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(54) ROTARY COMPRESSOR

(57) Provided is a rotary compressor capable of reducing pulsation based on an acoustic eigenvalue of a two-layer structured muffler. This rotary compressor (10) includes an upper muffler (50) including a first muffler (50A) provided on an inner side, and a second muffler (50B) provided on the outer side of the first muffler (50A) and covering the first muffler (50A). The acoustic eigenvalue of the pre-specified frequency (F) is excited in the first muffler (50A), and the second muffler (50B) absorbs a sound wave of the frequency (F) transmitted through the first muffler (50A). The intervals (L2) between second discharge openings (56B1, 56B2, 56B3) of the second muffler (50B) are 1/2 the interval (L1) between first discharge openings (56A1, 56A2) of the first muffler (50A), which is the most effective configuration for achieving the effects of the present invention.

FIG. 3A

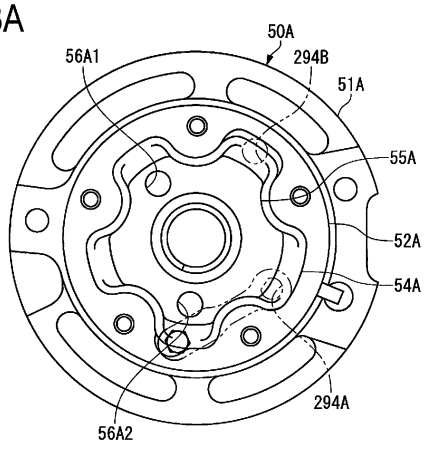
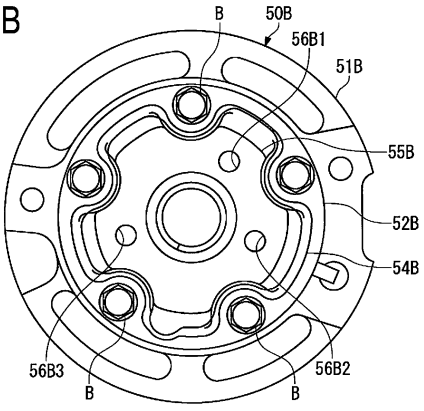


FIG. 3B



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Description

Technical Field

[0001] The present invention is related to a rotary compressor used in refrigerating equipment.

Background Art

[0002] As illustrated in FIG. 7, in a rotary compressor used in refrigerating equipment, a cylinder 2 having a cylindrical inner wall surface and a piston rotor 3 provided eccentrically with respect to a center of the cylinder 2 are provided in the interior of a sealed container 1. The piston rotor 3 is provided on a main shaft 4, which is provided along a central axis of the cylinder 2. The main shaft 4 is provided so as to rotate freely about the central axis via an upper bearing 5A and a lower bearing 5B that are fixed to the cylinder 2. A rotor 6A of a motor 6 is fixed to the main shaft 4. A stator 6B, which is fixed to an internal peripheral surface of the sealed container 1, is disposed on 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 rotates inside the cylinder 2. Note that the rotary compressor in FIG. 7 is a two-cylinder type compressor that includes two pairs of the cylinder 2 and the piston rotor 3 provided in an upper and lower arrangement.

[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 compressed refrigerant is discharged into an upper muffler 7A and a lower muffler 7B from a discharge opening, which is not illustrated, and then reaches the sealed container 1. The rotary compressor sucks up and compresses the refrigerant after performing gas-liquid separation on the refrigerant using an accumulator 8.

[0004] It has been known that the upper muffler having an internal external two-layer structure can improve a silencing effect by silencing a sound in two steps. Particularly, Patent Document 1 discloses an upper cover (corresponding to a muffler) having a two-layer structure of a first internal cover and a second external cover and a lower cover which is a third cover having a single-layer structure. A refrigerant discharged from the third cover flows into an interior of the second upper cover (exterior of the first cover). In this way, the first cover and the third cover share the use of the second cover. Thus, two steps of silencing a sound by a flow path extending from the third cover to the second cover can be achieved in addition to two steps of silencing a sound by a flow path extending from the first cover to the second cover.

Citation List

Patent Literature

[0005] Patent Document 1: JP 2001-280241 A

Summary of Invention

Technical Problems

[0006] Pulsation generated by a compression motion of a rotary compression mechanism formed of a cylinder and a piston rotor excites an acoustic eigenvalue and a structure eigenvalue while a refrigerant passes through an output flow passage. This induces vibration of the rotary compressor, thereby resulting in noise.

[0007] The pulsation due to the compression motion can be reduced by providing a two-layer structured muffler as disclosed in Patent Document 1. However, pulsation based on the acoustic eigenvalue of the muffler itself cannot be reduced, and the pulsation thus leaks from the muffler.

[0008] It is thus an object of the present invention to provide a rotary compressor capable of reducing pulsation based on an acoustic eigenvalue of a muffler itself by using a two-layer structured muffler.

Solution to Problem

[0009] A rotary compressor according to an aspect of the present invention includes: a sealed container, a rotary compression mechanism configured to compress and discharge a refrigerant that is supplied; an upper bearing and a lower bearing provided sandwiching the rotary compression mechanism; a main shaft rotatably supported by both the upper bearing and the lower bearing and extending through the rotary compression mechanism; an electric motor configured to rotationally drives the main shaft about a central axis of the main shaft; and a muffler into which the refrigerant discharged from the rotary compressor mechanism flows via a discharge port provided in the upper bearing, the rotary compression mechanism, the upper bearing and the lower bearing, the main shaft, the electrical motor, and the muffler being housed in the sealed container.

[0010] The muffler of the rotary compressor according to an aspect of the present invention includes a first muffler provided on an inner side, and a second muffler provided on an outer side of the first muffler and covering the first muffler. An acoustic eigenvalue of a frequency F that is pre-specified is excited in the first muffler. The second muffler absorbs a sound wave of the frequency F transmitted through the first muffler.

[0011] In the rotary compressor according to an aspect of the present invention, the first muffler includes a plurality of first discharge openings configured to discharge the refrigerant, which has flowed into the first muffler, to an interior of the second muffler. The second muffler in-

cludes a plurality of second discharge openings configured to discharge the refrigerant, which has passed through the plurality of first discharge openings and has flowed into the second muffler, to an interior of the sealed container. An interval between the plurality of second discharge openings can be determined on the basis of 1/2 an interval between the plurality of first discharge openings.

[0012] In the rotary compressor according to an aspect of the present invention, the interval between the plurality of first discharge openings can be an interval on a side that does not include the discharge port.

[0013] The interval between the plurality of first discharge openings can be specified such that a frequency of an acoustic eigenvalue is excited.

[0014] In the rotary compressor according to an aspect of the present invention, the first muffler can be in such a manner that the first muffler has two first discharge openings of the plurality of first discharge openings, and the second muffler has three or more second discharge openings of the plurality of second discharge openings.

[0015] In the rotary compressor according to an aspect of the present invention, the plurality of first discharge openings can be disposed on the same circumference.

[0016] The plurality of second discharge openings can be disposed on the same circumference.

[0017] Furthermore, the plurality of first discharge openings and the plurality of second discharge openings can be disposed on the same circumference. In this case, at least one of the plurality of second discharge openings can be adjacent to the plurality of first discharge openings on both sides of the at least one of the plurality of second discharge openings in a circumferential direction.

[0018] In the rotary compressor according to an aspect of the present invention, the plurality of first discharge openings and the plurality of second discharge openings can be disposed on an inner side of the discharge port in a radial direction.

