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

(11) EP 3 168 475 A1

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

(43) Date of publication:
17.05.2017 Bulletin 2017/20

(21) Application number: **15819766.5**

(22) Date of filing: **17.06.2015**

(51) Int Cl.:
F04B 39/00 *(2006.01)* ***F04C 29/12*** *(2006.01)*

(86) International application number:
PCT/JP2015/003029

(87) International publication number:
WO 2016/006167 (14.01.2016 Gazette 2016/02)

(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
Designated Validation States:
MA

(30) Priority: **10.07.2014 JP 2014141977**

(71) Applicant: **Mitsubishi Heavy Industries, Ltd.**
Tokyo 108-8215 (JP)

(72) Inventor: **YAKUSHIJI, Shunsuke**
Tokyo 108-8215 (JP)

(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie
158 rue de l'Université
75340 Paris Cedex 07 (FR)

(54) **ATTACHMENT STRUCTURE, AND ELECTRIC COMPRESSOR**

(57) Provided is an attachment structure in which a band is used to attach an auxiliary machine of a compressor, such as an accumulator, the attachment structure being capable of reducing the propagation of vibration from the compressor to the auxiliary machine. A compressor (1) has an accumulator (14) attached to the outer peripheral surface of a sealed container (11) by an attachment implement. The attachment implement is provided with: a bail strap (60) which surrounds and holds the periphery of any one of the sealed container (11) and the accumulator (14), and which is provided with an engagement connection end (62) and a fastening connection end (63); a bracket (70) which is fixed to the other one of the sealed container (11) and the accumulator (14), and which is provided with an engagement connection part (72) to be connected to the engagement connection end (62) of the bail strap (60), and a fastening connection part (73) to be connected to the fastening connection end (63) of the bail strap (60); and a buffer layer (62S) disposed between connecting sections of the bail strap (60) and the bracket (70).

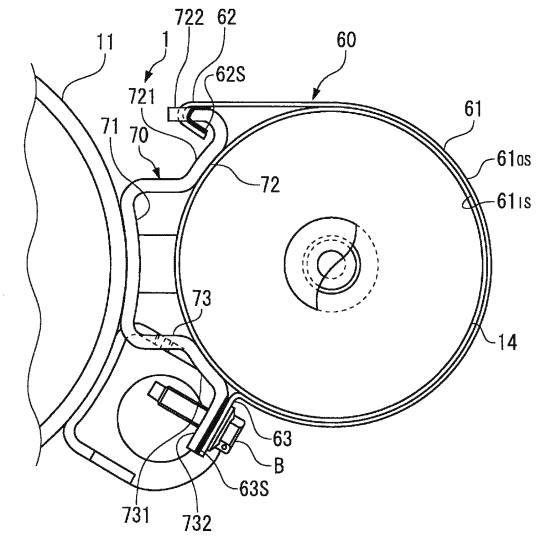


FIG. 3

EP 3 168 475 A1

Description

Technical Field

[0001] The present invention relates to vibration reducing structures suitable for use in rotary compressors including, for example, accumulators being auxiliary machines.

Background Art

[0002] As illustrated in FIG. 10, in a rotary compressor that is used in refrigerating equipment, cylinders 102 that have internal wall surfaces and piston rotors 103 that are provided eccentrically with respect to the centers of the cylinders 102 are provided in the interior of a sealed container 101. The piston rotors 103 are affixed to a main shaft 104 that is provided along the central axes of the cylinders 102. The main shaft 104 is provided so as to rotate freely about its central axis via an upper bearing 105A and a lower bearing 105B that are affixed to the cylinders 102. A rotor 106A of an electric motor 106 is affixed to the main shaft 104. A stator 106B that is affixed to the inner peripheral surface of the sealed container 101 is disposed around the outer peripheral side of the rotor 106A. The main shaft 104 is driven to rotate along with the rotor 106A by energizing the stator 106B, and the piston rotors 103 revolve inside the cylinders 102.

[0003] The rotary compressor sucks a refrigerant into compression chambers formed between the cylinders 102 and the piston rotors 103, and compresses the refrigerant by decreasing the volume of the compression chambers as a result of the rotation of the piston rotors 103. The rotary compressor sucks up and compresses the refrigerant after performing gas-liquid separation on the refrigerant using an accumulator 108.

[0004] The rotary compressor generates vibration when driving of the electric motor 106 rotates the main shaft 104. There are cases in which the vibration is transmitted in turn to the sealed container 101 and the accumulator 108, for example, and noise is generated.

[0005] Patent Document 1 discloses a rotary compressor in which noise and vibration generated by excitation of an accumulator are reduced.

[0006] According to Patent Document 1, part of a connection part (22, 22A) for attaching the accumulator to the outer peripheral surface of a sealed container (1) is bonded to the outer peripheral surface of the sealed container (1), and a pair of leg portions (22A) of the connection part is bonded to the outer peripheral surface of the accumulator (2). The leg portions (22A) extend outward at an angle between 26° and 45° with respect to the straight line connecting the center of the sealed container (1) and the center of the accumulator (2).

[0007] Patent Document 1 states that the above configuration can prevent an increase of noise and vibration due to resonance of the accumulator (2) by reducing a normal directional component in the propagation of vibration from the compressor to the accumulator (2).

Citation List

Patent Document

[0008] Patent Document 1: Japanese Unexamined Patent Application Publication No. 2013-119817A (FIGS. 1 and 3)

Summary of Invention

Technical Problem

[0009] In Patent Document 1, welding is performed to affix the sealed container (1) and the connection part (22, 22A) to each other and the accumulator (2) and the connection part (22, 22A) to each other; however, the accumulator can also be attached by winding a metal band around the accumulator, engaging the band, or fixing the band with a fastener, such as a screw and a bolt.

[0010] An object of the present invention is to provide an attachment structure in which a band is used to attach, to a vibration source such as a compressor, an auxiliary machine of the compressor, such as an accumulator, the attachment structure being capable of reducing the propagation of vibration from the vibration source to the auxiliary machine.

[0011] Another object of the present invention is to provide a rotary compressor including the attachment structure to reduce vibration of the accumulator.

Solution to Problem

[0012] In the light of the foregoing, the present invention provides an attachment structure for attaching an auxiliary machine to a container housing a vibration source therein by an attachment implement; the attachment implement including a holding band surrounding and holding a periphery of any one of the container and the auxiliary machine and including a first connection end and a second connection end, a bracket affixed to other one of the container and the auxiliary machine and including a first connection part connected to the first connection end of the holding band and a second connection part connected to the second connection end of the holding band, and a buffer layer disposed between connecting sections of the holding band and the bracket.

[0013] The attachment structure according to the present invention can prevent contact between metals, which readily propagate vibration, in the connecting sections of the holding band and the bracket, resulting in a reduction in the propagation of vibration from the container to the auxiliary machine.

[0014] In the attachment structure according to the present invention, a buffer material sheet is preferably disposed between the holding band and any one of the container and the auxiliary machine. This configuration

can reduce the propagation of vibration from the holding band to the any one of the container and the auxiliary machine.

[0015] In the attachment structure according to the present invention, a vibration damping structure is preferably disposed in a free region of the holding band. This configuration can reduce the propagation of vibration via the holding band.

[0016] In the attachment structure according to the present invention, when engagement is performed to connect the first connection end of the holding band with the first connection part of the bracket and to connect the second connection end of the holding band with the second connection part of the bracket, the vibration damping structure is preferably disposed in the free region facing each of the first connection end and the second connection end.

[0017] The region for disposing the vibration damping structure therein is provided at each of the first connection end and the second connection end by engagement, such that the free region has a wider area than when the free region is provided at one end, and the vibration damping structure is disposed in a wider area. This configuration improves a vibration damping function of the holding band.

[0018] In the attachment structure according to the present invention, when the vibration source is an electric motor and the bracket is weld-bonded, the bracket is preferably bonded to the auxiliary machine.

[0019] When the bracket is weld-bonded to the container housing the electric motor therein, the bracket should be bonded in a position other than at least the position where the electric motor is housed, to prevent thermal strain caused in the container by the welding from inhibiting stable rotation of the electric motor. In contrast, when the bracket is weld-bonded to the side of the auxiliary machine that does not house the electric motor, the welding position of the bracket can be determined without constraints of the position of the electric motor. This configuration allows the attachment structure including the bracket to be disposed in a position where vibration is less liable to transmit, for example, at a vibration node.

