockage d'huile (O1) à l'intérieur du boîtier (11) ;
un arbre rotatif (15) qui est disposé dans le boîtier (11) ;
un moteur (14) qui est disposé dans le boîtier (11) afin de faire tourner l'arbre rotatif (15) et comprend un stator (39) qui est prévu sur le côté radialement externe et un rotor (39) qui est prévu sur un côté radialement interne ;
une section de compression du côté de l'étage inférieur (12) qui est disposée d'un côté dans une direction axiale de l'arbre rotatif (15) par rapport au moteur (14) dans le boîtier (11) et est raccordée à l'arbre rotatif (15) afin de comprimer un gaz ;
un dispositif de palier (30) qui est disposé de l'autre côté dans la direction axiale par rapport au moteur (14) dans le boîtier (11) et comprend un palier (31a) qui supporte l'arbre rotatif (15) et un carter de palier (31b) qui supporte le palier (31a) sur le boîtier (11) ; et
une section de compression du côté de l'étage supérieur (13) qui est disposée plus loin de l'autre côté dans la direction axiale par rapport au dispositif de palier (30) et comprime en outre le gaz déchargé de la section de compression du côté de l'étage inférieur (12),
caractérisé en ce que :
le carter de palier (31b) comprend :

une pluralité de canaux d'aspiration (FC) qui sont prévus pour aspirer le gaz dans la section de compression du côté de l'étage supérieur (13) et chacun de la pluralité de canaux d'aspiration (FC) comprend une ouverture d'aspiration (FCa) qui est ouverte sur le premier côté dans la direction axiale, et
une surface de restriction (62) qui est disposée entre l'ouverture d'aspiration (FCa) et le moteur (14) et est prévue vers le côté radialement interne à partir d'une surface interne du boîtier (11) afin de limiter un écoulement du gaz vers l'ouverture d'aspiration (FCa) sur le côté radialement externe,
dans lequel :

la pluralité de canaux d'aspiration (FC) s'étendent pour être parallèles à l'axe (X) sur toute la région du carter de palier (31b) dans la direction de l'axe (X) avec des intervalles entre eux dans la direction circonférentielle (X), et
dans lequel la surface de restriction (62) comprend une pluralité d'encoches (63) qui sont découpées dans une partie d'extrémité sur le côté radialement interne vers le côté radialement interne dans une position correspondant à l'ouverture d'aspiration (FCa) et uniquement une position sur le côté radialement interne de l'ouverture d'aspiration (FCa) est ouverte vers le moteur (14).

2. Compresseur hermétique à deux étages (1) selon la revendication 1, comprenant en outre :
une plaque de restriction d'entrée (61) qui est fixée sur le carter de palier (31b), est formée selon une forme de plaque, et comprend la surface de restriction (62) sur le premier côté de la direction axiale.

3. Compresseur hermétique à deux étages (80) selon l'une quelconque des revendications 1 ou 2,
dans lequel une partie de bord interne (87a) sur le côté radialement interne de la surface de restriction (82) est disposée dans une position sur le côté radialement interne du stator (39), et
dans lequel la surface de restriction (82) ferme une partie de l'ouverture d'aspiration (FCa) afin de fixer une quantité d'admission du gaz requise dans la section de compression du côté de l'étage supérieur (13).

4. Compresseur hermétique à deux étages (1, 80) selon l'une quelconque des revendications 1 à 3, comprenant en outre :
un élément de joint d'étanchéité (66) qui est prévu

dans un espace entre une partie de bord externe (62b) sur le côté radialement externe de la surface de restriction et la surface interne du boîtier (11).

5. Compresseur hermétique à deux étages (1, 80) selon l'une quelconque des revendications 1 à 4, comprenant en outre :
Une section de retour d'huile (72) qui est prévue dans une position d'une partie d'extrémité sur le côté radialement externe dans le carter de palier (31b) et amène la section de compression du côté de l'étage supérieur (13) et le premier côté dans la direction axiale à partir du carter de palier (31b) dans le boîtier (11) à communiquer entre eux de sorte que l'huile provenant de la section de compression du côté de l'étage supérieur (13) peut s'écouler à travers la section de retour d'huile (72).

