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

(11) EP 2 873 863 A1

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

(43) Date of publication:
20.05.2015 Bulletin 2015/21

(21) Application number: **13809382.8**

(22) Date of filing: **21.06.2013**

(51) Int Cl.:
F04C 18/356 *(2006.01)* ***F04C 23/00*** *(2006.01)*
F04C 29/04 *(2006.01)*

(86) International application number:
PCT/JP2013/003890

(87) International publication number:
WO 2014/002456 (03.01.2014 Gazette 2014/01)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **26.06.2012 JP 2012142632**

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

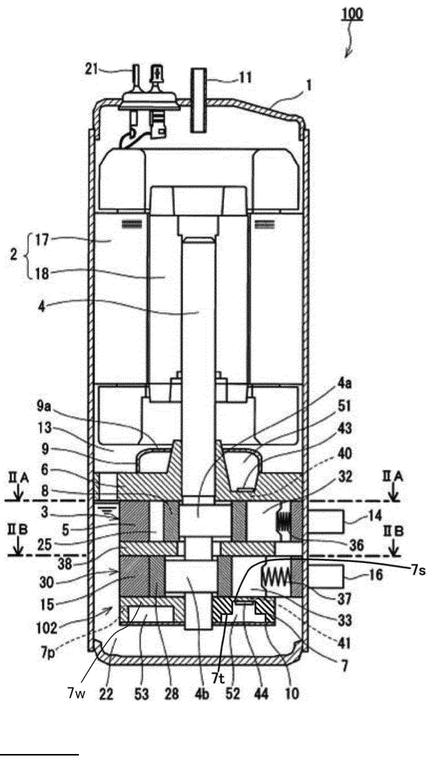
(72) Inventors:
- **NAKAI, Hiroaki**
  Osaka-shi, Osaka 540-6207 (JP)
- **OGATA, Takeshi**
  Osaka-shi, Osaka 540-6207 (JP)
- **SHIOTANI, Yu**
  Osaka-shi, Osaka 540-6207 (JP)
- **YOSHIDA, Hirofumi**
  Osaka-shi, Osaka 540-6207 (JP)
- **FUNAKOSHI, Daisuke**
  Osaka-shi, Osaka 540-6207 (JP)
- **KARINO, Tsuyoshi**
  Osaka-shi, Osaka 540-6207 (JP)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

(54) ROTARY COMPRESSOR

(57) A discharge port 41 of refrigerant is provided with a discharge valve 44. A thick section 7t of an end plate member 7 between the refrigerant discharge space 52 and a cylinder chamber 26 is made thicker than a minimum thick section 7wmin between an oil retaining section 53 and the cylinder chamber 26. That is, a thickness of the end plate member 7 of the discharged refrigerant space 52 in the vicinity of the discharge valve 44 which requires high rigidity is made thick, and a thickness of a thick section 7w of the end plate member 7 forming an oil retaining section 53 which is filled with oil whose temperature is lower than discharged refrigerant and oil in the oil reservoir 22 and which is desired to exert a heat-insulating effect near sucked refrigerant is made thin conversely. Hence, heat-reception of sucked refrigerant is suppressed.

[Fig. 1]



EP 2 873 863 A1

Description

[TECHNICAL FIELD]

[0001] The present invention relates to a two-cylinder rotary compressor used in an air conditioner, a freezing machine, a blower and a water heater.

[BACKGROUND TECHNIQUE]

[0002] A rotary compressor is widely used in an electric appliance such as an air conditioner, a heating system and a water heater. As one of methods for enhancing efficiency of the rotary compressor, there is proposed a technique for suppressing deterioration of efficiency caused when refrigerant (sucked refrigerant) sucked into a compression chamber receives heat from environment, i.e., suppressing so-called heat loss.

[0003] A rotary compressor of patent document 1 has a hermetic space in a suction-side portion of a cylinder as means for suppressing heat-reception of sucked refrigerant. This hermetic space restrains heat from being transmitted from high temperature refrigerant in a hermetic container to an inner wall of the cylinder.

[PRIOR ART DOCUMENT]

[PATENT DOCUMENT]

[0004] [PATENT DOCUMENT 1] Japanese Patent Application Laid-open No.H2-140486

[SUMMARY OF THE INVENTION]

[PROBLEM TO BE SOLVED BY THE INVENTION]

[0005] However, it is not always easy to form a hermetic space in a cylinder as in patent document 1. Hence, another technique capable of effectively suppress the heat-reception of sucked refrigerant is desired.

[MEANS FOR SOLVING THE PROBLEM]

[0006] To solve the conventional problem, a rotary compressor of the present invention includes a zone member which is mounted on an end plate (bearing) member and which forms, together with the end plate (bearing) member, a refrigerant discharge space in which refrigerant discharged from a discharge chamber through a discharge port can stay, in which the end plate (bearing) member is provided with a recess on the same side as a suction port as viewed from a reference plane which includes a center of a vane and a center axis of a cylinder when the vane most projects toward a center axis of the cylinder, and a portion of oil stored in an oil reservoir enters the recess, thereby forming an oil retaining section, wherein the discharge port is provided with a discharge valve which restrains the refrigerant from reversely flowing from the refrigerant discharge space into the discharge chamber, and a thick section of a portion of the end plate (bearing) member between the refrigerant discharge space and a cylinder chamber is made thicker than a minimum thick section of the end plate (bearing) member between the oil retaining section and the cylinder chamber.

[EFFECT OF THE INVENTION]

[0007] According to the present invention, the thick section of the end plate member of the discharged refrigerant space which requires high rigidity in the vicinity of the discharge valve is made thick, and the thick section of the end plate member forming an oil retaining section which is filled with oil having lower temperature than discharged refrigerant and oil in the oil reservoir and which is required to exert an heat-insulating effect in the vicinity of sucked refrigerant is made thin on the other hand. Therefore, it is possible to realize, at the same time, both reduction in material cost and enhancement of the heat-insulating effect caused by increasing the thickness of the oil retaining section. Especially, in the present invention, since a location where the heat-insulating effect is enhanced directly influences heat-reception of the sucked refrigerant, this effect is great.

[0008] Also when the change of the thickness of the end plate (bearing) member carried out in the present invention is applied to the end plate (bearing) member which does not have the oil retaining section and which entirely becomes a refrigerant discharge space, it is possible to reduce the thickness of the end plate (bearing) member which relates to heat-reception of the sucked refrigerant. However, refrigerant and sucked refrigerant in the discharge space which are heated to the highest temperature in the compressor deliver and receive heat through the end plate (bearing) member which is formed thin, heat-reception loss is increased by contraries.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0009]

Fig. 1 is a vertical sectional view of a rotary compressor according to an embodiment of the present invention;
Fig. 2 is a transverse sectional view of the rotary compressor shown in Fig. 1 taken along line IIA-IIA;
Fig. 3 is a transverse sectional view of the rotary compressor shown in Fig. 1 taken along line IIB-IIB;
Fig. 4 is an enlarged sectional view showing a position of a communication passage of the rotary compressor;
Fig. 5 is a bottom view of a lower bearing member of the rotary compressor;
Fig. 6 is a schematic diagram showing thickness variation between u and v;
Fig. 7 is a schematic diagram showing thickness var-

iation between u and v; and

Fig. 8 is a schematic diagram showing thickness variation between u and v.