[0020] The above-described attachment structure can have the configuration in which the vibration damping structure is disposed in the free region of the holding band and the configuration in which the bracket is affixed to the auxiliary machine by welding with an electric motor being the vibration source is independently compatible with the configuration in which the buffer layer is disposed between the connecting sections of the holding band and the bracket. The same can be applied to an electric compressor described below.

[0021] The above-described attachment structure can be applied to an electric compressor in which an electric motor and a compressing mechanism driven to rotate by the electric motor are housed in a sealed container having a substantially cylindrical outside shape and in which an accumulator is attached to the outer peripheral surface of the sealed container with an attachment implement.

[0022] The attachment implement applied to the electric compressor includes a holding band surrounding and holding a periphery of any one of the sealed container and the accumulator and including a first connection end and a second connection end, a bracket affixed to other one of the sealed container and the accumulator and including a first connection part connected to the first connection end of the holding band and a second connection part connected to the second connection end of the holding band, and a buffer layer disposed between connecting sections of the holding band and the bracket.

Advantageous Effects of Invention

[0023] The attachment structure according to the present invention that includes the buffer layer disposed between the connecting sections of the holding band and the bracket can reduce the propagation of vibration from the container housing the vibration source therein to the auxiliary machine.

[0024] Furthermore, the attachment structure according to the present invention that includes the vibration damping structure disposed in the free region of the holding band can also reduce the propagation of vibration from the container housing the vibration source therein to the auxiliary machine.

[0025] In addition, when the vibration source is an electric motor and the bracket is affixed by welding, the attachment structure according to the present invention that includes the bracket affixed to the auxiliary machine can reduce the propagation of vibration from the container housing the vibration source therein to the auxiliary machine by disposing the attachment structure in any position that is least subject to vibration.

Brief Description of Drawings

[0026]

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

FIG. 2 is a front view illustrating an accumulator included in the rotary compressor in FIG. 1.

FIG. 3 is a plan view illustrating the vicinity of the accumulator of the rotary compressor in FIG. 1.

FIGS. 4A to 4D illustrate a bail strap used for affixing the accumulator to the rotary compressor in FIG. 1. FIG. 4A is a side view of the bail strap, and FIG. 4B a front view. FIG. 4C is an enlarged view illustrating an engagement connection end in FIG. 4A. FIG. 4D is an enlarged view illustrating a fastening connection end in FIG. 4A.

FIGS. 5A to 5C are views from three sides illustrating a bracket used for affixing the accumulator to the rotary compressor in FIG. 1. FIG. 5A is a front view

of the bracket, FIG. 5B a side view, and FIG. 5C a plan view.

FIG. 6 is a plan view illustrating the vicinity of an accumulator of a rotary compressor according to a second embodiment of the present invention.

FIG. 7A is a partially enlarged view of FIG. 6.

FIG. 7B illustrates a method for configuring a vibration damping structure.

FIG. 8 is a plan view illustrating the vicinity of an accumulator of a rotary compressor according to a variation of the second embodiment.

FIGS. 9A and 9B illustrate the vicinity of an accumulator of a rotary compressor according to a third embodiment of the present invention. FIG. 9A is an exploded view of components. FIG. 9B illustrates the components assembled in predetermined positions.

FIG. 10 is a cross-sectional view illustrating a conventional rotary compressor.

Description of Embodiment(s)

[0027] The present invention will be described below in detail on the basis of embodiments illustrated in the attached drawings.

[First Embodiment]

[0028] A rotary compressor 1 according to a first embodiment of the present invention will now be described.

[0029] The compressor 1 uses a bail strap (holding band) 60 being a metal band to affix an accumulator (auxiliary machine) 14 to a sealed container 11 and has a structure to reduce the propagation of vibration from the sealed container 11 to the accumulator 14 via the bail strap 60.

[0030] A configuration of the compressor 1 will be described below, and then, effects and benefits of the compressor 1 will be described.

[Configuration of compressor 1]

[0031] As illustrated in FIG. 1, the compressor 1 is a so-called two-cylinder type rotary compressor in which disc-shaped cylinders 20A and 20B are provided in a two-level upper and lower arrangement inside the cylindrical sealed container 11.

[0032] 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 a main shaft 23 that is arranged along the central axis C of the sealed container 11. In this way, spaces R having a crescent-shaped cross-section are respectively 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.

[0033] 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°.

[0034] 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.

[0035] 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.

[0036] Furthermore, a discharge hole (not illustrated in the drawings) that discharges a 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 disposed in the discharge hole. 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.

[0037] As illustrated in FIG. 1, 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 central axis.

[0038] 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 C 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, upon the main shaft 23 rotating, the eccentric shaft portions 40A and 40B revolve around the central axis C 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.

[0039] The main shaft 23 protrudes upward from the upper bearing 29A, and a rotor 37 of an electric motor (vibration source) 36 for rotary driving of the main shaft 23 is integrally provided with the protruding section of the main shaft 23. A stator 38 is affixed to the inner peripheral surface of the sealed container 11 in correspondence with the rotor 37.

[0040] The upper bearing 29A is provided with a discharge hole (not illustrated in the drawings) that communicates 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 a muffler 45A that will be described below. Similarly, the lower bearing 29B is provided with a discharge hole (not illustrated in the drawings) that communicates 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 a muffler 45B that will be described below.

[0041] As illustrated in FIG. 1, in the compressor 1, the muffler 45A is mounted on the upper bearing 29A, and the muffler 45B is mounted on the lower bearing 29B. Upon the refrigerant that has passed through the upper bearing 29A and the lower bearing 29B flowing into the interior of the muffler 45A and the muffler 45B, 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 45A and the muffler 45B, and flows toward the upper part of the sealed container 11.

[0042] 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.

[0043] As illustrated in FIG. 1, in the compressor 1, the accumulator 14 that performs gas-liquid separation on the refrigerant before the refrigerant is supplied to the compressor 1 is affixed to the sealed container 11 via an attachment structure 50.

[0044] 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 1. 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.

[0045] The compressor 1 takes up the refrigerant into the accumulator 14 from an intake tube 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.

[0046] Then, the volume of the compression chambers R1 and R2 is gradually decreased by the rotation of the piston rotors 21A and 21B inside the cylinder 20A and 20B, and the refrigerant is compressed. The compressed refrigerant passes through the upper bearing 29A and the muffler 45A on the cylinder 20A side and passes through the lower bearing 29B and the muffler 45B on the cylinder 20B side, and is discharged into the interior of the sealed container 11 (the outside of the muffler 45A and the muffler 45B). After passing through the electric motor 36, the refrigerant is evacuated to a pipe that forms a refrigerant cycle, via a discharge tube 42 that is provided in an upper portion.

[0047] The accumulator 14 is attached to the sealed container 11 of the compressor 1 via the intake pipes 16A and 16B, and the accumulator 14 and the sealed container 11 are also affixed to each other through the attachment structure 50.

[0048] As illustrated in FIG. 1, the attachment structure 50 includes the bail strap 60 wound around the accumulator 14, a bracket 70 affixed to the sealed container 11, and a buffer material 75 made of a sheet rubber and disposed between the bail strap 60 and the sealed container 11.

[0049] As illustrated in FIGS. 3, 4A, 4B, 4C, and 4D, the bail strap 60 includes an engagement connection end (first connection end) 62 formed by bending one end into a U-shape, a fastening connection end (second connection end) 63 formed by bending the other end into an L-shape, and a fastening portion 61 extending between the engagement connection end 62 and the fastening connection end 63. The engagement connection end 62 is inserted into an engagement groove 723 (FIGS. 5A and 5B) provided in the bracket 70 to affix the one end of the bail strap 60 to the bracket 70. Furthermore, the fastening connection end 63 is fastened to the bracket 70 with a bolt B to affix the other end of the bail strap 60 to the bracket 70. A bolt hole 64 (FIG. 4B) for passing the bolt B therethrough is formed in the fastening connection end 63. When the engagement connection end 62 and the fastening connection end 63 are affixed to the bracket 70, the securing portion 61 is wound around the accumulator 14 and secures the accumulator 14.

[0050] The bail strap 60 is manufactured through sheet-metal processing in which a metal plate is subjected to punching and bending to have a shape illustrated in FIGS. 3, 4A, 4B, 4C, and 4D. The bracket 70 is manufactured in a similar manner.

[0051] The bail strap 60 is provided with a buffer layer 62S and a buffer layer 63S at the engagement connection end 62 and the fastening connection end 63, respectively. The buffer layer 62S and the buffer layer 63S may be formed by pasting a buffer material sheet composed of a buffer material made of, for example, natural or synthetic rubber, or synthetic resin. Alternatively, the layers may be formed by applying an adhesive gel and then curing the gel.