6. Compresseur hermétique à deux étages (80) comprenant :

un boîtier (11) qui comprend un stockage d'huile (O1) à l'intérieur du boîtier (11) ;
un arbre rotatif (15) qui est disposé dans le boîtier (11) ;
un moteur (14) qui est disposé dans le boîtier (11) afin de faire tourner l'arbre rotatif (15) et comprend un stator (39) qui est prévu sur un côté radialement externe et un rotor (39) qui est prévu sur un côté radialement interne ;
une section de compression du côté de l'étage inférieur (12) qui est disposée sur un côté dans la direction axiale de l'arbre rotatif (15) par rapport au moteur (14) dans le boîtier (11) et est raccordée à l'arbre rotatif (15) afin de comprimer un gaz ;
un dispositif de palier (30) qui est disposé de l'autre côté dans la direction axiale par rapport au moteur (14) dans le boîtier (11) et comprend un palier (31a) qui supporte l'arbre rotatif (15) et un carter de palier (31b) qui supporte le palier (31a) sur le boîtier (11) ; et
une section de compression du côté de l'étage supérieur (13) qui est disposée plus loin de l'autre côté dans la direction axiale par rapport au dispositif de palier (30) et comprime en outre le gaz déchargé par la section de compression du côté de l'étage inférieur (12),
caractérisé en ce que :
le carter de palier (31b) comprend :

une pluralité de canaux d'aspiration (FC) qui sont prévus pour aspirer le gaz dans la section de compression du côté de l'étage supérieur (13) et chacun de la pluralité de canaux d'aspiration (FC) comprend une ouverture d'aspiration (FCa) qui est ouverte vers le premier côté dans la direction axiale, et
une surface de restriction (82) qui est disposée entre l'ouverture d'aspiration (FCa) et le moteur (14) et est prévue vers le côté radialement interne à partir d'une surface interne du boîtier (11) afin de limiter un écoulement du gaz vers l'ouverture d'aspiration (FCa) sur le côté radialement externe,
dans lequel la pluralité de canaux d'aspiration (FC) s'étendent pour être parallèles à l'axe (X) sur toute la région du carter de palier (31b) dans la direction de l'axe (X) avec des intervalles entre eux dans la direction circonférentielle (X), et
dans lequel la surface de restriction (82) comprend :

une surface plate (86) qui est prévue sur une partie d'extrémité sur le côté radialement externe qui est un côté de surface interne du boîtier et est perpendiculaire à l'axe à former selon une forme annulaire autour de l'axe, et
une surface inclinée (87) qui est inclinée vers le premier côté dans la direction axiale de la surface plate (86) vers le côté radialement interne afin d'être formé selon une forme tronconique autour de l'axe.

