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

(11) **EP 3 480 467 A1**

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

(43) Date of publication:
08.05.2019 Bulletin 2019/19

(21) Application number: **17876515.2**

(22) Date of filing: **27.11.2017**

(51) Int Cl.:
F04C 18/02 *(2006.01)*

(86) International application number:
PCT/JP2017/042359

(87) International publication number:
WO 2018/101195 (07.06.2018 Gazette 2018/23)

(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:
MA MD

(30) Priority: **02.12.2016 JP 2016235045**

(71) Applicant: **Mitsubishi Heavy Industries Thermal Systems, Ltd.**
Tokyo 108-8215 (JP)

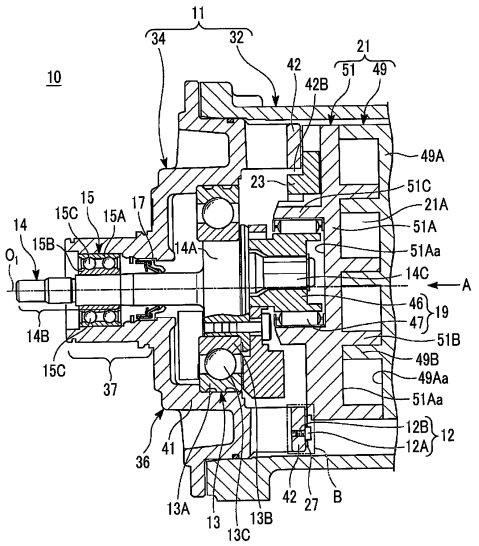
(72) Inventors:
- **SATO, Hajime**
  Tokyo 108-8215 (JP)
- **MIYAMOTO, Yoshiaki**
  Tokyo 108-8215 (JP)
- **MIZUNO, Hisao**
  Tokyo 108-8215 (JP)
- **NOGUCHI, Akihiro**
  Nagoya-shi
  Aichi 453-0862 (JP)
- **GOTO, Takashi**
  Nagoya-shi
  Aichi 453-0862 (JP)
- **SHIKANAI, Toshiyuki**
  Nagoya-shi
  Aichi 453-0862 (JP)
- **GOTO, Shusaku**
  Nagoya-shi
  Aichi 453-0862 (JP)

(74) Representative: **Cabinet Beau de Loménie**
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) SCROLL COMPRESSOR

(57) This scroll compressor has: a housing (11); a fixed scroll (49) and a orbiting scroll (51) which are provided in a rear housing (32) of the housing (11); a ring-like thrust plate (27) disposed between an end plate (51A) of the orbiting scroll (51) positioned on the side opposite the side on which the fixed scroll (49) is provided, and a plate placement surface of a front housing (34); and a plurality of bolts (12) which are fastened to the plate placement part (42) partitioning the plate placement surface, and restrict the position of the thrust plate (27) with respect to the plate placement part (42).

FIG. 1



EP 3 480 467 A1

Description

Technical Field

[0001] The present invention relates to a scroll compressor.
Priority is claimed on Japanese Patent Application No. 2016-235045, filed December 2, 2016, the content of which is incorporated herein by reference.

Background Art

[0002] Scroll compressors have a compressor body including a fixed scroll and an orbiting scroll.
[0003] The compressor body includes a compression chamber formed by the orbiting scroll meshing with the fixed scroll. The scroll compressors compress the fluid within the compression chamber by revolving and driving the orbiting scroll with respect to the fixed scroll. Such scroll compressors have a ring-like thrust plate as a member that suppresses seizure resulting from sliding of the orbiting scroll (for example, refer to PTL 1).
[0004] PTL 1 discloses a configuration in which the orbiting scroll is provided with a ring-like recessed portion that houses a portion of a thrust plate, and the position of the thrust plate is restricted by interposing the thrust plate between the orbiting scroll and the front housing (frame).

Citation List

Patent Literature

[0005] [PTL 1] Japanese Unexamined Patent Application Publication No. 2012-225257

Summary of Invention

Technical Problem

[0006] As described above, PTL 1 has a configuration in which the thrust plate is interposed between the orbiting scroll, which is revolved and driven with respect to the fixed scroll, and the front housing. For this reason, if a centrifugal force becomes large due to the orbiting of the orbiting scroll and a thrust load is increased, the position of the thrust plate deviates from the recessed portion and the thrust plate and the front housing interfere with each other. Therefore, there is a possibility that the thrust plate and its peripheral components (components disposed around the thrust plate) may be damaged.
[0007] Thus, an object of the invention is to provide a scroll compressor that can suppress damage to a thrust plate and its peripheral components.

Solution to Problem

[0008] In order to solve the above problems, a scroll compressor related to an aspect of the invention includes a housing that has a cylindrical rear housing, and a front housing including a plate placement surface; a fixed scroll that is provided within the rear housing and fixed to the rear housing; an orbiting scroll that is provided within the rear housing, partitions a compression chamber between the orbiting scroll and the fixed scroll by meshing the fixed scroll, and is revolved and driven around the fixed scroll; a ring-like thrust plate that is disposed between an end plate, in the orbiting scroll, disposed on a side opposite to a side where the fixed scroll is provided and the plate placement surface of the front housing; and a plurality of bolts that are fastened to a plate placement part, of the front housing, which partitions the plate placement surface and that restricts a position of the thrust plate with respect to the plate placement part.
[0009] According to the invention, by having the plurality of bolts that are fastened to the plate placement part partitioning the plate placement surface, in the front housing which does not turn, and that restrict the position of the thrust plate with respect to the plate placement part, it is possible to suppress the displacement of the thrust plate even in case where a centrifugal force becomes large due to the orbiting of the orbiting scroll and a thrust load is increased.
[0010] Accordingly, since any interference between the thrust plate and the front housing is suppressed, damage to the thrust plate and its peripheral components (components disposed around the thrust plate) can be suppressed.
[0011] Additionally, in the scroll compressor according to the aspect of the above invention, the plurality of bolts each may include a head part, and a shaft part having one end connected to the head part, and at least a portion of the head part may be disposed to protrude from the plate placement surface, and the thrust plate may have a plurality of through-holes that allow the head part to pass therethrough.
[0012] By adopting such a configuration, it is possible to dispose the thrust plate on the plate placement surface in a state where the plurality of bolts are fastened to the plate placement part, without detaching the plurality of bolts fastened to the plate placement part from the plate placement part. Accordingly, positional restriction of the thrust plate can be enhanced due to the fitting between the head parts of the bolts and the through-holes of the thrust plate.
[0013] Additionally, by configuring the thrust plate so as not to be directly fastened with the bolts, occurrence of distortion or deformation of the thrust plate resulting from the bolt fastening is suppressed. Thus, the reliability of the scroll compressor can be improved.
[0014] Additionally, in the scroll compressor according to the aspect of the invention, the head part of each of the plurality of bolts may be disposed outside the orbiting scroll, and an outer peripheral part of the end plate may be provided with a first cutout part capable of housing

the head part when the orbiting scroll is revolved.

[0015] By providing the first cutout part having such a configuration at the outer peripheral part of the end plate, the contact between the outer peripheral part of the orbiting scroll and the head parts of the bolts when the orbiting scroll is revolved can be suppressed.

[0016] Additionally, in the scroll compressor according to the aspect of the invention, a material of each of the plurality of bolts may be a material harder than a material of the orbiting scroll.

[0017] In this way, by using the material harder than the material of the orbiting scroll as the material of the plurality of bolts, even in case where the outer peripheral part of the orbiting scroll and the head parts of the bolts are in contact with each other when the orbiting scroll is revolved, damage to the head parts of the bolts may be suppressed. Accordingly, even in case where a thrust load is increased, displacement of the thrust plate can be suppressed by the plurality of bolts.

[0018] Additionally, in the scroll compressor according to the aspect of the above invention, the rear housing may include a suction port that suctions a fluid within the rear housing, and the plurality of bolts may be provided at positions separated from the suction port in a circumferential direction of the plate placement part.

[0019] In this way, by providing the plurality of bolts at positions separated from the suction port for suctioning the fluid in the circumferential direction of the plate placement part, the fluid does not easily collide against the head parts of the bolts. Accordingly, occurrence of turbulence in the airflow of the fluid within the housing can be suppressed.

[0020] In the scroll compressor according to the aspect of the invention, the plate placement part of the front housing may be provided with bolt holes to which the plurality of bolts are fastened, and each of the plurality of bolts may include a protruding part that is provided at the other end of a shaft part of each of the plurality of bolts, is made to have an outer diameter smaller than an outer diameter of the shaft part, and protrudes in an extending direction of the shaft part.