[EXPLANATION OF SYMBOLS]

[0010]

1	hermetic container
2	motor
3	first compressing block
4	shaft
4a	first eccentric portion
4b	second eccentric portion
5	first cylinder
6	upper bearing member (first end plate member)
7	lower bearing member (second end plate member)
7p	communication passage
7s	thick section
7t	thick section
7w	thick section
8	first piston
9	first closing member
10	second closing member
11	discharge pipe
13	interior space
14	first suction pipe
15	second cylinder
16	second suction pipe
17	stator
18	rotor
19	first suction port
20	second suction port
21	terminal
22	oil reservoir
25	first cylinder chamber
25a	first suction chamber
25b	first discharge chamber
26	second cylinder chamber
26a	second suction chamber
26b	second discharge chamber
28	second piston
30	second compressing block
32	first vane
33	second vane
34	first vane groove
35	second vane groove
36	first spring
37	second spring
38	middle plate
40	first discharge port
41	second discharge port
43	first discharge valve
44	second discharge valve
46	penetrating flow path
51, 52	refrigerant discharge space
53	oil retaining section
100	rotary compressor
102	compressing mechanism
H1	first reference plane
H2	second reference plane
H3	third reference plane

[MODE FOR CARRYING OUT THE INVENTION]

[0011] A first aspect of the invention provides a rotary compressor comprising: a hermetic container having an oil reservoir; a cylinder placed in the hermetic container; a piston placed in the cylinder; an end plate member mounted on the cylinder to form a cylinder chamber between the cylinder and the piston; a vane which partitions the cylinder chamber into a suction chamber and a discharge chamber; a suction port for guiding refrigerant to be compressed into the suction chamber; a discharge port which is formed in the end plate member and which discharges compressed refrigerant from the discharge chamber; and a zone member which is mounted on the end plate member and which forms, together with the end plate member, a refrigerant discharge space in which the refrigerant discharged from the discharge chamber through the discharge port can stay; in which the end plate member is provided with a recess on the same side as the suction port as viewed from a reference plane which includes a center of the vane and a center axis of the cylinder when the vane most projects toward the center axis of the cylinder, and a portion of oil stored in the oil reservoir enters the recess, thereby forming an oil retaining section, wherein the discharge port is provided with a discharge valve which restrains the refrigerant from reversely flowing from the refrigerant discharge space into the discharge chamber, and a thick section of a portion of the end plate (bearing) member between the refrigerant discharge space and the cylinder chamber is made thicker than a minimum thick section of the end plate (bearing) member between the oil retaining section and the cylinder chamber. According to this, it is possible to enhance rigidity of the end plate (bearing) on the side of the discharged refrigerant space where the discharge valve is provided, and the sucked refrigerant can receive heat. The oil retaining section does not influence rigidity in the vicinity of the discharge valve. By reducing the thickness of the end plate (bearing) member, capacity of the oil retaining section is increased, and it is possible to enhance the heat-insulating effect and to suppress the heat-reception of the sucked refrigerant.

[0012] According to a second aspect of the invention, in the rotary compressor of the first invention, the hermetic container is filled with the oil or the refrigerant having substantially the same pressure as discharge pressure of the refrigerant. According to this, temperature of the entire operating hermetic container rises to substantially the same temperature as the discharged refrigerant, and the heat-insulating effect of the sucked refrigerant of the first invention is more remarkably exerted.

[0013] According to a third aspect of the invention, especially in the rotary compressor of the first or second invention, the thick section of the end plate member between the oil retaining section and the cylinder chamber forms the minimum thick section at a position close to the suction port. According to this, a rate of heat-reception reducing effect of the sucked refrigerant to the rigidity reduction of the end plate member forming the oil retaining section can be increased. Therefore, it is possible to realize a rotary compressor having higher quality and higher performance.

[0014] According to a fourth aspect of the invention, especially in the rotary compressor of any one of the first to third inventions, a thickness of the thick section of the end plate member between the oil retaining section and the cylinder chamber becomes thinner toward the suction port. According to this, a ratio of heat-reception reduction effect of the sucked refrigerant by the oil retaining section can be enhanced to the maximum extent.

[0015] According to a fifth aspect of the invention, especially in the rotary compressor of any one of the first to fourth inventions, the end plate member is made of sintered material. According to this, it is possible to freely select the thickness of the end plate member at a location of the discharged refrigerant space and at a location of the oil retaining section, and it is possible to inexpensively realize the effect of the invention without increasing costs. Further, the sintered material has a large number of fine cavities therein, and the heat-insulating effect of the sintered material itself and the heat insulating configuration of the present invention can form a synergetic effect.

[0016] According to a sixth aspect of the invention, especially in the rotary compressor of any one of the first to fourth inventions, the end plate member is made of forged material. According to this, it is possible to adjust, at a forging stage, a thickness of the end plate member at a location of the discharged refrigerant space and a location of the oil retaining section. Therefore, as compared with a case where molded material is machined, it is possible to inexpensively realize the effect of the present invention without largely increasing costs.

[0017] According to a seventh aspect of the invention, especially in the rotary compressor of any one of the first to sixth inventions, the refrigerant is high pressure refrigerant, e.g., carbon dioxide. According to this, in the conventional technique, temperature of the compressor rises and heat-reception of the sucked refrigerant is increased, but in the present invention, since the oil retaining section having a higher heat-insulating effect insulates, it is possible to more remarkably suppress the heat-reception of the sucked refrigerant, and to provide an efficient compressor.

[0018] An embodiment of the present invention will be described below with reference to the drawings. The invention is not limited to the embodiment.

(Embodiment)

[0019] As shown in Fig. 1, a rotary compressor 100 of the embodiment includes a hermetic container 1, a motor 2, a compressing mechanism 102 and a shaft 4. The compressing mechanism 102 is placed at a lower location in the hermetic container 1. The motor 2 is placed in the hermetic container 1 at a location above the compressing mechanism 102. The compressing mechanism 102 and the motor 2 are connected to each other through the shaft 4. A terminal 21 for supplying electricity to the motor 2 is provided on an upper portion of the hermetic container 1. An oil reservoir 22 for retaining lubricant oil is formed in a bottom of the hermetic container 1.

[0020] The motor 2 is composed of a stator 17 and a rotor 18. The stator 17 is fixed to an inner wall of the hermetic container 1. The rotor 18 is fixed to the shaft 4. The rotor 18 and the shaft 4 are driven and rotated by the motor 2.