FIG. 1

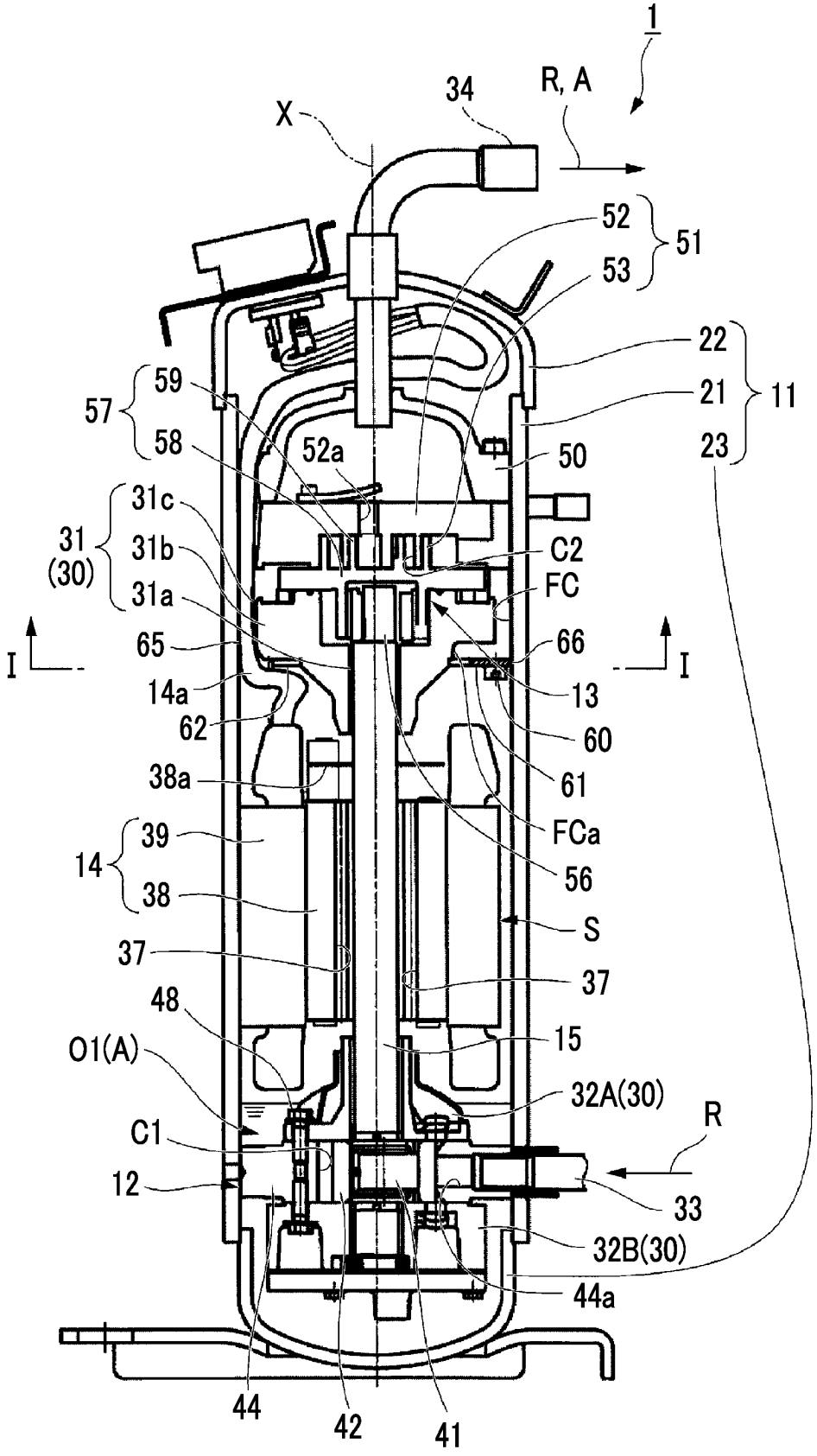

1
R, A
34
X
52
53
51
22
21
23
11
59
57
58
52a
50
31c
31b
31a
31
(30)
C2
FC
I
I
65
66
14a
13
62
60
61
38a
FCa
39
14
38
56
S
37
37
48
15
O1(A)
32A(30)
R
C1
12
33
32B(30)
44a
44
42
41

