



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

(43) Date of publication:
26.02.2020 Bulletin 2020/09

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

(21) Application number: **18848562.7**

(86) International application number:
PCT/JP2018/031262

(22) Date of filing: **24.08.2018**

(87) International publication number:
WO 2019/039575 (28.02.2019 Gazette 2019/09)

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

(72) Inventors:
• **YAMASHITA Takuma**
Tokyo 108-8215 (JP)
• **ITO Takahide**
Tokyo 108-8215 (JP)
• **KITAGUCHI Keita**
Tokyo 108-8215 (JP)
• **TAKEUCHI Makoto**
Tokyo 108-8215 (JP)
• **HIRATA Hirofumi**
Tokyo 108-8215 (JP)

(30) Priority: **25.08.2017 JP 2017162663**
08.09.2017 JP 2017173038
02.10.2017 JP 2017192774
20.10.2017 JP 2017203804

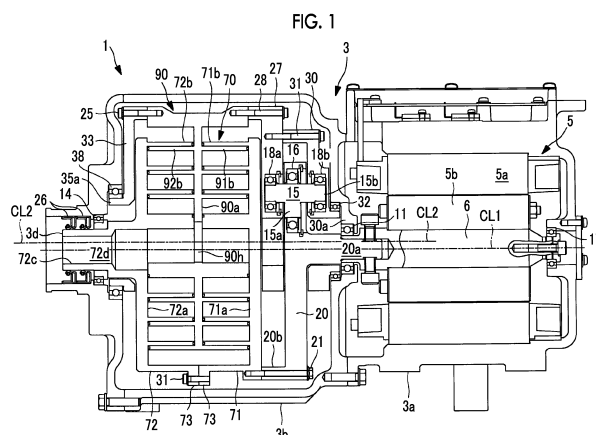
(74) Representative: **Cabinet Beau de Loménie**
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(71) Applicant: **Mitsubishi Heavy Industries, Ltd.**
Chiyoda-ku
Tokyo
100-8332 (JP)

(54) **TWIN ROTARY SCROLL TYPE COMPRESSOR**

(57) This co-rotating scroll compressor is provided with: a first side plate (27) which is arranged on the side of a drive-side rotational axis direction (CL1) with respect to a drive-side scroll member (70) and a driven-side scroll member (90), a second side plate (30) fixed at a predetermined gap in the direction of the drive-side rotational axis (CL1) with respect to the first side plate (27), and a center plate (20) arranged between the first side plate

(27) and the second side plate (30). The first side plate (27) is fixed to the driven-side scroll member (90), and the center plate (20) is fixed to the drive-side scroll member (70). A synchronization drive mechanism equipped with a crank pin (15) is disposed between the first side plate (27) and second side plate (30) and the center plate (20).



Description

Technical Field

[0001] The present invention relates to a co-rotating scroll compressor.

Background Art

[0002] A co-rotating scroll compressor is known in the related art (see PTL 1). The co-rotating scroll compressor is provided with a drive-side scroll and a driven-side scroll rotating synchronously with the drive-side scroll. A driven shaft supporting the rotation of the driven-side scroll is offset by a turning radius with respect to a drive shaft rotating the drive-side scroll. As a result, the drive shaft and the driven shaft are rotated in the same direction and at the same angular velocity.

Citation List

Patent Literature

[0003] [PTL 1] Japanese Patent No. 5443132

Summary of Invention

Technical Problem

[0004] In the co-rotating scroll compressor, a synchronization drive mechanism transmitting a drive force from a drive-side scroll member to a driven-side scroll member is used such that the drive-side scroll member and the driven-side scroll member perform rotating motions in the same direction and at the same angular velocity. Although a mechanism using a crank pin or a pin ring is conceivable as the synchronization drive mechanism, the life of the synchronization drive mechanism may be shortened due to compression heat transmission from the scroll member. A decrease in the life of the synchronization drive mechanism needs to be prevented particularly in a case where a lubricant is used.

[0005] When the synchronization drive mechanism is adopted between the two members, that is, the drive-side scroll member and the driven-side scroll member, a load is applied to the synchronization drive mechanism at two places, which may result in moment generation around the synchronization drive mechanism and a decrease in the life of the synchronization drive mechanism.

[0006] In a case where a pin ring or a crank pin provided with a rolling bearing is used as the synchronization drive mechanism, the lubricant that is enclosed in the rolling bearing may leak to the outside due to a centrifugal force, and then a decrease in bearing life may result from insufficient lubrication. In addition, the lubricant leakage may result in mixing into a compressed fluid and fluid contamination.

[0007] In a case where the crank pin provided with the

rolling bearing is used as the synchronization drive mechanism, it is necessary to provide at least two rolling bearings supporting crank pin rotation, which leads to an increase in cost.

[0008] In a case where the crank pin provided with the rolling bearing is used as the synchronization drive mechanism, the tolerance of the crank pin, the tolerance of the hole into which the rolling bearing is inserted, or the like may lead to internal force generation in the crank pin and a decrease in the life of the synchronization drive mechanism. In a case where cutting is performed with the crank pin integrated in particular, a crank pin machining error is likely to occur and the internal force that is generated in the crank pin may increase.

[0009] The present invention has been made in view of such circumstances, and an object of the present invention is to provide a co-rotating scroll compressor with which the life of a synchronization drive mechanism can be extended.

[0010] An object of the present invention is to provide a co-rotating scroll compressor with which the cost of a synchronization drive mechanism can be reduced.

[0011] An object of the present invention is to provide a co-rotating scroll compressor with which the life of a synchronization drive mechanism that is a crank pin mechanism can be extended.

Solution to Problem

[0012] A co-rotating scroll compressor according to an aspect of the present invention includes a drive-side scroll member driven to rotate around a rotational axis by a drive unit and having a spiral drive-side wall body disposed on a drive-side end plate, a driven-side scroll member in which a spiral driven-side wall body corresponding to the drive-side wall body is disposed on a driven-side end plate and the driven-side wall body meshes with the drive-side wall body to form a compression space, a synchronization drive mechanism transmitting a drive force of the drive unit to the driven-side scroll member such that the drive-side scroll member and the driven-side scroll member perform rotating motions in the same direction and at the same angular velocity, a first side plate disposed on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member, a second side plate fixed at a predetermined gap in the rotational axis direction with respect to the first side plate, and a center plate disposed between the first side plate and the second side plate. The first side plate is fixed to one of the drive-side scroll member and the driven-side scroll member. The center plate is fixed to the other of the drive-side scroll member and the driven-side scroll member. The synchronization drive mechanism is provided between the first and second side plates and the center plate.

[0013] The compression space is formed by the drive-side wall body disposed on the drive-side end plate of the drive-side scroll member and the driven-side wall

body of the driven-side scroll member meshing with each other. The drive-side scroll member is driven to rotate by the drive unit and the drive force is transmitted to the driven-side scroll member via the synchronization drive mechanism. As a result, the driven-side scroll member rotates and performs a rotating motion in the same direction and at the same angular velocity with respect to the drive-side scroll member. Provided in this manner is the co-rotating scroll compressor in which both the drive-side scroll member and the driven-side scroll member rotate.

[0014] The first side plate and the second side plate are provided on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member and the center plate is provided between the side plates. The synchronization drive mechanism is provided between both side plates and the center plate. Since the side plates and the center plate as members separate from both scroll members are provided with the synchronization drive mechanisms as described above, heating attributable to the compression heat from the scroll members can be decreased and the life of the synchronization drive mechanisms can be extended.

[0015] A load is applied to the synchronization drive mechanism from the center plate and the side plates on both sides thereof, and thus the moment around the center plate can be canceled and the life of the synchronization drive mechanisms can be extended.

[0016] The synchronization drive mechanisms are disposed by both side plates and the center plate being provided on the rotational axis direction side, and thus diameter reduction can be achieved as compared with a case where a synchronization drive mechanism is provided on radial direction sides of the scroll members.

[0017] In the co-rotating scroll compressor according to an aspect of the present invention, the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion and a crank pin end portion rolling bearing provided between both end portions of the eccentric shaft portion and the first and second side plates and an urging member urging an inner ring of the crank pin end portion rolling bearing toward a leading edge of the eccentric shaft portion in the eccentric axis direction is provided between the inner ring and the eccentric shaft portion.

[0018] The crank pin and the crank pin end portion rolling bearing constitute the synchronization drive mechanism and the crank pin end portion rolling bearing rotatably and pivotally supports both end portions of the crank pin with both side plates. The urging member urging the inner ring toward the leading edge of the eccentric shaft portion in the eccentric axis direction is provided between the inner ring of the crank pin end portion rolling bearing and the eccentric shaft portion of the crank pin. The urging member urges the inner ring of the crank pin end portion rolling bearing toward the leading edge, and thus an outer ring is pressed against the side plate via the

rolling body of the crank pin end portion rolling bearing. As a result, the crank pin end portion rolling bearing is put into a state where a preload is applied between the eccentric bearing of the crank pin and the side plate, it is possible to prevent slipping between the rolling body and the inner ring and slipping between the inner ring and the eccentric shaft portion, and the life of the synchronization drive mechanism can be extended.

[0019] An O-ring or the like is used as the urging member.

[0020] In the co-rotating scroll compressor according to an aspect of the present invention, the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion and a crank pin end portion rolling bearing provided between both end portions of the eccentric shaft portion and the first and second side plates and a preload is applied to the crank pin end portion rolling bearing in the eccentric axis direction by a gap between the first side plate and the second side plate.

[0021] The crank pin and the crank pin end portion rolling bearing constitute the synchronization drive mechanism and the crank pin end portion rolling bearing rotatably and pivotally supports both end portions of the crank pin with both side plates. A preload is applied to the crank pin end portion rolling bearing in the eccentric axis direction by the gap between the first side plate and the second side plate. As a result, it is possible to prevent slipping between the rolling body of the crank pin end portion rolling bearing and the inner ring and slipping between the inner ring and the eccentric shaft portion and the life of the synchronization drive mechanism can be extended.

[0022] By a specific preload application method, the gap between the side plates is narrowed when the second side plate is fastened to the first side plate. In other words, the gap determined by both side plates being fastened is kept smaller than the gap between both side plates determined by the crank pin end portion rolling bearing and the crank pin of the synchronization drive mechanism.

[0023] In the co-rotating scroll compressor according to an aspect of the present invention, the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion and a crank pin end portion rolling bearing provided between both end portions of the eccentric shaft portion and the first and second side plates and an elastic body is provided between an inner peripheral surface of an inner ring of the crank pin end portion rolling bearing and an outer peripheral surface of the eccentric shaft portion.

[0024] The crank pin and the crank pin end portion rolling bearing constitute the synchronization drive mechanism and the crank pin end portion rolling bearing rotatably and pivotally supports both end portions of the crank pin with both side plates. The elastic body is provided

between the inner peripheral surface of the inner ring of the crank pin end portion rolling bearing and the outer peripheral surface of the eccentric shaft portion. As a result, a reaction force is generated by the elastic body sandwiched between the inner ring and the eccentric shaft portion being deformed, slipping between the eccentric shaft portion and the inner ring can be prevented, and the life of the synchronization drive mechanism can be extended.

[0025] In the co-rotating scroll compressor according to an aspect of the present invention, among a fixing portion of the first side plate which is fixed to one of the drive-side scroll member and the driven-side scroll member and a fixing portion of the center plate which is fixed to the other of the drive-side scroll member and the driven-side scroll member, the fixing portion positioned on a radial inner side of a center of the scroll member has a structure in which a resin portion is interposed, and the fixing portion positioned on a radial outer side of the center of the scroll member has a structure using a metal portion without resin portion interposition.

[0026] The structure in which the resin portion is interposed is because the temperature of the fixing portion positioned on the radial inner side of the center of the scroll member tends to rise due to compression heat. As a result, it is possible to achieve life extension by suppressing a rise in the temperature of the synchronization drive mechanism.

[0027] The metallic structure without resin portion interposition is because a rise in temperature attributable to compression heat has little effect on the fixing portion positioned radially outward of the center of the scroll member. As a result, the fixing portion can be accurately assembled by means of metal, and thus the synchronization drive mechanism can be accurately positioned, phase shift reduction can be achieved between the drive-side scroll member and the driven-side scroll member, and compression performance improvement can be achieved.

[0028] The co-rotating scroll compressor according to an aspect of the present invention includes a drive-side scroll member driven to rotate around a rotational axis by a drive unit and having a spiral drive-side wall body disposed on a drive-side end plate, a driven-side scroll member in which a spiral driven-side wall body corresponding to the drive-side wall body is disposed on a driven-side end plate and the driven-side wall body meshes with the drive-side wall body to form a compression space, a synchronization drive mechanism transmitting a drive force to the driven-side scroll member such that the drive-side scroll member and the driven-side scroll member perform rotating motions in the same direction and at the same angular velocity, a first side plate disposed on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member, a second side plate fixed at a predetermined gap in the rotational axis direction with respect to the first side plate, and a center plate disposed between the first

side plate and the second side plate. The first side plate is fixed to one of the drive-side scroll member and the driven-side scroll member. The center plate is fixed to the other of the drive-side scroll member and the driven-side scroll member. The synchronization drive mechanism is provided between the first and second side plates and the center plate. A peripheral wall portion surrounding an outer peripheral side of the center plate is provided between the first side plate and the second side plate.

[0029] The compression space is formed by the drive-side wall body disposed on the drive-side end plate of the drive-side scroll member and the driven-side wall body of the driven-side scroll member meshing with each other. The drive-side scroll member is driven to rotate by the drive unit and the drive force is transmitted to the driven-side scroll member via the synchronization drive mechanism. As a result, the driven-side scroll member rotates and performs a rotating motion in the same direction and at the same angular velocity with respect to the drive-side scroll member. Provided in this manner is the co-rotating scroll compressor in which both the drive-side scroll member and the driven-side scroll member rotate.

[0030] The first side plate and the second side plate are provided on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member and the center plate is provided between the side plates. The synchronization drive mechanism is provided between both side plates and the center plate. The peripheral wall portion surrounding the outer peripheral side of the center plate is provided between the first side plate and the second side plate. As a result, even when the lubricant supplied to the synchronization drive mechanism is moved to the outer peripheral side by a centrifugal force, the lubricant can be held on the inner peripheral side of the peripheral wall portion, and thus an insufficient lubrication of the synchronization drive mechanism can be avoided and life extension can be achieved.

[0031] Usable as the synchronization drive mechanism is, for example, a crank mechanism provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion and a crank pin end portion rolling bearing provided between both end portions of the eccentric shaft portion and the first and second side plates. The rolling bearing is supplied with a lubricant.

[0032] The co-rotating scroll compressor according to an aspect of the present invention further includes a drive shaft portion rotating around the rotational axis and connected between the drive-side end plate and the drive unit. The center plate is fixed to the drive shaft portion. A hole portion for the first side plate through which the drive shaft portion passes is formed in the first side plate. A hole portion for the second side plate through which the drive shaft portion passes is formed in the second side plate. A first seal member is provided between the hole portion for the first side plate and the drive shaft

portion and/or between the hole portion for the second side plate and the drive shaft portion.

[0033] The drive shaft portion is provided between the drive-side end plate and the drive unit and the center plate is fixed to the drive shaft portion. As a result, a drive force is transmitted from the drive unit to the drive-side scroll member via the center plate.

[0034] The hole portions through which the drive shaft portion passes are respectively provided in the first side plate and the second side plate. As a result, a gap is inevitably formed between both side plates and the drive shaft portion. The first seal member is provided so as to seal the gap. As a result, it is possible to prevent lubricant leakage from the space between both side plates and the drive shaft portion.

[0035] A boots seal, a labyrinth seal, or the like can be adopted as the first seal member.

[0036] The co-rotating scroll compressor according to an aspect of the present invention further includes a drive shaft portion rotating around the rotational axis and connected between the drive-side end plate and the drive unit. The center plate is fixed to the drive shaft portion. A hole portion for the first side plate through which the drive shaft portion passes is formed in the first side plate. A hole portion for the second side plate through which the drive shaft portion passes is formed in the second side plate. A second seal member is provided between the first side plate and the center plate and/or between the second side plate and the center plate.

[0037] The drive shaft portion is provided between the drive-side end plate and the drive unit and the center plate is fixed to the drive shaft portion. As a result, a drive force is transmitted from the drive unit to the drive-side scroll member via the center plate.

[0038] The hole portions through which the drive shaft portion passes are respectively provided in the first side plate and the second side plate. As a result, a gap is inevitably formed between both side plates and the drive shaft portion. The second seal member is provided between both side plates and the center plate. As a result, it is possible to prevent lubricant leakage from the space between both side plates and the drive shaft portion.

[0039] Adoptable as the second seal member is, for example, a tip seal inserted in a circumferential groove formed in each side plate or the center plate.

[0040] In the co-rotating scroll compressor according to an aspect of the present invention, the first side plate is fixed to the drive-side wall body on an outer peripheral side, the second side plate is fixed to the first side plate, the drive unit is connected to a rotation center of the second side plate, the center plate is fixed to a driven shaft portion connected to a rotation center of the driven-side end plate, a hole portion for the first side plate through which the driven shaft portion passes is formed in the first side plate, and a rotation center region of the second side plate is closed by a wall portion.

[0041] The first side plate is fixed to the drive-side wall body on the outer peripheral side, the second side plate

is fixed to the first side plate, and the drive unit is connected to a substantial rotation center of the second side plate. As a result, a drive force is transmitted from the drive unit to the drive-side scroll member via the first side plate and the second side plate.

[0042] The drive force transmitted from both side plates via the synchronization drive mechanism is guided from the center plate to the driven-side scroll member by the center plate being fixed to the driven shaft portion connected to the rotation center of the driven-side end plate.

[0043] The driven shaft portion is disposed so as to pass through the hole portion for the first side plate formed in the first side plate. Since a drive force is transmitted from the center plate to the driven shaft portion via the synchronization drive mechanism, there is no need to form a hole portion for penetration by the driven shaft portion in the rotation center region of the second side plate. Accordingly, it is possible to adopt the second side plate that has a rotation center region closed by a wall portion, and thus lubricant leakage from the rotation center of the second side plate can be prevented.

[0044] The co-rotating scroll compressor according to an aspect of the present invention includes a drive-side scroll member driven to rotate around a rotational axis by a drive unit and having a spiral drive-side wall body disposed on a drive-side end plate, a driven-side scroll member in which a spiral driven-side wall body corresponding to the drive-side wall body is disposed on a driven-side end plate and the driven-side wall body meshes with the drive-side wall body to form a compression space, a synchronization drive mechanism transmitting a drive force of the drive unit to the driven-side scroll member such that the drive-side scroll member and the driven-side scroll member perform rotating motions in the same direction and at the same angular velocity, a first side plate disposed on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member, a second side plate fixed at a predetermined gap in the rotational axis direction with respect to the first side plate, and a center plate disposed between the first side plate and the second side plate. The first side plate is fixed to one of the drive-side scroll member and the driven-side scroll member. The center plate is fixed to the other of the drive-side scroll member and the driven-side scroll member. The synchronization drive mechanism is provided with a round bar-shaped pin provided between the first and second side plates and the center plate and a ring guiding the pin by an inner peripheral surface of the ring abutting against an outer periphery of the pin.

[0045] A pin ring mechanism provided with the round bar-shaped pin and the ring is adopted as the synchronization drive mechanism. As a result, it is possible to realize the synchronization drive mechanism without adopting a crank pin mechanism, and thus it is possible to achieve cost reduction without a complex configuration caused by a large number of bearings being adopted as

in the case of crank pin mechanisms.

[0046] In the co-rotating scroll compressor according to an aspect of the present invention, the ring is a rolling bearing provided on the center plate and both ends of the pin are press-fitted to the first side plate and the second side plate and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing.

[0047] The pin is press-fitted and fixed to both side plates, and thus the pin can be used as a positioning pin for both side plates.

[0048] Both ends of the pin are fixed to both side plates and the central portion of the pin abuts against the inner peripheral surface of the rolling bearing. Accordingly, inclination of the inner ring of the rolling bearing can be prevented, an oblique movement of a rolling member such as a ball can be prevented, and the life of the synchronization drive mechanism can be extended.

[0049] In the co-rotating scroll compressor according to an aspect of the present invention, the ring is a rolling bearing provided on the center plate and one end of the pin is press-fitted to one of the first side plate and the second side plate, the other end of the pin is fixed to the other of the first side plate and the second side plate via an elastic body, and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing.

[0050] One end of the pin is press-fitted and fixed to one of the side plates and the other end of the pin is fixed to the other of the side plates via the elastic body. As a result, both ends of the pin being incapable of being press-fitted to both side plates due to a component tolerance can be prevented, assembly can be facilitated, and cost reduction can be achieved.

[0051] In the co-rotating scroll compressor according to an aspect of the present invention, three or more synchronization drive mechanisms are provided to be spaced apart in a circumferential direction of the rotational axis, in two of the synchronization drive mechanisms, the ring is a rolling bearing provided on the center plate, both ends of the pin are press-fitted to the first side plate and the second side plate, and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing, and in the other synchronization drive mechanism, the ring is a rolling bearing provided on the center plate, one end of the pin is press-fitted to one of the first side plate and the second side plate, the other end of the pin is fixed to the other of the first side plate and the second side plate via an elastic body, and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing.

[0052] Two out of the three or more synchronization drive mechanisms have a function as a positioning pin as a configuration in which both ends of the pin are press-fitted and fixed to both side plates. As for the pin of the other synchronization drive mechanism, one end is press-fitted and fixed and the other end is fixed via the elastic body, which results in tolerance absorption. As a

result, both side plates can be positioned by means of the synchronization drive mechanism and assemblability improvement can be achieved.

[0053] In the co-rotating scroll compressor according to an aspect of the present invention, the ring is a rolling bearing provided on each of the first side plate and the second side plate and a longitudinal central portion of the pin is press-fitted to the center plate and both ends of the pin abut against an inner peripheral surface of the rolling bearing.

[0054] The central portion of the pin is press-fitted to the center plate and both ends of the pin abut against the inner peripheral surfaces of the rolling bearings provided on both side plates. Accordingly, both ends of the pin are not restrained by both side plates, and thus it is possible to avoid a situation in which the pin cannot be fixed during assembly due to the component tolerance of both side plates. As a result, assemblability improvement can be achieved.

[0055] In the co-rotating scroll compressor according to an aspect of the present invention, the ring is a slide bearing instead of the rolling bearing.

[0056] It is possible to achieve cost reduction by replacing the rolling bearing with the slide bearing (such as a floating bush bearing).

[0057] The moment of inertia of a rotation system such as the rolling bearing can be reduced, and thus response enhancement can be achieved.

[0058] The co-rotating scroll compressor according to an aspect of the present invention includes a drive-side scroll member driven to rotate around a rotational axis by a drive unit and having a spiral drive-side wall body disposed on a drive-side end plate, a driven-side scroll member in which a spiral driven-side wall body corresponding to the drive-side wall body is disposed on a driven-side end plate and the driven-side wall body meshes with the drive-side wall body to form a compression space, a synchronization drive mechanism transmitting a drive force of the drive unit to the driven-side scroll member such that the drive-side scroll member and the driven-side scroll member perform rotating motions in the same direction and at the same angular velocity, a first side plate disposed on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member, a second side plate fixed at a predetermined gap in the rotational axis direction with respect to the first side plate, and a center plate disposed between the first side plate and the second side plate. The first side plate is fixed to one of the drive-side scroll member and the driven-side scroll member. The center plate is fixed to the other of the drive-side scroll member and the driven-side scroll member. The synchronization drive mechanism is provided between the first and second side plates and the center plate and is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion, a first crank pin end portion rolling bearing provided between one end of the eccentric

shaft portion and the first side plate, a second crank pin end portion rolling bearing provided between the other end of the eccentric shaft portion and the second side plate, and a cylindrical portion rolling bearing provided between the cylindrical portion and the center plate. An elastic body is provided in at least one of spaces between an outer ring of the first crank pin end portion rolling bearing and the first side plate, between an outer ring of the second crank pin end portion rolling bearing and the second side plate, and between an outer ring of the cylindrical portion rolling bearing and the center plate or in at least one of spaces between an inner ring of the first crank pin end portion rolling bearing and the one end of the eccentric shaft portion, between an inner ring of the second crank pin end portion rolling bearing and the other end of the eccentric shaft portion, and between an inner ring of the cylindrical portion rolling bearing and the cylindrical portion.

[0059] The elastic body is provided between the outer ring of the rolling bearing of the synchronization drive mechanism and the side plate or the center plate or between the inner ring of the rolling bearing of the synchronization drive mechanism and the crank pin. As a result, the tolerance of the crank pin, the side plates, and the center plate can be absorbed by the elastic body being deformed, internal force generation in the crank pin can be avoided, and the life of the synchronization drive mechanism can be extended.

[0060] In addition, the machining tolerance of the crank pin can be mitigated and machining and management costs can be reduced.

[0061] In addition, the outer ring is pressed to the inner ring side by the elastic body, and thus it is possible to prevent slipping between the outer ring and the hole in which the outer ring is fitted.

[0062] In the co-rotating scroll compressor according to an aspect of the present invention, the elastic body is provided between the outer ring of the cylindrical portion rolling bearing and the center plate, the outer ring of the first crank pin end portion rolling bearing is press-fitted to the first side plate, and the outer ring of the second crank pin end portion rolling bearing is press-fitted to the second side plate.

[0063] The outer ring of the first crank pin end portion rolling bearing and the outer ring of the second crank pin end portion rolling bearing are press-fitted, and thus a centrifugal force is held by both crank pin end portion rolling bearings. The two rolling bearings bear the centrifugal force in this manner, and thus the load to be borne can be mitigated as compared with a case where the single cylindrical portion rolling bearing bears the centrifugal force.

[0064] In addition, the crank pin is supported at both ends by the two crank pin end portion rolling bearings, and thus the posture of the crank pin can be stabilized.

[0065] In the co-rotating scroll compressor according to an aspect of the present invention, an insertion hole into which the eccentric shaft portion is inserted is formed

in the cylindrical portion.

[0066] The eccentric shaft portion of the crank pin is inserted into the insertion hole formed in the cylindrical portion. As a result, the eccentric shaft portion and the cylindrical portion can be separate components and can be machined separately as for the crank pin. Accordingly, the axial centers at both ends of the eccentric shaft portion can be aligned as compared with a case where the eccentric shaft portion and the cylindrical portion are integrally machined.

