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(71) Applicant: **Valeo Japan Co., Ltd.**
Kumagaya-Shi SAITAMA 360-0193 (JP)

(72) Inventors:
- **TSUKAGOSHI, Sadamitsu**
  Kumagaya-shi Saitama 360-0193 (JP)
- **MOTOHASHI, Shunichiro**
  Kumagaya-shi Saitama 360-0193 (JP)

(74) Representative: **Valeo Systèmes Thermiques**
Service Propriété Intellectuelle
8, rue Louis Lormand
La Verrière
78320 Le Mesnil Saint Denis (FR)

(54) SCROLL COMPRESSOR

(57) An object of the invention is to achieve both weight reduction and weight balance of an orbiting scroll. A scroll compressor (10) includes a fixed scroll (70) and an orbiting scroll (80) stored in a housing (20), and a pin-and-ring rotation-preventing mechanism (90) that prevents rotation of the orbiting scroll (80). The orbiting scroll (80) includes an orbiting spiral body (82) erected from a first plate surface (81a) of a disk-shaped orbiting end plate (81) toward the fixed spiral body (73). The rotation-preventing mechanism (90) consists of a plurality of circular recessed portions (91) provided in a second plate surface (81b) of the orbiting end plate (81), and a plurality of pins (93) extending from the housing (20) into the plurality of recessed portions (91) to be engaged with the recessed portions (91). The orbiting end plate (81) has, in an outer peripheral surface (81c) thereof, at least one groove (111, 112) that does not communicate with the first plate surface (81a) or the second plate surface (81b) .

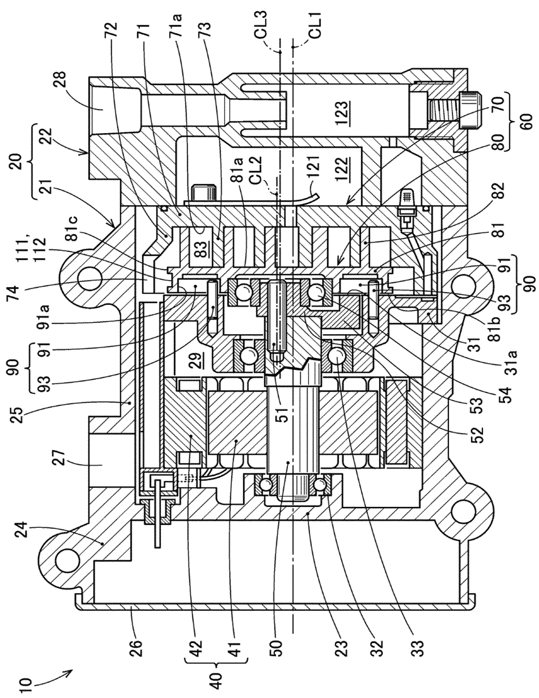


FIG.1

EP 4 033 101 A1

Description

Technical Field

[0001] The present invention relates to a technique for improving a scroll compressor.

Background Art

[0002] A scroll compressor includes a rotation-preventing mechanism that prevents rotation of an orbiting scroll (also referred to as a revolving scroll). As a rotation-preventing mechanism, an Oldham rotation-preventing mechanism adopting an Oldham ring has been widely used in the related art. The Oldham rotation-preventing mechanism is similar in principle with an Oldham coupling, and has an Oldham ring interposed between a plate surface of an orbiting end plate of an orbiting scroll and a housing wall surface facing the plate surface. The Oldham ring is an annular member centered on a driving shaft that drives the orbiting scroll, and is reciprocable only in a first straight line direction orthogonal to the driving shaft. On the other hand, the orbiting scroll is reciprocable with respect to the Oldham ring only in a second straight line direction orthogonal to the driving shaft. The first straight line direction is shifted by 90° with respect to the second straight line direction. Therefore, the orbiting scroll can revolve around an axis of the driving shaft while the rotation of the orbiting scroll is restricted.

[0003] Since the orbiting scroll and the Oldham ring have a predetermined mass, sufficient consideration is required for vibration in a radial direction due to revolution of the orbiting scroll. When the Oldham rotation-preventing mechanism described above is adopted, a vibration force (centrifugal force) in the radial direction due to the revolution of the orbiting scroll can be balanced by a counterweight provided on the driving shaft, whereas a vibration force due to reciprocation of the Oldham ring cannot be balanced by the counterweight. Thus, there is a limit to preventing the vibration in the radial direction due to the revolution of the orbiting scroll.

[0004] Therefore, in recent years, a pin-and-ring rotation-preventing mechanism has been adopted to replace the Oldham rotation-preventing mechanism. A scroll compressor including the pin-and-ring rotation-preventing mechanism is disclosed in, for example, Patent Literature 1.

[0005] The pin-and-ring rotation-preventing mechanism disclosed in Patent Literature 1 consists of a plurality of pins provided on a fixed-side member and a plurality of circular recessed portions individually engaged with the plurality of pins. The plurality of recessed portions are arranged and formed in a circumferential direction with respect to the plate surface of an orbiting end plate of an orbiting scroll. The plurality of pins extend into the plurality of recessed portions from a housing wall surface facing the plate surface of the orbiting end plate. The orbiting scroll simply revolves such that inner peripheral surfaces of the recessed portions are always in contact with the pins, and a member that reciprocates in the radial direction like the Oldham rotation-preventing mechanism is not used. This is advantageous for preventing the vibration of the orbiting scroll in the radial direction.

Citation List

Patent Literature

[0006] Patent Literature 1: WO2018/003032

Summary of Invention

Technical Problem

[0007] As described above, even if the pin-and-ring rotation-preventing mechanism is adopted, the vibration force in the radial direction due to the revolution of the orbiting scroll cannot be balanced unless a counterweight is provided on the driving shaft. Therefore, in order to reduce the size and weight of the counterweight and to reduce the weight of the entire compressor, it is preferable to use an orbiting scroll that is as light as possible.

[0008] An object of the invention is to provide a technique that can reduce the weight of an orbiting scroll in a scroll compressor adopting a pin-and-ring rotation-preventing mechanism.

Solution to Problem

[0009] In the following description, reference numerals in the accompanying drawings are appended in parentheses to facilitate understanding of the invention, but the invention is not limited to illustrated embodiments.

[0010] The invention provides a scroll compressor (10; 10A; 10B) including:

a housing (20);
a compression mechanism (60) stored in the housing (20) and consisting of a fixed scroll (70) and an orbiting scroll (80) ;
a driving shaft (50) rotatably supported by the housing (20) and configured to drive the orbiting scroll (80); and
a rotation-preventing mechanism (90) that prevents rotation of the orbiting scroll (80),
the fixed scroll (70) including a fixed end plate (71) supported so as to be non-rotatable relative to the housing (20), and a spiral-shaped fixed spiral body (73) erected from one plate surface (71a) of the fixed end plate (71),
the orbiting scroll (80) consists of a disk-shaped orbiting end plate (81) located to face the fixed spiral body (73), and a spiral-shaped orbiting spiral body (82) erected from a first plate surface (81a) of the orbiting end plate (81) toward the fixed spiral body (73) and combined with the fixed spiral body (73) to

form a compression chamber (83),

the orbiting end plate (81) being rotatably supported by an eccentric shaft (51) provided at one end of the driving shaft (50),

the rotation-preventing mechanism (90) consisting of

a plurality of circular recessed portions (91) provided in a second plate surface (81b) on a side opposite to the first plate surface (81a) and arranged in a circumferential direction of the second plate surface (81b), on the orbiting end plate (81), and

a plurality of pins (93) extending from a wall portion (31a) in the housing (20) that faces the second plate surface (81b) of the orbiting end plate (81) into the plurality of recessed portions (91) and individually engaged with inner peripheral surfaces (91a) of the plurality of recessed portions (91) directly or via ring members (92), in which

the orbiting end plate (81) has, in an outer peripheral surface (81c) thereof, at least one groove (111, 112; 112A; 112B) that does not communicate with the first plate surface (81a) or the second plate surface (81b).

[0011] Preferably, a groove (112; 112A; 112B) is provided between the plurality of recessed portions (91) adjacent to each other.

[0012] Preferably, the groove (112; 112A; 112B) is deepest at a position far from the plurality of recessed portions (91) adjacent to each other.

Advantageous Effects of Invention

[0013] According to the invention, the outer peripheral surface of the orbiting end plate is provided with at least one groove that does not communicate with the first plate surface or the second plate surface, so that it is possible to reduce the weight of the orbiting scroll. The groove does not communicate with the first plate surface or the second plate surface, and thus does not affect the first plate surface or the second plate surface. Therefore, the groove does not interfere with the orbiting spiral body erected on the first plate surface, and the second plate surface can be used as a sliding surface up to the vicinity of an outermost periphery thereof.

Brief Description of Drawings

[0014]

FIG. 1 is a cross-sectional view of a scroll compressor according to a first embodiment.

FIG. 2 is a perspective view of an orbiting scroll illustrated in FIG. 1.