[0021] In this way, by having the protruding part, which has an outer diameter smaller than the outer diameter of the shaft part and protrudes in the extending direction of the shaft part, at the other end of the shaft part of each of the plurality of bolts, it is possible to make the bolts independent from the bolt holes by inserting the protruding part into each bolt hole when the bolts are fastened to the bolt holes. Accordingly, the work of fastening the bolts to the plurality of bolt holes can be easily performed.

[0022] Additionally, the scroll compressor according to the aspect of the invention may further include a rotation suppressing member that is provided between the orbiting scroll and the thrust plate, suppresses rotation of the orbiting scroll, and includes a plurality of engaging projections, the thrust plate may include a plurality of insertion cutout parts into which the engaging projections are inserted, and the plurality of through-holes may be provided at positions separated from the plurality of insertion cutout parts.

[0023] In this way, by providing the plurality of through-holes at the positions separated from the plurality of insertion cutout parts, a decrease in the strength of the portions of the thrust plate partitioning the through-holes and the portions of the thrust plate partitioning the insertion cutout parts can be suppressed.

[0024] Additionally, in the scroll compressor according to the aspect of the invention, the front housing may include a plurality of second cutout parts that are provided in the outer peripheral part of the plate placement part in a circumferential direction, and are formed by cutting out the plate placement part corresponding to the plate placement surface, and the thrust plate may have claw parts that are provided in the outer peripheral part of the thrust plate in the circumferential direction and are respectively disposed within the plurality of second cutout parts in a bent state.

[0025] In this way, by having the claw parts that are respectively disposed in a bent state within the plurality of second cutout parts, it is possible to restrict the position of the thrust plate using both members of the claw parts and the head parts of the bolts. Thus, even in case where the thrust load is increased, the displacement of the thrust plate can be further suppressed. Additionally, it is possible to restrict the position of the thrust plate using both members of the claw parts and the head parts of the bolts. Accordingly, even in case where any one of the claw parts and the head parts of the bolts lose the function of positional restriction of the thrust plate due to wear or the like, it is possible to perform the positional restriction of the thrust plate using the other. Accordingly, the reliability of the scroll compressor can be improved.

[0026] Additionally, in the scroll compressor according to the aspect of the invention, the plurality of claw parts may be provided at positions different from formation positions of a plurality of through-holes provided in the thrust plate in a radial direction of the thrust plate.

[0027] By providing the plurality of claw parts at such positions, a decrease in the strength of the plurality of claw parts can be suppressed.

[0028] Additionally, in the scroll compressor according to the aspect of the invention, the plurality of claw parts may be disposed outside the formation positions of a plurality of through-holes provided in the thrust plate.

[0029] The plurality of claw parts are configured by bending the thrust plate that is a thin plate. For this reason, the claw parts may be damaged if the claw parts receive a large thrust load.

[0030] Thus, by providing the plurality of claw parts outside the formation positions (in other words, the positions of the plurality of bolts) of the plurality of through-holes provided in the thrust plate, the thrust plate abuts against the plurality of bolts disposed inside the plurality of claw parts even in case where a large thrust load is applied to the thrust plate. Accordingly, since it is possible to reduce the thrust load in the outer peripheral part of the

thrust plate. Accordingly, the plurality of claw parts do not receive a large thrust load. Hence, the displacement of the thrust plate can be further suppressed while suppressing damage to the plurality of claw parts.

[0031] Additionally, in the scroll compressor according to the aspect of the above invention, a first clearance formed between a head part of each of the bolts and each of through-holes of the thrust plate may be smaller than a second clearance formed between a position where the thrust plate is bent and each of the second cutout parts.

[0032] In this way, by making the first clearance smaller than second clearance, the portions of the thrust plate that partition the through-holes, and the bolts are brought into contact with each other when the thrust plate is displaced. Accordingly, it is possible to suppress the collision of the plurality of claw parts against corners of the second cutout parts. Accordingly, damage to the claw parts resulting from the claw parts colliding against the corners of the second cutout parts can be suppressed.

Advantageous Effects of Invention

[0033] Accordingly, damage to the thrust plate and its peripheral components (components disposed around the thrust plate) can be suppressed.

Brief Description of Drawings

[0034]

Fig. 1 is a sectional view schematically illustrating a schematic configuration of principal parts of a scroll compressor related to a first embodiment of the invention.

Fig. 2 is a schematic view for illustrating a positional relationship between a suction port constituting a housing, and a plurality of bolts.

Fig. 3 is a sectional view of the scroll compressor illustrated in Fig. 2 taken along line C_1-C_2.

Fig. 4 is a plan view schematically illustrating a rotation suppressing member illustrated in Fig. 1.

Fig. 5 is a sectional view for illustrating a modification example of bolts to be fastened to a plate placement part.

Fig. 6 is a sectional view schematically illustrating a schematic configuration of principal parts of a scroll compressor related to a modification example of the first embodiment.

Fig. 7 is a view schematically illustrating a schematic configuration of principal parts of a scroll compressor related to a second embodiment of the invention.

Fig. 8 is a sectional view of the scroll compressor illustrated in Fig. 7 taken along line D_1-D_2.

Description of Embodiments

[0035] Hereinafter, embodiments to which the invention is applied will be described in detail with reference to the drawings.

(First embodiment)

[0036] A scroll compressor 10 of a first embodiment of the invention will be described with reference to Figs. 1 to 3. In addition, O_1 illustrated in Fig. 1 represents an axis (hereinafter referred to as "an axis O1") of a drive shaft 14. Fig. 2 is a view of a plate placement part 42, a thrust plate 27, a bolt 12, and a rear housing 32, which are illustrated in Fig. 1, as seen from A. In Fig. 2, for the convenience of description, the rear housing 32 is illustrated in a section. E illustrated in Fig. 2 represents a circumferential direction (hereinafter referred to as "a circumferential direction E") of the plate placement part 42.

[0037] In Fig. 2, the same components as those of the structural body illustrated in Figs. 1 and 3 are denoted by the same reference signs. Additionally, for convenience of description, an end plate 51A (refer to Fig. 1), which is not illustrated in Fig. 2, is illustrated in Fig. 3.

[0038] The scroll compressor 10 has a housing 11, a plurality of the bolts 12, a main bearing 13, the drive shaft 14, a sub-bearing 15, a lip seal 17, a driven crank mechanism 19, a compressor body 21, a rotation suppressing member 23, and the thrust plate 27.

[0039] The housing 11 has a sealed structure and has the rear housing 32 and a front housing 34.

[0040] The rear housing 32 is a cylindrical cup-shaped member. One side of the rear housing 32 is an open end. The rear housing 32 has a suction port 35 for introducing a fluid into the housing 11 from the outside of the housing 11.

[0041] The front housing 34 is provided on the open end side of the rear housing 32 so as to block the open end of the rear housing 32. The front housing 34 has a first housing part 36 and a second housing part 37.

[0042] The first housing part 36 is fitted to the rear housing 32 via a seal member (for example, an O-ring or the like) on the open end side of the rear housing 32. The first housing part 36 has a main-bearing housing part 41 and the plate placement part 42. The main-bearing housing part 41 has a space capable of housing the main bearing 13 therein.

[0043] The plate placement part 42 is disposed between the main-bearing housing part 41 and an orbiting scroll 51 in the axis O_1. The plate placement part 42 protrudes in a direction toward the orbiting scroll 51 from the main-bearing housing part 41 located outside the main bearing 13.

[0044] The shape of the plate placement part 42 is a ring shape. The plate placement part 42 has a plate placement surface 42a that is a plane that faces the orbiting scroll 51. The plate placement surface 42a is a ring-like flat plane. The thrust plate 27 is disposed on the plate placement surface 42a.

[0045] The plate placement part 42 has a plurality of (for example, two as an example, in the case of Fig. 2)

and bolt holes 42A and a plurality of cutout grooves 42B. The bolts 12 are respectively fastened to the plurality of bolt holes 42A. It is preferable that the plurality of bolt holes 42A are provided, for example, at positions separated from the suction port 35 in the circumferential direction E of the plate placement part 42.

[0046] In this way, by providing the plurality of bolt holes 42A at the positions separated from the suction port 35 in the circumferential direction E of the plate placement part 42, it is possible to dispose the plurality of bolts 12 at the positions separated in the circumferential direction E of the plate placement part 42 from the suction port 35.

