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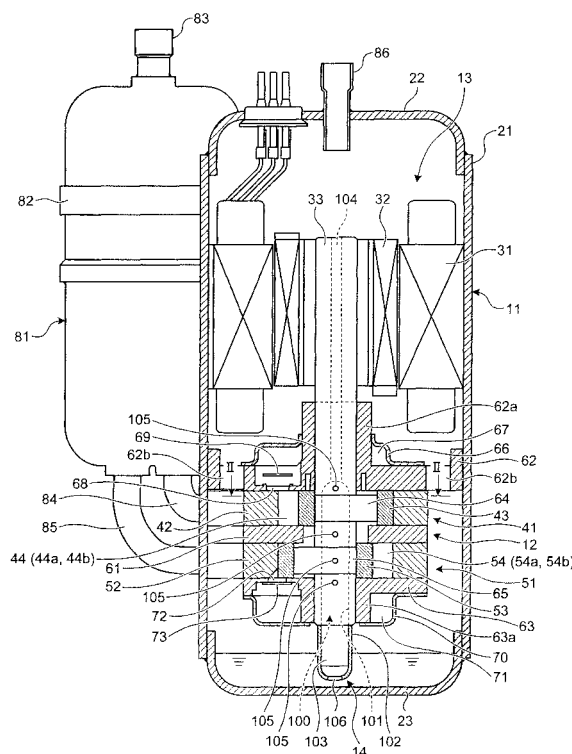
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(54) **Rotary compressor**

(57) According to one embodiment, a rotary compressor includes a compressor housing (11), a compressing unit (12), a motor (13), and an oil supply mechanism (14). The compressor housing (11) has an inlet (48) and an outlet (68, 72) of refrigerant. The compressing unit (12) compresses refrigerant sucked in from the inlet (48). The motor (13) drives the compressing unit (12) through a rotation shaft (33). The oil supply mechanism (14) supplies lubricant oil to the compressing unit (12) through an oil supply hole (100) of the rotation shaft (33). The oil supply mechanism (14) includes a housing hole (101), a pump case (102), and a pump vane (103). The housing hole (101) is communicated with the oil supply hole (100). The pump case (102) is fitted in the housing hole (101). The pump vane (103) is housed in the pump case (102), and includes a large width portion (107) which is locked by the upper inner surface of the pump case (102).

FIG.1



Description

FIELD

[0001] The embodiments discussed herein are directed to a rotary compressor.

BACKGROUND

[0002] A conventional rotary compressor is provided with a motor and a compressing unit in the sealed housing. The compressing unit is located below the motor and is driven by the motor. The compressing unit includes a cylinder, an annular piston, and a vane. The cylinder has an inlet and an outlet. The annular piston is attached to an eccentric portion of the rotation shaft of the motor to form an operation chamber the volume of which is variable. The vane moves in and out of the operation chamber from the cylinder and comes in contact with the annular piston, thereby partitioning the operation chamber into an inlet chamber and a compression chamber.

[0003] As the rotation shaft is rotated by the motor, the annular piston revolves via the eccentric portion inside the cylinder. Accordingly, refrigerant is sucked into the operation chamber from the inlet. The gas refrigerant is compressed by reducing the volume of the operation chamber. When the pressure reaches a predetermined level, the compressed gas refrigerant is discharged from the outlet, then passes through a gap in the motor as high-pressure refrigerant, and is discharged out of the sealed housing.

[0004] In the rotary compressor, lubricant oil is retained in the lower part of the sealed housing. The lubricant oil is pumped up by an oil supply mechanism and is supplied to the compressing unit for lubrication. For example, Japanese unexamined utility model application publication No. H06-049791 discloses a conventional technology related to such an oil supply mechanism. According to the conventional technology, in an oil supply device of a vertical compressor, a hollow hole is formed in the core of a crankshaft. A twisted pump vane is inserted in the hollow hole to pump up the lubricant oil. The twisted pump vane is provided with a large width portion wider than the inner diameter of the hollow hole. When being inserted in the hollow hole of the crankshaft, the twisted pump vane presses the inner wall of the hollow hole with the large width portion and thus is reliably fixed.

[0005] In the conventional oil supply device of the vertical compressor described above, first, the twisted pump vane is inserted into the hollow hole of the crankshaft, and then a pump case is inserted therein to cover the twisted pump vane. Thus, the large width portion of the twisted pump vane comes in contact with a stepped portion of the crankshaft and the upper end of the pump case, and thereby the twisted pump vane is positioned. However, when the pump case is inserted into the hollow hole of the crankshaft, the upper end of the pump case may tightly press the large width portion of the twisted

pump vane and deform the twisted pump vane (the large width portion).

SUMMARY

[0006] According to an aspect of the present invention, a rotary compressor includes a hollow compressor housing, a compressing unit, a motor, and an oil supply mechanism. The compressor housing is provided with an inlet and an outlet of refrigerant. The compressing unit is located in the lower part of the compressor housing to compress refrigerant sucked in from the inlet. The motor is located in the upper part of the compressor housing to drive the compressing unit through a rotation shaft. The oil supply mechanism supplies lubricant oil retained in the lower part of the compressor housing to the sliding portion of the compressing unit through an oil supply hole of the rotation shaft. The oil supply mechanism includes a housing hole, a pump case, and a pump vane. The housing hole has an opening in the lower end of the rotation shaft and is communicated with the oil supply hole. The pump case includes a lubricant oil inlet in the lower end and an opening in the upper end. The pump case is configured to be fitted in the housing hole. The pump vane has a plate-like shape and is housed in the housing hole and the pump case. The pump vane includes a large width portion at the longitudinal center, which is locked by the upper inner surface of the pump case.

[0007] The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the claims.

[0008] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWING(S)

[0009]

FIG. 1 is a vertical cross-sectional view of a rotary compressor according to an embodiment of the invention;

FIG. 2 is a cross-sectional view of a compressing unit of the rotary compressor taking along line II-II in FIG. 1;

FIG. 3 is a cross-sectional view of an oil supply mechanism of the rotary compressor illustrated in FIG. 1;

FIG. 4 is a cross-sectional view of the oil supply mechanism taking along line IV-IV in FIG. 3;

FIG. 5 is a front view of a twisted pump vane of the rotary compressor illustrated in FIG. 1 before twisted; and

FIG. 6 is a front view of the twisted pump vane after twisted.

