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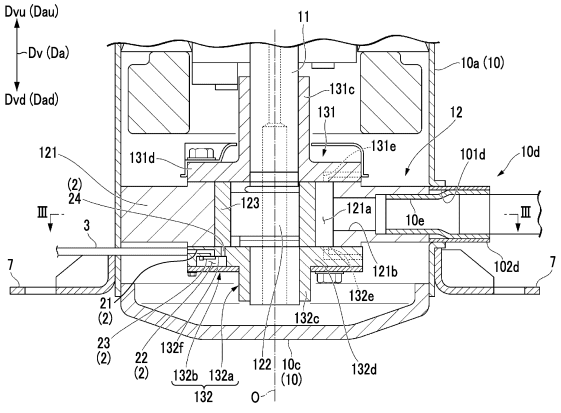
(54) ROTARY COMPRESSOR

(57) This rotary compressor comprises: a rotating axle that can rotate about an axis; a cylinder having formed therein a compression chamber that compresses a refrigerant as the rotating axle rotates; a bearing unit that is provided to the cylinder, and that can rotatably support the rotating axle; and an injection unit that is formed in the bearing unit, and that can supply the refrigerant into the compression chamber. The injection unit comprises: a port that allows a refrigerant supplied from the outside to flow therein; an intermediate pressure chamber which extends in the circumferential direction of the rotating axle, and into which the refrigerant is guided from the port; a check valve that is provided in the intermediate pressure chamber, and that prevents the refrigerant in the intermediate pressure chamber from flowing backwards to the port; and a plurality of injection openings that connect the intermediate pressure chamber and the compression chamber.

FIG. 2



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Description

Technical Field

[0001] The present disclosure relates to a rotary compressor.

[0002] This application claims priority to Japanese Patent Application No. 2022-124761, filed in Japan on August 4, 2022, the contents of which are incorporated herein by reference.

Background Art

[0003] For example, PTL 1 discloses a twin rotary compressor in which an injection refrigerant is supplied to each of a first compression chamber and a second compression chamber through an injection flow path.

[0004] In the injection flow path, the injection refrigerant is supplied to the first compression chamber through the first injection pipe connected to the injection muffler and the hole (first common hole, and first jet hole and second jet hole connected to the first common hole) formed in an upper bearing. In addition, the injection refrigerant is supplied to the second compression chamber through the second injection pipe connected to the injection muffler and the hole (the second common hole, the third jet hole, and the fourth jet hole connected to the second common hole) formed in the lower bearing.

[0005] The injection muffler is provided to suppress the refrigerant from flowing back from the compression chamber through the hole of the bearing in a case where the refrigerant is compressed in each compression chamber by communicating the first compression chamber with the second compression chamber such that a pressure difference does not occur. Accordingly, the injection refrigerant having a larger flow rate can be allowed to flow into the compression chamber.

Citation List

Patent Literature

[0006] [PTL 1] International Publication No. WO2020/031248

Summary of Invention

Technical Problem

[0007] By the way, in a case where the compression chamber is one of the rotary compressors, a check valve or the like may be disposed in a supply flow path of the injection refrigerant in order to suppress the injection refrigerant from flowing back from the compression chamber. In this case, since the refrigerant existing in the section from the compression chamber to the check valve in the supply flow path is not compressed in the compression chamber, this section is a dead volume that causes a decrease in the efficiency of the compressor.

[0008] For example, in order to reduce the dead volume that causes a decrease in compression efficiency, it is currently difficult to dispose a check valve inside a hole formed in the bearing because the inside of the hole is a narrow space. Therefore, there is a problem that a check valve needs to be disposed in a supply flow path that is connected to the hole of the bearing from the outside.

[0009] In addition, in the technique disclosed in PTL 1, the common holes (first common hole and second common hole) are formed in a straight line. Therefore, in a case where the number of holes (first jet holes, second jet holes, third jet holes, and fourth jet holes) for injection is increased for the purpose of increasing the flow rate, there is a problem that the arrangement of the holes is limited to a straight line.

[0010] The present disclosure has been made to solve the above-described problems, and an object of the present disclosure is to provide a rotary compressor capable of disposing injection holes with a high degree of freedom while suppressing the occurrence of dead volume.

Solution to Problem

[0011] In order to achieve the above object, a rotary compressor according to the present disclosure includes a rotary shaft that is rotatable about an axis line; a cylinder in which a compression chamber that compresses a refrigerant with rotation of the rotary shaft is formed; a bearing portion that is provided in the cylinder and rotatably supports the rotary shaft; and an injection portion that is formed in the bearing portion and is capable of supplying the refrigerant into the compression chamber, in which the injection portion includes a port through which the refrigerant supplied from an outside flows, an intermediate pressure chamber that extends in a circumferential direction of the rotary shaft and into which the refrigerant is introduced from the port, a check valve that is provided in the intermediate pressure chamber and prevents the refrigerant in the intermediate pressure chamber from flowing back to the port, and a plurality of injection holes through which the intermediate pressure chamber communicates with the compression chamber.

Advantageous Effects of Invention

[0012] According to the present disclosure, it is possible to provide a rotary compressor in which an injection hole can be disposed with a high degree of freedom while suppressing the generation of a dead volume.

Brief Description of Drawings

[0013]

Fig. 1 is a vertical cross-sectional view for explaining a configuration of a rotary compressor according to a

first embodiment of the present disclosure.
Fig. 2 is an enlarged view of a main portion in Fig. 1.
Fig. 3 is a diagram illustrating a cross-sectional view taken along the direction of the line III-III in Fig. 2.
Fig. 4 is a vertical cross-sectional view for explaining a configuration of a rotary compressor according to a second embodiment of the present disclosure, and is a part corresponding to Fig. 2.

Description of Embodiments

[0014] Hereinafter, an embodiment of the rotary compressor according to the present disclosure will be described with reference to the accompanying drawings.

<First Embodiment>

[0015] The rotary compressor is, for example, a sealed electric rotary compressor used for an air conditioner, a refrigerating apparatus, or the like.
[0016] As shown in Fig. 1, the rotary compressor 100 includes a compressor main body 1, an injection portion 2, an injection pipe 3, an accumulator 4, a suction pipe 5, a discharge pipe 6, and leg portion 7.
[0017] Hereinafter, the rotary compressor 100 will be simply referred to as a "compressor 100".
[0018] As the refrigerant compressed by the compressor 100, for example, a hydrofluoroolefin (HFO) refrigerant such as R32 or R454C, or a natural refrigerant such as CO2, propane, or helium can be used.

(Compressor Main Body)

[0019] The compressor main body 1 compresses a refrigerant supplied from the outside.
[0020] The compressor main body 1 includes a housing 10, a rotary shaft 11, a rotary compression portion 12, a bearing portion 13, and an electric motor 14.

(Housing)

[0021] The housing 10 is a pressure vessel extending in a vertical direction Dv (an up-down direction in Fig. 1) in a case where the compressor 100 is provided on a floor surface, a ground surface, or the like. The housing 10 forms an outer shell of the compressor main body 1. Hereinafter, for convenience of description, an upper side in the vertical direction Dv will be simply referred to as an "upper side Dvu", and a lower side in the vertical direction Dv will be simply referred to as a "lower side Dvd".
[0022] The housing 10 includes a main body portion 10a, an upper cover portion 10b, a lower cover portion 10c, a refrigerant introduction portion 10d, and a suction port 10e.
[0023] The main body portion 10a has a cylindrical shape extending in the vertical direction Dv. Therefore, the main body portion 10a has openings on both the upper side Dvu and the lower side Dvd.
[0024] The upper cover portion 10b is provided in the main body portion 10a so as to close the opening on the upper side Dvu in the main body portion 10a from the upper side Dvu.
[0025] The lower cover portion 10c is provided in the main body portion 10a so as to close the opening on the lower side Dvd in the main body portion 10a from the lower side Dvd. In the lower cover portion 10c, a leg portion 7 is provided, and the entire housing 10 is supported by the leg portion 7.
[0026] The refrigerant introduction portion 10d is a hole for introducing the refrigerant from the outside to the inside of the main body portion 10a.
[0027] The refrigerant introduction portion 10d has a side surface opening 101d formed to penetrate the main body portion 10a in the thickness direction of the main body portion 10a, and a cylindrical portion 102d disposed inside the side surface opening 101d.
[0028] The side surface opening 101d has a circular shape as an opening. The side surface opening 101d is disposed in a portion of the main body portion 10a on the lower side Dvd. The cylindrical portion 102d is fitted into the side surface opening 101d without a gap and extends from the side surface opening 101d to the outside of the main body portion 10a.
[0029] The suction port 10e is a member that is disposed inside the cylindrical portion 102d of the refrigerant introduction portion 10d and has a syringe shape. The suction port 10e is fitted to the cylindrical portion 102d without a gap. The distal end of the suction port 10e extends toward the inside of the main body portion 10a with respect to the cylindrical portion 102d. The rear end of the suction port 10e is flush with, for example, the opening portion of the cylindrical portion 102d.
[0030] Here, an accumulator 4 for gas-liquid separation of the refrigerant before supplying the refrigerant to the compressor main body 1 is disposed outside the housing 10. The accumulator 4 is fixed to the main body portion 10a in the housing 10, for example, via the bracket Br.
[0031] The refrigerant in the accumulator 4 is guided into the housing 10 through the suction pipe 5 connecting the accumulator 4 and the suction port 10e. One end of the suction pipe 5 extends into the accumulator 4. The other end of the suction pipe 5 is inserted into the suction port 10e.