FIG. 3 is a cross-sectional view taken along an axis of the orbiting scroll illustrated in FIG. 2.

FIG. 4 is a view of the orbiting scroll illustrated in FIG. 3 as seen from a first plate surface side of an orbiting end plate.

FIG. 5 is a view of the orbiting scroll illustrated in FIG. 3 as seen from a second plate surface side of the orbiting end plate.

FIG. 6 is a cross-sectional view taken along a line 6-6 in FIG. 3.

FIG. 7 is a cross-sectional view of an orbiting scroll of a scroll compressor according to a second embodiment as seen from a second plate surface side of an orbiting end plate (corresponding to a cross-sectional position in FIG. 6).

FIG. 8 is a cross-sectional view of an orbiting scroll of a scroll compressor according to a third embodiment as seen from a second plate surface side of an orbiting end plate (corresponding to the cross-sectional position in FIG. 6).

Description of Embodiments

[0015] Embodiments of the invention will be described below based on the accompanying drawings. The embodiments illustrated in the accompanying drawings are examples of the invention, and the invention is not limited to these embodiments.

<First Embodiment>

[0016] A scroll compressor 10 according to the first embodiment will be described with reference to FIGS. 1 to 6. As illustrated in FIG. 1, the scroll compressor 10 is suitable for use in a refrigeration cycle using a refrigerant as a working fluid, and is used in, for example, a refrigeration cycle of an automotive air conditioner. The use of the scroll compressor 10 is not limited.

[0017] The scroll compressor 10 is a so-called horizontally-oriented electric compressor, including: a horizontal housing 20; an electric motor 40 stored in the housing 20; a driving shaft 50 (including an output shaft of the electric motor 40) driven by the electric motor 40; and a compression mechanism 60 driven by the electric motor 40 via the driving shaft 50.

[0018] The housing 20 includes a horizontal and cylindrical first housing 21 and a second housing 22 that closes one opening of the first housing 21. The inside of the first housing 21 is divided into two in a longitudinal direction by an integral partition wall 23. One side of the partition wall 23 in the first housing 21 is referred to as a first cylindrical portion 24, and the other side is referred to as a second cylindrical portion 25. The first cylindrical portion 24 has an opening end closed by a lid 26. The first cylindrical portion 24 has an inverter device (not illustrated) stored therein. The inverter device supplies driving power to the electric motor 40. The second housing 22 is fastened to the first housing 21 by a fastening member (not illustrated) such as a bolt so as to close an opening end of the second cylindrical portion 25.

[0019] The housing 20 further includes a suction port 27 through which a refrigerant is suctioned into the housing 20 from the outside, and a discharge port 28 through which refrigerant compressed by the compression mechanism 60 is discharged from the housing 20. The suction port 27 is provided in the second cylindrical portion 25. The discharge port 28 is provided in the second housing 22.

[0020] The electric motor 40, the driving shaft 50, and the compression mechanism 60 are stored in the second cylindrical portion 25 of the first housing 21. The compression mechanism 60 is located on an opening side inside the second cylindrical portion 25. A space portion 29 between the partition wall 23 and the compression mechanism 60 inside the second cylindrical portion 25 is hereinafter referred to as a "low-pressure chamber 29". The electric motor 40 is located in the low-pressure chamber 29. The low-pressure chamber 29 communicates with the suction port 27.

[0021] A support block 31 is provided between the electric motor 40 and the compression mechanism 60 inside the second cylindrical portion 25. The support block 31 is restricted from both relative rotation with respect to the second cylindrical portion 25 and relative movement in an axial direction. Therefore, it can be considered that the support block 31 forms a part of the housing 20. Hereinafter, the support block 31 will be described as "a part of the housing 20" as appropriate.

[0022] The driving shaft 50 is located in the low-pressure chamber 29, extends horizontally in a longitudinal direction of the second cylindrical portion 25, and penetrates the support block 31 toward the compression mechanism 60. The driving shaft 50 is rotatably supported by a first bearing 32 provided in the partition wall 23 and a second bearing 33 provided in the support block 31. As a result, the driving shaft 50 extends horizontally in a longitudinal direction of the housing 20 and is rotatably supported by the housing 20. The bearings 32 and 33 are preferably configured with rolling bearings.

[0023] The driving shaft 50 includes an eccentric shaft 51 in one end surface penetrating the support block 31. The eccentric shaft 51 (eccentric pin 51) extends from the one end surface of the driving shaft 50 toward the compression mechanism 60, and is parallel to the driving shaft 50. The eccentric shaft 51 has a center line CL2 offset with respect to a center line CL1 of the driving shaft 50, and is rotatably fitted to an annular bush 52. A part of the bush 52 is integrally provided with a counterweight 53 (balance weight 53) protruding in the radial direction from the bush 52. Further, a bearing 54 (third bearing 54) is fitted to an outer peripheral surface of the bush 52. The third bearing 54 is preferably configured with a rolling bearing. An inner peripheral surface of the bush 52 fitted to the eccentric shaft 51 and the outer peripheral surface of the bush 52 fitted to the bearing 54 are not coaxial with each other. Thus, a known automatic alignment mechanism is formed to allow a center line CL3 of the orbiting scroll 80 to be positioned at an inner side of a rotation trajectory formed by the center line CL2 of the eccentric shaft 51.

[0024] The electric motor 40 includes a rotor 41 fixed to the driving shaft 50, and a stator 42 surrounding a periphery of the rotor 41. The stator 42 is fixed to an inner peripheral surface of the second cylindrical portion 25. The driving shaft 50 functions as the output shaft of the electric motor 40.

[0025] The compression mechanism 60 consists of a fixed scroll 70 and an orbiting scroll 80.

[0026] The fixed scroll 70 includes a disk-shaped fixed end plate 71, a cylindrical outer peripheral wall 72, and a spiral-shaped fixed spiral body 73. The fixed end plate 71 (also referred to as a fixed plate 71) is orthogonal to the center line CL2 of the eccentric shaft 51 and is supported so as to be non-rotatable relative to the housing 20. The outer peripheral wall 72 is a cylinder erected over an entire circumference from an outer edge of one plate surface 71a (surface 71a facing the electric motor 40) of the fixed end plate 71. The fixed spiral body 73 is located at an inner side of the outer peripheral wall 72 and is erected from the one plate surface 71a of the fixed end plate 71. The fixed spiral body 73 has, for example, an involute curved shape. The outer peripheral wall 72 of the fixed scroll 70 has a refrigerant suction port 74 for suctioning a refrigerant from a radially outer side to a radially inner side.

[0027] The orbiting scroll 80 is combined with the fixed scroll 70 and revolves around the fixed scroll 70.

[0028] Referring also to FIGS. 2 to 4, the orbiting scroll 80 includes a disk-shaped orbiting end plate 81 located to face the fixed spiral body 73, and a spiral-shaped orbiting spiral body 82.

[0029] The orbiting end plate 81 is orthogonal to the center line CL3 of the orbiting scroll 80 and is located at the inner side of the outer peripheral wall 72 of the fixed spiral body 73. A plate surface 81a of the orbiting end plate 81 facing the one plate surface 71a of the fixed end plate 71 is referred to as a "first plate surface 81a", and a surface 81b on a side opposite to the first plate surface 81a is referred to as a "second plate surface 81b".

[0030] The orbiting spiral body 82 is erected from the first plate surface 81a of the orbiting end plate 81 toward the fixed spiral body 73, and is combined with the fixed spiral body 73 to form a plurality of compression chambers 83. The orbiting spiral body 82 has, for example, an involute curved shape (see FIG. 4).

[0031] On the other hand, the center CL3 of the orbiting end plate 81 on the second plate surface 81b of the orbiting end plate 81 is formed with a circular supported recessed portion 84. The third bearing 54 (see FIG. 1) has an outer peripheral surface fitted to the supported recessed portion 84. The orbiting end plate 81 is rotatably supported by the eccentric shaft 51 provided in the driving shaft 50 via the third bearing 54. As a result, the orbiting scroll 80 is driven by the driving shaft 50. The driving shaft 50 rotates so that the orbiting scroll 80 can revolve (eccentrically rotate) around the axis CL2 of the driving shaft 50.

[0032] As illustrated in FIG. 1, the scroll compressor 10 includes a rotation-preventing mechanism 90 that prevents rotation of the orbiting scroll 80. The rotation-preventing mechanism 90 is a pin-and-ring rotation-preventing mechanism consisting of: a plurality of recessed portions 91 provided in the orbiting end plate 81; and a plurality of rotation-preventing pins 93 provided in the housing 20. Hereinafter, the recessed portions 91 are referred to as "pin-engaged recessed portions 91", and the pins 93 are referred to as "rotation-preventing pins 93".

[0033] Referring also to FIGS. 2, 3, and 5, the plurality of (e.g., six) pin-engaged recessed portions 91 are arranged at equal pitches in a circumferential direction in the second plate surface 81b of the orbiting end plate 81. That is, the plurality of pin-engaged recessed portions 91 are perfectly circular recessed portions positioned at equal pitches on a concentric circle around the center CL3 of the orbiting end plate 81.

