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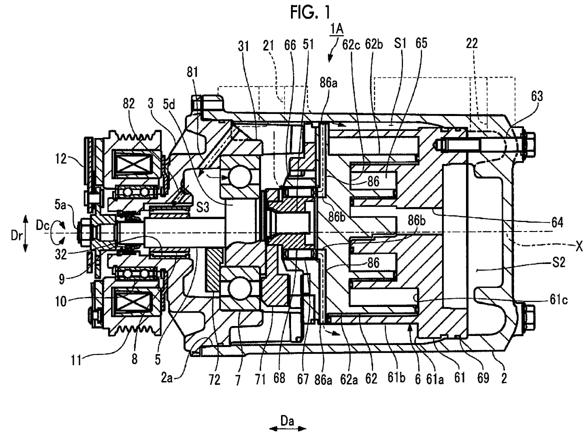
(54) **OPEN-TYPE COMPRESSOR**

(57) An open-type compressor (1A) equipped with: a drive shaft (5) rotationally driven around a central axis (X); a crank pin (51) eccentric thereto; a drive bearing (67) into which the crank pin (51) is inserted; an orbiting scroll (62) that has an orbiting end plate (62a) having a drive bearing accommodation part (66) in which the drive bearing (67) is accommodated, and an orbiting wrap (62b); and a housing (2) having an oil guiding unit (21) for guiding lubricating oil to the drive bearing (67). An oil path (86) connecting first openings (86a) that open at an outer circumferential surface and second openings (86b) that open inside the drive bearing accommodation part (66) is formed in the interior of the orbiting end plate (62a).

FIG. 1



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Description

Technical Field

[0001] The present invention relates to an open-type compressor.

[0002] This application claims the priority of Japanese Patent Application No. 2016-174902 filed on September 7, 2016, the content of which is incorporated herein by reference.

Background Art

[0003] In an open-type compressor, a metal housing internally has a crankshaft rotationally driven by an electric motor or an engine, an eccentric shaft disposed at a position offset from the crankshaft, an orbiting scroll rotatably supported by the eccentric shaft, and a fixed scroll facing the orbiting scroll (for example, refer to PTL 1). The orbiting scroll revolves around an axis of the crankshaft without any rotation, that is, the orbiting scroll performs orbiting movement. In this manner, a volume of a compression chamber formed between the fixed scroll and the orbiting scroll is changed so that a fluid introduced into the compression chamber is compressed.

[0004] According to the open-type compressor disclosed in PTL 1, the eccentric shaft is pivotably disposed inside a bottomed cylindrical boss formed in an end plate of the orbiting scroll via a drive bearing.

Citation List

Patent Literature

[0005] [PTL 1] Japanese Unexamined Patent Application Publication No. 2000-352377

Summary of Invention

Technical Problem

[0006] In the open-type compressor, the drive bearing is lubricated by a mist-like lubricant fed into the housing from the outside of the housing together with the fluid serving as a compression target. The drive bearing is accommodated inside an orbiting end plate of the orbiting scroll. Therefore, in some cases, depending on an operation condition of the open-type compressor, it may be difficult to sufficiently supply the mist-like lubricant to the drive bearing. If the lubricant is insufficiently supplied, the drive bearing is poorly lubricated, thereby causing a possibility that the drive bearing may be abnormally worn due to a load generated when the fluid is compressed between the fixed scroll and the orbiting scroll.

[0007] The present invention aims to provide an open-type compressor capable of stably supplying a lubricant to a drive bearing.

Solution to Problem

[0008] According to a first aspect of the present invention, there is provided an open-type compressor including a drive shaft to be rotationally driven around a central axis, a crank pin integrally formed in an end portion of the drive shaft, and being eccentric from the central axis in a direction orthogonal to the central axis, a drive bearing into which the crank pin is to be inserted, an orbiting scroll having an orbiting end plate having a drive bearing accommodating portion for accommodating the drive bearing, and an orbiting wrap extending from the orbiting end plate toward a side opposite to a side having the crank pin in an axial direction in which the central axis extends, and a housing accommodating the drive shaft, the crank pin, and the orbiting scroll, and having an oil introduction portion which introduces a lubricant to be supplied to the drive bearing from the outside. The orbiting end plate internally has an oil passage that allows a first opening which is open on an outer peripheral surface of the orbiting end plate and a second opening which is open inside the drive bearing accommodating portion to communicate with each other.

[0009] According to this configuration, a fluid is suctioned into a compression chamber while the orbiting end plate performs orbiting movement. Pressure of the first opening which is open on the outer peripheral surface of the orbiting end plate becomes lower than pressure in the second opening which is open inside the drive bearing accommodating portion. Therefore, the fluid starts to flow from the second opening toward the first opening inside the oil passage. In this manner, the lubricant contained inside the drive bearing accommodating portion is suctioned from the second opening which is open inside the drive bearing accommodating portion. As a result, the lubricant smoothly flows in the vicinity of the drive bearing, thereby restraining the lubricant from being stagnant.

[0010] In the open-type compressor according to a second aspect of the present invention, in the first aspect, the oil passage may extend in a radial direction inside the orbiting end plate.

[0011] According to this configuration, a flowing direction of the lubricant inside the oil passage can be coincident with a direction of a centrifugal force acting on the orbiting end plate. Therefore, the centrifugal force of the orbiting end plate can be efficiently utilized so as to allow the lubricant inside the oil passage to flow. As a result, the lubricant can more smoothly flow in the vicinity of the drive bearing.

[0012] In the open-type compressor according to a third aspect of the present invention, in the first aspect or the second aspect, the first opening may be formed at a position different from a position of the oil introduction portion in a circumferential direction around the central axis.

[0013] According to this configuration, the first opening and the oil introduction portion are separated from each other. Therefore, a refrigerant flowing from the oil introduction portion is less likely to flow into the oil passage from the first opening. Accordingly, it is possible to prevent the lubricant from being reduced in the vicinity of the drive bearing since the lubricant for lubricating the drive bearing is flushed with the refrigerant reversely flowing inside the oil passage.

[0014] In the open-type compressor according to a fourth aspect of the present invention, in any one of the first to third aspects, the oil passage may be disposed in the orbiting end plate while avoiding a stepped portion formed on a surface on a side having the orbiting wrap.

[0015] According to this configuration, the stepped portion of the orbiting end plate on which stress is concentrated and the oil passage are formed at the same position. Accordingly, it is possible to prevent the orbiting end plate from being partially thinned. Therefore, it is possible to restrain strength from being weakened in the vicinity of the stepped portion of the orbiting end plate on which the stress is concentrated.

[0016] In the open-type compressor according to a fifth aspect of the present invention, in any one of the first to fourth aspects, the drive shaft internally may have an oil supply passage having a first oil supply opening which is open while facing a space into which the lubricant is introduced inside the housing, and a second oil supply opening which is open while facing a space having the drive bearing.

[0017] According to this configuration, the lubricant can be supplied to the drive bearing accommodating portion through the oil supply passage from the space in which the lubricant is introduced into the housing. In this manner, a new lubricant can be stably supplied to the drive bearing.

[0018] In the open-type compressor according to a sixth aspect of the present invention, in the fifth aspect, the second oil supply opening may be formed at a position facing the drive bearing in the axial direction.

[0019] According to this configuration, the lubricant can be directly supplied to the drive bearing through the oil supply passage.

[0020] In the open-type compressor according to a seventh aspect of the present invention, in the fifth aspect or the sixth aspect, the oil supply passage may extend in the axial direction at a position offset to a side opposite to the crank pin across the central axis.

[0021] According to this configuration, a space for forming the oil supply passage is likely to be secured at a position close to the drive bearing in the radial direction. Therefore, the oil supply passage can be formed at the position close to the drive bearing.

[0022] In the open-type compressor according to an eighth aspect of the present invention, in any one of the fifth to seventh aspects, the oil supply passage may be formed by allowing the drive shaft and a balance weight disposed in the drive shaft so as to negate an eccentric force generated by orbiting of the crank pin and the orbiting scroll to communicate with each other.

[0023] According to this configuration, the lubricant can be supplied to the drive bearing, even if the balance weight is provided.

[0024] In the open-type compressor according to a ninth aspect of the present invention, in any one of the fifth to eighth aspects, the second oil supply opening may be formed in a tip portion of the crank pin located inside the drive bearing.

[0025] According to this configuration, the lubricant can be directly supplied to the drive bearing through the oil supply passage.

[0026] According to a tenth aspect of the present invention, there is provided an open-type compressor including a drive shaft to be rotationally driven around a central axis, a crank pin integrally formed in an end portion of the drive shaft, and eccentric from the central axis in a direction orthogonal to the central axis, a drive bearing into which the crank pin is to be inserted, an orbiting scroll having an orbiting end plate having a drive bearing accommodating portion for accommodating the drive bearing, and an orbiting wrap extending from the orbiting end plate toward a side opposite to a side having the crank pin in an axial direction in which the central axis extends, and a housing accommodating the drive shaft, the crank pin, and the orbiting scroll, and having an oil introduction portion which introduces a lubricant to be supplied to the drive bearing from the outside. The drive shaft internally has an oil supply passage having a first oil supply opening which is open while facing a space into which the lubricant is introduced inside the housing, and a second oil supply opening which is open while facing a space having the drive bearing.