[0047] Accordingly, since it is possible to suppress the collision of the fluid immediately after being suctioned from the suction port 35 against head parts 12A of bolts 12, occurrence of turbulence in an airflow formed within the housing 11 can be suppressed.

[0048] Additionally, as illustrated in Fig. 2, in case where the plate placement part 42 has two bolt holes 42A, the two bolt holes 42A may be disposed to face each other with the axis O_1 interposed therebetween. By providing the two bolt holes 42A at such positions, the position of the thrust plate 27 with respect to the plate placement part 42 can be firmly restricted using the two bolts 12.

[0049] In addition, although a case where the two bolt holes 42A are provided has been described as an example in Fig. 2, the number of bolt holes 42A may be plural and is not limited to two.

[0050] The cutout grooves 42B are formed by being cut out in portions of an inner peripheral part of the plate placement surface 42a. The plurality of (two as an example, in the case of Fig. 2) cutout grooves 42B are disposed in the circumferential direction of the plate placement part 42. As illustrated in Fig. 2, in case where two cutout grooves 42B are provided, the cutout grooves 42B may be disposed to face each other with the axis O_1 interposed therebetween.

[0051] Each of the plurality of bolts 12 has a head part 12A, and a shaft part 12B having one end connected to the head part 12A. The plurality of bolts 12 are provided at the plate placement part 42. The head parts 12A are fastened to the two bolt holes 42A in a state where lower surfaces 12Aa of the bolts 12 are in contact with the plate placement surface 42a. Accordingly, the entire head parts 12A protrude from the plate placement surface 42a. The plurality of bolts 12 are disposed in an outer peripheral part of the thrust plate 27 in a circumferential direction.

[0052] The head parts 12A of the bolts 12 are disposing within through-holes 64 (to be described below) of the thrust plate 27, so that when the thrust plate 27 is displaced, the thrust plate 27 partitioning the through-holes 64 abuts against the head parts, thereby suppressing the displacement of the thrust plate 27.

[0053] The plurality of bolts 12 may be provided, for example, at positions separated from the suction port 35 in the circumferential direction of the plate placement part 42.

[0054] In this way, by providing the plurality of bolts 12 at positions separated from the suction port 35 for suctioning the fluid in the circumferential direction of the plate placement part 42, the fluid does not easily collide against the head parts 12A of the bolts 12. Accordingly, occurrence of turbulence in the airflow of the fluid within the housing 11 can be suppressed.

[0055] The second housing part 37 is formed integrally with the first housing part 36 such that the first housing part 36 is disposed between the second housing part 37 and the orbiting scroll 51.

[0056] The second housing part 37 is a tubular member extends in the direction of the axis O_1, and both ends thereof are open ends. The outer diameter and the inner diameter of the second housing part 37 are configured so as to be smaller than the outer diameter and the inner diameter of the main-bearing housing part 41.

[0057] The main bearing 13 has an outer ring 13A, an inner ring 13B, and a plurality of rolling elements 13C. The outer ring 13A is fixed to the main-bearing housing part 41. The inner ring 13B is fixed to an outer peripheral part of a base end part 14A of the drive shaft 14. The plurality of rolling elements 13C are disposed between the outer ring 13A and the inner ring 13B.

[0058] The drive shaft 14 extends in the direction of the axis O_1, and has the base end part 14A, a tip part 14B, and a crankpin 14C.

[0059] The drive shaft 14 passes through the second housing part 37 from the inside of the housing 11. A portion of the tip part 14B of the drive shaft 14 is housed within the second housing part 37 in a state where a gap allowing the sub-bearing 15 to be disposed therein is interposed between the tip part and the second housing part 37.

[0060] A remaining portion (a portion located closer to a tip side than a portion of the tip part 14B) of the tip part 14B of the drive shaft 14 protrudes toward the outside of the second housing part 37.

[0061] The base end part 14A is larger in diameter than the tip part 14B. The crankpin 14C is provided at the base end part 14A located on the side opposite to the side where the tip part 14B is disposed. The crankpin 14C is disposed at a position that is eccentric by a predetermined dimension with respect to the axis O_1.

[0062] The sub-bearing 15 is provided between the second housing part 37 and a portion of the tip part 14B of the drive shaft 14. The sub-bearing 15 has an outer ring 15A, an inner ring 15B, and a plurality of rolling elements 15C. The outer ring 15A is fixed inside the second housing part 37.

[0063] The inner ring 15B is fixed to a partial outer peripheral part of the tip part 14B of the drive shaft 14. The plurality of rolling elements 15C are disposed between the outer ring 15A and the inner ring 15B.

[0064] Accordingly, the sub-bearing 15 rotatably supports the drive shaft 14 together with the main bearing 13.

[0065] The lip seal 17 is provided on an inner wall of the second housing part 37 located closer to the base end part 14A side of the drive shaft 14 than the sub-bearing 15. The lip seal 17 abuts against an outer peripheral surface of the drive shaft 14. The lip seal 17 is a seal member for maintaining the airtightness within the housing 11 (for preventing entering of the air outside the housing 11) .

[0066] The driven crank mechanism 19 has a drive bush 46 and a turning bearing 47. The drive bush 46 houses the crankpin 14C and is fixed to the outside of the crankpin 14C. The turning bearing 47 is provided outside the drive bush 46.

[0067] The compressor body 21 is housed within the housing 11 and has a fixed scroll 49 and the orbiting scroll 51.

[0068] The fixed scroll 49 has an end plate 49A and a wrap part 49B. The end plate 49A is orthogonal to the axis O_1. The end plate 49A is disposed to face the front housing 34 via the orbiting scroll 51 in the direction of the axis O_1. The end plate 49A is orthogonal to the axis O_1 and has one surface 49Aa that faces the orbiting scroll 51. The end plate 49A of the fixed scroll 49 is fixed to the rear housing 32 with bolts or the like.

[0069] The wrap part 49B has a spiral shape and is provided on the one surface 49Aa of the end plate 49A. The wrap part 49B is erected in the direction of the axis O_1.

[0070] The orbiting scroll 51 is disposed between the front housing 34 and the fixed scroll 49. The orbiting scroll 51 has the end plate 51A, a wrap part 51B, and a boss part 51C.

[0071] The end plate 51A is orthogonal to the axis O_1. The end plate 51A has one surface 51Aa that faces the one surface 49Aa of the fixed scroll 49, the other surface 51Ab, and a first cutout part 51Ac.

[0072] The one surface 51Aa is in contact with an inner peripheral part of the thrust plate 27 and is disposed inside positions where the head parts 12A of the plurality of bolts 12 are provided.

[0073] The other surface 51Ab is disposed on the side opposite to the one surface 51Aa and is orthogonal to the axis O_1. The other surface 51Ab faces the driven crank mechanism 19. The first cutout part 51Ac is provided at an outer peripheral part of the end plate 51A so as to be capable of housing the head parts 12A of the bolts 12 when the orbiting scroll 51 is revolved.

[0074] By providing the first cutout part 51Ac having such a configuration at the outer peripheral part of the end plate 51A, the contact between the outer peripheral part of the orbiting scroll 51 and the head parts 12A of the bolts 12 when the orbiting scroll 51 is revolved can be suppressed.

[0075] The wrap part 51B has a spiral shape and is provided on the one surface 51Aa of the end plate 51A. The wrap part 51B is erected in the direction of the axis O_1 (a direction toward the end plate 49A). The wrap part 51B meshes with the wrap part 49B. Accordingly, a compression chamber 21A that compresses the fluid is partitioned between the fixed scroll 49 and the orbiting scroll 51.

[0076] The boss part 51C is provided on the other surface 51Ab of the end plate 51A. The boss part 51C protrudes in a direction toward the front housing 34 from the other surface 51Ab of the end plate 51A. The boss part 51C houses a portion of the driven crank mechanism 19. The boss part 51C is coupled to the crankpin 14C via the driven crank mechanism 19.

[0077] Accordingly, the orbiting scroll 51 is configured to be capable of being revolved and driven with respect to the fixed scroll 49.

[0078] In addition, as the material of the plurality of bolts 12 described earlier, for example, a material harder than the material of the orbiting scroll 51 may be used.

[0079] In this way, by using the material harder than the material of the orbiting scroll 51 as the material of the plurality of bolts 12, even in case where the outer peripheral part of the orbiting scroll 51 and the head parts 12A of the bolts 12 are in contact with each other when the orbiting scroll 51 is revolved, damage to the head parts 12A of the bolts 12 may be suppressed. Accordingly, even in case where a thrust load is increased, displacement of the thrust plate 27 can be suppressed by the plurality of bolts 12.