FIG. 2

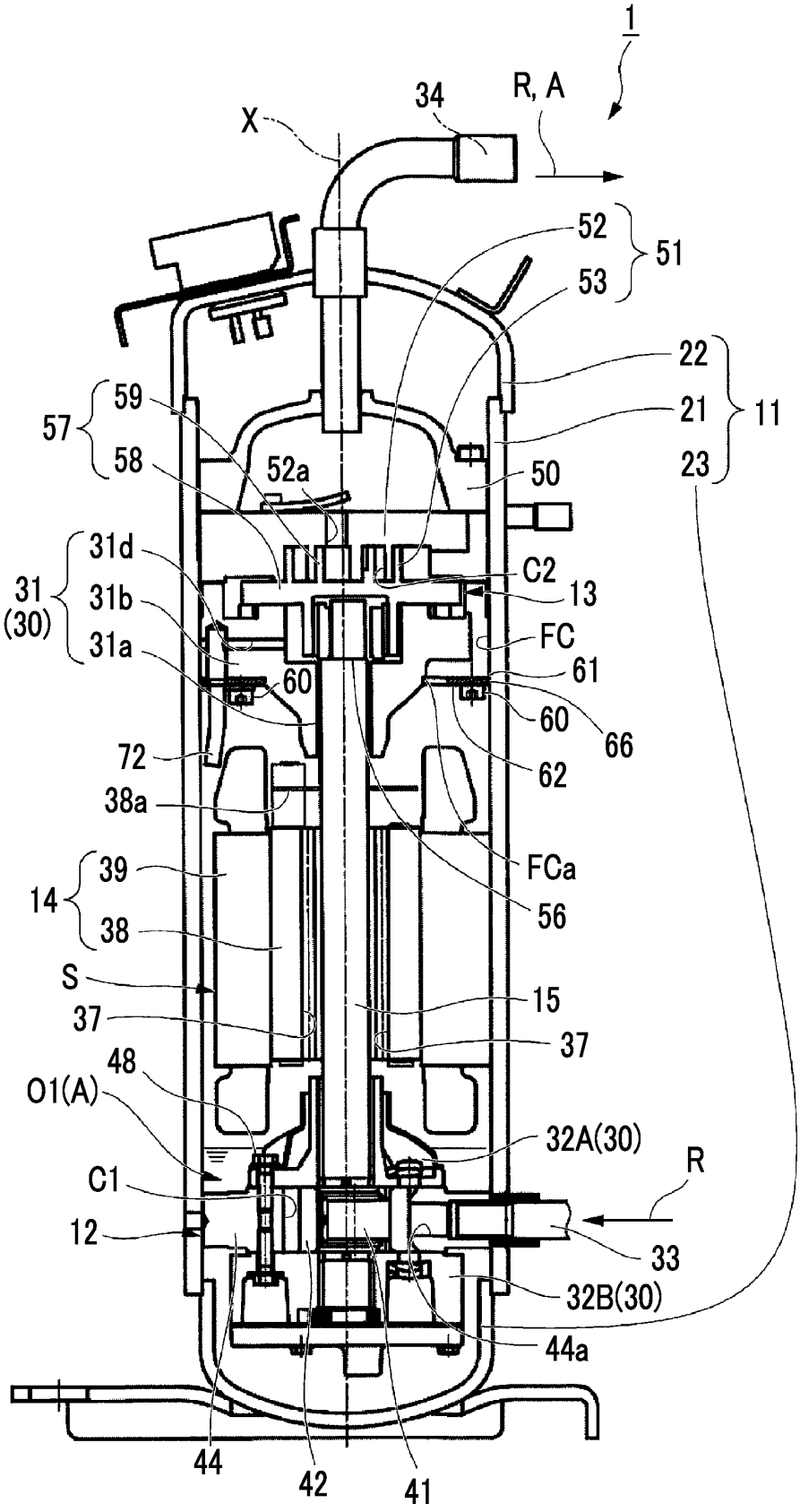

1
34
R, A
X
52
51
53
22
21
11
23
59
57
58
52a
50
31d
31
(30)
31b
31a
C2
13
FC
61
60
60
66
72
62
38a
FCa
39
14
38
56
S
15
37
37
48
O1(A)
32A(30)
R
C1
12
33
32B(30)
44a
44
42
41