[0021] The upper portion of the hermetic container 1 is provided with a discharge pipe 11. The discharge pipe 11 penetrates the upper portion of the hermetic container 1 and opens toward an interior space 13 of the hermetic container 1. The discharge pipe 11 functions as a discharge flow path through which refrigerant compressed by the compressing mechanism 102 is introduced to outside of the hermetic container 1. When the rotary compressor 100 operates, the interior space 13 of the hermetic container 1 is filled with compressed refrigerant. That is, the rotary compressor 100 is a high pressure shell-type compressor. According to the high pressure shell-type rotary compressor 100, since it is possible to cool the motor 2 by refrigerant, it is possible to expect that motor efficiency is enhanced. However, according to the high pressure shell-type compressor, on the other hand, temperature of the hermetic container 1 and temperature of the compressing mechanism 102 itself are substantially equal to discharge temperature, i.e., the temperature of the hermetic container 1 and the temperature of the compressing mechanism 102 itself are high. Therefore, heat-reception of sucked refrigerant is prone to occur.

[0022] The compressing mechanism 102 is operated by the motor 2 to compress refrigerant. More specifically, the compressing mechanism 102 includes a first compressing block 3, a second compressing block 30, an upper bearing member 6, a lower bearing member 7, a middle plate 38, a first closing member 9 (first muffler member) and a second closing member 10 (second muffler member). Refrigerant is compressed by the first compressing block 3 or the second compressing block 30. The first compressing block 3 and the second compressing block 30 are immersed in oil stored in the oil reservoir 22. In this embodiment, the first compressing block 3 is composed of parts which are in common with parts configuring the second compressing block 30. Therefore, the first compressing block 3 has the same suction capacity as that of the second compressing block 30.

[0023] As shown in Fig. 2, the first compressing block 3 is composed of a first cylinder 5, a first piston 8, a first vane 32, a first suction port 19, a first discharge port 40 and a first spring 36. As shown in Fig. 3, the second compressing block 30 is composed of a second cylinder 15, a second piston 28, a second vane 33, a second suction port 20, a second discharge port 41 and a second spring 37. The first cylinder 5 and the second cylinder 15 are concentrically placed.

[0024] The shaft 4 includes a first eccentric portion 4a and a second eccentric portion 4b. The first eccentric portion 4a and the second eccentric portion 4b project outward in a radial direction of the shaft 4. The first piston 8 and the second piston 28 are placed in the first cylinder 5 and the second cylinder 15, respectively. In the first cylinder 5, the first piston 8 is mounted on the first eccentric portion 4a. In the second cylinder 15, the second piston 28 is mounted on the second eccentric portion 4b. A first vane groove 34 and a second vane groove 35 are formed in the first cylinder 5 and the second cylinder 15, respectively. A position of the first vane groove 34 matches with a position of the second vane groove 35 in a rotation direction of the shaft 4. The first eccentric portion 4a projects in a direction which is 180° opposite from a projecting direction of the second eccentric portion 4b. That is, a phase difference between the first piston 8 and the second piston 28 is 180°. This configuration exerts an effect for reducing vibration and noise.

[0025] The upper bearing member 6 (first end plate member) is mounted on the first cylinder 5 such that a first cylinder chamber 25 is formed between an inner peripheral surface of the first cylinder 5 and an outer peripheral surface of the first piston 8. The lower bearing member 7 (second end plate member) is mounted on the second cylinder 15 such that a second cylinder chamber 26 is formed between an inner peripheral surface of the second cylinder 15 and an outer peripheral surface of the second piston 28. More specifically, the upper bearing member 6 is mounted on an upper portion of the first cylinder 5, and the lower bearing member 7 is mounted on a lower portion of the second cylinder 15. The middle plate 38 is placed between the first cylinder 5 and the second cylinder 15.

[0026] The first suction port 19 and the second suction port 20 are formed in the first cylinder 5 and the second cylinder 15, respectively. The first suction port 19 and the second suction port 20 open toward the first cylinder chamber 25 and the second cylinder chamber 26, respectively. A first suction pipe 14 and a second suction pipe 16 are connected to the first suction port 19 and the second suction port 20, respectively.

[0027] The first discharge port 40 and the second discharge port 41 are formed in the upper bearing member 6 and the lower bearing member 7, respectively. The first discharge port 40 and the second discharge port 41 open toward the first cylinder chamber 25 and the second cylinder chamber 26, respectively. The first discharge port 40 is provided with a first discharge valve 43 to open and close the first discharge port 40. The second discharge port 41 is provided with a second discharge valve 44 to open and close the second discharge port 41.

[0028] The first vane 32 (blade) is placed in the first vane groove 34 such that the first vane 32 can slide therein. The first vane 32 partitions the first cylinder chamber 25 along a circumferential direction of the first piston 8. According to this, the first cylinder chamber 25 is partitioned into a first suction chamber 25a and a first discharge chamber 25b. The second vane 33 (blade) is placed in the second vane groove 35 such that the second vane 33 can slide therein. The second vane 33 partitions the second cylinder chamber 26 along a circumferential direction of the second piston 28. According to this, the second cylinder chamber 26 is partitioned into a second suction chamber 26a and a second discharge chamber 26b. The first suction port 19 and the first discharge port 40 are located on left and right sides of the first vane 32, respectively. The second suction port 20 and the second discharge port 41 are located on left and right sides of the second vane 33. Refrigerant to be compressed is supplied to the first cylinder chamber 25 (first suction chamber 25a) through the first suction port 19. Refrigerant to be compressed is supplied to the second cylinder chamber 26 (second suction chamber 26a) through the second suction port 20. Refrigerant compressed in the first cylinder chamber 25 pushes and opens the first discharge valve 43, and is discharged from the first discharge chamber 25b through the first discharge port 40. Refrigerant compressed in the second cylinder chamber 26 pushes and opens the second discharge valve 44, and is discharged from the second discharge chamber 26b through the second discharge port 41.

[0029] The first piston 8 and the first vane 32 may be composed of a single part, i.e., a swing piston. The second piston 28 and the second vane 33 may be composed of a single part, i.e., a swing piston. The first vane 32 and the second vane 33 may be coupled to the first piston 8 and the second piston 28, respectively.

[0030] The first spring 36 and the second spring 37 are placed behind the first vane 32 and the second vane 33, respectively. The first spring 36 and the second spring 37 respectively push the first vane 32 and the second vane 33 toward a center of the shaft 4. A rear portion of the first vane groove 34 and a rear portion of the second vane groove 35 are in communication with the interior space 13 of the hermetic container 1. Therefore, pressure in the interior space 13 of the hermetic container 1 is applied to a back surface of the first vane 32 and a back surface of the second vane 33. Lubricant oil stored in the oil reservoir 22 is supplied to the first vane groove 34 and the second vane groove 35.

[0031] Refrigerant discharged from the first discharge chamber 25b through the first discharge port 40 can stay in a refrigerant discharge space 51. As shown in Fig. 1, the first closing member 9 is mounted on the upper bearing member 6 (first end plate member) such that the refrigerant discharge space 51 is formed on the opposite side from the first cylinder chamber 25. More specifically, the first closing member 9 is mounted on an upper portion of the upper bearing member 6 such that the refrigerant discharge space 51 is formed above the upper bearing member 6. The first discharge valve 43 is covered with the first closing member 9. A discharge port 9a is formed in the first closing member 9 for guiding refrigerant into the interior space 13 of the hermetic container 1. Refrigerant discharged from the second discharge chamber 26b through the second discharge port 41 can stay in a refrigerant discharge space 52. The second closing member 10 is mounted on the lower bearing member 7 (second end plate member) such that the refrigerant discharge space 52 is formed on the opposite side from the second cylinder chamber 26. Refrigerant can stay in the refrigerant discharge space 52. More specifically, the second closing member 10 is mounted on a lower portion of the lower bearing member 7 such that the refrigerant discharge space 52 is formed below the lower bearing member 7. The second discharge valve 44 is covered with the second closing member 10. The refrigerant discharge spaces 51 and 52 function as flow paths for refrigerant. The shaft 4 penetrates a central portion of the first closing member 9 and a central portion of the second closing member 10. The shaft 4 is supported by the upper bearing member 6 and the lower bearing member 7. According to this, the shaft 4 can rotate.

