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

(11) EP 3 889 432 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.10.2021 Bulletin 2021/40

(51) Int Cl.:
F04C 18/324 *(2006.01)* ***F04C 29/12*** *(2006.01)*

(21) Application number: **21162742.7**

(22) Date of filing: **16.03.2021**

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

(30) Priority: **02.04.2020 KR 20200040419**

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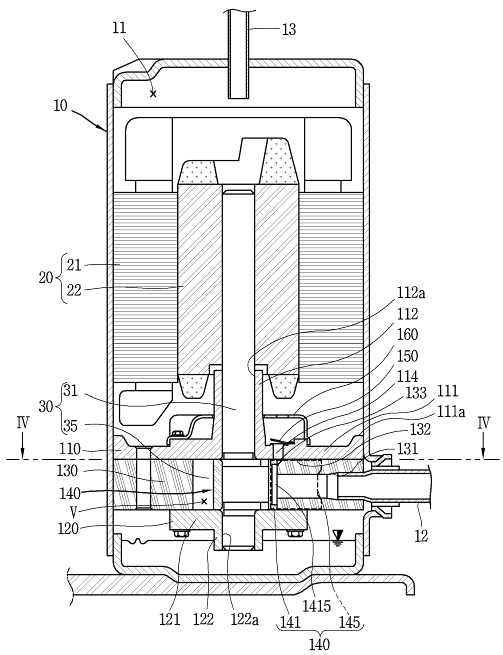
(54) ROTARY COMPRESSOR

(57) A rotary compressor includes: a rotational shaft; a bearing plate supporting the rotational shaft; a cylinder coupled to the bearing plate and provided with an inlet port and a vane slot formed along a circumferential direction to be spaced apart by a predetermined distance; a roller coupled to the rotational shaft, provided inside the cylinder to form a compression space together with the bearing plate and the cylinder, and provided with a hinge groove formed on an outer circumferential surface thereof; and a vane having one end slidingly coupled to the vane slot of the cylinder and another end rotatably coupled to the hinge groove of the roller. At least one suction guide portion is provided at the outer circumferential surface of the roller in a recessed manner.

FIG. 1



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Description

BACKGROUND

1. Technical Field

[0001] A compressor, and more particularly, a rotary compressor in which a roller and a vane are coupled to each other is disclosed herein.

2. Description of the Related Art

[0002] A rotary compressor compresses a refrigerant by using a roller that performs an orbiting motion in a compression space of a cylinder and a vane in contact with an outer circumferential surface of the roller to divide the compression space of the cylinder into a plurality of spaces.

[0003] The rotary compressor can be classified into a rolling piston type and a hinge vane type depending on whether the roller and the vane are coupled to each other. In the rolling piston type rotary compressor, the vane is detachably coupled to the roller to be in close contact with the roller. As for the hinge vane type rotary compressor, the vane is hinged to the roller. Such a hinge vane type rotary compressor is advantageous to reduce axial leakage since behavior (or movement) of the vane is more stable than that of the rolling piston type rotary compressor.

[0004] In general, rotary compressors can reduce a suction loss by reducing the vortex and reaction force of a sucked refrigerant using a shape of an inlet passage. Also, the larger a space of a compression chamber is, the better volumetric efficiency of a rotary compressor. A technique of increasing a suction space by forming a groove on an inner circumferential surface of a cylinder is disclosed in Patent Document 1 (Japanese Laid-Open Patent Application No. 2012-154235), which is hereby incorporated by reference.

SUMMARY

[0005] The invention is set out in the appended set of claims.

[0006] One aspect of the present disclosure is to provide a rotary compressor capable of improving volumetric efficiency by increasing the volume of a compression chamber.

[0007] Another aspect of the present disclosure is to provide a rotary compressor capable of increasing an amount of refrigerant sucked by reducing a suction reaction force of a refrigerant sucked into the compression chamber while expanding the volume of a compression chamber.

[0008] Still another aspect of the present disclosure is to provide a rotary compressor capable of improving motor efficiency by increasing the volume of a compression chamber while reducing weight of a drive unit.

[0009] Embodiments disclosed herein provide a rotary compressor that may have a vane hinged to a roller, and a groove formed on an outer circumferential surface of the roller.

[0010] Here, the cylinder may be provided with an inlet port, and the groove may be formed on a surface facing the inlet port.

[0011] A distance between two circumferential ends of the groove may be equal to an inner diameter of the inlet port.

[0012] The groove may be recessed from a middle portion of the outer circumferential surface of the roller.

[0013] The groove may axially penetrate through the roller.

[0014] Embodiments disclosed herein may also provide a rotary compressor having a cylinder in which an annular-shaped member and a disk-shaped member are hingedly coupled to each other. The annular-shaped member may be rotatably coupled to an eccentric portion of a rotational shaft, and the disk-shaped member may be slidingly coupled to the cylinder. A space forming a suction pressure may be created at one circumferential side and a space forming a discharge pressure may be generated at another circumferential side, with respect to the disk-shaped member. A suction guide groove may be recessed from an outer circumferential surface of the annular-shaped member that is belonged to the space forming the suction pressure.

[0015] Here, at least a part of an inner circumferential surface of the suction guide groove may be curved.

[0016] The inner circumferential surface of the suction guide groove may be symmetrical with respect to a circumferential center of the suction guide groove.

[0017] The inner circumferential surface of the suction guide groove may be asymmetric with respect to a circumferential center of the suction guide groove. The suction guide groove may be formed such that a length in a direction away from the vane is greater than a length in a direction closer to the vane.

[0018] Embodiments disclosed herein further provide a rotary compressor that may include: a rotational shaft; a bearing plate supporting the rotational shaft; a cylinder coupled to the bearing plate and provided with an inlet port and a vane slot formed along a circumferential direction to be spaced apart by a predetermined distance; a roller coupled to the rotational shaft, provided inside the cylinder to form a compression space together with the bearing plate and the cylinder, and provided with a hinge groove formed on an outer circumferential surface thereof; and a vane having one end slidingly coupled to the vane slot of the cylinder and another end rotatably coupled to the hinge groove of the roller. At least one suction guide portion may be provided at the outer circumferential surface of the roller in a recessed manner.

[0019] According to the present technique, a rotary compressor is presented. The rotary compressor includes a cylinder, a roller, a rotational shaft, and a vane. The cylinder has an inlet port and a vane slot. The inlet port and the vane slot are disposed at an inner circumferential surface of the cylinder and are circumferentially spaced apart from each other. The roller is housed or disposed inside the cylinder (concentrically or non-concentrically). A compression space is defined between the inner circumferential surface of the cylinder and an outer circumferential surface of the roller. The roller includes a hinge groove at the outer circumferential surface of roller. The rotational shaft is coupled to the roller. The vane has one end slidingly coupled to, i.e. housed into or received into, the vane slot of the cylinder and another end rotatably coupled to, i.e. housed into or received into, the hinge groove of the roller.

[0020] The rotary compressor may include a bearing plate supporting the rotational shaft.

[0021] The cylinder may be coupled to the bearing plate.

[0022] The roller, the cylinder and the bearing plate may together form the compression space.

[0023] At least one suction guide portion is provided or formed at the outer circumferential surface of the roller, The suction guide portion is formed in a recessed manner, i.e. the suction guide portion is a groove or recess formed at the outer circumferential surface of the roller, and may be referred to as the suction guide groove.

[0024] A position or location of the suction guide portion corresponds to a position or location of the inlet port.

[0025] The roller may be configured to perform an orbiting motion within the cylinder.

[0026] The suction guide portion may be positioned or located such that at least a part of the suction guide portion radially overlaps with at least a part of the inlet port (preferably with the entire inlet port), when the hinge groove is positioned to be in contact with the inner circumferential surface of the cylinder during the orbiting motion of the roller.

[0027] The suction guide portion may be positioned or located such that at least a part of the suction guide portion radially overlaps with at least a part of the inlet port (preferably with the entire inlet port), when the hinge groove is directly facing the vane slot during the orbiting motion of the roller.

[0028] The inlet port may be configured to receive a fluid, e.g. a refrigerant, to be compressed.

[0029] The rotary compressor may include a discharge port configured to discharge or output the fluid, e.g. the refrigerant, compressed by the rotary compressor.

[0030] The roller may be configured to perform an orbiting motion within the cylinder for compressing fluid received via the inlet port.

[0031] The roller may be a hollow cylinder, i.e. may have an annular cross-section. In other words the roller may have an inner circumferential surface.

[0032] In the present technique, the phrase "comes into contact" or like phrases are to be construed as comes into contact with during orbiting motion of the roller within the cylinder.

[0033] The roller may be driven by the rotating shaft to perform the orbiting motion of the roller.

[0034] The rotary compressor may include a motor or an actuator drivingly connected to the rotating shaft and configured to drive the rotating shaft.

[0035] The rotary compressor may be a vertical compressor.

[0036] The rotational shaft may extend vertically or may be aligned in a vertical direction, for example may be aligned in a vertical direction during use of the rotary compressor.

[0037] The suction guide portion may be provided at a side that faces the inlet port with respect to the hinge groove.

[0038] At least a part of the suction guide portion may radially overlap the inlet port when the hinge groove is brought into contact with an inner circumferential surface of the cylinder.

[0039] The suction guide portion may be provided at a position spaced apart from at least one of axial end surfaces of the roller by a predetermined axial height.

[0040] The suction guide portion may be provided at a position spaced apart from both axial end surfaces of the roller by a predetermined axial height.

[0041] The suction guide portion may be formed through both axial end surfaces of the roller.

[0042] The suction guide portion may be spaced apart by a first interval.

[0043] The first interval may be a shortest length from the hinge groove.

[0044] The first interval may be less than or equal to a radial thickness of the roller.

[0045] The first interval may be less than or equal to a second interval.

[0046] The second interval may be a distance between the inner circumferential surface of the roller and the hinge groove.

[0047] A maximum clearance point and a minimum clearance point may be formed between the inner circumferential surface of the cylinder and the outer circumferential surface of the roller along the circumferential direction.

[0048] The suction guide portion may be formed such that a circumferential end located further away from the hinge groove, of both circumferential ends thereof, is provided between the hinge groove and the maximum clearance point.

[0049] The circumferential end located further away from the hinge groove, of the both circumferential ends of the suction guide portion, may be located within a suction completion angle of the compression chamber.

[0050] A shortest length between the circumferential ends of the suction guide portion may be less than or equal to an inner diameter of the inlet port.

[0051] At least a part of an inner surface of the suction guide portion may be curved.

[0052] The inner surface of the suction guide portion may be arcuate.

[0053] At least a part of an inner surface of the suction guide portion may be linear.

[0054] The inner surface of the suction guide portion may be formed as inclined surfaces.

[0055] The inclined surfaces may be formed so that at least partially intersecting with each other.

[0056] The inclined surface, or in other words surfaces inclined with respect to each other, may also be inclined with respect to a radial direction of the roller.

[0057] The inclined surfaces may also be inclined with respect to a radial direction of the roller.

[0058] The inclined surfaces may be contiguous (i.e. may have a common edge or boundary) or non-contiguous (i.e. may be spaced apart) from each other.

[0059] The suction guide portion may be symmetric with respect to a circumferential center of the suction guide portion (i.e. center along a circumferential direction of the roller). In other words, the suction guide portion may comprise two circumferentially-adjacently disposed symmetric halves. In short, the suction guide portion may be bilaterally symmetrical with respect to a radial direction of the roller.

[0060] The suction guide portion may be asymmetric with respect to a circumferential center of the suction guide portion (i.e. center along a circumferential direction of the roller). In other words, the suction guide portion may comprise two circumferentially-adjacently disposed asymmetric halves. In short, the suction guide portion may be bilaterally asymmetrical with respect to a radial direction of the roller.

[0061] The suction guide portion may be provided in plurality along the circumferential direction.

[0062] A circumferential sealing surface may be formed between the plurality of suction guide portions along the circumferential direction.

[0063] The sum of shortest lengths of connecting two circumferential ends of the respective suction guide portions may be greater than an inner diameter of the inlet port.

BRIEF DESCRIPTION OF THE DRAWINGS

[0064]

FIG. 1 is a longitudinal cross-sectional view of a rotary compressor according to an embodiment of the present disclosure;

FIG. 2 is a horizontal cross-sectional view of a compression unit in the rotary compressor according to FIG. 1 taken along line "IV-IV" of FIG. 1;

FIG. 3 is a schematic view illustrating changes in position of a vane roller according to a rotation angle of a rotational shaft in the rotary compressor of the present disclosure;

FIG. 4 is a cut perspective view of the compression unit in FIG. 1;

FIG. 5 is a perspective view of a vane roller in FIG. 4;

FIG. 6 is a front view illustrating comparison of the vane roller with an inlet port in FIG. 5;

FIG. 7 is a cross-sectional view taken along line "V-V" of FIG. 5;

FIG. 8 is an enlarged cross-sectional view of the compression unit in FIG. 1;

FIG. 9 is a planar view illustrating dimensions of a suction guide portion;

FIG. 10 is a graph showing an amount of refrigerant discharge according to a processing angle of a suction guide portion;

FIG. 11 is a schematic view illustrating a process of refrigerant being sucked through a suction guide portion;

FIG. 12 is a graph showing changes in input torque according to an orbiting angle of a roller;

FIGS. 13 and 14 are cut-plane views respectively illustrating another embodiment of a suction guide portion;

FIG. 15 is a planar view illustrating still another embodiment of a suction guide portion;

FIG. 16 is a perspective view illustrating still another embodiment of a suction guide portion;

FIG. 17 is a perspective view illustrating still another embodiment of a suction guide portion; and

FIGS. 18A and 18B are planar views illustrating operation of the suction guide portion according to FIG. 17.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0065] Description will now be given in detail of a rotary compressor according to exemplary embodiments disclosed herein, with reference to the accompanying drawings. The rotary compressor according to the present disclosure may be classified into a single-type rotary compressor and a double-type rotary compressor according to the number of cylinders. The present disclosure relates to a rotary compressor having a roller and a vane coupled to each other. More particularly, the present disclosure relates to a shape of an outer circumferential surface of a roller, which may be employed in both the single-type and double-type rotary compressors. Hereinafter, a single- type rotary compressor will be used as an example, but it may be equally applied to a double-type rotary compressor as well.

[0066] FIG. 1 is a longitudinal cross-sectional view of a rotary compressor according to an embodiment of the present disclosure, and FIG. 2 is a horizontal cross-sectional view of a compression unit in the rotary compressor according to FIG. 1.

[0067] Referring to FIGS. 1 and 2, in the rotary compressor according to this embodiment, a motor unit 20 is installed in an inner space 11 of a casing 10, and a compression unit 100, which is disposed at a lower side of the motor unit 20 and mechanically connected by a rotational (or rotating) shaft 30, is installed in the inner space 11 of the casing 10.

[0068] The casing 10 is formed in a cylindrical shape to be disposed in a longitudinal (or vertical) direction.

