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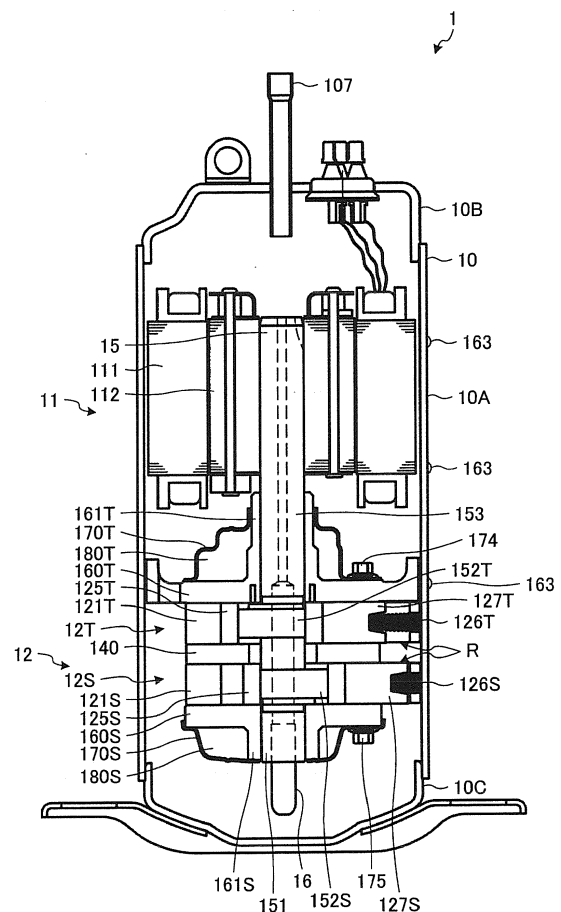
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(54) **ROTARY COMPRESSOR**

(57) A rotary compressor (1) includes: a sealed vertical compressor housing (10) in which a refrigerant discharging unit is provided at an upper part, a refrigerant intake unit is provided at a lower part, and lubricant oil is retained; a compressing unit (12) configured to be disposed in the compressor housing, include an upper end plate and a lower end plate that block an annular cylinder and end portions of the cylinder, and discharge a refrigerant sucked from the intake unit through the discharging unit by compressing the refrigerant in the cylinder; and a motor (11) configured to be disposed in the compressor housing, include a cylindrical stator (111) and a rotor (112) that is fixed to a rotation axis (15) to rotate in the stator, and drive the compressing unit via the rotation axis.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a rotary compressor used in an air conditioner or a refrigerating machine.

2. Description of Related Art

[0002] In the rotary compressor, if compressive strain is generated in a stator of a motor disposed in a compressor housing, magnetization characteristics of the stator are degraded to cause an increase in iron loss, and thus the efficiency of the motor is lowered.

[0003] For example, Japanese Laid-open Patent Publication No. 2010-255623 (Patent Document 1) discloses a compressor that includes a sealed vessel, a motor including at least a stator and a rotor and disposed in the sealed vessel, and a compression mechanism including at least an axis driven by the rotor. In the compressor, the outer diameter of the compression mechanism is greater than the outer diameter of the stator, and the compressor further includes a ring-shaped fixation member which is inserted between the sealed vessel and the outer diameter of the stator to be fixed to the outer circumference of the stator through an interference fit, and is welded to the sealed vessel at three locations.

[0004] In addition, Patent Document 1 discloses a compressor that includes a sealed vessel, a motor including at least a stator and a rotor and disposed in the sealed vessel, and a compression mechanism including at least an axis driven by the rotor. In the compressor, the outer diameter of the compression mechanism is greater than the outer diameter of the stator, and the compressor further includes a throttle part which is obtained by subjecting a part of the sealed vessel to drawing processing and of which the drawn part is in contact with the stator, the throttle part being fixed to the stator by laser welding.

[0005] Furthermore, Japanese Laid-open Patent Publication No. 2008-248889 (Patent Document 2) discloses a compressor that includes an annular stator, a rotor disposed in an internal space of the stator to be rotatable, and a sealed vessel including a cylindrical portion that accommodates the stator and the rotor, in which the stator and the cylindrical portion are fixed to each other at three or more locations in a circumferential direction by spot welding, in a state where a clearance of 0.01 mm to 0.30 mm is secured between an outer circumferential surface of the stator and an inner circumferential surface of the cylindrical portion. The compression mechanism of the compressor is screwed to a mounting plate, and the mounting plate is spot-welded to the cylindrical portion of the sealed vessel.

[0006] However, in the compressor disclosed in Patent

Document 1 that includes a ring-shaped fixation member which is inserted between the sealed vessel and the outer diameter of the stator to be fixed to the outer circumference of the stator through an interference fit, and is welded to the sealed vessel at three locations, the ring-shaped fixation member is fixed to the outer circumference of the stator through an interference fit. Therefore, there is a problem in that compressive strain is generated in the stator, and thus, the efficiency of the motor is lowered. In addition, there is also a problem in that the costs for the use of the fixation member are increased.

[0007] In addition, in the compressor disclosed in Patent Document 1 which includes a throttle part which is obtained by subjecting a part of the sealed vessel to drawing processing and of which the drawn part is in contact with the stator, and in which the throttle part is fixed to the stator by laser welding, a part of the sealed vessel is subjected to drawing processing. Therefore, there is a problem in that the costs for the drawing processing are increased.

[0008] Furthermore, in the compressor disclosed in Patent Document 2, the stator and the cylindrical portion are fixed to each other at three or more locations in a circumferential direction by spot welding, in a state where a radial clearance of 0.01 mm to 0.30 mm is secured between the stator and the cylindrical portion, the compression mechanism is screwed to a mounting plate, and the mounting plate is spot-welded to the cylindrical portion of the sealed vessel. Therefore, in a case where a radial clearance of 0.30 mm is provided between a stator and a cylindrical portion, there is a problem in that since the radial clearance is too large, it is necessary to perform centering of the stator with respect to the cylindrical portion, and thus assembly work is increased. In addition, since the compression mechanism is fixed to the cylindrical portion via the mounting plate, there is a problem in that costs for the use of the mounting plate are increased.

SUMMARY OF THE INVENTION

[0009] An object of the invention is to provide a rotary compressor in which compressive strain is not generated in a stator of a motor disposed in a compressor housing, the efficiency of the motor is high, and an increase in costs is suppressed.

[0010] According to the invention, there is provided a rotary compressor including: a sealed vertical compressor housing in which a refrigerant discharging unit is provided at an upper part, a refrigerant intake unit is provided at a lower part, and lubricant oil is retained; a compressing unit that is disposed in the compressor housing, includes an upper end plate and a lower end plate that block an annular cylinder and end portions of the cylinder, and discharges a refrigerant sucked from the intake unit through the discharging unit by compressing the refrigerant in the cylinder; and a motor that is disposed in the compressor housing, includes a cylindrical stator and a

rotor that is fixed to a rotation axis to rotate in the stator, and drives the compressing unit via the rotation axis, in which, in a case where an inner diameter of a body unit of the compressor housing is ϕD_m , an outer diameter of the upper end plate of the compressing unit is ϕD_b , and an outer diameter of the stator of the motor is ϕD_s , ϕD_m , ϕD_b , and ϕD_s are set such that two expressions of $-0.05 \text{ mm} \leq \phi D_m - \phi D_b \leq 0.05 \text{ mm}$ and $0.1 \text{ mm} \leq \phi D_m - \phi D_s \leq 0.2 \text{ mm}$ are satisfied, and an outer circumferential portion of the upper end plate and an outer circumferential portion of the stator are respectively spot-welded to the body unit of the compressor housing at a plurality of sites separated in a circumferential direction.