[0080] Next, the rotation suppressing member 23 will be described with reference to Figs. 1, 2, and 4. In Fig. 4, the rotation suppressing member 23 as seen in a plan view from the front housing 34 side is illustrated. Additionally, in Fig. 4, an Oldham ring is illustrated as an example of the rotation suppressing member 23.

[0081] The rotation suppressing member 23 is provided between the plate placement part 42 and the orbiting scroll 51. The rotation suppressing member 23 has a ring-like member 55, first engaging projections 56, and second engaging projections 57. The ring-like member 55 has a surface in contact with the end plate 51A of the orbiting scroll 51 and a surface 55a disposed on the side opposite to this surface. The surface 55a is a surface that faces the front housing 34.

[0082] The first engaging projections 56 are provided by the same number as that of the cutout grooves 42B on the surface 55a of the ring-like member 55. The first engaging projections 56 protrude in a direction orthogonal to the surface 55a of the ring-like member 55. The first engaging projections 56 are disposed at positions where the projections are insertable into the cutout grooves 42B.

[0083] A plurality of (two as an example in the case of Fig. 3) the second engaging projections 57 are provided on the surface 55a of the ring-like member 55 located on the side opposite to the surface 55a. The second engaging projections 57 protrude from the surface 55a of the ring-like member 55 located on the side opposite to the surface 55a. The second engaging projections 57 have a shape wider than the ring-like member 55. The second engaging projections 57 are inserted into groove parts

formed in the end plate 51A.

[0084] The rotation suppressing member 23 having the above configuration suppresses the rotation of the orbiting scroll 51.

[0085] In addition, although the Oldham ring has been described as an example of the rotation suppressing member 23 in Fig. 4, for example, a pin/link type rotation suppressing member, or other types of rotation suppressing members may be used.

[0086] Next, the thrust plate 27 will be described with reference to Figs. 1 to 4.

[0087] The thrust plate 27 is a thin metallic plate and is provided between the plate placement part 42 and the orbiting scroll 51. The thrust plate 27 has a plate body 61, a plurality of insertion cutout parts 62, and a plurality of through-holes 64.

[0088] The plate body 61 is a ring-like plate material. In the plate body 61, one entire overall surface is in contact with the plate placement surface 42a, and an inner peripheral part of the other surface is in contact with the end plate 51A of the orbiting scroll 51. Accordingly, the outer peripheral part of the plate body 61 is exposed from the end plate 51A.

[0089] The plurality of (two as an example in the case of Fig. 2) insertion cutout parts 62 are provided at an inner peripheral part of the plate body 61. The plurality of insertion cutout parts 62 are provided so as to correspond to the formation positions of the cutout grooves 42B.

[0090] Portions of the first engaging projections 56 are inserted into the plurality of insertion cutout parts 62. By inserting the first engaging projections 56 into the insertion cutout parts 62 and the cutout grooves 42B, the positions of the plate placement part 42, the thrust plate 27, and the rotation suppressing member 23 are restricted.

[0091] As illustrated in Fig. 2, in case where the two insertion cutout parts 62 are provided, two insertion cutout parts 62 may be disposed so as to face each other with the axis O_1 interposed therebetween. In addition, the number of insertion cutout parts 62 may be plural and is not limited to two.

[0092] The plurality of (two as an example in the case of Fig. 2) 64 are circular holes formed by passing through the outer peripheral part of the plate body 61. The diameter of the plurality of through-holes 64 is set to such a size that the through-holes allow the head parts 12A of the bolts 12 to pass therethrough. A first clearance CL_1 is provided between the plurality of through-holes 64 and the head parts 12A of the bolts 12. The plurality of through-holes 64 surround the head parts 12A of the bolts 12 via the first clearance CL_1.

[0093] In this way, by having the thrust plate 27 including the plurality of through-holes 64 having such a size that the head parts 12A of the bolts 12, which are disposed on the plate placement surface 42a of the plate placement part 42 and protrude from the plate placement surface 42a, can pass through the through-holes, it is possible to dispose the thrust plate 27 on the plate placement surface 42a in a state where the plurality of bolts 12 are fastened to the plate placement part 42, without detaching the plurality of bolts 12 fastened to the plate placement part 42 from the plate placement part 42.

[0094] Accordingly, positional restriction of the thrust plate 27 can be enhanced due to the fitting between the head parts 12A of the bolts 12 and the through-holes 64 of the thrust plate 27.

[0095] Additionally, by configuring the thrust plate 27 so as not to be directly fastened with the bolts 12, occurrence of distortion or deformation of the thrust plate 27 resulting from the bolt fastening is suppressed. Thus, the reliability of the scroll compressor 10 can be improved.

[0096] Additionally, the plurality of through-holes 64 may be provided, for example, at positions separated from the plurality of insertion cutout parts 62.

[0097] In this way, by providing the plurality of through-holes 64 at the positions separated from the plurality of insertion cutout parts 62, a decrease in the strength of the portions of the thrust plate 27 partitioning the through-holes 64 and the portions of the thrust plate 27 partitioning the insertion cutout parts 62 can be suppressed.

[0098] In the scroll compressor 10 having the above configuration, the orbiting scroll 51 is separated from the thrust plate 27 and replacement work (maintenance) of the thrust plate 27 is performed, in a state where the plurality of bolts 12 are fastened to the bolt holes 42A of the plate placement part 42.

[0099] According to the scroll compressor 10 of the first embodiment, by having the plurality of bolts 12 that are fastened to the plate placement part 42 partitioning the plate placement surface 42a, in the front housing 34 which does not turn, and that restrict the position of the thrust plate 27 with respect to the plate placement part 42, it is possible to suppress the displacement of the thrust plate 27 even in case where a centrifugal force becomes large due to the orbiting of the orbiting scroll 51 and a thrust load is increased.

[0100] Accordingly, since any interference between the thrust plate 27 and the front housing 34 is suppressed, damage to the thrust plate 27 and its peripheral components (components disposed around the thrust plate 27) can be suppressed.

[0101] Next, the modification example of the bolt fastened to the plate placement part 42 will be described with reference to Fig. 5. In Fig. 5, the same components as those of the structural body illustrated in Fig. 3 are denoted by the same reference signs.

[0102] A bolt 67 is configured to each bolt 12 except that the configuration of each bolt 12 illustrated in Fig. 3 is further provided with a protruding part 68. A plurality of the bolts 67 are fastened to the bolt holes 42A. The protruding part 68 is provided at the other end of the shaft part 12B.

[0103] The protruding part 68 protrudes in an extending direction of the shaft part 12B. The outer diameter of the protruding part 68 is configured so as to be smaller than the outer diameter of the shaft part 12B.

[0104] In this way, by having the protruding part 68, which has an outer diameter smaller than the outer diameter of the shaft part 12B and protrudes in the extending direction of the shaft part 12B, at the other end of the shaft part 12B of each of the plurality of bolts 67, it is possible to make the bolts 67 independent from the bolt holes 42A by inserting the protruding part 68 into each bolt hole 42A when the bolts 67 are fastened to the bolt holes 42A. Accordingly, the work of fastening the bolts 67 to the plurality of bolt holes 42A can be easily performed.

[0105] Next, a scroll compressor 70 related to a modification example of the first embodiment will be described with reference to Fig. 6. In Fig. 6, some of constituent elements of the scroll compressor 70 are illustrated. In Fig. 6, the same components as those of the structural body illustrated in Fig. 3 are denoted by the same reference signs.

[0106] The scroll compressor 70 is configured similarly to the scroll compressor 10 except having bolt holes 71 instead of the bolt holes 42A that constitute the scroll compressor 10 of the first embodiment.

[0107] Each bolt hole 71 has a head part housing part 71A and a shaft part hole 71B. The head part housing part 71A is provided on the plate placement surface 42a side of the plate placement part 42. The head part housing part 71A houses a portion of the head part 12A of each bolt 12. The shaft part hole 71B is a hole threadedly engaged with the shaft part 12B of the bolt 12 and is formed integrally with the head part housing part 71A.

[0108] By providing the bolt holes 71 considered as such a configuration in the plate placement part 42 and fastening the bolts 12 to the bolt holes 71, it is possible to reduce the amount of protrusion of the head parts 12A that protrude from the plate placement surface 42a.

