



EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.11.2023 Bulletin 2023/44

(21) Application number: **23151272.4**

(22) Date of filing: **12.01.2023**

(51) International Patent Classification (IPC):
F04C 18/344 ^(2006.01) **F04C 28/10** ^(2006.01)
F04C 29/00 ^(2006.01) **F01C 21/08** ^(2006.01)
F04C 23/00 ^(2006.01) **F04C 29/02** ^(2006.01)

(52) Cooperative Patent Classification (CPC):
F04C 18/3441; F01C 21/0845; F01C 21/0854;
F01C 21/0863; F01C 21/0872; F04C 23/008;
F04C 28/10; F04C 29/0035; F04C 29/023

(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 ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **29.04.2022 KR 20220053183**

(71) Applicant: **LG Electronics Inc.**
Seoul 07336 (KR)

(72) Inventors:

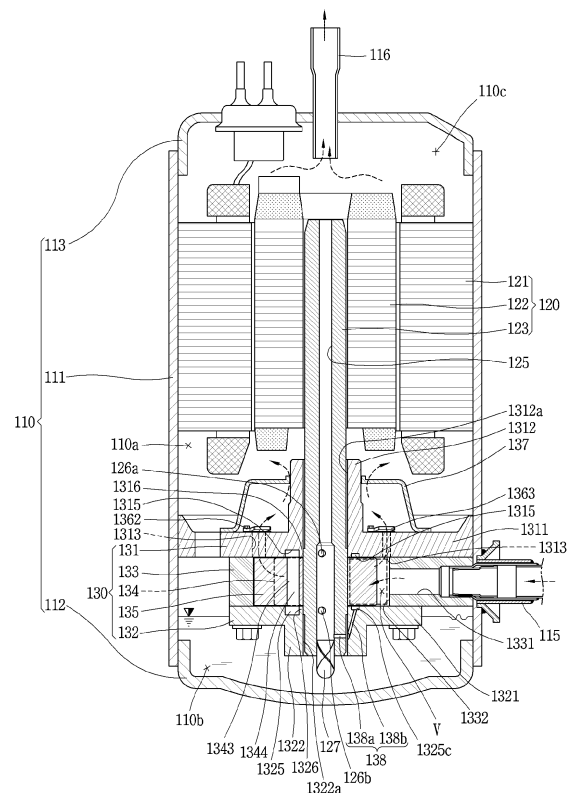
- **SHIN, Jinung**
Seoul 08592 (KR)
- **KANG, Seoungmin**
Seoul 08592 (KR)

(74) Representative: **Ter Meer Steinmeister & Partner**
Patentanwälte mbB
Nymphenburger Straße 4
80335 München (DE)

(54) **ROTARY COMPRESSOR**

(57) A rotary compressor is disclosed. A back pressure pocket closest to a discharge port among back pressure pockets disposed in at least one of main bearing and sub bearing is radially spaced from an inner circumferential surface of a bearing hole, and communicates with an inner space of a casing through a back pressure passage portion formed through at least one of the main and sub bearings. Accordingly, the back pressure pocket closest to the discharge port can strongly support a vane passing near a reference point toward a cylinder while forming discharge pressure or super discharge pressure higher than the discharge pressure. This can suppress chattering of the vane near the reference point to reduce vibration noise while suppressing wear between the vane and the cylinder to enhance compression efficiency. This can also suppress leakage between compression chambers, thereby preventing a delay of initial startup of the compressor.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a vane rotary compressor in which a vane is slidably inserted into a rotating roller.

BACKGROUND

[0002] A rotary compressor can be divided into two types, namely, a type in which a vane is slidably inserted into a cylinder to come in contact with a roller, and another type in which a vane is slidably inserted into a roller to come in contact with a cylinder. In general, the former is called a roller eccentric rotary compressor (hereinafter, referred to as a "rotary compressor"), and the latter is referred to as a vane concentric rotary compressor (hereinafter, referred to as a "vane rotary compressor").

[0003] As for a rotary compressor, a vane inserted in a cylinder is pulled out toward a roller by elastic force or back pressure to come into contact with an outer circumferential surface of the roller. On the other hand, for a vane rotary compressor, a vane inserted in a roller rotates together with the roller, and is pulled out by centrifugal force and back pressure to come into contact with an inner circumferential surface of a cylinder.

[0004] A rotary compressor independently forms compression chambers as many as the number of vanes per revolution of a roller, and the compression chambers simultaneously perform suction, compression, and discharge strokes. On the other hand, a vane rotary compressor continuously forms compression chambers as many as the number of vanes per revolution of a roller, and each compression chamber sequentially performs suction, compression, and discharge strokes. Accordingly, the vane rotary compressor has a higher compression ratio than the rotary compressor. Therefore, the vane rotary compressor is more suitable for high pressure refrigerants such as R32, R410a, and CO₂, which have low ozone depletion potential (ODP) and global warming index (GWP).

[0005] Such a vane rotary compressor is disclosed in each of Patent Document 1 (Japanese Laid-Open Patent Application No. JP2013-213438A), Patent Document 2 (US2015/0132168 A1), and Patent Document 3 (Korean Patent Application No. 10-2020-0057542). The vane rotary compressor disclosed in each of these patent documents discloses a structure in which a plurality of vanes are slidably inserted into a rotating roller.

[0006] In addition, in these patent documents, a back pressure chamber is formed at a rear end of each vane and communicates with back pressure pockets provided in a main bearing and a sub bearing. The back pressure pocket is divided into a first pocket forming intermediate pressure and a second pocket forming discharge pressure or intermediate pressure close to the discharge pressure. Based on a reference point (proximity, proximal

or contact point) at which a roller is close to a cylinder, the first pocket communicates with a back pressure chamber located at an upstream side, and the second pocket communicates with another back pressure chamber located at a downstream side.

[0007] However, in the related art vane rotary compressor, a compression cycle is shortened and a pressure difference between front and rear sides of a vane increases. This may make a behavior of the vane unstable, and cause so-called vane chattering that a front surface of the vane collides with an inner circumferential surface of a cylinder. This may occur intensively in the vicinity of a reference point where pressure of a compression chamber is highest, that is, to which a final discharge port is adjacent. This may cause wear of the inner circumferential surface of the cylinder or the front surface of the vane in the vicinity of the reference point. As a result, vibration noise may increase in the vicinity of the reference point and leakage between compression chambers may occur due to the wear between the cylinder and the vane. This may cause an increase in specific volume of suction refrigerant and an occurrence of suction loss, thereby lowering efficiency of the compressor.

[0008] In addition, in the related art vane rotary compressor, chattering in the vicinity of the reference point may severely occur at an initial startup (the beginning of an operation) of the compressor, which may further lower the efficiency of the compressor and even delay an air conditioning effect of an air conditioning apparatus employing the compressor.

[0009] In the related art vane rotary compressor, the vane reciprocates while an axial side surface thereof is in contact with a main bearing and/or sub bearing. During this process, the vane may be excessively brought into contact with the main bearing and/or sub bearing, which may cause the vane to reciprocate discontinuously. Then, the vane may be chattered more severely, thereby aggravating damages of the cylinder and/or vane and the suction loss.

[0010] Those problems become more serious when a high-pressure refrigerant such as R32, R410a, or CO₂ is used. In more detail, when the high-pressure refrigerant is used, the same level of cooling capability may be obtained as that obtained when using a relatively low-pressure refrigerant such as R134a, even though a volume of each compression chamber is reduced by increasing the number of vanes. However, if the number of vanes is increased, a compression cycle between the vane and the cylinder is shortened by that much, and the chattering of the vane in the vicinity of the reference point may be aggravated. This may be even worse under a low-temperature heating condition, a high-pressure ratio condition ($P_d / P_s \geq 6$), and a high-speed operating condition (above 80Hz).

SUMMARY

[0011] It is an object of the present disclosure to pro-

vide a rotary compressor capable of reducing vibration noise due to chattering of vanes during an operation of the compressor.

[0012] It is an object of the present disclosure to provide a rotary compressor capable of suppressing chattering of a vane by increasing force for pressing the vane passing near a reference point adjacent to a final discharge port toward a cylinder during an operation of the compressor.

[0013] It is an object of the present disclosure to provide a rotary compressor capable of suppressing uneven wear of a vane by applying uniform pressing force to the vane when the vane passes near a reference point during an operation of the compressor.

[0014] It is an object of the present disclosure to provide a rotary compressor, capable of enhancing efficiency of the compressor by suppressing a delay of an initial startup of the compressor.

[0015] It is an object of the present disclosure to provide a rotary compressor capable of quickly performing an initial startup operation by suppressing a refrigerant leakage near a reference point during an operation of the compressor.

[0016] It is an object of the present disclosure to provide a rotary compressor capable of further increasing efficiency of the compressor by reducing friction loss in other regions except for a region near a reference point while suppressing a refrigerant leakage near the reference point during an operation of the compressor.

[0017] It is an object of the present disclosure to provide a rotary compressor in which a vane can reciprocates continuously without interruption.

[0018] It is an object of the present disclosure to provide a rotary compressor capable of continuously reciprocating a vane by reducing friction loss between the vane and a main bearing and/or sub bearing facing the vane.

[0019] It is an object of the present disclosure to provide a rotary compressor capable of enhancing a lubricating effect by smoothly applying oil between a vane and a main bearing and/or sub bearing facing the vane.

[0020] It is an object of the present disclosure to provide a rotary compressor capable of effectively suppressing chattering of vanes even when a high-pressure refrigerant such as R32, R410a, or CO₂ is used.

[0021] The objects are solved by the features of the independent claims. Preferred embodiments are given in the dependent claims.

[0022] In order to achieve those aspects and other advantages of the present disclosure, there is provided a rotary compressor that may include a casing, a drive motor, a rotational shaft, a cylinder, a roller, vanes, a main bearing, and a sub bearing. The drive motor may be disposed in an inner space of the casing. The rotating shaft may be coupled to a rotor of the drive motor, and an oil supplying passage may be formed in a hollow shape through an inside of the rotating shaft. The cylinder may be disposed in the inner space of the casing to define a

compression space. The roller may be disposed on the rotating shaft and accommodated in the compression space. The roller may be eccentrically located with respect to an inner circumferential surface of the cylinder.

5 The vanes may be slidably inserted into vane slots disposed in the roller. The main bearing and the sub bearing may be disposed on both sides of the cylinder in an axial direction to form the compression space together with the cylinder. At least one of the main bearing and the sub bearing may include a discharge port through which refrigerant compressed in the compression space is discharged to the inner space of the casing, and one or more of back pressure pockets communicating with rear sides of the vanes are disposed at one side of the discharge port.

10 **[0023]** In one or more embodiments there might be a plurality of back pressure pockets being spaced apart from each other in a circumferential direction.

[0024] Here, a back pressure pocket that is closest to the discharge port of the plurality of back pressure pockets may communicate with the inner space of the casing by a back pressure passage portion penetrating through at least one of the main bearing and the sub bearing.

15 **[0025]** Accordingly, the back pressure pocket closest to the discharge port can strongly support a vane passing near a reference point adjacent to the discharge port toward a cylinder while forming discharge pressure or super discharge pressure higher than the discharge pressure. This can suppress chattering of the vane near the reference point to reduce vibration noise, and simultaneously suppress wear between the vane and the cylinder to enhance compression efficiency. This can also suppress leakage between compression chambers, thereby preventing a delay of an initial startup of the compressor.

20 Therefore, when the compressor is applied to an air conditioning apparatus, a delay of an air conditioning effect can be prevented.

25 **[0026]** In one example, each of the main bearing and the sub bearing may include a bearing hole in which the rotating shaft is inserted and supported. The back pressure pocket closest to the discharge port may be radially spaced apart from an inner circumferential surface of the bearing hole so as to be isolated from the bearing hole. Hence, the back pressure pocket closest to the discharge port can form an almost sealed space and secure discharge pressure or back pressure higher than the discharge pressure, thereby strongly supporting the vane toward the cylinder.

30 **[0027]** In another example, the rotating shaft may include an oil supply passage formed therein in a hollow shape, and at least one oil supply hole formed in a penetrating manner from an inner circumferential surface of the oil supply passage to an outer circumferential surface of the rotating shaft. The back pressure passage portion may have an inner diameter smaller than or equal to an inner diameter of the oil supply hole. This can prevent an occurrence of an oil shortage in another back pressure pocket, which results from that oil suctioned through the

35 40 45 50 55

oil supply passage excessively flows out through the back pressure passage portion.

[0028] In another example, the rotating shaft may include an oil supply passage formed therein in a hollow shape, and at least one oil supply hole formed in a penetrating manner from an inner circumferential surface of the oil supply passage to an outer circumferential surface of the rotating shaft. The back pressure passage portion may be located at one side of the oil supply hole in the axial direction. Accordingly, oil suctioned through the oil supply passage can quickly move to the back pressure passage portion, and simultaneously rigidity of the rotating shaft can be secured.

[0029] In another example, the back pressure passage portion may be formed to be eccentric from a center of the back pressure pocket to a reference point where the roller and the cylinder are closest to each other. With the configuration, the vane can block the back pressure passage portion at a position closest to the discharge port, so as to close the corresponding back pressure pocket and secure high back pressure.

[0030] In another example, the back pressure passage portion may be located at a position where the same periodically overlaps the vane during a reciprocating motion of the vane. Accordingly, the back pressure passage portion can be blocked periodically by the vane, such that the corresponding back pressure packet can form a closed space so as to secure high back pressure.

[0031] In another example, the back pressure passage portion may have an inner diameter smaller than a width of the vane. Accordingly, the back pressure passage portion can be blocked periodically by the vane, such that the corresponding back pressure packet can form a closed space so as to secure high back pressure.

[0032] In another example, the back pressure passage portion may include a first back pressure hole and a second back pressure hole. The first back pressure hole may penetrate from an inner circumferential surface of the oil supply passage to an outer circumferential surface of the rotating shaft. The second back pressure hole may be formed through at least one of the main bearing and the sub bearing to communicate with the first back pressure hole, so as to communicate with the back pressure pocket. Hence, high pressure oil can be introduced into the back pressure pocket closest to the discharge port by centrifugal force generated when the rotating shaft rotates.

[0033] Specifically, the second back pressure hole may have an inner diameter smaller than or equal to an inner diameter of the first back pressure hole. Accordingly, oil introduced into the back pressure pocket closest to the discharge port can be prevented from easily flowing out through the back pressure passage portion when the vane moves backward, thereby maintaining back pressure of the back pressure pocket.

[0034] Also, a communication groove may be formed between the first back pressure hole and the second back pressure hole. The communication groove may have a

cross-sectional area that is larger than at least one of a cross-sectional area of the first back pressure hole and a cross-sectional area of the second back pressure hole. This can reduce processing errors for the back pressure passage portion while the back pressure passage portion is formed in each of the rotating shaft and the main and sub bearings, and also can prevent blocking of the back pressure passage portion such that oil can be smoothly supplied to the back pressure pocket.

[0035] Specifically, the communication groove may be formed in an arcuate shape so that the first back pressure hole and the second back pressure hole communicate with each other periodically. Accordingly, the back pressure passage portion can be periodically blocked during an operation of the compressor, and hence the corresponding back pressure pocket can periodically form a closed space so as to minimize oil leakage therefrom, thereby securing high back pressure.

[0036] Also, the communication groove may be formed in a circular shape so that the first back pressure hole and the second back pressure hole communicate with each other continuously. This can allow oil to be continuously supplied to the back pressure pocket closest to the discharge port without interruption, thereby preventing in advance back pressure from being weakened due to an oil shortage in the back pressure pocket.

[0037] In another example, the back pressure passage portion may have one end communicating with the back pressure pocket closest to the discharge port, and another end communicating with the inner space of the casing through at least one of the main bearing and the sub bearing. This can facilitate the formation of the back pressure passage portion and simultaneously allow oil to be quickly flow into the back pressure pocket.

[0038] In another example, the back pressure pocket closest to the discharge port among the plurality of back pressure pockets may have a volume smaller than a volume of another back pressure pocket. This may result in maintaining pressure of the back pressure pocket closest to the discharge port to be higher than pressure of the another back pressure pocket.

[0039] Specifically, the back pressure pocket closest to the discharge port among the plurality of back pressure pockets may have an arcuate length shorter than an arcuate length of the another back pressure pocket. Accordingly, pressure of the back pressure pocket closest to the discharge port can be maintained to be higher than pressure of the another back pressure pocket and simultaneously a section where the vane is in close contact with the cylinder can be minimized so as to suppress an increase in friction loss.

[0040] Also, the back pressure pocket closest to the discharge port among the plurality of back pressure pockets may have a depth smaller than a depth of the another back pressure pocket. This may result in easily maintaining pressure of the back pressure pocket closest to the discharge port to be higher than pressure of the another back pressure pocket.

[0041] In another example, a lubricating portion may be formed at at least one of the main bearing and the sub bearing radially outside the back pressure pocket. At least portion of the lubricating portion may radially overlap the back pressure pocket closest to the discharge port. Hence, the vane can be in close contact with the main bearing and/or the sub bearing, which can suppress an occurrence of discontinuous sliding of the vane and reduce chattering of the vane at the same time, thereby enhancing compression efficiency and reliability.

[0042] Specifically, the lubricating portion may include a lubrication pocket and a lubrication passage. The lubrication pocket may be spaced apart from the back pressure pocket. The lubrication passage may connect the lubrication pocket and the inner space of the casing to guide oil stored in the inner space of the casing to the lubrication pocket. Thus, the oil stored in the inner space of the casing can be quickly supplied to the lubrication pocket, so as to form a wide and thick oil film between the vane and the bearing surface facing the same.

[0043] Also, the lubrication pocket may be configured as one groove extending in the circumferential direction. The lubrication passage may be provided by one or more in number in the circumferential direction of the lubrication pocket. This can increase a circumferential length of the lubrication pocket in contact with the vane, which may result in quickly and uniformly forming an oil film on the vane and the bearing surface facing the vane.

[0044] Also, the lubrication pocket may be provided in plurality spaced apart from each other in the circumferential direction. The lubrication passage may independently communicate with each of the plurality of lubrication pockets. This can decrease a circumferential length of the lubrication pocket, which may result in reducing friction loss between the vane and the lubrication pocket that crosses with respect to a reciprocating direction of the vane.

[0045] Also, the lubricating portion may include at least one lubrication passage formed through the sub bearing. The lubrication passage may have one end open toward the vane at one axial side surface of the sub bearing, and another end open toward the inner space of the casing at another axial side surface of the sub bearing. This can facilitate the formation of the lubricating portion and further shorten the circumferential length of the lubrication pocket, which may result in reducing friction loss between the vane and the lubrication pocket that crosses with respect to a reciprocating direction of the vane.

[0046] Also, the lubricating portion may include a lubrication pocket and a lubrication passage. The lubrication pocket may be spaced apart from the back pressure pocket. The lubrication passage may extend from at least one of the back pressure pockets excluding the back pressure pocket closest to the discharge port to communicate with the lubrication pocket. This can facilitate the formation of the lubricating portion and minimize an oil supplying length of the lubricating portion such that oil can be quickly supplied between the vane and the bear-

ing.

[0047] Specifically, an axial depth of the lubrication pocket may be smaller than or equal to an axial depth of the back pressure pocket to which the lubrication pocket is connected. This can suppress oil of the back pressure pocket from excessively flowing to the lubrication pocket, thereby appropriately maintaining the back pressure of the back pressure pocket.

10 BRIEF DESCRIPTION OF THE DRAWINGS

[0048]

FIG. 1 cross-sectional view of one embodiment of a vane rotary compressor of the disclosure.

FIG. 2 is an exploded perspective view illustrating a portion of a compression part in FIG. 1.

FIG. 3 is an assembled planar view of the compression part in FIG. 2.

FIG. 4 is an exploded perspective view of a sub bearing and a rotating shaft in FIG. 2.

FIG. 5 is an assembled planar view of FIG. 4.

FIG. 6 is a sectional view taken along the line "IX-IX" of FIG. 5.

FIG. 7 is a sectional view taken along the line "X-X" of FIG. 5.

FIG. 8 is a perspective view illustrating another embodiment of a communication groove of FIG. 2.

FIG. 9 is a cross-sectional view illustrating a process of supplying oil to a back pressure pocket in a rotary compressor in accordance with an embodiment of the present disclosure.

FIG. 10 is a graph showing comparison results of a vane contact force for each rotational angle of a vane rotary compressor of an embodiment of the present disclosure with that of the related art.

FIG. 11 perspective view illustrating another embodiment of a back pressure passage unit of FIG. 2.

FIG. 12 is an assembled cross-sectional view of FIG. 11.

FIG. 13 exploded perspective view of still another embodiment of a back pressure passage unit.

FIG. 14 is an assembled cross-sectional view of FIG. 13.

FIG. 15 exploded perspective view of another embodiment of the compression part in FIG. 1.

FIG. 16 is a planar view illustrating a main bearing in FIG. 15.

FIG. 17 is a planar view illustrating a sub bearing in FIG. 15.

FIG. 18 is an assembled cross-sectional view of FIG. 15.

FIG. 19 is a perspective view illustrating another embodiment of a lubricating portion in FIG. 15.

FIG. 20 is a cross-sectional view of FIG. 19.

FIG. 21 perspective view illustrating still another embodiment of the lubricating portion in FIG. 15.

FIG. 22 is a cross-sectional view of FIG. 21.

DETAILED DESCRIPTION

[0049] Description will now be given in detail of a vane rotary compressor according to exemplary implementations disclosed herein, with reference to the accompanying drawings.

[0050] The present disclosure describes a structure in which a vane spring is disposed in a roller, which may be equally applied to a vane rotary compressor in which a vane is slidably inserted into a roller. For example, the present disclosure may be equally applicable not only to a vane rotary compressor having an elliptical (hereinafter, asymmetric elliptical) cylinder, an inner circumferential surface of which has a plurality of curvatures, but also to a vane rotary compressor having a circular cylinder, an inner circumferential surface of which has one curvature. The present disclosure may also be equally applicable to a vane rotary compressor in which a vane slot into which a vane is slidably inserted is inclined by a predetermined angle with respect to a radial direction of a roller, as well as a vane rotary compressor in which a vane slot is formed in a radial direction of a roller. Hereinafter, an example in which an inner circumferential surface of a cylinder has an asymmetric elliptical shape and a vane slot is inclined with respect to a radial direction of a roller will be described as a representative example.

[0051] FIG. 1 is a cross-sectional view illustrating one implementation of a vane rotary compressor according to the present disclosure, FIG. 2 is an exploded perspective view illustrating a compression part in FIG. 1, and FIG. 3 is an assembled planar view of the compression part in FIG. 2.

[0052] Referring to FIG. 1, a vane rotary compressor according to this implementation includes a casing 110, a driving (or drive) motor 120, and a compression part 130. The drive motor 120 is installed in an upper inner space 110a of the casing 110, and the compression part 130 is installed in a lower inner space 110b of the casing 110. The drive motor 120 and the compression part 130 are connected through a rotating shaft 123.

[0053] The casing 110 that defines an outer appearance of the compressor may be classified as a vertical type and a horizontal type according to a compressor installation method. As for the vertical type casing, the drive motor 120 and the compression part 130 are disposed at upper and lower sides in an axial direction, respectively. As for the horizontal type casing, the drive motor 120 and the compression part 130 are disposed at left and right sides, respectively. The casing according to this implementation may be illustrated as the vertical type. However, the present disclosure may be equally applied to a case where the casing is arranged horizontally. Thus, upper and lower or left and right might be also designated as first and second.

[0054] The casing 110 includes an intermediate shell 111 having a cylindrical shape, a lower (first) shell 112 covering a lower (first) end of the intermediate shell 111, and an upper (second) shell 113 covering an upper (sec-

ond) end of the intermediate shell 111.

[0055] The drive motor 120 and the compression part 130 may be inserted into the intermediate shell 111 to be fixed thereto. A suction pipe 115 may penetrate through the intermediate shell 111 to be directly connected to the compression part 130. The lower (second) shell 112 may be coupled to the lower (second) end of the intermediate shell 111 in a sealing manner. An oil storage space 110b in which oil to be supplied to the compression part 130 is stored may be formed below the compression part 130. The oil storage space 110b is mainly formed by the lower (second) shell 112. The upper (first) shell 113 may be coupled to the upper (first) end of the intermediate shell 111 in a sealing manner. An oil separation space 110c may be formed above the drive motor 120 to separate oil from refrigerant discharged from the compression part 130. The oil separation space 110c may be mainly formed by the upper (first) shell 113.

[0056] The drive motor 120 constituting a motor part supplies power to cause the compression part 130 to be driven (rotate). The drive motor 120 includes a stator 121, a rotor 122, and a rotating shaft 123.

[0057] The stator 121 may be fixedly inserted or mounted into the casing 110. The stator 121 may be fixed to an inner circumferential surface of the casing 110 in a shrink-fitting manner or the like. For example, the stator 121 may be press-fitted into an inner circumferential surface of the intermediate shell 111.

