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

(11) EP 2 942 526 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
11.11.2015 Bulletin 2015/46

(21) Application number: **13877835.2**

(22) Date of filing: **26.09.2013**

(51) Int Cl.:
F04C 29/06 *(2006.01)* ***F04C 18/356*** *(2006.01)*
F04C 23/00 *(2006.01)*

(86) International application number:
PCT/JP2013/005732

(87) International publication number:
WO 2014/141331 (18.09.2014 Gazette 2014/38)

(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
Designated Extension States:
BA ME

(30) Priority: **12.03.2013 JP 2013048886**

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(54) **ROTARY COMPRESSOR**

(57) A rotary compressor is provided with: an upper bearing (29A) and a lower bearing (29B), which are provided so as to sandwich a rotary compression mechanism; a main shaft (23) which is rotatably supported by both the upper bearing (29A) and the lower bearing (29B) and which penetrates through the rotary compression mechanism; an electric motor (36) which rotationally drives the main shaft (23) about the axis of the main shaft (23); and a muffler (50A) which is affixed to the upper bearing (29A) and into which a refrigerant discharged from the rotary compression mechanism flows. The muffler (50A) has formed thereon a rib (56) which extends along the radial line which connects the affixation point (F) at which the upper bearing (29A) is affixed to a hermetic container (11) and the center of the main shaft (23).

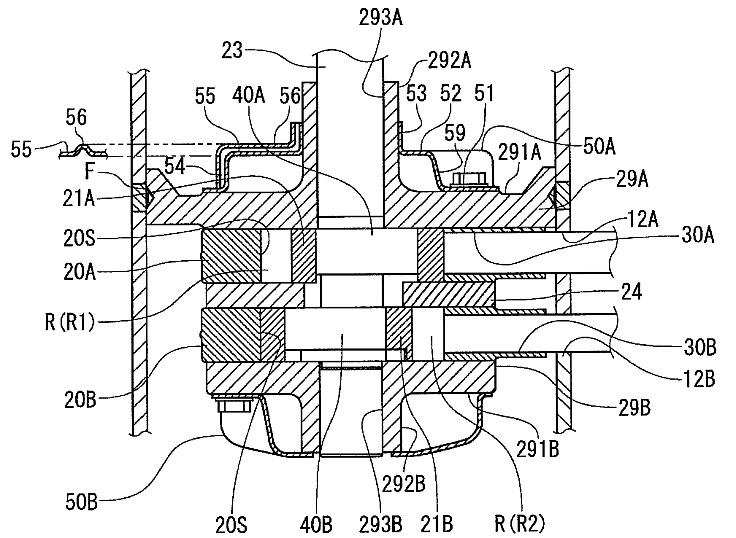

FIG. 2

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Description

TECHNICAL FIELD

[0001] The present invention relates to a rotary compressor that can suppress vibrations of a shaft that rotates integrally with a rotor of a motor.

BACKGROUND ART

[0002] As illustrated in FIG. 6, in a rotary compressor that is used in refrigerating equipment, a cylinder 2 that has a cylindrical inner wall surface and a piston rotor 3 that is provided eccentrically with respect to a center of the cylinder 2 are provided in the interior of a hermetic container 1. The piston rotor 3 is provided on a main shaft 4, which is provided along a center axis of the cylinder 2. The main shaft 4 is provided so as to rotate freely about the center axis via an upper bearing 5A and a lower bearing 5B that are affixed to the cylinder 2. A rotor 6A of a motor 6 is affixed to the main shaft 4. A stator 6B, which is affixed to an internal peripheral face of the hermetic container 1, is disposed around an outer peripheral side of the rotor 6A. The main shaft 4 is driven to rotate along with the rotor 6A by energizing the stator 6B, and the piston rotor 3 revolves inside the cylinder 2.

[0003] The rotary compressor sucks refrigerant into a compression chamber formed between the cylinder 2 and the piston rotor 3, and compresses the refrigerant by decreasing a volume of the compression chamber as a result of the rotation of the piston rotor 3. The rotary compressor sucks up and compresses the refrigerant after performing gas-liquid separation on the refrigerant using an accumulator 8.

[0004] In the rotary compressor, vibrations are generated when the main shaft 4 rotates, and there are cases in which those vibrations are transmitted in turn to the hermetic container 1 and the accumulator 8, for example, and noise is generated. Therefore, various proposals have been made up to the present time to reduce vibrations in the rotary compressor.

[0005] For example, in Patent Document 1, it is proposed to reduce the vibrations transmitted from an upper bearing to a hermetic container by interposing a cast support member that is effective in vibration dampening between the upper bearing and the hermetic container. Furthermore, in Patent Documents 2 and 3, it is proposed to reduce the vibrations by forming ribs on an upper bearing.

CITATION LIST

Patent Literature

[0006]

Patent Document 1: Japanese Unexamined Patent Application Publication No. H06-26478A

Patent Document 2: Japanese Unexamined Patent Application Publication No. H07-133781A

Patent Document 3: Japanese Unexamined Patent Application Publication No. S59-182691

SUMMARY OF INVENTION

Technical Problem

[0007] Although many proposals have been made up to the present time, as described above, as causes of vibrations extend over a wide range, vibration problems still exist. Increasing the rigidity of constituent elements of a rotary compressor, in particular, the upper bearing and the lower bearing that support the main shaft, which is a main cause of vibrations, is effective in reducing vibrations. However, similar to many other devices and machines, there is a demand for weight-saving in the rotary compressor, and in general, increasing the rigidity of the constituent elements results in a weight increase. It is thus not easy to satisfy the requirement for weight-saving.

[0008] Based on such a problem described above, it is an object of the present invention to provide a rotary compressor that can effectively reduce vibrations while suppressing a weight increase to a minimum.

Solution To Problem

[0009] A rotary compressor of the present invention includes: a rotary compression mechanism which compresses and discharges a supplied refrigerant; an upper bearing and a lower bearing which are provided so as to sandwich the rotary compression mechanism; a main shaft which is rotatably supported by both the upper bearing and the lower bearing and which extends through the rotary compression mechanism; an electric motor which rotationally drives the main shaft about the center axis of the main shaft; a muffler which is affixed to the upper bearing and into which the refrigerant discharged from the rotary compression mechanism flows; and a hermetic container which internally houses the rotary compression mechanism, the upper bearing, the lower bearing, the main shaft, the electric motor, and the muffler. A stiffening body is provided on at least one of the muffler and the upper bearing, the stiffening body extending along a radial line which connects the affixation point at which the upper bearing is affixed to the hermetic container and the center of the main shaft.

[0010] As will be described in more detail below, in the upper bearing, a larger strain occurs in an area from the affixation point to the center of the main shaft than in other areas. Here, by providing the stiffening body on at least one of the muffler and the upper bearing as a reinforcing member with respect to the area in which the strain is large, the present invention can improve rigidity with respect to the main shaft and reduce vibrations of the main shaft. Moreover, as it is sufficient to provide the stiffening body, the present invention can suppress a weight increase of the compressor to a minimum.