(Rotary Shaft)

[0032] The rotary shaft 11 is accommodated in the housing 10. Rotary shaft 11 can be rotated about an axis line O extending in the vertical direction Dv. For convenience of description, a direction in which the axis line O about the rotary shaft 11 extends will be referred to as an axial direction Da. In addition, the one side Dau in the axial direction Da will be simply referred to as "one side Dau", and the other side Dad in the axial direction Da will be simply referred to as "the other side Dad". The axial

direction Da in the present embodiment coincides with the vertical direction Dv, the one side Dau coincides with the upper side Dvu, and the other side Dad coincides with the lower side Dvd.

(Rotary Compression Portion)

[0033] The rotary compression portion 12 is accommodated in the housing 10 and compresses the refrigerant introduced by the refrigerant introduction portion 10d. The rotary compression portion 12 is disposed in a portion of the main body portion 10a of the housing 10 on the lower side Dvd.

[0034] The rotary compression portion 12 includes a cylinder 121, an eccentric shaft portion 122, a piston rotor 123, and a blade 124 (see Fig. 3).

[0035] The cylinder 121 is a member that has an annular shape and extends in the axial direction Da in a case of being accommodated in the housing 10. The cylinder 121 is fixed to a lower side Dvd portion of the inner peripheral surface of the main body portion 10a of the housing 10. A space inside the cylinder 121 defined by the inner peripheral surface of the cylinder 121 is the compression chamber 121a that compresses the refrigerant. That is, the cylinder 121 is formed with a cylindrical compression chamber 121a extending in the axial direction Da.

[0036] Further, the cylinder 121 is formed with suction holes 121b that penetrate from the inner peripheral surface to the outer peripheral surface of the cylinder 121. The above-described distal end of the suction port 10e of the refrigerant introduction portion 10d is inserted into the suction hole 121b without a gap. Therefore, the refrigerant is introduced into the compression chamber 121a through the suction port 10e. In addition, a blade groove 121c (see Fig. 3) that extends from the inner peripheral surface to the outer peripheral surface of the cylinder 121 and in which the blade 124 is disposed on the inner side is formed in the cylinder 121.

[0037] The eccentric shaft portion 122 is a cylindrical member that is provided integrally with the lower end portion of the rotary shaft 11. The eccentric shaft portion 122 is disposed in the compression chamber 121a at a position offset in a direction orthogonal to the axis line O about which the rotary shaft 11 is centered from the axis line O.

[0038] The piston rotor 123 is a member having a cylindrical shape with an outer diameter smaller than the inner diameter of the cylinder 121. The piston rotor 123 extends in the axial direction Da. The piston rotor 123 is provided in the eccentric shaft portion 122. Inside the piston rotor 123, the eccentric shaft portion 122 is disposed integrally with the piston rotor 123. The piston rotor 123 rotates together with the eccentric shaft portion 122 in a state of being eccentric with respect to the axis line O in accordance with the rotation of the rotary shaft 11.

[0039] As shown in Fig. 3, the blade 124 is a member that is disposed in the blade groove 121c formed in the cylinder 121 and has a plate shape. The blade 124 is guided to be slidable on an inner surface of the blade groove 121c and is held movably back and forth in the radial direction of the rotary shaft 11.

[0040] The blade 124 is elastically pressed toward the radial inner side of the rotary shaft 11 by a compression spring (not shown) disposed in the blade groove 121c. The blade 124 during the operation of the compressor 100 is pressed by the compression spring, so that the inner end edge in the radial direction is always in contact with the outer peripheral surface of the piston rotor 123.

[0041] Here, the eccentric shaft portion 122 has an outer diameter slightly smaller than the inner diameter of the piston rotor 123. Accordingly, in a case where the rotary shaft 11 rotates, the eccentric shaft portion 122 revolves about the axis line O, and the piston rotor 123 eccentrically rotates in the compression chamber 121a of the cylinder 121. In a case where the blades 124 advance in the radial direction with the eccentric rotation of the piston rotor 123, the blades 124 come into contact with the piston rotor 123. By the blade 124 comes into contact with the piston rotor 123, the blade 124, together with the piston rotor 123, partitions the inside of the compression chamber 121a into two regions.

[0042] Hereinafter, the position of the piston rotor 123 in a case where the entire blade 124 is accommodated in the blade groove 121c is referred to as an "initial position". That is, in the initial position, the blade 124 is in a state of not advancing into the compression chamber 121a. In addition, in the present embodiment, the phase angle of the piston rotor 123 in the initial position with respect to the axis line O is set to 0°. That is, the piston rotor 123 eccentrically rotates with the rotation of the rotary shaft 11, so that the phase angle of the piston rotor 123 with respect to the axis line O changes in a range of 0° to 360° counterclockwise as viewed from the upper side Dvu around the axis line O.

[0043] In a case where the refrigerant supplied from the suction port 10e of the refrigerant introduction portion 10d is introduced into the compression chamber 121a, the volume of one region of the two regions in the compression chamber 121a partitioned by the piston rotor 123 and the blade 124 gradually decreases due to the eccentric rotation of the piston rotor 123. As a result, the refrigerant present in one region is gradually compressed.

(Bearing portion)

[0044] As shown in Figs. 1 and 2, the bearing portion 13 supports the rotary shaft 11 to be rotatable in the housing 10. The bearing portions 13 are provided in the cylinder 121 and are disposed in pairs so as to sandwich the cylinder 121 from the axial direction Da.

[0045] Hereinafter, in the pair of bearing portions 13, the bearing portion 13 disposed on the one side Dau (upper side Dvu) with respect to the cylinder 121 will be referred to as an "upper bearing 131", and the bearing

portion 13 disposed on the other side Dad (lower side Dvd) with respect to the cylinder 121 will be referred to as a "lower bearing 132".

[0046] As shown in Fig. 2, the upper bearing 131 is fixed to the cylinder 121 from the one side Dau in a state of being slidably surround the rotary shaft 11 from the outer peripheral side.

[0047] The upper bearing 131 in the present embodiment includes a first tubular portion 131c and a first flange portion 131d.

[0048] The first tubular portion 131c has a cylindrical shape extending in the axial direction Da in a case where the bearing portion 13 is provided in the cylinder 121. The first tubular portion 131c slidably surrounds the rotary shaft 11 from the outer peripheral side.

[0049] The first flange portion 131d is a member that is integrally formed with the first tubular portion 131c and spreads from the first tubular portion 131c in a radial direction of the rotary shaft 11. The first flange portion 131d is disposed in a portion of the other side Dad of the first tubular portion 131c. The first flange portion 131d has an annular shape as viewed in the axial direction Da. The first flange portion 131d is fixed to a surface of the cylinder 121 facing the one side Dau by, for example, a fastening portion such as a bolt.

[0050] The lower bearing 132 is fixed to the cylinder 121 from the other side Dad in a state of being slidably surround the rotary shaft 11 from the outer peripheral side.

[0051] The lower bearing 132 according to the present embodiment includes a lower bearing main body 132a and a lower bearing cover portion 132b.

[0052] The lower bearing main body 132a includes a second tubular portion 132c and a second flange portion 132d.

[0053] The second tubular portion 132c has a cylindrical shape extending in the axial direction Da in a case where the bearing portion 13 is provided in the cylinder 121. The second tubular portion 132c slidably surrounds the rotary shaft 11 from the outer peripheral side.

[0054] The second flange portion 132d is a member that is integrally formed with the second tubular portion 132c and spreads from the second tubular portion 132c in a radial direction of the rotary shaft 11. The second flange portion 132d is fixed to a surface of the cylinder 121 facing the other side Dad by a fastening portion such as a bolt.

[0055] The second flange portion 132d is disposed in a portion of the second tubular portion 132c on the one side Dau. The second flange portion 132d has an annular shape as viewed in the axial direction Da. A recess 132f that is recessed toward the one side Dau and extends in a circumferential direction of the rotary shaft 11 is formed on a surface of the second flange portion 132d facing the other side Dad.