Advantageous Effects of Invention

[0027] According to the above-described open-type compressor, the lubricant can be stably supplied to the drive bearing.

Brief Description of Drawings

[0028]

Fig. 1 is a sectional view illustrating a configuration of an open-type scroll compressor according to a first embodiment of the present invention.

Fig. 2 is a view when an orbiting scroll of the open-type scroll compressor is viewed in an axial direction.

Fig. 3 is an enlarged sectional view illustrating a partial configuration of the open-type scroll compressor.

Fig. 4 is a sectional view illustrating a configuration of an open-type scroll compressor according to a second embodiment of the present invention.

Fig. 5 is a sectional view illustrating a configuration of an open-type scroll compressor according to a third embodiment of the present invention.

Fig. 6 is a sectional view illustrating a configuration of an open-type scroll compressor according to a fourth embodiment of the present invention.

Fig. 7 is a sectional view illustrating a configuration of an open-type scroll compressor according to a fifth embodiment of the present invention. Description of Embodiments

[0029] Hereinafter, an open-type compressor according to embodiments of the present invention will be described with reference to the drawings.

(First Embodiment)

[0030] Fig. 1 is a sectional view illustrating a configuration of an open-type scroll compressor according to a first embodiment. Fig. 2 is a view when an orbiting scroll of the open-type scroll compressor is viewed in an axial direction. Fig. 3 is an enlarged sectional view illustrating a partial configuration of the open-type scroll compressor.

[0031] As illustrated in Fig. 1, an open-type scroll compressor (open-type compressor) 1A according to the present embodiment includes a housing 2, a front housing 3, a drive shaft 5, a scroll compression mechanism 6, a main bearing 7, and a sub-bearing 8.

[0032] The housing 2 accommodates the drive shaft 5, a crank pin 51 (to be described later), the scroll compression mechanism 6 including an orbiting scroll 62 (to be described later), the main bearing 7, and the sub-bearing 8. The housing 2 extends in an axial direction Da along a central axis X. The housing 2 has a bottomed cylindrical shape in which one end portion 2a is open and the other end portion 2b is closed. A suction opening (oil introduction portion) 21 and a discharge port 22 are formed on an outer peripheral surface of the housing 2. The suction opening 21 (oil introduction portion) introduces a refrigerant (refrigerant gas) and a mist-like lubricant which are fluids into the housing 2 from the outside. The discharge port 22 discharges the refrigerant compressed by the scroll compression mechanism 6 outward of the housing 2.

[0033] Hereinafter, a direction in which the central axis X extends will be referred to as the axial direction Da. A radial direction based on the central axis X will be simply referred to as a radial direction Dr. In addition, a direction around the drive shaft centered on the central axis X will be referred to as a circumferential direction Dc.

[0034] The front housing 3 is attached to the housing 2 so as to close an opening on one end portion 2a side of the housing 2. The front housing 3 is fixed to the housing 2, thereby internally forming a space hermetically sealed with the housing 2. The scroll compression mechanism 6 and the drive shaft 5 are accommodated inside this hermetically sealed space. The front housing 3 has a bearing holding portion 31 in a portion to be inserted into the housing 2. The bearing holding portion 31 extends in a cylindrical shape toward the other end portion 2b of the housing 2. The bearing holding portion 31 has a first oil supply passage 81 penetrating through the bearing holding portion 31. The first oil supply passage 81 communicates with an inner space S3 inside the bearing holding portion 31 between the main bearing 7 and the sub-bearing 8. The front housing 3 has a second oil supply passage 82 which allows an inner space S3 and an outer peripheral side of the sub-bearing 8 inside a through-hole 32 to communicate with each other. In addition, a central portion of the front housing 3 has the through-hole 32 penetrating in the axial direction Da.

[0035] The drive shaft 5 is rotationally driven around the central axis X. The drive shaft 5 extends in the axial direction Da. The drive shaft 5 is rotatably supported by the front housing 3 via the main bearing 7 and the sub-bearing 8. One end portion 5a which is one side of the drive shaft 5 in the axial direction Da protrudes outward from the front housing 3 in a state where the drive shaft 5 is inserted into the through-hole 32. A lip seal 9 is disposed to maintain sealing performance between the drive shaft 5 and the through-hole 32. The drive shaft 5 has a disk-shaped disk portion 5d in an end portion on the other side (on the other end portion 2b side of the housing 2) in the axial direction Da.

[0036] On the other side in the axial direction Da of the disk portion 5d of the drive shaft 5, the crank pin 51 is disposed at a position eccentric as much as a predetermined dimension in the radial direction Dr which is a direction orthogonal to the central axis X of the drive shaft 5. The crank pin 51 protrudes from an end portion of the disk portion 5d of the drive shaft 5 toward the other end portion 2b of the housing 2. Therefore, the crank pin 51 is formed integrally with an end portion on the other side of the drive shaft 5 in the axial direction Da. If the drive shaft 5 is rotated around the central axis X, the crank pin 51 orbits along a circular orbit whose radius is set to a dimension in which the crank pin 51 is eccentric with respect to the central axis X in the radial direction Dr.

[0037] The main bearing 7 is fixed to the inside of the bearing holding portion 31 of the front housing 3. The disk portion 5d is fitted into the main bearing 7 so as to be rotatably supported.

[0038] The sub-bearing 8 is located on the front housing 3 side with respect to the main bearing 7. The sub-bearing 8 is disposed inside the through-hole 32 of the front housing 3. The drive shaft 5 is rotatably supported via the sub-bearing 8 in an intermediate portion in the axial direction Da between one end portion 5a and the disk portion 5d.

[0039] A pulley 11 is rotatably disposed in the front housing 3 via the bearing 10. A belt for transmitting a driving force from a driving source such as a motor and an engine is wound around the pulley 11. The pulley 11 and one end portion 5a of the drive shaft 5 are connected to each other via an electromagnetic clutch 12. The drive shaft 5 is rotated around the central axis X if external power for driving the pulley 11 is transmitted to the drive shaft 5 via the electromagnetic clutch 12.

[0040] The scroll compression mechanism 6 is connected to the drive shaft 5. The scroll compression mechanism 6 includes a fixed scroll 61 and an orbiting scroll 62.

[0041] The fixed scroll 61 integrally has a disk-shaped fixed end plate 61a and a spirally wounded fixed wrap 61b rising to the front housing 3 side (one side in the axial direction Da) with respect to the fixed end plate 61a.

[0042] The fixed end plate 61a is fixed to the other end portion 2b of the housing 2 via a bolt 63. A central portion of the fixed end plate 61a has a discharge port 64 for discharging the refrigerant compressed by the scroll compression mechanism 6.

[0043] The fixed wrap 61b is formed so that a height in the axial direction Da is gradually lowered from an outer peripheral side toward an inner peripheral side. In addition, in the fixed end plate 61a, a groove bottom surface 61c which is a surface on a side having the fixed wrap 61b gradually is formed so that the height is gradually raised from the outer peripheral side to the inner peripheral side on a side where the fixed wrap 61b rises. An O-ring 69 is disposed on the other side in the axial direction Da of the outer peripheral surface of the fixed end plate 61a. The O-ring 69 is in close contact with the inner peripheral surface of the housing 2. In this manner, a space between the inner peripheral surface of the housing 2 and the outer peripheral side of the fixed end plate 61a is divided into a discharge chamber S2 on the other side in the axial direction Da with respect to the O-ring 69 and a suction chamber S1 on one side in the axial direction Da in which the front housing 3 is located with respect to the O-ring 69.

[0044] The suction chamber S1 communicates with the suction opening 21 formed in the housing 2. A low pressure refrigerant circulating in a refrigerating cycle is suctioned through the suction opening 21, and the refrigerant is suctioned into the compression chamber 65 via the suction chamber S1.

[0045] As illustrated in Fig. 2, the orbiting scroll 62 integrally has a disk-shaped orbiting end plate 62a and a spirally wound orbiting wrap 62b rising to the fixed scroll 61 side (the other side in the axial direction Da) with respect to the orbiting end plate 62a.

[0046] The orbiting wrap 62 b extends toward a side in the axial direction Da which is opposite to a side where the crank pin 51 is located with respect to the orbiting end plate 62a. The orbiting wrap 62b is formed so that the height in the axial direction Da is gradually lowered from the outer peripheral side toward the inner peripheral side. A groove bottom surface 62c which is a surface on a side having the orbiting wrap 62b is formed so that the height is gradually raised from the outer peripheral side toward the inner peripheral side on the side where the orbiting wrap 62b rises. Therefore, the groove bottom surface 62c has a stepped portion 62t in which a length of the orbiting end plate 62a in the axial direction Da varies.