[0034] The plurality of rotation-preventing pins 93 are each configured as a round bar parallel to the driving shaft 50, and extend into the plurality of pin-engaged recessed portions 91 from the wall portion 31a in the housing 20 (e.g., the support block 31) that faces the second plate surface 81b of the orbiting end plate 81. The plurality of rotation-preventing pins 93 are individually engaged with inner peripheral surfaces 91a of the plurality of pin-engaged recessed portions 91 directly or via ring members 92 (member 92 illustrated by an imaginary line in FIG. 3). Therefore, the orbiting scroll 80 can move with respect to the housing 20 within a range of the inner peripheral surfaces 91a of the plurality of circular pin-engaged recessed portions 91.

[0035] The orbiting scroll 80 tends to rotate in accordance with rotation of the driving shaft 50, but is restricted from rotation by the pin-engaged recessed portions 91 and the rotation-preventing pins 93. Thus, the rotation-preventing mechanism 90 can prevent rotation motion of the orbiting scroll 80 while allowing revolution motion of the orbiting scroll 80.

[0036] In this way, in the pin-and-ring rotation-preventing mechanism 90, the plurality of rotation-preventing pins 93 are engaged with the inner peripheral surfaces 91a of the plurality of pin-engaged recessed portions 91, so that the rotation of the orbiting scroll 80 can be prevented. In addition, like the Oldham rotation-preventing mechanism, there is no member (Oldham ring) that reciprocates in the radial direction, and therefore it is not necessary to consider vibration derived from a reciprocating member. On the other hand, since the orbiting scroll 80 has a predetermined mass, a vibration force is generated in the radial direction due to revolution of the orbiting scroll 80. This vibration force in the radial direction due to the revolution of the orbiting scroll 80 is balanced by the counterweight 53 provided on the eccentric shaft 51.

[0037] As illustrated in FIGS. 2 and 5, the second plate surface 81b of the orbiting end plate 81 of the orbiting scroll 80 is provided with an annular sliding contact portion 101 and a plurality of center-of-gravity adjusting recessed portions 102.

[0038] The annular sliding contact portion 101 is a flat annular surface having a constant width and slightly protruding from an outer peripheral edge of the second plate surface 81b. The annular sliding contact portion 101 is capable of sliding contact with a wall surface of the wall portion 31a of the support block 31 (that is, a wall surface of the housing 20) when the orbiting scroll 80 revolves.

[0039] The plurality of center-of-gravity adjusting recessed portions 102 are recessed parts in the second plate surface 81b and are located radially inward relative to the annular sliding contact portion 101 so as to adjust a center-of-gravity position of the orbiting scroll 80. These center-of-gravity adjusting recessed portions 102 are arranged in a range from a winding end 82a (base point Sp) of the orbiting spiral body 82 illustrated in FIG. 4 to a spiral angle θ (about 180°) in front of the winding end 82a, and between a pin-engaged recessed portion 91 and an adjacent pin-engaged recessed portion 91. By providing the plurality of center-of-gravity adjusting recessed portions 102, the mass of the orbiting scroll 80 in a region θ corresponding to a winding end side of the orbiting spiral body 82 can be close to the mass of the orbiting scroll 80 in the other region. As a result, the center of gravity of the orbiting scroll 80 can coincide with the center CL3 of the orbiting end plate 81.

[0040] Here, as illustrated in FIG. 5, consider a plurality of straight lines L1 and a plurality of straight lines L2 extending radially from the center CL3 of the orbiting end plate 81 when the orbiting scroll 80 is viewed from the second plate surface 81b side of the orbiting end plate 81. Hereinafter, the plurality of straight lines L1 and the plurality of straight lines L2 will be described while being distinguished into the plurality of first straight lines L1 and the plurality of second straight lines L2. The plurality of first straight lines L1 are straight lines passing through centers of the pin-engaged recessed portions 91. The plurality of second straight lines L2 are straight lines each passing through the middle between pin-engaged recessed portions 91 adjacent to each other. All the straight lines L1 and L2 are arranged at equal angles.

[0041] The inner peripheral surfaces 91a of the pin-engaged recessed portions 91 are consistent with an inner peripheral surface of the annular sliding contact portion 101 at positions of the respective first straight lines L1. The plurality of center-of-gravity adjusting recessed portions 102 are located on the respective second straight lines L2. In an inner peripheral surfaces 102a of each of the center-of-gravity adjusting recessed portions 102, a surface 102b closer to the annular sliding contact portion 101 has a linear shape orthogonal to the second straight line L2, and is close to the annular sliding contact portion 101.

[0042] As illustrated in FIG. 6, on each first straight line L1, a thickness (first thickness) from an outer peripheral surface 81c of the orbiting end plate 81 to the inner peripheral surface 91a of the pin-engaged recessed portion 91 is Th1. On each second straight line L2, a thickness (second thickness) from the surface 102b that is closer to the annular sliding contact portion 101 in the inner peripheral surface 102a of the center-of-gravity adjusting recessed portion 102 to the outer peripheral surface 81c of the orbiting end plate 81 is Th2, which is thicker than the first thickness Th1 (Th2 > Th1) .

[0043] As illustrated in FIGS. 2, 3, and 6, the orbiting end plate 81 has, in the outer peripheral surface 81c, at least one groove 111 and/or groove 112 that does not communicate with the first plate surface 81a or the second plate surface 81b, for example, a first groove 111 and/or a second groove 112. The first groove 111 and the second groove 112 is configured to have a U-shaped cross-section (see FIG. 3) in which the outer peripheral surface 81c side of the orbiting end plate 81 is opened. The first groove 111 consists of a groove bottom surface 111a on the center CL3 side of the orbiting end plate 81, and a pair of flat groove side surfaces 111b extending from the groove bottom surface 111a toward the outer peripheral surface 81c. Similarly, the second groove 112 consists of a groove bottom surface 112a on the center CL3 side of the orbiting end plate 81, and a pair of flat groove side surfaces 112b extending from the groove bottom surface 112a toward the outer peripheral surface 81c.

[0044] A plurality of first grooves 111 are respectively located in the outer peripheral surface 81c of the orbiting end plate 81, at positions facing the pin-engaged recessed portions 91, that is, at positions on the first straight lines L1. The first grooves 111 are each an arc-shaped groove along the outer peripheral surface 81c. Therefore, the groove bottom surface 111a is an arc-shaped surface along the outer peripheral surface 81c.

[0045] As illustrated in FIG. 6, when the orbiting end plate 81 is viewed from a direction of the center CL3 (the second plate surface 81b side), the first grooves 111 are each recessed to the vicinity of the pin-engaged recessed portion 91. As described above, on the first straight line L1, the first thickness Th1 from the outer peripheral surface 81c of the orbiting end plate 81 to the inner peripheral surface 91a of the pin-engaged recessed portion 91 is relatively small. Therefore, on the first straight line L1, a depth De1 (first groove depth De1) from the outer peripheral surface 81c of the orbiting end plate 81 to the groove bottom surface 111a of each first groove 111 is relatively small.

[0046] On the other hand, a plurality of second grooves 112 are respectively provided between the plurality of pin-engaged recessed portions 91 and the adjacent pin-engaged recessed portions 91 in the outer peripheral surface 81c of the orbiting end plate 81. Preferably, the plurality of second grooves 112 are each arranged in the middle of the pin-engaged recessed portion 91 and the adjacent pin-engaged recessed portion 91. More specifically, when the orbiting end plate 81 is viewed from the direction of the center CL3 (the second plate surface 81b side), the second grooves 112 are each a linear groove located on the second straight line L2 and orthogonal to the second straight line L2. Therefore, the groove bottom surface 112b is a linear surface orthogonal to the second straight line L2.

[0047] When the orbiting end plate 81 is viewed from the direction of the center CL3 (the second plate surface 81b side), the second grooves 112 are each recessed to the vicinity of the center-of-gravity adjusting recessed portion 102. Therefore, the second grooves 112 are each deepest at a position P1 far from the pin-engaged recessed portion 91 and the adjacent pin-engaged recessed portion 91, that is, at a position P1 intersecting the second straight line L2. In other words, on the second straight line L2, the second grooves 112 each have a largest depth De2 (second groove depth De2) from the outer peripheral surface 81c of the orbiting end plate 81 to the groove bottom surface 112a. The second groove depth De2 is larger than the first groove depth De1 (De2 > De1).

[0048] An outline of operations of the scroll compressor 10 is as follows.

[0049] As illustrated in FIG. 1, the driving shaft 50 is driven by the electric motor 40, and thus the orbiting scroll 80 revolves. As a result, the refrigerant suctioned from the suction port 27 and the refrigerant in the low-pressure chamber 29 enter the compression chamber 83 through the refrigerant suction port 74 of the fixed scroll 70. Due to the revolution of the orbiting scroll 80, the compression chamber 83 moves toward a center side while gradually reducing an internal volume thereof, whereby the refrigerant in the compression chamber 83 is compressed. Due to increase in a pressure in the compression chamber 83 increases, a check valve 121 opens, and the compressed refrigerant flows into a discharge chamber 122 in the second housing 22 and enters an adjacent gas-liquid separation chamber 123. Gaseous refrigerant separated from oil by the gas-liquid separation chamber 124 is discharged to the outside from the discharge port 28.