[0058] The rotor 122 may be rotatably inserted into the stator 121, and the rotating shaft 123 may be press-fitted into a center of the rotor 122. Accordingly, the rotating shaft 123 rotates concentrically together with the rotor 122.

[0059] An oil supply passage 125 having a hollow hole shape is formed in a central portion of the rotating shaft 123.

[0060] The oil supply passage 125 may include first and second oil supply holes 126a and 126b and a first back pressure hole 138a being formed through a middle portion of the oil supply passage 125 toward an outer circumferential surface of the rotating shaft 123. The first oil supply hole 126a is formed to belong to a range of a main bush portion 1312 to be described later, and the second oil supply hole 126b and the first back pressure hole 138a is formed to belong to a range of a sub bearing portion 1322. The first oil supply hole 126a is formed above the roller 134. The second oil supply hole 126b and the first back pressure hole 138a may be formed below the roller 134 in vertical direction of the rotating shaft 123. The first back pressure hole 138a may be formed below the second oil supply hole 126b in vertical direction of the rotating shaft 123.

[0061] Each of the first oil supply hole 126a and the second oil supply hole 126b may be provided by one in number or in plurality. This embodiment illustrates an example in which each of the first oil supply hole 126a and the second oil supply hole 126b are provided in plurality along the circumferential direction.

[0062] The first back pressure hole 138a may communicate with a second back pressure hole 138b to be described later. Accordingly, high-pressure oil passing through the first back pressure hole 138a may be directly supplied to a third sub back pressure pocket 1325c to be described later through the second back pressure hole 138b. The first back pressure hole 138a will be described later together with the second back pressure hole 138b.

[0063] An oil pickup 127 may be installed in a middle or lower end of the oil supply passage 125. A gear pump, a viscous pump, or a centrifugal pump may be used for the oil pickup 127. This implementation illustrates a case in which the centrifugal pump is employed. Accordingly, when the rotating shaft 123 rotates, oil filled in the oil storage space 110b is pumped up by the oil pickup 127 and suctioned upward along the oil supply passage 125. The oil may be supplied partially to the third sub back pressure pocket 1325c through the first back pressure hole 138a, partially to the sub bearing surface 1322b of the sub bush portion 1322 through the second oil supply hole 126b, and partially to the main bearing surface 1312b of the main bush portion 1312 through the first oil supply hole 126a.

[0064] Meanwhile, the rotating shaft 123 may include a roller 134 to be described later. The roller 134 may extend integrally from the rotating shaft 123 or the rotating shaft 123 and the roller 134 that are separately manufactured may be post-assembled to each other. In this implementation, the rotating shaft 123 is post-assembled by being inserted into the roller 134. For example, a shaft hole 1341 may be formed through a center of the roller 134 in an axial direction and the rotating shaft 123 may be press-fitted into the shaft hole 1341 or coupled to the shaft hole 1341 to be movable in the axial direction. When the rotating shaft 123 is movably coupled to the roller 134 in the axial direction, a rotation preventing unit (not illustrated) may be provided between the rotating shaft 123 and the roller 134 so that the rotating shaft 123 can be locked with respect to the roller 134 in the circumferential direction.

[0065] The compression part 130 includes a main bearing 131, a sub bearing 132, a cylinder 133, a roller 134, and a vane 135. The main bearing 131 and the sub bearing 132 are respectively provided at upper and lower parts of the cylinder 133 to define a compression space V together with the cylinder 133, the roller 134 is rotatably installed in the compression space V, and the vane 135 is slidably inserted into the roller 134 to divide the compression space V into a plurality of compression chambers.

[0066] Referring to FIGS. 1 to 3, the main bearing 131 may be fixedly installed in or at the intermediate shell 111 of the casing 110. For example, the main bearing 131 may be inserted into the intermediate shell 111 and welded thereto.

[0067] The main bearing 131 may be coupled to an upper end of the cylinder 133 in a close contact manner. Accordingly, the main bearing 131 defines an upper sur-

face of the compression space V, and supports an upper surface of the roller 134 in the axial direction and at the same time supports an upper portion of the rotating shaft 123 in the radial direction.

[0068] The main bearing 131 may include a main plate portion 1311 and a main bush portion 1312. The main plate portion 1311 covers an upper part of the cylinder 133 to be coupled thereto, and the main bush portion 1312 axially extends from a center of the main plate portion 1311 toward the drive motor 120 so as to support the upper portion of the rotating shaft 123.

[0069] The main plate portion 1311 may have a disk shape, and an outer circumferential surface of the main plate portion 1311 may be fixed to the inner circumferential surface of the intermediate shell 111 in a close contact manner. At least one discharge port 1313 is formed through the main plate portion 1311 in the axial direction. In this embodiment, a plurality of discharge ports 1313a, 1313b, and 1313c are formed at predetermined distances along the circumferential direction, and a plurality of discharge valves 1361, 1362, 1363 for opening and closing the respective discharge ports 1313a, 1313b, and 1313c, are disposed on an upper surface of the main plate portion 1311. A discharge muffler 137 having a discharge space (no reference numeral given) to accommodate the plurality of discharge ports 1313a, 1313b, 1313c and discharge valves 1361, 1362, and 1363 may be disposed on an upper side of the main plate portion 1311.

[0070] Accordingly, the discharge ports 1313a, 1313b, and 1313c may be formed in the main bearing (or sub bearing) 131, instead of the cylinder 133, which can simplify the structure of the cylinder 133 so as to facilitate processing of the cylinder 133. In addition, surface pressure between the front surface of the vane 133 in the vicinity of the discharge port 1313a, 1313b, 1313c and the inner circumferential surface of the cylinder 133 facing it can be lowered and constantly maintained at the same time, while chattering of the vane 135 can be reduced so as to suppress wear and vibration noise between the front surface of the vane 135 and the inner circumferential surface of the cylinder 133 facing it.

[0071] A main back pressure pocket 1315 may be formed in a lower surface, namely, a main sliding surface 1311a of the main plate portion 1311 facing the upper surface of the roller 134, of both axial side surfaces of the main plate portion 1311.

[0072] The main back pressure pocket 1315 may be provided by one in number or may be provided in plurality along the circumferential direction. In this embodiment, as illustrated in FIGS. 2 and 3, a plurality of main back pressure pockets 1315a, 1315b, and 1315c are disposed at preset distances along a rotational direction of the roller 134 based on a reference point P to be described later.

[0073] For example, the main back pressure pocket 1315 according to the embodiment may include a first main back pressure pocket 1315a, a second main back pressure pocket 1315b, and a third main back pressure

pocket 1315c. The first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c may be formed in an arcuate shape and disposed at the preset distances in the circumferential direction.

[0074] Inner and outer circumferential surfaces of each of the first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c may be formed in a circular shape. Or the inner circumferential surface may be formed in a circular shape and the outer circumferential surface may be formed in an elliptical shape in consideration of a vane slot 1343 to be described later. This embodiment illustrates an example in which the outer circumferential surface of the first main back pressure pocket 1315a is formed in an elliptical shape.

[0075] The first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c may be formed within an outer diameter range of the roller 134. Accordingly, the first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c may be isolated from the compression space V. However, the first main back pressure pocket 1315a, the second main back pressure pocket, and the third main back pressure pocket 1315c may minutely communicate with each other through a gap between a lower surface, i.e., a main sliding surface 1311a of the main plate portion 1311 and the upper surface of the roller 134 facing each other unless a separate sealing member is provided therebetween.

[0076] The first main back pressure pocket 1315a may form pressure lower than pressure formed in the second main back pressure pocket 1315b, for example, form intermediate pressure between suction pressure and discharge pressure. In other words, oil (refrigerant oil) may pass through a fine passage between a first main bearing protrusion 1316a to be described later and the upper surface of the roller 134 so as to be introduced into the main back pressure pocket 1315a. The first main back pressure pocket 1315a may be formed in the range of a compression chamber forming intermediate pressure in the compression space V. Accordingly, the first main back pressure pocket 1315a maintains first intermediate pressure.

[0077] The second main back pressure pocket 1315b forms pressure higher than pressure formed in the first main back pressure pocket 1315a, for example, forms discharge pressure or second intermediate pressure between the first intermediate pressure close to the discharge pressure and the discharge pressure. In other words, as the inner circumferential surface of the second main back pressure pocket 1315b is completely or partially open toward the main bearing hole 1312a of the main bearing 131, such that oil introduced into the main bearing hole 1312a through the first oil supply hole 126a can be introduced into the second main back pressure pocket 1315b without substantial decompression. The

second main back pressure pocket 1315b may be formed in the range of a compression chamber forming discharge pressure or substantial discharge pressure in the compression space V. Accordingly, the second main back pressure pocket 1315b maintains the discharge pressure or the second intermediate pressure close to the discharge pressure.

[0078] The third main back pressure pocket 1315a forms pressure higher than pressure formed in the second main back pressure pocket 1315b, for example, forms super discharge pressure higher than the discharge pressure. In other words, the inner circumferential surface of the third main back pressure pocket 1315c is closed by being spaced apart from the main bearing hole 1312a, and at the same time, the third main back pressure pocket 1315c is isolated from the inner space of the casing. The third main back pressure pocket 1315c may be formed in the range of a compression chamber forming discharge pressure in the compression space V. Accordingly, the third main back pressure pocket 1315c maintains the super discharge pressure higher than the discharge pressure. The third main back pressure pocket 1315c will be described later together with a third sub back pressure pocket 1325c to be described later.

[0079] In addition, a first main bearing protrusion 1316a, a second main bearing protrusion 1316b, and a third main bearing protrusion 1316c may be formed on inner circumferential sides of the first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c, respectively, in a manner of extending from the main bearing surface 1312b of the main bush portion 1312. Accordingly, the first main back pressure pocket 1315a, the second main bearing protrusion 1316b, and the third main back pressure pocket 1315c can be sealed from outside and simultaneously the rotating shaft 123 can be stably supported.

[0080] The first main bearing protrusion 1316a, the second main bearing protrusion 1316b, and the third main bearing protrusion 1316c may have the same height or different heights.

[0081] For example, when the first main bearing protrusion 1316a, the second main bearing protrusion 1316b, and the third main bearing protrusion 1316c have the same height, an oil communication groove (not illustrated) or an oil communication hole (not illustrated) may be formed on an end surface of the second main bearing protrusion 1316b such that inner and outer circumferential surfaces of the second main bearing protrusion 1316b can communicate with each other. Accordingly, high-pressure oil (refrigerant oil) flowing into the main bearing surface 1312b can be introduced into the second main back pressure pocket 1315b through the oil communication groove (not illustrated) or the oil communication hole (not illustrated).

[0082] On the other hand, when the first main bearing protrusion 1316a, the second main bearing protrusion 1316b, and the third main bearing protrusion 1316b have

different heights, the height of the second main bearing protrusion 1316b may be lower than the height of the first main bearing protrusion 1316a and the height of the third main bearing protrusion 1316c. Accordingly, high-pressure oil (refrigerant oil) flowing into the main bearing hole 1312a can be introduced into the second main back pressure pocket 1315b by flowing over the second main bearing protrusion 1316b.

[0083] Referring to FIGS. 1 to 3, the sub bearing 132 may be coupled to a lower end of the cylinder 133 in a close contact manner. Accordingly, the sub bearing 132 defines a lower surface of the compression space V, and supports a lower surface of the roller 134 in the axial direction and at the same time supports a lower portion of the rotating shaft 123 in the radial direction.

[0084] The sub bearing 132 may include a sub plate portion 1321 and the sub bush portion 1322. The sub plate portion 1321 covers a lower part of the cylinder 133 to be coupled to thereto, and the sub bush portion 1322 axially extends from a center of the sub plate portion 1321 toward the lower shell 112 so as to support the lower portion of the rotating shaft 123.

[0085] The sub plate portion 1321 may have a disk shape like the main plate portion 1311, and an outer circumferential surface of the sub plate portion 1321 may be spaced apart from the inner circumferential surface of the intermediate shell 111.

[0086] A sub back pressure pocket 1325 may be formed on an upper surface of both axial side surfaces of the sub plate portion 1321, namely, a sub sliding surface 1321a of the sub plate portion 1321 facing the lower surface of the roller 134, to correspond to the main back pressure pocket 1315. The sub back pressure pocket 1325 may be provided by one in number or may be provided in plurality. In this embodiment, as illustrated in FIGS. 2 and 3, a plurality of sub back pressure pockets 1325a, 1325b, and 1325c may be disposed at preset distances along the circumferential direction.

[0087] For example, the sub back pressure pocket 1325 may include a first sub back pressure pocket 1325a, a second sub back pressure pocket 1325b, and a third sub back pressure pocket along the rotational direction of the roller 134 on the basis of the reference point P. These first sub back pressure pocket 1325a, second sub back pressure pocket 1325b, and third sub back pressure pocket 1325c may be formed to symmetric to the first main back pressure pockets 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c, respectively, based on the roller 134.

[0088] In other words, the first sub back pressure pocket 1325a and the first main back pressure pocket 1315a may be symmetric to each other, the second sub back pressure pocket 1325b and the second main back pressure pocket 1315b may be symmetric to each other, and the third sub back pressure pocket 1325c and the third main back pressure pocket 1315c may be symmetric to each other. Accordingly, a first sub bearing protrusion

1326a may be formed on an inner circumferential side of the first sub back pressure pocket 1325a, a second sub bearing protrusion 1326b on an inner circumferential side of the second sub back pressure pocket 1325b, and a third sub bearing protrusion 1326c on an inner circumferential side of the third sub back pressure pocket 1325c, respectively.

[0089] A description of the first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325c will be replaced with the description of the first main back pressure pocket 1315b, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c. Also, a description of the first sub bearing protrusion 1326a, the second sub bearing protrusion 1326b, and the third sub bearing protrusion 1326c will be replaced with the description of the first main bearing protrusion 1316b, the second main bearing protrusion 1315b, and the third main bearing protrusion 1316c.

[0090] However, in some cases, the first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325c may be asymmetric to the first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c, respectively, based on the roller 134. For example, the first sub back pressure pocket 1325a may be deeper than the first main back pressure pocket 1315a, the second sub back pressure pocket 1325b deeper than the second main back pressure pocket 1315b, and the third sub back pressure pocket 1325c deeper than third main back pressure pocket 1315c, respectively.

[0091] The third sub back pressure pocket 1325c forms pressure higher than pressure formed in the second sub back pressure pocket 1325b, that is, super discharge pressure, like the third main back pressure pocket 1315c. The third sub back pressure pocket 1325c will be described later together with the third main back pressure pocket 1315c.

[0092] Although not illustrated, only one of the main back pressure pocket [1315a, 1315b, 1315c] and the sub back pressure pocket [1325a, 1325b, 1325c] may be formed. In this case, the sub back pressure pockets [1325a, 1325b, 1325c] relatively adjacent to the oil storage space may be formed.

[0093] In addition, the second back pressure hole 138b described above is formed in the sub bush portion 1322. For example, one end of the second back pressure hole 138b may be open toward the inner circumferential surface of the sub bush portion 1322 to communicate with the first back pressure hole 138a of the rotating shaft 123, and another end of the second back pressure hole 138b may be open toward a bottom surface of the third sub back pressure pocket 1325c to communicate with the third sub back pressure pocket 1325c. Accordingly, oil that flows inward between the outer circumferential surface of the rotating shaft 123 and the inner circumferential surface of the sub bush portion 1322 through the

first back pressure hole 138a is directly introduced into the third sub back pressure pocket 1325c through the second back pressure hole 138b. The oil forms super discharge pressure together with a corresponding back pressure chamber 1344 in the third sub back pressure pocket 1325c, which is almost closed except for the second back pressure hole 138b, when the vane 135 passing through the third sub back pressure pocket 1325c moves backward. This will be described again later.

[0094] Meanwhile, the discharge port 1313 may be formed in the main bearing 131 as described above. However, the discharge port 1313 may be formed in the sub bearing 132, formed in each of the main bearing 131 and the sub bearing 132, or formed by penetrating between inner and outer circumferential surfaces of the cylinder 133. This implementation describes an example in which the discharge ports 1313 are formed in the main bearing 131.

[0095] The discharge port 1313, as aforementioned, may be provided in plurality 1313a, 1313b, and 1313c disposed at preset distances along a compression-proceeding direction (or the rotational direction of the roller), and the plurality of discharge ports 1313a, 1313b, and 1313c may be disposed at preset distances in the circumferential direction, namely, the rotational direction of the roller 134.

[0096] In addition, the plurality of discharge ports 1313a, 1313b, and 1313c may be formed individually, but may be formed as pairs, as illustrated in this implementation. For example, starting from a discharge port which is the most adjacent to the proximal portion 1332a, the first discharge port 1313a, the second discharge port 1313b, and the third discharge port 1313c of the discharge port 1313 may be sequentially arranged. Accordingly, as the compression space V approaches the reference point P, a discharge area of the discharge port 1313 can be secured even if a distance between the inner circumferential surface 1332 of the cylinder 133 and the outer circumferential surface 1342 of the roller 134 decreases. This can allow smooth discharge of compressed refrigerant and suppress overcompression and/or pressure pulsation.

[0097] Although not illustrated, when vane slots 1343a, 1343b, and 1343c to be described later are formed at unequal intervals, a circumferential length of each compression chamber V1, V2, V3 may be different, and the plurality of discharge ports may communicate with one compression chamber or one discharge port may communicate with the plurality of compression chambers.

[0098] Referring to FIGS. 1 to 3, the cylinder 133 according to this implementation may be in close contact with a lower surface of the main bearing 131 and be coupled to the main bearing 131 by a bolt together with the sub bearing 132. Accordingly, the cylinder 133 may be fixedly coupled to the casing 110 by the main bearing 131.

[0099] The cylinder 133 may be formed in an annular shape having a hollow space in its center to define the compression space V. The hollow space may be sealed

by the main bearing 131 and the sub bearing 132 to define the compression space V, and the roller 134 to be described later may be rotatably coupled to the compression space V.

[0100] The cylinder 133 may be provided with a suction port 1331 penetrating from an outer circumferential surface to an inner circumferential surface thereof. However, the suction port may alternatively be formed through the main bearing 131 or the sub bearing 132.

[0101] The suction port 1331 may be formed at one side of the reference point P to be described later in the circumferential direction. The discharge port 1313 described above may be formed through the main bearing 131 at another side of the reference point P in the circumferential direction that is opposite to the suction port 1331.

[0102] The inner circumferential surface 1332 of the cylinder 133 may be formed in an elliptical shape. The inner circumferential surface 1332 of the cylinder 133 according to this implementation may be formed in an asymmetric elliptical shape in which a plurality of ellipses, for example, four ellipses having different major and minor ratios are combined to have two origins.

[0103] In detail, the inner circumferential surface 1332 of the cylinder 133 according to the embodiment may be defined to have a first origin O that is a center of the roller 134 or a center of rotation of the roller 134 (an axial center or a diameter center of the cylinder) and a second origin O' biased from the first origin O toward the reference point P.

[0104] An X-Y plane formed around the first origin O may define a third quadrant Q3 and a fourth quadrant Q4, and an X-Y plane formed around the second origin O' may define a first quadrant Q1 and a second quadrant Q2. The third quadrant Q3 may be formed by a third ellipse, the fourth quadrant Q4 may be formed by a fourth ellipse, the first quadrant Q1 may be formed by the first ellipse, and the second quadrant Q2 may be formed by the second ellipse.

[0105] In addition, the inner circumferential surface 1332 of the cylinder 133 may include a proximal portion 1332a, a remote portion 1332b, and a curved portion 1332c. The proximal portion 1332a is a portion closest to the outer circumferential surface 1341 (or the center of rotation) of the roller 134, the remote portion 1332b is a portion farthest away from the outer circumferential surface 1342 of the roller 134, and the curved portion 1332c is a portion connecting the proximal portion 1332a and the remote portion 1332b.

[0106] The proximal portion 1332a may also be defined as the reference point P, and the first quadrant Q1 and the fourth quadrant Q4 may be divided based on the proximal portion 1332a. The suction port 1331 may be formed in the first quadrant Q1 and the discharge port 1313 may be formed in the fourth quadrant Q4, based on the proximal portion 1332a. Accordingly, when the vane 1351, 1352, 1353 passes the reference point P, a compression surface of the roller 134 in the rotational direction may

receive suction pressure as low pressure but an opposite compression rear surface may receive discharge pressure as high pressure. Then, while passing the reference point P, the roller 134 may receive the greatest fluctuating pressure between a front surface 1351 a, 1352a, 1353a of each vane 1351, 1352, 1353 that comes in contact with the inner circumferential surface of the cylinder 133 and a rear surface 1351b, 1352b, 1353b of each vane 1351, 1352, 1353 that faces the back pressure chamber 1344a, 1344b, 1344c. This may cause tremor of the vane 1351, 1352, 1353 significantly.

[0107] Referring to FIGS. 1 to 3, the roller 134 according to the implementation may be rotatably disposed in the compression space V of the cylinder 133, and the plurality of vanes 1351, 1352, 1353 to be explained later may be inserted in the roller 134 at predetermined intervals along the circumferential direction. Accordingly, the compression space V may be partitioned into as many compression chambers as the number of the plurality of vanes 1351, 1352, and 1353. This implementation illustrates an example in which the plurality of vanes 1351, 1352, and 1353 are three and thus the compression space V is partitioned into three compression chambers V1, V2, and V3.

[0108] As described above, the roller 134 may extend integrally from the rotating shaft 123 or may be manufactured separately from the rotating shaft 123 and then post-assembled to the rotating shaft 123. This implementation will be described based on an example in which the roller is post-assembled to the rotating shaft 123.

[0109] However, even when the roller 134 extends integrally from the rotating shaft 123, the rotating shaft 123 and the roller 134 may be formed similarly to those in this implementation, and the basic operating effects thereof may also be substantially the same as those of this implementation. However, when the roller 134 is post-assembled to the rotating shaft 123 as in this implementation, the roller 134 may be formed of a material different from the rotating shaft 123, for example, a material lighter than that of the rotating shaft 123. This can facilitate processing of the roller body 134, and simultaneously reduce a weight of a rotating body including the roller 134, thereby enhancing efficiency of the compressor.

[0110] The roller 134 according to this implementation may be formed as a single body, that is, an integral roller having one roller body (no reference numeral). However, the roller 134 may not be necessarily formed as the integral roller. For example, the roller 134 may be formed as a separable roller that is separated into a plurality of roller bodies (no reference numeral). This will be described later in another implementation. In this implementation, an integral roller 134 configured as a single body will be described as an example.

[0111] Referring to FIGS. 1 to 3, the roller 134 according to the implementation may be formed in an annular shape with a shaft hole 1341 at the center thereof. For example, the roller 134 may have inner and outer circumferential surfaces, and the inner and outer circumferential

surfaces of the roller 134 may be formed in a circular shape. However, the inner circumferential surface of the roller 134 may be formed as a continuous surface, whereas the outer circumferential surface of the roller 134 may be formed as a discontinuous surface due to an open surface of the vane slot 1343 disposed thereon. The vane slot 1343 may be provided by one in number or may be provided in plurality. This embodiment illustrates an example in which a plurality of vane slots 1343a, 1343b, and 1343c are formed at preset distances in the circumferential direction. Accordingly, the outer circumferential surface of the roller 134 may be formed to have discontinuous surfaces as many as the number of vane slots 1343a, 1343b, and 1343c.

[0112] Also, the rotation center Or of the roller 134 is coaxially located with an axial center (no reference numeral) of the rotating shaft 123, and the roller 134 rotates concentrically with the rotating shaft 123. However, as described above, as the inner circumferential surface 1332 of the cylinder 133 is formed in the asymmetric elliptical shape biased in a specific direction, the rotation center Or of the roller 134 may be eccentrically disposed with respect to an outer diameter center Oc of the cylinder 133. Accordingly, the outer circumferential surface 1342 of one side of the roller 134 is substantially brought into contact with the inner circumferential surface 1332 of the cylinder 133, precisely, the proximal portion 1332a, thereby defining the reference point P.

[0113] The reference point P may be formed in the proximal portion 1332a as described above. Accordingly, an imaginary line passing through the reference point P may correspond to a minor axis of an elliptical curve defining the inner circumferential surface 1332 of the cylinder 133.

[0114] In detail, the roller 134 may have the plurality of vane slots 1343a, 1343b, and 1343c, into which the vanes 1351, 1352, and 1353 to be described later are slidably inserted, respectively. The plurality of vane slots 1343a, 1343b, and 1343c may be formed at preset intervals along the circumferential direction. The outer circumferential surface 1342 of the roller 134 may have open surfaces that are open in the radial direction. A back pressure chamber 1344 (1344a, 1344b, and 1344c), which will be described later, may be formed in inner end portions that are opposite to the open surfaces, so as to have a closed shape in the radial direction.