[0011] In the invention, in a case where the inner diameter of the body unit of the compressor housing is ϕD_m , the outer diameter of the upper end plate of the compressing unit is ϕD_b , and the outer diameter of the stator of the motor is ϕD_s , ϕD_m , ϕD_b , and ϕD_s are set such that two expressions of $-0.05 \text{ mm} \leq \phi D_m - \phi D_b \leq 0.05 \text{ mm}$ and $0.1 \text{ mm} \leq \phi D_m - \phi D_s \leq 0.2 \text{ mm}$ are satisfied, and the outer circumferential portion of the upper end plate and the outer circumferential portion of the stator are respectively spot-welded to the body unit of the compressor housing at a plurality of sites separated in the circumferential direction. Therefore, the compressive strain is not generated in the stator of the motor disposed in the compressor housing, and thus the magnetization characteristics of the stator are not degraded. As a result, the efficiency of the motor is high and it is possible to suppress an increase in costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a vertical sectional view illustrating an example of a rotary compressor according to the invention.

Fig. 2 is a cross-sectional view illustrating a first compressing unit and a second compressing unit of the rotary compressor of the example, when seen from above.

Fig. 3 is a vertical sectional view illustrating a stator and a rotor of the rotary compressor of the example before being assembled.

Fig. 4 is a vertical sectional view illustrating the stator and the rotor of the rotary compressor of the example after being assembled.

Fig. 5 is a vertical sectional view illustrating the compressing unit and the stator of the rotary compressor and a body unit of a compressor housing of the example before being fitted to each other.

Fig. 6 is a vertical sectional view illustrating the compressing unit and the stator of the rotary compressor and the body unit of the compressor housing of the example after being fitted to each other.

Fig. 7 is a cross-sectional view taken along line A-A of Fig. 6.

Fig. 8 is a cross-sectional view taken along line B-B of Fig. 6.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Hereinafter, an embodiment (example) of the invention will be described in detail with reference to the drawings. Example

[0014] Fig. 1 is a vertical sectional view illustrating an example of a rotary compressor according to the invention. Fig. 2 is a cross-sectional view illustrating a first compressing unit and a second compressing unit of the rotary compressor of the example, when seen from above.

[0015] As illustrated in Fig. 1, a rotary compressor 1 includes a compressing unit 12 that is disposed on a lower part of a compressor housing 10 that is sealed and has a vertical cylindrical shape, and a motor 11 that is disposed on an upper part of the compressor housing 10 and drives the compressing unit 12 via a rotation axis 15.

[0016] A stator 111 of the motor 11 is formed in a cylindrical shape and is fixed to an inner circumferential surface of a body unit 10A of the compressor housing 10 by spot welding. A dimensional relationship and an assembly method of the body unit 10A of the compressor housing 10 and the stator 111 which are characteristic configurations of the rotary compressor 1 of the invention will be described below. A rotor 112 is disposed in the cylindrical stator 111 and is fixed to the rotation axis 15 by shrink-fitting which mechanically connects the motor 11 and the compressing unit 12.

[0017] The compressing unit 12 includes a first compressing unit 12S and a second compressing unit 12T. As illustrated in Fig. 2, the first compressing unit 12S includes an annular first cylinder 121S. The first cylinder 121S includes a first side-flared portion 122S that projects away from the annular outer circumference. A first inlet hole 135S and a first vane groove 128S are radially provided in the first side-flared portion 122S. In addition, the second compressing unit 12T is disposed on the upper side of the first compressing unit 12S. The second compressing unit 12T includes an annular second cylinder 121T. The second cylinder 121T includes a second side-flared portion 122T that projects away from the annular outer circumference. A second inlet hole 135T and a second vane groove 128T are radially provided in the second side-flared portion 122T.

[0018] As illustrated in Fig. 2, a first cylinder inner wall 123S having a circular shape is formed in the first cylinder 121S to be concentric with the rotation axis 15 of the motor 11. A first annular piston 125S having an outer diameter smaller than an inner diameter of the first cylinder 121S is disposed in the first cylinder inner wall 123S. A first cylinder chamber 130S that sucks, compresses, and discharges a refrigerant is formed between the first cylinder inner wall 123S and the first annular piston 125S. A second cylinder inner wall 123T having a circular shape is formed in the second cylinder 121T to

be concentric with the rotation axis 15 of the motor 11. A second annular piston 125T having an outer diameter smaller than an inner diameter of the second cylinder 121T is disposed in the second cylinder inner wall 123T. A second cylinder chamber 130T that sucks, compresses, and discharges a refrigerant is formed between the second cylinder inner wall 123T and the second annular piston 125T.

[0019] In the first cylinder 121S, the first vane groove 128S is formed along the entire height of the cylinder in a radial direction away from the first cylinder inner wall 123S. A flat first vane 127S is slidably fitted in the first vane groove 128S. In the second cylinder 121T, the second vane groove 128T is formed along the entire height of the cylinder in the radial direction away from the second cylinder inner wall 123T. A flat second vane 127T is slidably fitted in the second vane groove 128T.

[0020] As illustrated in Fig. 2, a first spring bore 124S is formed on the outer side of the first vane groove 128S in the radial direction so as to communicate with the first vane groove 128S from an outer circumferential portion of the first side-flared portion 122S. A first vane spring 126S (refer to Fig. 1) that presses a rear surface of the first vane 127S is inserted into the first spring bore 124S. A second spring bore 124T is formed on the outer side of the second vane groove 128T in the radial direction so as to communicate with the second vane groove 128T from an outer circumferential portion of the second side-flared portion 122T. A second vane spring 126T (refer to Fig. 1) that presses a rear surface of the second vane 127T is inserted into the second spring bore 124T.

[0021] At the time of activating the rotary compressor 1, the first vane 127S protrudes away from the first vane groove 128S into the first cylinder chamber 130S due to the repulsive force of the first vane spring 126S. A tip end of the first vane 127S is in contact with an outer circumferential surface of the first annular piston 125S, and by the first vane 127S, the first cylinder chamber 130S is divided into a first inlet chamber 131S and a first compression chamber 133S. Similarly, the second vane 127T protrudes away from the second vane groove 128T into the second cylinder chamber 130T due to the repulsive force of the second vane spring 126T. A tip end of the second vane 127T is in contact with an outer circumferential surface of the second annular piston 125T, and the second cylinder chamber 130T is divided by the second vane 127T into a second inlet chamber 131T and a second compression chamber 133T.

[0022] In addition, in the first cylinder 121S, a first pressure guiding-in path 129S is formed which communicates with the outer side of the first vane groove 128S in the radial direction and the inside of the compressor housing 10 via an opening portion R (refer to Fig. 1), introduces the compressed refrigerant in the compressor housing 10, and applies back pressure to the first vane 127S by the pressure of the refrigerant. The compressed refrigerant in the compressor housing 10 is also introduced through the first spring bore 124S. In addition, in the sec-

ond cylinder 121T, a second pressure guiding-in path 129T is formed which communicates with the outer side of the second vane groove 128T in the radial direction and the inside of the compressor housing 10 via the opening portion R (refer to Fig. 1), introduces the compressed refrigerant in the compressor housing 10, and applies back pressure to the second vane 127T by the pressure of the refrigerant. The compressed refrigerant in the compressor housing 10 is also introduced through the second spring bore 124T.