[0032] The refrigerant discharge space 52 is in communication with the refrigerant discharge space 51 through a penetrating flow path 46. The penetrating flow path 46 penetrates the lower bearing member 7, the second cylinder 15, the middle plate 38, the first cylinder 5 and the upper bearing member 6 in a direction parallel to a rotation axis of the shaft 4. Refrigerant compressed by the second compressing block 30 merges with refrigerant compressed by the first compressing block 3 in an interior space of the first closing member 9, i.e., in the refrigerant discharge space 51. Hence, even if a volume of the refrigerant discharge space 52 is slightly insufficient, a sound deadening effect can be obtained by the refrigerant discharge space 51 in the first closing member 9. A cross sectional area (area of flow path) of the penetrating flow path 46 is geater than a cross sectional area (area of flow path) of the second discharge port 41. According to this, it is possible to prevent pressure loss from increasing.

[0033] As shown Fig. 3, in the present invention, a first reference plane H1, a second reference plane H2 and a third reference plane H3 are defined as follows. A plane which includes a center axis O_1 of the second cylinder 15 and a center of the second vane 33 when the second vane 33 most projects toward the center axis O_1 of the second cylinder 15 is defined as the first reference plane H1. The first reference plane H1 passes through a center of the second vane groove 35. A plane which includes the center axis O_1 and which is perpendicular to the first reference plane H1 is defined as the second reference plane H2. A plane which includes a center of the second suction port 20 and the center axis O_1 is defined as the third reference plane H3. The center axis O_1 of the second cylinder 15 substantially matches with the rotation axis of the shaft 4 and a center axis of the first cylinder 5.

[0034] As shown in Fig. 1, the compressing mechanism 102 further includes an oil retaining section 53. The oil retaining section 53 is formed on the same side as the second suction port 20 as viewed from the first reference plane H1 and on the opposite side from the second cylinder chamber 26 while sandwiching the lower bearing member 7 between the oil retaining section 53 and the second cylinder chamber 26. More specifically, the oil retaining section 53 is in contact with a lower surface of the lower bearing member 7. The oil retaining section 53 is configured such that oil stored in the oil reservoir 22 is taken into the oil retaining section 53 and a flow of the oil which is taken is suppressed more than a flow of oil in the oil reservoir 22. The flow of oil in the oil retaining section 53 is slower than the flow of oil in the oil reservoir 22.

[0035] In the rotary compressor 100, an oil surface in the oil reservoir 22 is located higher than a lower surface of the first cylinder 5. To secure reliability, it is preferable that the oil surface in the oil reservoir 22 is higher than an upper surface of the first cylinder 5 and lower than a lower surface of the motor 2 during operation of the rotary compressor. The second cylinder 15, the lower bearing member 7 and the second closing member 10 are immersed in oil in the oil reservoir 22. Therefore, oil in the oil reservoir 22 can flow into the oil retaining section 53.

[0036] Refrigerant to be compressed is in a low temperature and low pressure state. On the other hand, compressed refrigerant is in a high temperature and high pressure state. Hence, during operation of the rotary compressor 100, a specific temperature distribution is generated in the lower bearing member 7. More specifically, when the lower bearing member 7 is divided into a suction-side portion and a discharge-side portion, temperature of the suction-side portion is relatively low, and the discharge-side portion is one of portions the compressor having the high temperature. The lower bearing member 7 is divided into a suction-side portion and a discharge-side portion by the first reference plane H1. The suction-side portion includes a portion directly below the second suction port 20, and the second discharge port 41 is provided in the discharge-side portion.

[0037] In this embodiment, the oil retaining section 53 is formed on the same side as the second suction port 20 as viewed from the first reference plane H1. The oil retaining section 53 is in contact with a lower surface of the lower bearing member 7. In this case, since oil retained by the oil retaining section 53 functions as heat insulating material, it is possible to restrain heat of refrigerant (compressed refrigerant) of the refrigerant discharge space 52 from moving toward refrigerant (sucked refrigerant) sucked into the second cylinder chamber 26 through the lower bearing member 7. Even if another member is placed between the oil retaining section 53 and the lower surface of the lower bearing member 7, this other member can be regarded as a portion of the lower bearing member 7.

[0038] As shown in Figs. 1 and 5, in this embodiment, a first recess formed in the lower bearing member 7 is closed by the second closing member 10. According to this, the oil retaining section 53 is formed. According to this structure, since it is possible to avoid increase in the thickness of the lower bearing member 7, it is possible to avoid increase in cost of parts, and this is also an advantage in reduction in weight of the rotary compressor 100. Alternatively, the oil retaining section 53 may be formed by closing the first recess by a member which is different from the second closing member 10.

[0039] The lower bearing member 7 is further provided with communication passages 7p. The communication passages 7p extend in a lateral direction to bring the oil reservoir 22 and the oil retaining section 53 into communication with each other. Oil in the oil reservoir 22 can flow into the oil retaining section 53 through the communication passages 7p (communication hole). If the plurality of communication passages 7p are formed, oil in the oil reservoir 22 can reliably flow into the oil retaining section 53. A size of each of the communication passages 7p is adjusted to such a necessary and sufficient size that oil in the oil reservoir 22 flows into the oil retaining section 53. Hence, a flow of oil in the oil retaining section 53 is slower than a flow of oil in the oil reservoir 22. Therefore, in the oil retaining section 53, oil forms relatively stable thermal stratification.

[0040] In this embodiment, the communication passages 7p are composed of small through holes. The communication passages 7p may be composed of other structures such as slits. As shown in Fig. 4, in a direction parallel to the rotation axis of the shaft 4, upper ends of the communication passages 7p is located in a lower surface 7h of the lower bearing member 7, or exist at a location higher than the lower surface 7h of the lower bearing member 7. According to such a configuration, it is possible to prevent air or refrigerant from remaining in the oil retaining section 53.

[0041] A second recess formed in the lower bearing member 7 is closed by the second closing member 10. According to this, the refrigerant discharge space 52 is formed. That is, the first recess which functions as the oil retaining section 53 and the second recess which functions as the refrigerant discharge space 52 are formed in the lower bearing member 7. The second closing member 10 is composed of a single plate-shaped member. An opening end surface of the first recess and an opening end surface of the second recess exist on the same plane so that both the first recess and the second recess are closed by the second closing member 10. Such a structure is extremely simple, and it is possible to avoid increase in the number of parts.

