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

(11) EP 2 653 650 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.10.2013 Bulletin 2013/43

(21) Application number: **13161289.7**

(22) Date of filing: **27.03.2013**

(51) Int Cl.:
F01C 21/02 *(2006.01)* ***F04C 29/02*** *(2006.01)*
F04C 18/02 *(2006.01)* ***F04C 29/00*** *(2006.01)*

(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

(30) Priority: **29.03.2012 JP 2012077203**

(71) Applicant: **KABUSHIKI KAISHA TOYOTA JIDOSHOKKI**
Kariya-shi,
Aichi-ken 448-8671 (JP)

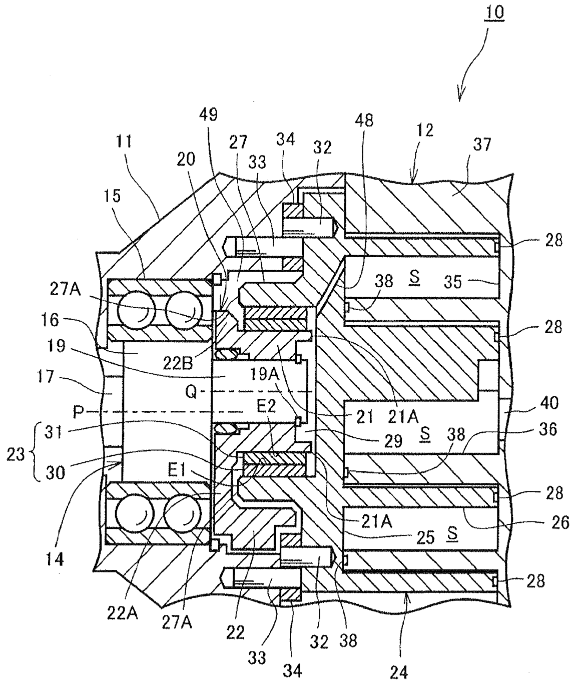
(72) Inventors:
- **Nakashima, Akihiro**
  Aichi-ken, 448-8671 (JP)
- **Sato, Shinichi**
  Aichi-ken, 448-8671 (JP)
- **Saiki, Akio**
  Aichi-ken, 448-8671 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) Scroll type compressor

(57) A scroll type compressor includes a housing, fixed and orbiting scroll members, a rotary shaft, a drive bushing, a plain bearing, a boss, a drive mechanism accommodation space and a compression chamber. The rotary shaft includes an eccentric pin on which the drive bushing is rotatably fitted. The boss is formed in the orbiting scroll member. The drive bushing is slidably inserted in the boss. In the drive mechanism accommodation space formed by the housing, the eccentric pin, the drive bushing and the bearing are disposed and upstream and downstream spaces are defined by the bearing. The compression chamber is formed by the fixed and the orbiting scroll members. A clearance is formed facing the sliding surface of the bearing. A communication passage is formed in the orbiting scroll member for communication between the compression chamber and the upstream space or the clearance and is opened toward the bearing.

FIG. 2



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a scroll type compressor which includes an oil-feed mechanism adapted to supply lubricating oil to a bearing which supports a orbiting scroll member connected to a rotary shaft of the scroll type compressor.

[0002] Japanese Patent Application Publication No. 10-141256 discloses a scroll type compressor in which a compression chamber is formed by engagement of wraps of the fixed and orbiting scroll members which are disposed to face each other. The orbiting scroll member is formed with a cylindrical boss extending from the center of the end plate of the orbiting scroll member. A drive bushing is rotatably fitted within the boss through a roller bearing and the crank pin of the drive shaft is slidably fitted in the drive bushing. During the operation of the scroll type compressor, the orbiting scroll member is driven to make an orbiting motion relative to the fixed scroll member and the compression chamber formed between the movable and the fixed scroll members is moved inwardly toward the center of the movable and the fixed scroll members while reducing the volume of the compression chamber, thereby compressing the refrigerant gas in the compression chamber.

[0003] An oil-feed passage is formed in the end plate of the orbiting scroll member for communication between the high-pressured region of the compression chamber and a space within the boss. The oil-feed passage includes an inner small-diameter portion, an outer large-diameter portion and a conical portion which connects the small-diameter portion and the large-diameter portion. A ring is inserted in the large-diameter portion of the oil-feed passage and fixed by any suitable means, such as press-fitting or adhering, for preventing leakage of oil from the outer periphery of the oil-feed passage. The ring has an oil-feed hole or a restricted passage whose diameter is smaller than the small-diameter portion of the oil-feed passage. In the scroll type compressor, lubrication of the movable bearing is accomplished by bypassing part of the refrigerant gas containing lubricating oil from the high-pressure region of the compression chamber to the space within the boss through the oil-feed passage.

[0004] However, according to the scroll type compressor disclosed in the above Publication wherein a roller bearing is used for supporting the drive bushing, refrigerant gas flows in the axial direction of the compressor through a clarance formed in the bearing freely. A ring having a restricted passage whose diameter is smaller than that of the oil- feed passage need to be provided for preventing excessive flow of refrigerant gas from the high- pressure region of the compression chamber. The use of a roller bearing for supporting drive bushing increase the number of parts and the bearing itself is complicated in structure and requires a large space in the radial direction of the compressor for installation.

[0005] The present invention is directed to providing a scroll type compressor which includes a bearing adapted to support the orbiting scroll member connected to the rotary shaft, having a simple structure and capable of lubricating the bearing effectively.

SUMMARY OF THE INVENTION

[0006] In accordance with the present invention, a scroll type compressor includes a housing, fixed and orbiting scroll members, a rotary shaft, a drive bushing, a bearing, a boss, a drive mechanism accommodation space and a compression chamber. The fixed scroll member is joined to the housing. The orbiting scroll member makes an orbital motion. The rotary shaft includes an eccentric pin extending toward the fixed scroll member and is supported in the housing. The drive bushing is rotatably fitted on the eccentric pin. The bearing is formed of a plain bearing and includes a sliding surface. The boss is formed in the orbiting scroll member. The drive bushing is slidably inserted and supported by the bearing in the boss. The drive mechanism accommodation space is formed by the housing. The eccentric pin, the drive bushing and the bearing are disposed in the drive mechanism accommodation space. Upstream and downstream spaces are defined in the drive mechanism accommodation space by the bearing. The compression chamber is formed by the fixed and the orbiting scroll members. A clearance is formed facing the sliding surface of the bearing. A communication passage is formed in the orbiting scroll member for communication between the compression chamber and the upstream space or the clearance. The communication passage is opened toward the bearing.