[0067] The co-rotating scroll compressor according to an aspect of the present invention includes a drive-side scroll member driven to rotate around a rotational axis by a drive unit and having a spiral drive-side wall body disposed on a drive-side end plate, a driven-side scroll member in which a spiral driven-side wall body corresponding to the drive-side wall body is disposed on a driven-side end plate the driven-side wall body meshes with the drive-side wall body to form a compression space, a synchronization drive mechanism transmitting a drive force of the drive unit to the driven-side scroll member such that the drive-side scroll member and the driven-side scroll member perform rotating motions in the same direction and at the same angular velocity, a first side plate disposed on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member, a second side plate fixed at a predetermined gap in the rotational axis direction with respect to the first side plate, and a center plate disposed between the first side plate and the second side plate. The first side plate is fixed to one of the drive-side scroll member and the driven-side scroll member. The center plate is fixed to the other of the drive-side scroll member and the driven-side scroll member. The synchronization drive mechanism is provided between the first and second side plates and the center plate and is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion. An insertion hole into which the eccentric shaft portion is inserted is formed in the cylindrical portion.

[0068] The eccentric shaft portion of the crank pin is inserted into the insertion hole formed in the cylindrical portion. As a result, the eccentric shaft portion and the cylindrical portion can be separate components and can be machined separately. Accordingly, the axial centers at both ends of the eccentric shaft portion can be aligned as compared with a case where the eccentric shaft portion and the cylindrical portion are integrally machined. Accordingly, an internal force applied to the crank pin can be reduced and the life of the synchronization drive mechanism can be extended.

Advantageous Effects of Invention

[0069] Since the side plates and the center plate as members separate from the drive-side scroll member and the driven-side scroll member are provided with the syn-

chronization drive mechanisms, heating attributable to the compression heat from the scroll members can be decreased and the life of the synchronization drive mechanisms can be extended.

[0070] The peripheral wall portion surrounding the outer peripheral side of the center plate is provided between the first side plate and the second side plate and the lubricant is held on the inner peripheral side of the peripheral wall portion, and thus the life of the synchronization drive mechanisms can be extended.

[0071] It is possible to simplify the configuration of the synchronization drive mechanism and achieve cost reduction by adopting the pin ring mechanism.

[0072] Tolerance absorption is performed by the elastic body being deformed, and thus internal force generation in the crank pin can be avoided and the life of the synchronization drive mechanisms can be extended.

Brief Description of Drawings

[0073]

Fig. 1 is a longitudinal cross-sectional view illustrating a co-rotating scroll compressor according to a first embodiment of the present invention.

Fig. 2 is a perspective view illustrating a scroll member, both side plates, and a center plate of the co-rotating scroll compressor illustrated in Fig. 1.

Fig. 3 is a plan view illustrating the first drive-side scroll part illustrated in Fig. 1.

Fig. 4 is a plan view illustrating the second drive-side scroll part illustrated in Fig. 1.

Fig. 5 is a longitudinal cross-sectional view illustrating a second embodiment of the present invention and a part around a synchronization drive mechanism.

Fig. 6 is a longitudinal cross-sectional view illustrating Modification Example 1 of the second embodiment.

Fig. 7 is a longitudinal cross-sectional view illustrating Modification Example 2 of the second embodiment.

Fig. 8 is a longitudinal cross-sectional view illustrating a third embodiment of the present invention and a part around the synchronization drive mechanism.

Fig. 9 is a longitudinal cross-sectional view illustrating the co-rotating scroll compressor according to a fourth embodiment of the present invention.

Fig. 10 is a plan view illustrating the first drive-side wall body illustrated in Fig. 9.

Fig. 11 is a plan view illustrating the first driven-side wall body illustrated in Fig. 9.

Fig. 12 is a plan view illustrating the side plate and the center plate.

Fig. 13 is a longitudinal cross-sectional view illustrating a co-rotating scroll compressor according to a fifth embodiment of the present invention.

Fig. 14 is a longitudinal cross-sectional view illustrating

a co-rotating scroll compressor according to a sixth embodiment of the present invention.

Fig. 15 is a longitudinal cross-sectional view illustrating a co-rotating scroll compressor according to a seventh embodiment of the present invention.

Fig. 16 is a plan view illustrating the first drive-side wall body illustrated in Fig. 15.

Fig. 17 is a plan view illustrating the first driven-side wall body illustrated in Fig. 15.

Fig. 18 is a plan view illustrating the side plate and the center plate.

Fig. 19 is an enlarged longitudinal cross-sectional view illustrating a part around a pin ring mechanism.

Fig. 20 is a longitudinal cross-sectional view illustrating a modification example of the pin ring mechanism.

Fig. 21 is a longitudinal cross-sectional view illustrating a part around the pin ring mechanism of the co-rotating scroll compressor according to an eighth embodiment.

Fig. 22 is a longitudinal cross-sectional view illustrating a modification example of Fig. 21.

Fig. 23 is a longitudinal cross-sectional view illustrating a pin ring mechanism provided with a slide bearing as a modification example.

Fig. 24 is a longitudinal cross-sectional view illustrating the co-rotating scroll compressor according to a ninth embodiment of the present invention.

Fig. 25 is a plan view illustrating the first drive-side wall body illustrated in Fig. 24.

Fig. 26 is a plan view illustrating the first driven-side wall body illustrated in Fig. 24.

Fig. 27 is a plan view illustrating the side plate and the center plate.

Fig. 28 is a longitudinal cross-sectional view illustrating a part around an eccentric shaft portion of a crank pin.

Fig. 29 is a longitudinal cross-sectional view illustrating Modification Example 1 of the ninth embodiment.

Fig. 30 is a longitudinal cross-sectional view illustrating Modification Example 2 of the ninth embodiment.

Fig. 31 is a longitudinal cross-sectional view illustrating Modification Example 3 of the ninth embodiment.

Fig. 32A is a front view illustrating the crank pin of the co-rotating scroll compressor according to a tenth embodiment of the present invention.

Fig. 32B is a front view illustrating a crank pin as a reference example of Fig. 32A.

50 Description of Embodiments

[0074] Hereinafter, embodiments according to the present invention will be described with reference to the drawings.

[First Embodiment]

[0075] Hereinafter, a first embodiment of the present

invention will be described with reference to the drawings including Fig. 1.

[0076] Fig. 1 illustrates a co-rotating scroll compressor 1. The co-rotating scroll compressor 1 can be used as a turbocharger compressing combustion air (a fluid) supplied to an internal combustion engine such as a vehicular engine, a compressor for supplying compressed air to an air electrode of a fuel cell, or a compressor for supplying compressed air used for a braking device of a vehicle such as a railway vehicle.

[0077] The co-rotating scroll compressor 1 is provided with a housing 3, a motor (drive unit) 5 accommodated on one end side of the housing 3, and a drive-side scroll member 70 and a driven-side scroll member 90 accommodated on the other end side of the housing 3.

[0078] The housing 3 has a substantially cylindrical shape and is provided with a motor accommodation portion 3a accommodating the motor 5 and a scroll accommodation portion 3b accommodating the scroll members 70 and 90.

[0079] A discharge port 3d for discharging compressed air is formed in an end portion of the scroll accommodation portion 3b. The housing 3 is provided with an air intake port (not illustrated in Fig. 1) suctioning air.

[0080] The motor 5 is driven by power being supplied from a power supply source (not illustrated). The rotation of the motor 5 is controlled by a command from a control unit (not illustrated). A stator 5a of the motor 5 is fixed to the inner peripheral side of the housing 3. A rotor 5b of the motor 5 rotates around a drive-side rotational axis CL1. A drive shaft 6 extending on the drive-side rotational axis CL1 is connected to the rotor 5b. The drive shaft 6 is connected to a shank 20a of a center plate 20 driving a first drive-side scroll part 71 of the drive-side scroll member 70.

[0081] A drive-side bearing 11 rotatably supporting the drive shaft 6 is provided at the front end (left end in Fig. 1) of the drive shaft 6. A rear end bearing 17 rotatably supporting the drive shaft 6 between the housing 3 and the rear end bearing 17 is provided at the rear end (right end in Fig. 1) of the drive shaft 6, that is, in the end portion of the drive shaft 6 that is on the side opposite to the drive-side scroll member 70.

[0082] The drive-side scroll member 70 is provided with the first drive-side scroll part 71 on the motor 5 side and a second drive-side scroll part 72 on the discharge port 3d side.

[0083] The first drive-side scroll part 71 is provided with a first drive-side end plate 71a and a first drive-side wall body 71b.

[0084] The first drive-side end plate 71a extends in a direction orthogonal to the drive-side rotational axis CL1. The first drive-side end plate 71a is fixed by means of a bolt 21 to a plurality of fixing portions 20b provided on the outer periphery of the center plate 20. As illustrated in Fig. 2, three fixing portions 20b of the center plate 20 are provided at substantially equal gaps in a circumferential direction. The fixing portion 20b is not limited there-

to in number.

[0085] The first drive-side end plate 71a is substantially disk-shaped in plan view. As illustrated in Fig. 3, three spiral first drive-side wall bodies 71b, that is, spiral first drive-side wall bodies 71b in the form of three flights are provided on the first drive-side end plate 71a. The first drive-side wall bodies 71b in the form of three flights are disposed at equal gaps around the drive-side rotational axis CL1. Each of winding end portions 71e of the first drive-side wall bodies 71b is independent without being fixed to the other wall portion. In other words, a wall portion interconnecting and reinforcing the respective winding end portions 71e is not provided. The first drive-side wall body 71b may be one, two, or four or more in the number of flights.

[0086] As illustrated in Fig. 1, the second drive-side scroll part 72 is provided with a second drive-side end plate 72a and a second drive-side wall body 72b. The second drive-side wall body 72b is in the form of three flights similarly to the first drive-side wall body 71b (see Fig. 2) described above. Each of the winding end portions of the second drive-side wall bodies 72b is independent without being fixed to the other wall portion. In other words, a wall portion interconnecting and reinforcing the respective winding end portions is not provided. The second drive-side wall body 72b may be one, two, or four or more in the number of flights.

[0087] A second drive-side shaft portion 72c extending in the drive-side rotational axis CL1 direction is connected to the second drive-side end plate 72a. The second drive-side shaft portion 72c is provided rotatably with respect to the housing 3 via a second drive-side bearing 14, which is a ball bearing. The second drive-side end plate 72a is provided with a discharge port 72d, which is along the drive-side rotational axis CL1.

[0088] Two seal members 26 are provided between the second drive-side shaft portion 72c and the housing 3 and on the leading edge side (left side in Fig. 1) of the second drive-side shaft portion 72c beyond the second drive-side bearing 14. The two seal members 26 and the second drive-side bearing 14 are disposed at predetermined gaps in the drive-side rotational axis CL1 direction. Enclosed between the two seal members 26 is a lubricant that is grease such as a semi-solid lubricant. The seal member 26 may be one in number. In this case, the lubricant is enclosed between the seal member 26 and the second drive-side bearing 14.

[0089] The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed in a state where the leading edges (free ends) of the wall bodies 71b and 72b face each other. The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed by a bolt 31, which is fastened to flange portions 73 provided at a plurality of places in the circumferential direction so as to protrude to a radial outer side.

[0090] In the driven-side scroll member 90, a driven-side end plate 90a is positioned substantially at the center in an axial direction (the horizontal direction in the draw-

ing). A through-hole 90h is formed at the center of the driven-side end plate 90a and compressed air flows to the discharge port 72d.

[0091] A first driven-side wall body 91b and a second driven-side wall body 92b are provided on both sides of the driven-side end plate 90a, respectively. The first driven-side wall body 91b installed on the motor 5 side from the driven-side end plate 90a meshes with the first drive-side wall body 71b of the first drive-side scroll part 71 and the second driven-side wall body 92b installed on the discharge port 3d side from the driven-side end plate 90a meshes with the second drive-side wall body 72b of the second drive-side scroll part 72.

[0092] Three first driven-side wall bodies 91b, that is, first driven-side wall bodies 91b in the form of three flights are provided as illustrated in Fig. 4. The driven-side wall bodies 91b in the form of three flights are disposed at equal gaps around a driven-side rotational axis CL2. The second driven-side wall body 92b is similar in configuration. Each of the driven-side wall bodies 91b and 92b may be one, two, or four or more in the number of flights.

[0093] A support member 33 is provided on the discharge port 3d side (left side in Fig. 1) of the driven-side scroll member 90. The support member 33 is fixed by a bolt 25 to the leading edge (free end) of the second driven-side wall body 92b.

[0094] A shank 35a for the support member is provided on the central axis side of the support member 33 and the shank 35a for the support member is fixed to the housing 3 via a bearing 38 for a second support member, which is an angular ball bearing. As a result, the driven-side scroll member 90 rotates around the second central axis CL2 via the support member 33.

[0095] A first side plate 27 is provided on the motor 5 side (right side in Fig. 1) of the driven-side scroll member 90. The first side plate 27 is fixed by a bolt 28 to the leading edge (free end) of the first driven-side wall body 91b.

[0096] A second side plate 30 is provided at a predetermined gap on the motor 5 side of the first side plate 27. The second side plate 30 is fixed by the bolt 31 to the first side plate 27. A shank 30a for the second side plate is provided on the central axis side of the second side plate 30 and the shank 30a for the second side plate is fixed to the housing 3 via a bearing 32 for the second side plate, which is an angular ball bearing. As a result, the driven-side scroll member 90 rotates around the second central axis CL2 via the second side plate 30 and the first side plate 27.

[0097] The center plate 20 is disposed between the first side plate 27 and the second side plate 30. As illustrated in Fig. 2, the center plate 20 is directly fixed to the drive-side scroll member 70 and the first side plate 27 is directly fixed to the driven-side scroll member 90.

[0098] A crank pin 15 is provided between the first and second side plates 27 and 30 and the center plate 20. The crank pin 15 has a cylindrical portion 15a at the center and an eccentric shaft portion 15b, which has an eccen-

tric axis (see reference sign CL3 in Fig. 5) eccentric to the central axis of the cylindrical portion 15a.

[0099] Provided on the outer periphery of the cylindrical portion 15a is a bearing 16 for the cylindrical portion, which is an angular ball bearing. As a result, the cylindrical portion 15a is rotatable with respect to the center plate 20.

[0100] A bearing 18a for a first eccentric shaft portion (crank pin end portion rolling bearing) and a bearing 18b for a second eccentric shaft portion (crank pin end portion rolling bearing), which are angular ball bearings, are provided at both ends of the eccentric shaft portion 15b, respectively. As a result, the eccentric shaft portion 15b is rotatable with respect to the first side plate 27 and the second side plate 30.

[0101] The crank pin 15 and the respective bearings 16, 18a, and 18b are used as synchronization drive mechanisms transmitting the drive force of the motor 5 to the driven-side scroll member 90 such that both scroll members 70 and 90 perform revolving and orbiting motions in synchronization.

[0102] It is preferable that a plurality of the synchronization drive mechanisms provided with the crank pin 15 are provided. For example, three synchronization drive mechanisms are provided at equal angular gaps around the drive-side rotational axis CL3.

[0103] The co-rotating scroll compressor 1 configured as described above operates as follows.

[0104] The drive shaft 6 is rotated around the drive-side rotational axis CL1 by the motor 5, and then the center plate 20 also rotates via the shank 20a connected to the drive shaft 6. By the center plate 20 rotating, the drive-side scroll member 70 connected via the fixing portion 20b rotates around the drive-side rotational axis CL1. The drive force transmitted to the center plate 20 is transmitted from the first side plate 27 and the second side plate 30 to the driven-side scroll member 90 via the crank pin 15 as a synchronization drive mechanism and the driven-side scroll member 90 rotates around the driven-side rotational axis CL2. At this time, the crank pin 15 rotates with respect to the center plate 20 and both side plates via the respective bearings 16, 18a, and 18b, and thus both scroll members 70 and 90 relatively perform the revolving and orbiting motions.

[0105] By both scroll members 70 and 90 performing the revolving and orbiting motions, the air suctioned from the intake port of the housing 3 is suctioned from the outer peripheral sides of both scroll members 70 and 90 and taken into the compression chamber formed by both scroll members 70 and 90. Then, the compression chamber formed by the first drive-side wall body 71b and the first driven-side wall body 91b and the compression chamber formed by the second drive-side wall body 72b and the second driven-side wall body 92b are separately compressed. The air is compressed as the volume of each compression chamber decreases with a movement to the center side. The air compressed by the first drive-side wall body 71b and the first driven-side wall body 91b

passes through the through-hole 90h formed in the driven-side end plate 90a and merges with the air compressed by the second drive-side wall body 72b and the second driven-side wall body 92b, and the merged air is discharged from the discharge port 3d of the housing 3 to the outside through the discharge port 72d.

[0106] The present embodiment has the following action and effect.

[0107] The first side plate 27 and the second side plate 30 are provided on the rotational axis direction CL1 side and the rotational axis direction CL2 side with respect to the drive-side scroll member 70 and the driven-side scroll member 90 and the center plate 20 is provided between the side plates 27 and 30. The crank pin 15 and the respective bearings 16, 18a, and 18b are provided as the synchronization drive mechanisms between both side plates 27 and 30 and the center plate 20. Since the side plates 27 and 30 and the center plate 20 as members separate from both scroll members 70 and 90 are provided with the synchronization drive mechanisms as described above, heating attributable to the compression heat from the scroll members 70 and 90 can be decreased as compared with a case where a synchronization drive mechanism is provided with respect to end plates of the scroll members 70 and 90 and the life of the synchronization drive mechanisms can be extended.

[0108] A load is applied to the crank pin 15 from the center plate 20 and the side plates 27 and 30 on both sides thereof, and thus the moment around the cylindrical portion 15a of the crank pin 15 can be canceled and the life of the synchronization drive mechanisms can be extended.

[0109] The synchronization drive mechanisms are disposed by both side plates 27 and 30 and the center plate 20 being provided on the rotational axis CL1 direction side and the rotational axis CL2 direction side, and thus diameter reduction can be achieved as compared with a case where a synchronization drive mechanism is provided on radial direction sides of the scroll members 70 and 90.

[0110] Although the crank pin 15 is used as a synchronization drive mechanism in the present embodiment, the present invention is not limited thereto. For example, a pin ring mechanism that a pin member and a ring member constitute may be used.

[Second Embodiment]

[0111] Next, a second embodiment of the present invention will be described. The present embodiment relates to a synchronization drive mechanism provided with the crank pin 15 described in the first embodiment. Accordingly, the overall configuration of the co-rotating scroll compressor 1 is similar to that of the first embodiment and will not be described below.

[0112] As illustrated in Fig. 5, in end portions 15c on both sides of the eccentric shaft portion 15b of the crank pin 15, small-diameter portions 15d smaller in diameter

than a central portion 15e are provided at the positions where the inner rings of the bearings 18a and 18b for the eccentric shaft portions are attached. A step section 15j between the central portion 15e and the small-diameter portion 15d is provided with an O-ring (urging member) 19.

[0113] The O-ring 19 urges the inner rings of the bearings 18a and 18b for the eccentric shaft portions in the eccentric axis CL3 direction toward the leading edge of the crank pin 15.

[0114] In Fig. 5, reference sign 41 denotes a seal plate for sealing a lubricant and reference sign 42 denotes a stopper ring for fixing the seal plate 41.

[0115] The present embodiment has the following action and effect.

[0116] The O-ring 19 is provided between the inner rings of the bearings 18a and 18b for the eccentric shaft portions and the eccentric shaft portion 15b of the crank pin 15 and the O-ring 19 urges the inner rings in the eccentric axis CL3 direction toward the leading edge of the eccentric shaft portion 15b. The O-ring 19 urges the inner rings of the bearings 18a and 18b for the eccentric shaft portions toward the leading edge, and thus an outer ring is pressed against the side plates 27 and 30 via the balls (rolling bodies) of the bearings 18a and 18b for the eccentric shaft portions. As a result, the bearings 18a and 18b for the eccentric shaft portions are put into a state where a preload is applied between the eccentric shaft portion 15b of the crank pin 15 and the side plates 27 and 30, it is possible to prevent slipping between the ball and the inner ring and slipping between the inner ring and the eccentric shaft portion 15b, and the life of the synchronization drive mechanism can be extended.

<Modification Example 1>

[0117] The configuration illustrated in Fig. 6 may be adopted, instead of or along with the present embodiment, as means for applying a preload to the bearings 18a and 18b for the eccentric shaft portions.

[0118] Fig. 6 illustrates a state where the second side plate 30 is yet to be fixed to the first side plate 27 by the bolt 31. In this state, a gap *t* is formed between the first side plate 27 and the leading edge of a fixing portion 30b of the second side plate 30. In this manner, the gap determined by both side plates 27 and 30 being fastened by means of the bolt 31 is kept smaller than the gap between both side plates 27 and 30 determined by the crank pin 15 and the respective bearings 16, 18a, and 18b. As a result, the gap between the side plates 27 and 30 is narrowed when the second side plate 30 is fastened to the first side plate 27 by means of the bolt 31 and a preload can be applied in the eccentric axis CL3 direction to the bearings 18a and 18b for the eccentric shaft portions.

<Modification Example 2>

[0119] The configuration illustrated in Fig. 7 may be adopted, instead of or along with the present embodiment, as means for preventing the inner rings of the bearings 18a and 18b for the eccentric shaft portions from slipping.

[0120] As illustrated in Fig. 7, an O-ring (elastic body) 22 is provided between the inner peripheral surface of the inner ring of the bearing 18a for the first eccentric shaft portion and the outer peripheral surface of the eccentric shaft portion 15b. The O-ring 22 urges the inner ring of the bearing 18a for the first eccentric shaft portion to the radial outer side about the eccentric axis CL3 by means of the reaction force resulting from deformation of the O-ring 22. As a result, slipping between the eccentric shaft portion 15b and the inner ring can be prevented.

[0121] The bearing 18b for the second eccentric shaft portion may be provided with the O-ring 22.

[Third Embodiment]

[0122] Next, a third embodiment of the present invention will be described. The present embodiment is different from the first embodiment in terms of the fixing portion 20b fixing the center plate 20 to the drive-side scroll member 70. The third embodiment is similar to the first embodiment regarding the other points, and thus the points will not be described below.

[0123] As illustrated in Fig. 8, a fixing portion 20b' of the center plate 20 is positioned on the drive-side rotational axis CL1 side with respect to a fixing portion 27a of the first side plate 27 and the fixing portion 30b of the second side plate 30. The fixing portion 20b' of the center plate 20 has a structure in which a resinous shaft portion 40 made of resin is interposed. The other part of the center plate 20 is metallic and made of aluminum alloy or iron.

[0124] The fixing portion 27a of the first side plate 27 and the fixing portion 30b of the second side plate 30 have a metallic structure without resin portion interposition.

[0125] The present embodiment has the following action and effect.

[0126] The structure in which the resinous shaft portion 40 is interposed is because the temperature of the fixing portion 20b' of the center plate 20, which is positioned radially inward of the centers of the scroll members 70 and 90, tends to rise due to compression heat. As a result, it is possible to achieve life extension by suppressing a rise in the temperature of the synchronization drive mechanism provided with the crank pin 15.

[0127] The metallic structure without resin portion interposition is because a rise in temperature attributable to compression heat has little effect on the fixing portion 27a of the first side plate 27 and the fixing portion 30b of the second side plate 30, which are positioned radially outward of the centers of the scroll members 70 and 90. As a result, the fixing portions 27a and 30b can be accu-

ately assembled by means of metal, and thus the synchronization drive mechanism can be accurately positioned, phase shift reduction can be achieved between the drive-side scroll member 70 and the driven-side scroll member 90, and compression performance improvement can be achieved.

[Fourth Embodiment]

[0128] Hereinafter, a fourth embodiment of the present invention will be described with reference to the drawings including Fig. 9.

[0129] Fig. 9 illustrates the co-rotating scroll compressor 1. The co-rotating scroll compressor 1 can be used as a turbocharger compressing combustion air (a fluid) supplied to an internal combustion engine such as a vehicular engine, a compressor for supplying compressed air to an electrode of a fuel cell, or a compressor for supplying compressed air used for a braking device of a vehicle such as a railway vehicle.

[0130] The co-rotating scroll compressor 1 is provided with the housing 3, the motor (drive unit) 5 accommodated on one end side of the housing 3, and the drive-side scroll member 70 and the driven-side scroll member 90 accommodated on the other end side of the housing 3.

[0131] The housing 3 has a substantially cylindrical shape and is provided with the motor accommodation portion 3a accommodating the motor 5 and the scroll accommodation portion 3b accommodating the scroll members 70 and 90.

[0132] The discharge port 3d for discharging compressed air is formed in an end portion of the scroll accommodation portion 3b. The housing 3 is provided with an air intake port (not illustrated in Fig. 9) suctioning air.

[0133] The motor 5 is driven by power being supplied from a power supply source (not illustrated). The rotation of the motor 5 is controlled by a command from a control unit (not illustrated). The stator 5a of the motor 5 is fixed to the inner peripheral side of the housing 3. The rotor 5b of the motor 5 rotates around the drive-side rotational axis CL1. The drive shaft 6 extending on the drive-side rotational axis CL1 is connected to the rotor 5b. The drive shaft 6 is connected to a drive shaft portion 71d fixed to the first drive-side scroll part 71 of the drive-side scroll member 70.

[0134] The drive-side bearing 11 rotatably supporting the drive shaft 6 is provided at the front end (left end in Fig. 9) of the drive shaft 6. The rear end bearing 17 rotatably supporting the drive shaft 6 between the housing 3 and the rear end bearing 17 is provided at the rear end (right end in Fig. 9) of the drive shaft 6, that is, in the end portion of the drive shaft 6 that is on the side opposite to the drive-side scroll member 70.

[0135] The drive-side scroll member 70 is provided with the first drive-side scroll part 71 on the motor 5 side and the second drive-side scroll part 72 on the discharge port 3d side.

[0136] The first drive-side scroll part 71 is provided with

the first drive-side end plate 71a and the first drive-side wall body 71b.

[0137] The first drive-side end plate 71a extends in a direction orthogonal to the drive-side rotational axis CL1. The drive shaft portion 71d extending on and along the drive-side rotational axis CL1 is fixed to the rotation center of the first drive-side end plate 71a.

[0138] The center plate 20 is fixed to the drive shaft portion 71d. The center plate 20 extends in parallel with the first drive-side end plate 71a.

[0139] The first drive-side end plate 71a is substantially disk-shaped in plan view. As illustrated in Fig. 10, the three spiral first drive-side wall bodies 71b, that is, the spiral first drive-side wall bodies 71b in the form of three flights are provided on the first drive-side end plate 71a. The first drive-side wall bodies 71b in the form of three flights are disposed at equal gaps around the drive-side rotational axis CL1. The first drive-side wall body 71b may be one, two, or four or more in the number of flights.