[0042] As shown in Fig. 5, the oil retaining section 53 is formed in a zone of a portion of a peripheral environment of the shaft 4, and the refrigerant discharge space 52 is formed in a zone of other portion of the peripheral environment of the shaft 4. The oil retaining section 53 is completely isolated from the refrigerant discharge space 52 by ribs 7k provided on the lower bearing member 7. Most of the refrigerant discharge space 52 is formed on the same side as the second discharge port 41 as viewed from the first reference plane H1. On the other hand, the oil retaining section 53 is formed on the same side of the second suction port 20 as viewed from the first reference plane H1. According to this positional relationship, it is possible to restrain heat of refrigerant discharged into the refrigerant discharge space 52 from moving toward refrigerant sucked into the second cylinder chamber 26.

[0043] In this embodiment, a portion of the oil retaining section 53 is formed on the same side as the second discharge port 41 as viewed from the first reference plane H1. Alternatively, the entire oil retaining section 53 may be formed on the same side as the second suction port 20 as viewed from the first reference plane H1.

[0044] As shown in Fig. 1, a thickness of a thick section 7s of the lower bearing member 7 where the discharge valve is placed in the vicinity of the second discharge valve 44 in the second recess which forms the refrigerant discharge space 52 is thinner than a thickness of a thick section 7w of the first recess which forms the oil retaining section 53. As will be described below, when the thick section 7w in the first recess which forms the oil retaining section 53 is not constant, a thickness of the thick section 7s is thinner than a minimum thick section 7wmin in the first recess which forms the oil retaining section 53. That is, refrigerant corresponding to a volume in the second discharge port 41 is not discharged from the second discharge valve 44, and becomes a re-compressed refrigerant. Therefore, if the thickness of the thick section 7s where the discharge valve is placed is made as thin as possible, performance of the compressor is enhanced. However, rigidity of the thick section 7s where the discharge valve is placed is lowered as compared with other portions. Therefore, the entire thickness of the lower bearing member 7 between refrigerant discharge space 52 and the cylinder chamber 26 can not be made thin. Therefore, to compensate rigidity corresponding to a thinned amount of the thickness in the vicinity of the thick section 7s where the discharge valve is placed, it is necessary to provide a thick section 7t. Under such circumstance, in the conventional technique, the thickness of only the thick section 7s where the discharge valve is placed is made thin, and the thickness of the lower bearing member 7 of other portions including the oil retaining section 53 is made thick as the same level as the thickness of the thick section 7t. On the other hand, according to the lower bearing member 7 of the present invention, the thick section 7t of a portion between the refrigerant discharge space 52 and the cylinder chamber 26 is made thicker than the minimum thick section 7wmin between the oil retaining section 53 and the cylinder chamber 26.

Therefore, since the thick section 7w between the oil retaining section 53 and the cylinder chamber 26 is thinner than the thick section 7t, the heat-insulating effect of the oil retaining section 53 is enhanced, and it is possible to suppress the heat-reception of sucked refrigerant.

[0045] Further, in this embodiment, a thickness of the thick section 7w of the lower bearing member 7 between the oil retaining section 53 and the cylinder chamber 26 which forms is varied. As shown in Fig. 5, the minimum thick section 7wmin is formed at a point u of the oil retaining section 53 which is close to the second suction port 20, and the thickness of the thick section 7w of the lower bearing member 7 is increased toward a point v of the second eccentric portion 4b of the shaft 4 which moves forward in the rotation direction. Fig. 6 shows an example of thickness variation of the thick section 7w. The thickness is reduced toward the point u which largely influences heat-reception of sucked refrigerant, i.e., an oil heat insulating is made larger toward the point u. According to this, it is possible to compensate reduction in rigidity of the thick section 7s, to suppress reduction in heat-reception of sucked refrigerant, and to realize a reliable and efficient compressor.

[0046] As shown in Fig. 7 also, gradient of the thickness of the thick section 7w may be varied. As shown in Fig. 8, the thickness of the thick section 7w may be varied in a phased manner.

[0047] Although the present invention is described based on the two-cylinder rotary compressor, the same configuration can be applied also to a one-cylinder rotary compressor, i.e., the lower bearing member 7 can be provided with the oil retaining section 53.

[INDUSTRIAL APPLICABILITY]

[0048] The present invention is useful for a compressor of a refrigeration cycle device which can be utilized for an electric appliance such as a water heater, a hot-water heating device and an air conditioner.

Claims

1. A rotary compressor comprising:

a hermetic container having an oil reservoir;
a cylinder placed in the hermetic container;
a piston placed in the cylinder;
an end plate member mounted on the cylinder to form a cylinder chamber between the cylinder and the piston;
a vane which partitions the cylinder chamber into a suction chamber and a discharge chamber;
a suction port for guiding refrigerant to be compressed into the suction chamber;
a discharge port which is formed in the end plate member and which discharges compressed refrigerant from the discharge chamber; and
a zone member which is mounted on the end plate member and which forms, together with the end plate member, a refrigerant discharge space in which the refrigerant discharged from the discharge chamber through the discharge port can stay; in which
the end plate member is provided with a recess on the same side as the suction port as viewed from a reference plane which includes a center of the vane and a center axis of the cylinder when the vane most projects toward the center axis of the cylinder, and a portion of oil stored in the oil reservoir enters the recess, thereby forming an oil retaining section, wherein
the discharge port is provided with a discharge valve which restrains the refrigerant from reversely flowing from the refrigerant discharge space into the discharge chamber, and
a thick section of a portion of the end plate member between the refrigerant discharge space and the cylinder chamber is made thicker than a minimum thick section of the end plate member between the oil retaining section and the cylinder chamber.

2. The rotary compressor according to claim 1, wherein the hermetic container is filled with the oil or the refrigerant having substantially the same pressure as discharge pressure of the refrigerant.

3. The rotary compressor according to claim 1 or 2, wherein the thick section of the end plate member between the oil retaining section and the cylinder chamber forms the minimum thick section at a position close to the suction port.