[0011] The stiffening body of the present invention increases a secondary moment of area of the cross section of the muffler and the upper bearing, and includes an overall structural section that improves the rigidity with respect to bending and twisting, and a rib is typical of this stiffening body.

[0012] When the stiffening rib is provided on the muffler, it is possible to form the stiffening rib integrally with the muffler, and it is also possible to form the stiffening rib separately from the muffler and affix the separate stiffening rib to the muffler.

[0013] When the stiffening body is formed integrally with the muffler, it is possible to form a refrigerant channel (a first refrigerant channel), through which the refrigerant that is discharged from the interior of the muffler to the interior of the hermetic container passes, in the stiffening body. In this mode, there is an advantage that both the stiffening body and the refrigerant channel can be integrally formed with the muffler through sheet metal working.

[0014] Furthermore, when the stiffening rib is formed separately from the muffler, it is possible to form the refrigerant channel (the second refrigerant channel), through which the refrigerant that is discharged from the interior of the muffler to the interior of the hermetic container passes, in the muffler while avoiding the stiffening body. This mode is effective in a case in which it is necessary for the stiffening body to be a shape that cannot be integrally formed with the muffler.

Advantageous Effects of Invention

[0015] According to the present invention, as the stiffening body is simply provided on at least one of the muffler and the upper bearing with respect to the area in which the strain is large, it is possible to improve rigidity with respect to the main shaft and reduce vibrations of the main shaft while suppressing a weight increase to a minimum.

Brief Description of Drawings

[0016]

FIG. 1 is a cross-sectional view schematically illustrating a configuration of a rotary compressor according to a first embodiment of the present invention.

FIG. 2 is a longitudinal cross-sectional view illustrating a vicinity of a rotary mechanism of the rotary compressor illustrated in FIG. 1.

FIG. 3 is a lateral cross-sectional view illustrating the vicinity of the rotary mechanism of the rotary compressor illustrated in FIG. 1.

FIGS. 4A and 4B illustrate a rotary compressor according to a second embodiment of the present invention, where FIG. 4A is a lateral cross-sectional view corresponding to FIG. 3 and FIG. 4B is a longitudinal cross-sectional view corresponding to FIG. 2.

FIGS. 5A and 5B illustrate a rotary compressor according to a third embodiment of the present invention, where FIG. 5A is a lateral cross-sectional view corresponding to FIG. 3 and FIG. 5B is a longitudinal cross-sectional view corresponding to FIG. 2.

FIG. 6 is a cross-sectional view illustrating a conventional rotary compressor.

Description of Embodiments

[0017] Below, the present invention will be described in detail based on embodiments illustrated in the attached drawings.

[First Embodiment]

[0018] Hereinafter, a compressor 10 according to a first embodiment of the present invention will be described. The compressor 10 is characterized in that it reduces vibrations of a main shaft 23 by having ribs 56, each of which correspond to a stiffening body, formed integrally with a muffler 50A that will be described below.

[0019] A configuration of the compressor 10 will be described below, and then, effects and benefits of the compressor 10 will be described.

[Configuration of compressor 10]

[0020] As illustrated in FIG. 1, the compressor 10 is a so-called two-cylinder type compressor in which disc-shaped cylinders 20A and 20B are provided in a two-level upper and lower arrangement inside a cylindrical hermetic container 11. A cylindrical cylinder internal wall surface 20S is formed on the interior of each of the cylinders 20A and 20B. Cylindrical piston rotors 21A and 21B are respectively arranged inside the cylinders 20A and 20B, and each of the piston rotors 21A and 21B has an outer diameter that is smaller than an inner diameter of the cylinder internal wall surface 20S. The piston rotors 21A and 21B are respectively inserted into and affixed to eccentric shaft portions 40A and 40B of the main shaft 23 that is arranged along a center axis of the hermetic container 11. In this way, spaces R having a crescent-shaped cross-section are respectively formed between the cylinder internal wall surface 20S of the cylinders 20A and 20B and an outer peripheral face of the piston rotors 21A and 21B.

[0021] Here, the upper side piston rotor 21A and the lower side piston rotor 21B are provided so that a phase between them differs by 180 degrees.

[0022] Furthermore, a disc-shaped partition plate 24 is provided between the upper and lower cylinders 20A and 20B. Due to the partition plate 24, the space R inside the upper side cylinder 20A and the space R of the lower side cylinder 20B do not communicate with each other, and are partitioned into a compression chamber R1 and a compression chamber R2.

[0023] Blades (not illustrated in the drawings) that divide each of the compression chambers R1 and R2 into two sections are provided in the upper and lower cylinders 20A and 20B. The blades are supported in insertion grooves that extend in the radial direction of the cylinders 20A and 20B, so that the blades can be freely advanced or retracted in a direction to approach or move away from the piston rotors 21A and 21B.

[0024] Furthermore, a discharge hole (not illustrated in the drawings), which discharges the refrigerant, is provided in a predetermined position in each of the cylinders 20A and 20B, and a reed valve (not illustrated in the drawings) is provided in the discharge hole. When the pressure of the compressed refrigerant reaches a predetermined value, the reed valve is pushed open and the refrigerant is discharged to the outside of the cylinders 20A and 20B.

[0025] The main shaft 23 is supported by an upper bearing 29A that is affixed to the cylinder 20A and a lower bearing 29B that is affixed to the cylinder 20B, so that the main shaft 23 can freely rotate about its center axis.

[0026] The main shaft 23 is provided with the eccentric shaft portions 40A and 40B that are offset in a direction orthogonal to the center axis of the main shaft 23. Each of the eccentric shaft portions 40A and 40B has an outer diameter that is slightly smaller than the inner diameter of each of the piston rotors 21A and 21B. In this way, when the main shaft 23 rotates, the eccentric shaft portions 40A and 40B revolve around the center axis of the main shaft 23 and the upper and lower piston rotors 21A and 21B rotate eccentrically inside the cylinders 20A and 20B. At that time, the distal edge of each of the above-described blades advances and retracts in accordance with the movement of the piston rotors 21A and 21B and is constantly pushed by the piston rotors 21A and 21B.

[0027] The main shaft 23 extends while protruding upward from the upper bearing 29A, and a rotor 37 of an electric motor 36 for rotary driving of the main shaft 23 is integrally provided with the protruding section of the main shaft 23. The stator 38 is affixed to the internal peripheral face of the hermetic container 11 so that the stator 38 faces an outer peripheral portion of the rotor 37.

[0028] As illustrated in FIG. 2 and FIG. 3, the upper bearing 29A is provided with a base portion 291A and a sleeve 292A that stands up vertically from the base portion 291A. The base portion 291A and the sleeve 292A are formed so that their axial centers are aligned, and a bearing surface 293A that supports the main shaft 23 is formed around the axial center. An outer peripheral face of the base portion 291A of the upper bearing 29A is affixed to the internal peripheral face of the hermetic container 11 at affixation points F in three locations. The base portion 291A is affixed, for example, by welding, tightening using a bolt, and the like.