[0109] Accordingly, a width W of the first cutout part 51Ac (the width in the direction of the axis O_1 illustrated in Fig. 1) can be made smaller as compared to a structural body (a structural body in which the entire head parts 12A protrude from the plate placement surface 42a) illustrated in Fig. 3.

(Second Embodiment)

[0110] A scroll compressor 75 of a second embodiment will be described with reference to Figs. 3, 7, and 8. In Fig. 7, only principal parts of the scroll compressor 75 are schematically illustrated. Additionally, in Fig. 7, the same components as those of the structural body illustrated in Fig. 2 are denoted by the same reference signs. Additionally, in Fig. 8, the same components as those of the structural body illustrated in Fig. 1 and 7 are denoted by the same reference signs.

[0111] The scroll compressor 75 of the second embodiment is configured similarly to the scroll compressor 10 except that the plate placement part 42 described in the first embodiment is provided with a plurality of second cutout parts 76 and a thrust plate 78 is provided instead of the thrust plate 27 that constitutes the scroll compressor 10 of the first embodiment.

[0112] The plurality of second cutout parts 76 are provided in the outer peripheral part of the plate placement part 42 that partitions the plate placement surface 42a, in the circumferential direction.

[0113] Each second cutout part 76 has a surface 76a orthogonal to the plate placement surface 42a. The second cutout part 76 can be disposed, for example, between a bolt 12 and a cutout groove 42B.

[0114] By providing the second cutout part 76 at such a position, the second cutout part 76 can be disposed at a position where an insertion cutout part 62 and a through-hole 64 are not provided.

[0115] The thrust plate 78 is configured similarly to the scroll compressor 10 described in the first embodiment except for having a plurality of claw parts 79.

[0116] The plurality of claw parts 79 are configured such that portions protruding from an outer peripheral edge of the plate body 61 are bent toward the second cutout parts 76 side. The claw parts 79 are disposed within the plurality of second cutout parts 76.

[0117] In this way, by having the claw parts 79 that are respectively disposed in a bent state within the plurality of second cutout parts 76, it is possible to restrict the position of the thrust plate 78 using both members of the claw parts 79 and the head parts 12A of the bolts 12. Thus, even in case where the thrust load is increased, the displacement of the thrust plate 78 can be further suppressed.

[0118] Additionally, it is possible to restrict the position of the thrust plate 78 using both members of the claw parts 79 and the head parts 12A of the bolts 12. Accordingly, even in case where any one of the claw parts 79 and the head parts 12A of the bolts 12 lose the function of positional restriction of the thrust plate 78 due to wear or the like, it is possible to perform the positional restriction of the thrust plate 78 using the other. Accordingly, the reliability of the scroll compressor 75 can be improved.

[0119] Additionally, the plurality of claw parts 79 may be disposed, for example, outside the formation positions of the plurality of through-holes 64 provided in the thrust plate 78.

[0120] The plurality of claw parts 79 are configured by bending the thrust plate 78 that is a thin metallic plate. For this reason, the claw parts 79 may be damaged if the claw parts receive a large thrust load.

[0121] Thus, by providing the plurality of claw parts 79 outside the formation positions (in other words, the positions of the plurality of bolts 12) of the plurality of through-holes 64 provided in the thrust plate 78, the thrust plate 78 abuts against the plurality of bolts 12 disposed inside the plurality of claw parts 79 even in case where a large thrust load is applied to the thrust plate 78. Accordingly, since it is possible to reduce the thrust load in the outer peripheral part of the thrust plate 78, the plurality of claw parts 79 do not receive a large thrust load.

[0122] Accordingly, the displacement of the thrust plate 78 can be further suppressed while suppressing damage to the plurality of claw parts 79.

[0123] Moreover, the plurality of claw parts 79 may be provided at positions different from the formation positions of the plurality of through-holes 64 provided in the thrust plate 78 in a radial direction of the thrust plate 78.

[0124] By providing the plurality of claw parts 79 at such positions, a decrease in the strength of the plurality of claw parts 79 can be suppressed.

[0125] A second clearance CL_2 is formed between the surface 76a of a second cutout part 76 and a claw part 79. The first clearance CL_1 described earlier may be, for example, made smaller than the second clearance CL_2.

[0126] In this way, by making the first clearance CL_1 smaller than second clearance CL_2, the portions of the thrust plate 78 that partition the through-holes 64, and the bolts 12 are brought into contact with each other when the thrust plate 78 is displaced. Accordingly, it is possible to suppress the collision of the claw parts 79 against corners 76A of the second cutout parts 76. Accordingly, damage to the claw parts 79 resulting from the claw parts 79 colliding against the corners 76A of the second cutout parts 76 can be suppressed.

[0127] According to the scroll compressor 75 of the second embodiment, the plurality of claw parts 79 disposed in the outer peripheral edge of the thrust plate 78 in the circumferential direction are provided in addition to the plurality of bolts 12 that restrict the position of the thrust plate 78 with respect to the plate placement part 42. Accordingly, the displacement of the thrust plate 78 can be further suppressed while suppressing the damage to the plurality of claw parts 79.

[0128] In addition, in the second embodiment, the bolts 67 illustrated in Fig. 5 may be used instead of the plurality of bolts 12. Additionally, in the second embodiment, the bolt holes 71 illustrated in Fig. 6 may be used.

[0129] Although the preferable embodiments for carrying out invention have been described above in detail, the invention is not limited to the relevant specific embodiments, and various deformations and changes can be made within the scope of the invention described in the claims.

Industrial Applicability

[0130] The invention is applicable to the scroll compressor. Reference Signs List

[0131]

10, 70, 75:	scroll compressor
11:	housing
12, 67:	bolt
12A:	head part
12B:	shaft part
12Aa:	lower surface
13:	main bearing
13A, 15A:	outer ring
13B, 15B:	inner ring
13C, 15C:	rolling element
14:	drive shaft
14A:	base end part
14B:	tip part
14C:	crankpin
15:	sub-bearing
17:	lip seal
19:	driven crank Mechanism
21:	compressor body
21A:	compression chamber
23:	rotation suppressing member
27, 78:	thrust plate
32:	rear housing
34:	front housing
35:	suction port
36:	first housing part
37:	second housing part
41:	main-bearing housing part
42:	plate placement part
42a:	plate placement surface
42A, 71:	bolt hole
42B:	cutout groove
46:	drive bush
47:	turning bearing
49:	fixed scroll
49A, 51A:	end plate
49Aa, 51Aa:	one surface
49B, 51B:	wrap part
51:	orbiting scroll
51A:	end plate
51Ab:	other surface
51Ac:	first cutout part
51B:	wrap part
51C:	boss part
55:	ring-like member
55a, 76a:	surface
56:	first engaging projection
57:	second engaging projection
61:	plate body
62:	insertion cutout part
64:	through-hole
68:	protruding part
71:	head part housing part
71B:	shaft part hole
76:	second cutout part
76A:	corner
79:	claw part
B:	region
E:	circumferential direction
CL_1:	first clearance
CL_2:	second clearance
O_1:	axis
W:	width

Claims

1. A scroll compressor comprising:

   a housing that has a cylindrical rear housing, and a front housing including a plate placement surface;
   a fixed scroll that is provided within the rear housing and fixed to the rear housing;
   an orbiting scroll that is provided within the rear housing, partitions a compression chamber between the orbiting scroll and the fixed scroll by meshing the fixed scroll, and is revolved and driven around the fixed scroll;
   a ring-like thrust plate that is disposed between an end plate, in the orbiting scroll, disposed on a side opposite to a side where the fixed scroll is provided and the plate placement surface of the front housing; and
   a plurality of bolts that are fastened to a plate placement part, of the front housing, which partitions the plate placement surface and that restricts a position of the thrust plate with respect to the plate placement part.

2. The scroll compressor according to Claim 1,
   wherein the plurality of bolts each include a head part, and a shaft part having one end connected to the head part, and at least a portion of the head part is disposed to protrude from the plate placement surface, and
   wherein the thrust plate has a plurality of through-holes that allow the head part to pass therethrough.

3. The scroll compressor according to Claim 2,
   wherein the head part of each of the plurality of bolts is disposed outside the orbiting scroll, and
   wherein an outer peripheral part of the end plate is provided with a first cutout part capable of housing the head part when the orbiting scroll is revolved.

4. The scroll compressor according to any one of Claims 1 to 3,
   wherein a material of each of the plurality of bolts is a material harder than a material of the orbiting scroll.

5. The scroll compressor according to any one of Claims 1 to 4,
   wherein the rear housing includes a suction port that suctions a fluid within the rear housing, and
   wherein the plurality of bolts are provided at positions separated from the suction port in a circumferential direction of the plate placement part.