[0052] The buffer layer 62S of the engagement connection end 62 is disposed on an inner peripheral surface 60_{IS} of the bail strap 60. When the engagement connection end 62 is inserted into the engagement groove 723 of the bracket 70 and engaged with the engagement connection part 72, the buffer layer 62S is positioned between the engagement connection end 62 and the bracket 70 to prevent contact between the metals, which will be described in detail later.

[0053] The buffer layer 63S of the fastening connection end 63 is disposed on the inner peripheral surface 60_{IS}

of the bail strap 60. When the fastening connection end 63 is fastened to the bracket 70 with the bolt B, the buffer layer 63S is positioned between the fastening connection end 63 and the bracket 70 to prevent contact between the metals, which will be described in detail later.

[0054] As illustrated in FIGS. 3, 5A, 5B, and 5C, the bracket 70 includes a weld-bonded portion 71 to be affixed to the sealed container 11, and the engagement connection part (first connection part) 72 and a fastening connection part (second connection part) 73 respectively provided at tip ends of flanges 714 and 714 of the weld-bonded portion 71 used for affixing the bail strap 60.

[0055] The bracket 70 is arranged in a predetermined position and then bonded and affixed to the sealed container 11 by welding the weld-bonded portion 71.

[0056] The weld-bonded portion 71 has a similar cross section to that of a steel channel and includes a web 711 and the flanges 714 and 714 rising perpendicularly from both edges of the web 711. The web 711 is curved so as to have a curvature equivalent to that of the outer peripheral surface of the sealed container 11 and is provided with a pair of positioning protrusions 713 and 713 that are disposed on a bonded surface 712 to be bonded to the sealed container 11 with a space therebetween and are used for positioning with respect to the sealed container 11. The positioning protrusions 713 and 713 are fitted into positioning grooves (not illustrated in the drawings) formed in predetermined positions of the outer peripheral surface of the sealed container 11 to position the bracket 70.

[0057] The engagement connection part 72 and the fastening connection part 73 are each formed to have a substantially L-shaped cross section and respectively correspond to the engagement connection end 62 and the fastening connection end 63 of the bail strap 60.

[0058] The engagement connection part 72 includes a first supporting portion 721 and an engagement portion 722 formed by bending the tip end of the first supporting portion 721. The first supporting portion 721 comes into contact with the accumulator 14 and supports the accumulator 14. The surface in contact with the accumulator 14 has a curvature equivalent to that of the outer peripheral surface of the accumulator 14. Similarly, a second supporting portion 731 of the fastening connection part 73 comes into contact with the accumulator 14 and supports the accumulator 14. The surface in contact with the accumulator 14 has a curvature equivalent to that of the outer peripheral surface of the accumulator 14. The engagement groove 723 for engagement with the engagement connection end 62 of the bail strap 60 is formed in the engagement portion 722.

[0059] The fastening connection part 73 includes the second supporting portion 731 and a fastening portion 732 formed by bending the tip end of the second supporting portion 731. The flat fastening portion 732 supports the fastening connection end 63, laminated thereon, of the bail strap 60 and fastens and affixes the fastening connection end 63 by fastening the bolt B. A screw hole 733 through which the bolt B passes and that has a female thread formed thereon for engagement with the male thread of the bolt B is formed in the fastening portion 732.

[0060] The flanges 714, the first supporting portion 721, and the second supporting portion 731 of the bracket 70 are elastic, and their elastic deformation converts vibration energy into thermal energy, resulting in a reduction in the propagation of vibration.

[0061] As illustrated in FIGS. 1 and 2, the buffer material 75 is composed of a rubber sheet and wound around the accumulator 14. The buffer material 75 is disposed between the accumulator 14 and the bail strap 60 to reduce the propagation of vibration from the bail strap 60 to the accumulator 14.

[0062] The buffer material 75 surrounds the outer peripheral surface of the accumulator 14 by almost one round and is held between the accumulator 14 and the bail strap 60 by the bail strap 60 securing the buffer material 75 on its periphery.

[0063] The accumulator 14 is attached to the sealed container 11 with the attachment structure 50 including the above-described bail strap 60, bracket 70, and buffer material 75. In specific, the outer peripheral surface of the accumulator 14 is brought into contact with the first supporting portion 721 and the second supporting portion 731 of the bracket 70 weld-bonded in a predetermined position of the sealed container 11 as illustrated in FIGS. 1 to 3. In this state, the engagement connection end 62 of the bail strap 60 is fitted into the engagement groove 723 formed in the engagement portion 722 of the engagement connection part 72 of the bracket 70 to engage the engagement connection end 62 with the engagement connection part 72. The fastening connection end 63 of the bail strap 60 is then overlapped on the fastening portion 732 of the fastening connection part 73 of the bracket 70. Consequently, the securing portion 61 of the bail strap 60 covers the periphery of the accumulator 14. Then, the bolt B with its screw portion having passed through the bolt hole 64 is screwed into the screw hole 733 of the fastening portion 732. The bolt B is screwed until its head portion reaches the fastening portion 732 and required securing force is yielded. This completes the attachment of the accumulator 14.

[0064] An effect of the compressor 1 will now be described. The effect relates to a reduction in the propagation of vibration generated by driving of the electric motor 36 in the main body of the compressor 1 including the sealed container 11, to the accumulator 14.

[0065] As illustrated in FIGS. 3, 4A, 4B, 4C, and 4D, in the present embodiment, the buffer layer 62S is provided at the engagement connection end 62 of the bail strap 60 and positioned between the engagement connection end 62 and the engagement portion 722 of the bracket 70. Furthermore, the buffer layer 63S is provided at the fastening connection end 63 of the bail strap 60 and positioned between the fastening connection end 63 and the fastening portion 732 of the bracket 70. The buffer

layers 62S and 63S positioned between the bail strap 60 and the bracket 70 decrease the transmissibility of vibration generated in the sealed container 11, from the bracket 70 to the bail strap 60, resulting in a reduction in vibration of the accumulator 14.

[Second Embodiment]

[0066] Next, a compressor 2 according to a second embodiment of the present invention will be described with reference to FIGS. 6, 7A, and 7B.

[0067] The compressor 2 has the same basic configuration as the compressor 1, and the same components in FIGS. 6 to 8 have the same reference characters used for the compressor 1. Features, differing from the compressor 1, of the compressor 2 will be mainly described below.

[0068] As illustrated in FIGS. 6, 7A, and 7B, the compressor 2 includes a vibration damping structure 65 in the bail strap 60. The vibration damping structure 65 is disposed in a free region F that is on the side provided with the engagement connection end 62 of the bail strap 60 and does not come into contact with the accumulator 14 and the bracket 70 so as not to have direct mechanical constraints. Here, it is assumed that the vibration damping structure 65 extends in the entire free region F in the width direction W (See FIG. 4B) of the bail strap 60. Alternatively, the vibration damping structure 65 may extend only in a partial region in the width direction W.

[0069] The vibration damping structure 65 has a similar structure to that of a laminated damping steel sheet.

[0070] A laminated damping steel sheet has a structure in which a viscoelastic resin layer having a thickness of approximately several tens μm is disposed between two steel sheets, and shear deformation of the viscoelastic resin layer due to bending vibration converts vibration energy into thermal energy to yield vibration damping effects.

[0071] The vibration damping structure 65 is composed of a viscoelastic resin layer 67 and a steel sheet 68 with the bail strap 60 functioning as one of the two steel sheets. In other words, the vibration damping structure 65 has a laminated structure in which the viscoelastic resin layer 67 is disposed between the bail strap 60 and the steel sheet 68.

[0072] As illustrated in FIG. 7B, the vibration damping structure 65 is obtained by laminating the viscoelastic resin layer 67 and the steel sheet 68 to prepare a vibration damping structure preparatory body 66 and pasting the viscoelastic resin layer 67 side on the bail strap 60.

[0073] Here, the vibration damping structure 65 disposed on the outer peripheral surface 60_{os} of the bail strap 60 is exemplified. Alternatively, the vibration damping structure 65 may be disposed on the inner peripheral surface 60_{IS} or on both of the outer peripheral surface 60_{OS} and the inner peripheral surface 60_{IS}.

[0074] In the present embodiment, the vibration damping structure 65 is disposed in the free region F. Consequently, even when vibration is transmitted from the bracket 70, shear deformation of the viscoelastic resin layer 67 of the vibration damping structure 65 damps vibration in the free region F. The propagation of vibration to the accumulator 14 can thus be reduced.