[0029] The lower bearing 29B is provided with a base portion 291B and a sleeve 292B that stands up vertically from the base portion 291B. The base portion 291B and the sleeve 292B are formed so that their axial centers are aligned, and a bearing surface 293B that supports the main shaft 23 is formed around the axial center.

[0030] The upper bearing 29A and the lower bearing 29B are disposed so that the base portion 291A and the base portion 291B face each other, and the upper bearing 29A supports the main shaft 23 between the cylinder 20A and the electric motor 36. A section of the main shaft 23 that protrudes downward from the cylinder 20B is supported by the lower bearing 29B.

[0031] The upper bearing 29A is provided with a discharge hole (not illustrated in the drawings) that is communicated with the discharge hole formed in the cylinder 20A, and the refrigerant that has passed through the cylinder 20A passes through the discharge hole in the upper bearing 29A and is discharged to the interior of the muffler 50A that will be described below. Similarly, the lower bearing 29B is provided with a discharge hole (not illustrated in the drawings) that is communicated with the discharge hole formed in the cylinder 20B, and the refrigerant that has passed through the cylinder 20B passes through the discharge hole in the lower bearing 29B and is discharged to the interior of the muffler 50B that will be described below.

[0032] In the compressor 10, the muffler 50A is mounted on the upper bearing 29A, and the muffler 50B is also mounted on the lower bearing 29B. When the refrigerant that has passed through the upper bearing 29A and the lower bearing 29B flows into the interior of the muffler 50A and the muffler 50B, respectively, a pulsating component is removed. The refrigerant from which the pulsating component has been removed passes through a discharge channel formed in the muffler 50A and the muffler 50B, and flows in an upward direction of the hermetic container 11.

[0033] Openings 12A and 12B are formed in the sides of the hermetic container 11, in positions facing outer peripheral faces of the cylinders 20A and 20B. Intake ports 30A and 30B, which are communicated as far as a predetermined position of the cylinder internal wall surface 20S, are formed in the cylinders 20A and 20B, in positions facing the openings 12A and 12B.

[0034] In the compressor 10, an accumulator 14, which performs gas-liquid separation of the refrigerant before the refrigerant is supplied to the compressor 10, is affixed to the hermetic container 11 via a stay 15.

[0035] Intake pipes 16A and 16B are provided in the accumulator 14, for causing the refrigerant inside the accumulator 14 to be sucked into the compressor 10. The tip portions of the intake pipes 16A and 16B are connected to the intake ports 30A and 30B via the openings 12A and 12B.

[0036] The compressor 10 takes up the refrigerant into the accumulator 14 from an intake opening 14a of the accumulator 14, performs gas-liquid separation on the refrigerant inside the accumulator 14, and supplies the resulting gas phase from the intake pipes 16A and 16B to the compression chambers R1 and R2, which are internal spaces of the cylinders 20A and 20B, via the intake ports 30A and 30B.

[0037] Then, the volume of the compression chambers R1 and R2 is gradually decreased by the eccentric rotation of the piston rotors 21A and 21B, and the refrigerant is compressed. The compressed refrigerant passes through the upper bearing 29A and the muffler 50A on the cylinder 20A side and passes through the lower bearing 29B and the muffler 50B on the cylinder 20B side, and is discharged into the interior of the hermetic container 11 (the outside of the muffler 50A and the muffler 50B). After passing through the electric motor 36, the refrigerant is evacuated to a pipe that forms a refrigerant cycle, via a discharge opening 42 that is provided in an upper portion.

[0038] In the present embodiment, the muffler 50A that is mounted on the upper bearing 29A is provided with a function to support the main shaft 23, in addition to the upper bearing 29A. By providing the muffler 50A with the function to support the main shaft 23, vibrations of the main shaft 23 are reduced. In order for the muffler 50A to deploy this function, it is provided with the following structure.

[0039] As illustrated in FIG. 2 and FIG. 3, the muffler 50A is provided with a flange 51, a cup 52 that stands up from the flange 51, and a sleeve 53 that stands up from the cup 52. In the muffler 50, the flange 51, the cup 52 and the sleeve 53 are integrally formed by sheet metal working of a flat metal plate such as an aluminum alloy plate, for example.

[0040] The flange 51 is a portion that is used to affix the muffler 50A to the upper bearing 29A, and is a flat member having a circular external shape. At the same time as abutting a top surface of the upper bearing 29A without any gap therebetween, the flange 51 is affixed to the upper bearing 29A in three locations, by bolts B that penetrate through the flange 51. Note that portions to which the bolts B of the flange 51 are affixed correspond to indentations 59 that are formed by a side wall 54 of the cup 52 being indented toward a center of the cup 52 in the radial direction.

[0041] The cup 52 is provided with the hollow cylindrical side wall 54 and a top plate 55 that covers an opening formed at a tip end of the side wall 54.

[0042] The top plate 55 has a ring shape with an outer periphery and an inner periphery, and the outer periphery side is connected to the side wall 54 while the inner periphery side is connected to the sleeve 53.

[0043] The top plate 55 is provided with the ribs 56 that are integrally formed with the top plate.

[0044] The ribs 56 are provided along the radial direction of the top plate 55 and are each formed as a U shape by a part of the top plate 55 being folded upward and then back downward. Thus, the interior of each of the ribs 56 communicates with the interior of the cup 52.

[0045] The ribs 56 are provided in three locations with an interval therebetween in the circumferential direction. If an end portion on the outer peripheral side of each of the ribs 56 is extended toward the outer side in the radial direction, the affixation point F at which the upper bearing 29A is affixed to the hermetic container 11 is reached. Furthermore, if an end portion on the inner peripheral side of each of the ribs 56 is extended toward the inner side in the radial direction, the center axis of the main shaft 23 is reached. In other words, each of the ribs 56 is provided corresponding to a line (substantially along a line) connecting the center axis of the main shaft 23 and the affixation point F.

[0046] The ribs 56 are formed continuously from the top plate 55 to the lower edge of the side wall 54, and at the same time, are formed continuously from the top plate 55 to the top edge of the sleeve 53. In other words, the ribs 56 are provided extending from the lower edge of the cup 52 to the upper edge of the sleeve 53, and contribute to improving the rigidity of the cup 52 and the sleeve 53.

[0047] The sleeve 53 stands up vertically from the inner periphery of the top plate 55 and a top end of the sleeve 53 is open. The internal peripheral face of the sleeve 53 is in contact with the outer peripheral face of the sleeve 292A of the upper bearing 29A, and supports the sleeve 292A from around the sleeve 292A. As described above, the ribs 56 are provided from the lower edge to the upper edge of the sleeve 53 and thus, in comparison to a case in which the ribs 56 are not provided, the rigidity of the sleeve 53 is high.

[Effects and benefits of compressor 10]

[0048] Next, the effects and benefits of the compressor 10 according to the first embodiment will be described.