[0023] The first inlet hole 135S, that causes the first inlet chamber 131S and an external unit to communicate with each other, is provided in the first side-flared portion 122S of the first cylinder 121S in order to suck the refrigerant from the external unit into the first inlet chamber 131S. The second inlet hole 135T, that causes the second inlet chamber 131T and the external unit to communicate with each other, is provided in the second side-flared portion 122T of the second cylinder 121T in order to suck the refrigerant from the external unit into the second inlet chamber 131T. The cross sectional shapes of the first inlet hole 135S and the second inlet hole 135T are circles.

[0024] As illustrated in Fig. 1, an intermediate partition plate 140 is disposed between the first cylinder 121S and the second cylinder 121T and partitions the first cylinder chamber 130S (refer to Fig. 2) of the first cylinder 121S from the second cylinder chamber 130T (refer to Fig. 2) of the second cylinder 121T. In addition, the intermediate partition plate 140 blocks an upper end portion of the first cylinder 121S and a lower end portion of the second cylinder 121T.

[0025] A lower end plate 160S is disposed on the lower end portion of the first cylinder 121S and blocks the first cylinder chamber 130S of the first cylinder 121S. In addition, an upper end plate 160T is disposed on the upper end portion of the second cylinder 121T and blocks the second cylinder chamber 130T of the second cylinder 121T. The lower end plate 160S blocks the lower end portion of the first cylinder 121S and the upper end plate 160T blocks the upper end portion of the second cylinder 121T.

[0026] A sub-bearing unit 161S is formed on the lower end plate 160S, and a sub-axis unit 151 of the rotation axis 15 is rotatably supported by the sub-bearing unit 161S. A main-bearing unit 161T is formed on the upper end plate 160T, and a main-axis unit 153 of the rotation axis 15 is rotatably supported by the main-bearing unit 161T.

[0027] The rotation axis 15 includes a first eccentric portion 152S and a second eccentric portion 152T which are eccentric to each other by deviating the phases thereof by 180°. The first eccentric portion 152S is rotatably fitted in the first annular piston 125S of the first compressing unit 12S. The second eccentric portion 152T is rotatably fitted in the second annular piston 125T of the second compressing unit 12T.

[0028] If the rotation axis 15 is rotated, the first annular

piston 125S revolves along the first cylinder inner wall 123S in the first cylinder 121S in a clockwise direction in Fig. 2. The first vane 127S is moved in a reciprocating manner by following the revolution of the piston. According to the movement of the first annular piston 125S and the first vane 127S, the volumes of the first inlet chamber 131S and the first compression chamber 133S are continuously changed, and thus the compressing unit 12 continuously sucks, compresses, and discharges the refrigerant in sequence. If the rotation axis 15 is rotated, the second annular piston 125T revolves along the second cylinder inner wall 123T in the second cylinder 121T in the clockwise direction in Fig. 2. The second vane 127T is moved in a reciprocating manner by following the revolution of the piston. According to the movement of the second annular piston 125T and the second vane 127T, the volumes of the second inlet chamber 131T and the second compression chamber 133T are continuously changed, and thus the compressing unit 12 continuously sucks, compresses, and discharges the refrigerant in sequence.

[0029] As illustrated in Fig. 1, a cover for lower end plate 170S is disposed on the lower side of the lower end plate 160S and a lower muffler chamber 180S is formed between the cover for lower end plate 170S and the lower end plate 160S. The first compressing unit 12S is opened toward the lower muffler chamber 180S. That is, a first outlet 190S (refer to Fig. 2) that communicates with the first compression chamber 133S of the first cylinder 121S and the lower muffler chamber 180S is provided on the lower end plate 160S in the vicinity of the first vane 127S. A reed valve type first discharge valve (not illustrated) that prevents backflow of the compressed refrigerant is disposed in the first outlet 190S.

[0030] The lower muffler chamber 180S is one chamber formed in an annular shape, and is a part of a communication path which causes the discharging side of the first compressing unit 12S to communicate with the inside of an upper muffler chamber 180T through a refrigerant path 136 (refer to Fig. 2) that penetrates the lower end plate 160S, the first cylinder 121S, the intermediate partition plate 140, the second cylinder 121T, and the upper end plate 160T. The lower muffler chamber 180S reduces the pressure pulsation of the discharged refrigerant. A first discharge valve cap (not illustrated) for restricting an opening amount of bent of the first discharge valve is fixed together with the first discharge valve by a rivet so as to overlap the first discharge valve. The first outlet 190S, the first discharge valve, and the first discharge valve cap configure a first discharge valve unit of the lower end plate 160S.

[0031] As illustrated in Fig. 1, a cover for upper end plate 170T is disposed on the upper side of the upper end plate 160T and the upper muffler chamber 180T is formed between the cover for upper end plate 170T and the upper end plate 160T. A second outlet 190T (refer to Fig. 2), that communicates with the second compression chamber 133T of the second cylinder 121T and the upper

muffler chamber 180T, is provided on the upper end plate 160T in the vicinity of the second vane 127T. A reed valve type second discharge valve (not illustrated), that prevents backflow of the compressed refrigerant, is disposed in the second outlet 190T. A second discharge valve cap (not illustrated) for restricting an opening amount of bent of the second discharge valve is fixed together with the second discharge valve by a rivet so as to overlap the second discharge valve. The upper muffler chamber 180T reduces the pressure pulsation of the discharged refrigerant. The second outlet 190T, the second discharge valve, and the second discharge valve cap configure a second discharge valve unit of the upper end plate 160T.

[0032] The cover for lower end plate 170S, the lower end plate 160S, the first cylinder 121S, and the intermediate partition plate 140 are inserted from the lower side and are fastened to the second cylinder 121T by using a plurality of penetrating bolts 175 that are screwed into female screws provided on the second cylinder 121T. The cover for upper end plate 170T and the upper end plate 160T are inserted from the upper side and are fastened to the second cylinder 121T by using a penetrating bolt 174 that is screwed into the female screw provided on the second cylinder 121T. The cover for lower end plate 170S, the lower end plate 160S, the first cylinder 121S, the intermediate partition plate 140, the second cylinder 121T, the upper end plate 160T, and the cover for upper end plate 170T, which are integrally fastened by using the plurality of penetrating bolts 174 and 175 and the like, configure the compressing unit 12. In the compressing unit 12, the outer circumferential portion of the upper end plate 160T is fixed to the body unit 10A of the compressor housing 10 by spot welding, and thus the compressing unit 12 is fixed to the compressor housing 10. The dimensional relationship of the upper end plate 160T and the body unit 10A will be described below.

[0033] The low pressure refrigerant of a refrigerant circuit is guided to the first compressing unit 12S through an accumulator (not illustrated) and the first inlet hole 135S (refer to Fig. 2) of the first cylinder 121S. In addition, the low pressure refrigerant of the refrigerant circuit is guided to the second compressing unit 12T through the accumulator (not illustrated) and the second inlet hole 135T (refer to Fig. 2) of the second cylinder 121T. That is, the first inlet hole 135S and the second inlet hole 135T are connected to an evaporator of the refrigerant circuit in parallel.

[0034] A discharge pipe 107 as a discharging unit that is connected to the refrigerant circuit and discharges the high pressure refrigerant to a condenser side of the refrigerant circuit is connected to the top of the compressor housing 10. That is, the first outlet 190S and the second outlet 190T are connected to the condenser of the refrigerant circuit.