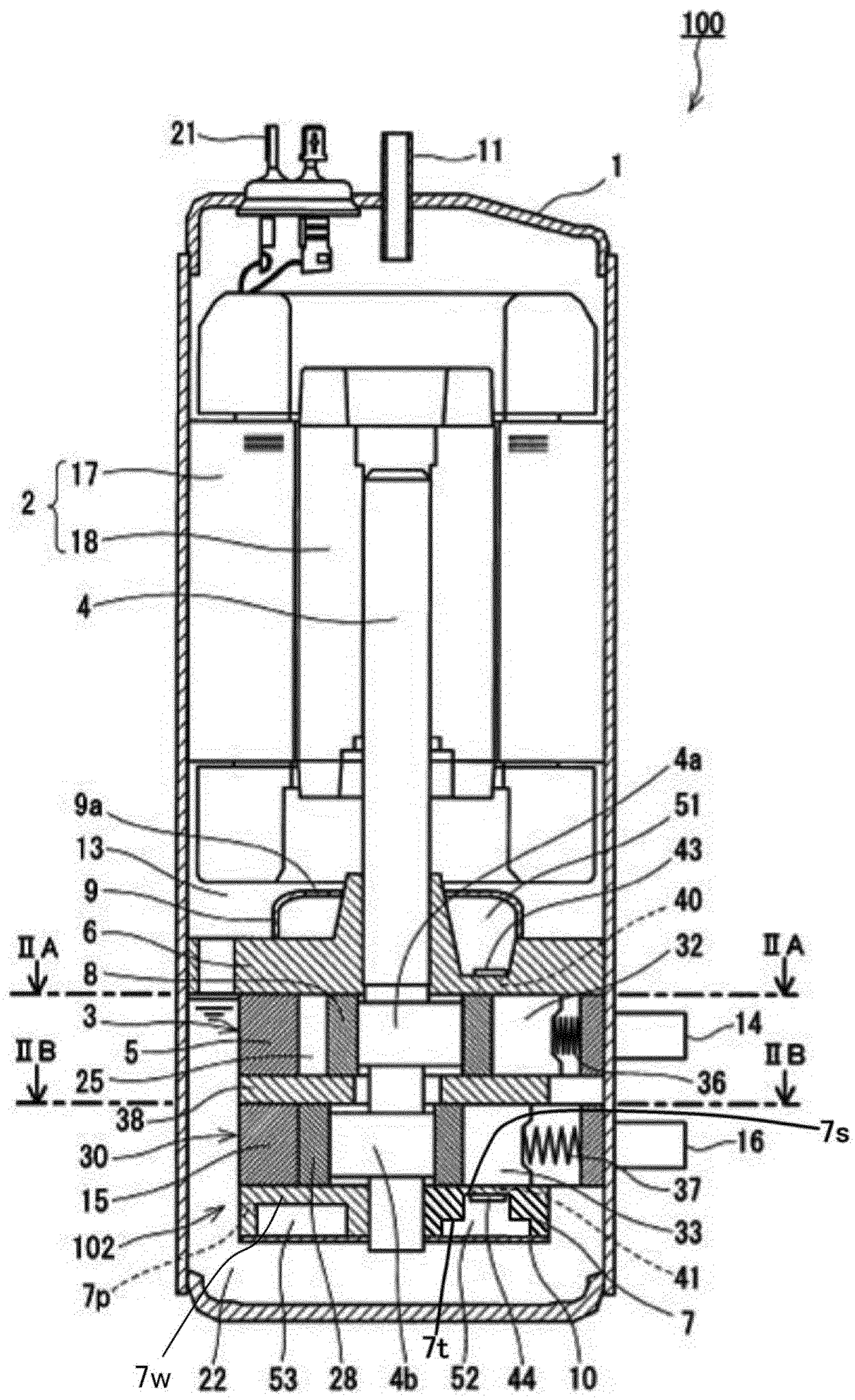
4. The rotary compressor according to any one of claims 1 to 3, wherein a thickness of the thick section of the end plate member between the oil retaining section and the cylinder chamber becomes thinner toward the suction port.

5. The rotary compressor according to any one of claims 1 to 4, wherein the end plate member is made of sintered material.

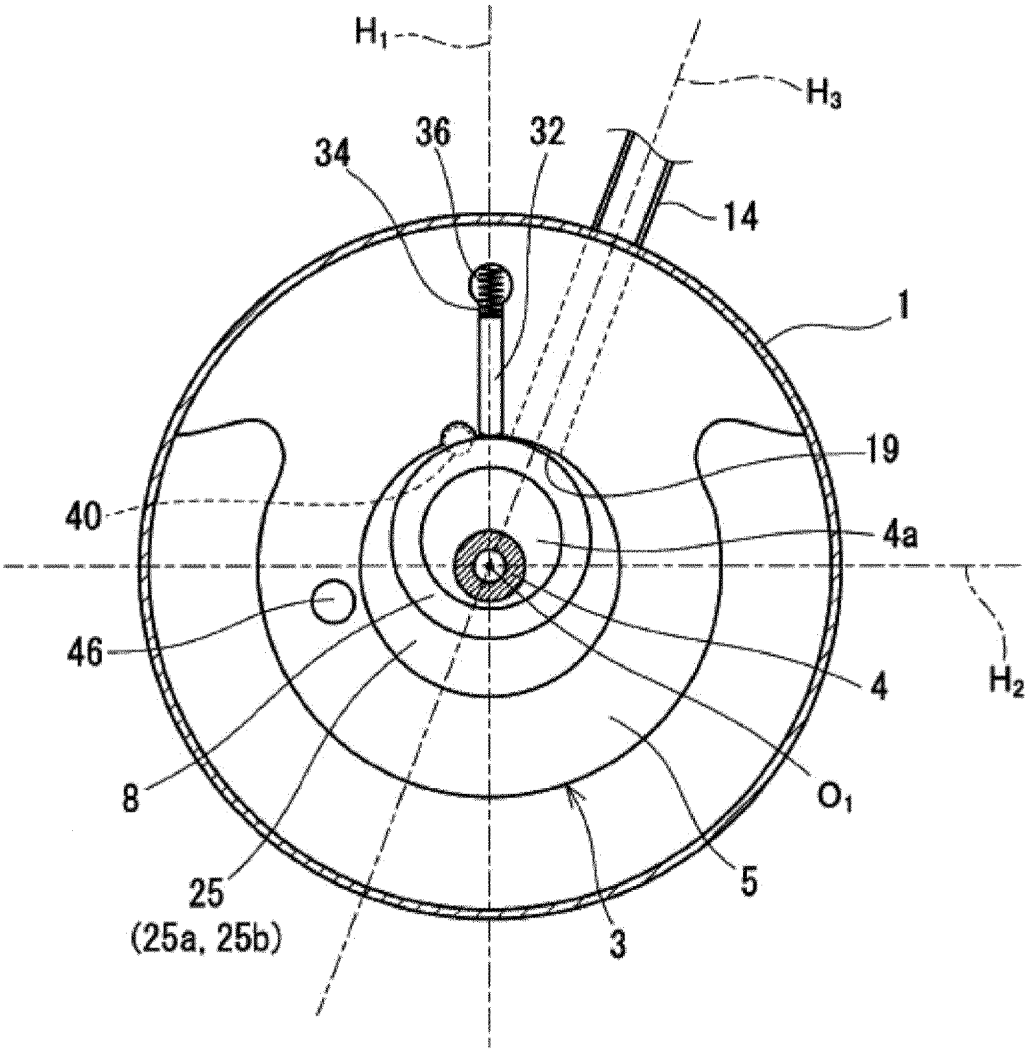
6. The rotary compressor according to any one of claims 1 to 4, wherein the end plate member is made of forged material.

7. The rotary compressor according to any one of claims 1 to 6, wherein the refrigerant is high pressure refrigerant, e.g., carbon dioxide.