[0007] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a longitudinal sectional view showing a scroll type compressor according to a first preferred embodiment of the present invention;

Fig. 2 is a partially fragmentary longitudinal sectional view showing the scroll type compressor of Fig. 1;

Fig. 3 is a sectional view that is taken along the line A-A in Fig. 1;

Fig. 4 is a partially fragmentary longitudinal sectional view showing a scroll type compressor according to a second preferred embodiment of the present invention; and

Fig. 5 is a partially fragmentary longitudinal sectional view showing a scroll type compressor according to a third preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] The following will describe a scroll type compressor according to a first preferred embodiment of the present invention with reference to Figs. 1 through 3. The scroll type compressor forms a part of a refrigerant circuit which is provided in a vehicle air conditioner.

[0010] Referring to Fig. 1, the scroll type compressor is designated by reference numeral 10. The scroll type compressor 10 includes a first housing 11, a fixed scroll member 12 joined to the first housing 11 and a second housing 13 joined to the fixed scroll member 12. A rotary shaft 14 having an axis P is rotatably supported in the first housing 11 through a ball bearing 15 so as to be rotatable around the axis P. The rotary shaft 14 includes a large-diameter shaft portion 16 supported by the ball bearing 15 and a small-diameter shaft portion 17 extending toward the outside of the first housing 11 from the large-diameter shaft portion 16. The first housing 11 has an axial hole 18 through which the small-diameter shaft portion 17 of the rotary shaft 14 is inserted. A pulley (not shown) is mounted to the small-diameter shaft portion 17 for rotating the rotary shaft 14 by receiving the power from an engine EG serving as an external drive source through a belt (not shown). Thus, the rotational speed of the rotary shaft 14 varies corresponding to the rotational speed of the engine EG.

[0011] An eccentric pin 19 is formed on one end surface of the large-diameter shaft portion 16 on the side thereof that is opposite from the small-diameter shaft portion 17 and extends toward the fixed scroll member 12 or an orbiting scroll member 24 which will be described later. The eccentric pin 19 has an axis Q which is eccentric with respect to the axis P of the rotary shaft 14. As the rotary shaft 14 is rotated, the eccentric pin 19 is rotated eccentrically with respect to the axis P of the rotary shaft 14. A drive bushing 20 of a substantially tubular shape is rotatably fitted on the eccentric pin 19. The drive bushing 20 includes a tubular portion 21 in which the eccentric pin 19 is inserted and a balance weight 22 formed integrally with the tubular portion 21 and extending from the tubular portion 21 in radial direction of the scroll type compressor 10. Referring to Fig. 2, the tubular portion 21 of the drive bushing 20 includes a projection 21A extending in the axial direction of the scroll type compressor 10 toward the end of the orbiting scroll member 24 which will be described later. The projection 21A serves as a first projecting portion. The projection 21A extends further than one end of a bearing 23, which will be described later, on the side thereof that is adjacent to the orbiting scroll member 24. The balance weight 22 is correct the imbalance of rotation caused by eccentric rotation of the eccentric pin 19 and the tubular portion 21 of the drive bushing 20 by the rotation of the rotary shaft 14. The balance weight 22 includes a weight portion 22A having the center of gravity of the balance weight 22 and extending radially from the proximal end of the eccentric pin 19 and a projection 22B extending also radially toward the proximal end of the eccentric pin 19. The projection 22B of the balance weight 22 serves as a second projecting portion. As shown in Fig. 2, movement of the drive bushing 20 in the direction of the axis Q is restricted by a circular clip 19A which is mounted to the eccentric pin 19 at a position adjacent to the distal end thereof.

[0012] The orbiting scroll member 24 is rotatably connected to the drive bushing 20 through the bearing 23. The orbiting scroll member 24 includes a disk-shaped base plate 25, a spiral wall 26 and a boss 27 which are all formed unitarily. The boss 27 supports the drive bushing 20. The disk surface of the base plate 25 extends perpendicularly to the axis P. The spiral wall 26 extends from the base plate 25 from the side thereof that faces the fixed scroll member 12. The base of the spiral wall 26 is connected to the base plate 25 and the top of the spiral wall 26 faces the fixed scroll member 12. The spiral wall 26 includes a surface extending parallel to the axis P. As shown in Fig. 2, a groove is formed in the distal end of the spiral wall 26 and a seal member 28 is mounted in the groove.

[0013] The first housing 11, the ball bearing 15, the drive bushing 20, the bearing 23 and the orbiting scroll member 24 cooperate to define a drive mechanism accommodation space for the drive mechanism. The drive mechanism accommodation space includes an upstream space 29 formed on the upstream side of the bearing 23 and a downstream space 49 formed on the downstream side of the bearing 23. In other words, the upstream and the downstream spaces 29, 49 are defined by the bearing 23 in the drive mechanism accommodation space. The eccentric pin 19 of the rotary shaft 14 which is an element of the drive mechanism for driving the orbiting scroll member 24, the drive bushing 20 and the bearing 23 are disposed in the drive mechanism accommodation space.

[0014] The drive bushing 20 is slidably inserted in the boss 27 of the orbiting scroll member 24 and rotatably supported in the boss 27 by the bearing 23. The boss 27 is formed on the center of the base plate 25 on the side thereof facing eccentric pin 19. The drive bushing 20 is rotatably supported in the boss 27 by the bearing 23. The boss 27 has an end surface 27A on the side thereof that is adjacent to the ball bearing 15. The eccentric pin 19, the drive bushing 20, the bearing 23 and the base plate 25 cooperate to form the upstream space 29 inside the boss 27. The inside of the boss 27 is a cylindrical space. The upstream space 29 is a closed space. The projection

21A of the drive bushing 20 extends in the upstream space 29.

[0015] The bearing 23 disposed between the tubular portion 21 of the drive bushing 20 and the boss 27 of the orbiting scroll member 24 is formed of a plurality of plain bearings. As shown in Fig. 2, the bearing 23 includes a first plain bearing 30 which is press-fitted to the inner surface of the boss 27 and a second plain bearing 31 which is interposed between the first plain bearing 30 and the drive bushing 20 in the radial direction of the eccentric pin 19. Each of the first plain bearing 30 and the second plain bearing 31 is a tubular bush bearing. The inner peripheral surface of the first plain bearing 30 and the outer peripheral surface of the second plain bearing 31 are slidable relative to each other and the outer peripheral surface of the drive bushing 20 and the inner surface of the second plain bearing 31 are also slidable relative to each other. Each of the inner peripheral surface of the first plain bearing 30 and the outer peripheral surface of the second plain bearing 31 serves as a sliding surface and a micro clearance E1 is formed between the inner peripheral surface of the first plain bearing 30 and the outer peripheral surface of the second plain bearing 31. Each of the outer peripheral surface of the tubular portion 21 of the drive bushing 20 and the inner peripheral surface of the second plain bearing 31 serves as the sliding surface and a micro clearance E2 is formed between the outer peripheral surface of the tubular portion. Refrigerant gas may be flowed through these micro clearances E1, E2, so that an oil film of lubricating oil that is contained in the refrigerant gas is formed in the micro clearances E1, E2 and the sliding surfaces of the first and the second plain bearings 30, 31 are lubricated by such lubricating oil. The dimension of the micro clearances E1, E2 in radial direction of the eccentric pin 19 is set to such an extent that the first and the second plain bearings 30, 31 are slidable relative to each other and is significantly smaller than that of a clearance formed in a roller bearing. Thus, the first and the second plain bearings 30, 31 are disposed such that the upstream space 29 is closed tight enough to store therein lubricating oil.