6. The scroll compressor according to any one of Claims 1 to 5,
   wherein the plate placement part of the front housing is provided with bolt holes to which the plurality of bolts are fastened, and
   wherein each of the plurality of bolts includes a protruding part that is provided at the other end of a shaft part of each of the plurality of bolts, is made to have an outer diameter smaller than an outer diameter of the shaft part, and protrudes in an extending direction of the shaft part.

7. The scroll compressor according to Claim 2, further comprising:

   a rotation suppressing member that is provided between the orbiting scroll and the thrust plate, suppresses rotation of the orbiting scroll, and includes a plurality of engaging projections,
   wherein the thrust plate includes a plurality of insertion cutout parts into which the engaging projections are inserted, and
   wherein the plurality of through-holes are provided at positions separated from the plurality of insertion cutout parts.

8. The scroll compressor according to any one of Claims 1 to 7,
   wherein the front housing includes a plurality of second cutout parts that are provided in the outer peripheral part of the plate placement part in a circumferential direction, and are formed by cutting out the plate placement part corresponding to the plate placement surface, and
   wherein the thrust plate has claw parts that are provided in the outer peripheral part of the thrust plate in the circumferential direction and are respectively disposed within the plurality of second cutout parts in a bent state.

9. The scroll compressor according to Claim 8,
   wherein the plurality of claw parts are provided at positions different from formation positions of a plurality of through-holes provided in the thrust plate in a radial direction of the thrust plate.

10. The scroll compressor according to Claim 8 or 9,
    wherein the plurality of claw parts are disposed outside the formation positions of a plurality of through-holes provided in the thrust plate.

11. The scroll compressor according to any one of Claims 8 to 10,
    wherein a first clearance formed between a head part of each of the bolts and each of through-holes of the thrust plate is smaller than a second clearance formed between a position where the thrust plate is bent and each of the second cutout parts.

FIG. 1

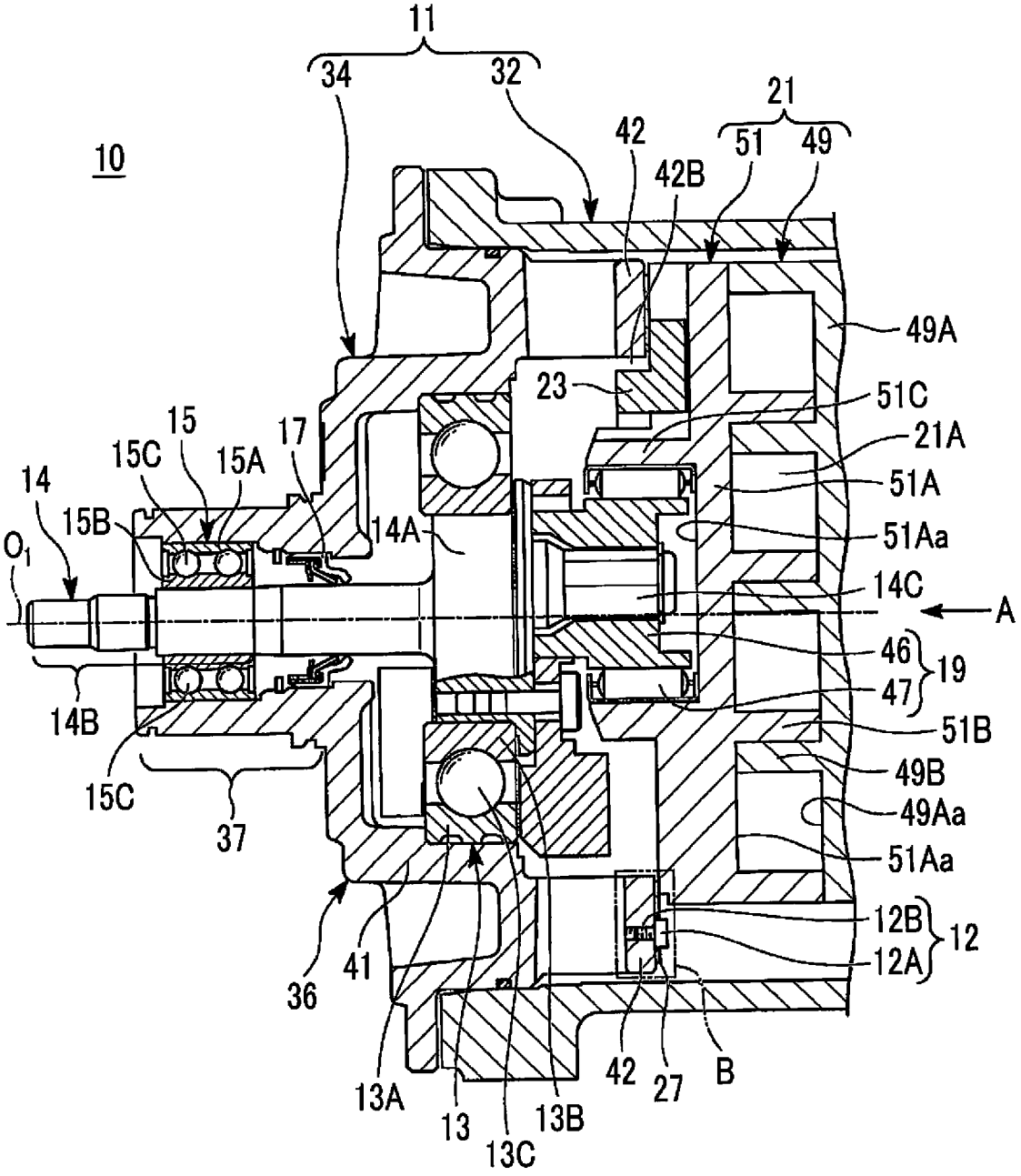

11
34
32
21
51
49
42
42B
10
49A
23
51C
21A
51A
51Aa
14C
A
46
19
47
51B
49B
49Aa
51Aa
12B
12
12A
42
27
B
13A
13
13B
13C
36
41
37
15C
14B
14
15B
15C
15
15A
17
14A
O1