[0019] In the rotary compressor according to an aspect of the present invention, the first muffler has a single first discharge opening configured to discharge the refrigerant, which has flowed into the first muffler, to the interior of the second muffler. The second muffler has a plurality of second discharge openings configured to discharge the refrigerant, which has passed through the single first discharge opening and has flowed into the second muffler, to the interior of the sealed container. An interval between the plurality of second discharge openings can be determined on the basis of 1/2 an interval between the single first discharge opening and the discharge port.

[0020] In the rotary compressor according to an aspect of the present invention, the plurality of second discharge openings can be disposed on the same circumference. Furthermore, the single first discharge opening and the plurality of second discharge openings can be disposed on the same circumference.

[0021] In the rotary compressor according to an aspect of the present invention, a position/positions of the single first discharge opening or the plurality of first discharge openings and positions of the plurality of second discharge openings are preferably displaced from one another without overlapping in a plan view of the first muffler and the second muffler.

Advantageous Effects of Invention

[0022] The rotary compressor according to an aspect of the present invention includes a two-layer structured muffler. The two-layer structured muffler includes a first muffler provided on an inner side and a second muffler provided on an outer side of the first muffler and covering the first muffler. An acoustic eigenvalue of a pre-specified frequency F is excited in the first muffler. The second muffler absorbs a sound wave of the frequency F transmitted through the first muffler. Thus, pulsation based on an acoustic eigenvalue of the muffler itself can be reduced.

Brief Description of Drawings

[0023]

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

FIG. 2 is a partial enlarged view of FIG. 1.

FIGS. 3A and 3B illustrate a muffler of the rotary compressor in FIG. 1. FIG. 3A is a plan view of a first muffler. FIG. 3B is a plan view of a second muffler.

FIG. 4A is a plan view schematically illustrating a muffler in which arrangement of first discharge openings of the first muffler and second discharge openings of the second muffler is illustrated. FIG. 4B is a diagram illustrating the principle of silencing a sound according to the present embodiment.

FIGS. 5A and 5B are schematic views illustrating another example of arrangement of the first discharge opening of the first muffler and the second discharge openings of the second muffler.

FIGS. 6A and 6B are schematic views illustrating another example of arrangement of the first discharge openings of the first muffler and the second discharge openings of the second muffler.

FIG. 7 is a vertical cross-sectional view illustrating a schematic configuration of a conventional rotary compressor.

Description of Embodiment

[0024] An embodiment of the present invention will be described hereinafter with reference to the appended drawings.

[0025] A compressor 10 according to the present embodiment includes a rotary compressing mechanism. An upper muffler 50, which will be described below, has a two-layer structure, and arrangement of a discharge

opening for a refrigerant in each of the layers is specified. Accordingly, pulsation based on an acoustic eigenvalue of the upper muffler 50 itself can be suppressed.

[0026] A configuration of the compressor 10 will be described below, and then, functions and effects of the compressor 10 will be described.

Configuration of compressor 10

[0027] As illustrated in FIG. 1, the compressor 10 is a so-called two-cylinder type rotary compressor in which disc-shaped cylinders 20A and 20B provided in a two-level upper and lower arrangement are housed inside a cylindrical sealed 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 arranged inside the cylinders 20A and 20B, respectively, and each of the piston rotors 21A and 21B has an outer diameter smaller than an inner diameter of the cylinder internal wall surface 20S. The piston rotors 21A and 21B are respectively inserted into and fixed to eccentric shaft portions 40A and 40B of a main shaft 23 arranged along a central axis of the sealed container 11. In this way, spaces having a crescent-shaped opening cross-section are each formed between the cylinder internal wall surfaces 20S of the cylinders 20A and 20B and outer peripheral surfaces of the piston rotors 21A and 21B in a plan view.

[0028] Here, the upper side piston rotor 21A and the lower side piston rotor 21B are provided such that a phase between them differs by 180 degrees.

[0029] Furthermore, a disc-shaped partition plate 24 is provided between the upper cylinder 20A and the lower cylinder 20B. Due to the partition plate 24, a space inside the upper side cylinder 20A and a space inside the lower side cylinder 20B do not communicate with each other, and are partitioned into a compression chamber R1 and a compression chamber R2.

[0030] 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.

[0031] Furthermore, a discharge opening (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 opening. Upon the pressure of the compressed refrigerant reaching a predetermined value, the reed valve is pushed open and the refrigerant is discharged to the outside of the cylinders 20A and 20B.

[0032] The main shaft 23 is supported by an upper bearing 29A fixed to the cylinder 20A and a lower bearing 29B fixed to the cylinder 20B, so that the main shaft 23 can freely rotate about its central axis. The upper bearing 29A and the lower bearing 29B are provided sandwiching the rotary compression mechanism.

[0033] The main shaft 23 is provided with the eccentric shaft portions 40A and 40B that are offset in a direction orthogonal to the central axis of the main shaft 23, that is to say, that are disposed to be displaced from the main shaft 23. Each of the eccentric shaft portions 40A and 40B has an outer diameter slightly smaller than the inner diameter of each of the piston rotors 21A and 21B. In this way, upon the main shaft 23 rotating, the eccentric shaft portions 40A and 40B rotate around the central axis of the main shaft 23, and the upper and lower piston rotors 21A and 21B rotate inside the cylinders 20A and 20B. At that time, the distal edge of each of the above-described blades is constantly pushed by the piston rotors 21A and 21B while advancing and retracting in accordance with the movement of the piston rotors 21A and 21B.

[0034] 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 the main shaft 23 is integrally provided with the protruding section of the main shaft 23. A stator 38 is fixed to an internal peripheral surface of the sealed container 11 such that the stator 38 faces an outer peripheral portion of the rotor 37.

[0035] As illustrated in FIG. 1 and FIG. 2, 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 such 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 surface of the base portion 291A of the upper bearing 29A is fixed to the internal peripheral surface of the sealed container 11 at fixing points in a plurality of locations. The base portion 291A is fixed, for example, by welding, tightening using a bolt, and the like.

[0036] 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 such that their axial centers are aligned, and a bearing surface 293B that supports the main shaft 23 is formed around the axial center.

[0037] 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. The upper bearing 29A supports the main shaft 23 between the cylinder 20A and the electric motor 36. The lower bearing 29B supports the main shaft 23 at a portion protruding downward from the cylinder 20B.

[0038] The upper bearing 29A is provided with a discharge port 294A (see FIG. 3A) that communicates with the discharge opening (not illustrated in the drawings) formed in the cylinder 20A, and the refrigerant that has passed through the cylinder 20A passes through the discharge port 294A and is discharged to the interior of the upper muffler 50 that will be described below. Similarly, the lower bearing 29B is provided with a discharge port

(not illustrated in the drawings) that communicates with the discharge opening (not illustrated in the drawings) formed in the cylinder 20B, and the refrigerant that has passed through the cylinder 20B passes through the discharge port and is discharged to the interior of a lower muffler 60 that will be described below.

[0039] In the compressor 10, the upper muffler 50 is mounted on the upper bearing 29A, and the lower muffler 60 is mounted on the lower bearing 29B. Upon the refrigerant that has passed through the upper bearing 29A and the lower bearing 29B each flowing into the interior of the upper muffler 50 and the lower muffler 60, a pulsating component is removed. The refrigerant from which the pulsating component has been removed passes through a first discharge opening 56A formed in the upper muffler 50 and a second discharge opening 56B formed in the lower muffler 60, and flows in an upward direction of the sealed container 11. The upper muffler 50 will be described below in detail.