[0035] In the compressor housing 10, the lubricant oil is enclosed approximately up to the height of the second cylinder 121T. In addition, the lubricant oil is sucked

through a lubricating pipe 16, which is attached to the lower end portion of the rotation axis 15, by a pump impeller (not illustrated) inserted into a lower portion of the rotation axis 15, and circulates in the compressing unit 12, thereby performing lubrication between sliding components (the first annular piston 125S and the second annular piston 125T) and performing sealing of a minute gap of the compressing unit 12.

[0036] Next, the characteristic configuration of the rotary compressor 1 of the example will be described with reference to Figs. 3 to 8. Fig. 3 is a vertical sectional view illustrating a stator and a rotor of the rotary compressor of the example before being assembled. Fig. 4 is a vertical sectional view illustrating the stator and the rotor of the rotary compressor of the example after being assembled. Fig. 5 is a vertical sectional view illustrating the compressing unit and the stator of the rotary compressor and a body unit of a compressor housing of the example before being fitted to each other. Fig. 6 is a vertical sectional view illustrating the compressing unit and the stator of the rotary compressor and the body unit of the compressor housing of the example after being fitted to each other. Fig. 7 is a cross-sectional view taken along line A-A of Fig. 6. Fig. 8 is a cross-sectional view taken along line B-B of Fig. 6.

[0037] As illustrated in Fig. 3, the outer diameter ϕD_r of the rotor 112 of the motor 11 is formed to be smaller than the inner diameter ϕD_t of the stator 111 by 1.4 mm and the clearance between the outer circumferential surface of the rotor 112 and the inner circumferential surface of the stator 111 is 0.7 mm. The thickness of a shim 201 of a gap gage 200 which performs centering between the rotor 112 and the stator 111, is 0.6 mm, that is, smaller by 0.1 mm than the 0.7 mm of clearance between the outer circumferential surface of the rotor 112 and the inner circumferential surface of the stator 111.

[0038] As illustrated in Fig. 5, the outer diameter ϕD_s of the stator 111 of the motor 11 is formed to be smaller than the outer diameter ϕD_b of the upper end plate 160T of the compressing unit 12 ($\phi D_s < \phi D_b$). In addition, the inner diameter ϕD_m of the body unit 10A of the compressor housing 10 is formed to be greater than the outer diameter ϕD_s of the stator 111 by 0.1 mm to 0.2 mm ($0.1 \text{ mm} \leq \phi D_m - \phi D_s \leq 0.2 \text{ mm}$). Furthermore, the inner diameter ϕD_m of the body unit 10A is formed in a range of -0.05 mm to +0.05 mm relative to the outer diameter ϕD_b of the upper end plate 160T ($-0.05 \text{ mm} \leq \phi D_m - \phi D_b \leq 0.05 \text{ mm}$). As illustrated in Figs. 7 and 8, the body unit 10A is formed in a cylindrical shape obtained by rolling a steel sheet and welding the end portions of the sheet by butt welding, and the accuracy of the dimension of the inner diameter ϕD_m and the roundness are lower than those in a case where the body unit is formed by deep drawing or machining (a butt-welded site 165 is illustrated in Figs. 7 and 8).

[0039] Next, a method of fixing the motor 11 and the compressing unit 12 that are connected to each other via the rotation axis 15, in the body unit 10A of the compres-

sor housing 10 will be described. As illustrated in Figs. 3 and 4, at the time of assembling the motor 11, the stator 111 is placed on the upper end portion of a cylindrical assembly jig 210 including a circular concave portion 211 at the bottom thereof. The gap gage 200 of which a plurality of the shims 201 are attached to the outer circumferential portion is set to the upper portion of the stator 111.

[0040] The compressing unit 12 in which the rotor 112 is fixed to the rotation axis 15 is lowered by placing the rotor 112 downward so that the end portion of the rotation axis 15 comes into contact with an upper convex portion 202 of the gap gage 200. If the compressing unit 12 is further lowered, the rotor 112 is guided to the shim 201 of the gap gage 200 and is inserted into the stator 111 so that the gap gage 200 is pushed downward. As illustrated in Fig. 4, if a lower convex portion 203 of the gap gage 200 is fitted into the concave portion 211 of the assembly jig 210, the rotor 112 is completely inserted into the stator 111 and is centered by the shims 201, and thus the motor 11 is assembled.

[0041] Next, as illustrated in Figs. 5 and 6, in a state where the motor 11 and the compressing unit 12 are placed on the assembly jig 210, the upper end plate 160T of the compressing unit 12 and the stator 111 of the motor 11 are fitted into the body unit 10A of the compressor housing 10. Since the inner diameter ϕD_m of the body unit 10A is in a range of -0.05 mm to +0.05 mm relative to the outer diameter ϕD_b of the upper end plate 160T, the fitting between the body unit 10A and the upper end plate 160T is light press-fitting or light shrink-fitting in comparison with general press-fitting or shrink-fitting. Since the inner diameter ϕD_m of the body unit 10A is formed to be greater than the outer diameter ϕD_s of the stator 111 by 0.1 mm to 0.2 mm, the fitting between the body unit 10A and the stator 111 can be performed in a non-contact manner or in a single-sided contact manner in which compressive force is not applied. As illustrated in Fig. 6, the body unit 10A is lowered until the lower end thereof comes into contact with a step portion 212 of the assembly jig 210, and thus the fitting work is ended. In this state, a clearance of 0.05 mm to 0.10 mm is formed between the inner circumferential portion of the body unit 10A and the outer circumferential portion of the stator 111, and the centering between the stator 111 and the rotor 112 is performed.

[0042] Next, a method of fixing the upper end plate 160T of the compressing unit 12 and the stator 111 of the motor 11 to the body unit 10A of the compressor housing 10 will be described with reference to Figs. 6 to 8. In the body unit 10A, three holes 164 are provided (three or more holes 164 may be provided) at an interval of 120° in a circumferential direction respectively at a position where the upper end plate 160T is fitted, a position of the stator 111 on the compressing unit 12 side, and a position of the stator 111 symmetrical to the position on the compressing unit 12 side. Welding wire is inserted into the holes 164 and the body unit 10A and

the upper end plate 160T are firstly welded by spot welding. Next, the body unit 10A and the stator 111 are welded at the position of the stator 111 on the compressing unit 12 side and the position of the stator 111 symmetrical to the position on the compressing unit 12 side. The welding at the position on the compressing unit 12 side, and the welding at the position symmetrical to the position on the compressing unit 12 side, may be performed in an arbitrary order. Spot-welded sites 163 are illustrated in Fig. 6 (the holes 164 are completely blocked by spot welding and stand the pressure of the compressed refrigerant). Thereafter, the gap gage 200 is detached.

[0043] The motor 11 which is centered by the compressing unit 12 and the gap gage 200 is positioned in the body unit 10A to be fixed by firstly welding the body unit 10A and the upper end plate 160T. The stator 111 is directly welded to the body unit 10A in a state of being centered and in a state of not receiving compressive force in the radial direction from the body unit 10A. Therefore, the compressive strain is not generated in the stator 111, and thus the magnetization characteristics of the stator are not degraded so that iron loss is not increased. As a result, the efficiency of the motor 11 is high and it is possible to suppress an increase in costs.