[0140] As illustrated in Fig. 9, the second drive-side scroll part 72 is provided with the second drive-side end plate 72a and the second drive-side wall body 72b. The second drive-side wall body 72b is in the form of three flights similarly to the first drive-side wall body 71b (see Fig. 10) described above. The second drive-side wall body 72b may be one, two, or four or more in the number of flights.

[0141] The second drive-side shaft portion 72c extending in the drive-side rotational axis CL1 direction is connected to the second drive-side end plate 72a. The second drive-side shaft portion 72c is provided rotatably with respect to the housing 3 via the second drive-side bearing 14, which is a ball bearing. The second drive-side end plate 72a is provided with the discharge port 72d, which is along the drive-side rotational axis CL1.

[0142] The two seal members 26 are provided between the second drive-side shaft portion 72c and the housing 3 and on the leading edge side (left side in Fig. 9) of the second drive-side shaft portion 72c beyond the second drive-side bearing 14. The two seal members 26 and the second drive-side bearing 14 are disposed at predetermined gaps in the drive-side rotational axis CL1 direction. Enclosed between the two seal members 26 is a lubricant that is grease such as a semi-solid lubricant. The seal member 26 may be one in number. In this case, the lubricant is enclosed between the seal member 26 and the second drive-side bearing 14.

[0143] The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed in a state where the leading edges (free ends) of the wall bodies 71b and 72b face each other. The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed by the bolt 31, which is fastened to the flange portions 73 provided at a plurality of places in the circumferential direction so as to protrude to the radial outer side.

[0144] In the driven-side scroll member 90, the driven-side end plate 90a is positioned substantially at the center in the axial direction (horizontal direction in the drawing).

The through-hole 90h is formed at the center of the driven-side end plate 90a and compressed air flows to the discharge port 72d.

[0145] The first driven-side wall body 91b and the second driven-side wall body 92b are provided on both sides of the driven-side end plate 90a, respectively. The first driven-side wall body 91b installed on the motor 5 side from the driven-side end plate 90a meshes with the first drive-side wall body 71b of the first drive-side scroll part 71 and the second driven-side wall body 92b installed on the discharge port 3d side from the driven-side end plate 90a meshes with the second drive-side wall body 72b of the second drive-side scroll part 72.

[0146] The three first driven-side wall bodies 91b, that is, the first driven-side wall bodies 91b in the form of three flights are provided as illustrated in Fig. 11. The driven-side wall bodies 91b in the form of three flights are disposed at equal gaps around the driven-side rotational axis CL2. The second driven-side wall body 92b is similar in configuration. Each of the driven-side wall bodies 91b and 92b may be one, two, or four or more in the number of flights.

[0147] The support member 33 is provided on the discharge port 3d side (left side in Fig. 9) of the driven-side scroll member 90. The support member 33 is fixed by the bolt 25 to the leading edge (free end) of the second driven-side wall body 92b.

[0148] The shank 35a for the support member is provided on the central axis side of the support member 33 and the shank 35a for the support member is fixed to the housing 3 via the bearing 38 for the second support member, which is an angular ball bearing. As a result, the driven-side scroll member 90 rotates around the driven-side rotational axis CL2 via the support member 33.

[0149] The first side plate 27 is provided on the motor 5 side (right side in Fig. 9) of the driven-side scroll member 90. The first side plate 27 is fixed by the bolt 28 to the leading edge (free end) of the first driven-side wall body 91b. Formed at the rotation center of the first side plate 27 is a hole portion 27h for the first side plate for penetration by the drive shaft portion 71d.

[0150] The second side plate 30 is provided at a predetermined gap on the motor 5 side of the first side plate 27. The second side plate 30 is fixed by a bolt 34 to the first side plate 27. Formed at the rotation center of the second side plate 30 is a hole portion 30h for the second side plate for penetration by the drive shaft portion 71d.

[0151] The shank 30a for the second side plate is provided on the central axis side of the second side plate 30 and the shank 30a for the second side plate is fixed to the housing 3 via the bearing 32 for the second side plate, which is an angular ball bearing. As a result, the driven-side scroll member 90 rotates around the driven-side rotational axis CL2 via the second side plate 30 and the first side plate 27.

[0152] A first protruding wall portion 27b protruding toward the second side plate 30 is provided on the outer peripheral side end surface of the first side plate 27. A

second protruding wall portion 30c protruding toward the first side plate 27 is provided on the outer peripheral side end surface of the second side plate 30. The protruding wall portions 27b and 30c constitute a peripheral wall portion by being attached to each other and fixed in a liquid-tight state. As a result, the center plate 20 disposed between the first side plate 27 and the second side plate 30 is accommodated in a space S surrounded by both protruding wall portions 27b and 30c as illustrated in Fig. 12.

[0153] As illustrated in Fig. 9, the crank pin 15 is provided between the first and second side plates 27 and 30 and the center plate 20. The crank pin 15 has the cylindrical portion 15a at the center and the eccentric shaft portion 15b, which has an eccentric axis eccentric to the central axis of the cylindrical portion 15a. Provided on the outer periphery of the cylindrical portion 15a is the bearing 16 for the cylindrical portion, which is a ball bearing. As a result, the cylindrical portion 15a is rotatable with respect to the center plate 20. A lubricant such as grease is enclosed in the bearing 16 for the cylindrical portion.

[0154] The bearing 18a for the first eccentric shaft portion (crank pin end portion rolling bearing 18a) and the bearing 18b for the second eccentric shaft portion (crank pin end portion rolling bearing 18b), which are ball bearings, are provided at both ends of the eccentric shaft portion 15b, respectively. As a result, the eccentric shaft portion 15b is rotatable with respect to the first side plate 27 and the second side plate 30. A lubricant such as grease is enclosed in each of the bearings 18a and 18b for the eccentric shaft portions.

[0155] The crank pin 15 and the respective bearings 16, 18a, and 18b are used as synchronization drive mechanisms transmitting a drive force from the drive shaft portion 71d to the driven-side scroll member 90 such that both scroll members 70 and 90 perform revolving and orbiting motions in synchronization.

[0156] It is preferable that a plurality of the synchronization drive mechanisms provided with the crank pin 15 are provided. For example, three synchronization drive mechanisms are provided at equal angular gaps around the drive-side rotational axis CL3 (see Fig. 12).

[0157] The co-rotating scroll compressor 1 configured as described above operates as follows.

[0158] The drive shaft 6 is rotated around the drive-side rotational axis CL1 by the motor 5, and then the center plate 20 as well as the drive-side scroll member 70 rotates around the drive-side axis CL1 via the drive shaft portion 71d connected to the drive shaft 6. By the center plate 20 rotating, the drive force transmitted to the center plate 20 is transmitted from the first side plate 27 and the second side plate 30 to the driven-side scroll member 90 via the crank pin 15 as a synchronization drive mechanism and the driven-side scroll member 90 rotates around the driven-side rotational axis CL2. At this time, the crank pin 15 rotates with respect to the center plate 20 and both side plates via the respective bearings

16, 18a, and 18b, and thus both scroll members 70 and 90 relatively perform the revolving and orbiting motions.

[0159] By both scroll members 70 and 90 performing the revolving and orbiting motions, the air suctioned from the intake port of the housing 3 is suctioned from the outer peripheral sides of both scroll members 70 and 90 and taken into the compression chamber formed by both scroll members 70 and 90. Then, the compression chamber formed by the first drive-side wall body 71b and the first driven-side wall body 91b and the compression chamber formed by the second drive-side wall body 72b and the second driven-side wall body 92b are separately compressed. The air is compressed as the volume of each compression chamber decreases with a movement to the center side. The air compressed by the first drive-side wall body 71b and the first driven-side wall body 91b passes through the through-hole 90h formed in the driven-side end plate 90a and merges with the air compressed by the second drive-side wall body 72b and the second driven-side wall body 92b, and the merged air is discharged from the discharge port 3d of the housing 3 to the outside through the discharge port 72d.

[0160] The present embodiment has the following action and effect.

[0161] The first side plate 27 and the second side plate 30 are provided on the rotational axis CL1 direction side and the rotational axis CL2 direction side with respect to the drive-side scroll member 70 and the driven-side scroll member 90 and the center plate 20 is provided between the side plates 27 and 30. The crank pin 15 and the respective bearings 16, 18a, and 18b are provided as the synchronization drive mechanisms between both side plates 27 and 30 and the center plate 20. Further, the first protruding wall portion 27b and the second protruding wall portion 30c are provided between the first side plate 27 and the second side plate 30 as the peripheral wall portion surrounding the outer peripheral side of the center plate 20. As a result, even when the lubricant supplied to the synchronization drive mechanism (specifically, each of the bearings 16, 18a, and 18b) is moved to the outer peripheral side by a centrifugal force, the lubricant can be held on the inner peripheral side of the liquid-tight peripheral wall portion, and thus an insufficient lubrication of the synchronization drive mechanism can be avoided and life extension can be achieved.

[0162] In addition, it is possible to prevent the compressed air from being contaminated by preventing lubricant leakage.

[0163] Although the peripheral wall portion is constituted by means of the first protruding wall portion 27b and the second protruding wall portion 30c in the present embodiment, the present invention is not limited thereto. The peripheral wall portion may be provided so as to surround the outer periphery of the center plate 20. For example, the first protruding wall portion 27b may constitute the peripheral wall portion alone or the second protruding wall portion 30c may constitute the peripheral wall portion alone. In addition, the peripheral wall portion

may be configured by means of a member other than the side plates 27 and 30.

[0164] Although the crank pin 15 is used as a synchronization drive mechanism in the present embodiment, the present invention is not limited thereto and the synchronization drive mechanism may be any synchronization drive mechanism requiring lubricant supply. For example, a pin ring mechanism that a pin member and a ring member constitute may be used.

[Fifth Embodiment]

[0165] Next, a fifth embodiment of the present invention will be described. The present embodiment differs from the fourth embodiment in that a seal member is provided with respect to the side plates 27 and 30. Accordingly, the overall configuration of the co-rotating scroll compressor 1 is similar to that of the fourth embodiment and will not be described below.

[0166] As illustrated in Fig. 13, a first seal member 43 is provided between the first side plate 27 and the drive shaft portion 71d. A boots seal or a labyrinth seal can be adopted as the first seal member 43.

[0167] A second seal member 44 is provided between end surfaces of the second side plate 30 and the center plate 20. An annular and resinous tip seal can be adopted as the second seal member 44. The second seal member 44 is accommodated in a circumferential groove formed in the end surface of the second side plate 30. The second seal member 44 may be installed on the center plate 20 side by means of circumferential groove formation in the center plate 20.

[0168] The present embodiment has the following action and effect.

[0169] Sealing is performed between the first side plate 27 and the drive shaft portion 71d by the first seal member 43 being provided. As a result, it is possible to prevent lubricant leakage from the space between the first side plate 27 and the drive shaft portion 71d. The first seal member 43 may be provided between the second side plate 30 and the drive shaft portion 71d.

[0170] The second seal member 44 is provided between the second side plate 30 and the center plate 20. As a result, it is possible to prevent lubricant leakage from the space between the second side plate 30 and the drive shaft portion 71d. The second seal member 44 may be provided between the first side plate 27 and the center plate 20.

[Sixth Embodiment]

[0171] Next, a sixth embodiment of the present invention will be described. The present embodiment differs from the fourth embodiment in that the side plates 27 and 30 are the drive side and the center plate 20 is the driven side. The sixth embodiment is similar to the fourth embodiment regarding the other points, and thus the points will not be described below.

[0172] As illustrated in Fig. 14, the drive shaft 6 (see Fig. 9) of the motor 5 is connected to a drive shaft portion 30d protruding to the motor 5 side from the rotation center of the second side plate 30. Accordingly, the drive force from the motor 5 is transmitted from the second side plate 30 to a drive-side scroll member 50 via the first side plate 27. In other words, the driven-side scroll member 90 of the fourth embodiment is the drive side.

[0173] A drive force is transmitted from both side plates 27 and 30 to the center plate 20 via the synchronization drive mechanism provided with the crank pin 15. A driven shaft portion 61d is fixed to the center plate 20. The driven shaft portion 61d is provided at the rotation center of a first driven-side end plate 61a of a driven-side scroll member 60. Accordingly, the drive-side scroll member 70 of the fourth embodiment is the driven side.

[0174] As in the fourth embodiment, the first protruding wall portion 27b of the first side plate 27 and the second protruding wall portion 30c of the second side plate 30 constitute a peripheral wall portion. Accordingly, the configuration, action, and effect thereof will not be described below.

[0175] Unlike in the fourth embodiment, the rotation center region of the second side plate 30 is not provided with a hole portion (the hole portion 30h for the second side plate: see Fig. 9). The rotation center region of the second side plate 30 is closed by a wall portion.

[0176] The present embodiment has the following action and effect.

[0177] The drive shaft portion 30d is provided with respect to the rotation center of the second side plate 30. As a result, a drive force is transmitted from the motor 5 to the drive-side scroll member 50 via the first side plate 27 and the second side plate 30.

[0178] The drive force transmitted from both side plates 27 and 30 via the synchronization drive mechanism is guided from the center plate 20 to the driven-side scroll member 60 by the center plate 20 being fixed to the driven shaft portion 61d connected to the rotation center of the first driven-side end plate 61a of the driven-side scroll member 60. The driven shaft portion 61d is disposed so as to pass through the hole portion 27h for the first side plate formed in the first side plate 27. Since a drive force is transmitted from the center plate 20 to the driven shaft portion 61d via the synchronization drive mechanism, there is no need to form a hole portion for penetration by the driven shaft portion 61d in the rotation center region of the second side plate 30. Accordingly, it is possible to adopt the second side plate 30 that has a rotation center region closed by a wall portion, and thus lubricant leakage from the rotation center of the second side plate 30 can be prevented.

[0179] In addition, there is no need to provide a bearing rotatably supporting the driven shaft portion 61d. Accordingly, the drive-side bearing 11 (see Fig. 9) of the fourth embodiment can be omitted and the number of components can be reduced.

[Seventh Embodiment]

[0180] Hereinafter, a seventh embodiment of the present invention will be described with reference to the drawings including Fig. 15.

[0181] Fig. 15 illustrates the co-rotating scroll compressor 1. The co-rotating scroll compressor 1 can be used as a turbocharger compressing combustion air (a fluid) supplied to an internal combustion engine such as a vehicular engine, a compressor for supplying compressed air to an air electrode of a fuel cell, or a compressor for supplying compressed air used for a braking device of a vehicle such as a railway vehicle.

[0182] The co-rotating scroll compressor 1 is provided with the housing 3, the motor (drive unit) 5 accommodated on one end side of the housing 3, and the drive-side scroll member 70 and the driven-side scroll member 90 accommodated on the other end side of the housing 3.

[0183] The housing 3 has a substantially cylindrical shape and is provided with the motor accommodation portion 3a accommodating the motor 5 and the scroll accommodation portion 3b accommodating the scroll members 70 and 90.

[0184] The discharge port 3d for discharging compressed air is formed in an end portion of the scroll accommodation portion 3b. The housing 3 is provided with an air intake port (not illustrated in Fig. 15) suctioning air.

[0185] The motor 5 is driven by power being supplied from a power supply source (not illustrated). The rotation of the motor 5 is controlled by a command from a control unit (not illustrated). The stator 5a of the motor 5 is fixed to the inner peripheral side of the housing 3. The rotor 5b of the motor 5 rotates around the drive-side rotational axis CL1. The drive shaft 6 extending on the drive-side rotational axis CL1 is connected to the rotor 5b. The drive shaft 6 is connected to the drive shaft portion 71d fixed to the first drive-side scroll part 71 of the drive-side scroll member 70.

[0186] The drive-side bearing 11 rotatably supporting the drive shaft 6 is provided at the front end (left end in Fig. 15) of the drive shaft 6. A rear end bearing 24 rotatably supporting the drive shaft 6 between the housing 3 and the rear end bearing 24 is provided at the rear end (right end in Fig. 15) of the drive shaft 6, that is, in the end portion of the drive shaft 6 that is on the side opposite to the drive-side scroll member 70.

[0187] The drive-side scroll member 70 is provided with the first drive-side scroll part 71 on the motor 5 side and the second drive-side scroll part 72 on the discharge port 3d side.

[0188] The first drive-side scroll part 71 is provided with the first drive-side end plate 71a and the first drive-side wall body 71b.

[0189] The first drive-side end plate 71a extends in a direction orthogonal to the drive-side rotational axis CL1. The drive shaft portion 71d extending on and along the drive-side rotational axis CL1 is fixed to the rotation center of the first drive-side end plate 71a.

[0190] The center plate 20 is fixed to the drive shaft portion 71d. The center plate 20 extends in parallel with the first drive-side end plate 71a.

[0191] The first drive-side end plate 71a is substantially disk-shaped in plan view. As illustrated in Fig. 16, the three spiral first drive-side wall bodies 71b, that is, the spiral first drive-side wall bodies 71b in the form of three flights are provided on the first drive-side end plate 71a. The first drive-side wall bodies 71b in the form of three flights are disposed at equal gaps around the drive-side rotational axis CL1. The first drive-side wall body 71b may be one, two, or four or more in the number of flights.

[0192] As illustrated in Fig. 15, the second drive-side scroll part 72 is provided with the second drive-side end plate 72a and the second drive-side wall body 72b. The second drive-side wall body 72b is in the form of three flights similarly to the first drive-side wall body 71b (see Fig. 16) described above. The second drive-side wall body 72b may be one, two, or four or more in the number of flights.

[0193] The second drive-side shaft portion 72c extending in the drive-side rotational axis CL1 direction is connected to the second drive-side end plate 72a. The second drive-side shaft portion 72c is provided rotatably with respect to the housing 3 via the second drive-side bearing 14, which is a ball bearing. The second drive-side end plate 72a is provided with the discharge port 72d, which is along the drive-side rotational axis CL1.

[0194] The two seal members 26 for a second drive shaft portion are provided between the second drive-side shaft portion 72c and the housing 3 and on the leading edge side (left side in Fig. 15) of the second drive-side shaft portion 72c beyond the second drive-side bearing 14. The two seal members 26 for the second drive shaft portion and the second drive-side bearing 14 are disposed at predetermined gaps in the drive-side rotational axis CL1 direction. Enclosed between the two seal members 26 for the second drive shaft portion is a lubricant that is grease such as a semi-solid lubricant. The seal member 26 for the second drive shaft portion may be one in number. In this case, the lubricant is enclosed between the seal member 26 for the second drive shaft portion and the second drive-side bearing 14.

[0195] The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed in a state where the leading edges (free ends) of the wall bodies 71b and 72b face each other. The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed by the bolt 31, which is fastened to the flange portions 73 provided at a plurality of places in the circumferential direction so as to protrude to the radial outer side.

[0196] In the driven-side scroll member 90, the driven-side end plate 90a is positioned substantially at the center in the axial direction (horizontal direction in the drawing). The through-hole 90h is formed at the center of the driven-side end plate 90a and compressed air flows to the discharge port 72d.

[0197] The first driven-side wall body 91b and the sec-

ond driven-side wall body 92b are provided on both sides of the driven-side end plate 90a, respectively. The first driven-side wall body 91b installed on the motor 5 side from the driven-side end plate 90a meshes with the first drive-side wall body 71b of the first drive-side scroll part 71 and the second driven-side wall body 92b installed on the discharge port 3d side from the driven-side end plate 90a meshes with the second drive-side wall body 72b of the second drive-side scroll part 72.

[0198] The three first driven-side wall bodies 91b, that is, the first driven-side wall bodies 91b in the form of three flights are provided as illustrated in Fig. 17. The driven-side wall bodies 91b in the form of three flights are disposed at equal gaps around the driven-side rotational axis CL2. The second driven-side wall body 92b is similar in configuration. Each of the driven-side wall bodies 91b and 92b may be one, two, or four or more in the number of flights.

[0199] The support member 33 is provided on the discharge port 3d side (left side in Fig. 15) of the driven-side scroll member 90. The support member 33 is fixed by the bolt 25 to the leading edge (free end) of the second driven-side wall body 92b.

[0200] The shank 35a for the support member is provided on the central axis side of the support member 33 and the shank 35a for the support member is fixed to the housing 3 via the bearing 38 for the second support member, which is a ball bearing. As a result, the driven-side scroll member 90 rotates around the driven-side rotational axis CL2 via the support member 33.

[0201] The first side plate 27 is provided on the motor 5 side (right side in Fig. 15) of the driven-side scroll member 90. The first side plate 27 is fixed by the bolt 28 to the leading edge (free end) of the first driven-side wall body 91b. Formed at the rotation center of the first side plate 27 is the hole portion 27h for the first side plate for penetration by the drive shaft portion 71d.

[0202] The second side plate 30 is provided at a predetermined gap on the motor 5 side of the first side plate 27. The second side plate 30 is fixed by the bolt 34 to the first side plate 27. Formed at the rotation center of the second side plate 30 is the hole portion 30h for the second side plate for penetration by the drive shaft portion 71d.

[0203] The shank 30a for the second side plate is provided on the central axis side of the second side plate 30 and the shank 30a for the second side plate is fixed to the housing 3 via the bearing 32 for the second side plate, which is a ball bearing. As a result, the driven-side scroll member 90 rotates around the driven-side rotational axis CL2 via the second side plate 30 and the first side plate 27. The closed space that is formed between the second side plate 30 and the first side plate 27 is supplied with a lubricant such as oil and grease, and a sliding portion is lubricated as a result.

[0204] The first protruding wall portion 27b protruding toward the second side plate 30 is provided on the outer peripheral side end surface of the first side plate 27. The

second protruding wall portion 30c protruding toward the first side plate 27 is provided on the outer peripheral side end surface of the second side plate 30. The protruding wall portions 27b and 30c constitute a peripheral wall portion by being attached to each other and fixed in a liquid-tight state. As a result, the center plate 20 disposed between the first side plate 27 and the second side plate 30 is accommodated in the space S surrounded by both protruding wall portions 27b and 30c as illustrated in Fig. 18.

[0205] As illustrated in Fig. 15, the pin ring mechanism (synchronization drive mechanism) 15 is provided between the first and second side plates 27 and 30 and the center plate 20. The pin ring mechanism 15 is provided with a round bar-shaped pin 45 and a rolling bearing (ring) 46, which guides the pin 45 by the inner peripheral surface of the rolling bearing 46 abutting against the outer periphery of the pin 45.

[0206] As illustrated in Fig. 18, three pin ring mechanisms 15 are provided at equal angular gaps around the rotation center of the center plate 20. The pin ring mechanism 15 may be four or more in number.

[0207] Fig. 19 is an enlarged view of the part around the pin ring mechanism 15.

[0208] One end (the left end) of the pin 45 is press-fitted and fixed to the first side plate 27 and the other end (right end) of the pin 45 is press-fitted and fixed to the second side plate 30. The longitudinal central portion of the pin 45 abuts against the inner peripheral surface of an inner ring 46b of the rolling bearing 46.

[0209] The rolling bearing 46, which is a ball bearing, is fitted in a hole portion formed in the center plate 20. The rolling bearing 46 is provided with an outer ring 46a, the inner ring 46b, a plurality of balls (rolling members) 46c, and a holder (not illustrated) holding each ball 46c. A lubricant such as grease is enclosed in the rolling bearing 46.

[0210] The pin ring mechanism 15 is used as a synchronization drive mechanism transmitting a drive force from the drive shaft portion 71d to the driven-side scroll member 90 such that both scroll members 70 and 90 relatively perform revolving and orbiting motions in synchronization.

[0211] The co-rotating scroll compressor 1 configured as described above operates as follows.

[0212] The drive shaft 6 is rotated around the drive-side rotational axis CL1 by the motor 5, and then the center plate 20 as well as the drive-side scroll member 70 rotates around the drive-side axis CL1 via the drive shaft portion 71d connected to the drive shaft 6. By the center plate 20 rotating, the drive force transmitted to the center plate 20 is transmitted from the first side plate 27 and the second side plate 30 to the driven-side scroll member 90 via the pin ring mechanism 15 as a synchronization drive mechanism and the driven-side scroll member 90 rotates around the driven-side rotational axis CL2. At this time, the pin ring mechanism 15 causes both scroll members 70 and 90 to relatively perform the re-

volving and orbiting motions.

[0213] By both scroll members 70 and 90 performing the revolving and orbiting motions, the air suctioned from the intake port of the housing 3 is suctioned from the outer peripheral sides of both scroll members 70 and 90 and taken into the compression chamber formed by both scroll members 70 and 90. Then, the compression chamber formed by the first drive-side wall body 71b and the first driven-side wall body 91b and the compression chamber formed by the second drive-side wall body 72b and the second driven-side wall body 92b are separately compressed. The air is compressed as the volume of each compression chamber decreases with a movement to the center side. The air compressed by the first drive-side wall body 71b and the first driven-side wall body 91b passes through the through-hole 90h formed in the driven-side end plate 90a and merges with the air compressed by the second drive-side wall body 72b and the second driven-side wall body 92b, and the merged air is discharged from the discharge port 3d of the housing 3 to the outside through the discharge port 72d.

[0214] The present embodiment has the following action and effect.

[0215] The pin ring mechanism 15 provided with the round bar-shaped pin 45 and the rolling bearing 46 is adopted as a synchronization drive mechanism. As a result, it is possible to realize the synchronization drive mechanism without adopting a crank pin mechanism, and thus it is possible to achieve cost reduction without a complex configuration caused by a large number of bearings being adopted as in the case of crank pin mechanisms.

[0216] The pin 45 is press-fitted and fixed to the side plates 27 and 30, and thus the pin 45 can be used as a positioning pin for both side plates 27 and 30.

[0217] Both ends of the pin 45 are fixed to both side plates 27 and 30 and the central portion of the pin 45 abuts against the inner peripheral surface of the rolling bearing 46. Accordingly, inclination of the inner ring 46b of the rolling bearing 46 can be prevented, an oblique movement of the ball 46c can be prevented, and the life of the synchronization drive mechanism can be extended.

[Modification Example 1]

[0218] The present embodiment can be modified as follows. As illustrated in Fig. 20, in a pin ring mechanism 15A of the present modification example, one end (the left end) of the pin 45 is press-fitted and fixed to the first side plate 27 as in the seventh embodiment and the other end (right end) of the pin 45 is fixed to the second side plate 30 via an O-ring (elastic body) 47.

[0219] The present modification example has the following action and effect.