[0115] The plurality of vane slots 1343a, 1343b, and 1343c may be defined as a first vane slot 1343a, a second vane slot 1343b, and a third vane slot 1343c along a compression-progressing direction (the rotational direction of the roller). The first vane slot 1343a, the second vane slot 1343b, and the third vane slot 1343c may be formed at uniform or non-uniform intervals along the circumferential direction.

[0116] For example, each of the vane slots 1343a, 1343b, and 1343c may be inclined by a preset angle with respect to the radial direction, so as to secure a sufficient length of each of the vanes 1351, 1352, and 1353. Ac-

cordingly, when the inner circumferential surface 1332 of the cylinder 133 is formed in the asymmetric elliptical shape, even if a distance from the outer circumferential surface 1342 of the roller 134 to the inner circumferential surface 1332 of the cylinder 133 increases, the separation of the vanes 1351, 1352, and 1353 from the vane slots 1343a, 1343b, and 1343c can be suppressed, which may result in enhancing the design freedom for the inner circumferential surface 1332 of the cylinder 133 as well as that of the roller 134.

[0117] A direction in which the vane slots 1343a, 1343b, and 1343c are inclined may be a reverse direction to the rotational direction of the roller 134. That is, the front surfaces 1351a, 1352a, and 1353a of the vanes 1351, 1352, and 1353 in contact with the inner circumferential surface 1332 of the cylinder 133 may be tilted toward the rotational direction of the roller 134. This may be preferable in that a compression start angle can be formed ahead in the rotational direction of the roller 134 so that compression can start quickly.

[0118] The back pressure chamber 1344 is formed in a central portion of the roller 134, that is, in an inner end of the vane slot 1343. The back pressure chamber 1344 extends laterally from the vane slot 1343. Accordingly, the back pressure chamber 1344 communicates with the vane slot 1343 to form a kind of back pressure space to support the vane 135 slidably inserted into the vane slot 1343 toward the inner circumferential surface 1332 of the cylinder 133.

[0119] The back pressure chamber 1344 is formed as many as the number of vane slots 1343. The back pressure chamber 1344 according to the embodiment includes three back pressure chambers 1344a, 1344b, and 1344c, like the vane slots 1343a, 1343b, and 1343c, and the three back pressure chambers 1344a, 1344b, and 1344c are formed in one-to-one correspondence with the three vane slots 1343a, 1343b, and 1343c.

[0120] The plurality of back pressure chambers 1344a, 1344b, and 1344c may accommodate oil (or refrigerant) of discharge pressure or intermediate pressure toward the rear sides of the vanes 1351, 1352, and 1353, that is, rear surfaces 1351c, 1352c, and 1353c of the vanes 1351, 1352, 1353. The vanes 1351, 1352, and 1353 may be pressed toward the inner circumferential surface of the cylinder 133 by the pressure of the oil (or refrigerant). Hereinafter, a direction toward the inner circumferential surface of the cylinder based on a motion direction of the vane may be defined as the front, and an opposite side to the direction may be defined as the rear.

[0121] Although not illustrated, the plurality of vane slots 1343a, 1343b, and 1343c may be formed in the radial direction, that is, radially with respect to the rotation center Or of the roller 134. Operating effects to be obtained by the configuration are similar to those in the following implementation in which the plurality of vane slots 1343a, 1343b, and 1343c are inclined with respect to the rotation center Or of the roller 134, which will be described later, so a description thereof will be replaced with a de-

scription of the implementation to be given later.

[0122] The plurality of back pressure chamber 1342a, 1342b, and 1342c may be hermetically sealed by the main bearing 131 and the sub bearing 132. In other words, the back pressure chambers 1344a, 1344b, and 1344c may independently communicate with the back pressure pockets 1315 and 1325 and may also communicate with each other by the back pressure pockets 1315 and 1325. In this embodiment, an example in which some back pressure chambers 1344 communicate with each other by other back pressure pockets 1315 and 1325 is illustrated.

[0123] Specifically, as each of the plurality of back pressure chambers 1344a, 1344b, and 1344c penetrates in the axial direction, one end of each of the back pressure chambers 1344a, 1344b, and 1344c in the axial direction communicates with the main back pressure pocket 1315a, 1315b, 1315c and another end of each of the back pressure chambers 1344a, 1344b, and 1344c in the axial direction communicates with the sub back pressure pocket 1325a, 1325b, 1325c. Accordingly, oil that passes through both of the back pressure pockets 1315 and 1325 is filled in each of the back pressure chambers 1344a, 1344b, and 1344c. Accordingly, theoretically, internal pressure (back pressure) of the back pressure chamber 1344 may be understood to be the same as internal pressure of each back pressure pocket 1315 and 1325. Hereinafter, the back pressure may also be described as pressure of the back pressure chamber 1344 and pressure of the back pressure pockets 1315 and 1325.

[0124] Referring to FIGS. 1 to 3, the vane 135 according to the embodiment may be provided in plurality to be individually inserted into the plurality of vane slots 1343a, 1343b, and 1343c. In other words, the plurality of vanes 1351, 1352, and 1353 may be slidably inserted into the respective vane slots 1343a, 1343b, and 1343c. Accordingly, the plurality of vanes 1351, 1352, and 1353 may have substantially the same shape as the respective vane slots 1343a, 1343b, and 1343c.

[0125] For example, the plurality of vanes 1351, 1352, 1353 may be defined as a first vane 1351, a second vane 1352, and a third vane 1353 along the rotational direction of the roller 134. The first vane 1351 may be inserted into the first vane slot 1343a, the second vane 1352 into the second vane slot 1343b, and the third vane 1353 into the third vane slot 1343c, respectively.

[0126] The plurality of vanes 1351, 1352, and 1353 may have substantially the same shape. For example, the plurality of vanes 1351, 1352, and 1353 may each be formed in a substantially rectangular parallelepiped shape, and the front surfaces 1351a, 1352a, 1353a of the vanes 1351, 1352, and 1353 in contact with the inner circumferential surface 1332 of the cylinder 133 may be curved in the circumferential direction. Accordingly, the front surfaces 1351a, 1352a, and 1353a of the vanes 1351, 1352, and 1353 can come into line-contact with the inner circumferential surface 1332 of the cylinder 133,

thereby reducing friction loss.

[0127] Hereinafter, an operation of the vane rotary compressor with a hybrid cylinder will be described.

[0128] That is, when power is applied to the drive motor 120, the rotor 122 of the drive motor 120 and the rotating shaft 123 coupled to the rotor 122 rotate together, causing the roller 134 coupled to the rotating shaft 123 or integrally formed therewith to rotate together with the rotating shaft 123.

[0129] The plurality of vanes 1351, 1352, and 1353 are drawn out from the respective vane slots 1343a, 1343b, and 1343c by centrifugal force generated by the rotation of the roller 134, so as to be brought into contact with the inner circumferential surface 1332 of the cylinder 133.

[0130] Then, the compression space V of the cylinder 133 is divided into compression chambers (including a suction chamber or discharge chamber) V1, V2, and V3, which are as many as the number of vanes 1351, 1352, and 1353, by the plurality of vanes 1351, 1352, and 1353.

[0131] Each of the compression chambers V1, V2, and V3 changes in volume by the shape of the inner circumferential surface 1332 of the cylinder 133 and the eccentricity of the roller 134 while moving along the rotation of the roller 134. Refrigerants suctioned into the respective compression chambers V1, V2, and V3 are compressed while moving along the roller 134 and the vanes 1351, 1352, and 1353, and discharged into the inner space of the casing 110 through the respective discharge ports 1313a, 1313b, and 1313c. This series of processes is repeated.

[0132] At this time, the refrigerant compressed in each compression chamber generates gas reaction force and pushes the vane 1351, 1352, 1353 drawn out from the roller 134 toward the inside of the vane slot, but this gas reaction force is offset by centrifugal force generated by the rotation of the roller 134 and back pressure of the back pressure chamber 1344a, 1344b, 1344c supporting the rear surface 1351b, 1351b, 1351c of the vane 1351, 1352, 1353. Then, the front surface 1351a, 1352a, 1353a of the vane 1351, 1352, 1353 is kept in contact with the inner circumferential surface 1332 of the cylinder 133, thereby suppressing leakage between the compression chambers V1, V2, and V3.

[0133] However, as described above, in the vane rotary compressor according to the implementation, the front surfaces 1351a, 1352a, and 1353a of the vanes 1351, 1352, 1353 may simultaneously receive compression pressure and suction pressure in a section from the reference point P between the cylinder 133 and the roller 134 and the suction port 1331. For this reason, each of the vanes 1351, 1352, and 1353 may be more trembled in the section than in other sections due to pressure imbalance. The trembling of the vanes 1351, 1352, and 1353 may cause leakage between the compression chambers and hitting noise and vibration between the cylinder 1333 and each of the vanes 1351, 1352, and 1353. In addition, the inner circumferential surface 1332 of the cylinder 133 or the front surfaces 1351a, 1352a,

and 1353a of the vanes 1351, 1352, and 1353 may be worn, which may aggregate suction loss and compression loss.

[0134] Accordingly, in this embodiment, the pressure of the back pressure pocket 1315, 1325 for pressing the vane 135 toward the inner circumferential surface 1332 of the cylinder 133 can be formed in various ways so that the vane 135 is stably supported toward the cylinder 133. In particular, the back pressure pockets 1315 and 1325 in the vicinity of the reference point P can maintain discharge pressure or pressure higher than the discharge pressure, so as to prevent the vane 135 passing through the vicinity of the reference point P from being pushed due to insufficient back pressure, thereby effectively suppressing chattering of the vane 135.

[0135] FIG. 4 is an exploded perspective view of a sub bearing and a rotating shaft in FIG. 2, FIG. 5 is an assembled planar view of FIG. 4, FIG. 6 is a sectional view taken along the line "IX-IX" of FIG. 5, FIG. 7 is a sectional view taken along the line "X-X" of FIG. 5, and FIG. 8 is a perspective view illustrating another embodiment of a communication groove of FIG. 2.

[0136] Referring back to FIGS. 1 to 3, the main back pressure pocket 1315 and the sub back pressure pocket 1325 may be formed in the main bearing 131 and the sub bearing 132, respectively. Each of the main back pressure pocket 1315 and the sub back pressure pocket 1325 may include a plurality of back pressure pockets [1315a, 1315b, and 1315c], [1325a, 1325b, 1325c] each having different pressure in the circumferential direction.

[0137] For example, the number of each of the main back pressure pocket 1315 and the sub back pressure pocket 1325 may be three [1315a, 1315b, 1315c], [1325a, 1325b, 1325c]. These three back pressure pockets [1315a, 1315b, 1315c], [1325a, 1325b, 1325c] may form first intermediate pressure, second intermediate pressure (or first discharge pressure), and super discharge pressure (or second discharge pressure), respectively.

[0138] Although not illustrated, each of the main back pressure pocket 1315 and the sub back pressure pocket 1325 may be more than three in number. However, even in this case, each of the back pressure pockets may be formed to have different pressure along the rotational direction of the roller 134, for example, gradually higher pressure along the rotational direction of the roller 134 based on the reference point P.

[0139] As described above, since the main back pressure pocket 1315 and the sub back pressure pocket 1325 are formed to correspond to each other based on the roller 134 except for a back pressure passage portion 138, which will be described later, the sub back pressure pocket 1325 will be mainly described, and a description of the main back pressure pocket 1315 will be replaced with the description of the sub back pressure pocket 1325.

[0140] Referring to FIGS. 4 and 5, the sub back pressure pocket 1325 may include a first sub back pressure

pocket 1325a, a second sub back pressure pocket 1325b, and a third sub back pressure pocket 1325c. The first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325c may be sequentially disposed, based on the reference point P as a starting point, at preset distances in the rotational direction of the roller 134.

[0141] For example, in the compression space V, the first sub back pressure pocket 1325a may be formed in a region forming pressure between suction pressure and intermediate pressure, the second sub back pressure pocket 1325b in a region forming pressure between intermediate pressure and discharge pressure, and the third sub back pressure pocket 1325c in a region forming discharge pressure or super discharge pressure, respectively. Accordingly, the first sub back pressure pocket 1325a forms first intermediate pressure, the second sub back pressure pocket 1325b forms second intermediate pressure (or first discharge pressure) higher than the first intermediate pressure, and the third sub back pressure pocket 1325c forms super discharge pressure (or second discharge pressure) higher than the second intermediate pressure.

[0142] The first sub back pressure pocket 1325a may be structurally formed as an almost closed space. For example, an inner circumferential side of the first sub back pressure pocket 1325a is blocked by the first sub bearing protrusion 1326a to be almost isolated from the inner space 110a of the casing 110. Accordingly, pressure of oil flowing into the first sub back pressure pocket 1325a over the first sub bearing protrusion 1326a is lowered to the first intermediate pressure.

[0143] In addition, as an outer circumferential side of the first sub back pressure pocket 1325a is disposed in a relatively low suction pressure and first intermediate pressure region, the oil in the first sub back pressure pocket 1325a may leak into the compression space V through a gap between the sub bearing 132 and the roller 134. Accordingly, the first sub back pressure pocket 1325a has a widest pocket volume while its pocket pressure (back pressure) is lowest first intermediate pressure. Hereinafter, the fact that a back pressure pocket forms a closed space does not mean a completely sealed closed space, and a case in which a passage communicating with the back pressure pocket is not specifically provided will be described as a closed space for convenience. Therefore, a case in which a communication passage communicating with a back pressure pocket such as the second sub back pressure pocket 1325b to be described later is specifically provided will be described as an open space for convenience.

[0144] The second sub back pressure pocket 1325b may be formed as an open space. For example, an inner circumferential side of the second sub back pressure pocket 1325b has a second sub bearing protrusion 1326b with a low height or a communication passage (no reference numeral given), so that the rotating shaft 123 is open to the inner space 110a of the casing 110 through

the oil supply passage 125. Accordingly, the second sub back pressure pocket 1325b defines an open space while forming the second intermediate pressure (or first discharge pressure) higher than the first intermediate pressure.

[0145] The third sub back pressure pocket 1325c may be formed as a semi-closed space. For example, an inner circumferential side of the third sub back pressure pocket 1325c may be blocked by a third sub bearing protrusion 1326c to be closed from the inner space 110a of the casing 110. However, since the third sub back pressure pocket 1325c, as described above, communicates directly with the oil supply passage 125 of the rotating shaft 123 through the back pressure passage portion 138 to be described later, it does not structurally define a completely closed space with respect to the inner space 110a of the casing 110.

[0146] However, since the third sub back pressure pocket 1325c is formed in a discharge pressure region and the back pressure passage portion has a small inner diameter even if the inner circumferential side is blocked by the third sub bearing protrusion 1326c, the third sub back pressure pocket 1325c may be understood as a substantially closed space. Accordingly, the third sub back pressure pocket 1325c defines a semi-closed space while forming the super discharge pressure (second discharge pressure) higher than the second intermediate pressure (or first discharge pressure).

[0147] Referring to FIGS. 4 to 7, a volume of the third sub back pressure pocket 1325c according to the embodiment may be smaller than a volume of the first sub back pressure pocket 1325a as well as a volume of the second sub back pressure pocket 1325b. Accordingly, it may be advantageous in that internal pressure of the third sub back pressure pocket 1325c is formed to be higher than internal pressure of the second sub back pressure pocket 1325b.

[0148] The first sub back pressure pocket 1325a may have a longest arcuate length L1 and the third sub back pressure pocket 1325c may have a shortest arcuate length L3. In other words, the arcuate length L3 of the third sub back pressure pocket 1325c may be shorter than the arc length L1 of the first sub back pressure pocket 1325a, and shorter than or equal to an arcuate length L2 of the second sub back pressure pocket 1325b. This can suppress an excessive increase in section in which the vane 135 receives back pressure of super discharge pressure. Accordingly, chattering between the vane 135 and the cylinder 133, which occurs in the vicinity of the reference point P, can be suppressed while an increase in friction loss in the section can effectively be prevented.

[0149] For example, if the reference point P is 0°, the first sub back pressure pocket 1325a may have a section from approximately 0° to 150°, the second sub back pressure pocket 1325b may have a section from approximately 160° to 260°, and the third sub back pressure pocket 1325c may have a section from approximately 270° to 350°. Then, even in the case where the vane 135 or the

vane slot 1343 is inclined by a preset angle with respect to a radial direction passing through the center of rotation Or of the roller 134 as in the embodiment, the back pressure chamber 1344 to which the vane 135 belongs communicates with the third sub back pressure pocket 1325c while the corresponding vane 135 passes through the reference point P. Accordingly, the rear surface 1351b, 1352b, 1353b of the corresponding vane 135 receives the pressure of the third sub back pressure pocket 1325c, that is, the back pressure corresponding to the super discharge pressure, and thus the front surface 1351a, 1352a, 1353a of the vane 135 overcomes the high discharge pressure in the vicinity of the reference point P so as to be brought into close contact with the inner circumferential surface 1332 of the cylinder 133.

[0150] Referring to FIGS. 6 and 7, a radial width (hereafter, also referred to as a width) (no reference numeral given) of the third sub back pressure pocket 1325c may be smaller than radial widths (no reference numeral given) of the other sub back pressure pocket 1325a, 1325b, and an axial depth (hereinafter, also referred to as a depth) H3 of the third sub back pressure pocket 1325c may be smaller than axial depths H1 and H2 of the other sub back pressure pockets 1325a and 1325b. In addition, a length L3 and/or a width (no reference numeral given) and/or depth H3 of the third sub back pressure pocket 1325c may be smaller than lengths L1 and L2 and/or widths (no reference numeral given) and/or depths H1 and H2 of the other back pressure packets 1325a and 1325b. This embodiment illustrates an example in which the length L3, width (no reference numeral given), and depth H3 of the third sub back pressure pocket 1325c is smaller than of the lengths L1 and L2, widths (no reference numeral given), and depths H1 and H2 of the other sub back pressure pockets 1325a and 1325b.

[0151] Accordingly, the volume of the third sub back pressure pocket 1325c may be smaller than the volume of the first sub back pressure pocket 1325a as well as the volume of the second sub back pressure pocket 1325b. This can be advantageous in terms of maintaining the pressure of the third sub back pressure pocket 1325c to be higher than the internal pressure of the first sub back pressure pocket 1325a as well as the internal pressure of the second sub back pressure pocket 1325b.

[0152] Although not illustrated, it is not always necessary that the length L3, width (no reference numeral given), and depth H3 of the third sub back pressure pocket 1325c is smaller than of the lengths L1 and L2, widths (no reference numeral given), and depths H1 and H2 of the other sub back pressure pockets 1325a and 1325b. For example, the length L3, width (no reference numeral given) and depth H3 of the third sub back pressure pocket 1325c may be equal to or slightly larger than at least the length L2, width (no reference numeral given), and depth H2 of the neighboring second sub back pressure pocket 1325b.

[0153] Even in this case, the inner circumferential side

of the second sub back pressure pocket 1325b is open or has a communication passage (no reference numeral given) so as to define a so-called open space. On the other hand, the third sub back pressure pocket 1325c communicates with the inner space 110a of the casing 110 by the back pressure passage portion 138 to define a semi-closed space, but as illustrated in FIG. 5, it defines a substantially closed space because the back pressure passage portion 138 has the small inner diameter and the vane 135 closes it during the reciprocating motion of the vane 135. Therefore, the pressure of the third sub back pressure pocket 1325c can be higher than the pressure of the second sub back pressure pocket 1325b.

[0154] Referring to FIGS. 4 to 7, the third sub back pressure pocket 1325c, as described above, communicates with the inner space 110a of the casing 110 through the back pressure passage portion 138, precisely, the oil supply passage 125 which is an internal passage of the rotating shaft 123. Accordingly, some of oil sucked up through the oil supply passage 125 of the rotating shaft 123 are directly introduced into the third sub back pressure pocket 1325c through the back pressure passage portion 138.

[0155] The back pressure passage portion 138 includes a first back pressure hole 138a, a second back pressure hole 138b, and a communication groove 138c. The first back pressure hole 138a is formed through the rotating shaft 123, and the second back pressure hole 138b is formed through the sub bearing 132. The first back pressure hole 138a and the second back pressure hole 138b may communicate with each other periodically or continuously through the communication groove 138c. In this embodiment, an example in which the first back pressure hole 138a and the second back pressure hole 138b communicate periodically will be described first, and an example in which the first back pressure hole 138a and the second back pressure hole 138b communicate continuously will be described later.

[0156] Referring to FIGS. 4 and 5, the first back pressure hole 138a according to this embodiment penetrates from an inner circumferential surface of the oil supply passage 125 constituting the inner circumferential surface of the rotating shaft 123 to the outer circumferential surface of the rotating shaft 123, and it may also be understood as a third oil supply hole. In other words, the first oil supply hole 126a, the second oil supply hole 126b, and the first back pressure hole 138a are disposed at preset distances in the axial direction, as aforementioned. The first oil supply hole 126a penetrates radially toward the main bearing hole 1312a, and each of the second oil supply hole 126b and the first back pressure hole 138a penetrates radially toward the sub bearing hole 1322a. The first back pressure hole 138a communicates with the second back pressure hole 138b at a position lower than the second oil supply hole 126b.

[0157] The first back pressure hole 138a may be provided by one in number or in plurality in the circumferential direction. In this embodiment, an example including

the single first back pressure hole 138a is illustrated. However, the present disclosure may be equally applied to the case in which the plurality of first back pressure holes 138a are disposed.

[0158] The first back pressure hole 138a may be formed to be smaller than or equal to the first oil supply hole 126a and/or the second oil supply hole 126b. For example, an inner diameter D31 of the first back pressure hole 138a may be smaller than an inner diameter D1 of the first oil supply hole 126a and/or an inner diameter D2 of the second oil supply hole 126b within a range in which pressure of oil passing through the back pressure passage portion 138 is not lowered. This can prevent oil suctioned through the oil supply passage 125 from flowing out excessively through the first back pressure hole 138a before reaching the first oil supply hole 126a or the second oil supply hole 126b, thereby suppressing an occurrence of oil shortage in another back pressure pocket.

[0159] As illustrated in this embodiment, the inner diameter D31 of the first back pressure hole 138a is smaller than the inner diameter D1 of the first oil supply hole 126a and/or the inner diameter D2 of the second oil supply hole 126b, and thus the inner diameter D1 of the first oil supply hole 126a or the inner diameter D2 of the second oil supply hole 126b becomes larger than the inner diameter D3 of the back pressure passage portion 138. Accordingly, the oil suctioned through the oil supply passage 125 can be sufficiently supplied to the first and second main back pressure pockets 1315a and 1315b and the first and second sub back pressure pockets 1325a and 1325b through the first and second oil supply holes 126a and 126b. This can prevent in advance an occurrence of insufficient back pressure due to an oil shortage in the first or second main back pressure pocket 1315a or 1315b or the first or second sub back pressure pocket 1325a or 1325b. At the same time, an occurrence of friction loss due to an oil shortage on the main bearing surface 1312b and/or the sub bearing surface 1322b can be prevented in advance.

[0160] In addition, the first back pressure hole 138a may be formed on the same circumference as the second oil supply hole 126b, but may preferably be formed at a height as different as possible from a height of the second oil supply hole 126b. For example, the first back pressure hole 138a may be located at a lower position than the second oil supply hole 126b, that is, at a lower end of the rotating shaft 123. Accordingly, the first back pressure hole 138a is located closer to the oil storage space 110b of the casing 110 than the second oil supply hole 126b.

[0161] Then, the oil suctioned through the oil supply passage 125 can be introduced into the first back pressure hole 138a before reaching the second oil supply hole 126b, to be supplied to the third main back pressure pocket 1315c and the third sub back pressure pocket 1325c, other than the other back pressure pockets 1315a, 1325a, 1315b, 1325b. This can suppress the vane 135 from being spaced apart from the cylinder 133 in the vicinity of the reference point P at the initial startup

of the compressor, thereby preventing an initial startup failure. Accordingly, when the compressor is applied to an air conditioning apparatus, a delay of an air conditioning effect can be prevented.

[0162] At the same time, when the first back pressure hole 138a and the second oil supply hole 126b are formed on the same circumference, the rigidity of the rotating shaft 123 may decrease. However, as the first back pressure hole 138a and the second oil supply hole 126b are spaced apart in the axial direction, the decrease in rigidity of the rotating shaft can be suppressed and reliability can be enhanced.

[0163] Referring to FIGS. 4 to 7, the second back pressure hole 138b according to the embodiment may be formed through between the third sub back pressure pocket 1325c and the inner circumferential surface of the sub bearing 132. For example, one end of the second back pressure hole 138b is open to a bottom surface of the third sub back pressure pocket 1325c, and another end of the second back pressure hole 138b is open to the sub bearing surface 1322b defining the inner circumferential surface of the sub bearing hole 1322a. Accordingly, the third sub back pressure pocket 1325c can communicate with the first back pressure hole 138a through the second back pressure hole 138b.