DESCRIPTION OF THE EMBODIMENT(S)

[0010] Exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0011] FIG. 1 is a vertical cross-sectional view of a rotary compressor according to an embodiment of the invention. FIG. 2 is a cross-sectional view of a compressing unit of the rotary compressor taking along line II-II in FIG. 1. FIG. 3 is a cross-sectional view of an oil supply mechanism of the rotary compressor. FIG. 4 is a cross-sectional view of the oil supply mechanism taking along line IV-IV in FIG. 3. FIG. 5 is a front view of a twisted pump vane of the rotary compressor before twisted. FIG. 6 is a front view of the twisted pump vane after twisted.

[0012] As illustrated in FIGS. 1 and 2, the rotary compressor of the embodiment comprises a compressor housing 11, a compressing unit 12, a motor 13, and an oil supply mechanism 14. The compressor housing 11 is a hollow sealed housing formed of a cylindrical housing body 21, a cover 22 above the housing body 21, and a bottom 23 fixed to the lower end of the housing body 21. The compressing unit 12 is located in the lower part of the compressor housing 11. The compressing unit 12 compresses gas refrigerant sucked in, and thereby discharges it as high-pressure refrigerant.

[0013] The motor 13 is located in the upper part of the compressor housing 11. The motor 13 includes a starter 31 and a rotor 32. The starter 31 is shrink fit to the inner periphery of the compressor housing 11 to be fixed thereto. The starter 31 is spaced apart from the center of the rotation shaft 33 by a predetermined distance, and is shrink fit to a rotation shaft 33 to be fixed thereto. The rotation shaft 33 extends downward and is mechanically connected to the compressing unit 12. Thus, the motor 13 drives the compressing unit 12 via the rotation shaft 33.

[0014] The oil supply mechanism 14 functions as an oil supply pump, and supplies lubricant oil retained in the lower part of the compressor housing 11 to the sliding portion of the compressing unit 12 through an oil supply hole 100 of the rotation shaft 33, which will be described later.

[0015] In the following, the compressing unit 12 will be described in detail. The compressing unit 12 comprises a first compressing unit 41 and a second compressing unit 51. The first compressing unit 41 is located above the second compressing unit 51. The first compressing unit 41 and the second compressing unit 51 are of basically the same configuration, and operate in a similar manner, and are arranged one on top of the other.

[0016] The first compressing unit 41 includes a short cylindrical first cylinder 42 at the outer periphery. The first cylinder 42 has a circular first cylinder inner wall 42a that is formed concentric with the rotation shaft 33 of the motor 13. Inside the first cylinder 42 (the first cylinder inner wall 42a) is a first annular piston 43 having a smaller outer diameter than the inner diameter of the first cylinder 42. Between the first cylinder inner wall 42a and a first piston

outer wall 43a of the first annular piston 43, a first operation chamber (compression space) 44 is defined and formed. The first operation chamber 44 is capable of compressing refrigerant sucked therein and discharges the compressed refrigerant.

[0017] In the first cylinder 42, a first vane groove 45 is formed from the first cylinder inner wall 42a along the radial direction over the height of the first cylinder 42. A flat plate-like first vane 46 is fitted in the first vane groove 45. The first vane 46 is supported and biased by a first spring (not illustrated) attached to the recess of the first vane groove 45 in a direction to protrude into the first operation chamber 44.

[0018] Usually, the first vane 46 is biased by the first spring in a direction to protrude from the first vane groove 45 into the first operation chamber 44, and the end is in contact with the outer periphery of the first annular piston 43. Accordingly, the first operation chamber 44 is partitioned by the first vane 46 into a first inlet chamber 44a and a first compression chamber 44b.

[0019] Further, in the first cylinder 42, a back pressure guide passage 47 is formed to allow the recess of the first vane groove 45 to be communicated with the inside of the compressor housing 11 to apply a back pressure to the first vane 46 by the pressure of compressed refrigerant. The first cylinder 42 is provided with a first inlet 48 that allows the first inlet chamber 44a to be communicated with the outside so that refrigerant can be sucked into the first inlet chamber 44a from the outside.

[0020] On the other hand, as with the first compressing unit 41, the second compressing unit 51 includes a short cylindrical second cylinder 52 at the outer periphery. The second cylinder 52 has a circular second cylinder inner wall that is formed concentric with the rotation shaft 33 of the motor 13. Inside the second cylinder 52 (the second cylinder inner wall) is a second annular piston 53 having a smaller outer diameter than the inner diameter of the second cylinder 52. Between the second cylinder inner wall and a second piston outer wall of the second annular piston 53, a second operation chamber (compression space) 54 is defined and formed. The second operation chamber 54 is capable of compressing refrigerant sucked therein and discharges the compressed refrigerant.

[0021] In the second cylinder 52, a second vane groove (not illustrated) is formed from the second cylinder inner wall along the radial direction over the height of the second cylinder 52. A flat plate-like second vane (not illustrated) is fitted in the second vane groove. The second vane is supported and biased by a second spring (not illustrated) attached to the recess of the second vane groove in a direction to protrude into the second operation chamber 54.

[0022] Usually, the second vane is biased by the second spring in a direction to protrude from the second vane groove into the second operation chamber 54, and the end is in contact with the outer periphery of the second annular piston 53. Accordingly, the second operation chamber 54 is partitioned by the second vane into a sec-

ond inlet chamber 54a and a second compression chamber 54b.

[0023] Although not illustrated, in the second cylinder 52, a back pressure guide passage is formed to allow the recess of the second vane groove to be communicated with the inside of the compressor housing 11 to apply a back pressure to the second vane by the pressure of compressed refrigerant. The second cylinder 52 is provided with a second inlet (not illustrated) that allows the second inlet chamber 54a to be communicated with the outside so that refrigerant can be sucked into the second inlet chamber 54a from the outside.

[0024] A partition 61 is placed between the first cylinder 42 and the second cylinder 52 so that the first compressing unit 41 and the second compressing unit 51 operate independently in the compressing unit 12. The partition 61 is arranged to define the first operation chamber 44 and the second operation chamber 54. An upper end plate 62 is arranged above the first cylinder 42 to close the first operation chamber 44. Meanwhile, A lower end plate 63 is arranged below the second cylinder 52 to close the second operation chamber 54.