[0220] One end of the pin 45 is press-fitted and fixed to the first side plate 27 and the other end of the pin 45 is fixed to the second side plate 30 via the O-ring 47. As

a result, both ends of the pin 45 being incapable of being press-fitted to both side plates 27 and 30 due to a component tolerance can be prevented, assembly can be facilitated, and cost reduction can be achieved.

[0221] The O-ring 47 is provided on the second side plate 30 side in the present modification example, the O-ring 47 may be provided on the first side plate 27 side.

[Modification Example 2]

[0222] The pin ring mechanism 15 of the present embodiment illustrated in Fig. 19 and the pin ring mechanism 15A of Modification Example 1 illustrated in Fig. 20 may be combined with each other.

[0223] Specifically, as illustrated in Fig. 18, two out of the three pin ring mechanisms are the pin ring mechanisms 15 illustrated in Fig. 19 and the remaining one pin ring mechanism is the pin ring mechanism 15A illustrated in Fig. 20.

[0224] The present modification example has the following action and effect.

[0225] Two out of the three pin ring mechanisms have a function as a positioning pin as a configuration in which both ends of the pin 45 are press-fitted and fixed to both side plates 27 and 30. As for the pin 45 of the other pin ring mechanism, one end is press-fitted and fixed and the other end is fixed via the O-ring 47, which results in tolerance absorption. As a result, both side plates 27 and 30 can be positioned by means of the pin ring mechanism 15 and assemblability improvement can be achieved.

[Eighth Embodiment]

[0226] Next, an eighth embodiment of the present invention will be described. The present embodiment differs from the seventh embodiment in terms of the configuration of the pin ring mechanism. The eighth embodiment is similar to the seventh embodiment regarding the other points, and thus the points will not be described below.

[0227] As illustrated in Fig. 21, in a pin ring mechanism 15B of the present embodiment, the first side plate 27 and the second side plate 30 are provided with rolling bearings 49 and 51, respectively. The longitudinal central portion of the pin 45 is press-fitted and fixed to the center plate 20. Both ends of the pin 45 abut against the inner peripheral surfaces of the rolling bearings 49 and 51.

[0228] The present embodiment has the following action and effect.

[0229] The central portion of the pin 45 is press-fitted to the center plate 20 and both ends of the pin 45 abut against the inner peripheral surfaces of the rolling bearings 49 and 51 provided on both side plates 27 and 30. Accordingly, both ends of the pin 45 are not restrained by both side plates 27 and 30, and thus it is possible to avoid a situation in which the pin 45 cannot be fixed during assembly due to the component tolerance of both side plates 27 and 30. As a result, assemblability improve-

ment can be achieved.

[0230] O-rings (elastic bodies) 23 may be respectively provided at both ends of the pin 45 as illustrated in Fig. 22. Then, the impact at a time when the pin 45 abuts against the inner peripheral surfaces of the rolling bearings 49 and 51 can be mitigated and noise can be reduced.

[0231] Although the rolling bearings 46, 49, and 51 are adopted as members receiving the pin 45 in the embodiments described above, a slide bearing such as a floating bush bearing may be adopted instead. For example, a slide bearing 48 may be provided instead of the rolling bearing 46 illustrated in Fig. 19 as illustrated in Fig. 23. Then, cost reduction can be achieved as compared with a case where the rolling bearing is adopted. In addition, the moment of inertia of a rotation system such as the rolling bearing can be reduced, and thus response enhancement can be achieved. Lubricant-based lubrication is required particularly in a case where the slide bearing is adopted, and thus more suitable is a liquid-tight structure in which the protruding wall portions 27b and 30c of both side plates 27 and 30 are attached to each other as illustrated in Fig. 15. However, such a liquid-tight structure does not limit the present invention including each of the embodiments described above.

[Ninth Embodiment]

[0232] Hereinafter, a ninth embodiment of the present invention will be described with reference to the drawings including Fig. 24.

[0233] Fig. 24 illustrates the co-rotating scroll compressor 1. The co-rotating scroll compressor 1 can be used as a turbocharger compressing combustion air (a fluid) supplied to an internal combustion engine such as a vehicular engine, a compressor for supplying compressed air to an air electrode of a fuel cell, or a compressor for supplying compressed air used for a braking device of a vehicle such as a railway vehicle.

[0234] The co-rotating scroll compressor 1 is provided with the housing 3, the motor (drive unit) 5 accommodated on one end side of the housing 3, and the drive-side scroll member 70 and the driven-side scroll member 90 accommodated on the other end side of the housing 3.

[0235] The housing 3 has a substantially cylindrical shape and is provided with the motor accommodation portion 3a accommodating the motor 5 and the scroll accommodation portion 3b accommodating the scroll members 70 and 90.

[0236] The discharge port 3d for discharging compressed air is formed in an end portion of the scroll accommodation portion 3b. The housing 3 is provided with an air intake port (not illustrated in Fig. 24) suctioning air.

[0237] The motor 5 is driven by power being supplied from a power supply source (not illustrated). The rotation of the motor 5 is controlled by a command from a control unit (not illustrated). The stator 5a of the motor 5 is fixed to the inner peripheral side of the housing 3. The rotor

5b of the motor 5 rotates around the drive-side rotational axis CL1. The drive shaft 6 extending on the drive-side rotational axis CL1 is connected to the rotor 5b. The drive shaft 6 is connected to the drive shaft portion 71d fixed to the first drive-side scroll part 71 of the drive-side scroll member 70.

[0238] The drive-side bearing 11 rotatably supporting the drive shaft 6 is provided at the front end (left end in Fig. 24) of the drive shaft 6. The rear end bearing 17 rotatably supporting the drive shaft 6 between the housing 3 and the rear end bearing 17 is provided at the rear end (right end in Fig. 24) of the drive shaft 6, that is, in the end portion of the drive shaft 6 that is on the side opposite to the drive-side scroll member 70.

[0239] The drive-side scroll member 70 is provided with the first drive-side scroll part 71 on the motor 5 side and the second drive-side scroll part 72 on the discharge port 3d side.

[0240] The first drive-side scroll part 71 is provided with the first drive-side end plate 71a and the first drive-side wall body 71b.

[0241] The first drive-side end plate 71a extends in a direction orthogonal to the drive-side rotational axis CL1. The drive shaft portion 71d extending on and along the drive-side rotational axis CL1 is fixed to the rotation center of the first drive-side end plate 71a.

[0242] The center plate (a bearing support member) 20 is fixed to the drive shaft portion 71d. The center plate 20 extends in parallel with the first drive-side end plate 71a.

[0243] The first drive-side end plate 71a is substantially disk-shaped in plan view. As illustrated in Fig. 25, the three spiral first drive-side wall bodies 71b, that is, the spiral first drive-side wall bodies 71b in the form of three flights are provided on the first drive-side end plate 71a. The first drive-side wall bodies 71b in the form of three flights are disposed at equal gaps around the drive-side rotational axis CL1. The first drive-side wall body 71b may be one, two, or four or more in the number of flights.

[0244] As illustrated in Fig. 24, the second drive-side scroll part 72 is provided with the second drive-side end plate 72a and the second drive-side wall body 72b. The second drive-side wall body 72b is in the form of three flights similarly to the first drive-side wall body 71b (see Fig. 25) described above. The second drive-side wall body 72b may be one, two, or four or more in the number of flights.

[0245] The second drive-side shaft portion 72c extending in the drive-side rotational axis CL1 direction is connected to the second drive-side end plate 72a. The second drive-side shaft portion 72c is provided rotatably with respect to the housing 3 via the second drive-side bearing 14, which is a ball bearing. The second drive-side end plate 72a is provided with the discharge port 72d, which is along the drive-side rotational axis CL1.

[0246] The two seal members 26 for the second drive shaft portion are provided between the second drive-side shaft portion 72c and the housing 3 and on the leading

edge side (left side in Fig. 24) of the second drive-side shaft portion 72c beyond the second drive-side bearing 14. The two seal members 26 for the second drive shaft portion and the second drive-side bearing 14 are disposed at predetermined gaps in the drive-side rotational axis CL1 direction. Enclosed between the two seal members 26 for the second drive shaft portion is a lubricant that is grease such as a semi-solid lubricant. The seal member 26 for the second drive shaft portion may be one in number. In this case, the lubricant is enclosed between the seal member 26 for the second drive shaft portion and the second drive-side bearing 14.

[0247] The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed in a state where the leading edges (free ends) of the wall bodies 71b and 72b face each other. The first drive-side scroll part 71 and the second drive-side scroll part 72 are fixed by the bolt 31, which is fastened to the flange portions 73 provided at a plurality of places in the circumferential direction so as to protrude to the radial outer side.

[0248] In the driven-side scroll member 90, the driven-side end plate 90a is positioned substantially at the center in the axial direction (horizontal direction in the drawing). The through-hole 90h is formed at the center of the driven-side end plate 90a and compressed air flows to the discharge port 72d.

[0249] The first driven-side wall body 91b and the second driven-side wall body 92b are provided on both sides of the driven-side end plate 90a, respectively. The first driven-side wall body 91b installed on the motor 5 side from the driven-side end plate 90a meshes with the first drive-side wall body 71b of the first drive-side scroll part 71 and the second driven-side wall body 92b installed on the discharge port 3d side from the driven-side end plate 90a meshes with the second drive-side wall body 72b of the second drive-side scroll part 72.

[0250] The three first driven-side wall bodies 91b, that is, the first driven-side wall bodies 91b in the form of three flights are provided as illustrated in Fig. 26. The driven-side wall bodies 91b in the form of three flights are disposed at equal gaps around the driven-side rotational axis CL2. The second driven-side wall body 92b is similar in configuration. Each of the driven-side wall bodies 91b and 92b may be one, two, or four or more in the number of flights.

[0251] The support member 33 is provided on the discharge port 3d side (left side in Fig. 24) of the driven-side scroll member 90. The support member 33 is fixed by the bolt 25 to the leading edge (free end) of the second driven-side wall body 92b.

[0252] The shank 35a for the support member is provided on the central axis side of the support member 33 and the shank 35a for the support member is fixed to the housing 3 via the bearing 38 for the second support member, which is an angular ball bearing. As a result, the driven-side scroll member 90 rotates around the driven-side rotational axis CL2 via the support member 33.

[0253] The first side plate (a bearing support member)

27 is provided on the motor 5 side (right side in Fig. 24) of the driven-side scroll member 90. The first side plate 27 is fixed by the bolt 28 to the leading edge (free end) of the first driven-side wall body 91b. Formed at the rotation center of the first side plate 27 is the hole portion 27h for the first side plate for penetration by the drive shaft portion 71d.

[0254] The second side plate (a bearing support member) 30 is provided at a predetermined gap on the motor 5 side of the first side plate 27. The second side plate 30 is fixed by the bolt 34 to the first side plate 27. Formed at the rotation center of the second side plate 30 is the hole portion 30h for the second side plate for penetration by the drive shaft portion 71d.

[0255] The shank 30a for the second side plate is provided on the central axis side of the second side plate 30 and the shank 30a for the second side plate is fixed to the housing 3 via the bearing 32 for the second side plate, which is an angular ball bearing. As a result, the driven-side scroll member 90 rotates around the driven-side rotational axis CL2 via the second side plate 30 and the first side plate 27.

[0256] The first protruding wall portion 27b protruding toward the second side plate 30 is provided on the outer peripheral side end surface of the first side plate 27. The second protruding wall portion 30c protruding toward the first side plate 27 is provided on the outer peripheral side end surface of the second side plate 30. The protruding wall portions 27b and 30c constitute a peripheral wall portion by being attached to each other and fixed in a liquid-tight state. As a result, the center plate 20 disposed between the first side plate 27 and the second side plate 30 is accommodated in the space S surrounded by both protruding wall portions 27b and 30b as illustrated in Fig. 27.

[0257] As illustrated in Fig. 24, the crank pin 15 is provided between the first and second side plates 27 and 30 and the center plate 20. The crank pin 15 has the cylindrical portion 15a at the center and the first eccentric shaft portion 15b and a second eccentric shaft portion 15f, which have eccentric axes which are eccentric to the central axis of the cylindrical portion 15a. The first eccentric shaft portion 15b protrudes to one side (the left side) of the cylindrical portion 15a and the second eccentric shaft portion 15f protrudes to the other side (right side) of the cylindrical portion 15a. As a result, the crank pin 15 has a symmetrical shape about the cylindrical portion 15a.

[0258] Provided on the outer periphery of the cylindrical portion 15a is the bearing 16 for the cylindrical portion (a cylindrical portion rolling bearing), which is an angular ball bearing. As a result, the cylindrical portion 15a is rotatable with respect to the center plate 20. A lubricant such as grease is enclosed in the bearing 16 for the cylindrical portion.

[0259] The first eccentric shaft portion 15b is provided with the bearing 34 for the first eccentric shaft portion (a first crank pin end portion rolling bearing), which is an

angular ball bearing. As a result, the first eccentric shaft portion 15b is rotatable with respect to the first side plate 27. Grease (a lubricant) is enclosed in the bearing 34 for the first eccentric shaft portion.

[0260] The second eccentric shaft portion 15f is provided with a bearing 35 for the second eccentric shaft portion (second crank pin end portion rolling bearing), which is an angular ball bearing. As a result, the second eccentric shaft portion 15f is rotatable with respect to the second side plate 30. Grease (a lubricant) is enclosed in the bearing 35 for the second eccentric shaft portion.

[0261] The crank pin 15 and the respective bearings 16, 34, and 35 are used as synchronization drive mechanisms transmitting a drive force from the drive shaft portion 71d to the driven-side scroll member 90 such that both scroll members 70 and 90 perform revolving and orbiting motions in synchronization.

[0262] It is preferable that a plurality of the synchronization drive mechanisms provided with the crank pin 15 are provided. For example, three synchronization drive mechanisms are provided at equal angular gaps around the rotational axes CL1 and CL2 (see Fig. 27).

[0263] Fig. 28 is an enlarged view of the part around the crank pin 15.

[0264] The bearing 16 for the cylindrical portion is provided with an outer ring 16a, an inner ring 16b, balls 16c disposed between the outer ring 16a and the inner ring 16b, and a holder (not illustrated) holding the respective balls 16c at equal gaps.

[0265] The outer ring 16a is fitted to a circular groove formed in the center plate 20 via an O-ring (elastic body) 36. The O-ring 36 is disposed in a state where the O-ring 36 is deformed by a predetermined amount and the O-ring 36 presses the outer ring 16a in the inner ring 16b direction.

[0266] The inner ring 16b is press-fitted and fitted to the cylindrical portion 15a.

[0267] A seal member 52 for sealing a lubricant is provided on a side (the right side in Fig. 28) of the bearing 16 for the cylindrical portion. The seal member 52 has an annular shape and the outer peripheral side of the seal member 52 is fixed to a side portion of the outer ring 16a. The seal member 52 is not fixed to the inner ring 16b and a predetermined gap is provided with respect to a side portion of the inner ring 16b. The inner peripheral end of the seal member 52 extends to the side portion of the inner ring 16b. More specifically, the inner peripheral end of the seal member 52 extends to the inner peripheral side beyond the outer periphery of the inner ring 16b.

[0268] A snap ring 55 for fixing the seal member 52 in place is provided on a side (the right side in the drawing) of the seal member 52.

[0269] The bearing 34 for the first eccentric shaft portion is provided with an outer ring 34a, an inner ring 34b, a plurality of balls 34c disposed between the outer ring 34a and the inner ring 34b, and a holder (not illustrated) holding the respective balls 34c at equal gaps.

[0270] The outer ring 34a is fitted by press-fitting to a circular groove formed in the first side plate 27. The inner ring 34b is fitted to the first eccentric shaft portion 15b by press-fitting.

[0271] A seal member 53 for sealing a lubricant is provided on a side (the right side in Fig. 28) of the bearing 34 for the first eccentric shaft portion. The seal member 53 has an annular shape and the outer peripheral side of the seal member 53 is fixed to a side portion of the outer ring 34a. The seal member 53 is not fixed to the inner ring 34b and a predetermined gap is provided with respect to a side portion of the inner ring 34b. The inner peripheral end of the seal member 53 extends to the side portion of the inner ring 34b. More specifically, the inner peripheral end of the seal member 53 extends to the inner peripheral side beyond the outer periphery of the inner ring 34b.

[0272] A snap ring 56 for fixing the seal member 53 in place is provided on a side (the right side in the drawing) of the seal member 53.

[0273] The bearing 35 for the second eccentric shaft portion is provided with an outer ring 35a, an inner ring 35b, a plurality of balls 35c disposed between the outer ring 35a and the inner ring 35b, and a holder (not illustrated) holding the respective balls 35c at equal gaps.

[0274] The outer ring 35a is fitted by press-fitting to a circular groove formed in the second side plate 30. The inner ring 35b is fitted to the second eccentric shaft portion 15f by press-fitting.

[0275] A seal member 54 for sealing a lubricant is provided on a side (the left side in Fig. 28) of the bearing 35 for the second eccentric shaft portion. The seal member 54 has an annular shape and the outer peripheral side of the seal member 54 is fixed to a side portion of the outer ring 35a. The seal member 54 is not fixed to the inner ring 35b and a predetermined gap is provided with respect to a side portion of the inner ring 35b. The inner peripheral end of the seal member 54 extends to the side portion of the inner ring 35b. More specifically, the inner peripheral end of the seal member 54 extends to the inner peripheral side beyond the outer periphery of the inner ring 35b.

[0276] A snap ring 57 for fixing the seal member 54 in place is provided on a side (the right side in the drawing) of the seal member 54.

[0277] The co-rotating scroll compressor 1 configured as described above operates as follows.

[0278] The drive shaft 6 is rotated around the drive-side rotational axis CL1 by the motor 5, and then the center plate 20 as well as the drive-side scroll member 70 rotates around the drive-side axis CL1 via the drive shaft portion 71d connected to the drive shaft 6. By the center plate 20 rotating, the drive force transmitted to the center plate 20 is transmitted from the first side plate 27 and the second side plate 30 to the driven-side scroll member 90 via the crank pin 15 as a synchronization drive mechanism and the driven-side scroll member 90 rotates around the driven-side rotational axis CL2. At this

time, the crank pin 15 rotates with respect to the center plate 20 and both side plates via the respective bearings 16, 34, and 35, and thus both scroll members 70 and 90 relatively perform the revolving and orbiting motions.

[0279] By both scroll members 70 and 90 performing the revolving and orbiting motions, the air suctioned from the intake port of the housing 3 is suctioned from the outer peripheral sides of both scroll members 70 and 90 and taken into the compression chamber formed by both scroll members 70 and 90. Then, the compression chamber formed by the first drive-side wall body 71b and the first driven-side wall body 91b and the compression chamber formed by the second drive-side wall body 72b and the second driven-side wall body 92b are separately compressed. The air is compressed as the volume of each compression chamber decreases with a movement to the center side. The air compressed by the first drive-side wall body 71b and the first driven-side wall body 91b passes through the through-hole 90h formed in the driven-side end plate 90a and merges with the air compressed by the second drive-side wall body 72b and the second driven-side wall body 92b, and the merged air is discharged from the discharge port 3d of the housing 3 to the outside through the discharge port 72d.

[0280] The present embodiment has the following action and effect.

[0281] As illustrated in Fig. 28, the O-ring 36 is provided between the center plate 20 and the outer ring 16a of the bearing 16 for the cylindrical portion. As a result, the tolerance of the crank pin 15, the side plates 27 and 30, and the center plate 20 can be absorbed by the O-ring 36 being deformed, internal force generation in the crank pin 15 can be avoided, and the life of the synchronization drive mechanism can be extended.

[0282] In addition, the machining tolerance of the crank pin 15 can be mitigated and machining and management costs can be reduced.

[0283] In addition, the outer ring 16a is pressed to the inner ring 16b side by the O-ring 36, and thus it is possible to prevent slipping between the outer ring 16a and the hole in which the outer ring 16a is fitted.

[0284] The outer ring 34a of the bearing 34 for the first eccentric shaft portion and the outer ring 35a of the bearing 35 for the second eccentric shaft portion are press-fitted, and thus the centrifugal force around the rotational axes CL1 and CL2 is held by the bearings 34 and 35 for the eccentric shaft portions. The two bearings 34 and 35 bear the centrifugal force in this manner, and thus the load to be borne can be mitigated as compared with a case where the single bearing 16 for the cylindrical portion bears the centrifugal force.

[0285] In addition, the crank pin 15 is supported at both ends by the two bearings 34 and 35 for the eccentric shaft portions, and thus the posture of the crank pin 15 can be stabilized.

[Modification Example 1]

[0286] The present embodiment can be modified as follows.

5 **[0287]** The outer ring 16a of the bearing 16 for the cylindrical portion may be press-fitted and the outer rings 34a and 35a of both bearings 34 and 35 for the eccentric shaft portions may be provided with an O-ring 37 as illustrated in Fig. 29.

10 **[0288]** Then, the tolerance of the crank pin 15, the side plates 27 and 30, and the center plate 20 can be absorbed by the O-ring 37 being deformed, internal force generation in the crank pin 15 can be avoided, and the life of the synchronization drive mechanism can be extended.

15 **[0289]** In addition, the machining tolerance of the crank pin 15 can be mitigated and machining and management costs can be reduced.

20 **[0290]** In addition, the outer ring 16a is pressed to the inner ring 16b side by the O-ring 36, and thus it is possible to prevent slipping between the outer ring 16a and the hole in which the outer ring 16a is fitted.

[Modification Example 2]

25 **[0291]** The present embodiment can be modified as follows.

[0292] The outer rings 34a and 35a of both bearings 34 and 35 for the eccentric shaft portions may be provided with the O-ring 37 with the outer ring 16a of the bearing 16 for the cylindrical portion provided with the O-ring 36 as illustrated in Fig. 30.

30 **[0293]** Then, the tolerance of the crank pin 15, the side plates 27 and 30, and the center plate 20 can be absorbed by the O-rings 36 and 37 being deformed, internal force generation in the crank pin 15 can be avoided, and the life of the synchronization drive mechanism can be extended.

35 **[0294]** In addition, the machining tolerance of the crank pin 15 can be mitigated and machining and management costs can be reduced.

40 **[0295]** In addition, the outer ring 16a is pressed to the inner ring 16b side by the O-ring 36, and thus it is possible to prevent slipping between the outer ring 16a and the hole in which the outer ring 16a is fitted.

[Modification Example 3]

[0296] The present embodiment can be modified as follows.

50 **[0297]** The outer ring 16a of the bearing 16 for the cylindrical portion and the outer rings 34a and 35a of both bearings 34 and 35 for the eccentric shaft portions may be press-fitted and an O-ring 38 may be provided between the crank pin 15 and each of the inner rings 16b, 34b, and 35b as illustrated in Fig. 31.

55 **[0298]** Then, the tolerance of the crank pin 15, the side plates 27 and 30, and the center plate 20 can be absorbed by the O-ring 38 being deformed, internal force genera-

tion in the crank pin 15 can be avoided, and the life of the synchronization drive mechanism can be extended.

[0299] In addition, the machining tolerance of the crank pin 15 can be mitigated and machining and management costs can be reduced.

[0300] The O-ring 38 may be provided only between the crank pin 15 and the inner ring 16b of the bearing 16 for the cylindrical portion or only between the crank pin 15 and the inner rings 34b and 35b of both bearings 34 and 35 for the eccentric shaft portions.

[Tenth Embodiment]

[0301] Next, a tenth embodiment of the present invention will be described. The present embodiment differs from the ninth embodiment in terms of the configuration of the crank pin 15. The tenth embodiment is similar to the ninth embodiment regarding the other points, and thus the points will not be described below.

[0302] As illustrated in Fig. 32A, the components including the cylindrical portion 15a and an eccentric shaft portion 15g constitute a crank pin 15'. The first eccentric shaft portion 15b and the second eccentric shaft portion 15f are provided at both ends of the eccentric shaft portion 15g, respectively.

[0303] An insertion hole 15a1 into which the eccentric shaft portion 15g is inserted is formed in the cylindrical portion 15a. The eccentric shaft portion 15g is fixed by being press-fitted into the insertion hole 15a1.

[0304] The crank pin 15 illustrated in the ninth embodiment is illustrated in Fig. 32B. The cylindrical portion 15a, the first eccentric shaft portion 15b, and the second eccentric shaft portion 15f are integrated in the crank pin 15 formed by being cut out from the same material.

[0305] The present embodiment has the following action and effect.

[0306] The eccentric shaft portion 15g of the crank pin 15' is inserted into the insertion hole 15a1 formed in the cylindrical portion 15a. As a result, the eccentric shaft portion 15g and the cylindrical portion 15a can be separate components and can be machined separately. Accordingly, the axial centers of the first eccentric shaft portion 15b and the second eccentric shaft portion 15f at both ends of the eccentric shaft portion 15g can be aligned as compared with a case where the eccentric shaft portion 15g and the cylindrical portion 15a are integrally machined (Fig. 32B). Accordingly, an internal force applied to the crank pin 15' can be reduced and the life of the synchronization drive mechanism can be extended.

[0307] Although the crank pin 15' of the present embodiment can be applied in place of the crank pin 15 of the ninth embodiment, the crank pin 15' of the present embodiment is not limited to the configuration of the ninth embodiment and can be applied as a crank pin used in a co-rotating scroll compressor.