[0047] As illustrated in Fig. 1, a drive bearing accommodating portion 66 for accommodating the drive bearing 67 is formed on a surface opposite to the groove bottom surface 62c of the orbiting end plate 62a in the axial direction Da. The drive bearing accommodating portion 66 has a cylindrical shape protruding to one side in the axial direction Da.

[0048] The crank pin 51 is inserted into the drive bearing 67 via a drive bush 68. That is, the drive bearing 67 is disposed in a cylindrical shape so as to cover the crank pin 51 from the outside in the radial direction Dr. The drive bearing 67 accommodates the drive bush 68 fixed to the outer peripheral surface of the crank pin 51 in a pivotable state. In this manner, since the drive shaft 5 is rotated around the central axis X, the orbiting scroll 62 is driven so as to freely and smoothly revolve and orbit around the fixed scroll 61 together with the crank pin 51 which orbits along the circular orbit.

[0049] Furthermore, as illustrated in Fig. 3, the orbiting end plate 62a internally has an oil passage 86 extending outward in the radial direction Dr from the central portion of the orbiting end plate 62a in the radial direction Dr. As illustrated in Fig. 2, two oil passages 86 according to the present embodiment are formed at positions different as much as 180° from each other in the circumferential direction Dc so as to interpose the central axis X therebetween with respect to the orbiting end plate 62a.

[0050] The oil passage 86 is not limited to an example in which two are formed with respect to the orbiting end plate 62a. For example, only one oil passage 86 may be formed with respect to the orbiting end plate 62a, or three or more oil passages 86 may be formed.

[0051] As illustrated in Fig. 3, each of the oil passages 86 allows a first opening 86a which is open on an outer peripheral surface 62f of the orbiting end plate 62a and a second opening 86b which is open inside the drive bearing accommodating portion 66 to communicate with each other. The oil passage 86 linearly extends to the outer peripheral surface 62f inside the orbiting end plate 62a in the radial direction Dr.

[0052] The second opening 86b is formed on a surface facing one side of the drive bearing accommodating portion 66 in the axial direction Da so as to face the drive bearing 67. The second opening 86b is formed so as to project inward in the radial direction Dr from the inner peripheral surface to which the drive bearing 67 of the drive bearing accommodating portion 66 is attached. Therefore, the second opening 86b is formed inside the drive bearing accommodating portion 66 so as to be visible when the drive bearing accommodating portion 66 is viewed from one side in the axial direction Da. For example, it is preferable that an opening area of the second opening 86b has an opening area having a size equal to or larger than 1/2 of a flow path cross section parallel to the axial direction Da of the oil passage 86.

[0053] As illustrated in Fig. 2, this oil passage 86 is formed at a position avoiding the stepped portion 62t of the groove bottom surface 62c in the orbiting end plate 62a. That is, the oil passage 86 is formed so as to be located at the position different from the position of the stepped portion 62t of the groove bottom surface 62c in the circumferential direction Dc.

[0054] As illustrated in Figs. 1 and 3, a main balance weight 71 and a sub-balance weight 72 which negate an eccentric force generated by orbiting of the crank pin 51 and the orbiting scroll 62 are disposed in the drive shaft 5.

[0055] The main balance weight 71 is disposed between the drive shaft 5 and the orbiting scroll 62 in order to eliminate imbalance caused by the orbiting scroll 62 which orbits eccentrically with respect to the central axis X. The main balance weight 71 is located so as to be adjacent to the other side in the axial direction Da with respect to the disk portion 5d.

[0056] The sub-balance weight 72 is disposed between the disk portion 5d of the drive shaft 5 and the sub-bearing 8 in order to eliminate the imbalance caused by the orbiting scroll 62 which orbits eccentrically with respect to the central axis X. The sub-balance weight 72 is located so as to be adjacent to one side in the axial direction Da with respect to the disk portion 5d.

[0057] The fixed wrap 61b of the fixed scroll 61 and the orbiting wrap 62b of the orbiting scroll 62 are disposed so as to mesh with each other. A pair of compression chambers 65 is symmetrically formed with respect to a scroll center between the fixed scroll 61 and the orbiting scroll 62. The compression chambers 65 are partitioned by the fixed end plate 61a and the fixed wrap 61b, and the orbiting end plate 62a and the orbiting wrap 62b so as to be continuous in a spirally wound shape. In this manner, when the refrigerant is compressed by the compression chambers 65 moving while reducing a volume from the outer peripheral side to the center side, the refrigerant is compressed in both the circumferential direction Dc and the axial direction Da of the fixed wrap 61b and the orbiting wrap 62b. Therefore, the scroll compression mechanism 6 has a configuration capable of so-called three-dimensionally compressing the refrigerant.

[0058] This scroll compression mechanism 6 is driven by the drive shaft 5, and the refrigerant flowing into the housing 2 from the suction opening 21 formed in the housing 2 is suctioned into the compression chamber 65 from the outer peripheral side. The refrigerant suctioned into the compression chamber 65 is compressed by moving the compression chamber 65 from an outer peripheral position to a center position while the volume of the compression chamber 65 is gradually reduced. The compressed refrigerant is supplied from the discharge port 64 formed in the fixed end plate 61a of the fixed scroll 61 to the discharge chamber S2 formed in a gap between the fixed end plate 61a of the fixed scroll 61 and the other end portion 2b of the housing 2. Thereafter, the refrigerant is discharged from the discharge port 22 to the refrigerating cycle side outside the housing 2.

[0059] In addition, in this open-type scroll compressor 1A, a mist-like lubricant together with the fluid is introduced into the housing 2 from the suction opening 21. As illustrated in Fig. 3, a portion of the mist-like lubricant introduced into the housing 2 from the suction opening 21 is introduced into the inner space S3 of the bearing holding portion 31 through the first oil supply passage 81. The lubricant is supplied to the main bearing 7 by the portion of the lubricant introduced into the inner space S3.

[0060] In addition, the portion of the mist-like lubricant introduced into the inner space S3 is supplied into the through-hole 32 through the second oil supply passage 82. In this manner, the lubricant is supplied to the sub-bearing 8.

[0061] According to the open-type scroll compressor 1A in the first embodiment described above, if the orbiting scroll 62 orbits due to the rotation of the drive shaft 5, the scroll compression mechanism 6 suctions the refrigerant into the compression chamber 65 from the suction chamber S1 disposed on the outer peripheral side. As a result, the pressure of the first opening 86a which is open on the outer peripheral surface 62f of the orbiting end plate 62a becomes lower than the pressure of the second opening 86b which is open inside the drive bearing accommodating portion 66. Therefore, in the oil passage 86, the refrigerant or the lubricant starts to flow by being suctioned from the second opening 86b disposed on the drive bearing accommodating portion 66 side toward the first opening 86a disposed on the outer peripheral side communicating with the suction chamber S1. In this manner, the lubricant contained inside the drive bearing accommodating portion 66 is suctioned from the second opening 86b which is open inside the drive bearing accommodating portion 66. As a result, the portion of the mist-like lubricant introduced into the housing 2 from the suction opening 21 is suctioned into the drive bearing accommodating portion 66 which accommodates the drive bearing 67. Therefore, the lubricant can smoothly flow in the vicinity of the drive bearing 67, and the lubricant is restrained from being stagnant. In this manner, the lubricant can be stably supplied to the drive bearing 67.

[0062] In addition, the oil passage 86 is formed so as to linearly extend to the outer peripheral surface 62f in the radial direction Dr inside the orbiting end plate 62a. Therefore, if a hole extending from the outer peripheral surface 62f in the radial direction Dr is formed in the orbiting end plate 62a, the oil passage 86 can be formed, and the oil passage 86 can be easily processed.

[0063] Furthermore, the oil passage 86 extends in the radial direction Dr. Accordingly, a flowing direction of the lubricant inside the oil passage 86 can be coincident with a direction of a centrifugal force acting on the orbiting end plate 62a. Therefore, the centrifugal force of the orbiting end plate 62a can be efficiently utilized so as to allow the lubricant inside the oil passage 86 to flow toward the first opening 86a from the second opening 86b. As a result, the lubricant can more smoothly flow in the vicinity of the drive bearing 67.

[0064] Furthermore, the oil passage 86 is disposed while avoiding the stepped portion 62t of the orbiting end plate 62a. Therefore, the stepped portion 62t of the orbiting end plate 62a whose thickness varies and the oil passage 86 are formed at the same position. Accordingly, it is possible to prevent the orbiting end plate 62a from being partially thinned. Therefore, it is possible to restrain strength from being weakened in the vicinity of the stepped portion 62t of the orbiting end plate 62a on which stress is concentrated.

[0065] In addition, the opening area of the second opening 86b which is open inside the drive bearing accommodating portion 66 in the oil passage 86 is set to a size equal to or larger than 1/2 of a cross section of a portion 86c extending in radial direction Dr of the orbiting end plate 62a. Accordingly, it is possible to restrain clogging when the lubricant flows to the second opening 86b. Therefore, the lubricant contained inside the drive bearing accommodating portion 66 can be efficiently suctioned from the second opening 86b, thereby enabling the lubricant to reliably flow in the vicinity of the drive bearing 67.