[0025] Thus, the upper end plate 62, the first cylinder 42, the partition 61, the second cylinder 52, and the lower end plate 63 are in this order from the top to the bottom, and are integrally fixed by a fixing bolt (not illustrated). The outer periphery of the upper end plate 62 is fitted and fixed to the inner periphery of the compressor housing 11.

[0026] An upper bearing 62a is formed at the center of the upper end plate 62. The upper bearing 62a rotatably supports the rotation shaft 33. A lower bearing 63a is formed at the center of the lower end plate 63. The lower bearing 63a rotatably supports the rotation shaft 33. The upper end plate 62 is provided with a plurality of arc long through holes 62b that are formed at regular intervals in the circumference direction at the outer periphery. Through the through holes 62b, lubricant oil mixed with refrigerant in the compressing unit 12 and discharged above the compressor housing 11 is separated from the refrigerant and returns to the lower part of the compressor housing 11.

[0027] The rotation shaft 33 is provided on the end side (the lower side) with a first eccentric portion 64 and a second eccentric portion 65, the phase of which is shifted by 180° to be eccentric. The first eccentric portion 64 is slidably fitted to the inside of the first annular piston 43 of the first compressing unit 41 and is rotatable. The second eccentric portion 65 is slidably fitted to the inside of the second annular piston 53 of the second compressing unit 51 and is rotatable.

[0028] Accordingly, when the rotation shaft 33 rotates, the first and second eccentric portions 64 and 65 integrally rotate. Through the first and second eccentric portions 64 and 65, the first and second annular pistons 43 and 53 revolve and rotate. That is, when the rotation shaft 33 rotates clockwise in FIG. 2, the first eccentric portion 64 rotates in the same direction while sliding against the

first annular piston 43. The first annular piston 43 rotates counterclockwise in FIG. 2 so that the first piston outer wall 43a moves along the first cylinder inner wall 42a while rotating, and also revolves clockwise in FIG. 2. Similarly, when the rotation shaft 33 rotates, the second eccentric portion 65 rotates in the same direction, and the second annular piston 53 rotates and revolves.

[0029] When the first and second annular pistons 43 and 53 rotate and revolve, along with the movement of them, the first vane 46 and the second vane (not illustrated) move back and forth. Accordingly, along with the movement of the first and second annular pistons 43 and 53, the volume of the first inlet chamber 44a, the second inlet chamber 54a, the first compression chamber 44b, and the second compression chamber 54b continuously changes. As a result, the first compressing unit 41 and the second compressing unit 51 continuously suck in refrigerant and compress it, thereby discharging the compressed refrigerant.

[0030] An upper muffler cover 66 is fixed on the upper end plate 62 such that an upper muffler chamber 67 is formed between the upper end plate 62 and the upper muffler cover 66. Formed in the upper end plate 62 is a first outlet 68 that allows the first compression chamber 44b of the first cylinder 42 to be communicated with the upper muffler chamber 67. The first outlet 68 is provided with a first outlet valve 69 that prevents the backflow of compressed refrigerant. The upper muffler chamber 67 reduces the pressure pulsation of discharged refrigerant.

[0031] A lower muffler cover 70 is fixed to the bottom of the lower end plate 63 such that a lower muffler chamber 71 is formed between the lower end plate 63 and the lower muffler cover 70. Formed in the lower end plate 63 is a second outlet 72 that allows the second compression chamber 54b of the second cylinder 52 to be communicated with the lower muffler chamber 71. The second outlet 72 is provided with a second outlet valve 73 that prevents the backflow of compressed refrigerant. The lower muffler chamber 71 reduces the pressure pulsation of discharged refrigerant.

[0032] Although not illustrated, in the outer peripheral wall of the cylindrical compressor housing 11, first and second through holes are formed to be separated from each other in the axial direction. Besides, on the outer peripheral wall of the cylindrical compressor housing 11, an accumulator 81 formed of an independent cylindrical sealed housing is supported by an accumulator holder (not illustrated) and an accumulator band 82. The top of the accumulator 81 is connected to a system connecting pipe 83 connected to the low pressure side of the refrigeration cycle.

[0033] The bottom of the accumulator 81 is connected to an end of a first inlet pipe 84 and a second inlet pipe 85. The first inlet pipe 84 and the second inlet pipe 85 extend through the first and second through holes of the compressor housing 11, and the other end thereof is connected to each of the first inlet 48 and the second inlet (not illustrated) of the first cylinder 42 and the second

cylinder 52 in the first compressing unit 41 and the second compressing unit 51.

[0034] The compressor housing 11 is connected to an outlet pipe 86 that is connected to the high pressure side of the refrigeration cycle to discharge high pressure refrigerant to the high pressure side of the refrigeration cycle. That is, the first outlet 68 and the second outlet 72 are communicated with the high pressure side of the refrigeration cycle via the outlet pipe 86.

[0035] Lubricant oil is retained in the lower part of the compressor housing 11. The oil supply mechanism 14 supplies the lubricant oil to the sliding portion of the compressing unit 12 through the oil supply hole 100 of the rotation shaft. The oil supply mechanism 14 comprises a housing hole 101, a pump case 102, and a pump vane 103.

[0036] That is, in the oil supply mechanism 14, as illustrated in FIGS. 1, 3, and 4, the housing hole 101 is formed in the bottom of the rotation shaft 33 and has an opening in the lower end. On the other hand, a through hole 104 is formed in the top of the rotation shaft 33. The through hole 104 has an opening in the upper end and is communicated with the housing hole 101. At the middle of the rotation shaft 33, a horizontal hole 105 is formed that passes through in the radial direction to be communicated with the housing hole 101. The oil supply hole 100 includes the housing hole 101, the through hole 104, and the horizontal hole 105. The horizontal hole 105 is provided correspondingly to the upper bearing 62a, the first annular piston 43, the second annular piston 53, and the lower bearing 63a.