[0040] Openings 12A and 12B are formed in the sides of the sealed container 11, in positions facing outer peripheral surfaces of the cylinders 20A and 20B. Intake ports 30A and 30B that communicate as far as predetermined positions of the cylinder internal wall surfaces 20S are formed in the cylinders 20A and 20B, in positions facing the openings 12A and 12B.

[0041] 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 fixed to the sealed container 11 via a stay 15.

[0042] 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 leading end portions of the intake pipes 16A and 16B are connected to the intake ports 30A and 30B via the openings 12A and 12B.

[0043] The compressor 10 takes up the refrigerant into the accumulator 14 from an intake port 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 of the cylinders 20A and 20B.

[0044] 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 upper muffler 50 near the cylinder 20A and passes through the lower bearing 29B and the lower muffler 60 near the cylinder 20B, and is discharged into the interior of the sealed container 11 and the outside of the upper muffler 50 and the lower muffler 60. After passing through the electric motor 36, the refrigerant is exhausted to a pipe that forms a refrigerant cycle, via a discharge port 42 provided in an upper portion.

[0045] Next, the upper muffler 50 of the present embodiment will be described.

[0046] As illustrated in FIG. 2 and FIGS. 3A and 3B, the upper muffler 50 has a two-layer structure formed of a first muffler 50A provided to an inner side and a second muffler 50B provided to an outer side of the first muffler 50A and covering the first muffler 50A. Both of the first muffler 50A and the second muffler 50B are fixed to the upper bearing 29A by a plurality of bolts B.

[0047] As illustrated in FIG. 2 and FIGS. 3A and 3B, the first muffler 50A is provided with a flange 51A and a cup 52A that stands up from the flange 51A. In the first muffler 50A, the flange 51 and the cup 52 are integrally formed by sheet metal working of a flat metal plate such as an aluminum alloy plate, for example.

[0048] The flange 51A is a portion that is used to fix the upper muffler 50 to the upper bearing 29A, and is a flat member having a circular external shape in a plan view. While the flange 51 abuts a top surface of the upper bearing 29A without any gap therebetween, the flange 51A is fixed to the upper bearing 29A in a plurality of locations, which are five locations in the present embodiment, by the plurality of bolts B that penetrate through the flange 51A. Note that portions to which the bolts B of the flange 51A are attached are provided in indentations that are formed by a side wall 54A of the cup 52A being indented toward a center of the cup 52A in the radial direction.

[0049] The cup 52A is provided with the hollow cylindrical side wall 54A and a top plate 55A that covers an opening at an upper end of the side wall 54A. The top plate 55A has a ring shape with an outer periphery and an inner periphery, and the outer periphery side is connected to the side wall 54A while the inner periphery side abuts the sleeve 292A of the upper bearing 29A.

[0050] The second muffler 50B has the same basic configuration as that of the first muffler 50A, so that the same components as those of the first muffler 50A are denoted by the references in which A is changed to B in FIGS. 1 to 3B, and their description will be omitted.

[0051] In the upper muffler 50, the compressed refrigerant discharged from discharge ports 294A and 294B (FIG. 3A) provided in the upper bearing 29A passes through a refrigerant path that passes through in the order of the first muffler 50A and the second muffler 50B, and is discharged into the interior of the sealed container 11 and the outside of the upper muffler 50 and the lower muffler 60. The discharge port 294B is used for discharging the compressed refrigerant, which has been discharged to the lower muffler 60 once and has passed through the lower bearing 29B and then through the upper bearing 29A, into the first muffler 50A.

[0052] To form this refrigerant path, as illustrated in FIGS. 3A and 3B, the first muffler 50A has two first discharge openings 56A1 and 56A2 formed so as to penetrate the back and front of the top plate 55A, and the second muffler 50B has three second discharge openings 56B1, 56B2, and 56B3 formed so as to penetrate the back and front of the top plate 55B. In other words,

the compressed refrigerant passes through in the order of the discharge ports 294A and 294B of the upper bearing 29A, the internal space of the first muffler 50A, the first discharge openings 56A1 and 56A2 of the first muffler 50A, the space between the second muffler 50B and the first muffler 50A, and the second discharge openings 56B1, 56B2, and 56B3 of the second muffler 50B. Note that the first discharge openings 56A1 and 56A2 and the second discharge openings 56B1, 56B2, and 56B3 are formed so as to be displaced from one another without overlapping in the plan view of the first muffler 50A and the second muffler 50B. For example, the compressed refrigerant is prevented from passing through the second discharge opening 56B1 directly from the first discharge opening 56A1.

[0053] Positions of the first discharge openings 56A1 and 56A2 of the first muffler 50A and the second discharge openings 56B1, 56B2, and 56B3 of the second muffler 50B are specified as follows.

[0054] In the first muffler 50A, the positions of the first discharge openings 56A1 and 56A2 are specified such that an acoustic eigenvalue of a frequency F at which a sound wants to be silenced in the first muffler 50A is the most excited. Specifically, as illustrated in FIG. 4A, an acoustic eigenvalue is specified by an interval L1 between the first discharge opening 56A1 and the first discharge opening 56A2 along a circumferential direction. By adopting the positions of the first discharge openings 56A1 and 56A2, the first muffler 50A is actively expanded and contracted at the frequency F at which a sound wants to be silenced, and pulsating energy is converted into heat energy. Accordingly, pulsation can be suppressed. Note that there can be two possible intervals between the first discharge opening 56A1 and the first discharge opening 56A2 along the circumferential direction, and it is assumed that the interval L1 herein is an interval on a side that does not include the discharge ports 294A and 294B. In the present embodiment, it is assumed that the interval L1 is the interval on the side that does not include the discharge ports 294A and 294B, but an interval on a side that includes the discharge ports 294A and 294B can be the interval L1 depending on an interval between the discharge port 294A and the discharge port 294B.

[0055] The second muffler 50B absorbs a sound wave of the frequency F that is transmitted through the first muffler 50A, and suppresses transmission of the pulsation to the outside of the second muffler 50B. To achieve this, the positions of the second discharge openings 56B1, 56B2, and 56B3 of the second muffler 50B are set such that an interval L2 between adjacent discharge openings including the first discharge openings 56A1 and 56A2 is 1/2 the interval L1 between the first discharge openings 56A1 and 56A2. In FIG. 4A, for example, the interval L2 between the second discharge opening 56B1 and the second discharge opening 56B3 is 1/2 L1, the interval L2 between the discharge opening 56B3 and the discharge opening 56A2 is 1/2 L1, and the interval L2 between the second discharge opening 56B2 and the first discharge opening 56A1 is 1/2 L1. Accordingly, the second muffler 50B resonates at a wavelength which is 1/2 a wavelength of a sound wave, the sound wave having a wavelength at which the first muffler 50A resonates, so that the second muffler 50B can absorb the sound wave transmitted through the first muffler 50A.

[0056] FIG. 4B schematically illustrates what has been described so far. It is the most preferable manner that the interval L2 herein is 1/2 L1, but the effects of the present invention can be still obtained even if the interval L2 is slightly deviated from 1/2 L2. In other words, the interval L2 can be determined on the basis of 1/2L1 in the present invention.

Functions and effects of compressor 10

[0057] The functions and effects of the compressor 10 according to the present embodiment will be described.

[0058] In the compressor 10, the upper muffler 50 has the two-layer structure of the first muffler 50A and the second muffler 50B, and the frequency F at which a sound wants to be silenced in the first muffler 50A can be specified. Thus, pulsation of a target frequency can be reliably reduced.