[0016] The pins 32 are press-fitted in the base plate 25 at positions adjacent to the periphery thereof such that the axis of the pins 32 is parallel to the axis P of the rotary shaft 14. Pins 33 are press-fitted in the first housing 11 at positions adjacent to the pins 32 such that the axis of the pins 33 is parallel to that of the pins 32. The pins 32, 33 are inserted in holes of a ring 34. The pins 32, 33 and the ring 34 serves as an automatic anti-rotation mechanism adapted to prevent the rotation of the orbiting scroll member 24 on the axis Q of the eccentric pin 19. When the rotary shaft 14 rotates, the orbiting scroll member 24 makes an orbital motion around the axis P without rotating on the axis Q of the eccentric pin 19 or on its own axis. Thus, the orbiting scroll member 24 is adapted to make an orbital motion around the axis P without rotating on its own axis.

[0017] The fixed scroll member 12 includes a base plate 35, a spiral wall 36 and an outer shell 37 connected to the first housing 11, which are integrally formed. The base plate 35 is arranged so that its disk surface extends perpendicular to the axis P and the spiral wall 36 extends from the surface of the base plate 35 on the side facing the orbiting scroll member 24. The spiral wall 36 has a surface which extends parallel to the axis P and a groove which is formed in the distal end of the spiral wall 36 and a seal member 38 is mounted in the groove.

[0018] Referring to Fig. 3, the outer shell 37 of the fixed scroll member 12 has a suction port 39 formed therethrough and connected to an external refrigerant circuit (not shown) and refrigerant gas is introduced into the fixed scroll member 12 from the external refrigerant circuit through the suction port 39. A discharge port 40 is formed in the center of the base plate 35 of the fixed scroll member 12 and compressed refrigerant gas is discharged through the discharge port 40.

[0019] As shown in Fig. 1, the second housing 13 is fixed to the base plate 35 of the fixed scroll member 12. A discharge chamber 41 is formed by and between the base plate 35 and the second housing 13 for communication with the discharge port 40. In the discharge chamber 41, a reed type discharge valve 42 adapted to open and close the discharge port 40 and a retainer plate 43 regulating the maximum opening angle of the discharge valve 42 are fixed to the base plate 35 by a bolt (not shown). A discharge passage 44 is formed in the second housing 13 for communication with the discharge chamber 41 and connected to the external refrigerant circuit.

[0020] A tubular oil separator 45 is mounted in the discharge passage 44. When refrigerant gas is flowed through the discharge passage 44, part of the lubricating oil contained in the refrigerant gas is separated from the refrigerant gas by the oil separator 45 and the separated lubricating oil is stored in an oil chamber 46 which is formed at a position lower than the discharge chamber 41. A filter 47 is provided in the passage formed between the discharge passage 44 and the oil chamber 46 for removing foreign matter contained in the lubricating oil. The lubricating oil stored in the oil chamber 46 is flowed through a passage (not shown) and then introduced into the suction port 39.

[0021] According to the scroll type compressor 10, the spiral wall 36 of the fixed scroll member 12 and the spiral wall 26 of the orbiting scroll member 24 are engaged in contact with each other so that a compression chamber S is formed between the spiral walls 36 and 26. As shown in Fig. 3, a pair of the compression chambers S of the substantially the same volume is formed around the discharge port 40. The volume of the compression chamber S is reduced in accordance with the orbiting motion of the orbiting scroll member 24, so that the refrigerant gas is compressed in the compression chamber S.

[0022] A communication passage 48 is formed in the base plate 25 of the orbiting scroll member 24 for communication between the compression chamber S and the upstream space 29. The communication passage 48 is adapted to allow refrigerant gas containing lubricating oil in the compression chamber S to flow into the upstream space 29. The opening of the communication passage 48 on the side of the compression chamber S is formed in the base plate 25 at a position that is adjacent to the outer periphery of the base of the spiral wall 26. The opening of the communication passage 48 on the side of the upstream space 29 is formed in the base plate 25 at a position adjacent to the base of the boss 27 and also to the end surface of the bearing 23. In other words, the communication passage 48 is opened toward the bearing 23. The downstream space 49 in the first housing 11 which supports the large-diameter shaft portion 16 of the rotary shaft 14 is sealed by a seal G. The boss 27 extends in the downstream space 49. The balance weight 22 extends in the downstream space 49 in the radial direction of the scroll type compressor 10 or the projection 22B of the balance weight 22 extends in the downstream space 49. The downstream and the upstream spaces 49, 29 in the first housing 11 have a suction pressure and the refrigerant gas in the compression chamber S having a pressure that is higher than the suction pressure is flowed through the communication passage 48 into the upstream space 29. The downstream and the upstream spaces 49, 29 communicate with each other through the micro clearances E1, E2 formed between the sliding surfaces of the bearing 23 and the drive bushing 20 and each of the micro clearances E1, E2 functions to regulate the flow of lubricating oil passing therethrough.

[0023] The following will describe the operation of the scroll type compressor 10 according to the first preferred embodiment, During the operation of the scroll type compressor 10, power from the external drive source is transferred to the rotary shaft 14 and the orbiting scroll member 24 connected to the eccentric pin 19 is rotated around the axis P by the rotation of the rotary shaft 14. The pins 32, 33 and the ring 34 prevent the rotation of the orbiting scroll member 24 around its own axis and, therefore, the orbiting scroll member 24 makes an orbital motion around the axis P without rotating on its own axis.

[0024] The compression chamber S formed between the orbiting scroll member 24 and the fixed scroll member 12 is reduced in volume while being moved inwardly of the scroll members 24, 12 by the orbital motion of the orbiting scroll member 24. Thus, the refrigerant gas trapped into the compression chamber S through the suction port 39 is compressed and the pressure of the refrigerant gas is increased to be relatively high. The compressed refrigerant gas is flowed out through the discharge port 40 while opening the discharge valve 42 and then flowed into the discharge chamber 41. The refrigerant gas in the discharge chamber 41 is introduced into the discharge passage 44 and the oil separator 45 disposed in the discharge passage 44 separates lubricating oil contained in the refrigerant gas from the refrigerant gas. The refrigerant gas having the lubricating oil separated therefrom is discharged into the external refrigerant circuit and the separated lubricating oil is flowed through the filter 47 and then stored in the oil chamber 46.