[0037] The pump case 102 is a cylindrical pipe in the lower end of which is formed a lubricant oil inlet 106 having the inner diameter as a small diameter. The pump case 102 has an opening in the upper end and is fitted in the housing hole 101. The pump vane 103 is of a plate-like shape and is housed in the housing hole 101 and the pump case 102. The pump vane 103 is provided with a large width portion 107 at the center in the longitudinal direction. The large width portion 107 is locked by the upper inner surface of the pump case 102.

[0038] The housing hole 101 formed in the rotation shaft 33 comprises a housing hole main body 101a, a stepped portion 101b, and an attachment hole 101c. The attachment hole 101c is located below the housing hole main body 101a with the stepped portion 101b therebetween and has a diameter slightly larger than that of the housing hole main body 101a. The upper end portion of the pump case 102 is fitted in the attachment hole 101c of the housing hole 101 and is in contact with the stepped portion 101b, whereby the pump case 102 is positioned. The pump case 102 is press-fitted into the attachment hole 101c to be fixed to the rotation shaft 33. In this case, preferably, a press fitting margin is set to 0 to 0.06 mm between the pump case 102 and the attachment hole 101c. It is also preferable that the inner diameter of the housing hole main body 101a is substantially the same as that of the pump case 102.

[0039] The pump case 102 is deformable at least in the radial direction. In the embodiment, the pump case 102 is made of copper, and thus is a little elastically deformable.

[0040] The pump vane 103 is twisted by a predetermined degree, 180° in the embodiment, in the circumference direction. As illustrated in FIG. 5, a plate 201 having a predetermined length L and a predetermined width W is provided with bulges 202a and 202b formed over a region LI of a predetermined length at the center in the longitudinal direction. The bulges 202a and 202b extend from both sides 203a and 203b of a portion of the plate 201 in the predetermined width W, respectively, in the width direction by a predetermined length W1. Between the sides 203a and 203b of the portion in the predetermined width W and the bulges 202a and 202b, inclined portions 204a and 204b are formed, respectively. The inclined portions 204a and 204b are inclined at a predetermined angle α . The inclined portions 204a and 204b are formed on both sides of the bulges 202a and 202b, respectively. Further, curved portions 205 are formed at the four corners of the plate 201. The curved portions 205 each have a predetermined radius R. The inclined portions 204a and 204b, and the curved portions 205 may be formed when press work is performed on the plate 201. The inclined portions 204a and 204b, and the curved portions 205 may be also formed by chamfering the corners of the plate 201 or by barrel polishing after the press work.

[0041] The plate 201 thus formed is twisted 180° to form the pump vane 103 as illustrated in FIG. 6. At this time, only the longitudinal end portions of the plate 201 are not twisted to form flat portions 130a and 130b. The pump vane 103 is longitudinally symmetrical about the large width portion 107 formed at the center in the longitudinal direction.

[0042] The twisted pump vane 103 is processed such that the width of the large width portion 107 is equal to or wider than the inner diameter of the pump case 102. The large width portion 107 is press-fitted into the pump case 102, and the pump vane 103 is fixed by the inner periphery of the pump case 102. Preferably, a press fitting margin is set to 0 to 0.5 mm between the large width portion 107 of the pump vane 103 and the pump case 102. The pump vane 103 is made of an inexpensive elastically deformable material such as carbon steel for tools (i.e., spring steel) and cold rolled steel. Therefore, the pump vane 103 is deformable in the twisted direction. When the pump vane 103 (the large width portion 107) is press-fitted into the pump case 102, it is deformed in the twisted direction and is fixed. Preferably, the angle α of the inclined portions 204a and 204b of the pump vane 103 is set to 10° to 45°.

[0043] The pump vane 103 need not necessarily twisted 180°, and may be twisted by different degrees appropriately set. The large width portion 107 may be formed by providing a bulge to only one side of the pump vane 103 in the width direction. The inclined portions 204a and

204b need not necessarily be straight lines, and may be curved lines, i.e., arcs that allow the sides 203a and 203b and the bulges 202a and 202b to smoothly continue, respectively.

[0044] Upon forming the oil supply mechanism 14 by assembling the housing hole 101, the pump case 102, and the pump vane 103 thus obtained, the pump vane 103 is press-fitted into the pump case 102 and is fixed. Then, the pump case 102 to which the pump vane 103 is fixed is press-fitted into the housing hole 101 of the rotation shaft 33 and is fixed.

[0045] When the large width portion 107 of the pump vane 103 is press-fitted into the pump case 102, the pump vane 103 is elastically deformed in the twisted direction, and the diameter is reduced. On the other hand, the pump case 102 is elastically deformed in the radial direction, and the diameter is increased. This reduces the force required to press-fit the pump vane 103 (the large width portion 107) into the pump case 102, resulting in less dust produced by the rubbing of the large width portion 107 and the pump case 102. Besides, the pump vane 103 is made of a material such as carbon steel for tools and cold rolled steel and is elastically deformable. Therefore, the pump vane 103 can be press-fitted into the pump case 102 with a small hand press, and the assembly can be easily and reliably performed through press fitting. When the pump case 102 to which the pump vane 103 is fixed is press-fitted into the housing hole 101 of the rotation shaft 33, the elastically deformed pump case 102 with an increased diameter recovers to the original state. Thus, the pump vane 103 is held tightly by the pump case 102 and is secured.

[0046] Further, when the large width portion 107 of the pump vane 103 is press-fitted into the pump case 102, the longitudinal end portion (the corners of the flat portion 103b) of the pump vane 103 housed in the pump case 102 comes in contact with the inner surface of the pump case 102, and thereby the pump vane 103 is positioned. When the pump case 102 to which the pump vane 103 is fixed is press-fitted into the housing hole 101 of the rotation shaft 33, the end portion of the pump case 102 comes in contact with the stepped portion 101b, and thereby the pump case 102 is positioned. At this point, the longitudinal end portion (the corners of the flat portion 103a) of the pump vane 103 housed in the housing hole 101 is separate from the inner surface of the housing hole 101.