However, in some implementations, the casing 10 may be disposed in a horizontal direction.

[0069] The motor unit 20 includes a stator 21 press-fitted to an inner circumferential surface of the casing 10, and a rotor 22 rotatably inserted into the stator 21. The rotational shaft 30 is press-fitted to the rotor 22. The rotational shaft 30 is provided with an eccentric portion 35 eccentrically disposed with respect to a shaft portion 31. A roller 141 of a vane roller 140 to be described hereinafter is slidingly coupled to the eccentric portion 35.

[0070] The compression unit 100 includes a main bearing plate (hereinafter, main bearing) 110, a sub bearing plate (hereinafter, sub bearing) 120, a cylinder 130, and the vane roller 140. The main bearing 110 and the sub bearing 120 are respectively provided on both sides in an axial direction with respect to the cylinder 130, so as to form a compression space V inside the cylinder 130.

[0071] The main bearing 110 and the sub bearing 120 radially support the rotational shaft 30 that penetrates through the cylinder 130. The vane roller 140 is coupled to the eccentric portion 35 of the rotational shaft 30, so as to compress a refrigerant while performing an orbiting motion in the cylinder 130.

[0072] The main bearing 110 is provided with a main plate 111 having a disc shape. A side wall portion 111a having an annular shape is provided at an edge of the main plate 111 so as to be shrink-fitted or welded to the inner circumferential surface of the casing 10. A main bearing portion 112 protruding upward, namely toward the motor unit 20 from a central (or middle) portion of the main plate 111. A main bearing (or main shaft-receiving) hole 112a is formed through the main bearing portion 112 so as to allow the rotational shaft 30 to be inserted and supported.

[0073] The sub bearing 120 is provided with a sub plate 121 having a disk (or plate) shape so as to be fastened to the main bearing 110 by a bolt together with the cylinder 130. In case where the cylinder 130 is fixed to the casing 10, the main bearing 110 and the sub bearing 120 may be fastened to the cylinder 130 by a bolt, respectively. In case where the sub bearing 120 is fixed to the casing 10, the cylinder 130 and the main bearing 110 may be fastened to the sub bearing 120 by a bolt.

[0074] A sub bearing portion 122 protruding downward, namely toward a bottom surface of the casing 10 from a central portion of the sub plate 121, and a sub bearing (or shaft-receiving) hole 122a is formed through the sub bearing portion 122 on the same axis as the main bearing hole 112a. A lower end of the rotational shaft 30 is supported by the sub bearing hole 122a.

[0075] The cylinder 130 has an annular shape. An inner circumferential surface of the cylinder 130 has a circular shape with a constant inner diameter. The inner diameter of the cylinder 130 is greater than an outer diameter of the roller 141. Accordingly, the compression space V is formed between the inner circumferential surface of the cylinder 130 and an outer circumferential surface of the roller 141.

[0076] For example, the inner circumferential surface of the cylinder 130 may define an outer wall surface of the compression space V, the outer circumferential surface of the roller 141 may define an inner wall surface of the compression space V, and a vane 145 may define a side wall surface of the compression space V. As the roller 141 performs an orbiting motion, the outer wall surface of the compression space V forms a fixed wall, whereas the inner wall and side wall surfaces of the compression space V may form a variable wall whose position is variable.

[0077] An inlet port 131 is provided at the cylinder 130. A vane slot 132 is provided at one side of the inlet port 131 in a circumferential direction, and a discharge guide groove 133 is provided at an opposite side of the inlet port 131 with the vane slot 132 interposed therebetween.

[0078] The inlet port 131 radially penetrates through an outer circumferential surface and the inner circumferential surface of the cylinder 130. A suction (or intake) pipe 12 penetrating through the casing 10 is connected to an outer circumferential side of the inlet port 131. Accordingly, a refrigerant is sucked into the compression space V of the cylinder 130 through the suction pipe 12 and the inlet port 131.

[0079] The inlet port 131 generally has a circular cross section. However, in some implementations, it may have an elliptical cross section, or angular (or angled) cross section. In this embodiment, description will be given of an example in which the inlet port 131 has the circular cross section. Thus, an inner diameter of the inlet port 131 is constant in this embodiment.

[0080] The vane slot 132 is formed long on the inner circumferential surface of the cylinder 130 in a direction toward the outer circumferential surface thereof. An inner circumferential side of the vane slot 132 is opened, and an outer circumferential side thereof is closed, or formed in an open manner to be blocked (or covered) by the inner circumferential surface of the casing 10.

[0081] The vane slot 132 has a width substantially equal to a thickness or width of the vane 145 so as to allow the vane 145 of the vane roller 140, which will be described hereinafter, to slide. Accordingly, both side (or lateral) surfaces of the vane 145 are supported by both inner wall surfaces of the vane slot 132, allowing the vane 145 to slide substantially in a straight line.

[0082] The discharge guide groove 133 having a hemispherical shape is formed by chamfering inner edges of the cylinder 130. The discharge guide groove 133 serves to guide a refrigerant compressed in the compression space V of the cylinder 130 to an outlet port 114 of the main bearing 110. Accordingly, the discharge guide groove 133 is provided at a position that overlaps the outlet port 114 in axial projection, so as to communicate with the outlet port 114.

[0083] However, since the discharge guide groove 133 causes dead volume, the discharge guide groove 133 may not be provided. Or the discharge guide groove 133 with the minimum dead volume may be provided.

[0084] Meanwhile, as described above, the vane roller 140 includes the roller 141 and the vane 145. The roller 141 and the vane 145 may be formed as a single body, or be coupled to allow relative movement. In this embodiment, an example in which the roller and the vane are rotatably coupled to each other will be mainly discussed.

[0085] The roller 141 has a cylindrical shape. The roller 141 may be formed in a circular shape with its inner and outer circumferential surfaces having the same center. In some implementations, the roller 141 may have a circular shape with its inner and outer circumferential surfaces having different centers.

[0086] An axial height of the roller 141 is substantially equal to a height of the inner circumferential surface of the cylinder 130. However, as the roller 141 slides with respect to the main bearing 110 and the sub bearing 120, the axial height of the roller 141 may be slightly less than the height of the inner circumferential surface of the cylinder 130.

[0087] Heights of the inner and outer circumferential surface of the roller 141 are substantially the same. Accordingly, both axial cross sections that connect the inner circumferential surface and the outer circumferential surface of the roller 141 define a sealing surface, respectively. These sealing surfaces are respectively perpendicular to the inner circumferential surface of the roller 141 or the outer circumferential surface of the roller 141. However, an edge between the inner circumferential surface of the roller 141 and each sealing surface, or an edge between the outer circumferential surface of the roller 141 and each sealing surface may be slightly inclined or formed as a curved surface.

[0088] Further, the roller 141 is rotatably inserted into the eccentric portion 35 of the rotational shaft 30 to be coupled, and the vane 145 is slidingly coupled to the vane slot 132 of the cylinder 130, allowing the vane 145 to be hinged to the outer circumferential surface of the roller 141. Accordingly, when the rotational shaft 30 rotates, the roller 141 performs an orbiting motion inside the cylinder 130 by the eccentric portion 35, and the vane 145 reciprocates while being coupled to the roller 141.

[0089] However, the roller 141 may be located at the same center as the cylinder 130. In some implementations, the roller 141 may be slightly eccentric from the cylinder 130. For example, when a center of the roller 141 coincides with a center of the cylinder 130, a gap or clearance (hereinafter, allowable clearance) between the inner circumferential surface of the cylinder 130 and the outer circumferential surface of the roller 141 is almost constant along the circumferential direction. Then, a compression stroke is started when a contact point, where the inner circumferential surface of the cylinder 130 is at the most adjacent to the outer circumferential surface of the roller 131, reaches a circumferential end 131a of the inlet port 131. This compression stroke is performed in a consistent manner up to a discharge stroke.

[0090] However, when the center of the roller 141 and the center of the cylinder 130 coincide with each other, pressure of a compression chamber gradually rises, so that refrigerant leakage may occur in the process of reaching the discharge stroke due to a pressure difference between a preceding compression chamber and a following compression chamber.

[0091] As such, the center of the roller 141 may be eccentric with respect to the center of the cylinder 130. For example, a center O' of the roller 141 is eccentric with respect to a center O of the cylinder 130 (concentric with an axial center) in a direction close to the outlet port 114. Accordingly, an allowable clearance at a side where the inlet port 131 is located with respect to a virtual line that connects a center O" of a hinge groove 1411 and the axial center O is wide to be approximately 40 to 50μm, and an allowable clearance at an opposite side where the outlet port 114 is located is narrow to be approximately 10 to 20μm.

[0092] Then, even when the allowable clearance is wide in the initial compression stroke, a pressure difference between a preceding compression chamber V1 and a following compression chamber V2 is not significant. Thus, the amount of refrigerant leakage between the compression chambers V1 and V2 is small. Further, even when the pressure difference between the preceding compression chamber V1 and the following compression chamber V2 increases as pressure of the preceding compression chamber V1 gradually increases to reach the discharge stroke, the relatively narrow allowable clearance allows refrigerant leakage between the compression chambers V1 and V2 to be suppressed. This will be discussed later again together with a suction guide portion.

[0093] The roller 141 has an annular shape with an inner diameter that allows the inner circumferential surface thereof to be brought into sliding contact with an outer circumferential surface of the eccentric portion 35 of the rotational shaft 30. The roller 141 has a radial width (thickness) enough to secure a sealing distance from the hinge groove 1411, which will be described hereinafter.

[0094] The thickness of the roller 141 may be constant along the circumferential direction, or may vary in some implementations. For example, the inner circumferential surface of the roller 141 may have an elliptical shape.

[0095] However, in order to minimize a load when the rotational shaft 30 rotates, the inner and outer circumferential surfaces of the roller 141 may be formed in a circular shape having the same center, and a radial thickness t1 of the roller 141 may be constant along the circumferential direction.

[0096] One hinge groove 1411 in which a hinge protrusion 1452 of the vane 145 to be described later is rotatably inserted is provided on the outer circumferential surface of the roller 141. An outer circumferential surface of the hinge groove 1411 is formed in an open arcuate shape.

[0097] An inner diameter of the hinge groove 1411 is greater than an outer diameter of the hinge protrusion

1452, and has a size sufficient to allow the hinge protrusion 1452 to slide without being separated therefrom in an inserted state.

[0098] A suction guide portion 1415 is provided at one side of the hinge groove 1411, namely, in a rotation (or rotational) direction of the rotational shaft 30. The suction guide portion will be discussed later again with the vane roller.

[0099] Meanwhile, the vane 145 includes a sliding portion 1451 and the hinge protrusion 1452.

[0100] The sliding portion 1451 is a portion that defines a vane body, and has a flat-plate shape with a predetermined length and thickness. For example, the sliding portion 1451 has a shape of a rectangular hexagon as a whole. In addition, the sliding portion 1451 has a length enough for the vane 145 to be remained at the vane slot 132 even when the roller 141 is completely moved to an opposite side of the vane slot 132.

[0101] The hinge protrusion 1452 is extendedly provided at a front end of the sliding portion 1451 that faces the roller 141. The hinge protrusion 1452 has a cross-sectional area enough to be inserted into the hinge groove 1411 and rotated. The hinge protrusion 1452 may have a semi-circular shape, or a substantially circular cross-sectional shape excluding a connecting portion so as to correspond to the hinge groove 1411.

[0102] In the drawings, unexplained reference numerals 13, 150, and 160 denote a discharge pipe, a discharge valve, and a discharge muffler, respectively.

[0103] The rotary compressor according to this embodiment may operate as follows.

[0104] When power is applied to the motor unit 20, the rotor 22 of the motor unit 20 rotates, allowing the rotational shaft 30 to be rotated. Then, a refrigerant is introduced into the compression space V of the cylinder 130 while the roller 141 of the vane roller 140 coupled to the eccentric portion 35 of the rotational shaft 30 performs an orbiting motion.

[0105] This refrigerant is pressurized by the roller 141 and the vane 145 of the vane roller 140, causes the discharge valve 150 provided at the main bearing 110 to open, is discharged into an inner space of the muffler 160 through the outlet port 114, and is then discharged into the inner space 11 of the casing 10. Such series of processes are repeated.

[0106] Here, positions (or locations) of the roller 141 and the vane 145 are changed according to a rotation angle of the rotational shaft 30. FIG. 3 is a schematic view illustrating changes in position of a vane roller according to a rotation angle of a rotational shaft in the rotary compressor according the present disclosure.

[0107] First, in the drawing, from a position where the eccentric portion 35 of the rotational shaft 30 faces the vane slot 132, a virtual line that passes through an axial center of the rotational shaft 30 (coaxial with the axial center of the cylinder) O and the center O" of the hinge groove 1411 is at 0° This corresponds to (a) of FIG. 3. At this time, the hinge groove 1411 of the roller 141 is almost in contact with the inner circumferential surface of the cylinder 130, allowing the vane 145 to be drawn (or introduced) into the vane slot 132.

[0108] Next, in (b) of FIG. 3, the rotational shaft 30 is rotated approximately 60°, and in (b) of FIG. 3, the rotational shaft 30 is rotated about 120°. In these states, the hinge groove 1411 of the roller 141 is spaced apart from the inner circumferential surface of the cylinder 130, and a part (or portion) of the vane 145 is pulled or drawn out from the vane slot 132. At this time, the following compression chamber V2 forms a suction chamber, and thus a refrigerant is introduced therein through the inlet port 131. On the other hand, the preceding compression chamber V1 forms a compression chamber, allowing a refrigerant filled therein to be compressed. Since the refrigerant accommodated in the preceding compression chamber V1 has not yet reached at a discharge pressure, a gas force or vane reaction force is not generated in the preceding compression chamber VI, or a level (or amount) that is negligible even if it is generated.

[0109] Next, in (d) of FIG. 3, the rotational shaft 30 is rotated approximately 180°. In this state, the hinge groove 1411 of the roller 141 is furthest apart from the inner circumferential surface of the cylinder 131, and the vane 145 is pulled out from the vane slot 132 to the maximum. In the preceding compression chamber VI, a compression stroke has progressed considerably, and thus the refrigerant accommodated therein is almost close to the discharge pressure.

[0110] Next, in (e) of FIG. 3, the rotational shaft 30 is rotated about 240°. In this state, the hinge groove 1411 of the roller 145 moves back to the inner circumferential surface of the cylinder 130, and the vane 145 is partially introduced into the vane slot 132. At this time, the refrigerant accommodated in the preceding compression chamber V1 has reached the discharge pressure so that a discharge stoke has been started, or is about to start. Accordingly, in this state, a pressure difference between the preceding compression chamber V1 and the compression chamber V2 reaches the maximum or almost the maximum, and thus, the allowable clearance between the cylinder 130 and the roller 141 becomes almost the minimum, as described above.