[0025] During the operation of the scroll type compressor 10, a part of the refrigerant gas in the compression chamber S that is in the process of reducing its volume is flowed into the upstream space 29 through the communication passage 48 formed in the orbiting scroll member 24. Since the upstream and the downstream spaces 29, 49 have a suction pressure, the refrigerant gas in the compression chamber S is flowed into the upstream space 29 due to the pressure differential between the upstream space 29 and the compression chamber S. The upstream and the downstream spaces 29, 49 communicate with each other through the micro clearance E1 between the sliding surfaces of the first and the second plain bearings 30, 31 of the bearing 23 and the micro clearance E2 between the sliding surfaces of the second plain bearing 31 and the drive bushing 20. When the pressure of the upstream space 29 becomes higher than that of the downstream space 49, the refrigerant gas in the upstream space 29 is flowed to pass through the micro clearances E1, E2 due to the pressure differential between the upstream and the downstream spaces 29, 49. Therefore, the lubricating oil contained in the refrigerant gas forms an oil film between the sliding surfaces which form the micro clearances E1, E2, the sliding surfaces are lubricated by the lubricating oil.

[0026] The micro clearances E1, E2 of the bearing 23 function to regulate the flow of lubricating oil passing through the micro clearances E1, E2. Since the pressure of the upstream space 29 is slightly lower than that of the compression chamber S, the refrigerant gas in the compression chamber S is not flowed excessively into the upstream space 29, so that the pressure of the compression chamber S is not excessively reduced. Lubricating oil contained in the refrigerant gas in the downstream space 49 lubricates sliding parts, such as the ball bearing 15, the pins 32, 33 and the ring 34. The lubricating oil in the refrigerant gas flowing from the compression chamber S and stored in the upstream space 29 is dispersed by the projection 21A of the drive bushing 20, so that the lubricating oil may be flowed easily through the micro clearances E1, E2. Part of the lubricating oil flowed toward the inner side of the projection 21A is directed toward the fist and the second plain bearings 30, 31 by the centrifugal force generated by the rotation of the drive bushing 20. The projection 22B of the rotating drive bushing 20 and the end surface 27A of the rotating boss 27 disperse the lubricating oil in the downstream space 49, so that lubricating oil is easily supplied to the sliding parts which needs lubrication.

[0027] The scroll type compressor 10 according to the first preferred embodiment offers the following advantageous effects.

(1) The micro clearances E1, E2 between the sliding surfaces of the bearing 23 function as a throttle to regulate the flow of lubricating oil passing through the micro clearances E1, E2, so that the refrigerant

gas in the compression chamber S is not flowed excessively into the upstream space 29. The scroll type compressor 10 dispenses with a member which functions to regulate the flow of lubricating oil in a communication passage formed in the orbiting scroll member as in the case of a conventional scroll type compressor. In a case that each of the bearing 23 and the communication passage 48 has a simple structure, the sliding surface of the bearing 23 may be lubricated effectively.

(2) A part of the refrigerant gas in the compression chamber S is flowed to the upstream space 29 through the communication passage 48, from where the refrigerant gas is flowed through the micro clearances E1, E2 between the sliding surfaces of the bearing 23. Thus, the lubricating oil contained in the refrigerant gas flows easily over the entire sliding surfaces of the bearing 23, thereby to form an oil film and lubricate the sliding surfaces of the bearing 23.

(3) The bearing 23 includes the first plain bearing 30 located on the outer peripheral surface of the drive bushing 20 and the second plain bearing 31 interposed between the first plain bearing 30 and the boss 27 of the orbiting scroll member 24. Thus, the area of the sliding surfaces of the bearing 23 is increased and the relative rotational speed of the sliding surfaces is reduced, so that the durability of the bearing 23 is improved. The lubricating oil contained in the refrigerant gas flowed into the upstream space 29 and then through the micro clearances E1, E2 can lubricate the sliding surfaces of the bearing 23 effectively.

(4) The use of a plain bearing for the bearing 23 may reduce the space required for installation of the bearing in the radial direction of the scroll type compressor 10, as compared with a roller bearing, and also decrease the number of parts of the bearing, so that the manufacturing cost of the scroll type compressor 10 may be reduced.

(5) Micro clearances serving as a passage for the refrigerant for communication between the upstream and the downstream spaces 29, 49 and having a flow regulating mechanism may be formed by the first and the second plain bearings 30, 31 without any additional machining.

(6) Since the scroll type compressor 10 is driven in conjunction with the engine EG, or the rotary shaft 14 is driven to rotate in conjunction with the engine EG or a vehicle external drive source, the bearing 23 of the scroll type compressor 10 may be lubricated regularly while the engine EG is running.

[0028] The following will describe a scroll type compressor according to a second preferred embodiment of the present invention. The scroll type compressor of the second preferred embodiment differs from that of the first preferred embodiment in the structure of the bearing and the communication passage formed in the orbiting scroll member. The same reference numerals and description of the first preferred embodiment for the common elements and components are applicable to the second preferred embodiment. In the following second preferred embodiment, the same reference numerals and symbols as used in the description of the first preferred embodiment will be used and the description of the same parts and elements will be omitted.

[0029] Referring to Fig. 4, the scroll type compressor is designated by the reference numeral 50 and the scroll type compressor 50 includes a bearing 51 which has a simple tubular shape and is a plain bearing. The bearing 51 is press-fitted to the drive bushing 20. The outer peripheral surface of the bearing 51 and the inner peripheral surface of the boss 27 serve as the sliding surface. A micro clearance E3 is formed between these two sliding surfaces. The upstream and the downstream spaces 29, 49 communicate with each other through the micro clearance E3.

[0030] A communication passage 52 is formed in the orbiting scroll member 24 for communication between the compression chamber S and the inner peripheral surface of the boss 27 and opened toward the bearing 51. A part of the refrigerant gas in the compression chamber S reaches the outer peripheral surface of the bearing 51 and the inner peripheral surface of the boss 27 through the communication passage 52 and then is flowed to the upstream and the downstream spaces 29, 49 through the micro clearance E3. Thus, the outer peripheral surface of the bearing 51 and the inner peripheral surface of the boss 27 are lubricated by the lubricating oil contained in the refrigerant gas. Since the micro clearance E3 formed between the outer peripheral surface of the bearing 51 and the inner peripheral surface of the boss 27 functions to regulate the flow of the refrigerant gas passing through the micro clearance E3, so that the refrigerant gas in the compression chamber S is not flowed excessively into the upstream and the downstream spaces 29, 49.

[0031] According the scroll type compressor 50 of the second preferred embodiment, the same advantageous effects as the effects (1), (4) and (6) of the first preferred embodiment are obtained. Furthermore, the use of a single plain bearing for the bearing 51 and direct supply of refrigerant gas from the compression chamber S to the sliding surface of the bearing 51 help to form an oil film on the sliding surface of the bearing 51 by the lubricating oil contained in the refrigerant gas, thus making possible positive lubrication of the sliding surface. The bearing 51 and the boss 27 may form a passage for communication between the communication passage 52 and the respective upstream space 29 and the downstream space 49 having a flow regulating mechanism. In addition, the use of a single plain bearing for the bearing 51 makes it possible for the boss 27 to be made smaller in thickness.