FIG. 3

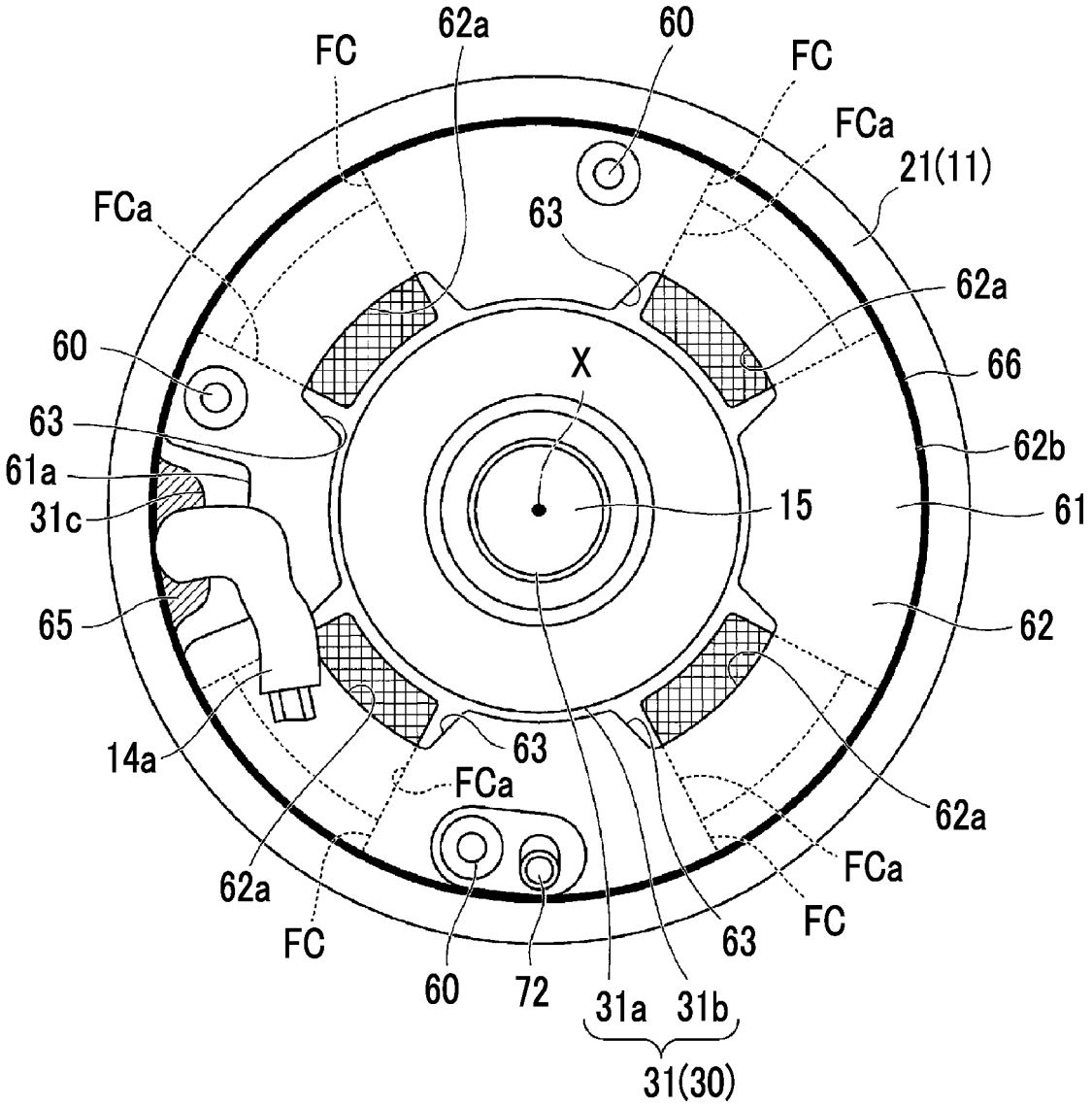

62a
60
FC
FC
FCa
21(11)
FCa
63
62a
60
X
66
63
62b
61a
15
61
31c
65
62
14a
63
FCa
62a
FCa
62a
FC
FC
63
60
72
31a
31b
31(30)