(Second Embodiment)

[0066] Next, a second embodiment of the open-type compressor according to the present invention will be described. The open-type compressor illustrated in the second embodiment has a different oil passage. Therefore, in the description of the second embodiment, the same reference numerals will be given to elements which are the same as those according to the first embodiment, and repeated description will be omitted. That is, configurations of the open-type compressor which are common to the configurations described in the first embodiment will be omitted in the description.

[0067] As illustrated in Fig. 4, an oil passage 86A according to the second embodiment is disposed so as to avoid not only the stepped portion 62t but also a position which overlaps the suction opening 21 in the circumferential direction Dc around the central axis X. Therefore, a first opening 860a according to the second embodiment is formed at a position of the circumferential direction Dc is formed at a position different from the position of the suction opening 21 in the circumferential direction Dc.

[0068] In a state where the open-type scroll compressor 1A is stopped and the orbiting scroll 62 is not rotated, the refrigerant may reversely flow (liquid backflow) in some cases. However, in the second embodiment, the respective positions of the first opening 860a and the suction opening 21 are separated from each other in the circumferential direction Dc. Therefore, even if the refrigerant reversely flows, the refrigerant flowing from the suction opening 21 is less likely to flow into the oil passage 86A from the first opening 860a. Therefore, it is possible to prevent the lubricant from being reduced in the vicinity of the drive bearing 67 since the lubricant for lubricating the drive bearing 67 is flushed with the refrigerant reversely flowing inside the oil passage 86A.

(Third Embodiment)

[0069] Next, a third embodiment of an open-type compressor according to the present invention will be described. A configuration of a third embodiment described below is different from that of the first embodiment and the second embodiment in that the drive shaft has an oil supply passage. Therefore, the same reference numerals will be given to elements which are the same as those according to the first embodiment and the second embodiment, and repeated description will be omitted.

[0070] Fig. 5 is a sectional view illustrating a configuration of the open-type scroll compressor according to this embodiment.

[0071] As illustrated in Fig. 5, in an open-type scroll compressor 1B according to the third embodiment, a drive shaft oil supply passage (oil supply passage) 83 for supplying the lubricant to the drive bearing 67 is formed inside the drive shaft 5. The drive shaft oil supply passage 83 supplies the lubricant from the inner space S3 serving as a space into which the lubricant is introduced, to the drive bearing accommodating portion 66 serving as a space where the drive bearing 67 is located. The drive shaft oil supply passage 83 according to the third embodiment linearly extends in the axial direction Da. The drive shaft oil supply passage 83 is formed at a position offset to a side opposite to the crank pin 51 across the central axis X in the circumferential direction Dc. The drive shaft oil supply passage 83 according to the present embodiment is formed at a position whose phase is different as much as 180° from that of the crank pin 51 in the circumferential direction Dc around the central axis X. The drive shaft oil supply passage 83 has a first oil supply opening 83a which is open to face the inner space S3 inside the housing 2 and a second oil supply opening 83b which is open to face the drive bearing accommodating portion 66. The drive shaft oil supply passage 83 is configured to include a third oil supply passage 831 formed in the disk portion 5d, a fourth oil supply passage 832 formed in the main balance weight 71, and a fifth oil supply passage 833 formed in the sub-balance weight 72.

[0072] The first oil supply opening 83a and the second oil supply opening 83b according to the third embodiment are formed at positions offset to a side opposite to the crank pin 51 across the central axis X. The first oil supply opening 83a is formed at the position which is the same as the position of the second oil supply opening 83b in the circumferential direction Dc and the radial direction Dr. The second oil supply opening 83b is formed so as to face a surface facing one side of the drive bearing 67 in the axial direction Da.

[0073] The third oil supply passage 831 penetrates the disk portion 5d in the axial direction Da. The third oil supply passage 831 linearly extends parallel to the central axis X.

[0074] The fourth oil supply passage 832 penetrates the main balance weight 71 in the axial direction Da. The fourth oil supply passage 832 linearly extends parallel to the central axis X. The fourth oil supply passage 832 is formed at a position communicating with the third oil supply passage 831. An opening on the other side of the fourth oil supply passage 832 in the axial direction Da is the second oil supply opening 83b.

[0075] The fifth oil supply passage 833 penetrates the sub-balance weight 72 in the axial direction Da. The fifth oil supply passage 833 linearly extends parallel to the central axis X. The fifth oil supply passage 833 is formed at a position communicating with the third oil supply passage 831. An opening on one side of the fifth oil supply passage 833 in the axial direction Da is the first oil supply opening 83a.

[0076] Here, in view of assembling tolerance of the main balance weight 71 and the sub-balance weight 72, it is preferable that the inner diameter of the fourth oil supply passage 832 of the main balance weight 71 and the fifth oil supply passage 833 of the sub-balance weight 72 is larger than the inner diameter of the third oil supply passage 831 formed in the disk portion 5d.

[0077] A portion of the lubricant introduced into the inner space S3 of the bearing holding portion 31 flows into the fifth oil supply passage 833 from the first oil supply opening 83a. Thereafter, the portion of the lubricant is circulated through the fifth oil supply passage 833, the third oil supply passage 831, and the fourth oil supply passage 832 in this order, and is supplied to the drive bearing 67 from the second oil supply opening 83b.

[0078] As a result, a new lubricant is supplied to the drive bearing 67.

[0079] Therefore, according to the open-type scroll compressor 1B in the third embodiment described above, the lubricant can be supplied to the drive bearing 67 inside the drive bearing accommodating portion 66 from the inner space S3 into which the lubricant is introduced, through the third oil supply passage 831, the fourth oil supply passage 832, and the fifth oil supply passage 833. In this manner, the new lubricant can be stably supplied to the drive bearing 67.

[0080] In addition, the third oil supply passage 831, the fourth oil supply passage 832, and the fifth oil supply passage 833 are offset to the side opposite to the crank pin 51. Therefore, each space for forming the third oil supply passage 831, the fourth oil supply passage 832, and the fifth oil supply passage 833 with respect to the disk portion 5d, the main balance weight 71, and the sub-balance weight 72 is likely to be secured at the position close to the drive bearing 67 in the radial direction Dr. Therefore, the third oil supply passage 831, the fourth oil supply passage 832, and the fifth oil supply passage 833 can be formed at the position close to the drive bearing 67.

[0081] In addition, the second oil supply opening 83b is open so as to face the drive bearing 67 in the axial direction Da. Therefore, the lubricant can be directly supplied to the drive bearing 67 through the drive shaft oil supply passage 83. In this manner, the lubricant can be more reliably supplied to the drive bearing 67.

[0082] Furthermore, a portion of the drive shaft oil supply passage 83 is formed in the main balance weight 71 and the sub-balance weight 72. Therefore, even in a case where the main balance weight 71 and the sub-balance weight 72 are provided, the lubricant can be supplied to the drive bearing 67 by forming the fourth oil supply passage 832 and the fifth oil supply passage 833.

(Fourth Embodiment)

[0083] Next, a fourth embodiment of an open-type compressor according to the present invention will be described. A configuration of a fourth embodiment described below is different from that of the third embodiment in that the fourth embodiment employs a different configuration of the oil supply passage. Therefore, the same reference numerals will be given to elements which are the same as those according to the first to third embodiments, and repeated description will be omitted.

[0084] Fig. 6 is a sectional view illustrating a configuration of the open-type scroll compressor according to the fourth embodiment.

[0085] As illustrated in Fig. 6, in an open-type scroll compressor 1C according to the fourth embodiment, a drive shaft oil supply passage (oil supply passage) 88 for supplying the lubricant to the drive bearing 67 is formed in the drive shaft 5 and the crank pin 51.

[0086] The drive shaft oil supply passage 88 penetrates the disk portion 5d and the crank pin 51 in a direction including the axial direction Da. The drive shaft oil supply passage 88 according to the present embodiment linearly extends in a direction inclined with respect to the axial direction Da. The drive shaft oil supply passage 88 has a first oil supply opening 88a which is open in the disk portion 5d while facing the inner space S3, and a second oil supply opening 88b which is open inside the drive bearing accommodating portion 66. The drive shaft oil supply passage 88 according to the fourth embodiment is not formed in the main balance weight 71 or the sub-balance weight 72. The first oil supply opening 88a is formed on a surface 5g of the disk portion 5d on the front housing 3 side. The second oil supply opening 88b is formed in a tip portion of the crank pin 51 located inside the drive bearing 67. The second oil supply opening 88b according to the present embodiment is formed in a tip surface 51g which is an end surface facing the other side of the tip portion in the axial direction Da.

[0087] A portion of the lubricant introduced into the inner space S3 of the bearing holding portion 31 flows into the drive shaft oil supply passage 88 from the first oil supply opening 88a. Thereafter, the lubricant is circulated inside the drive shaft oil supply passage 88, and is supplied to the drive bearing 67 from the second oil supply opening 88b. As a result, a new lubricant is supplied to the drive bearing 67.