[0059] In a rotary compressor, pulsation by a refrigerant immediately after being discharged from a compression chamber has a large frequency component determined by dimensions of the compression chamber. If the pulsation of this frequency can be reduced in the present embodiment, a problem of noise due to the pulsation can be mostly solved. Particularly in the present embodiment, only the interval L1 between the first discharge openings 56A1 and 56A2 and the intervals L2 between the second discharge openings 56B1, 56B2, and 56B3 need to be adjusted, so that the pulsation can be reduced at low cost.

[0060] Besides the above-described embodiment, as long as there is no departure from the spirit and scope of the present invention, configurations explained in the above-described embodiment can be selected as desired, or can be changed to other configurations as necessary.

[0061] The embodiment described above illustrates the example of providing the two first discharge openings 56A1 and 56A2 of the first muffler 50A, but the present invention is also applicable to a case where a single first discharge opening 56A1 is provided in the first muffler 50A as illustrated in FIG. 5A. In this case, intervals between the second discharge openings 56B1, 56B2, and 56B3 are determined as illustrated in FIG. 5B on the basis of an interval L1 or an interval L3 between the discharge port 294A and the first discharge opening 56A1 illustrated in FIG. 5A.

[0062] The discharge port 294A is not taken into consideration for specifying the interval L1 (interval L2) in the embodiment described above because the interval between the discharge port 294A and the first discharge opening 56A1 is extremely small, the corresponding frequency is high, and it is determined that the discharge

port 294A does not need to be targeted for noise reduction.

[0063] As illustrated in FIG. 6A and FIG. 6B, the present invention is also applicable to a case where three or more first discharge openings 56A1, 56A2, and 56A3 are provided in the first muffler 50A. In this case, the second discharge openings 56B1, 56B2, and 56B3 are provided in the second muffler 50B.

[0064] In the embodiment described above, the two-cylinder type rotary compressor is the example of the upper muffler 50, but the present invention is also applicable to a muffler of a one-cylinder type rotary compressor.

Reference Signs List

[0065]

10 Compressor
11 Sealed container
12A, 12B Opening
14 Accumulator
14a Intake port
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
294A, 294B Discharge port
30A, 30B Intake port
36 Electric motor
37 Rotor
38 Stator
40A, 40B Eccentric shaft portion
42 Discharge port
50 Upper muffler
50A First muffler
50B Second muffler
51A, 51B Flange
52A, 52B Cup
54A, 54B Side wall
55A, 55B Top plate
56A1, 56A2, 56A3 First discharge opening
56B1, 56B2, 56B3 Second discharge opening
60 Lower muffler
R1, R2 Compression chamber

Claims

1. A rotary compressor comprising:
a sealed container;
a rotary compression mechanism configured to compress and discharge a refrigerant that is supplied;
an upper bearing and a lower bearing provided sandwiching the rotary compression mechanism;
a main shaft rotatably supported by both the upper bearing and the lower bearing and extending through the rotary compression mechanism;
an electric motor configured to rotationally drive the main shaft about a central axis of the main shaft; and
a muffler into which the refrigerant discharged from the rotary compressor mechanism flows via a discharge port provided in the upper bearing,
the rotary compression mechanism, the upper bearing and the lower bearing, the main shaft, the electric motor, and the muffler being housed in the sealed container, wherein
the muffler includes
a first muffler provided on an inner side, and
a second muffler provided on an outer side of the first muffler and covering the first muffler,
an acoustic eigenvalue of a frequency F that is pre-specified is excited in the first muffler, and
the second muffler absorbs a sound wave of the frequency F transmitted through the first muffler.

2. The rotary compressor according to claim 1, wherein the first muffler includes a plurality of first discharge openings configured to discharge the refrigerant, which has flowed into the first muffler, to an interior of the second muffler,
the second muffler includes a plurality of second discharge openings configured to discharge the refrigerant, which has passed through the plurality of first discharge openings and has flowed into the second muffler, to an interior of the sealed container, and
an interval between the plurality of second discharge openings is determined on the basis of 1/2 an interval between the plurality of first discharge openings.

3. The rotary compressor according to claim 2, wherein the interval between the plurality of first discharge openings is an interval on a side that does not include the discharge port.

4. The rotary compressor according to claim 2 or 3, wherein the interval between the plurality of first discharge openings is specified such that a frequency of an acoustic eigenvalue is excited.

5. The rotary compressor according to any one of claims 2 to 4, wherein
the first muffler includes two first discharge openings of the plurality of first discharge openings, and

the second muffler has three or more second discharge openings of the plurality of second discharge openings.

6. The rotary compressor according to any one of claims 2 to 5, wherein the plurality of first discharge openings are disposed on the same circumference.

7. The rotary compressor according to any one of claims 2 to 6, wherein the plurality of second discharge openings are disposed on the same circumference.

8. The rotary compressor according to any one of claims 2 to 5, wherein the plurality of first discharge openings and the plurality of second discharge openings are disposed on the same circumference.

9. The rotary compressor according to claim 8, wherein at least one of the plurality of second discharge openings is adjacent to the plurality of first discharge openings on both sides of the at least one of the plurality of second discharge openings in a circumferential direction.

10. The rotary compressor according to any one of claims 2 to 9, wherein the plurality of first discharge openings and the plurality of second discharge openings are disposed on an inner side of the discharge port in a radial direction.

11. The rotary compressor according to claim 1, wherein the first muffler includes a single first discharge opening configured to discharge the refrigerant, which has flowed into the first muffler, to the interior of the second muffler,
the second muffler includes a plurality of second discharge openings configured to discharge the refrigerant, which has passed through the single first discharge opening and has flowed into the second muffler, to the interior of the sealed container, and
an interval between the plurality of second discharge openings is determined on the basis of 1/2 an interval between the single first discharge opening and the discharge port.

12. The rotary compressor according to claim 11, wherein the plurality of second discharge openings are disposed on the same circumference.

13. The rotary compressor according to claim 11, wherein the single first discharge opening and the plurality of second discharge openings are disposed on the same circumference.

14. The rotary compressor according to any one of claims 2 to 13, wherein a position/positions of the single first discharge opening or the plurality of first discharge openings and positions of the plurality of second discharge openings are displaced from one another without overlapping in a plan view of the first muffler and the second muffler.