[0111] Next, in (f) of FIG. 3, the rotational shaft 30 is rotated about 300°. In this state, the refrigerant in the preceding compression chamber V1 is almost discharged, and the hinge groove 1411 of the roller 141 is almost in contact with the inner circumferential surface of the cylinder 130, and the vane 145 is almost introduced into the vane slot 132. In this state, the pressure difference between the preceding compression chamber V1 and the following compression chamber V2 is reduced, and thus the allowable clearance between the cylinder 130 and the roller 141 is gradually increased.

[0112] As described above, in the rotary compressor, volume efficiency is determined according to volume of the compression chamber due to its characteristics, and the vortex and reaction force of a sucked refrigerant are decreased due to a shape of a suction flow path. When the volume of the compression chamber is increased, the volume efficiency of the compressor may be improved. Further, when the suction flow path is formed in a forward direction of refrigerant, the vortex and reaction force of the refrigerant may be reduced.

[0113] Thus, in this embodiment, the suction guide portion (or suction guide groove) may be formed on at least one of the inner circumferential surface of the cylinder and the outer circumferential surface of the roller constituting the compression chamber. The suction guide portion may be recessed from the inner circumferential surface of the cylinder and/or recessed from the outer circumferential surface of the roller, so that the volume of the compression chamber is increased.

[0114] However, when the suction guide portion is provided on the inner circumferential surface of the cylinder, a compression starting time point (or compression start angle) may be delayed depending on a shape of the suction guide portion, and a motor input may not be decreased as weight of the roller is not reduced. On the other hand, when the suction guide portion is provided on the outer circumferential surface of the roller, the compression starting time point may be prevented from being delayed depending on the shape of the suction guide portion, and weight of the roller is decreased, thereby reducing the motor input. As a result, motor efficiency may be increased.

[0115] Therefore, an example in which the suction guide portion is provided on the outer circumferential surface of the roller will be mainly discussed hereinafter. However, the suction guide portion is not necessarily provided only on the outer circumferential surface of the roller. That is, the suction guide portion may be provided on the outer circumferential surface of the roller and/or the inner circumferential surface of the cylinder.

[0116] FIG. 4 is a cut perspective view of the compression unit in FIG. 1, FIG. 5 is a perspective view of a vane roller in FIG. 4, FIG. 6 is a front view illustrating comparison of the vane roller with an inlet port in FIG. 5, and FIG. 7 is a cross-sectional view taken along line "V-V" of FIG. 6.

[0117] Referring to FIGS. 4 to 7, the roller 141 that partially defines the vane roller 140 may have a cylindrical shape with a predetermined thickness and height, as described above. The hinge groove 1411 in which the vane 145 is rotatably inserted may be formed on one side of the outer circumferential surface of the roller 141, and the suction guide portion 1415 may be provided on one side (right side in the drawings) in a circumferential direction of the hinge groove 1411.

[0118] The suction guide portion 1415 may be recessed from the outer circumferential surface of the roller 141 toward the center O' of the roller 141 by a predetermined depth. Therefore, the suction guide portion 1415 may be interchangeably used with the suction guide groove.

[0119] The suction guide portion 1415 may be provided at a side of a rotational direction of the rotational shaft 30 with respect to the center O" of the hinge groove 1411, namely, a side that faces the inlet port 131. However, as the roller 141 moves relative to the cylinder 130, the suction guide portion 1415 may be out of a range of the inlet port 131 depending on an orbiting position (moved position) of the roller 141.

[0120] Accordingly, the suction guide portion 1415 may be provided at a position where at least a part thereof radially overlaps the inlet port 131 with respect to an orbiting position of the roller 141 is at 0° (i.e., when the hinge groove of the roller is closest to the inner circumferential surface of the cylinder). This will be described again later.

[0121] In addition, the suction guide portion 1415 may be provided at an intermediate position of the outer circumferential surface of the roller 141 in the axial direction, or may axially penetrate through both surfaces or one surface of the roller 141. In FIGS. 4 to 7, the suction guide portion 1415 is provided in the middle portion of the roller 141 in the axial direction. An embodiment in which the suction guide portion 1415 axially penetrates through the surface of the roller 141 will be discussed later.

[0122] Referring to FIGS. 5 to 7, the suction guide portion 1415 may be spaced apart from both end surfaces of the roller 141 in the axial direction by a predetermined distance. Accordingly, the suction guide portion 1415 may be located substantially at the middle of the outer circumferential surface of the roller 141, and axial sealing surfaces 141a and 141b may be formed on both sides of the suction guide portion 1415 in the axial direction, respectively.

[0123] Here, the axial sealing surfaces 141a and 141b are defined as a gap or distance between an axial surface of the roller 141 and an axial surface of the suction guide portion 1415. Of the axial sealing surfaces 141a and 141b, a side adjacent to the motor unit 20 may be referred to as an upper axial sealing surface (first axial sealing surface) 141a, and an opposite side (the other side) may be referred to as a lower axial sealing surface (second axial sealing surface) 141b.

[0124] A circumferential length of the first axial sealing surface 141a and a circumferential length of the second axial sealing surface 141b may be equal, or different. An axial length of the first axial sealing surface 141a and an axial length of the second axial sealing surface 141b may be equal, or different. In FIG. 4, the axial sealing surfaces 141a and 141b have the same circumferential and axial lengths.

[0125] For example, when the first sealing surface 141a and the second axial sealing surface 141b have the same circumferential and axial lengths, the first sealing surface 141a and the second sealing surface 141b may be easily formed. Further, as a center of gravity of the roller 141 with respect to the eccentric portion 35 of the rotational shaft 30 is located at an axial center of the eccentric portion 35, behavior (or movement) of the roller 141 may be constantly maintained.

[0126] Alternatively, the circumferential or axial length of the first axial sealing surface 141a may be greater than the circumferential or axial length of the second axial sealing surface 141b. As the outlet port 114 is provided at the main bearing 110 located at an upper side of an axial direction of the roller 141, a refrigerant in the preceding compression chamber V1 forming the discharge chamber is more upwardly concentrated. This may effectively prevent the refrigerant from being introduced into the following compression chamber V2 defining the suction chamber through an upper surface of the vane 145 or an upper surface of the roller 141.

[0127] The suction guide portion 1415 may be, preferably, spaced apart from the hinge groove 1411 of the roller 141 by a predetermined distance. That is, the suction guide portion 1415 is similar to providing a thickness (or weight)-reduced portion in a periphery of the hinge groove 1411 of the roller 141. Accordingly, a thickness between the suction guide portion 1415 and the hinge groove 1411 becomes thinner (or smaller), the suction guide portion 1415 should be located as far as possible from the hinge groove 1411 to prevent the roller 141 damage.

[0128] However, conversely, providing the suction guide potion 1415 as close as possible to the hinge groove 1411 is advantageous in terms of suction (or intake) volume, since the suction guide portion 1415 is a space for accommodating a refrigerant flowing into the compression chamber forming the suction chamber through the inlet port 131.

[0129] For example, a shortest interval or distance (first interval) L1 between the suction guide portion 1415 and the hinge groove 1411 may be less than or equal to a radial thickness t1 of the roller 141. More precisely, the first interval L1 may be less than or equal to a shortest interval or distance (second interval) L2 between the inner circumferential surface of the roller 141 and the hinge groove 1411. That is, the first interval L1 may be 0.7 to 0.9 times the second interval L2. The second interval L2 may be approximately 2 mm.

[0130] The suction guide portion 1415 may be radially spaced apart from the inner circumferential surface of the roller 141 by a predetermined distance. That is, since a thickness of the roller 141 where the suction guide portion 1415 is formed is thin (or small), the roller 141 may be deformed as force generated when the rotational shaft 30 rotates is transferred from the eccentric portion 35. Thus, an appropriate gap or distance is required between an inner surface of the suction guide portion 1415 and the inner circumferential surface of the roller 141.

[0131] However, the roller 141 is coupled to the eccentric portion 35 of the rotational shaft 30 in a manner of allowing relative movement, thereby receiving a less force than the hinge groove 1411. Accordingly, a shortest interval or distance (third interval) L3 between the inner surface of the suction guide portion 1415 and the inner circumferential surface of the roller 141 may be approximately less than or equal to the first interval L1 or the second interval L2.

[0132] Meanwhile, in order for the suction guide portion 1415 to be formed as deep as possible in the radial direction, the inner diameter of the roller 141 should be as small as possible. However, the inner diameter of the roller 141 is limited (or restricted) by an outer diameter of the rotational shaft 30, an inner diameter of the main bearing hole 112a, or an inner diameter of the sub bearing hole 122a.

[0133] FIG. 8 is an enlarged cross-sectional view of the compression unit in FIG. 1. For example, as for the sub bearing 120, a chamfered portion 123 is provided at a corner where the sub plate 121 and the sub bearing hole 122a meet. Accordingly, an inner circumferential surface of the chamfered portion 123 and the inner circumferential surface the roller 141 should interfere with each other in the radial direction by a predetermined interference distance (fourth interval) L4 while the roller 141 is rotating. The fourth interval L4 may be approximately half of the first interval L1.

[0134] Meanwhile, as described above, the suction guide portion 1415, which is a groove formed on the outer circumferential surface of the roller 141, allows the volume of the compression space V to be increased. Thus, the longer the suction guide portion 1415 in the circumferential direction, the better the volumetric efficiency.

[0135] However, the suction guide portion 1415 is spaced apart from the inner circumferential surface of the cylinder 130 even when the outer circumferential surface of the roller 141 is in contact with the inner circumferential surface of the cylinder 130. Accordingly, the suction guide portion 1415 may serve as a kind of refrigerant leakage passage as it provides communication between the preceding compression chamber V1 and the following compression chamber V2.

[0136] In order to prevent this, the suction guide portion 1415 according to this embodiment is provided within a range that may prevent or minimize refrigerant leakage along the circumferential direction. Hereinafter, a circumferential end of the suction guide portion 1415 adjacent to the hinge groove 1411 will be referred to as a first end 1415a or as first circumferential end 1415a, and an opposite end (the other end) will be referred to as a second end 1415b or as second circumferential end 1415b.

[0137] FIG. 9 is a planar view illustrating dimensions (or size) of a suction guide portion.

[0138] Referring to FIG. 9, the suction guide portion 1415 according to this embodiment may be provided within a range, which is from an end 1411a of the hinge groove 1411 to a maximum clearance point (or position) P1. That is, the first end 1415a of the suction guide portion 1415 may be located as close as possible to the end 1411a of the hinge groove 1411, and the second end 1415b of the suction guide portion 1415 may be located as close as possible to the maximum clearance point P1.

[0139] Of both ends of the hinge groove 1411, the end 1411a of the hinge groove 1411 may be defined as an end adjacent to an inlet port 131, and the maximum clearance point P1 may be defined as a point of the maximum allowable clearance between the inner circumferential surface of the cylinder 130 and the outer circumferential surface of the roller 141.

[0140] As described above, as each of the inner circumferential surface of the cylinder 130 and the outer circumferential surface of the roller 141 has the circular shape, a clearance between the roller 141 and the cylinder 130 is constant along the circumferential direction when the center O' of the roller 141 coincides with the center O of the cylinder 130.

[0141] However, as the center O' of the roller 141 is, usually, eccentric from the center O of the cylinder 130, the clearance between the inner circumferential surface of the cylinder 130 and the outer circumferential surface of the roller 141 varies along the circumferential direction. That is, referring to FIG. 9, the maximum clearance point P1 and a minimum clearance point (or position) P2 are located at opposite positions with a phase difference of 180°. The minimum clearance point P2 may be defined as a point of the minimum allowable clearance between the inner circumferential surface of the cylinder 130 and the outer circumferential surface of the roller 141.

[0142] Accordingly, the clearance gradually increases from the minimum clearance point P2 where a clearance t22 is the smallest to the maximum clearance point P1 where a clearance t21 is the largest. Conversely, the clearance gradually decreases from the maximum clearance point P1 to the minimum clearance point P2 which is exactly 180 degrees opposite to the maximum clearance point P1.

[0143] If a position where the hinge groove 1411 is closest to the inner circumferential surface of the cylinder 130 is 0°, then the minimum clearance point P2 is at approximately 260 degrees, which is approximately a discharge start (or starting) angle. Accordingly, the maximum clearance point P1 is located at approximately 80° with a phase difference of 180° from the minimum clearance point P2. This may vary according to dimensions of the compressor.

[0144] Thus, the second end 1415b of the suction guide portion 1415 according to this embodiment may be provided at a position less than or equal to the maximum clearance point P2, namely, a range from 0°, at which the hinge groove 1411 is closest to the inner circumferential surface of the cylinder 130, to 80° with respect to the rotational direction of the rotational shaft 30.

[0145] When the suction guide portion 1415 is formed out of a range of the maximum clearance point PI, a large (or excessive) amount of refrigerant in the preceding compression chamber V1 is leaked into the following compression chamber V2, causing a compression loss in the preceding compression chamber V1. As a result, the actual volumetric efficiency may be reduced. Thus, the second end 1415b of the suction guide portion 1415, namely a maximum processing angle θ of the second end 1415b of the suction guide portion 1415 should be provided within the range of the maximum clearance point PI, as described above.

[0146] However, even when the second end 1415b of the suction guide portion 1415 is provided within the range of the maximum clearance point PI, an amount of refrigerant discharge may vary. That is, as the entire outer circumferential surface of the roller 141 is sequentially brought into the entire inner circumferential surface of the cylinder 130 while performing an orbiting motion, the suction guide portion 1415 also radially faces (or meets) the inner circumferential surface of the cylinder 130, from the first end 1415a to the second end 1415b, along the circumferential direction.

[0147] Accordingly, the two compression chambers V1 and V2 communicate with each other or are separated from each other, depending on a position (or angle) where the suction guide portion 1415 faces (or meets) the inner circumferential surface of the cylinder 130, and thus an actual compression start angle (or the amount of refrigerant leakage between the compression chambers) may vary.

[0148] For example, in case the suction guide portion 1415 is formed at 80 degrees, which is the maximum processing angle θ, the preceding compression chamber V1 and the following compression chamber V2 communicate with each other through the suction guide portion 1415 even when the inlet port 131 is closed. Then, a part (or some) of refrigerant accommodated in the preceding compression chamber V1 flows back to the following compression chamber V2, and eventually the amount of refrigerant discharged from the preceding compression chamber V1 is decreased to a certain level (or degree).

[0149] However, when the suction guide portion 1415 is provided between 0° and a suction completion angle (or compression start angle), the preceding compression chamber V1 is separated from the following compression chamber V2 at the suction completion angle, thereby suppressing refrigerant leakage between the compression chambers through the suction guide portion 1415. As a result, the amount of refrigerant discharged from the preceding compression chamber V1 is reduced. This may prevent a decrease in the amount of refrigerant discharged from the preceding compression chamber V1. FIG. 10 is a graph showing an amount of refrigerant discharge according to a processing angle of a suction guide portion.