[0075] In the present embodiment, the vibration damping structure 65 disposed only in the free region F is exemplified. Alternatively, the vibration damping structure 65 may be disposed in a region other than the free region F. However, since shear deformation of the viscoelastic resin layer 67 provides the vibration damping effects of the vibration damping structure 65, the vibration damping structure 65 is preferably disposed in a section selected for yielding the effects and benefits. Furthermore, the vibration damping structure 65 may be disposed not only on the bail strap 60 but also on the bracket 70 side.

[0076] The vibration damping effects of the vibration damping structure 65 can be more effectively yielded by expanding the free region F and disposing the vibration damping structure 65 in the free region F. FIG. 8 illustrates an example in which the vibration damping structure 65 is disposed on the basis of this viewpoint.

[0077] In a compressor 1 in FIG. 8, both ends of the bail strap 60 and the bracket 70 are affixed by engagement, such that the free region F can be expanded twice as large as the example in FIG. 6. Consequently, the vibration damping effects can be doubled by disposing the vibration damping structure 65 in each of the free regions F.

[0078] The second embodiment illustrated in FIGS. 6 to 8 exemplifies a configuration without the buffer layers 62S and 63S in the first embodiment; however, the buffer layers 62S and 63S in the first embodiment may be applied to the second embodiment.

[Third Embodiment]

[0079] Next, a compressor 3 according to a third embodiment of the present invention will be described with reference to FIGS. 9A and 9B.

[0080] The compressor 3 has the same basic configuration as the compressors 1 and 2, and the same components in FIGS. 9A and 9B have the same reference characters used for the compressors 1 and 2. Features, differing from the compressors 1 and 2, of the compressor 3 will be mainly described below.

[0081] As illustrated in FIGS. 9A and 9B, the compressor 3 has a structure in which a bracket 70 is bonded to the accumulator 14 and a bail strap 60 is wound around the sealed container 11.

[0082] The bail strap 60 and the bracket 70 follow the configuration of the second embodiment. The bail strap 60 includes two engagement connection ends 62 on both ends thereof, and the bracket 70 includes two engagement connection parts 72 on both ends thereof.

[0083] In the bracket 70, a weld-bonded portion 71 is affixed to the accumulator 14 by welding. In the bail strap 60, a securing portion 61 (not illustrated in the drawings)

is wound around the sealed container 11, and the engagement connection ends 62 and 62 are respectively engaged with the engagement connection parts 72 and 72 of the bracket 70 to affix the accumulator 14 to the sealed container 11.

[0084] The compressor 3 according to the third embodiment does not have constraints on the height position of attaching the bracket 70 by welding, which will be described below, and thus achieves such an effect that the attachment structure 50 can be disposed in a position selected so that vibration from the sealed container 11 is the less liable to propagate to the accumulator 14.

[0085] As illustrated in FIG. 1, the sealed container 11 houses the electric motor 36 therein and also functions as the case of the electric motor 36. The sealed container 11 is thus required to have a high roundness especially at a section housing the electric motor 36 to ensure stable rotation of the rotor 37. Since welding of the bracket 70 to the sealed container 11 inevitably causes thermal strain in the sealed container 11, the bracket 70 is welded in a region other than a region A housing the electric motor 36 to prevent influences of the thermal strain on the region A in the first and second embodiments in which the bracket 70 is welded to the sealed container 11.

[0086] Welding of the bracket 70 to the sealed container 11 has constraints on the height position of welding as described above. Unfortunately, the constraints on the welding position is undesirable in consideration of the propagation of vibration. That is, the stator 38 of the housed electric motor 36 is fitted inside the sealed container 11, such that the region A of the sealed container 11 has high rigidity and readily reduces the amplitude of vibration. Therefore, when the bracket 70 is affixed in the region A, vibration from the sealed container 11 is less liable to propagate to the bracket 70.

[0087] For this reason, the bracket 70 is welded to the accumulator 14, which is not adversely affected by thermal strain by welding, in the present embodiment. This configuration enables the bracket 70 to be affixed by welding in a position selected in a wide region B including the region A illustrated in FIG. 1 to readily reduce the amplitude of vibration. Thermal strain by welding is not generated in the sealed container 11, and stable rotation of the electric motor 36 is thus ensured.

[0088] Furthermore, the compressor 3 according to the third embodiment also achieves such an effect that the magnitude of exciting force input to the bracket 70 is reduced by winding the bail strap 60 around the sealed container 11, which will be described below.

[0089] It is understood that vibration of the sealed container 11 generates exciting force F (F_1, F_2, F_3, and F_4) to the outside approximately in the positions indicated in FIG. 9B. When the exciting force F_1, F_2, F_3, and F_4 overlaps and generates greater exciting force, vibration propagated via the bracket 70 to the accumulator 14 increases. It is thus required to prevent the exciting force F_1, F_2, F_3, and F_4 from overlapping to reduce vibration of the accumulator 14. The present embodiment has the configuration in which the bracket 70 is affixed to the accumulator 14 by welding and the bail strap 60 is wound around the sealed container 11 having a larger diameter than that of the accumulator 14, and a distance between F_1 and F_2 and a distance between F_3 and F_4 can thus be increased, resulting in a reduction of overlapping exciting force.

[0090] In the present embodiment, the sealed container 11, around which the bail strap 60 is wound, has a larger external diameter than that of the accumulator 14. The distance D between the positions in which the exciting force F_1 and the exciting force F_2 are generated and the distance D between the positions in which the exciting force F_3 and the exciting force F_4 are generated can thus be increased in comparison with the case in which the bail strap 60 is wound around the accumulator 14. The increase in the distances between the exciting force F (F_1, F_2, F_3, and F_4) to disperse the force enables input of the exciting force to the bracket 70 with the phase of the exciting force differing from each other, resulting in a prevention of overlapping exciting force.

[0091] The third embodiment illustrated in FIG. 9 exemplifies a configuration without the buffer layers 62S and 63S in the first embodiment and the vibration damping structure 65 in the second embodiment; however, the buffer layers 62S and 63S in the first embodiment and the vibration damping structure 65 in the second embodiment may be applied to the third embodiment.

[0092] The present invention has been described with reference to the first, second, and third embodiments. However, as long as there is no departure from the spirit and scope of the present invention, configurations described in the above embodiments can be selected as desired, or can be changed to other configurations as necessary.

[0093] The above embodiments exemplify the electric motor of the rotary compressor being a vibration source and the accumulator being an auxiliary machine associated with the vibration source; however, these should not be construed to limit the present invention. The present invention can be widely applied to a combination of a vibration source other than a rotary compressor and an auxiliary machine other than an accumulator.

[0094] Furthermore, if the present invention is applied to a rotary compressor, its specific configuration should not be limited to those described in the embodiments. The present invention can be widely applied to a rotary compressor including a rotary compressing mechanism, a sealed container, and an accumulator.

Reference Signs List

[0095]

1, 2, 3	Compressor
11	Sealed container
12A	Opening
12B	Opening

14	Accumulator (Auxiliary machine)
14a	Intake tube
16A	Intake pipe
16B	Intake pipe
20A	Cylinder
20B	Cylinder
20S	Cylinder internal wall surface
21A	Piston rotor
21B	Piston rotor
23	Main shaft
24	Partition plate
29A	Upper bearing
29B	Lower bearing
30A	Intake port
30B	Intake port
36	Electric motor (Vibration source)
37	Rotor
38	Stator
40A	Eccentric shaft portion
40B	Eccentric shaft portion
42	Discharge tube
45A	Muffler
45B	Muffler
50	Attachment structure
60	Bail strap (Holding band)
60_{IS}	Inner peripheral surface
60_{OS}	Outer peripheral surface
61	Securing portion
62	Engagement connection end (First connection end)
62S	Buffer layer
63	Fastening connection end (Second connection end)
63S	Buffer layer
64	Bolt hole
65	Vibration damping structure
66	Vibration damping structure preparatory body
67	Viscoelastic resin layer
68	Steel sheet
70	Bracket
71	Weld-bonded portion
72	Engagement connection part (First connection part)
73	Fastening connection part (Second connection part)
75	Buffer material
711	Web
712	Bonded surface
713	Positioning protrusion
714	Flange
721	First supporting portion
722	Engagement portion
723	Engagement groove
731	Second supporting portion
732	Fastening portion
733	Screw hole
B	Bolt
C	Central axis
R	Space
R1	Compression chamber
R2	Compression chamber

Claims

1. An attachment structure for attaching an auxiliary machine to a container housing a vibration source therein by an attachment implement;
the attachment implement comprising:

a holding band surrounding and holding a periphery of any one of the container and the auxiliary machine and including a first connection end and a second connection end; and
a bracket affixed to other one of the container and the auxiliary machine and including a first connection part connected to the first connection end of the holding band and a second connection part connected to the second connection end of the holding band; and
the attachment implement comprising:

a buffer layer disposed between connecting sections of the holding band and the bracket; or
a vibration damping structure disposed in a free region of the holding band.