[0088] Therefore, according to the open-type scroll compressor 1C in the fourth embodiment described above, the lubricant can be supplied to the tip surface 51g located in the rear inside the drive bearing 67 through the drive shaft oil supply passage 88 from the inner space S3 in which the lubricant is introduced into the housing 2. Accordingly, the lubricant can be directly supplied to the drive bearing 67. In this manner, a new lubricant can be stably supplied to the drive bearing 67.

[0089] In the present embodiment, the drive shaft oil supply passage 88 is formed to be inclined with respect to the central axis X. However, as the drive shaft oil supply passage 88 is closer to the drive bearing 67, the drive shaft oil supply passage 88 may be formed to be inclined so as to be separated outward in the radial direction Dr from the central axis X. In this case, the mist-like lubricant flowing into the drive shaft oil supply passage 88 is likely to be discharged toward the drive bearing 67 from the second oil supply opening 88b by the centrifugal force.

(Fifth Embodiment)

[0090] Next, a fifth embodiment of an open-type compressor according to the present invention will be described. The fifth embodiment described below includes the oil passage and the oil supply passage which are described in the first embodiment, the third embodiment, and the fourth embodiment.

[0091] Fig. 7 is a sectional view illustrating a configuration of the open-type scroll compressor according to the fifth embodiment.

[0092] As illustrated in Fig. 7, an open-type scroll compressor 1D according to the fifth embodiment has the oil passage 86, the drive shaft oil supply passage 83, and the drive shaft oil supply passage 88.

[0093] Therefore, according to the open-type scroll compressor 1D in the fifth embodiment described above, the lubricant can be supplied to the drive bearing 67 from the inner space S3 by the drive shaft oil supply passage 83 and the drive shaft oil supply passage 88 which are different from those according to the above-described embodiments. Therefore, the lubricant can be directly supplied to the drive bearing 67. In this manner, a new lubricant can be stably supplied to the drive bearing 67. Furthermore, since the oil passage 86 is formed, the lubricant contained in the drive bearing accommodating portion 66 is suctioned from the second opening 86b. As a result, the lubricant more smoothly flows in the vicinity of the drive bearing 67. Therefore, while the new lubricant is supplied to the drive bearing 67, the lubricant can be restrained from being stagnant in the vicinity of the drive bearing 67.

[0094] In this manner, the new lubricant can be more stably supplied to the drive bearing 67.

[0095] Hitherto, the embodiments according to the present invention have been described in detail with reference to the drawings. However, the respective configurations and combinations thereof in the respective embodiments are merely examples. The configurations can be added, omitted, substituted, and modified within the scope not departing from the gist of the present invention. In addition, the present invention is not limited by the embodiments, and is limited only by the appended claims.

[0096] The fourth embodiment described above includes all of the oil passage 86 described in the first embodiment, the drive shaft oil supply passage 88 described in the third embodiment, and the drive shaft oil supply passage 88 described in the fourth embodiment. However, a configuration may be adopted which includes at least two of these.

Industrial Applicability

[0097] According to the above-described open-type compressor, the lubricant can be stably supplied to the drive bearing.

Reference Signs List

[0098]

1A, 1B, 1C, 1D open-type scroll compressor (open-type compressor)
2 housing
2a one end portion
2b other end portion
3 front housing
5 drive shaft
5a one end portion
5d disk portion
5g surface
6 scroll compression mechanism
7 main bearing
8 sub-bearing
9 lip seal
10 bearing
11 pulley
12 electromagnetic clutch
21 suction opening (oil introduction portion)
22 discharge port
31 bearing holding portion
32 through-hole
51 crank pin
51g tip surface
61 fixed scroll
61a fixed end plate
61b fixed wrap
61c groove bottom surface
62 orbiting scroll
62a orbiting end plate
62b orbiting wrap
62c groove bottom surface
62f outer peripheral surface
62t stepped portion
63 bolt
64 discharge port
65 compression chamber
66 drive bearing accommodating portion
67 drive bearing
68 drive bush
69 O-ring
71 main balance weight
72 sub-balance weight

81 first oil supply passage
82 second oil supply passage
83, 88 drive shaft oil supply passage
83a, 88a first oil supply opening
83b, 88b second oil supply opening
831 third oil supply passage
832 fourth oil supply passage
833 fifth oil supply passage
86, 86A oil passage
S1 suction chamber
S2 discharge chamber
S3 inner space (space)
X central axis
Da axial direction
Dr radial direction
Dc circumferential direction

Claims

1. An open-type compressor comprising:

   a drive shaft to be rotationally driven around a central axis;
   a crank pin integrally formed in an end portion of the drive shaft, and being eccentric from the central axis in a direction orthogonal to the central axis;
   a drive bearing into which the crank pin is to be inserted;
   an orbiting scroll having an orbiting end plate having a drive bearing accommodating portion for accommodating the drive bearing, and an orbiting wrap extending from the orbiting end plate toward a side opposite to a side having the crank pin in an axial direction in which the central axis extends; and
   a housing accommodating the drive shaft, the crank pin, and the orbiting scroll, and having an oil introduction portion which introduces a lubricant to be supplied to the drive bearing from the outside,
   wherein the orbiting end plate internally has an oil passage that allows a first opening which is open on an outer peripheral surface of the orbiting end plate and a second opening which is open inside the drive bearing accommodating portion to communicate with each other.

2. The open-type compressor according to Claim 1, wherein the oil passage extends in a radial direction inside the orbiting end plate.

3. The open-type compressor according to Claim 1 or 2, wherein the first opening is formed at a position different from a position of the oil introduction portion in a circumferential direction around the central axis.

4. The open-type compressor according to any one of Claims 1 to 3, wherein the oil passage is disposed in the orbiting end plate while avoiding a stepped portion formed on a surface on a side having the orbiting wrap.

5. The open-type compressor according to any one of Claims 1 to 4, wherein the drive shaft internally has an oil supply passage having a first oil supply opening which is open while facing a space into which the lubricant is introduced inside the housing, and a second oil supply opening which is open while facing a space having the drive bearing.

6. The open-type compressor according to Claim 5, wherein the second oil supply opening is formed at a position facing the drive bearing in the axial direction.

7. The open-type compressor according to Claim 5 or 6, wherein the oil supply passage extends in the axial direction at a position offset to a side opposite to the crank pin across the central axis.

8. The open-type compressor according to any one of Claims 5 to 7, wherein the oil supply passage is formed by allowing the drive shaft and a balance weight disposed in the drive shaft so as to negate an eccentric force generated by orbiting of the crank pin and the orbiting scroll to communicate with each other.

9. The open-type compressor according to any one of Claims 5 to 8, wherein the second oil supply opening is formed in a tip portion of the crank pin located inside the drive bearing.

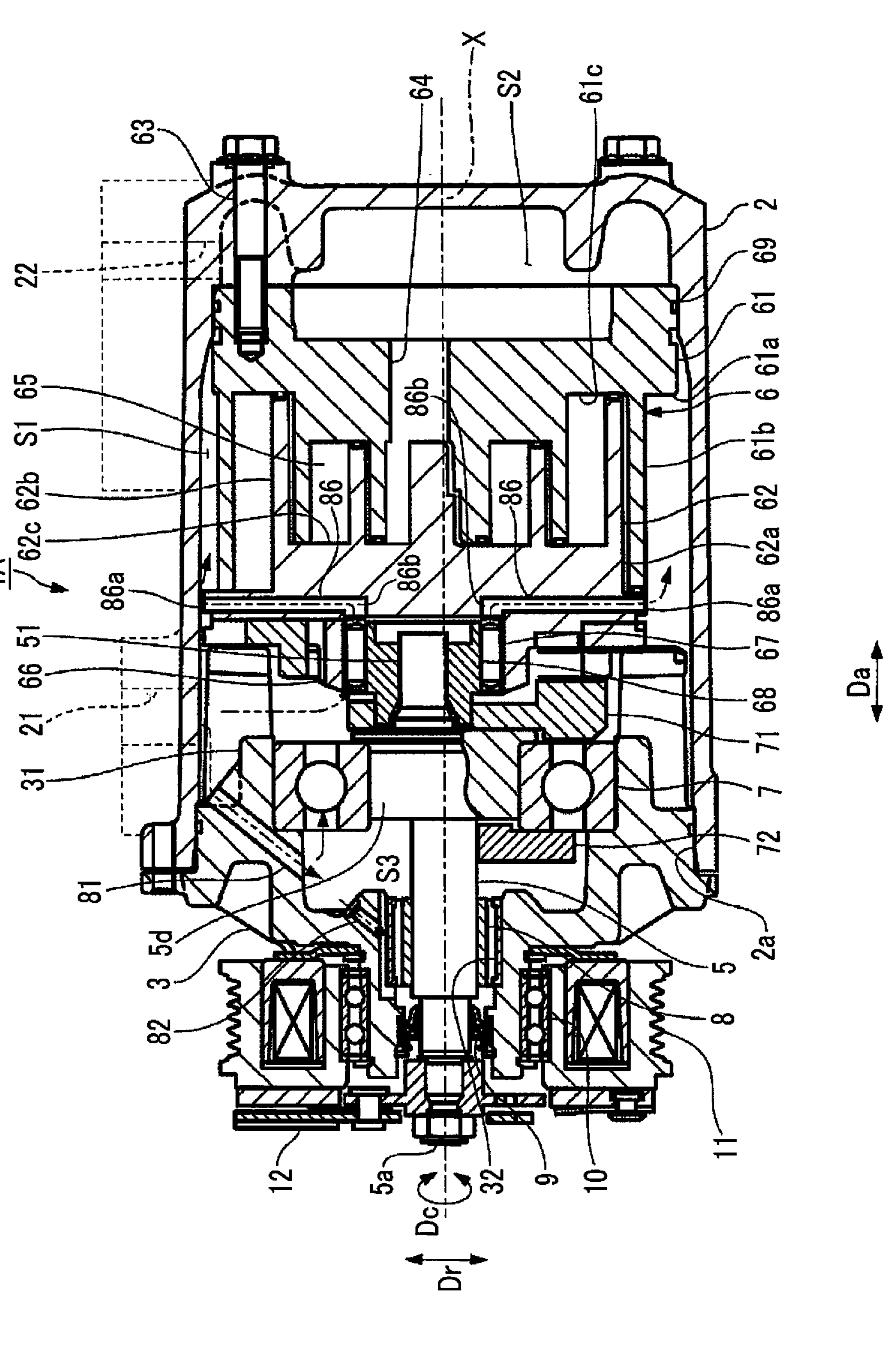
10. An open-type compressor comprising:

    a drive shaft to be rotationally driven around a central axis;
    a crank pin integrally formed in an end portion of the drive shaft, and eccentric from the central axis in a direction orthogonal to the central axis;
    a drive bearing into which the crank pin is to be inserted;
    an orbiting scroll having an orbiting end plate having a drive bearing accommodating portion for accommodating the drive bearing, and an orbiting wrap extending from the orbiting end plate toward a side opposite to a side having the crank pin in an axial direction in which the central axis extends; and
    a housing accommodating the drive shaft, the crank pin, and the orbiting scroll, and having an oil introduction portion which introduces a lubri-

cant to be supplied to the drive bearing from the outside,

wherein the drive shaft internally has an oil supply passage having a first oil supply opening which is open while facing a space into which the lubricant is introduced inside the housing, and a second oil supply opening which is open while facing a space having the drive bearing.

FIG. 1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61c
86b
86
2
69
61
61a
6
61b
62
62a
86a
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S3
8
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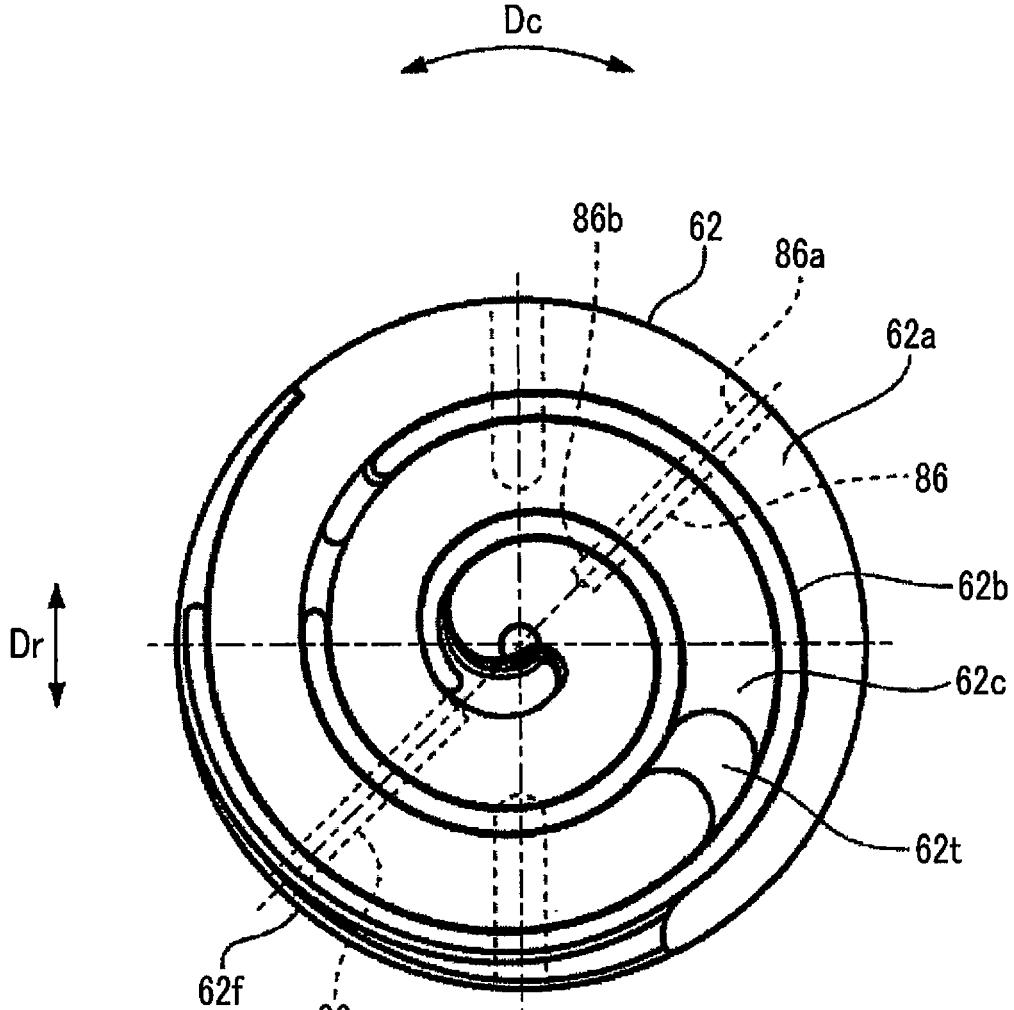
9
32
5a
Dc
Dr
Da

FIG. 2



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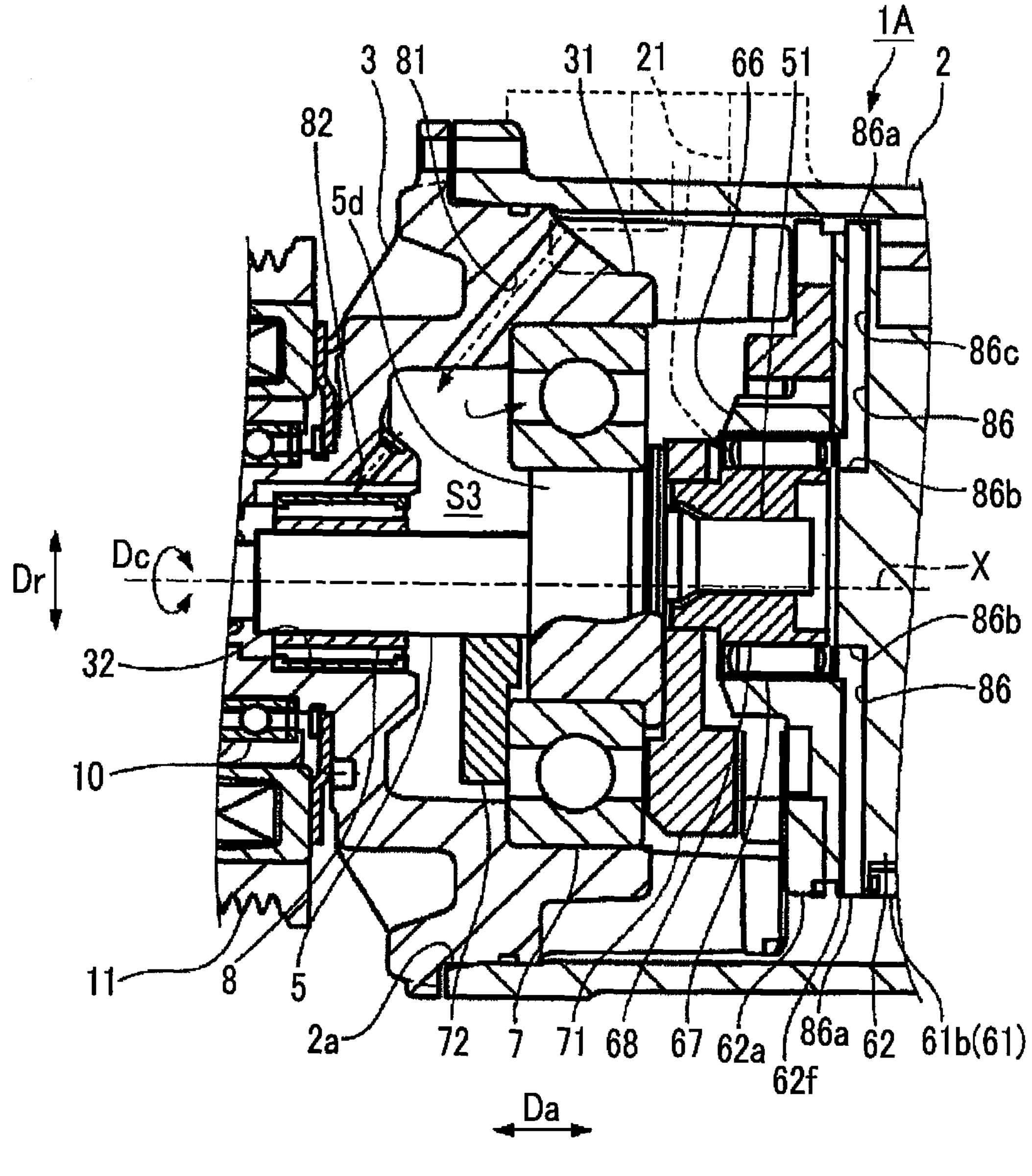
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51
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5d
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S3
Dc
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32
86
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Da