[0150] Referring to FIG. 10, it can be seen that an amount of refrigerant discharge drastically decreases when the maximum processing angle θ for the second end 1415b of the suction guide portion 1415 exceeds 80°, which is an angle corresponding to the maximum clearance point P1 of the suction guide portion 1415. Thus, the final processing angle of the suction guide portion 1415 should be within the range of 0° to 80°, which is the angle of the maximum clearance point P1.

[0151] However, it can be seen that the amount of refrigerant discharge gradually decreases as a position of the suction guide portion 1415 moves from the maximum clearance point P1 to the inlet port 131. In addition, the amount of refrigerant sucked is kept constant to a point (D=L5) that is a position of the suction guide portion 1415 (i.e., the second end of the suction guide portion) is the same as the circumferential end 131a of the inlet port 131 (a side adjacent to the vane slot is defined as a starting end).

[0152] This is because an angle (or time point) at which the outer circumferential surface of the roller 141 comes into contact with the circumferential end 131a of the inlet port 131 is the suction completion angle for the preceding compression chamber VI, as described above, the preceding compression chamber V1 is separated from the following compression chamber V2 at the suction completion angle, thereby suppressing refrigerant leakage between the compression chambers through the suction guide portion 1415.

[0153] Therefore, the second end 1415b of the suction guide portion 1415 may be, preferably, formed at an area where the outer circumferential surface of the roller 141 is in contact with the end 131a of the inlet port 131, namely, the suction completion angle (or compression start angle). This corresponds to a position of the circumferential end 131a of the inlet port 131, and a position of the hinge grove 1411 rotated by approximately 15 to 20° with respect to an angle at which the hinge groove 1411 is in contact with the cylinder 130. This may slightly vary depending on a specification of the compressor.

[0154] Referring back to FIGS. 6 and 7, a shortest circumferential length (or distance) L5 of the suction guide portion 1415 may be substantially equal to an inner diameter D of the inlet port 131. The shortest circumferential length L5 of the suction guide portion 1415 is a straight line connecting the first end 1415a and the second end 1415b of the suction guide portion 1415. Hereinafter, the shortest circumferential length L5 of the suction guide portion 1415 will be referred to as the shortest distance of the suction guide portion 1415.

[0155] Meanwhile, the shortest length L5 of the suction guide portion 1415 may be less than the inner diameter (circumferential inner diameter) D of the inlet port 131. However, in this case, as the inlet port 131 faces the suction guide portion 1415 at a position adjacent to the outer circumferential surface of the roller 141 in the vicinity of the suction guide portion 1415, a refrigerant sucked through the inlet port 131 may collide with the periphery of guide portion 1415, thereby causing the vortex or reaction force. Thus, the shortest length L5 of the suction guide portion 1415 with greater than or equal to the inner diameter D of the inlet port 131 may be advantageous in terms of increasing a suction volume.

[0156] An axial distance (or length) L6 of the suction guide portion 1415 may be greater than or equal to the inner diameter (axial length) D of the inlet port 131. More preferably, the axial distance L6 of the suction guide portion 1415 (see FIG. 6) may be greater than the inner diameter D of the inlet port 131, which is more advantageous in terms of increasing the suction volume.

[0157] Further, the suction guide portion 1415 may have various inner surface shapes. However, the inner surface of the suction guide portion 1415 may be, preferably, formed in a manner of allowing a refrigerant sucked through the inlet port 131 to flow smoothly along an orbiting direction of the roller 141.

[0158] FIG. 11 is a schematic view illustrating a process of refrigerant being sucked through a suction guide portion. Referring to FIG. 11, the suction guide portion 1415 according to this embodiment is recessed from the outer circumferential surface of the roller 141 by a predetermined depth, and its inner surface may be formed as a curved surface. Here, the inner surface of the suction guide portion 1415 may be entirely or partially formed as a curved surface.

[0159] The suction guide portion 1415 according to this embodiment may be formed such that a first inner surface 1415c that defines an inner circumferential surface thereof in axial projection may have a semi-circular or arcuate shape. In this case, a curvature of the first inner surface 1415c of the suction guide portion 1415 may be set according to a specification of the compressor, but generally it may be greater than or equal to a curvature of the outer circumferential surface of the roller 141.

[0160] The first inner surface 1415c of the suction guide portion 1415 may be formed such that both sides of the first inner surface 1415c in the circumferential direction are symmetric with respect to a center line CL of the inlet port 131 in a state that a circumferential center P3 of the first inner surface 1415c coincides with the center line CL of the inlet port 131. This may allow the suction guide portion 1415 to be easily processed. In addition, all of the refrigerant introduced through the inlet port 131 may smoothly flow in the suction guide portion 1415, thereby reducing flow resistance.

[0161] Further, among the inner surfaces of the suction guide portion 1415, a second inner surface 1415d defining an upper inner surface and a third inner surface 1415e defining a lower inner surface may be respectively formed as a flat surface. This may allow the suction guide portion 1415 to be provided at the middle of the outer circumferential surface of the roller 141 while increasing volume of the suction guide portion 1415 to the maximum.

[0162] The inlet guide portion according to this embodiment may provide the following effects.

[0163] That is, a refrigerant is sucked into the compression space V through the inlet port 131. The inlet port 131 is formed in a normal direction with respect to the outer circumferential surface of the roller 141. Thus, a direction in which the refrigerant is sucked is the normal direction with respect to the outer circumferential surface of the roller 141, and a gap between the outer circumferential surface of the roller 141 and the inner circumferential surface of the cylinder 130 is very narrow.

[0164] Accordingly, if the suction guide portion 1415 is not provided at the outer circumferential surface of the roller 141, a refrigerant, introduced into the compression space V forming the suction chamber through the inlet port 131, collides with the outer circumferential surface of the roller 141 turning at a high speed, causing a vortex, or backflow of refrigerant to the inlet port due to a suction reaction force.

[0165] However, when the suction guide portion 1415 is recessed from the outer circumferential surface of the roller 141 by a predetermined depth, as in this embodiment, a gap between the outer circumferential surface of the roller 141 and the cylinder 130 is widened by the suction guide portion 1415. That is, the suction guide portion 1415 serves as a kind of buffer space for the refrigerant to be sucked.

[0166] Then, the refrigerant sucked into the compression space V forming the suction chamber through the inlet port 131 is introduced into the suction guide portion 1415 that faces the inlet port 131, and then smoothly flows along the roller 141 as an impact caused by collision is reduced.

[0167] Accordingly, the vortex of the refrigerant sucked into the compression space V defining the suction chamber may be suppressed, and the suction reaction force of refrigerant may also be reduced. Then, the refrigerant is smoothly sucked into the compression space V defining the suction chamber, and the amount of refrigerant sucked is increased, thereby improving compressor efficiency.

[0168] In addition, the suction guide portion 1415 serves as a kind of thickness or weight-reduced portion, weight of the roller 141 may be reduced by the volume of the suction guide portion 1415. As the weight of the roller 141 is reduced, the overall motor input is decreased, allowing the compressor efficiency to be improved. FIG. 12 is a graph showing changes in input torque according to an orbiting angle of a roller. A suction guide portion is not employed in a roller of the related art, whereas the suction guide portion is provided at the outer circumferential surface of the roller of the present disclosure.

[0169] It can be seen that input torque in the preset disclosure is reduced compared to the related art. When the suction guide potion is not provided as in the related art, weight of the roller is increased accordingly, and thus the input torque of the motor is increased. In contrast, when the suction guide portion 1415 is provided at the roller 141 as in the present disclosure, weight of the roller is decreased accordingly, and thus the input torque of the motor is reduced.

[0170] Hereinafter, another example of the suction guide portion will be described.

[0171] That is, in the previous embodiment, the inner surface of the suction guide portion is formed in the arcuate shape. However, the inner surface of the suction guide portion 1415 may be formed as a straight surface, or a combination of straight surface and curved surface.

[0172] FIGS. 13 and 14 are cut-plane views respectively illustrating another embodiment of a suction guide portion.

[0173] Referring to FIG. 13, a part of the first inner surface 1415c of the suction guide portion 1415 according to this embodiment may have a wedge cross-sectional shape. For example, the first inner surface 1415c of the suction guide portion 1415 may be formed such that its outer circumferential side is formed as a straight surface parallel to a lengthwise direction of the inlet port 131, and its inner circumferential side has a wedge cross-sectional shape narrowing toward the center.

[0174] Accordingly, the shortest circumferential length L5 of the suction guide portion 1415 may be greater than or equal to the inner diameter D of the inlet port 131. The shortest circumferential length L5 of the suction guide portion 1415 may be less than the inner diameter D of the inlet port 131.

[0175] Even when the inner surface of the suction guide portion 1415 has the wedge cross-sectional shape, its basic configuration and effects are similar to those of the previous embodiment. Therefore, a detailed description thereof will be omitted.

[0176] However, in this embodiment, as the first inner surface 1415c of the suction guide portion 1415 has the wedge cross-sectional shape, the suction guide portion 1415 may be formed as a straight surface as a whole. Compared to the suction guide portion 1415 having the arcuate inner surface, the suction guide portion 1415c in this embodiment may be processed in an easier manner.

[0177] In case the shortest length L5 of the suction guide portion 1415 is the same, volume of the suction guide portion 1415 in this embodiment may be increased compared to the suction guide portion 1415 having the arcuate inner surface.

[0178] Accordingly, weight of the roller 141 at a side (or part) of the inlet guide portion 1415 in this embodiment is reduced compared to the roller 141 in the previous embodiment, allowing a motor input to be further reduced.

[0179] Further, when the first inner surface 1415c of the suction guide portion 1415 is formed in the wedge cross-sectional shape as in this embodiment, a refrigerant sucked into the compression space V forming the suction chamber through the inlet port 131 smoothly flows in the suction guide portion 1415, thereby effectively reducing the vortex and reaction force of the refrigerant.

[0180] Alternatively, the first inner surface 1415c of the suction guide portion 1415 may be formed in a rectangular cross-sectional shape as a whole, as illustrated in the embodiment of FIG. 14. For example, the suction guide portion 1415 may be formed such that its outer circumferential side is formed as a straight surface parallel to the lengthwise direction of the inlet port 131, and its inner circumferential side is formed as a straight surface orthogonal to the lengthwise direction of the inlet port 131.

[0181] Accordingly, a length (or distance) L51, which is the shortest outer circumferential length of the suction guide portion 1415 may be equal to a length (or distance) L52, which is the shortest inner circumferential length L52 of the suction guide portion 1415, and greater than or equal to the inner diameter D of the suction guide portion 1415. Alternatively, the length L51 may be slightly greater than the length L52.

[0182] Even when the inner surface of the suction guide portion 1415 has the rectangular cross-sectional shape, its basic configuration and effects are similar to those of the previous embodiments. Therefore, a detailed description thereof will be omitted.

[0183] However, in this embodiment, as the first inner surface of the suction guide portion 1415 has the square cross-sectional shape, the suction guide portion 1415 may be formed as a straight surface as a whole. Accordingly, the suction guide portion 1415 in this embodiment may be easily processed compared to the suction guide portion 1415 having the inner surface with the arcuate or wedge shape.

[0184] If the shortest length of the suction guide portion 1415 is equal, volume of the suction guide portion 1415 having the first inner surface 1415c with the rectangular cross-sectional shape as in this embodiment may be increased compared to the first inner surface 1415c of the suction guide portion 1415 having the arcuate or rectangular cross-sectional shape as in the previous embodiments.

[0185] Accordingly, weight of the roller 141 at the side of the suction guide portion 1415 according to this embodiment is further reduced compared to the previous embodiments, and thus a motor input may be further reduced than those of the previous embodiments.

[0186] Furthermore, when the first inner surface 1415c of the suction guide portion 1415 has the rectangular cross-sectional shape as in this embodiment, this may provide a buffer for a refrigerant sucked into the compression space V forming the suction chamber through the inlet port 131, thereby effectively reducing the vortex and reaction force of the refrigerant.

[0187] Although not illustrated, the inner circumferential side of the suction guide portion 1415 may be curved along the inner circumferential surface of the roller 141, and volume of the suction guide portion 1415 may be increased accordingly.

[0188] Hereinafter, a description will be given of still another embodiment of a suction guide portion according to the present disclosure.

[0189] That is, in the previous embodiments, the suction guide portion 1415 is circumferentially symmetrical with respect to a virtual line extending from the central line CL of the inlet portion 131. However, in some implementations, both sides of the suction guide portion 1415 may be circumferentially asymmetric with respect to the virtual line.

[0190] FIG. 15 is a cut planar view illustrating still another embodiment of a suction guide portion. Referring to FIG. 15, the first inner surface 1415c of the suction guide portion 1415 may be formed such that one side of the first inner surface 1415c in the circumferential direction is closed and another side thereof in the circumferential direction is opened. For example, of the first inner surface 1415c of the suction guide portion 1415, the first inner surface 1415c at the first end 1415a adjacent to the hinge groove 1411 may be parallel along the lengthwise direction of the inlet port 131 by a predetermined depth, and the first inner surface 1415c at the second end 1415b opposite to the first end 1415a may be orthogonal to the lengthwise direction of the inlet port 131, from the first inner surface 1415c at the first end 1415a.

[0191] Accordingly, the suction guide portion 1415 may be formed in a 'L' shape as a whole, and the first inner surface 1415c at the first end 1415a adjacent to the vane 145 may be closed, whereas the first inner surface 1415c at the second end 1415b away from the vane 145 may be open.

[0192] Even when the inner surface of the suction guide portion 1415 has the asymmetric shape, its basic configuration and effects are similar to those of the previous embodiments. Therefore, a detailed description thereof will be omitted.

[0193] However, in this embodiment, the first inner surface 1415c of the suction guide portion 1415 is formed such that a side adjacent to the vane 145 is closed, and a side away from the vane 145 is open, and thus the suction guide portion 1415 may be processed in an easier manner compared to the suction guide portion 1415 with both circumferentially symmetric ends closed (or blocked) as in the previous embodiments.

[0194] In addition, as one circumferential end of the suction guide portion 1415 is open, volume may be increased compared to the suction guide portion 1415 having with both circumferentially symmetric ends closed as in the previous embodiments.

[0195] Accordingly, weight of the roller 141 at the suction guide portion 1415 according to this embodiment is further reduced compared to the roller 141 of the previous embodiments, thereby leading to a further decrease in motor input.

[0196] Further, when one circumferential end of the suction guide portion 1415 is open as in this embodiment, a refrigerant sucked into the compression space V forming the suction chamber through the inlet port 131 may quickly flow in a rotational direction of the roller 141, thereby effectively reducing the vortex and reaction force of the refrigerant.

[0197] Hereinafter, a description will be given of still another embodiment of the suction guide portion.