[0049] When a strain distribution of the compressor 10 during operation was verified by simulation, in the upper bearing 29A, it was confirmed that strain in areas from each of the affixation points F toward the center axis of the main shaft 23 along the radial direction was larger than that in other areas. This means that, in the areas in which the strain is large, a degree of load of the support of the main shaft 23 is larger than in other areas. Meanwhile, the compressor 10 supports the main shaft 23, via the upper bearing 29A, using the muffler 50A that is provided with the ribs 56. At the same time, the ribs 56 are formed in three locations along lines in the radial direction that connect each of the affixation points F of the upper bearing 29A with the center of the main shaft 23, and it can thus be said that they are provided in positions that are most effective in terms of suppressing vibrations. Thus, while alleviating the large strain that occurs in the upper bearing 29A in areas along the radial direction from the affixation point F to the center axis of the main shaft 23, the muffler 50A supports the main shaft 23 via the upper bearing 29A using the sleeve 53, and it is thus possible to reduce whirling of the main shaft 23. As a result, the compressor 10 can increase the rigidity of the muffler 50A with almost no increase in weight, and it is possible to suppress the occurrence of noise resulting from vibrations being transmitted from the hermetic container 11 to the accumulator 14.

[0050] Furthermore, the muffler 50A compensates for part of the rigidity that is required for the upper bearing 29A, and an effect is thus anticipated that the rigidity of the upper bearing 29A can be reduced and weight saving of the upper bearing 29A can be achieved.

[0051] In the muffler 50A, the inside of each of the ribs 56 is communicated with the interior of the muffler 50A. Therefore, the refrigerant that passes through the cylinder 20A and flows into the muffler 50A flows through a refrigerant channel (a first refrigerant channel) 61 in the interior of the rib 56, finally passes through the interior of the rib 56 of the sleeve 53, and is discharged into the interior of the hermetic container 11 from the top end of the sleeve 53. As a result, the refrigerant that has flowed into the muffler 50A has a smooth flow along the main shaft 23 and is discharged, and there is thus little pressure loss of the discharged refrigerant. Furthermore, as the refrigerant is discharged from around the main shaft 23 and there is a separation gap to the stator 38 of the electric motor 36 in the radial direction, it is difficult for the discharged refrigerant to excite the stator 38. Also as a result of this, the compressor 10 can achieve a reduction in noise caused by vibrations.

[Modified example of compressor 10]

[0052] The compressor 10 according to the first embodiment is provided with the three ribs 56 corresponding to the three affixation points F, but the present invention is not limited to this example, and it is allowable to provide less than three of the ribs or four or more of the ribs. For example, when there are the three affixation points F, when there is a case in which strain in only an area from one specific affixation point F toward the inner periphery becomes high, it is practical to selectively provide the rib corresponding to the relevant affixation point F only.

[0053] In the compressor 10, the example is given that if each of the ribs 56 is extended, it reaches the affixation point F, but the present invention is not limited to this example. Even if an extension line of the rib is slightly displaced from the affixation point F, as long as at least part of the rib overlaps the area in which the strain is large, it is evident that the shaft rigidity of the main shaft 23 can be improved. The present invention defines the case in which a part of or all of the rib overlaps the area in which the strain is large as being along the line in the radial direction that connects the affixation point F and the center, and the formation of the rib that falls under this definition is included in the present invention.

[0054] Next, in the compressor 10, it is most preferable that the rib 56 be continuously formed from the lower edge of the cup 52 to the upper edge of the sleeve 53. However, this is merely a preferable mode, and it is possible to form the rib on any section from the cup 52 to the sleeve 53, such as an example in which the rib is provided only on the sleeve 53 and the side wall 54, or an example in which the rib is provided only on the sleeve 53 and the top plate 55, for example.

[0055] In the compressor 10, the sleeve 53 of the muffler 50A is in contact with the upper bearing 29A apart from the space in the interior of the rib 56, but the present invention is not limited to this example. For example, a structure can be adopted in which only a section on which the rib 56 is formed is in contact with and supports the upper bearing 29A. Note that, in the present embodiment, the rib 56 also serves as the refrigerant channel 61 that discharges the refrigerant to the outside of the muffler 50A, and it is not necessary to provide another discharge hole for discharging the refrigerant. Here, in order to increase the shaft rigidity of the main shaft 23, the sleeve 53 is caused to be in contact with the upper bearing 29A apart from the space in the interior of the rib 56.

[Second Embodiment]

[0056] In the first embodiment, the ribs 56 are formed integrally with the muffler 50A, but in a compressor 110 of a second embodiment, ribs 57 and the muffler 50A are manufactured separately in advance and the ribs 57 are bonded to the muffler 50A, as illustrated in FIGS. 4A and 4B. For the bonding, a known method can be applied, such as welding, soldering, or adhesion. In this case, the interior of the ribs 57 and the interior of the muffler 50A are partitioned by the top plate 55, and the ribs 57 do not function as a channel for the refrigerant. Therefore, as illustrated in FIG. 4A, discharge holes (second refrigerant channels) 60 that are channels for the refrigerant are formed in the top plate 55. Note that a gap that corresponds to the discharge holes may be provided between the sleeve 53 and the sleeve 292A of the upper bearing 29A.

[0057] The compressor 110 is provided with the ribs 57, and, similarly to the first embodiment, it is possible to suppress the occurrence of noise caused by vibrations transmitted from the hermetic container 11 to the accumulator 14.

[0058] In the case in which the ribs 56 are integrally formed with the muffler 50A, it is possible that there are restrictions on the shape and dimensions of the ribs 56 from the viewpoint of processability. For example, in a case where it is necessary to make the ribs 56 taller, it is sometimes difficult to integrally form the ribs 56. However, the ribs 57 that are manufactured separately have almost no such restrictions and it is possible to respond to various shapes and dimensions that are required.

[0059] Furthermore, in a mode in which the ribs and the top plate are formed as separate entities, it is preferable that the ribs extend as far as the flange 51 in order to improve the rigidity.

[Third Embodiment]

[0060] In the first embodiment and the second embodiment, the ribs 56 and 57 are provided on the muffler 50A, but in a compressor 120 of a third embodiment, ribs 58 are provided on the upper bearing 29A, as illustrated in FIGS. 5A and 5B. Positions in which the ribs 58 are provided are the same as those of the first embodiment and the second embodiment.

[0061] Note that, when there is interference between the ribs 58 of the upper bearing 29A and the muffler 50A, which is not illustrated in FIGS. 5A and 5B, treatment is executed on the muffler 50A so that the interference is avoided. Furthermore, the muffler 50A is provided with a structure in which the refrigerant is discharged from the muffler 50A, such as by providing the discharge holes 60 provided in the second embodiment, for example.