[0047] Accordingly, as illustrated in FIG. 1, when the rotation shaft 33 rotates in the oil supply mechanism 14, the pump case 102 and the pump vane 103 integrally rotate. With the centrifugal force of the rotation, lubricant oil retained in the lower part of the compressor housing 11 can be pumped up. More specifically, the lubricant oil retained in the compressor housing 11 enters into the pump case 102 through the lubricant oil inlet 106, and is pumped up in the housing hole 101 by the rotation of the pump vane 103. The lubricant oil is then supplied to the upper bearing 62a, the first annular piston 43, the second

annular piston 53, the lower bearing 63a, and the like through the horizontal hole 105 to lubricate them. After lubricating the components, the lubricant oil enters into the first operation chamber 44 and the second operation chamber 54 through a small gap between components that define the first compressing unit 41 and the second compressing unit 51. The lubricant oil lubricates the sliding portions of the respective components and provides pressure sealing to the small gap. Thereafter, the lubricant oil is discharged.

[0048] In the following, the operation of the rotary compressor of the embodiment will be described. When the rotary compressor is activated, refrigerant flows from the low pressure side of the refrigeration cycle into the accumulator 81 through the system connecting pipe 83. The refrigerant is separated into liquid refrigerant and gas refrigerant. The liquid refrigerant is accumulated in the lower part of the accumulator 81, while the gas refrigerant is accumulated in the upper part.

[0049] In the compressor housing 11, the rotation shaft 33 is driven by the motor 13 and rotates. Through the first and second eccentric portions 64 and 65, the first and second annular pistons 43 and 53 revolve and rotate. As the first and second annular pistons 43 and 53 revolve while rotating in the first cylinder 42 and the second cylinder 52, the volume of the first inlet chamber 44a and the second inlet chamber 54a increases. Accordingly, the gas refrigerant in the accumulator 81 is sucked into the first inlet chamber 44a and the second inlet chamber 54a via the first inlet pipe 84, the second inlet pipe 85, the first inlet 48, and the second inlet (not illustrated).

[0050] When the first and second annular pistons 43 and 53 make one revolution, the first inlet chamber 44a and the second inlet chamber 54a are shut off from the first inlet 48 and the second inlet (not illustrated). The first inlet chamber 44a and the second inlet chamber 54a switch to the first compression chamber 44b and the second compression chamber 54b, respectively, to compress the gas refrigerant.

[0051] When the pressure of the compressed refrigerant in the first compression chamber 44b and the second compression chamber 54b reaches that of the upper muffler chamber 67 and the lower muffler chamber 71 located downstream of the first outlet valve 69 and the second outlet valve 73 of the first outlet 68 and the second outlet 72, the first outlet valve 69 and the second outlet valve 73 are opened. The compressed refrigerant is discharged through the first outlet 68 and the second outlet 72 into the upper muffler chamber 67 and the lower muffler chamber 71. The upper muffler chamber 67 and the lower muffler chamber 71 reduce the pressure pulsation of the refrigerant that causes noise. The refrigerant is then discharged into the compressor housing 11 as high pressure refrigerant.

[0052] After that, the high pressure refrigerant flows through the core cutout (not illustrated) of the starter 31 of the motor 13, and a gap between the core and a winding. The high pressure refrigerant is sent to the upper

part of the motor 13, and is discharged to the high pressure side of the refrigeration cycle through the outlet pipe 86.

[0053] At this time, the lubricant oil retained in the lower part of the compressor housing 11 is pumped up by the oil supply mechanism 14 to lubricate the upper bearing 62a, the first annular piston 43, the second annular piston 53, the lower bearing 63a, and the like. More specifically, the pump case 102 and the pump vane 103 rotate with the rotation shaft 33, the lubricant oil is pumped up by the centrifugal force in the housing hole 101, and is supplied to the upper bearing 62a, the first annular piston 43, the second annular piston 53, the lower bearing 63a, and the like through the horizontal hole 105 to lubricate them. After lubricating the components, the lubricant oil is sent back to the lower part of the compressor housing 11.

[0054] As described above, according to the embodiment, the rotary compressor comprises the compressing unit 12, the motor 13, and the oil supply mechanism 14.. The compressing unit 12 compresses refrigerant sucked in the lower part of the compressor housing 11. The motor 13 is located above the compressor housing 11 and drives the compressing unit 12 through the rotation shaft 33. The oil supply mechanism 14 supplies lubricant oil retained in the lower part of the compressor housing 11 to the sliding portion of the compressing unit 12 through the oil supply hole 100 of the rotation shaft 33. The oil supply mechanism 14 comprises the housing hole 101, the pump case 102, and the pump vane 103. The housing hole 101 formed in the bottom of the rotation shaft 33 has an opening in the lower end, and is communicated with the oil supply hole 100. The pump case 102 is provided with the lubricant oil inlet 106 in the lower end and an opening in the upper end, and is fitted in the housing hole 101. The pump vane 103 is of a plate-like shape and is housed in the housing hole 101 and the pump case 102. The pump vane 103 is provided with the large width portion 107 at the longitudinal center. The large width portion 107 is locked by the upper inner surface of the pump case 102.

[0055] In other words, the pump vane 103 is locked by the upper inner surface of the pump case 102 through the large width portion. The pump case 102 is fitted in the housing hole 101 of the rotation shaft 33. With this, the pump vane 103 is placed in the oil supply hole 100 of the rotation shaft 33. Accordingly, when the pump case 102 is fitted in the housing hole 101, the pump vane 103 does not touch the housing hole 101. This prevents the deformation of the pump vane 103 and improves the assembly efficiency.

[0056] Moreover, according to the embodiment, the longitudinal end portion of the pump vane 103 housed in the pump case 102 comes in contact with the inner surface of the pump case 102, and thereby the pump vane 103 is positioned. In this manner, the pump vane 103 is positioned at a predetermined location relative to the pump case 102. Accordingly, the pump vane 103 is easily

positioned at a predetermined location in the housing hole 101 by only fitting the pump case 102 in the housing hole 101. This improves the assembly efficiency.

[0057] On the other hand, the longitudinal end portion of the pump vane 103 housed in the housing hole 101 is separate from the inner surface of the housing hole 101. That is, the pump vane 103 is in contact with the pump case 102 at one end to be positioned, and is separate from the housing hole 101 at the other end. Therefore, excessive stress is not placed on the pump vane 103. Thus, it is possible to prevent the deformation or damage of the pump vane 103 and increase the durability.