[0198] That is, in the previous embodiments, the suction guide portion 1415 may be recessed from the middle of the outer circumferential surface of the roller 141 by a predetermined depth. However, in some implementations, the suction guide portion 1415 may penetrate through one or both axial surfaces of the roller 141. Hereinafter, an example in which the suction guide portion 1415 penetrates through both axial surfaces of the roller will be mainly discussed.

[0199] FIG. 16 is a perspective view illustrating still another embodiment of a suction guide portion.

[0200] Referring to FIG. 16, the suction guide portion

1415 according to the present embodiment may penetrate from an upper axial surface to a lower axial surface of the roller 141. Here, axial sealing surfaces on both sides of the suction guide portion 1415 are not provided.

[0201] In addition, the suction guide portion 1415 may have the same (or constant) cross-sectional shape along the axial direction. The suction guide portion 1415 may also be formed in a different (or non-constant) cross-sectional shape along the axial direction. However, the same cross-sectional shape along the axial direction may be more suitable in terms of processing.

[0202] Further, the suction guide portion 1415 may have various shapes as in the previous embodiments, for example, an arcuate cross-sectional shape, a wedge cross-sectional shape, a rectangular cross-sectional shape, an asymmetric cross-sectional shape, and the like. Hereinafter, the arcuate cross-sectional shape will be described as a representative example.

[0203] The suction guide portion 1415 according to this embodiment may be recessed from the outer circumferential surface of the roller 141 by a predetermined depth while having an arcuate cross-sectional shape as in the embodiment of FIG. 5.

[0204] The first end 1415a of the suction guide portion 1415 may be spaced apart from the hinge groove 1411 by the predetermined first interval L1. The second end 1415b of the suction guide portion 1415 may be provided within a range from the contact point (more precisely, the end of the inlet port) to the suction completion angle or compression start angle. In detail, referring to FIGS. 6 to 9, the second end 1415b of the suction guide portion 1415 may be formed up to the outer circumferential surface of the roller 141 in contact with the end 131a of the inlet port 131. Alternatively, the suction guide portion 1415 may be formed up to the maximum clearance point P1.

[0205] As described above, the shortest length L5 of the suction guide portion 1415 may be greater than or equal to the inner diameter D of the inlet port 131. Alternatively, the shortest length L5 of the suction guide portion 1415 may be less than the inner diameter D of the inlet port 131.

[0206] The suction guide portion 1415 according to this embodiment has the same basic structure and operation effects as the suction guide portion 1415 of the previous embodiments. However, in this embodiment, as the suction guide portion 1415 is formed through the both axial surfaces as well as the outer circumferential surface of the roller 141, the first axial sealing surface and the second axial sealing surface may not be required.

[0207] Accordingly, the suction guide portion 1415 may be processed more easily, and volume of the suction guide portion 1415 may also be increased. In addition, weight of the roller 141 is further reduced compared to the roller 141 of the embodiment illustrated in FIG. 5, allowing a motor input to be further reduced.

[0208] Hereinafter, a description will be given of still another embodiment of the suction guide portion according to the present disclosure.

[0209] That is, in the previous embodiments, one suction guide portion is formed on the outer circumferential surface of the roller along the circumferential direction. However, in some implementations, a plurality of suction guide portions 1415 may be provided along the circumferential direction.

[0210] FIG. 17 is a perspective view illustrating still another embodiment of a suction guide portion, and FIGS. 18A and 18B are planar views illustrating operation of the suction guide portion according to FIG. 17.

[0211] Referring to FIG. 17, the suction guide portion 1415 according to this embodiment may include a first guide portion 1416 and a second guide portion 1417. A circumferential sealing surface 141c may be formed between the first guide portion 1416 and the second guide portion 1417 along the circumferential direction with a predetermined interval (5th interval) L7.

[0212] Although not illustrated, as for the suction guide portion 1415, in addition to the first and second guide portions 1416 and 1417, a third guide portion, a fourth guide portion, and more may be sequentially provided along the circumferential direction with the sealing surface 141c interposed therebetween. For the sake of convenience, the following description is limited to the first guide portion and the second guide portion.

[0213] In addition, the first guide portion 1416 and the second guide portion 1417 may have the same shape, or have different shapes. For the sake of convenience, an example in which the first guide portion 1416 and the second guide portion 1417 have the same shape will be mainly discussed.

[0214] A first end 1416a of the first guide portion 1416 is spaced apart from the hinge groove 1411 by the first interval L1, as in the previous embodiments, and a second end 1416b of the first guide portion 1416 may be formed within a range from the contact point (more precisely, the end of the inlet port) to the suction completion angle or compression start angle. In detail, as described above, the second end 1416b of the first guide portion 1416 may be formed up to the outer circumferential surface of the roller 141 in contact with the end 131a of the inlet port 131.

[0215] A shortest length L5' of the first guide portion 1416 and a shortest length L5" of the second guide portion 1417 may be greater than or equal to the inner diameter D of the inlet port 131. Accordingly, the shortest length L5 of the suction guide portion 1415, which is the sum of the shortest length L5' of the first guide portion 1416 and the shortest length L5" of the second guide portion 1417, may be approximately two times greater than the inner diameter D of the inlet port 131.

[0216] Even when the suction guide portion 1415 is implemented as the plurality of guide portions 1416 and 1417 as in this embodiment, its basic configuration and effects are similar to the guide portion implemented as one guide suction guide 1415 of the previous embodiments. Therefore, a detailed description thereof will be omitted.

[0217] However, in this embodiment, as the suction guide portion 1415 is provided in plurality along the circumferential surface with the circumferential sealing surface 141c interposed therebetween, the entire (or overall) circumferential length L5 of the suction guide portion 1415 (hereinafter, "arc length of the suction guide portion" or "shortest interval of the suction guide portion") may be increased as compared to the previous embodiments.

[0218] Here, volume of the compression chamber increases as the arc length of the suction guide portion 1415 increases, allowing volumetric efficiency to be improved. However, when the arc length of the suction guide portion 1415 increases, the corresponding compression chamber may communicate with the preceding compression chamber V1 through the suction guide portion 1415 before the corresponding compression chamber reaches the suction completion angle (approx. 80°). Then, a part of refrigerant compressed in the compression chamber leaks into a compression chamber forming the suction chamber through the suction guide potion 1415, leading to a decrease in discharge amount.

[0219] Accordingly, the suction guide portion 1415 according to this embodiment is provided with the first guide portion 1416 and the second guide portion 1417, and the circumferential sealing surface 141c may be provided between the first guide portion 1416 and the second guide portion 1417 by the fifth interval L7. As a result, a refrigerant compressed in the preceding compression chamber V1 may be prevented from flowing back to the following compression chamber V2.

[0220] As illustrated in FIG. 18A, when the roller 141 is at 0°, the first guide portion 1416 and the second guide portion 1417 of the suction guide portion 1415 are partially included in the preceding compression chamber V1 defining the suction chamber. Here, the total volume of the preceding compression chamber V1 is the sum of the first guide portion 1416, the second guide portion 1417, which are included in the preceding compression chamber VI, and the corresponding compression chamber volumes. Thus, the suction volume of the compression chamber defining the suction chamber is increased compared to the previous embodiments in which one suction guide portion 1415 is provided.

[0221] As shown in FIG. 18B, when the roller 141 is turned approximately 20 degrees, the first guide portion 1416 is located at the following compression chamber V2 in communication with the inlet port 131, and the second guide portion 1417 is located at the preceding compression chamber V1. Here, as the circumferential sealing surface 141c is provided between the first guide portion 1416 and the second guide portion 1417 by the fifth interval L7, the first guide portion 1416 and the second guide portion 1417 are apart from each other in the circumferential direction. Accordingly, a refrigerant in the preceding compression chamber V1 at which the second guide portion 1417 is located may not flow back to the following compression chamber V2 at which the first guide portion 1416 is located. As a result, a substantial discharge amount may be increased.

[0222] Further, as volume of the suction guide portion 1415 increases, weight of the roller 141 is reduced accordingly. As a result, a motor input may be decreased and compressor efficiency may be improved.

[0223] Meanwhile, although not illustrated in the drawings, the first guide portion 1416 and the second guide portion 1417 may have different shapes. For example, the first guide portion 1416 may be formed through the both axial surfaces of the roller 141, and the second guide portion 1417 may be recessed from the middle of the outer circumferential surface of the roller 141. The first guide portion 1416 may have a large volume, and the second guide portion 1417 may have a small volume. Further, the first guide portion 1416 may be formed as a curved surface, and the second guide portion 1417 may be formed as a straight surface, or vice versa.

[0224] In the rotary compressor according to the embodiments of the present disclosure, at least one suction guide portion is provided at a circumferential surface of a hinge-vane type roller, the volume of a compression chamber may be increased and volumetric efficiency of the compressor may be improved accordingly.

[0225] In addition, the suction guide portion is provided at the circumferential surface of the hinge-vane type roller to be recessed from a surface facing an inlet port. Accordingly, the volume of the compression chamber may be increased while reducing a suction reaction force of a refrigerant sucked into the compression chamber. This may suppress backflow or formation of a vortex caused by collision with an outer circumferential surface of the roller when the refrigerant is sucked, thereby improving an amount of refrigerant sucked.

[0226] As the suction guide portion is formed at the outer circumferential surface of the hinge-vane type roller in a recessed manner, the volume of the compression chamber may be increased while reducing weight of the roller. As a result, a motor input may be reduced and motor efficiency may be increased accordingly.

[0227] As the suction guide portion is provided within a range from a hinge groove to a maximum clearance point, refrigerant leakage between the compression chambers caused by the suction guide portion is minimized, thereby improving volumetric efficiency owing to the suction guide portion.

[0228] In the hinge-vane type roller of the present disclosure, the suction guide portion is provided in a range from the hinge groove to a suction completion angle or discharge start angle. This may allow the suction guide portion to be formed at the outer circumferential surface of the roller in a recessed manner while preventing refrigerant leakage between the compression chambers. Accordingly, efficiency of the compressor may be improved.

[0229] A suction reaction force may increase when using a high-pressure refrigerant such as R32, and thus the suction guide portion according to the embodiments of the present disclosure may be usefully employed in the hinge-vane type rotary compressor to which the high-pressure refrigerant is applied.

Claims

1. A rotary compressor comprising:

   a cylinder (130) comprising an inlet port (131) and a vane slot (132), wherein the inlet port (131) and the vane slot (132) are disposed at an inner circumferential surface of the cylinder (130) and are circumferentially spaced apart from each other;
   a roller (140) disposed inside the cylinder (130), wherein a compression space (V) is defined between the inner circumferential surface of the cylinder (130) and an outer circumferential surface of the roller (140), and wherein the roller (140) comprises a hinge groove (1411) at the outer circumferential surface of roller (140);
   a rotational shaft (30) coupled to the roller (140); and
   a vane (145) having one end slidingly coupled to the vane slot (132) of the cylinder (130) and another end rotatably coupled to the hinge groove (1411) of the roller (140);
   characterized in that at least one suction guide portion (1415) is provided at the outer circumferential surface of the roller (140) in a recessed manner.

2. The rotary compressor of claim 1, wherein the suction guide portion (1415) is provided at a side of the outer circumferential surface of the roller (140) that faces the inlet port (131) with respect to the hinge groove (1411); and/or
   wherein the suction guide portion (1415) is disposed such that at least a part of the suction guide portion (1415) radially overlaps with the inlet port (131) when the hinge groove (1411) is positioned to be in contact with the inner circumferential surface of the cylinder (130).

3. The rotary compressor of claim 1 or 2, wherein the suction guide portion (1415) is provided at a position spaced apart from at least one of axial end surfaces of the roller (140) by a predetermined axial height.

4. The rotary compressor of any one of claims 1 to 3, wherein the suction guide portion (1415) is formed through at least one of axial end surfaces of the roller (140).

5. The rotary compressor of any one of claims 1 to 4, wherein the suction guide portion (1415) is spaced apart from the hinge groove (1411) by a first interval (L1).

6. The rotary compressor of claim 5, wherein the first interval (LI) is less than or equal to a radial thickness (t1) of the roller (140); and/or
   wherein the first interval (LI) is less than or equal to a second interval (L2) that is a distance between an inner circumferential surface of the roller (140) and the hinge groove (1411).

7. The rotary compressor of any one of claims 1 to 6, wherein a maximum clearance point (PI) and a minimum clearance point (P2) are defined between the inner circumferential surface of the cylinder (130) and the outer circumferential surface of the roller (140) spaced apart along the circumferential direction; and
   wherein the suction guide portion (1415) comprises a first circumferential end (1415a) and a second circumferential end (1415b), the first circumferential end (1415a) located between the hinge groove (1411) and the second circumferential end (1415b); and
   wherein the second circumferential end (1415b) is located between the hinge groove (1411) and the maximum clearance point (PI).

8. The rotary compressor of any one of claims 1 to 7, wherein the suction guide portion (1415) comprises a first circumferential end (1415a) and a second circumferential end (1415b), the first circumferential end (1415a) located between the hinge groove (1411) and the second circumferential end (1415b); and
   wherein at a suction completion angle of a compression chamber (VI), the second circumferential end (1415b) is in contact with the inner circumferential surface of the cylinder (130) such that the compression chamber (VI) is disconnected from the inlet port (131).

9. The rotary compressor of any one of claims 1 to 8, wherein the suction guide portion (1415) comprises a first circumferential end (1415a) and a second circumferential end (1415b), the first circumferential end (1415a) located between the hinge groove (1411) and the second circumferential end (1415b); and
   wherein a shortest length between the circumferential ends (1415a, 1415b) of the suction guide portion (1415) is less than or equal to a diameter of the inlet port (131).

10. The rotary compressor of any one of claims 1 to 9, wherein an inner surface (1415c) of the suction guide portion (1415) is arcuate.

11. The rotary compressor of any one of claims 1 to 9, wherein at least a part of an inner surface (1415c) of the suction guide portion (1415) is linear.

12. The rotary compressor of claim 11, wherein the inner surface (1415c) of the suction guide portion (1415) comprises surfaces inclined with respect to a radial direction of the roller (141), and with respect to each other.

13. The rotary compressor of any one of claims 1 to 12, wherein the suction guide portion (1415) is bilaterally symmetric or bilaterally asymmetric with respect to a radial direction of the roller (141).

14. The rotary compressor of any one of claims 1 to 13, wherein the suction guide portion (1415) is provided in plurality along the circumferential direction, and
wherein a circumferential sealing surface (141c) is formed between the plurality of suction guide portions (1416, 1417) along the circumferential direction.

15. The rotary compressor of claim 14, wherein each of the suction guide portions (1416, 1417) comprises a first circumferential end (1416a, 1417a) and a second circumferential end (1416b, 1417b) circumferentially spaced apart from each other; and
wherein a sum of shortest lengths (L5', L5") of each suction guide portion (1416, 1417) is greater than a diameter of the inlet port (131);
wherein the shortest length (L5', L5") for each suction guide portion (1416, 1417) is shortest distance between the circumferential ends (1416a, 1417a, 1416b, 1417b) of the suction guide portion (1416, 1417).