[0044] In addition, the stator 111 is fixed to the body unit 10A by spot welding at the position of the stator 111 on the compressing unit 12 side and the position of the stator 111 symmetrical to the position on the compressing unit 12 side. Therefore, even if the rotary compressor 1 receives impact such as falling, the stator 111 is not damaged due to the dislocation of the caulking, which is between the welding position on the compressing unit 12 side and the position symmetrical to the welding position on the compressing unit 12 side, of the stator 111 that is formed by caulking the stacked steel sheets. Furthermore, as illustrated in Fig. 8, if the circumferential directional positions of the spot-welded sites 163 of the upper end plate 160T, the circumferential directional positions of the spot-welded sites 163 of the stator 111 on the compressing unit 12 side, and the circumferential directional positions of the spot-welded sites 163 of the stator 111 which are the positions symmetrical to the circumferential directional positions on the compressing unit 12 side are disposed such that the phases thereof are shifted from each other in the circumferential direction, the welded sites are not aligned in a straight line in an axial direction. Therefore, the distance between the welded sites of which the strength is relatively weak becomes great, and thus the strength of the body unit 10A does not become weak. In addition, since the maximum clearance between the inner circumferential portion of the body unit 10A and the outer circumferential portion of the stator 111 is 0.10 mm, a spatter due to welding does not enter the compressor housing 10.

[0045] After the compressing unit 12 and the motor 11 are welded to be fixed to the body unit 10A, if a bottom 10C and a top 10B are welded to the body unit 10A by full circle welding as illustrated in Fig. 1, the assembly of

the rotary compressor 1 is completed. The invention can be applied to a single cylinder type rotary compressor and a two-stage compression type rotary compressor.

[0046] Hereinbefore, the example has been described, but the example is not limited by the contents described above. In addition, the components described above include those that can be easily conceived by those skilled in the art, those that are substantially identical thereto, and those in a scope of so-called equivalents. In addition, the components described above can be appropriately combined. Furthermore, at least one of various omission, replacement, and modification of the components can be performed without departing from the gist of the example.

Claims

1. A rotary compressor (1) comprising:

a sealed vertical compressor housing (10) in which a refrigerant discharging unit is provided at an upper part, a refrigerant intake unit is provided at a lower part, and lubricant oil is retained; a compressing unit (12) configured to be disposed in the compressor housing (10), include an upper end plate and a lower end plate that block an annular cylinder and end portions of the cylinder, and discharge a refrigerant sucked from the intake unit through the discharging unit by compressing the refrigerant in the cylinder; and

a motor (11) configured to be disposed in the compressor housing, include a cylindrical stator (111) and a rotor (112) that is fixed to a rotation axis (15) to rotate in the stator, and drive the compressing unit via the rotation axis, wherein, in a case where an inner diameter of a body unit (10A) of the compressor housing is ϕD_m , an outer diameter of the upper end plate of the compressing unit is ϕD_b , and an outer diameter of the stator of the motor is ϕD_s , ϕD_m , ϕD_b , and ϕD_s are set such that two expressions of $-0.05 \text{ mm} \leq \phi D_m - \phi D_b \leq 0.05 \text{ mm}$ and $0.1 \text{ mm} \leq \phi D_m - \phi D_s \leq 0.2 \text{ mm}$ are satisfied, and an outer circumferential portion of the upper end plate and an outer circumferential portion of the stator are respectively spot-welded to the body unit of the compressor housing at a plurality of sites separated in a circumferential direction.

2. The rotary compressor according to claim 1, wherein the spot welding between the stator of the motor and the body unit of the compressor housing is performed after the spot welding between the upper end plate of the compressing unit and the body unit.

3. The rotary compressor according to claim 2, wherein the spot welding between the stator of the motor and

the body unit of the compressor housing is performed in a state where centering between the stator and the rotor of the motor is performed.