2. The attachment structure according to claim 1, wherein a buffer material sheet is disposed between the holding band and any one of the container and the auxiliary machine.

3. The attachment structure according to claim 1 or 2, wherein the attachment implement, when comprising the buffer layer, comprises a vibration damping structure in a free region of the holding band.

4. The attachment structure according to any one of claims 1 to 3, wherein:

engagement is performed to connect the first connection end of the holding band with the first connection part of the bracket and to connect the second connection end of the holding band with the second connection part of the bracket; and
the vibration damping structure is disposed in the free region facing each of the first connection end and the second connection end.

5. The attachment structure according to any one of claims 1 to 4, wherein:

the vibration source is an electric motor; and
when weld-bonding the bracket, the bracket is

bonded to the auxiliary machine.

6. An attachment structure for attaching an auxiliary machine to a container housing an electric motor being a vibration source therein by an attachment implement;
the attachment implement comprising:

a holding band surrounding and holding a periphery of the container and including a first connection end and a second connection end; and
a bracket affixed to the auxiliary machine by welding and including a first connection part connected to the first connection end of the holding band and a second connection part connected to the second connection end of the holding band.

7. An electric compressor, comprising the attachment implement according to any one of claims 1 to 5.

8. An electric compressor, comprising the attachment implement according to claim 6.

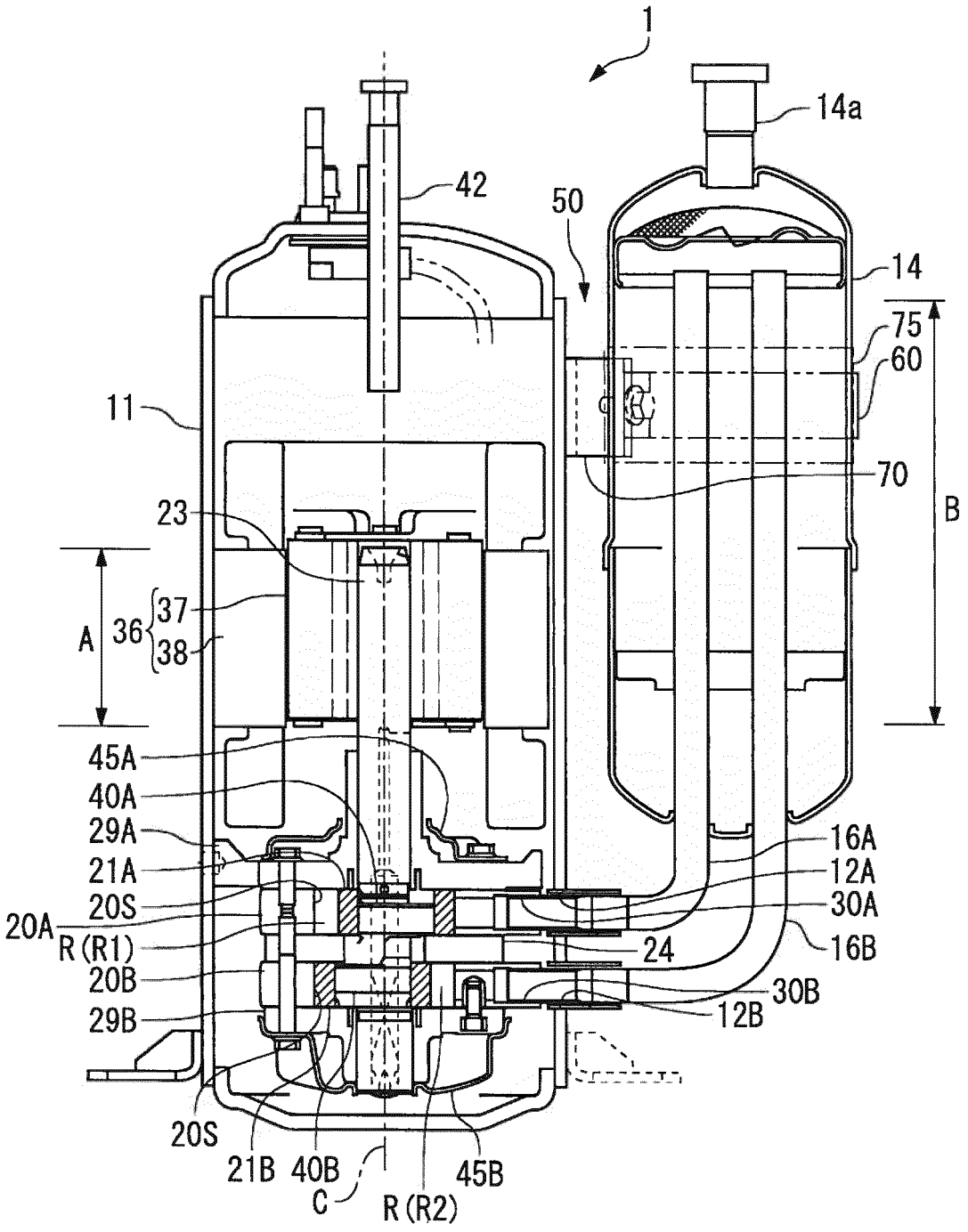

1
14a
42
50
14
75
60
11
70
B
23
A
36
37
38
45A
40A
29A
21A
20S
20A
R (R1)
20B
29B
16A
12A
30A
16B
24
30B
12B
20S
21B
40B
C
R (R2)
45B