FIG. 1

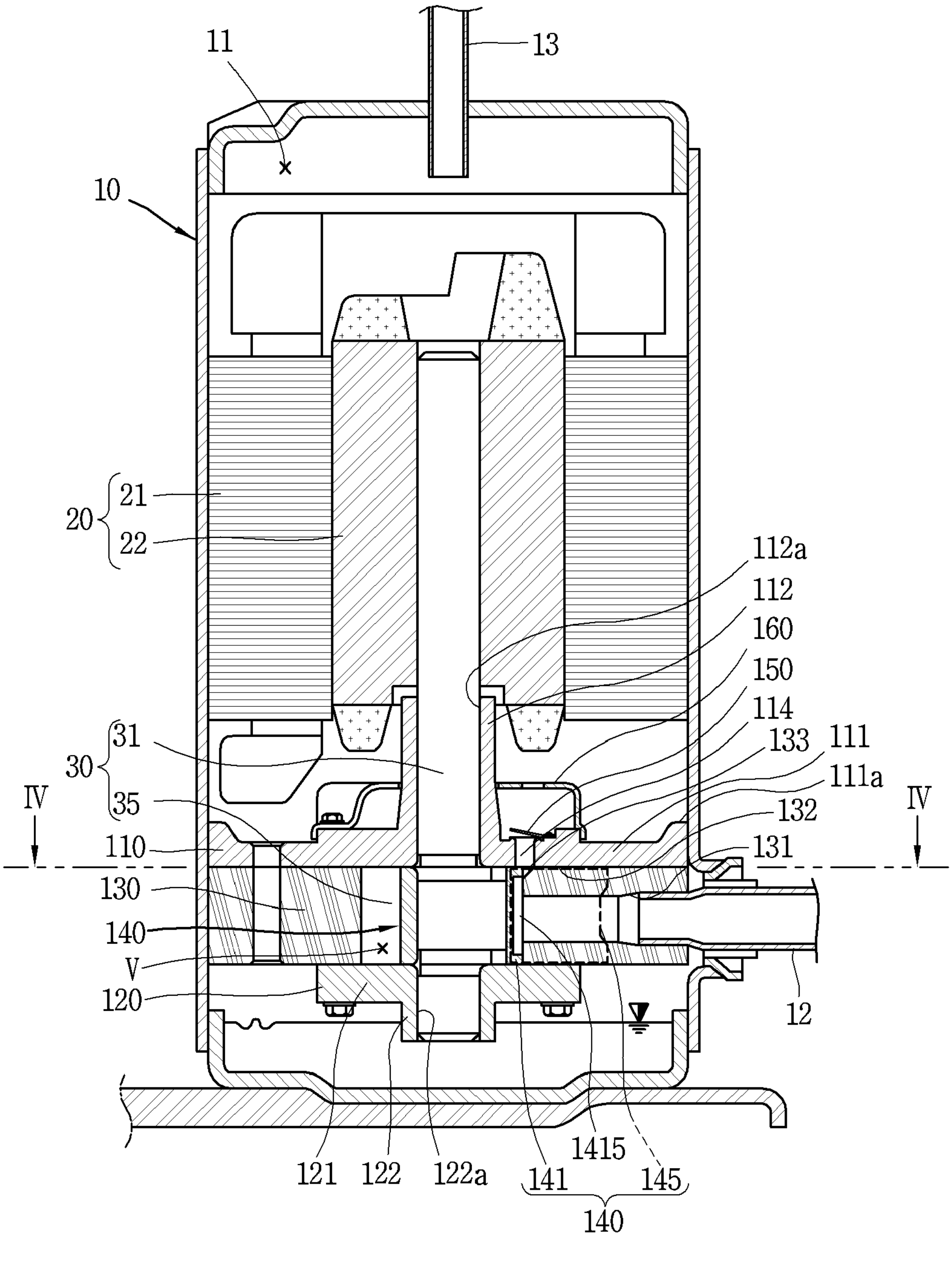

11
13
10
20
21
22
112a
112
160
150
114
133
111
111a
30
31
35
IV
IV
132
110
131
130
140
V
120
12
121
122
122a
1415
141
145
140

FIG. 2

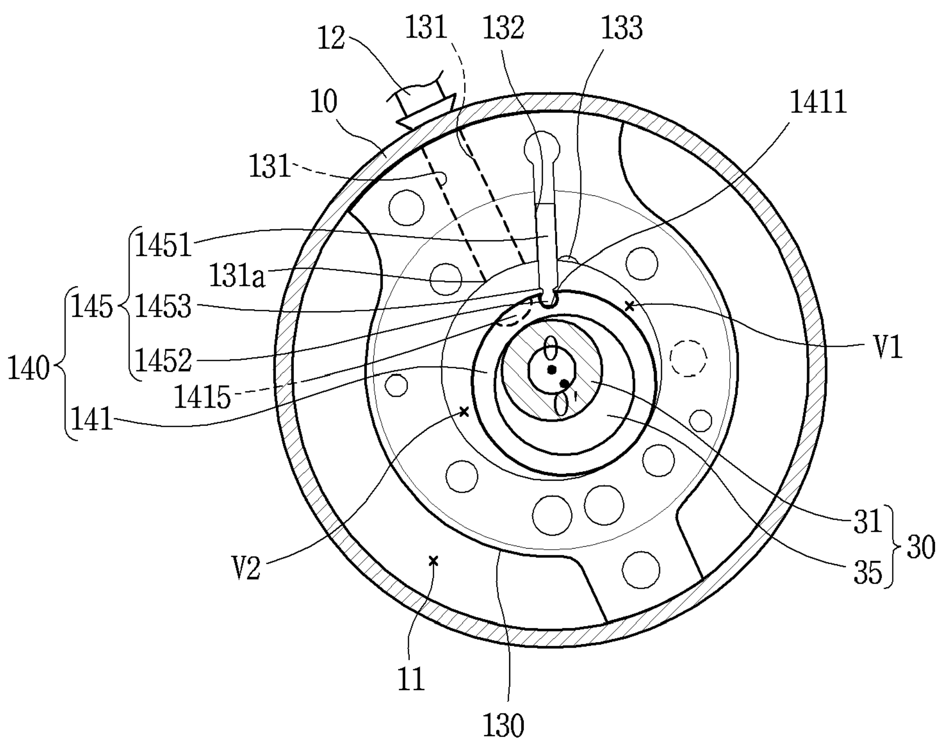

12
131
132
133
10
1411
131
1451
131a
145
1453
140
1452
1415
141
V1
0
0'
31
30
35
V2
11
130

FIG. 3

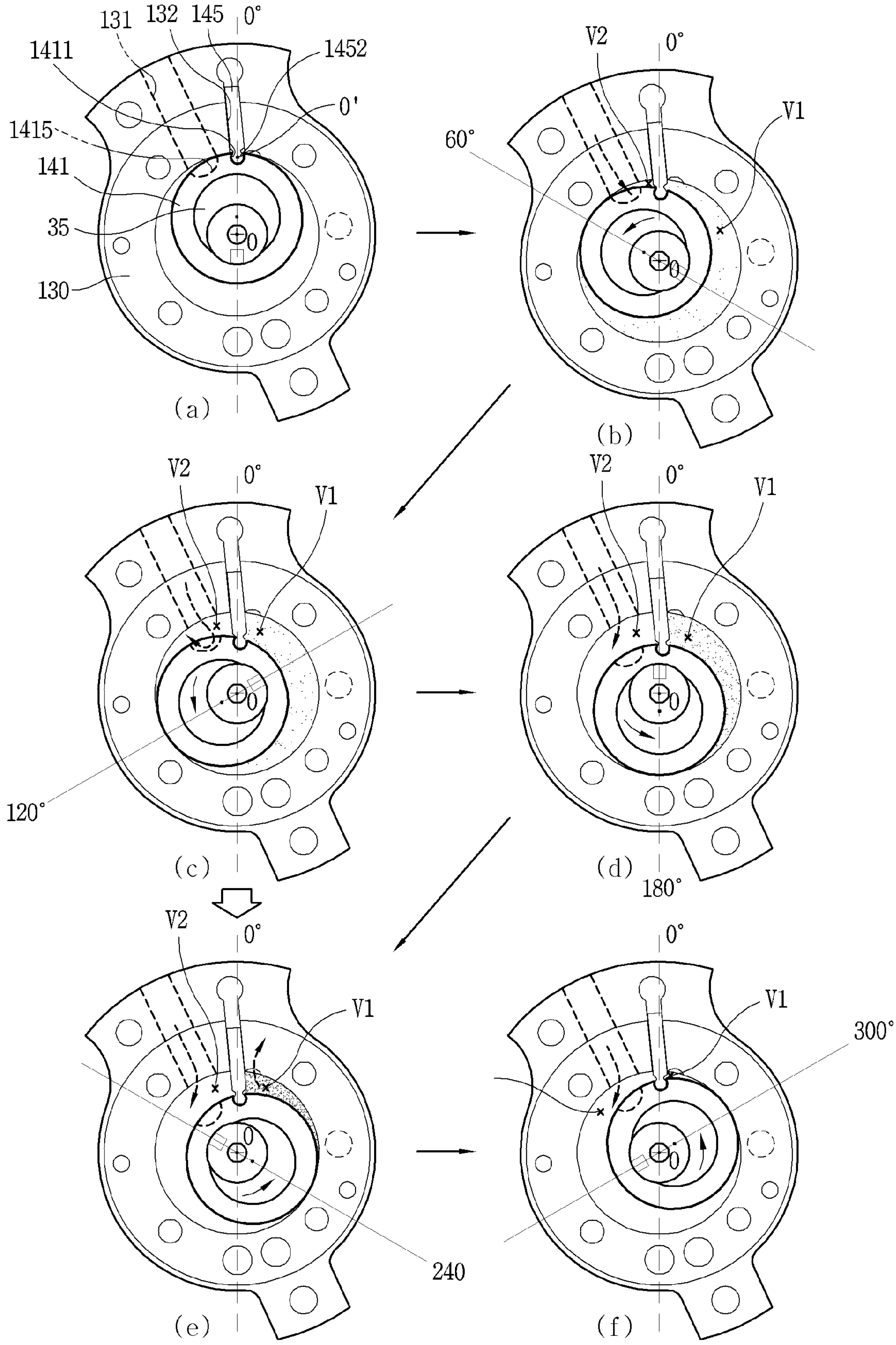

131
132
145
0°
1411
1452
0'
1415
141
35
0
130
(a)
V2
0°
V1
60°
0
(b)
V2
0°
V1
0
120°
(c)
V2
0°
V1
0
(d)
180°
V2
0°
V1
0
240
(e)
0°
V1
300°
0
(f)

FIG. 4

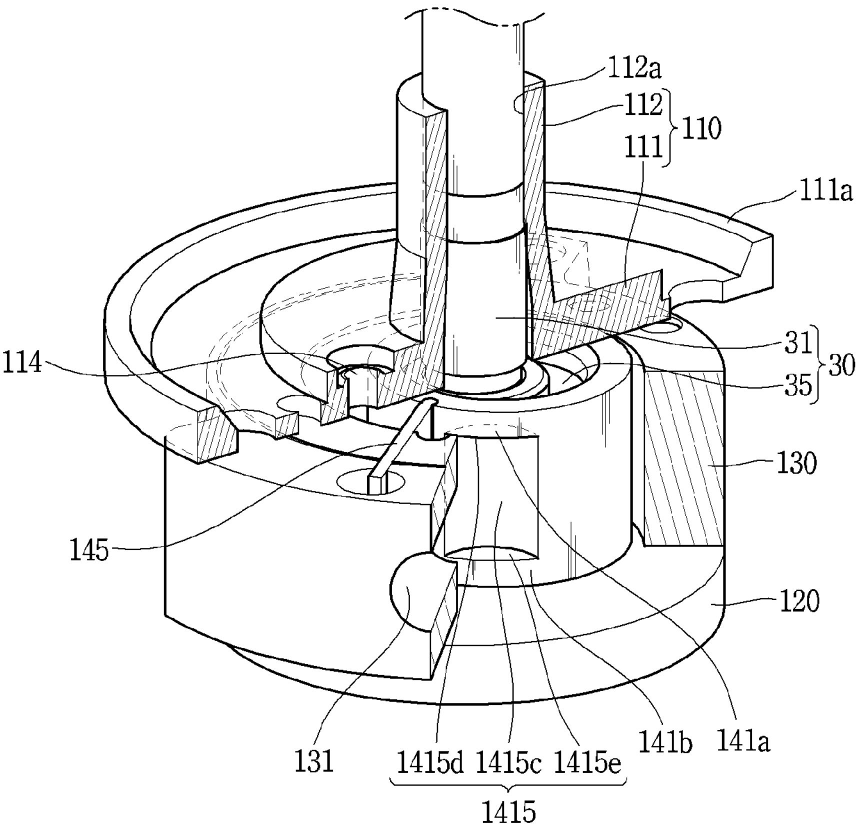

112a
112
110
111
111a
114
31
30
35
130
145
120
131
1415d
1415c
1415e
141b
141a
1415