[0062] The compressor 120 is provided with the ribs 58, and, similarly to the first embodiment, it is possible to suppress the occurrence of noise caused by the vibrations transmitted from the hermetic container 11 to the accumulator 14. In particular, in the compressor 120, the ribs 58 are provided on the upper bearing 29A that is thicker than the muffler 50A, and thus, a degree of improvement in the rigidity with respect to the main shaft is greater and it is possible to more effectively suppress the vibrations. Furthermore, when the thickness of the upper bearing 29A is reduced in order to achieve weight saving, it is also effective to provide the ribs 58 in order to secure the rigidity of the bearing itself.

[0063] The embodiments of the present invention are described above. However, as long as there is no departure from the spirit and scope of the present invention, configurations described in the modes of the above embodiments can be selected as desired, or can be changed to other configurations as necessary.

[0064] For example, in the embodiments described above, the two-cylinder type compressor is described, but the present invention is not limited to this. For example, the present invention can be applied to a one-cylinder type compressor or can be applied to a two-stage compressor that combines a scroll compression mechanism and a rotary compression mechanism.

[0065] Furthermore, in the above-described embodiments, stiffening ribs are described that each extends along the line in the radial direction from the affixation point at which the upper bearing is affixed to the hermetic container to the center of the main shaft. However, depending on a shape and deformation mode of the upper bearing, for example, in a case in which it is desired to suppress deformation such as twisting of the bearing, it is also effective to provide the stiffening ribs along the circumferential direction.

Reference Signs List

[0066]

10,110,120 Compressor
11 Hermetic container
12A, 12B Opening
14 Accumulator
14a Intake opening
15 Stay
16A, 16B Intake pipe
20A, 20B Cylinder
20S Cylinder internal wall surface
21A, 21B Piston rotor
23 Main shaft
24 Partition plate
29A Upper bearing
29B Lower bearing
291A, 291B Base portion
292A, 292B Sleeve
293A, 293B Bearing surface
30A, 30B Intake port
36 Electric motor
37 Rotor
38 Stator
40A, 40B Eccentric shaft portion
42 Discharge opening
50A, 50B Muffler
51 Flange
52 Cup
53 Sleeve
54 Side wall
55 Top plate
56, 57, 58 Rib (stiffening body)
59 Indentation
60 Discharge hole (second refrigerant channel)
61 Refrigerant channel (first refrigerant channel)
B Bolt
F Affixation point
R Space
R1, R2 Compression chamber

Claims

1. A rotary compressor comprising:

a rotary compression mechanism that compresses and discharges a supplied refrigerant;
an upper bearing and a lower bearing which are provided so as to sandwich the rotary compression mechanism;
a main shaft which is rotatably supported by both the upper bearing and the lower bearing and which extends through the rotary compression mechanism;
an electric motor which rotationally drives the main shaft about a center axis of the main shaft;
a muffler which is affixed to the upper bearing, and into which the refrigerant discharged from the rotary compression mechanism flows; and
a hermetic container which internally houses the rotary compression mechanism, the upper bearing, the lower bearing, the main shaft, the electric motor, and the muffler,

a stiffening body being provided on at least one of the muffler and the upper bearing, the stiffening body extending along a radial line which connects the affixation point at which the upper bearing is affixed to the hermetic container and the center of the main shaft.

2. The rotary compressor according to claim 1, wherein the stiffening body is provided on the muffler.

3. The rotary compressor according to claim 1 or 2, wherein the stiffening body is formed integrally with the muffler.

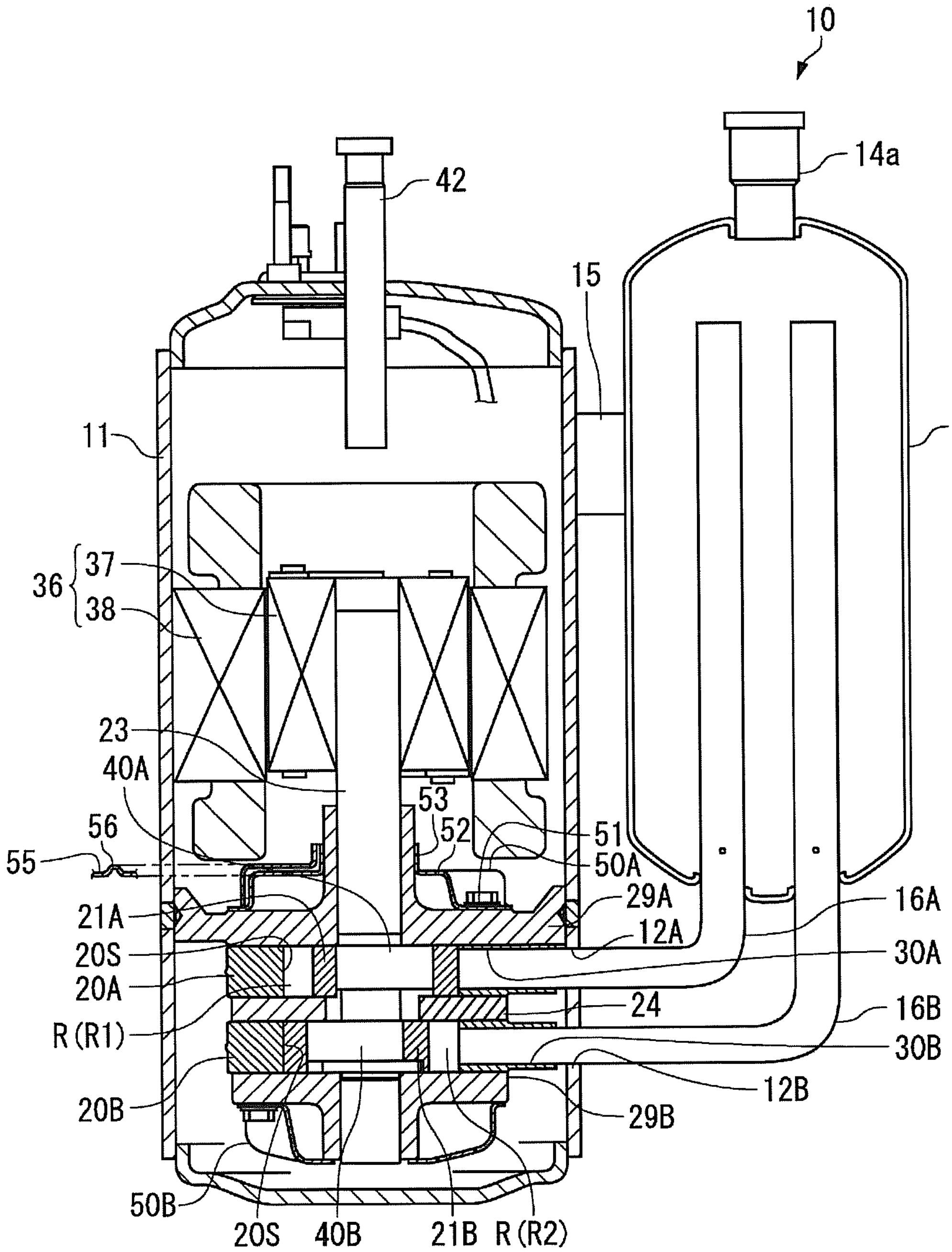
4. The rotary compressor according to claim 1, wherein the muffler includes the stiffening body that is integrally formed with the muffler, and
a first refrigerant channel which is formed in the stiffening body and through which the refrigerant that is discharged from the interior of the muffler to the interior of the hermetic container passes.