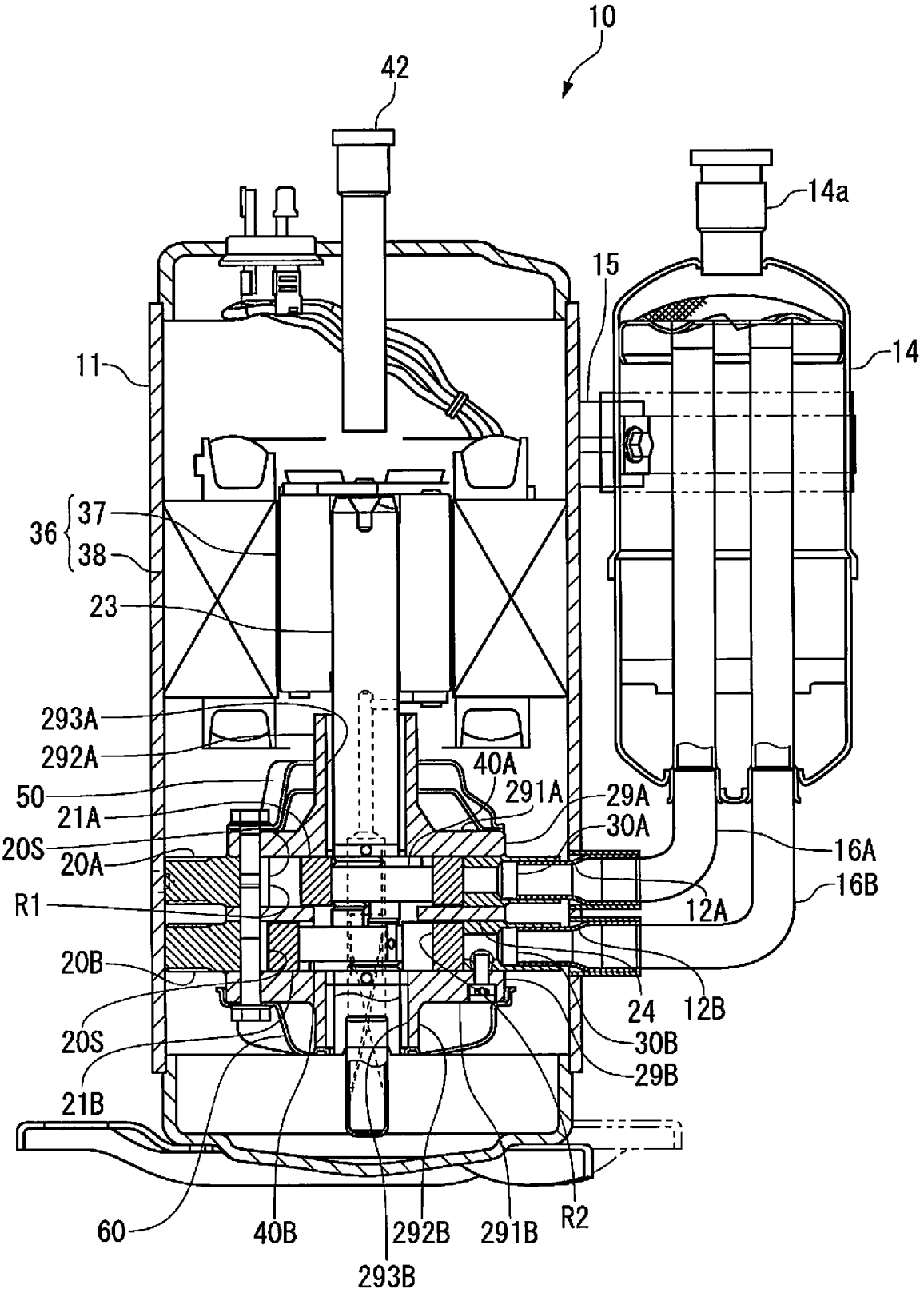

10
42
14a
15
14
11
36
37
38
23
293A
292A
50
21A
20S
20A
R1
20B
20S
21B
60
40B
293B
292B
291B
R2
40A
291A
29A
30A
16A
16B
12A
12B
24
30B
29B