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FIG. 1

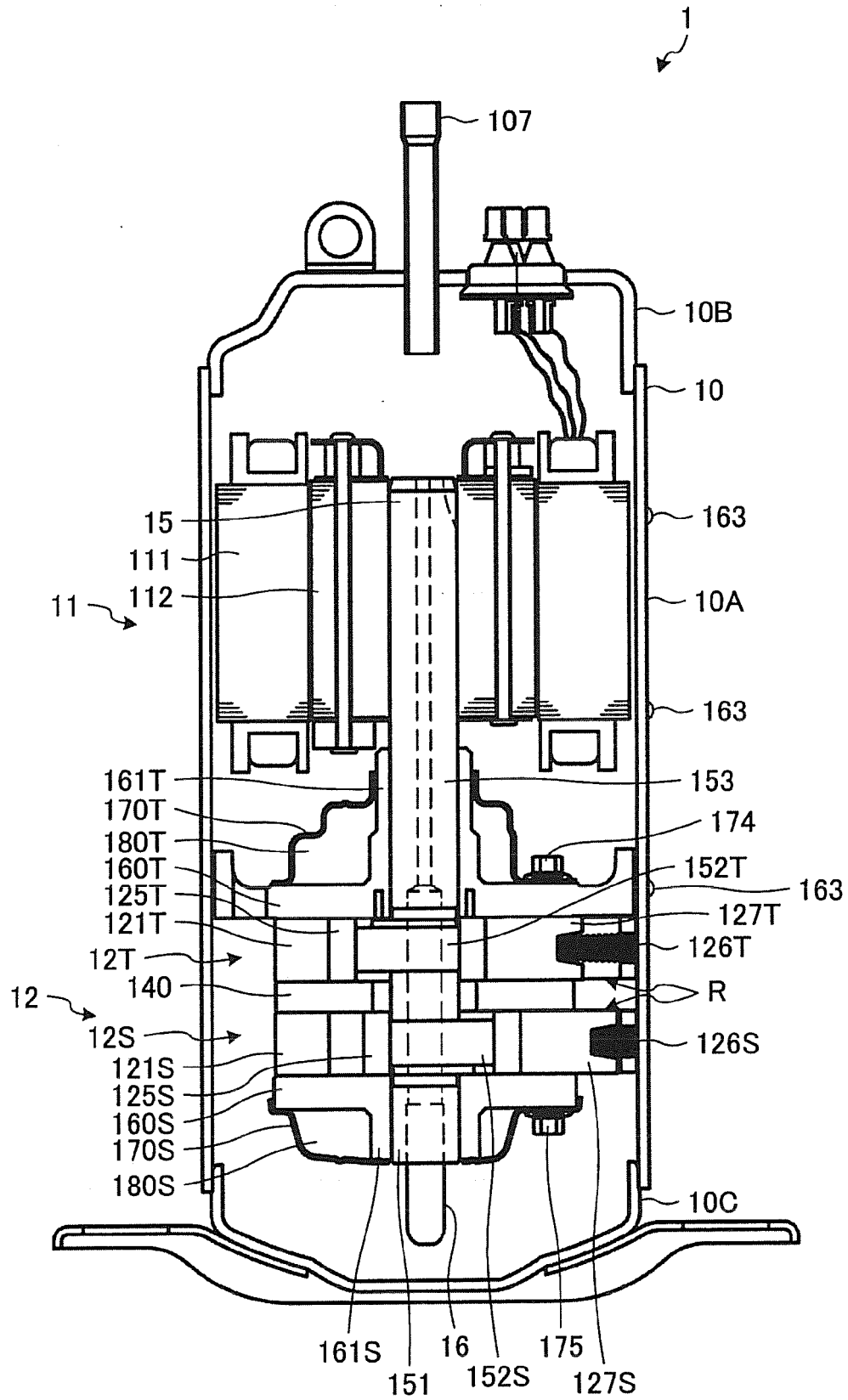


FIG. 2

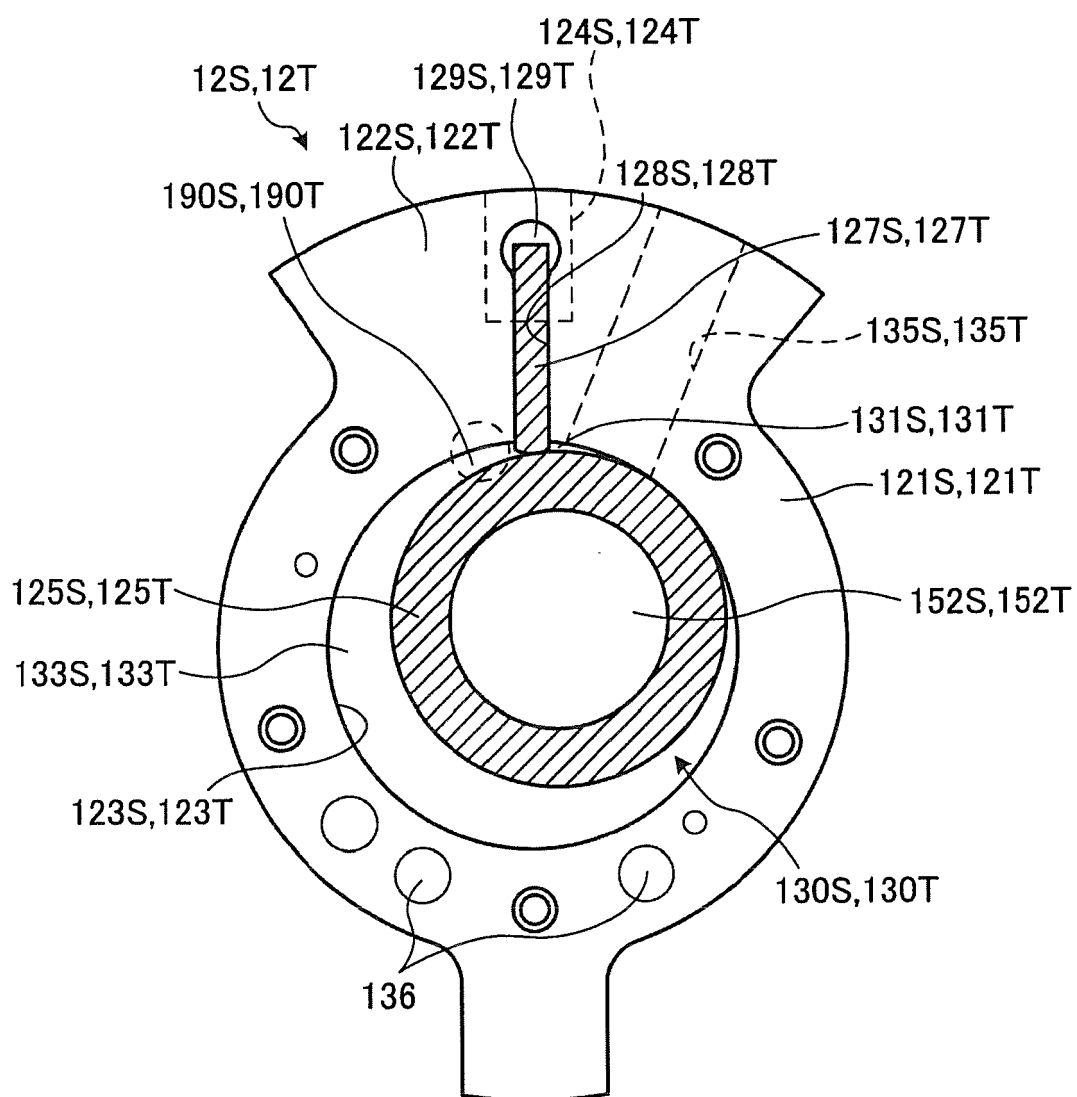


FIG. 3

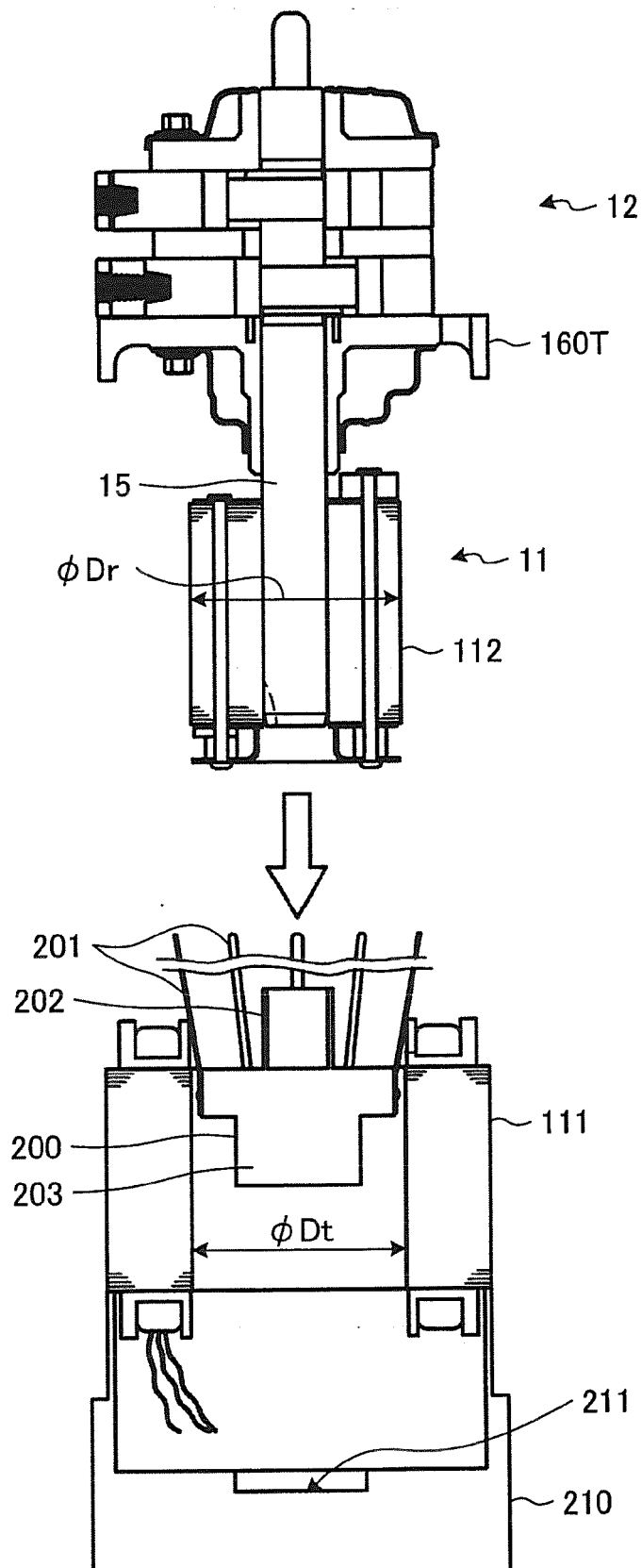


FIG. 4

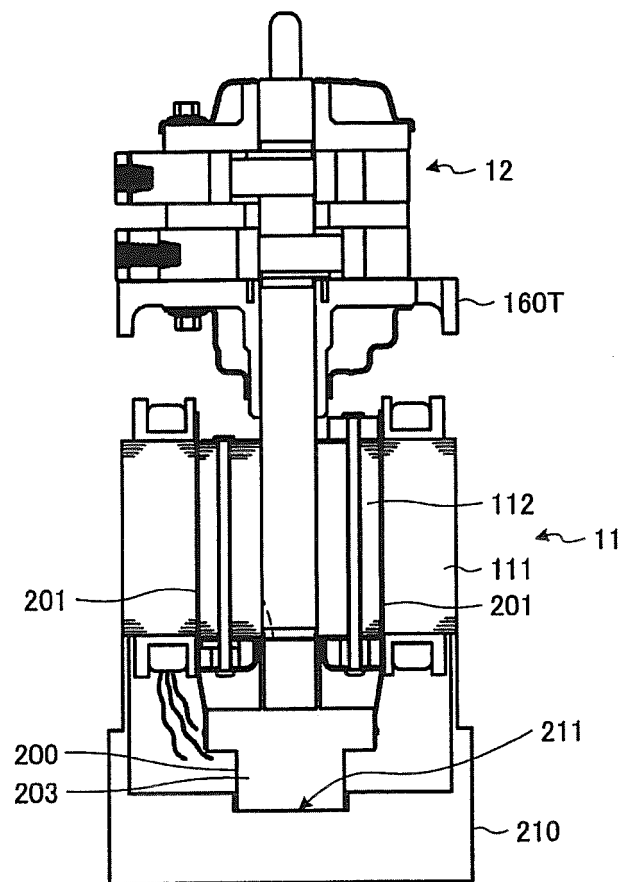


FIG. 5

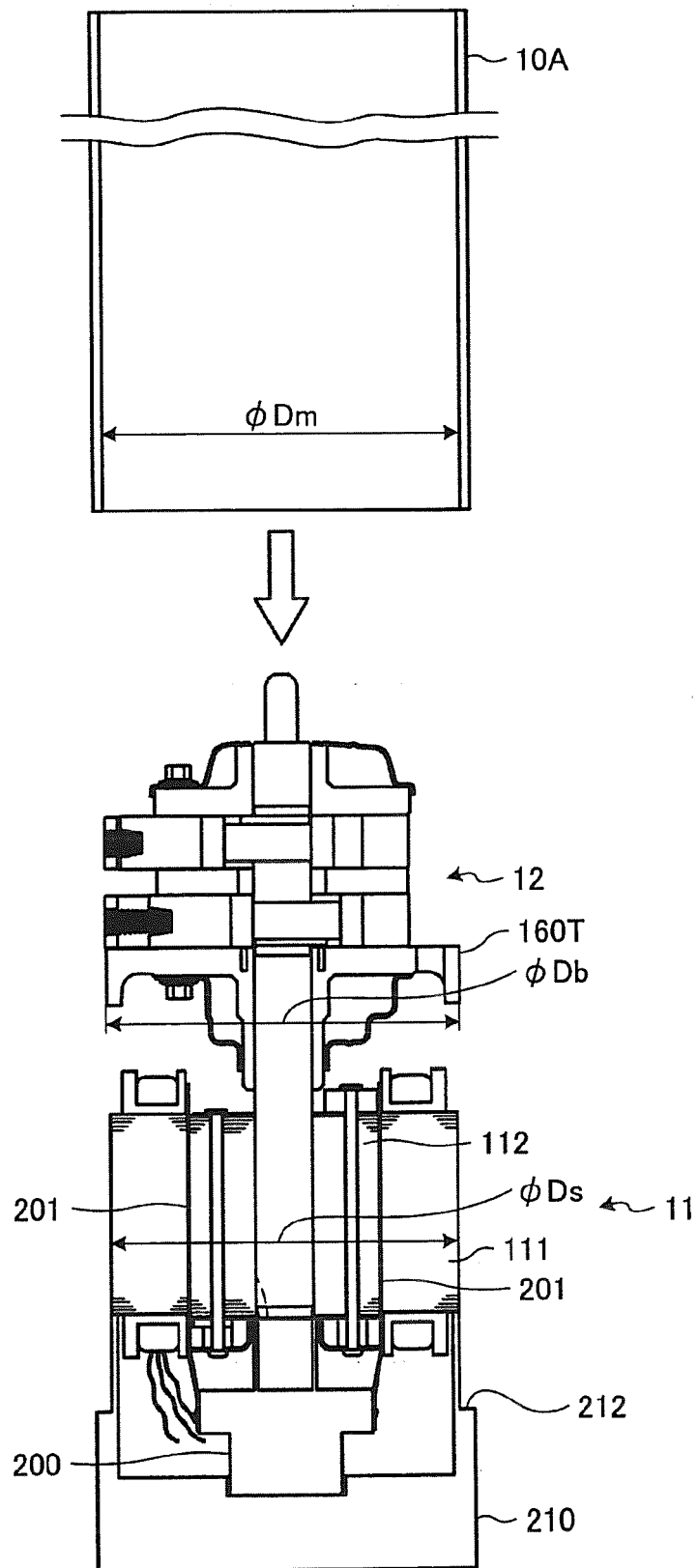


FIG. 6

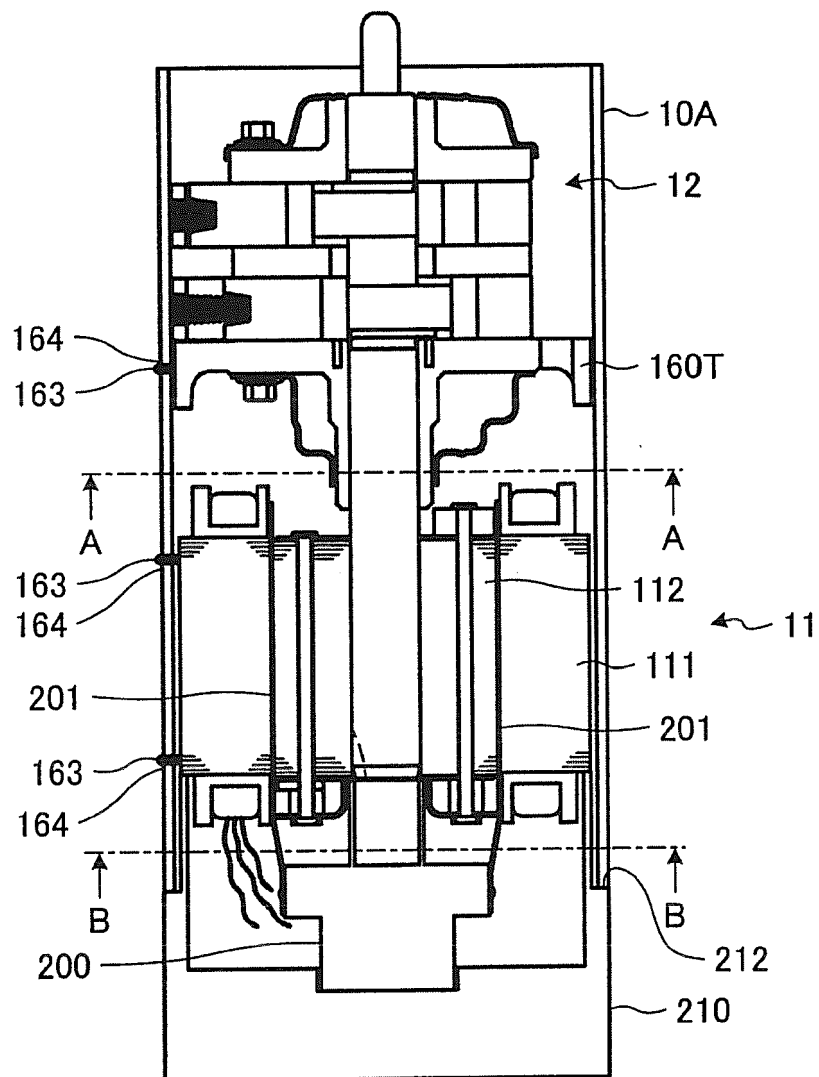


FIG. 7

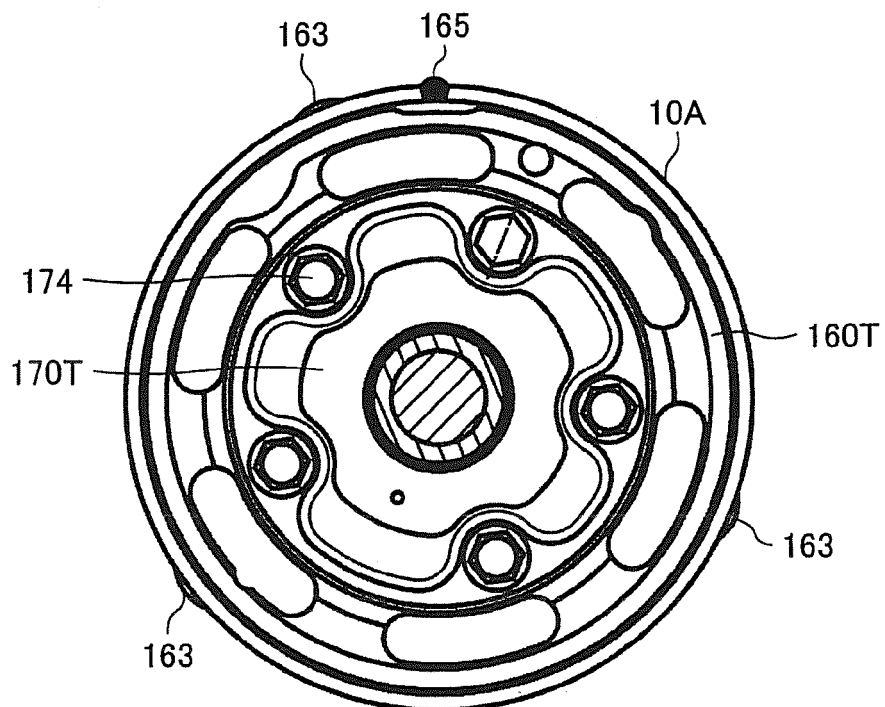
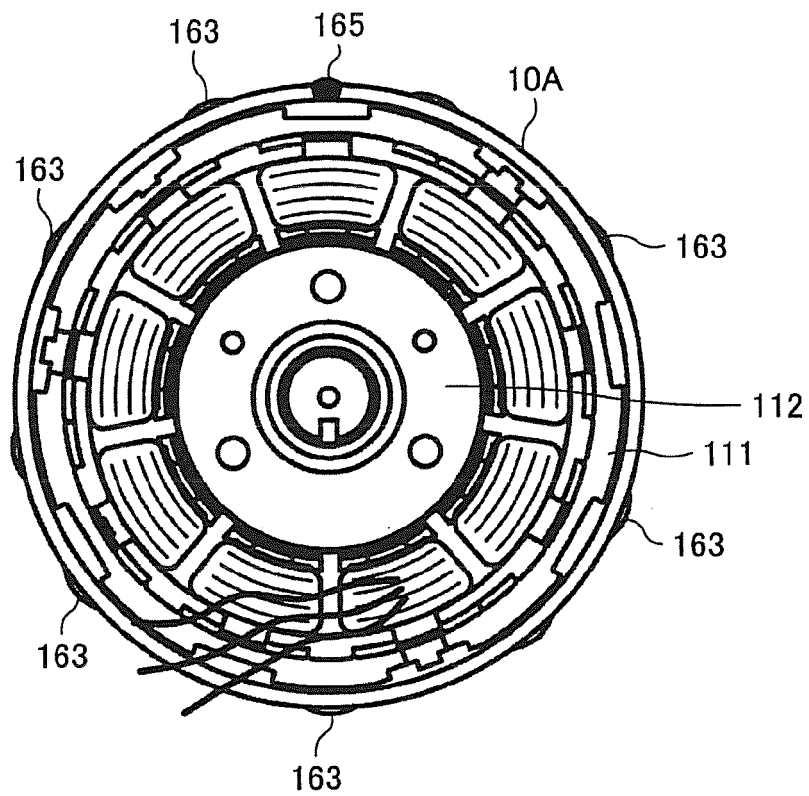


FIG. 8





EUROPEAN SEARCH REPORT

 Application Number
 EP 16 16 2407

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EPO FORM 1503 03.02 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 050 960 A1 (DAIKIN IND LTD [JP]) 22 April 2009 (2009-04-22) * paragraph [0008] - paragraph [0010]; figure 1 *	1-3	INV. F04C23/00 F04C18/356