FIG. 1

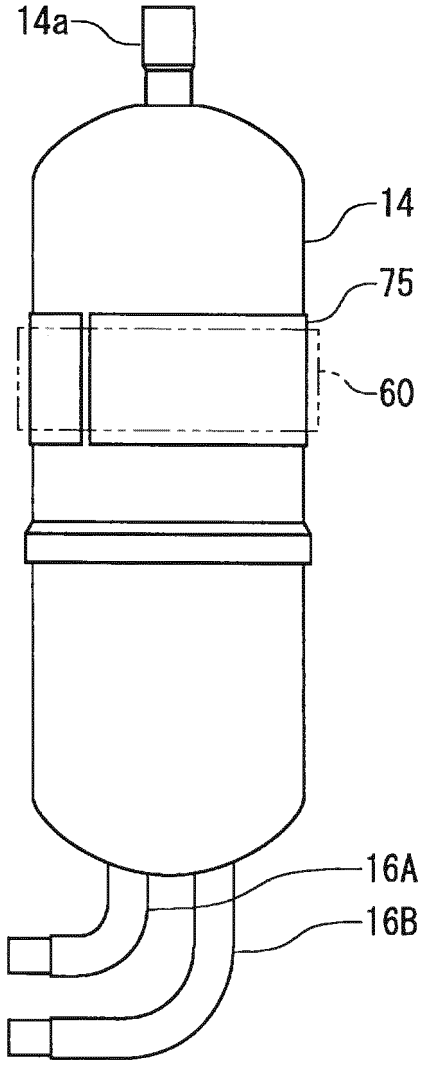


FIG. 2

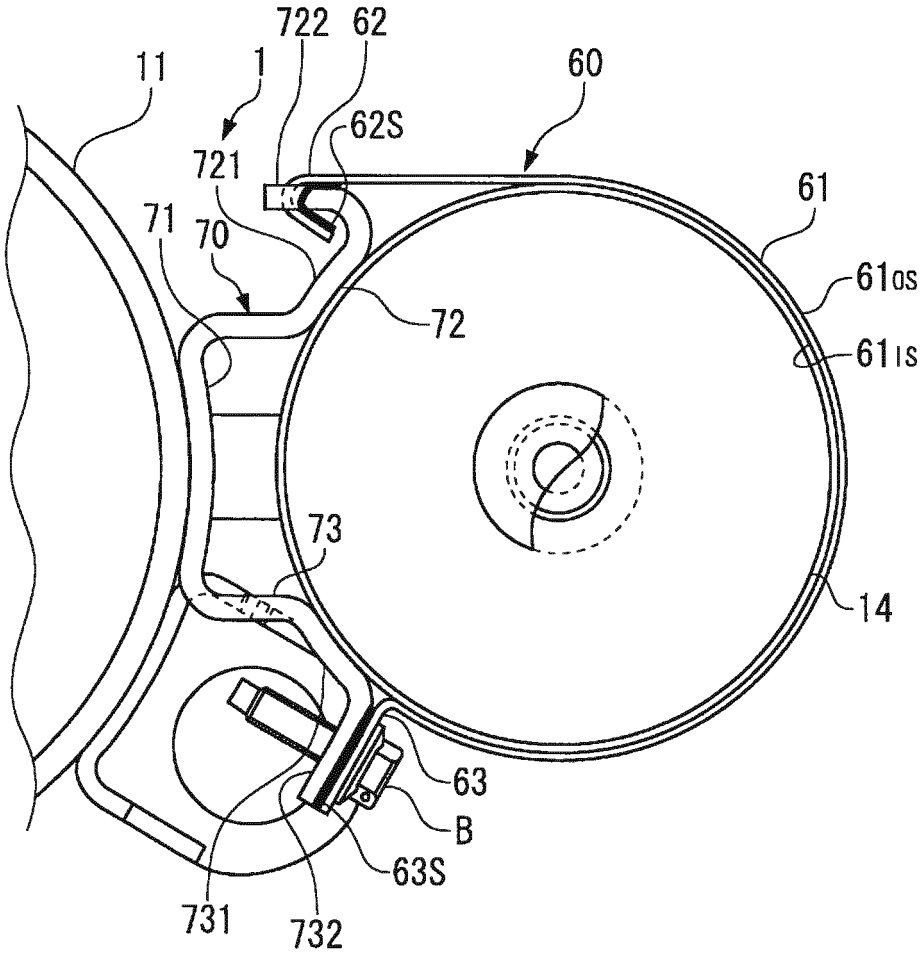


FIG. 3

FIG. 4A

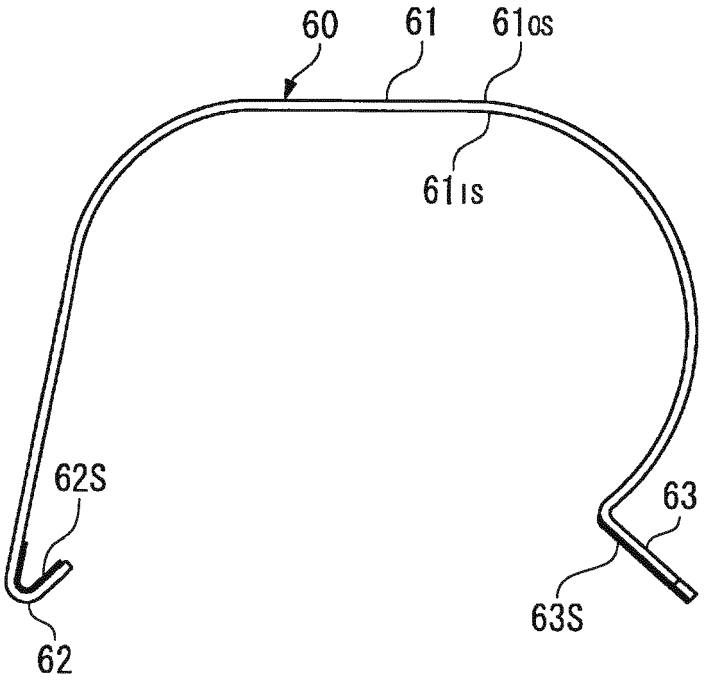


FIG. 4B

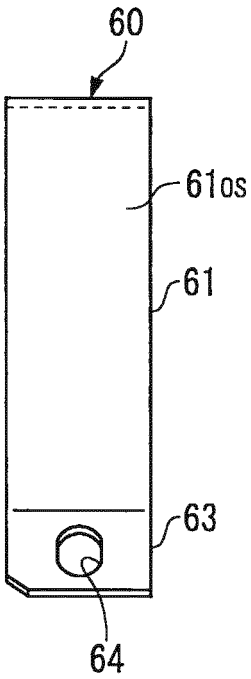


FIG. 4C

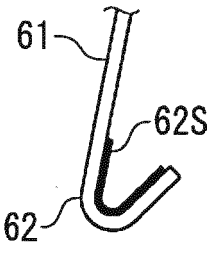


FIG. 4D

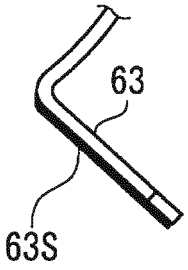


FIG. 5A

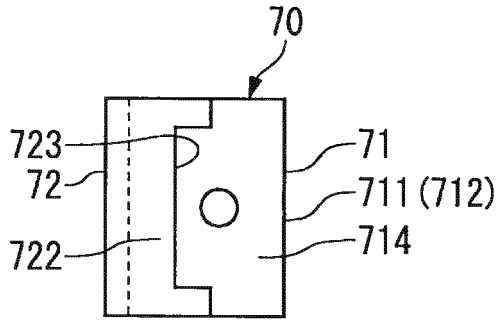


FIG. 5B

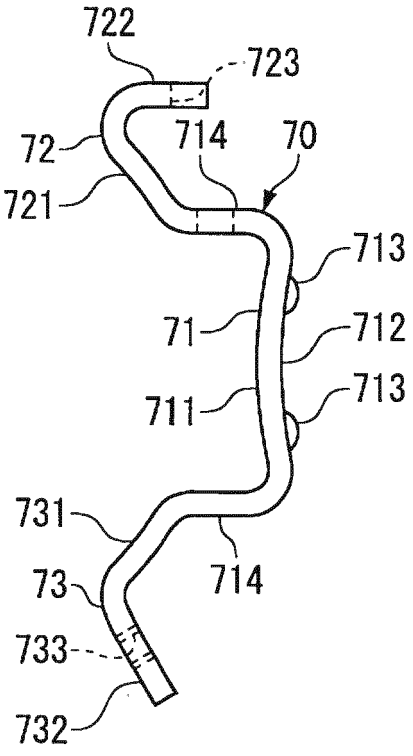
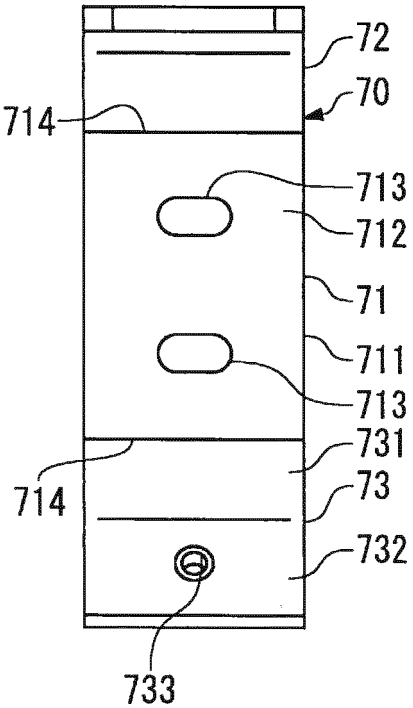