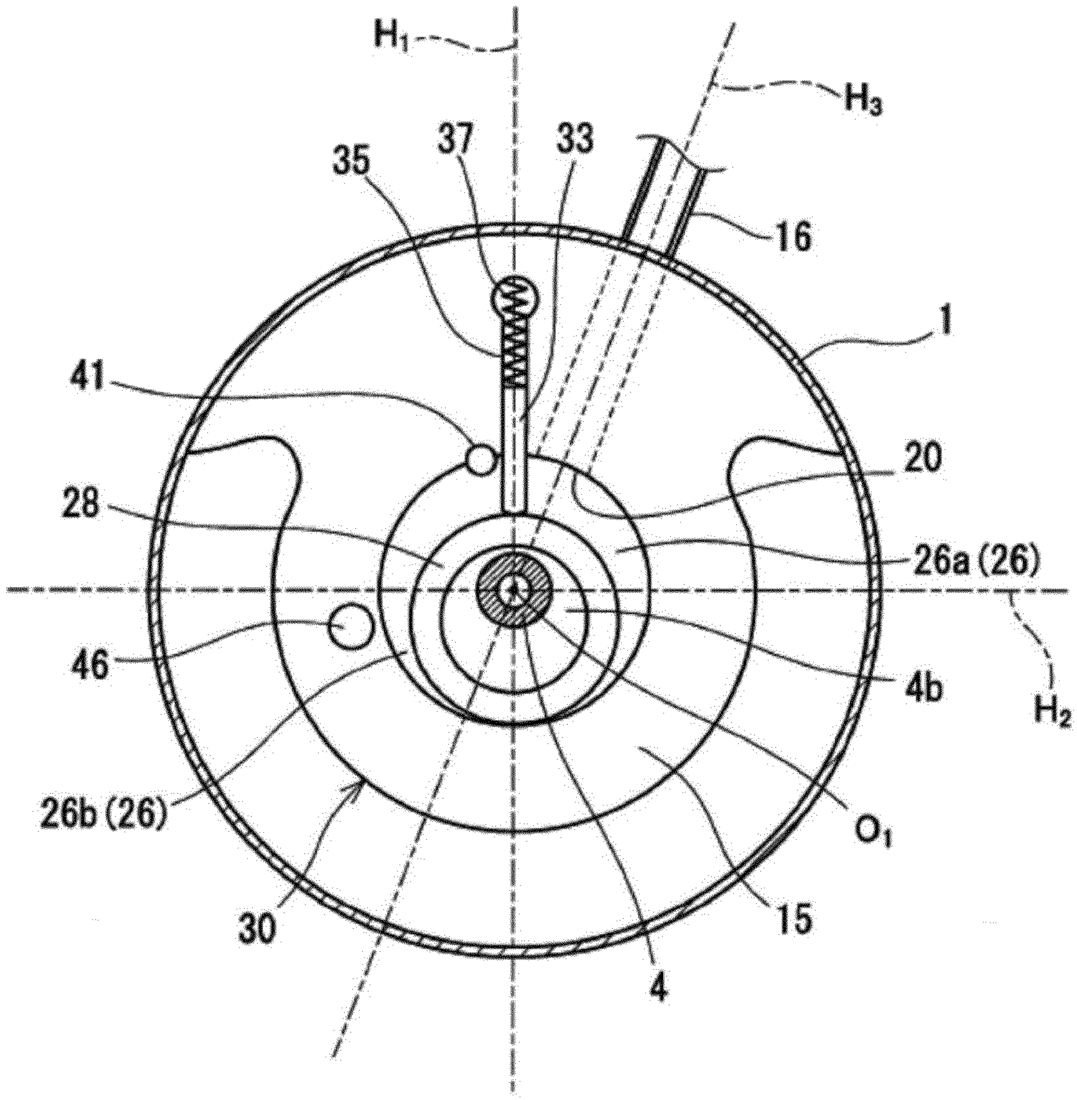
[Fig. 1]


100
21
11
1
2
17
18
4
4a
9a
51
13
43
9
40
6
32
IIA
IIA
8
3
14
IIB
5
IIB
25
36
38
7s
30
16
15
37
33
102
41
7p
7
7t
7w
22
53
28
4b
52
44
10

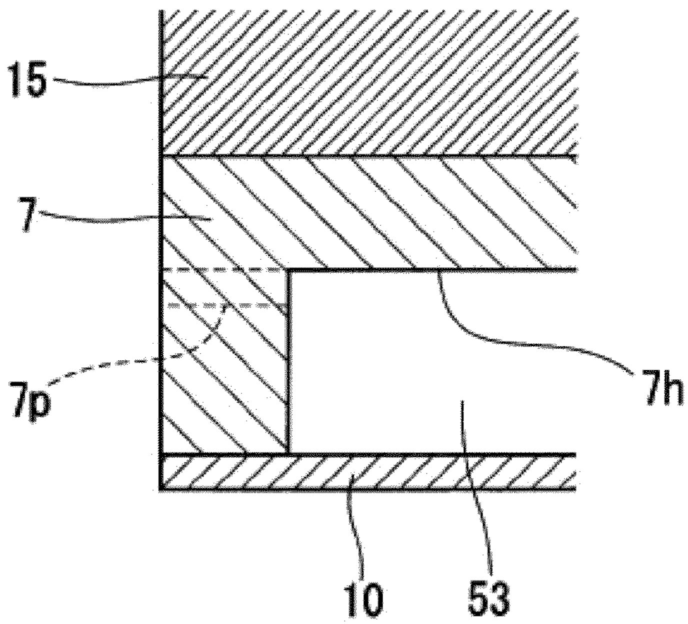
[Fig. 2]



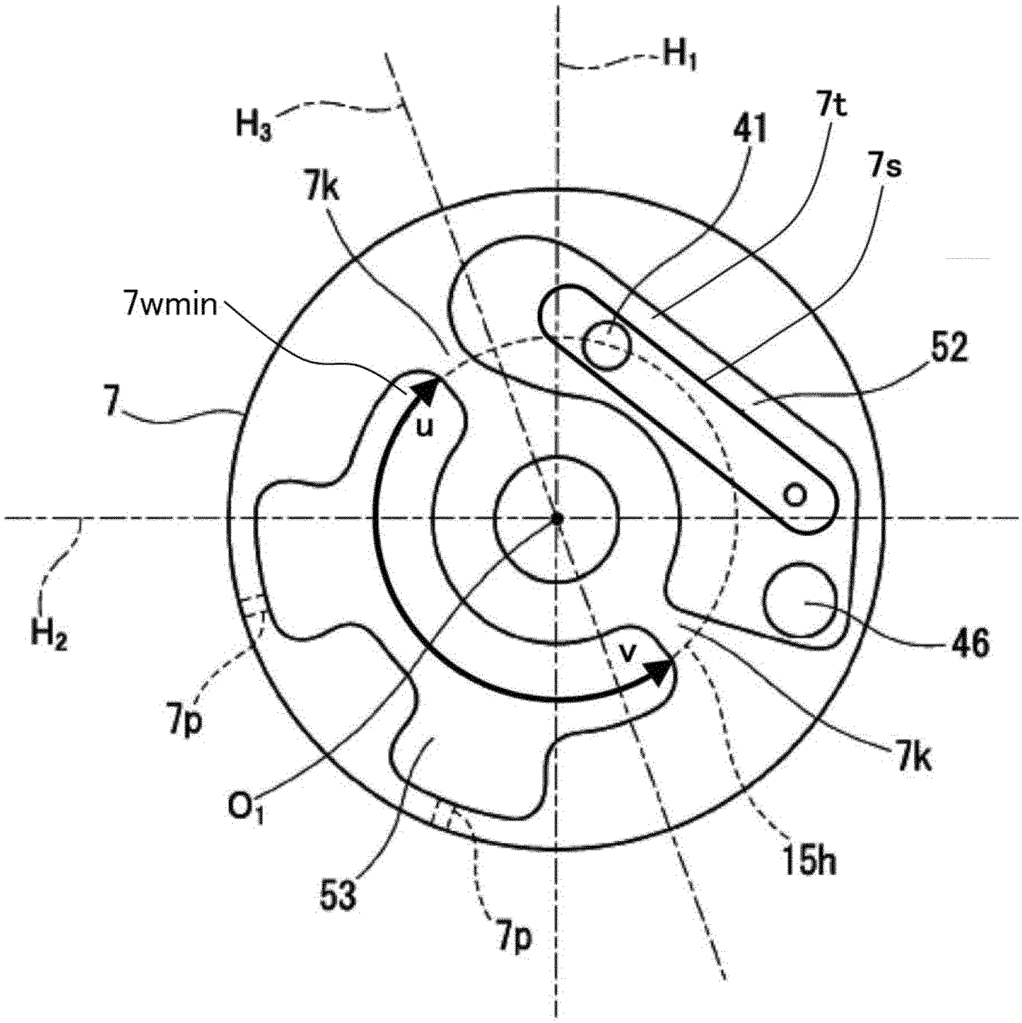
[Fig. 3]