5. The rotary compressor according to claim 1, wherein the muffler includes the stiffening rib that is formed separately from the muffler and that is affixed to the muffler, and
a second refrigerant channel through which the refrigerant that is discharged from the interior of the muffler to the interior of the hermetic container passes.

6. The rotary compressor according to claim 5, wherein the interior of the rib 57 and the interior of the muffler are partitioned by a top plate, and
the second refrigerant channel is formed in the top plate.

7. The rotary compressor according to claim 1, wherein the stiffening body is provided on the upper bearing.

8. The rotary compressor according to any one of claims 1 to 7, wherein the stiffening body is a plurality of stiffening ribs.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14a
42
15
14
11
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38
23
40A
53
52
51
50A
56
55
21A
29A
16A
12A
20S
30A
20A
24
R (R1)
16B
30B
12B
20B
29B
50B
20S
40B
21B
R (R2)

FIG. 1

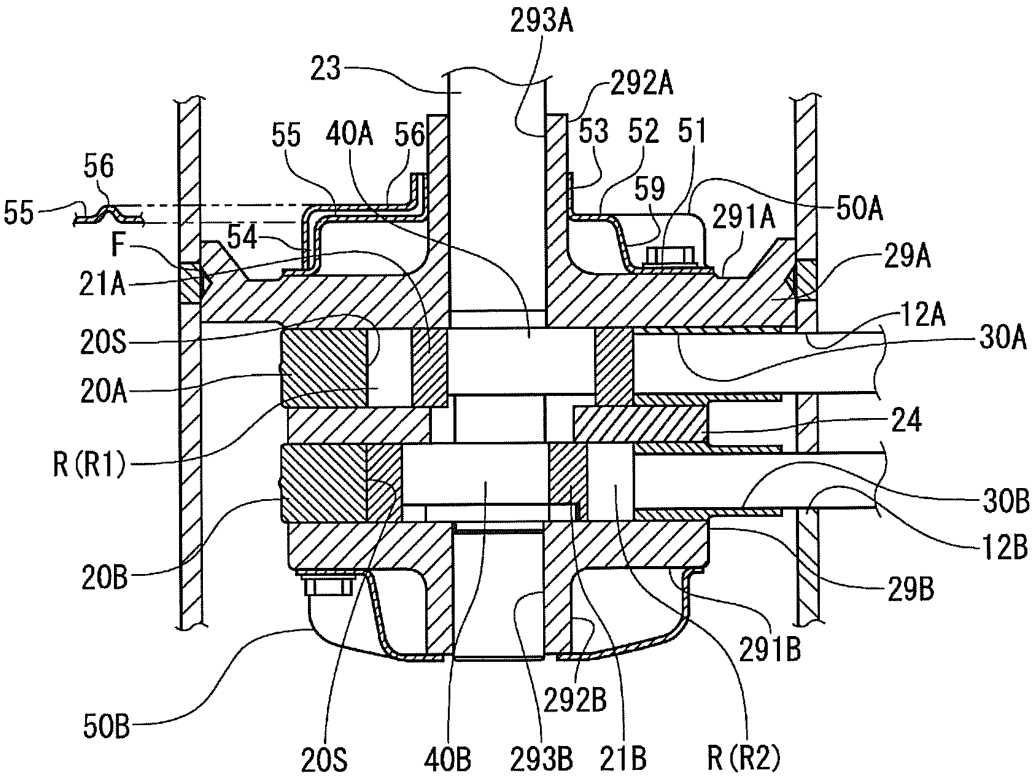
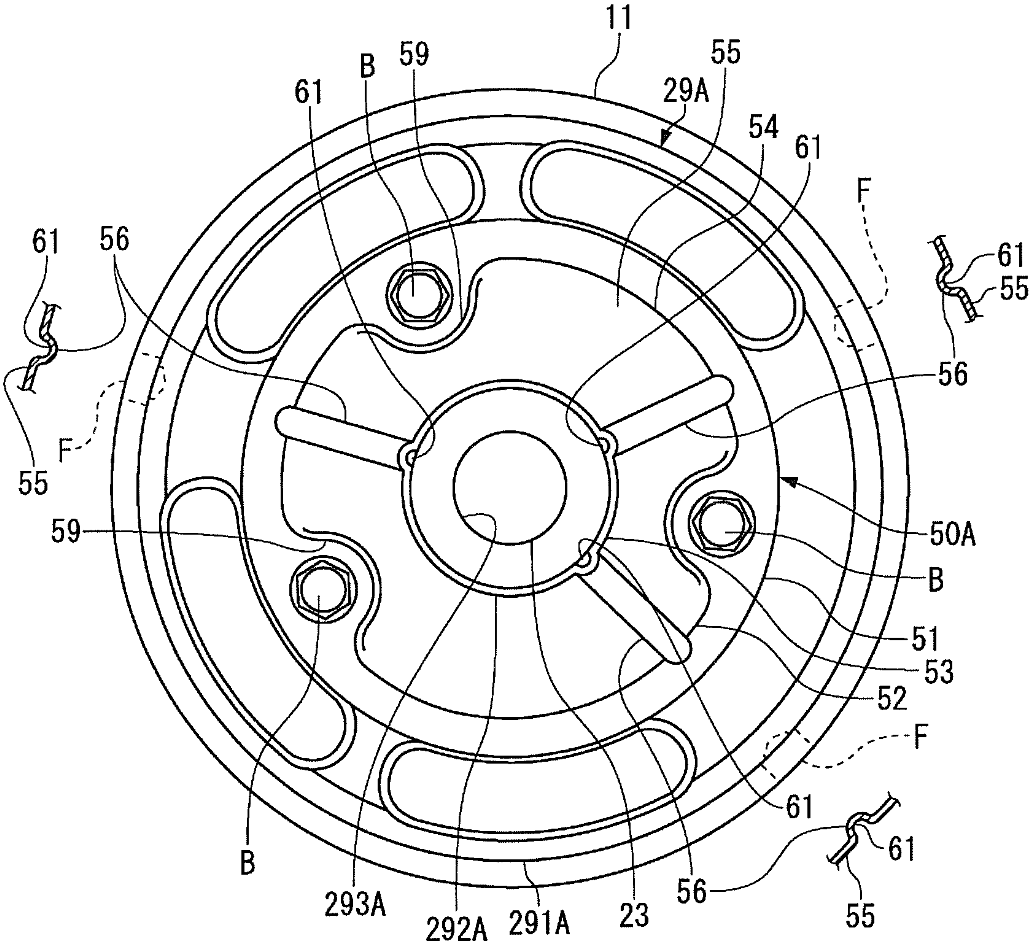