Reference Signs List

[0308]

5	1 Co-rotating scroll compressor
	3 Housing
	3a Motor accommodation portion
	3b Scroll accommodation portion
	3d Discharge port
10	5 Motor (drive unit)
	5a Stator
	5b Rotor
	6 Drive shaft
	11 Drive-side bearing
15	15 Crank pin (synchronization drive mechanism)
	15a Cylindrical portion
	15a1 Insertion hole
	15b Eccentric shaft portion, first eccentric shaft portion
20	15c End portion
	15d Small-diameter portion
	15e Central portion
	15f Second eccentric shaft portion
	15g Eccentric shaft portion
25	16 Bearing for cylindrical portion
	17 Rear end bearing
	18a Bearing for first eccentric shaft portion (crank pin end portion rolling bearing)
	18b Bearing for second eccentric shaft portion (crank pin end portion rolling bearing)
30	19 O-ring (urging member)
	20 Center plate
	20a Shank
	20b Fixing portion
35	21 Bolt
	22 O-ring (elastic body)
	23 O-ring (elastic body)
	25 Bolt
	26 Seal member
40	27 First side plate
	27a Fixing portion
	27b First protruding wall portion
	27h Hole portion for first side plate
	28 Bolt
45	30 Second side plate
	30a Shank for second side plate
	30b Fixing portion
	30c Second protruding wall portion
	30d Drive shaft portion
50	30h Hole portion for second side plate
	31 Bolt
	32 Bearing for second side plate
	33 Support member
	34 Bearing for first eccentric shaft portion (first crank pin end portion rolling bearing)
55	34a Outer ring
	34b Inner ring
	34c Ball

35 Bearing for second eccentric shaft portion (second crank pin end portion rolling bearing)

35a Outer ring

35b Inner ring

35c Ball

36, 37, 38 O-ring (elastic body)

40 Resinous shaft portion (resin portion)

41 Seal plate

42 Stopper ring

43 First seal member

44 Second seal member

45 Pin

46 Rolling bearing (ring)

46a Outer ring

46b Inner ring

46c Ball (rolling member)

47 O-ring (elastic body)

48 Slide bearing

49 Rolling bearing

50 Drive-side scroll member

51 Rolling bearing

52, 53, 54 Seal member

55, 56, 57 Snap ring

60 Driven-side scroll member

61a First driven-side end plate

61d Driven shaft portion

70 Drive-side scroll member

71 First drive-side scroll part

71a First drive-side end plate

71b First drive-side wall body

71d Drive shaft portion

72 Second drive-side scroll part

72a Second drive-side end plate

72b Second drive-side wall body

72c Second drive-side shaft portion

72d Discharge port

73 Flange portion

90 Driven-side scroll member

90h Through-hole

91 First driven-side scroll part

91b First driven-side wall body

92b Second driven-side wall body

CL1 Drive-side rotational axis

CL2 Driven-side rotational axis

CL3 Eccentric axis

t Gap

S Space

5

10

15

20

25

30

35

40

45

50

55

driven-side wall body corresponding to the drive-side wall body is disposed on a driven-side end plate and the driven-side wall body meshes with the drive-side wall body to form a compression space;

a synchronization drive mechanism transmitting a drive force of the drive unit to the driven-side scroll member such that the drive-side scroll member and the driven-side scroll member perform rotating motions in the same direction and at the same angular velocity;

a first side plate disposed on the rotational axis direction side with respect to the drive-side scroll member and the driven-side scroll member;

a second side plate fixed at a predetermined gap in the rotational axis direction with respect to the first side plate; and

a center plate disposed between the first side plate and the second side plate, wherein

the first side plate is fixed to one of the drive-side scroll member and the driven-side scroll member,

the center plate is fixed to the other of the drive-side scroll member and the driven-side scroll member, and

the synchronization drive mechanism is provided between the first and second side plates and the center plate.

2. The co-rotating scroll compressor according to Claim 1, wherein

the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion and a crank pin end portion rolling bearing provided between both end portions of the eccentric shaft portion and the first and second side plates, and

an urging member urging an inner ring of the crank pin end portion rolling bearing toward a leading edge of the eccentric shaft portion in the eccentric axis direction is provided between the inner ring and the eccentric shaft portion.

3. The co-rotating scroll compressor according to Claim 1, wherein

the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion and a crank pin end portion rolling bearing provided between both end portions of the eccentric shaft portion and the first and second side plates, and

a preload is applied to the crank pin end portion rolling bearing in the eccentric axis direction by a gap between the first side plate and the second side plate.

Claims

1. A co-rotating scroll compressor comprising:

a drive-side scroll member driven to rotate around a rotational axis by a drive unit and having a spiral drive-side wall body disposed on a drive-side end plate;

a driven-side scroll member in which a spiral

4. The co-rotating scroll compressor according to Claim 1, wherein
the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion and a crank pin end portion rolling bearing provided between both end portions of the eccentric shaft portion and the first and second side plates, and an elastic body is provided between an inner peripheral surface of an inner ring of the crank pin end portion rolling bearing and an outer peripheral surface of the eccentric shaft portion.
5. The co-rotating scroll compressor according to any one of Claims 1 to 4, wherein among a fixing portion of the first side plate which is fixed to one of the drive-side scroll member and the driven-side scroll member and a fixing portion of the center plate which is fixed to the other of the drive-side scroll member and the driven-side scroll member, the fixing portion positioned on a radial inner side of a center of the scroll member has a structure in which a resin portion is interposed, and the fixing portion positioned on a radial outer side of the center of the scroll member has a structure using a metal portion without resin portion interposition.
6. The co-rotating scroll compressor according to Claim 1, wherein a peripheral wall portion surrounding an outer peripheral side of the center plate is provided between the first side plate and the second side plate.
7. The co-rotating scroll compressor according to Claim 6, further comprising
a drive shaft portion rotating around the rotational axis and connected between the drive-side end plate and the drive unit, wherein
the center plate is fixed to the drive shaft portion,
a hole portion for the first side plate through which the drive shaft portion passes is formed in the first side plate,
a hole portion for the second side plate through which the drive shaft portion passes is formed in the second side plate, and
a first seal member is provided between the hole portion for the first side plate and the drive shaft portion and/or between the hole portion for the second side plate and the drive shaft portion.
8. The co-rotating scroll compressor according to Claim 6 or 7, further comprising
a drive shaft portion rotating around the rotational axis and connected between the drive-side end plate and the drive unit, wherein
the center plate is fixed to the drive shaft portion,
a hole portion for the first side plate through which the drive shaft portion passes is formed in the first side plate,
a hole portion for the second side plate through which the drive shaft portion passes is formed in the second side plate, and
a second seal member is provided between the first side plate and the center plate and/or between the second side plate and the center plate.
9. The co-rotating scroll compressor according to Claim 6, wherein
the first side plate is fixed to the drive-side wall body on an outer peripheral side,
the second side plate is fixed to the first side plate, the drive unit is connected to a rotation center of the second side plate,
the center plate is fixed to a driven shaft portion connected to a rotation center of the driven-side end plate,
a hole portion for the first side plate through which the driven shaft portion passes is formed in the first side plate, and
a rotation center region of the second side plate is closed by a wall portion.
10. The co-rotating scroll compressor according to Claim 1, wherein the synchronization drive mechanism is provided with a round bar-shaped pin provided between the first and second side plates and the center plate and a ring guiding the pin by an inner peripheral surface of the ring abutting against an outer periphery of the pin.
11. The co-rotating scroll compressor according to Claim 10, wherein
the ring is a rolling bearing provided on the center plate, and
both ends of the pin are press-fitted to the first side plate and the second side plate and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing.
12. The co-rotating scroll compressor according to Claim 10, wherein
the ring is a rolling bearing provided on the center plate, and
one end of the pin is press-fitted to one of the first side plate and the second side plate, the other end of the pin is fixed to the other of the first side plate and the second side plate via an elastic body, and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing.
13. The co-rotating scroll compressor according to Claim 10, wherein
three or more synchronization drive mechanisms are provided to be spaced apart in a circumferential direction of the rotational axis,

in two of the synchronization drive mechanisms, the ring is a rolling bearing provided on the center plate, both ends of the pin are press-fitted to the first side plate and the second side plate, and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing, and in the other synchronization drive mechanism, the ring is a rolling bearing provided on the center plate, one end of the pin is press-fitted to one of the first side plate and the second side plate, the other end of the pin is fixed to the other of the first side plate and the second side plate via an elastic body, and a longitudinal central portion of the pin abuts against an inner peripheral surface of the rolling bearing.

14. The co-rotating scroll compressor according to Claim 10, wherein the ring is a rolling bearing provided on each of the first side plate and the second side plate, and a longitudinal central portion of the pin is press-fitted to the center plate and both ends of the pin abut against an inner peripheral surface of the rolling bearing.
15. The co-rotating scroll compressor according to any one of Claims 11 to 14, wherein the ring is a slide bearing instead of the rolling bearing.
16. The co-rotating scroll compressor according to Claim 1, wherein the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion, a first crank pin end portion rolling bearing provided between one end of the eccentric shaft portion and the first side plate, a second crank pin end portion rolling bearing provided between the other end of the eccentric shaft portion and the second side plate, and a cylindrical portion rolling bearing provided between the cylindrical portion and the center plate, and an elastic body is provided in at least one of spaces between an outer ring of the first crank pin end portion rolling bearing and the first side plate, between an outer ring of the second crank pin end portion rolling bearing and the second side plate, and between an outer ring of the cylindrical portion rolling bearing and the center plate or in at least one of spaces between an inner ring of the first crank pin end portion rolling bearing and the one end of the eccentric shaft portion, between an inner ring of the second crank pin end portion rolling bearing and the other end of the eccentric shaft portion, and between an inner ring of the cylindrical portion rolling bearing and the cylindrical portion.

17. The co-rotating scroll compressor according to

Claim 16, wherein

the elastic body is provided between the outer ring of the cylindrical portion rolling bearing and the center plate,

the outer ring of the first crank pin end portion rolling bearing is press-fitted to the first side plate, and the outer ring of the second crank pin end portion rolling bearing is press-fitted to the second side plate.

18. The co-rotating scroll compressor according to Claim 16 or 17, wherein an insertion hole into which the eccentric shaft portion is inserted is formed in the cylindrical portion.
19. The co-rotating scroll compressor according to Claim 1, wherein the synchronization drive mechanism is provided with a crank pin having an eccentric shaft portion having an eccentric axis which is eccentric to a central axis of a central cylindrical portion, and an insertion hole into which the eccentric shaft portion is inserted is formed in the cylindrical portion.