[0164] The second back pressure hole 138b may be smaller than or equal to the first back pressure hole 138a. For example, an inner diameter D32 of the second back pressure hole 138b may be the same as an inner diameter D31 of the first back pressure hole 138a. In other words, the inner diameter D32 of the second back pressure hole 138b may be smaller than the inner diameter D1 of the first oil supply hole 126a and/or the inner diameter D2 of the second oil supply hole 126b. Accordingly, oil introduced into the third sub back pressure pocket 1325c can be prevented from easily flowing out through the second back pressure hole 138b and the first oil supply hole 138a when the vane 135 moves backward, which can result in sufficiently maintaining the back pressure of the third sub back pressure pocket 1325c.

[0165] Although not illustrated, the inner diameter D32 of the second back pressure hole 138b may be larger than the inner diameter D31 of the first back pressure hole 138a. In other words, the inner diameter D31 of the first back pressure hole 138a may be larger than the inner diameter D32 of the second back pressure hole 138b and smaller than the inner diameters D1 and D2 of the first and second oil supply holes 126a and 126b.

[0166] In this case, a part of the oil suctioned through the oil supply passage 125 flows between the inner circumferential surface of the sub bearing 132 and the outer circumferential surface of the rotating shaft 123 through the first back pressure hole 138a. The part of the oil is then partially guided to the third sub back pressure pocket 1325c through the second back pressure hole 138b and the remaining of the part of the oil lubricates between the inner circumferential surface of the sub bearing 132 and the outer circumferential surface of the rotating shaft 123.

Accordingly, oil can be sufficiently supplied even to the third sub back pressure pocket 1325c, while effectively lubricating even the sub bearing surface 1322b between the inner circumferential surface of the sub bearing 132 and the outer circumferential surface of the rotating shaft 123.

[0167] In addition, the second back pressure hole 138b may be formed through a center of the third sub back pressure pocket 1325c or may be formed through the same at an eccentric position. In this embodiment, an example in which the second back pressure hole 138b is formed through the sub bearing surface 1322b at a position eccentric to a side from the center of the third sub back pressure pocket 1325c, precisely, toward the reference point P is illustrated.

[0168] In other words, the second oil supply hole may be formed at a position where it intermittently overlaps the vane 135 during the reciprocating motion of the vane 135, and the inner diameter D32 of the second oil supply hole 138b may be smaller than a width t of the vane 135. Accordingly, as illustrated in FIGS. 3 and 5, the vane 135 passing through the third sub back pressure pocket 1325c can block the second back pressure hole 138b at a position where it receives high gas repulsive force from the compression space V, in other words, a position close to the third discharge port 1313c. With the configuration, the third sub back pressure pocket 1325c can define a closed space at a position where the vane 135 is closest to the third discharge port 1313c, so as to form high back pressure. If the second back pressure hole 138b is formed in the center of the third sub back pressure pocket 1325c or opposite to that illustrated in the embodiment, the second back pressure hole 138b may be open at the position where the vane 135 is closest to the third discharge port 1313c and the third sub back pressure pocket 1325c may not define the closed space. Then, the back pressure of the third sub back pressure pocket 1325c may be lowered at a position where the vane 135 is close to the third discharge port 1313c, and thus the vane 135 may not be effectively supported.

[0169] Also, the second back pressure hole 138b may be inclined obliquely. Accordingly, oil passing through the first back pressure hole 138a can smoothly flow into the third sub back pressure pocket 1325c without interruption.

[0170] Although not illustrated, the second back pressure hole 138b may be bent. For example, the second back pressure hole 138b may include a first through hole portion extending axially from the third sub back pressure pocket 1325c, and a second through hole portion (not illustrated) formed through the inner circumferential surface of the sub bearing hole 1322a from the outer circumferential surface of the sub bearing 132 via the first through hole portion. In this case, the back pressure passage portion 138 serves as a kind of oil storage space. Accordingly, a predetermined amount of oil can be stored in the back pressure passage portion 138 even when the compressor is stopped, and then can be quickly supplied

to the third sub back pressure pocket 1325c when the compressor is restarted or can lubricate the sub bearing surface 1322b.

[0171] The communication groove 138c according to the embodiment is formed between the first back pressure hole 138a and the second back pressure hole 138b. Accordingly, the first back pressure hole 138a and the second back pressure hole 138b can communicate with each other through the communication groove 138c.

[0172] The communication groove 138c may be formed in at least one of an outer end of the first back pressure hole 138a and an inner end of the second back pressure hole 138b facing the same. In other words, the communication groove 1413 may be formed in at least one of the outer circumferential surface of the rotating shaft 123 and the sub bearing surface 1322b defining the inner circumferential surface of the sub bearing 132 facing the outer circumferential surface of the rotating shaft 123. This embodiment illustrates an example in which the communication groove 138c is formed in the inner end of the second back pressure hole 138b, that is, in the sub bearing surface 1322b. However, the communication groove 138c may alternatively be formed in the outer circumferential surface of the rotating shaft 123 or may be formed in each of the outer circumferential surface of the rotating shaft 123 and the sub bearing surface 1322b.

[0173] However, when the communication groove 138c is formed in the sub bearing 132, as described above, it may be recessed by a preset depth into the sub bearing surface 1322b. However, a bearing (not illustrated) configured as a bush bearing may be inserted into the sub bearing surface 1322b. In this case, the communication groove 138c may be formed directly in the sub bearing surface 1322b, or may be formed as a communication groove through a bearing (not illustrated) inserted into the sub bearing surface 1322b. Hereinafter, it will be described that the communication groove 138c is formed in the sub bearing surface 1322b for convenience. Also, an example in which a second communication groove 1382c is formed in the main bearing surface 1312b will be described later in another embodiment.

[0174] Referring to FIG. 4, the communication groove 138c may be formed in an arcuate shape long in the circumferential direction. In this case, the communication groove 138c may be formed to have the same width and depth in the circumferential direction, and its center may be deep and both ends shallow. In other words, when the communication groove 138c is formed to be recessed into the sub bearing surface 1322b, as described above, the width or depth of the communication groove 138c may be large in center and small in both ends. However, when the communication groove 138c is formed through a bearing (not illustrated) inserted into the sub bearing surface 1322b, it may be understood that the communication groove 138c is formed to have the same width and depth in the circumferential direction.

[0175] However, since this embodiment illustrates the

example in which the communication groove 138c is formed in the sub bearing surface 1322b, it will be understood that the communication groove 138c is formed so that the width and depth of the center are larger than the width and depth of both ends. In this case, the communication groove 138c can be easily processed into an arcuate shape and oil can be more smoothly guided to the second back pressure hole 138b.

[0176] When the communication groove 138c is formed in the arcuate shape, an arcuate length of the communication groove 138c may be longer than the inner diameter D31 of the first back pressure hole 138a, and communicates with the first back pressure hole 138a periodically. For example, the arc length of the communication groove 138c may be formed so that an arcuate angle formed by being connected to the first back pressure hole 138a is smaller than at least 360°, that is, smaller than 180°. Accordingly, the communication groove 138c can communicate with the first back pressure hole 138a periodically, not continuously. Accordingly, during the operation of the compressor, the back pressure passage portion 138 is periodically blocked in a section (rotational angle) in which the communication groove 138c does not communicate with the first back pressure hole 138a. Then, the third sub back pressure pocket 1325c can become a closed space and thus oil leakage from the third sub back pressure pocket 1325c can be minimized such that the third sub back pressure pocket 1325c can maintain high back pressure. This may result in more stably supporting the vane.

[0177] However, the communication groove 138c may alternatively be formed in a circular shape. The communication groove 138c may be formed to have the same depth along the circumferential direction. Accordingly, the first back pressure hole 138a and the second back pressure hole 138b can continuously communicate with each other through the communication groove 138c even when the rotating shaft 123 rotates.

[0178] However, when the communication groove 138c is formed in the circular shape, it may be advantageous in terms of processing that the communication groove 138c is formed in the outer circumferential surface of the rotating shaft 123 rather than the inner circumferential surface of the sub bearing 132. In other words, as a bearing (not illustrated) configured as a bush bearing is inserted into the sub bearing surface 1322b, it is difficult to form the communication groove in the circular shape in the inner circumferential surface of the sub bearing 132, that is, the sub bearing surface 1322b. Accordingly, as illustrated in FIG. 8, the communication groove 138c may extend into the circular shape from the outer circumferential surface of the rotating shaft 123 in the circumferential direction.

[0179] As described above, when the communication groove 138c is formed in the circular shape to continuously communicate with the first back pressure hole 138a, oil passing through the first back pressure hole 138a can continuously be supplied into the second back

pressure hole 138b through the communication groove 138c and then continuously be supplied into the third sub back pressure pocket 1325c without interruption. This can prevent in advance decrease in back pressure due to an oil shortage in the third sub back pressure pocket 1325c, more precisely, in the corresponding back pressure chamber 1344.

[0180] Meanwhile, as described above, the main bearing 131 may further include the third main back pressure pocket 1315c in addition to the first main back pressure pocket 1315a and the second main back pressure pocket 1315b. The first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c may be formed symmetrically with the first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325b. However, unlike the third sub back pressure pocket 1325c, the third main back pressure pocket 1315c may not separately include the back pressure passage portion 138 that communicates directly with the oil supply passage 125, and oil introduced into the third sub back pressure pocket 1325c may move to the third main back pressure pocket 1315c through the back pressure chamber 1344.

[0181] The first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back pressure pocket 1315c may communicate with the first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325b, respectively, through the corresponding back pressure chambers 1344 passing through the back pressure pockets. Accordingly, each vane 135 is pressed toward the cylinder 133 by the back pressure of each back pressure chamber 1344, which is defined as the same pressure as pressure of each back pressure pocket 1315 and 1325, and the front surface 1351a, 1352a, 1353a of the vane 135 is slidably brought into contact with the inner circumferential surface 1332 of the cylinder 133.

[0182] Hereinafter, a description will be given of operating effects of the back pressure passage portion in the vane rotary compressor according to the embodiment. FIG. 9 is a cross-sectional view illustrating a process of supplying oil to a back pressure pocket in a rotary compressor in accordance with an embodiment.

[0183] Referring to FIG. 9, in the vane rotary compressor according to the embodiment, the plurality of back pressure pockets 1315 and 1325 having different back pressures may be formed in the main bearing 131 and/or the sub bearing 132 in the rotational direction of the roller 134, and the third main back pressure pocket 1315c and the third sub back pressure pocket 1325c that are closest to the third discharge port 1313c may form higher pressure than the other back pressure pockets 1315 and 1325.

[0184] In other words, as the third sub back pressure pocket 1325c is directly connected to the oil supply passage 125 of the rotating shaft 123 through the back pres-

sure passage portion 138, a part of oil suctioned along the oil supply passage 125 is introduced directly into the third sub back pressure pocket 1325c through the back pressure passage portion 138. Accordingly, oil in the third sub back pressure pocket 1325c and the third main back pressure pocket 1315c communicating therewith forms super discharge pressure (second discharge pressure) higher than discharge pressure (first discharge pressure) due to an increase in pressure by centrifugal force and an increase in pressure in a closed space.

[0185] Then, the rear surface 1351b, 1352b, 1353b of the vane 135 passing through the reference point P receives high back pressure of super discharge pressure (second discharge pressure), which is transmitted from the corresponding back pressure chamber 1344 through the third main back pressure pocket 1315c and/or the third sub back pressure pocket 1325c.

[0186] The vane 135 passing the reference point P receives high back pressure due to the third main back pressure pocket 1315c and the third sub back pressure pocket 1325c to be pressed toward the inner circumferential surface 1332 of the cylinder 133. Accordingly, the front surface 1351a, 1352a, 1353a of each vane 135 passing through the reference point P may be brought into close contact with the inner circumferential surface 1332 of the cylinder 133, thereby preventing chattering of the vane 135. This can suppress wear of the inner circumferential surface 1332 of the cylinder 133 or the front surface 1351a, 1352a, 1353a of the vane 135 in the vicinity of the reference point P, and simultaneously preventing leakage between compression chambers while reducing vibration noise in the vicinity of the reference point P, thereby improving compression efficiency.

[0187] In addition, the chattering of the vane 135 may be more severe at the initial startup of the compressor. However, oil is quickly supplied to the third sub back pressure pocket 1325c in the vicinity of the reference point P through the back pressure passage portion 138, which communicates with the lower end portion of the oil supply passage 125. Accordingly, the vane can be brought into close contact with the cylinder near the reference point P even at the initial startup of the compressor. This can prevent an initial startup failure and enhance compression efficiency. Therefore, an air conditioning effect can be quickly exhibited when the compressor is applied to an air conditioning apparatus, thereby enhancing reliability.

[0188] This can also be confirmed through the graph shown in FIG. 10. FIG. 10 is a graph showing comparison results of a vane contact force for each rotational angle of a vane rotary compressor according to an embodiment of the present disclosure with that of the related art.

[0189] As shown in FIG. 10, the vane contact force [N] exceeds a reference value of zero (0) until a rotation angle of the rotating shaft 123 is approximately 240°, and thus the state in which the front surface 1351a, 1352a, 1353a of the vane 135 is almost brought into contact with the inner circumferential surface 1332 of the cylinder 133

can be maintained. However, the vane contact force [N] may be abruptly lowered from after the rotation angle of the rotating shaft 123 exceeds approximately 240°. This is because, as described above, pressure in the compression chamber V3 near the reference point P increases significantly.

[0190] In the related art (indicated by a dashed-dotted line), the main back pressure pocket 1315 and the sub back pressure pocket 1325 form discharge pressure (first discharge pressure) or second intermediate pressure lower than the discharge pressure even at a position closest to the reference point P, and thus the vane contact force [N] is lower than the reference value (0). For this reason, in the related art, the front surface 1351a, 1352a, 1353a of the vane 135 is spaced apart from the inner circumferential surface 1332 of the cylinder 133 in the vicinity of the reference point P, which may cause chattering of the vane 135 and leakage between the compression chambers.

[0191] However, in this embodiment (indicated by a solid line), as described above, the main back pressure pocket 1315 and the sub back pressure pocket 1325 forming the super discharge pressure (second discharge pressure) are located at the position closest to the third discharge port 1313c. Accordingly, the vane contact force [N] greater than the reference value (0) is maintained even after the rotation angle of the rotating shaft 123 passes approximately 240°. Therefore, in this embodiment, the front surface 1351a, 1352a, 1353a of the vane 135 can be kept brought into contact with the inner circumferential surface 1332 of the cylinder 133 in the vicinity of the reference point P, which can prevent the chattering of the vane 135 and the leakage between the compression chambers.

[0192] Those effects described above can be more expected in the rotary compressor according to the implementation when a high-pressure refrigerant such as R32, R410a, or CO2 is used.

[0193] Hereinafter, a description will be given of another embodiment of a back pressure passage portion.

[0194] That is, in the previous embodiment, the back pressure passage portion is formed continuously through the sub bearing and the rotating shaft, but in some cases, may be formed merely through the sub bearing.

[0195] FIG. 11 is a perspective view illustrating another embodiment of a back pressure passage unit of FIG. 2, and FIG. 12 is an assembled cross-sectional view of FIG. 11.

[0196] Referring to FIGS. 11 and 12, the basic configuration and operating effects of the vane rotary compressor according to this embodiment are almost the same as those of the previous embodiment, a detailed description thereof will be replaced with the description of the previous embodiment. For example, the basic configuration of the main bearing 131, the sub bearing 132, the cylinder 133, the roller 134, and the vane 135 constituting the compression part in the vane rotary compressor according to this embodiment is substantially the same as

those of the previous embodiment.

[0197] In addition, the first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325c are sequentially disposed in a sub sliding surface 1321a of the sub bearing 132, based on the reference point P as a starting point in the rotational direction of the roller 134. The first sub back pressure pocket 1325a is formed from a suction pressure region to an intermediate pressure region, the second sub back pressure pocket 1325b is formed from the intermediate pressure region to a discharge pressure region. Also, the third sub back pressure pocket 1325c is connected to the back pressure passage portion 138 so as to directly communicate with the inner space 110a of the casing 110 forming the discharge pressure, and is formed in the discharge pressure region. Accordingly, the first sub back pressure pocket 1325a forms first intermediate pressure, the second sub back pressure pocket 1325b forms second intermediate pressure (or first discharge pressure) higher than the first intermediate pressure, and the third sub back pressure pocket 1325c forms super discharge pressure (or second discharge pressure) higher than the second intermediate pressure.

[0198] However, the back pressure passage portion 138 according to the embodiment may be formed through the sub bearing 132 so that the third sub back pressure pocket 1325c is directly connected to the inner space 110a of the casing 110. For example, the back pressure passage portion 138 may include only one through hole. An upper end of the back pressure passage portion 138 may be formed through the bottom surface of the third sub back pressure pocket 1325c to communicate with the third sub back pressure pocket 1325c, and a lower end of the back pressure passage portion 138 may be formed through up to a lower end of the sub bearing 132, i.e., a lower surface of the sub plate portion 1321 defining an opposite surface of the sub sliding surface 1321a, so as to be immersed in the oil storage space 110b of the casing 110.

[0199] The back pressure passage portion 138 may be formed eccentrically from the center of the third sub back pressure pocket 1325c toward the reference point P. The operating effects according to this embodiment are the same as those in the previous embodiment.

[0200] An inner diameter D33 of the back pressure passage portion 138, as in the previous embodiment, may be smaller than the inner diameter D1 of the first oil supply hole 126a and the inner diameter D2 of the second oil supply hole 126b. The operating effects according to this embodiment are almost similar to those in the previous embodiment. However, in the previous embodiment, the back pressure passage portion 138 communicates with the oil supply passage 125 of the rotating shaft 123 such that oil is pumped using centrifugal force generated when the rotating shaft 123 rotates, whereas this embodiment illustrates that oil is supplied by using pressure of the inner space 110a of the casing 110. Accordingly, it may be advantageous in terms of oil supply that the inner

diameter D33 of the back pressure passage portion 138 is slightly larger than the inner diameters D31 and D32 of the back pressure passage portion 138 in the embodiment of FIG. 4.

[0201] However, even in this case, when the inner diameter D33 of the back pressure passage portion 138 is excessively large, for example, larger than or equal to the inner diameter D1 of the first oil supply hole 126a and the inner diameter D2 of the second oil supply hole 126b, oil in the third sub back pressure pocket 1325c may flow into the back pressure passage portion 138 when the vane moves backward, which may be disadvantageous in forming sufficient second discharge pressure. Therefore, the inner diameter D33 of the back pressure passage portion 138 may preferably be smaller than the inner diameter D1 of the first oil supply hole 126a and/or the inner diameter D2 of the second oil supply hole 126b.

[0202] As described above, when the back pressure passage portion 138 is formed through the sub bearing 132, the back pressure passage portion 138 can be easily processed, thereby reducing a manufacturing cost. In this case, not only the length of the back pressure passage portion 138 can be shortened but also the back pressure passage portion 138 can be maintained in an open state, so that oil can be quickly supplied to the third sub back pressure pocket 1325c at the initial startup of the compressor. This can more effectively suppress the initial startup failure.

[0203] Hereinafter, a description will be given of still another implementation of a back pressure passage portion.

[0204] That is, the back pressure passage portion is formed through only the sub bearing in the previous embodiments, but in some cases, may be formed through each of the sub bearing and the main bearing.

[0205] FIG. 13 is an exploded perspective view illustrating still another embodiment of a back pressure passage unit and FIG. 14 is an assembled cross-sectional view of FIG. 13.

[0206] Referring to FIGS. 13 and 14, the basic configuration and operating effects of the vane rotary compressor according to this embodiment are almost the same as those of the previous embodiment, a detailed description thereof will be replaced with the description of the previous embodiment. For example, the basic configuration of the main bearing 131, the sub bearing 132, the cylinder 133, the roller 134, and the vane 135 constituting the compression part in the vane rotary compressor according to this embodiment is substantially the same as those of the previous embodiment.

[0207] In addition, the first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325c are sequentially disposed in the sub sliding surface 1321a of the sub bearing 132 based on the reference point P as a starting point in the rotational direction of the roller 134. Also, the first main back pressure pocket 1315a, the second main back pressure pocket 1315b, and the third main back

pressure pocket 1315c are sequentially disposed in the main sliding surface 1312a of the main bearing 131 based on the reference point P as a starting point in the rotational direction of the roller 134.

[0208] However, in this embodiment, the third sub back pressure pocket 1325c and the oil supply passage 125 of the rotating shaft 123 may communicate with each other through a first back pressure passage portion 1381, and the third main back pressure pocket 1315c and the oil supply passage 125 of the rotating shaft 123 may communicate with each other through a second back pressure passage portion 1382. Accordingly, a part of oil suctioned through the oil supply passage 125 can be supplied to the third sub back pressure pocket 1325c through the first back pressure passage portion 1381, and to the third main back pressure pocket 1315c through the second back pressure passage portion 1382. Therefore, the back pressure of the third sub back pressure pocket 1325c and the third main back pressure pocket 1315c can be raised to super discharge pressure (or second discharge pressure), which may result in more effectively supporting the rear surface of the vane 135 passing through the reference point P.

[0209] Specifically, the first back pressure passage portion 1381 may include a first back pressure hole 1381a, a second back pressure hole 1381b, and a first communication groove 1381c. The first back pressure hole 1381a is the same as the first back pressure hole 138a of the embodiment of FIG. 4, the second back pressure hole 1381b is the same as the second back pressure hole 138b of the embodiment of FIG. 4, and the first communication groove 1381c is the same as the communication groove 138c of the embodiment of FIG. 4. Therefore, a description of the specific configuration and operating effects of the first back pressure hole 1381a, the second back pressure hole 1381b, and the first communication groove 1381c will be replaced with the description of the first back pressure hole 138a, the second back pressure hole 138b, and the communication groove 138c.

[0210] The second back pressure passage portion 1382 may include a third back pressure hole 1382a, a fourth back pressure hole 1382b, and a second communication groove 1382c.

[0211] The third back pressure hole 1382a, similar to the first back pressure hole 1381a, may be formed through from the inner circumferential surface of the rotating shaft 123 defining the inner circumferential surface of the oil supply passage 125 to the outer circumferential surface of the rotating shaft 123. The fourth back pressure hole 1382b, similar to the second back pressure hole 1381b, may be formed through between the third main back pressure pocket 1315c and the main bearing hole 1312a of the main bearing 131. Also, the second communication groove 1382c, similar to the first communication groove 1381c, may be recessed into an arcuate or circular shape into the inner circumferential surface of the main bearing hole 1312a and/or the outer

circumferential surface of the rotating shaft 123.

[0212] The third back pressure hole 1382a is substantially the same as the first back pressure hole 1381a, the fourth back pressure hole 1382b is substantially the same as the first back pressure hole 1381a, and the second communication groove 1382c is the same as the first communication groove 1381c. Therefore, a description of the third back pressure hole 1382a, the fourth back pressure hole 1382b, and the second communication groove 1382c of the second back pressure passage portion 1382 will be replaced with the description of the first back pressure hole 1381a, the second back pressure hole 1381b, and the first communication groove 1381c of the previous embodiment.

[0213] As described above, when the first back pressure passage portion 1381 and the second back pressure passage portion 1382 are respectively formed, oil is directly supplied from the oil supply passage 125 of the rotating shaft 123 to the third sub back pressure pocket 1325c and the third main back pressure pocket 1315c through the first back pressure passage portion 1381 and the second back pressure passage portion 1382. Accordingly, the pressure of the third sub back pressure pocket 1325c and the pressure of the third main back pressure pocket 1315c are maintained almost uniformly, so that back pressure in the corresponding back pressure chamber 1344 between the third sub back pressure pocket 1325c and the third main back pressure pocket 1315c can be uniformly distributed in the axial direction. Thus, the back pressure for the corresponding vane 135 passing through between the third sub back pressure pocket 1325c and the third main back pressure pocket 1315c can be uniformly distributed along the axial direction, thereby more effectively reducing chattering and/or uneven wear between the vane 135 and the cylinder 133.

[0214] This can be particularly advantageous in a vertical rotary compressor. That is, in the vertical rotary compressor, oil is dropped due to its own weight, so an amount of oil in the third main back pressure pocket 1315c is relatively smaller than an amount of oil in the third sub back pressure pocket 1325c. Due to this, back pressure with respect to the rear side of the vane 135 is unevenly distributed along the axial direction in the vicinity of the reference point P, and this may increase chattering and/or uneven wear of the vane 135 and the cylinder 133. However, as in the embodiment, when the first back pressure passage portion 1381 is connected to the third sub back pressure pocket 1325c and the second back pressure passage portion 1382 is connected to the third main back pressure pocket 1315c, respectively, the back pressure with respect to the vane 135 may be distributed almost uniformly along the axial direction. This can reduce chattering between the vane 135 and the cylinder 133 and friction loss due to the chattering in the vicinity of the reference point P in the vertical rotary compressor, thereby enhancing compression efficiency.