293A
23
292A
55
40A
56
53
52
51
56
55
59
50A
291A
54
F
21A
29A
20S
12A
30A
20A
24
R (R1)
30B
12B
20B
29B
291B
292B
50B
20S
40B
293B
21B
R (R2)

FIG. 2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29A
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B
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54
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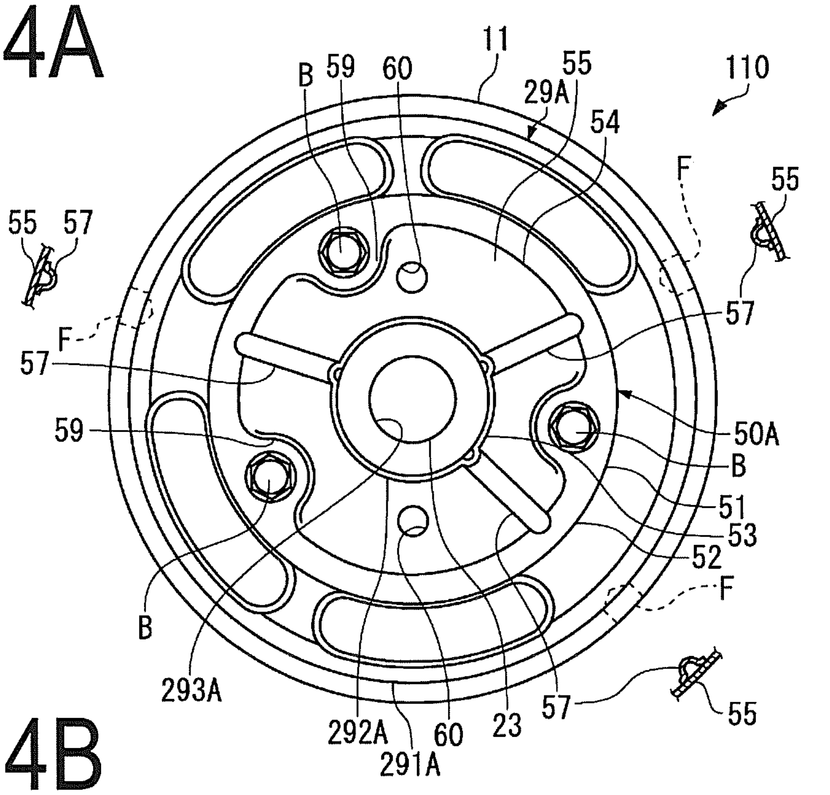
F
61
56
61
55
56
55
F
59
50A
B
51
53
52
F
61
61
56
B
293A
292A
291A
23
56
55

FIG. 3

FIG. 4A


B
59
60
11
55
29A
54
110
F
55
55
57
57
F
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51
53
52
F
B
293A
292A
60
23
57
55
291A

FIG. 4B

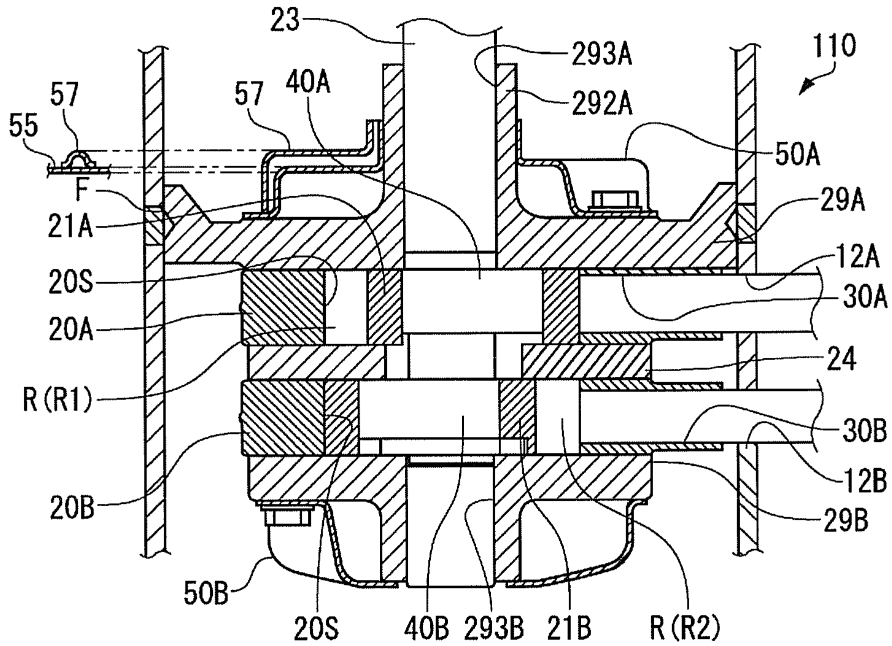

23
293A
110
57
40A
292A
55
57
50A
F
29A
21A
12A
20S
30A
20A
24
R (R1)
30B
20B
12B
29B
50B
20S
40B
293B
21B
R (R2)

FIG. 5A

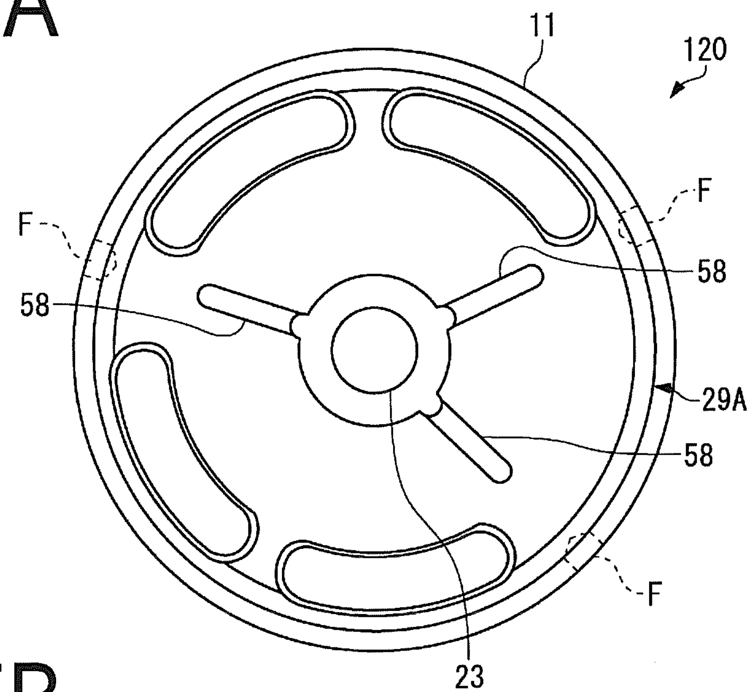
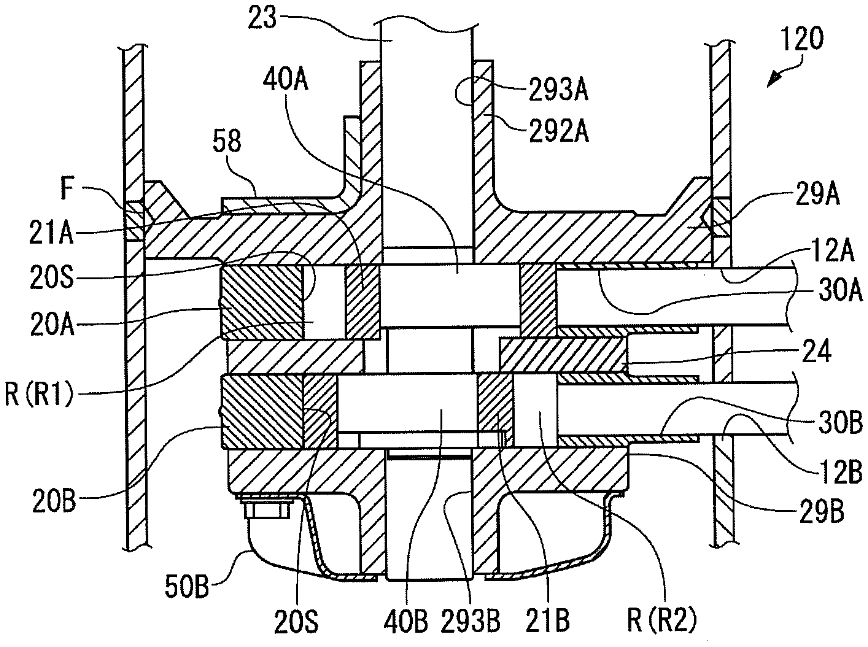