[0032] The following will describe a scroll type compressor according to a third preferred embodiment of the present invention. Referring to Fig. 5, the scroll type compressor is designated by reference numeral 60 and the scroll type compressor 60 includes a bearing 61 which is made of a single tubular plain bearing slidable relative to the drive bushing 20 and the boss 27. The outer peripheral surface of the bearing 61 and the inner peripheral surface of the boss 27 serve as the sliding surface and a micro clearance E4 is formed between these sliding surfaces. The outer peripheral surface of the drive bushing 20 and the inner peripheral surface of the bearing 61 also serve as the sliding surface and a micro clearance E5 is formed between these sliding surfaces. The upstream and the downstream spaces 29, 49 communicate with each other through the micro clearances E4, E5.

[0033] A communication passage 48 having substantially the same structure as the counterpart of the first preferred embodiment is formed in the orbiting scroll member 24 so as to be opened toward the bearing 61. Apart of the refrigerant gas in the compression chamber S is flowed into the upstream space 29 through the communication passage 48 and then into the downstream space 49 through the micro clearances E4, E5. Thus, an oil film is formed by the lubricating oil contained in the refrigerant gas on the outer and the inner peripheral surfaces of the bearing 61, the inner peripheral surface of the boss 27 and the outer peripheral surface of the drive bushing 20, thereby lubricating these surfaces. Each of the micro clearances E4, E5 functions to regulate the flow of refrigerant gas passing therethrough, so that the refrigerant gas in the compression chamber S is not flowed excessively into the upstream and the downstream spaces 29, 49.

[0034] According the scroll type compressor 60 of the third preferred embodiment, the same advantageous effects as the effects (1), (4) and (6) of the first preferred embodiment are obtained. Furthermore, the used of the bearing 61 having sliding surfaces which are in sliding contact with the outer peripheral surface of the drive bushing 20 and the inner peripheral surface of the boss 27 increases the area of the sliding surfaces, with the result that the relative rotational speed of the sliding surfaces is reduced and the durability of the bearing 61 is improved, accordingly. In addition, the use of a simple plain bearing for the bearing 61 helps to reduce the thickness of the boss 27.

[0035] The present invention is not limited to the above-described first through third embodiments, but may be modified in various ways within the scope of the invention, as exemplified below.

[0036] According to the first through the third preferred embodiments, one or two plain bearings are used for the bearing 23, 51 or 61. Alternatively, three or more plain bearings may be used for the bearing 23,51 or 61, As the number of the plain bearings used for the bearing is increased, the number of the clearances formed between the plain bearings are increased, so that the relative rotational speed of the sliding surfaces is reduced.

[0037] According to the first through the third preferred embodiments, the surfaces of the plain bearings used as the bearing, the outer peripheral surface of the drive bushing 20 and the inner peripheral surface of the boss 27 serve as the sliding surface. The sliding surfaces may have surface treatment or coating for improving the lubrication and durability. Alternatively, the whole surface of plain bearings may have surface treatment or coating.

[0038] According to the first preferred embodiment, the outer peripheral surface of the drive bushing 20 and the inner peripheral surface of the second plain bearing 31 serve as the sliding surface and the micro clearance E2 is formed between these sliding surfaces. Alternatively, the second plain bearing 31 may be fixed to the drive bushing 20. In this structure, the inner peripheral surfaces of the first and the second plain bearings 30, 31 serve as the sliding surface and a micro clearance is formed only between the inner peripheral surfaces of the first and the second plain bearings 30, 31, through which refrigerant gas is flowed.

[0039] According to the first through the third preferred embodiment, the drive bushing 20 is rotatably fitted on the eccentric pin 19. Alternatively, the drive bushing may be press-fitted on the eccentric pin.

Claims

1. A scroll type compressor (10, 50, 60) comprising:

a housing;
a fixed scroll member (12) joined to the housing
an orbiting scroll member (24) adapted to make an orbital motion, and
a rotary shaft (14) including an eccentric pin (19) extending toward the orbiting scroll member (24), the rotary shaft (14) supported in the housing;
a drive bushing (20) rotatably fitted on the eccentric pin (19);
a boss (27) formed in the orbiting scroll member (24), the boss (27) in which the drive bushing (20) is slidably inserted;
a bearing (23, 51, 61) by which the drive bushing (20) is rotatably supported in the boss (27);
a drive mechanism accommodation space formed by the housing, the drive mechanism accommodation space in which the eccentric pin (19), the drive bushing (20) and the bearing (23, 51, 61) are disposed; and
a compression chamber (S) formed by the fixed scroll member (12) and the orbiting scroll member (24),
characterized in that a bearing (23, 51, 61) is formed of a plain bearing and includes a sliding

surface,
wherein an upstream space (29) and a downstream space (49) are defined in the drive mechanism accommodation space by the bearing (23, 51, 61),
wherein a clearance (E1, E2, E3, E4, E5) is formed facing the sliding surface of the bearing (23, 51, 61) for communication between the upstream space and the downstream space,
wherein a communication passage (48, 52) is formed in the orbiting scroll member (24) for communication between the compression chamber (S) and the upstream space (29) or between the compression chamber (S) and the clearance (E1, E2, E3, E4, E5) and opened toward the bearing (23, 51, 61).

2. The scroll type compressor (10, 60) according to claim 1, **characterized in that** the communication passage (48, 52) communicates between the compression chamber (S) and the upstream space (29).

3. The scroll type compressor (10) according to claim 2, **characterized in that** the drive bushing (20) has a outer peripheral surface, the bearing (23) includes a first plain bearing (30) located on the outer peripheral surface of the drive bushing (20) and having a tubular shape and a second plain bearing (31) interposed between the first plain bearing (30) and the drive bushing (20) in the radial direction of the eccentric pin (19) and having a tubular shape.

4. The scroll type compressor (50, 60) according to claim 1 or 2, **characterized in that** the bearing (51, 61) is formed of a single tubular plain bearing and at least one of the outer peripheral surface of the bearing (51, 61) or the inner peripheral surface of the bearing (51, 61) serves as the sliding surface of the bearing (51,61).

5. The scroll type compressor (10, 50, 60) according to any one of claims 1 through 4, **characterized in that** the rotary shaft (14) is driven to rotate in conjunction with a vehicle external drive source.

6. The scroll type compressor (10, 50, 60) according to any one of claims 1 through 5, **characterized in that** the drive bushing (20) includes a first projecting portion (21A) extending in the upstream space (29) toward an end of the orbiting scroll member (24).