[0215] Although not illustrated, the first back pressure passage portion 1381 may not communicate with the oil

supply passage 125 of the rotating shaft 123 but directly communicate with the inner space 110a of the casing 110 through the sub bearing 132 as in the embodiment of FIG. 11. This will be replaced with the description of the embodiment of FIG. 11.

[0216] Hereinafter, a description will be given of another embodiment of a sub bearing.

[0217] That is, in the previous embodiments, the main back pressure pocket and the sub back pressure pocket are formed in the main sliding surface and the sub sliding surface, respectively, but in some cases, a lubricating portion in addition to the main back pressure pocket or the sub back pressure pocket may further be formed on at least one of the main sliding surface and the sub sliding surface. Hereinafter, an example in which a first lubricating portion and a second lubricating portion are respectively formed on the main sliding surface and the sub sliding surface will be mainly described.

[0218] FIG. 15 is an exploded perspective view illustrating another embodiment of the compression part in FIG. 1, FIG. 16 is a planar view illustrating a main bearing in FIG. 15, FIG. 17 is a planar view illustrating a sub bearing in FIG. 15, and FIG. 18 is an assembled cross-sectional view of FIG. 15.

[0219] Referring to FIGS. 15 to 18, the basic configuration and operating effects of the vane rotary compressor according to this embodiment are almost the same as those of the previous embodiment, a detailed description thereof will be replaced with the description of the previous embodiment. For example, the basic configuration of the main bearing 131, the sub bearing 132, the cylinder 133, the roller 134, and the vane 135 constituting the compression part in the vane rotary compressor according to this embodiment is substantially the same as those of the previous embodiment.

[0220] In addition, the first sub back pressure pocket 1325a, the second sub back pressure pocket 1325b, and the third sub back pressure pocket 1325c are sequentially disposed in a sub sliding surface 1321a of the sub bearing 132, based on the reference point P as a starting point in the rotational direction of the roller 134. The first sub back pressure pocket 1325a is formed from a suction pressure region to an intermediate pressure region, the second sub back pressure pocket 1325b is formed from the intermediate pressure region to a discharge pressure region, and the third sub back pressure pocket 1325c is formed in the discharge pressure region. Accordingly, the first sub back pressure pocket 1325a forms first intermediate pressure, the second sub back pressure pocket 1325b forms second intermediate pressure (or first discharge pressure), and the third sub back pressure pocket 1325c forms super discharge pressure (or second discharge pressure).

[0221] In addition, the third sub back pressure pocket 1325c may communicate with the oil supply passage 125 of the rotating shaft 123 through the first back pressure passage portion 1381, and the third main back pressure pocket 1315c may communicate with the oil supply pas-

sage 125 of the rotating shaft 123 through the second back pressure passage portion 1382. Since the first back pressure passage portion 1381 and the second back pressure passage portion 1382 are the same as those in the previous embodiment of FIG. 13, a description thereof will be replaced with the description of the previous embodiment of FIG. 13.

[0222] However, in this embodiment, the first lubricating portion 1391 may be formed on the sub sliding surface 1321a of the sub bearing 132 and the second lubricating portion 1392 may be formed on the main sliding surface 1312a of the main bearing 131, respectively. The first lubricating portion 1391 and the second lubricating portion 1392 may be formed at positions corresponding to each other in the axial direction with the roller 134 or the vane 135 interposed therebetween.

[0223] The first lubricating portion 1391 may include a first lubrication pocket 1391a and a first lubrication passage 1391b. The first lubrication pocket 1391a is a portion substantially defining a space of the first lubricating portion 1391, and the first lubrication passage 1391b is a portion for guiding oil to the first lubrication pocket 1391a.

[0224] The first lubrication pocket 1391a may be formed to surround the second sub back pressure pocket 1325b and the third sub back pressure pocket 1325c radially with a preset distance at an outer circumferential side of the second sub back pressure pocket 1325b and the third sub back pressure pocket 1325c. Accordingly, the first lubrication pocket 1391a may radially overlap the second sub back pressure pocket 1325b and the third sub back pressure pocket 1325c.

[0225] Specifically, the first lubrication pocket 1391a may be formed in an arcuate shape. An arcuate length L4 of the first lubrication pocket 1391a may be longer than or equal to a length that is the sum of an arcuate length L2 of the second sub back pressure pocket 1325b and an arcuate length L3 of the third sub back pressure pocket 1325c. This embodiment illustrates an example in which the arcuate length L4 of the first lubrication pocket 1391a is longer than the length that is the sum of the arcuate length L2 of the second sub back pressure pocket 1325b and the arcuate length L3 of the third sub back pressure pocket 1325c. Accordingly, the upper surface of the corresponding vane 135 passing through the second sub back pressure pocket 1325b and the third sub back pressure pocket 1325c in the axial direction almost always slides laterally across the first lubrication pocket 1391a.

[0226] The first lubrication passage 1391b may be formed such that the first lubrication pocket 1391a and the oil storage space 110b of the casing 110 communicate with each other. For example, an upper end of the first lubrication passage 1391b in the axial direction may communicate with the first lubrication pocket 1391a through a bottom surface of the first lubrication pocket 1391a, and a lower end of the first lubrication passage 1391b in the axial direction may be immersed in the oil storage space 110b of the casing 110 through a lower

surface of the sub plate portion 1321 so as to communicate with the oil storage space 110b. Accordingly, oil stored in the oil storage space 110b of the casing 110 can be directly supplied to the first lubrication pocket 1391a through the first lubrication passage 1391b.

[0227] An inner diameter D4 of the first lubrication passage 1391b may be larger than or equal to the inner diameter D3 of the first back pressure passage portion 1381. Accordingly, oil stored in the oil storage space 110b of the casing 110 can quickly move into the first lubrication pocket 1391a through the first lubrication passage 1391b.

[0228] The second lubricating portion 1392 may include a second lubrication pocket 1392a and a second lubrication passage 1392b. The second lubrication pocket 1392a is a portion substantially defining a space of the second lubricating portion 1392, and the second lubrication passage 1392b is a portion for guiding oil to the second lubrication pocket 1392a.

[0229] The second lubrication pocket 1392a may be formed symmetrically with the first lubrication pocket 1391a based on the roller 134. Accordingly, a description of the second lubrication pocket 1392a will be replaced with the description of the first lubrication pocket 1391a.

[0230] The second lubrication passage 1392b may be formed to connect an inner circumferential surface of the second lubrication pocket 1392a and an outer circumferential surface of the second main back pressure pocket 1315b or the third main back pressure pocket 1315c facing it. This embodiment illustrates an example in which the second lubrication passage 1392b extends from the second main back pressure pocket 1315b to the second lubrication pocket 1392a.

[0231] If the second lubrication passage 1392b extends from the third main back pressure pocket 1315c to the second lubrication pocket 1392a, a volume of the third main back pressure pocket 1315c is larger than a volume of the second main back pressure pocket 1315b, which may be disadvantageous in increasing pressure of the third main back pressure pocket 1315c. Accordingly, it may be advantageous that the second lubrication passage 1392b is not connected to the third main back pressure pocket 1315c and connected to the second main back pressure pocket 1315b in order to secure the super discharge pressure (or second discharge pressure) of the third main back pressure pocket 1315c.

[0232] In addition, as the second lubrication passage 1392b is connected to the second main back pressure pocket 1315b, oil in the second main back pressure pocket 1315b can be supplied to the second lubrication pocket 1392a. Accordingly, oil can be quickly supplied to the second lubrication pocket 1392a without adding a separate lubrication passage.

[0233] As illustrated in the embodiment, when the second lubrication pocket 1392a is connected to the second main back pressure pocket 1315b by the second lubrication passage 1392b, a width (no reference numeral given) and/or axial depth H4 of the second lubrication

pocket 1392a may be smaller than or equal to a width (no reference numeral given) and/or axial depth H2 of the second main back pressure pocket 1315b.

[0234] For example, when the width and/or axial depth H4 of the second lubrication pocket 1392a is larger than the width and/or axial depth H2 of the second main back pressure pocket 1315b, oil in the second main back pressure pocket 1315b may excessively flow out into the second lubrication pocket 1392a through the second lubrication passage 1392b. Then, an amount of oil to be supplied to the corresponding back pressure chamber 1344 may be decreased, and thereby the back pressure with respect to the corresponding vane 135 may be weakened. Therefore, it may be advantageous in term of back pressure that the width and/or axial depth H4 of the second lubrication pocket 1392a is smaller than or equal to the width and/or axial depth H2 of the second main back pressure pocket 1315b and/or the third main back pressure pocket 1315c.

[0235] As described above, when the first lubricating portion 1391 is formed on the sub bearing 132 and the second lubricating portion 1392 is formed on the main bearing 131, respectively, an axial side surface of the corresponding vane 135, which passes through the second sub back pressure pocket 1325b and the second main back pressure pocket 1315b and the third sub back pressure pocket 1325c and the third main back pressure pocket 1315c, laterally slides across the first lubrication pocket 1391a and the second lubrication pocket 1392a. Accordingly, oil accommodated in the first lubrication pocket 1391a and the second lubrication pocket 1392a forms a wide and thick oil film between the axial side surface of the vane 135 passing through the first lubrication pocket 1391a and the second lubrication pocket 1392a and the sub sliding surface 1321a and the main sliding surface 1311a facing the axial side surface of the vane 135.

[0236] This can prevent a so-called 'discontinuous sliding phenomenon' that the axial side surface of the vane 135 temporarily stops and then slides due to being excessively in close contact with the sub sliding surface 1321a and/or the main sliding surface 1311a. Then, the vane 135 can slide smoothly along the vane slot 1343 so as to be prevented from chattering. This can also suppress an aggravation of collision force with the cylinder 133 due to the discontinuous sliding of the vane 135, thereby more effectively preventing wear of the vane 135 and/or the cylinder 133.

[0237] Hereinafter, another implementation of a first lubricating portion and a second lubricating portion will be described.

[0238] That is, in the previous embodiment, the first lubrication pocket and the second lubrication pocket are each formed as one long groove, but in some cases, at least one of the first lubrication pocket and the second lubrication pocket may be formed as a plurality of grooves.

[0239] FIG. 19 is a perspective view illustrating another

embodiment of a lubricating portion in FIG. 15, and FIG. 20 is a cross-sectional view of FIG. 19.

[0240] Referring to FIGS. 19 and 20, the basic configuration and operating effects of the vane rotary compressor according to this embodiment are almost the same as those of the previous embodiments. For example, the basic configuration of the main bearing 131, the sub bearing 132, the cylinder 133, the roller 134, and the vane 135 constituting the compression part in the vane rotary compressor according to this embodiment is substantially the same as those of the previous embodiment.

[0241] In addition, in the vane rotary compressor according to the embodiment, the main bearing 131 may include first, second, and third main back pressure pockets 1315a, 1315b, and 1315c at predetermined distances along the circumferential direction, and the sub bearing 132 may include first, second, and third sub back pressure pockets 1325a, 1325b, and 1325c at predetermined distances along the circumferential direction. The main back pressure pockets 1315a, 1315b, and 1315c and the sub back pressure pockets 1325a, 1325b, and 1325c may be formed in the same way as the main back pressure pocket 1315 and the sub back pressure pocket 1325 of the previous embodiments.

[0242] In addition, the vane rotary compressor according to this embodiment may include a first back pressure passage portion 1381 and a second back pressure passage portion 1382, and these back pressure passage portions 1381 and 1382 may also be formed in the same manner as the back pressure passage portions 1381 and 1382 of the previous embodiments.

[0243] However, the vane rotary compressor according to this embodiment includes the first lubricating portion 1391 and the second lubricating portion 1392, but the first lubrication pocket 1391a and/or the second lubrication pocket 1392a may be formed as a plurality of grooves, unlike the previous embodiment of FIG. 15. This embodiment illustrates an example in which the first lubrication pocket 1391a is formed as a plurality of grooves and the second lubrication pocket 1392a is formed as a single groove.

[0244] For example, as illustrated in FIG. 19, the first lubrication pocket 1391a may be divided into a plurality of grooves disposed at predetermined distances along the circumferential direction. In this case, each of the plurality of grooves configuring the first lubrication pocket 1391a may be formed in a circular shape or a short arcuate shape.

[0245] In addition, the first lubrication passages 1391b may independently communicate with the respective grooves of the first lubrication pocket 1391a. In this case, one end of the first lubrication passage 1391b may directly communicate with the first lubrication pocket 1391a and another end may directly communicate with the oil storage space 110b of the casing 110, as illustrated in the previous embodiment of FIG. 15. Accordingly, oil stored in the oil storage space 110b of the casing 110 can quickly move into the grooves of the first lubrication

pocket 1391a through the first lubrication passages 1391b, respectively.

[0246] As described above, when the first lubrication pocket 1391a is formed as the plurality of grooves, oil can be continuously supplied to the first lubrication pocket 1391a. The oil then forms a wide and thick oil film on the entire sub sliding surface 1321a over the first lubrication pocket 1391a, thereby reducing friction loss between the vane 135 and the sub sliding surface 1321a.

[0247] In addition, in this embodiment, as the first lubrication pocket 1391a is shortened, an intersecting section, which is generated in the circumferential direction between the vane 135 and the first lubricating portion 1391 (precisely, the first lubrication pocket), is decreased. Thus, the vane 135 is more brought into contact with the flat sub sliding surface 1321a in the circumferential direction, thereby reducing friction loss between the vane 135 and the sub sliding surface 1321a.

[0248] Hereinafter, still another embodiment of a first lubricating portion and a second lubricating portion will be described.

[0249] That is, the previous embodiments illustrate the lubrication pockets, but in some cases, a lubrication passage may be merely provided without a lubrication pocket.

[0250] FIG. 21 is a perspective view illustrating still another embodiment of the lubricating portion in FIG. 15, and FIG. 22 is a cross-sectional view of FIG. 21.

[0251] Referring to FIGS. 21 and 22, the basic configuration and operating effects of the vane rotary compressor according to this embodiment are almost the same as those of the previous embodiments. For example, the basic configuration of the main bearing 131, the sub bearing 132, the cylinder 133, the roller 134, and the vane 135 constituting the compression part in the vane rotary compressor according to this embodiment is substantially the same as those of the previous embodiment.

[0252] In addition, in the vane rotary compressor according to the embodiment, the main bearing 131 may include first, second, and third main back pressure pockets 1315a, 1315b, and 1315c disposed at predetermined distances along the circumferential direction, and the sub bearing 132 may include first, second, and third sub back pressure pockets 1325a, 1325b, and 1325c disposed at predetermined distances in the circumferential direction. These main back pressure pockets 1315a, 1315b, 1315c and sub back pressure pockets 1325a, 1325b, 1325c may be formed in the same way as the main back pressure pocket 1315 and the sub back pressure pocket 1325 of the previous embodiments.

[0253] In addition, the vane rotary compressor according to this embodiment may include a first back pressure passage portion 1381 and a second back pressure passage portion 1382, and these back pressure passage portions 1381 and 1382 may also be formed in the same manner as the back pressure passage portions 1381 and 1382 of the previous embodiments.

[0254] However, the vane rotary compressor accord-

ing to this embodiment may include the first lubricating portion 1391 and the second lubricating portion 1392, but any one of the first lubricating portion 1391 and the second lubricating portion 1392 may merely include a lubrication passage. In this embodiment, an example in which the first lubricating portion 1391 includes a plurality of first lubrication passages 1391b is illustrated. Since the second lubricating portion 1391 is the same as that in the embodiment of FIG. 15, it will be understood by the description of the embodiment of FIG. 15.

[0255] The first lubricating portion 1391 according to this embodiment may include a plurality of first lubrication passages 1391b.

[0256] The plurality of first lubrication passages 1391b may pass through the sub bearing 132 and communicate with the oil storage space 110b of the casing 110. For example, an upper end of the first lubrication passage 1391b in the axial direction may communicate with the sub sliding surface 1321a and a lower end of the first lubrication passage 1391b in the axial direction may be immersed in the oil storage space 110b of the casing 110 through a lower surface of the sub plate portion 1321 so as to communicate with the oil storage space 110b. Accordingly, oil stored in the oil storage space 110b of the casing 110 can be directly supplied to the sub sliding surface 1321a through the first lubrication passage 1391b.

[0257] An inner diameter D4 of each of the plurality of first lubrication passages 1391b may be larger than or equal to the inner diameter D3 of the first back pressure passage portion 1381. Accordingly, oil stored in the oil storage space 110b of the casing 110 can be quickly supplied to the sub sliding surface 1321a through the first lubrication passages 1391b.

[0258] Also, the plurality of first lubrication passages 1391b may be disposed at equal distances in the circumferential direction. The plurality of first lubrication passages 1391b may have the same inner diameter or different inner diameters. For example, the inner diameter of the first lubrication passage 1391b may be increased as it approaches the reference point P based on the rotational direction of the roller 134. In this embodiment, an example is shown in which the plurality of first lubrication passages 1391b have the same inner diameter. Accordingly, the processing of the first lubrication passages 1391b can be easy, and oil can be supplied to the sub sliding surface 1321a almost uniformly.

[0259] As described above, even when the first lubricating portion 1391 includes only the plurality of first lubrication passages 1391b, oil stored in the oil storage space 110b of the casing 110 can be continuously supplied to the sub sliding surface 1321a through the first lubrication passages 1391b, and widely spread on the sub sliding surface 1321a. Accordingly, even if the lubrication pocket 1391a as in the previous embodiment is not formed in the sub sliding surface 1321a, a wide and thick oil film can be formed on the sub sliding surface 1321a, thereby lowering friction loss between the vane

135 and the sub sliding surface 1321a. This can prevent discontinuous sliding of the vane 135, thereby suppressing chattering of the vane 135.

[0260] In addition, in the embodiment, as the first lubrication pocket 1391a in the embodiments of FIGS. 15 and 19 is excluded, the intersecting section in the circumferential direction between the vane 135 and the first lubricating portion 1391 is much more shortened. Thus, the vane 135 is brought into contact with the substantially flat sub sliding surface 1321a in the circumferential direction, thereby further reducing friction loss between the vane 135 and the sub sliding surface 1321a.

[0261] Although not illustrated, the discharge port may be formed through the cylinder instead of the main bearing and the sub bearing. In this case as well, the vane support structure using the compression coil spring may be applied equally.

Claims

1. A rotary compressor comprising:

a casing (110);
 a drive motor (120) disposed in an inner space (110a) of the casing (110);
 a rotating shaft (123) coupled to a rotor (122) of the drive motor (120), wherein an oil supply passage (125) is formed through an inside of the rotating shaft (123);
 a cylinder (133) disposed in an inner space (110b) of the casing (110) to define a compression space (V);
 a roller (134) disposed on the rotating shaft (123), the roller (134) is accommodated in the compression space (V) and is eccentric with respect to an inner circumferential surface of the cylinder (133);
 vanes (1351, 1352, 1353) slidably inserted into vane slots (1343a, 1343b, and 1343c) provided in the roller (134); and
 a main bearing (131) and a sub bearing (132) respectively disposed on both sides of the cylinder (133) in an axial direction to define the compression space (V) together with the cylinder (133),
 wherein at least one of the main bearing (131) and the sub bearing (132) includes a discharge port (1313) through which refrigerant compressed in the compression space (V) is discharged to the inner space (110a) of the casing (110),
 wherein one or more back pressure pockets (1315, 1325) are disposed at one side of the discharge port (1313) communicating with rear sides of the vanes (1351, 1352, 1353)

2. The rotary compressor of claim 1, wherein a plurality

of back pressure pockets (1315, 1325) are disposed communicating with rear sides of the vanes (1351, 1352, 1353), wherein the plurality of back pressure pockets (1315, 1325) are spaced apart from each other in a circumferential direction.

3. The rotary compressor of claim 2, wherein a back pressure pocket (1315, 1325) that is closest to the discharge port (1313) of the plurality of back pressure pockets (1315, 1325) communicates with the inner space (110a) of the casing (110) by a back pressure passage portion (138) penetrating through at least one of the main bearing (131) and the sub bearing (132).

4. The rotary compressor of any one of the preceding claims, wherein each of the main bearing (131) and the sub bearing (132) includes a bearing hole (1312a, 1322a) in which the rotating shaft (123) is inserted and supported, and/or the back pressure pocket (1315, 1325) closest to the discharge port (1313) is radially spaced apart from an inner circumferential surface of the bearing hole (1312a, 1322a) so as to be isolated from the bearing hole (1312a, 1322a).

5. The rotary compressor of any one of the preceding claims, wherein the rotating shaft (123) includes an oil supply passage (125) formed therein in a hollow shape, and at least one oil supply hole (126a, 126b) formed through from an inner circumferential surface of the oil supply passage (125) to an outer circumferential surface of the rotating shaft (123), and/or wherein the back pressure passage portion (138) has an inner diameter smaller than or equal to an inner diameter of the oil supply hole (126a, 126b).

6. The rotary compressor of any one of the preceding claims 3-5, wherein the back pressure passage portion (138) is located at one side of the oil supply hole (125) in the axial direction.

7. The rotary compressor of any one of the preceding claims, wherein the back pressure passage portion (138) is formed to be eccentric from a center of the back pressure pocket (1315, 1325) to a reference point where the roller (134) and the cylinder (133) are closest to each other; and/or the back pressure passage portion (138) is located at a position where the same periodically overlaps the vane (1351, 1352, 1353) during a reciprocating motion of the vane (1351, 1352, 1353); and/or the back pressure passage portion (138) has an inner diameter smaller than a width of the vane (1351, 1352, 1353).

8. The rotary compressor of any one of claims 1 to 7, wherein the back pressure passage portion (138) comprises at least one of:

a first back pressure hole (138a) formed in a penetrating manner from an inner circumferential surface of the oil supply passage (125) to an outer circumferential surface of the rotating shaft (123); and

a second back pressure hole (138b) formed through at least one of the main bearing (131) and the sub bearing (132) to communicate with the first back pressure hole (138a), so as to communicate with the back pressure pocket (1315, 1325), and/or

wherein the second back pressure hole (138b) has an inner diameter smaller than or equal to an inner diameter of the first back pressure hole (138a).

9. The rotary compressor of claim 8, wherein a communication groove (138c) is formed between the first back pressure hole (138a) and the second back pressure hole (138b), and/or the communication groove (138c) has a cross-sectional area larger than at least one of a cross-sectional area of the first back pressure hole (138a) and a cross-sectional area of the second back pressure hole (138b); and/or the communication groove (138c) is formed in an arcuate shape so that the first back pressure hole (138a) and the second back pressure hole (138b) communicate with each other periodically, or the communication groove (138c) is formed in a circular shape so that the first back pressure hole (138a) and the second back pressure hole (138b) communicate with each other continuously.

10. The rotary compressor of any one of claims 1 to 9, wherein the back pressure passage portion (138) has one end communicating with the back pressure pocket (1315, 1325) closest to the discharge port (1313), and another end communicating with the inner space of the casing (110) through at least one of the main bearing (131) and the sub bearing (132), and/or wherein the back pressure pocket (1315, 1325) closest to the discharge port (1313) among the plurality of back pressure pockets (1315, 1325) has a volume smaller than a volume of another back pressure pocket (1315, 1325).

11. The rotary compressor of claim 10, wherein the back pressure pocket (1315, 1325) closest to the discharge port (1313) among the plurality of back pressure pockets (1315, 1325) has an arcuate length shorter than an arcuate length of the other back pressure pocket (1315, 1325), or wherein the back pressure pocket (1315, 1325) closest to the discharge port (1313) among the plurality of back pressure pockets (1315, 1325) has a depth smaller than a depth of the another back pressure pocket (1315, 1325).