[0058] Further, according to the embodiment, the housing hole 101 comprises the housing hole main body 101a, the stepped portion 101b, and the attachment hole 101c having a larger diameter. The upper end portion of the pump case 102 is fitted in the attachment hole 101c and is in contact with the stepped portion 101b, and thereby the pump case 102 is positioned. In this manner, by positioning the pump case 102 using the stepped portion 101b of the housing hole 101, the pump vane 103 is positioned with respect to the housing hole 101. This eliminates the need to directly position the pump vane 103. Thus, it is possible to prevent the deformation or damage of the pump vane 103 as well as to improve the assembly efficiency.

[0059] Further, according to the embodiment, the bulges 202a and 202b are formed at the longitudinal center of the pump vane 103 to extend outward. The bulges 202a and 202b form the large width portion 107 having a width equal to or wider than the inner diameter of the pump case 102. Since the large width portion 107 is formed in such a simple manner, the manufacturing cost can be reduced.

[0060] Besides, the inclined portions 204a and 204b are formed between the bulges 202a and 202b and the sides 203a and 203b of the pump vane 103, respectively. When the pump vane 103 is fitted into the pump case 102, the large width portion (the bulges 202a and 202b) is fitted from the sides 203a and 203b through the inclined portions 204a and 204b. Thus, the pump vane 103 can be smoothly fitted into the pump case 102. This reduces dust produced by rubbing in the pump case 102 and the pump vane 103 as well as preventing damage to them.

[0061] The pump vane 103 is twisted by a predetermined degree in the circumference direction and is made of a material that allows the pump vane 103 to be elastically deformable in the twisted direction. Accordingly, when fitted into the pump case 102, the pump vane 103 is elastically deformed in the twisted direction. Thus, the pump vane 103 can be smoothly fitted into the pump case 102.

[0062] Further, according to the embodiment, the pump case 102 is deformable at least in the radial direction. Accordingly, when the pump vane 103 is fitted into the pump case 102, the pump case 102 is deformed so that the pump vane 103 can be smoothly fitted into the pump case 102. After that, when the pump case 102 is

fitted in the housing hole 101, the elastically deformed pump case 102 recovers to the original state. Thus, the pump vane 103 can be fixed securely to the pump case 102.

[0063] Furthermore, according to the embodiment, the large width portion 107, i.e., the bulges 202a and 202b, the sides 203a and 203b, the inclined portions 204a and 204b, and the curved portions 205, is formed such that the pump vane 103 is point-symmetrical about the center. Therefore, the direction in which the pump vane 103 is fitted into the pump case 102 is not restricted, which improves the assembly efficiency.

[0064] All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the invention and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although the embodiment(s) of the present inventions have been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

Claims

1. A rotary compressor comprising:

a hollow compressor housing (11) that is provided with an inlet (48) and an outlet (68, 72) of refrigerant;

a compressing unit (12) that is located in a lower part of the compressor housing (11) to compress refrigerant sucked in from the inlet (48);

a motor (13) that is located in an upper part of the compressor housing (11) to drive the compressing unit (12) through a rotation shaft (33); and

an oil supply mechanism (14) that supplies lubricant oil retained in a lower part of the compressor housing (11) to a sliding portion of the compressing unit (12) through an oil supply hole (100) of the rotation shaft (33), wherein the oil supply mechanism (14) includes

a housing hole (101) that has an opening in a lower end of the rotation shaft (33) and is communicated with the oil supply hole (100),

a pump case (102) that includes a lubricant oil inlet (106) in a lower end and an opening in an upper end, the pump case (102) configured to be fitted in the housing hole (101), and

a pump vane (103) that has a plate-like shape and is housed in the housing hole (101) and the pump case (102), the pump vane (103) including a large width portion (107) at a longitudinal cent-

er, which is locked by an upper inner surface of the pump case (102).

2. The rotary compressor according to claim 1, wherein a longitudinal end portion of the pump vane (103) housed in the pump case (102) is configured to be in contact with an inner surface of the pump case (102) to position the pump vane (103).

3. The rotary compressor according to claim 2, wherein a longitudinal end portion of the pump vane (103) housed in the housing hole (101) is separate from an inner surface of the housing hole (101).

4. The rotary compressor according to any one of claims 1 to 3, wherein the longitudinal center of the pump vane (103) bulges in at least one width direction to form a bulge (202a, 202b) that allows the large width portion (107) to have a width equal to or wider than an inner diameter of the pump case (102).

5. The rotary compressor according to claim 4, wherein an inclined portion (204a, 204b) is formed between the bulge (202a, 202b) and a side (203a, 203b) of the pump vane (103).

6. The rotary compressor according to any one of claims 1 to 5, wherein the pump vane (103) is twisted by a predetermined degree in a circumference direction and is made of a material that allows the pump vane (103) to be elastically deformable in a direction in which the pump vane (103) is twisted.

7. The rotary compressor according to any one of claims 1 to 6, wherein the pump case (102) is deformable at least in a radial direction.