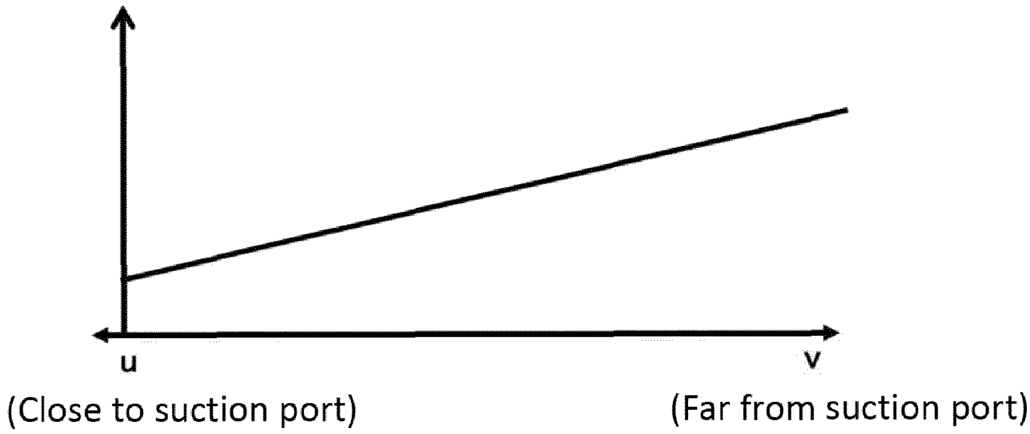
[Fig. 4]



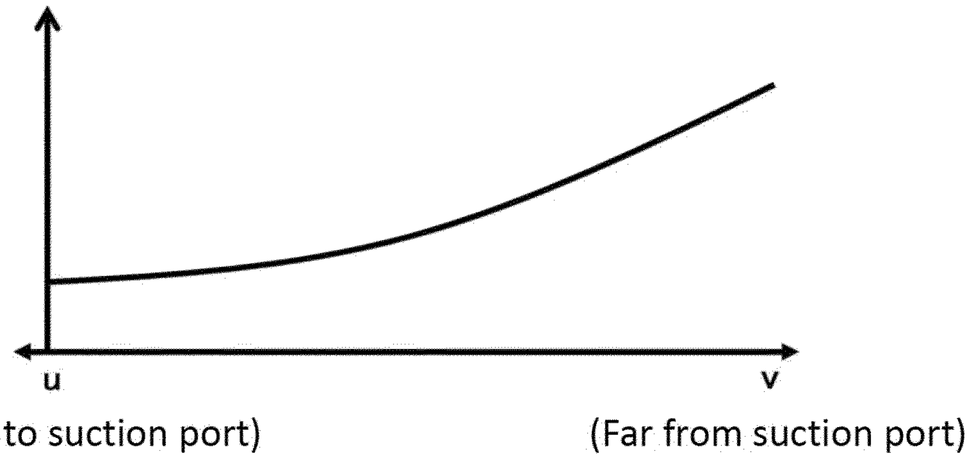
[Fig. 5]



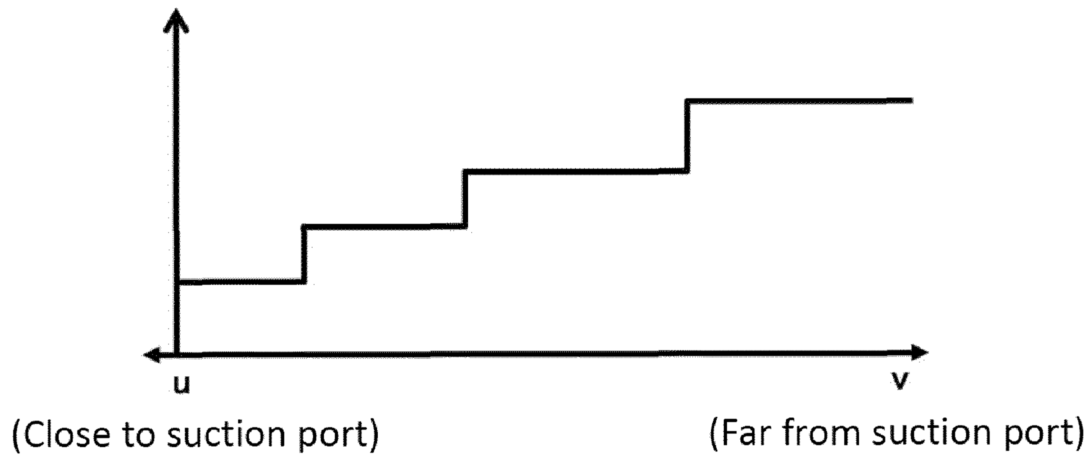
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/003890

A. CLASSIFICATION OF SUBJECT MATTER
F04C18/356(2006.01)i, *F04C23/00*(2006.01)i, *F04C29/04*(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)
F04C18/356, F04C23/00, F04C29/04

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

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2009-002299 A (Daikin Industries, Ltd.), 08 January 2009 (08.01.2009), paragraph [0048]; fig. 1 to 6 (Family: none)	1-7
A	JP 64-000387 A (Sanyo Electric Co., Ltd.), 05 January 1989 (05.01.1989), page 2, lower left column, line 12 to lower right column, line 15; fig. 1, 2 (Family: none)	1-7

☐ 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
10 September, 2013 (10.09.13)	24 September, 2013 (24.09.13)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (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 H2140486 B **[0004]**