FIG. 4

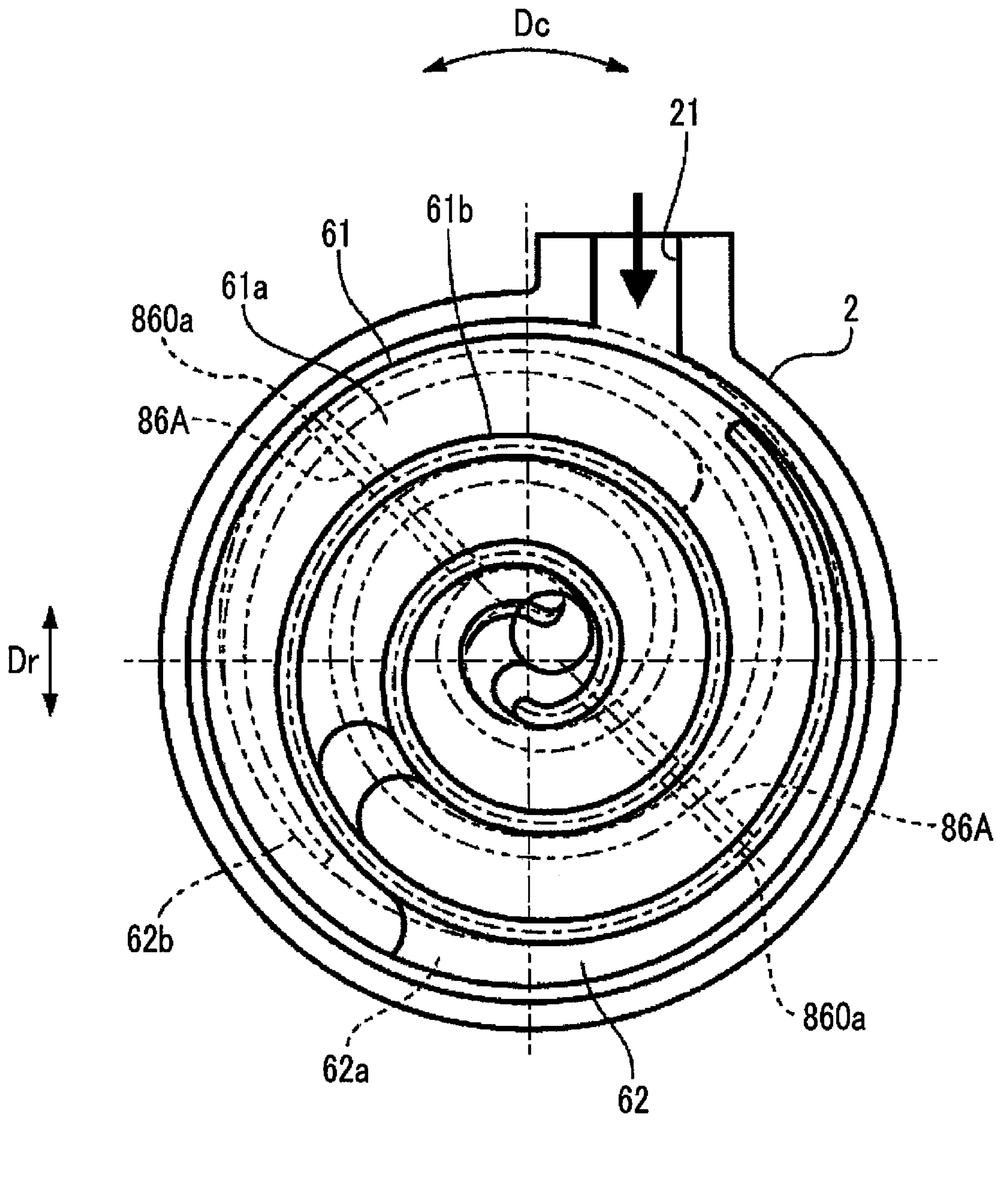
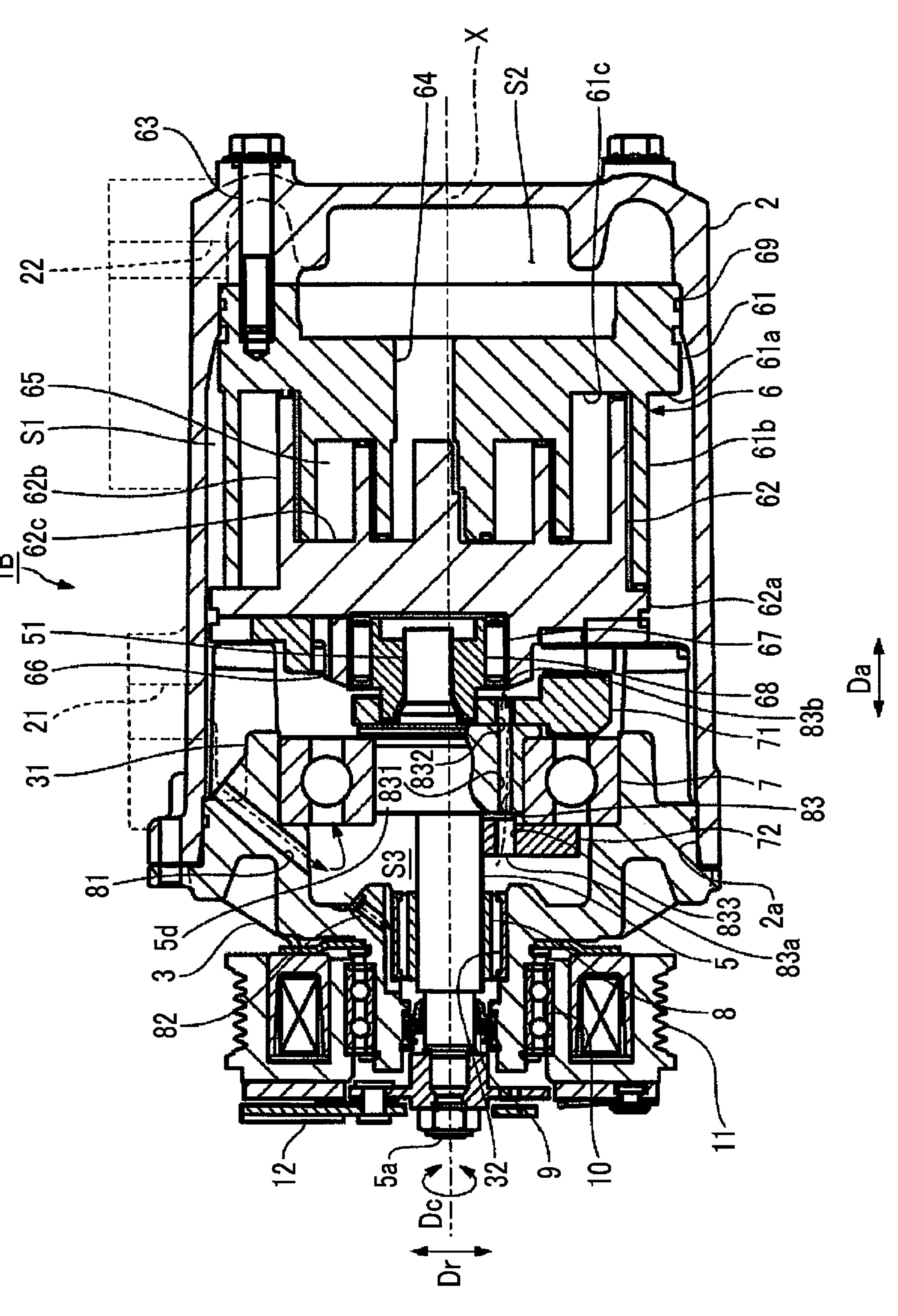