FIG.1

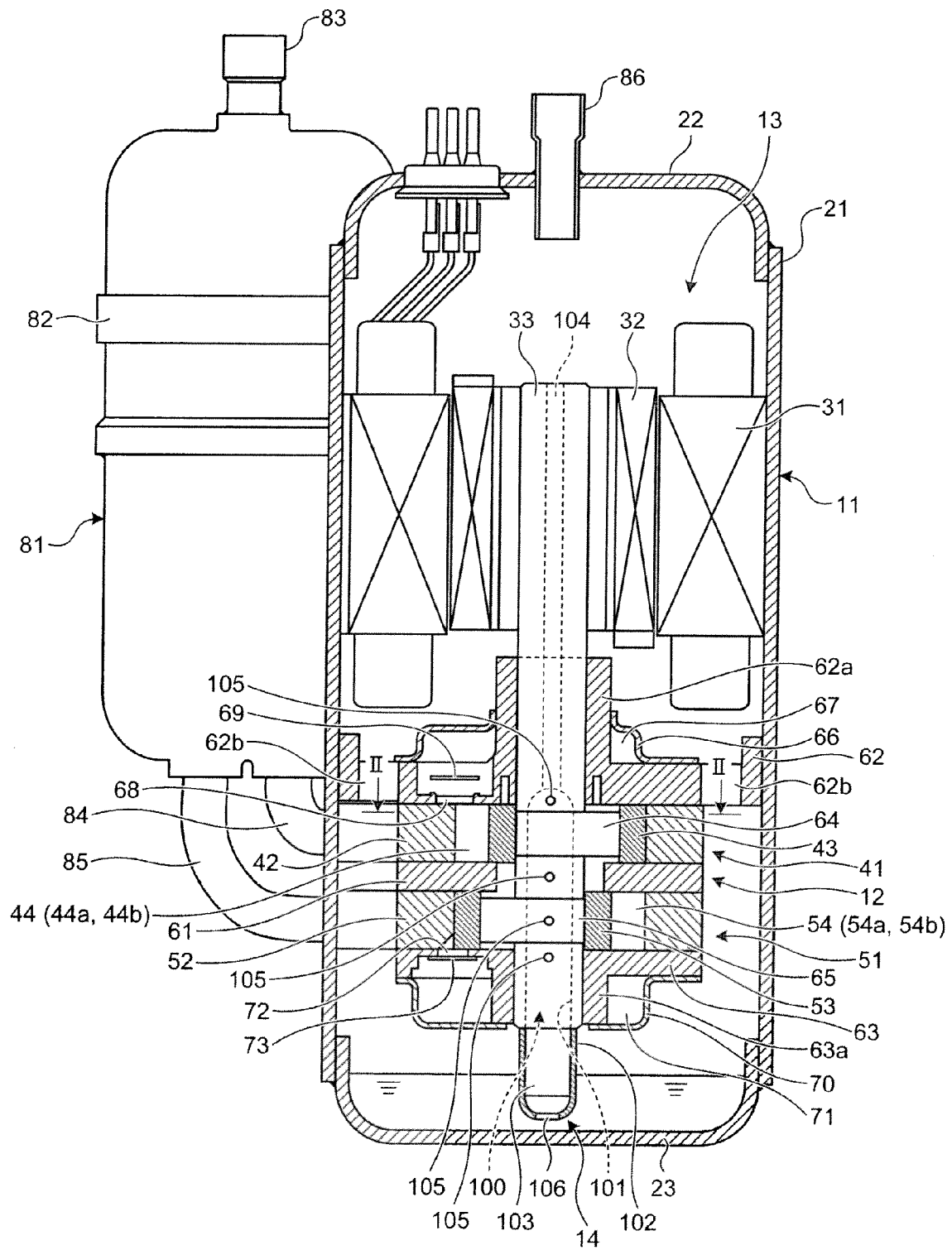


FIG.2

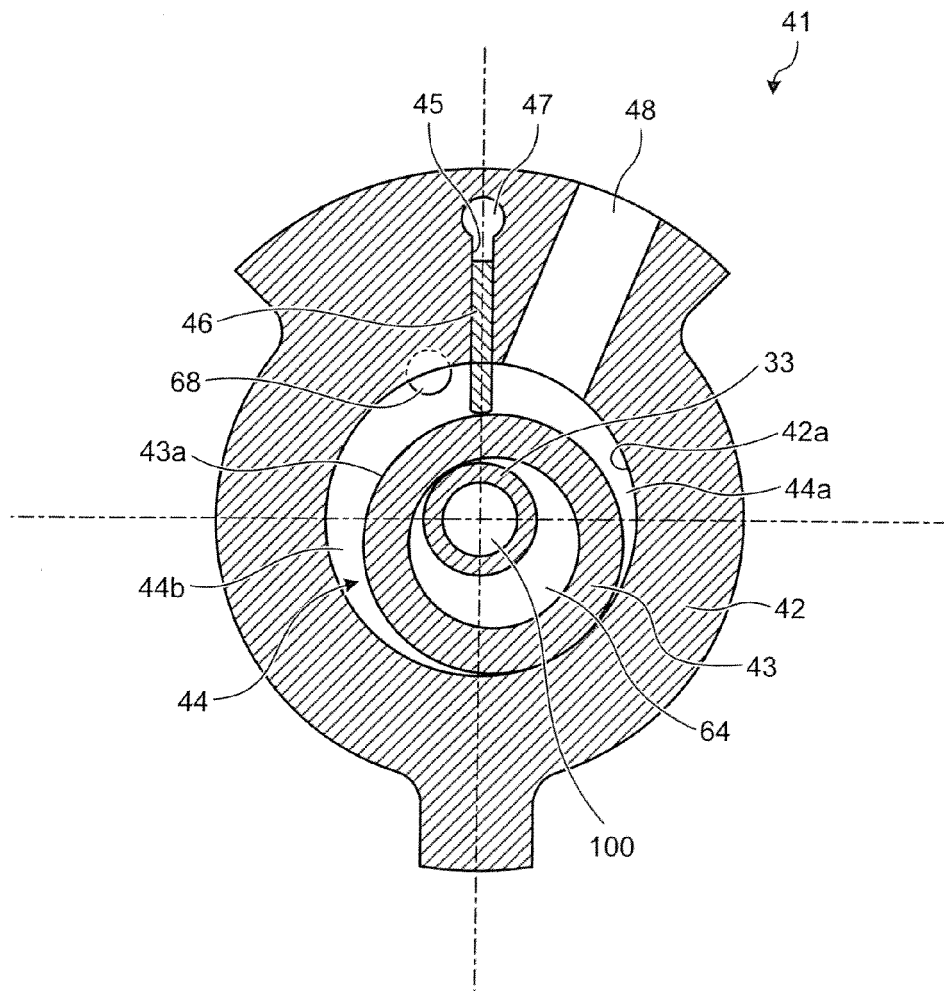


FIG.3

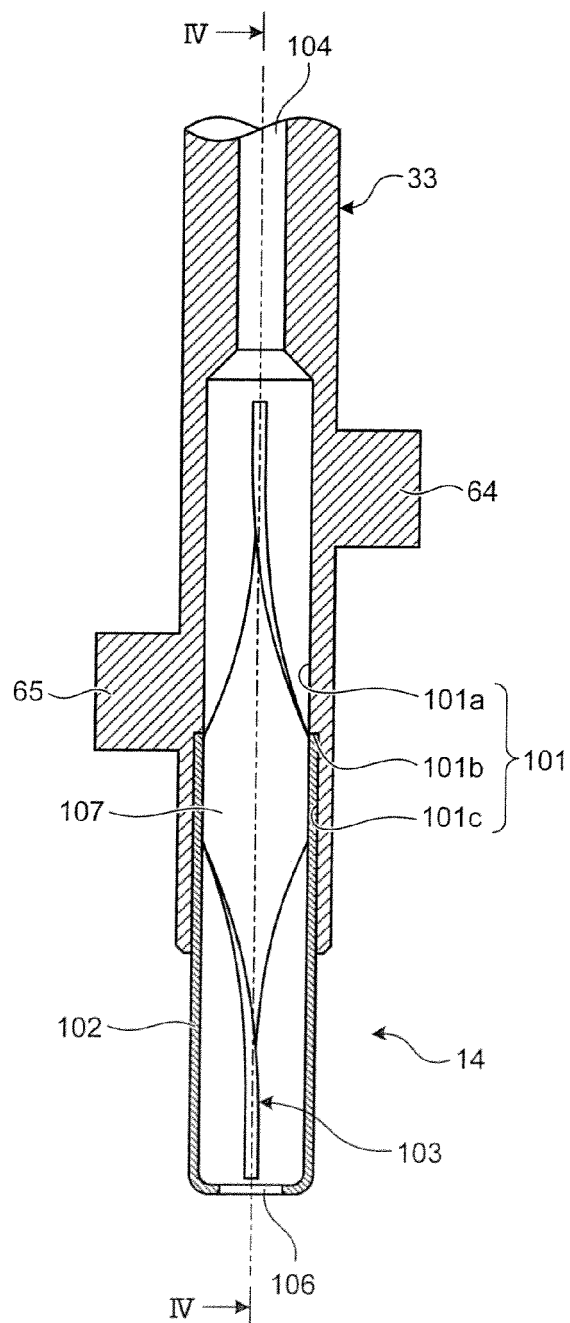


FIG.4

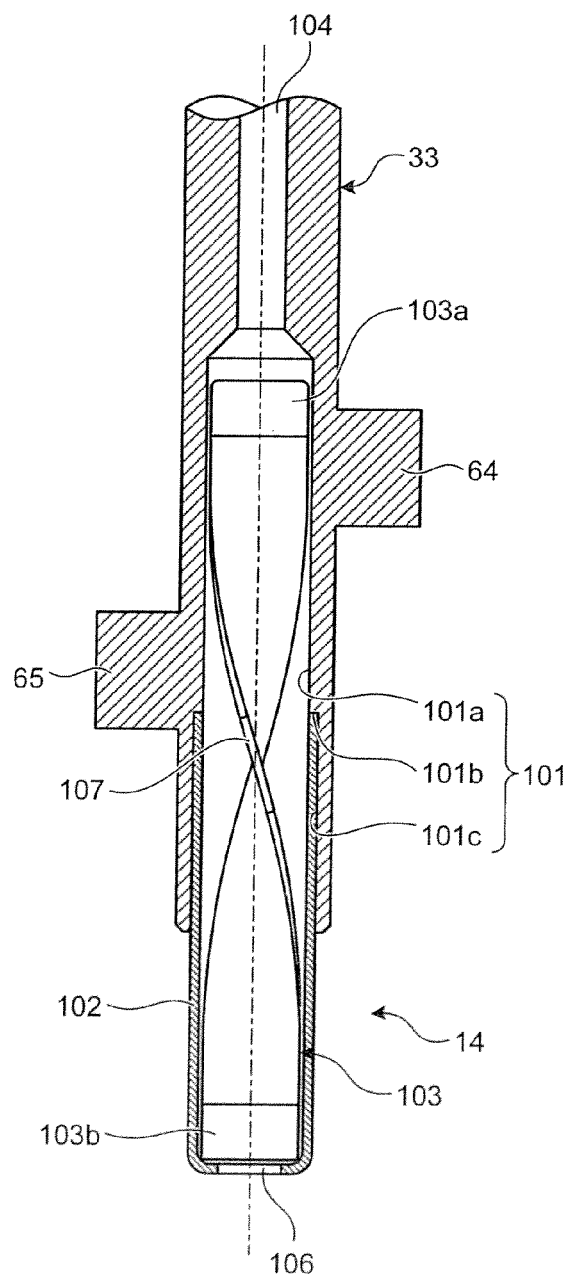