12. The rotary compressor of any one of claims 1 to 11, wherein a lubricating portion (1392) is formed at at least one of the main bearing (131) and the sub bearing (132) radially outside the back pressure pocket (1315, 1325); and/or at least portion of the lubricating portion (1392) radially overlaps the back pressure pocket (1315, 1325) closest to the discharge port (1313). 5
13. The rotary compressor of claim 12, wherein the lubricating portion (1392) comprises: 10
- a lubrication pocket (1391a) spaced apart from the back pressure pocket (1315, 1325); and 15
- a lubrication passage (1391b) connecting the lubrication pocket (1391a) and the inner space (110b) of the casing (110) to guide oil stored in the inner space of the casing to the lubrication pocket (1391a), 20
- wherein the lubrication pocket (1391a) is configured as one groove extending in the circumferential direction, and 20
- wherein the lubrication passage (1391b) is provided by one or more in number in the circumferential direction of the lubrication pocket (1391a), or 25
- wherein the lubrication passage (1391b) independently communicates with each of the plurality of lubrication pockets (1391a). 30
14. The rotary compressor of claim 12, wherein the lubricating portion (1392) comprises at least one lubrication passage (1391b) formed through the sub bearing (132), and 35
- wherein the lubrication passage (1391b) has one end open toward the vane (1351, 1352, 1353) at one axial side surface of the sub bearing (132), and another end open toward the inner space of the casing (110) at another axial side surface of the sub bearing (132). 40
15. The rotary compressor of claim 12, wherein the lubricating portion (1392) comprises:
- a lubrication pocket (1391a) spaced apart from the back pressure pocket (1315, 1325); and 45
- a lubrication passage (1391b) extending from at least one of the back pressure pockets (1315, 1325), excluding the back pressure pocket (1315, 1325) closest to the discharge port (1313), to communicate with the lubrication pocket (1391a). 50
- 55