FIG. 1

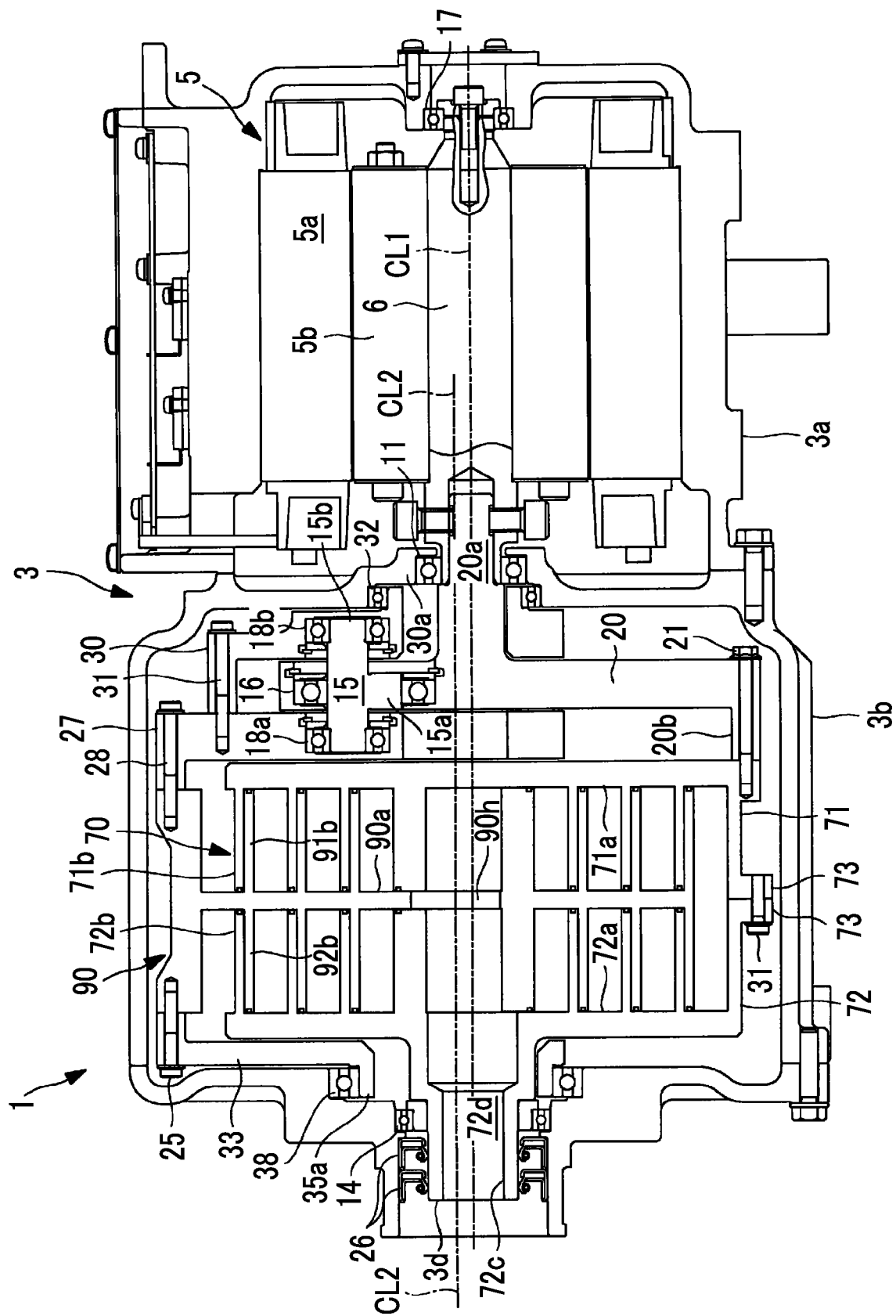


FIG. 2

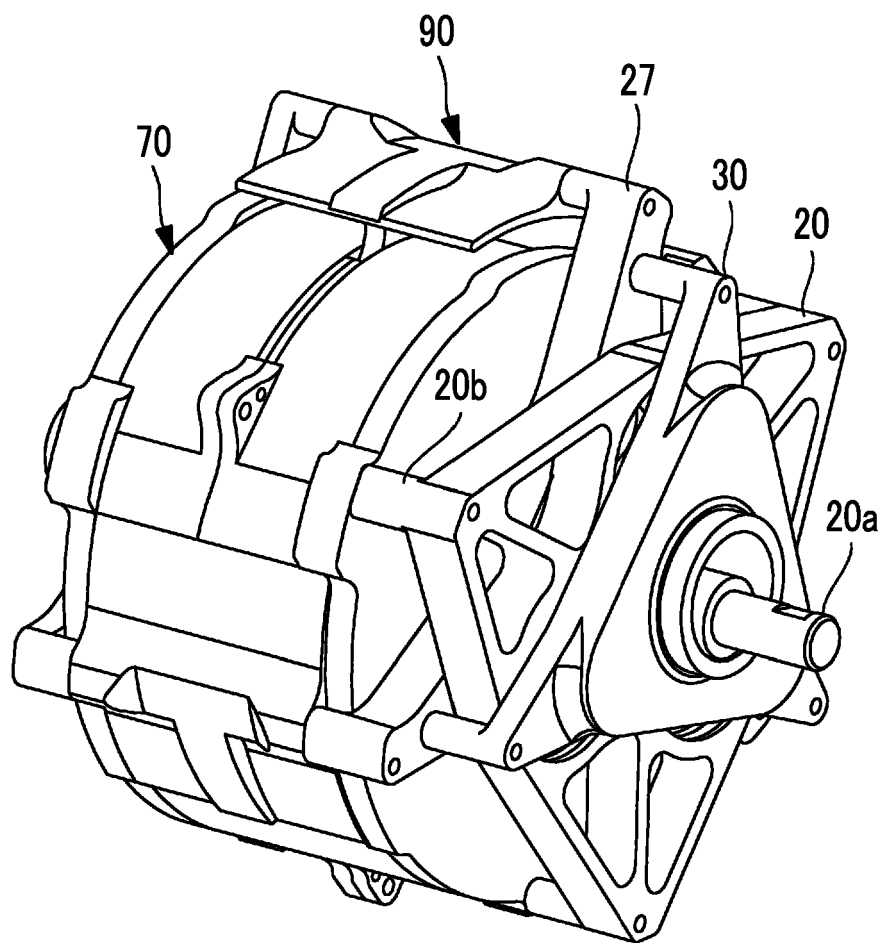


FIG. 3

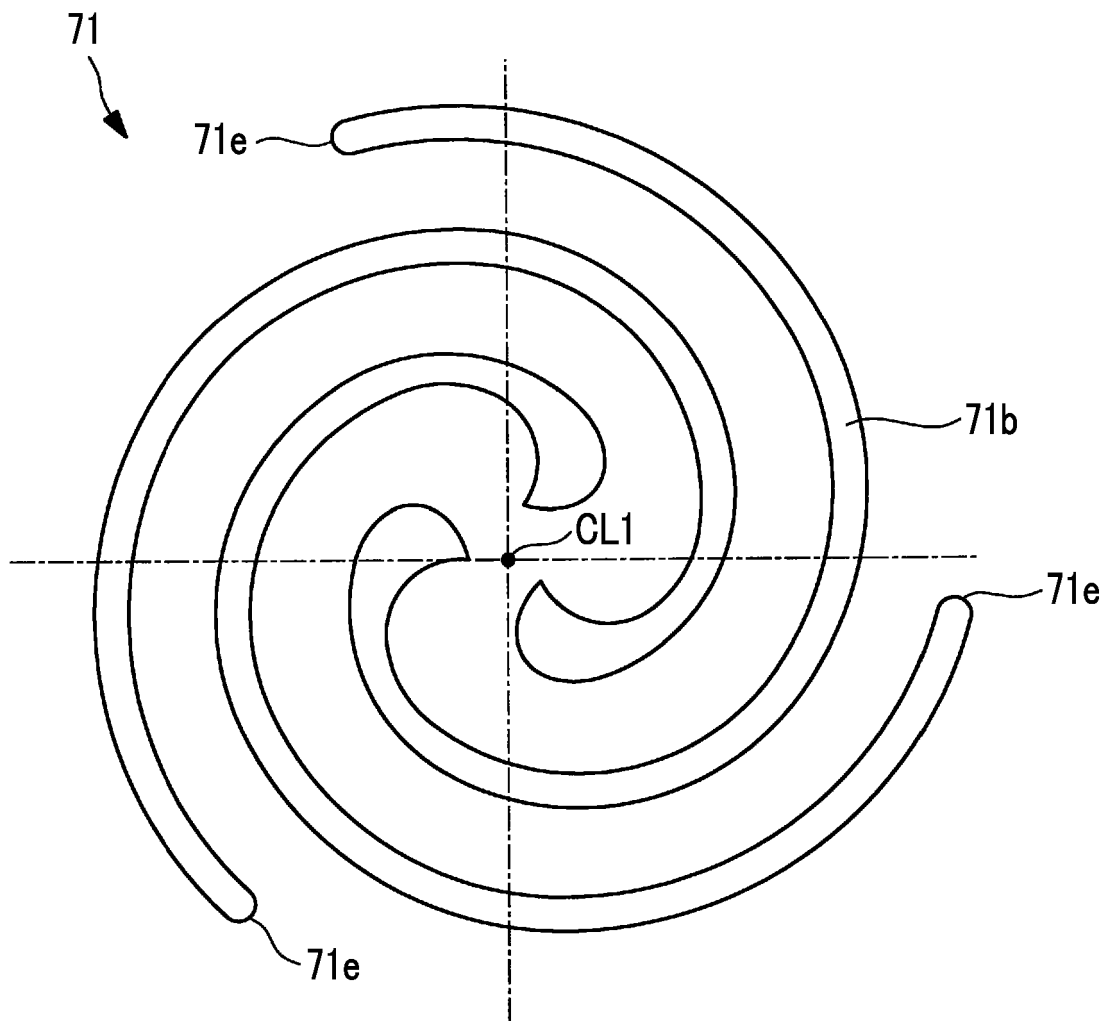


FIG. 4

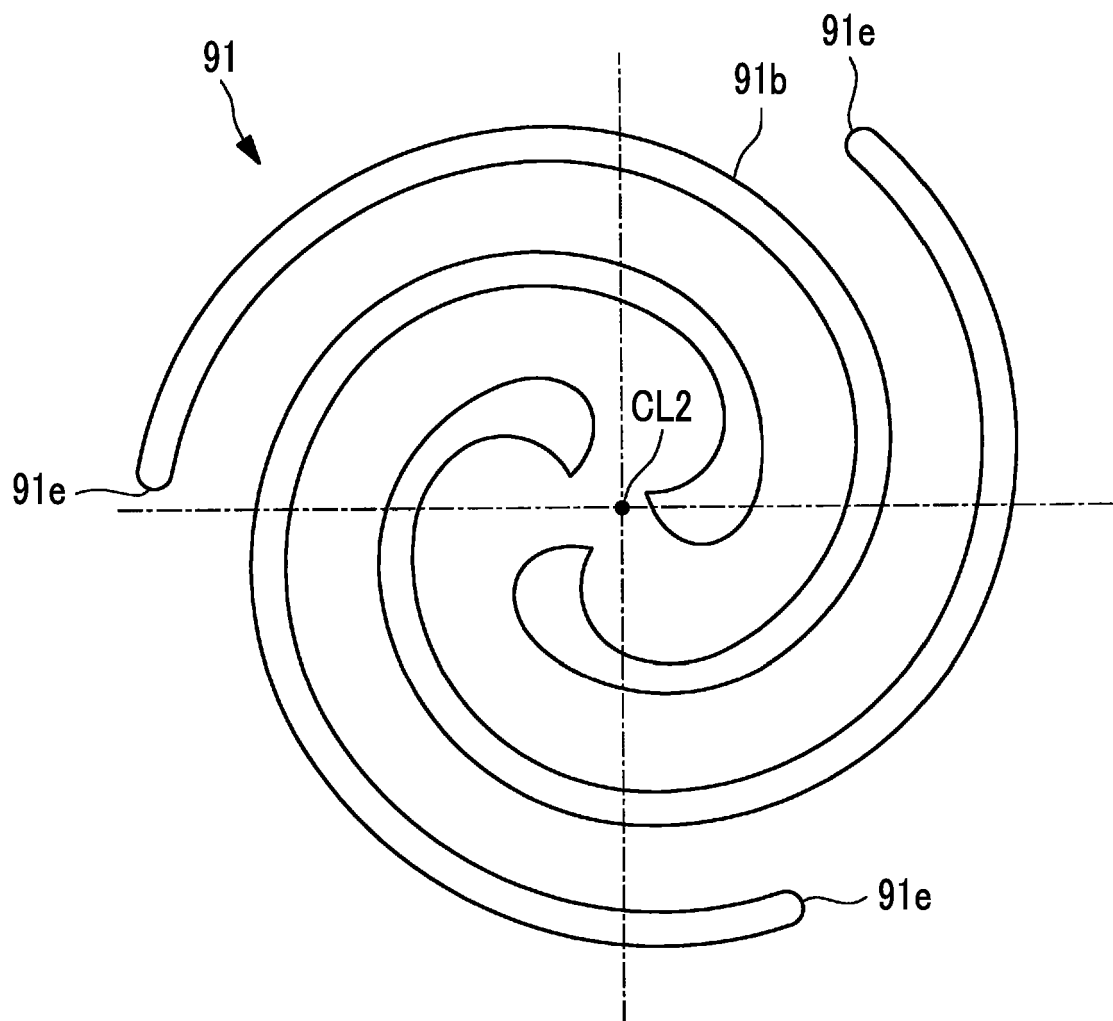


FIG. 5

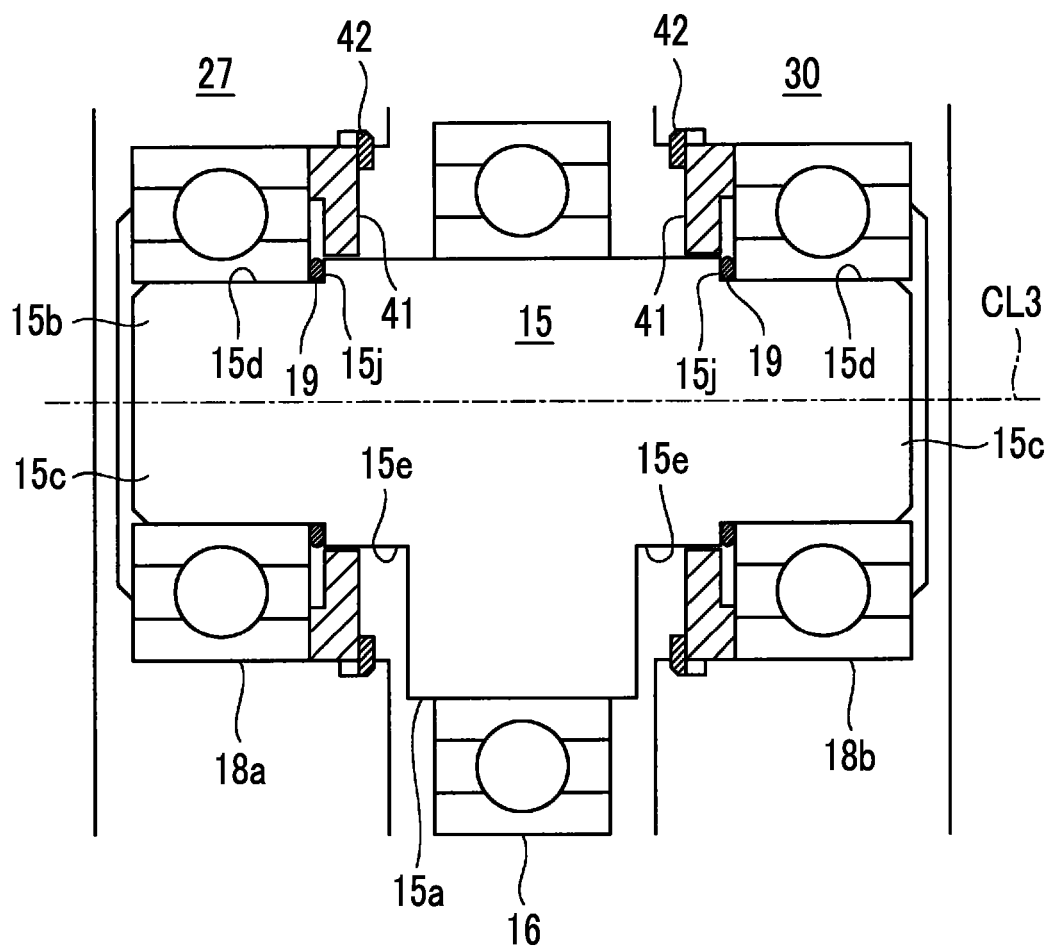


FIG. 6

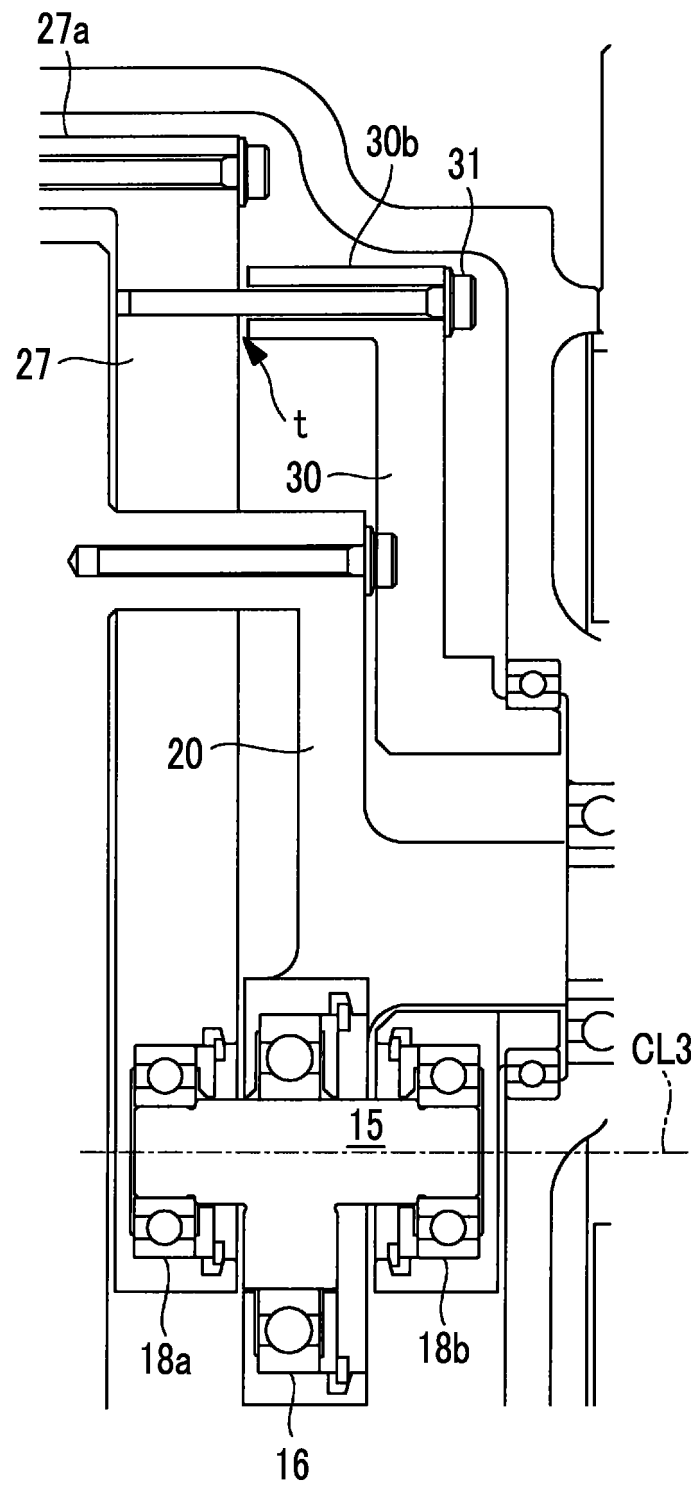


FIG. 7

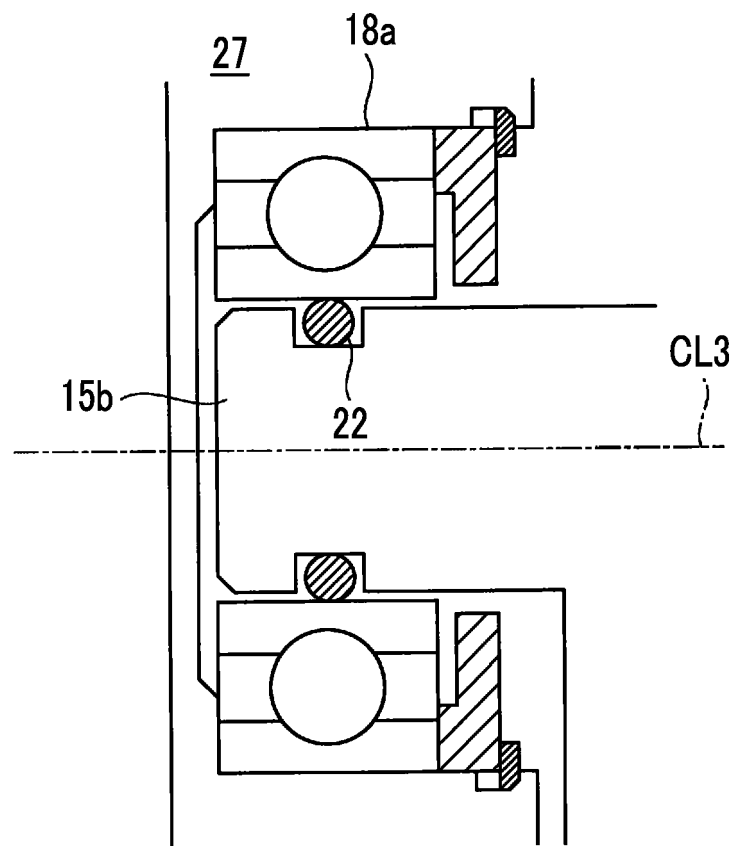


FIG. 8

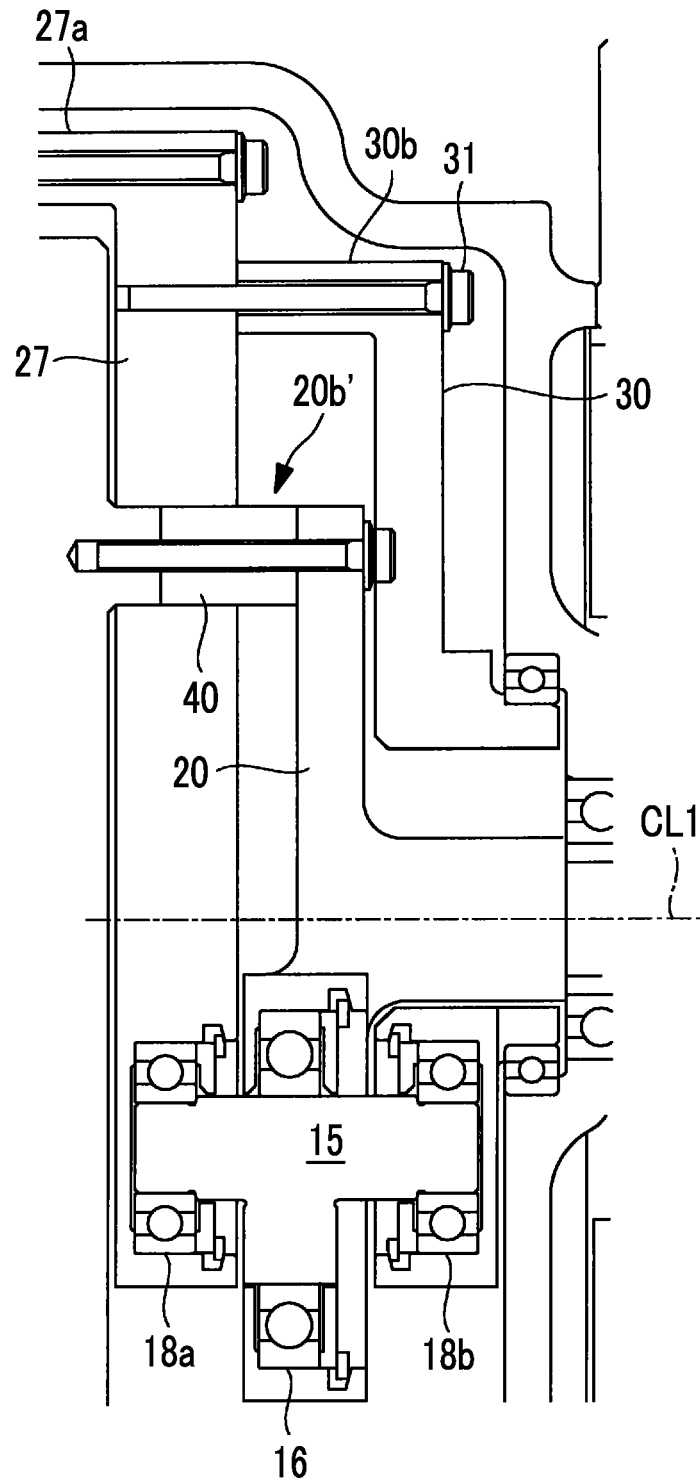


FIG. 9

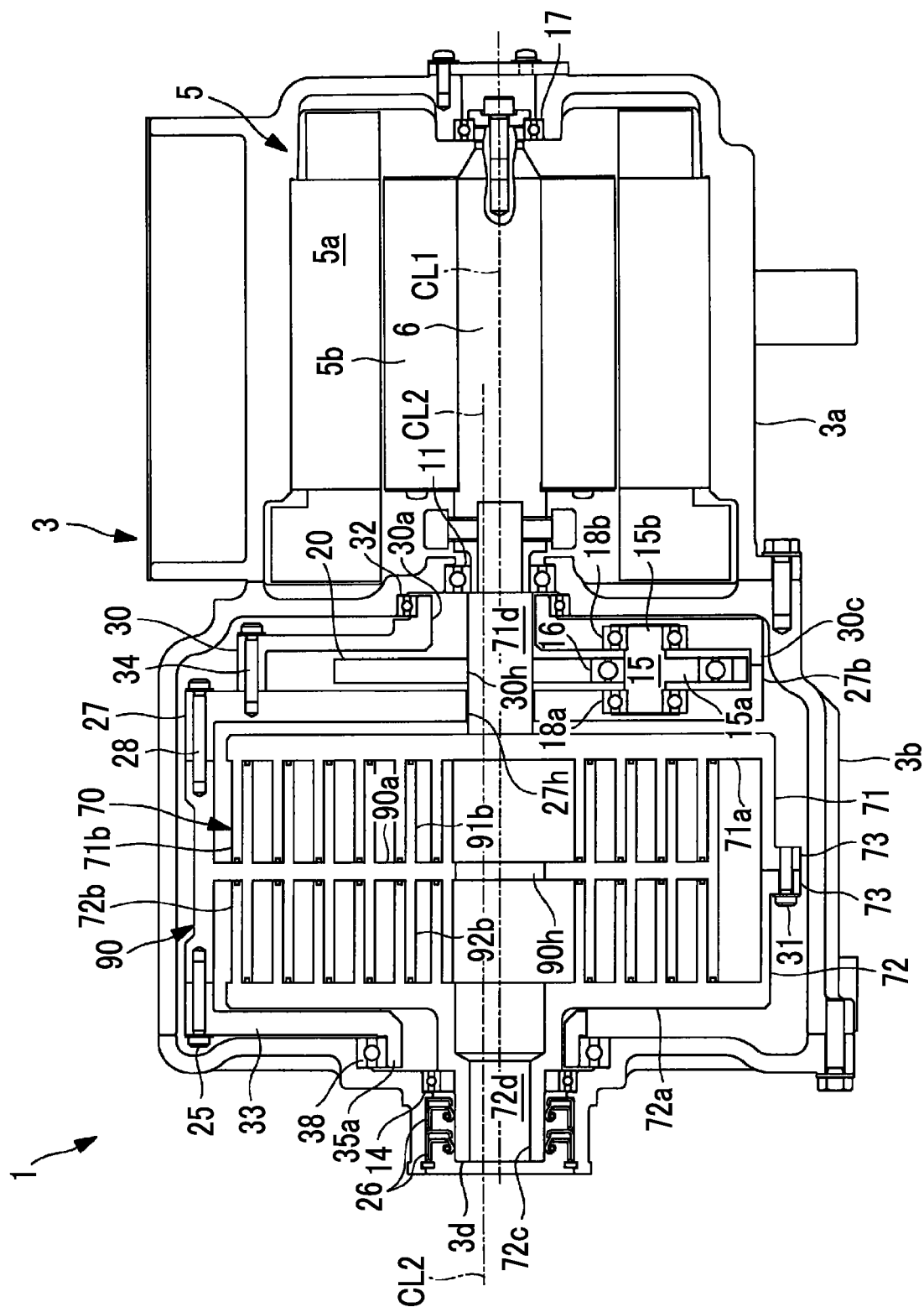


FIG. 10

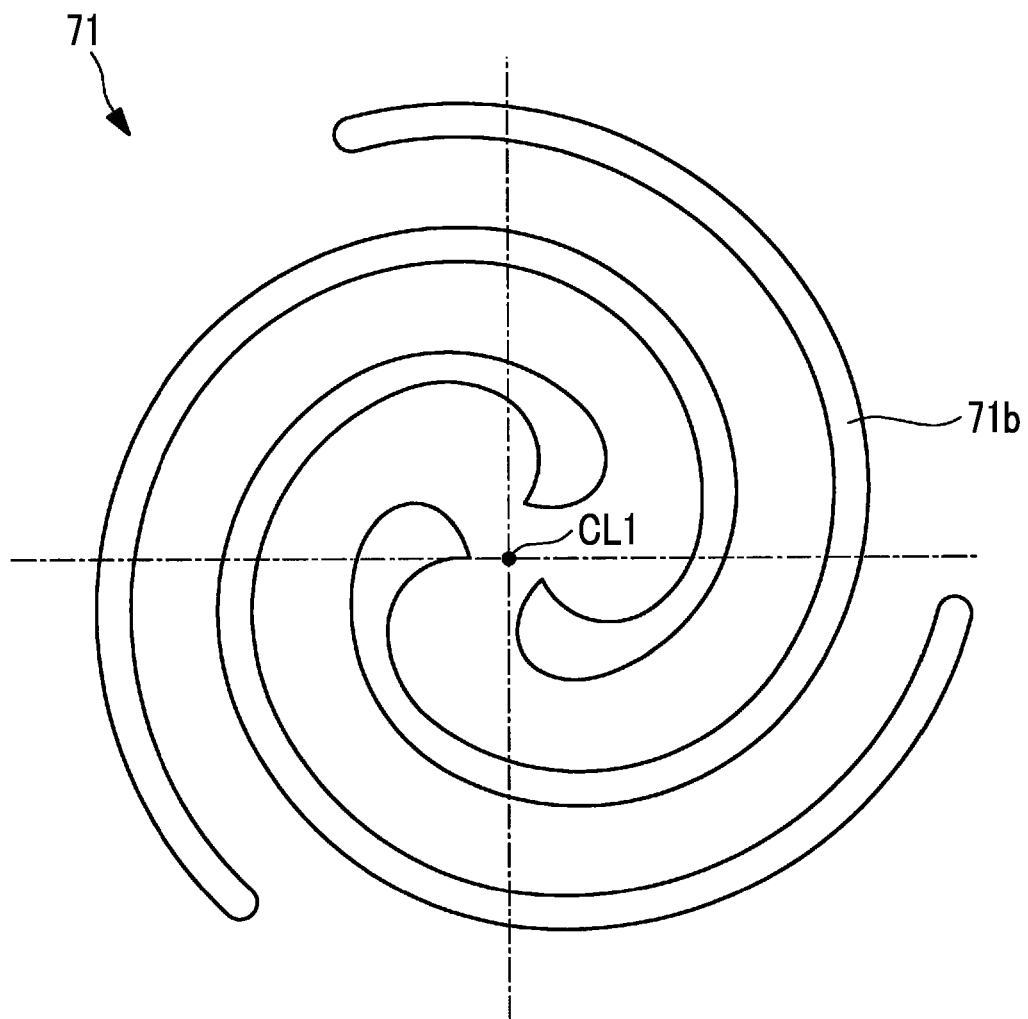


FIG. 11

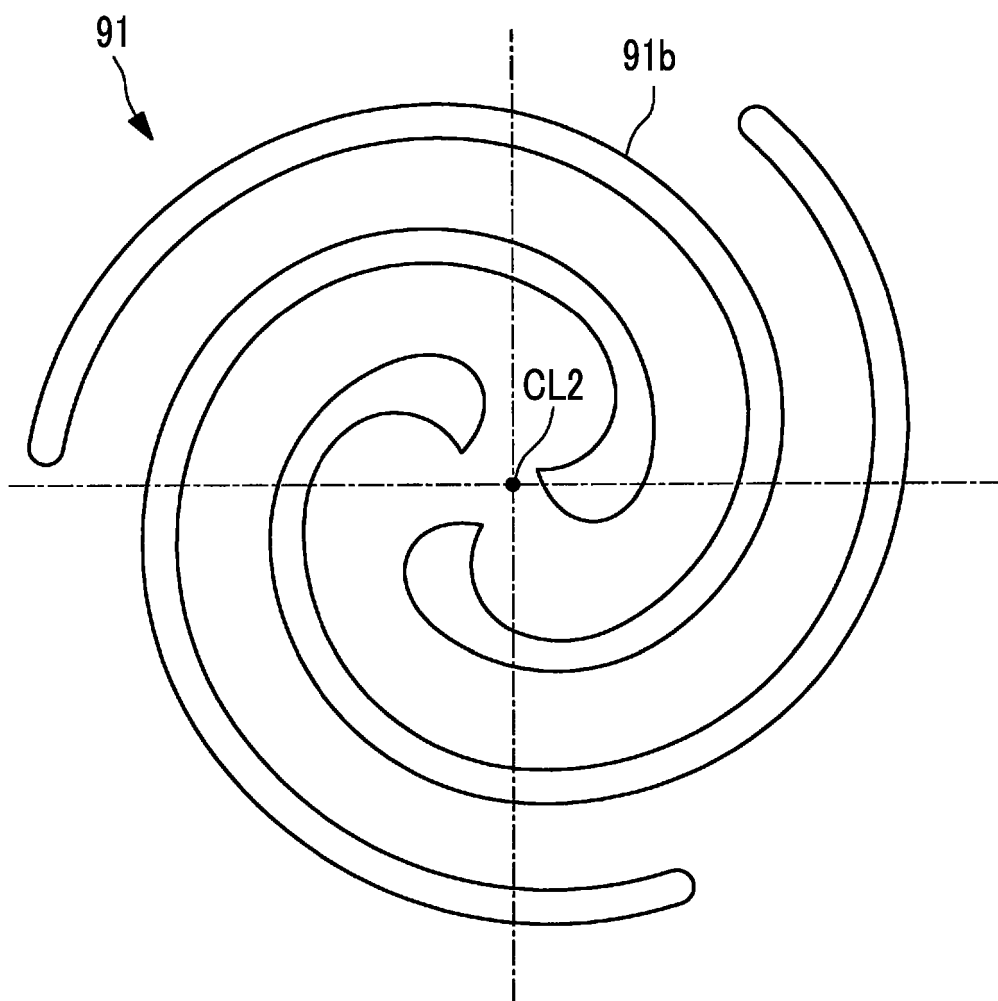


FIG. 12

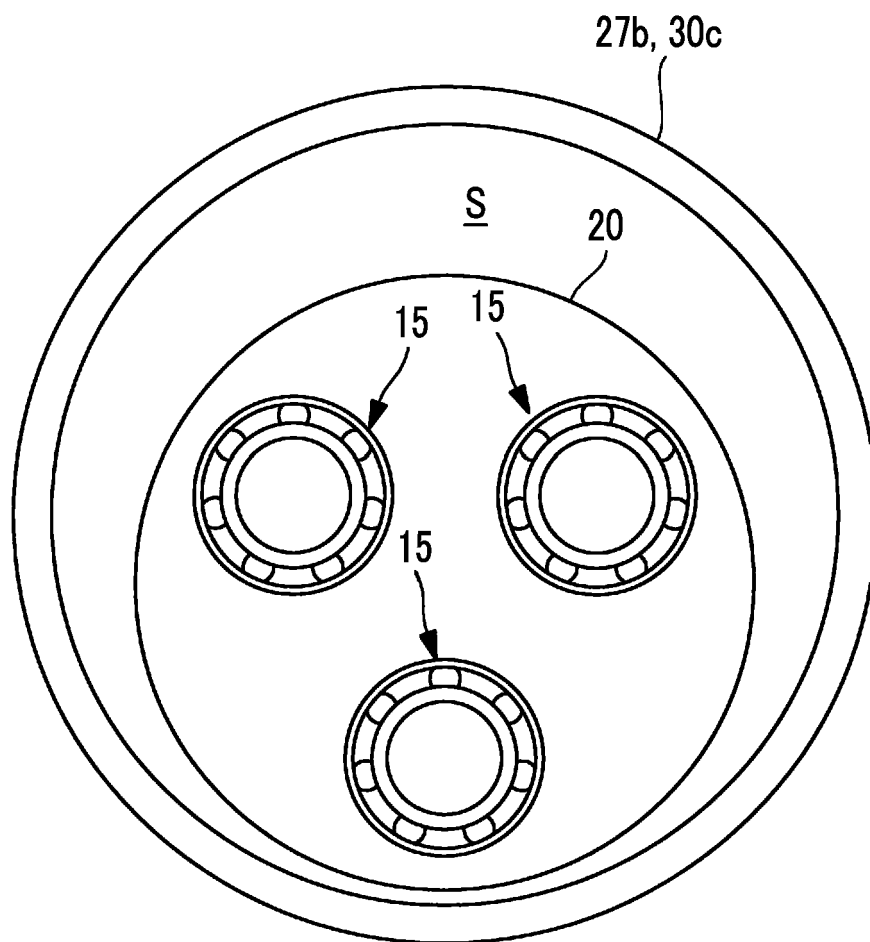


FIG. 13

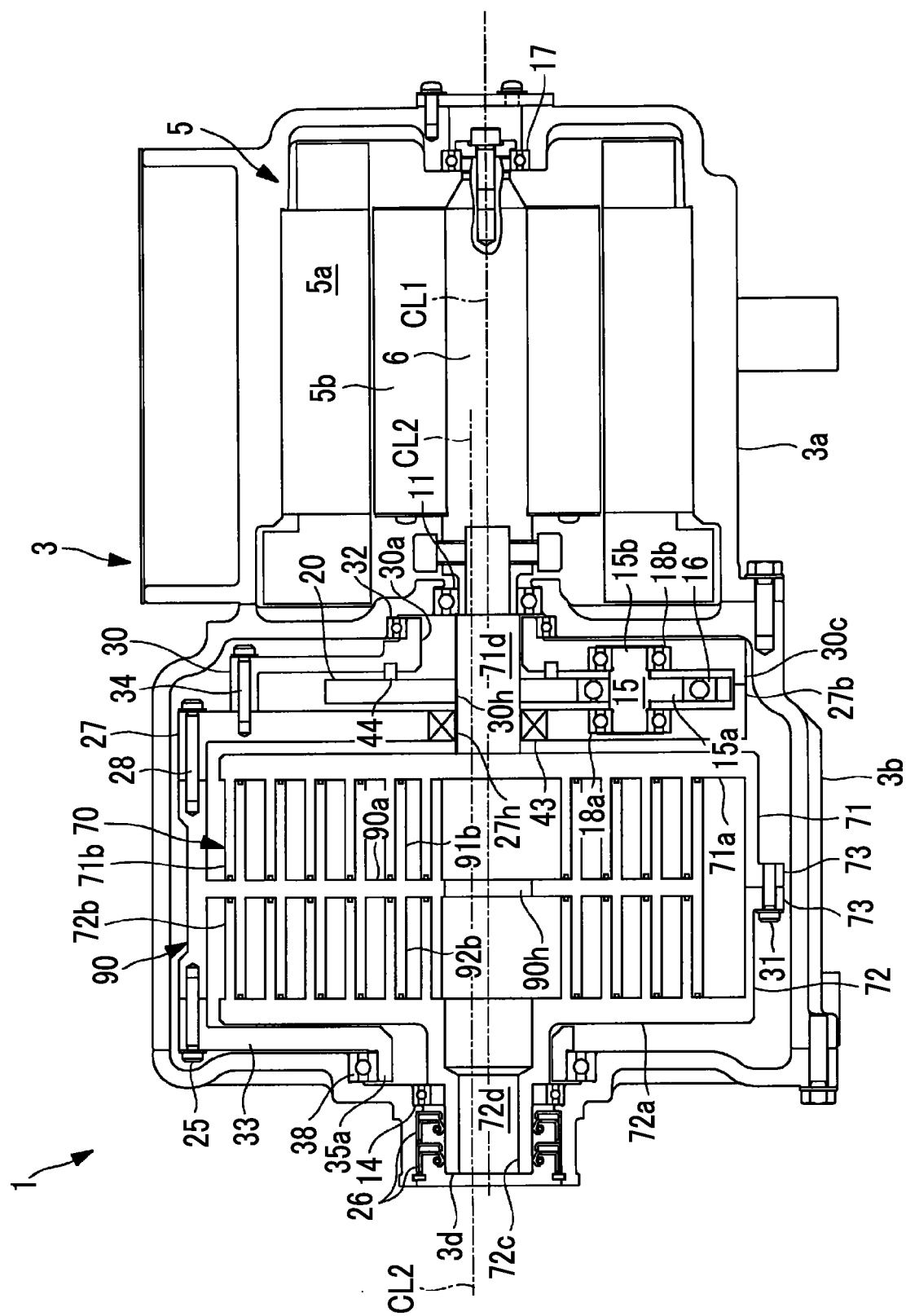


FIG. 14

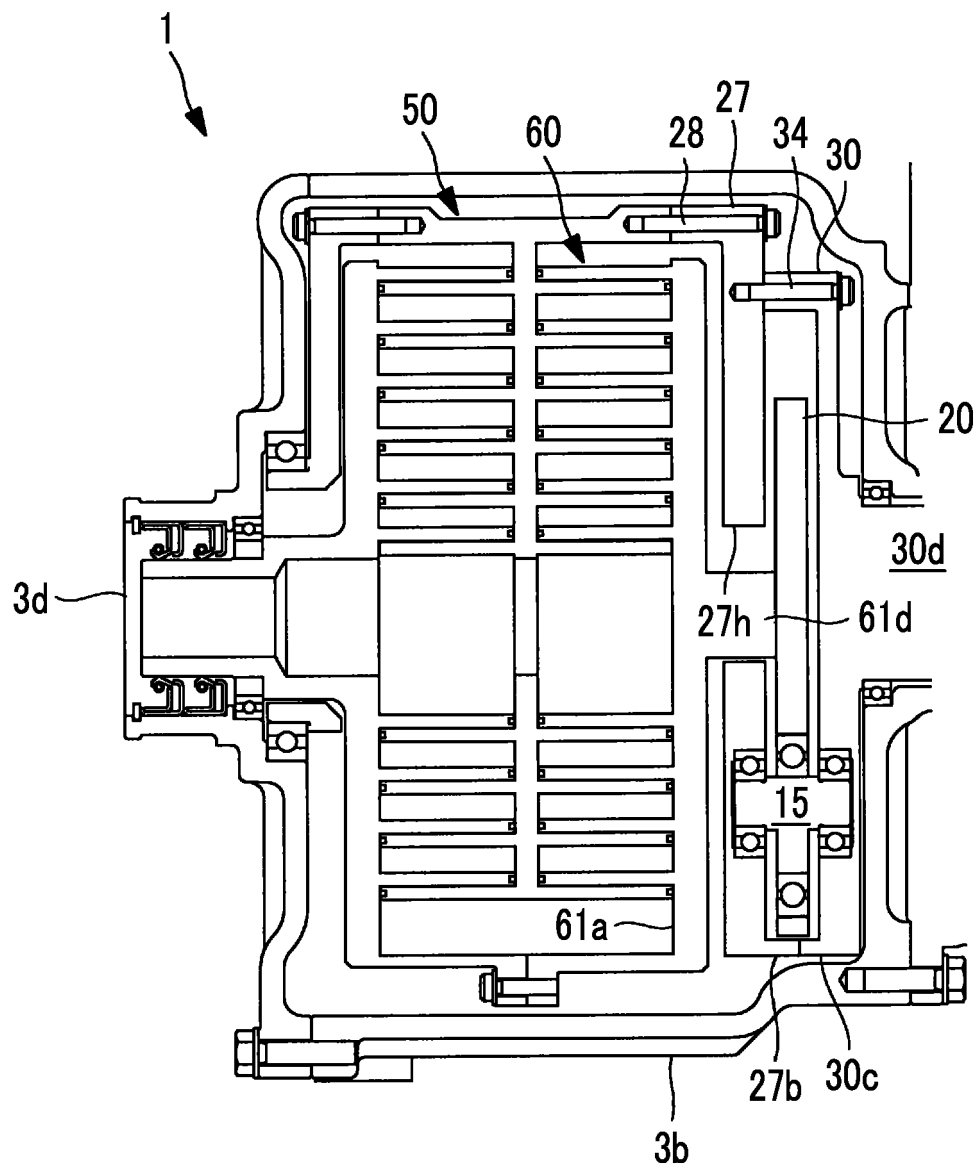


FIG. 15

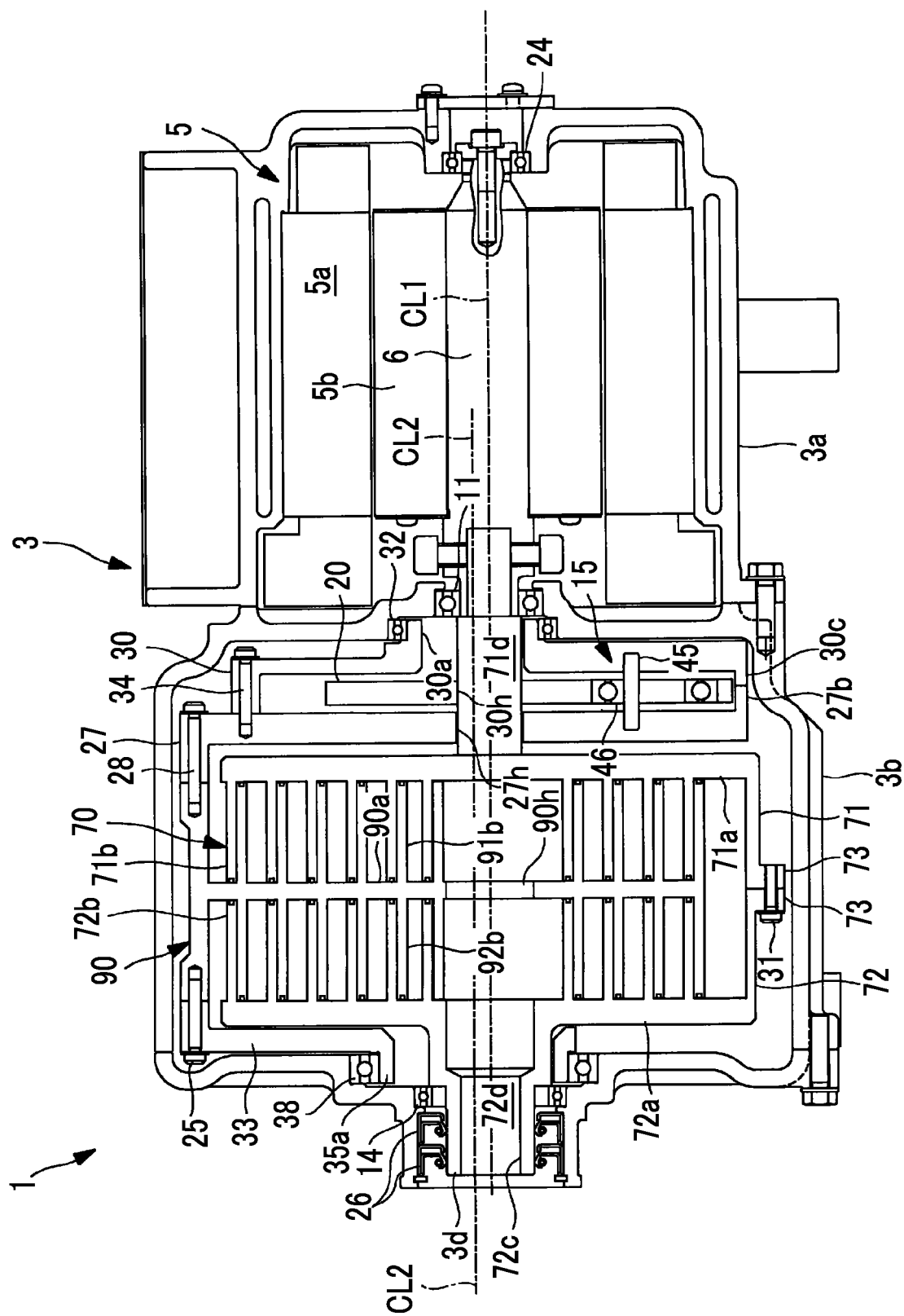


FIG. 16