[0056] The lower bearing cover portion 132b is provided on a surface of the second flange portion 132d facing the other side Dad so as to close the recess 132f formed in the second flange portion 132d from the other side Dad. The lower bearing cover portion 132b is provided in the second flange portion 132d so as to surround the second tubular portion 132c from the outer peripheral side. The lower bearing cover portion 132b can be attached to and detached from the second flange portion 132d. The lower bearing cover portion 132b is fixed to the second flange portion 132d by, for example, a fastening portion such as a bolt.

[0057] Here, discharge holes 131e and 132e for discharging the compressed refrigerant into the space in the housing 10 are formed in the first flange portion 131d of the upper bearing 131 and the second flange portion 132d of the lower bearing main body 132a. Therefore, the discharge holes 131e and 132e communicate the space outside the rotary compression portion 12 in the compression chamber 121a and the housing 10.

[0058] The discharge hole 131e formed in the first flange portion 131d is opened in, for example, a surface facing the other side Dad of the first flange portion 131d and an outer peripheral surface of the first flange portion 131d. The discharge hole 132e formed in the second flange portion 132d is opened in, for example, a surface facing the one side Dau of the second flange portion 132d and an outer peripheral surface of the second flange portion 132d.

[0059] For example, a reed valve (not shown) as a discharge valve is disposed at openings of the discharge holes 131e and 132e formed in the outer peripheral surface of the first flange portion 131d and the outer peripheral surface of the second flange portion 132d. The refrigerant that is compressed to increase the pressure to a predetermined pressure pushes open the reed valve and is discharged to the outside of the bearing portion 13 in the housing 10 through the discharge holes 131e and 132e. The refrigerant discharged into the housing 10 from the discharge holes 131e and 132e is sent to a device outside the compressor 100 through the discharge pipe 6 provided in the upper cover portion 10b of the housing 10.

[0060] Opening portions of the discharge holes 131e and 132e that are provided to open into the compression chamber 121a are disposed in a range in which the phase angle with respect to the axis line O is greater than 315° and less than 360°, for example. In addition, the opening portion of the suction hole 121b that opens into the compression chamber 121a is disposed in a range in which the phase angle with respect to the axis line O is greater than 0° and less than 45°, for example.

(Electric Motor)

[0061] The electric motor 14 is accommodated in the housing 10 and rotates the rotary shaft 11.

[0062] The electric motor 14 includes a rotor 141 and a stator 142.

[0063] The rotor 141 is a rotor that is fixed to the rotary shaft 11 so as to surround the rotary shaft 11 from the outer peripheral side on the upper side Dvu with respect

to the rotary compression portion 12. The stator 142 is a stator that is fixed to an inner surface of the main body portion 10a of the housing 10 so as to surround the rotor 141 from the outer peripheral side. A power source (not shown) that supplies power is connected to the stator 142. The electric motor 14 rotates the rotary shaft 11 by the power supplied from the power source.

(Injection Portion)

[0064] The injection portion 2 is independent of the refrigerant introduction portion 10d and supplies the refrigerant from the outside into the compression chamber 121a of the cylinder 121. The injection portion 2 is formed in the lower bearing 132 of the bearing portion 13.

[0065] The injection portion 2 according to the present embodiment includes a port 21, an intermediate pressure chamber 22, a check valve 23, and an injection hole 24.

(Port)

[0066] The port 21 is a hole formed in the second flange portion 132d of the lower bearing 132. The port 21 extends from the outer peripheral surface of the second flange portion 132d to the inner surface of the recess 132f formed in the second flange portion 132d. Therefore, the port 21 is opened to each of the outer peripheral surface of the second flange portion 132d and the inner surface of the recess 132f.

[0067] Here, an injection pipe 3 for supplying a refrigerant is connected to the opening of the port 21 formed in the outer peripheral surface of the second flange portion 132d. Therefore, the refrigerant from the outside is supplied to the port 21 through the injection pipe 3. The injection pipe 3 penetrates the main body portion 10a of the housing 10 and is connected to a device (not shown) for supplying a refrigerant for injection disposed outside the housing 10.

(Intermediate Pressure Chamber)

[0068] The intermediate pressure chamber 22 is a chamber formed in the lower bearing 132. The intermediate pressure chamber 22 in the present embodiment is the recess 132f formed in the second flange portion 132d. Specifically, the intermediate pressure chamber 22 is defined by closing the recess 132f formed in the second flange portion 132d by the lower bearing cover portion 132b. Therefore, the intermediate pressure chamber 22 is opened by removing the lower bearing cover portion 132b from the lower bearing main body 132a. The refrigerant that flows through the port 21 flows into the intermediate pressure chamber 22.

(Check Valve)

[0069] The check valve 23 is provided in the intermediate pressure chamber 22 and is a reed valve for preventing the refrigerant that has flowed into the intermediate pressure chamber 22 from the port 21 from flowing back to the port 21. The check valve 23 is disposed in the intermediate pressure chamber 22 so as to block an opening portion of the port 21 that opens into the intermediate pressure chamber 22.

(Injection Hole)

[0070] The injection hole 24 is a hole that communicates the intermediate pressure chamber 22 with the compression chamber 121a formed in the cylinder 121. The injection hole 24 extends from an inner surface facing the other side Dad in the intermediate pressure chamber 22 to the one side Dau toward the compression chamber 121a. The injection hole 24 is opened in each of the inner surface of the recess 132f and the surface of the second flange portion 132d facing the one side Dau.

[0071] A plurality of injection holes 24 in the present embodiment are formed. As shown in Figs. 2 and 3, the plurality of injection holes 24 extend in the axial direction Da and are arranged at equal intervals in the circumferential direction of the rotary shaft 11. As shown in Fig. 3, in the present embodiment, a case where four injection holes 24 are disposed is illustrated as an example.

[0072] Here, in a case where the compression chamber 121a is divided into two parts by the side where the opening portion of the suction hole 121b is disposed and the side where the opening portions of the discharge holes 131e and 132e are disposed, the opening portions of the plurality of injection holes 24 are disposed on the side where the opening portions of the discharge holes 131e and 132e are disposed. In the present embodiment, the opening portions of the plurality of injection holes 24 that open into the compression chamber 121a are disposed in a range of, for example, 200° to 300° in which the phase angle with respect to the axis line O.

[0073] In addition, as shown in Fig. 2, the port 21, the intermediate pressure chamber 22, and the lower bearing cover portion 132b of the lower bearing 132 of the injection portion 2 are disposed in the axial direction Da in order of port 21, intermediate pressure chamber 22, lower bearing cover portion 132b. In other words, the port 21, the intermediate pressure chamber 22, and the lower bearing cover portion 132b are disposed in order of the port 21, the intermediate pressure chamber 22, and the lower bearing cover portion 132b in a direction away from the compression chamber 121a.

(Operations and Effects)

[0074] In the above configuration, since the intermediate pressure chamber 22 of the injection portion 2 is formed in the lower bearing 132, the check valve 23 can be disposed in the intermediate pressure chamber 22. Accordingly, for example, the length of the flow path of the refrigerant between the compression chamber 121a and the check valve 23 can be shortened as compared

with a case where the check valve 23 is disposed in the injection pipe 3 or the like outside the bearing portion 13. Therefore, it is possible to suppress the generation of dead volume. In addition, since the intermediate pressure chamber 22 formed in the lower bearing 132 extends in the circumferential direction, the injection holes 24 opening into the compression chamber 121a can be disposed in the circumferential direction. The injection holes 24 can be disposed with a high degree of freedom.

[0075] In addition, in the above configuration, since the plurality of injection holes 24 extend from the intermediate pressure chamber 22 in the axial direction Da, the length of the injection holes 24 can be formed to be the shortest. Therefore, it is possible to further suppress the generation of dead volume. In addition, since the injection holes 24 are formed in a plurality of the injection holes 24, the amount of refrigerant that can be supplied to the compression chamber 121a can be increased. Further, since the plurality of injection holes 24 are arranged at equal intervals in the circumferential direction of the rotary shaft 11, the time when each injection hole 24 opens in the compression chamber 121a in the process of compressing the refrigerant can be aligned. Therefore, it is possible to improve the supply efficiency of the refrigerant to the compression chamber 121a by the injection portion 2.

[0076] In addition, in the above configuration, since the port 21, the intermediate pressure chamber 22, and the lower bearing cover portion 132b are disposed in the direction away from the compression chamber 121a in this order, the intermediate pressure chamber 22 can be opened without passing through the port 21 in a case where the lower bearing cover portion 132b is removed from the lower bearing main body 132a. That is, the check valve 23 disposed in the intermediate pressure chamber 22 can be accessed by removing the lower bearing cover portion 132b. As a result, the check valve 23 can be easily maintained without removing the lower bearing 132 from the cylinder 121 or the like.