[0050] Description of the scroll compressor 10 according to the first embodiment provided above is summarized as follows.

[0051] As illustrated in FIGS. 2, 3, and 6, the orbiting end plate 81 has, in the outer peripheral surface 81c, at least one groove 111 and/or groove 112, so that it is possible to reduce the weight of the orbiting scroll 80. In addition, it is possible to reduce the size and weight of the counterweight 53 for balancing the vibration force due to the revolution of the orbiting scroll 80. Further, the grooves 111 and 112 do not communicate with the first plate surface 81a or the second plate surface 81b, and thus do not affect the first plate surface 81a or the second plate surface 81b. Therefore, the grooves 111 and 112 do not interfere with the orbiting spiral body 82 erected on the first plate surface 81a. In addition, the second plate surface 81b can be used as a sliding surface (annular sliding contact portion 101) with respect to the wall surface of the housing 20 up to the vicinity of an outermost periphery thereof.

[0052] Further, as illustrated in FIG. 6, the groove 112 (second groove 112) is provided between the pin-engaged recessed portions 91 adjacent to each other (the pin-engaged recessed portion 91 and the adjacent pin-engaged recessed portion 91) . The groove 112 is provided between the pin-engaged recessed portions 91 adjacent to each other, so that the groove can be formed with the larger second groove depth De2 while avoiding interference with each of the pin-engaged recessed portions 91. As a result, it is possible to further reduce the weight of the orbiting scroll 80.

[0053] In addition, each groove 112 can be disposed at an optimum position in the orbiting scroll 80. Each groove 112 can be disposed freely only in a necessary part at a position where the groove 112 does not interfere with the pin-engaged recessed portion 91. Thus, it is easy to balance the weight of the orbiting scroll 80 by the grooves 112. The orbiting scroll 80 is not increased in size in order to achieve weight balance. Therefore, the degree of flexibility in designing the grooves 112 can be increased. In this way, it is possible to achieve both weight reduction of the orbiting scroll 80 and the weight balance of the orbiting scroll 80.

[0054] Further, the groove 112 (second groove 112) is deepest at the position P1 far from the plurality of pin-engaged recessed portions 91 adjacent to each other (the pin-engaged recessed portion 91 and the adjacent pin-engaged recessed portion 91). In the outer peripheral surface 81c of the orbiting end plate 81, a position farther from the pin-engaged recessed portions 91 adjacent to each other causes the groove bottom surface 112a of each groove 112 to interfere less with the pin-engaged recessed portions 91. In view of this, the depth De2 (second groove depth De2) of each groove 112 is largest at the position P1 far from the position of the recessed portions 91. Therefore, the weight of the orbiting scroll 80 can be further reduced.

[0055] When cutting the orbiting scroll 80, the orbiting scroll 80 is fixed to (held by) a fixing base of a processing machine by a fixing claw such as a chuck or a clamper (not illustrated) . The orbiting scroll 80 can be easily and reliably fixed to the fixing base such as a bed or a table by hooking the fixing claw on any one of the plurality of grooves 111 or 112. In addition, the grooves 111 or 112 are each located at a position avoiding the recessed portion 91 (on the second straight line L2) in the outer peripheral surface 81c of the orbiting end plate 81. The orbiting scroll 80 can be fixed in a swing axial direction by effectively using the groove side surfaces 111b of the groove 111 or the groove side surfaces 112b of the groove 112 to hook the fixing claw. Therefore, the fixing claw can be hooked without causing distortion in the orbiting scroll 80, which has a relatively low rigidity.

[0056] Next, a scroll compressor 10A according to a second embodiment will be described with reference to FIG. 7.

<Second Embodiment>

[0057] FIG. 7 illustrates a cross-sectional configuration of an orbiting scroll 80A of the scroll compressor 10A according to the second embodiment as viewed from the second plate surface 81b side of the orbiting end plate 81, and corresponds to a cross-sectional position in FIG. 6.

[0058] The scroll compressor 10A according to the second embodiment is characterized in that the second grooves 112 according to the first embodiment illustrated in FIGS. 1 to 6 is changed to second grooves 112A illustrated in FIG. 7. Other basic configurations are the same as those of the scroll compressor 10 according to the first embodiment. Parts common to those of the scroll compressor 10 according to the first embodiment are denoted by the same reference numerals, and detailed description thereof will be omitted.

[0059] Each second groove 112A according to the second embodiment has a configuration in which the outer peripheral surface 81c side of the orbiting end plate 81 is opened similarly to the first embodiment, and consists of a groove bottom surface 112a on the center CL3 side of the orbiting end plate 81 and a pair of flat groove side surfaces 112b from the groove bottom surface 112a toward the outer peripheral surface 81c. More specifically, as illustrated in FIG. 7, when the orbiting end plate 81 is viewed from the direction of the center CL3 (the second plate surface 81b side), each second groove 112A is recessed in an arc shape from the outer peripheral surface 81c of the orbiting end plate 81. Therefore, the groove bottom surface 112b is also an arc-shaped surface recessed in an arc shape from the outer peripheral surface 81c of the orbiting end plate 81.

[0060] When the orbiting end plate 81 is viewed from the direction of the center CL3 (the second plate surface 81b side), each second groove 112A is recessed to the vicinity of the center-of-gravity adjusting recessed portion 102. Therefore, the second grooves 112A are each deepest at the position P1 far from the plurality of pin-engaged recessed portions 91 adjacent to each other, that is, at the position P1 intersecting the second straight line L2. In other words, on the second straight line L2, the second grooves 112A each have a largest depth De2A (second groove depth De2A) from the outer peripheral surface 81c of the orbiting end plate 81 to the groove bottom surface 112a.

[0061] The scroll compressor 10A according to the second embodiment can achieve the same effects as in the first embodiment.

[0062] In the second embodiment, the surface 102b, which is closer to the annular sliding contact portion 101 in the inner peripheral surface 102a of each of the center-of-gravity adjusting recessed portions 102, may be an arc-shaped surface along the groove bottom surface 112a of the second groove 112A. In this case, the second groove depth De2A can be set to be larger than the second groove depth De2 according to the first embodiment illustrated in FIG. 6.

[0063] Next, a scroll compressor 10B according to a third embodiment will be described with reference to FIG. 8.

<Third Embodiment>

[0064] FIG. 8 illustrates a cross-sectional configuration of an orbiting scroll 80B of the scroll compressor 10B according to the third embodiment as viewed from the second plate surface 81b side of the orbiting end plate 81, and corresponds to the cross-sectional position in FIG. 6. The scroll compressor 10B according to the third embodiment is characterized in that the second grooves 112 according to the first embodiment illustrated in FIGS. 1 to 6 is changed to second grooves 112B illustrated in FIG. 8. Other basic configurations are the same as those of the scroll compressor 10 according to the first embodiment. Parts common to those of the scroll compressor 10 according to the first embodiment are denoted by the same reference numerals, and detailed description thereof will be omitted.

[0065] Each second groove 112B according to the third embodiment has a configuration in which the outer peripheral surface 81c side of the orbiting end plate 81 is opened similarly to the first embodiment, and consists of a groove bottom surface 112a on the center CL3 side of the orbiting end plate 81 and a pair of flat groove side surfaces 112b from the groove bottom surface 112a toward the outer peripheral surface 81c. More specifically, as illustrated in FIG. 8, when the orbiting end plate 81 is viewed from the direction of the center CL1 (the second plate surface 81b side), each second groove 112B is recessed in a rectangular shape from the outer peripheral surface 81c of the orbiting end plate 81. Therefore, the groove bottom surface 112b is a linear surface orthogonal to the second straight line L2.

[0066] When the orbiting end plate 81 is viewed from the direction of the center CL3 (the second plate surface 81b side), each second groove 112B is recessed to the vicinity of the center-of-gravity adjusting recessed portion 102. Therefore, the second grooves 112B are each deepest at the position P1 far from the plurality of pin-engaged recessed portions 91 adjacent to each other, that is, at the position P1 intersecting the second straight line L2.

[0067] The scroll compressor 10B according to the third embodiment can achieve the same effects as in the first embodiment.

[0068] The scroll compressor 10; 10A; 10B according to the invention is not limited to the embodiments as long as functions and effects of the invention are achieved.

[0069] The scroll compressor 10; 10A; 10B is not limited to a horizontally-oriented electric compressor, and may be configured such that the driving shaft 50 is driven by an external power source. For example, the scroll compressor may be a belt-driven scroll compressor in which engine power is transmitted to a pulley provided on the driving shaft 50 by a belt.

[0070] The orbiting scroll 80 is not limited to a configuration including the annular sliding contact portion 101 or the center-of-gravity adjusting recessed portions 102.