FIG. 5

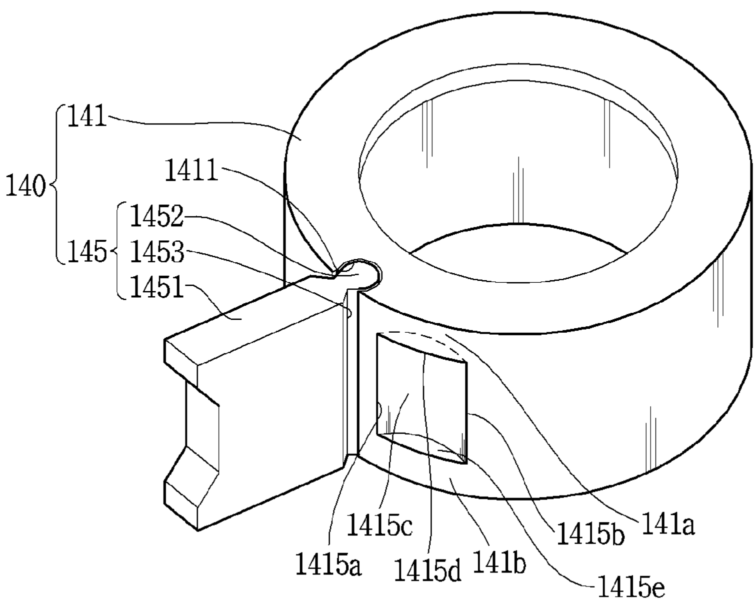

141
140
1411
1452
145
1453
1451
1415c
1415b
141a
1415a
1415d
141b
1415e

FIG. 6

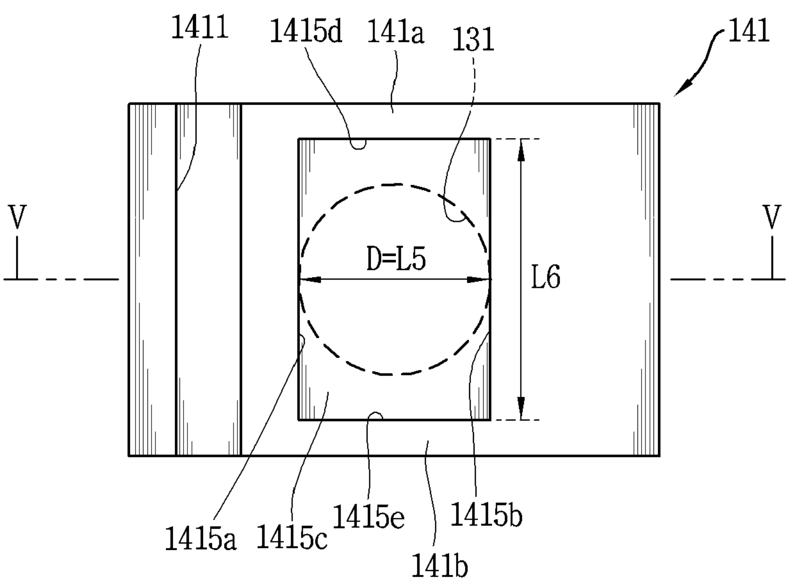

1411
1415d
141a
131
141
V
V
D=L5
L6
1415a
1415c
1415e
1415b
141b

FIG. 7

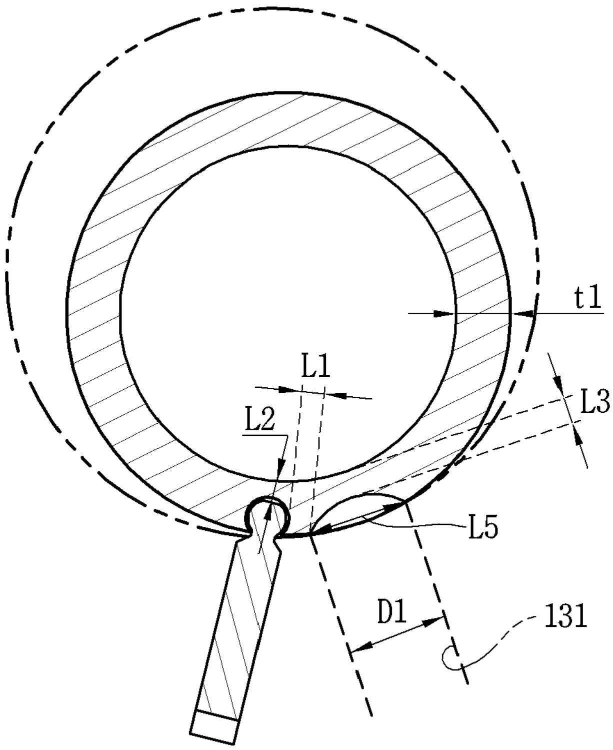

t1
L1
L2
L3
L5
D1
131

FIG. 8

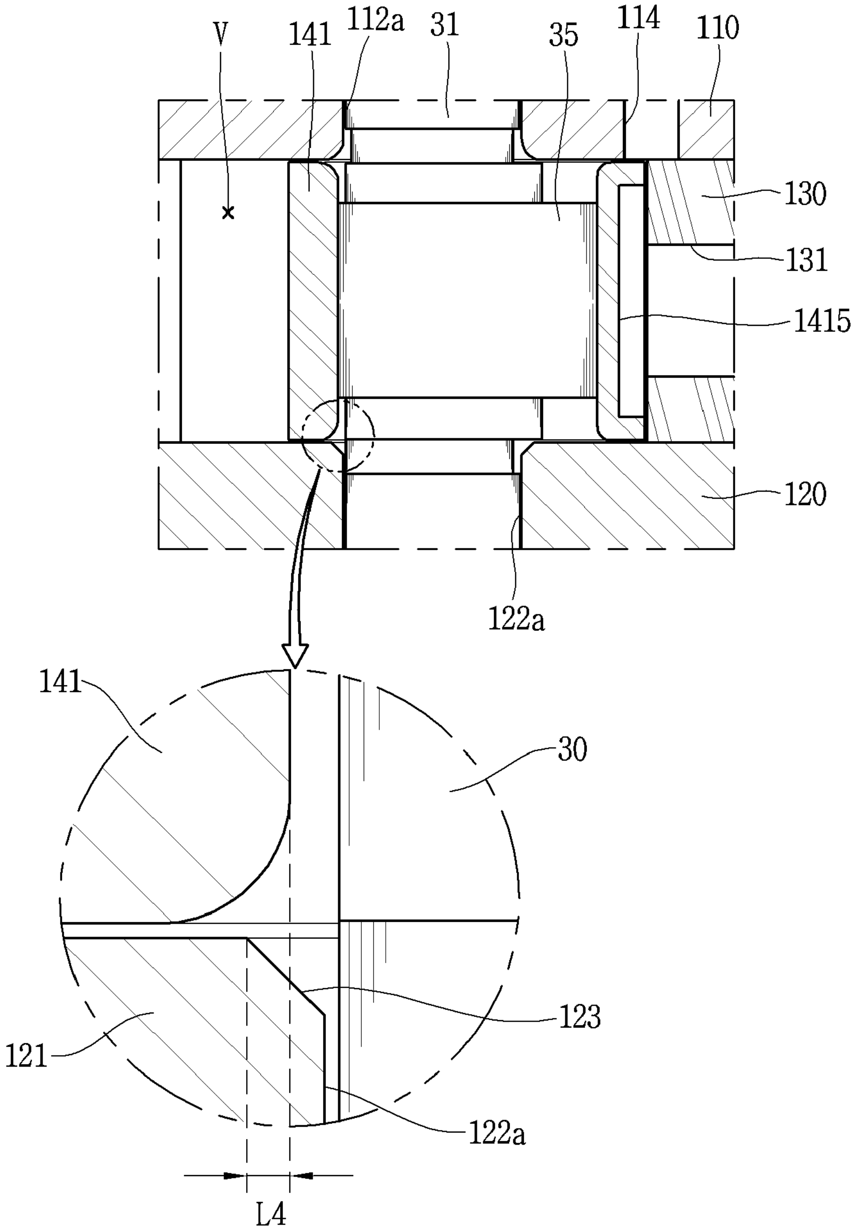

V
141
112a
31
35
114
110
130
131
1415
120
122a
141
30
123
121
122a
L4

FIG. 9

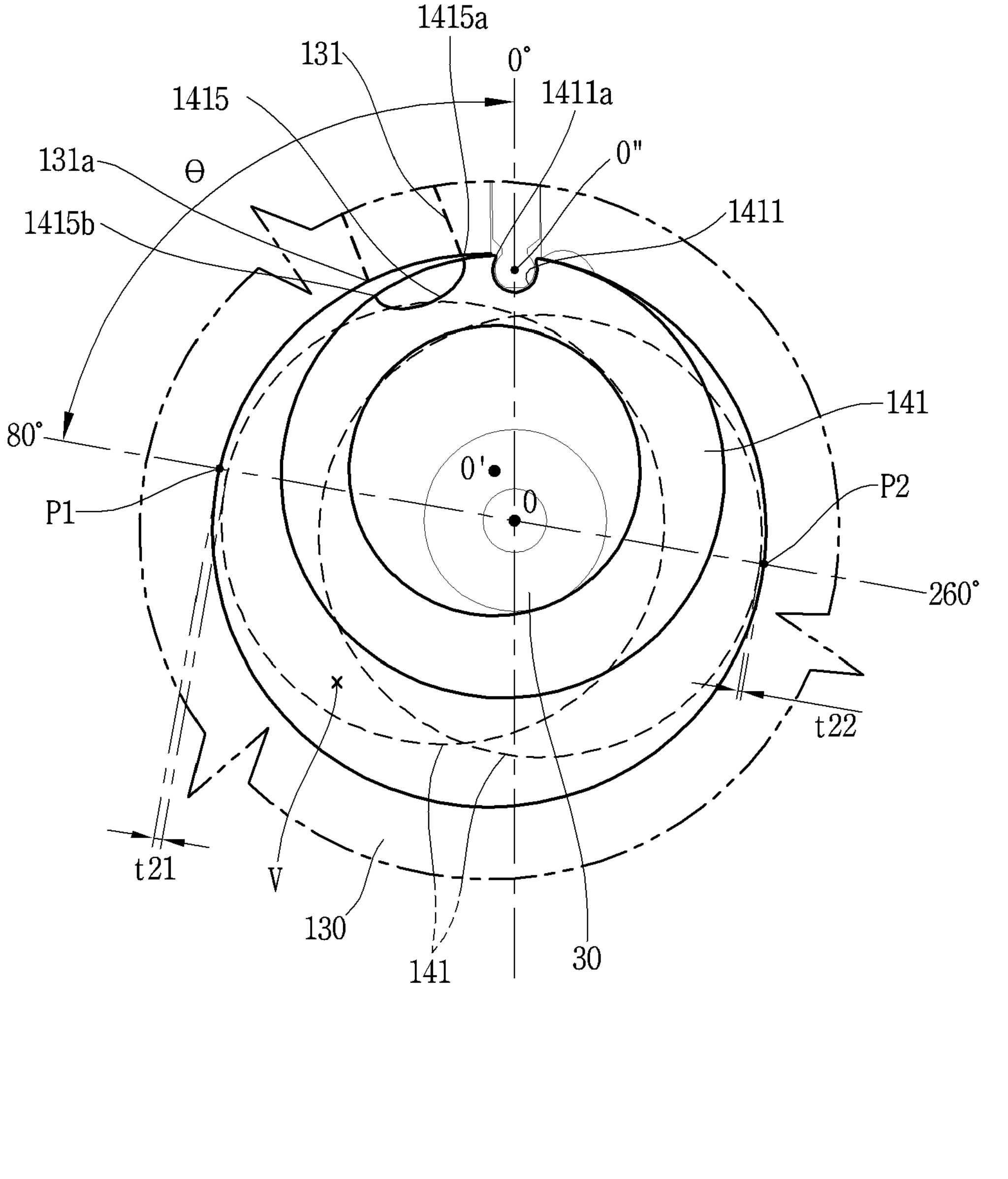

1415a
131
0°
1411a
1415
0"
131a
θ
1411
1415b
141
80°
0'
P1
0
P2
260°
t22
t21
V
130
141
30