<Second Embodiment>

[0077] Next, a second embodiment of the rotary compressor 100 according to the present disclosure will be described with reference to Fig. 4. In the second embodiment described below, configurations common to the first embodiment described above will be denoted by the same reference numerals in the drawings and the description thereof will be omitted.

[0078] The compressor 100 according to the present embodiment is a twin rotary compressor having two compression chambers 121a.

[0079] The compressor 100 includes a compressor main body 1, an injection portion 2, a first injection pipe 31, a second injection pipe 32, an accumulator 4, a first suction pipe 51, a second suction pipe 52, a discharge pipe 6, and a leg portion 7.

[0080] The compressor main body 1 includes a housing 10, a rotary shaft 11, a rotary compression portion 12a, a bearing portion 13, and an electric motor 14.

[0081] The housing 10 includes a main body portion 10a, an upper cover portion 10b, a lower cover portion 10c, a first refrigerant introduction portion 10h, a second refrigerant introduction portion 10i, a first suction port 10f, and a second suction port 10g.

[0082] The first refrigerant introduction portion 10h has a first side surface opening 101h formed to penetrate the main body portion 10a in the thickness direction of the main body portion 10a, and a first tubular portion 131c disposed inside the first side surface opening 101h.

[0083] The first side surface opening 101h has a circular shape as an opening. The first cylindrical portion 102h is fitted to the first side surface opening 101h without a gap and extends from the first side surface opening 101h to the outside of the main body portion 10a.

[0084] The first suction port 10f is a member that is disposed inside the first cylindrical portion 102h of the first refrigerant introduction portion 10h and has a syringe shape. The first suction port 10f is fitted to the first cylindrical portion 102h without a gap. A distal end of the first suction port 10f extends toward the inside of the main body portion 10a with respect to the first cylindrical portion 102h. The rear end of the first suction port 10f is flush with, for example, the opening portion of the first cylindrical portion 102h.

[0085] The second refrigerant introduction portion 10i is disposed on the lower side Dvd (the other side Dad) than the first refrigerant introduction portion 10h. The second refrigerant introduction portion 10i has a second side surface opening 101i that is formed to penetrate the main body portion 10a in the thickness direction of the main body portion 10a, and a second cylindrical portion 102i that is disposed inside the second side surface opening 101i.

[0086] The second side surface opening 101i has a circular opening. The second cylindrical portion 102i is fitted to the second side surface opening 101i without a gap, and extends from the second side surface opening 101i to the outside of the main body portion 10a.

[0087] The second suction port 10g is a member that is disposed inside the second cylindrical portion 102i of the second refrigerant introduction portion 10i and has a syringe shape. The second suction port 10g is fitted to the second cylindrical portion 102i without a gap. The distal end of the second suction port 10g extends toward the inside of the main body portion 10a with respect to the second cylindrical portion 102i. The rear end of the second suction port 10g is flush with, for example, the opening portion of the second cylindrical portion 102i.

[0088] The refrigerant in the accumulator 4 is guided to the inside of the housing 10 through a first suction pipe 51 that connects the accumulator 4 and the first suction port 10f and a second suction pipe 52 that connects the accumulator 4 and the second suction port 10g. One end of the first suction pipe 51 and the second suction pipe 52 extends in the accumulator 4. The other end of the

first suction pipe 51 is inserted into the first suction port 10f, and the other end of the second suction pipe 52 is inserted into the second suction port 10g.

[0089] The rotary compression portion 12a includes a first cylinder 120a, a second cylinder 120d, a first eccentric shaft portion 122a, a second eccentric shaft portion 122b, a first piston rotor 123a, a second piston rotor 123b, an intermediate plate 125, and a blade (not shown).

[0090] The first cylinder 120a is a member that has an annular shape and extends in the axial direction Da in a case of being accommodated in the housing 10. The first cylinder 120a is fixed to a portion of the inner peripheral surface of the main body portion 10a of the housing 10 on the lower side Dvd. A space in the first cylinder 120a defined by the inner peripheral surface of the first cylinder 120a is the first compression chamber 120b that compresses the refrigerant. That is, the first cylinder 120a is formed with a cylindrical first compression chamber 120b extending in the axial direction Da.

[0091] In addition, a first suction hole 120c that penetrates from an inner peripheral surface to an outer peripheral surface of the first cylinder 120a is formed in the first cylinder 120a. The above-described distal end of the first suction port 10f of the first refrigerant introduction portion 10h is inserted into the first suction hole 120c without a gap. Therefore, the refrigerant is introduced into the first compression chamber 120b through the first suction port 10f. In addition, a blade groove (not shown) that extends from an inner peripheral surface to an outer peripheral surface and in which a blade is disposed on an inner side is formed in the first cylinder 120a.

[0092] The first eccentric shaft portion 122a is a member that is provided integrally with the rotary shaft 11 and has a cylindrical shape. The first eccentric shaft portion 122a is disposed in the compression chamber 121a at a position offset in a direction orthogonal to the axis line O about which the rotary shaft 11 is centered from the axis line O.

[0093] The first piston rotor 123a is a member having a cylindrical shape having an outer diameter smaller than the inner diameter of the first cylinder 120a. The first piston rotor 123a extends in the axial direction Da. The first piston rotor 123a is provided in the first eccentric shaft portion 122a. The first eccentric shaft portion 122a is disposed inside the first piston rotor 123a integrally with the first piston rotor 123a. The first piston rotor 123a rotates together with the first eccentric shaft portion 122a in a state of being eccentric with respect to the axis line O in accordance with the rotation of the rotary shaft 11. The first piston rotor 123a is eccentrically rotated in the first compression chamber 120b due to the rotation of the rotary shaft 11, similarly to the piston rotor 123 described in the first embodiment.

[0094] The second cylinder 120d is a member that has an annular shape and extends in the axial direction Da in a case of being accommodated in the housing 10. The second cylinder 120d is fixed to a portion of the inner peripheral surface of the main body portion 10a of the housing 10 on the lower side Dvd with respect to the first cylinder 120a. A space inside the second cylinder 120d defined by the inner peripheral surface of the second cylinder 120d is the second compression chamber 120e in which the refrigerant is compressed. That is, the second cylinder 120d is formed with a cylindrical second compression chamber 120e extending in the axial direction Da.

[0095] In addition, a second suction hole 120f that penetrates from an inner peripheral surface to an outer peripheral surface of the second cylinder 120d is formed in the second cylinder 120d. The distal end of the second suction port 10g of the refrigerant introduction portion 10i is inserted into the second suction hole 120f without a gap. Therefore, the refrigerant is introduced into the second compression chamber 120e through the second suction port 10g. In addition, a blade groove (not shown) that extends from an inner peripheral surface to an outer peripheral surface and in which the blade is disposed on the inner side is formed in the second cylinder 120d.

[0096] The second eccentric shaft portion 122b is a member that is provided integrally with the rotary shaft 11 and has a cylindrical shape. The second eccentric shaft portion 122b is disposed in the second compression chamber 120e at a position offset in a direction orthogonal to the axis line O about which the rotary shaft 11 is centered from the axis line O. The second eccentric shaft portion 122b in the present embodiment is, for example, offset in a direction opposite to a direction in which the first eccentric shaft portion 122a is offset from the rotary shaft 11.

[0097] Each of the second piston rotors 123b is a member having a cylindrical shape with an outer diameter smaller than the inner diameter of the second cylinder 120d. The second piston rotor 123b extends in the axial direction Da. The second piston rotor 123b is provided in the second eccentric shaft portion 122b. The second eccentric shaft portion 122b is disposed inside the second piston rotor 123b integrally with the second piston rotor 123b. The second piston rotor 123b rotates together with the second eccentric shaft portion 122b in a state of being eccentric with respect to the axis line O in accordance with the rotation of the rotary shaft 11. Similar to the piston rotor 123 described in the first embodiment, the second piston rotor 123b is eccentrically rotated in the second compression chamber 120e due to the rotation of the rotary shaft 11.

[0098] The intermediate plate 125 is disposed between the first cylinder 120a and the second cylinder 120d, and is a member that isolates the first compression chamber 120b formed in the first cylinder 120a from the second compression chamber 120e formed in the second cylinder 120d. The intermediate plate 125 in the present embodiment has a cylindrical shape and is fixed to an inner surface of the main body portion 10a of the housing 10.

[0099] The upper bearing 131 is provided in the first cylinder 120a on the one side Dau with respect to the first

cylinder 120a and rotatably supports the rotary shaft 11 in the housing 10. The lower bearing 132 is provided in the second cylinder 120d on the other side Dad with respect to the second cylinder 120d and rotatably supports the rotary shaft 11 in the housing 10. Therefore, the upper bearing 131 and the lower bearing 132 are disposed so as to sandwich the first cylinder 120a and the second cylinder 120d from the axial direction Da.