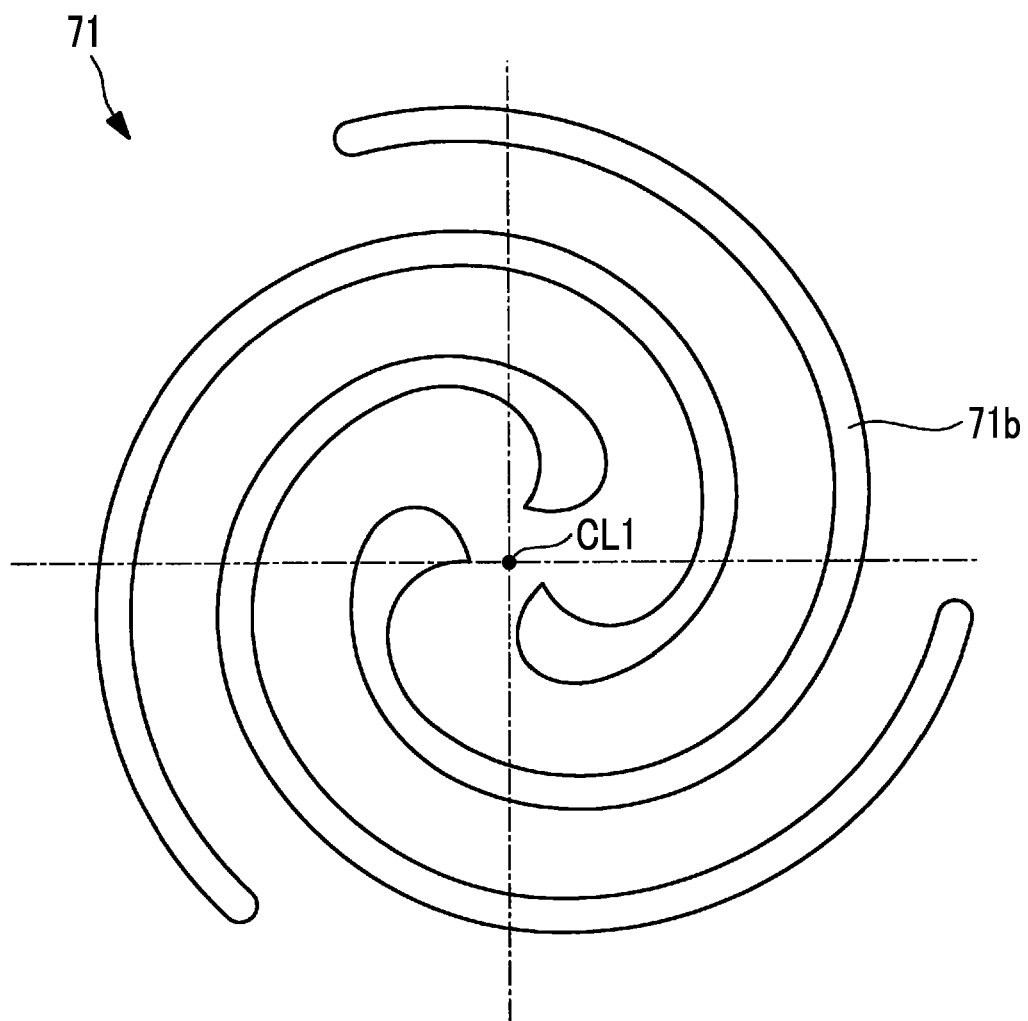


FIG. 17

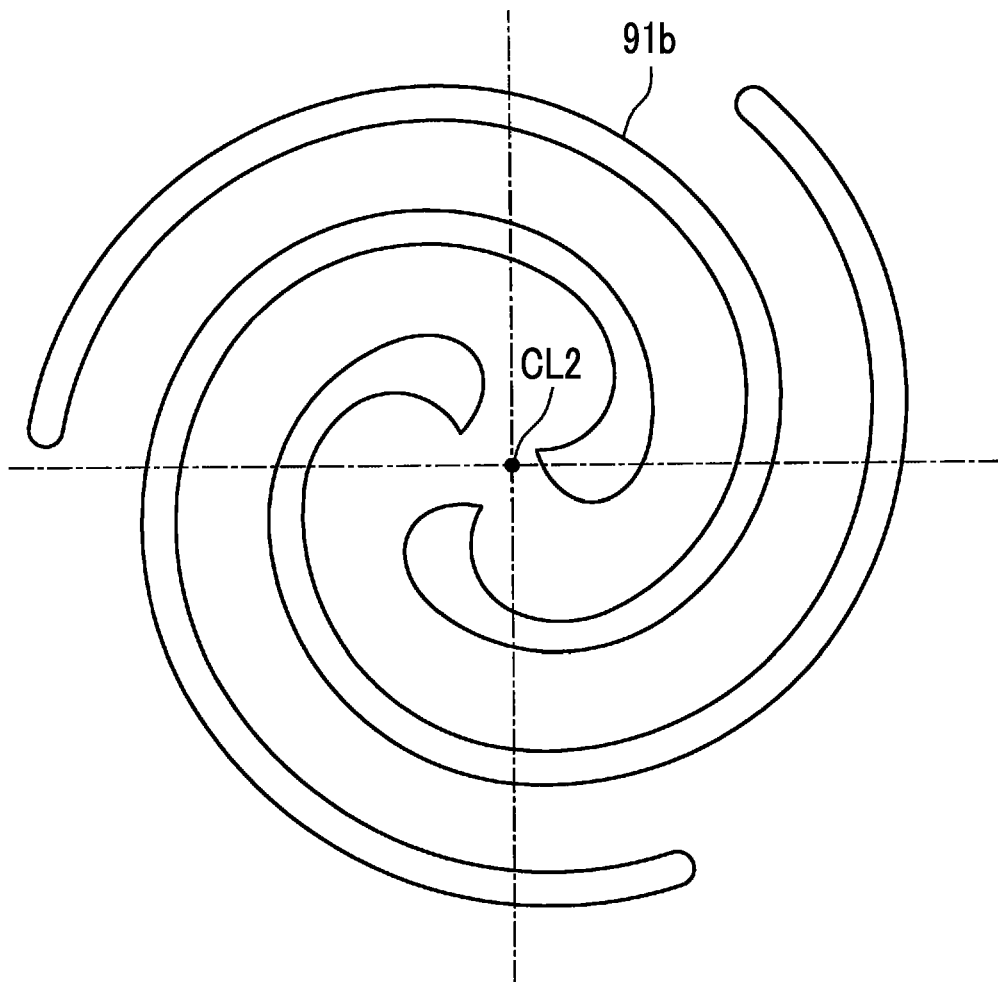


FIG. 18

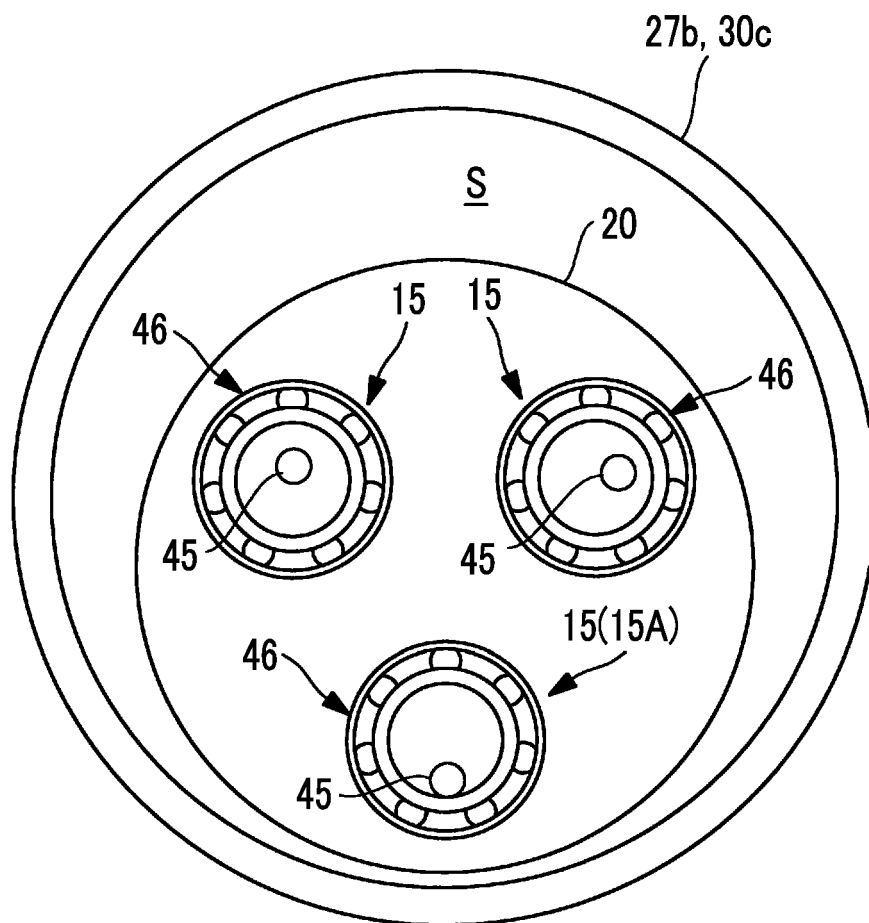


FIG. 19

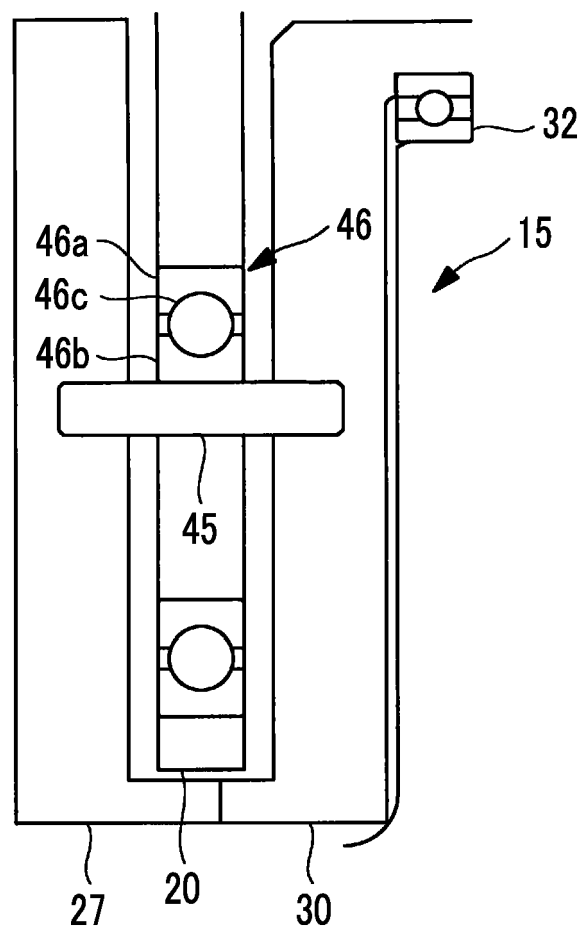


FIG. 20

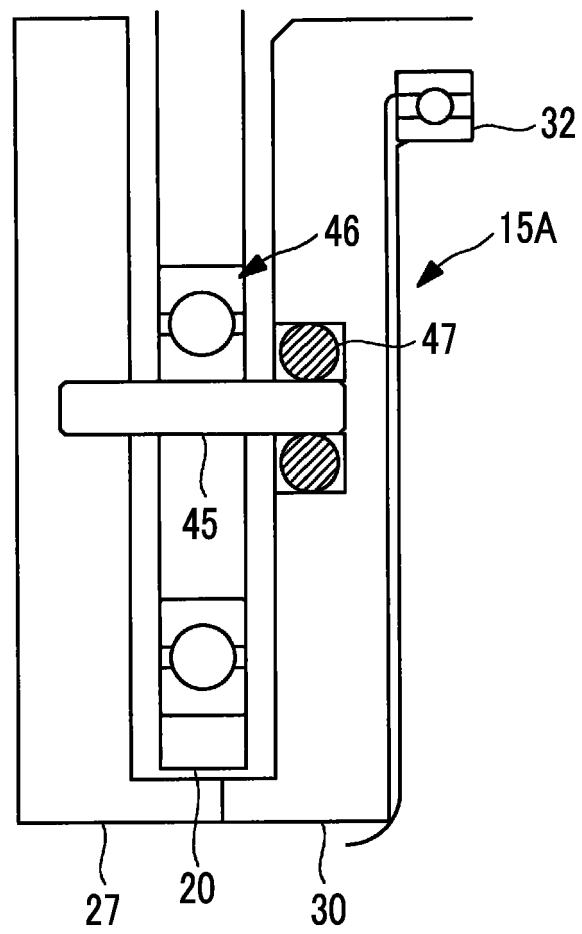


FIG. 21

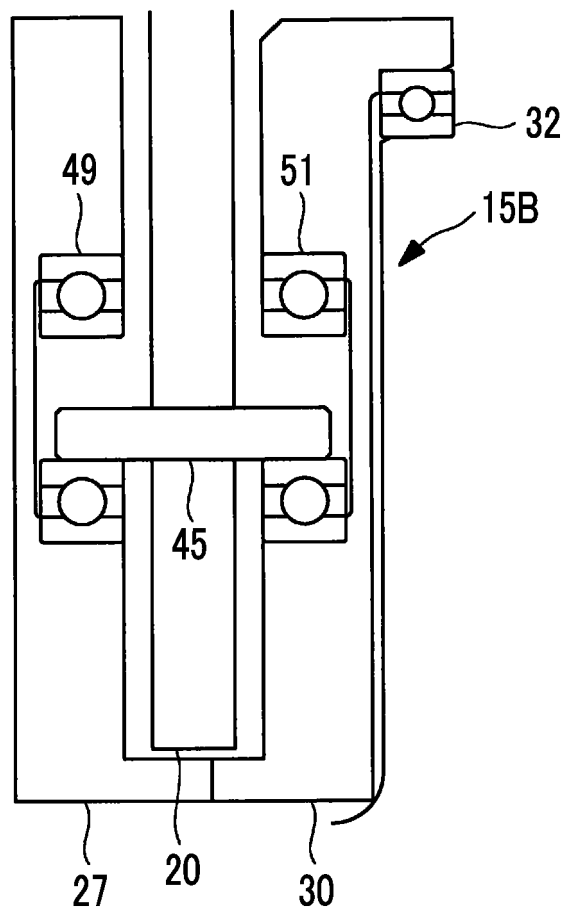


FIG. 22

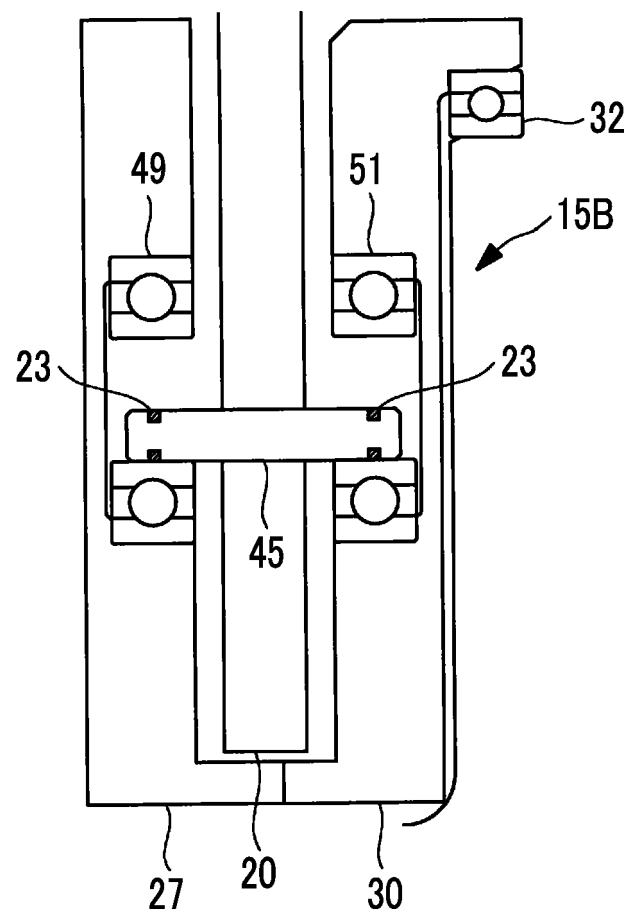


FIG. 23

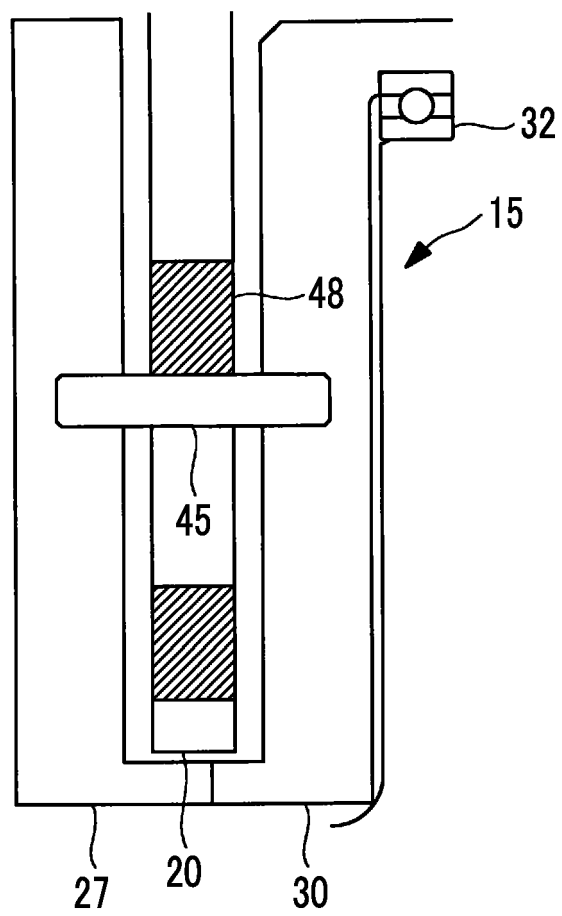


FIG. 24

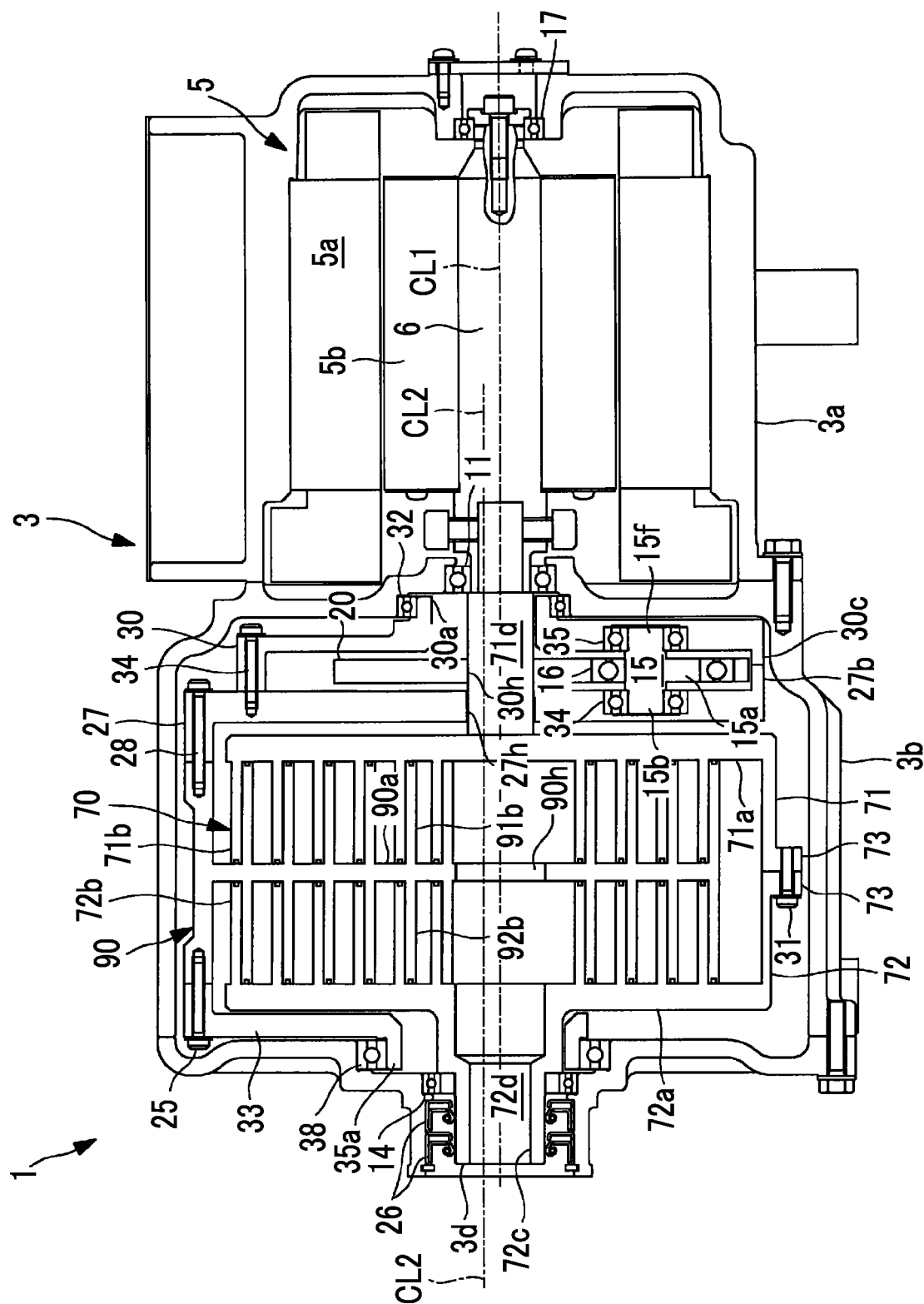


FIG. 25

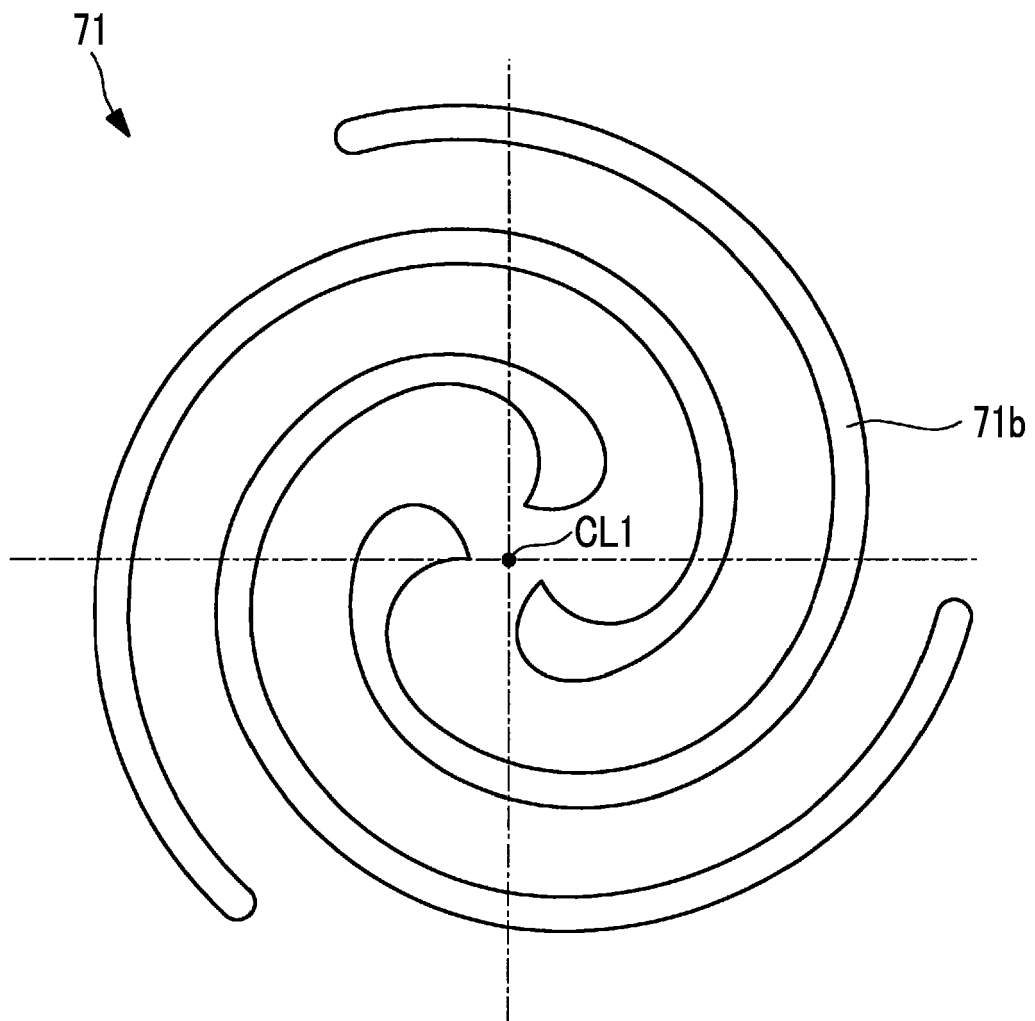


FIG. 26

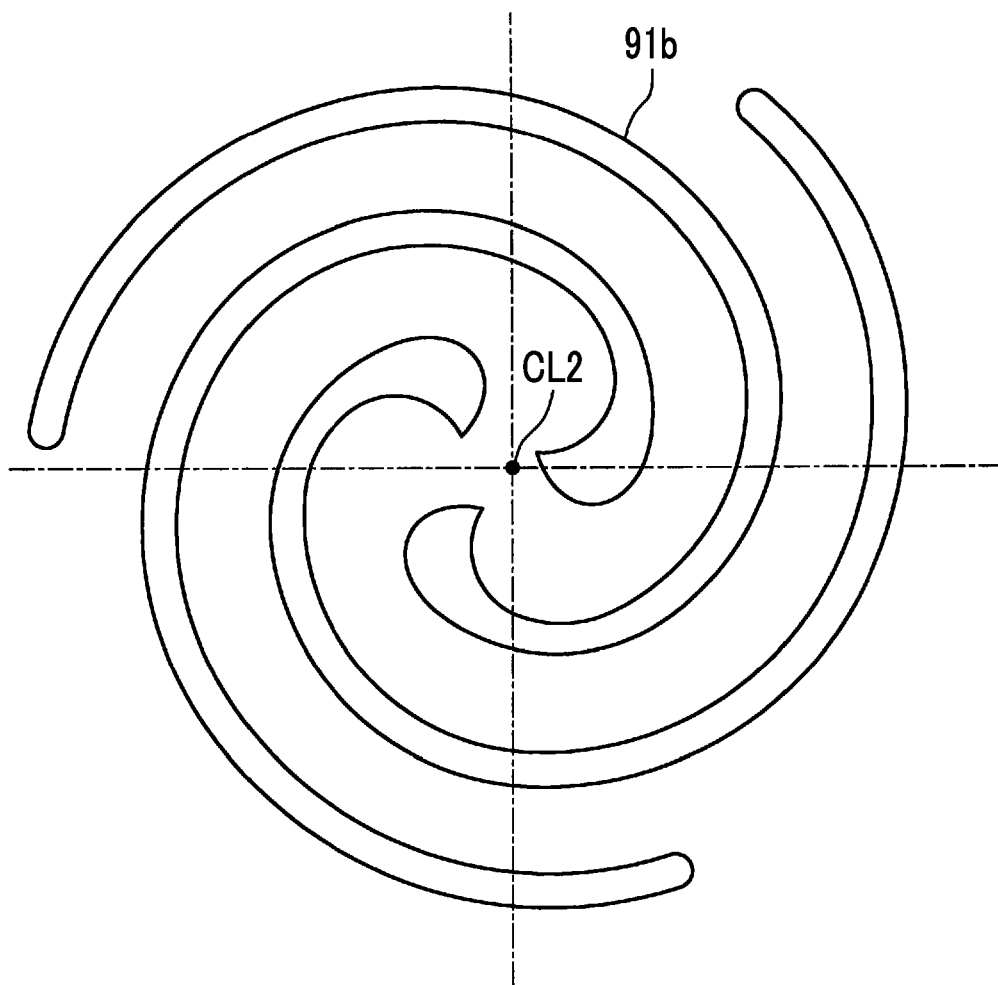


FIG. 27

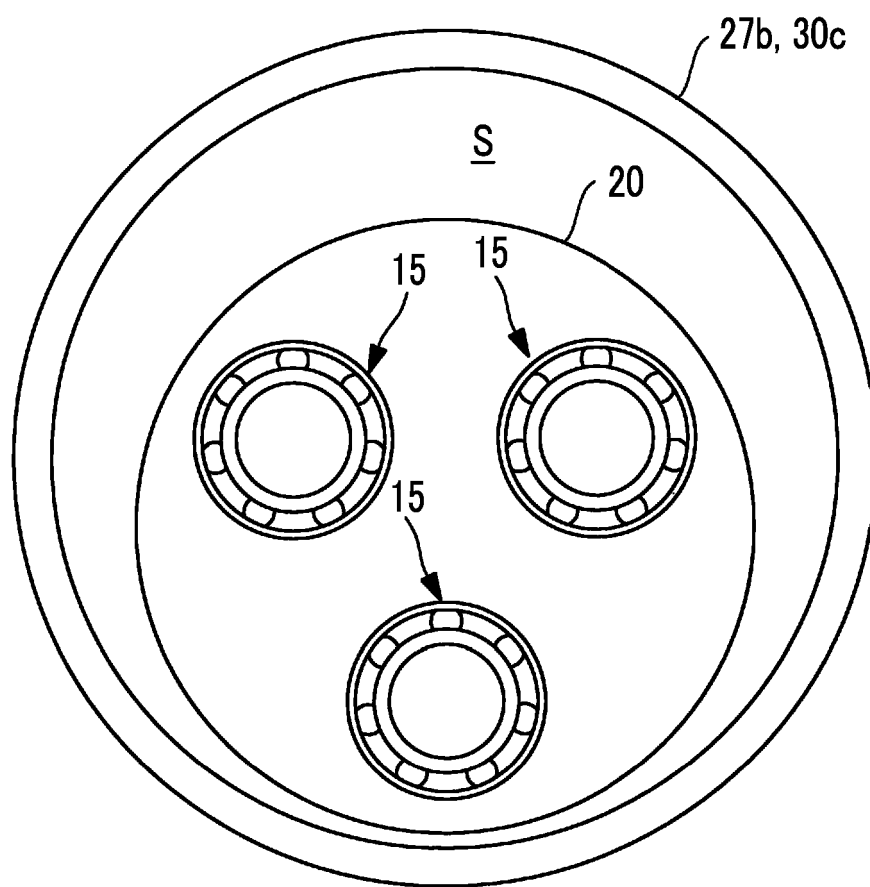


FIG. 28

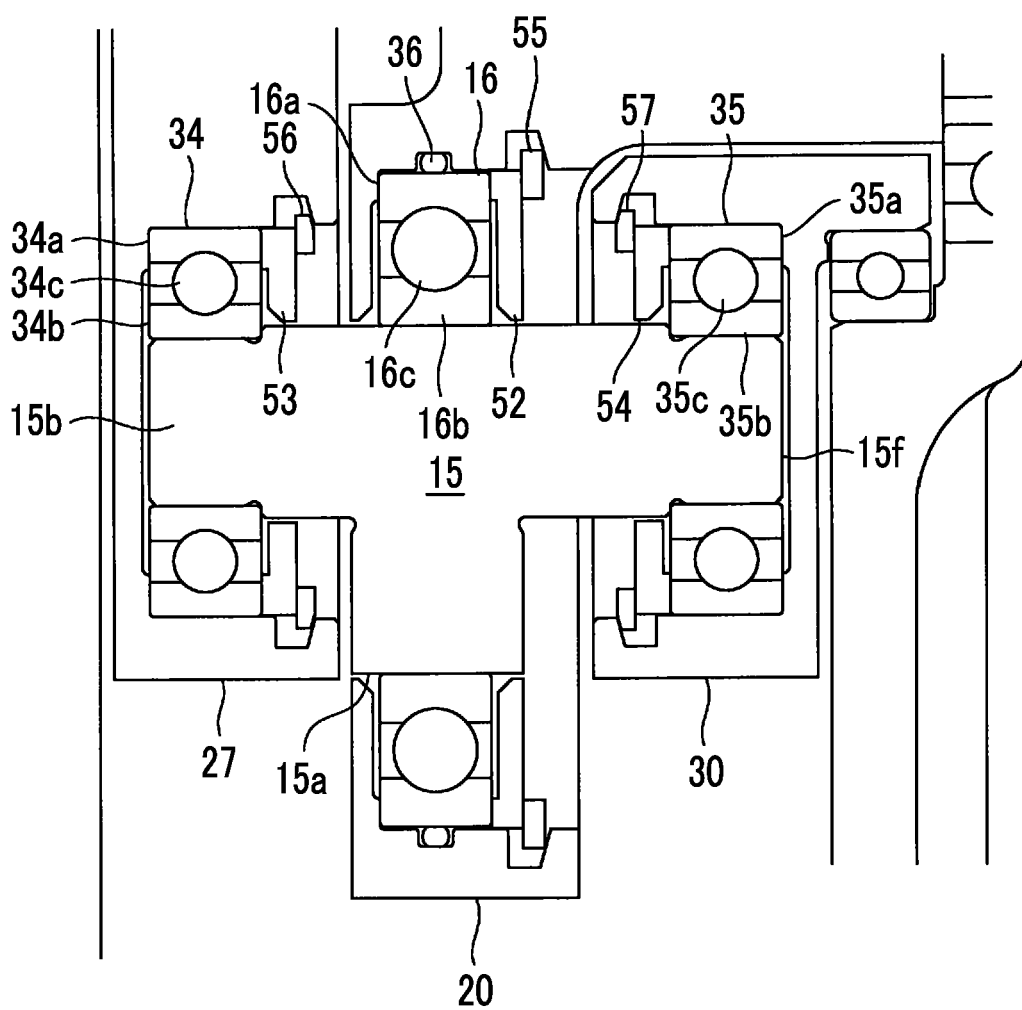


FIG. 29

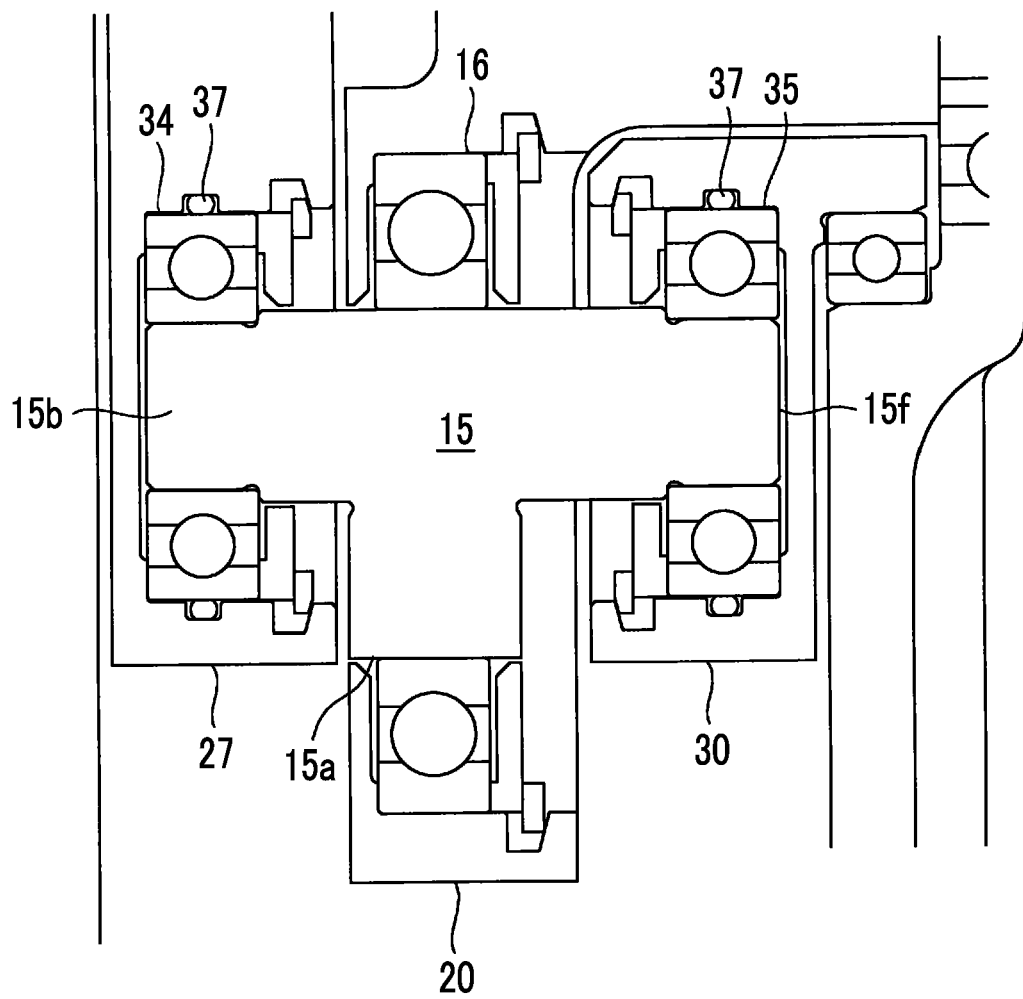


FIG. 30

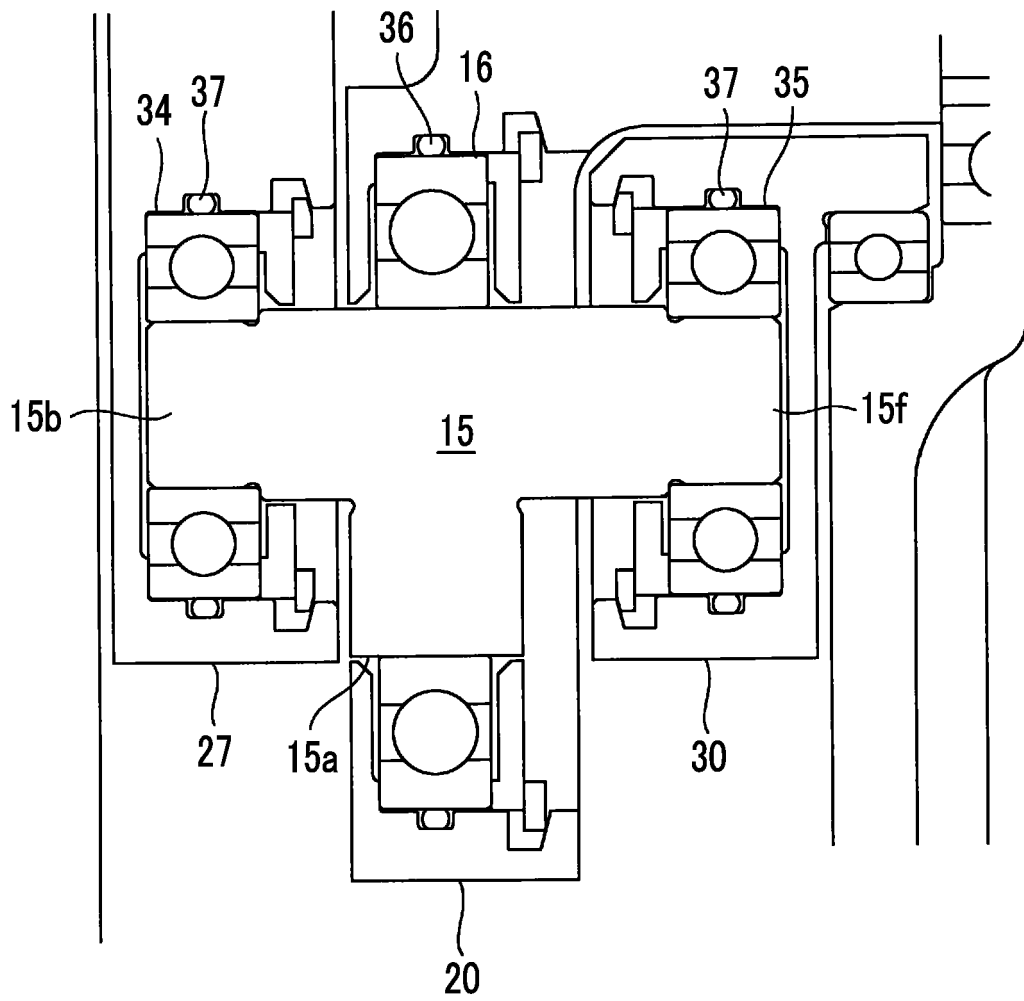


FIG. 31

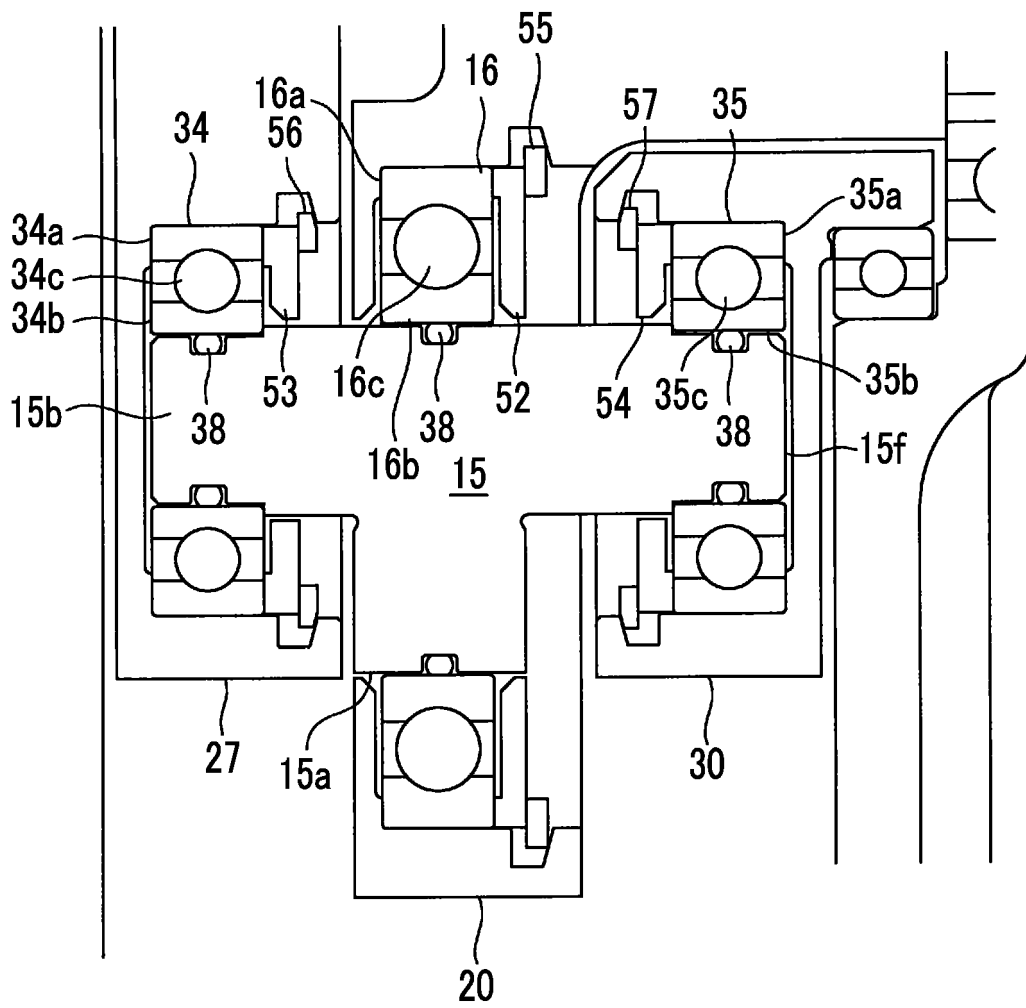