FIG. 1

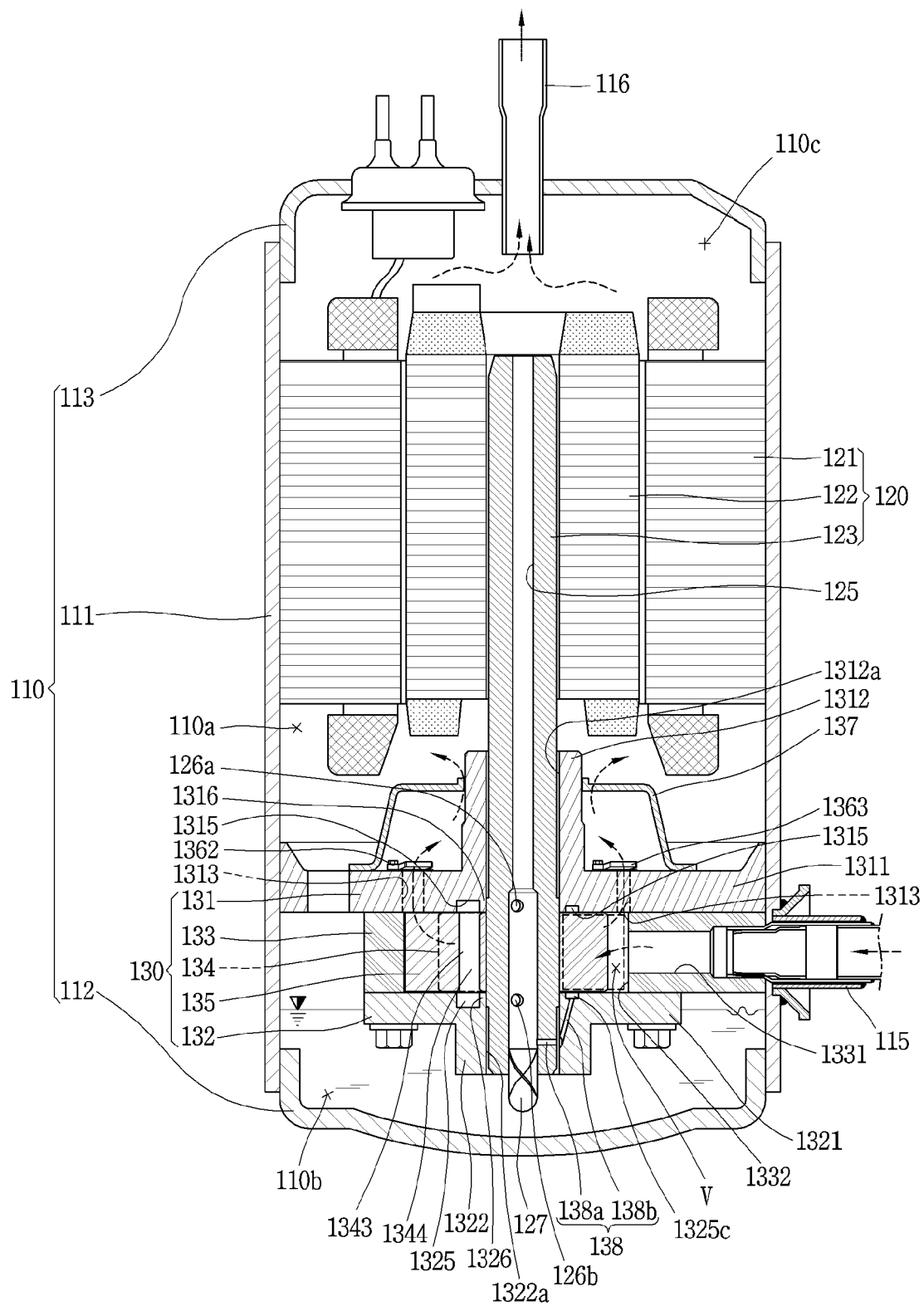


FIG. 2

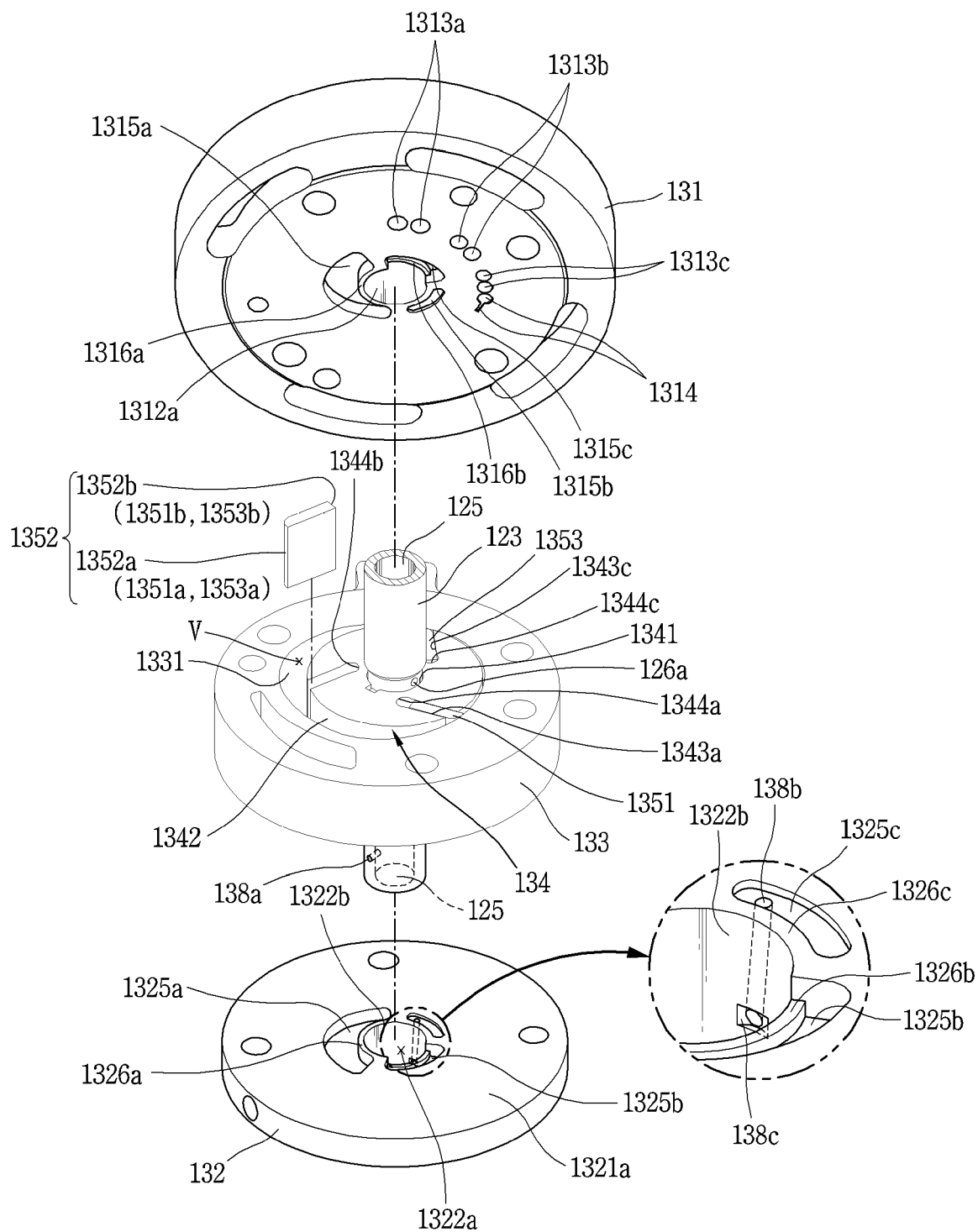


FIG. 3

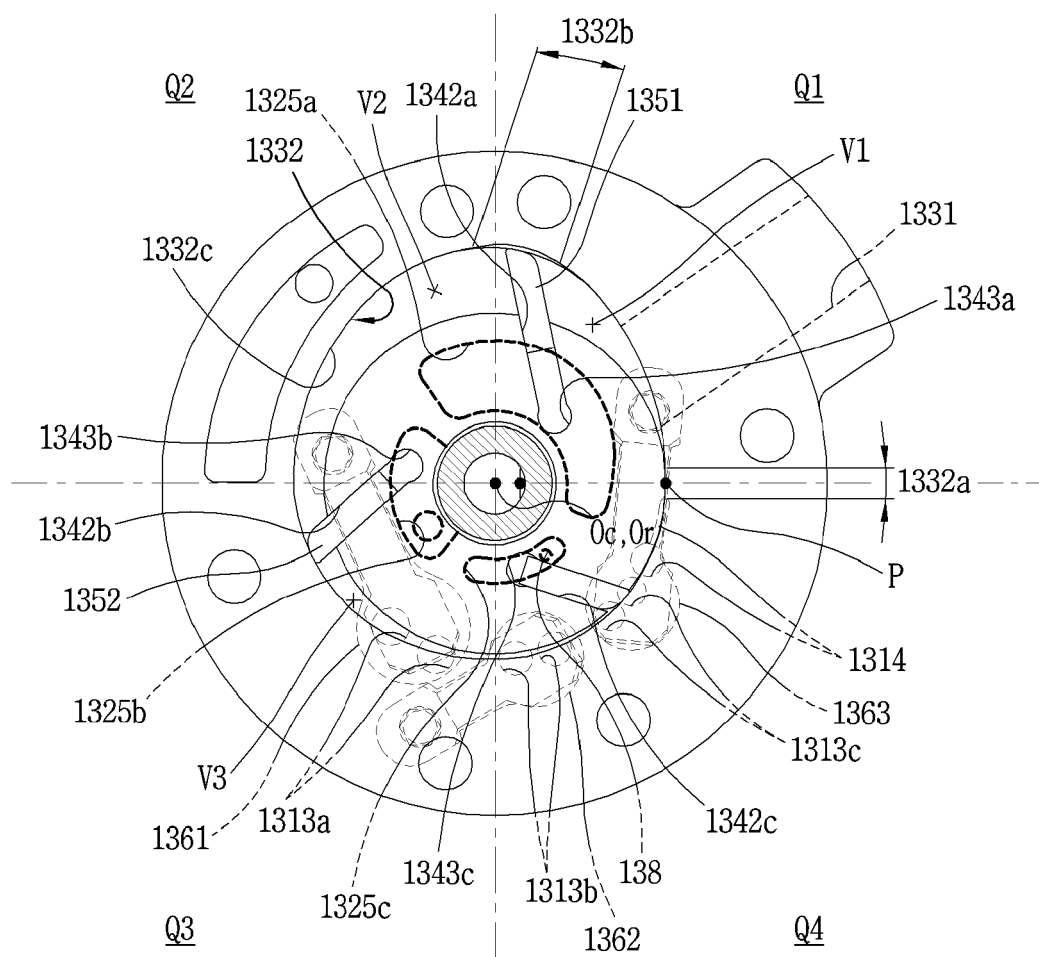


FIG. 4

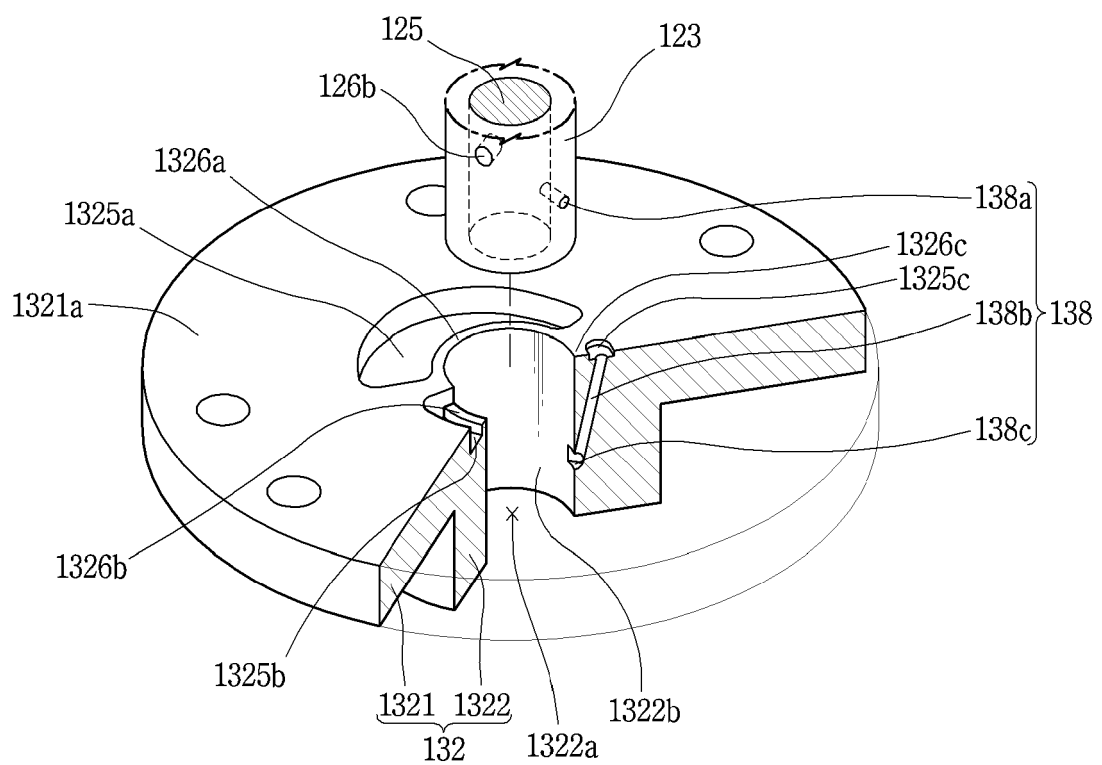


FIG. 5

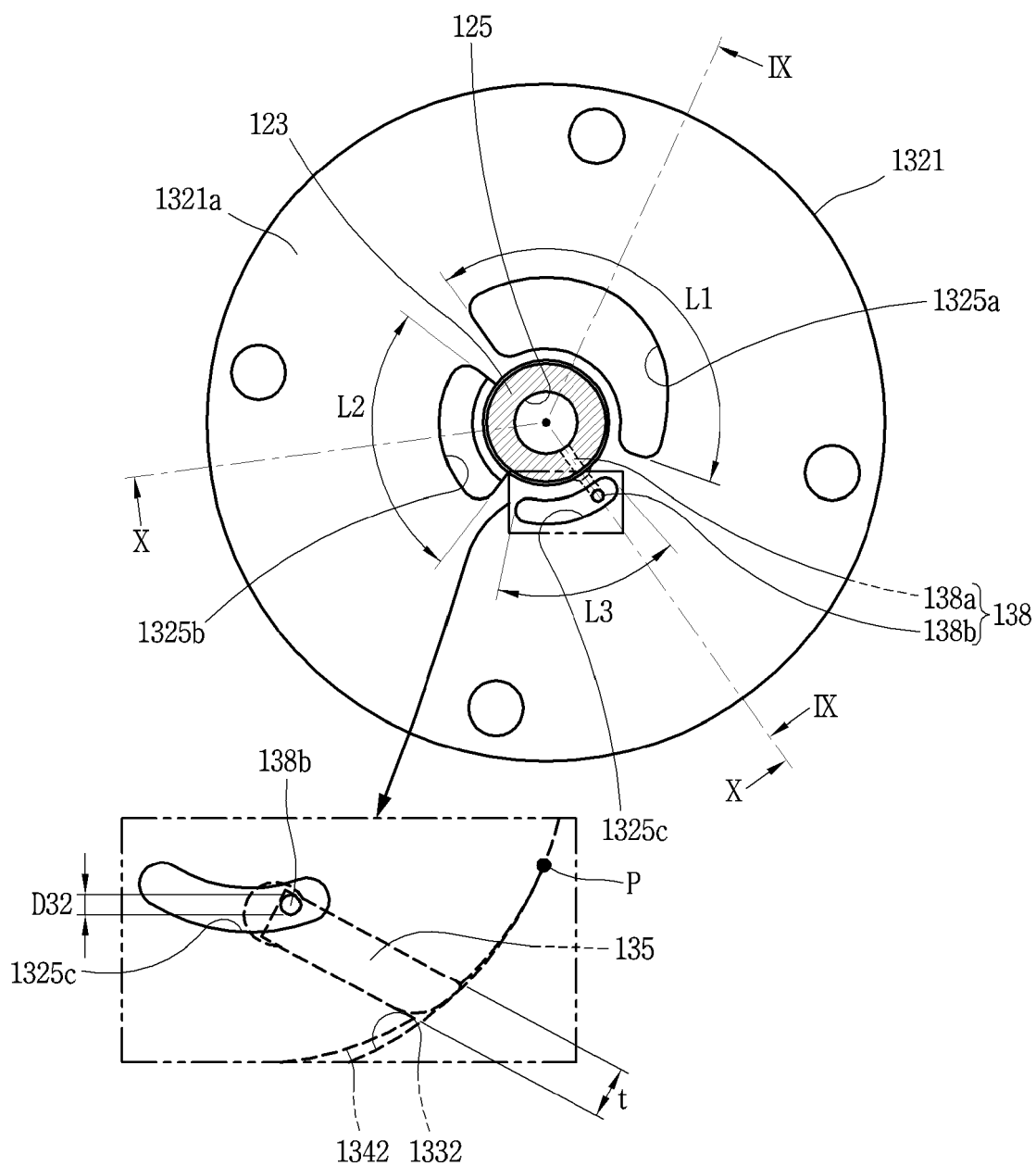


FIG. 6

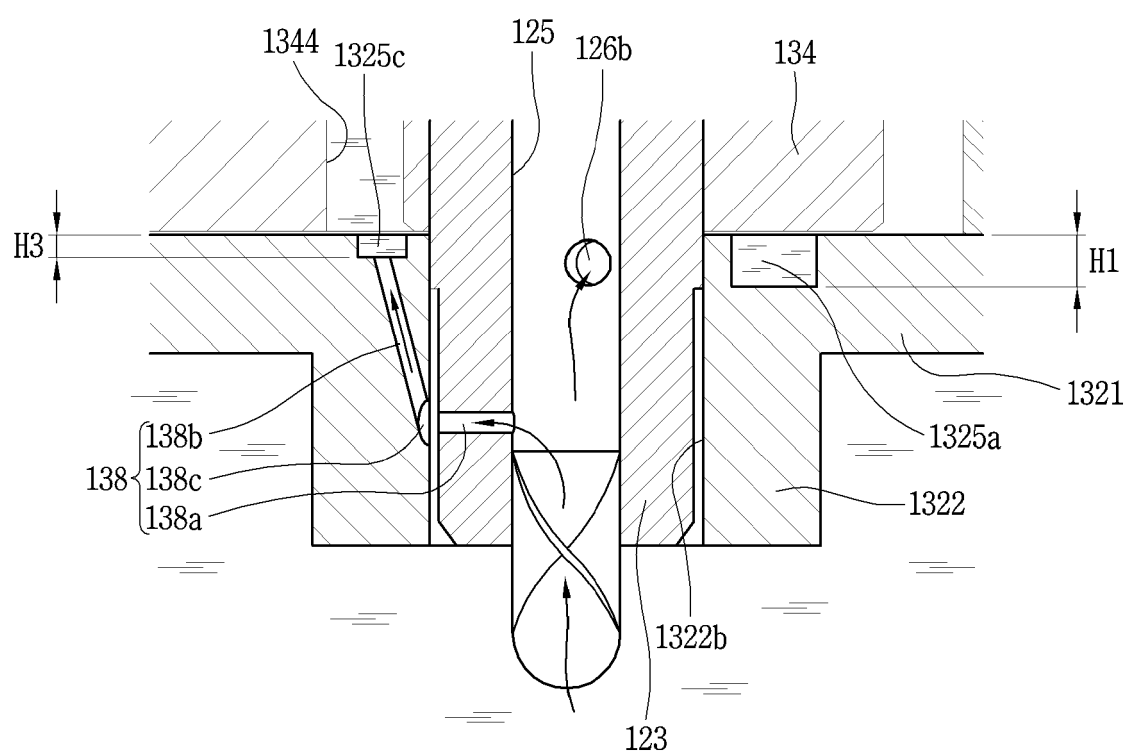


FIG. 7

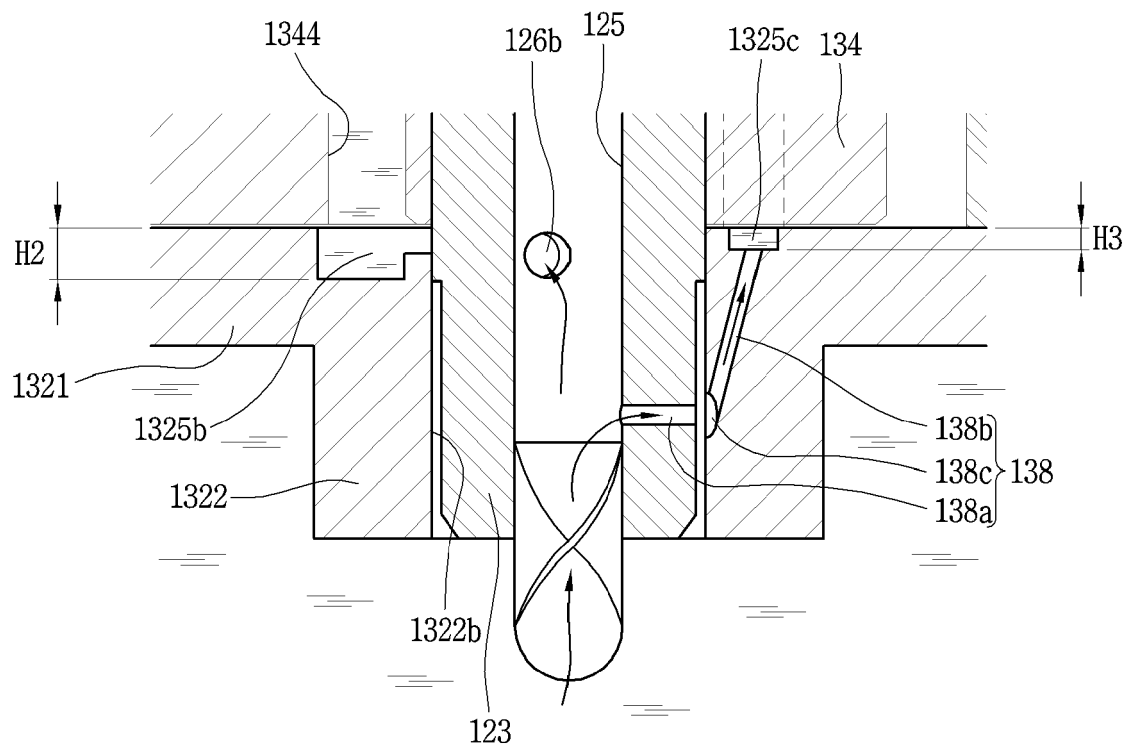


FIG. 8

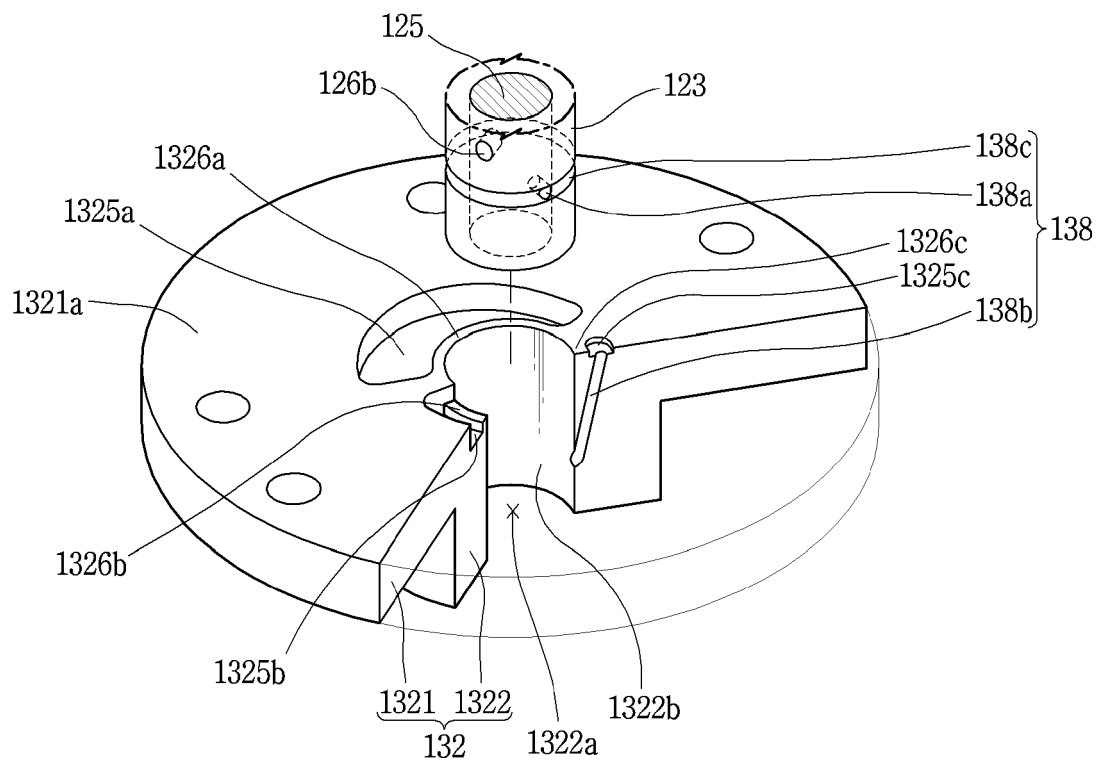


FIG. 9

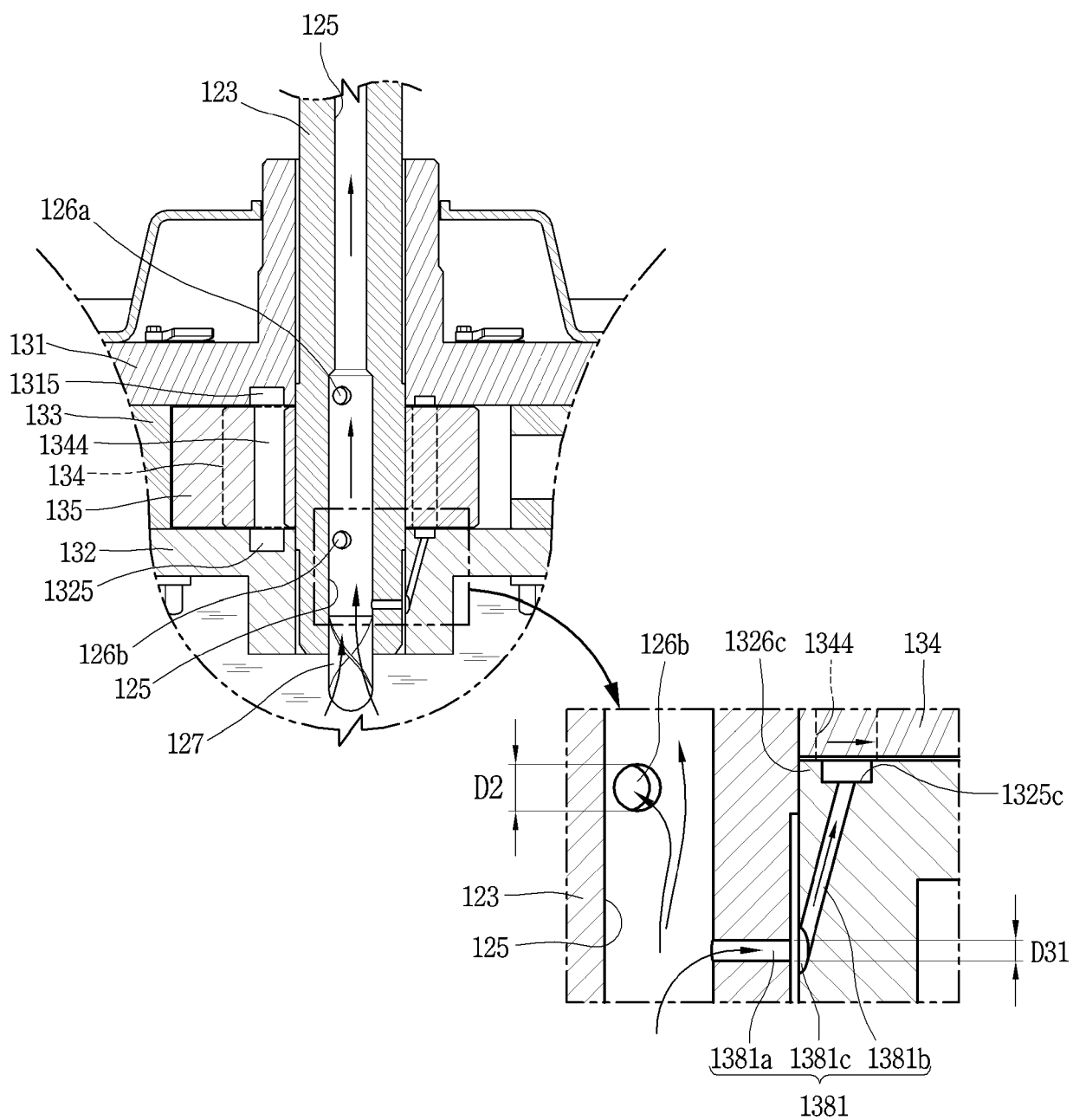


FIG. 10

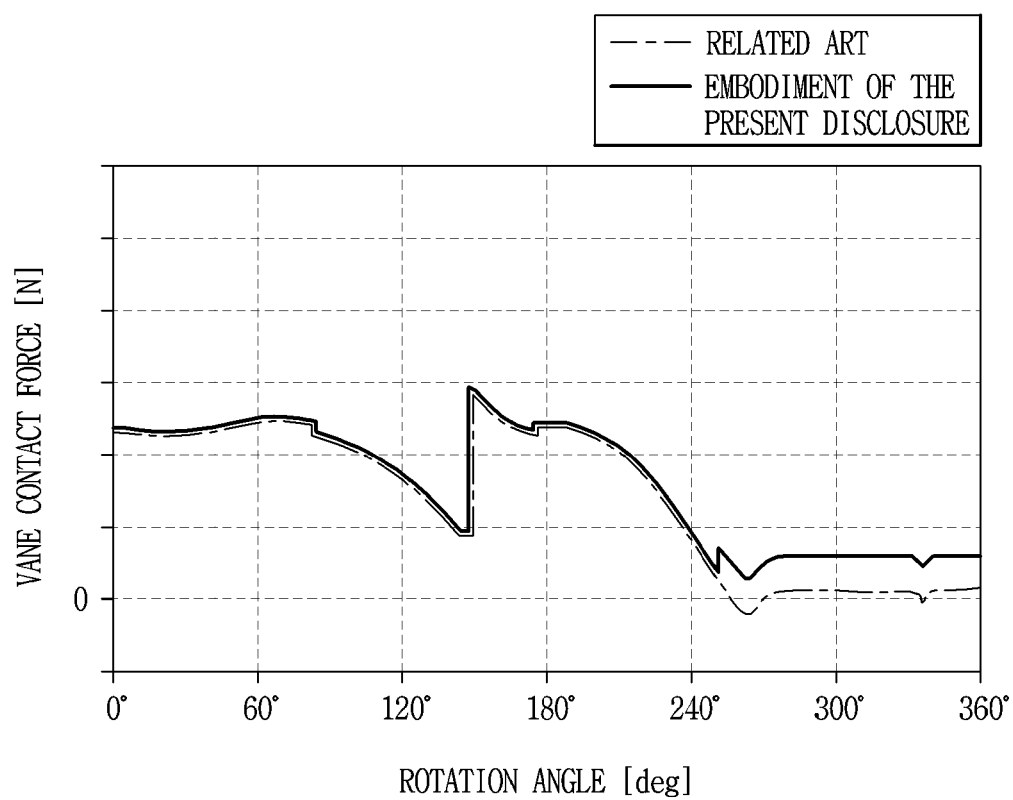


FIG. 11

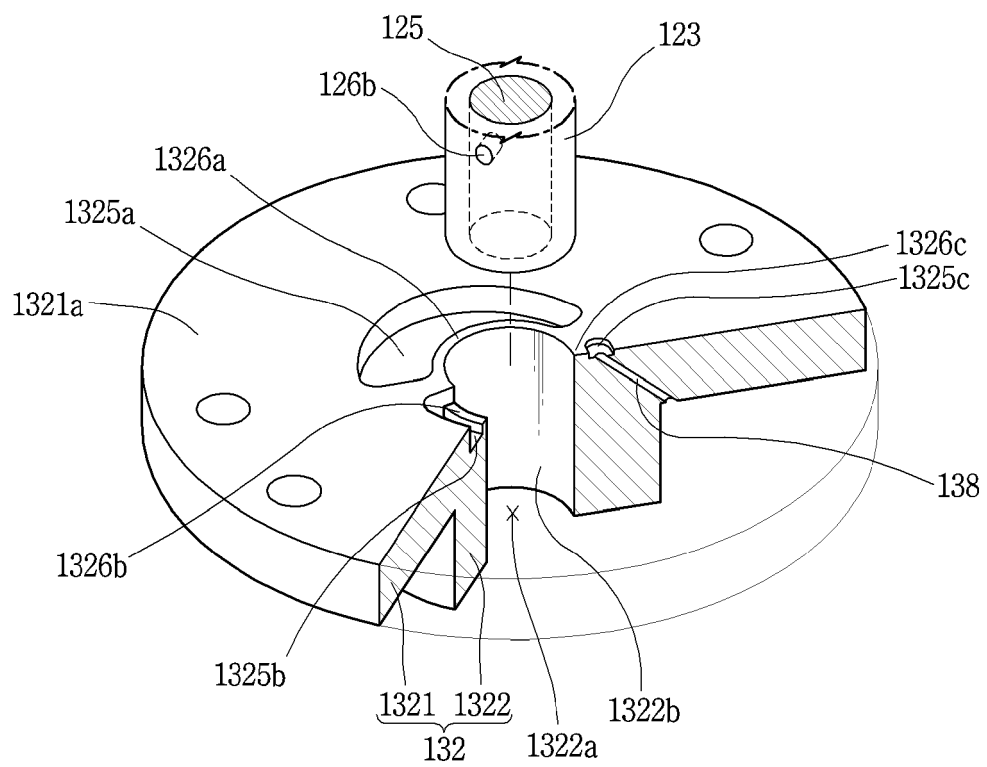


FIG. 12

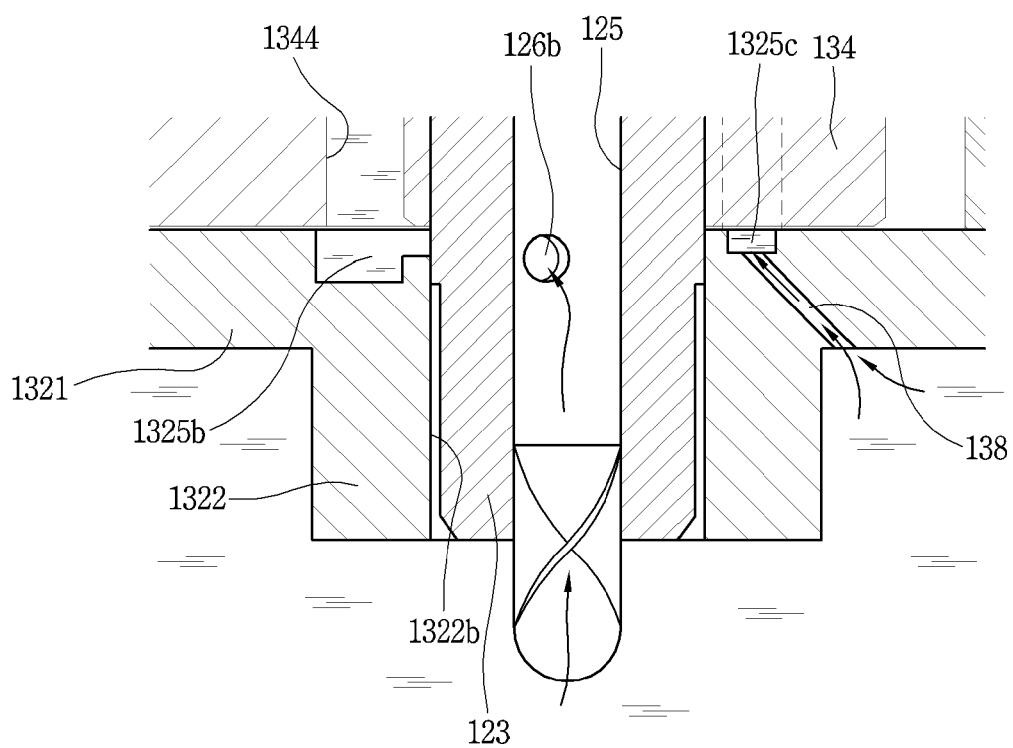


FIG. 13

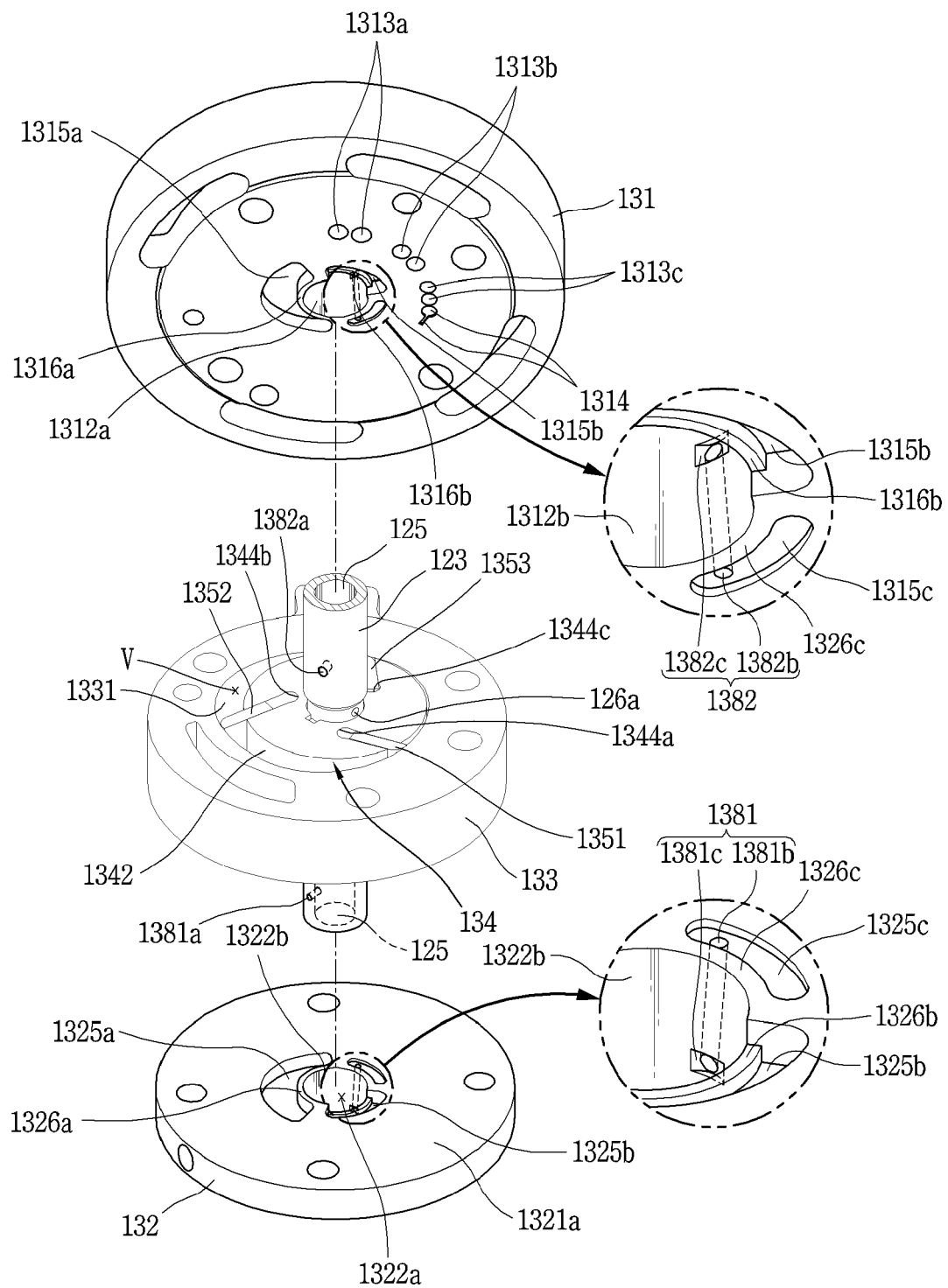


FIG. 14

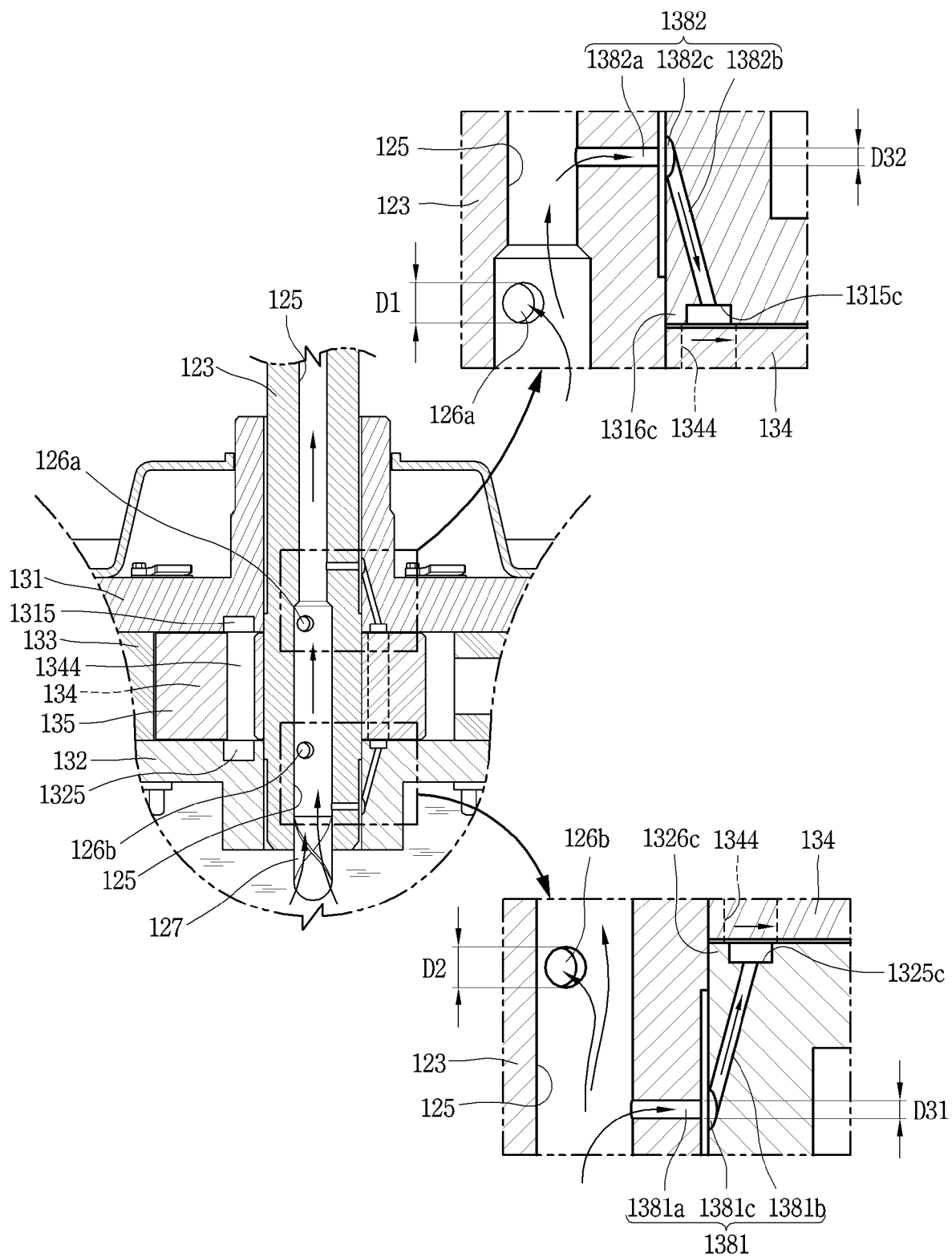


FIG. 15

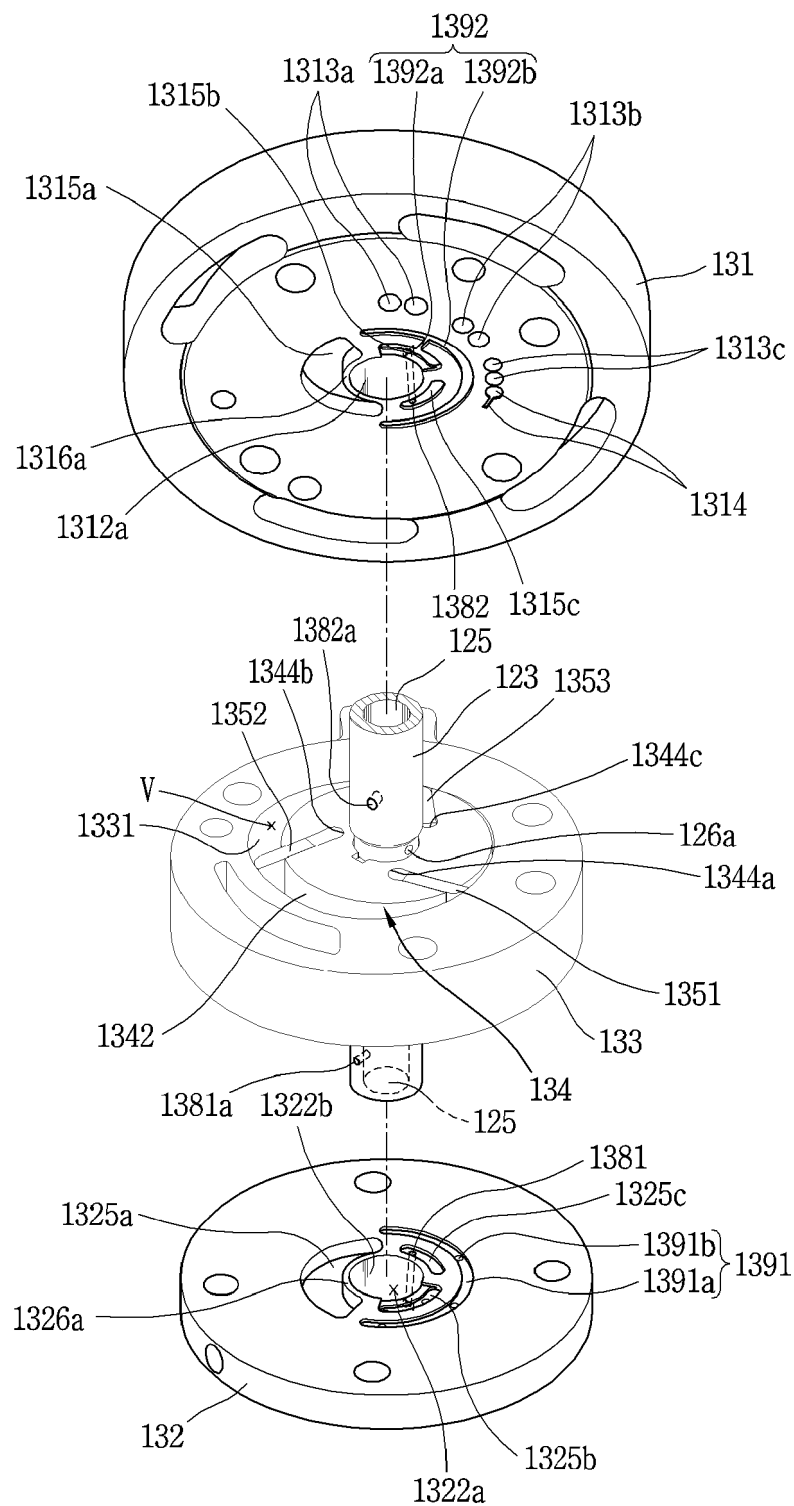


FIG. 16

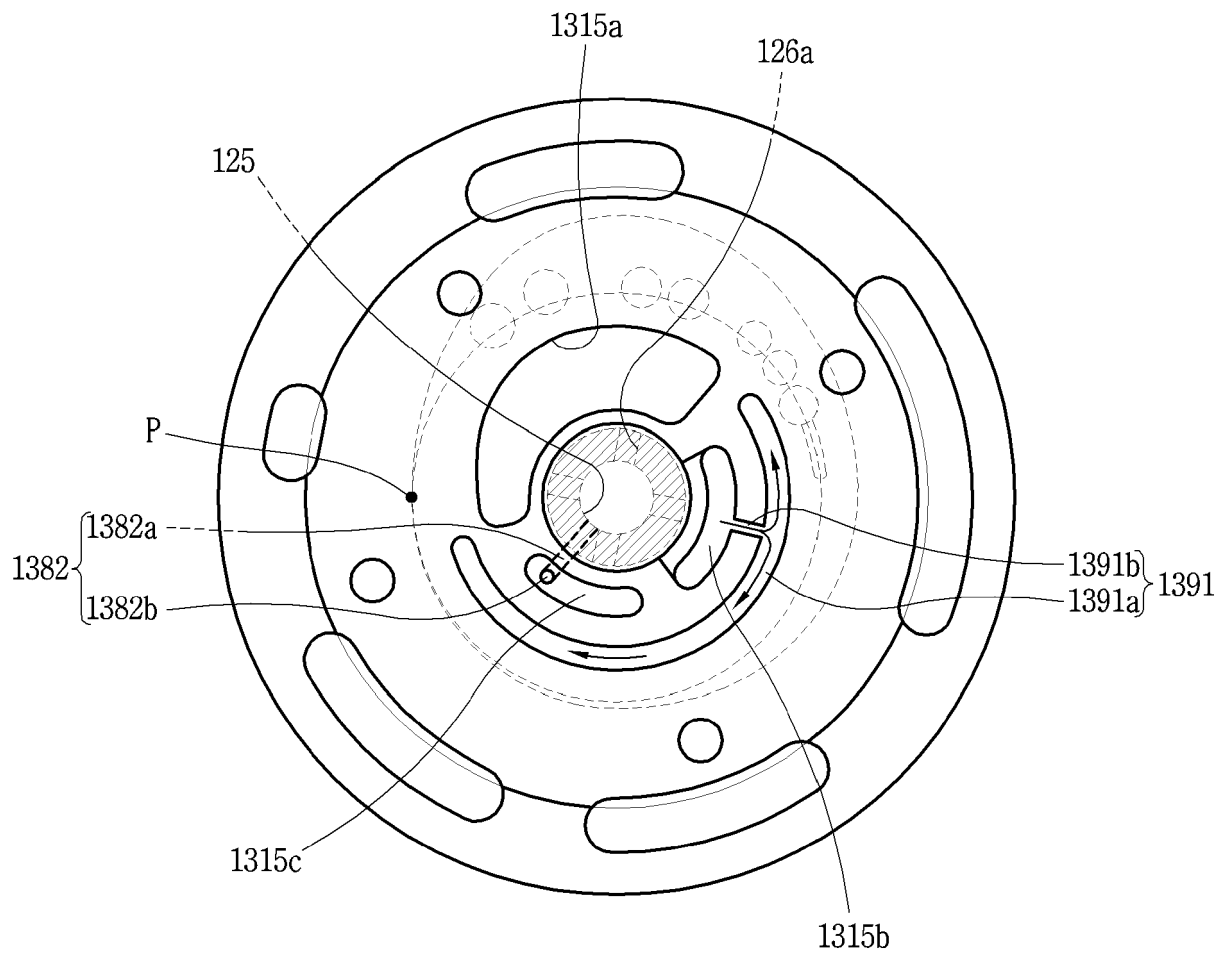


FIG. 17

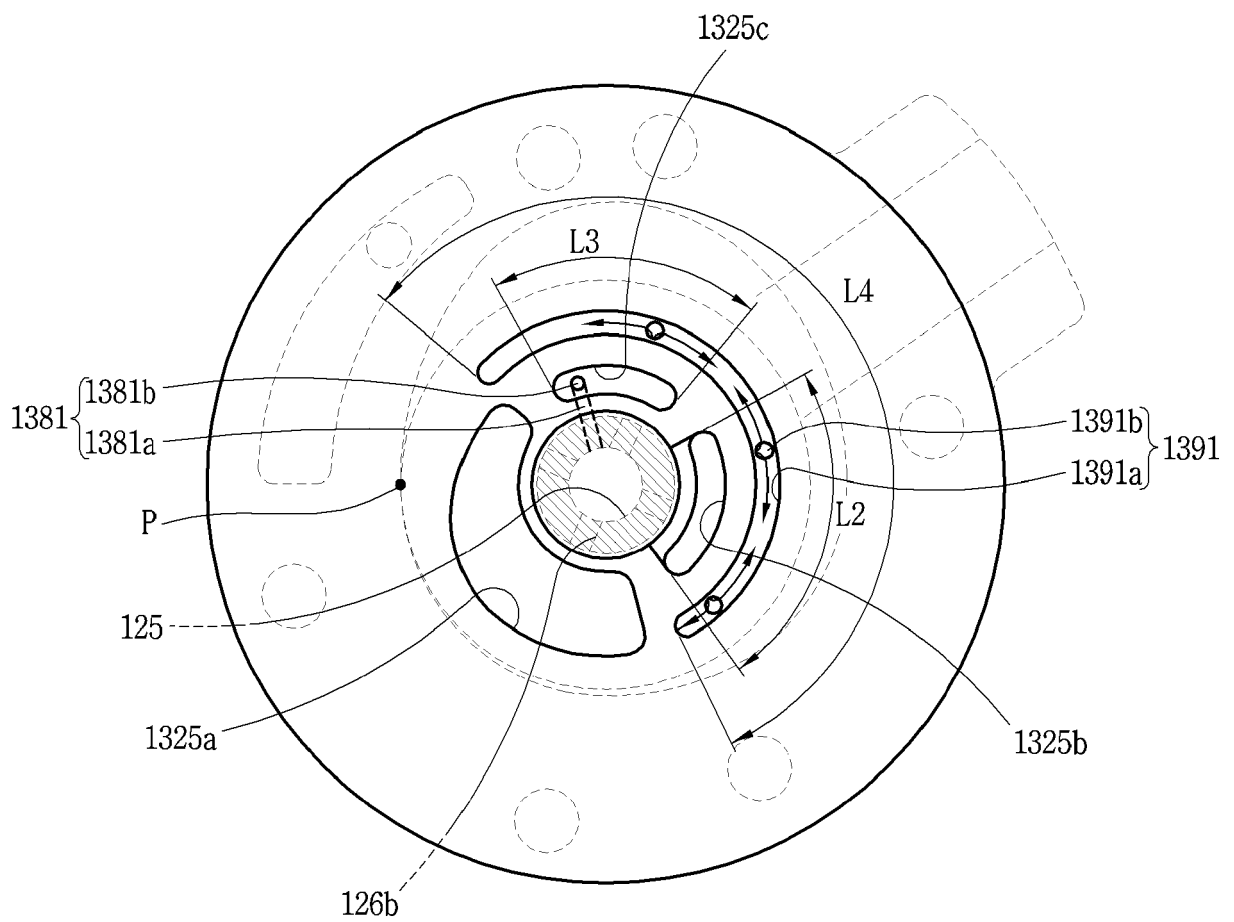


FIG. 18

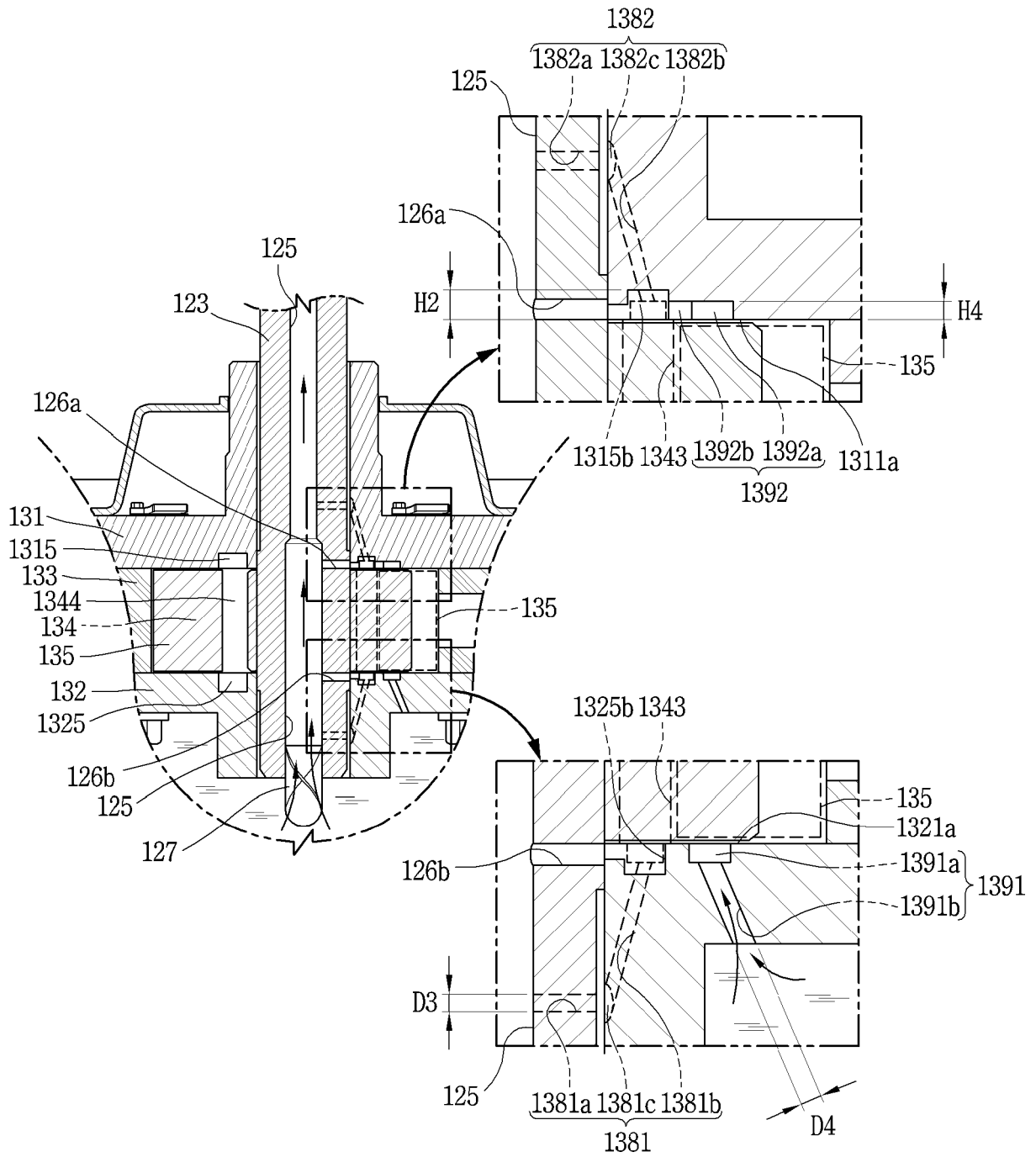


FIG. 19

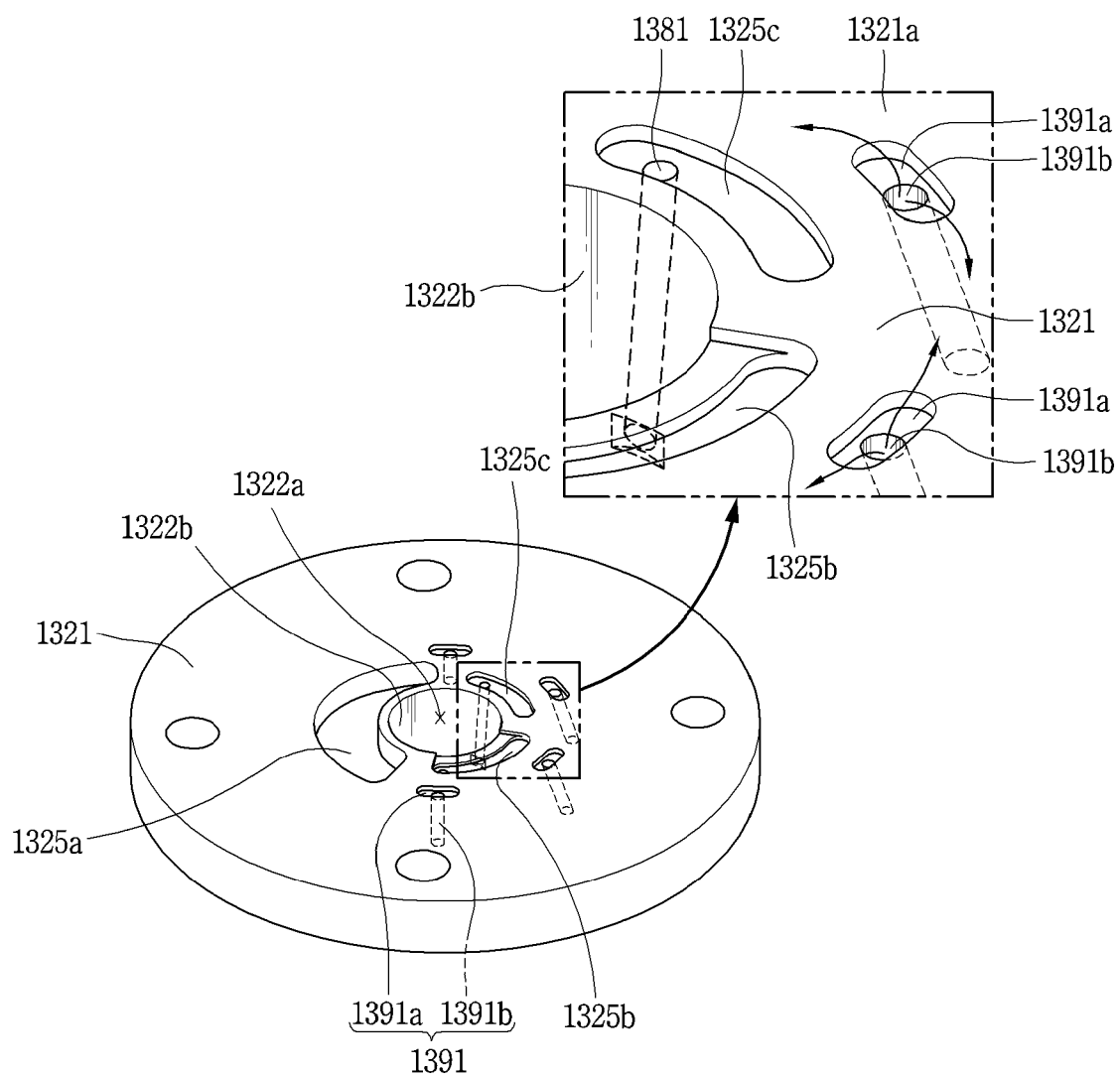


FIG. 20

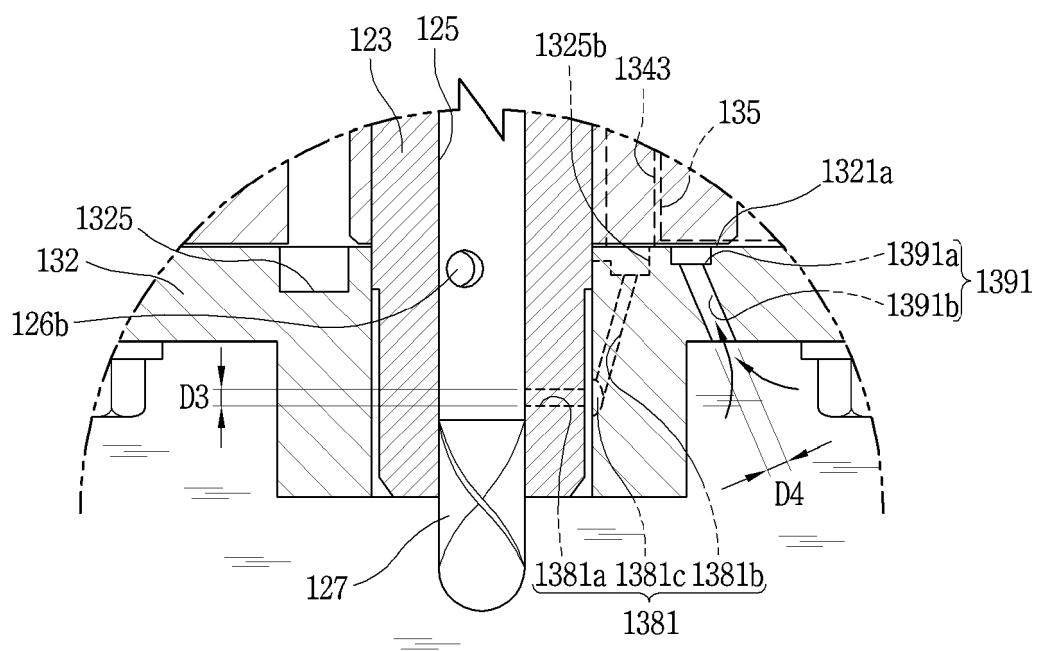


FIG. 21

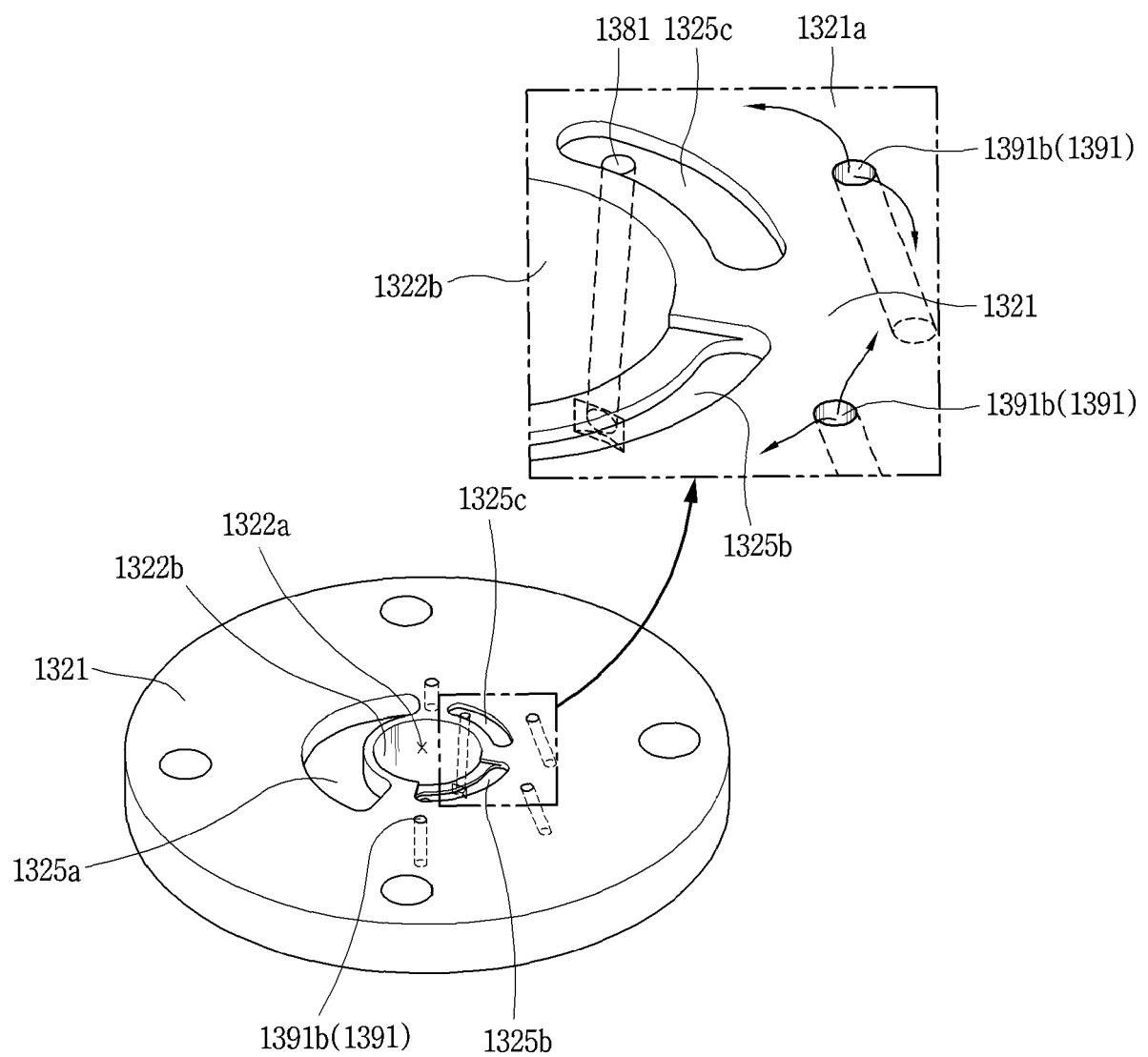
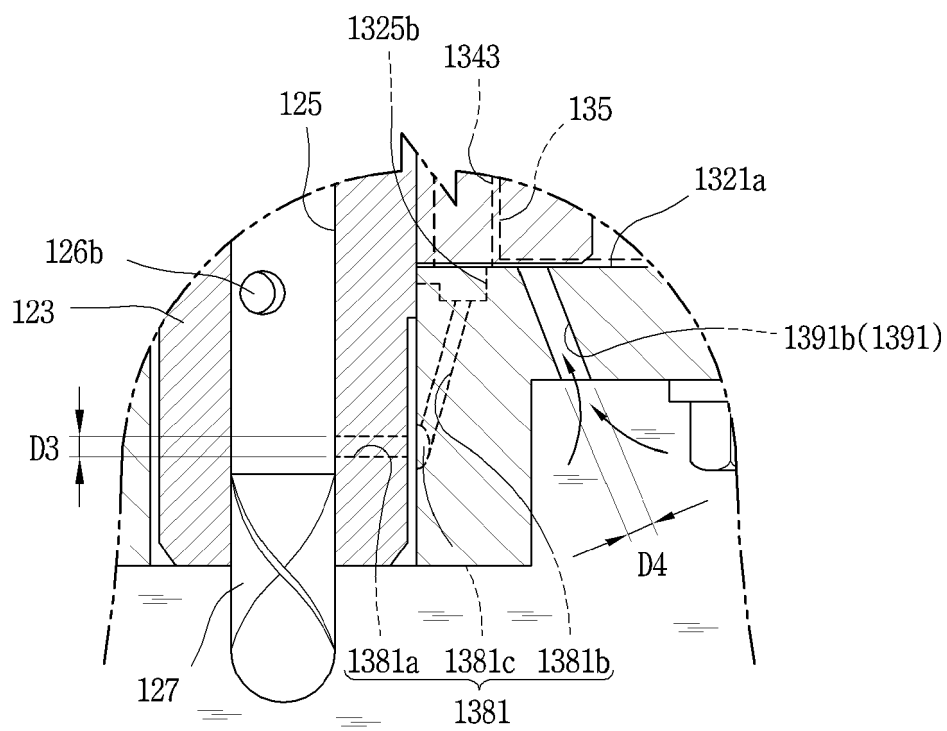


FIG. 22





EUROPEAN SEARCH REPORT

Application Number

EP 23 15 1272

5

10

15

20

25

30

35

40

45

50

55

2

EPO FORM 1503 03.82 (F04C01)

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	US 2020/158111 A1 (PARK JOONHONG [KR] ET AL) 21 May 2020 (2020-05-21)	1-11	INV.
A	* figures 1,2,5 *	12-15	F04C18/344
	-----		F04C28/10