[0100] The upper bearing 131 is fixed to the first cylinder 120a from the one side Dau in a state of being slidably surround the rotary shaft 11 from the outer peripheral side. The lower bearing 132 is fixed to the second cylinder 120d from the other side Dad in a state of being slidably surround the rotary shaft 11 from the outer peripheral side.

[0101] The upper bearing 131 includes an upper bearing main body 131a and an upper bearing cover portion 131b. The upper bearing main body 131a includes a first tubular portion 131c and a first flange portion 131d.

[0102] The first tubular portion 131c has a cylindrical shape extending in the axial direction Da in a case where the upper bearing 131 is provided in the first cylinder 120a. The first tubular portion 131c is slidably surround the rotary shaft 11 from the outer peripheral side. The first flange portion 131d is a member that is integrally formed with the first tubular portion 131c and spreads from the first tubular portion 131c in a radial direction of the rotary shaft 11. The first flange portion 131d is fixed to a surface of the first cylinder 120a facing the other side Dad by a fastening portion such as a bolt. The first flange portion 131d is disposed in the other side Dad of the first tubular portion 131c. The first flange portion 131d has an annular shape as viewed in the axial direction Da. A recess 131f that is recessed toward the other side Dad and extends in a circumferential direction of the rotary shaft 11 is formed on a surface of the first flange portion 131d facing the one side Dad.

[0103] The upper bearing cover portion 131b is provided on a surface facing the one side Dau of the first flange portion 131d so as to close the recess 131f formed in the first flange portion 131d from the one side Dau. The upper bearing cover portion 131b is provided in the first flange portion 131d so as to surround the first tubular portion 131c from the outer peripheral side. The upper bearing cover portion 131b can be attached to and detached from the first flange portion 131d. The upper bearing cover portion 131b is fixed to the first flange portion 131d by, for example, a fastening portion such as a bolt.

[0104] The lower bearing 132 according to the present embodiment includes a lower bearing main body 132a and a lower bearing cover portion 132b.

[0105] The lower bearing main body 132a includes a second tubular portion 132c and a second flange portion 132d.

[0106] The second tubular portion 132c has a cylindrical shape extending in the axial direction Da in a case where the lower bearing 132 is provided in the second cylinder 120d. The second tubular portion 132c is slidable on the outer peripheral side of the rotary shaft 11.

[0107] The second flange portion 132d is a member that is integrally formed with the second tubular portion 132c and spreads from the second tubular portion 132c in a radial direction of the rotary shaft 11. The second flange portion 132d is fixed to a surface of the second cylinder 120d facing the other side Dad by a fastening portion such as a bolt.

[0108] The second flange portion 132d is disposed in a portion of the second tubular portion 132c on the one side Dau. The second flange portion 132d has an annular shape as viewed in the axial direction Da. A recess 132f that is recessed toward the one side Dau and extends in a circumferential direction of the rotary shaft 11 is formed on a surface of the second flange portion 132d facing the other side Dad.

[0109] The lower bearing cover portion 132b is provided on a surface of the second flange portion 132d facing the other side Dad so as to close the recess 132f formed in the second flange portion 132d from the other side Dad. The lower bearing cover portion 132b is provided in the second flange portion 132d so as to surround the second tubular portion 132c from the outer peripheral side. The lower bearing cover portion 132b can be attached to and detached from the second flange portion 132d. The lower bearing cover portion 132b is fixed to the second flange portion 132d by, for example, a fastening portion such as a bolt.

[0110] The injection portion 2 according to the present embodiment includes a first injection portion 20a formed in the upper bearing 131 and a second injection portion 20b formed in the lower bearing 132.

[0111] The first injection portion 20a includes a first port 21a, a first intermediate pressure chamber 22a, a first check valve 23a, and a first injection hole 24a.

[0112] The first port 21a is a hole formed in the first flange portion 131d of the upper bearing 131. The first port 21a extends from the outer peripheral surface of the first flange portion 131d to the inner surface of the recess 131f formed in the first flange portion 131d. Therefore, the first port 21a is opened to each of the outer peripheral surface of the first flange portion 131d and the inner surface of the recess 131f. A first injection pipe 31 for supplying a refrigerant is connected to an opening of the first port 21a formed in the outer peripheral surface of the first flange portion 131d. Therefore, the refrigerant from the outside is supplied to the first port 21a through the first injection pipe 31. The first injection pipe 31 penetrates the main body portion 10a of the housing 10 and is connected to a device (not shown) that is disposed outside the housing 10 and supplies a refrigerant for injection.

[0113] The first intermediate pressure chamber 22a is a chamber formed in the upper bearing 131. The first intermediate pressure chamber 22a is the recess 131f formed in the first flange portion 131d. Specifically, the first intermediate pressure chamber 22a is defined by closing the recess 131f formed in the first flange portion

131d by the upper bearing cover portion 131b. Therefore, the first intermediate pressure chamber 22a is opened by removing the upper bearing cover portion 131b from the upper bearing main body 131a. The refrigerant that flows through the first port 21a flows into the first intermediate pressure chamber 22a.

[0114] The first check valve 23a is provided in the first intermediate pressure chamber 22a and is a reed valve for preventing the refrigerant that has flowed into the first intermediate pressure chamber 22a from the port 21 from flowing back to the first port 21a. The first check valve 23a is disposed in the first intermediate pressure chamber 22a so as to block an opening portion of the first port 21a that opens into the first intermediate pressure chamber 22a.

[0115] The first injection hole 24a is a hole that communicates the first intermediate pressure chamber 22a with the first compression chamber 120b formed in the first cylinder 120a. The first injection hole 24a extends from the inner surface facing the one side Dau in the first intermediate pressure chamber 22a to the other side Dad in the first compression chamber 120b. The first injection hole 24a is opened in each of the inner surface of the recess 131f and the surface of the first flange portion 131d facing the other side Dda.

[0116] The first port 21a, the first intermediate pressure chamber 22a, and the upper bearing cover portion 131b of the upper bearing 131 of the first injection portion 20a are disposed in order of the first port 21a, the first intermediate pressure chamber 22a, and the upper bearing cover portion 131b in the axial direction Da. In other words, the first port 21a, the first intermediate pressure chamber 22a, and the upper bearing cover portion 131b are disposed in order of the first port 21a, the first intermediate pressure chamber 22a, and the upper bearing cover portion 131b in a direction away from the first compression chamber 120b.

[0117] The second injection portion 20b includes a second port 21b, a second intermediate pressure chamber 22b, a second check valve 23b, and a second injection hole 24b.

[0118] The second port 21b is a hole formed in the second flange portion 132d of the lower bearing 132. The second port 21b extends from the outer peripheral surface of the second flange portion 132d to the inner surface of the recess 132f formed in the second flange portion 132d. Therefore, the second port 21b is opened to each of the outer peripheral surface of the second flange portion 132d and the inner surface of the recess 132f. An opening of the second port 21b formed in the outer peripheral surface of the second flange portion 132d is connected to the second injection pipe 32 for supplying the refrigerant. Therefore, the refrigerant from the outside is supplied to the second port 21b through the second injection pipe 32. The second injection pipe 32 penetrates the main body portion 10a of the housing 10 and is connected to a device (not shown) or the like disposed outside the housing 10 to supply a refrigerant for injection.

[0119] The second intermediate pressure chamber 22b is a chamber formed in the lower bearing 132. The second intermediate pressure chamber 22b is the recess 132f formed in the second flange portion 132d. Specifically, the second intermediate pressure chamber 22b is defined by closing the recess 132f formed in the second flange portion 132d by the lower bearing cover portion 132b. Therefore, the second intermediate pressure chamber 22b is opened by removing the lower bearing cover portion 132b from the lower bearing main body 132a. The refrigerant that flows through the second port 21b flows into the second intermediate pressure chamber 22b.

[0120] The second check valve 23b is provided in the second intermediate pressure chamber 22b and is a reed valve for preventing the refrigerant that has flowed into the second intermediate pressure chamber 22b from the port 21 from flowing back to the second port 21b. The second check valve 23b is disposed in the second intermediate pressure chamber 22b so as to block an opening portion of the second port 21b that opens into the second intermediate pressure chamber 22b.

[0121] The second injection hole 24b is a hole that communicates the second intermediate pressure chamber 22b with the second compression chamber 120e formed in the second cylinder 120d. The second injection hole 24b extends from the inner surface facing the other side Dad in the second intermediate pressure chamber 22b to the other side Dad in the second compression chamber 120e. The first injection hole 24a is open to each of the inner surface of the recess 132f and the surface of the second flange portion 132d facing the one side Dau.