7. The scroll type compressor (10, 50, 60) according to any one of claims 1 through 6, **characterized in that** the drive bushing (20) includes a second projecting portion (22B) extending in the downstream space (49) toward a proximal end of the eccentric pin (19).

8. The scroll type compressor (10, 50, 60) according to any one of claims 1 through 7, **characterized in that** the boss (27) includes an end surface (27A) extending in the downstream space (49).

FIG. 1

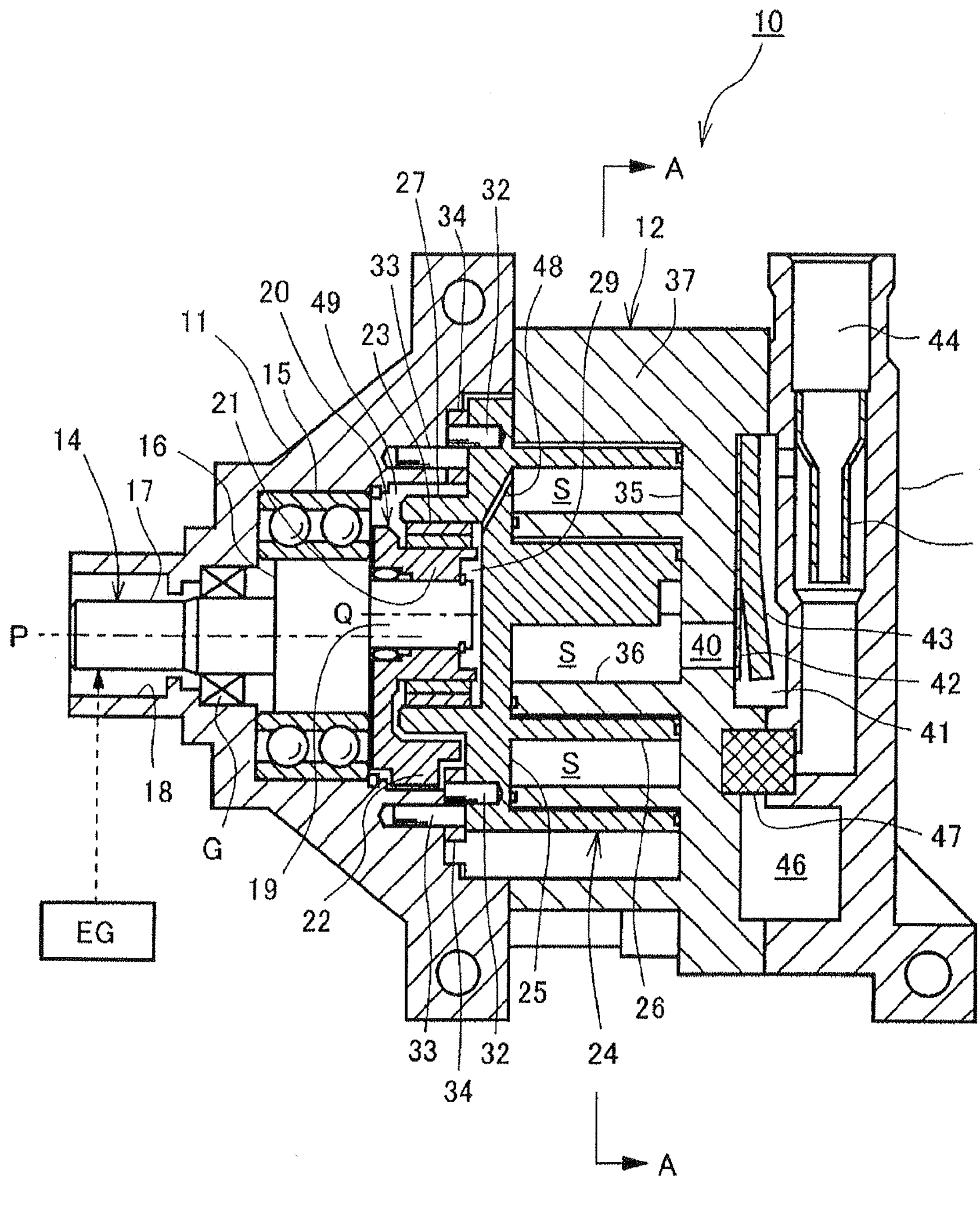

10
A
27
32
34
12
33
48
29
37
20
49
11
23
15
44
21
16
14
S
35
13
17
45
Q
P
S
36
40
43
42
41
S
18
47
G
46
19
22
EG
25
26
33
32
24
34
A