FIG. 10

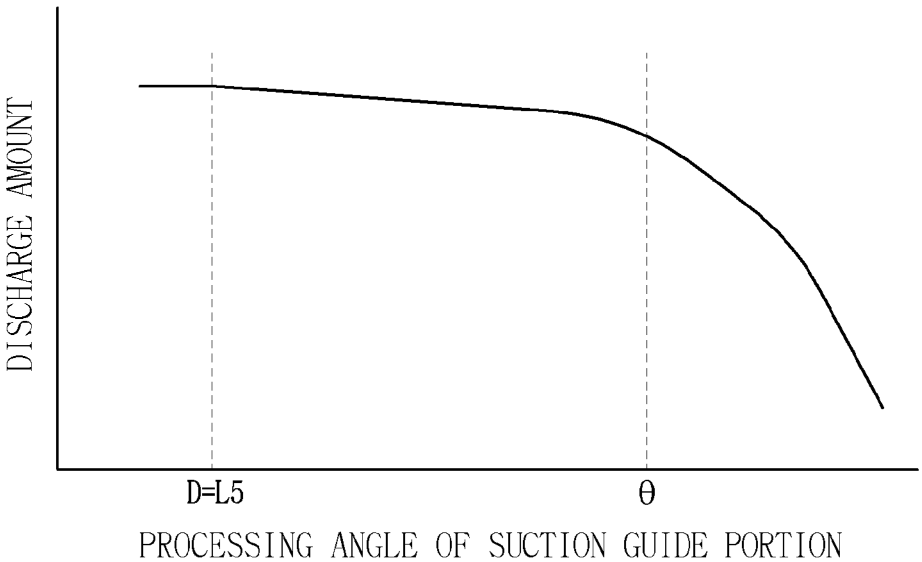

DISCHARGE AMOUNT
D=L5
θ
PROCESSING ANGLE OF SUCTION GUIDE PORTION

FIG. 11

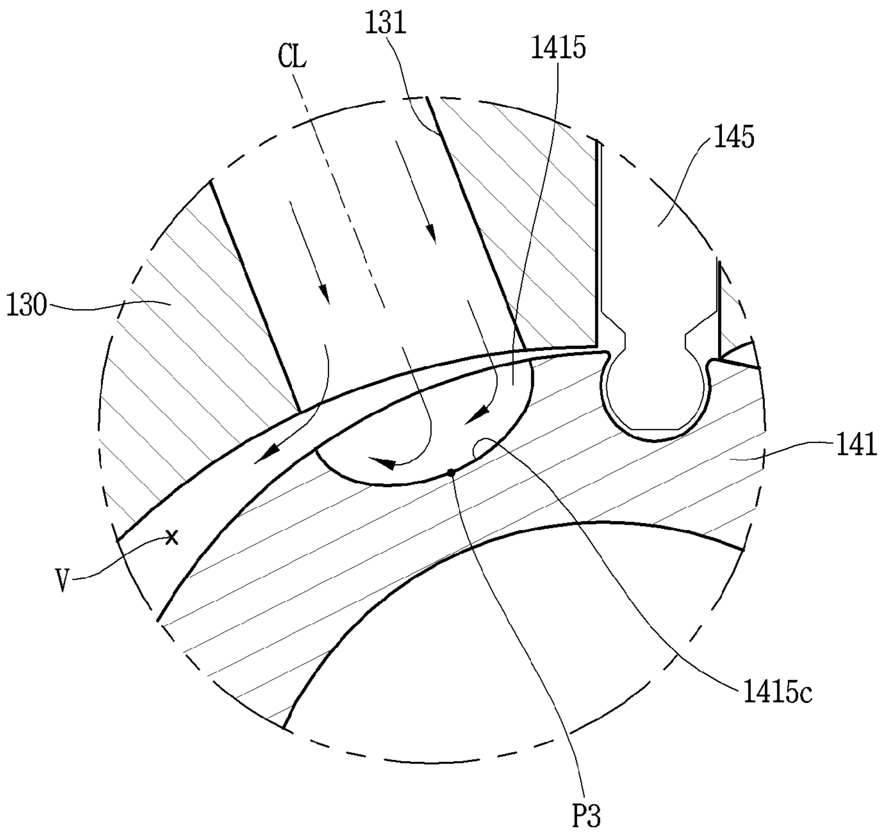

131
CL
1415
145
130
141
V
1415c
P3

FIG. 12

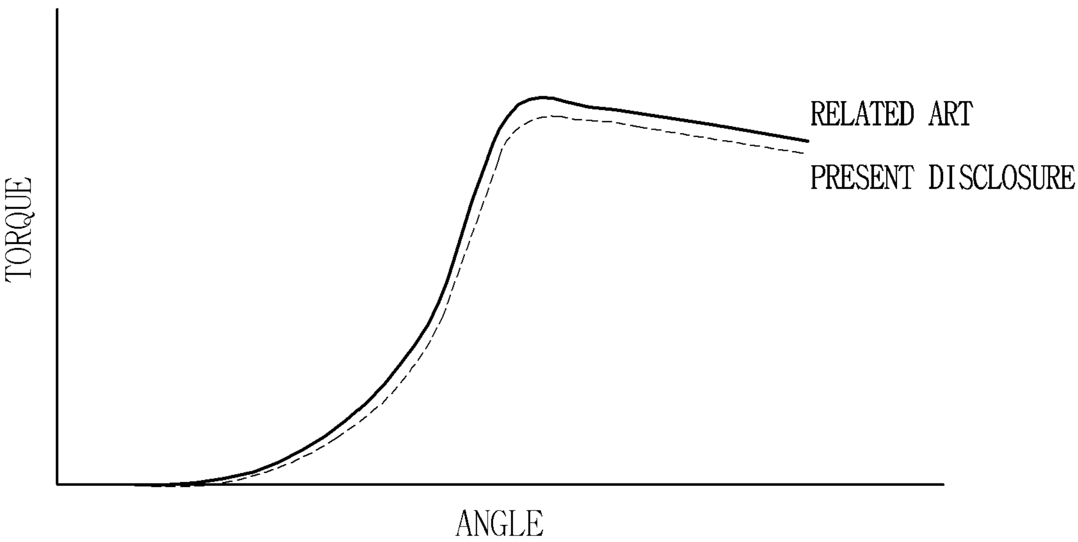

RELATED ART
PRESENT DISCLOSURE
TORQUE
ANGLE

FIG. 13

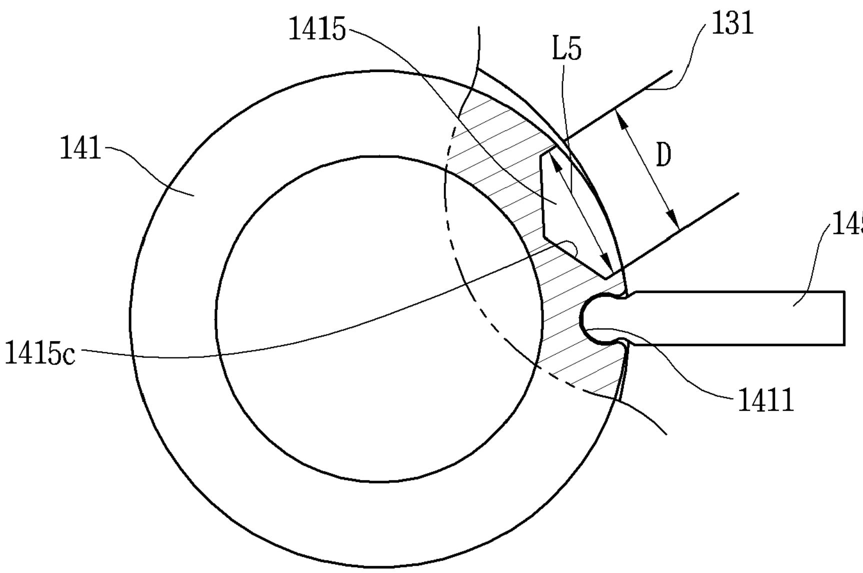

1415
L5
131
141
D
145
1415c
1411

FIG. 14

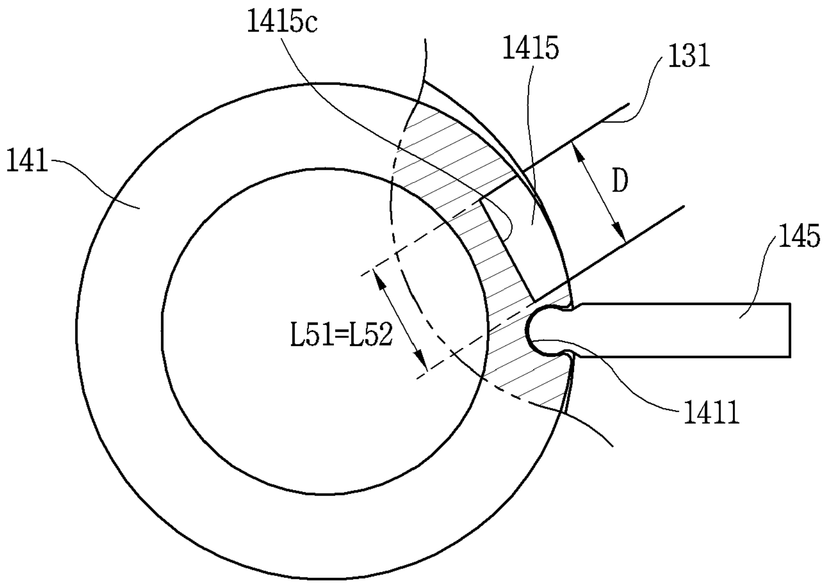

1415c
1415
131
141
D
145
L51=L52
1411

FIG. 15

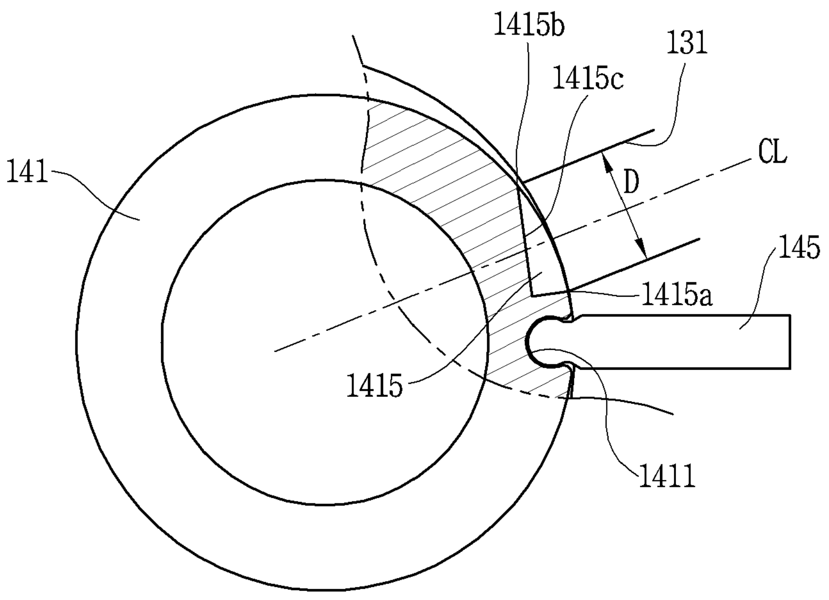

1415b
131
1415c
CL
141
D
145
1415a
1415
1411

FIG. 16

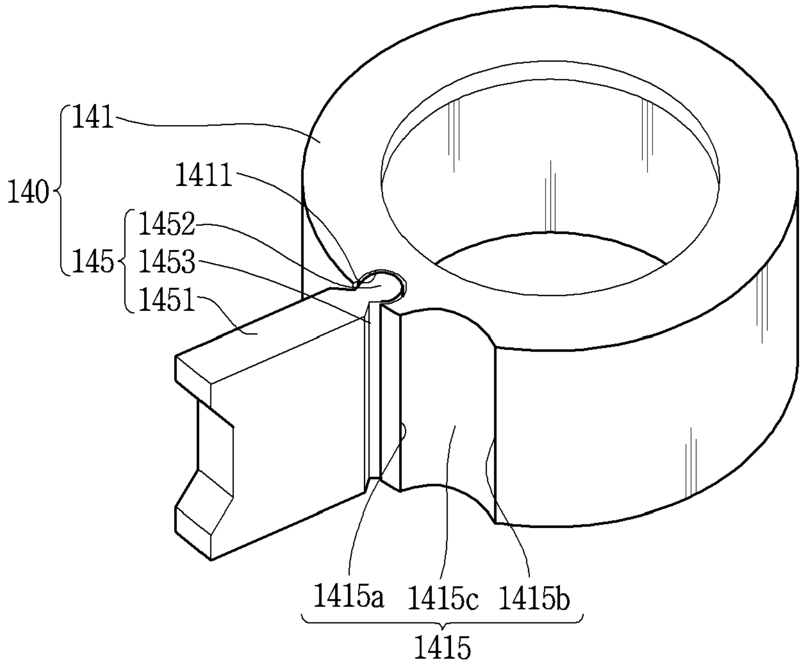

140
141
1411
145
1452
1453
1451
1415a
1415c
1415b
1415

FIG. 17

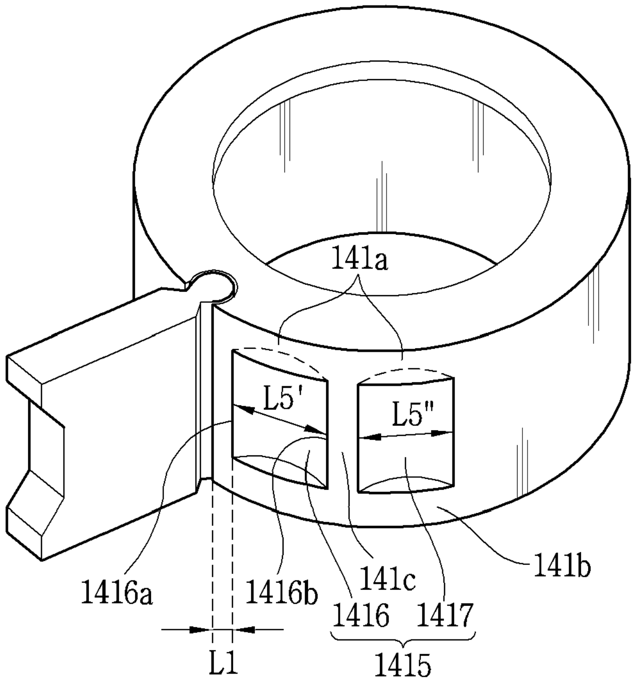

141a
L5'
L5"
1416a
1416b
141c
141b
1416
1417
1415
L1

FIG. 18A

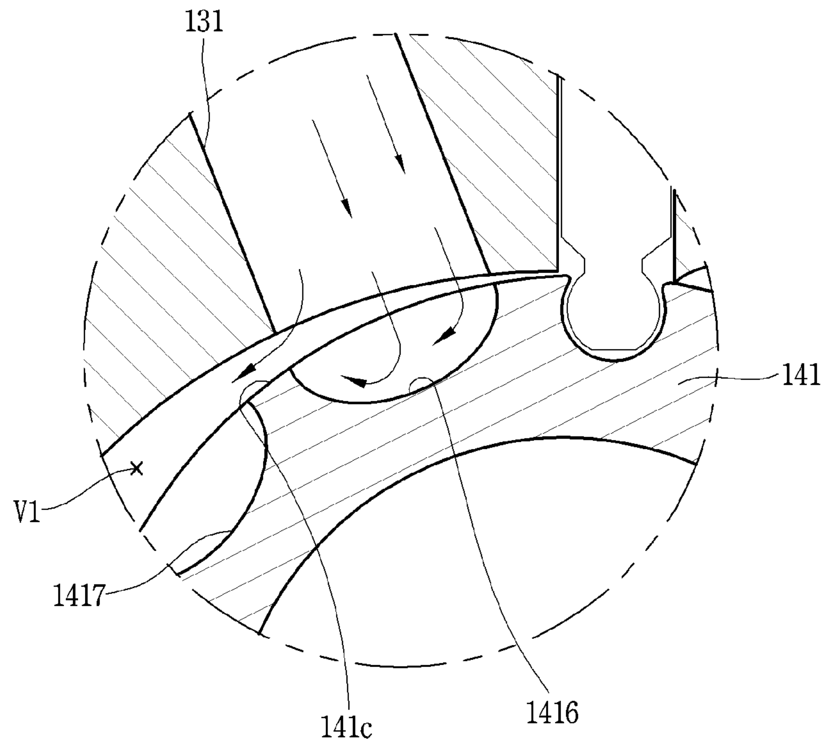
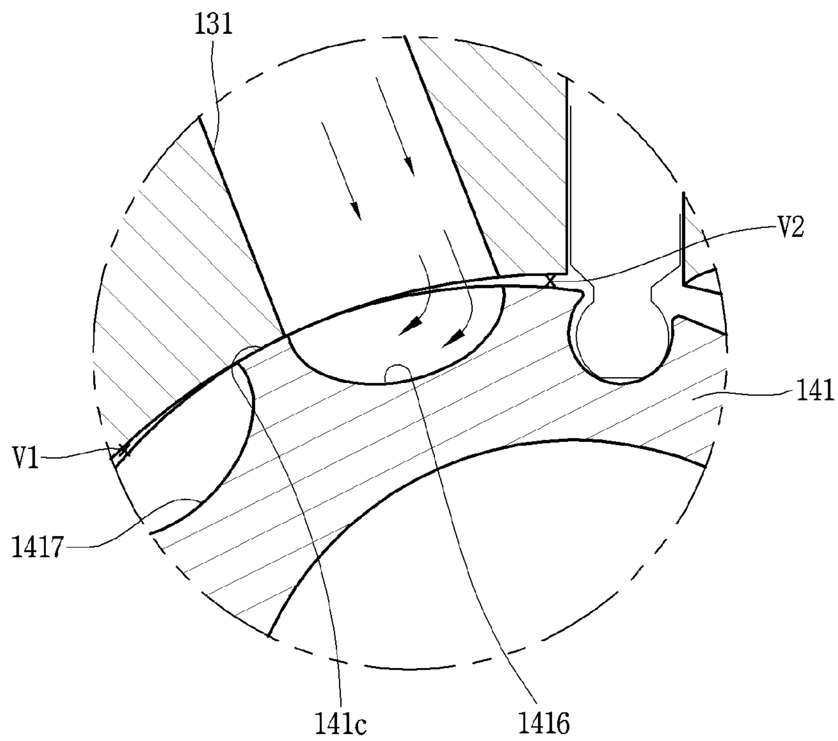


FIG. 18B



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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 2742

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	EP 0 683 320 A1 (DAIKIN IND LTD [JP]) 22 November 1995 (1995-11-22) * figures * * column 6, line 10 - column 9, line 24 *	1-14 15	INV. F04C18/324 F04C29/12
Y A	EP 3 194 781 B1 (LG ELECTRONICS INC [KR]) 23 October 2019 (2019-10-23) * figures 2,3 * * paragraph [0026] - paragraph [0048] *	1-14 15	

TECHNICAL FIELDS SEARCHED (IPC)

F04C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	11 June 2021	Bocage, Stéphane

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11-06-2021

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		US 2017275996 A1	28-09-2017
		WO 2016043439 A1	24-03-2016

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