X	US 2021/363990 A1 (SHIN JINUNG [KR] ET AL) 25 November 2021 (2021-11-25)	1-11	F04C29/00
A	* figures 1-4 *	12-15	F01C21/08
	-----		F04C23/00
X	EP 3 933 206 A1 (GREE ELECTRIC APPLIANCES INC ZHUHAI [CN]) 5 January 2022 (2022-01-05)	1,12-15	F04C29/02
A	* figures 1,5,8,11 *	2-11	
	* paragraph [0038] *		

X	EP 3 786 454 A1 (GREE ELECTRIC APPLIANCES INC ZHUHAI [CN]) 3 March 2021 (2021-03-03)	1,12-15	
A	* figures 1-3,9,10 *	2-11	
	* paragraph [0037] *		

			TECHNICAL FIELDS SEARCHED (IPC)
			F04C
			F01C
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		25 September 2023	Durante, Andrea
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 23 15 1272

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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-09-2023

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2020158111 A1	21-05-2020	CN 111197575 A	26-05-2020
		KR 20200057542 A	26-05-2020
		US 2020158111 A1	21-05-2020
		US 2022034318 A1	03-02-2022
US 2021363990 A1	25-11-2021	CN 215292888 U	24-12-2021
		KR 20210144364 A	30-11-2021
		US 2021363990 A1	25-11-2021
EP 3933206 A1	05-01-2022	CN 109737065 A	10-05-2019
		EP 3933206 A1	05-01-2022
		US 2022034323 A1	03-02-2022
		WO 2020173118 A1	03-09-2020
EP 3786454 A1	03-03-2021	CN 108930651 A	04-12-2018
		EP 3786454 A1	03-03-2021
		JP 7329542 B2	18-08-2023
		JP 2022516817 A	03-03-2022
		US 2021207602 A1	08-07-2021
		WO 2020042432 A1	05-03-2020

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 2013213438 A [0005]
- US 20150132168 A1 [0005]
- KR 1020200057542 [0005]