[0071] The shape and size of the grooves 111, 112; 112A; 112B are not limited to those in the first to third embodiments, and can be set freely.

[0072] In addition, it is sufficient to have at least one of any grooves 111, 112; 112A; 112B with respect to the outer peripheral surface 81c of the orbiting end plate 81.

Industrial Applicability

[0073] The scroll compressor 10; 10A; 10B according to the invention is suitable for use in a refrigeration cycle of an automotive air conditioner.

Reference Signs List

[0074]

10 scroll compressor (first embodiment)
10A scroll compressor (second embodiment)
10B scroll compressor (third embodiment)
20 housing
31a wall portion
50 driving shaft
51 eccentric shaft
60 compression mechanism
70 fixed scroll
71 fixed end plate
71a one plate surface
73 fixed spiral body
80 orbiting scroll (first embodiment)
80A orbiting scroll (second embodiment)
80B orbiting scroll (third embodiment)
81 orbiting end plate
81a first plate surface
81b second plate surface
81c outer peripheral surface
82 orbiting spiral body
83 compression chamber
90 rotation-preventing mechanism
91 recessed portion (pin-engaged recessed portion)
91a inner peripheral surface
92 ring member
93 pin (rotation-preventing pin)
111 first groove
112 second groove (first embodiment)
112A second groove (second embodiment)
112B second groove (third embodiment)

Claims

1. A scroll compressor (10; 10A; 10B) comprising:

a housing (20);
a compression mechanism (60) stored in the

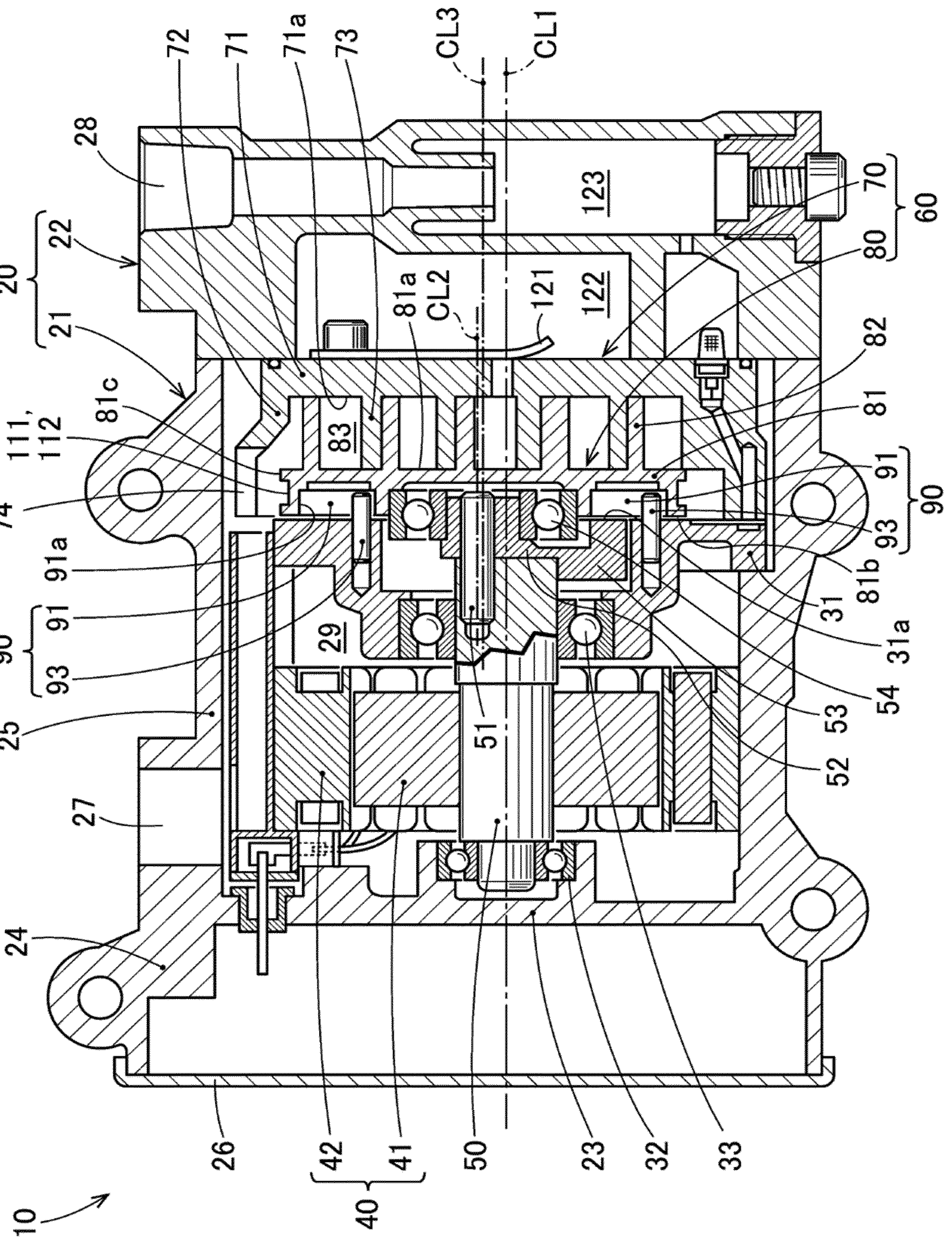
housing (20) and consisting of a fixed scroll (70) and an orbiting scroll (80);
a driving shaft (50) rotatably supported by the housing (20) and configured to drive the orbiting scroll (80); and
a rotation-preventing mechanism (90) that prevents rotation of the orbiting scroll (80),
the fixed scroll (70) including a fixed end plate (71) supported so as to be non-rotatable relative to the housing (20), and a spiral-shaped fixed spiral body (73) erected from one plate surface (71a) of the fixed end plate (71),
the orbiting scroll (80) including a disk-shaped orbiting end plate (81) located to face the fixed spiral body (73), and a spiral-shaped orbiting spiral body (82) erected from a first plate surface (81a) of the orbiting end plate (81) toward the fixed spiral body (73) and combined with the fixed spiral body (73) to form a compression chamber (83),
the orbiting end plate (81) being rotatably supported by an eccentric shaft (51) provided at one end of the driving shaft (50),
the rotation-preventing mechanism (90) consisting of

a plurality of circular recessed portions (91) provided in a second plate surface (81b) on a side opposite to the first plate surface (81a) and arranged in a circumferential direction of the second plate surface (81b), on the orbiting end plate (81), and
a plurality of pins (93) extending from a wall portion (31a) in the housing (20) that faces the second plate surface (81b) of the orbiting end plate (81) into the plurality of recessed portions (91) and individually engaged with inner peripheral surfaces (91a) of the plurality of recessed portions (91) directly or via ring members (92), wherein

the orbiting end plate (81) has, in an outer peripheral surface (81c) thereof, at least one groove (111, 112; 112A; 112B) that does not communicate with the first plate surface (81a) or the second plate surface (81b).

2. The scroll compressor according to claim 1, wherein the groove (112; 112A; 112B) is provided between the plurality of recessed portions (91) adjacent to each other.

3. The scroll compressor according to claim 1, wherein the groove (112; 112A; 112B) is deepest at a position far from the plurality of recessed portions (91) adjacent to each other.