11
120
F
F
58
58
29A
58
F
23

FIG. 5B


23
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F
29A
21A
12A
20S
30A
20A
24
R(R1)
30B
12B
20B
29B
50B
20S
40B
293B
21B
R(R2)

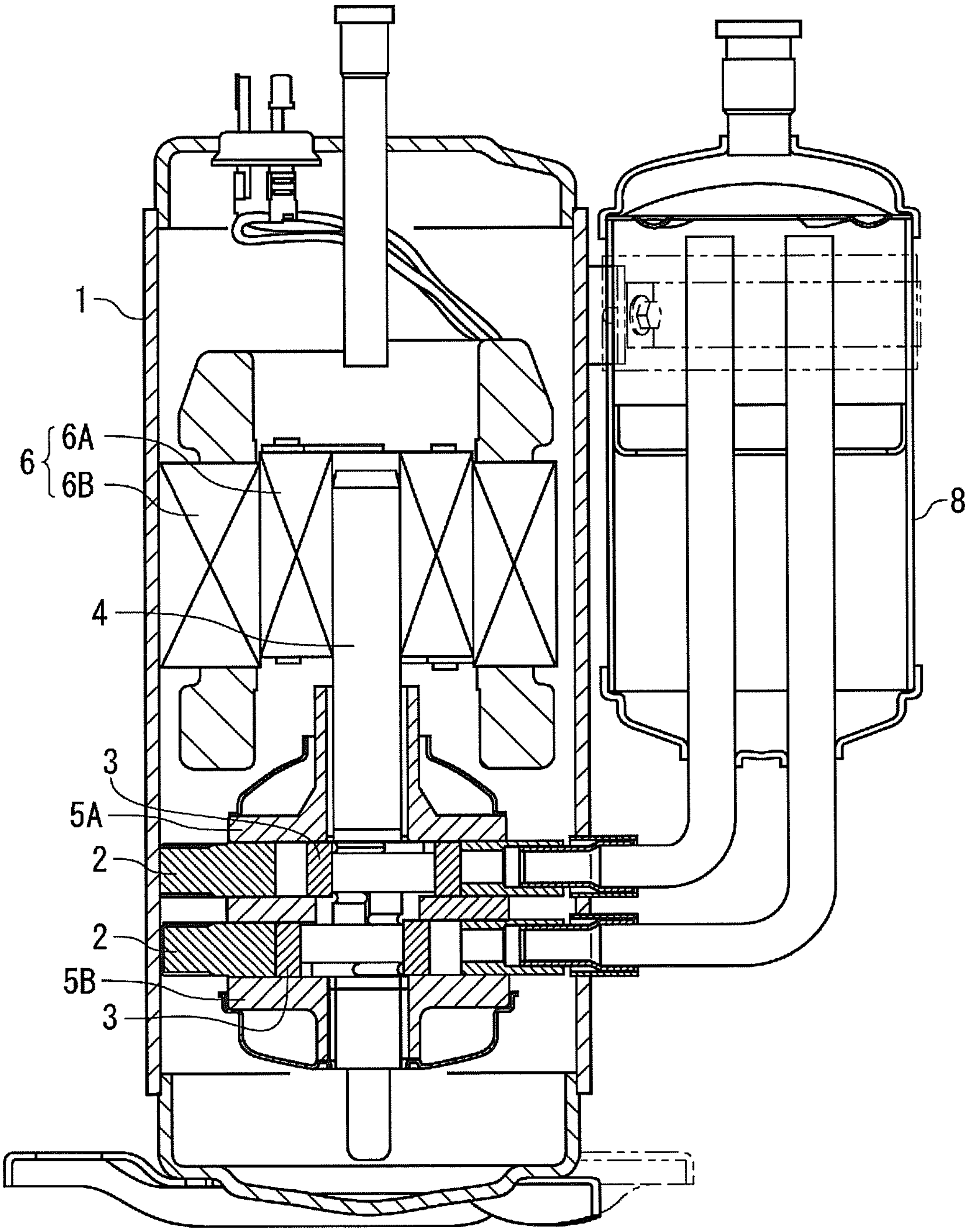

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/005732

A. CLASSIFICATION OF SUBJECT MATTER
F04C29/06(2006.01)i, *F04C18/356*(2006.01)i, *F04C23/00*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04C29/06, F04C18/356, F04C23/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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.
X Y A	JP 7-133781 A (Sanyo Electric Co., Ltd.), 23 May 1995 (23.05.1995), entire text; all drawings (Family: none)	1,7-8 2-3,5 4,6
Y	JP 10-9172 A (Hitachi, Ltd.), 13 January 1998 (13.01.1998), entire text; all drawings (Family: none)	2-3,5
Y	JP 6-58283 A (Sanyo Electric Co., Ltd.), 01 March 1994 (01.03.1994), entire text; all drawings (Family: none)	5

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

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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
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"&" document member of the same patent family

Date of the actual completion of the international search 30 October, 2013 (30.10.13)	Date of mailing of the international search report 12 November, 2013 (12.11.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/005732

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-116787 A (Panasonic Corp.), 27 May 2010 (27.05.2010), entire text; all drawings (Family: none)	1-8
A	JP 2010-116786 A (Panasonic Corp.), 27 May 2010 (27.05.2010), entire text; all drawings (Family: none)	1-8
A	JP 2012-77636 A (Daikin Industries, Ltd.), 19 April 2012 (19.04.2012), paragraph [0030]; fig. 1 (Family: none)	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H0626478 A **[0006]**
- JP H07133781 A **[0006]**
- JP S59182691 B **[0006]**