FIG. 1

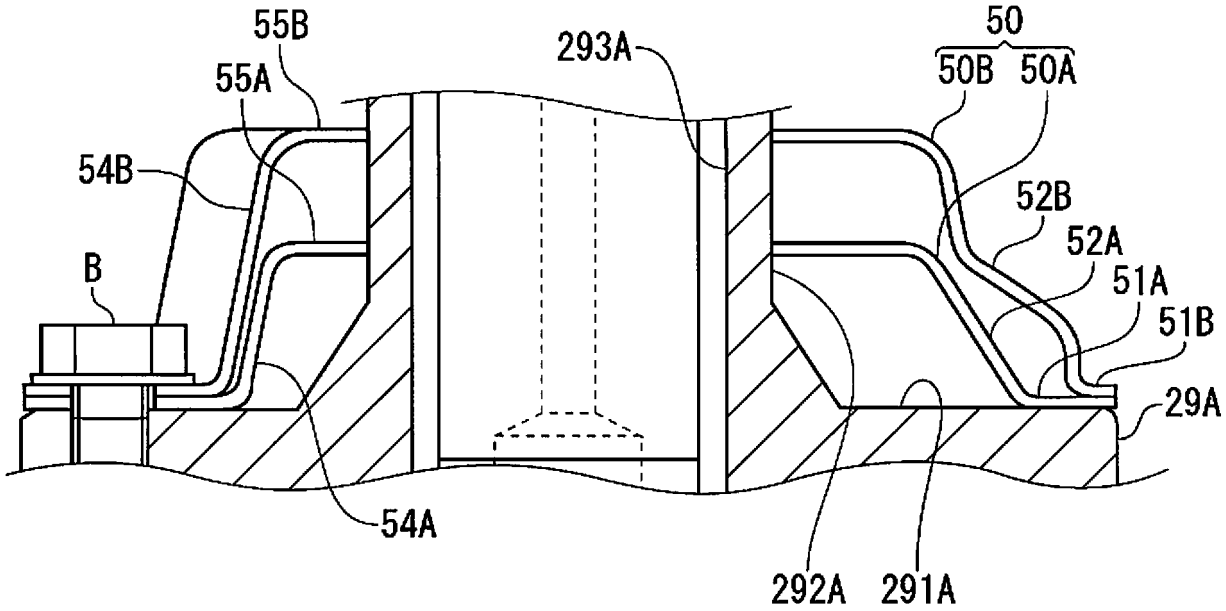


FIG. 2

FIG. 3A

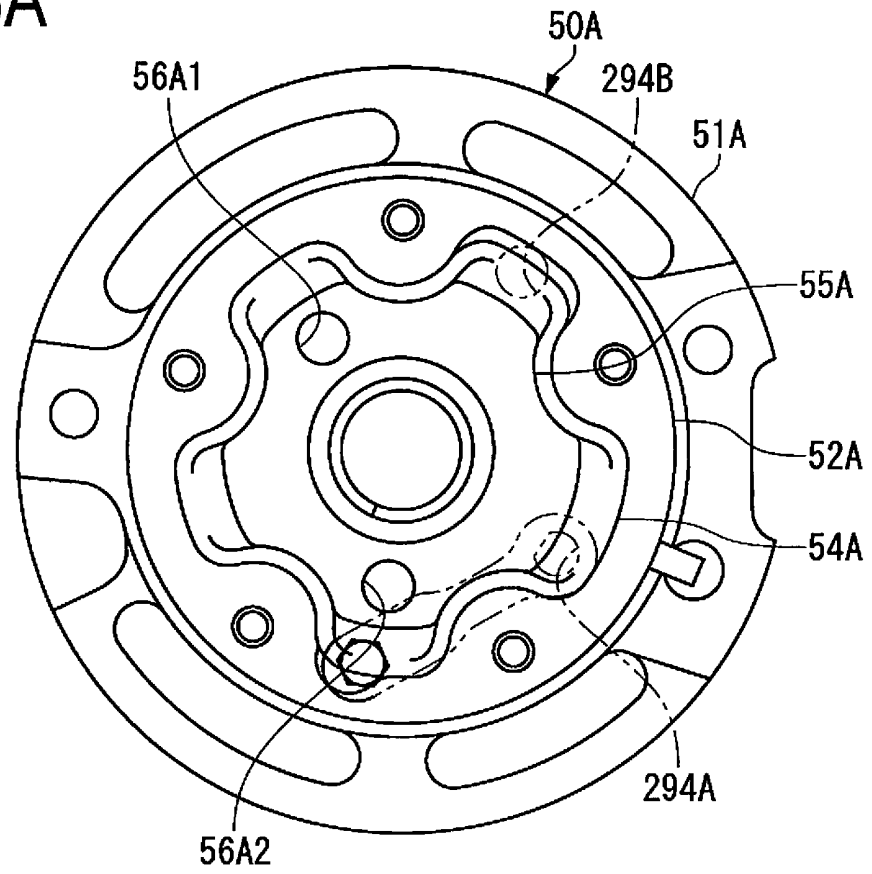

50A
56A1
294B
51A
55A
52A
54A
294A
56A2

FIG. 3B

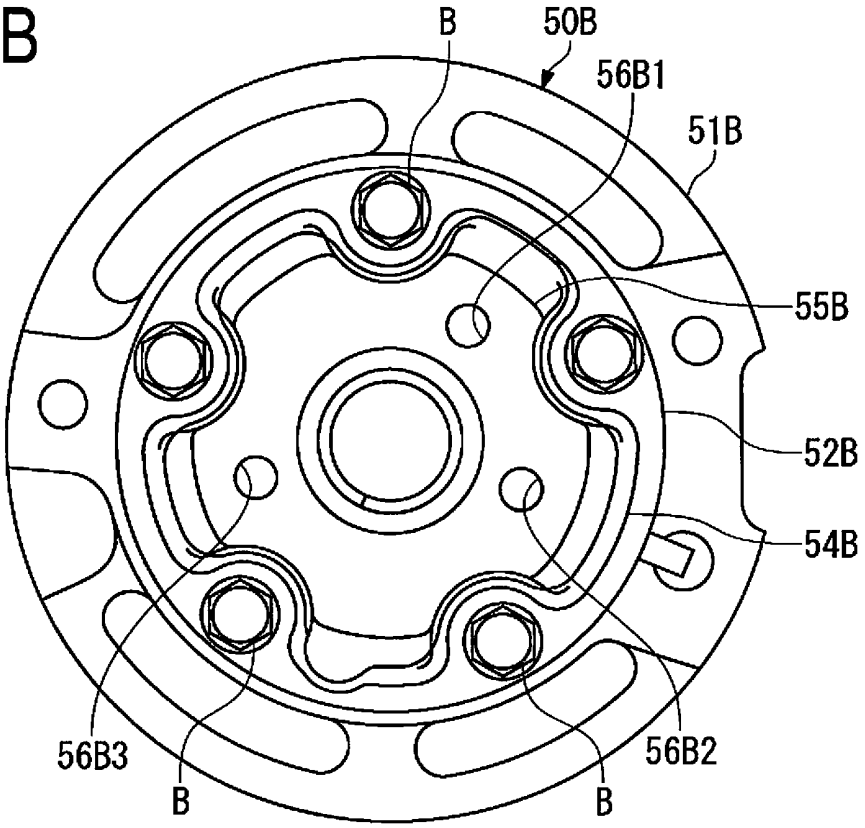

B
50B
56B1
51B
55B
52B
54B
56B3
B
B
56B2

FIG. 4A

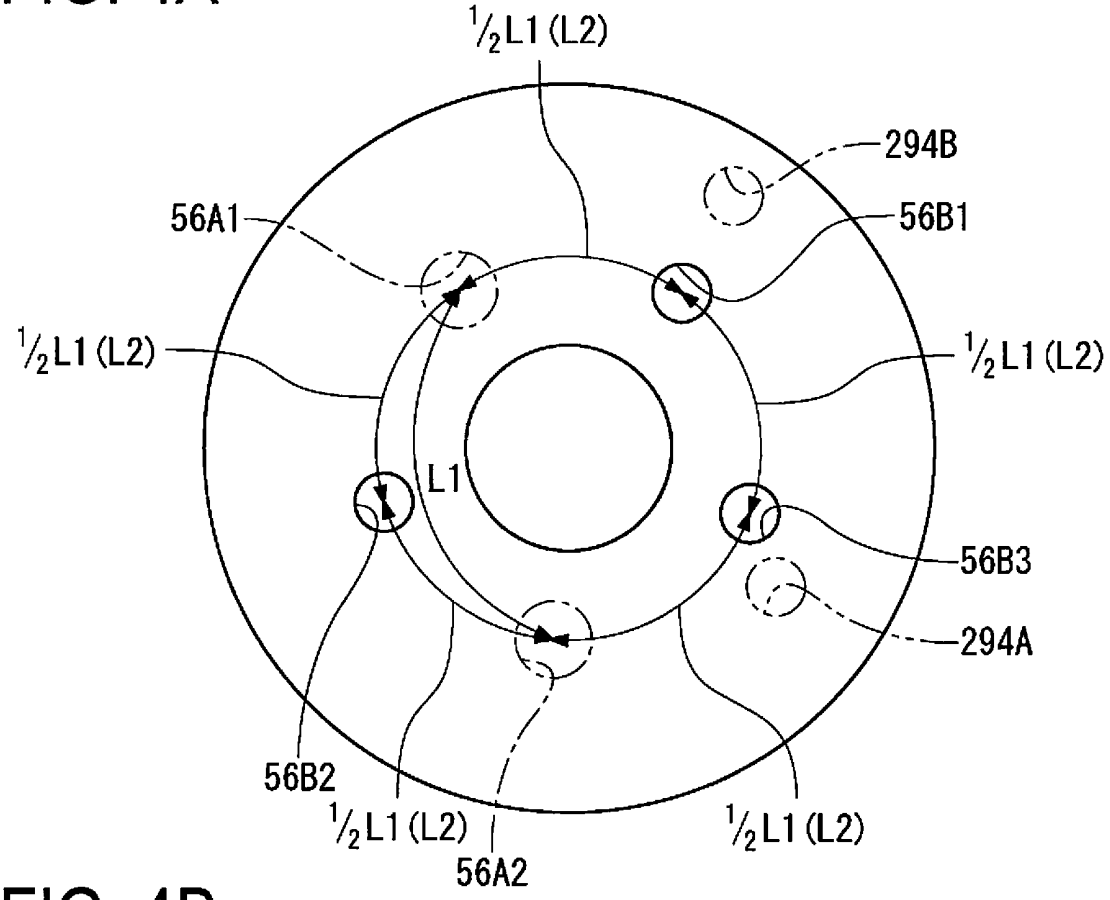

1/2L1 (L2)
294B
56A1
56B1
1/2L1 (L2)
1/2L1 (L2)
L1
56B3
294A
56B2
1/2L1 (L2)
1/2L1 (L2)
56A2

FIG. 4B

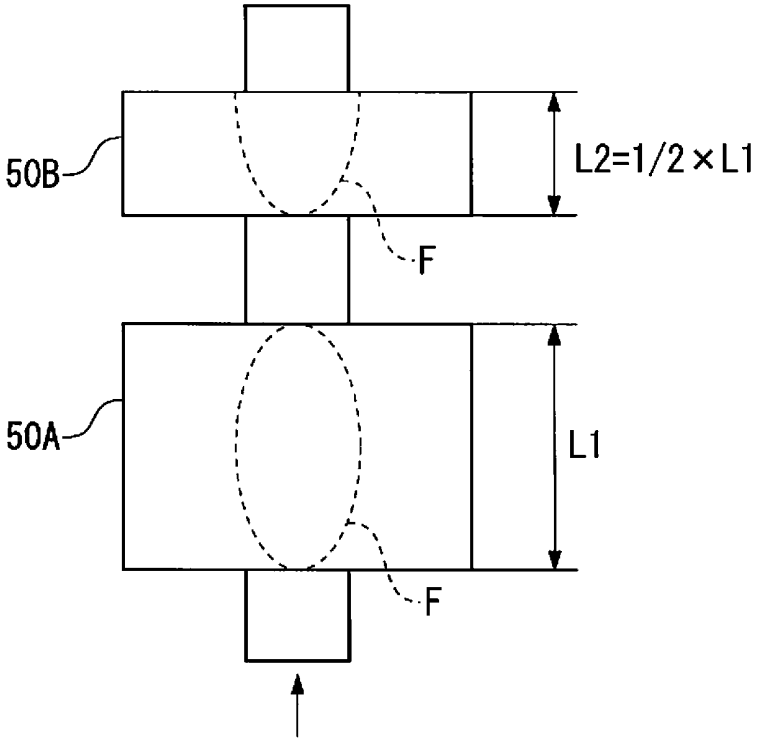

50B
L2=1/2×L1
F
50A
L1
F

FIG. 5A

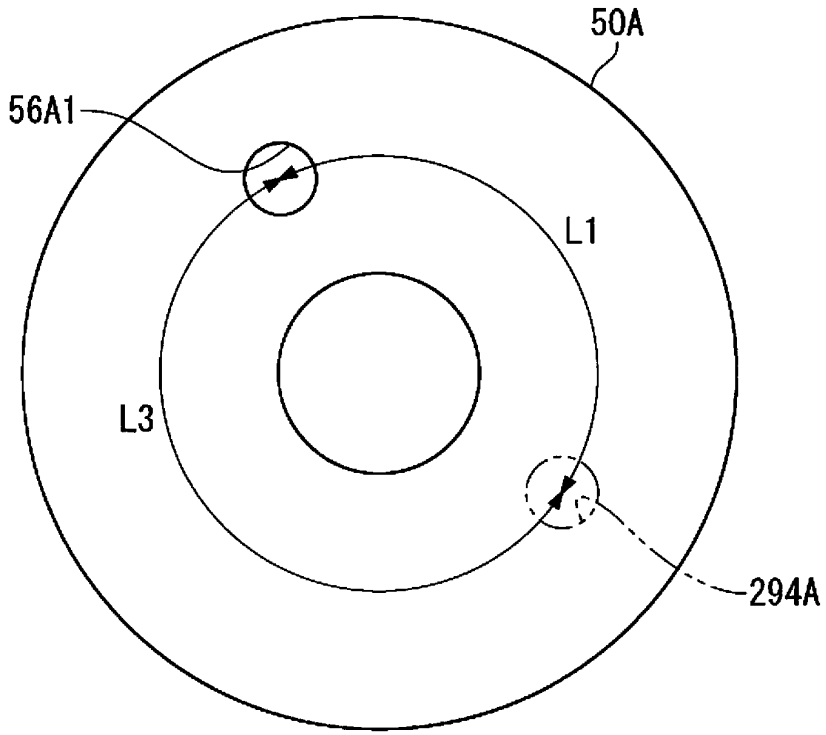


FIG. 5B

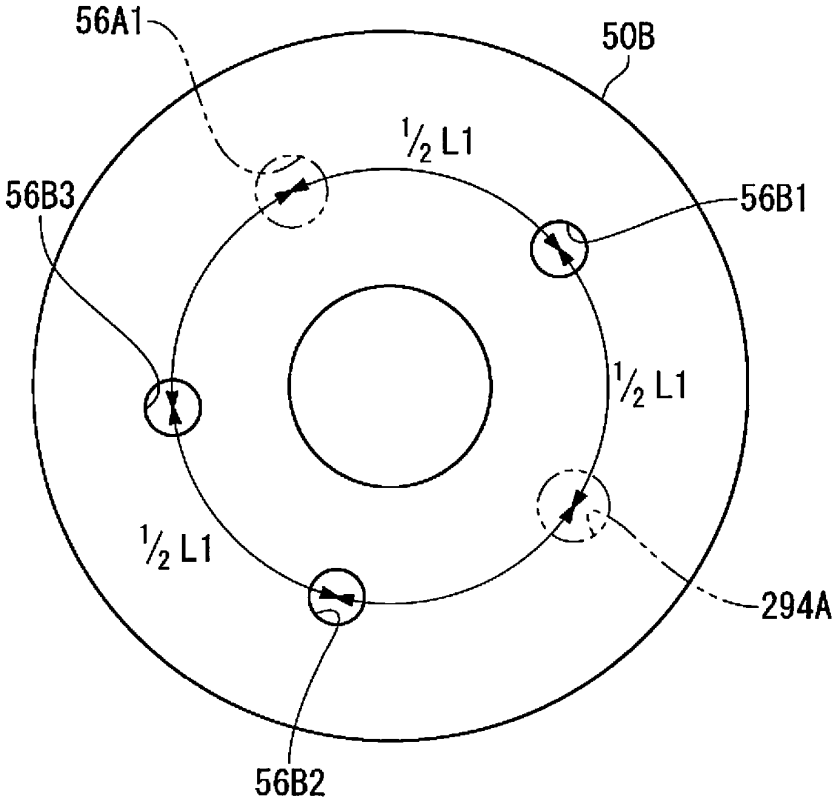


FIG. 6A