72
71
71a
73
CL3
CL1
28
123
70
60
20
22
21
81a
CL2
121
122
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81c
111,
112
83
81
91
90
74
91a
93
81b
31
31a
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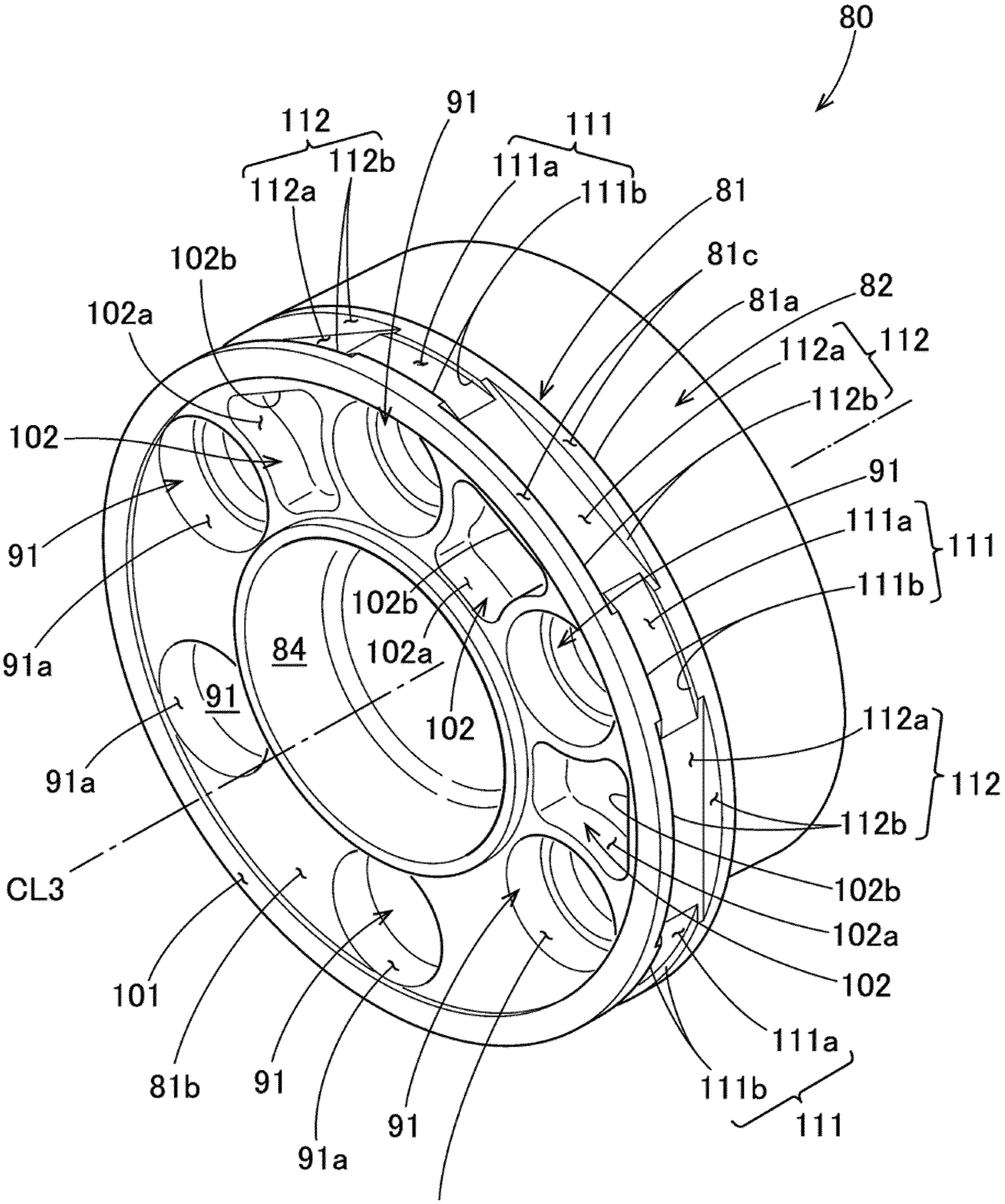
10

FIG.1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111a
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91a
111b
102b
84
102a
91
102
91a
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CL3
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102a
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91a
91a