FIG. 4

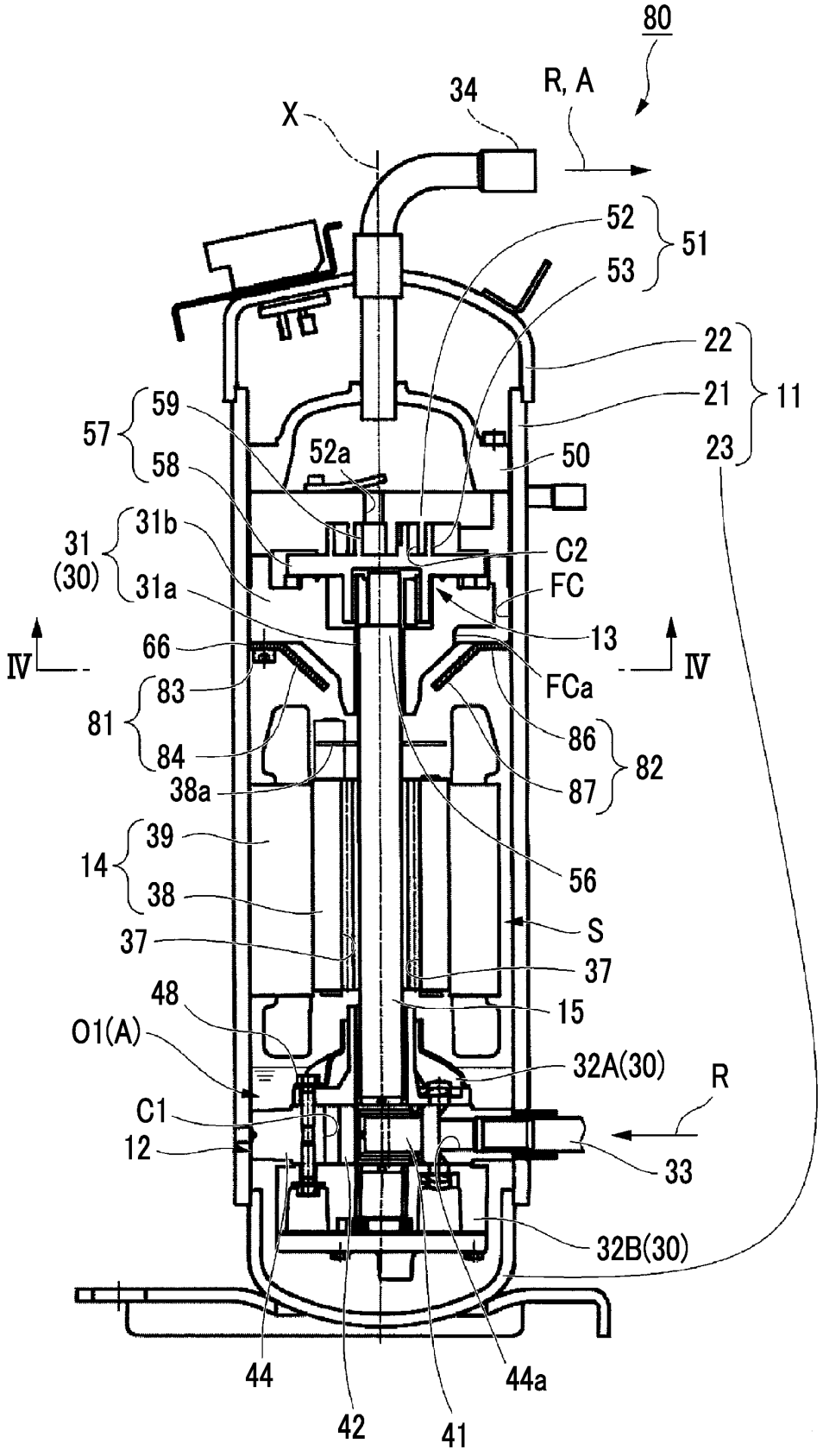

80
R, A
34
X
52
51
53
22
21
11
23
59
57
58
52a
50
31b
31
(30)
31a
C2
FC
13
IV
IV
66
83
81
84
FCa
86
82
87
38a
39
14
38
56
37
S
37
48
15
O1(A)
32A(30)
R
C1
12
33
32B(30)
44
44a
42
41