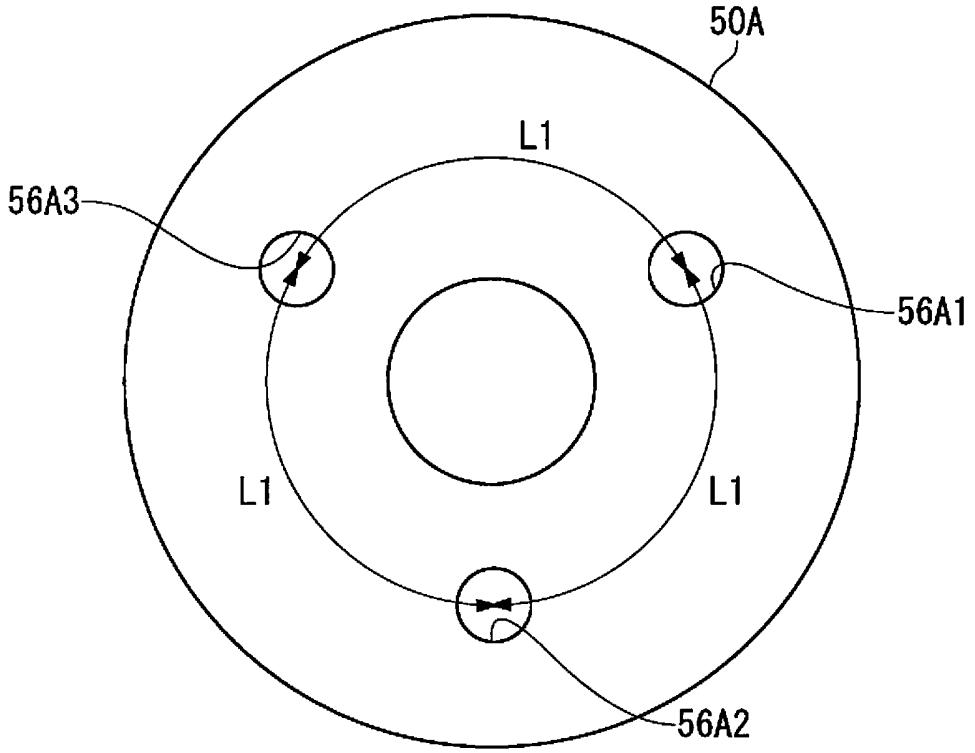
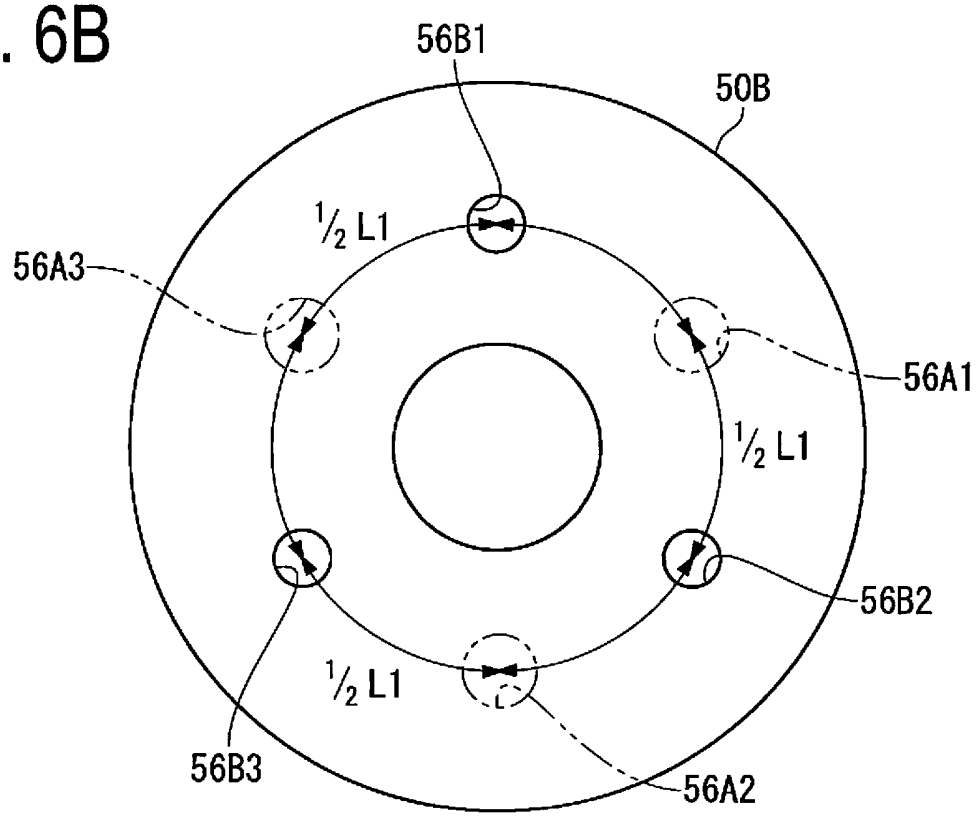

50A
L1
56A3
56A1
L1
L1
56A2

FIG. 6B


56B1
50B
½ L1
56A3
56A1
½ L1
56B2
½ L1
56B3
56A2

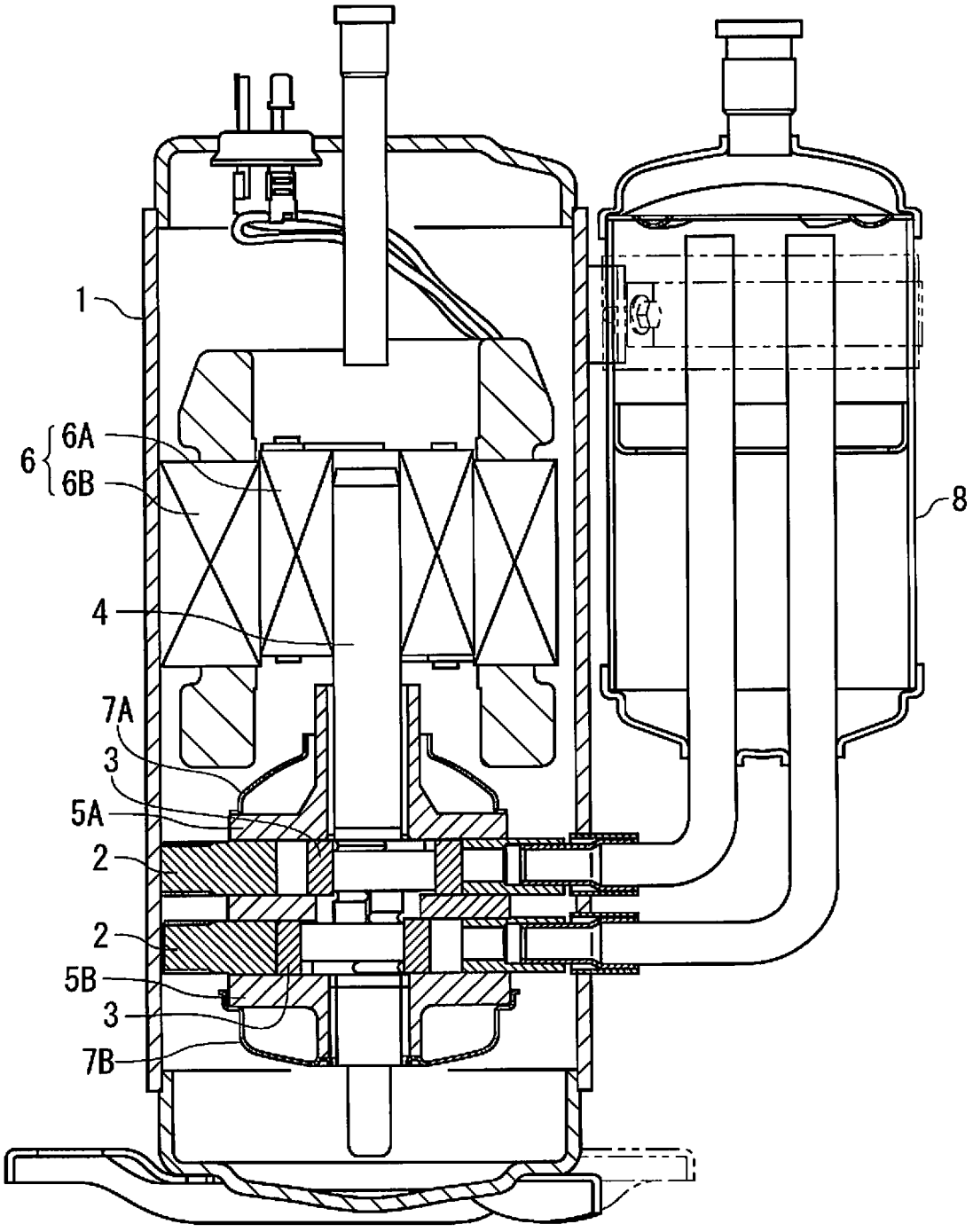


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/004503

A. CLASSIFICATION OF SUBJECT MATTER
F04C29/06(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

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 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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.
A	JP 5-133377 A (Sanyo Electric Co., Ltd.), 28 May 1993 (28.05.1993), paragraphs [0008] to [0013]; fig. 1 to 4 (Family: none)	1-14
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 096419/1979(Laid-open No. 13565/1981) (Matsushita Electric Industrial Co., Ltd.), 05 February 1981 (05.02.1981), specification, page 2, line 7 to page 6, line 8; fig. 1 to 4 (Family: none)	1-14

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

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"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
02 November 2016 (02.11.16)	15 November 2016 (15.11.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001280241 A **[0005]**