FIG.2

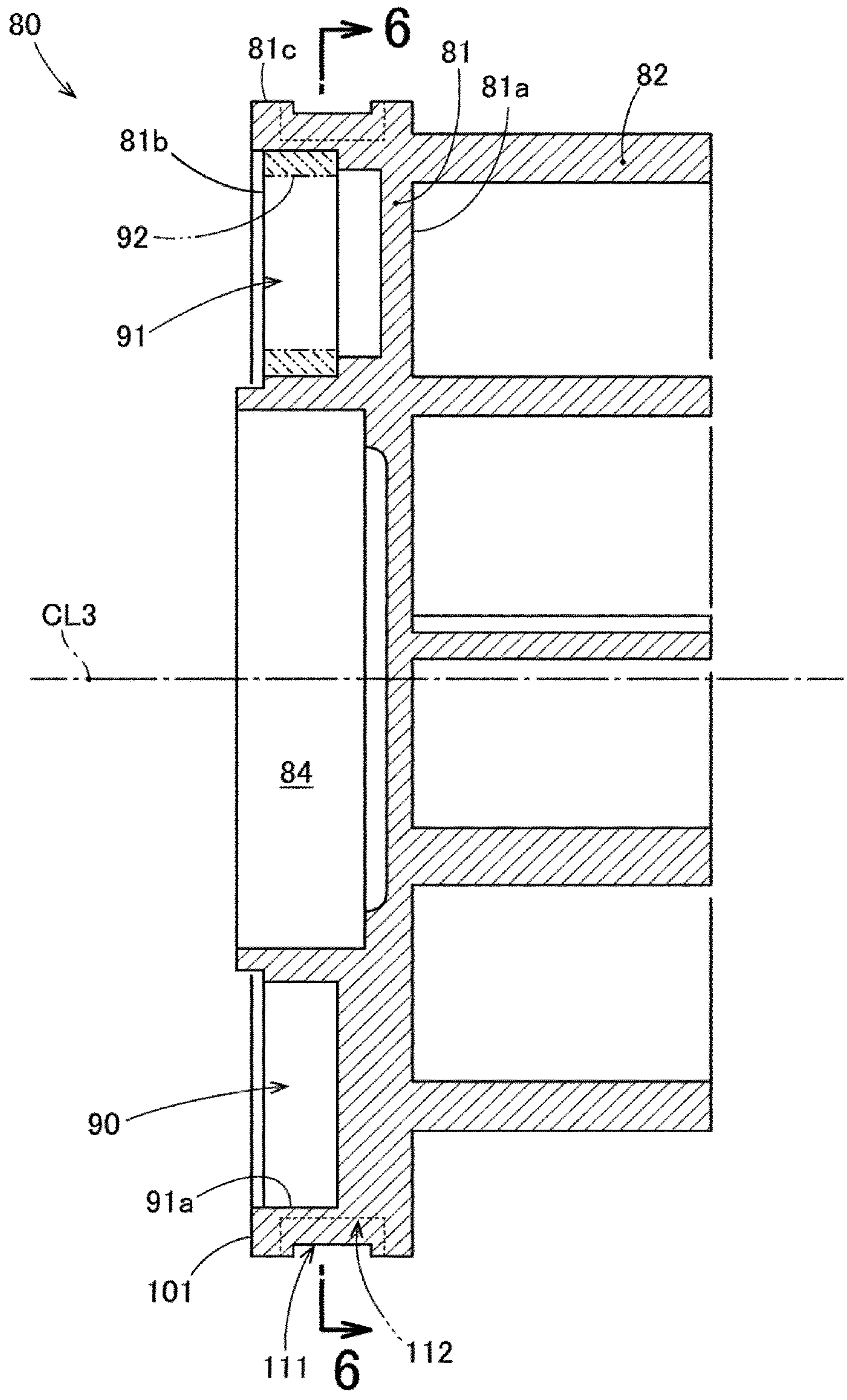


FIG.3

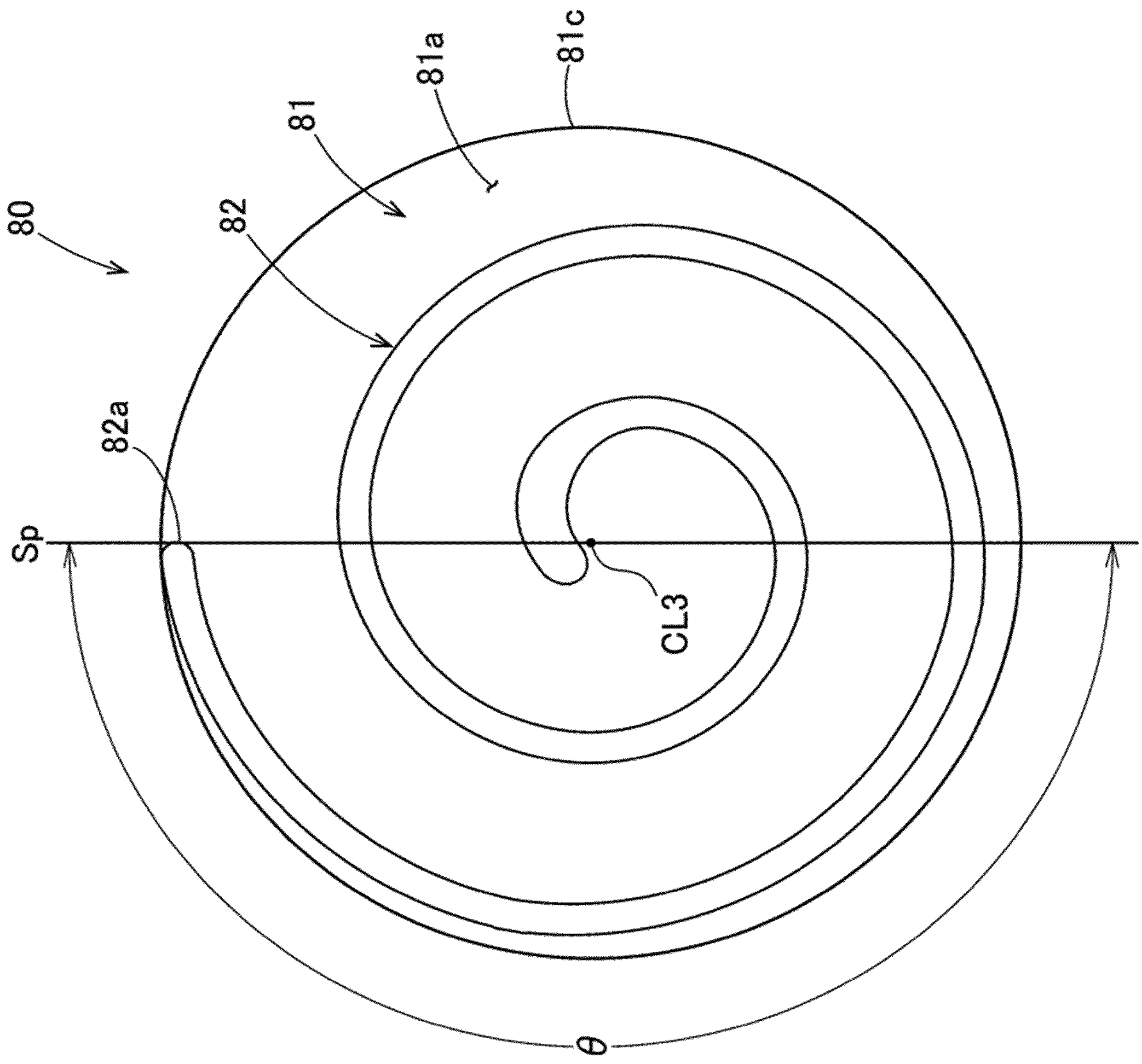


FIG.4

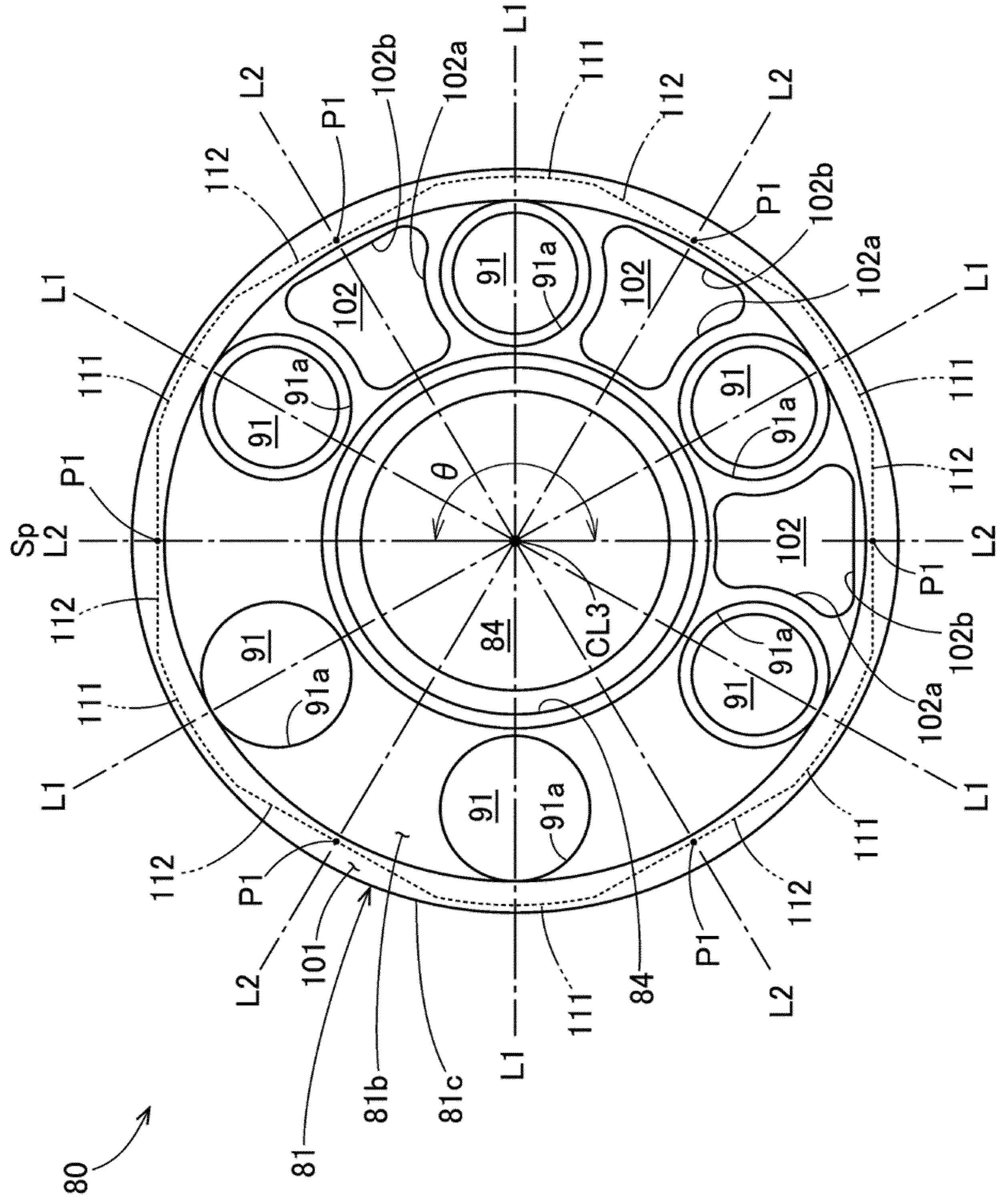
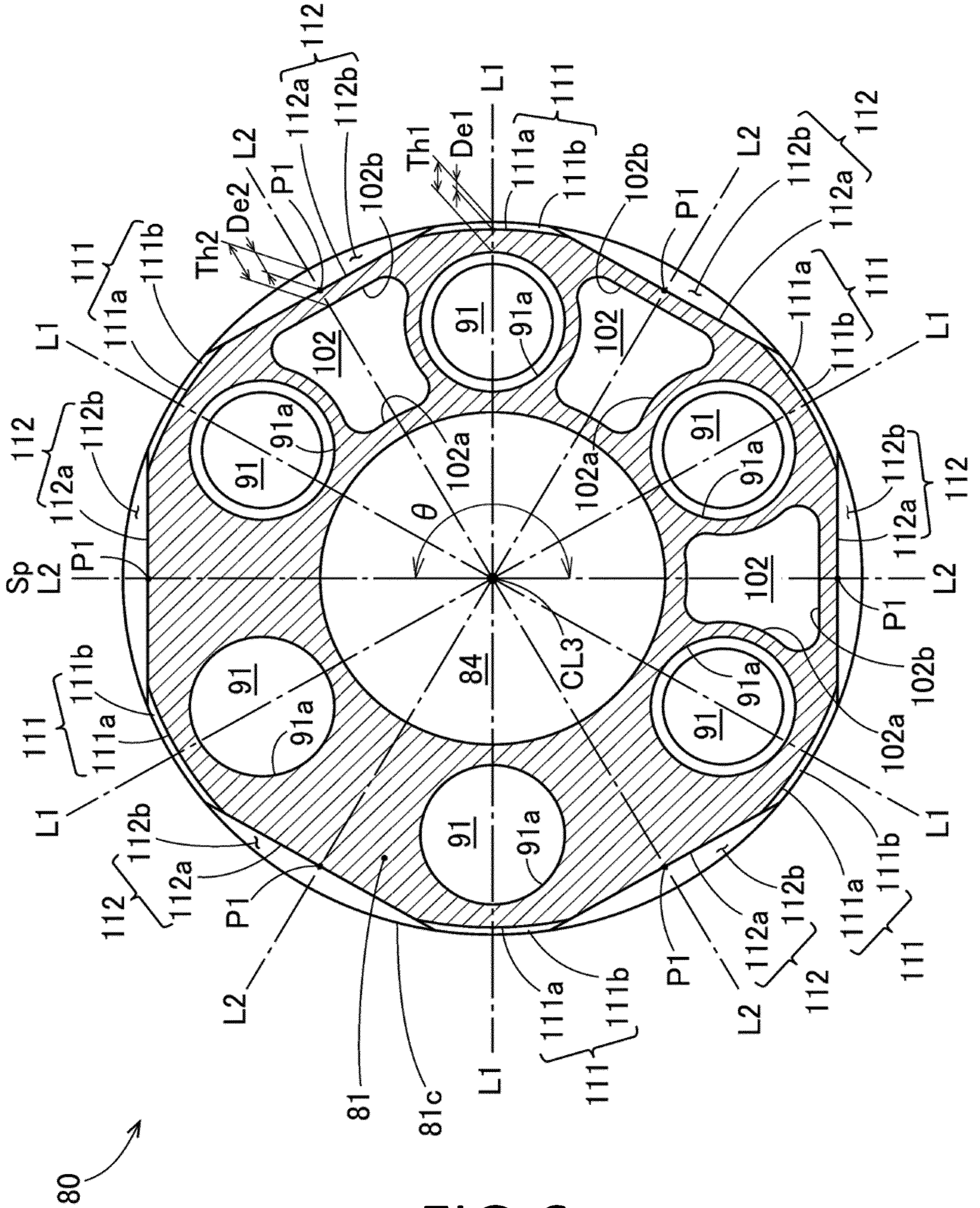