FIG. 2

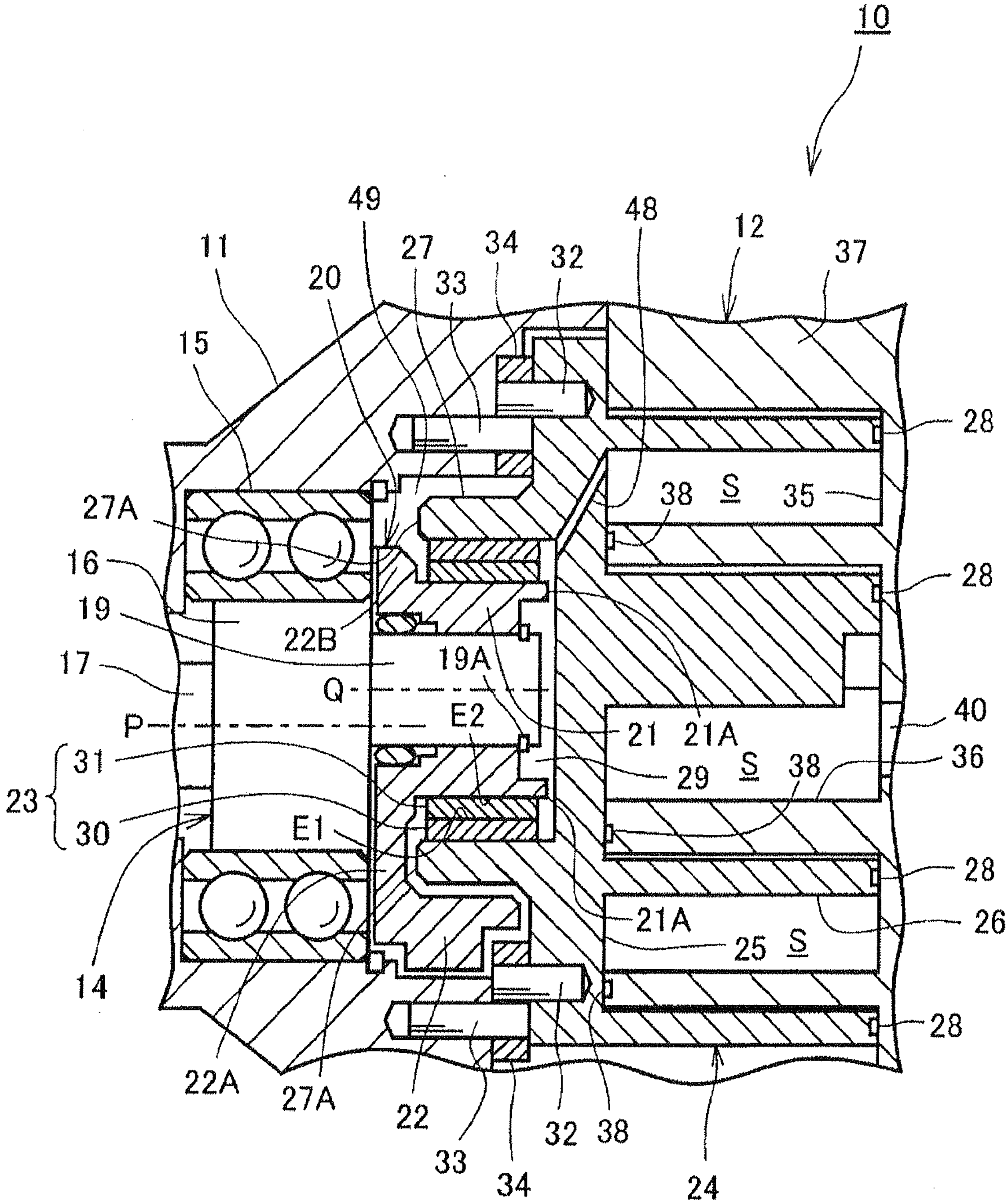

10
49
48
12
37
11
27
34
32
20
33
15
28
27A
38
S
35
16
28
19
22B
19A
17
Q
40
P
E2
21
21A
23
31
29
S
38
36
30
E1
28
21A
26
25
S
14
28
22A
27A
22
32
38
33
34
24