[0122] The second port 21b, the second intermediate pressure chamber 22b, and the lower bearing cover portion 132b of the lower bearing 132 of the second injection portion 20b are disposed in order of the second port 21b, the second intermediate pressure chamber 22b, and the lower bearing cover portion 132b in the axial direction Da. In other words, the second port 21b, the second intermediate pressure chamber 22b, and the lower bearing cover portion 132b are disposed in order of the second port 21b, the second intermediate pressure chamber 22b, and the lower bearing cover portion 132b in a direction away from the second compression chamber 120e.

[0123] The configuration described in the second embodiment can also achieve the same operations and effects as those described in the first embodiment.

(Other Embodiments)

[0124] The embodiment of the present disclosure has been described in detail above with reference to the drawings. However, a specific configuration is not limited to the configuration of the embodiment, and additions, omissions, substitutions, and other modifications of the configuration can be made without departing from the

scope of the present disclosure.

[0125] The injection portion 2 described in the first embodiment may be formed only in the upper bearing 131. Therefore, for example, the configuration may be adopted in which the injection portion 2 described in the first embodiment is not formed in the lower bearing 132 and only the first injection portion 20a described in the second embodiment is formed in the upper bearing 131 described in the first embodiment.

[0126] In addition, the injection portion 2 may be formed in both the upper bearing 131 and the lower bearing 132. Therefore, for example, a configuration may be adopted in which the injection portion 2 described in the first embodiment is not formed in the lower bearing 132, the first injection portion 20a described in the second embodiment is formed in the upper bearing 131 described in the first embodiment, and the second injection portion 20b described in the second embodiment is formed in the lower bearing 132 described in the first embodiment.

[0127] In addition, the injection portion 2 capable of supplying the refrigerant to each of the first compression chamber 120b and the second compression chamber 120e may be formed in the intermediate plate 125 described in the second embodiment.

<Additional Notes>

[0128] The rotary compressor described in each embodiment is grasped as follows, for example.

[0129]

(1) A rotary compressor 100 according to a first aspect includes a rotary shaft 11 that is rotatable about an axis line O, a cylinder 121 in which a compression chamber 121a that compresses a refrigerant with rotation of the rotary shaft 11 is formed, a bearing portion 13 that is provided in the cylinder 121 and rotatably supports the rotary shaft 11, and an injection portion 2 that is formed in the bearing portion 13 and is capable of supplying the refrigerant into the compression chamber 121a, in which the injection portion 2 includes a port 21 through which the refrigerant supplied from an outside flows, an intermediate pressure chamber 22 that extends in a circumferential direction of the rotary shaft 11 and into which the refrigerant is introduced from the port 21, a check valve 23 that is provided in the intermediate pressure chamber 22 and prevents the refrigerant in the intermediate pressure chamber 22 from flowing back to the port 21, and a plurality of injection holes 24 through which the intermediate pressure chamber 22 communicates with the compression chamber 121a.

[0130] Accordingly, for example, the length of the flow path of the refrigerant between the compression chamber 121a and the check valve 23 disposed in the intermediate pressure chamber 22 can be shortened as compared with a case where the check valve 23 is disposed in the flow path for supplying the refrigerant disposed outside the bearing portion 13. In addition, since the intermediate pressure chamber 22 formed in the bearing portion 13 extends in the circumferential direction, the injection holes 24 opening into the compression chamber 121a can be disposed in the circumferential direction.

[0131] (2) The rotary compressor 100 according to a second aspect is the rotary compressor 100 according to (1), in which the plurality of injection holes 24 may extend in the axial direction Da and may be arranged at equal intervals in the circumferential direction.

[0132] As a result, it is possible to form the shortest length of the injection hole 24 extending from the intermediate pressure chamber 22 to the compression chamber 121a. In addition, the time when each injection hole 24 opens in the compression chamber 121a in the process of compressing the refrigerant can be aligned.

[0133] (3) The rotary compressor 100 according to a third aspect is the rotary compressor 100 according to (1) or (2), in which the bearing portion 13 includes a bearing main body in which the injection portion 2 is formed, and a cover portion that is provided to be attachable to and detachable from the bearing main body and that opens the intermediate pressure chamber 22 by being removed from the bearing main body, and the port 21, the intermediate pressure chamber 22, and the cover portion are disposed in order of the port 21, the intermediate pressure chamber 22, and the cover portion in a direction away from the compression chamber 121a.

[0134] Accordingly, in a case where the cover portion is removed from the bearing main body, the intermediate pressure chamber 22 can be opened without passing through the port 21. In other words, the cover portion can be removed to access the check valve 23 disposed in the intermediate pressure chamber 22.

Industrial Applicability

[0135] According to the present disclosure, it is possible to provide a rotary compressor in which an injection hole can be disposed with a high degree of freedom while suppressing the generation of a dead volume. Reference Signs List

[0136]

1: compressor main body
2: injection portion
3: injection pipe
4: accumulator
5: suction pipe
6: discharge pipe
7: leg portion
10: housing
10a: main body portion
10b: upper cover portion

10c: lower cover portion
10d: refrigerant introduction portion
10e: suction port
10f: first suction port
10g: second suction port
10h: first refrigerant introduction portion
10i: second refrigerant introduction portion
11: rotary shaft
12, 12a: rotary compression portion
13: bearing portion
14: electric motor
20a: first injection portion
20b: second injection portion
21: port
21a: first port
21b: second port
22: intermediate pressure chamber
22a: first intermediate pressure chamber
22b: second intermediate pressure chamber
23: check valve
23a: first check valve
23b: second check valve
24: injection hole
24a: first injection hole
24b: second injection hole
31: first injection pipe
32: second injection pipe
100: compressor
101d: side surface opening
101h: first side surface opening
101i: second side surface opening
102d: cylindrical portion
102h: first cylindrical portion
102i: second cylindrical portion
120a: first cylinder
120b: first compression chamber
120c: first suction hole
120d: second cylinder
120e: second compression chamber
120f: second suction hole
121: cylinder
121a: compression chamber
121b: suction hole
121c: blade groove
122: eccentric shaft portion
122a: first eccentric shaft portion
122b: second eccentric shaft portion
123: piston rotor
123a: first piston rotor
123b: second piston rotor
124: blade
125: intermediate plate
131: upper bearing
131a: upper bearing main body
131b: upper bearing cover portion
131c: first tubular portion
131d: first flange portion
131e, 132e: discharge hole
131f, 132f: recess
132: lower bearing
132a: lower bearing main body
132b: lower bearing cover portion
132c: second tubular portion
132d: second flange portion
141: rotor
142: stator
Br: bracket
Da: axial direction
Dad: other side
Dau: one side
Dv: vertical direction
Dvd: lower side
Dvu: upper side
O: axis line

Claims

1. A rotary compressor comprising:

a rotary shaft that is rotatable about an axis line;
a cylinder in which a compression chamber that compresses a refrigerant with rotation of the rotary shaft is formed;
a bearing portion that is provided in the cylinder and rotatably supports the rotary shaft; and
an injection portion that is formed in the bearing portion and is capable of supplying the refrigerant into the compression chamber,
wherein the injection portion includes

a port through which the refrigerant supplied from an outside flows, an intermediate pressure chamber that extends in a circumferential direction of the rotary shaft and into which the refrigerant is introduced from the port,
a check valve that is provided in the intermediate pressure chamber and prevents the refrigerant in the intermediate pressure chamber from flowing back to the port, and
a plurality of injection holes through which the intermediate pressure chamber communicates with the compression chamber.

2. The rotary compressor according to claim 1, wherein the plurality of injection holes extend in the axial direction and are arranged at equal intervals in the circumferential direction.

3.