FIG.5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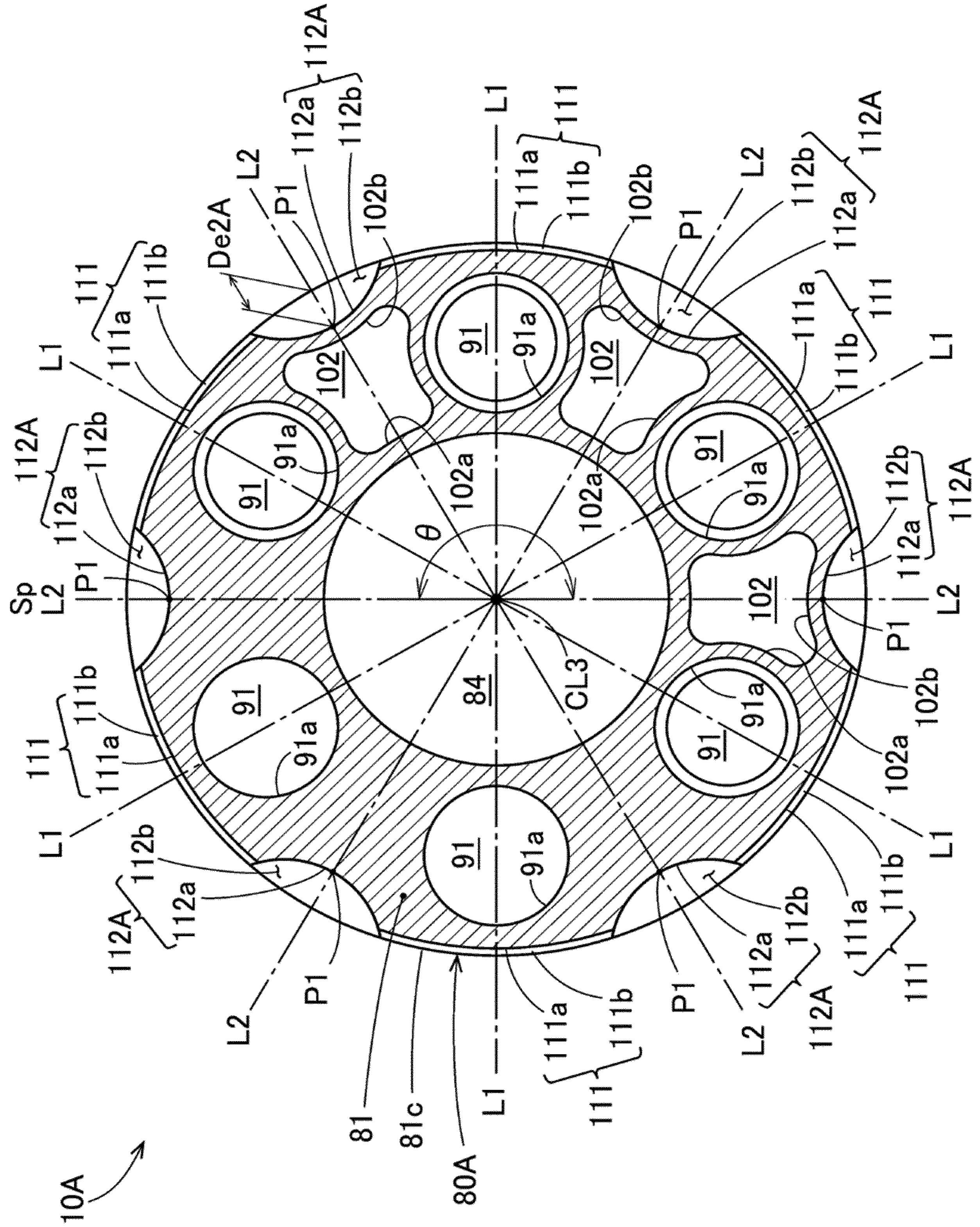
Sp
Th1
De1
Th2
De2
θ
CL3

FIG.6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De2A
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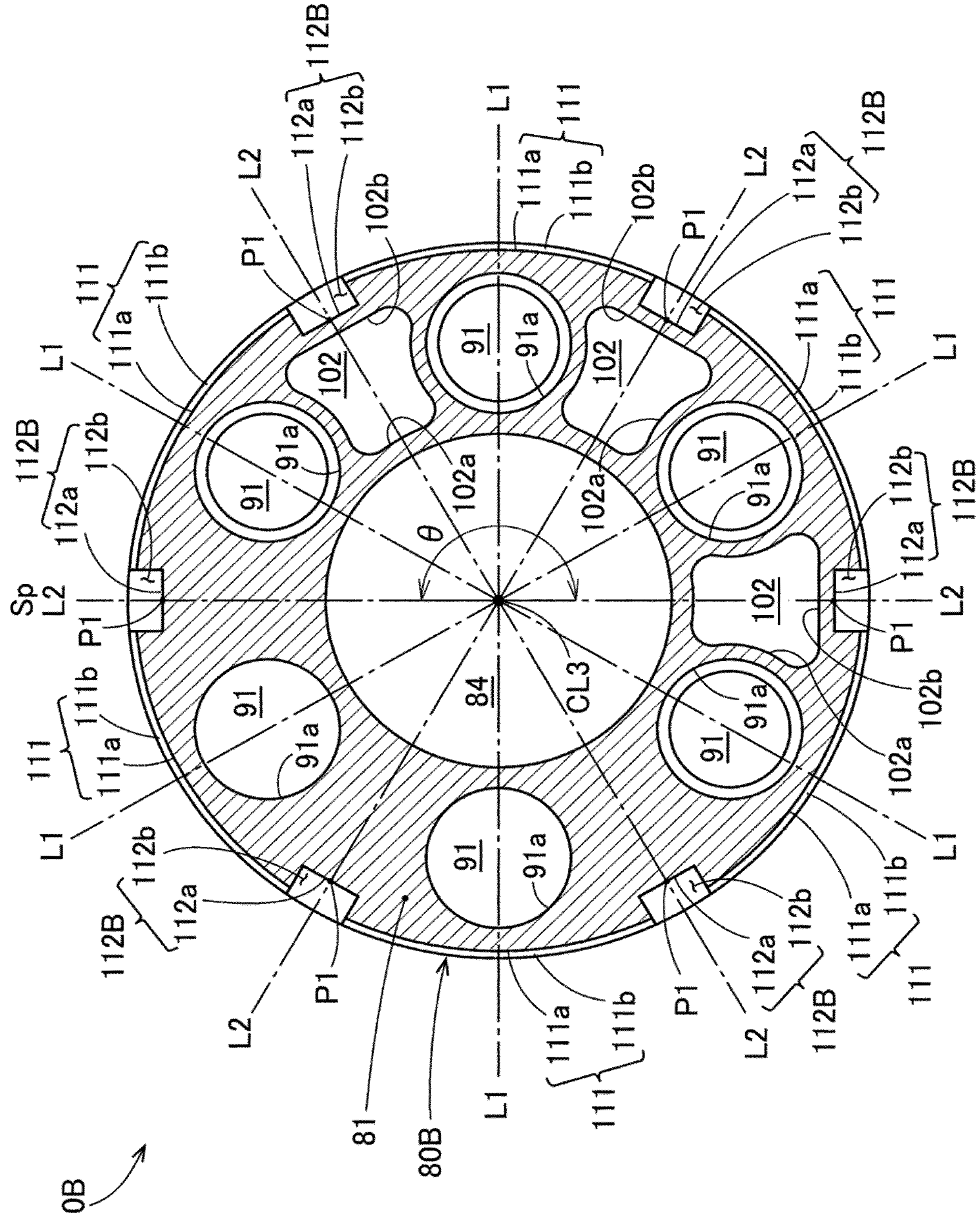
θ

FIG.7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CL3
81
80B
10B

FIG.8

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2020/034308

A. CLASSIFICATION OF SUBJECT MATTER
F04C 18/02(2006.01)i
FI: F04C18/02 311E

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04C18/02

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2018/003032 A1 (VALEO JAPAN CO., LTD.) 04 January 2018 (2018-01-04) paragraphs [0025]-[0058], fig. 1-5	1-3
Y	JP 2000-320478 A (SANDEN CORP.) 21 November 2000 (2000-11-21) paragraphs [0024]-[0027], fig. 3	1-3
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 9099/1985 (Laid-open No. 126095/1986) (TOSHIBA CORP.) 07 August 1986 (1986-08-07) specification, page 8, line 10 to page 9, line 14, fig. 1-3	1-3

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 November 2020 (06.11.2020)	24 November 2020 (24.11.2020)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/034308

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 61-98985 A (TOKICO, LTD.) 17 May 1986 (1986-05-17) page 4, upper left column, lines 13-20, page 5, lower left column, lines 12-13, fig. 1	1-3

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/034308

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2018/003032 A1	04 Jan. 2018	CN 109642569 A	
JP 2000-320478 A	21 Nov. 2000	(Family: none)	
JP 61-126095 U1	07 Aug. 1986	(Family: none)	
JP 61-98985 A	17 May 1986	(Family: none)	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2018003032 A **[0006]**