FIG.5

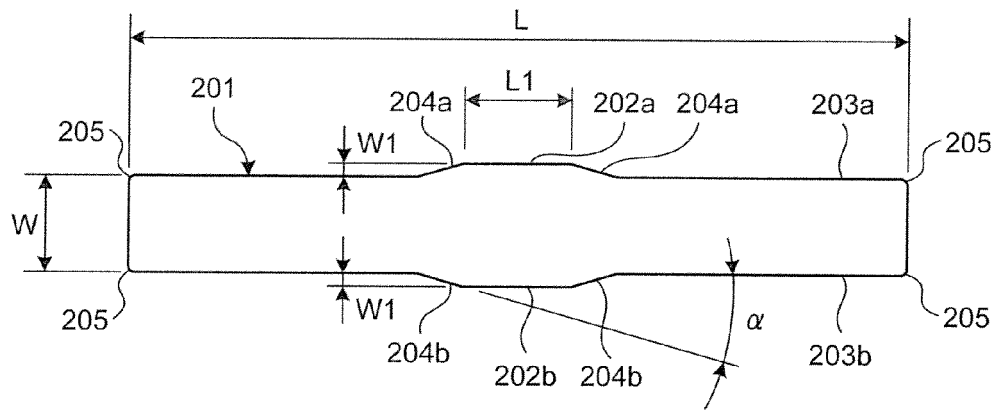
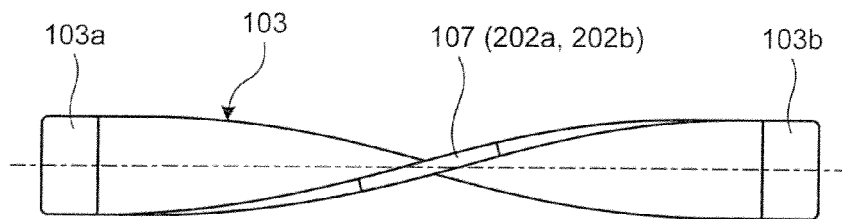


FIG.6



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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