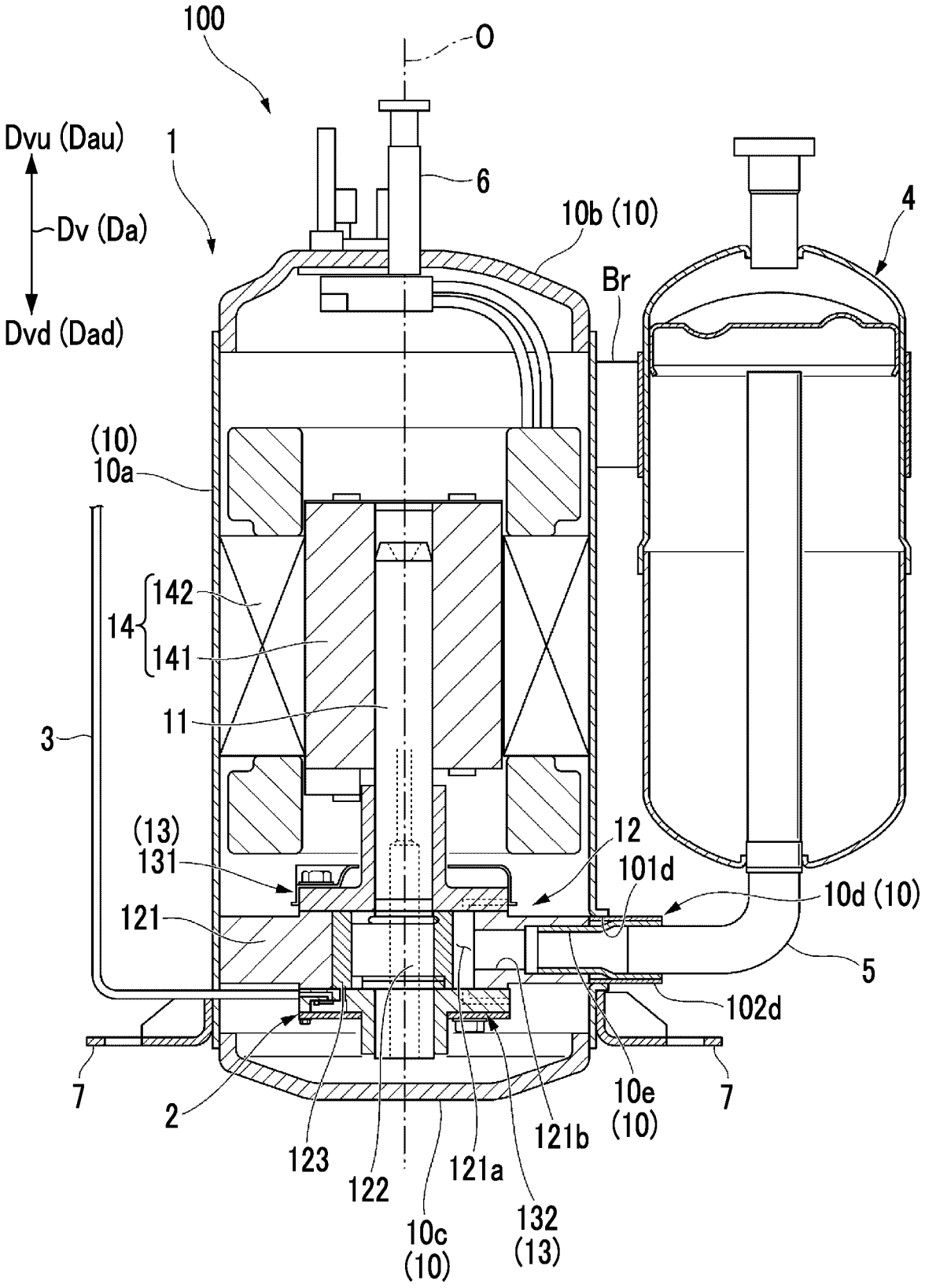
The rotary compressor according to claim 1 or 2, wherein the bearing portion includes

a bearing main body in which the injection

portion is formed, and
a cover portion that is provided to be attachable to and detachable from the bearing main body and that opens the intermediate pressure chamber by being removed from the bearing main body, and

the port, the intermediate pressure chamber, and the cover portion are disposed in the order of the port, the intermediate pressure chamber, and the cover portion in a direction away from the compression chamber.

FIG. 1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O
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Dvd (Dad)
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Br
(10)
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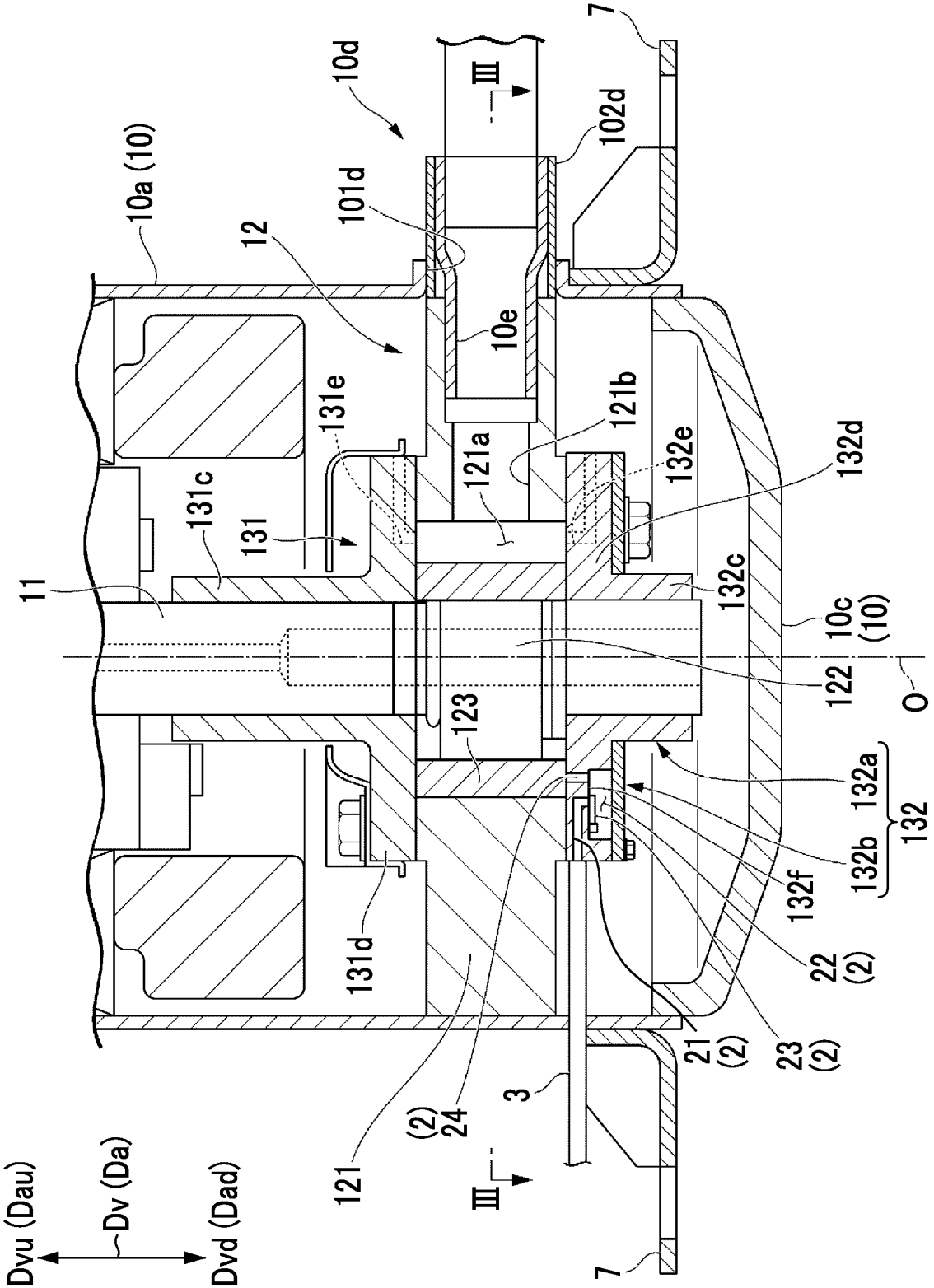
11
3
(13)
131
121
12
101d
10d (10)
5
102d
7
2
123
122
121a
10c
(10)
132
(13)
121b
10e
(10)
7