FIG. 3

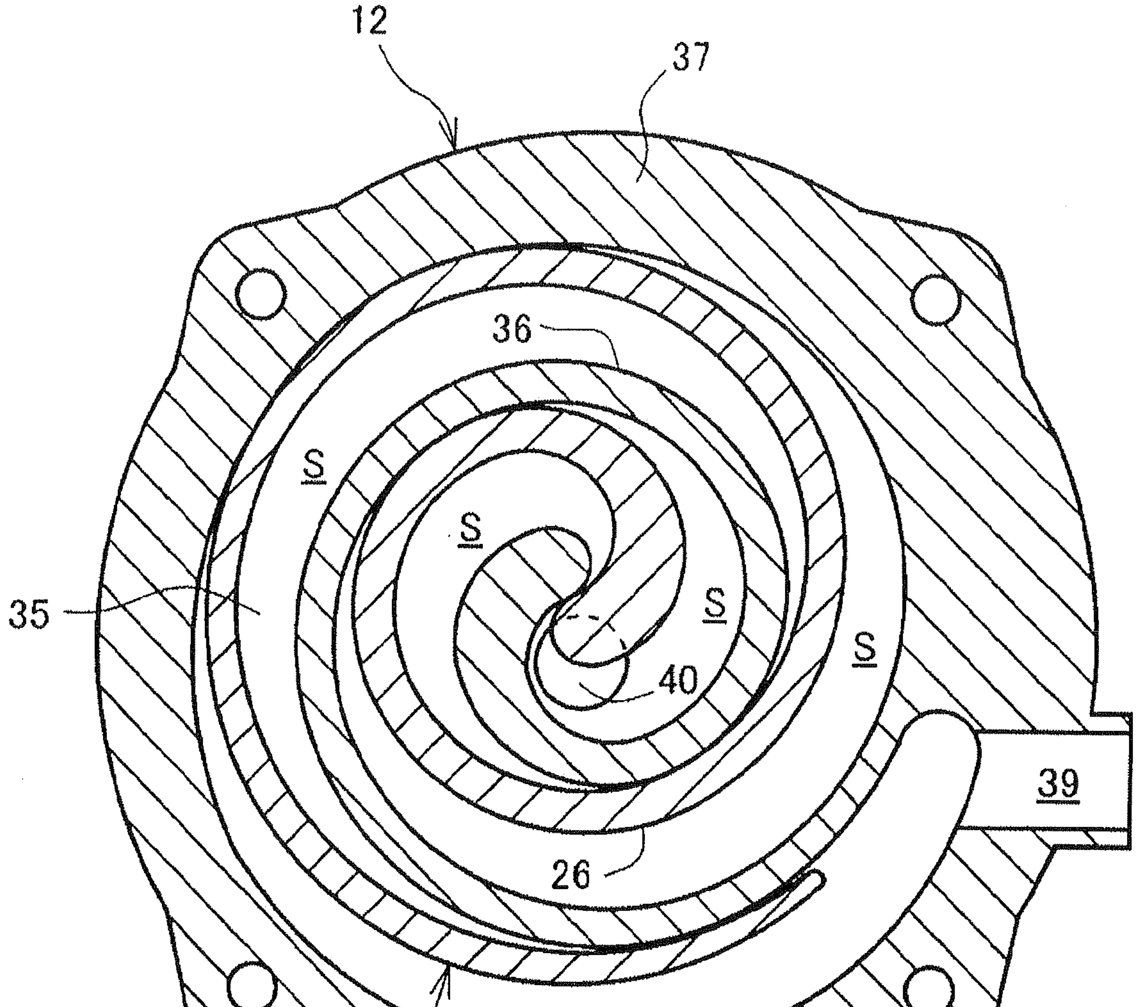


FIG. 4

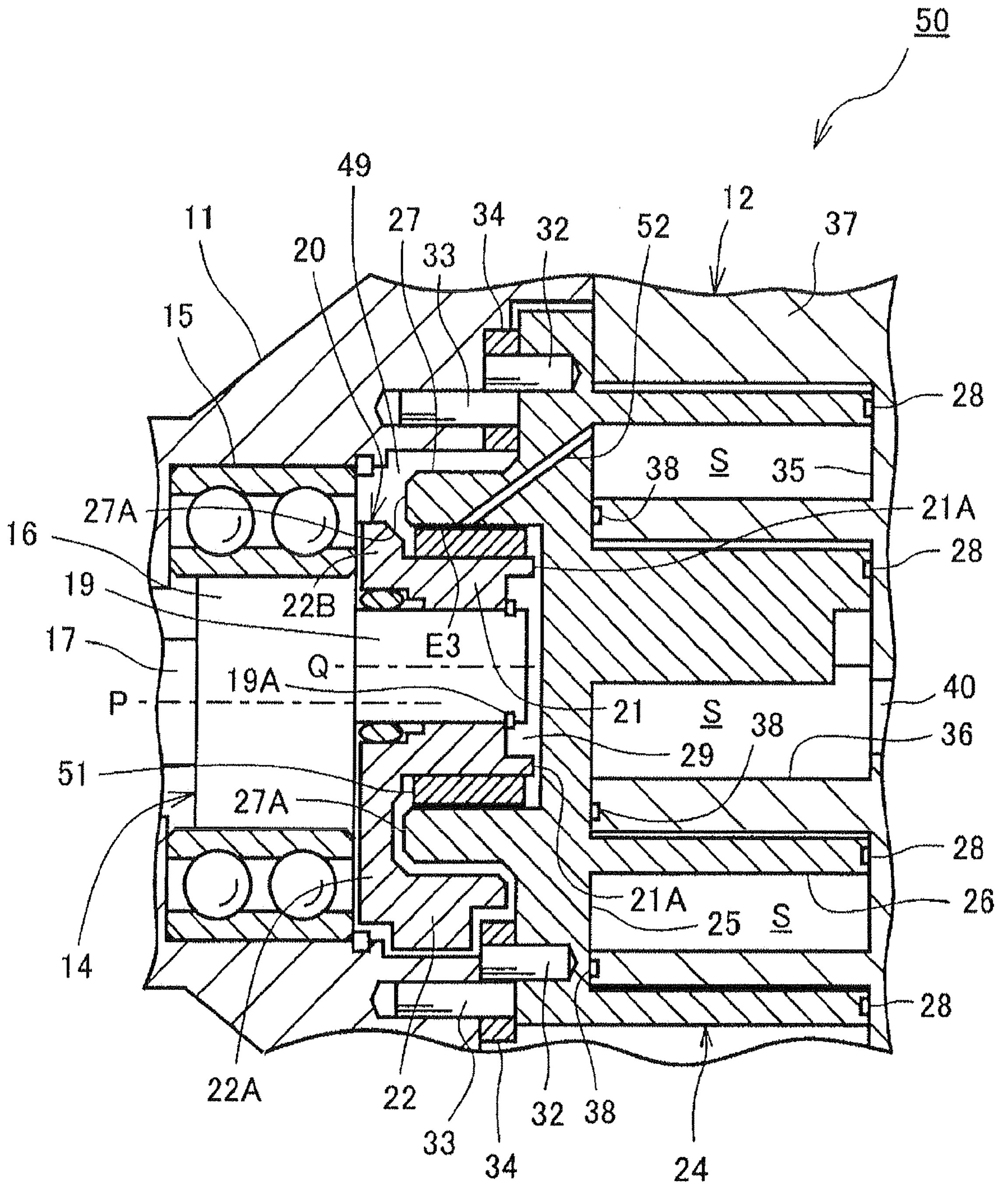
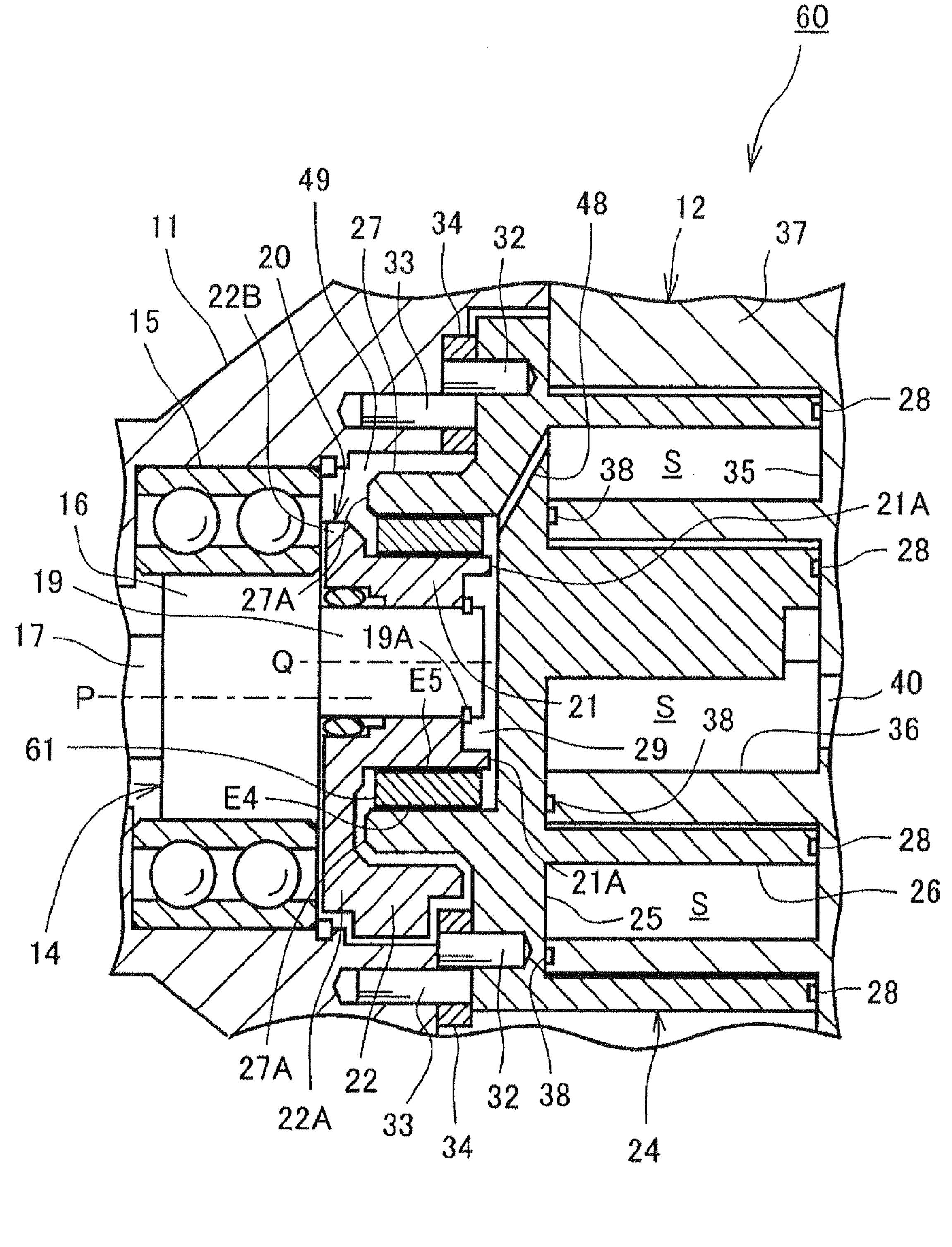

50
49
11
27
34
32
52
12
37
20
33
15
28
38
S
35
27A
21A
16
28
19
22B
E3
17
Q
40
19A
P
21
S
38
36
29
51
27A
28
21A
26
25
S
14
28
22A
22
32
38
33
34
24

FIG. 5


60
11
15
16
19
17
P
61
14
22B
20
49
27
33
34
32
48
12
37
28
S
35
38
21A
27A
19A
Q
E5
21
40
36
29
E4
25
26
22A
22
24

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 10141256 A **[0002]**