FIG. 5C



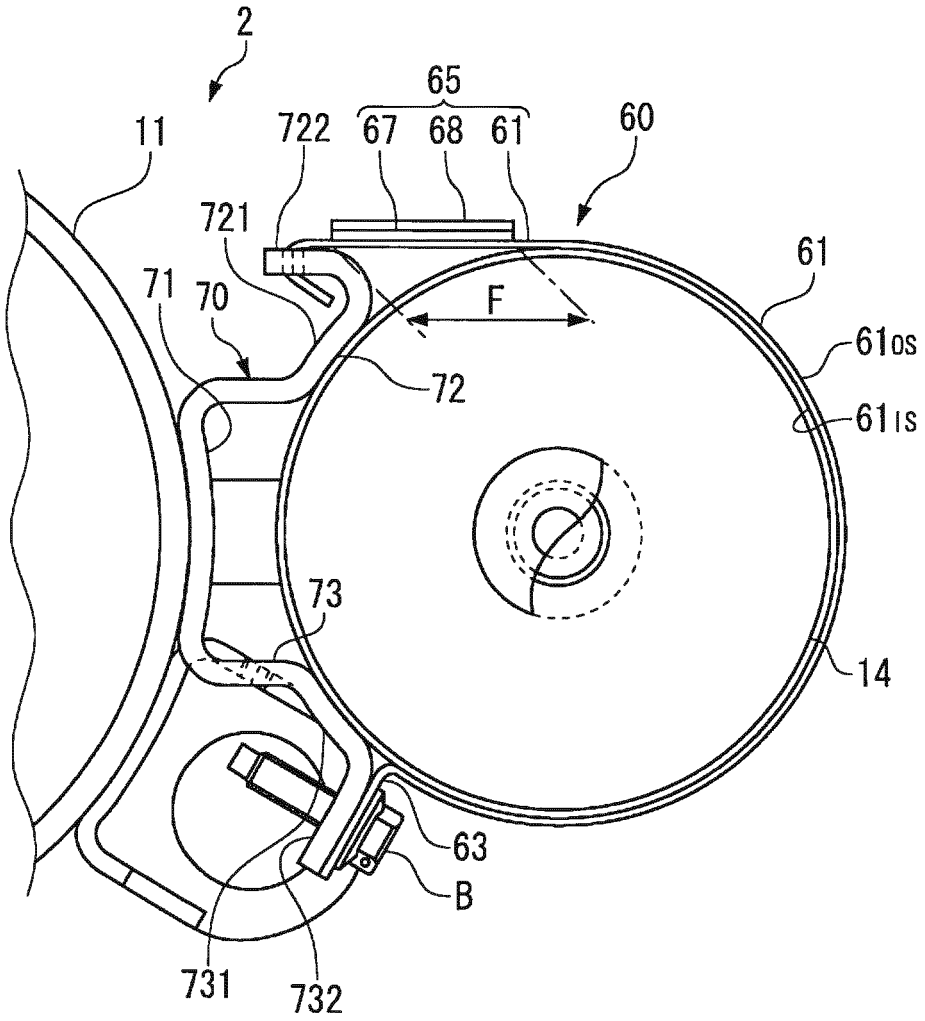


FIG. 6

FIG. 7A

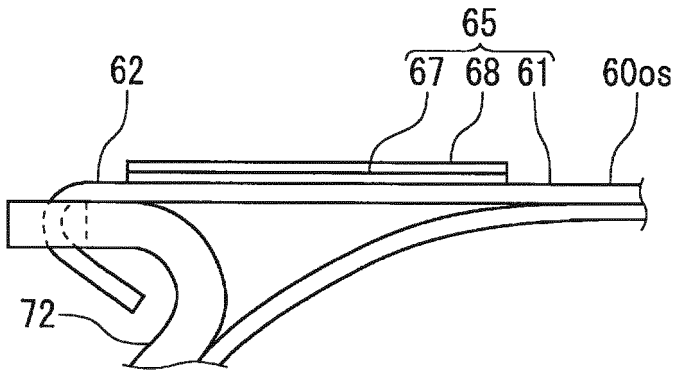
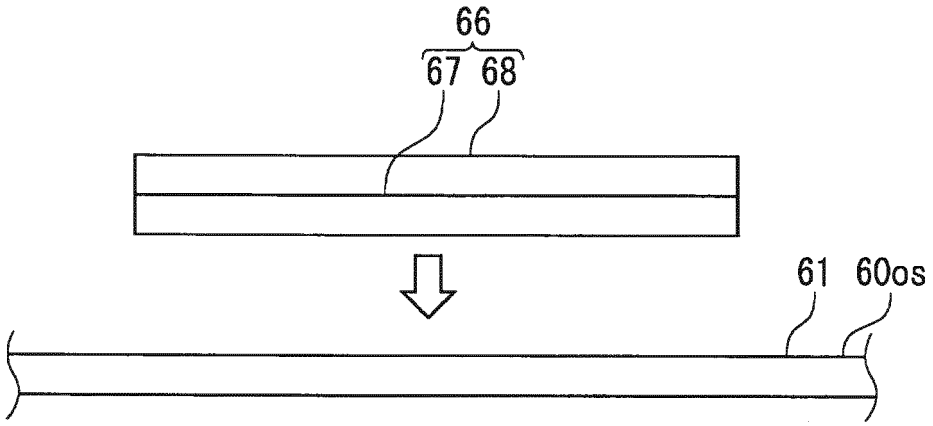