FIG. 2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132e
132d
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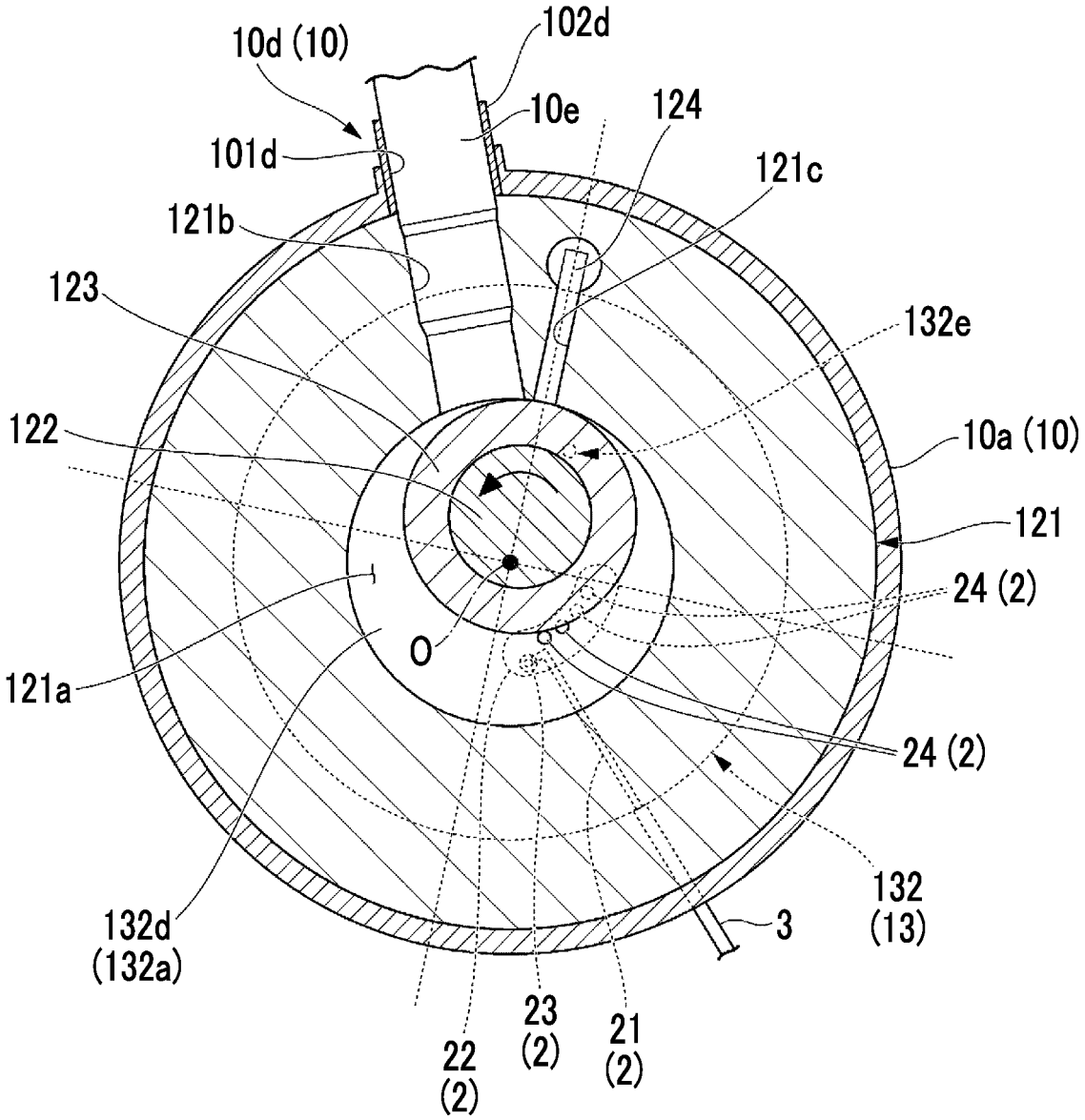
10c (10)
122
O
123
132a
132
132b
132f
131d
22 (2)
21 (2)
23 (2)
121
(2) 24
3
III
7
Dvu (Dau)
Dv (Da)
Dvd (Dad)

FIG. 3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10a (10)
121
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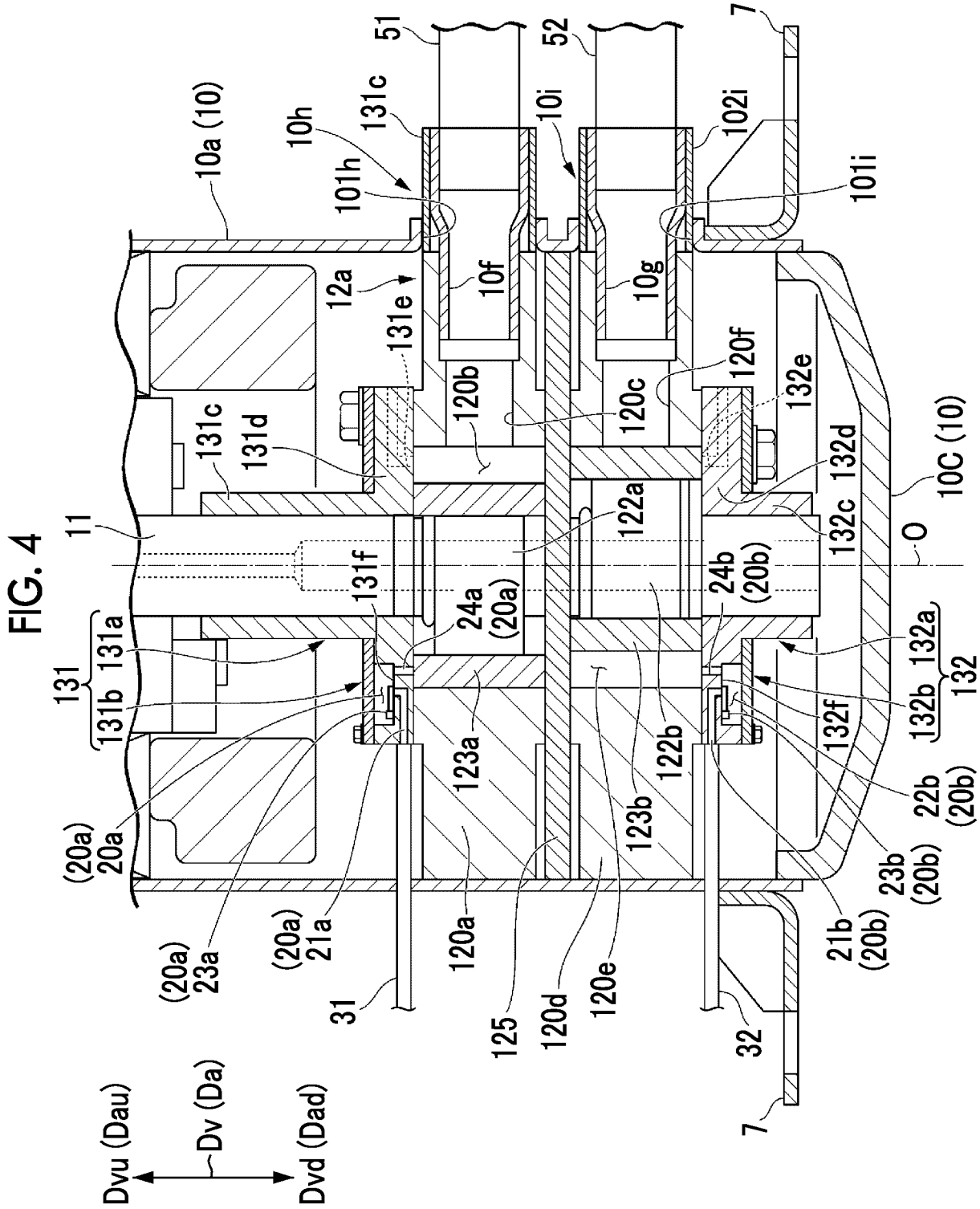
(2)
23
(2)
21
(2)

FIG. 4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Dvd (Dad)
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7
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131e
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10g
120f
120b
120c
132e
131c
131d
132d
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122a
132c
O
131f
24b (20b)
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(20a) 21a
23b (20b)
21b (20b)
31
120a
125
120d
120e
32
7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/028286

A. CLASSIFICATION OF SUBJECT MATTER

F04C 29/04(2006.01)i; ***F04C 18/356***(2006.01)i; ***F04C 29/00***(2006.01)i; ***F04C 29/12***(2006.01)i
FI: F04C29/04 M; F04C18/356 A; F04C18/356 J; F04C29/00 B; F04C29/12 E

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04C29/04; F04C18/356; F04C29/00; F04C29/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2019/202976 A1 (TOSHIBA CARRIER CORP) 24 October 2019 (2019-10-24) paragraphs [0021]-[0053], fig. 1-6	1-3
Y	JP 10-259788 A (NIPPON SOKEN INC) 29 September 1998 (1998-09-29) paragraphs [0012], [0018]-[0020], [0027], [0030]-[0031], fig. 1-3	1-3
Y	JP 2020-133407 A (PANASONIC IP MAN CORP) 31 August 2020 (2020-08-31) paragraphs [0061]-[0070], fig. 3, 5-6	1-3
Y	JP 2015-129467 A (TOYOTA IND CORP) 16 July 2015 (2015-07-16) paragraphs [0029], [0034], fig. 2	1-3
A	JP 2019-167839 A (TOSHIBA CARRIER CORP) 03 October 2019 (2019-10-03) paragraphs [0009]-[0037], fig. 1-4	1-3
A	WO 2019/049226 A1 (TOSHIBA CARRIER CORP) 14 March 2019 (2019-03-14) paragraphs [0011]-[0031], fig. 1-4	1-3
A	JP 10-281090 A (MITSUBISHI ELECTRIC CORP) 20 October 1998 (1998-10-20) paragraph [0027], fig. 1-5	1-3

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 October 2023	**24 October 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/028286

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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