FIG. 32A

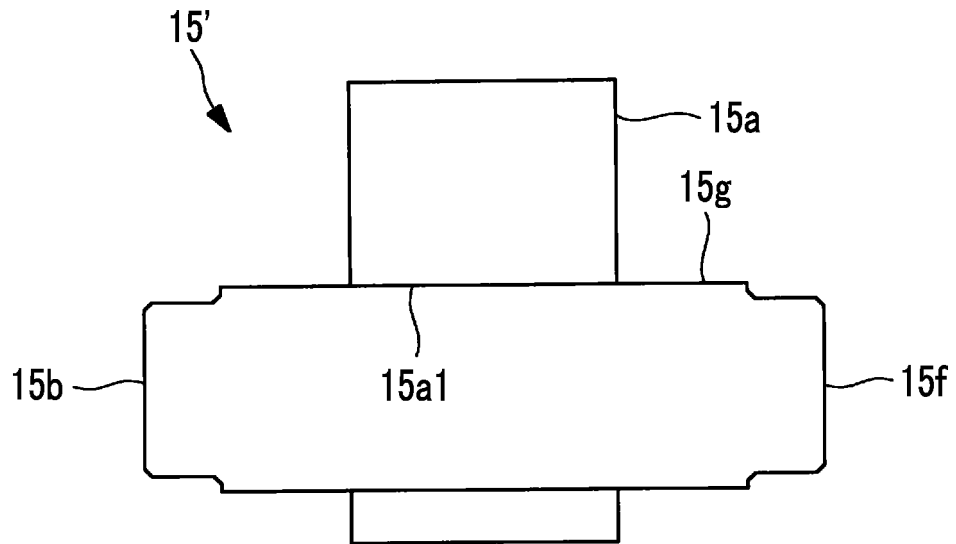
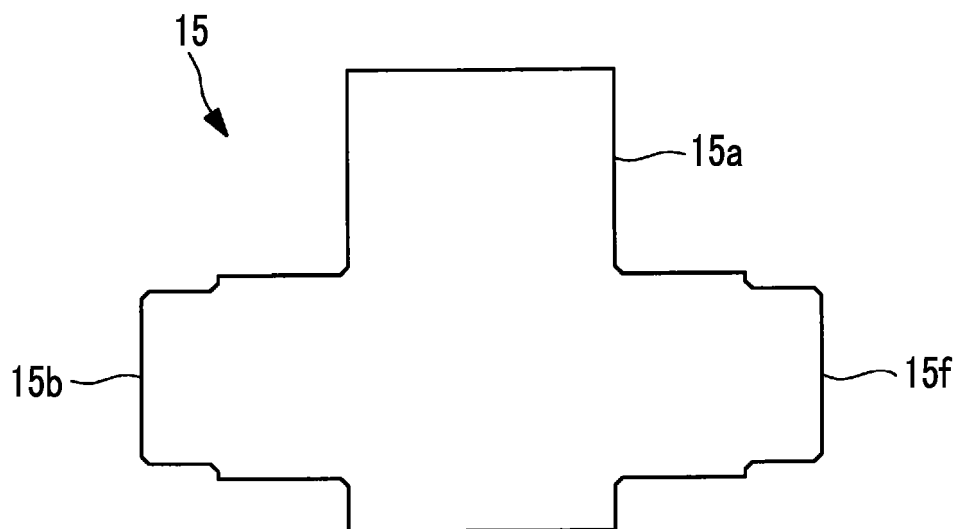


FIG. 32B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/031262

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.
A	JP 4-72487 A (SANYO ELECTRIC CO., LTD.) 06 March 1992, page 3, upper right column, line 9 to page 4, upper left column, line 1, fig. 1-3 (Family: none)	1-19
A	JP 5-157076 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 22 June 1993, paragraph [0007], fig. 1 (Family: none)	1-19



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
06 November 2018 (06.11.2018)Date of mailing of the international search report
20 November 2018 (20.11.2018)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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 5443132 B [0003]