FIG. 7B



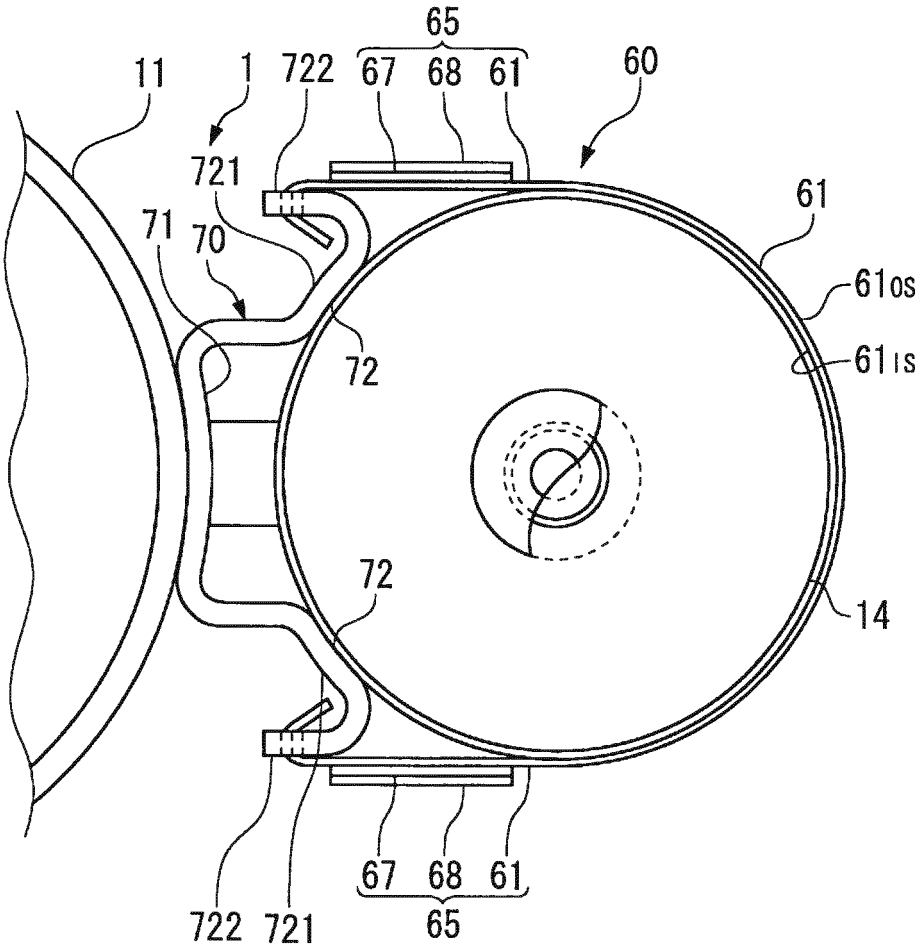

65
11
1
722
67
68
61
60
721
61
71
70
61os
61is
72
72
14
67
68
61
722
721
65

FIG. 8

FIG. 9A

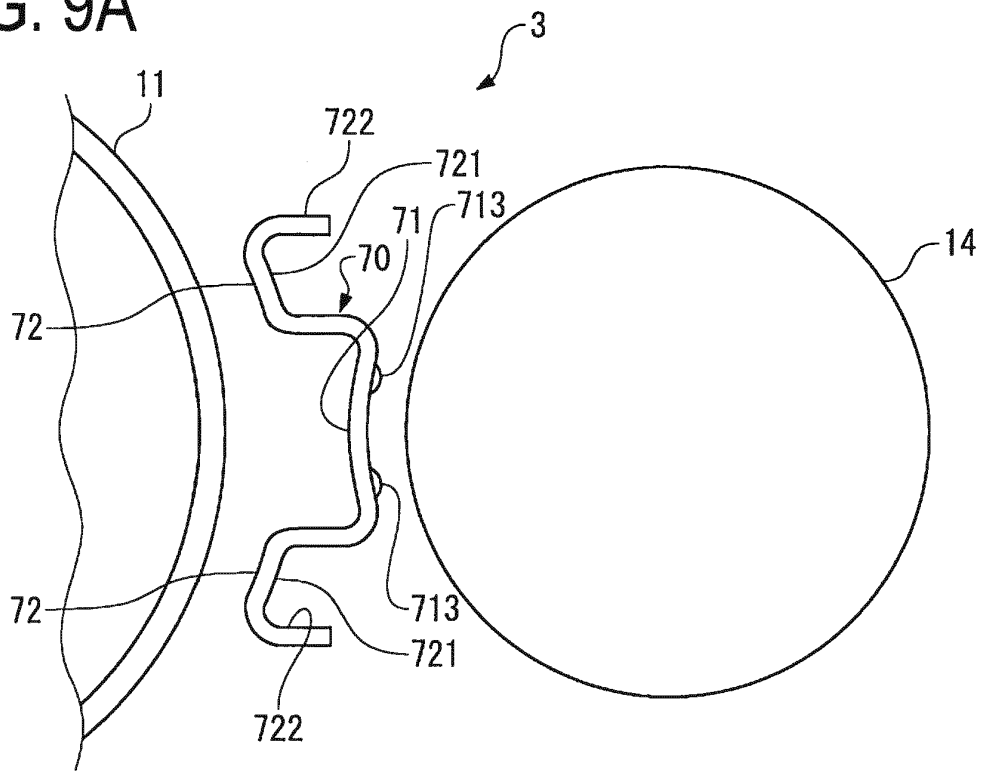
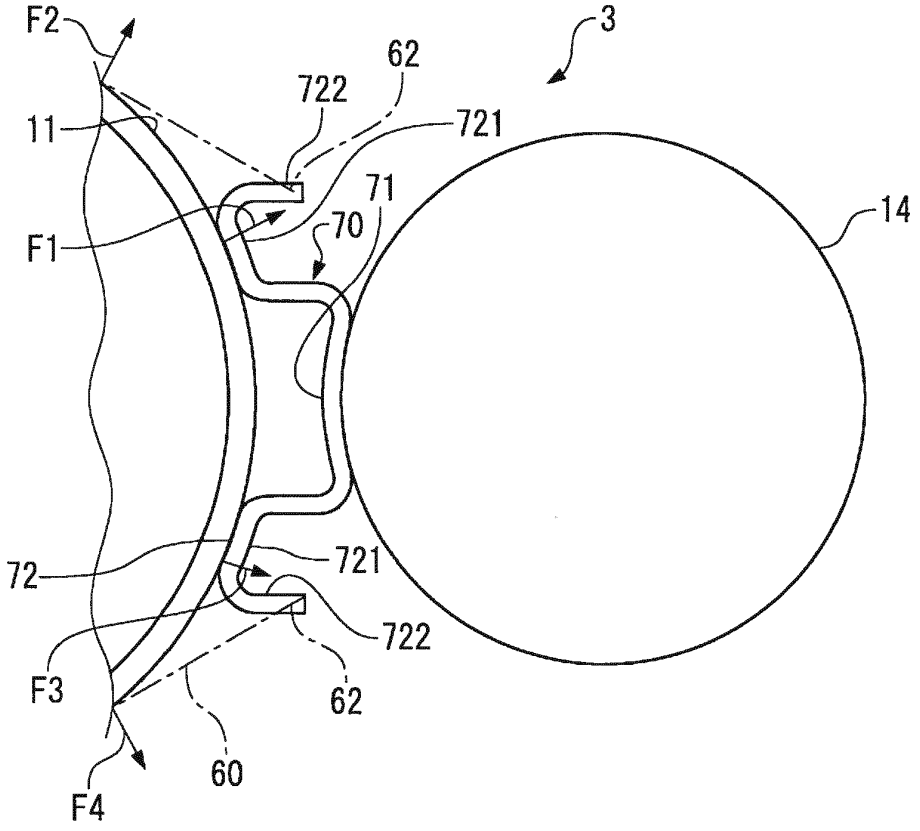

3
11
722
721
713
71
70
14
72
72
713
721
722

FIG. 9B


F2
3
62
722
11
721
71
14
F1
70
72
721
722
F3
62
60
F4

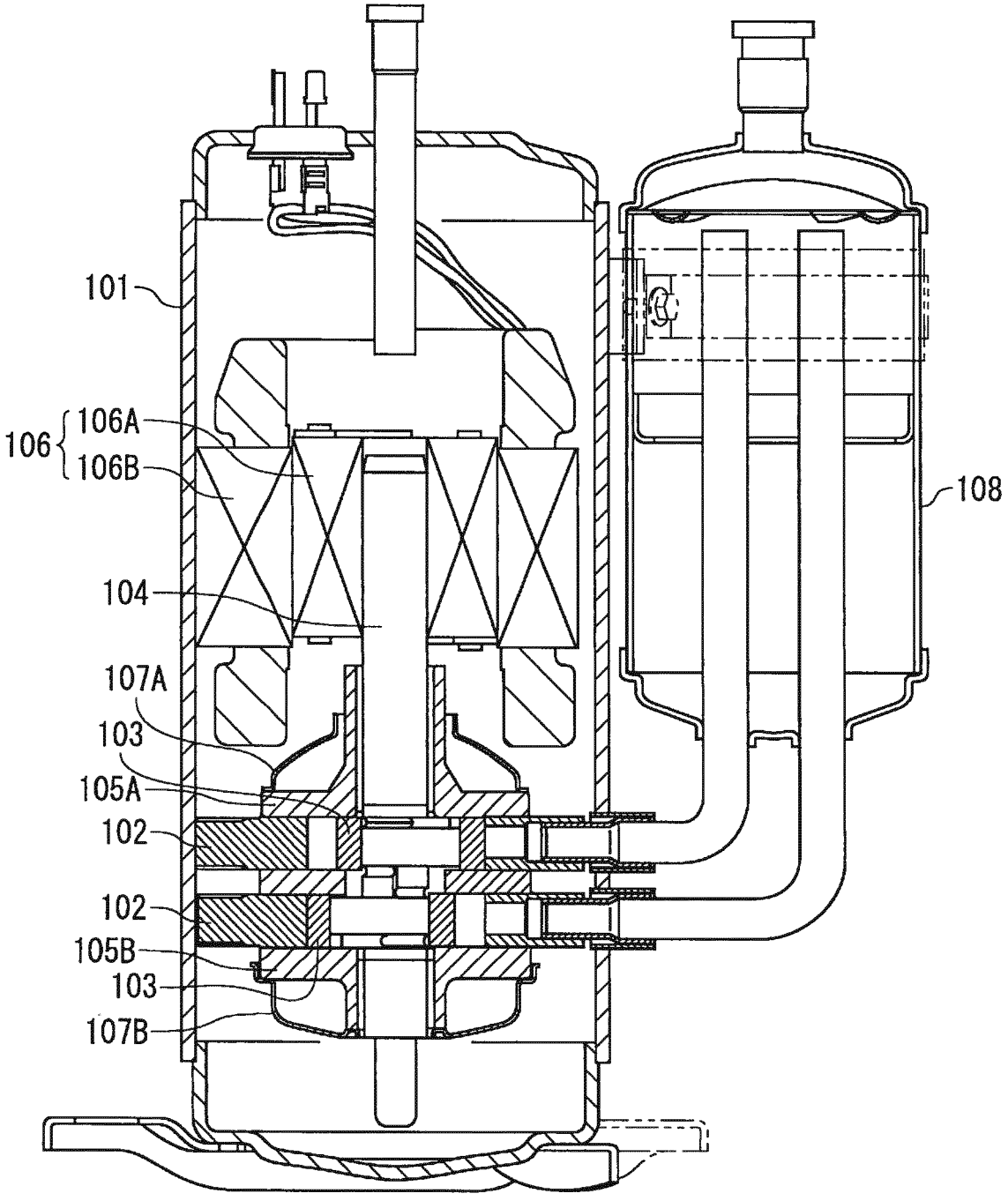


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/003029

A. CLASSIFICATION OF SUBJECT MATTER
F04B39/00(2006.01)i, *F04C29/12*(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)
F04B39/00, F04C29/12

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	1996-2015
Kokai Jitsuyo Shinan Koho	1971-2015	Toroku Jitsuyo Shinan Koho	1994-2015

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 A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 6047/1981(Laid-open No. 120775/1982) (Mitsubishi Electric Corp.), 27 July 1982 (27.07.1982), fig. 1; claims (Family: none)	1,2,6-8 3-5
Y A	JP 2003-136948 A (Nippon Soken, Inc.), 14 May 2003 (14.05.2003), paragraphs [0012] to [0013] (Family: none)	1,2,6-8 3-5

☒ 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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
09 September 2015 (09.09.15)	29 September 2015 (29.09.15)
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) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/003029

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 2009-162222 A (Daikin Industries, Ltd.), 23 July 2009 (23.07.2009), fig. 1 to 3; claim 1 & WO 2009/078355 A1	1-8

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2013119817 A **[0008]**