A	EP 2 000 671 A1 (DAIKIN IND LTD [JP]) 10 December 2008 (2008-12-10) * paragraph [0070] - paragraph [0071]; figures 1,7 *	1-3	
A	EP 2 138 722 A1 (DAIKIN IND LTD [JP]) 30 December 2009 (2009-12-30) * the whole document *	1-3	
A	EP 2 330 301 A1 (MITSUBISHI HEAVY IND LTD [JP]) 8 June 2011 (2011-06-08) * the whole document *	1-3	
			TECHNICAL FIELDS SEARCHED (IPC)
			F04C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 July 2016	Examiner Alquezar Getan, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 16 2407

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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50

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ORM P0459

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2050960 A1	22-04-2009	AU 2007282514 A1	14-02-2008
		CN 101501336 A	05-08-2009
		CN 102094788 A	15-06-2011
		EP 2050960 A1	22-04-2009
		JP 2008045431 A	28-02-2008
		KR 20090029850 A	23-03-2009
		US 2010166577 A1	01-07-2010
		WO 2008018499 A1	14-02-2008

EP 2000671 A1	10-12-2008	AU 2007230458 A1	04-10-2007
		CN 101395374 A	25-03-2009
		EP 2000671 A1	10-12-2008
		JP 2007255332 A	04-10-2007
		KR 20080091865 A	14-10-2008
		US 2009123308 A1	14-05-2009
		WO 2007111141 A1	04-10-2007

EP 2138722 A1	30-12-2009	AU 2008233911 A1	09-10-2008
		CN 101646869 A	10-02-2010
		EP 2138722 A1	30-12-2009
		JP 4241849 B2	18-03-2009
		JP 2008255808 A	23-10-2008
		KR 20090122257 A	26-11-2009
		US 2010021321 A1	28-01-2010
		WO 2008120463 A1	09-10-2008

EP 2330301 A1	08-06-2011	EP 2330301 A1	08-06-2011
		JP 5535511 B2	02-07-2014
		JP 2010236488 A	21-10-2010
		WO 2010113735 A1	07-10-2010

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010255623 A [0003]
- JP 2008248889 A [0005]