FIG. 5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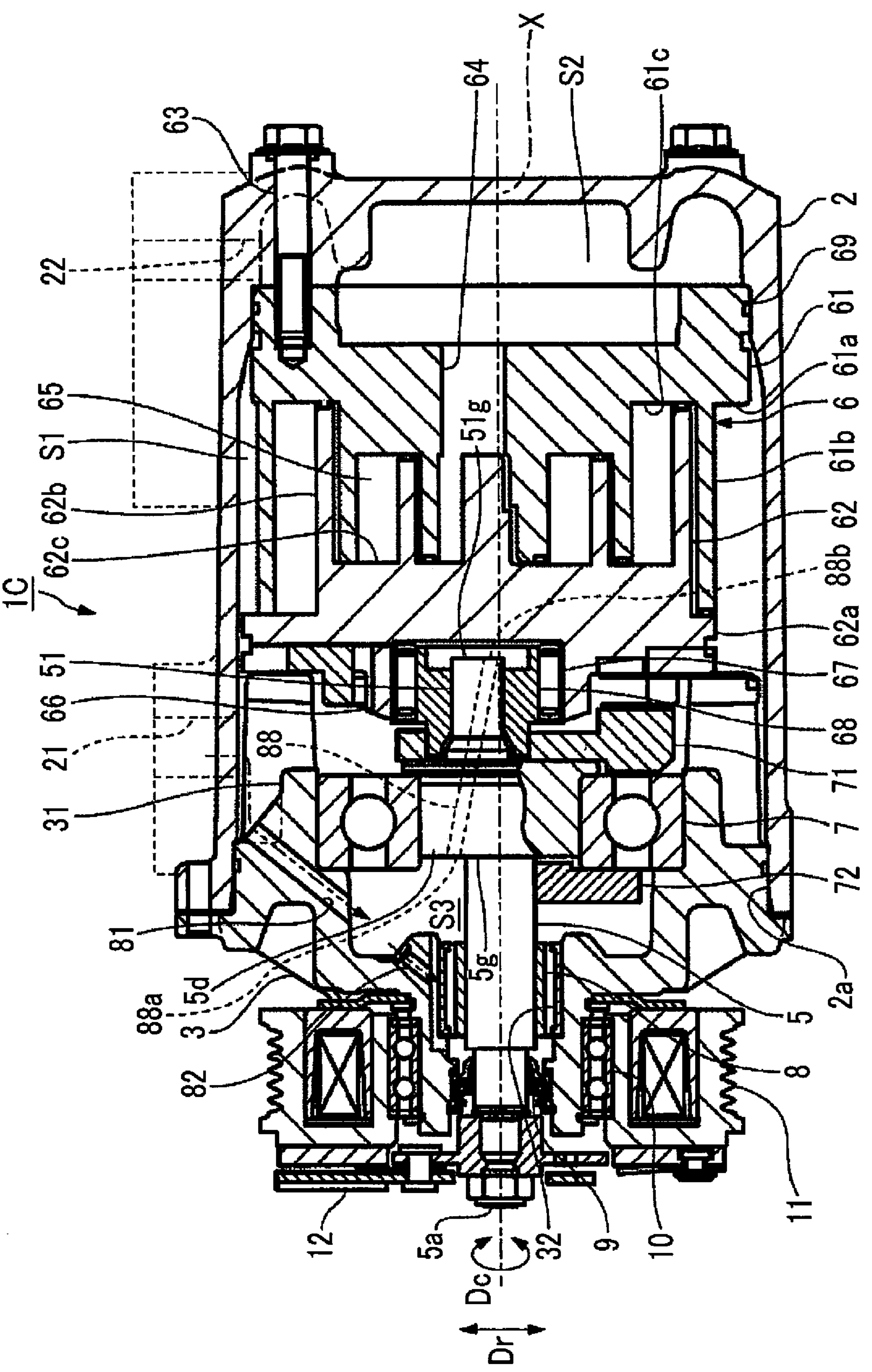
51
66
21
31
67
68
83b
71
7
83
72
831
832
81
5d
S3
833
2a
3
5
83a
82
8
11
10
9
32
5a
12
Dc
Dr
Da

FIG. 6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88
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31
7
72
81
S3
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2a
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82
8
11
12
5a
32
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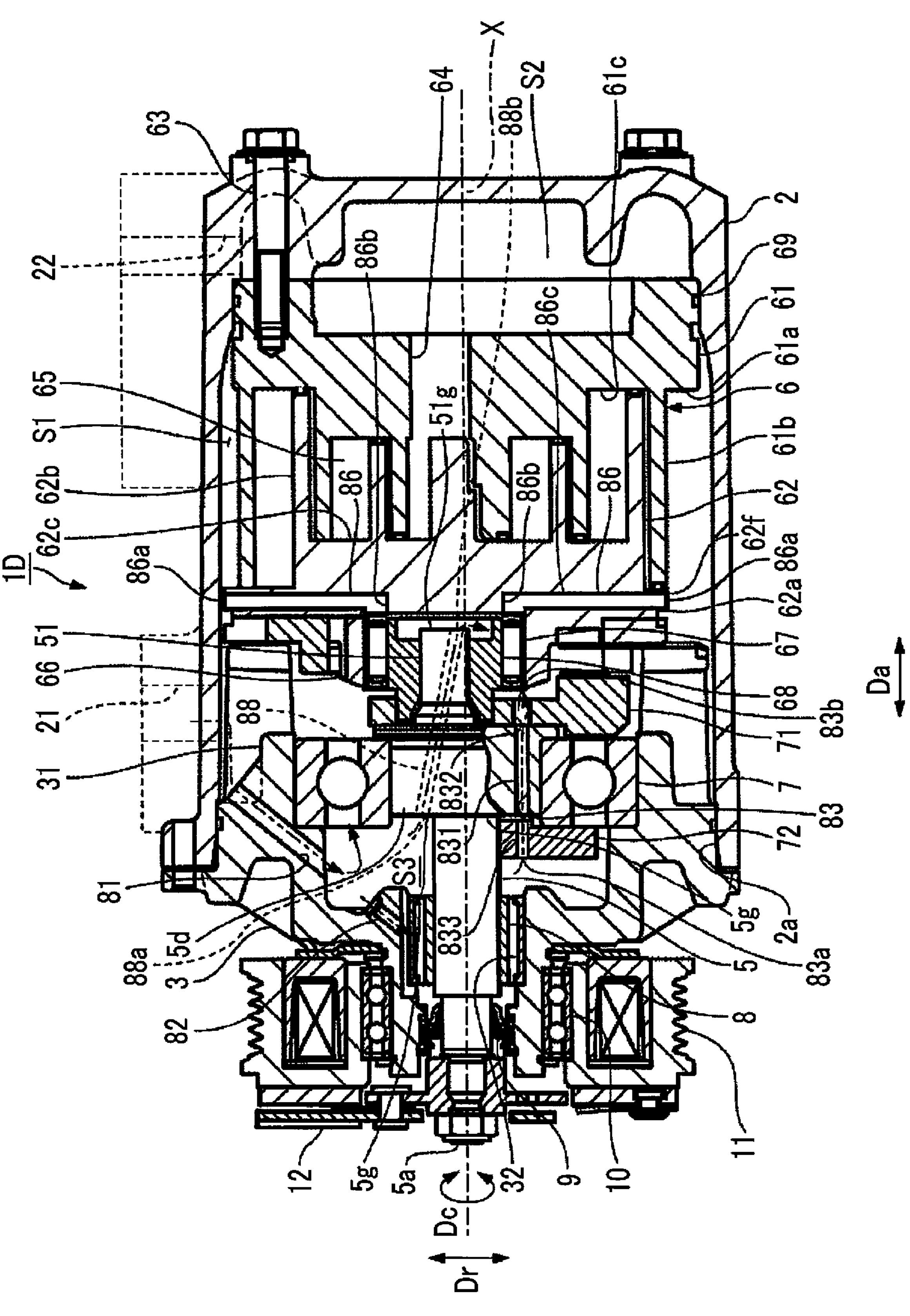
10
Dc
Dr
Da

FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/032261

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F04C18/02 (2006. 01)i, F04C29/02 (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, F04C29/02

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

Japanese Published Examined Utility Model Applications	1922-1996
Japanese Published Unexamined Utility Model Applications	1971-2017
Japanese Examined Utility Model Registrations	1996-2017
Japanese Registered Utility Model Specifications	1994-2017

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 11-30188 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 02 February 1999, paragraphs [0002]-[0010], [0017]-[0023], fig. 2 (Family: none)	1-2, 5, 9-10 3-4, 6-8

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

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed

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"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
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 November 2017 (21.11.2017)	05 December 2017 (05.12.2017)

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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/032261

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 55-35154 A (SANKYO DENKI CO., LTD.) 12 March 1980, page 3, lower right column, line 8 to page 4, upper right column, line 18, page 6, upper left column, line 13 to lower right column, line 2, fig. 2 & US 4314796 A, column 4, line 28 to column 5, line 10, column 7, line 56 to column 8, line 3, fig. 2 & EP 9350 A1	10 1-9
A	JP 56-143386 A (HITACHI, LTD.) 09 November 1981, entire text, all drawings (Family: none)	1-10
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 196807/1982 (Laid-open No. 130096/1983) (SANDEN CORP.) 02 September 1983, entire text, all drawings (Family: none)	1-10

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

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Patent documents cited in the description

- JP 2016174902 A **[0002]**
- JP 2000352377 A **[0005]**