FIG. 2

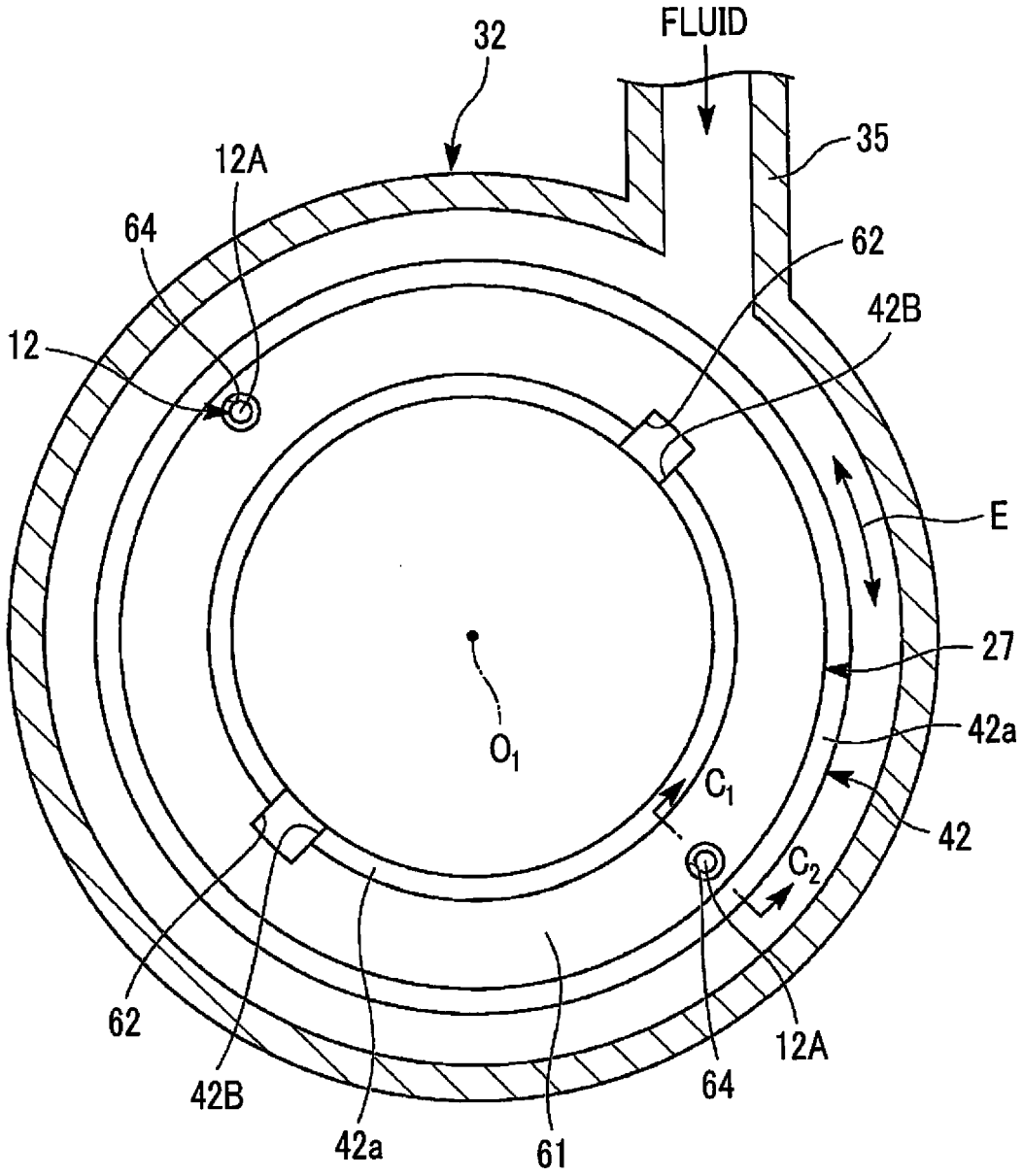

32
FLUID
35
12A
64
62
12
42B
E
27
42a
42
O_1
C_1
C_2
62
42B
42a
61
64
12A

FIG. 3

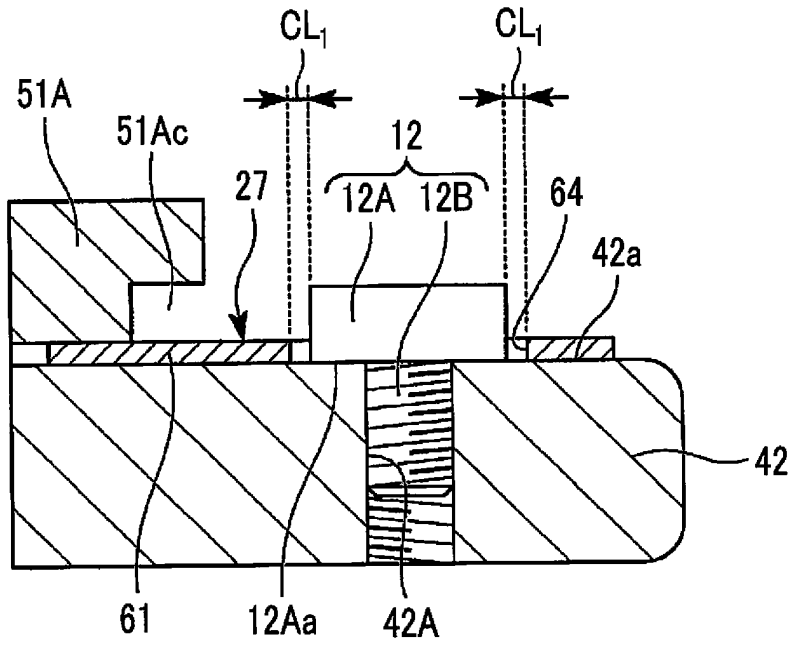

CL1
CL1
51A
51Ac
12
12A
12B
27
64
42a
42
61
12Aa
42A

FIG. 4

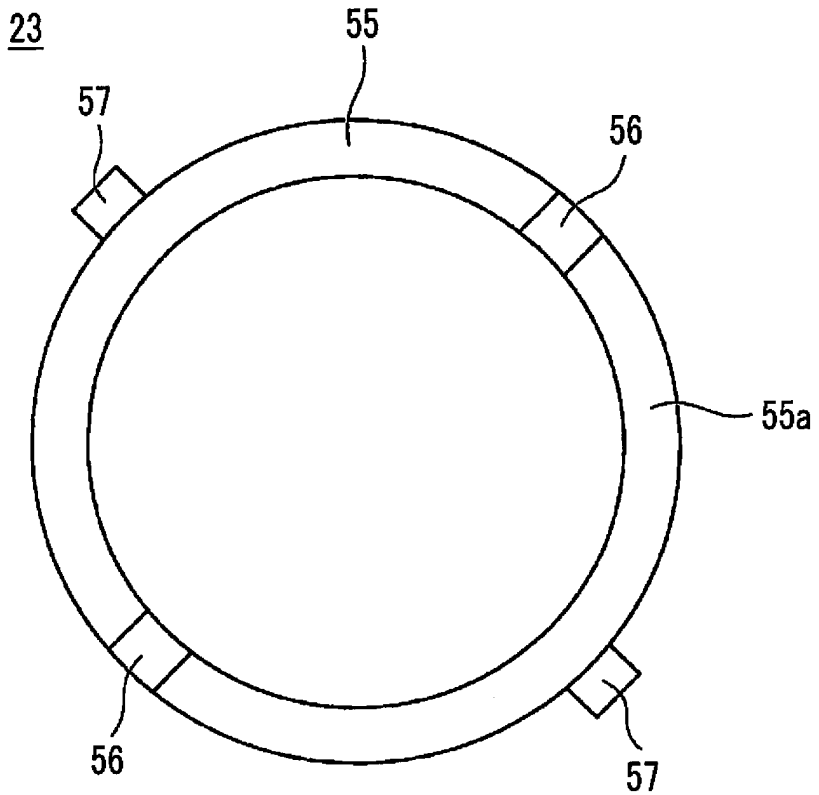

23
55
57
56
55a
56
57

FIG. 5

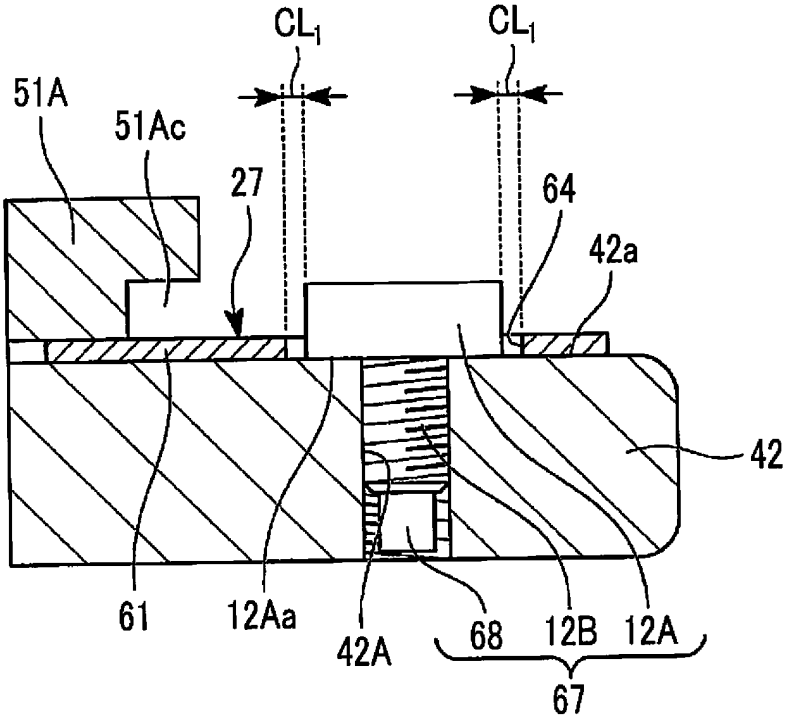

CL1
CL1
51A
51Ac
27
64
42a
42
61
12Aa
42A
68
12B
12A
67

FIG. 6

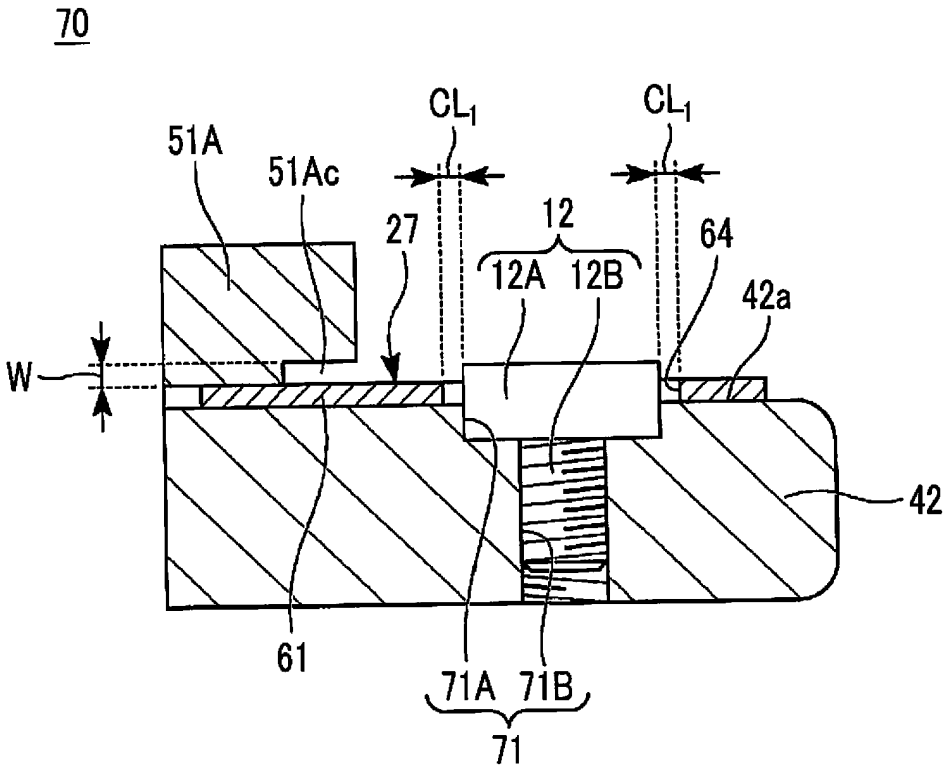

70
CL1
CL1
51A
51Ac
27
12
12A
12B
64
42a
W
42
61
71A
71B
71

FIG. 7

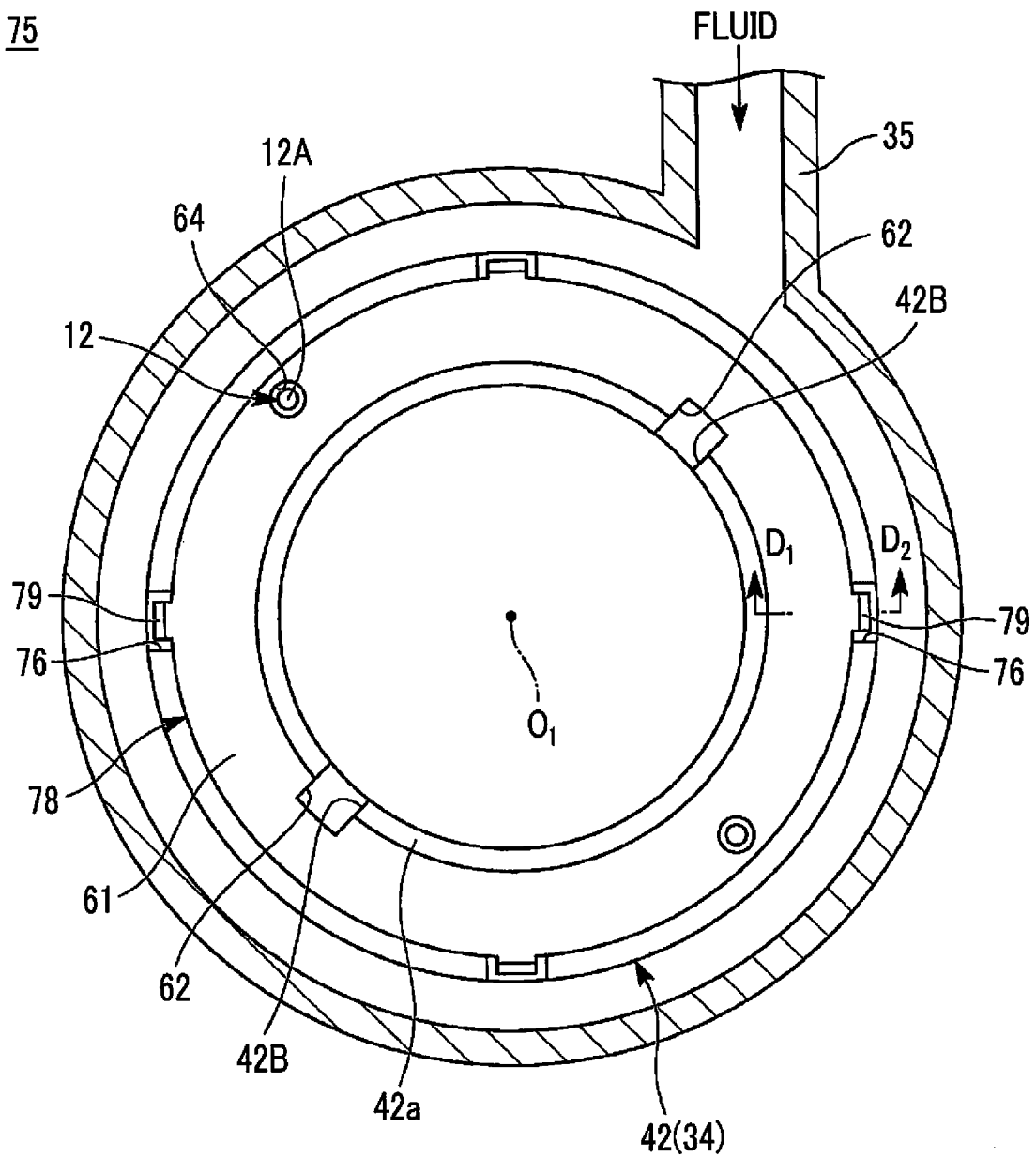
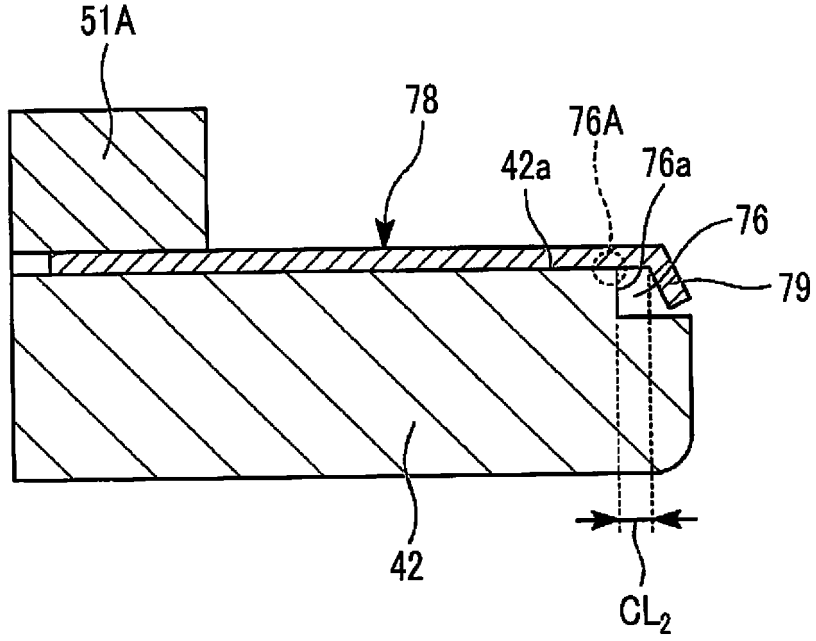

75
FLUID
35
12A
64
62
42B
12
D1
D2
79
79
76
76
O1
78
61
62
42B
42a
42(34)

FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/042359

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F04C18/02(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. 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	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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.
X Y A	JP 2016-151264 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 22 August 2016, paragraphs [0022]-[0038], fig. 1-3, & EP 3081815 A1, paragraphs [0027]-[0047], fig. 1-3	1, 4-6, 8-10 1, 4-6 2-3, 7,11
Y A	JP 2003-166528 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 13 June 2003, paragraphs [0015]-[0020], fig. 1-2 (Family: none)	1, 4-6 2-3, 7,11
Y A	JP 57-173585 A (MITSUBISHI ELECTRIC CORP.) 25 October 1982, page 2, lower right column, line 4 to page 3, lower left column, line 20, fig. 3, 6(a) (Family: none)	1, 4-6 2-3, 7,11

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

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

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/042359

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2016-200062 A (SANDEN AUTOMOTIVE COMPONENTS CORP.) 01 December 2016 & CN 106050656 A	1-11

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2016235045 A **[0001]**
- JP 2012225257 A **[0005]**