FIG. 5

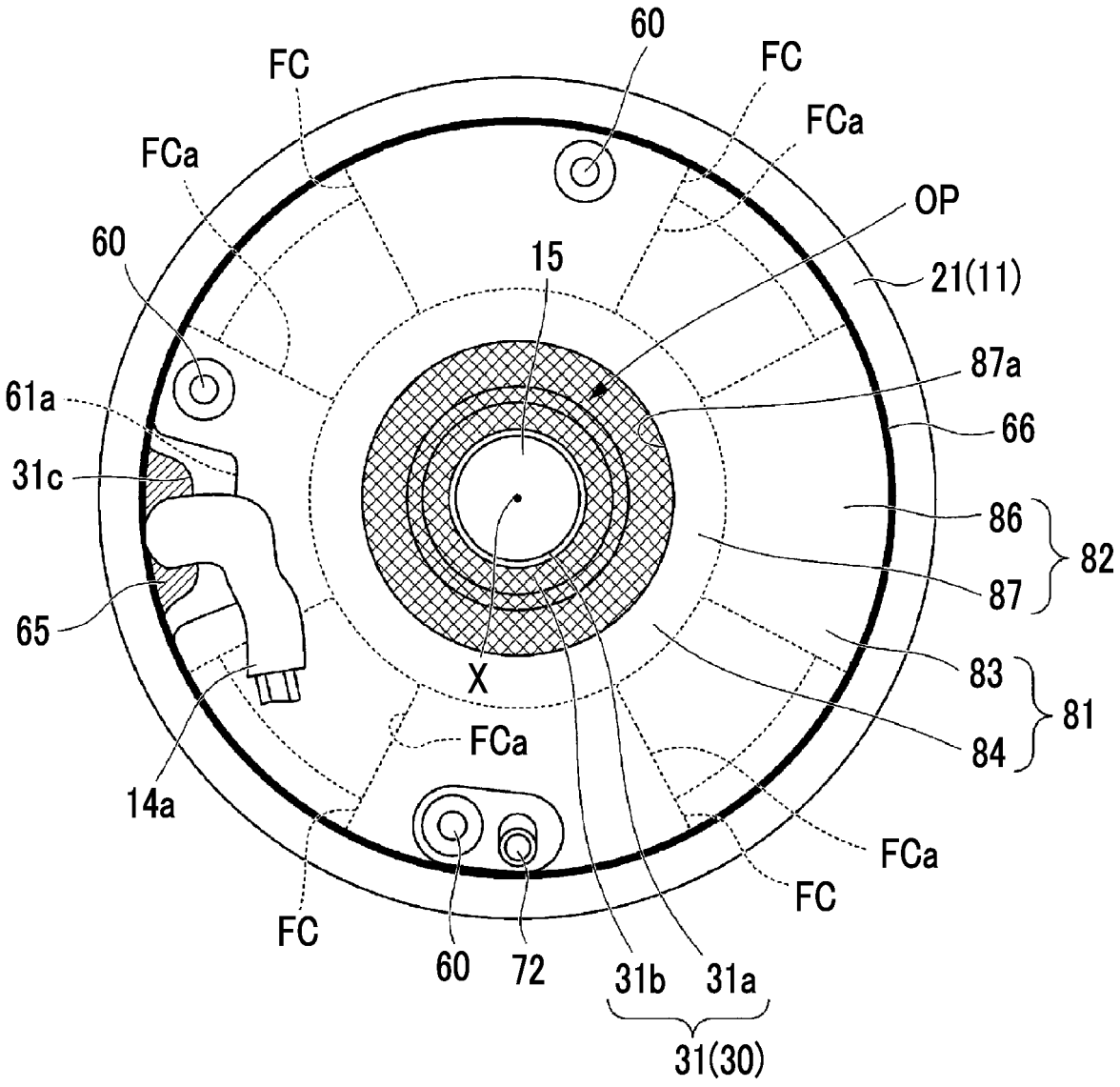
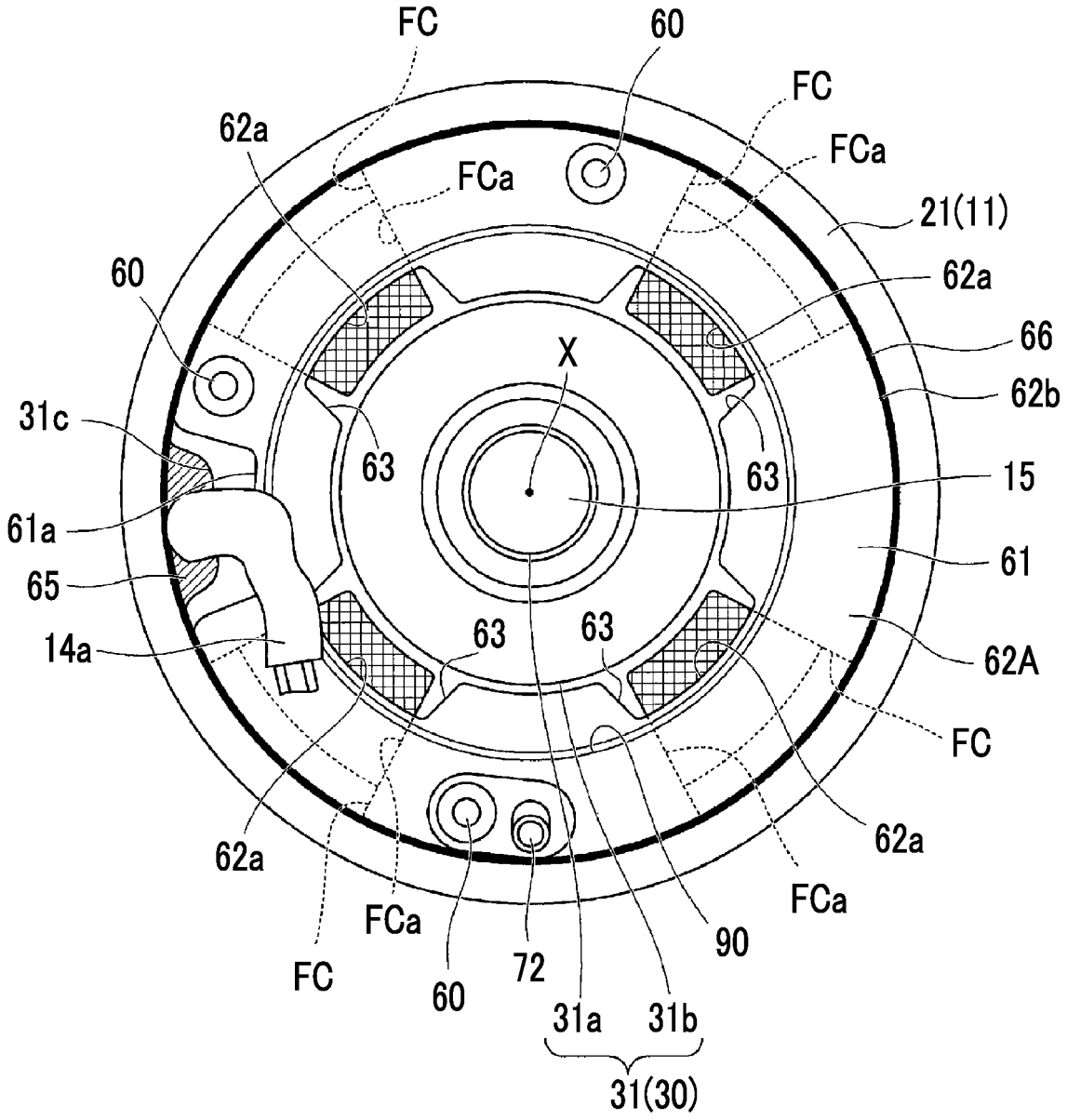

60
FC
FC
FCa
FCa
OP
60
15
21(11)
87a
61a
66
31c
86
82
87
65
83
X
81
84
FCa
14a
FCa
FC
FC
60
72
31b
31a
31(30)

FIG. 6


FC
60
FC
62a
FCa
FCa
21(11)
60
62a
66
X
62b
31c
63
63
15
61a
61
65
63
63
14a
62A
FC
62a
62a
FCa
FCa
90
FC
60
72
31a
31b
31(30)

REFERENCES CITED IN THE DESCRIPTION

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